Appendix G

Stage 1 Archaeological Assessment

Prepared by Archaeological Research Associates, 2015

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DRAFT

Stage 1 Archaeological Assessment
Harrington Dam and Embro Dam
Class Environmental Assessment
963656 Road 96 and 843970 Road 84
Township of Zorra
Part of Lot 30, Concession 2 and
Part of Lot 15, Concession 4
Geographic Township of West Zorra
Oxford County, Ontario

Prepared for
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&
The Upper Thames River Conservation Authority
&
The Ministry of Tourism, Culture and Sport

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Project #P007-0690
PIF #P007-0690-2015

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Original Report

EXECUTIVE SUMMARY

Under a contract awarded by Ecosystem Recovery Inc. in May 2015, Archaeological Research Associates Ltd. carried out a Stage 1 archaeological assessment of lands involved in the Class Environment Assessment of the Harrington Dam and the Embro Dam in the Township of Zorra, Oxford County, Ontario. The project is being conducted for the Upper Thames River Conservation Authority to evaluate alternatives for the two dams. This report documents the background research and fieldwork involved in the assessment, and presents conclusions and recommendations pertaining to archaeological concerns within the study area. The assessment was triggered by the requirements set out in the *Environmental Assessment Act*.

The Stage 1 assessment was conducted in May 2015 under licence #P007, PIF #P007-0690-2015. At the time of assessment, the Harrington Dam parcel comprised Harrington Pond, the Harrington Grist Mill, a gravel driveway, pedestrian bridges, maintained lawns, wooded areas and part of an agricultural field, whereas the Embro Dam parcel comprised Embro Pond, a pavilion, a culvert, maintained lawns and wooded areas. All field observations were made from accessible public lands; accordingly, no permissions were required for property access.

The results of the assessment indicate that the study area currently comprises a mixture of areas of archaeological potential and areas of no archaeological potential. Archaeological Research Associates Ltd. recommends that all areas of archaeological potential that could be impacted by the project be subject to a Stage 2 property assessment in advance of any construction impacts. The identified areas of no archaeological potential are not recommended for further assessment.

It is requested that this report be entered into the *Ontario Public Register of Archaeological Reports*, as provided for in Section 65.1 of the *Ontario Heritage Act.*

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GLOSSARY OF ABBREVIATIONS

ARA – Archaeological Research Associates Ltd.
CHVI – Cultural Heritage Value or Interest
MTC – (Former) Ministry of Tourism and Culture
MTCS – Ministry of Tourism, Culture and Sport
PIF – Project Information Form
S&Gs – Standards and Guidelines for Consultant Archaeologists
UTRCA – Upper Thames River Conservation Authority

PERSONNEL

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1.0 PROJECT CONTEXT

1.1 Development Context

Under a contract awarded by Ecosystem Recovery Inc. in May 2015, ARA carried out a Stage 1 archaeological assessment of lands involved in the Class Environment Assessment of the Harrington Dam and the Embro Dam in the Township of Zorra, Oxford County, Ontario. The project is being conducted for the UTRCA to evaluate alternatives for the two dams. This report documents the background research and fieldwork involved in the assessment, and presents conclusions and recommendations pertaining to archaeological concerns within the study area. The assessment was triggered by the requirements set out in the *Environmental Assessment Act*.

The subject study area consists of an irregular-shaped 5.66 ha parcel of land at the Harrington Dam (963656 Road 96) and a rectilinear 3.14 ha parcel of land at the Embro Dam (843970 Road 84), both located in the western part of the Township of Zorra (see Map 1–Map 2). The Harrington Dam parcel is generally bounded by Road 96 (County Road 28) to the north, Victoria Street to the east, agricultural lands to the south and a maintained lawn to west, whereas the Embro Dam parcel is generally bounded by Road 84 (County Road 16) to the north, agricultural lands to the east and southeast and the remainder of the Embro Pond Conservation Area to the west. At the time of assessment, the Harrington Dam parcel comprised Harrington Pond, the Harrington Grist Mill, a gravel driveway, pedestrian bridges, maintained lawns, wooded areas and part of an agricultural field, whereas the Embro Dam parcel comprised Embro Pond, a pavilion, a culvert, maintained lawns and wooded areas. In legal terms, the Harrington Dam parcel falls on part of Lot 30, Concession 2 in the Geographic Township of West Zorra, whereas the Embro Dam parcel falls on part of Lot 15, Concession 4 in the Geographic Township of West Zorra.

The Stage 1 assessment was conducted in May 2015 under licence #P007, PIF #P007-0690-2015. All field observations were made from accessible public lands; accordingly, no permissions were required for property access. In compliance with the objectives set out in Section 1.0 of the *S&Gs* (MTC 2011:13–23), this investigation was carried out in order to:

- Provide information concerning the study area's geography, history and current land condition;
- Determine the presence of known archaeological sites in the study area;
- Present strategies to mitigate project impacts to such sites, if they are located;
- Evaluate in detail the study area's archaeological potential; and
- Recommend appropriate strategies for Stage 2 archaeological assessment, if some or all of the study area has archaeological potential.

The assessment was conducted in accordance with the provisions of the *Ontario Heritage Act*, R.S.O. 1990, c. O.18. All notes, photographs and records pertaining to the project are currently housed in ARA's processing facility located at 154 Otonabee Drive, Kitchener. Subsequent long-term storage will occur at ARA's secure storage facility located in Kitchener.

The MTCS is asked to review the results and recommendations presented in this report and express their satisfaction with the fieldwork and reporting through a *Letter of Review and Entry into the Ontario Public Register of Archaeological Reports*.

1.2 Historical Context

After a century of archaeological work in southern Ontario, scholarly understanding of the historic usage of lands in Oxford County has become very well-developed. What follows is a detailed summary of the archaeological cultures that have settled in the vicinity of the study area over the past 11,000 years; from the earliest Palaeo-Indian hunters to the most recent Euro-Canadian farmers.

1.2.1 Pre-Contact

1.2.1.1 Palaeo-Indian Period

The first documented evidence of occupation in southern Ontario dates to around 9000 BC, after the retreat of the Wisconsinan glaciers and the formation of Lake Algonquin, Early Lake Erie and Early Lake Ontario (Karrow and Warner 1990; Jackson et al. 2000:416–419). At that time (or perhaps even earlier) small Palaeo-Indian bands moved into the region, leading mobile lives based on the communal hunting of large game and the collection of plant-based food resources (Ellis and Deller 1990:38; MCL 1997:34). Current understanding suggests that Palaeo-Indian peoples ranged over very wide territories in order to live sustainably in a post-glacial environment with low biotic productivity. This environment changed considerably during this period, developing from a sub-arctic spruce forest to a boreal forest dominated by pine (Ellis and Deller 1990:52–54, 60).

An Early Palaeo-Indian period (ca. 9000–8400 BC) and a Late Palaeo-Indian period (ca. 8400–7500 BC) are discernable amongst the lithic spear and dart points. Early points are characterized by grooves or 'flutes' near the base while the later examples lack such fluting. All types would have been used to hunt caribou and other 'big game'. Archaeological sites from both time-periods typically served as small campsites or 'way-stations' (occasionally with hearths or fire-pits), where tool manufacture/maintenance and hide processing would have taken place. For the most part, these sites tend to be small (less than 200 sq. m) and ephemeral (Ellis and Deller 1990:51–52, 60–62). Many parts of the Palaeo-Indian lifeway remain unknown.

1.2.1.2 Archaic Period

Beginning in the early 8th millennium BC, the biotic productivity of the environment began to increase as the climate warmed and southern Ontario was colonized by deciduous forests. This caused the fauna of the area to change as well, and ancient peoples developed new forms of tools and alternate hunting practices to better exploit both animal and plant-based food sources. These new archaeological cultures are referred to as 'Archaic'. Thousands of years of gradual change in stone tool styles allows for the recognition of Early (7500–6000 BC), Middle (6000–2500 BC) and Late Archaic periods (2500–900 BC) (MCL 1997:34).

The Early and Middle Archaic periods are characterized by substantial increases in the number of archaeological sites and a growing diversity amongst stone tool types and exploited raw materials. Notable changes in Archaic assemblages include a shift to notched or stemmed projectile points, a growing prominence of net-sinkers (notched pebbles) and an increased reliance on artifacts like bone fish hooks and harpoons. In addition to these smaller items, archaeologists also begin to find evidence of more massive wood working tools such as ground stone axes and chisels (Ellis et al. 1990:65–67).

Towards the end of the Middle Archaic (ca. 3500 BC), the archaeological evidence suggests that populations were 1) increasing in size, 2) paying more attention to ritual activities, 3) engaging in long distance exchange (e.g. in items such as copper) and 4) becoming less mobile (Ellis et al. 1990:93; MCL 1997:34). Late Archaic peoples typically made use of shoreline/riverine sites located in rich environmental zones during the spring, summer and early fall, and moved further inland to deer hunting and fruit-gathering sites during late fall and winter (Ellis et al. 1990:114).

During the Late Archaic these developments continued, and new types of projectile points appeared along with the first true cemeteries. Excavations of burials from this time-frame indicate that human remains were often cremated and interred with numerous grave goods, including items such as projectile points, stone tools, red ochre, materials for fire-making kits, copper beads, bracelets, beaver incisors, and bear maxilla masks (Ellis et al. 1990:115–117). Interestingly, these true cemeteries may have been established in an attempt to solidify territorial claims, linking a given band or collection of bands to a specific geographic location.

From the tools unearthed at Archaic period sites it is clear that these people had an encyclopaedic understanding of the environment that they inhabited. The number and density of the sites that have been found suggest that the environment was exploited in a successful and sustainable way over a considerable period of time. The success of Archaic lifeways is attested to by clear evidence of steady population increases over time. Eventually, these increases set the stage for the final period of Pre-Contact occupation—the Woodland Period (Ellis et al. 1990:120).

1.2.1.3 Early and Middle Woodland Periods

The beginning of the Woodland period is primarily distinguished from the earlier Archaic by the widespread appearance of pottery. Although this difference stands out prominently amongst the archaeological remains, it is widely believed that hunting and gathering remained the primary subsistence strategy throughout the Early Woodland period (900–400 BC) and well into the Middle Woodland period (400 BC–AD 600). In addition to adopting ceramics, communities also grew in size during this period and participated in developed and widespread trade relations (Spence et al. 1990; MCL 1997:34).

The first peoples to adopt ceramics in the vicinity of the study area are associated with the Meadowood archaeological culture. This culture is characterized by distinctive Meadowood preforms, side-notched Meadowood points and Vinette 1 ceramics (thick and crude handmade pottery with cord-marked decoration). Meadowood peoples are believed to have been organized in bands of roughly 35 people, and some of the best documented sites are fall camps geared towards the hunting of deer and the gathering of nuts (Spence et al. 1990:128–137).

Ceramic traditions continued to develop during the subsequent Middle Woodland period, and three distinct archaeological cultures emerged in southern Ontario: 'Point Peninsula' north and northeast of Lake Ontario, 'Couture' near Lake St. Clair and 'Saugeen' in the rest of southwestern Ontario (see Map 3). These cultures all shared a similar method of decorating pottery, using either dentate or pseudo-scallop shell stamp impressions, but they differed in terms of preferred vessel shape, zones of decoration and surface finish (Spence et al. 1990:142–43).

The local Saugeen complex, which appears to have extended from Lake Huron to as far east as the Humber River and the Niagara Peninsula, is characterized by stamped pottery, distinctive projectile points, cobble spall scrapers and a lifeway geared towards the exploitation of seasonally-available resources such as game, nuts and fish (Spence et al. 1990:147–156). Although relatively distant from the study area, the Donaldson site along the Saugeen River may be representative of a typical Saugeen settlement; it was occupied in the spring by multiple bands that came to exploit spawning fish and bury members who had died elsewhere during the year (Finlayson 1977:563–578). The archaeological remains from this site include post-holes, hearth pits, garbage-dumps (middens), cemeteries and even a few identifiable rectangular structures (Finlayson 1977:234–514).

During the Middle to Late Woodland transition (AD 600–900), the first rudimentary evidence of maize (corn) horticulture appears in southern Ontario. Based on the available archaeological evidence, which comes primarily from the vicinity of the Grand and Credit Rivers, this pivotal development was not particularly widespread (Fox 1990a:171, Figure 6.1). The adoption of maize horticulture instead appears to be linked to the emergence of the Princess Point complex, whose material remains include decorated ceramics (combining cord roughening, impressed lines and punctuate designs), triangular projectile points, T-based drills, steatite and ceramic pipes, and ground stone chisels and adzes (Fox 1990a:174–188).

The distinctive artifacts and horticultural practices of Princess Point peoples have led to the suggestion that they were directly ancestral to the later Iroquoian-speaking populations of southern Ontario (Warrick 2000:427). These artifacts have not been found in the vicinity of the study area, however, suggesting that a gradual transition between Saugeen and Early Iroquoian lifeways took place here instead.

1.2.1.4 Late Woodland Period

In the Late Woodland period (ca. AD 900–1600), the practice of maize horticulture spread beyond the western end of Lake Ontario, allowing for population increases which in turn led to larger settlement sizes, higher settlement density and increased social complexity amongst the peoples involved. These developments are believed to be linked to the spread of Iroquoian-speaking populations in the area; ancestors of the historically-documented Huron, Neutral and Haudenosaunee Nations. Other parts of southern Ontario, including the Georgian Bay littoral, the Bruce Peninsula and the vicinity of Lake St. Clair, were inhabited by Algonkian-speaking peoples, who were much less agriculturally-oriented.

Late Woodland archaeological remains from the greater vicinity of the study area show three major stages of cultural development prior to European contact: 'Early Iroquoian', 'Middle Iroquoian' and 'Late Iroquoian' (Dodd et al. 1990; Lennox and Fitzgerald 1990; Williamson 1990).

Early Iroquoians (AD 900–1300) lived in small villages (ca. 0.4 ha) of between 75 and 200 people, and each settlement consisted of four or five longhouses up to 15 m in length. The houses contained central hearths and pits for storing maize (which made up 20–30% of their diet), and the people produced distinctive pottery with decorative incised rims (Warrick 2000:434–438). The best documented Early Iroquoian culture in the local area is the Glen Meyer complex, which is characterized by well-made and thin-walled pottery, ceramic pipes, gaming discs, and a variety of stone, bone, shell and copper artifacts (Williamson 1990:295–304).

Over the next century (AD 1300–1400), Middle Iroquoian culture became dominant in southern Ontario, and distinct 'Uren' and 'Middleport' stages of development have been identified. Both houses and villages dramatically increased in size during this time: longhouses grew to as much as 33 m in length, settlements expanded to 1.2 ha in size and village populations swelled to as many as 600 people. Middle Iroquoian villages were also better planned, suggesting emerging clan organization, and most seem to have been occupied for perhaps 30 years prior to abandonment (Dodd et al. 1990:356–359; Warrick 2000:439–446).

During the Late Iroquoian period (AD 1400–1600), the phase just prior to widespread European contact, it becomes possible to differentiate between the archaeologically-represented groups that would become the Huron and the Neutral Nations. The study area itself lies within the territorial boundaries of the Pre-Contact Neutral Nation, documented in lands as far west as Chatham and as far east as New York State.

The Neutral Nation is well represented archaeologically: typical artifacts include ceramic vessels and pipes, lithic chipped stone tools, ground stone tools, worked bone, antler and teeth, and exotic goods obtained through trade with other Aboriginal (and later European) groups (Lennox and Fitzgerald 1990:411–437). The population growth so characteristic of earlier Middleport times appears to have slowed considerably during the Late Iroquoian period, and the Pre-Contact Neutral population likely stabilized at around 20,000 by the early 16th century (Warrick 2000:446).

Pre-Contact Neutral villages were much larger than Middleport villages, with average sizes in the neighbourhood of 1.7 ha. Exceptional examples of these could reach 5 ha in size, containing longhouses over 100 m in length and housing 2,500 individuals. This seemingly rapid settlement growth is thought to have been linked to Middleport 'baby boomers' starting their own families and needing additional living space (Warrick 2000:446–449).

It has been suggested that the size of these villages, along with the necessary croplands to sustain them, may have had some enduring impacts on the landscapes that surrounded them. In particular, there has been a correlation postulated between Pre-Contact era corn fields and modern stands of white pine (Janusas 1987:69–70, Figure 7). Aside from these villages, the

Pre-Contact Neutral also made use of hamlets, agricultural field cabins, specialized camps (e.g., fishing camps) and cemeteries (MCL 1997:35; Warrick 2000:449).

For the most part, Pre-Contact Neutral archaeological sites occur in isolated clusters defined by some sort of geographic region, usually within a watershed or another well-defined topographic feature. It has been suggested that these clusters represent distinct tribal units, which may have been organized as a larger confederacy akin to the historic Five Nations Iroquois (Lennox and Fitzgerald 1990:410). Nineteen main clusters of villages have been identified, the closet manifestation of which is known simply as the 'London Cluster'. This cluster, which includes the Lawson, Windermere, Ronto, Smallman, Black Kat and Mathews sites, appears to have flourished primarily in the 15th century (Lennox and Fitzgerald 1990:Table 13.1).

Late Pre-Contact Neutral sites are largely absent in this part of southern Ontario, indicative of substantial shifts in local settlement patterns (see Map 4). By the early 16th century there was a definite contraction of earlier territories, perhaps linked to the consolidation of tribal units, and by AD 1534 the Neutral appear to have moved east of the Grand River (Warrick 2000:454). Although scholars once thought that this shift was linked to a desire for better access to European goods, the fact that the fur trade did not begin for several decades has led to the recognition of an alternate reason—war. Later historical sources suggest that the Neutral were engaged in hostilities with the Fire Nation (possibly the Mascouten), an Algonkian-speaking people to the southwest known archaeologically as the Western Basin Tradition. Remains from the frontier zone include strongly fortified villages and earthworks, clearly illustrating a defensive mindset (Lennox and Fitzgerald 1990:437–438; Warrick 2000:449–451).

The end of the Late Woodland period can be conveniently linked to the arrival and spread of European fur traders in southern Ontario, and a terminus of AD 1600 effectively serves to demarcate some substantial changes in Aboriginal material culture. Prior to the establishment of the fur trade, items of European manufacture are extremely rare on Pre-Contact Neutral sites, save for small quantities of reused metal scrap. With the onset of the fur trade ca. AD 1580, European trade goods appear in ever-increasing numbers, and glass beads, copper kettles, iron axes and iron knives have all been found during excavations (Lennox and Fitzgerald 1990:425–432).

1.2.2 Early Contact

1.2.2.1 European Explorers

One of the first Europeans to venture into what would become Ontario was Étienne Brûlé, who was sent by Samuel de Champlain in Summer 1610 to accomplish three goals: 1) to consolidate an emerging friendship between the French and the First Nations, 2) to learn their languages, and 3) to better understand their unfamiliar customs. Other Europeans would subsequently be sent by the French to train as interpreters. These men became *coureurs de bois*, "living Indian-style ... on the margins of French society" (Gervais 2004:182). Such 'woodsmen' played an essential role in all later communications with the First Nations.

Champlain himself made two trips to Ontario: in 1613, he journeyed up the Ottawa River searching for the North Sea, and in 1615/1616, he travelled up the Mattawa River and descended to Lake Nipissing and Lake Huron to explore Huronia (Gervais 2004:182–185). He learned about many First Nations groups during his travels, including prominent Iroquoian-speaking peoples such as the Wendat (Huron), Petun (Tobacco) and '*la nation neutre*' (the Neutrals), and a variety of Algonkian-speaking Anishinabeg bands.

Champlain's *Carte de la Nouvelle France* (1632) encapsulates his accumulated knowledge of the area (see Map 5). Although the distribution of the Great Lakes is clearly an abstraction in this early map, important details concerning the terminal Late Woodland occupation of southern Ontario are discernable. Numerous Aboriginal groups are identified throughout the area, for example, and prolific Neutral village sites can be seen 'west' and 'south' of *Lac St. Louis* (Lake Ontario).

1.2.2.2 Trading Contacts and Conflict

The first half of the 17th century saw a marked increase in trading contacts between the First Nations and European colonists, especially in southern Ontario. Archaeologically, these burgeoning relations are clearly manifested in the widespread appearance of items of European manufacture by AD 1630, including artifacts such as red and turquoise glass beads, scissors, drinking glasses, keys, coins, firearms, ladles and medallions. During this time, many artifacts such as projectile points and scrapers began to be manufactured from brass, copper and iron scrap, and some European-made implements completely replaced more traditional tools (Lennox and Fitzgerald 1990:432–437).

Nicholas Sanson's *Le Canada, ou Nouvelle France* (1656) provides an excellent representation of southern Ontario at this time of heightened contact. Here the lands of the Neutral Nation are clearly labelled with the French rendering of their Huron name, '*Attawandaron*' (see Map 6). Unfortunately, this increased contact had the disastrous consequence of introducing European diseases into First Nations communities. These progressed from localized outbreaks to much more widespread epidemics (MCL 1997:35; Warrick 2000:457). Archaeological evidence of disease-related population reduction appears in the form of reduced longhouse sizes, the growth of multi-ossuary cemeteries and the loss of traditional craft knowledge and production skills (Lennox and Fitzgerald 1990:432–433).

1.2.2.3 Five Nations Invasion

The importance of European trading contacts eventually led to increasing factionalism and tension between the First Nations, and different groups began to vie for control of the lucrative fur trade (itself a subject of competition between the French and British). In what would become Ontario, the Huron, the Petun, and their Anishinabeg trading partners allied themselves with the French. In what would become New York, the League of the Haudenosaunee (the Five Nations Iroquois at that time) allied themselves with the British. The latter alliance may have stemmed from Champlain's involvement in Anishinabeg and Huron attacks against Iroquoian strongholds in 1609 and 1615, which engendered enmity against the French (Lajeunesse 1960:xxix). Interposed between the belligerents, the members of the Neutral Nation refused to become involved in the conflict.

Numerous military engagements occurred between the two opposing groups during the first half of the 17th century, as competition over territories rich in fur-bearing animals increased. These tensions boiled over in the middle of the 17th century, leading to full-scale regional warfare (MNCFN 2010:5). In a situation likely exacerbated by epidemics brought by the Europeans and the decimation of their population, a party of roughly 1,000 Mohawk and Seneca warriors set upon Huronia in March 1649. The Iroquois desired to remove the Huron Nation altogether, as they were a significant obstacle to controlling the northern fur trade (Hunt 1940:91–92).

The Huron met their defeat in towns such as Saint Ignace and Saint Louis (Sainte-Marie was abandoned and burned by the Jesuits in the spring of 1649). Those that were not killed were either adopted in the Five Nations as captives or dispersed to neighbouring regions and groups (Ramsden 1990:384). The Petun shared a similar fate, and the remnants of the affected groups formed new communities outside of the disputed area, settling in Quebec (Wendake), in the area of Michilimackinac and near Lake St. Clair (where they were known as the Wyandot).

Anishinabeg populations from southern Ontario, including the Ojibway, Odawa and Pottawatomi, fled westward to escape the Iroquois (Schmalz 1977:2). The Neutral were targeted in 1650 and 1651, and the Iroquois took multiple frontier villages (one with over 1,600 men) and numerous captives (Coyne 1895:18). The advance of the Iroquois led to demise of the Neutral Nation as a distinct cultural entity (Lennox and Fitzgerald 1990:456).

For the next four decades, southern Ontario remained an underpopulated wilderness (Coyne 1895:20). This rich hunting ground was exploited by the Haudenosaunee to secure furs for trade with the Dutch and the English, and settlements were established along the north shore of Lake Ontario at places like Teiaiagon on the Humber River and Ganatswekwyagon on the Rouge River (Williamson 2008:51). The Haudenosaunee are also known to have traded with the northern Anishinabeg during the second half of the 17th century (Smith 1987:19).

Due to their mutually violent history, the Haudenosaunee did not permit French explorers and missionaries to travel directly into southern Ontario for much of the 17th century. Instead, they had to journey up the Ottawa River to Lake Nipissing and then paddle down the French River into Georgian Bay (Lajeunesse 1960:xxix). New France was consequently slow to develop in southern Ontario, at least until the fall of several Iroquoian strongholds in 1666 and the opening of the St. Lawrence and Lake Ontario route to the interior (Lajeunesse 1960:xxxii).

In 1669, the Haudenosaunee allowed an expedition of 21 men to pass through their territory. This expedition, which included François Dollier de Casson (a Sulpician priest) and René Bréhant de Galinée, managed to reach and explore the Grand River, which they named *le Rapide* after the swiftness of its current. These men descended the Grand to reach Lake Erie, and they wintered at the future site of Port Dover (Coyne 1895:21). Galinée's map is one of the earliest documented representations of the interior of southwestern Ontario (see Map 7). In it, he notes the locations of several former Neutral villages at the western end of Lake Ontario, likely consisting of abandoned ruins.

1.2.2.4 Anishinabeg Influx

The fortunes of the Five Nations began to change in the 1690s, as disease and casualties from battles with the French took a toll on the formerly-robust group (Smith 1987:19). On July 19, 1701, the Haudenosaunee ceded lands in southern Ontario to King William III with the provision that they could still hunt freely in their former territory (Coyne 1895:28). However, judging from the land cessions to follow, this agreement appears to have lacked any sort of binding formality.

According to the traditions of the Algonkian-speaking Anishinabeg, Ojibway, Odawa and Potawatomi bands began to mount an organized counter-offensive against the Iroquois in the late 17th century (MNCFN 2010:5). Around the turn of the 18th century, the Anishinabeg of the Great Lakes expanded into Haudenosaunee lands, and attempted to trade directly with the French and the English (Smith 1987:19). This led to a series of battles between the opposing groups, in which the Anishinabeg were more successful (Coyne 1895:28).

Haudenosaunee populations subsequently withdrew into New York State, and Anishinabeg bands established themselves in southern Ontario. Many of these bands were mistakenly grouped together by the immigrating Europeans under the generalized designations of 'Chippewa/ Ojibway' and 'Mississauga'. 'Mississauga', for example, quickly became a term applied to many Algonkian-speaking groups around Lake Erie and Lake Ontario (Smith 1987:19), despite the fact that the Mississaugas were but one part of the larger Ojibway Nation (MNCFN 2010:3).

The Anishinabeg are known to have taken advantage of the competition between the English and French over the fur trade, and they were consequently well-supplied with European goods. The Mississaugas, for example, traded primarily with the French and received "everything from buttons, shirts, ribbons to combs, knives, looking glasses, and axes" (Smith 1987:22). The British, on the other hand, were well-rooted in New York State and enjoyed mutually beneficial relations with the Haudenosaunee.

As part of this influx, many members of the Algonkian-speaking Ojibway, Potawatomi and Odawa First Nations came back to Lake Huron littoral. Collectively, these people came to be known as the Chippewas of Saugeen Ojibway Territory (also Saugeen Ojibway Nation). These Algonkian-speakers established themselves in the Bruce Peninsula, all of Bruce and Grey Counties, and parts of Huron, Dufferin, Wellington, and Simcoe Counties (Schmalz 1977:233).

Throughout the 1700s and into the 1800s, Anishinabeg populations hunted, fished, gardened and camped along the rivers, floodplains and forests of southern Ontario (Warrick 2005:2). However, their 'footprint' was exceedingly light, and associated archaeological sites are both rare and difficult to detect. Around 1720, French traders are known to have established a trading post at the western end of Lake Ontario, and the Mississaugas were actively involved in the regional fur trade (MNCFN 2010:09). In September 1750, construction began on another trading post in the vicinity of present-day Toronto, which was called Fort Rouillé, or Fort Toronto. Fort Rouillé was completed in Spring 1751 and served as an outstation for the larger Fort Niagara until it was abandoned and burned in 1759 (Williamson 2008:56).

Historical maps from the 18th century shed valuable light on the cultural landscape of what would become southern Ontario. H. Popple's *A Map of the British Empire in America* (1733), for example, shows the Neutral and Huron/Petun Nations destroyed by the Haudenosaunee ca. 1650, and also demonstrates the ephemeral environmental impact of the mobile Anishinabeg (see Map 8). This map also includes an early rendering of the Thames River, although its full extent was clearly not yet understood.

1.2.2.5 Relations and Ambitions

The late 17th and early 18th centuries bore witness to the continued growth and spread of the fur trade across all of what would become the Province of Ontario. The French, for example, established and maintained trading posts along the Upper Great Lakes, offering enticements to attract fur traders from the First Nations. Even further north, Britain's Hudson Bay Company dominated the fur trade. Violence was common between the two parties, and peace was only achieved with the Treaty of Utrecht in 1713 (Ray 2015). Developments such as these resulted in an ever-increasing level of contact between European traders and local Aboriginal communities.

As the number of European men living in Ontario increased, so too did the frequency of their relations with Aboriginal women. Male employees and former employees of French and British companies began to establish families with these women, a process which resulted in the ethnogenesis of a distinct Aboriginal people: the Métis. Comprised of the descendants of those born from such relations (and subsequent intermarriage), the Métis emerged as a distinct Aboriginal people during the 1700s (MNO 2015).

Métis settlements developed along freighting waterways and watersheds, and were tightly linked to the spread and growth of the fur trade. These settlements were part of larger regional communities, connected by "the highly mobile lifestyle of the Métis, the fur trade network, seasonal rounds, extensive kinship connections and a shared collective history and identity" (MNO 2015).

In 1754, hostilities over trade and the territorial ambitions of the French and the British led to the Seven Years' War (often called the French and Indian War in North America), in which many Anishinabeg bands fought on behalf of the French. After the French surrender in 1760, these bands adapted their trading relationships accordingly, and formed a new alliance with the British (Smith 1987:22). In addition to cementing British control over the Province of Quebec, the Crown's victory over the French also proved pivotal in catalyzing the Euro-Canadian settlement process. The resulting population influx caused the demographics of many areas to change considerably.

R. Sayer and J. Bennett's *General Map of the Middle British Colonies in America* (1776) provides an excellent view of the ethnic landscape of southern Ontario prior to the widespread arrival of European settlers. This map clearly depicts the Thames River ('the Long River without Falls'), the Grand River ('the Great River'), the territory of the Ojibway and the virtually untouched lands of southwestern Ontario (see Map 9).

1.2.3 The Euro-Canadian Era

1.2.3.1 British Colonialism

With the establishment of absolute British control came a new era of land acquisition and organized settlement. In the *Royal Proclamation* of 1763, which followed the Treaty of Paris, the British government recognized the title of the First Nations to the land they occupied. In essence, the 'right of soil' had to be purchased by the Crown prior to European settlement (Lajeunesse 1960:cix). Numerous treaties and land surrenders were accordingly arranged by the Crown, and great swaths of territory were acquired from the Ojibway and other First Nations. These first purchases established a pattern "for the subsequent extinction of Indian title" (Gentilcore and Head 1984:78).

The first land purchases in Ontario took place along the shores of Lake Ontario and Lake Erie, as well as in the immediate 'back country'. Such acquisitions began in August 1764, when a 3.0 km strip of land on the west side of the Niagara River was surrendered by the Seneca First Nation (Surtees 1994:97; NRC 2010). Although many similar territories were purchased by the Crown in subsequent years, it was only with the conclusion of the American Revolutionary War (1775–1783) that the British began to feel a pressing need for additional land. In the aftermath of the conflict, waves of United Empire Loyalists came to settle in the Province of Quebec, driving the Crown to seek out property for those who had been displaced. This influx had the devastating side effect of sparking the slow death of the fur trade, which was a primary source of income for many First Nations groups.

By the mid-1780s, the British recognized the need to 1) secure a military communication route from Lake Ontario to Lake Huron other than the vulnerable passage through Niagara, Lake Erie and Lake St. Clair; 2) acquire additional land for the United Empire Loyalists; and 3) modify the administrative structure of the Province of Quebec to accommodate future growth. The first two concerns were addressed through the negotiation of numerous 'land surrenders' with Anishinabeg groups north and west of Lake Ontario, and the third concern was mitigated by the establishment of the first administrative districts in the Province of Quebec.

On July 24, 1788, Sir Guy Carleton, Baron of Dorchester and Governor-General of British North America, divided the Province of Quebec into the administrative districts of Hesse, Nassau, Mecklenburg and Lunenburg (AO 2011). The vicinity of the study area fell within the Hesse District at this time, which consisted of a massive tract of land encompassing all of the western and inland parts of the province extending due north from the tip of Long Point on Lake Erie in the east. According to early historians, "this division was purely conventional and nominal, as the country was sparsely inhabited … the necessity for minute and accurate boundary lines had not become pressing" (Mulvany et al. 1885:13).

Further change came in December 1791, when the Parliament of Great Britain's *Constitutional Act* created the Provinces of Upper Canada and Lower Canada from the former Province of Quebec. Colonel John Graves Simcoe was appointed as Lieutenant-Governor of Upper Canada, and he became responsible for governing the new province, directing its settlement and establishing a constitutional government modelled after that of Britain (Coyne 1895:33).

Simcoe initiated several schemes to populate and protect the newly-created province, employing a settlement strategy that relied on the creation of shoreline communities with effective transportation links between them. These communities, inevitably, would be composed of lands obtained from the First Nations, and many more purchases were subsequently arranged. The eastern and southern parts of Oxford County, for example, were acquired on December 7, 1792 as part of the second 'Between the Lakes Purchase', conducted to enhance Governor Haldimand's original purchase from 1784. In this transaction, the Mississaugas received goods worth 1,180.74 Quebec pounds as compensation for approximately 1,215,000 ha (NRC 2010).

In July 1792, Simcoe divided the province into 19 counties consisting of previously-settled lands, new lands open for settlement and lands not yet acquired by the Crown. These new counties stretched from Essex in the west to Glengarry in the east. Three months later, in October 1792, an Act of Parliament was passed whereby the four districts established by Lord Dorchester were renamed as the Western, Home, Midland and Eastern Districts. The vicinity of the study area nominally fell within the boundaries of Kent County in the Western District at this time, which comprised all of the territory of Upper Canada that was not included in the other 18 counties (AO 2011). In essence, Kent was the largest county ever created, stretching from Lake Erie to Hudson's Bay (McGeorge 1939:36). This arrangement would not last, however, and the 'northern' parts of Kent County would soon be sectioned off to form separate counties.

1.2.3.2 Oxford County

Shortly after the creation of Upper Canada, the original arrangement of the province's districts and counties was deemed inadequate. As population levels increased, smaller administrative bodies became desirable, resulting in the division of the largest units into more 'manageable' component parts. The first major changes in the vicinity of the study area took place in 1798, when an Act of Parliament called for the realignment of the Home and Western Districts and the formation of the London and Niagara Districts. Many new counties and townships were subsequently created (AO 2011).

The vicinity of the study area became part of Oxford County in the London District at this time. D.W. Smyth's *A Map of the Province of Upper Canada* (1800) and J. Purdy's *A Map of Cabotia* (1814) show the layout of the first townships in this area (see Map 10–Map 11). Although Oxford County would endure for the entirety of the Euro-Canadian era, it was not excluded from the many changes associated with the evolving administrative landscape. In 1821, for example, the county was enlarged through the addition of the Townships of Nissouri and Zorra (see Map 12). In the 1830s and early 1840s, the layout of what would become southern Ontario was significantly altered through the creation of the Huron, Brock, Wellington, Talbot and Simcoe Districts (AO 2011). Oxford became part of the Brock District in November 1839 and part of Canada West in the new United Province of Canada in February 1841 (see Map 13).

The earliest settler in Oxford County was Thomas Horner, who first came to the Township of Blenheim from New Jersey in 1793 to inspect the area and select a mill site. Horner's uncle, Thomas Watson, Esquire, had aided Governor Simcoe when he was imprisoned by the Americans, and Simcoe had invited Watson's friends and relations to settle in Blenheim in 1792.

Watson sent his son (also named Thomas) with Horner in response to Simcoe's request. To accommodate the arrival of Horner and other settlers, Simcoe had the first three concessions of Blenheim surveyed by "Surveyor Jones and his Indian Party" (Shenston 1852:29).

A second grant was made by Governor Simcoe in 1795 to Major Thomas Ingersoll, a Loyalist soldier from Massachusetts. The grant was a reward for Ingersoll's service in the Revolutionary War and was made on the condition that 40 families had to be settled on the land within 10 years. By 1805, 40 families had attempted settlement of the area, but many had been discouraged by the hardness of life there and abandoned their holdings. At the time, the historically-surveyed Dundas Street was the only road traversing the area, and it was more of a roughhewn and boggy trail than a real road (MTO 1984). As a result, Ingersoll lost his charter and moved to Port Credit where he died in 1812 (Frost and Stoyles 2003:4).

Between 1815 and 1824, heavy immigration from the Old World resulted in the doubling of the non-Aboriginal population of Upper Canada from 75,000 to 150,000. This dramatic increase was a result of the outcome of the War of 1812 and the Crown's efforts to populate the province's interior. A total of six major land-cession agreements were then pursued, which would yield nearly 3,000,000 ha of lands for Euro-Canadian settlement (Surtees 1994:112). These agreements were concerned with lands located well beyond the original waterfront settlements of Upper Canada, and included the Lake Simcoe-Nottawasaga, Ajetance, Rice Lake, Rideau, Long Woods and Huron Tract Purchases (Surtees 1994:113–119).

In October 1818, John Askin, Superintendent of Indian Affairs at Amherstburg, was sent to the Thames River area between London and Chatham in order to arrange for the purchase of a large tract of land to the north. Askin met with the chiefs of the Ojibway bands of the Chenal Ecarté, the St. Clair River, Bear Creek, the Ausable River and the Thames River, and began negotiations for lands on the Thames River and on Lake Huron just north of the Ausable River, extending inland as far as the Grand River Tract. The Ojibway leaders agreed to sell the land, and stipulated that 1) six reserves be set aside for them and that 2) a blacksmith and farm instructor be stationed near the reserves (Surtees 1994:117).

Based on Askin's report, the government decided to purchase the subject tract through two agreements: the 'Long Woods Purchase' and the 'Huron Tract Purchase'. The Long Woods area interested the Crown the most, as it was immediately north of the Thames River and was the next logical destination for Euro-Canadian settlers. Askin met with the Ojibway in 1819, and a provisional agreement was created which involved the surrender of 210,000 ha in exchange for an annuity of 600 pounds in currency and goods. The Huron Tract provisional agreement was also negotiated that same year, in which over 1,000,000 ha were to be sold for an annuity of 1,375 pounds in currency and goods (Surtees 1994:117–118).

Neither agreement was executed, however, as objections over the nature of the cash payments led to the revision of both proposals. The Long Woods Purchase was finally completed on November 28, 1822, and almost 552,190 ha were exchanged for 600 pounds in currency (NRC 2010). Specifically, a *per capita* payment of 2 pounds 10 shillings was agreed upon, to a maximum of 240 persons (Surtees 1994:118). The Huron Tract Purchase took longer to settle, and it was not pursued in earnest until John Galt's Canada Company began to materialize. This

purchase was completed on July 10, 1827 for 1,375 pounds in currency (NRC 2010). Over the ensuing years, these lands would become parts of Waterloo, Wellington, Huron, Lambton, Middlesex and Oxford Counties. The vicinity of the study area was acquired as part of the Huron Tract Purchase, which extended westerly from the South Thames River and the western limits of the second 'Between the Lakes Purchase'.

Eventually, county roads were improved and the pace of settlement in the county increased, with the bulk of immigrants coming from Scotland, England and Ireland. By 1842, the population of Oxford County had reached 16,271 (Smith 1846:20). Settlement subsequently occurred at such a pace that, by 1846, no remaining Crown Lands were available for sale in the entirety of the county (Smith 1846:20). Woodstock, located in the northwest corner of the Township of East Oxford, served as the District town throughout this period of rapid growth (Smith 1846:20, 233).

As the population of the county increased, so did public frustration with the Government, which was largely Crown-appointed and dominated by members of the privileged 'Family Compact'. In 1837, many Oxonians (people of Oxford County) led by their local member of the Legislative Assembly, Dr. Charles Duncombe, joined the Upper Canada Rebellion. Their efforts were soon thwarted, and Duncombe was forced to flee to America (Stagg 2013). Success came in 1839, however, with the creation of the Brock District. This new district consisted solely of Oxford County (formerly part of the London District)—a move that was intended to provide the county with more political autonomy (AO 2011). The new political system made settlement in Canada West more attractive, particularly to Americans, and caused the population of Oxford County to surge to 31,448 by 1852.

Following the abolishment of the district system in 1849, the counties of Canada West were reconfigured once again. Oxford County emerged to stand on its own as an independent municipality at this time, comprising the Townships of Blandford, Blenheim, Dereham, East Nissouri, North Oxford, East Oxford, West Oxford, North Norwich, South Norwich, East Zorra and West Zorra (see Map 14). The county was known for its high, rolling lands that offered excellent opportunities for cultivation, as well as its many waterways, including the Grand River, the Thames River, Otter Creek and Catfish Creek (Smith 1846:20).

In 1853, the arrival of the Great Western Railway encouraged further settlement within Oxford County. The railway allowed the area's residents to prosper as producers and exporters of grain and cheese. Increased demand for such products, accompanied by increasing prices, created considerable prosperity during the Crimean War (1853–1856) and the American Civil War (1861–1865). By the late 19th century, the county was traversed by multiple railway lines, and major population centres had developed in each township (see Map 15).

On January 1, 1975, major revisions to Oxford County's structure occurred when the historic townships were amalgamated into five new municipalities: Zorra, East Zorra-Tavistock, Blandford-Blenheim, South-West Oxford and Norwich. The urban centres of Ingersoll, Tillsonburg and Woodstock were retained, although there were modifications to their layouts.

1.2.3.3 Township of West Zorra

In historic times, the Township of Zorra was bounded by the Townships of Downie and South Easthope to the north, the Townships of Wilmot and Blandford to the east, the Township of North Oxford to the south and the Township of Nissouri to the west. According to early historical sources, the township contained "very excellent land, and the timber is generally hard wood, maple, oak, elm, beech, etc." (Smith 1846:226), and "its general aspect is rolling, and the soil rich and fertile, producing excellent crops of grain and fruit" (Sutherland 1862:94). The land was well-watered by various tributaries of the Thames River, providing power for milling operations (Sutherland 1862:94).

The Township of Zorra was surveyed by Shubal Parke in 1820, and by January 1820, a total of 27,951 ha had been granted in parcels of various sizes. Most of the parcels were 40.5 ha (100 acres) or 81.0 ha (200 acres) in size, but Thaddeus Davis was granted 2,051.4 ha (5,069 acres) and Thomas Merritt and James Kerby were granted 404.7 ha (1,000 acres). Joseph Randell, Daniel Randell, Robert Roseburgh, Thomas Roseburgh, Samuel Roseburgh, Lewis Evans, Shubal Parke and Thomas Woomack were only granted 20.2 ha (50 acres) each. The township was first organized in 1822, and only 58.7 ha (145 acres) had been cleared at that time (Shenston 1852:164–165).

The population of Zorra as a whole was 2,722 in 1842, and there was one grist mill and three saw mills in operation. A total of 24,370 ha were taken up by ca. 1846, 4,301 ha of which were under cultivation (Smith 1846:226). The Township of Zorra was divided into the municipalities of West and East Zorra in 1845, and West Zorra comprised the portion of the Township of Zorra located west of the line between Concessions 8 and 9 (Shenston 1852:28; Sutherland 1862:94). The first lot sold by the government was Lot 12, Concession 4, the northern half of which was acquired by Barnabus Ford, Jr. and the southern half of which was acquired by Abel Ford in January 1832 (Shenston 1852:173).

By 1851, the population of West Zorra was 3,302, and by 1861, it was 3,691. The majority of the population was of Scottish origin at that time (Sutherland 1862:94), and there were 64 McKays, 25 Murrays, 24 Rosses, 19 Sutherlands, 15 McLeods and 13 McDonalds on an enumerator list from the mid-19th century (Shenston 1852:173). In the mid-19th century, there were three saw mills, two grist mills, one wheat and barley mill, one oat mill, one carding and fulling mill and one tannery in the township (Shenston 1852:173). In 1862, the major roads in the township included the "Ingersoll, North Oxford, East Nissouri, and West Zorra Gravel Road" and the "North Oxford and West Zorra Gravel Road" (Sutherland 1862:94).

As a testament to the prosperity of the farming industry in West Zorra, "The West Zorra Agricultural Society" was formed in 1854 and ran an annual exhibition. The association met at the Albion Hotel in Embro, and the show ground was on the green opposite the hotel. Prizes were awarded for "horses, cattle, sheep, swine, dairy produce, grain, vegetables, domestic manufactures, farming implements, other mechanic works, fruit and field roots" (Sutherland 1862:94). The Western Ontario Pacific Railway (operated by Canadian Pacific) was surveyed in 1886 and opened in 1887, whereas the St. Marys & Western Ontario Railway and the Tillsonburg, Lake Erie & Pacific Railway (both operated by Canadian Pacific) were opened in 1908 and abandoned in 1995 (Zadro and Delamere 2009).

The principal historic communities in West Zorra included Harrington in the northwest and Embro in the south-centre, although smaller settlements also developed at Brooksdale, Youngsville and Maplewood (see Map 16). Harrington (originally called Springville) had a population of approximately 100 in 1862, and it contained a post office, a school, saw, flouring and oatmeal mills, general stores as well as shoe, carpenter, cabinet-maker, wagon and other workshops at that time (Sutherland 1862:128). Embro developed 9.6 km from the 'Governor's Road' (Dundas Street) and it had excellent hydraulic power for mill purposes. By 1846, Embro had a population of roughly 150 and contained one grist and saw mill, a carding machine and cloth factory, a distillery, a tannery, three stores, two taverns, one wagon maker, two blacksmiths, three shoemakers and one tailor (Smith 1846:54). By 1862, the settlement had a population of 551 and boasted three flouring and grist mills, one saw mill, a woollen factory, a tannery and a post office, and its business included mercantile stores, workshops and a brick hotel called the Albion (Sutherland 1862:122–124).

1.2.3.4 The Study Area

As discussed in Section 1.1, the Harrington Dam parcel falls on part of Lot 30, Concession 2 in the Geographic Township of West Zorra, whereas the Embro Dam parcel falls on part of Lot 15, Concession 4 in the Geographic Township of West Zorra. The lots in this area were laid out during the early 19th century, and the vicinity of the study area was well-settled for the remainder of the Euro-Canadian period.

In an attempt to reconstruct the historic land use of the study area, ARA examined three historical maps that documented past residents, structures (e.g., homes, businesses and public buildings) and features during the mid- and late 19th century. Specifically, the following maps were consulted:

- G.C. Tremaine's *Tremaine's Map of Oxford County, Canada West* (1857) at a scale of 60 chains to 1 inch (OHCMP 2015),
- *Harrington* from Walker & Miles' *Topographical and Historical Atlas of the County of Oxford* (1876) at a scale of 10 chains to 1 inch (McGill University 2001); and
- *West Zorra Township* from Walker & Miles' *Topographical and Historical Atlas of the County of Oxford* (1876) at a scale of 45 chains to 1 inch (McGill University 2001).

The consulted historical maps were georeferenced and integrated into ARA's GIS database, and the limits of the study area are illustrated in Map 17–Map 19. The content of these maps is referenced throughout the following historic land use summary.

G.C. Tremaine's *Tremaine's Map of Oxford County, Canada West* (1857) indicates that the community of Harrington was well-established around the Harrington Dam parcel, and the Harrington Pond and Grist Mill are illustrated within the study area (a saw mill is also shown to the west). The lands southwest of the community were owned by William Ross, whereas the lands to the southeast were owned by L.D. Demarest (Demorest). According to Sutherland's *County of Oxford Gazetteer and General Business Directory for 1862-3,* D.L. Demorest was a post master and saw mill owner, Richard Paige was the proprietor of the Harrington Mills, and Sutherland & White were the proprietors of the Harrington Oatmeal Mill (Sutherland 1862:129).

The Embro Dam parcel, on the other hand, falls within lands owned by George Leonard, and a grist mill is shown within the study area. Sutherland's *County of Oxford Gazetteer and General Business Directory for 1862-3* lists Mrs. Munro as the proprietress of Spring Creek Mills on Lot 15, Concession 4 (Sutherland 1862:103).

West Zorra Township from Walker & Miles' *Topographical and Historical Atlas of the County of Oxford* (1876) indicates that the majority of Lot 30, Concession 2 was owned by S.F. Rounds at that time, and a school house and church are illustrated in the northwestern and south-central parts, respectively. S.F. Rounds is listed as an American-born farmer and mill owner who settled in the Township of West Zorra in 1837, and he collected his mail from the Harrington post office. The northern part of the lot comprised the community of Harrington, and *Harrington* from Walker & Miles' *Topographical and Historical Atlas of the County of Oxford* (1876) provides a comprehensive picture of the settlement. The mill pond is shown, as is the Harrington Grist Mill on the east bank of 'Trout Creek' (now Harrington-West Drain). Regarding the Embro Dam parcel, *West Zorra Township* from Walker & Miles' *Topographical and Historical Atlas of the County of Oxford* (1876) indicates that Lot 15, Concession 4 was owned by Thomas Sutherland, and a grist mill is illustrated on the east side of 'Spring Brook' (now Youngsville Drain). Few biographical details are listed for Sutherland, save for the fact that he collected his mail from the Embro post office (McGill University 2001).

The Harrington Grist Mill is a major feature of the Harrington Dam parcel, and it was built by United Empire Loyalist D.L. Demorest. It operated continuously from 1846 to 1966, save for short periods in 1903 (when the mill dam broke), 1923 (when the mill was destroyed by fire) and 1949 (when the mill dam broke again). The original structure consisted of pine timbers and a split shingle roof, and it was powered by an overshot wheel (later replaced by a more efficient turbine in the 1880s). The mill initially used the French Burr stone system for producing flour, but in the late 1890s, modern milling equipment was introduced in the form of an oat roller and chopper (the oat roller at the mill was manufactured by Whitelaw Machinery of Woodstock). The mill was acquired by the UTRCA in 1966, and it then remained closed and unused (HCC 2008).

In 1999, the Harrington Community Club entered into a lease agreement in order to preserve and restore the mill as a museum and educational site. The work involved "re-installations, new foundation and re-alignments to loosen up the running gear" (Dale 2010:6). The restorations also included recladding the structure in board and batten, installing a new roof, restoring the oat roller from the 1890s and restoring the turbine (Fischer and Harris 2007:219). Interestingly, there is an advertisement for Harrington Mills, Gristing and Chopping in Walker & Miles' *Topographical and Historical Atlas of the County of Oxford* (1876), listing the proprietor as J.S. Betzner. The advertisement reads: "Harrington Mills, J.S. Betzner, Proprietor, Gristing and Chopping, Done on Short Notice. Highest Market Price for Wheat and other Grain" (Walker & Miles 1876:94).

ARA also consulted a historic aerial image of the properties from 1954 to gain a better understanding of their more recent land use (see Map 20). The Harrington Dam parcel comprised Harrington Pond, the Harrington Grist Mill and a laneway running along the western edge of the study area at this time. The Embro Dam parcel comprised Spring Brook and adjacent grassed and wooded areas, but no structures or features are visible (University of Toronto 2009).

1.2.4 Summary of Past and Present Land Use

During Pre-Contact and Early Contact times, the vicinity of the study area would have comprised a mixture of deciduous trees and open areas. It seems clear that the First Nations managed the landscape to some degree, but the extent of such management is unknown. During the early 19th century, Euro-Canadian settlers arrived in the area and began to clear the forests for agricultural purposes. Over the course of the Euro-Canadian era, the Harrington Dam parcel would have fallen within the community of Harrington and contained a mill pond surrounded by homes, roadways and businesses. The Embro Dam parcel contained a mill pond surrounded by agricultural lands and wooded areas. At the time of assessment, the Harrington Dam parcel comprised Harrington Pond, the Harrington Grist Mill, a gravel driveway, pedestrian bridges, maintained lawns, wooded areas and part of an agricultural field, whereas the Embro Dam parcel comprised Embro Pond, a pavilion, a culvert, maintained lawns and wooded areas.

1.2.5 Additional Background Information

Given that no other archaeological assessment reports have been prepared for the project, and that no other assessments have been documented in the immediate area (see Section 1.3.1), additional relevant background information was not available to inform ARA's archaeological potential modelling or recommendations (MTC 2011:125).

1.3 Archaeological Context

1.3.1 Previous Archaeological Work

In order to determine whether any archaeological assessments had been previously conducted within the limits of, or immediately adjacent to the study area, ARA submitted an inquiry to the Archaeology Data Coordinator (MTCS 2015) and conducted extensive independent background research. As a result of these investigations, it was determined that there are no reports on record documenting past work within a 50 m radius.

1.3.2 Summary of Registered or Known Archaeological Sites

An archival search was conducted using the MTCS's Ontario Archaeological Sites Database in order to determine the presence of any registered archaeological resources which might be located within a 1 km radius of the study area (MTCS 2015). The results of this search indicate that there are no previously-identified archaeological sites within these limits. The lack of documented archaeological sites in the vicinity of the study area should not be taken as an indicator that the area was unattractive or undesirable for human occupation. Instead, this absence of sites is likely related to a lack of local archaeological exploration.

1.3.3 Natural Environment

Environmental factors played a substantial role in shaping early land-use and site selection processes, particularly in small Pre-Contact societies with non-complex, subsistence-oriented economies. Euro-Canadian settlers also gravitated towards favourable environments, particularly those with agriculturally-suitable soils. In order to fully comprehend the archaeological context

of the study area, the following four features of the local natural environment must be considered: 1) forests; 2) drainage systems; 3) physiography; and 4) soil types.

The study area lies within the deciduous forest, which is the southernmost forest region in Ontario and is dominated by agricultural and urban areas. This region generally has the greatest diversity of tree species, while at the same time having the lowest proportion of forest. It has most of the tree and shrubs species found in the Great Lakes–St. Lawrence forest (e.g., eastern white pine, red pine, eastern hemlock, white cedar, yellow birch, sugar and red maple, basswood, red oak, black walnut, butternut, tulip, magnolia, black gum, and many types of oaks and hickories), and also contains black walnut, butternut, tulip, magnolia, black gum, many types of oaks, hickories, sassafras and red bud. The deciduous forest region has the most diverse forest life in Ontario, including rare species such as the southern flying squirrel, red-bellied woodpecker, black rat snake, milk snake and gray tree frog (MNRF 2014).

With an area of almost 3,000,000 ha, the deciduous forest region has largely been cleared, and only scattered woodlots remain on sites too poor for agriculture (MNRF 2014). In Pre-Contact times, however, these dense forests would have been particularly bountiful. It is believed that the First Nations of the Great Lakes region exploited close to 500 plant species for food, beverages, food flavourings, medicines, smoking, building materials, fibres, dyes and basketry (Mason 1981:59–60). Furthermore, this diverse vegetation would have served as both home and food for a wide range of game animals, including white tailed deer, turkey, passenger pigeon, cottontail rabbit, elk, muskrat and beaver (Mason 1981:60).

In terms of local drainage systems, the Harrington Dam parcel lies within the Trout Creek watershed, which makes up 5% of the Upper Thames River watershed and drains parts of Zorra, Perth South, Perth East, St. Marys and Stratford into the North Thames River at St. Marys. The Embro Dam parcel lies within the Mud Creek watershed, which also makes up 5% of the Upper Thames River watershed and drains parts of Zorra and East Zorra-Tavistock into the Middle Thames River downstream of Embro (UTRCA 2012). Specifically, the Harrington Dam parcel is traversed by a tributary of Trout Creek (Harrington-West Drain) and is located 294 m south of Trout Creek and 397 m southeast of the Wildwood Reservoir. The Embro Dam parcel is traversed by a tributary of North Branch Creek West (Youngsville Drain) and is located 4.1 km west of Mud Creek and 4.0 km northwest of the Middle Thames River.

Physiographically, the study area lies within the region known as the Oxford Till Plain, which occupies a central position in the peninsula of southwestern Ontario. This plain covers approximately 156,000 ha and has a drumlinized surface. The till consists of a pale brown calcareous loam with limestone and grey/pale brown dolostone (Chapman and Putnam 1984:143). The underlying bedrock consists of limestone and dolostone belonging to the Middle Devonian Detroit River group (Davidson 1989:42).

The soils within the Harrington Dam parcel consist primarily of Muck (M) in the north and Guelph loam (Gl) to the south, although there is also some Bottom Land (B.L.) and Fox sandy loam-rolling phase (Fxsl-r) in the southwest. The Embro Dam parcel consists entirely of Guelph loam (Wicklund and Richards 1961:Soil Map). The characteristics of these soils can be summarized as follows:

- Muck: An Alluvial soil consisting of deep organic deposits underlain by sand, silt and clay with a depressional topography, a stone-free matrix and very poor drainage qualities;
- Guelph loam: A Grey-Brown Podzolic consisting of calcareous loam till with a smooth moderately-to-steeply rolling topography, a slightly stony matrix and good drainage qualities;
- Bottom Land: An Alluvial soil consisting of recent alluvium with a level topography, a stone-free matrix and variable drainage qualities; and
- Fox sandy loam-rolling phase: A Grey-Brown Podzolic consisting of calcareous sand with a smooth very gently sloping to rolling topography, a stone-free matrix and good drainage qualities.

In summary, the study area possesses a number of environmental characteristics which would have made it attractive to both Pre-Contact and Euro-Canadian populations. The rich deciduous forest and the nearby water sources would have attracted a wide variety of game animals, and consequently, early hunters. The areas of well-drained soils would have been ideal for the maize horticulture of Middle to Late Woodland peoples and the mixed agriculture practiced by later Euro-Canadian populations. The proximity of the study area to Trout Creek, Mud Creek and the Upper and Middle Thames Rivers—principal transportation routes in both Pre-Contact and Euro-Canadian times—would also have influenced its settlement and land-use history.

1.3.4 Archaeological Fieldwork and Property Conditions

The Stage 1 property inspection was carried out on May 19, 2015 under licence #P007, PIF #P007-0690-2015. The assessment involved the visual survey of the study area and the documentation of all areas of archaeological potential. All field observations were made from accessible public lands; accordingly, no permissions were required for property access.

Key personnel involved in the assessment included P.J. Racher, Project Director; C.E. Gohm, Operations Manager; C.J. Gohm, Deliverables Manager; V. Cafik, Assistant Project Manager; and H. Buckton, Field Director.

At the time of assessment, the Harrington Dam parcel comprised Harrington Pond, the Harrington Grist Mill, a gravel driveway, pedestrian bridges, maintained lawns, wooded areas and part of an agricultural field, whereas the Embro Dam parcel comprised Embro Pond, a pavilion, a culvert, maintained lawns and wooded areas. The specific weather and lighting conditions for the day of assessment are summarized in Section 2.2. No unusual physical features were encountered during the property inspection that affected the results of the Stage 1 assessment.

2.0 STAGE 1 BACKGROUND STUDY

2.1 Summary

The Stage 1 assessment, conducted under licence #P007, PIF #P007-0690-2015, was accomplished through an examination of the archaeology, history, geography and current land condition of the vicinity of the study area. This background study was carried out using archival sources (e.g., historical publications and records) and current academic and archaeological publications (e.g., archaeological studies and reports). It also included the analysis of modern topographic maps (at a 1:50,000 scale), recent satellite imagery and historical maps/atlases of the most detailed scale available (i.e., 60 chains to 1 inch, 10 chains to 1 inch and 45 chains to 1 inch).

With occupation beginning approximately 11,000 years ago, the greater vicinity of the study area comprises a complex chronology of Pre-Contact and Euro-Canadian histories (see Section 1.2). Artifacts associated with Palaeo-Indian, Archaic, Woodland and Early Contact traditions are well-attested in Oxford County, and Euro-Canadian archaeological sites dating to pre-1900 and post-1900 contexts are likewise common. The lack of documented archaeological sites in the vicinity of the study area should not be taken as an indicator that the area was unattractive or undesirable for human occupation. Instead, this absence is more likely related to a lack of local archaeological exploration (see Section 1.3.2).

As mentioned in Section 1.3.3, the natural environment of the study area would have been attractive to both Pre-Contact and Euro-Canadian populations as a result of proximity to Harrington-West Drain, Trout Creek, Youngsville Drain and North Branch Creek West (all primary water sources). The areas of well-drained soils and the diverse local vegetation would also have encouraged settlement throughout Ontario's lengthy history. Euro-Canadian populations would have been particularly drawn to Road 96, Elizabeth Street and Victoria Street at the Harrington Dam parcel as well as Road 84 and 37th Line at the Embro Dam parcel (all historically-surveyed thoroughfares).

In summary, the Stage 1 assessment included an up-to-date listing of sites from the MTCS's Ontario Archaeological Sites Database (within at least a 1 km radius), the consideration of previous local archaeological fieldwork (within at least a 50 m radius), the analysis of topographic and historic maps (at the most detailed scale available), and the study of aerial photographs/satellite imagery. In this manner, the standards for background research set out in Section 1.1 of the *S&Gs* (MTC 2011:14–15) were met.

2.2 Field Methods (Property Inspection)

In order to gain first-hand knowledge of the geography, topography and current condition of the study area, a property inspection was conducted on May 19, 2015. Although optional, Section 1.2 of the *S&Gs* (MTC 2011:15–17) outlines the appropriateness of such an option when a greater level of detail is needed to recommend further assessment strategies. All field observations were made from accessible public lands; accordingly, no permissions were required for property access.

Environmental conditions were ideal during the property inspection, with partly cloudy skies, a high of 14 °C and good lighting. ARA therefore confirms that fieldwork was carried out under weather and lighting conditions that met the requirements set out in Section 1.2 Standard 2 of the *S&Gs* (MTC 2011:16).

Given the narrow nature of the study area around each pond, the lands were subjected to a systematic survey at an interval of ≤ 15 m in accordance with the requirements set out in Section 1.2 of the *S&Gs* (MTC 2011:15–17). Specifically, the systematic survey began in the northeastern part of each parcel and progressed clockwise around the southern and western parts. The visually surveyed areas were examined under ideal weather and lighting conditions with high ground surface visibility.

The property inspection/visual survey confirmed that all features of archaeological potential (e.g., historically-surveyed roadways, etc.) were present where they were previously identified, and did not result in the identification of any additional features of archaeological potential not visible on mapping (e.g., relic water channels, patches of well-drained soils, etc.). No new structures or built features (e.g., heritage structures, plaques, monuments, cemeteries, etc.) were identified that would affect assessment strategies (MTC 2011:16–17). The property inspection result in the identification of several areas of no archaeological potential, however, which are discussed in Section 2.3.

2.3 Analysis and Conclusions

In addition to the relevant historical sources and the results of past excavations and surveys (see Section 1.2–Section 1.3), the archaeological potential of a property can be assessed using its soils, hydrology and landforms as considerations. What follows is an in-depth analysis of the archaeological potential of the study area, which incorporates the results of the property inspection conducted in May 2015.

Throughout southern Ontario, scholars have noted a strong association between site locations and waterways. Young, Horne, Varley, Racher and Clish, for example, state that "either the number of streams and/or stream order is always a significant factor in the positive prediction of site presence" (1995:23). They further note that certain types of landforms, such as moraines, seem to have been favoured by different groups throughout prehistory (Young et al. 1995:33). According to Janusas (1988:1), "the location of early settlements tended to be dominated by the proximity to reliable and potable water resources." Site potential modeling studies (Peters 1986; Pihl 1986) have found that most prehistoric archaeological sites are located within 300 m of either extant water sources or former bodies of water, such as post-glacial lakes.

While many of these studies do not go into detail as to the basis for this pattern, Young, Horne, Varley, Racher and Clish (1995) suggest that the presence of streams would have been a significant attractor for a host of plant, game and fish species, encouraging localized human exploitation and settlement. Additionally, lands in close proximity to streams and other water courses were highly valued for the access they provided to transportation and communication routes. Primary water sources (e.g., lakes, rivers, streams and creeks) and secondary water sources (e.g., intermittent streams and creeks, springs, marshes and swamps) are therefore of pivotal importance for identifying archaeological potential (MTC 2011:17).

Section 1.3.1 of the *S&Gs* (MTC 2011:17–18) emphasizes the following six features and characteristics as being additional indicators of positive potential for Pre-Contact archaeological materials: 1) features associated with extinct water sources (glacial lake shorelines, relic river channels, shorelines of drained lakes, etc.); 2) the presence of pockets of well-drained soils (for habitation and agriculture); 3) elevated topography (e.g. drumlins, eskers, moraines, knolls, etc.); 4) distinctive landforms that may have been utilized as spiritual sites (waterfalls, rocky outcrops, caverns, etc.); 5) proximity to valued raw materials (quartz, ochre, copper, chert outcrops, medicinal flora, etc.); and 6) accessibility of plant and animal food sources (spawning areas, migratory routes, prairie lands, etc.).

Conversely, it must be understood that non-habitational sites (e.g., burials, lithic quarries, kill sites, etc.) may be located anywhere. Potential modeling appears to break down when it comes to these idiosyncratic sites, many of which have more significance than their habitational counterparts due to their relative rarity. The Stage 1 archaeological assessment practices outlined in Section 1.4.1 of the *S&Gs* (MTC 2011:20–21) ensure that these important sites are not missed, as no areas can be exempt from test pit survey unless both a background study and property inspection have been completed (unless the lands are already exempt due to disturbance, etc.).

With the development of integrated 'complex' economies in the Euro-Canadian era, settlement tended to become less dependent upon local resource procurement/production and more tied to wider economic networks. As such, proximity to transportation routes (roads, canals, etc.) became the most significant predictor of site location, especially for Euro-Canadian populations. In the early Euro-Canadian era (pre-1850), when transport by water was the norm, sites tended to be situated along major rivers and creeks—the 'highways' of their day. With the opening of the interior of the province to settlement after about 1850, sites tended to be more commonly located along historically-surveyed roads. Section 1.3.1 of the *S&Gs* (MTC 2011:18) recognizes trails, passes, roads, railways and portage routes as examples of such early transportation routes.

In addition to transportation routes, Section 1.3.1 of the *S&Gs* (MTC 2011:18) emphasizes three other indicators of positive potential for Euro-Canadian archaeological materials: 1) areas of early settlement (military outposts, pioneer homesteads or cabins, early wharfs or dock complexes, pioneer churches, early cemeteries, etc.); 2) properties listed on a municipal register, designated under the *Ontario Heritage Act* or otherwise categorized as a federal, provincial or municipal historic landmark/site; and 3) properties identified with possible archaeological sites, historical events, activities or occupations, as identified by local histories or informants.

Based on the location, drainage and topography of the subject lands and the application of land-use modelling, it seems clear that the study area, in its pristine state, would have potential for both Pre-Contact and Euro-Canadian archaeological sites. Local indicators of archaeological potential include four primary water sources (Harrington-West Drain, Trout Creek, Youngsville Drain and North Branch Creek West), five historically-surveyed roadways (Road 96, Elizabeth Street, Victoria Street, Road 84 and 37th Line) and two areas of early Euro-Canadian settlement (Harrington and Embro). The representation of historic mills on both properties in mapping from 1857 and 1876 suggests that these areas have significant potential for Euro-Canadian material culture and features.

In its current state, however, the study area retains only part of this archaeological potential (see Image 1–Image 4). Section 2.1 of the *S&Gs* (MTC 2011:28) states that lands that 1) are sloped > 20°, 2) are permanently wet, 3) consist of exposed bedrock or 4) have been subject to extensive and deep land alterations can be considered exempt from requiring Stage 2 assessment. These guidelines serve as effective criteria for identifying areas of no archaeological potential.

ARA's property inspection/visual survey, coupled with the analysis of modern satellite imagery and topographic mapping, resulted in the identification of several areas of disturbance within the assessed area (see Image 5–Image 10). Specifically, deep land alterations have resulted in the removal of archaeological potential from 1) the driveways/walkways associated with the grist mill and pedestrian bridges at the Harrington Dam parcel, 2) the footprint of the Harrington Grist Mill and a look-out platform at the Harrington Dam parcel, 3) the footprint of a concrete-footed pavilion at the Embro Dam parcel and 4) culverts and/or dams at the north and south ends of the ponds at both parcels. Natural areas of no archaeological potential included several permanently wet areas associated with the waterways and ponds at both parcels (see Image 11–Image 12), and two area of lands sloped > 20° at the Embro Dam parcel (see Image 13–Image 14). The remainder of the assessed area either has potential for Pre-Contact and Euro-Canadian archaeological materials or requires test-pitting to confirm disturbance.

Based on the results of the visual survey, both the Harrington and Embro Dam parcels currently comprise a mixture of areas of archaeological potential and areas of no archaeological potential. In total, 4.49% (0.25 ha) of the Harrington Dam parcel falls within an agricultural field and requires pedestrian survey at an interval of ≤ 5 m, 52.00% (2.94 ha) falls within 300 m of a feature of archaeological potential and requires test pit survey at an interval of ≤ 5 m, 3.45% (0.20 ha) was identified as disturbed and 40.06% (2.27 ha) was found to be permanently wet. Regarding the Embro Dam parcel, 66.79% (2.09 ha) falls within 300 m of a feature of archaeological potential and requires test pit survey at an interval of ≤ 5 m, 0.19% (0.01 ha) was identified as disturbed, 30.96% (0.97 ha) was found to be permanently wet and 2.06% (0.07 ha) was sloped > 20°. The identified areas of archaeological potential and areas of no archaeological potential (separated by class or category) are depicted in Map 21–Map 22.

3.0 RECOMMENDATIONS

The results of the assessment indicated that the study area currently comprises a mixture of areas of archaeological potential and areas of no archaeological potential (see Map 21–Map 22). ARA recommends that all areas of archaeological potential that could be impacted by the project be subject to a Stage 2 property assessment in advance of construction.

In accordance with the requirements set out in Section 2.1 of the *S&Gs* (MTC 2011:28–39), the following assessment strategies should be utilized:

- For recently cultivated or actively cultivated lands, the assessment must be conducted using the pedestrian survey method at an interval of ≤ 5 m. All ground surfaces must be recently ploughed, weathered by one heavy rainfall, and provide at least 80% visibility. If archaeological materials are encountered in the course of the pedestrian survey, the transect interval must be closed to 1 m and a close inspection of the ground must be conducted for 20 m in all directions.
- For lands where ploughing is not possible or viable (e.g., wooded areas; pasture with high rock content; abandoned farmland with heavy brush and weed growth; and gardens, parkland or lawns which will remain in use for several years after the survey), the assessment must be conducted using the test pit survey method. A test pit survey interval of ≤ 5 m is required in all areas less than 300 m from any feature of archaeological potential, and a test pit survey interval of ≤ 10 m is required in all areas more than 300 m from any feature of archaeological potential. Each test pit must be excavated into the first 5 cm of subsoil, and the resultant pits must be examined for stratigraphy, cultural features and/or evidence of fill. The soil from each test pit must be screened through mesh with an aperture of no greater than 6 mm and examined for archaeological materials.

The identified areas of no archaeological potential are not recommended for further assessment. It is requested that this report be entered into the *Ontario Public Register of Archaeological Reports*, as provided for in Section 65.1 of the *Ontario Heritage Act.*

4.0 ADVICE ON COMPLIANCE WITH LEGISLATION

Section 7.5.9 of the *S&Gs* requires that the following information be provided for the benefit of the proponent and approval authority in the land use planning and development process (MTC 2011:126–127):

- This report is submitted to the Minister of Tourism, Culture and Sport as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act*, R.S.O. 1990, c 0.18. The report is reviewed to ensure that it complies with the standards and guidelines that are issued by the Minister, and that the archaeological fieldwork and report recommendations ensure the conservation, protection and preservation of the cultural heritage of Ontario. When all matters relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the Ministry of Tourism, Culture and Sport, a letter will be issued by the ministry stating that there are no further concerns with regard to alterations to archaeological sites by the proposed development.
- It is an offence under Sections 48 and 69 of the *Ontario Heritage Act* for any party other than a licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed archaeological fieldwork on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeology Reports referred to in Section 65.1 of the *Ontario Heritage Act*.
- Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48 (1) of the *Ontario Heritage Act*. The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with Section 48 (1) of the *Ontario Heritage Act*.
- The *Cemeteries Act*, R.S.O. 1990 c. C.4 and the *Funeral, Burial and Cremation Services Act*, 2002, S.O. 2002, c.33 (when proclaimed in force) require that any person discovering human remains must notify the police or coroner and the Registrar of Cemeteries at the Ministry of Consumer Services.

5.0 IMAGES

Image 1: Current Land Conditions, Harrington Dam
(Photo Taken on May 19, 2015; Facing Southwest)

Image 2: Current Land Conditions, Harrington Dam
(Photo Taken on May 19, 2015; Facing Southwest)

Image 3: Current Land Conditions, Embro Dam
(Photo Taken on May 19, 2015; Facing Southeast)

Image 4: Current Land Conditions, Embro Dam
(Photo Taken on May 19, 2015; Facing Northeast)

Image 5: Area of No Archaeological Potential, Harrington Dam – Disturbed
(Photo Taken on May 19, 2015; Facing North)

Image 6: Area of No Archaeological Potential, Harrington Dam – Disturbed
(Photo Taken on May 19, 2015; Facing Southwest)

Image 7: Area of No Archaeological Potential, Harrington Dam – Disturbed
(Photo Taken on May 19, 2015; Facing North)

Image 8: Area of No Archaeological Potential, Harrington Dam – Disturbed
(Photo Taken on May 19, 2015; Facing Southeast)

Image 9: Area of No Archaeological Potential, Harrington Dam – Disturbed
(Photo Taken on May 19, 2015; Facing Northwest)

Image 10: Area of No Archaeological Potential, Embro Dam – Disturbed
(Photo Taken on May 19, 2015; Facing South)

Image 11: Area of No Archaeological Potential, Harrington Dam – Permanently Wet
(Photo Taken on May 19, 2015; Facing Southeast)

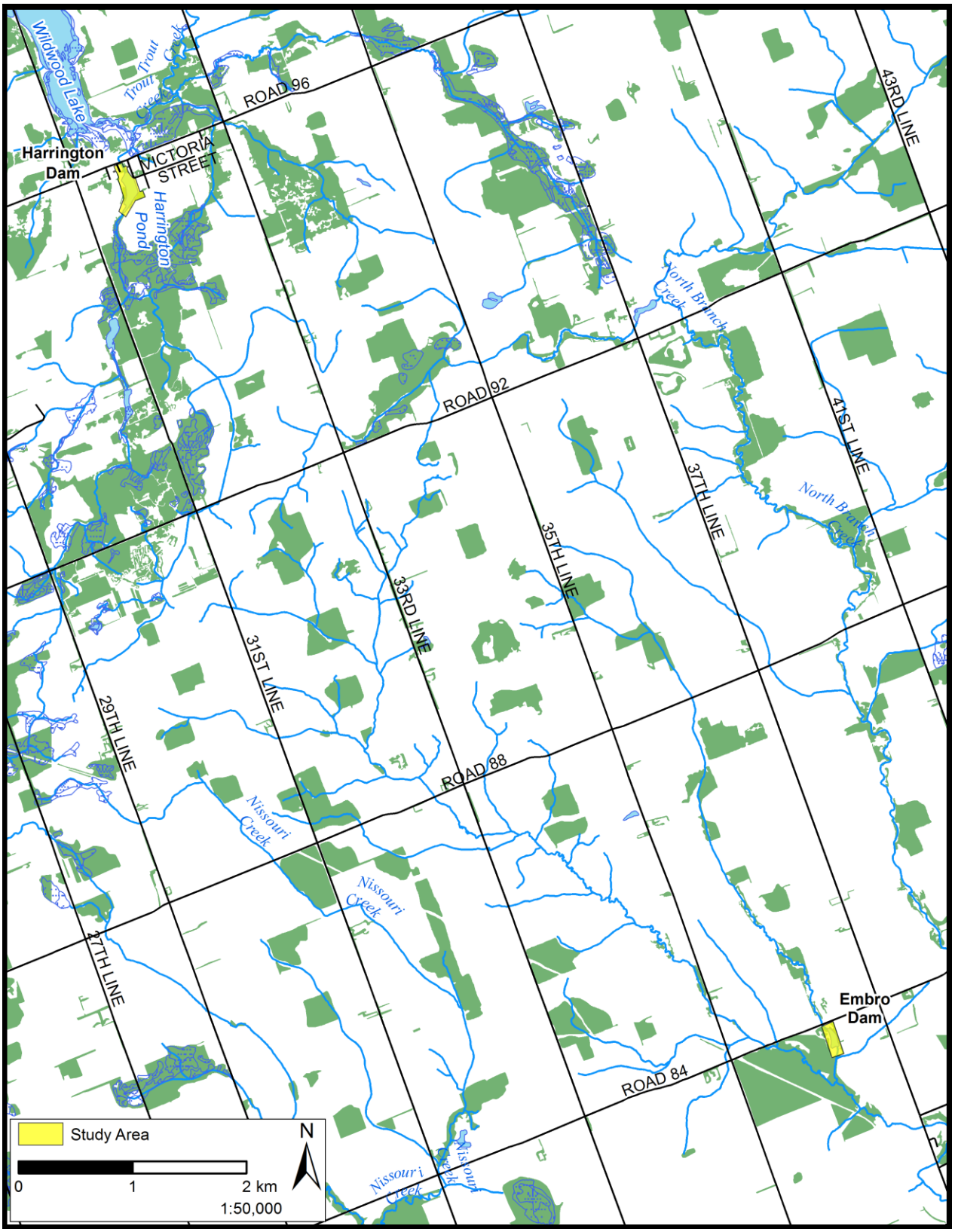
Image 12: Area of No Archaeological Potential, Embro Dam – Permanently Wet
(Photo Taken on May 19, 2015; Facing Southeast)

Image 13: Area of No Archaeological Potential, Embro Dam – Slope > 20°
(Photo Taken on May 19, 2015; Facing North)

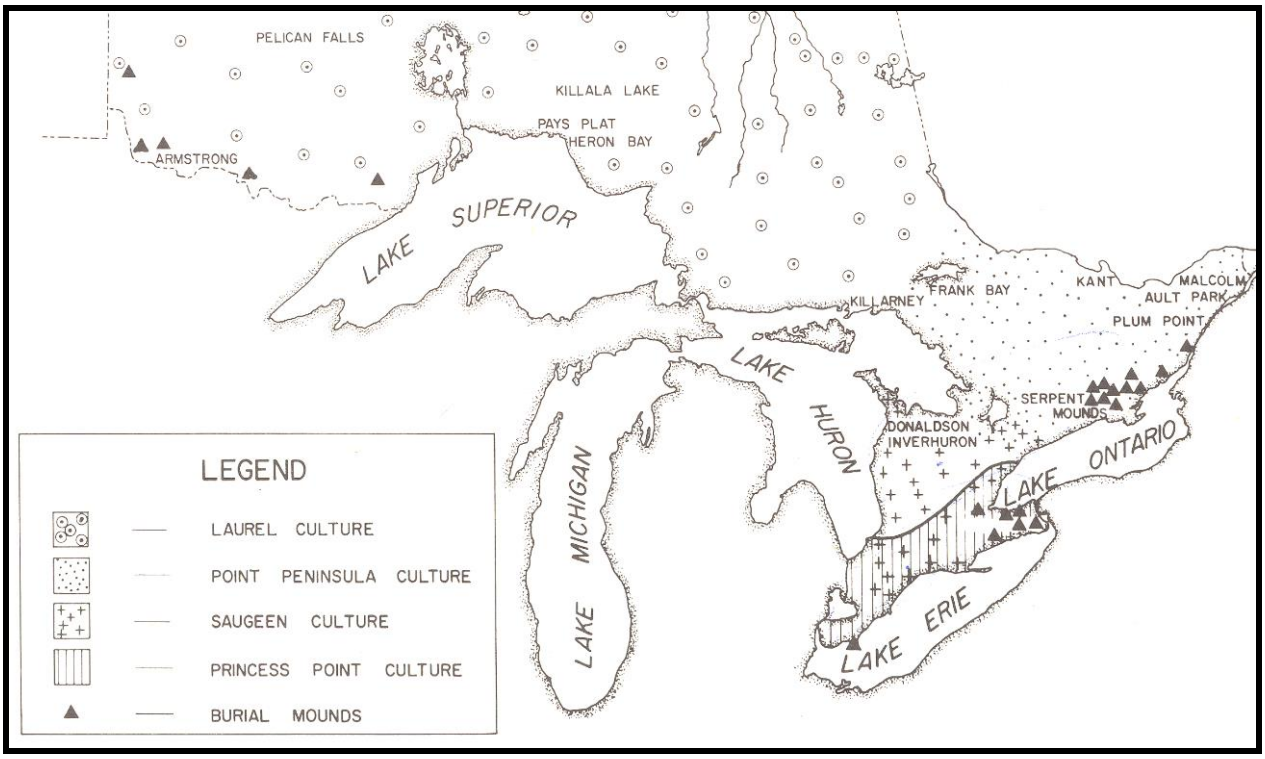
Image 14: Area of No Archaeological Potential, Embro Dam – Slope > 20°
(Photo Taken on May 19, 2015; Facing Northwest)

6.0 MAPS

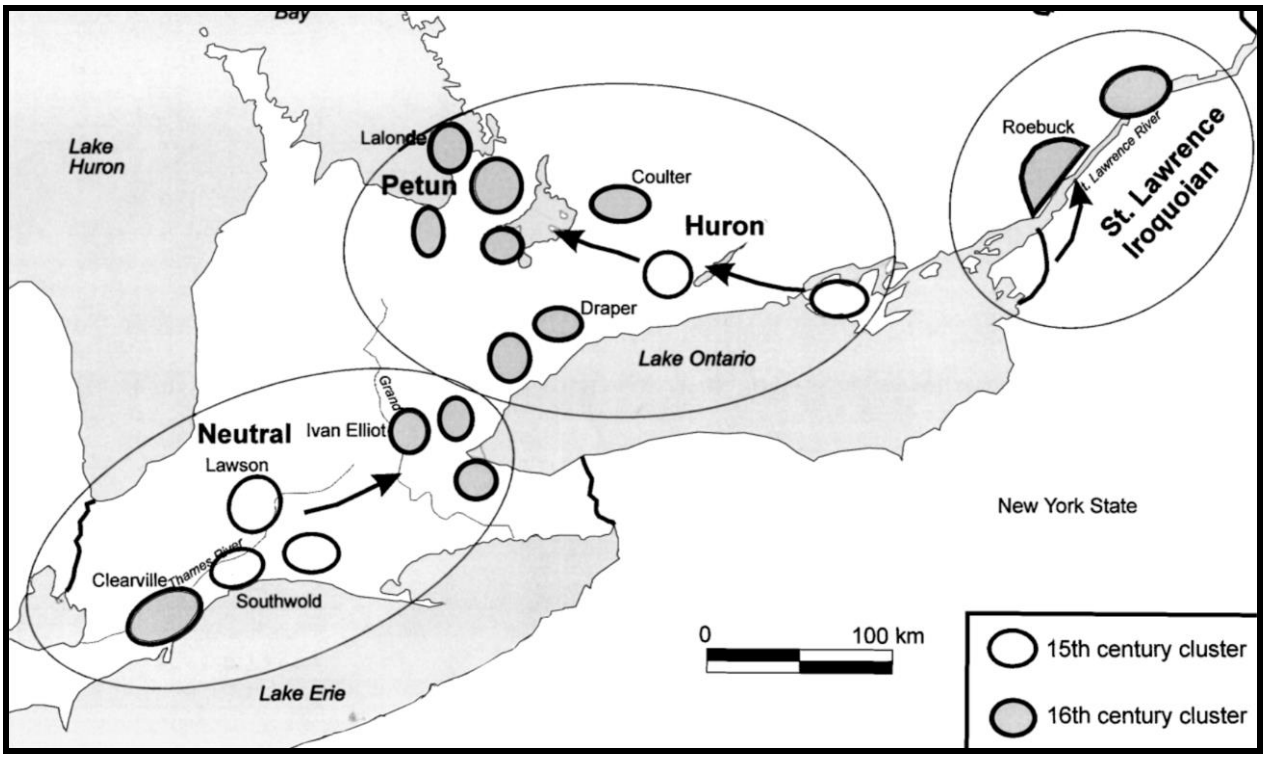
Map 1: Location of the Study Area in the Province of Ontario
(NRC 2002)



Map 2: Location of the Study Area in the Township of Zorra
(Produced by ARA under licence from Ontario MNRF, © Queen's Printer 2015)



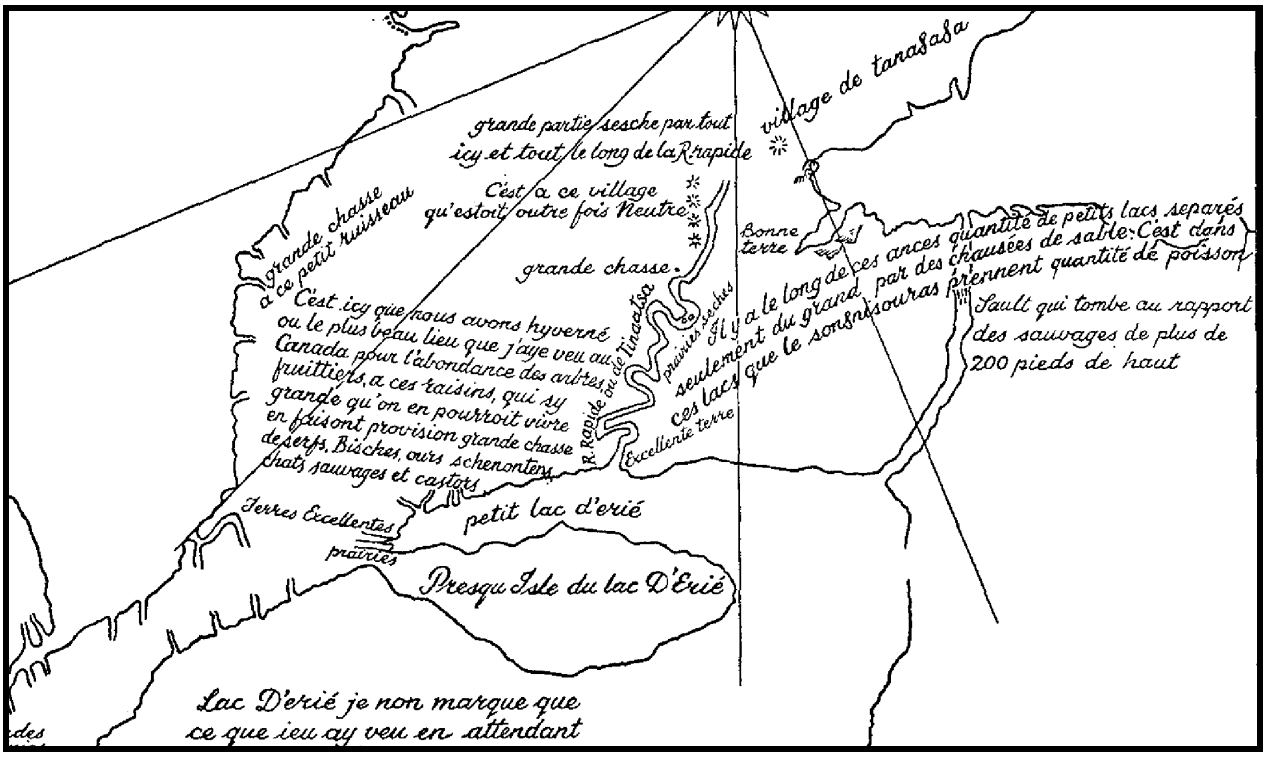
Map 3: Map of Middle Woodland Period Complexes
(Wright 1972:Map 4)



Map 4: Pre-Contact Iroquoian Site Clusters
(Warrick 2000:Figure 10)

Map 5: Detail from S. de Champlain's *Carte de la Nouvelle France* (1632)
(Gentilcore and Head 1984:Map 1.2)

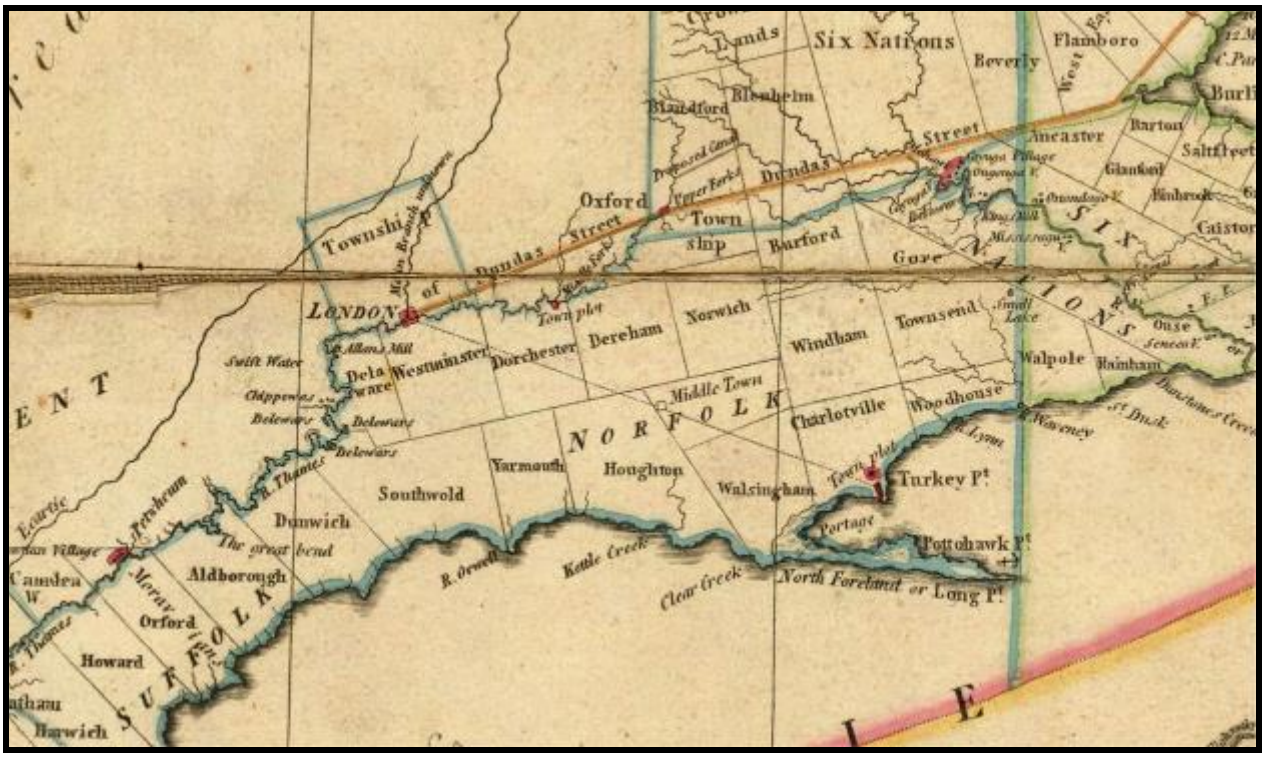
Map 6: Detail from N. Sanson's *Le Canada, ou Nouvelle France* (1656)
(Gentilcore and Head 1984:Map 1.10)



Map 7: Detail from the Map of Galinée's Voyage (1670)
(Lajeunesse 1960:Map 2)

Map 8: Detail from H. Popple's *A Map of the British Empire in America* (1733)
(Cartography Associates 2009)

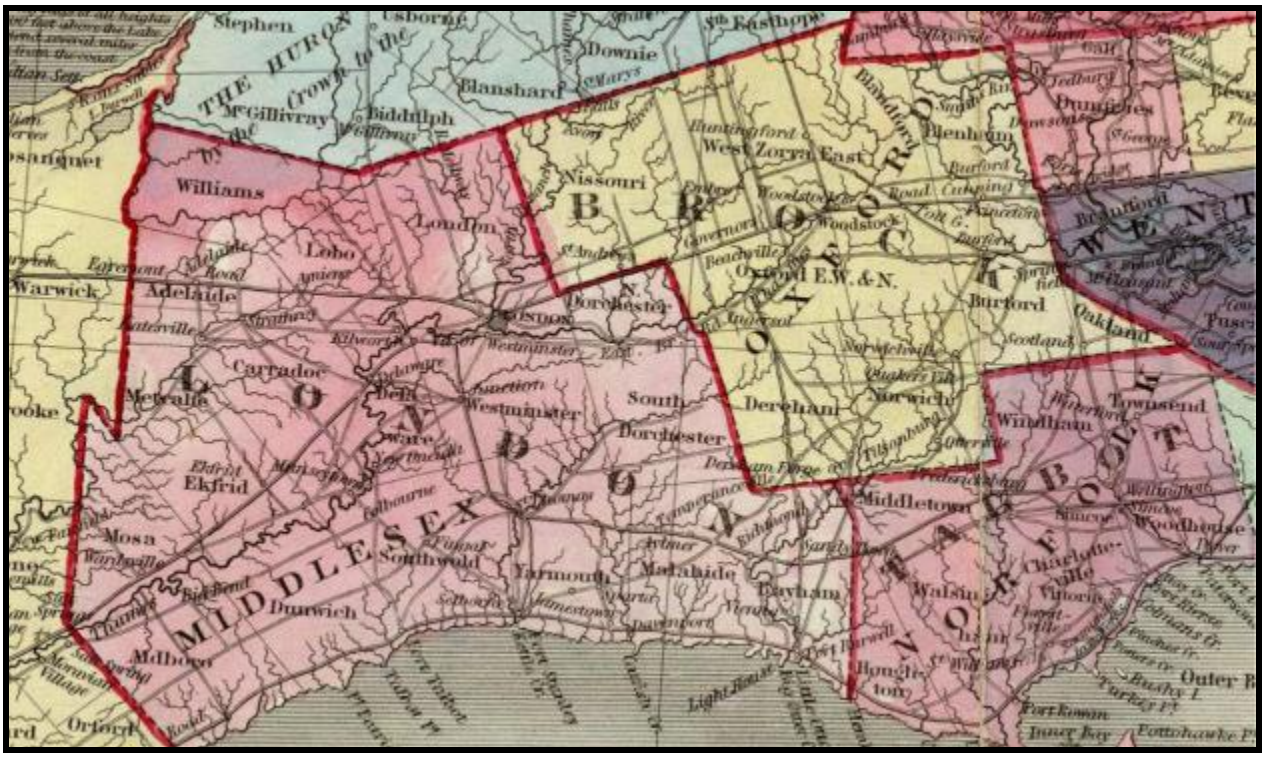
Map 9: Detail from R. Sayer and J. Bennett's *General Map of the Middle British Colonies in America* (1776)
(Cartography Associates 2009)



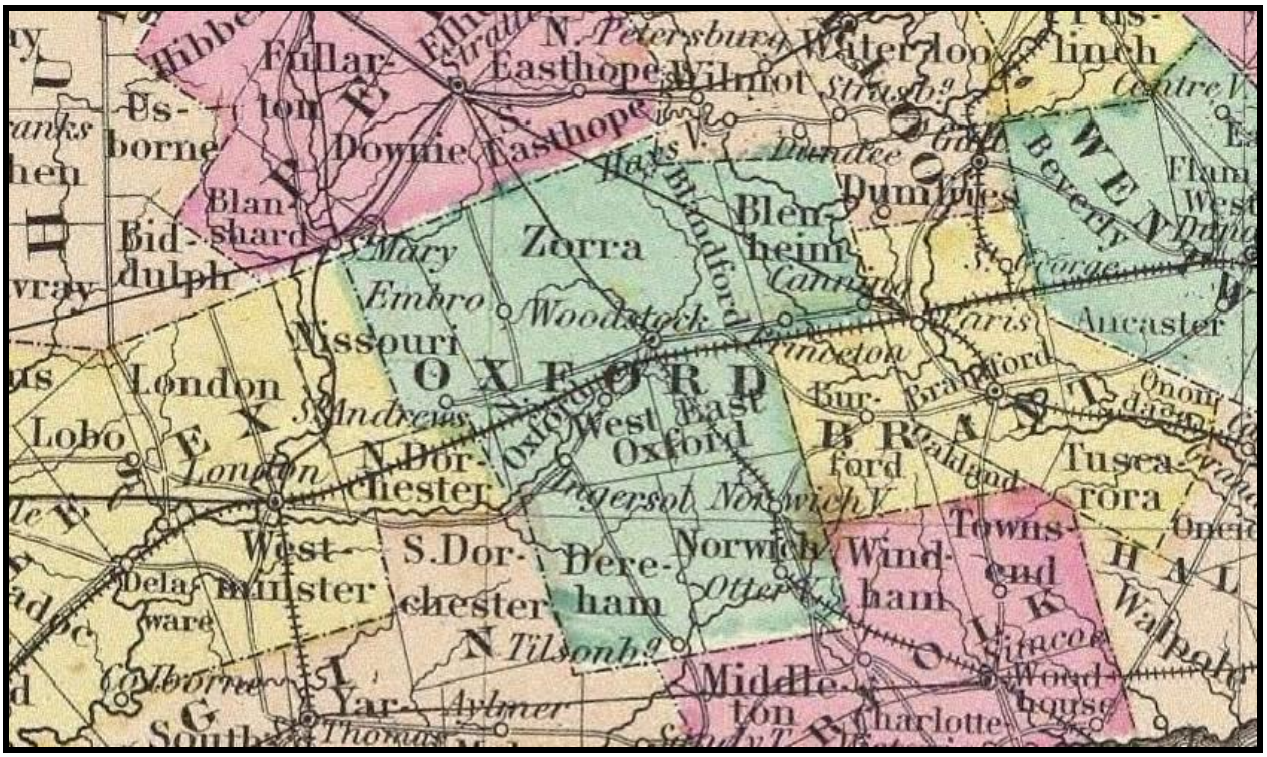
Map 10: Detail from D.W. Smyth's *A Map of the Province of Upper Canada* (1800)
(Cartography Associates 2009)

Map 11: Detail from J. Purdy's *A Map of Cabotia* (1814)
(Cartography Associates 2009)

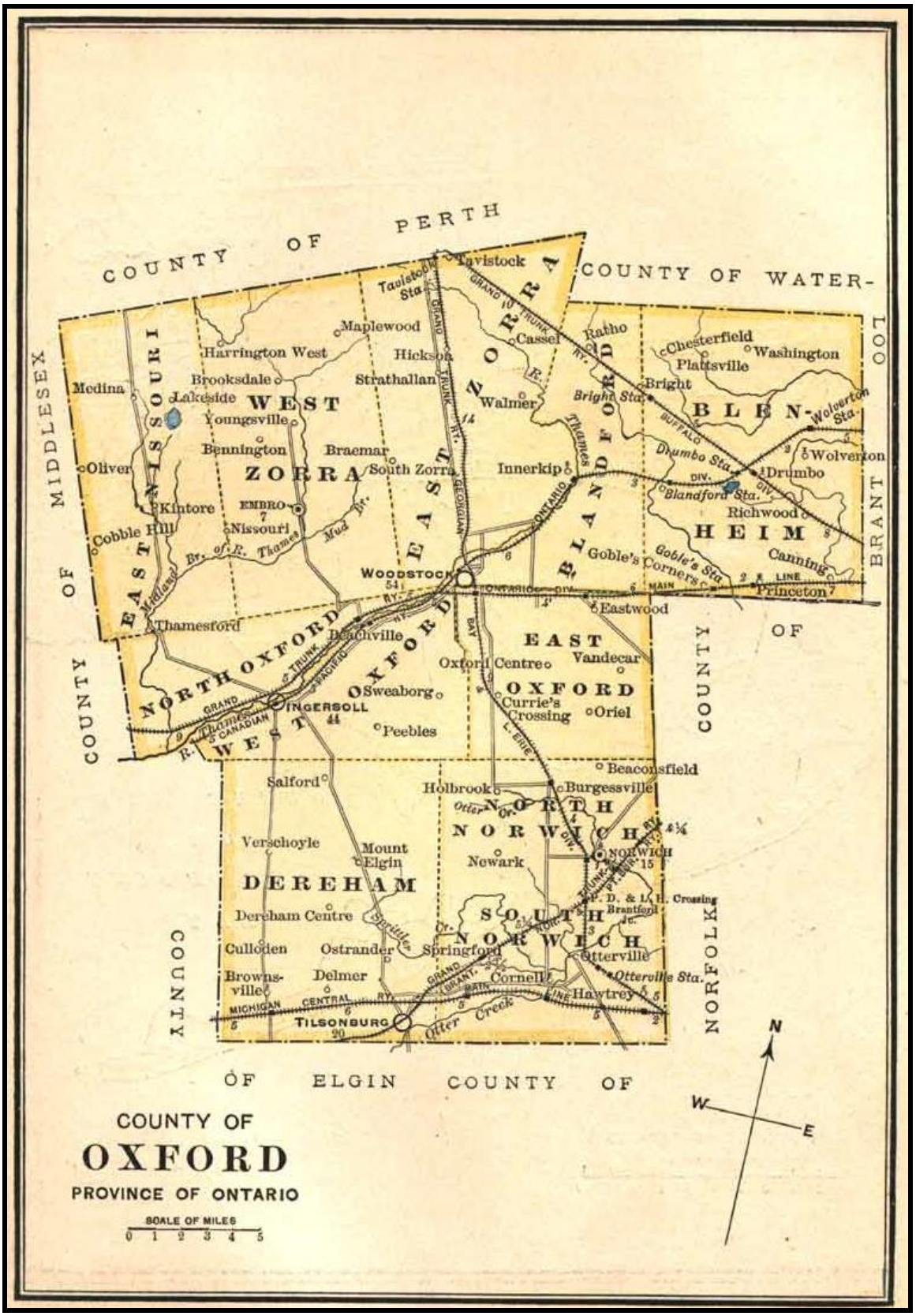
Map 12: Detail from J. Arrowsmith's *Upper Canada* (1837)
(Cartography Associates 2009)



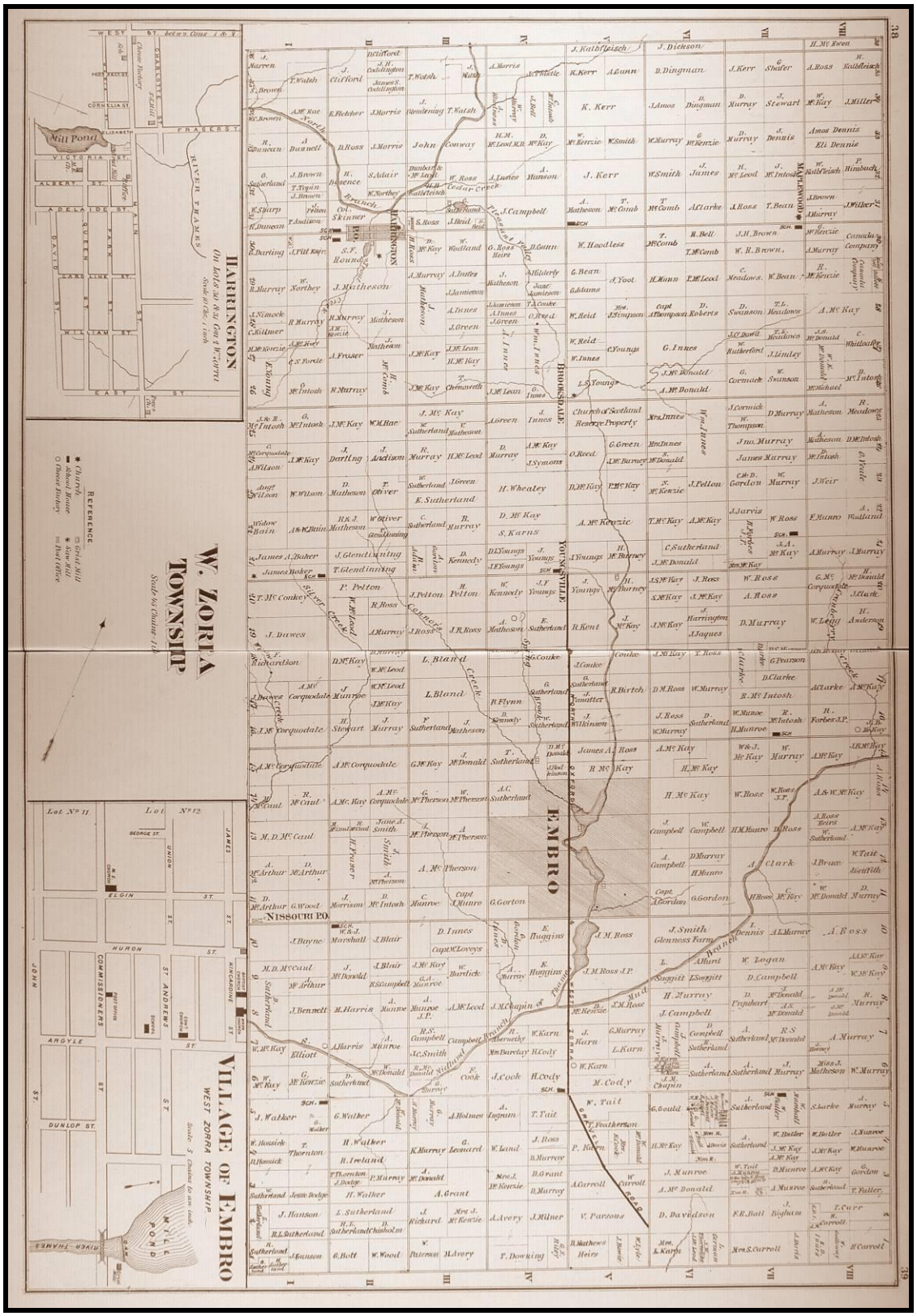
Map 13: Detail from J. Bouchette's *Map of the Provinces of Canada* (1846)
(Cartography Associates 2009)



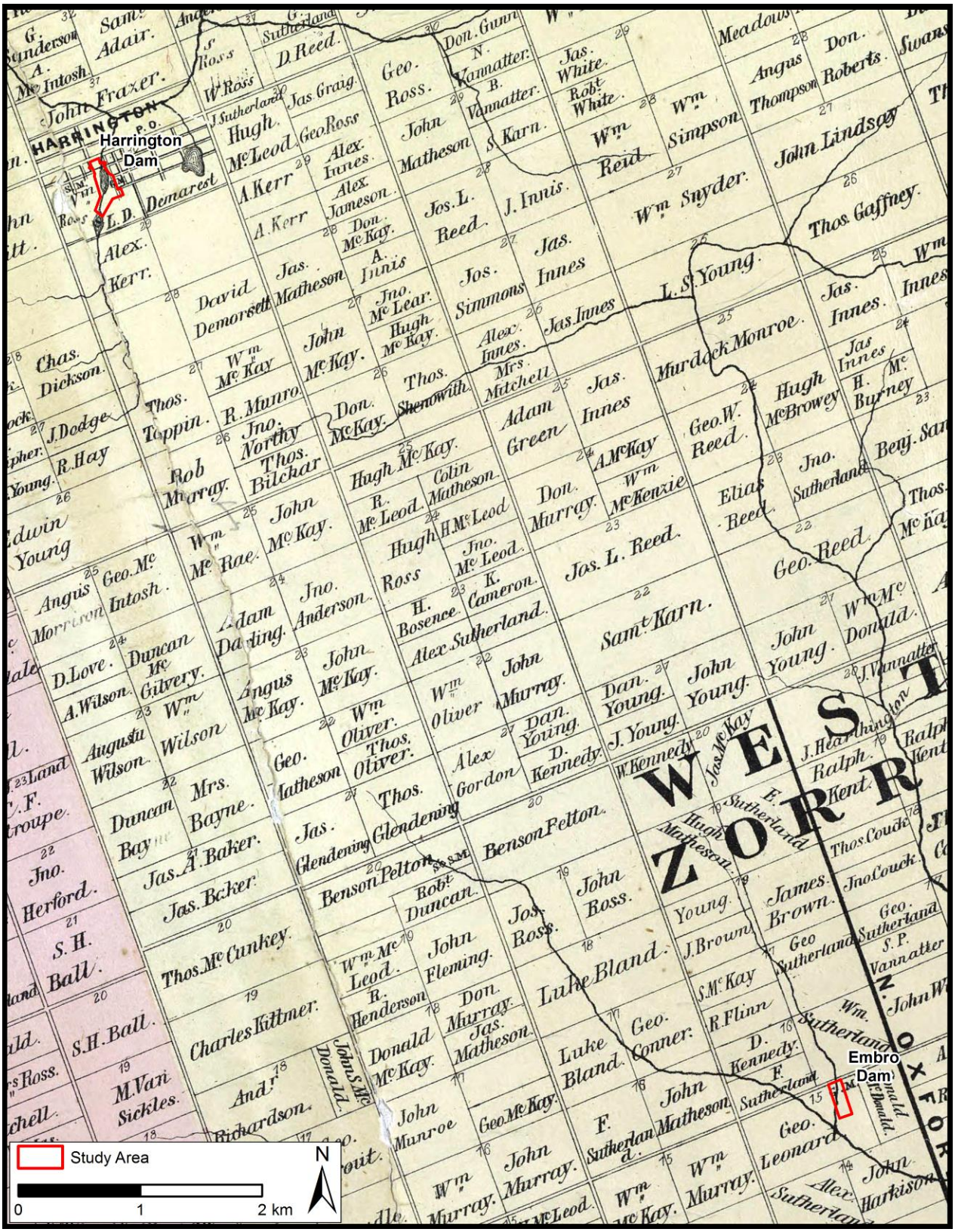
Map 14: Detail from G.W. Colton's *Canada West* (1856)
(Cartography Associates 2009)



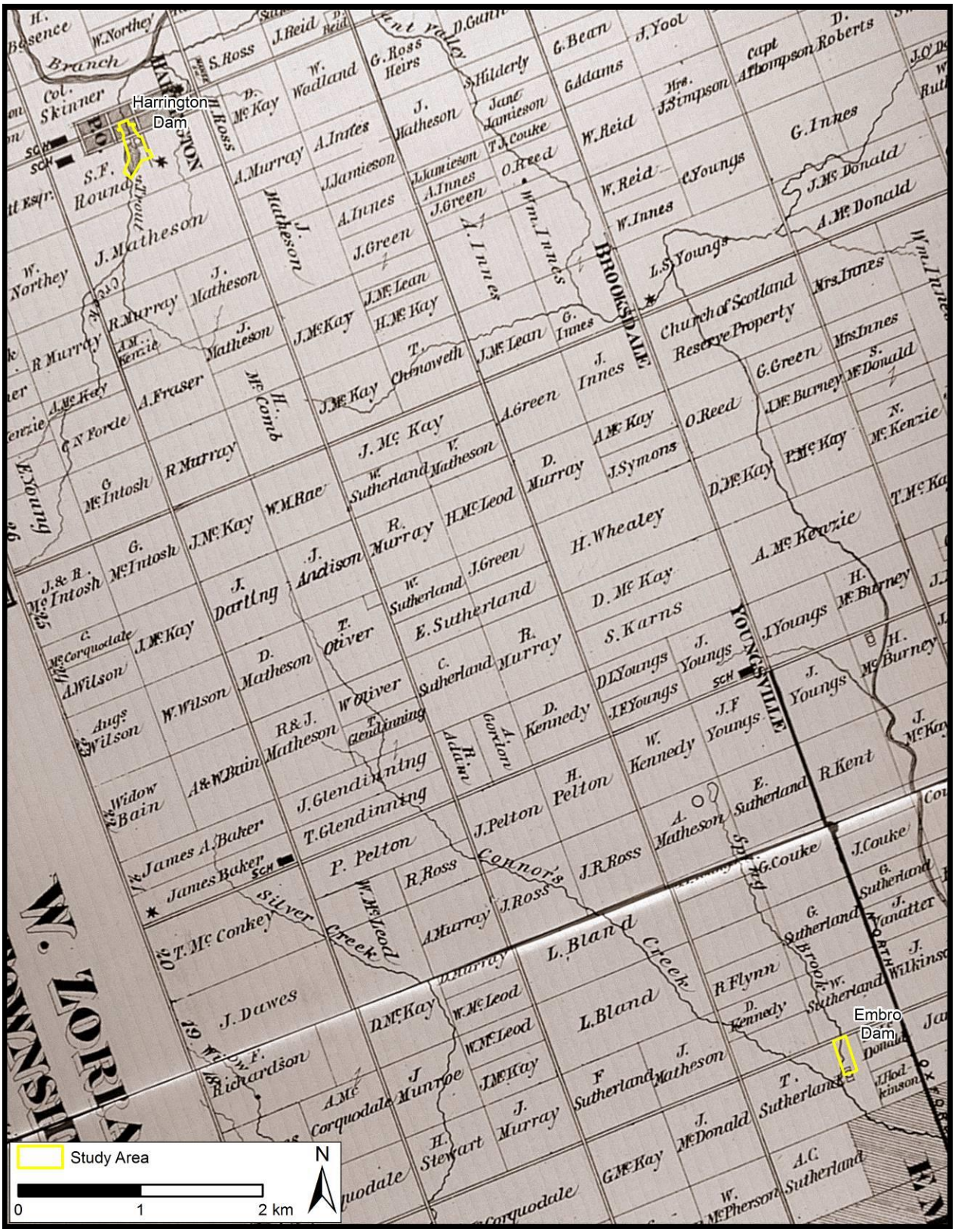
Map 15: Oxford County from W.J. Gage and Co.'s *Gage's County Atlas* (1886)
(W.J. Gage and Co. 1886)



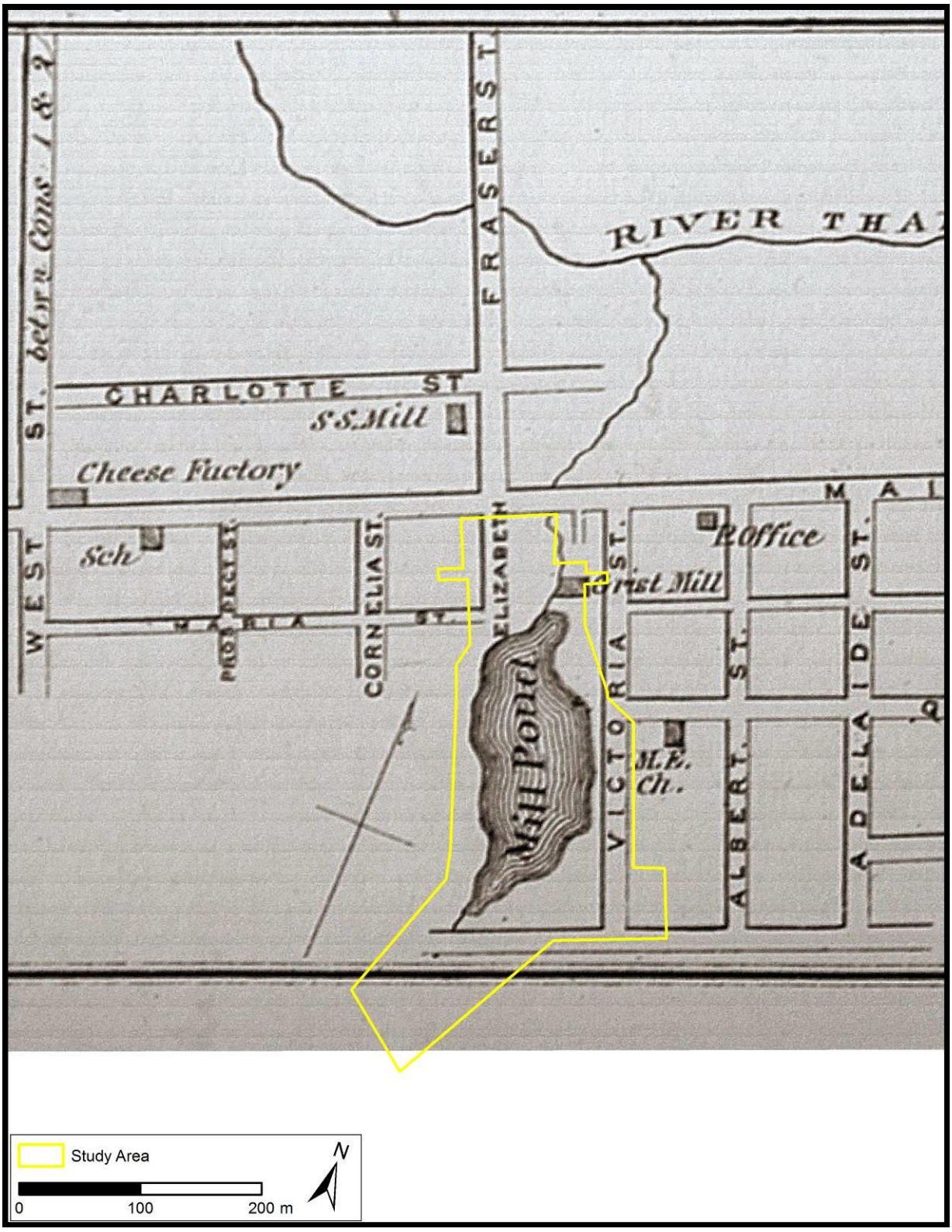
Map 16: ***West Zorra Township*** **from Walker & Miles'** ***Topographical and Historical Atlas of the County of Oxford*** **(1876)**
(McGill University 2001)



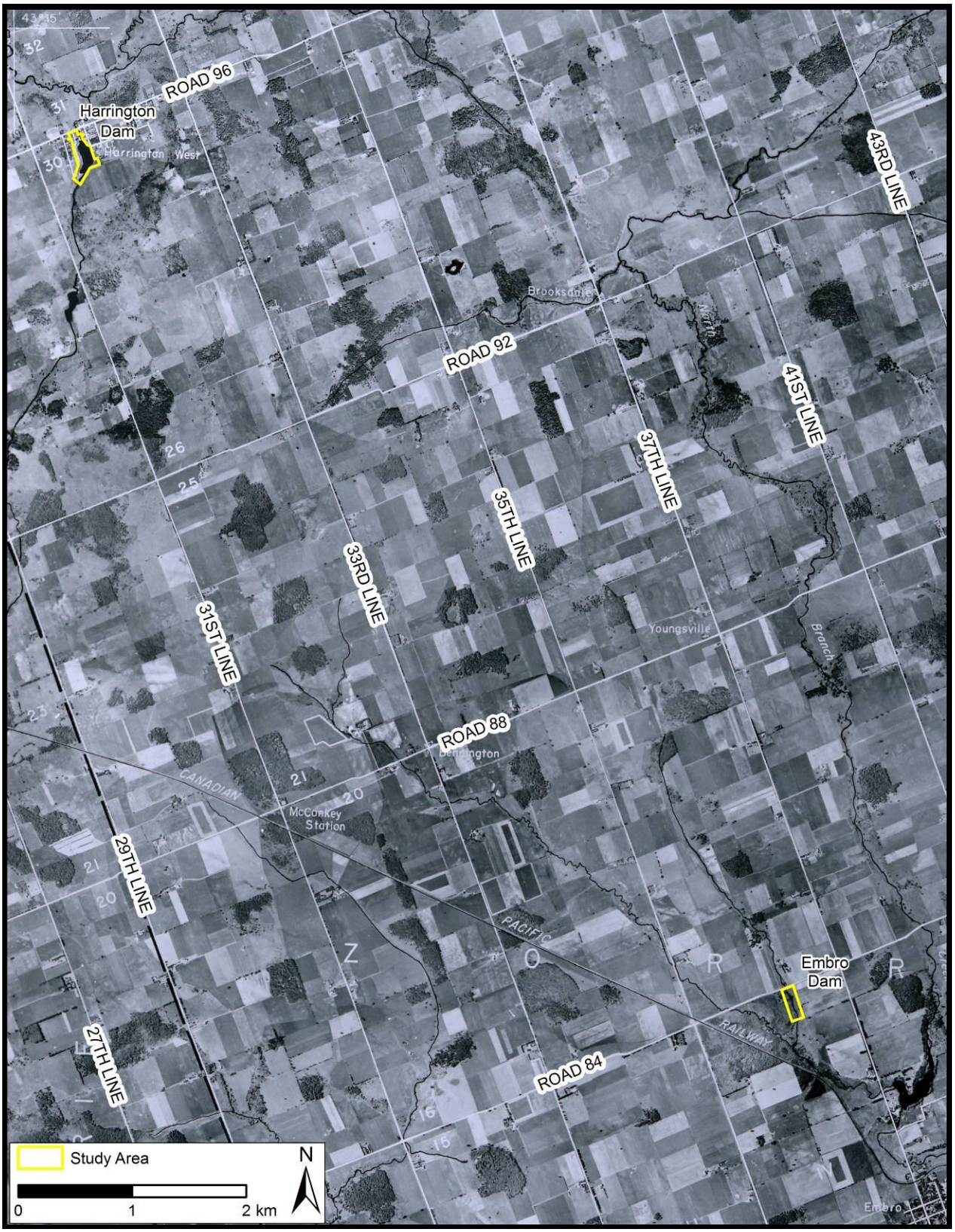
Map 17: Detail from G.C. Tremaine's *Tremaine's Map of the County of Oxford, Ontario* (1857), Showing the Study Area
(OHCMP 2015)



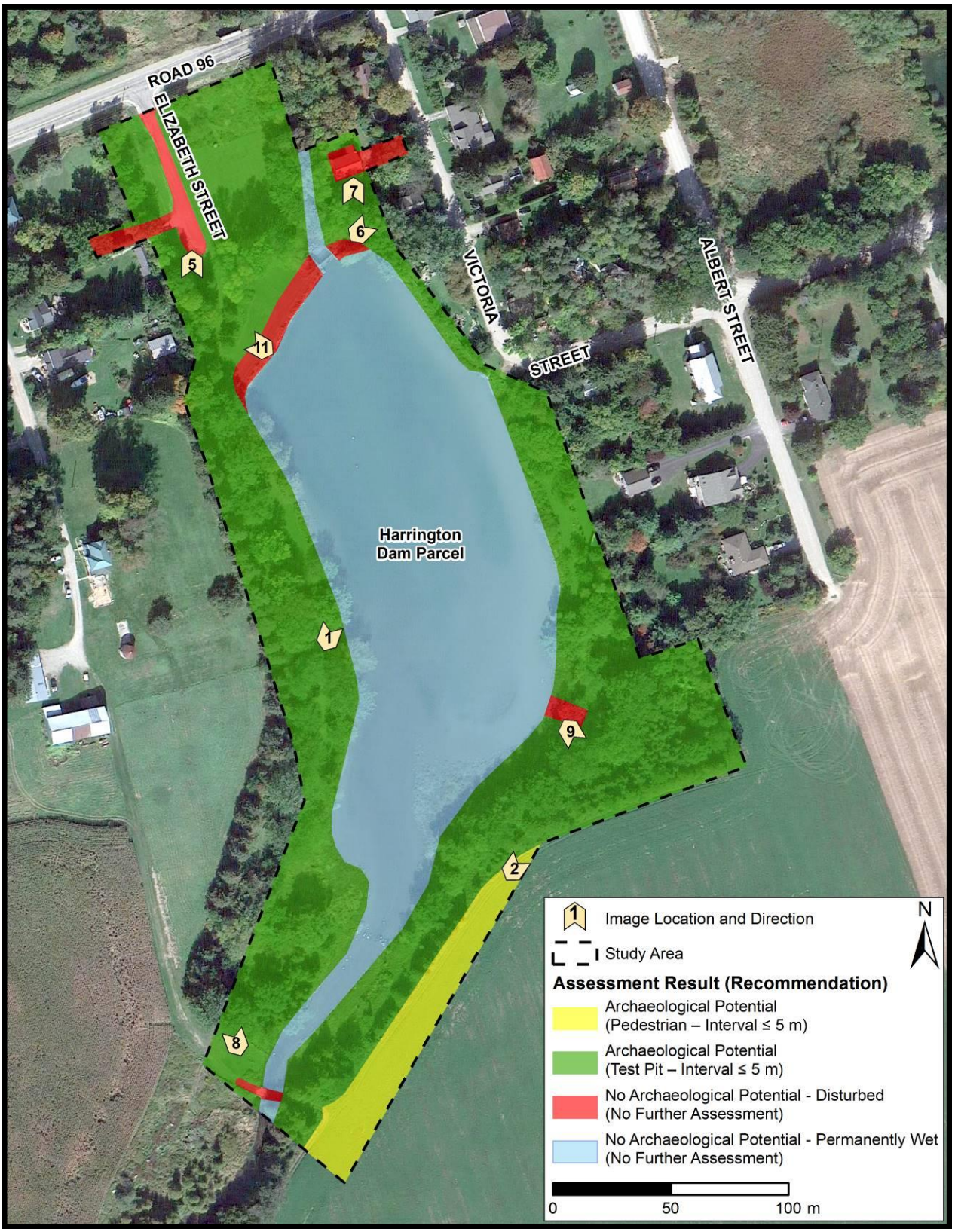
Map 18: *West Zorra Township* from Walker & Miles' *Topographical and Historical Atlas of the County of Oxford* (1876), Showing the Study Area
(McGill University 2001)



Map 19: Detail of *Harrington* from Walker & Miles' *Topographical and Historical Atlas of the County of Oxford* (1876)
(McGill University 2001)



Map 20: Historic Aerial Image (1954), Showing the Study Area
(University of Toronto 2009)



Map 21: Assessment Results, Harrington Dam
(Google Earth 2013)

Map 22: Assessment Results, Embro Dam
(Google Earth 2013)

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Appendix H

Dam Hazard Classification Memo

Prepared by Ecosystem Recovery Inc. July 2015

ecosystem recovery inc.
PROFESSIONAL ENGINEERS

Memorandum

550 Parkside Drive, Unit B1, Waterloo, ON, N2L 5V4
Tel 519.621.1500 ■ Fax 226.240.1080

To:	Rick Goldt, C.E.T	**Date:**	July 28, 2015
From:	David Arseneau, P.Eng.	**ERI Project No.:**	1505
Re:	Embro Dam Hazard Potential Classification Update		

Background

The Embro Dam was constructed at an unknown date however the dam and property were purchased by the UTRCA in 1958. At the time of the purchase, the dam was in a state of disrepair and therefore the structure was replaced. The dam and pond were rebuilt for recreational and water supply purposes. The dam is an earth embankment dam with a grassed emergency spillway. The dam was overtopped in the summer of 2000, however only minor damage was reported. The dam is approximately 4.5m in height and 100m in length with a reservoir area of 0.05 km^2. The upstream pond slopes are inclined between 3 and 4:1 whereas the downstream slopes of the dam are inclined between 2 and 3:1.

Current Hazard Classification

A dam safety assessment report for Embro Dam was completed in 2007 (Acres), which included a dam hazard potential classification. The report references the Ministry of Natural Resource's 1999 Dam Safety Guidelines. The dam hazard potential classifications are summarized in the Dam Safety Guidelines and is reproduced below in **Table 1-1**. The Embro Dam was assessed for hydrotechnical issues and scored a rating of very low for flood and earthquake hazards referencing economic loss or loss of life. The environmental hazard potential was expected not to exceed a rating of very low. Based on the 1999 Dam Safety Guidelines, the minimum inflow design floods for dams are determined based on the height and storage characteristics of the dam and the hazard potential rating. The Embro Dam is classified as a small dam in both height and storage and with a rating of very low, the minimum inflow design floods are required to be the 25-year to 50-year flood. A hydraulic and hydrologic assessment was completed in order to confirm the very low rating for loss of life and determine the appropriate minimum IDF. The rating of very low for flood flows was confirmed and an IDF of 50-year, 8-day spring snowmelt event was utilized. The IDF was utilized to determine if Embro Dam had appropriate freeboard to safely pass the flood flows. It was determined that the dam will be overtopped and the spillway is not adequate to pass the IDF.

Updates to DHC Methodology

The Hazard Potential Classifications and Inflow Design Flood criteria have been modified since the completion of the 2007 Dam Safety Assessment for Embro Dam. The revised hazard potential ratings are summarized in **Table 1-2**. The hazard potential ratings have been revised as low, moderate, high and very high. The hazard categories have been revised to life safety, property loss, environmental losses and cultural – built heritage losses. The hazard categories for each hazard potential rating have been modified and improved to be more descriptive. The assessment of life safety is conducted with the application of the 2 x 2 rule which is described in the notes that correspond to the summary of the updated classifications in **Table 1-2**. Property damage is assessed based on third party losses, does not include costs associated with the failure of the dam, and losses must include present and anticipated development. The selection of the minimum inflow design floods can be determined based on the hazard potential ratings of each hazard categories. It is recommended that the hazard potential classification be reviewed and updated if major works are being completed for the study site.

Table 1-1. Hazard Potential Classifications for Dams: SELECTION CRITERIA (MNR, 1999)

Hazard Potential	Loss of Life	Economic and Social Losses	Environmental Losses
Very Low	Potential for loss of life: None	Damage to dam only. Little damage to other property. Estimated losses do not exceed $100,000	Environmental Consequences: Short-term: Minimal Long-term: None
Low	Potential for loss of life: None. The inundation area (the area that could be flooded if the dam fails) is typically undeveloped.	Minimal damage to agriculture, other dams or structures not for human habitation. No damage to residential, commercial, industrial or land to be developed within 20 years. Estimated losses do not exceed $1 million.	No significant loss or deterioration of fish and/or wildlife habitat. Loss of marginal habitat only. Feasibility and/or practicality of restoration or compensating in kind is high, and/or good capability of channel to maintain or restore itself.
Significant	Potential for loss of life: None expected Development within inundation area is predominantly rural or agricultural, or is managed so that the land usage is for transient activities such as with day use facilities. There must be a reliable element of warning if larger development exists.	Appreciable damage to agricultural operations, other dams or residential, commercial, industrial development, or lands to be developed within 20 years. Estimated losses do not exceed $10 million.	Loss or significant deterioration of important fish and/or wildlife habitat. Feasibility and/or practicality of restoration and/or compensating in kind is high, and/or good capability of channel to maintain or restore itself.
High	Potential for loss of life: One or more. Development within inundation area typically includes communities, extensive commercial and industrial areas, main highways, public utilities and other infrastructure.	Extensive damage to communities, agricultural operations, other dams and infrastructure. Typically includes destruction of or extensive damage to large residential areas, concentrated commercial and industrial land uses, highways, railways, power lines, pipelines and other utilities. Estimated losses exceed $10 million.	Loss or significant deterioration of critical fish and/or wildlife habitat. Feasibility and/or practicality of restoration and/or compensating in kind is low, and/or poor capability of channel to maintain or restore itself.

* Supporting References: MNR Guidelines for Approval Under the Lakes and River Improvement Act, 1977
MNR Fisheries Section, 1999
US Army Corps of Engineers, Dam Safety Assurance Program, 1995
Dam Structure Assessment Program, Ontario Hydro, 1990

Notes:

1. Consideration should be given to the cascade effect of dam failures in situations where several dams are situated along the same watercourse. If failure of an upstream dam could contribute to failure of a downstream dam(s), the minimum hazard potential classification of the upstream dam should be the same as or greater than the highest downstream hazard potential classification of the downstream(s).

2. Economic losses refer to all direct and indirect losses to third parties; they do not include losses to owner, Such as loss of the dam, associated facilities and appurtenances, loss of revenue, etc.

3. Estimated losses refer to incremental losses resulting from failure of the dam or misoperation of the dam And appurtenant facilities

4. For Hazard Potential Classification and Safety Criteria for tailings dams, refers to “Guidelines for Proponents, Rehabilitation of Mines”, issued by Ontario Ministry of Northern Development and Mines, 1995

Table 1-2. Hazard Potential Classification (MNR, 2011)

	Hazard Categories – Incremental Losses[1]			
Hazard Potential	**Life Safety[2]**	**Property Losses[3]**	**Environmental Losses**	**Cultural – Built Heritage Losses**
Low	No potential loss of life.	Minimal damage to property with estimated losses not to exceed $300,000.	Minimal loss of fish and/or wildlife habitat with high capability of natural restoration resulting in a very low likelihood of negatively affecting the status of the population.	Reversible damage to municipally designated cultural heritage sites under the Ontario Heritage Act.
Moderate	No potential loss of life.	Moderate damage with estimated losses not to exceed $3 million, to agricultural, forestry, mineral aggregate and mining, and petroleum resource operations, other dams or structures not for human habitation, infrastructure and services including local roads and railway lines. The inundation zone is typically undeveloped or predominantly rural or agricultural, or it is managed so that the land usage is for transient activities such as with day-use facilities Minimal damage to residential, commercial, and industrial areas, or land identified as designated growth areas as shown in official plans.	Moderate loss or deterioration of fish and/or wildlife habitat with moderate capability of natural restoration resulting in a low likelihood of negatively affecting the status of the population	Irreversible damage to municipally designated cultural heritage sites under the Ontario Heritage Act. Reversible damage to provincially designated cultural heritage sites under the Ontario Heritage Act or nationally recognized heritage sites.
High	Potential loss of life of 1-10 persons	Appreciable damage with estimated losses not to exceed $30 million, to agricultural, forestry, mineral aggregate and mining, and petroleum resource operations, other dams or residential, commercial, industrial areas, infrastructure and services, or land identified as designated growth areas as shown in official plans Infrastructure and services includes regional roads, railway lines, or municipal water and wastewater treatment facilities and publicly-owned utilities.	Appreciable loss of fish and/ or wildlife habitat or significant deterioration of critical fish and/or wildlife habitat with reasonable likelihood of being able to apply natural or assisted recovery activities to promote species recovery to viable population levels. Loss of a portion of the population of a species classified under the Ontario Endangered Species Act as Extirpated, Threatened or Endangered, or reversible damage to the habitat of that species.	Irreversible damage to provincially designated cultural heritage sites under the Ontario Heritage Act or damage to nationally recognized heritage sites.
Very High	Potential loss of life of 11 or more persons.	Extensive damage, estimated losses in excess of $30 million, to buildings, agricultural, forestry, mineral aggregate and mining, and petroleum resource operations, infrastructure and services. Typically includes destruction of, or extensive damage to, large residential, institutional, concentrated commercial and industrial areas and major infrastructure and services, or land identified as designated growth areas as shown in official plans. Infrastructure and services includes highways, railway lines or municipal water and wastewater treatment facilities and publicly-owned utilities.	Extensive loss of fish and/ or wildlife habitat or significant deterioration of critical fish and/or wildlife habitat with very little or no feasibility of being able to apply natural or assisted recovery activities to promote species recovery to viable population levels. Loss of a viable portion of the population of a species classified under the Ontario Endangered Species Act as Extirpated, Threatened or Endangered or irreversible damage to the habitat of that species.	

Notes
1. Incremental losses are those losses resulting from dam failure above those which would occur under the same conditions (flood, earthquake or other event) with the dam in place but without failure of the dam.
2. Life safety. Refer to Technical Guide – River and Streams Systems: Flooding Hazard Limits, Ontario Ministry of Natural Resources, 2002, for definition of 2 x 2 rule. The 2 x 2 rule defines that people would be at risk if the product of the velocity and the depth exceeded 0.37 square metres per second or if velocity exceeds 1.7 metres per second or if depth of water exceeds 0.8 metres. For dam failures under normal (sunny day) conditions the potential for loss of life is assessed based on both permanent dwellings (including habitable dwellings, trailer parks and seasonal campgrounds) and transient persons.
3. Property losses refer to all direct losses to third parties; they do not include losses to the owner, such as loss of the dam, or revenue. The dollar losses, where identified, are indexed of Statistics Canada values Year 2000.
4. An HPC must be developed under both flood and normal (sunny day) conditions.
5. Evaluation of the hazard potential is based on both present land use and on anticipated development as outlined in the pertinent official planning documents (e.g. Official Plan). In the absence of an approved Official Plan the HPC should be based on expected

development within the foreseeable future. Under the Provincial Policy Statement, '*designated growth areas*' means lands within *settlement areas* designated in an official plan for growth over the long-term planning horizon (specifies normal time horizon of up to 20 years), but which have not yet been fully developed. *Designated growth areas* include lands which are *designated and available* for residential growth in accordance with the policy, as well as lands required for employment and other uses (Italicized terms as defined in the PPS, 2005).

6. Where several dams are situated along the same watercourse, consideration must be given to the cascade effect of failures when classifying the structures, such that if failure of an upstream dam could contribute of failure of a downstream dam, then the HPC of the upstream dam must be the same as or greater than that of the downstream structure.
7. The HPC is determined by the highest potential consequences, whether life safety, property losses, environmental losses, or cultural-built heritage losses.

Revised DHC

The dam hazard potential classification requires update based on the 2011 Guidelines and due to the Class EA being completed for Embro Dam. Aerial photographs of Embro Dam were examined and it was determined that no significant land use changes occurred from 2006 to 2013 and it is presumed that no significant land use changes are expected to occur in the foreseeable future (**Figure 1**). Therefore, the hazard potential classifications of the study site should remain similar to that of the 2007 Dam Safety Assessment. Life safety hazard was rated as very low and given that no new permanent dwellings have been constructed in the study area, it is reasonable to assign a HPC of low for the current conditions of Embro Dam. Similarly, it is expected that the incremental hazard potential for property loss, environmental losses and heritage losses will remain low. Therefore, the overall incremental hazard potential for Embro Dam would be low based on these hazard potential ratings.

Summary of Revised Hazard Potential Ratings:

- Life Safety: LOW
- Property Losses: LOW
- Environmental Losses: LOW
- Cultural-Built Heritage Losses: LOW

Canadian Dam Safety Guidelines

In addition to the MNR Dam Safety Guidelines, the Canadian Dam Association (CDA) specifies safety guidelines for dams. The CDA dam classifications are summarized in **Table 1-3**. The dam classification system breaks down hazard potentials into population at risk and incremental losses. PAR assigns a rating to how many people will be affected in the event of a flood and is determined based on the presence of temporary or permanent residents. The incremental losses hazard potentials are similar to the MNR guidelines with loss of life, environmental, cultural and economic losses. The population at risk at Embro Dam would be none given that there are no permanent or temporary residences within the inundation zone and a dam classification of low is applicable. Similarly, the incremental losses for loss of life would be a rating of low due people not being expected within the inundation zone. Given that the inundation zone is primarily agricultural, it is expected that environmental, cultural and economic losses are expected to be low. Therefore, the overall hazard potential for Embro Dam according to the CDA guidelines would be low.

Summary of CDA Hazard Potential Ratings:

- Population at Risk: LOW
- Loss of Life: LOW
- Environmental Losses: LOW
- Cultural Losses: LOW
- Economic Losses: LOW

Figure 1: Aerial Photo Comparison of Study Area (Google Inc., 2015)

Table 1-3. Dam Classification (CDA, 2007)

Dam class	Population at risk [note 1]	Incremental losses		
		Loss of Life [note 2]	Environmental and cultural values	Infrastructure and economics
Low	None	0	Minimal short-term loss No long-term loss	Low economic losses; area contains limited infrastructure or services
Significant	Temporary only	Unspecified	No significant loss or deterioration of fish or wildlife habitat Loss of marginal habitat only Restoration or compensation in kind highly possible	Losses to recreational facilities, seasonal workplaces, and infrequently used transportation routes
High	Permanent	10 or fewer	Significant loss or deterioration of *important* fish or wildlife habitat Restoration or compensation in kind possible but impractical	High economic losses affecting infrastructure, public transportation, and commercial facilities
Very high	Permanent	100 or fewer	Significant loss or deterioration of *critical* fish or wildlife habitat Restoration or compensation in kind possible but impractical	Very high economic losses affecting important infrastructure or services (e.g., highway, industrial facility, storage facilities for dangerous substances)
Extreme	Permanent	More than 100	Major loss of *critical* fish or wildlife habitat Restoration or compensation in kind impossible	Extreme losses affecting critical infrastructure or services (e.g., hospital, major industrial complex, major storage facilities for dangerous substances)

Note 1. Definitions for population at risk:

None – There is no identifiable population at risk, so there is no possibility of loss of life other than through unforeseeable misadventure.

Temporary – People are only temporarily in the dam-breach inundation zone (e.g., seasonal cottage use, passing through on transportation routes, participating in recreational activities).

Permanent – The population at risk is ordinarily located in the dam-breach inundation zone (e.g., as permanent residents); three consequence classes (high, very high, extreme) are proposed to allow for more detailed estimates of potential loss of life (to assist in decision-making if the appropriate analysis is carried out).

Note 2. Implications for loss of life:

Unspecified – The appropriate level of safety required at a dam where people are temporarily at risk depends on the number of people, the exposure time, the nature of their activity, and other conditions. A higher class could be appropriate, depending on the requirements. However, the design flood requirement, for example, might not be higher if the temporary population is not likely to be present during the flood season

References

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Appendix I

Sediment Testing Results

Prepared by ALS, September 2015

ECOSYSTEM RECOVERY INC.
ATTN: David Arseneau
1023 Rife Road, Unit A
Cambridge On N1R 5S3

Date Received: 20-AUG-15
Report Date: 04-SEP-15 07:36 (MT)
Version: FINAL

Client Phone: 519-621-1500

Certificate of Analysis

Lab Work Order #: L1660729
Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers:
Legal Site Desc:

Comments: Grain size data is attached to the end of the report

LAURA ERMETA
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1660729-1 HAR U/S Sampled By: CLIENT on 20-AUG-15 @ 11:15 Matrix: SOIL							
Physical Tests							
Conductivity	0.435		0.0040	mS/cm		29-AUG-15	R3256335
% Moisture	70.8		0.10	%	20-AUG-15	21-AUG-15	R3250064
pH	6.87		0.10	pH units		22-AUG-15	R3251697
Cyanides							
Cyanide, Weak Acid Diss	0.091		0.050	ug/g	24-AUG-15	25-AUG-15	R3253230
Saturated Paste Extractables							
SAR	0.40		0.10	SAR		29-AUG-15	R3256812
Calcium (Ca)	150		1.0	mg/L		29-AUG-15	R3256812
Magnesium (Mg)	16.5		1.0	mg/L		29-AUG-15	R3256812
Sodium (Na)	19.6		1.0	mg/L		29-AUG-15	R3256812
Metals							
Antimony (Sb)	<1.0		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Arsenic (As)	2.0		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Barium (Ba)	93.1		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Beryllium (Be)	<0.50		0.50	ug/g	28-AUG-15	31-AUG-15	R3257094
Boron (B)	8.0		5.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Boron (B), Hot Water Ext.	1.52		0.10	ug/g	28-AUG-15	29-AUG-15	R3256801
Cadmium (Cd)	<0.50		0.50	ug/g	28-AUG-15	31-AUG-15	R3257094
Chromium (Cr)	13.3		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Cobalt (Co)	4.1		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Copper (Cu)	12.2		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Lead (Pb)	11.1		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Mercury (Hg)	0.0572		0.0050	ug/g	28-AUG-15	30-AUG-15	R3256457
Molybdenum (Mo)	<1.0		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Nickel (Ni)	7.7		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Selenium (Se)	<1.0		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Silver (Ag)	<0.20		0.20	ug/g	28-AUG-15	31-AUG-15	R3257094
Thallium (Tl)	<0.50		0.50	ug/g	28-AUG-15	31-AUG-15	R3257094
Uranium (U)	<1.0		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Vanadium (V)	14.3		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Zinc (Zn)	66.8		5.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Speciated Metals							
Chromium, Hexavalent	<0.20		0.20	ug/g	20-AUG-15	21-AUG-15	R3250857
Volatile Organic Compounds							
Acetone	1.10		0.50	ug/g	21-AUG-15	24-AUG-15	R3252144
Benzene	<0.0068		0.0068	ug/g	21-AUG-15	24-AUG-15	R3252144
Bromodichloromethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Bromoform	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Bromomethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Carbon tetrachloride	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Chlorobenzene	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Dibromochloromethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1660729-1 HAR U/S Sampled By: CLIENT on 20-AUG-15 @ 11:15 Matrix: SOIL							
Volatile Organic Compounds							
Chloroform	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,2-Dibromoethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,2-Dichlorobenzene	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,3-Dichlorobenzene	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,4-Dichlorobenzene	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Dichlorodifluoromethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,1-Dichloroethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,2-Dichloroethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,1-Dichloroethylene	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
cis-1,2-Dichloroethylene	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
trans-1,2-Dichloroethylene	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,3-Dichloropropene (cis & trans)	<0.042		0.042	ug/g		24-AUG-15	
Methylene Chloride	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,2-Dichloropropane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
cis-1,3-Dichloropropene	<0.030		0.030	ug/g	21-AUG-15	24-AUG-15	R3252144
trans-1,3-Dichloropropene	<0.030		0.030	ug/g	21-AUG-15	24-AUG-15	R3252144
Ethylbenzene	<0.018		0.018	ug/g	21-AUG-15	24-AUG-15	R3252144
n-Hexane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Methyl Ethyl Ketone	<0.50		0.50	ug/g	21-AUG-15	24-AUG-15	R3252144
Methyl Isobutyl Ketone	<0.50		0.50	ug/g	21-AUG-15	24-AUG-15	R3252144
MTBE	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Styrene	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,1,1,2-Tetrachloroethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,1,2,2-Tetrachloroethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Tetrachloroethylene	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Toluene	<0.080		0.080	ug/g	21-AUG-15	24-AUG-15	R3252144
1,1,1-Trichloroethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,1,2-Trichloroethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Trichloroethylene	<0.010		0.010	ug/g	21-AUG-15	24-AUG-15	R3252144
Trichlorofluoromethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Vinyl chloride	<0.020		0.020	ug/g	21-AUG-15	24-AUG-15	R3252144
o-Xylene	<0.020		0.020	ug/g	21-AUG-15	24-AUG-15	R3252144
m+p-Xylenes	<0.030		0.030	ug/g	21-AUG-15	24-AUG-15	R3252144
Xylenes (Total)	<0.050		0.050	ug/g		24-AUG-15	
Surrogate: 4-Bromofluorobenzene	94.8		70-130	%	21-AUG-15	24-AUG-15	R3252144
Surrogate: 1,4-Difluorobenzene	97.7		70-130	%	21-AUG-15	24-AUG-15	R3252144
Hydrocarbons							
F1 (C6-C10)	<5.0		5.0	ug/g	21-AUG-15	24-AUG-15	R3252144
F1-BTEX	<5.0		5.0	ug/g		28-AUG-15	
F2 (C10-C16)	<30	DLHM	30	ug/g	20-AUG-15	21-AUG-15	R3252895
F2-Naphth	<30		30	ug/g		28-AUG-15	

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1660729-1 HAR U/S Sampled By: CLIENT on 20-AUG-15 @ 11:15 Matrix: SOIL							
Hydrocarbons							
F3 (C16-C34)	160	DLHM	150	ug/g	20-AUG-15	21-AUG-15	R3252895
F3-PAH	160		150	ug/g		28-AUG-15	
F4 (C34-C50)	<150	DLHM	150	ug/g	20-AUG-15	21-AUG-15	R3252895
Total Hydrocarbons (C6-C50)	<210		210	ug/g		28-AUG-15	
Chrom. to baseline at nC50	YES				20-AUG-15	21-AUG-15	R3252895
Surrogate: 2-Bromobenzotrifluoride	84.8		60-140	%	20-AUG-15	21-AUG-15	R3252895
Surrogate: 3,4-Dichlorotoluene	107.7		60-140	%	21-AUG-15	24-AUG-15	R3252144
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Acenaphthylene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Anthracene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Benzo(a)anthracene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Benzo(a)pyrene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Benzo(b)fluoranthene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Benzo(g,h,i)perylene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Benzo(k)fluoranthene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Chrysene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Dibenzo(ah)anthracene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Fluoranthene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Fluorene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Indeno(1,2,3-cd)pyrene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
1+2-Methylnaphthalenes	<0.13		0.13	ug/g		28-AUG-15	
1-Methylnaphthalene	<0.090	DLHM	0.090	ug/g	20-AUG-15	28-AUG-15	R3254254
2-Methylnaphthalene	<0.090	DLHM	0.090	ug/g	20-AUG-15	28-AUG-15	R3254254
Naphthalene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Phenanthrene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Pyrene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Surrogate: 2-Fluorobiphenyl	91.2		50-140	%	20-AUG-15	28-AUG-15	R3254254
Surrogate: p-Terphenyl d14	85.3		50-140	%	20-AUG-15	28-AUG-15	R3254254
Organochlorine Pesticides							
Aldrin	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
gamma-hexachlorocyclohexane	<0.30	RRR	0.30	ug/g	20-AUG-15	24-AUG-15	R3252425
a-chlordane	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
Chlordane (Total)	<0.85		0.85	ug/g		24-AUG-15	
g-chlordane	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
op-DDD	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
pp-DDD	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
Total DDD	<0.85		0.85	ug/g		24-AUG-15	
o,p-DDE	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
pp-DDE	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
Total DDE	<0.85		0.85	ug/g		24-AUG-15	

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Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1660729-1 HAR U/S Sampled By: CLIENT on 20-AUG-15 @ 11:15 Matrix: SOIL							
Organochlorine Pesticides							
op-DDT	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
pp-DDT	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
Total DDT	<0.85		0.85	ug/g		24-AUG-15	
Dieldrin	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
Endosulfan I	<1.0	DLUI	1.0	ug/g	20-AUG-15	24-AUG-15	R3252425
Endosulfan II	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
Endosulfan (Total)	<1.2		1.2	ug/g		24-AUG-15	
Endrin	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
Heptachlor	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
Heptachlor Epoxide	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
Hexachlorobenzene	<0.30	RRR	0.30	ug/g	20-AUG-15	24-AUG-15	R3252425
Hexachlorobutadiene	<0.30	RRR	0.30	ug/g	20-AUG-15	24-AUG-15	R3252425
Hexachloroethane	<0.30	RRR	0.30	ug/g	20-AUG-15	24-AUG-15	R3252425
Methoxychlor	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
Surrogate: 2-Fluorobiphenyl	101.7		50-140	%	20-AUG-15	24-AUG-15	R3252425
Surrogate: d14-Terphenyl	90.4		50-140	%	20-AUG-15	24-AUG-15	R3252425
Report Remarks : DLM- Extract was run at a dilution due to high sample matrix background. DLHM- Detection limit adjusted: Sample has high moisture content.							
L1660729-2 HAR D/S Sampled By: CLIENT on 20-AUG-15 @ 11:00 Matrix: SOIL							
Physical Tests							
Conductivity	0.344		0.0040	mS/cm		29-AUG-15	R3256335
% Moisture	77.2		0.10	%	20-AUG-15	21-AUG-15	R3250064
pH	6.76		0.10	pH units		22-AUG-15	R3251697
Cyanides							
Cyanide, Weak Acid Diss	0.092		0.050	ug/g	24-AUG-15	25-AUG-15	R3253230
Saturated Paste Extractables							
SAR	0.45		0.10	SAR		29-AUG-15	R3256812
Calcium (Ca)	234		1.0	mg/L		29-AUG-15	R3256812
Magnesium (Mg)	27.4		1.0	mg/L		29-AUG-15	R3256812
Sodium (Na)	27.6		1.0	mg/L		29-AUG-15	R3256812
Metals							
Antimony (Sb)	<1.0		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Arsenic (As)	2.7		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Barium (Ba)	235		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Beryllium (Be)	<0.50		0.50	ug/g	28-AUG-15	31-AUG-15	R3257094
Boron (B)	6.7		5.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Boron (B), Hot Water Ext.	1.18		0.10	ug/g	28-AUG-15	29-AUG-15	R3256801
Cadmium (Cd)	<0.50		0.50	ug/g	28-AUG-15	31-AUG-15	R3257094
Chromium (Cr)	14.9		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Cobalt (Co)	4.5		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Copper (Cu)	16.2		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1660729-2 HAR D/S Sampled By: CLIENT on 20-AUG-15 @ 11:00 Matrix: SOIL							
Metals							
Lead (Pb)	11.7		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Mercury (Hg)	0.0563		0.0050	ug/g	28-AUG-15	30-AUG-15	R3256457
Molybdenum (Mo)	<1.0		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Nickel (Ni)	10.2		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Selenium (Se)	<1.0		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Silver (Ag)	<0.20		0.20	ug/g	28-AUG-15	31-AUG-15	R3257094
Thallium (Tl)	<0.50		0.50	ug/g	28-AUG-15	31-AUG-15	R3257094
Uranium (U)	<1.0		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Vanadium (V)	15.2		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Zinc (Zn)	71.1		5.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Speciated Metals							
Chromium, Hexavalent	<0.20		0.20	ug/g	20-AUG-15	21-AUG-15	R3250857
Volatile Organic Compounds							
Acetone	1.25		0.50	ug/g	21-AUG-15	24-AUG-15	R3252144
Benzene	<0.0068		0.0068	ug/g	21-AUG-15	24-AUG-15	R3252144
Bromodichloromethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Bromoform	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Bromomethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Carbon tetrachloride	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Chlorobenzene	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Dibromochloromethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Chloroform	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,2-Dibromoethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,2-Dichlorobenzene	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,3-Dichlorobenzene	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,4-Dichlorobenzene	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Dichlorodifluoromethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,1-Dichloroethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,2-Dichloroethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,1-Dichloroethylene	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
cis-1,2-Dichloroethylene	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
trans-1,2-Dichloroethylene	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,3-Dichloropropene (cis & trans)	<0.042		0.042	ug/g		24-AUG-15	
Methylene Chloride	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,2-Dichloropropane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
cis-1,3-Dichloropropene	<0.030		0.030	ug/g	21-AUG-15	24-AUG-15	R3252144
trans-1,3-Dichloropropene	<0.030		0.030	ug/g	21-AUG-15	24-AUG-15	R3252144
Ethylbenzene	<0.018		0.018	ug/g	21-AUG-15	24-AUG-15	R3252144
n-Hexane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Methyl Ethyl Ketone	0.79		0.50	ug/g	21-AUG-15	24-AUG-15	R3252144
Methyl Isobutyl Ketone	<0.50		0.50	ug/g	21-AUG-15	24-AUG-15	R3252144

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1660729-2 HAR D/S Sampled By: CLIENT on 20-AUG-15 @ 11:00 Matrix: SOIL							
Volatile Organic Compounds							
MTBE	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Styrene	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,1,1,2-Tetrachloroethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,1,2,2-Tetrachloroethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Tetrachloroethylene	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Toluene	<0.080		0.080	ug/g	21-AUG-15	24-AUG-15	R3252144
1,1,1-Trichloroethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
1,1,2-Trichloroethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Trichloroethylene	<0.010		0.010	ug/g	21-AUG-15	24-AUG-15	R3252144
Trichlorofluoromethane	<0.050		0.050	ug/g	21-AUG-15	24-AUG-15	R3252144
Vinyl chloride	<0.020		0.020	ug/g	21-AUG-15	24-AUG-15	R3252144
o-Xylene	<0.020		0.020	ug/g	21-AUG-15	24-AUG-15	R3252144
m+p-Xylenes	<0.030		0.030	ug/g	21-AUG-15	24-AUG-15	R3252144
Xylenes (Total)	<0.050		0.050	ug/g		24-AUG-15	
Surrogate: 4-Bromofluorobenzene	87.7		70-130	%	21-AUG-15	24-AUG-15	R3252144
Surrogate: 1,4-Difluorobenzene	99.0		70-130	%	21-AUG-15	24-AUG-15	R3252144
Hydrocarbons							
F1 (C6-C10)	<5.0		5.0	ug/g	21-AUG-15	24-AUG-15	R3252144
F1-BTEX	<5.0		5.0	ug/g		28-AUG-15	
F2 (C10-C16)	<30	DLHM	30	ug/g	20-AUG-15	21-AUG-15	R3252895
F2-Naphth	<30		30	ug/g		28-AUG-15	
F3 (C16-C34)	320	DLHM	150	ug/g	20-AUG-15	21-AUG-15	R3252895
F3-PAH	320		150	ug/g		28-AUG-15	
F4 (C34-C50)	260	DLHM	150	ug/g	20-AUG-15	21-AUG-15	R3252895
Total Hydrocarbons (C6-C50)	580		210	ug/g		28-AUG-15	
Chrom. to baseline at nC50	YES				20-AUG-15	21-AUG-15	R3252895
Surrogate: 2-Bromobenzotrifluoride	78.6		60-140	%	20-AUG-15	21-AUG-15	R3252895
Surrogate: 3,4-Dichlorotoluene	102.7		60-140	%	21-AUG-15	24-AUG-15	R3252144
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Acenaphthylene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Anthracene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Benzo(a)anthracene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Benzo(a)pyrene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Benzo(b)fluoranthene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Benzo(g,h,i)perylene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Benzo(k)fluoranthene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Chrysene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Dibenzo(ah)anthracene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Fluoranthene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Fluorene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1660729-2 HAR D/S Sampled By: CLIENT on 20-AUG-15 @ 11:00 Matrix: SOIL							
Polycyclic Aromatic Hydrocarbons							
Indeno(1,2,3-cd)pyrene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
1+2-Methylnaphthalenes	<0.13		0.13	ug/g		28-AUG-15	
1-Methylnaphthalene	<0.090	DLHM	0.090	ug/g	20-AUG-15	28-AUG-15	R3254254
2-Methylnaphthalene	<0.090	DLHM	0.090	ug/g	20-AUG-15	28-AUG-15	R3254254
Naphthalene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Phenanthrene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Pyrene	<0.15	DLHM	0.15	ug/g	20-AUG-15	28-AUG-15	R3254254
Surrogate: 2-Fluorobiphenyl	88.0		50-140	%	20-AUG-15	28-AUG-15	R3254254
Surrogate: p-Terphenyl d14	82.4		50-140	%	20-AUG-15	28-AUG-15	R3254254
Organochlorine Pesticides							
Aldrin	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
gamma-hexachlorocyclohexane	<0.30	RRR	0.30	ug/g	20-AUG-15	24-AUG-15	R3252425
a-chlordane	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
Chlordane (Total)	<0.85		0.85	ug/g		24-AUG-15	
g-chlordane	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
op-DDD	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
pp-DDD	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
Total DDD	<0.85		0.85	ug/g		24-AUG-15	
o,p-DDE	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
pp-DDE	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
Total DDE	<0.85		0.85	ug/g		24-AUG-15	
op-DDT	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
pp-DDT	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
Total DDT	<0.85		0.85	ug/g		24-AUG-15	
Dieldrin	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
Endosulfan I	<0.90	DLUI	0.90	ug/g	20-AUG-15	24-AUG-15	R3252425
Endosulfan II	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
Endosulfan (Total)	<1.1		1.1	ug/g		24-AUG-15	
Endrin	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
Heptachlor	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
Heptachlor Epoxide	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
Hexachlorobenzene	<0.30	RRR	0.30	ug/g	20-AUG-15	24-AUG-15	R3252425
Hexachlorobutadiene	<0.30	RRR	0.30	ug/g	20-AUG-15	24-AUG-15	R3252425
Hexachloroethane	<0.30	RRR	0.30	ug/g	20-AUG-15	24-AUG-15	R3252425
Methoxychlor	<0.60	RRR	0.60	ug/g	20-AUG-15	24-AUG-15	R3252425
Surrogate: 2-Fluorobiphenyl	94.4		50-140	%	20-AUG-15	24-AUG-15	R3252425
Surrogate: d14-Terphenyl	101.2		50-140	%	20-AUG-15	24-AUG-15	R3252425
Report Remarks : DLM- Extract was run at a dilution due to high sample matrix background. DLHM- Detection limit adjusted: Sample has high moisture content.							
L1660729-3 EMB U/S Sampled By: CLIENT on 20-AUG-15 @ 12:40 Matrix: SOIL							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1660729-3 EMB U/S Sampled By: CLIENT on 20-AUG-15 @ 12:40 Matrix: SOIL							
Physical Tests							
Conductivity	0.415		0.0040	mS/cm		29-AUG-15	R3256335
% Moisture	65.7		0.10	%	20-AUG-15	21-AUG-15	R3250064
pH	6.84		0.10	pH units		22-AUG-15	R3251697
Cyanides							
Cyanide, Weak Acid Diss	0.102		0.050	ug/g	24-AUG-15	25-AUG-15	R3253230
Saturated Paste Extractables							
SAR	0.30		0.10	SAR		29-AUG-15	R3256812
Calcium (Ca)	114		1.0	mg/L		29-AUG-15	R3256812
Magnesium (Mg)	13.3		1.0	mg/L		29-AUG-15	R3256812
Sodium (Na)	12.6		1.0	mg/L		29-AUG-15	R3256812
Metals							
Antimony (Sb)	<1.0		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Arsenic (As)	2.6		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Barium (Ba)	81.2		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Beryllium (Be)	<0.50		0.50	ug/g	28-AUG-15	31-AUG-15	R3257094
Boron (B)	6.3		5.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Boron (B), Hot Water Ext.	1.18		0.10	ug/g	28-AUG-15	29-AUG-15	R3256801
Cadmium (Cd)	<0.50		0.50	ug/g	28-AUG-15	31-AUG-15	R3257094
Chromium (Cr)	14.4		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Cobalt (Co)	4.2		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Copper (Cu)	13.2		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Lead (Pb)	9.2		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Mercury (Hg)	0.0380		0.0050	ug/g	28-AUG-15	30-AUG-15	R3256457
Molybdenum (Mo)	<1.0		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Nickel (Ni)	9.4		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Selenium (Se)	<1.0		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Silver (Ag)	<0.20		0.20	ug/g	28-AUG-15	31-AUG-15	R3257094
Thallium (Tl)	<0.50		0.50	ug/g	28-AUG-15	31-AUG-15	R3257094
Uranium (U)	<1.0		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Vanadium (V)	18.1		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Zinc (Zn)	64.2		5.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Speciated Metals							
Chromium, Hexavalent	<0.20		0.20	ug/g	20-AUG-15	21-AUG-15	R3250857
Volatile Organic Compounds							
Acetone	<1.0	DLHM	1.0	ug/g	21-AUG-15	26-AUG-15	R3252341
Benzene	<0.014	ABL	0.014	ug/g	21-AUG-15	24-AUG-15	R3252341
Bromodichloromethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Bromoform	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Bromomethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Carbon tetrachloride	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Chlorobenzene	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Dibromochloromethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1660729-3 EMB U/S Sampled By: CLIENT on 20-AUG-15 @ 12:40 Matrix: SOIL							
Volatile Organic Compounds							
Chloroform	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,2-Dibromoethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,2-Dichlorobenzene	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,3-Dichlorobenzene	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,4-Dichlorobenzene	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Dichlorodifluoromethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,1-Dichloroethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,2-Dichloroethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,1-Dichloroethylene	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
cis-1,2-Dichloroethylene	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
trans-1,2-Dichloroethylene	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,3-Dichloropropene (cis & trans)	<0.085		0.085	ug/g		26-AUG-15	
Methylene Chloride	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,2-Dichloropropane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
cis-1,3-Dichloropropene	<0.060	ABL	0.060	ug/g	21-AUG-15	24-AUG-15	R3252341
trans-1,3-Dichloropropene	<0.060	ABL	0.060	ug/g	21-AUG-15	24-AUG-15	R3252341
Ethylbenzene	<0.036	ABL	0.036	ug/g	21-AUG-15	24-AUG-15	R3252341
n-Hexane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Methyl Ethyl Ketone	<1.0	ABL	1.0	ug/g	21-AUG-15	24-AUG-15	R3252341
Methyl Isobutyl Ketone	<1.0	ABL	1.0	ug/g	21-AUG-15	24-AUG-15	R3252341
MTBE	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Styrene	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,1,1,2-Tetrachloroethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,1,2,2-Tetrachloroethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Tetrachloroethylene	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Toluene	<0.16	ABL	0.16	ug/g	21-AUG-15	24-AUG-15	R3252341
1,1,1-Trichloroethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,1,2-Trichloroethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Trichloroethylene	<0.020	ABL	0.020	ug/g	21-AUG-15	24-AUG-15	R3252341
Trichlorofluoromethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Vinyl chloride	<0.040	ABL	0.040	ug/g	21-AUG-15	24-AUG-15	R3252341
o-Xylene	<0.040	ABL	0.040	ug/g	21-AUG-15	24-AUG-15	R3252341
m+p-Xylenes	<0.060	ABL	0.060	ug/g	21-AUG-15	24-AUG-15	R3252341
Xylenes (Total)	<0.072		0.072	ug/g		26-AUG-15	
Surrogate: 4-Bromofluorobenzene	77.1		70-130	%	21-AUG-15	24-AUG-15	R3252341
Surrogate: 1,4-Difluorobenzene	82.3		70-130	%	21-AUG-15	24-AUG-15	R3252341
Hydrocarbons							
F1 (C6-C10)	<10	DLHM	10	ug/g	21-AUG-15	26-AUG-15	R3252341
F1-BTEX	<10		10	ug/g		28-AUG-15	
F2 (C10-C16)	<20	DLHM	20	ug/g	20-AUG-15	21-AUG-15	R3252895
F2-Naphth	<20		20	ug/g		28-AUG-15	

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1660729-3 EMB U/S Sampled By: CLIENT on 20-AUG-15 @ 12:40 Matrix: SOIL							
Hydrocarbons							
F3 (C16-C34)	130	DLHM	100	ug/g	20-AUG-15	21-AUG-15	R3252895
F3-PAH	130		100	ug/g		28-AUG-15	
F4 (C34-C50)	<100	DLHM	100	ug/g	20-AUG-15	21-AUG-15	R3252895
Total Hydrocarbons (C6-C50)	<140		140	ug/g		28-AUG-15	
Chrom. to baseline at nC50	YES				20-AUG-15	21-AUG-15	R3252895
Surrogate: 2-Bromobenzotrifluoride	93.2		60-140	%	20-AUG-15	21-AUG-15	R3252895
Surrogate: 3,4-Dichlorotoluene	49.0	SOL:MI	60-140	%	21-AUG-15	26-AUG-15	R3252341
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Acenaphthylene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Anthracene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Benzo(a)anthracene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Benzo(a)pyrene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Benzo(b)fluoranthene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Benzo(g,h,i)perylene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Benzo(k)fluoranthene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Chrysene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Dibenzo(ah)anthracene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Fluoranthene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Fluorene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Indeno(1,2,3-cd)pyrene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
1+2-Methylnaphthalenes	<0.085		0.085	ug/g		28-AUG-15	
1-Methylnaphthalene	<0.060	DLHM	0.060	ug/g	20-AUG-15	28-AUG-15	R3254254
2-Methylnaphthalene	<0.060	DLHM	0.060	ug/g	20-AUG-15	28-AUG-15	R3254254
Naphthalene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Phenanthrene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Pyrene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Surrogate: 2-Fluorobiphenyl	91.2		50-140	%	20-AUG-15	28-AUG-15	R3254254
Surrogate: p-Terphenyl d14	85.9		50-140	%	20-AUG-15	28-AUG-15	R3254254
Organochlorine Pesticides							
Aldrin	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
gamma-hexachlorocyclohexane	<0.20	RRR	0.20	ug/g	20-AUG-15	24-AUG-15	R3252425
a-chlordane	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
Chlordane (Total)	<0.57		0.57	ug/g		24-AUG-15	
g-chlordane	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
op-DDD	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
pp-DDD	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
Total DDD	<0.57		0.57	ug/g		24-AUG-15	
o,p-DDE	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
pp-DDE	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
Total DDE	<0.57		0.57	ug/g		24-AUG-15	

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1660729-3 EMB U/S Sampled By: CLIENT on 20-AUG-15 @ 12:40 Matrix: SOIL							
Organochlorine Pesticides							
op-DDT	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
pp-DDT	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
Total DDT	<0.57		0.57	ug/g		24-AUG-15	
Dieldrin	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
Endosulfan I	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
Endosulfan II	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
Endosulfan (Total)	<0.57		0.57	ug/g		24-AUG-15	
Endrin	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
Heptachlor	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
Heptachlor Epoxide	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
Hexachlorobenzene	<0.20	RRR	0.20	ug/g	20-AUG-15	24-AUG-15	R3252425
Hexachlorobutadiene	<0.20	RRR	0.20	ug/g	20-AUG-15	24-AUG-15	R3252425
Hexachloroethane	<0.20	RRR	0.20	ug/g	20-AUG-15	24-AUG-15	R3252425
Methoxychlor	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
Surrogate: 2-Fluorobiphenyl	101.1		50-140	%	20-AUG-15	24-AUG-15	R3252425
Surrogate: d14-Terphenyl	101.9		50-140	%	20-AUG-15	24-AUG-15	R3252425
Report Remarks : ABL-Analysis compromised due to type of sample jar received. Losses may have occurred according to 511 Regulation. Detection limit adjusted for high moisture. Report Remarks : DLM- Extract was run at a dilution due to high sample matrix background. DLHM- Detection limit adjusted: Sample has high moisture content.							
L1660729-4 EMB D/S Sampled By: CLIENT on 20-AUG-15 @ 12:20 Matrix: SOIL							
Physical Tests							
Conductivity	0.267		0.0040	mS/cm		29-AUG-15	R3256335
% Moisture	65.5		0.10	%	20-AUG-15	21-AUG-15	R3250064
pH	6.94		0.10	pH units		22-AUG-15	R3251697
Cyanides							
Cyanide, Weak Acid Diss	<0.050		0.050	ug/g	20-AUG-15	21-AUG-15	R3252350
Saturated Paste Extractables							
SAR	0.30		0.10	SAR		29-AUG-15	R3256812
Calcium (Ca)	174		1.0	mg/L		29-AUG-15	R3256812
Magnesium (Mg)	26.2		1.0	mg/L		29-AUG-15	R3256812
Sodium (Na)	16.0		1.0	mg/L		29-AUG-15	R3256812
Metals							
Antimony (Sb)	<1.0		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Arsenic (As)	3.2		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Barium (Ba)	133		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Beryllium (Be)	<0.50		0.50	ug/g	28-AUG-15	31-AUG-15	R3257094
Boron (B)	8.4		5.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Boron (B), Hot Water Ext.	1.46		0.10	ug/g	28-AUG-15	29-AUG-15	R3256801
Cadmium (Cd)	<0.50		0.50	ug/g	28-AUG-15	31-AUG-15	R3257094
Chromium (Cr)	18.3		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1660729-4 EMB D/S Sampled By: CLIENT on 20-AUG-15 @ 12:20 Matrix: SOIL							
Metals							
Cobalt (Co)	5.2		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Copper (Cu)	16.4		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Lead (Pb)	11.3		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Mercury (Hg)	0.0458		0.0050	ug/g	28-AUG-15	30-AUG-15	R3256457
Molybdenum (Mo)	<1.0		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Nickel (Ni)	12.3		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Selenium (Se)	<1.0		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Silver (Ag)	<0.20		0.20	ug/g	28-AUG-15	31-AUG-15	R3257094
Thallium (Tl)	<0.50		0.50	ug/g	28-AUG-15	31-AUG-15	R3257094
Uranium (U)	<1.0		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Vanadium (V)	22.5		1.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Zinc (Zn)	79.7		5.0	ug/g	28-AUG-15	31-AUG-15	R3257094
Speciated Metals							
Chromium, Hexavalent	<0.20		0.20	ug/g	20-AUG-15	21-AUG-15	R3250857
Volatile Organic Compounds							
Acetone	<1.0	ABL	1.0	ug/g	21-AUG-15	24-AUG-15	R3252341
Benzene	<0.014	ABL	0.014	ug/g	21-AUG-15	24-AUG-15	R3252341
Bromodichloromethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Bromoform	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Bromomethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Carbon tetrachloride	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Chlorobenzene	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Dibromochloromethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Chloroform	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,2-Dibromoethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,2-Dichlorobenzene	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,3-Dichlorobenzene	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,4-Dichlorobenzene	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Dichlorodifluoromethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,1-Dichloroethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,2-Dichloroethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,1-Dichloroethylene	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
cis-1,2-Dichloroethylene	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
trans-1,2-Dichloroethylene	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,3-Dichloropropene (cis & trans)	<0.085		0.085	ug/g		25-AUG-15	
Methylene Chloride	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,2-Dichloropropane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
cis-1,3-Dichloropropene	<0.060	ABL	0.060	ug/g	21-AUG-15	24-AUG-15	R3252341
trans-1,3-Dichloropropene	<0.060	ABL	0.060	ug/g	21-AUG-15	24-AUG-15	R3252341
Ethylbenzene	<0.036	ABL	0.036	ug/g	21-AUG-15	24-AUG-15	R3252341
n-Hexane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1660729-4 EMB D/S Sampled By: CLIENT on 20-AUG-15 @ 12:20 Matrix: SOIL							
Volatile Organic Compounds							
Methyl Ethyl Ketone	<1.0	ABL	1.0	ug/g	21-AUG-15	24-AUG-15	R3252341
Methyl Isobutyl Ketone	<1.0	ABL	1.0	ug/g	21-AUG-15	24-AUG-15	R3252341
MTBE	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Styrene	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,1,1,2-Tetrachloroethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,1,2,2-Tetrachloroethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Tetrachloroethylene	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Toluene	<0.16	ABL	0.16	ug/g	21-AUG-15	24-AUG-15	R3252341
1,1,1-Trichloroethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
1,1,2-Trichloroethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Trichloroethylene	<0.020	ABL	0.020	ug/g	21-AUG-15	24-AUG-15	R3252341
Trichlorofluoromethane	<0.10	ABL	0.10	ug/g	21-AUG-15	24-AUG-15	R3252341
Vinyl chloride	<0.040	ABL	0.040	ug/g	21-AUG-15	24-AUG-15	R3252341
o-Xylene	<0.040	ABL	0.040	ug/g	21-AUG-15	24-AUG-15	R3252341
m+p-Xylenes	<0.060	ABL	0.060	ug/g	21-AUG-15	24-AUG-15	R3252341
Xylenes (Total)	<0.072		0.072	ug/g		25-AUG-15	
Surrogate: 4-Bromofluorobenzene	77.9		70-130	%	21-AUG-15	24-AUG-15	R3252341
Surrogate: 1,4-Difluorobenzene	82.9		70-130	%	21-AUG-15	24-AUG-15	R3252341
Hydrocarbons							
F1 (C6-C10)	<5.0		5.0	ug/g	21-AUG-15	26-AUG-15	R3252341
F1-BTEX	<5.0		5.0	ug/g		28-AUG-15	
F2 (C10-C16)	<20	DLHM	20	ug/g	20-AUG-15	21-AUG-15	R3252895
F2-Naphth	<20		20	ug/g		28-AUG-15	
F3 (C16-C34)	<100	DLHM	100	ug/g	20-AUG-15	21-AUG-15	R3252895
F3-PAH	<100		100	ug/g		28-AUG-15	
F4 (C34-C50)	<100	DLHM	100	ug/g	20-AUG-15	21-AUG-15	R3252895
Total Hydrocarbons (C6-C50)	<140		140	ug/g		28-AUG-15	
Chrom. to baseline at nC50	YES				20-AUG-15	21-AUG-15	R3252895
Surrogate: 2-Bromobenzotrifluoride	82.9		60-140	%	20-AUG-15	21-AUG-15	R3252895
Surrogate: 3,4-Dichlorotoluene	49.4	SOL:MI	60-140	%	21-AUG-15	26-AUG-15	R3252341
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Acenaphthylene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Anthracene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Benzo(a)anthracene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Benzo(a)pyrene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Benzo(b)fluoranthene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Benzo(g,h,i)perylene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Benzo(k)fluoranthene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Chrysene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Dibenzo(ah)anthracene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1660729-4 EMB D/S Sampled By: CLIENT on 20-AUG-15 @ 12:20 Matrix: SOIL							
Polycyclic Aromatic Hydrocarbons							
Fluoranthene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Fluorene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Indeno(1,2,3-cd)pyrene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
1+2-Methylnaphthalenes	<0.085		0.085	ug/g		28-AUG-15	
1-Methylnaphthalene	<0.060	DLHM	0.060	ug/g	20-AUG-15	28-AUG-15	R3254254
2-Methylnaphthalene	<0.060	DLHM	0.060	ug/g	20-AUG-15	28-AUG-15	R3254254
Naphthalene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Phenanthrene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Pyrene	<0.10	DLHM	0.10	ug/g	20-AUG-15	28-AUG-15	R3254254
Surrogate: 2-Fluorobiphenyl	89.5		50-140	%	20-AUG-15	28-AUG-15	R3254254
Surrogate: p-Terphenyl d14	84.6		50-140	%	20-AUG-15	28-AUG-15	R3254254
Organochlorine Pesticides							
Aldrin	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
gamma-hexachlorocyclohexane	<0.20	RRR	0.20	ug/g	20-AUG-15	24-AUG-15	R3252425
a-chlordane	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
Chlordane (Total)	<0.57		0.57	ug/g		24-AUG-15	
g-chlordane	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
op-DDD	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
pp-DDD	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
Total DDD	<0.57		0.57	ug/g		24-AUG-15	
o,p-DDE	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
pp-DDE	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
Total DDE	<0.57		0.57	ug/g		24-AUG-15	
op-DDT	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
pp-DDT	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
Total DDT	<0.57		0.57	ug/g		24-AUG-15	
Dieldrin	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
Endosulfan I	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
Endosulfan II	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
Endosulfan (Total)	<0.57		0.57	ug/g		24-AUG-15	
Endrin	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
Heptachlor	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
Heptachlor Epoxide	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
Hexachlorobenzene	<0.20	RRR	0.20	ug/g	20-AUG-15	24-AUG-15	R3252425
Hexachlorobutadiene	<0.20	RRR	0.20	ug/g	20-AUG-15	24-AUG-15	R3252425
Hexachloroethane	<0.20	RRR	0.20	ug/g	20-AUG-15	24-AUG-15	R3252425
Methoxychlor	<0.40	RRR	0.40	ug/g	20-AUG-15	24-AUG-15	R3252425
Surrogate: 2-Fluorobiphenyl	103.4		50-140	%	20-AUG-15	24-AUG-15	R3252425
Surrogate: d14-Terphenyl	110.6		50-140	%	20-AUG-15	24-AUG-15	R3252425

Report Remarks : ABL-Analysis compromised due to type of sample jar received. Losses may have occurred according to 511 Regulation. Detection limit adjusted for high moisture.
Report Remarks : DLM- Extract was run at a dilution due to high sample matrix background.

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1660729-4 EMB D/S Sampled By: CLIENT on 20-AUG-15 @ 12:20 Matrix: SOIL DLHM- Detection limit adjusted: Sample has high moisture content.							
L1660729-5 HAR U/S TCLP Sampled By: CLIENT on 20-AUG-15 @ 11:15 Matrix: SOIL							
Sample Preparation							
Initial pH	8.19		0.10	pH units		21-AUG-15	R3252585
Final pH	4.79		0.10	pH units		21-AUG-15	R3252585
TCLP Extractables							
Cyanide, Weak Acid Diss	<0.10		0.10	mg/L		24-AUG-15	R3252758
Fluoride (F)	<10		10	mg/L		26-AUG-15	R3254613
Nitrate and Nitrite as N	<4.0		4.0	mg/L		26-AUG-15	R3254613
Nitrate-N	<2.0		2.0	mg/L		26-AUG-15	R3254613
Nitrite-N	<2.0		2.0	mg/L		26-AUG-15	R3254613
TCLP Metals							
Arsenic (As)	<0.050		0.050	mg/L		24-AUG-15	R3252744
Barium (Ba)	0.88		0.50	mg/L		24-AUG-15	R3252744
Boron (B)	<2.5		2.5	mg/L		24-AUG-15	R3252744
Cadmium (Cd)	<0.0050		0.0050	mg/L		24-AUG-15	R3252744
Chromium (Cr)	<0.050		0.050	mg/L		24-AUG-15	R3252744
Lead (Pb)	<0.050		0.050	mg/L		24-AUG-15	R3252744
Mercury (Hg)	<0.00010		0.00010	mg/L		24-AUG-15	R3252294
Selenium (Se)	<0.25		0.25	mg/L		24-AUG-15	R3252744
Silver (Ag)	<0.0050		0.0050	mg/L		24-AUG-15	R3252744
Uranium (U)	<0.25		0.25	mg/L		24-AUG-15	R3252744
L1660729-6 HAR D/S TCLP Sampled By: CLIENT on 20-AUG-15 @ 11:00 Matrix: SOIL							
Sample Preparation							
Initial pH	8.02		0.10	pH units		21-AUG-15	R3252585
Final pH	5.17		0.10	pH units		21-AUG-15	R3252585
TCLP Extractables							
Cyanide, Weak Acid Diss	<0.10		0.10	mg/L		24-AUG-15	R3252758
Fluoride (F)	<10		10	mg/L		26-AUG-15	R3254613
Nitrate and Nitrite as N	<4.0		4.0	mg/L		26-AUG-15	R3254613
Nitrate-N	<2.0		2.0	mg/L		26-AUG-15	R3254613
Nitrite-N	<2.0		2.0	mg/L		26-AUG-15	R3254613
TCLP Metals							
Arsenic (As)	<0.050		0.050	mg/L		24-AUG-15	R3252744
Barium (Ba)	1.51		0.50	mg/L		24-AUG-15	R3252744
Boron (B)	<2.5		2.5	mg/L		24-AUG-15	R3252744
Cadmium (Cd)	<0.0050		0.0050	mg/L		24-AUG-15	R3252744
Chromium (Cr)	<0.050		0.050	mg/L		24-AUG-15	R3252744
Lead (Pb)	<0.050		0.050	mg/L		24-AUG-15	R3252744
Mercury (Hg)	<0.00010		0.00010	mg/L		24-AUG-15	R3252294

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1660729-6 HAR D/S TCLP Sampled By: CLIENT on 20-AUG-15 @ 11:00 Matrix: SOIL							
TCLP Metals							
Selenium (Se)	<0.25		0.25	mg/L		24-AUG-15	R3252744
Silver (Ag)	<0.0050		0.0050	mg/L		24-AUG-15	R3252744
Uranium (U)	<0.25		0.25	mg/L		24-AUG-15	R3252744
L1660729-7 EMB U/S TCLP Sampled By: CLIENT on 20-AUG-15 @ 12:40 Matrix: SOIL							
Sample Preparation							
Initial pH	7.98		0.10	pH units		21-AUG-15	R3252585
Final pH	5.03		0.10	pH units		21-AUG-15	R3252585
TCLP Extractables							
Cyanide, Weak Acid Diss	<0.10		0.10	mg/L		24-AUG-15	R3252758
Fluoride (F)	<10		10	mg/L		26-AUG-15	R3254613
Nitrate and Nitrite as N	<4.0		4.0	mg/L		26-AUG-15	R3254613
Nitrate-N	<2.0		2.0	mg/L		26-AUG-15	R3254613
Nitrite-N	<2.0		2.0	mg/L		26-AUG-15	R3254613
TCLP Metals							
Arsenic (As)	<0.050		0.050	mg/L		24-AUG-15	R3252744
Barium (Ba)	0.78		0.50	mg/L		24-AUG-15	R3252744
Boron (B)	<2.5		2.5	mg/L		24-AUG-15	R3252744
Cadmium (Cd)	<0.0050		0.0050	mg/L		24-AUG-15	R3252744
Chromium (Cr)	<0.050		0.050	mg/L		24-AUG-15	R3252744
Lead (Pb)	<0.050		0.050	mg/L		24-AUG-15	R3252744
Mercury (Hg)	<0.00010		0.00010	mg/L		24-AUG-15	R3252294
Selenium (Se)	<0.25		0.25	mg/L		24-AUG-15	R3252744
Silver (Ag)	<0.0050		0.0050	mg/L		24-AUG-15	R3252744
Uranium (U)	<0.25		0.25	mg/L		24-AUG-15	R3252744
L1660729-8 EMB D/S TCLP Sampled By: CLIENT on 20-AUG-15 @ 12:20 Matrix: SOIL							
Sample Preparation							
Initial pH	8.35		0.10	pH units		21-AUG-15	R3252585
Final pH	5.79		0.10	pH units		21-AUG-15	R3252585
TCLP Extractables							
Cyanide, Weak Acid Diss	<0.10		0.10	mg/L		24-AUG-15	R3252758
Fluoride (F)	<10		10	mg/L		26-AUG-15	R3254613
Nitrate and Nitrite as N	<4.0		4.0	mg/L		26-AUG-15	R3254613
Nitrate-N	<2.0		2.0	mg/L		26-AUG-15	R3254613
Nitrite-N	<2.0		2.0	mg/L		26-AUG-15	R3254613
TCLP Metals							
Arsenic (As)	<0.050		0.050	mg/L		24-AUG-15	R3252744
Barium (Ba)	0.84		0.50	mg/L		24-AUG-15	R3252744
Boron (B)	<2.5		2.5	mg/L		24-AUG-15	R3252744
Cadmium (Cd)	<0.0050		0.0050	mg/L		24-AUG-15	R3252744

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1660729-8 EMB D/S TCLP Sampled By: CLIENT on 20-AUG-15 @ 12:20 Matrix: SOIL							
TCLP Metals							
Chromium (Cr)	<0.050		0.050	mg/L		24-AUG-15	R3252744
Lead (Pb)	<0.050		0.050	mg/L		24-AUG-15	R3252744
Mercury (Hg)	<0.00010		0.00010	mg/L		24-AUG-15	R3252294
Selenium (Se)	<0.25		0.25	mg/L		24-AUG-15	R3252744
Silver (Ag)	<0.0050		0.0050	mg/L		24-AUG-15	R3252744
Uranium (U)	<0.25		0.25	mg/L		24-AUG-15	R3252744

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	F1 (C6-C10)	DLHM	L1660729-3, -4
Duplicate	Acetone	DLHM	L1660729-3, -4
Duplicate	Antimony (Sb)	DUP-H	L1660729-1, -2, -3, -4
Laboratory Control Sample	n-Hexane	MES	L1660729-3, -4
Matrix Spike	Acetone	MES	L1660729-3, -4
Matrix Spike	Dichlorodifluoromethane	MES	L1660729-3, -4

Sample Parameter Qualifier key listed:

Qualifier	Description
ABL	Approximate Result: May Be Biased Low
DLHM	Detection Limit Adjusted: Sample has High Moisture Content
DLUI	Detection Limit Raised: Unknown Interference generated an apparent false positive test result.
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
RRR	Refer to Report Remarks for issues regarding this analysis
SOL:MI	Surrogate recovery outside acceptable limits due to matrix interference

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
B-HWS-R511-WT	Soil	Boron-HWE-O.Reg 153/04 (July 2011)	HW EXTR, EPA 6010B

A dried solid sample is extracted with calcium chloride, the sample undergoes a heating process. After cooling the sample is filtered and analyzed by ICP/OES.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

CHLORDANE-T-CALC-WT	Soil	Chlordane Total sums	CALCULATION

Aqueous sample is extracted by liquid/liquid extraction with a solvent mix. After extraction, a number of clean up techniques may be applied, depending on the sample matrix and analyzed by GC/MS.

CN-TCLP-WT	Waste	Cyanide for O. Reg 347	APHA 4500CN C E
CN-WAD-R511-WT	Soil	Cyanide (WAD)-O.Reg 153/04 (July 2011)	MOE 3015/APHA 4500CN I-WAD

The sample is extracted with a strong base for 16 hours, and then filtered. The filtrate is then distilled where the cyanide is converted to cyanogen chloride by reacting with chloramine-T, the cyanogen chloride then reacts with a combination of barbituric acid and isonicotinic acid to form a highly colored complex.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

CR-CR6-IC-WT	Soil	Hexavalent Chromium in Soil	SW846 3060A/7199

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Method 7199, published by the United States Environmental Protection Agency (EPA). The procedure involves analysis for chromium (VI) by ion chromatography using diphenylcarbazide in a sulphuric acid solution.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

DDD-DDE-DDT-CALC-WT	Soil	DDD, DDE, DDT sums	CALCULATION

Aqueous sample is extracted by liquid/liquid extraction with a solvent mix. After extraction, a number of clean up techniques may be applied, depending on the sample matrix and analyzed by GC/MS.

EC-R511-WT	Soil	Conductivity-O.Reg 153/04 (July 2011)	MOEE E3138

A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

ENDOSULFAN-T-CALC-WT	Soil	Endosulfan Total sums	CALCULATION

Reference Information

Aqueous sample is extracted by liquid/liquid extraction with a solvent mix. After extraction, a number of clean up techniques may be applied, depending on the sample matrix and analyzed by GC/MS.

F-TCLP-WT	Waste	Fluoride (F) for O. Reg 347	APHA 4110 B-Ion Chromatography

F1-F4-511-CALC-WT	Soil	F1-F4 Hydrocarbon Calculated Parameters	CCME CWS-PHC, Pub #1310, Dec 2001-S

Analytical methods used for analysis of CCME Petroleum Hydrocarbons have been validated and comply with the Reference Method for the CWS PHC.

Hydrocarbon results are expressed on a dry weight basis.

In cases where results for both F4 and F4G are reported, the greater of the two results must be used in any application of the CWS PHC guidelines and the gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
In samples where BTEX and F1 were analyzed , F1-BTEX represents a value where the sum of Benzene, Toluene, Ethylbenzene and total Xylenes has been subtracted from F1.

In samples where PAHs, F2 and F3 were analyzed, F2-Naphth represents the result where Naphthalene has been subtracted from F2. F3-PAH represents a result where the sum of Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Phenanthrene, and Pyrene has been subtracted from F3.

Unless otherwise qualified, the following quality control criteria have been met for the F1 hydrocarbon range:
1. All extraction and analysis holding times were met.
2. Instrument performance showing response factors for C6 and C10 within 30% of the response factor for toluene.
3. Linearity of gasoline response within 15% throughout the calibration range.

Unless otherwise qualified, the following quality control criteria have been met for the F2-F4 hydrocarbon ranges:
1. All extraction and analysis holding times were met.
2. Instrument performance showing C10, C16 and C34 response factors within 10% of their average.
3. Instrument performance showing the C50 response factor within 30% of the average of the C10, C16 and C34 response factors.
4. Linearity of diesel or motor oil response within 15% throughout the calibration range.

F1-HS-511-WT	Soil	F1-O.Reg 153/04 (July 2011)	E3398/CCME TIER 1-HS

Fraction F1 is determined by extracting a soil or sediment sample as received with methanol, then analyzing by headspace-GC/FID.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

F2-F4-511-WT	Soil	F2-F4-O.Reg 153/04 (July 2011)	MOE DECPH-E3398/CCME TIER 1

Fractions F2, F3 and F4 are determined by extracting a soil sample with a solvent mix. The solvent recovered from the extracted soil sample is dried and treated to remove polar material. The extract is analyzed by GC/FID.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

HG-200.2-CVAA-WT	Soil	Mercury in Soil by CVAAS	EPA 200.2/1631E (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAAS.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

HG-TCLP-WT	Waste	Mercury (CVAA) for O.Reg 347	SW846 7470A

LEACH-TCLP-WT	Waste	Leachate Procedure for Reg 347	EPA 1311

Inorganic and Semi-Volatile Organic contaminants are leached from waste samples in strict accordance with US EPA Method 1311, "Toxicity Characteristic Leaching Procedure" (TCLP). Test results are reported in leachate concentration units (normally mg/L).

MET-200.2-CCMS-WT	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CRC ICPMS.

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. This method does not dissolve all silicate materials and may result in a partial extraction. depending on the sample matrix, for some metals, including, but not limited to Al, Ba, Be, Cr, Sr, Ti, Tl, and V.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

MET-TCLP-WT	Waste	O.Reg 347 TCLP Leachable Metals	EPA 200.8

Reference Information

METHYLNAPS-CALC-WT	Soil	ABN-Calculated Parameters	SW846 8270
MOISTURE-WT	Soil	% Moisture	Gravimetric: Oven Dried
N2N3-TCLP-WT	Waste	Nitrate/Nitrite-N for O. Reg 347	APHA 4110 B-Ion Chromatography
PAH-511-WT	Soil	PAH-O.Reg 153/04 (July 2011)	SW846 3510/8270

A representative sub-sample of soil is fortified with deuterium-labelled surrogates and a mechanical shaking techniqueis used to extract the sample with a mixture of methanol and toluene. The extracts are concentrated and analyzed by GC/MS. Depending on the analytical GC/MS column used benzo(j)fluoranthene may chromatographically co-elute with benzo(b)fluoranthene or benzo(k)fluoranthene.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

PEST-OC-511-WT	Soil	OC Pesticides-O.Reg 153/04 (July 2011)	SW846 8270 (511)

Soil sample is extracted in a solvent, after extraction a number of clean up techniques may be applied, depending on the sample matrix and analyzed by GC/MS.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

PH-R511-WT	Soil	pH-O.Reg 153/04 (July 2011)	MOEE E3137A

A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

SAR-R511-WT	Soil	SAR-O.Reg 153/04 (July 2011)	SW846 6010C

A dried, disaggregated solid sample is extracted with deionized water, the aqueous extract is separated from the solid, acidified and then analyzed using a ICP/OES.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

VOC-1,3-DCP-CALC-WT	Soil	Regulation 153 VOCs	SW8260B/SW8270C
VOC-511-HS-WT	Soil	VOC-O.Reg 153/04 (July 2011)	SW846 8260 (511)

Soil and sediment samples are extracted in methanol and analyzed by headspace-GC/MS.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

XYLENES-SUM-CALC-WT	Soil	Sum of Xylene Isomer Concentrations	CALCULATION

Total xylenes represents the sum of o-xylene and m&p-xylene.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L1660729 Report Date: 04-SEP-15

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
B-HWS-R511-WT	**Soil**							
Batch R3256801								
WG2160183-3 DUP		**L1662898-1**						
Boron (B), Hot Water Ext.		0.21	0.20		ug/g	8.0	40	29-AUG-15
WG2160183-2 IRM		**SALINITY_SOIL4**						
Boron (B), Hot Water Ext.			86.5		%		70-130	29-AUG-15
WG2160183-1 MB								
Boron (B), Hot Water Ext.			<0.10		ug/g		0.1	29-AUG-15
WG2160183-4 MS		**L1662898-1**						
Boron (B), Hot Water Ext.			102.9		%		60-140	29-AUG-15
CN-WAD-R511-WT	**Soil**							
Batch R3252350								
WG2153548-3 DUP		**L1660281-10**						
Cyanide, Weak Acid Diss		<0.050	<0.050	RPD-NA	ug/g	N/A	35	21-AUG-15
WG2153548-2 LCS								
Cyanide, Weak Acid Diss			83.1		%		80-120	21-AUG-15
WG2153548-1 MB								
Cyanide, Weak Acid Diss			<0.050		ug/g		0.05	21-AUG-15
WG2153548-4 MS		**L1660281-10**						
Cyanide, Weak Acid Diss			92.4		%		70-130	21-AUG-15
Batch R3253230								
WG2157085-3 DUP		**L1659445-12**						
Cyanide, Weak Acid Diss		0.116	0.134		ug/g	15	35	25-AUG-15
WG2157085-2 LCS								
Cyanide, Weak Acid Diss			117.3		%		80-120	25-AUG-15
WG2157085-1 MB								
Cyanide, Weak Acid Diss			<0.050		ug/g		0.05	25-AUG-15
WG2157085-4 MS		**L1659445-12**						
Cyanide, Weak Acid Diss			106.5		%		70-130	25-AUG-15
CR-CR6-IC-WT	**Soil**							
Batch R3250857								
WG2153601-4 CRM		**WT-SQC012**						
Chromium, Hexavalent			75.3		%		70-130	21-AUG-15
WG2153601-3 DUP		**L1660312-16**						
Chromium, Hexavalent		<0.20	<0.20	RPD-NA	ug/g	N/A	35	21-AUG-15
WG2153601-2 LCS								
Chromium, Hexavalent			94.6		%		80-120	21-AUG-15
WG2153601-1 MB								
Chromium, Hexavalent			<0.20		ug/g		0.2	21-AUG-15

Quality Control Report

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EC-R511-WT	**Soil**							
Batch R3256335								
WG2160189-4 DUP		**WG2160189-3**						
Conductivity		0.174	0.176		mS/cm	1.1	20	29-AUG-15
WG2160489-1 LCS								
Conductivity			100.0		%		90-110	29-AUG-15
WG2160189-1 MB								
Conductivity			<0.0040		mS/cm		0.044	29-AUG-15
F1-HS-511-WT	**Soil**							
Batch R3252144								
WG2154427-3 DUP		**WG2154427-5**						
F1 (C6-C10)		<5.0	<5.0	RPD-NA	ug/g	N/A	50	24-AUG-15
WG2154427-2 LCS								
F1 (C6-C10)			80.9		%		80-120	24-AUG-15
WG2154427-1 MB								
F1 (C6-C10)			<5.0		ug/g		5	24-AUG-15
Surrogate: 3,4-Dichlorotoluene			74.3		%		60-140	24-AUG-15
WG2154427-7 MS		**WG2154427-6**						
F1 (C6-C10)			80.2		%		60-140	24-AUG-15
Batch R3252341								
WG2154724-3 DUP		**WG2154724-5**						
F1 (C6-C10)		<10	<10	RPD-NA	ug/g	N/A	50	26-AUG-15
WG2154724-2 LCS								
F1 (C6-C10)			83.4		%		80-120	24-AUG-15
WG2154724-1 MB								
F1 (C6-C10)			<5.0		ug/g		5	24-AUG-15
Surrogate: 3,4-Dichlorotoluene			76.2		%		60-140	24-AUG-15
WG2154724-7 MS		**WG2154724-6**						
F1 (C6-C10)			76.7		%		60-140	26-AUG-15
F2-F4-511-WT	**Soil**							
Batch R3252895								
WG2153651-3 CRM		**ALS PHC2 IRM**						
F2 (C10-C16)			82.2		%		70-130	21-AUG-15
F3 (C16-C34)			90.6		%		70-130	21-AUG-15
F4 (C34-C50)			94.0		%		70-130	21-AUG-15
WG2153651-5 DUP		**WG2153651-4**						
F2 (C10-C16)		18	18		ug/g	2.9	40	21-AUG-15
F3 (C16-C34)		<50	<50	RPD-NA	ug/g	N/A	40	21-AUG-15
F4 (C34-C50)		<50	<50	RPD-NA	ug/g	N/A	40	21-AUG-15

Quality Control Report

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F2-F4-511-WT	**Soil**							
Batch R3252895								
WG2153651-2 LCS								
F2 (C10-C16)			92.4		%		80-120	21-AUG-15
F3 (C16-C34)			106.2		%		80-120	21-AUG-15
F4 (C34-C50)			110.5		%		80-120	21-AUG-15
WG2153651-1 MB								
F2 (C10-C16)			<10		ug/g		10	21-AUG-15
F3 (C16-C34)			<50		ug/g		50	21-AUG-15
F4 (C34-C50)			<50		ug/g		50	21-AUG-15
Surrogate: 2-Bromobenzotrifluoride			82.8		%		60-140	21-AUG-15
HG-200.2-CVAA-WT	**Soil**							
Batch R3256457								
WG2160202-2 CRM		**WT-CANMET-TILL1**						
Mercury (Hg)			93.0		%		70-130	30-AUG-15
WG2160202-6 DUP		**WG2160202-5**						
Mercury (Hg)		0.0504	0.0517		ug/g	2.6	40	30-AUG-15
WG2160202-4 LCS								
Mercury (Hg)			98.5		%		80-120	30-AUG-15
WG2160202-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	30-AUG-15
MET-200.2-CCMS-WT	**Soil**							
Batch R3257094								
WG2160202-2 CRM		**WT-CANMET-TILL1**						
Antimony (Sb)			93.7		%		70-130	31-AUG-15
Arsenic (As)			102.4		%		70-130	31-AUG-15
Barium (Ba)			103.6		%		70-130	31-AUG-15
Beryllium (Be)			103.5		%		70-130	31-AUG-15
Cadmium (Cd)			89.4		%		70-130	31-AUG-15
Chromium (Cr)			103.9		%		70-130	31-AUG-15
Cobalt (Co)			101.5		%		70-130	31-AUG-15
Copper (Cu)			96.7		%		70-130	31-AUG-15
Lead (Pb)			85.9		%		70-130	31-AUG-15
Molybdenum (Mo)			97.9		%		70-130	31-AUG-15
Nickel (Ni)			100.4		%		70-130	31-AUG-15
Selenium (Se)			96.4		%		70-130	31-AUG-15
Silver (Ag)			96.0		%		70-130	31-AUG-15
Thallium (Tl)			87.7		%		70-130	31-AUG-15

Quality Control Report

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-WT	**Soil**							
Batch R3257094								
WG2160202-2 CRM		**WT-CANMET-TILL1**						
Uranium (U)			101.2		%		70-130	31-AUG-15
Vanadium (V)			109.0		%		70-130	31-AUG-15
Zinc (Zn)			100.2		%		70-130	31-AUG-15
WG2160202-6 DUP		**WG2160202-5**						
Antimony (Sb)		4.41	2.61	DUP-H	ug/g	51	30	31-AUG-15
Arsenic (As)		12.4	14.5		ug/g	16	30	31-AUG-15
Barium (Ba)		72.9	72.1		ug/g	1.1	40	31-AUG-15
Beryllium (Be)		0.50	0.47		ug/g	5.0	30	31-AUG-15
Boron (B)		5.6	5.9		ug/g	4.5	30	31-AUG-15
Cadmium (Cd)		0.484	0.574		ug/g	17	30	31-AUG-15
Chromium (Cr)		59.1	60.3		ug/g	2.1	30	31-AUG-15
Cobalt (Co)		16.6	16.6		ug/g	0.4	30	31-AUG-15
Copper (Cu)		59.2	56.4		ug/g	4.7	30	31-AUG-15
Lead (Pb)		25.9	26.6		ug/g	2.6	40	31-AUG-15
Molybdenum (Mo)		4.59	4.47		ug/g	2.7	40	31-AUG-15
Nickel (Ni)		81.9	86.9		ug/g	5.9	30	31-AUG-15
Selenium (Se)		<0.20	<0.20	RPD-NA	ug/g	N/A	30	31-AUG-15
Silver (Ag)		1.10	1.60		ug/g	36	40	31-AUG-15
Thallium (Tl)		0.116	0.119		ug/g	2.6	30	31-AUG-15
Uranium (U)		0.821	0.891		ug/g	8.2	30	31-AUG-15
Vanadium (V)		101	96.1		ug/g	4.8	30	31-AUG-15
Zinc (Zn)		83.8	80.7		ug/g	3.7	30	31-AUG-15
WG2160202-3 LCS								
Antimony (Sb)			98.1		%		80-120	31-AUG-15
Arsenic (As)			94.6		%		80-120	31-AUG-15
Barium (Ba)			99.7		%		80-120	31-AUG-15
Beryllium (Be)			103.2		%		80-120	31-AUG-15
Boron (B)			101.0		%		80-120	31-AUG-15
Cadmium (Cd)			102.8		%		80-120	31-AUG-15
Chromium (Cr)			93.2		%		80-120	31-AUG-15
Cobalt (Co)			93.7		%		80-120	31-AUG-15
Copper (Cu)			93.6		%		80-120	31-AUG-15
Lead (Pb)			95.1		%		80-120	31-AUG-15

Quality Control Report

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-WT	**Soil**							
Batch R3257094								
WG2160202-3 LCS								
Molybdenum (Mo)			103.8		%		80-120	31-AUG-15
Nickel (Ni)			92.2		%		80-120	31-AUG-15
Selenium (Se)			94.6		%		80-120	31-AUG-15
Silver (Ag)			90.0		%		80-120	31-AUG-15
Thallium (Tl)			91.1		%		80-120	31-AUG-15
Uranium (U)			90.5		%		80-120	31-AUG-15
Vanadium (V)			96.1		%		80-120	31-AUG-15
Zinc (Zn)			94.1		%		80-120	31-AUG-15
WG2160202-1 MB								
Antimony (Sb)			<0.10		mg/kg		0.1	31-AUG-15
Arsenic (As)			<0.10		mg/kg		0.1	31-AUG-15
Barium (Ba)			<0.50		mg/kg		0.5	31-AUG-15
Beryllium (Be)			<0.10		mg/kg		0.1	31-AUG-15
Boron (B)			<5.0		mg/kg		5	31-AUG-15
Cadmium (Cd)			<0.020		mg/kg		0.02	31-AUG-15
Chromium (Cr)			<0.50		mg/kg		0.5	31-AUG-15
Cobalt (Co)			<0.10		mg/kg		0.1	31-AUG-15
Copper (Cu)			<0.50		mg/kg		0.5	31-AUG-15
Lead (Pb)			<0.50		mg/kg		0.5	31-AUG-15
Molybdenum (Mo)			<0.10		mg/kg		0.1	31-AUG-15
Nickel (Ni)			<0.50		mg/kg		0.5	31-AUG-15
Selenium (Se)			<0.20		mg/kg		0.2	31-AUG-15
Silver (Ag)			<0.10		mg/kg		0.1	31-AUG-15
Thallium (Tl)			<0.050		mg/kg		0.05	31-AUG-15
Uranium (U)			<0.050		mg/kg		0.05	31-AUG-15
Vanadium (V)			<0.20		mg/kg		0.2	31-AUG-15
Zinc (Zn)			<2.0		mg/kg		2	31-AUG-15
MOISTURE-WT	**Soil**							
Batch R3250064								
WG2153723-3 DUP		**L1659744-10**						
% Moisture		5.16	5.05		%	2.1	20	21-AUG-15
WG2153723-2 LCS								
% Moisture			99.9		%		90-110	21-AUG-15
WG2153723-1 MB								

Quality Control Report

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOISTURE-WT	**Soil**							
Batch R3250064								
WG2153723-1 MB								
% Moisture			<0.10		%		0.1	21-AUG-15
PAH-511-WT	**Soil**							
Batch R3254254								
WG2153749-5 DUP		**WG2153749-4**						
1-Methylnaphthalene		<0.030	<0.030	RPD-NA	ug/g	N/A	40	26-AUG-15
2-Methylnaphthalene		<0.030	<0.030	RPD-NA	ug/g	N/A	40	26-AUG-15
Acenaphthene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	26-AUG-15
Acenaphthylene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	26-AUG-15
Anthracene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	26-AUG-15
Benzo(a)anthracene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	26-AUG-15
Benzo(a)pyrene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	26-AUG-15
Benzo(b)fluoranthene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	26-AUG-15
Benzo(g,h,i)perylene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	26-AUG-15
Benzo(k)fluoranthene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	26-AUG-15
Chrysene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	26-AUG-15
Dibenzo(ah)anthracene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	26-AUG-15
Fluoranthene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	26-AUG-15
Fluorene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	26-AUG-15
Indeno(1,2,3-cd)pyrene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	26-AUG-15
Naphthalene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	26-AUG-15
Phenanthrene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	26-AUG-15
Pyrene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	26-AUG-15
WG2153749-3 IRM		**ALS PAH1 RM**						
1-Methylnaphthalene			96.1		%		50-140	26-AUG-15
2-Methylnaphthalene			99.8		%		50-140	26-AUG-15
Acenaphthene			68.5		%		50-140	26-AUG-15
Acenaphthylene			109.1		%		50-140	26-AUG-15
Anthracene			72.3		%		50-140	26-AUG-15
Benzo(a)anthracene			103.7		%		50-140	26-AUG-15
Benzo(a)pyrene			96.5		%		50-140	26-AUG-15
Benzo(b)fluoranthene			101.3		%		50-140	26-AUG-15
Benzo(g,h,i)perylene			96.9		%		50-140	26-AUG-15
Benzo(k)fluoranthene			98.5				50-140	

Quality Control Report

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-511-WT	**Soil**							
Batch R3254254								
WG2153749-3 IRM		**ALS PAH1 RM**						
Benzo(k)fluoranthene			98.5		%		50-140	26-AUG-15
Chrysene			119.7		%		50-140	26-AUG-15
Dibenzo(ah)anthracene			124.3		%		50-140	26-AUG-15
Fluoranthene			111.8		%		50-140	26-AUG-15
Fluorene			69.2		%		50-140	26-AUG-15
Indeno(1,2,3-cd)pyrene			89.5		%		50-140	26-AUG-15
Naphthalene			93.5		%		50-140	26-AUG-15
Phenanthrene			103.2		%		50-140	26-AUG-15
Pyrene			109.1		%		50-140	26-AUG-15
WG2153749-2 LCS								
1-Methylnaphthalene			87.3		%		50-140	26-AUG-15
2-Methylnaphthalene			88.0		%		50-140	26-AUG-15
Acenaphthene			89.7		%		50-140	26-AUG-15
Acenaphthylene			90.2		%		50-140	26-AUG-15
Anthracene			89.7		%		50-140	26-AUG-15
Benzo(a)anthracene			86.3		%		50-140	26-AUG-15
Benzo(a)pyrene			93.3		%		50-140	26-AUG-15
Benzo(b)fluoranthene			88.5		%		50-140	26-AUG-15
Benzo(g,h,i)perylene			74.0		%		50-140	26-AUG-15
Benzo(k)fluoranthene			86.6		%		50-140	26-AUG-15
Chrysene			93.1		%		50-140	26-AUG-15
Dibenzo(ah)anthracene			80.8		%		50-140	26-AUG-15
Fluoranthene			87.9		%		50-140	26-AUG-15
Fluorene			90.2		%		50-140	26-AUG-15
Indeno(1,2,3-cd)pyrene			78.5		%		50-140	26-AUG-15
Naphthalene			87.6		%		50-140	26-AUG-15
Phenanthrene			87.4		%		50-140	26-AUG-15
Pyrene			93.3		%		50-140	26-AUG-15
WG2153749-1 MB								
1-Methylnaphthalene			<0.030		ug/g		0.03	26-AUG-15
2-Methylnaphthalene			<0.030		ug/g		0.03	26-AUG-15
Acenaphthene			<0.050		ug/g		0.05	26-AUG-15
Acenaphthylene			<0.050		ug/g		0.05	26-AUG-15
Anthracene			<0.050		ug/g		0.05	26-AUG-15

Quality Control Report

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-511-WT	**Soil**							
Batch R3254254								
WG2153749-1 MB								
Benzo(a)anthracene			<0.050		ug/g		0.05	26-AUG-15
Benzo(a)pyrene			<0.050		ug/g		0.05	26-AUG-15
Benzo(b)fluoranthene			<0.050		ug/g		0.05	26-AUG-15
Benzo(g,h,i)perylene			<0.050		ug/g		0.05	26-AUG-15
Benzo(k)fluoranthene			<0.050		ug/g		0.05	26-AUG-15
Chrysene			<0.050		ug/g		0.05	26-AUG-15
Dibenzo(ah)anthracene			<0.050		ug/g		0.05	26-AUG-15
Fluoranthene			<0.050		ug/g		0.05	26-AUG-15
Fluorene			<0.050		ug/g		0.05	26-AUG-15
Indeno(1,2,3-cd)pyrene			<0.050		ug/g		0.05	26-AUG-15
Naphthalene			<0.050		ug/g		0.05	26-AUG-15
Phenanthrene			<0.050		ug/g		0.05	26-AUG-15
Pyrene			<0.050		ug/g		0.05	26-AUG-15
Surrogate: 2-Fluorobiphenyl			89.4		%		50-140	26-AUG-15
Surrogate: p-Terphenyl d14			85.3		%		50-140	26-AUG-15
PEST-OC-511-WT	**Soil**							
Batch R3252425								
WG2153809-4 DUP		**WG2153809-3**						
Aldrin		<0.020	<0.020	RPD-NA	ug/g	N/A	40	24-AUG-15
a-chlordane		<0.020	<0.020	RPD-NA	ug/g	N/A	40	24-AUG-15
g-chlordane		<0.020	<0.020	RPD-NA	ug/g	N/A	40	24-AUG-15
op-DDD		<0.020	<0.020	RPD-NA	ug/g	N/A	40	24-AUG-15
pp-DDD		<0.020	<0.020	RPD-NA	ug/g	N/A	40	24-AUG-15
o,p-DDE		<0.020	<0.020	RPD-NA	ug/g	N/A	40	24-AUG-15
pp-DDE		<0.020	<0.020	RPD-NA	ug/g	N/A	40	24-AUG-15
op-DDT		<0.020	<0.020	RPD-NA	ug/g	N/A	40	24-AUG-15
pp-DDT		<0.020	<0.020	RPD-NA	ug/g	N/A	40	24-AUG-15
Dieldrin		<0.020	<0.020	RPD-NA	ug/g	N/A	40	24-AUG-15
Endosulfan I		<0.020	<0.020	RPD-NA	ug/g	N/A	40	24-AUG-15
Endosulfan II		<0.020	<0.020	RPD-NA	ug/g	N/A	40	24-AUG-15
Endrin		<0.020	<0.020	RPD-NA	ug/g	N/A	40	24-AUG-15
gamma-hexachlorocyclohexane		<0.010	<0.010	RPD-NA	ug/g	N/A	40	24-AUG-15
Heptachlor		<0.020	<0.020	RPD-NA	ug/g	N/A	40	24-AUG-15

Quality Control Report

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PEST-OC-511-WT	**Soil**							
Batch R3252425								
WG2153809-4 DUP		**WG2153809-3**						
Heptachlor Epoxide		<0.020	<0.020	RPD-NA	ug/g	N/A	40	24-AUG-15
Hexachlorobenzene		<0.010	<0.010	RPD-NA	ug/g	N/A	40	24-AUG-15
Hexachlorobutadiene		<0.010	<0.010	RPD-NA	ug/g	N/A	40	24-AUG-15
Hexachloroethane		<0.010	<0.010	RPD-NA	ug/g	N/A	40	24-AUG-15
Methoxychlor		<0.020	<0.020	RPD-NA	ug/g	N/A	40	24-AUG-15
WG2153809-2 LCS								
Aldrin			99.8		%		50-140	24-AUG-15
a-chlordane			94.5		%		50-140	24-AUG-15
g-chlordane			98.4		%		50-140	24-AUG-15
op-DDD			92.4		%		50-140	24-AUG-15
pp-DDD			88.8		%		50-140	24-AUG-15
o,p-DDE			88.7		%		50-140	24-AUG-15
pp-DDE			94.0		%		50-140	24-AUG-15
op-DDT			86.8		%		50-140	24-AUG-15
pp-DDT			87.5		%		50-140	24-AUG-15
Dieldrin			89.8		%		50-140	24-AUG-15
Endosulfan I			89.3		%		50-140	24-AUG-15
Endosulfan II			106.5		%		50-140	24-AUG-15
Endrin			112.4		%		50-140	24-AUG-15
gamma-hexachlorocyclohexane			97.1		%		50-140	24-AUG-15
Heptachlor			96.2		%		50-140	24-AUG-15
Heptachlor Epoxide			89.5		%		50-140	24-AUG-15
Hexachlorobenzene			93.7		%		50-140	24-AUG-15
Hexachlorobutadiene			100.9		%		50-140	24-AUG-15
Hexachloroethane			99.9		%		50-140	24-AUG-15
Methoxychlor			95.1		%		50-140	24-AUG-15
WG2153809-1 MB								
Aldrin			<0.020		ug/g		0.02	24-AUG-15
a-chlordane			<0.020		ug/g		0.02	24-AUG-15
g-chlordane			<0.020		ug/g		0.02	24-AUG-15
op-DDD			<0.020		ug/g		0.02	24-AUG-15
pp-DDD			<0.020		ug/g		0.02	24-AUG-15
o,p-DDE			<0.020		ug/g		0.02	24-AUG-15
pp-DDE			<0.020		ug/g		0.02	24-AUG-15

Quality Control Report

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PEST-OC-511-WT	**Soil**							
Batch R3252425								
WG2153809-1 MB								
op-DDT			<0.020		ug/g		0.02	24-AUG-15
pp-DDT			<0.020		ug/g		0.02	24-AUG-15
Dieldrin			<0.020		ug/g		0.02	24-AUG-15
Endosulfan I			<0.020		ug/g		0.02	24-AUG-15
Endosulfan II			<0.020		ug/g		0.02	24-AUG-15
Endrin			<0.020		ug/g		0.02	24-AUG-15
gamma-hexachlorocyclohexane			<0.010		ug/g		0.01	24-AUG-15
Heptachlor			<0.020		ug/g		0.02	24-AUG-15
Heptachlor Epoxide			<0.020		ug/g		0.02	24-AUG-15
Hexachlorobenzene			<0.010		ug/g		0.01	24-AUG-15
Hexachlorobutadiene			<0.010		ug/g		0.01	24-AUG-15
Hexachloroethane			<0.010		ug/g		0.01	24-AUG-15
Methoxychlor			<0.020		ug/g		0.02	24-AUG-15
Surrogate: 2-Fluorobiphenyl			93.9		%		50-140	24-AUG-15
Surrogate: d14-Terphenyl			94.7		%		50-140	24-AUG-15
WG2153809-5 MS		**WG2153809-3**						
Aldrin			90.5		%		50-140	24-AUG-15
a-chlordane			76.6		%		50-140	24-AUG-15
g-chlordane			78.1		%		50-140	24-AUG-15
op-DDD			74.4		%		50-140	24-AUG-15
pp-DDD			89.6		%		50-140	24-AUG-15
o,p-DDE			74.2		%		50-140	24-AUG-15
pp-DDE			76.5		%		50-140	24-AUG-15
op-DDT			72.7		%		50-140	24-AUG-15
pp-DDT			80.2		%		50-140	24-AUG-15
Dieldrin			73.4		%		50-140	24-AUG-15
Endosulfan I			71.4		%		50-140	24-AUG-15
Endosulfan II			74.2		%		50-140	24-AUG-15
Endrin			100.5		%		50-150	24-AUG-15
gamma-hexachlorocyclohexane			80.0		%		50-140	24-AUG-15
Heptachlor			83.7		%		50-140	24-AUG-15
Heptachlor Epoxide			74.4		%		50-140	24-AUG-15
Hexachlorobenzene			79.9		%		50-140	24-AUG-15
Hexachlorobutadiene			85.2		%		50-140	24-AUG-15

Quality Control Report

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PEST-OC-511-WT	**Soil**							
Batch R3252425								
WG2153809-5 MS		**WG2153809-3**						
Hexachloroethane			84.7		%		50-140	24-AUG-15
Methoxychlor			85.0		%		50-140	24-AUG-15
PH-R511-WT	**Soil**							
Batch R3251697								
WG2154220-1 DUP		**L1660729-1**						
pH		6.87	6.83	J	pH units	0.04	0.3	22-AUG-15
WG2155305-2 LCS								
pH			7.05		pH units		6.7-7.3	22-AUG-15
SAR-R511-WT	**Soil**							
Batch R3256812								
WG2160189-4 DUP		**WG2160189-3**						
Calcium (Ca)		27.6	33.9		mg/L	21	40	29-AUG-15
Sodium (Na)		1.3	1.5		mg/L	14	40	29-AUG-15
Magnesium (Mg)		2.2	2.4		mg/L	10	40	29-AUG-15
WG2160189-2 IRM		**WT SAR1**						
Calcium (Ca)			109.3		%		70-130	29-AUG-15
Sodium (Na)			103.4		%		70-130	29-AUG-15
Magnesium (Mg)			106.3		%		70-130	29-AUG-15
WG2160189-1 MB								
Calcium (Ca)			<1.0		mg/L		1	29-AUG-15
Sodium (Na)			<1.0		mg/L		1	29-AUG-15
Magnesium (Mg)			<1.0		mg/L		1	29-AUG-15
VOC-511-HS-WT	**Soil**							
Batch R3252144								
WG2154427-3 DUP		**WG2154427-5**						
1,1,1,2-Tetrachloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
1,1,2,2-Tetrachloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
1,1,1-Trichloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
1,1,2-Trichloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
1,1-Dichloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
1,1-Dichloroethylene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
1,2-Dibromoethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
1,2-Dichlorobenzene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
1,2-Dichloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15

Quality Control Report

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R3252144								
WG2154427-3 DUP		**WG2154427-5**						
1,2-Dichloropropane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
1,3-Dichlorobenzene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
1,4-Dichlorobenzene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
Acetone		<0.50	<0.50	RPD-NA	ug/g	N/A	40	24-AUG-15
Benzene		<0.0068	<0.0068	RPD-NA	ug/g	N/A	40	24-AUG-15
Bromodichloromethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
Bromoform		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
Bromomethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
Carbon tetrachloride		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
Chlorobenzene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
Chloroform		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
cis-1,2-Dichloroethylene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
cis-1,3-Dichloropropene		<0.030	<0.030	RPD-NA	ug/g	N/A	40	24-AUG-15
Dibromochloromethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
Dichlorodifluoromethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
Ethylbenzene		<0.018	<0.018	RPD-NA	ug/g	N/A	40	24-AUG-15
n-Hexane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
Methylene Chloride		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
MTBE		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
m+p-Xylenes		0.039	0.039		ug/g	0.6	40	24-AUG-15
Methyl Ethyl Ketone		<0.50	<0.50	RPD-NA	ug/g	N/A	40	24-AUG-15
Methyl Isobutyl Ketone		<0.50	<0.50	RPD-NA	ug/g	N/A	40	24-AUG-15
o-Xylene		0.038	0.037		ug/g	0.6	40	24-AUG-15
Styrene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
Tetrachloroethylene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
Toluene		<0.080	<0.080	RPD-NA	ug/g	N/A	40	24-AUG-15
trans-1,2-Dichloroethylene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
trans-1,3-Dichloropropene		<0.030	<0.030	RPD-NA	ug/g	N/A	40	24-AUG-15
Trichloroethylene		<0.010	<0.010	RPD-NA	ug/g	N/A	40	24-AUG-15
Trichlorofluoromethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	24-AUG-15
Vinyl chloride		<0.020	<0.020	RPD-NA	ug/g	N/A	40	24-AUG-15
WG2154427-2 LCS								
1,1,1,2-Tetrachloroethane			101.0		%		60-130	24-AUG-15

Quality Control Report

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R3252144								
WG2154427-2 LCS								
1,1,2,2-Tetrachloroethane			114.8		%		60-130	24-AUG-15
1,1,1-Trichloroethane			105.1		%		60-130	24-AUG-15
1,1,2-Trichloroethane			106.0		%		60-130	24-AUG-15
1,1-Dichloroethane			82.0		%		60-130	24-AUG-15
1,1-Dichloroethylene			89.4		%		60-130	24-AUG-15
1,2-Dibromoethane			99.6		%		70-130	24-AUG-15
1,2-Dichlorobenzene			100.5		%		70-130	24-AUG-15
1,2-Dichloroethane			106.9		%		60-130	24-AUG-15
1,2-Dichloropropane			109.7		%		70-130	24-AUG-15
1,3-Dichlorobenzene			97.2		%		70-130	24-AUG-15
1,4-Dichlorobenzene			98.2		%		70-130	24-AUG-15
Acetone			116.7		%		60-140	24-AUG-15
Benzene			101.0		%		70-130	24-AUG-15
Bromodichloromethane			108.4		%		50-140	24-AUG-15
Bromoform			113.4		%		70-130	24-AUG-15
Bromomethane			98.8		%		50-140	24-AUG-15
Carbon tetrachloride			103.6		%		70-130	24-AUG-15
Chlorobenzene			98.2		%		70-130	24-AUG-15
Chloroform			104.0		%		70-130	24-AUG-15
cis-1,2-Dichloroethylene			102.0		%		70-130	24-AUG-15
cis-1,3-Dichloropropene			101.4		%		70-130	24-AUG-15
Dibromochloromethane			105.8		%		60-130	24-AUG-15
Dichlorodifluoromethane			75.6		%		50-140	24-AUG-15
Ethylbenzene			91.7		%		70-130	24-AUG-15
n-Hexane			103.8		%		70-130	24-AUG-15
Methylene Chloride			104.9		%		70-130	24-AUG-15
MTBE			102.1		%		70-130	24-AUG-15
m+p-Xylenes			94.6		%		70-130	24-AUG-15
Methyl Ethyl Ketone			105.6		%		60-140	24-AUG-15
Methyl Isobutyl Ketone			119.1		%		60-140	24-AUG-15
o-Xylene			103.2		%		70-130	24-AUG-15
Styrene			106.9		%		70-130	24-AUG-15
Tetrachloroethylene			108.4		%		60-130	24-AUG-15

Quality Control Report

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R3252144								
WG2154427-2 LCS								
Toluene			108.9		%		70-130	24-AUG-15
trans-1,2-Dichloroethylene			101.3		%		60-130	24-AUG-15
trans-1,3-Dichloropropene			99.2		%		70-130	24-AUG-15
Trichloroethylene			103.5		%		60-130	24-AUG-15
Trichlorofluoromethane			105.2		%		50-140	24-AUG-15
Vinyl chloride			93.0		%		60-140	24-AUG-15
WG2154427-1 MB								
1,1,1,2-Tetrachloroethane			<0.050		ug/g		0.05	24-AUG-15
1,1,2,2-Tetrachloroethane			<0.050		ug/g		0.05	24-AUG-15
1,1,1-Trichloroethane			<0.050		ug/g		0.05	24-AUG-15
1,1,2-Trichloroethane			<0.050		ug/g		0.05	24-AUG-15
1,1-Dichloroethane			<0.050		ug/g		0.05	24-AUG-15
1,1-Dichloroethylene			<0.050		ug/g		0.05	24-AUG-15
1,2-Dibromoethane			<0.050		ug/g		0.05	24-AUG-15
1,2-Dichlorobenzene			<0.050		ug/g		0.05	24-AUG-15
1,2-Dichloroethane			<0.050		ug/g		0.05	24-AUG-15
1,2-Dichloropropane			<0.050		ug/g		0.05	24-AUG-15
1,3-Dichlorobenzene			<0.050		ug/g		0.05	24-AUG-15
1,4-Dichlorobenzene			<0.050		ug/g		0.05	24-AUG-15
Acetone			<0.50		ug/g		0.5	24-AUG-15
Benzene			<0.0068		ug/g		0.0068	24-AUG-15
Bromodichloromethane			<0.050		ug/g		0.05	24-AUG-15
Bromoform			<0.050		ug/g		0.05	24-AUG-15
Bromomethane			<0.050		ug/g		0.05	24-AUG-15
Carbon tetrachloride			<0.050		ug/g		0.05	24-AUG-15
Chlorobenzene			<0.050		ug/g		0.05	24-AUG-15
Chloroform			<0.050		ug/g		0.05	24-AUG-15
cis-1,2-Dichloroethylene			<0.050		ug/g		0.05	24-AUG-15
cis-1,3-Dichloropropene			<0.030		ug/g		0.03	24-AUG-15
Dibromochloromethane			<0.050		ug/g		0.05	24-AUG-15
Dichlorodifluoromethane			<0.050		ug/g		0.05	24-AUG-15
Ethylbenzene			<0.018		ug/g		0.018	24-AUG-15
n-Hexane			<0.050		ug/g		0.05	24-AUG-15
Methylene Chloride			<0.050		ug/g		0.05	24-AUG-15

Quality Control Report

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R3252144								
WG2154427-1 MB								
MTBE			<0.050		ug/g		0.05	24-AUG-15
m+p-Xylenes			<0.030		ug/g		0.03	24-AUG-15
Methyl Ethyl Ketone			<0.50		ug/g		0.5	24-AUG-15
Methyl Isobutyl Ketone			<0.50		ug/g		0.5	24-AUG-15
o-Xylene			<0.020		ug/g		0.02	24-AUG-15
Styrene			<0.050		ug/g		0.05	24-AUG-15
Tetrachloroethylene			<0.050		ug/g		0.05	24-AUG-15
Toluene			<0.080		ug/g		0.08	24-AUG-15
trans-1,2-Dichloroethylene			<0.050		ug/g		0.05	24-AUG-15
trans-1,3-Dichloropropene			<0.030		ug/g		0.03	24-AUG-15
Trichloroethylene			<0.010		ug/g		0.01	24-AUG-15
Trichlorofluoromethane			<0.050		ug/g		0.05	24-AUG-15
Vinyl chloride			<0.020		ug/g		0.02	24-AUG-15
Surrogate: 1,4-Difluorobenzene			99.6		%		70-130	24-AUG-15
Surrogate: 4-Bromofluorobenzene			100.7		%		70-130	24-AUG-15
WG2154427-4 MS		**WG2154427-5**						
1,1,1,2-Tetrachloroethane			98.0		%		50-140	24-AUG-15
1,1,2,2-Tetrachloroethane			111.0		%		50-140	24-AUG-15
1,1,1-Trichloroethane			101.2		%		50-140	24-AUG-15
1,1,2-Trichloroethane			136.4		%		50-140	24-AUG-15
1,1-Dichloroethane			80.3		%		50-140	24-AUG-15
1,1-Dichloroethylene			80.6		%		50-140	24-AUG-15
1,2-Dibromoethane			112.7		%		50-140	24-AUG-15
1,2-Dichlorobenzene			99.8		%		50-140	24-AUG-15
1,2-Dichloroethane			104.5		%		50-140	24-AUG-15
1,2-Dichloropropane			101.9		%		50-140	24-AUG-15
1,3-Dichlorobenzene			94.9		%		50-140	24-AUG-15
1,4-Dichlorobenzene			94.6		%		50-140	24-AUG-15
Acetone			74.9		%		50-140	24-AUG-15
Benzene			96.3		%		50-140	24-AUG-15
Bromodichloromethane			98.2		%		50-140	24-AUG-15
Bromoform			117.8		%		50-140	24-AUG-15
Bromomethane			82.0		%		50-140	24-AUG-15
Carbon tetrachloride			97.9		%		50-140	24-AUG-15

Quality Control Report

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R3252144								
WG2154427-4 MS		**WG2154427-5**						
Chlorobenzene			99.2		%		50-140	24-AUG-15
Chloroform			100.4		%		50-140	24-AUG-15
cis-1,2-Dichloroethylene			100.3		%		50-140	24-AUG-15
cis-1,3-Dichloropropene			90.1		%		50-140	24-AUG-15
Dibromochloromethane			108.6		%		50-140	24-AUG-15
Dichlorodifluoromethane			62.4		%		50-140	24-AUG-15
Ethylbenzene			91.4		%		50-140	24-AUG-15
n-Hexane			93.3		%		50-140	24-AUG-15
Methylene Chloride			97.0		%		50-140	24-AUG-15
MTBE			99.3		%		50-140	24-AUG-15
m+p-Xylenes			93.8		%		50-140	24-AUG-15
Methyl Ethyl Ketone			107.8		%		50-140	24-AUG-15
Methyl Isobutyl Ketone			109.6		%		50-140	24-AUG-15
o-Xylene			97.9		%		50-140	24-AUG-15
Styrene			100.9		%		50-140	24-AUG-15
Tetrachloroethylene			109.4		%		50-140	24-AUG-15
Toluene			111.9		%		50-140	24-AUG-15
trans-1,2-Dichloroethylene			92.3		%		50-140	24-AUG-15
trans-1,3-Dichloropropene			117.1		%		50-140	24-AUG-15
Trichloroethylene			100.3		%		50-140	24-AUG-15
Trichlorofluoromethane			90.1		%		50-140	24-AUG-15
Vinyl chloride			76.3		%		50-140	24-AUG-15
Batch R3252341								
WG2154724-3 DUP		**WG2154724-5**						
1,1,1,2-Tetrachloroethane		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
1,1,2,2-Tetrachloroethane		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
1,1,1-Trichloroethane		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
1,1,2-Trichloroethane		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
1,1-Dichloroethane		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
1,1-Dichloroethylene		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
1,2-Dibromoethane		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
1,2-Dichlorobenzene		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
1,2-Dichloroethane		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15

Quality Control Report

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R3252341								
WG2154724-3 DUP		**WG2154724-5**						
1,2-Dichloropropane		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
1,3-Dichlorobenzene		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
1,4-Dichlorobenzene		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
Acetone		<1.0	<1.0	RPD-NA	ug/g	N/A	40	26-AUG-15
Benzene		<0.014	<0.014	RPD-NA	ug/g	N/A	40	24-AUG-15
Bromodichloromethane		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
Bromoform		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
Bromomethane		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
Carbon tetrachloride		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
Chlorobenzene		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
Chloroform		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
cis-1,2-Dichloroethylene		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
cis-1,3-Dichloropropene		<0.060	<0.060	RPD-NA	ug/g	N/A	40	24-AUG-15
Dibromochloromethane		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
Dichlorodifluoromethane		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
Ethylbenzene		<0.036	<0.036	RPD-NA	ug/g	N/A	40	24-AUG-15
n-Hexane		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
Methylene Chloride		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
MTBE		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
m+p-Xylenes		<0.060	<0.060	RPD-NA	ug/g	N/A	40	24-AUG-15
Methyl Ethyl Ketone		<1.0	<1.0	RPD-NA	ug/g	N/A	40	24-AUG-15
Methyl Isobutyl Ketone		<1.0	<1.0	RPD-NA	ug/g	N/A	40	24-AUG-15
o-Xylene		<0.040	<0.040	RPD-NA	ug/g	N/A	40	24-AUG-15
Styrene		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
Tetrachloroethylene		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
Toluene		<0.16	<0.16	RPD-NA	ug/g	N/A	40	24-AUG-15
trans-1,2-Dichloroethylene		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
trans-1,3-Dichloropropene		<0.060	<0.060	RPD-NA	ug/g	N/A	40	24-AUG-15
Trichloroethylene		<0.020	<0.020	RPD-NA	ug/g	N/A	40	24-AUG-15
Trichlorofluoromethane		<0.10	<0.10	RPD-NA	ug/g	N/A	40	24-AUG-15
Vinyl chloride		<0.040	<0.040	RPD-NA	ug/g	N/A	40	24-AUG-15
WG2154724-2 LCS								
1,1,1,2-Tetrachloroethane			104.3		%		60-130	24-AUG-15

Quality Control Report

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R3252341								
WG2154724-2 LCS								
1,1,2,2-Tetrachloroethane			110.0		%		60-130	24-AUG-15
1,1,1-Trichloroethane			107.0		%		60-130	24-AUG-15
1,1,2-Trichloroethane			117.8		%		60-130	24-AUG-15
1,1-Dichloroethane			106.8		%		60-130	24-AUG-15
1,1-Dichloroethylene			111.0		%		60-130	24-AUG-15
1,2-Dibromoethane			108.3		%		70-130	24-AUG-15
1,2-Dichlorobenzene			110.0		%		70-130	24-AUG-15
1,2-Dichloroethane			107.5		%		60-130	24-AUG-15
1,2-Dichloropropane			123.9		%		70-130	24-AUG-15
1,3-Dichlorobenzene			105.5		%		70-130	24-AUG-15
1,4-Dichlorobenzene			107.4		%		70-130	24-AUG-15
Acetone			129.3		%		60-140	24-AUG-15
Benzene			119.8		%		70-130	24-AUG-15
Bromodichloromethane			104.8		%		50-140	24-AUG-15
Bromoform			95.4		%		70-130	24-AUG-15
Bromomethane			111.7		%		50-140	24-AUG-15
Carbon tetrachloride			101.2		%		70-130	24-AUG-15
Chlorobenzene			110.2		%		70-130	24-AUG-15
Chloroform			113.6		%		70-130	24-AUG-15
cis-1,2-Dichloroethylene			111.1		%		70-130	24-AUG-15
cis-1,3-Dichloropropene			108.5		%		70-130	24-AUG-15
Dibromochloromethane			104.0		%		60-130	24-AUG-15
Dichlorodifluoromethane			76.9		%		50-140	24-AUG-15
Ethylbenzene			104.4		%		70-130	24-AUG-15
n-Hexane			134.0	MES	%		70-130	24-AUG-15
Methylene Chloride			117.4		%		70-130	24-AUG-15
MTBE			105.2		%		70-130	24-AUG-15
m+p-Xylenes			108.4		%		70-130	24-AUG-15
Methyl Ethyl Ketone			119.7		%		60-140	24-AUG-15
Methyl Isobutyl Ketone			112.2		%		60-140	24-AUG-15
o-Xylene			103.0		%		70-130	24-AUG-15
Styrene			98.4		%		70-130	24-AUG-15
Tetrachloroethylene			102.6		%		60-130	24-AUG-15

Quality Control Report

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch	**R3252341**							
WG2154724-2	**LCS**							
Toluene			110.5		%		70-130	24-AUG-15
trans-1,2-Dichloroethylene			123.0		%		60-130	24-AUG-15
trans-1,3-Dichloropropene			108.4		%		70-130	24-AUG-15
Trichloroethylene			101.9		%		60-130	24-AUG-15
Trichlorofluoromethane			110.8		%		50-140	24-AUG-15
Vinyl chloride			120.2		%		60-140	24-AUG-15
WG2154724-1	**MB**							
1,1,1,2-Tetrachloroethane			<0.050		ug/g		0.05	24-AUG-15
1,1,2,2-Tetrachloroethane			<0.050		ug/g		0.05	24-AUG-15
1,1,1-Trichloroethane			<0.050		ug/g		0.05	24-AUG-15
1,1,2-Trichloroethane			<0.050		ug/g		0.05	24-AUG-15
1,1-Dichloroethane			<0.050		ug/g		0.05	24-AUG-15
1,1-Dichloroethylene			<0.050		ug/g		0.05	24-AUG-15
1,2-Dibromoethane			<0.050		ug/g		0.05	24-AUG-15
1,2-Dichlorobenzene			<0.050		ug/g		0.05	24-AUG-15
1,2-Dichloroethane			<0.050		ug/g		0.05	24-AUG-15
1,2-Dichloropropane			<0.050		ug/g		0.05	24-AUG-15
1,3-Dichlorobenzene			<0.050		ug/g		0.05	24-AUG-15
1,4-Dichlorobenzene			<0.050		ug/g		0.05	24-AUG-15
Acetone			<0.50		ug/g		0.5	24-AUG-15
Benzene			<0.0068		ug/g		0.0068	24-AUG-15
Bromodichloromethane			<0.050		ug/g		0.05	24-AUG-15
Bromoform			<0.050		ug/g		0.05	24-AUG-15
Bromomethane			<0.050		ug/g		0.05	24-AUG-15
Carbon tetrachloride			<0.050		ug/g		0.05	24-AUG-15
Chlorobenzene			<0.050		ug/g		0.05	24-AUG-15
Chloroform			<0.050		ug/g		0.05	24-AUG-15
cis-1,2-Dichloroethylene			<0.050		ug/g		0.05	24-AUG-15
cis-1,3-Dichloropropene			<0.030		ug/g		0.03	24-AUG-15
Dibromochloromethane			<0.050		ug/g		0.05	24-AUG-15
Dichlorodifluoromethane			<0.050		ug/g		0.05	24-AUG-15
Ethylbenzene			<0.018		ug/g		0.018	24-AUG-15
n-Hexane			<0.050		ug/g		0.05	24-AUG-15
Methylene Chloride			<0.050		ug/g		0.05	24-AUG-15

Quality Control Report

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R3252341								
WG2154724-1 MB								
MTBE			<0.050		ug/g		0.05	24-AUG-15
m+p-Xylenes			<0.030		ug/g		0.03	24-AUG-15
Methyl Ethyl Ketone			<0.50		ug/g		0.5	24-AUG-15
Methyl Isobutyl Ketone			<0.50		ug/g		0.5	24-AUG-15
o-Xylene			<0.020		ug/g		0.02	24-AUG-15
Styrene			<0.050		ug/g		0.05	24-AUG-15
Tetrachloroethylene			<0.050		ug/g		0.05	24-AUG-15
Toluene			<0.080		ug/g		0.08	24-AUG-15
trans-1,2-Dichloroethylene			<0.050		ug/g		0.05	24-AUG-15
trans-1,3-Dichloropropene			<0.030		ug/g		0.03	24-AUG-15
Trichloroethylene			<0.010		ug/g		0.01	24-AUG-15
Trichlorofluoromethane			<0.050		ug/g		0.05	24-AUG-15
Vinyl chloride			<0.020		ug/g		0.02	24-AUG-15
Surrogate: 1,4-Difluorobenzene			105.5		%		70-130	24-AUG-15
Surrogate: 4-Bromofluorobenzene			98.7		%		70-130	24-AUG-15
WG2154724-4 MS		**WG2154724-5**						
1,1,1,2-Tetrachloroethane			103.1		%		50-140	24-AUG-15
1,1,2,2-Tetrachloroethane			116.2		%		50-140	24-AUG-15
1,1,1-Trichloroethane			102.0		%		50-140	24-AUG-15
1,1,2-Trichloroethane			122.9		%		50-140	24-AUG-15
1,1-Dichloroethane			106.2		%		50-140	24-AUG-15
1,1-Dichloroethylene			100.5		%		50-140	24-AUG-15
1,2-Dibromoethane			113.0		%		50-140	24-AUG-15
1,2-Dichlorobenzene			106.2		%		50-140	24-AUG-15
1,2-Dichloroethane			114.2		%		50-140	24-AUG-15
1,2-Dichloropropane			126.2		%		50-140	24-AUG-15
1,3-Dichlorobenzene			98.0		%		50-140	24-AUG-15
1,4-Dichlorobenzene			101.0		%		50-140	24-AUG-15
Acetone			141.0	MES	%		50-140	24-AUG-15
Benzene			118.0		%		50-140	24-AUG-15
Bromodichloromethane			109.0		%		50-140	24-AUG-15
Bromoform			100.7		%		50-140	24-AUG-15
Bromomethane			103.5		%		50-140	24-AUG-15
Carbon tetrachloride			94.5		%		50-140	24-AUG-15

Quality Control Report

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R3252341								
WG2154724-4 MS		**WG2154724-5**						
Chlorobenzene			107.1		%		50-140	24-AUG-15
Chloroform			114.6		%		50-140	24-AUG-15
cis-1,2-Dichloroethylene			110.5		%		50-140	24-AUG-15
cis-1,3-Dichloropropene			101.9		%		50-140	24-AUG-15
Dibromochloromethane			108.1		%		50-140	24-AUG-15
Dichlorodifluoromethane			40.9	MES	%		50-140	24-AUG-15
Ethylbenzene			90.9		%		50-140	24-AUG-15
n-Hexane			95.1		%		50-140	24-AUG-15
Methylene Chloride			120.3		%		50-140	24-AUG-15
MTBE			103.7		%		50-140	24-AUG-15
m+p-Xylenes			96.6		%		50-140	24-AUG-15
Methyl Ethyl Ketone			136.8		%		50-140	24-AUG-15
Methyl Isobutyl Ketone			124.9		%		50-140	24-AUG-15
o-Xylene			91.6		%		50-140	24-AUG-15
Styrene			87.1		%		50-140	24-AUG-15
Tetrachloroethylene			89.5		%		50-140	24-AUG-15
Toluene			100.9		%		50-140	24-AUG-15
trans-1,2-Dichloroethylene			115.2		%		50-140	24-AUG-15
trans-1,3-Dichloropropene			99.7		%		50-140	24-AUG-15
Trichloroethylene			95.6		%		50-140	24-AUG-15
Trichlorofluoromethane			92.7		%		50-140	24-AUG-15
Vinyl chloride			102.4		%		50-140	24-AUG-15
CN-TCLP-WT	**Waste**							
Batch R3252758								
WG2155995-3 DUP		**L1660225-1**						
Cyanide, Weak Acid Diss		<0.10	<0.10	RPD-NA	mg/L	N/A	20	24-AUG-15
WG2155995-2 LCS								
Cyanide, Weak Acid Diss			94.8		%		70-130	24-AUG-15
WG2155995-1 MB								
Cyanide, Weak Acid Diss			<0.10		mg/L		0.1	24-AUG-15
WG2155995-4 MS		**L1660225-1**						
Cyanide, Weak Acid Diss			91.0		%		50-150	24-AUG-15
F-TCLP-WT	**Waste**							

Quality Control Report

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F-TCLP-WT	**Waste**							
Batch R3254613								
WG2157829-3 DUP		**L1660225-1**						
Fluoride (F)		<10	<10	RPD-NA	mg/L	N/A	30	26-AUG-15
WG2157829-2 LCS								
Fluoride (F)			90.2		%		70-130	26-AUG-15
WG2157829-1 MB								
Fluoride (F)			<10		mg/L		10	26-AUG-15
WG2157829-4 MS		**L1660225-1**						
Fluoride (F)			98.4		%		50-150	26-AUG-15
HG-TCLP-WT	**Waste**							
Batch R3252294								
WG2155827-3 DUP		**L1660225-1**						
Mercury (Hg)		<0.00010	<0.00010	RPD-NA	mg/L	N/A	50	24-AUG-15
WG2155827-2 LCS								
Mercury (Hg)			97.3		%		70-130	24-AUG-15
WG2155827-1 MB								
Mercury (Hg)			<0.00010		mg/L		0.0001	24-AUG-15
WG2155827-4 MS		**L1660225-1**						
Mercury (Hg)			94.3		%		50-140	24-AUG-15
MET-TCLP-WT	**Waste**							
Batch R3252744								
WG2155709-4 DUP		**WG2155709-3**						
Silver (Ag)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	40	24-AUG-15
Arsenic (As)		0.096	0.093		mg/L	2.6	40	24-AUG-15
Boron (B)		<2.5	<2.5	RPD-NA	mg/L	N/A	40	24-AUG-15
Barium (Ba)		<0.50	<0.50	RPD-NA	mg/L	N/A	40	24-AUG-15
Cadmium (Cd)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	40	24-AUG-15
Chromium (Cr)		<0.050	<0.050	RPD-NA	mg/L	N/A	40	24-AUG-15
Lead (Pb)		<0.050	<0.050	RPD-NA	mg/L	N/A	40	24-AUG-15
Selenium (Se)		<0.25	<0.25	RPD-NA	mg/L	N/A	40	24-AUG-15
Uranium (U)		<0.25	<0.25	RPD-NA	mg/L	N/A	40	24-AUG-15
WG2155709-2 LCS								
Silver (Ag)			102.4		%		70-130	24-AUG-15
Arsenic (As)			95.6		%		70-130	24-AUG-15
Boron (B)			91.6		%		70-130	24-AUG-15
Barium (Ba)			95.2		%		70-130	24-AUG-15
Cadmium (Cd)			95.5		%		70-130	24-AUG-15

Quality Control Report

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TCLP-WT	**Waste**							
Batch R3252744								
WG2155709-2 LCS								
Chromium (Cr)			95.2		%		70-130	24-AUG-15
Lead (Pb)			97.2		%		70-130	24-AUG-15
Selenium (Se)			97.6		%		70-130	24-AUG-15
Uranium (U)			99.2		%		70-130	24-AUG-15
WG2155709-1 MB								
Silver (Ag)			<0.0050		mg/L		0.005	24-AUG-15
Arsenic (As)			<0.050		mg/L		0.05	24-AUG-15
Boron (B)			<2.5		mg/L		2.5	24-AUG-15
Barium (Ba)			<0.50		mg/L		0.5	24-AUG-15
Cadmium (Cd)			<0.0050		mg/L		0.005	24-AUG-15
Chromium (Cr)			<0.050		mg/L		0.05	24-AUG-15
Lead (Pb)			<0.050		mg/L		0.05	24-AUG-15
Selenium (Se)			<0.25		mg/L		0.25	24-AUG-15
Uranium (U)			<0.25		mg/L		0.25	24-AUG-15
WG2155709-5 MS		**WG2155709-3**						
Silver (Ag)			93.9		%		50-150	24-AUG-15
Arsenic (As)			102.0		%		50-150	24-AUG-15
Boron (B)			98.1		%		50-150	24-AUG-15
Barium (Ba)			99.1		%		50-150	24-AUG-15
Cadmium (Cd)			101.3		%		50-150	24-AUG-15
Chromium (Cr)			100.0		%		50-150	24-AUG-15
Lead (Pb)			98.9		%		50-150	24-AUG-15
Selenium (Se)			102.8		%		50-150	24-AUG-15
Uranium (U)			102.7		%		50-150	24-AUG-15
N2N3-TCLP-WT	**Waste**							
Batch R3254613								
WG2157829-3 DUP		**L1660225-1**						
Nitrate-N		<2.0	<2.0	RPD-NA	mg/L	N/A	30	26-AUG-15
Nitrite-N		<2.0	<2.0	RPD-NA	mg/L	N/A	30	26-AUG-15
WG2157829-2 LCS								
Nitrate-N			98.9		%		70-130	26-AUG-15
Nitrite-N			101.3		%		70-130	26-AUG-15
WG2157829-1 MB								
Nitrate-N			<2.0		mg/L		2	26-AUG-15

Quality Control Report

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
N2N3-TCLP-WT	**Waste**							
Batch R3254613								
WG2157829-1 MB								
Nitrite-N			<2.0		mg/L		2	26-AUG-15
WG2157829-4 MS		**L1660225-1**						
Nitrate-N			96.4		%		50-150	26-AUG-15
Nitrite-N			95.4		%		50-150	26-AUG-15

Quality Control Report

Workorder: L1660729 Report Date: 04-SEP-15

Client: ECOSYSTEM RECOVERY INC.
1023 Rife Road, Unit A
Cambridge On N1R 5S3
Contact: David Arseneau

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
DLHM	Detection Limit Adjusted: Sample has High Moisture Content
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
J	Duplicate results and limits are expressed in terms of absolute difference.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

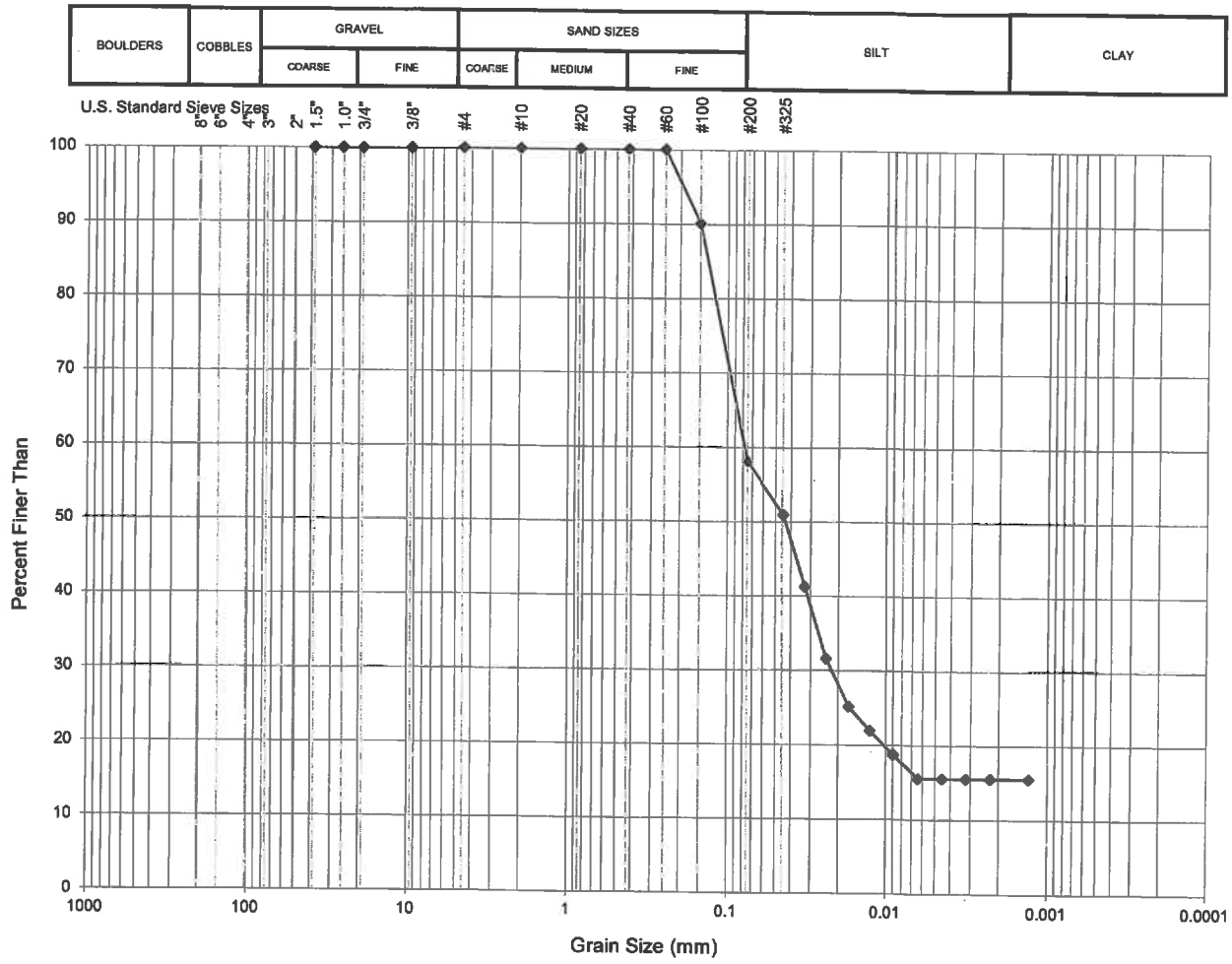
ALS Environmental

WATERLOO

PARTICLE SIZE DISTRIBUTION CURVE

ASTM METHOD D422-63

Project Name:	ECOSYSTEM RECOVERY INC
Project Number:	EP24780
Sample Location:	
Sample Number:	HAR U/S
Sample Depth:	
Lab ID Number:	L1660729-1
Technician:	MPBH
Sampler:	
Dates:	
Collected On:	8/20/2015
Analyzed:	9/3/2015



DESCRIPTION	SOIL CLASSIFICATION DESCRIPTIVE MODIFIERS		SUMMARY	
SAND AND SILT WITH CLAY	AND	36 - 50 %	GRAVEL	0 %
Sample is Silica	ADJECTIVE (e.g. sandy)	21 - 35 %	SAND	42 %
ESTIMATED HAZEN NUMBER: 1.29E-05 cm/s	WITH	11 - 20 %	SILT + CLAY	58 %
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM	TRACE	1 - 10 %		

GRAIN SIZE DETERMINATIONS

Project Name:	ECOSYSTEM RECOVERY INC	Sample Location:	
Project Number:	EP24780	Sample Number:	HAR U/S
Sampler:		Sample Depth:	
Technician:	MPBH	Date Sampled:	8/20/2015
Lab ID Number:	L1660729-1	Date Submitted:	8/20/2015
		Date Completed:	9/3/2015

Total Sample Weight	148 grams	Specific Gravity:	2.650
Hydro. Sample Weight	50.000 grams	Liquid Specific Gravity:	1.000
% Past #10	1.000 * 100	Grav Factor:	1.606
Sub Factor	2.960		

Sieve Size	Weight Retained (grams)	Percent Retained	Diameter (mm)	Cum. % Retained	Cum. % Passing
38.1 mm. DIA.:	0.000	0.000	38.100	0.000	100.000
25.4 mm. DIA.:	0.000	0.000	25.400	0.000	100.000
19.0 mm. DIA.:	0.000	0.000	19.000	0.000	100.000
9.5 mm. DIA.:	0.000	0.000	9.500	0.000	100.000
NO. 4 SIEVE :	0.000	0.000	4.500	0.000	100.000
NO. 10 SIEVE :	0.000	0.000	2.000	0.000	100.000
NO. 20 SIEVE :	0.000	0.000	0.850	0.000	100.000
NO. 40 SIEVE :	0.000	0.000	0.425	0.000	100.000
NO. 60 SIEVE :	0.000	0.000	0.250	0.000	100.000
NO. 100 SIEVE:	5.000	10.000	0.150	10.000	90.000
NO. 200 SIEVE:	16.000	32.000	0.075	42.000	58.000

Time (min)		Temperature (C)	Diameter (mm)	% Suspended (Subsample)	% Suspended (Total Sample)
1.00	18.0	23.7	0.044	50.821	50.821
2.00	15.0	23.7	0.032	41.184	41.184
4.00	12.0	23.7	0.024	31.548	31.548
8.00	10.0	23.7	0.017	25.124	25.124
15.00	9.0	23.7	0.013	21.911	21.911
30.00	8.0	23.7	0.009	18.699	18.699
60.00	7.0	23.7	0.006	15.487	15.487
120.00	7.0	23.7	0.005	15.487	15.487
240.00	7.0	23.7	0.003	15.487	15.487
480.00	7.0	23.7	0.002	15.487	15.487
1440.00	7.0	23.7	0.001	15.487	15.487

GRAIN SIZE	% BY WT.	DIA. RANGE (mm)
% GRAVEL :	0.00	> 4.5
% COARSE SAND :	0.00	2.0 - 4.5
% MEDIUM SAND :	0.00	0.425 - 2.0
% FINE SAND :	42.00	0.075 - 0.425
% SILT :	42.51	0.075 - 0.002
% CLAY :	15.49	< 0.002
% CLAY :	15.49	< 0.005

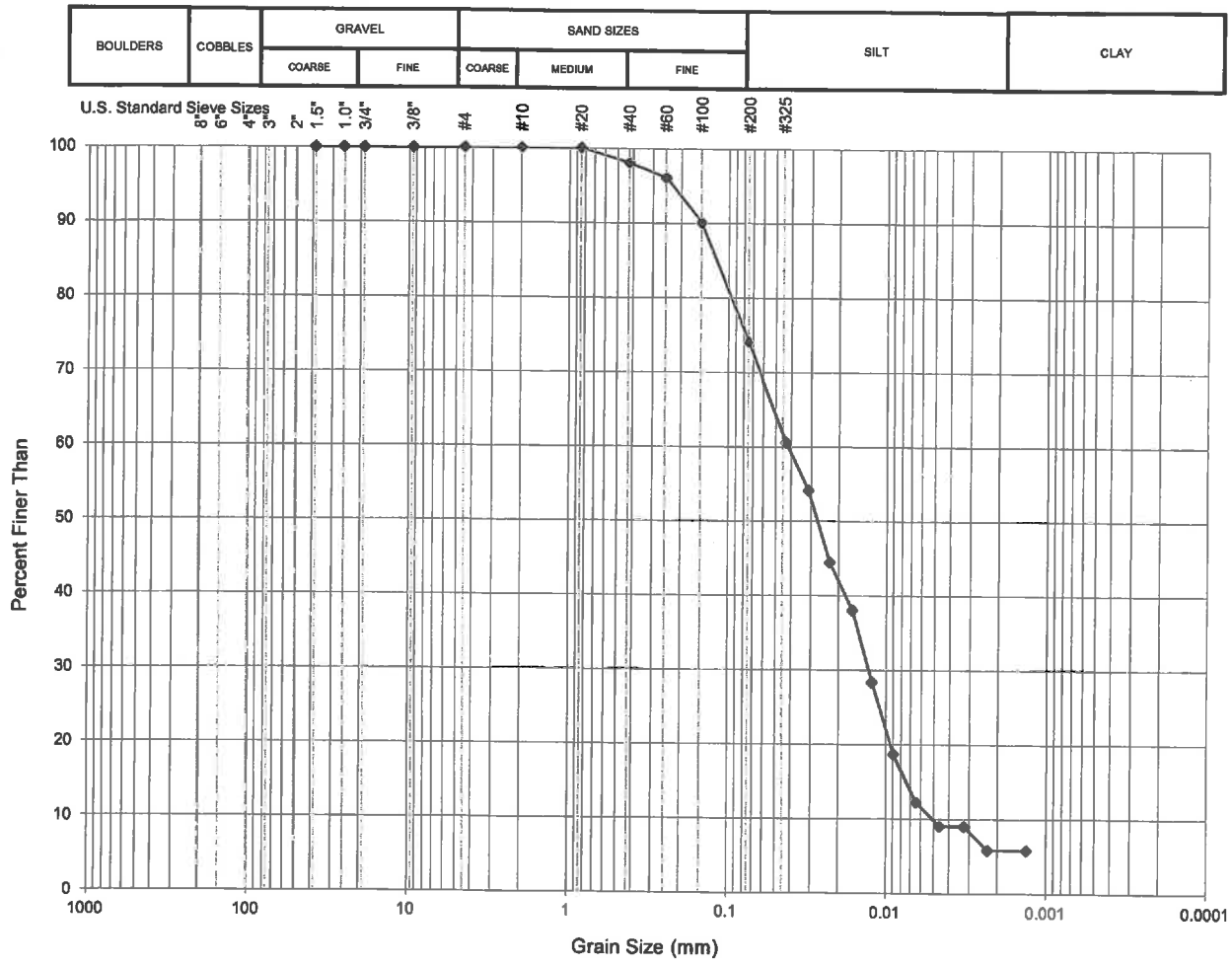
ALS Environmental

WATERLOO

PARTICLE SIZE DISTRIBUTION CURVE

ASTM METHOD D422-63

Project Name:	ECOSYSTEM RECOVERY INC
Project Number:	EP24780
Sample Location:	
Sample Number:	HAR D/S
Sample Depth:	
Lab ID Number:	L1660729-2
Technician:	MPBH
Sampler:	
Dates:	
Collected On:	8/20/2015
Analyzed:	9/3/2015



DESCRIPTION	SOIL CLASSIFICATION DESCRIPTIVE MODIFIERS		SUMMARY	
SANDY SILT, TRACE CLAY	AND	36 - 50 %	GRAVEL	0 %
	ADJECTIVE (e.g. sandy)	21 - 35 %	SAND	26 %
ESTIMATED HAZEN NUMBER: 2.58E-05 cm/s	WITH	11 - 20 %	SILT + CLAY	74 %
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM	TRACE	1 - 10 %		

GRAIN SIZE DETERMINATIONS

Project Name:	ECOSYSTEM RECOVERY INC	Sample Location:	
Project Number:	EP24780	Sample Number:	HAR D/S
Sampler:		Sample Depth:	
Technician:	MPBH	Date Sampled:	8/20/2015
Lab ID Number:	L1660729-2	Date Submitted:	8/20/2015
		Date Completed:	9/3/2015

Total Sample Weight	112 grams	Specific Gravity:	2.650
Hydro. Sample Weight	50.000 grams	Liquid Specific Gravity:	1.000
% Past #10	1.000 * 100	Grav Factor:	1.606
Sub Factor	2.240		

Sieve Size	Weight Retained (grams)	Percent Retained	Diameter (mm)	Cum. % Retained	Cum. % Passing
38.1 mm. DIA.:	0.000	0.000	38.100	0.000	100.000
25.4 mm. DIA.:	0.000	0.000	25.400	0.000	100.000
19.0 mm. DIA.:	0.000	0.000	19.000	0.000	100.000
9.5 mm. DIA.:	0.000	0.000	9.500	0.000	100.000
NO. 4 SIEVE :	0.000	0.000	4.500	0.000	100.000
NO. 10 SIEVE :	0.000	0.000	2.000	0.000	100.000
NO. 20 SIEVE :	0.000	0.000	0.850	0.000	100.000
NO. 40 SIEVE :	1.000	2.000	0.425	2.000	98.000
NO. 60 SIEVE :	1.000	2.000	0.250	4.000	96.000
NO. 100 SIEVE:	3.000	6.000	0.150	10.000	90.000
NO. 200 SIEVE:	8.000	16.000	0.075	26.000	74.000

Time (min)		Temperature (C)	Diameter (mm)	% Suspended (Subsample)	% Suspended (Total Sample)
1.00	21.0	23.7	0.043	60.457	60.457
2.00	19.0	23.7	0.031	54.033	54.033
4.00	16.0	23.7	0.023	44.396	44.396
8.00	14.0	23.7	0.016	37.972	37.972
15.00	11.0	23.7	0.012	28.336	28.336
30.00	8.0	23.7	0.009	18.699	18.699
60.00	6.0	23.7	0.006	12.275	12.275
120.00	5.0	23.7	0.005	9.063	9.063
240.00	5.0	23.7	0.003	9.063	9.063
480.00	4.0	23.7	0.002	5.851	5.851
1440.00	4.0	23.7	0.001	5.851	5.851

GRAIN SIZE	% BY WT.	DIA. RANGE (mm)
% GRAVEL :	0.00	> 4.5
% COARSE SAND :	0.00	2.0 - 4.5
% MEDIUM SAND :	2.00	0.425 - 2.0
% FINE SAND :	24.00	0.075 - 0.425
% SILT :	68.15	0.075 - 0.002
% CLAY :	5.85	< 0.002
% CLAY :	9.84	< 0.005

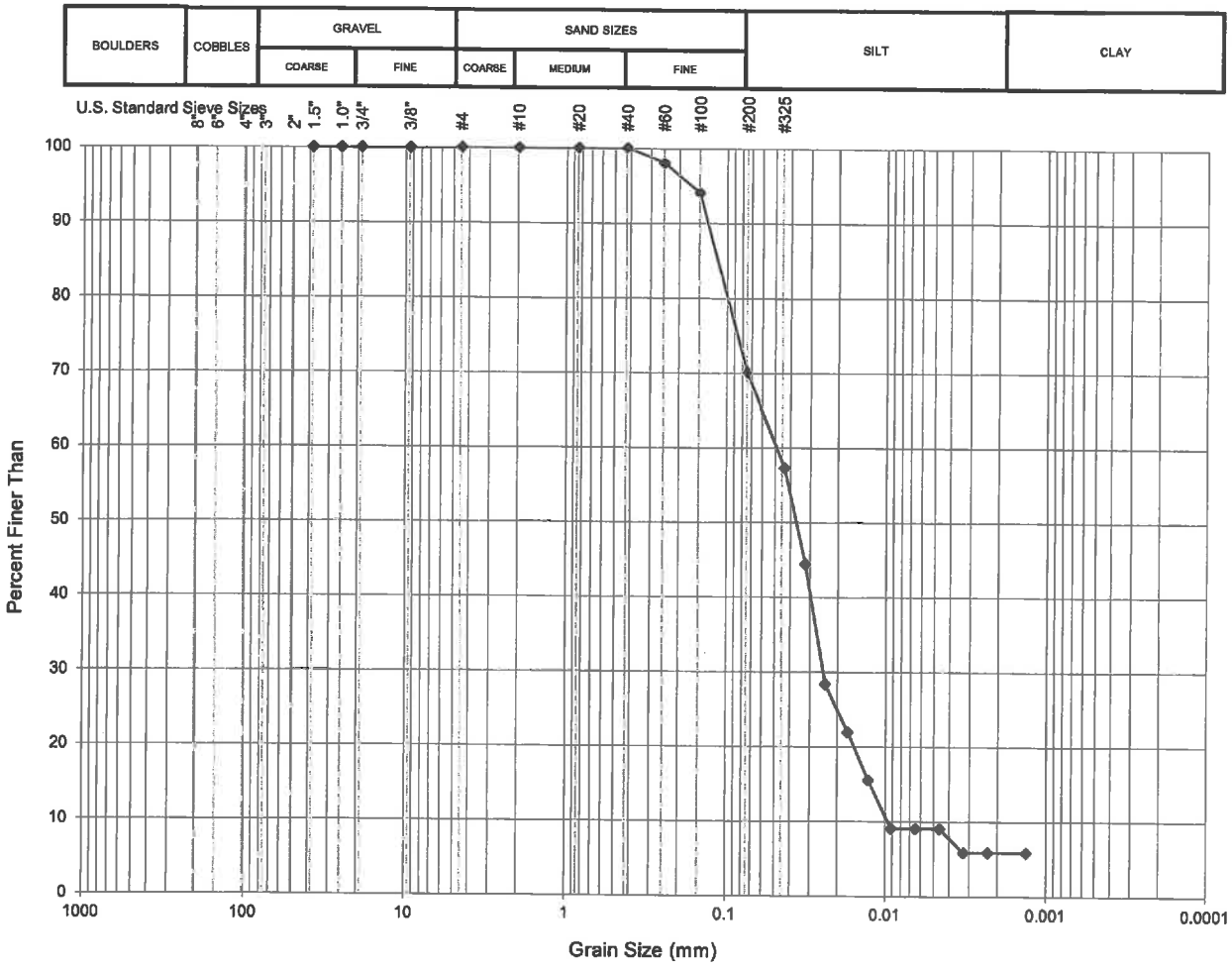
ALS Environmental

WATERLOO

PARTICLE SIZE DISTRIBUTION CURVE

ASTM METHOD D422-63

Project Name:	ECOSYSTEM RECOVERY INC
Project Number:	EP24780
Sample Location:	
Sample Number:	EMB U/S
Sample Depth:	
Lab ID Number:	L1660729-3
Technician:	MPBH
Sampler:	
Dates:	
Collected On:	8/20/2015
Analyzed:	9/3/2015



DESCRIPTION	SOIL CLASSIFICATION DESCRIPTIVE MODIFIERS		SUMMARY	
SANDY SILT, TRACE CLAY	AND	36 - 50 %	GRAVEL	0 %
	ADJECTIVE (e.g. sandy)	21 - 35 %	SAND	30 %
ESTIMATED HAZEN NUMBER: 9.35E-05 cm/s	WITH	11 - 20 %	SILT + CLAY	70 %
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM	TRACE	1 - 10 %		

GRAIN SIZE DETERMINATIONS

Project Name:	ECOSYSTEM RECOVERY INC	Sample Location:	
Project Number:	EP24780	Sample Number:	EMB U/S
Sampler:		Sample Depth:	
Technician:	MPBH	Date Sampled:	8/20/2015
Lab ID Number:	L1660729-3	Date Submitted:	8/20/2015
		Date Completed:	9/3/2015

Total Sample Weight	159 grams	Specific Gravity:	2.650
Hydro. Sample Weight	50.000 grams	Liquid Specific Gravity:	1.000
% Past #10	1.000 * 100	Grav Factor:	1.606
Sub Factor	3.180		

Sieve Size	Weight Retained (grams)	Percent Retained	Diameter (mm)	Cum. % Retained	Cum. % Passing
38.1 mm. DIA.:	0.000	0.000	38.100	0.000	100.000
25.4 mm. DIA.:	0.000	0.000	25.400	0.000	100.000
19.0 mm. DIA.:	0.000	0.000	19.000	0.000	100.000
9.5 mm. DIA.:	0.000	0.000	9.500	0.000	100.000
NO. 4 SIEVE :	0.000	0.000	4.500	0.000	100.000
NO. 10 SIEVE :	0.000	0.000	2.000	0.000	100.000
NO. 20 SIEVE :	0.000	0.000	0.850	0.000	100.000
NO. 40 SIEVE :	0.000	0.000	0.425	0.000	100.000
NO. 60 SIEVE :	1.000	2.000	0.250	2.000	98.000
NO. 100 SIEVE:	2.000	4.000	0.150	6.000	94.000
NO. 200 SIEVE:	12.000	24.000	0.075	30.000	70.000

Time (min)		Temperature (C)	Diameter (mm)	% Suspended (Subsample)	% Suspended (Total Sample)
1.00	20.0	23.7	0.043	57.245	57.245
2.00	16.0	23.7	0.032	44.396	44.396
4.00	11.0	23.7	0.024	28.336	28.336
8.00	9.0	23.7	0.017	21.911	21.911
15.00	7.0	23.7	0.013	15.487	15.487
30.00	5.0	23.7	0.009	9.063	9.063
60.00	5.0	23.7	0.007	9.063	9.063
120.00	5.0	23.7	0.005	9.063	9.063
240.00	4.0	23.7	0.003	5.851	5.851
480.00	4.0	23.7	0.002	5.851	5.851
1440.00	4.0	23.7	0.001	5.851	5.851

GRAIN SIZE	% BY WT.	DIA. RANGE (mm)
% GRAVEL :	0.00	> 4.5
% COARSE SAND :	0.00	2.0 - 4.5
% MEDIUM SAND :	0.00	0.425 - 2.0
% FINE SAND :	30.00	0.075 - 0.425
% SILT :	64.15	0.075 - 0.002
% CLAY :	5.85	< 0.002
% CLAY :	9.06	< 0.005

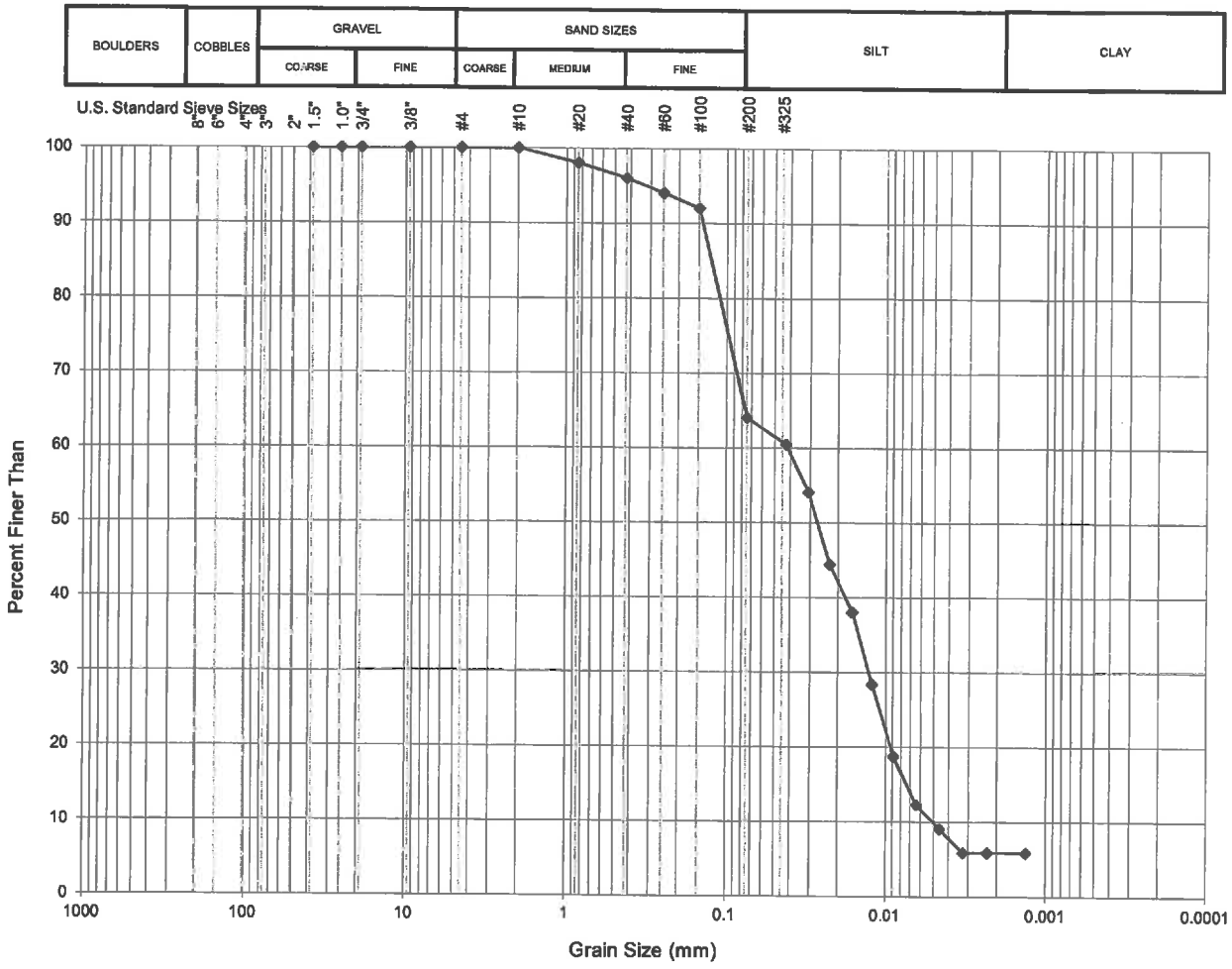
ALS Environmental

WATERLOO

PARTICLE SIZE DISTRIBUTION CURVE

ASTM METHOD D422-63

Project Name:	ECOSYSTEM RECOVERY INC
Project Number:	EP24780
Sample Location:	
Sample Number:	EMB D/S
Sample Depth:	
Lab ID Number:	L1660729-4
Technician:	MPBH
Sampler:	
Dates:	
Collected On:	8/20/2015
Analyzed:	9/3/2015



DESCRIPTION	SOIL CLASSIFICATION DESCRIPTIVE MODIFIERS		SUMMARY	
SILT AND CLAY, TRACE CLAY	AND	36 - 50 %	GRAVEL	0 %
	ADJECTIVE (e.g. sandy)	21 - 35 %	SAND	36 %
ESTIMATED HAZEN NUMBER: 2.58E-05 cm/s	WITH	11 - 20 %	SILT + CLAY	64 %
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM	TRACE	1 - 10 %		

GRAIN SIZE DETERMINATIONS

Project Name:	ECOSYSTEM RECOVERY INC	Sample Location:	
Project Number:	EP24780	Sample Number:	EMB D/S
Sampler:		Sample Depth:	
Technician:	MPBH	Date Sampled:	8/20/2015
Lab ID Number:	L1660729-4	Date Submitted:	8/20/2015
		Date Completed:	9/3/2015

Total Sample Weight	173 grams	Specific Gravity:	2.650
Hydro. Sample Weight	50.000 grams	Liquid Specific Gravity:	1.000
% Past #10	1.000 * 100	Grav Factor:	1.606
Sub Factor	3.460		

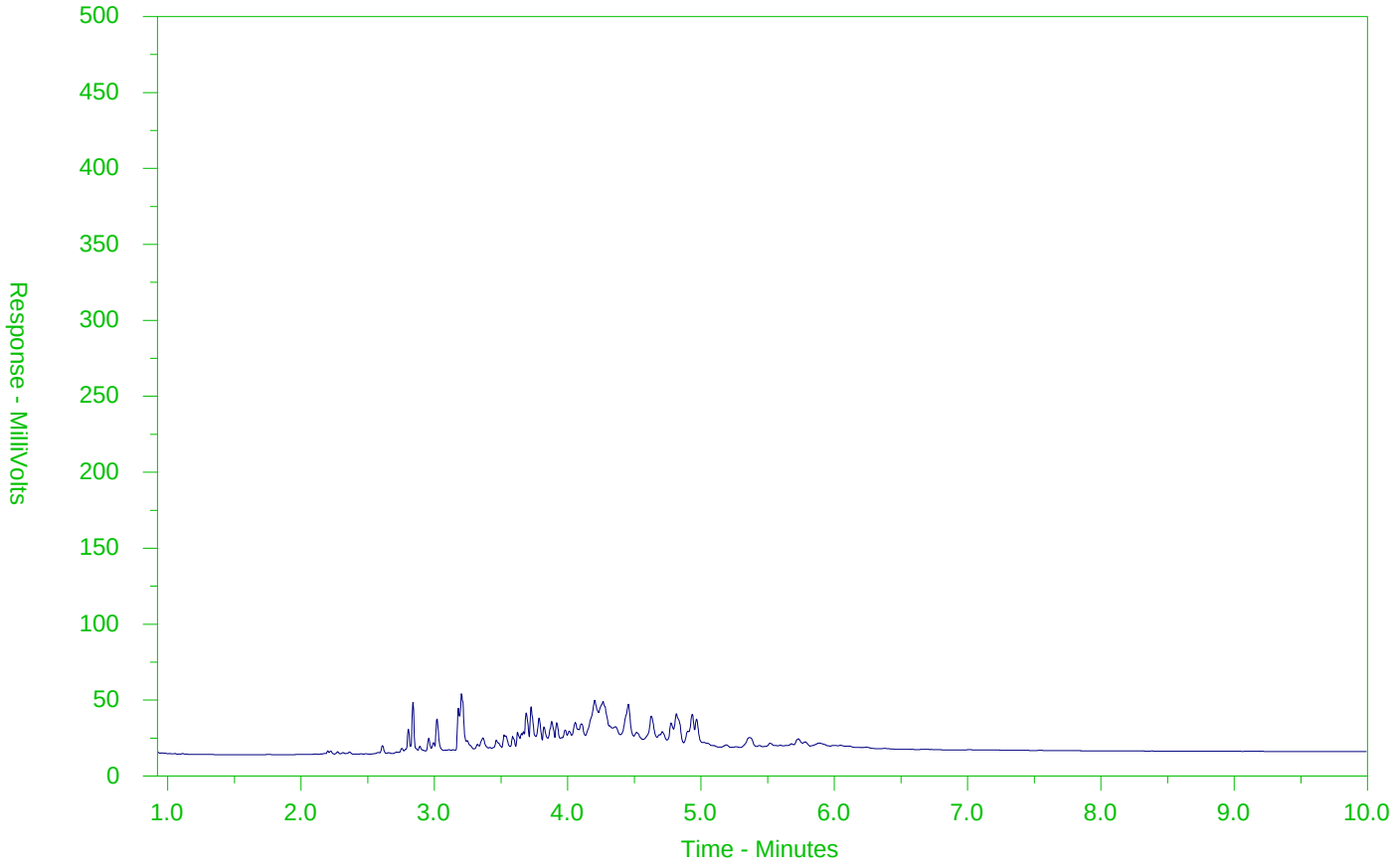
Sieve Size	Weight Retained (grams)	Percent Retained	Diameter (mm)	Cum. % Retained	Cum. % Passing
38.1 mm. DIA.:	0.000	0.000	38.100	0.000	100.000
25.4 mm. DIA.:	0.000	0.000	25.400	0.000	100.000
19.0 mm. DIA.:	0.000	0.000	19.000	0.000	100.000
9.5 mm. DIA.:	0.000	0.000	9.500	0.000	100.000
NO. 4 SIEVE :	0.000	0.000	4.500	0.000	100.000
NO. 10 SIEVE :	0.000	0.000	2.000	0.000	100.000
NO. 20 SIEVE :	1.000	2.000	0.850	2.000	98.000
NO. 40 SIEVE :	1.000	2.000	0.425	4.000	96.000
NO. 60 SIEVE :	1.000	2.000	0.250	6.000	94.000
NO. 100 SIEVE:	1.000	2.000	0.150	8.000	92.000
NO. 200 SIEVE:	14.000	28.000	0.075	36.000	64.000

Time (min)		Temperature (C)	Diameter (mm)	% Suspended (Subsample)	% Suspended (Total Sample)
1.00	21.0	23.7	0.043	60.457	60.457
2.00	19.0	23.7	0.031	54.033	54.033
4.00	16.0	23.7	0.023	44.396	44.396
8.00	14.0	23.7	0.016	37.972	37.972
15.00	11.0	23.7	0.012	28.336	28.336
30.00	8.0	23.7	0.009	18.699	18.699
60.00	6.0	23.7	0.006	12.275	12.275
120.00	5.0	23.7	0.005	9.063	9.063
240.00	4.0	23.7	0.003	5.851	5.851
480.00	4.0	23.7	0.002	5.851	5.851
1440.00	4.0	23.7	0.001	5.851	5.851

GRAIN SIZE	% BY WT.	DIA. RANGE (mm)
% GRAVEL :	0.00	> 4.5
% COARSE SAND :	0.00	2.0 - 4.5
% MEDIUM SAND :	4.00	0.425 - 2.0
% FINE SAND :	32.00	0.075 - 0.425
% SILT :	58.15	0.075 - 0.002
% CLAY :	5.85	< 0.002
% CLAY :	9.84	< 0.005

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L1660729-1
Client Sample ID: HAR U/S



← F2 →	← F3 →	← F4 →	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	75°C
346°F	549°F	898°F	1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

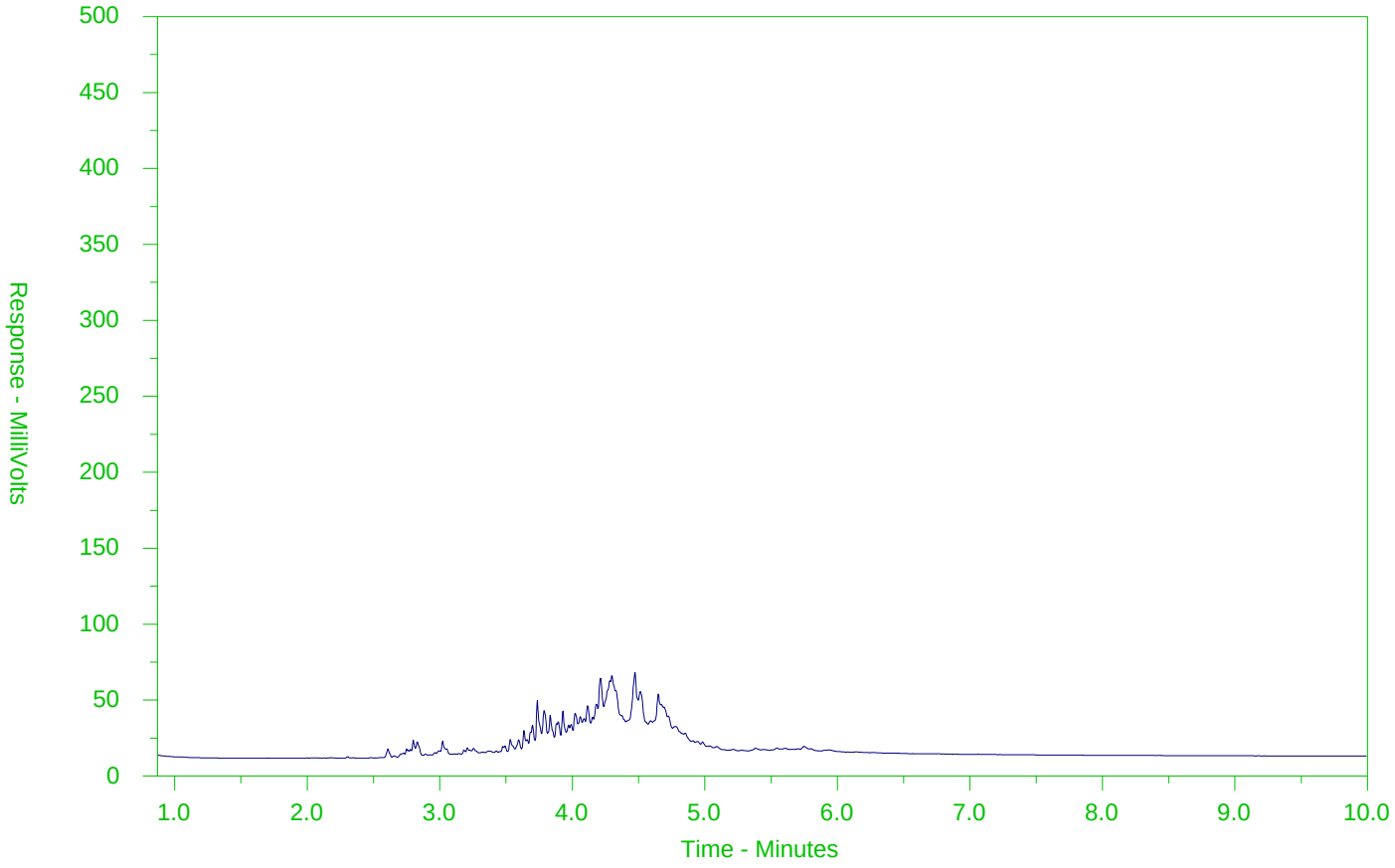
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L1660729-2
Client Sample ID: HAR D/S



← F2 →	← F3 →	← F4 →	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	75°C
346°F	549°F	898°F	1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

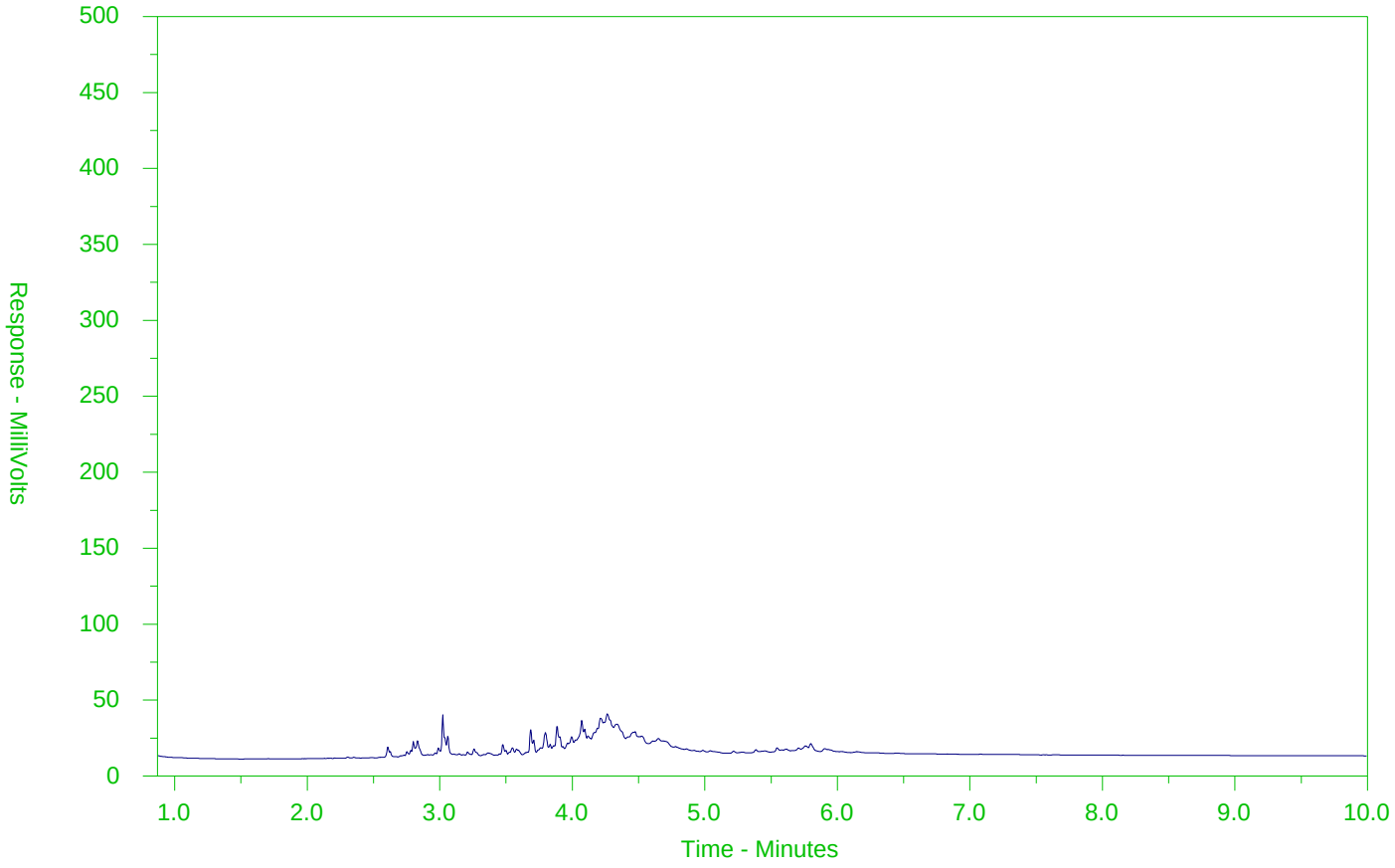
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L1660729-3
Client Sample ID: EMB U/S



← F2 →	← F3 →	← F4 →	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	75°C
346°F	549°F	898°F	1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

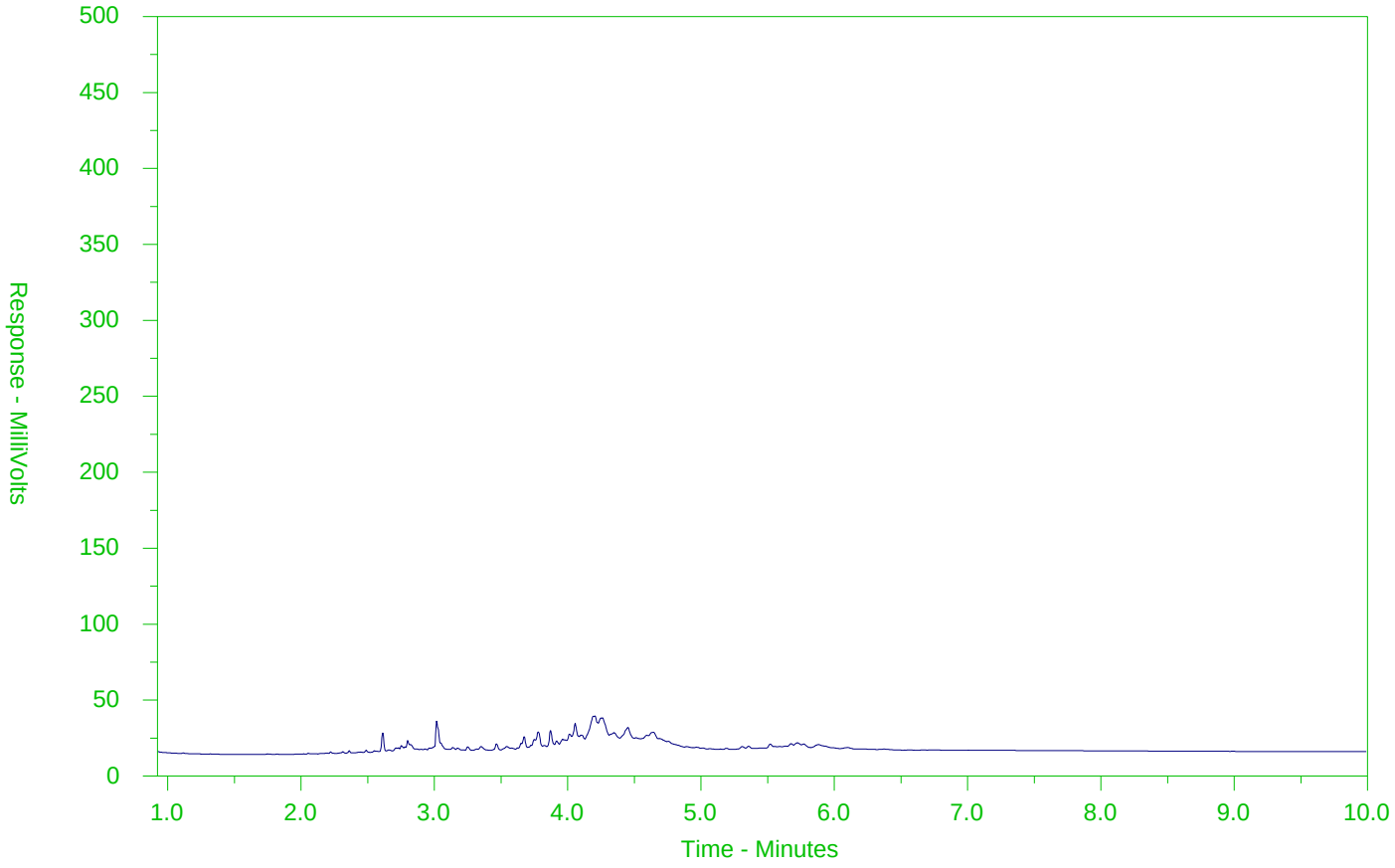
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L1660729-4
Client Sample ID: EMB D/S



← F2 →	← F3 →	← F4 →	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	75°C
346°F	549°F	898°F	1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L1660729-COFC

COC Number: 14 -

Page ____ of ____

Report To		Report Format / Distribution		Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	Ecosystem Recovery (cash client)	Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	David Arseneau	Quality Control (QC) Report with Report	☑ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	1023 Rife Road, Unit A Cambridge, ON N1R 5S3	☐ Criteria on Report - provide details below if box checked		E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
		Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:		Email 1 or Fax	david.arseneau@ecosystemrecovery.ca	Specify Date Required for E2,E or P:
		Email 2		

Invoice To	Same as Report To ☑ Yes ☐ No	Invoice Distribution		Analysis Request
	Copy of Invoice with Report ☐ Yes ☐ No	Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:		Email 1 or Fax	david.arseneau@ecosystemrecovery.ca	
Contact:		Email 2		

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q48358	Approver ID:	Cost Center:
Job #:		GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:	Aug-20	Location:	

ALS Lab Work Order # (lab use only)	L1660729	ALS Contact:	Sampler:

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	GRAIN SIZE-WT	PAH-511-WT	PEST-OC-511-P-WT	R511-INORGANICS-P-WT	VOC-R511,F1-F4-P-WT		INORGANICS-TCLP-P-WT						Number of Containers
1	HAR U/S	20-08-15	11:15	Soil	R	R	R	R	R								5
2	HAR D/S	20-AUG-15	11:00	Soil	R	R	R	R	R								5
3	EMB U/S	20-AUG-15	12:40	Soil	R	R	R	R	R								5
4	EMB D/S	20-AUG-15	12:20	Soil	R	R	R	R	R								5
5	HAR U/S	20-AUG-15	11:15	Waste							R						2
6	HAR D/S	20-AUG-15	11:00	Waste							R						2
7	EMB U/S	20-AUG-15	12:40	Waste							R						2
8	EMB D/S	20-AUG-15	12:20	Waste							R						2

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? ☐ Yes ☑ No	
Are samples for human drinking water use? ☐ Yes ☑ No	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice packs ☐ Yes ☒ No ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
			6		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date: 20AUG15	Time: 2:40	Received by:	Date:	Time:	Received by:	Date: 20/8/15	Time: 14:40

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Public Consultation Index

Notice of Intent
Agency & Stakeholder Contact List

Public Information Centre #1

Notice of Intent and First Public Information Centre	June 10, 2015
PIC Materials (Presentation and Boards)	June 23, 2015
Blank Comment Form	June 23, 2015
Sign Up Sheet	June 23, 2015
Completed Comment Forms	June 23, 2015

Public Information Centre #2

Notice of Second Public Information Centre	April 22, 2016
PIC Materials (Presentation and Boards)	May 10, 2016
PIC Meeting Minutes	May 10, 2016
Blank Comment Form	May 26, 2016
Sign Up Sheet	May 10, 2016
Completed Comment Forms	May 10, 2016 to October 16, 2016

Public Information Centre #3

Notice of Third Public Information Centre	October 06, 2016
PIC Materials (Presentation and Boards)	October 17, 2016
PIC Meeting Minutes	October 17, 2016
Blank Comment Form	October 18, 2016
Sign Up Sheet	October 17, 2016
Completed Comment Forms	October 17, 2016 to January 18, 2017

Upper Thames River Conservation Authority

Embro Dam
Class Environmental Assessment

NOTICE OF INTENT

Upper Thames River Conservation Authority (UTRCA), through their consultant Ecosystem Recovery Inc., is undertaking a Class Environmental Assessment for the Embro Dam in the Township of Zorra. The map below shows the location of the study area.

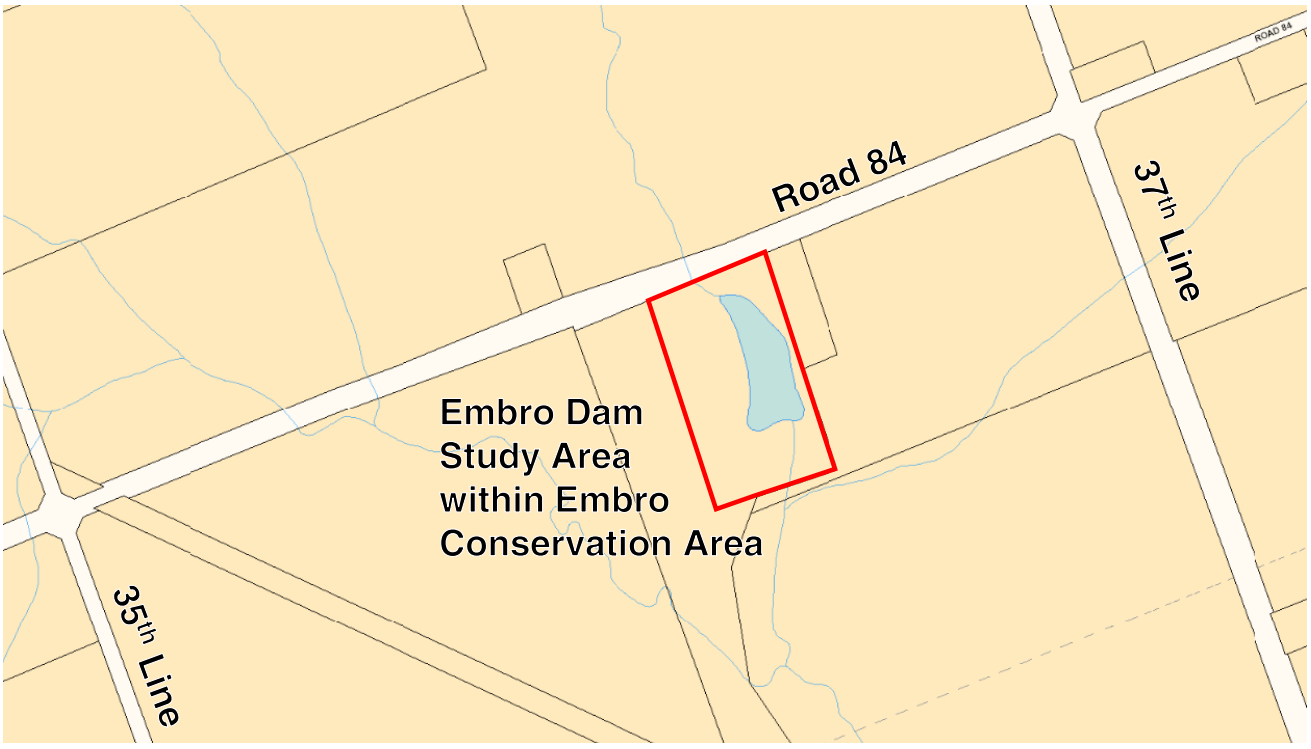
The UTRCA commissioned a Dam Safety Review (DSR) of the Embro Dam which was completed in 2007. The DSR identified issues with the spillway capacity and embankment stability of the dam. This Class EA study was initiated to assess the existing site conditions and constraints, and to develop potential alternatives to address the identified issues at the dam.

The project will be carried out under the *Conservation Ontario Class Environmental Assessment for Remedial Flood and Erosion Control Works* document.

The Project Team invites public input and comments, and will incorporate them into the planning and design of this project. The public will be notified in advance of a Public Information Centre that will be held to present information on the project and receive public feedback. To submit comments, request further information, or to join the project mailing list, please contact:

Mr. Rick Goldt, C.E.T.
Supervisor, Water Control Structures
Upper Thames River Conservation Authority
1424 Clarke Road
London, Ontario, N5V 5B9
Tel: 519-451-2800 ext. 244
Fax: 519-451-1188
goldtr@thamesriver.on.ca

Mr. Wolfgang Wolter
Senior Project Manager
Ecosystem Recovery Inc.
550 Parkside Drive, Unit B1
Waterloo, Ontario, N2L 5V4
Tel: 519-621-1500
Fax: 226-240-1080
wolfgang.wolter@ecosystemrecovery.ca



HARRINGTON AND EMBRO DAMS CLASS EA
AGENCY & STAKEHOLDER CONTACT LIST

A.	**PROVINCIAL**					
	AGENCY NAME	CONTACT PERSON	NOTICE SENT	RESPONSE (Y/N)	FOLLOW UP (Y/N)	COMMENT?
1	UTRCA Land Use Regulations 1424 Clarke Road London, Ontario, N5V 5B9 Tel: 519.451.2800 Ext. 237 Fax: 519.451.1188 winfieldk@thamesriver.on.ca	Karen Winfield Land Use Regulations Officer				
2	Conservation Ontario 120 Bayview Parkway Newmarket, Ontario L3Y 4W3 905-895-0716	TBD	Jun-15			
3	Ministry of the Environment London Regional and District Offices 733 Exeter Rd London ON N6E 1L3 Tel: 519-873-5000 Fax: 519-873-5020	TBD EA Planning Coordinator	Jun-15			
4	Ministry of the Environment Environmental Assessment and Approvals Branch EAABGen@ontario.ca	*only Notice of Commencement and Completion via email				
5	Ministry of Natural Resources and Forestry Aylmer - District Office 615 John St N Aylmer ON N5H 2S8 Tel: 519-773-9241	TBD District Planner	Jun-15			
6	Ministry of Tourism, Culture & Sport 401 Bay Street 17th Floor Toronto, ON M7A 0A7	Heritage Planner	Jun-15	17-Jul-15		Please send presentation from PIC 1
B.	**FEDERAL**					
	AGENCY NAME	CONTACT PERSON	NOTICE SENT	RESPONSE (Y/N)	FOLLOW UP (Y/N)	COMMENT?
1	Central and Arctic Region Fisheries and Oceans Canada 520 Exmouth Street Sarnia, ON, N1G 4Y2	Regional Manager	Jun-15			
C.	**MUNICIPALITIES**					
	AGENCY NAME	CONTACT PERSON	NOTICE SENT	RESPONSE (Y/N)	FOLLOW UP (Y/N)	COMMENT?
1	Township of Zorra Phone: 519-485-2490 Ext 226 Fax: 519-485-2520 dmacleod@zorra.on.ca	Don MacLeod Chief Administrative Officer				
D.	**UTILITIES**					
	AGENCY NAME	CONTACT PERSON	NOTICE SENT	RESPONSE (Y/N)	FOLLOW UP (Y/N)	COMMENT?
1	Need to identify utilities that may be impacted at each project site	TBD				
E.	**FIRST NATIONS/ABORIGINAL (Provisional)**					
	AGENCY NAME	CONTACT PERSON	NOTICE SENT	RESPONSE (Y/N)	FOLLOW UP (Y/N)	COMMENT?
1	Ministry of Aboriginal Affairs 160 Bloor Street East, 9th Floor Toronto, ON, M7A 2E6	Ms. Heather Levesque Manager, Consultation Unit	Jun-15	27-Jul-15		First Natons in the project area: Six Nations of Grand River, Oneida Nation of the Thames, Chippewas of the Thames, Haudenosaunee Confederacy, Munsee-Delaware Nation
2	AANDC 25 St. Clair Avenue East, 8th Floor Toronto, ON, M4T 1M2	Environment Unit Re: EA Coordination	Jun-15			
3	Oneida Nation of the Thames 2212 Elm Avenue SOUTHWOLD, Ontario NOL 2GO (519) 652-3244 (Fax) 652-2930 Sheri.Doxtator@oneida.on.ca	Chief Sheri Doxtator	Jun-15			
4	Chippewas of the Thames 320 Chippewa Road, RR#1 Muncey Ontario, Canada phone: 519-289-5555	TBD	Jun-15			

	Fax: 519-289-2230 email: info@cottfn.com					
5	Caldwell First Nation Box 338 14 Orange Street Leamington, Ontario, N8H 1P5 phone: 519-322-1766 fax: 519-322-1533 email: cfnchief@live.com	Chief Louise Hillier	Jun-15			
F.	**COMMUNITY GROUPS / NGO'S**					
	AGENCY NAME	CONTACT PERSON	NOTICE SENT	RESPONSE (Y/N)	FOLLOW UP (Y/N)	COMMENT?
1	Embro Pond Association PO BOX 348 Embro, Ontario N0J 1J0 email: embropond@hotmail.com	TBD	Jun-15			
2	Harrington and Area Community Association 539 Victoria St S Harrington, ON N0J 1J0 phone: 519-475-4097	Doug Diplock, Chair Philip Kerr, Vice-Chair	Jun-15			
3	Thames River Anglers Thames River Anglers Association 2202 Coronation Drive London, Ontario, N6G 0B9 email: traa@anglers.org	TBD	Jun-15			
4	Trout Unlimited Unit #1, 27 Woodlawn Road West Guelph, ON, N1H 1G8 phone: (519) 763-0888	Stacey Stevens Ontario Office Coordinator	Jun-15			
5	Ontario Nature 214 King Street West, Suite 612 Toronto, ON M5H 3S6 Tel: 416-444-8419 Fax: 416-444-9866 E-mail: info@ontarionature.org	TBD	Jun-15			
6	Ontario Federation of Anglers and Hunters 4601 Guthrie Drive, PO Box 2800 Peterborough, ON, K9J 8L5 Phone: 705-748-OFAH (6324) Fax: 705-748-9577 Email: ofah@ofah.org	TBD	Jun-15			
7	Ducks Unlimited Canada 740 Huronia Road, Unit 1 Barrie, ON L4N 6C6 Tel: 705-721-4444 Fax: 705-721-4999 Email: du_barrie@ducks.ca	TBD	Jun-15			
8	Woodstock Field Naturalist's Club P.O. Box 20037 RPO Woodstock Centre Woodstock, ON, N4S 8X8 Email: WoodstockFNC@gmail.com	Roger Boyd President	Jun-15			
9	Oxford County Trails Council Email: oxfordtrails@gmail.com	TBD				
10	Stratford Field Naturalists c/o Sharon McKay P.O. Box 21113 RPO Stratford, ON N5A 7V4 Email: naturestratford@gmail.com	Marilyn Ohler, President	Jun-15			
11	Tavistock and District Rod & Gun Club Box #1 R.R. #3, Embro, ON, N0J1J0 Tel: 519-275-1867 E-mail: tdrgc@outlook.com Site: www.tdrgc.com	Tim Segeren, 2015 Club President				

Appendix J

Agency and Public Correspondence

Public Consultation Index

Notice of Intent
Agency & Stakeholder Contact List

Public Information Centre #1

Notice of Intent and First Public Information Centre	June 10, 2015
PIC Materials (Presentation and Boards)	June 23, 2015
Blank Comment Form	June 23, 2015
Sign Up Sheet	June 23, 2015
Completed Comment Forms	June 23, 2015

Public Information Centre #2

Notice of Second Public Information Centre	April 22, 2016
PIC Materials (Presentation and Boards)	May 10, 2016
PIC Meeting Minutes	May 10, 2016
Blank Comment Form	May 26, 2016
Sign Up Sheet	May 10, 2016
Completed Comment Forms	May 10, 2016 to October 16, 2016

Public Information Centre #3

Notice of Third Public Information Centre	October 06, 2016
PIC Materials (Presentation and Boards)	October 17, 2016
PIC Meeting Minutes	October 17, 2016
Blank Comment Form	October 18, 2016
Sign Up Sheet	October 17, 2016
Completed Comment Forms	October 17, 2016 to January 18, 2017

Upper Thames River Conservation Authority

Embro Dam
Class Environmental Assessment

NOTICE OF INTENT AND FIRST PUBLIC INFORMATION CENTRE

THE STUDY

Upper Thames River Conservation Authority (UTRCA), through their consultant Ecosystem Recovery Inc., is undertaking a Class Environmental Assessment (Class EA) for the Embro Dam in the Township of Zorra. The map on the reverse of this page shows the location of the study area.

The UTRCA commissioned a Dam Safety Review (DSR) of the Embro Dam which was completed in 2007. The DSR identified issues with the spillway capacity and embankment stability of the dam. This Class EA study was initiated to assess the existing site conditions and constraints, and to develop potential alternatives to address the identified issues at the dam.

The project will be carried out under the *Conservation Ontario Class Environmental Assessment for Remedial Flood and Erosion Control Works* document.

WE WANT TO HEAR FROM YOU

Public consultation is a key component of this study. The Project Team invites public input and comments, and will incorporate them into the planning and design of this project. Three public information centres are proposed for this Class EA: June 2015 to provide an overview of the study and Class EA process; September 2015 to review alternative solutions and evaluation criteria; and November 2015 to present the preferred alternative for the Embro Dam. The first public information centre will take place at the following time and location:

Date:	**June 23rd, 2015**
Time:	**7:00 p.m. to 9:00 p.m.**
Place:	**Embro Zorra Community Centre** **355644 35th Line** **Embro, Ontario**

An overview presentation will be held at 7:00 p.m. followed by questions and discussion.

STUDY CONTACTS

To submit comments, request further information, or to join the project mailing list, please send an email to the project email address:

embro_dam@thamesriver.on.ca

Contact information for the project team leaders is listed below:

Mr. Rick Goldt, C.E.T.
Supervisor, Water Control Structures
Upper Thames River Conservation Authority
1424 Clarke Road
London, Ontario, N5V 5B9
Tel: 519-451-2800 ext. 244
Fax: 519-451-1188
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Senior Project Manager
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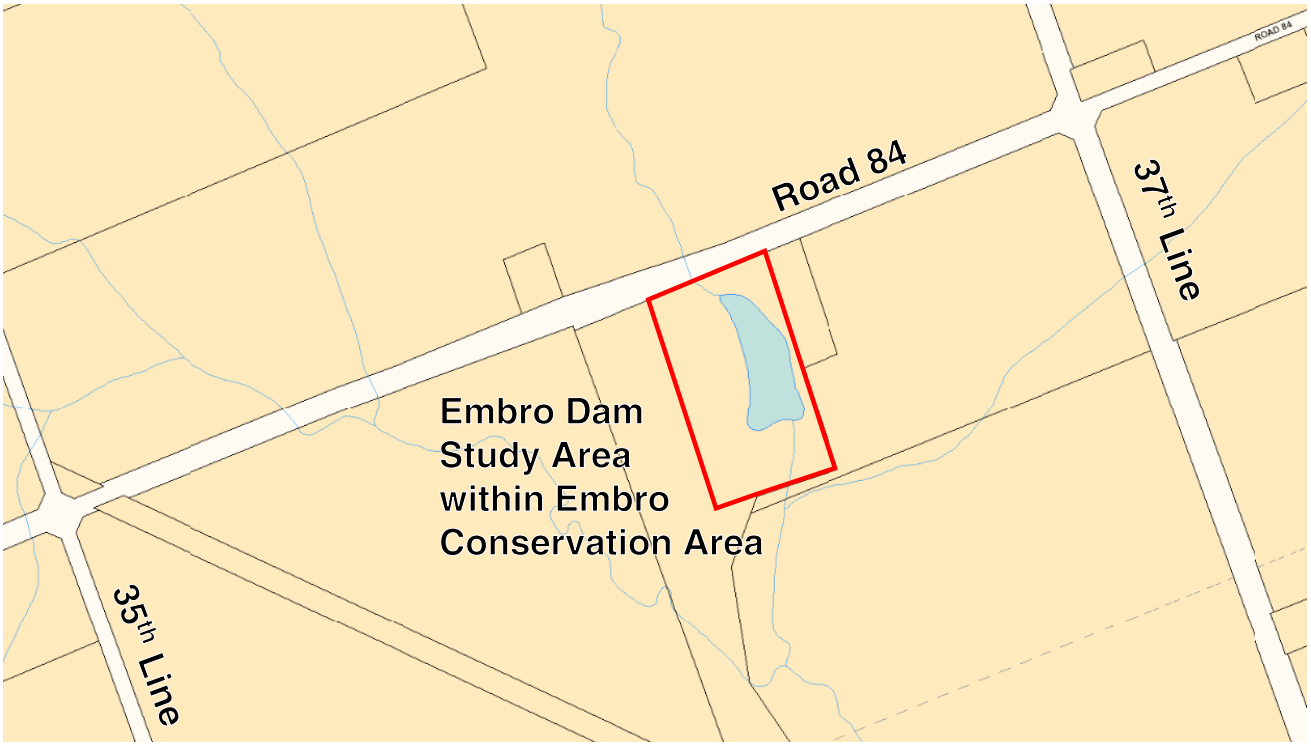

Road 84
37th Line
35th Line
Embro Dam
Study Area
within Embro
Conservation Area

Public Information Centre #1
PIC Presentation Slides

Embro Dam
Class Environmental Assessment

Public Information Centre #1

Upper Thames River Conservation Authority
Embro Zorra Community Centre
June 23rd, 2015 7:00 p.m. to 9:00 p.m.

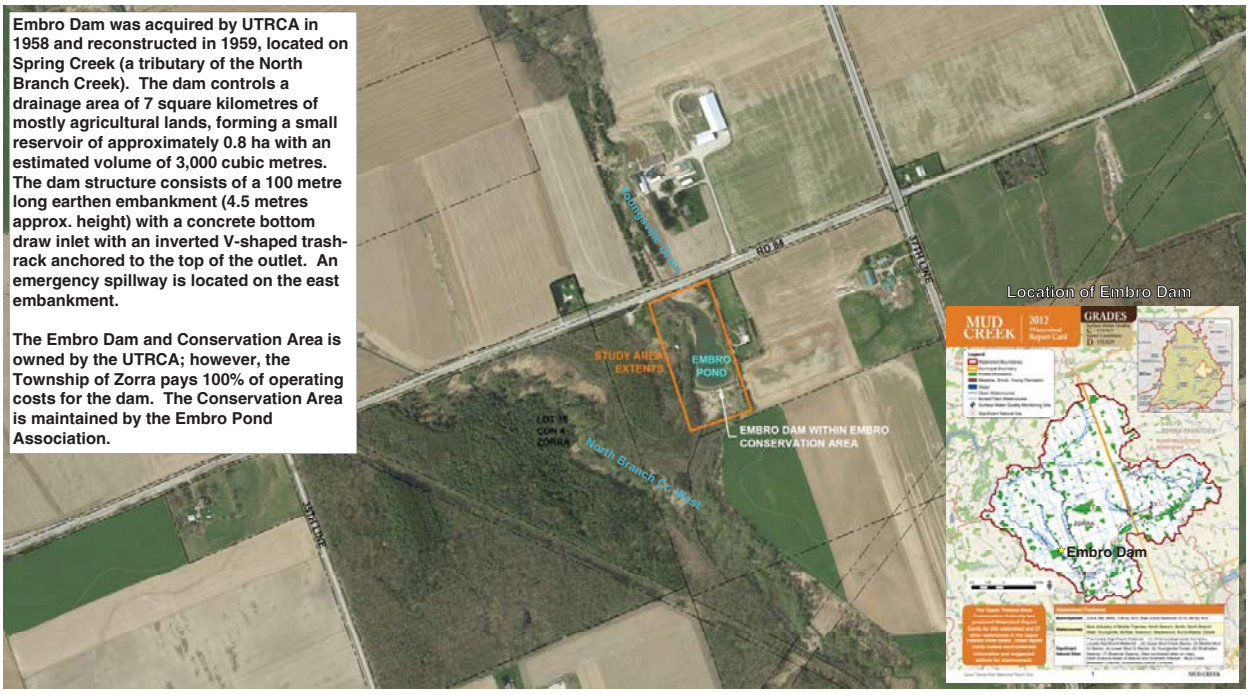
UPPER THAMES RIVER CONSERVATION AUTHORITY

ecosystem recovery inc. PROFESSIONAL ENGINEERS

Embro Dam Study Area

Embro Dam was acquired by UTRCA in 1958 and reconstructed in 1959, located on Spring Creek (a tributary of the North Branch Creek). The dam controls a drainage area of 7 square kilometres of mostly agricultural lands, forming a small reservoir of approximately 0.8 ha with an estimated volume of 3,000 cubic metres. The dam structure consists of a 100 metre long earthen embankment (4.5 metres approx. height) with a concrete bottom draw inlet with an inverted V-shaped trash-rack anchored to the top of the outlet. An emergency spillway is located on the east embankment.

The Embro Dam and Conservation Area is owned by the UTRCA; however, the Township of Zorra pays 100% of operating costs for the dam. The Conservation Area is maintained by the Embro Pond Association.



UPPER THAMES RIVER CONSERVATION AUTHORITY

Upper Thames River Conservation Authority
Public Information Centre

ecosystem recovery inc. PROFESSIONAL ENGINEERS

Problem Statement: Why is a Class EA Necessary?

Significant concerns related to the structural integrity and hydraulic capacity of the Embro Dam have been identified through recent engineering assessments.

- ***Acres International. July, 2007****. Dam Safety Assessment Report for Embro Dam: Upstream and downstream embankment slopes do not meet stability acceptance criteria*
- ***Naylor Engineering Associates. September 2008****. Geotechnical Investigation Embro Dam Embankment Stability Assessment: The existing dam does not meet current standards and is not considered stable under existing conditions*

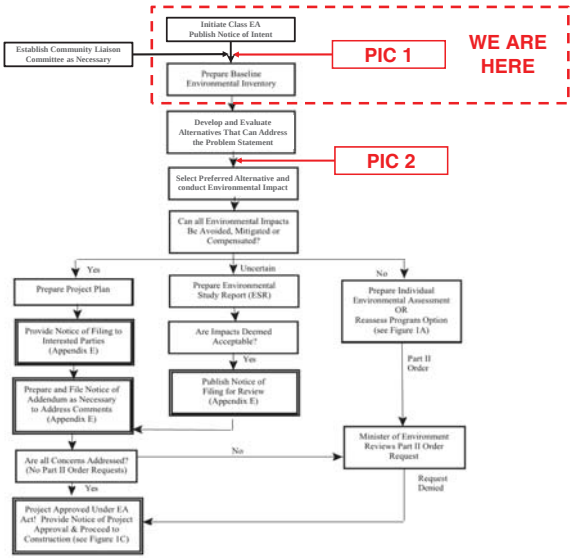
A Class Environmental Assessment has been initiated to evaluate a range of alternatives to address the identified issues in consideration of the environmental, social, economic, and technical aspects of the dam.

Class Environmental Assessment Process and Problem Statement

Class EA Process for Conservation Ontario Class Environmental Assessment for Remedial Flood and Erosion Control Works

In a nutshell:

- Publish Notice of Intent to advise all affected about the study
- Undertake a program to collect background information and relevant data on the study area
- Prepare a characterization of the study area as it relates to the problem statement, this includes technical, social and cost factors
- Develop alternatives that could address the issues
- Evaluate alternatives against a criteria (technical, social and cost)
- Select the preferred alternative
- Prepare concept level plans to depict the preferred alternative
- Prepare the EA report (project plan) and file for 30 days



Public Participation as Part of the Class EA Process

The process requires that proponents make public contact at two occasions, typically the Notice of Intent and Notice of Filing. These Notices invite interested members of the public to review and comment on the study process and results.

The UTRCA has elected to conduct three Public Information Centres (PICs) in addition to the two mandatory public contact notices, to deliver information to the community and to receive comments, feedback and input into the study. The PICs occur:

- **June 2015** – Introduction to the Study and Class EA Process
- **September 2015** (planned) – Presentation of Baseline Characterization and Potential Alternatives
- **November 2015** (planned) – Presentation of Preferred Alternative

Embro Dam and Area Description

The Embro Dam is approximately 100 m in length, 4.5 m in height and includes 1.1 m of freeboard. The entire dam is founded on overburden as opposed to bedrock or engineered soil.

The dam contains water year round and includes approximately 3.4 m of head acting across the dam.

Low earth fill embankment, a grassed, emergency spillway is located at the east end of the embankment. This spillway has a clear width of about 4.0 m and the inlet invert is 0.6 m below the crest of the dam.

The outlet of the dam includes a concrete bottom draw inlet structure covered with grated trashrack.

A 762 mm diameter (inner) concrete pipe conveys flow from the pond to a pool at the creek outlet.

The Embro Dam is located within the Embro Conservation Area, with recent restoration and improvement works undertaken by the Embro Pond Association.

UPPER THAMES RIVER CONSERVATION AUTHORITY

Upper Thames River Conservation Authority
Public Information Centre

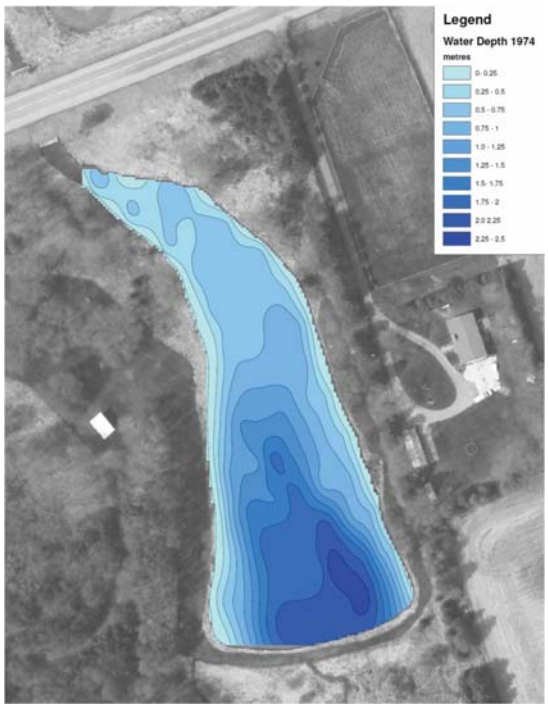
ecosystem recovery inc. PROFESSIONAL ENGINEERS

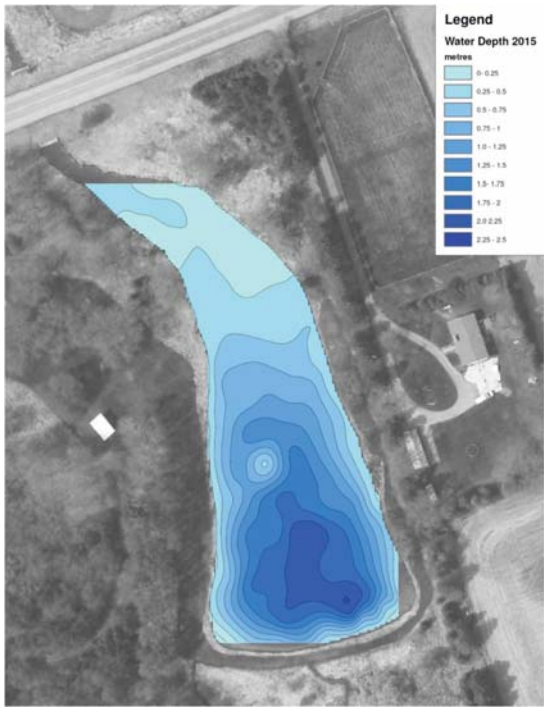
Field Data Collection and Site Characterization

A range of technical, environmental, and social factors will be characterized at the study site to provide insight into the generation of potential alternatives for the dam, as well as the evaluation of those alternatives.

Topographic Survey	**Aquatic Biology**	**Geotechnical Engineering and Hydrogeology**	**Civil Engineering (Dam Structure and Hazard Assessment)**
Hydrology	**Terrestrial Biology**	**Sediment Quality**	**Water Quality**
Fluvial Geomorphology	**Cultural/Social Environment**	**Archaeology**	**Sediment Survey**

Field Data Collection and Site Characterization – Sediment Survey





Next Steps and Contact Information

Next Steps for our project team include:

- Compile and review feedback from this Public Information Centre
- Complete field investigations and characterization of the study area
- Develop alternatives for the Dam to present at the next Public Information Centre, currently planned for September 2015
- Determine if community interest exists for a tour of dam reconstruction and removal projects in southwestern Ontario

To provide feedback and comments to the project team, please send all correspondence to the project email address:

embro_dam@thamesriver.on.ca

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UPPER THAMES RIVER CONSERVATION AUTHORITY

Upper Thames River Conservation Authority
Public Information Centre

ecosystem recovery inc. PROFESSIONAL ENGINEERS

Public Information Centre #1
PIC Presentation Boards

Embro Dam
Class Environmental Assessment

Public Information Centre #1

Upper Thames River Conservation Authority
Embro Zorra Community Centre
June 23rd, 2015 7:00 p.m. to 9:00 p.m.

UPPER THAMES RIVER
CONSERVATION AUTHORITY

ecosystem recovery inc.
PROFESSIONAL ENGINEERS

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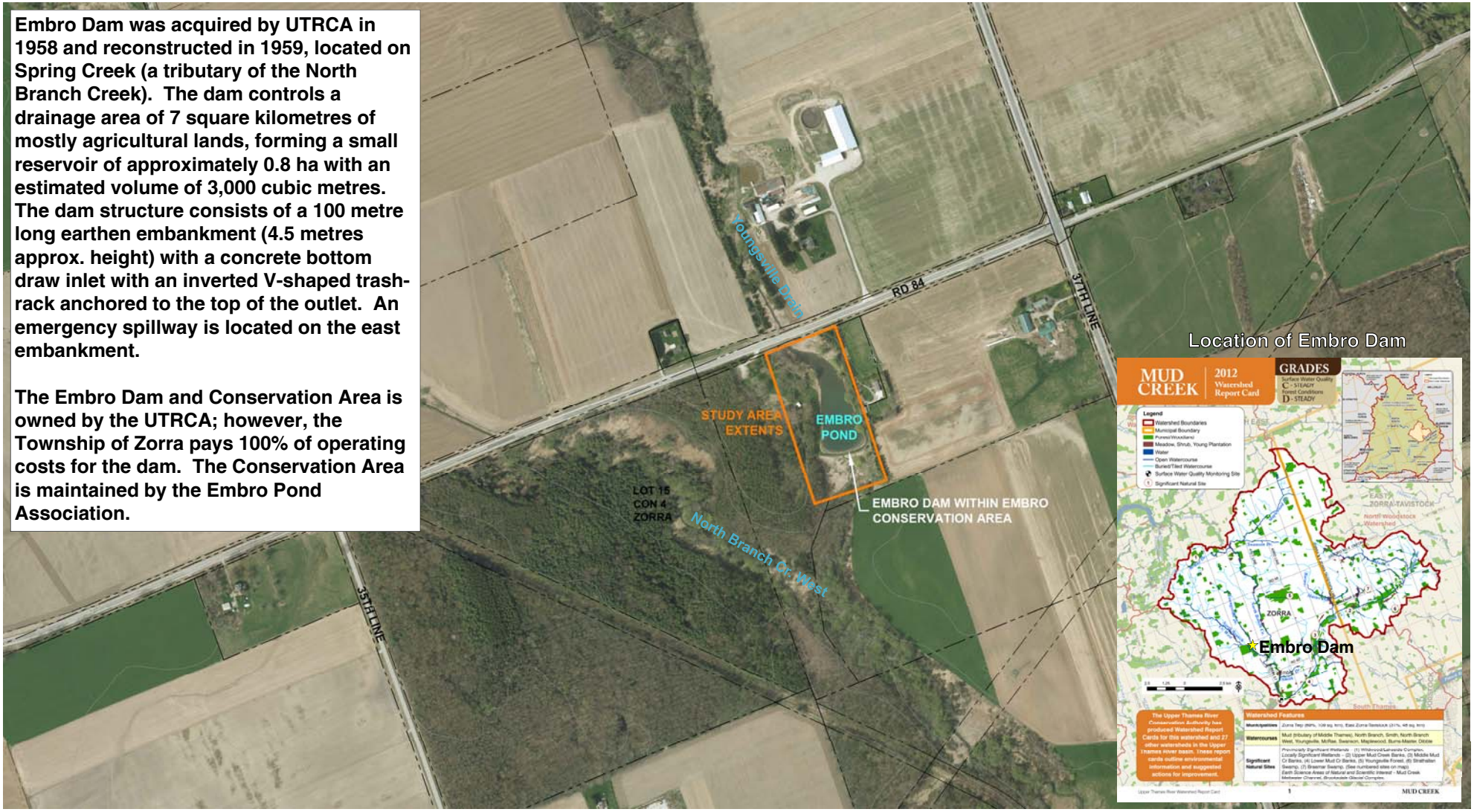

UPPER THAMES RIVER CONSERVATION AUTHORITY

Upper Thames River Conservation Authority
Public Information Centre

ecosystem recovery inc. PROFESSIONAL ENGINEERS

Class Environmental Assessment Process and Problem Statement

Problem Statement

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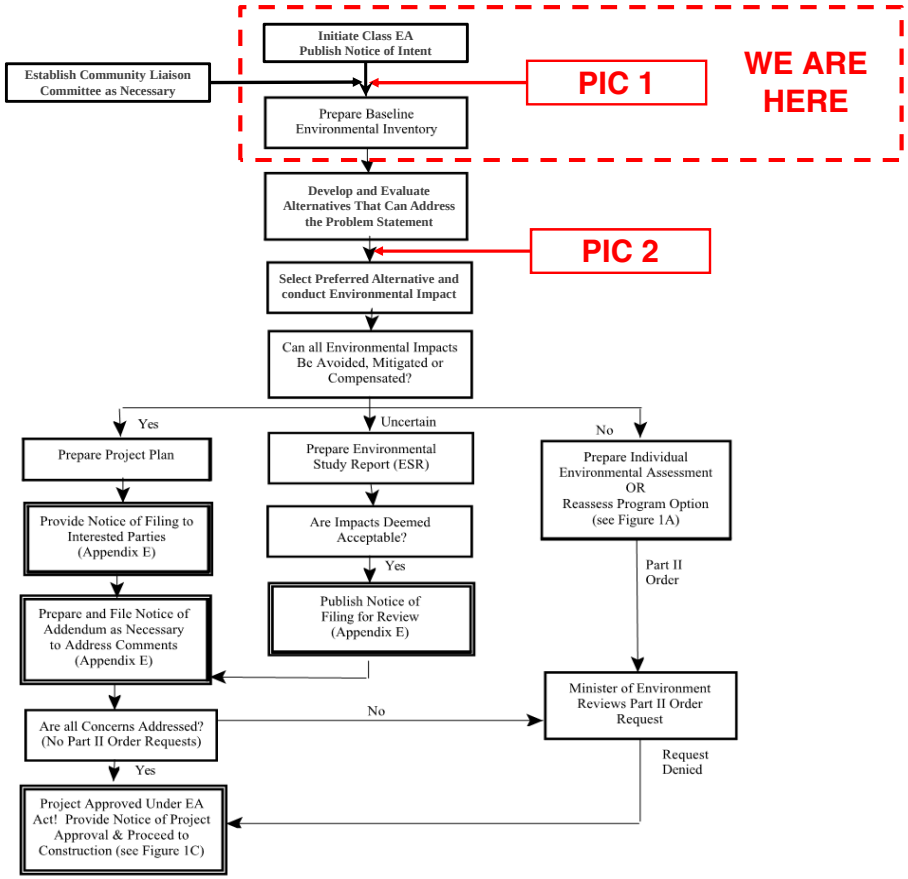
Class EA Process for Conservation Ontario Class Environmental Assessment for Remedial Flood and Erosion Control Works



UPPER THAMES RIVER CONSERVATION AUTHORITY

Upper Thames River Conservation Authority
Public Information Centre

ecosystem recovery inc. PROFESSIONAL ENGINEERS

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The Embro Dam is located within the Embro Conservation Area, with recent restoration and improvement works undertaken by the Embro Pond Association.

UPPER THAMES RIVER CONSERVATION AUTHORITY

Upper Thames River Conservation Authority
Public Information Centre

ecosystem recovery inc. PROFESSIONAL ENGINEERS

Field Data Collection and Site Characterization

A range of technical, environmental, and social factors will be characterized at the study site to provide insight into the generation of potential alternatives for the dam, as well as the evaluation of those alternatives.

Topographic Survey

Topographic characterization of the study area using GPS, total station, or level surveys.

A topographic survey is required to establish physical constraints on potential alternatives for the dam and pond, as well as to develop concept designs.

Topographic surveys are currently underway at the Embro Dam site.

Aquatic Biology

Characterization of aquatic life in the pond, as well as upstream and downstream of the pond, including an inventory of fish and benthic macroinvertebrates (bugs).

Understanding of the aquatic biology at each site is critical to characterize the current impacts of the pond and dam, and potential impacts and opportunities for proposed alternatives.

Aquatic biology surveys and analysis are currently underway.

Geotechnical Engineering and Hydrogeology

Geotechnical engineering and hydrogeology will consider the stability of the dam embankments and the flow of groundwater through and around the dam (seepage).

Characterization of the current dam stability and seepage is critical in developing potential alternatives for the dam, as well as understanding the risks and impacts of various alternatives.

Geotechnical stability assessments have been previously completed and led to the initiation of this study. Further review will take place in the context of this Class EA.

Civil Engineering (Dam Structure and Hazard Assessment)

A characterization of the current dam structure will be undertaken, including an update of the Dam Hazard Classification, under the *Lakes and Rivers Improvement Act*, to understand risks to downstream persons and property.

Legislation and guidelines for the management of dam structures have changed in recent years, requiring the results of the previous Dam Safety Assessments to be reclassified and a new Dam Hazard Classification established.

The assessment and revision of the Dam Hazard Classification is currently in progress.

Hydrology

Hydrologic characterization of the site includes monitoring and rating of river flows upstream and downstream of the dam.

An understanding of the site hydrology is required to inform the operational parameters so that potential alternatives can be generated, and to inform a number of other technical disciplines such as aquatic biology, water quality, and fluvial geomorphology.

Characterization of site hydrology is currently underway, including flow measurements during rain events and comparison to other similar watersheds.

Terrestrial Biology

The terrestrial biology of the site includes the range of vegetative and wildlife species that inhabit the site, as well as connectivity to adjacent natural areas and the significance of species found on site (i.e., Species at Risk, Endangered Species).

Understanding of the terrestrial biology of the site is required to establish and characterize the impacts of potential alternatives for the dam, and to recommend restoration and enhancement strategies for the site.

Terrestrial biology surveys are currently underway at the site.

Sediment Quality

Characterization of the sediment quality in the reservoir involves the collection of sediment samples and analysis at a laboratory to identify a range of constituents of interest (i.e., metals, nutrients, pesticides, hazardous materials).

An understanding of the sediment quality at the site is critical for understanding the potential impacts of proposed alternatives for the dam, particularly related to the costs associated with removal and disposal. In addition, upstream pollutant sources may be identified.

Sediment testing at the reservoir will be undertaken during summer 2015.

Water Quality

Water quality sampling at the site involves collection of water samples during dry weather and wet weather conditions, at locations upstream and downstream of the dam as well as within the pond. Samples are analysed at a laboratory for constituents of interest (i.e., metals, nutrients, pesticides, temperature, dissolved oxygen).

Analysing water quality at the site is required to understand the impact of the current dam and pond on the watercourse, specifically on the ability of the watercourse to support aquatic life.

Water quality samples will be completed throughout the summer of 2015.

UPPER THAMES RIVER CONSERVATION AUTHORITY

Upper Thames River Conservation Authority
Public Information Centre

ecosystem recovery inc. PROFESSIONAL ENGINEERS

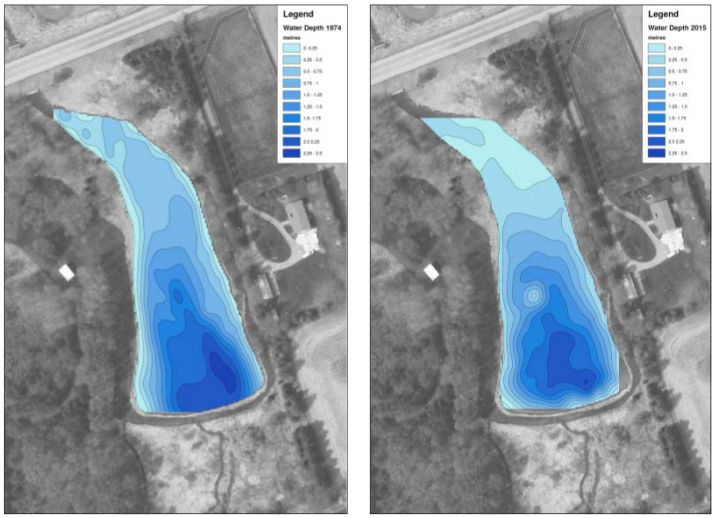
Field Data Collection and Site Characterization

Sediment Survey

Survey of the pond bottom and depths of sediment are completed using GPS survey equipment.

A sediment survey is required to estimate the current quantity of sediment in the pond and to estimate the rate at which sediment is accumulating in the pond, to inform potential alternatives for the dam.

Preliminary sediment depths and volumes have been determined at the pond; contour maps showing water depth (indirectly showing sediment accumulation) are shown at right.

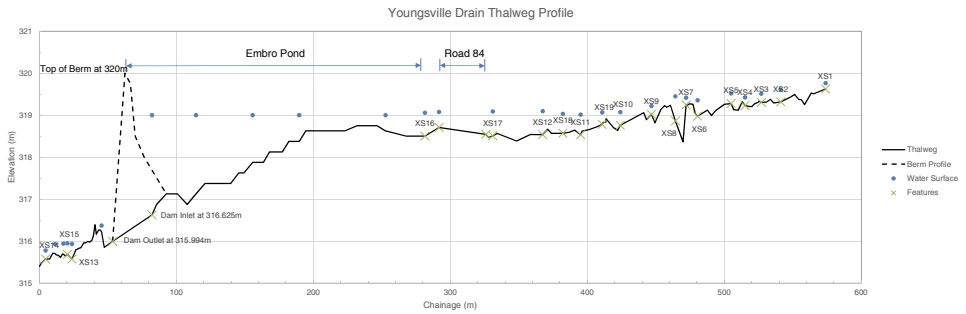


Fluvial Geomorphology

Fluvial geomorphology aims to understand the processes and functions of rivers and creeks, and their role in transporting sediment and providing habitat for aquatic life. A geomorphic characterization of the site, as well as the watercourse upstream and downstream of the site, has been partially completed.

An understanding of the natural watercourse function around the pond is important to characterize impacts of potential alternatives, as well as the current impact of the pond and dam on river processes.

The geomorphic characterization is currently in progress.



Archaeology

A Stage 1 archaeological assessment is being completed for the study area to identify known archaeological sites in the area, evaluate the site's archaeological potential, and recommend mitigation strategies if needed. The assessment will be completed under the provisions of the Ontario Heritage Act.

An archaeological assessment is required to identify potential archaeological and heritage sites that may impact alternatives for the dam, forming constraints and providing opportunities for enhancement and protection of heritage sites.

The assessment is currently in progress.

Cultural/Social Environment

The cultural and social environment of the site includes current and historical uses of the site, and its role as a community gathering and recreational place.

A thorough characterization and understanding of the cultural and social environment is required to understand the impacts of potential alternatives for the dam, and serves to ensure that the "human environment" is considered alongside technical, environmental, and economic criteria.

The review of cultural and social environment is ongoing, and will be supplemented by the input of interested and engaged residents.

UPPER THAMES RIVER CONSERVATION AUTHORITY

Upper Thames River Conservation Authority
Public Information Centre

ecosystem recovery inc. PROFESSIONAL ENGINEERS

Next Steps and Contact Information

Next Steps for our project team include:

- Compile and review feedback from this Public Information Centre
- Complete field investigations and characterization of the study area
- Develop alternatives for the Dam to present at the next Public Information Centre, currently planned for September 2015
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To provide feedback and comments to the project team, please send all correspondence to the project email address:

embro_dam@thamesriver.on.ca

For further information please contact:

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UPPER THAMES RIVER CONSERVATION AUTHORITY

Upper Thames River Conservation Authority
Public Information Centre

ecosystem recovery inc. PROFESSIONAL ENGINEERS

Upper Thames River Conservation Authority
Embro Dam
Class Environmental Assessment

PUBLIC INFORMATION CENTRE – COMMENT FORM

Upper Thames River Conservation Authority (UTRCA), through their consultant Ecosystem Recovery Inc., is undertaking a Class Environmental Assessment (Class EA) for the Embro Dam in the Township of Zorra. The UTRCA commissioned a Dam Safety Review (DSR) of the Embro Dam which was completed in 2007. The DSR identified issues with the spillway capacity and embankment stability of the dam. This Class EA study was initiated to assess the existing site conditions and constraints, and to develop potential alternatives to address the identified issues at the dam.

The project will be carried out under the *Conservation Ontario Class Environmental Assessment for Remedial Flood and Erosion Control Works* document.

Public consultation is a key component of this study. Although the study is in an early stage, the project team welcomes public input and comments, and will incorporate them into the planning and design of this project. Please provide any comments in the space provided below.

_____

_____

_____

_____

_____

_____

Thank you for your participation.

Please print your name and address below, and leave your completed Comment Form in the box provided.

You may also email your comments to embro_dam@thamesriver.on.ca, or mail/fax your comments to:

Mr. Rick Goldt, C.E.T.
Supervisor, Water Control Structures
Upper Thames River Conservation Authority
1424 Clarke Road
London, Ontario, N5V 5B9
Tel: 519-451-2800 ext. 244
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550 Parkside Drive, Unit B1
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Tel: 519-621-1500
Fax: 226-240-1080
wolfgang.wolter@ecosystemrecovery.ca

Name: _____

Address & Postal Code: _____

E-mail Address: _____

Embro Dam Class EA

Public Information Centre #1, June 23, 2015

Sign Up sheet to receive notices and information during the EA project

ecosystem recovery inc.
PROFESSIONAL ENGINEERS

Name (print)	Full Address	Mailing address (if different)	Phone #	Email (print)	Would like to receive: (please check mark)	
					Notices	PIC erials
Randy Bailey	[redacted]					✓
Brian McCowan						✓
Tyler Turpin						✓
Carol Harrison						
Marie Keasey						
Margaret Lupton						
Don Campbell						✓

Personal information on this form is collected under the authority of the Conservation Authorities Act and will be used for the purposes of the Embro Dam Class EA only. Questions about the collection of personal information should be directed to: General Manager, Upper Thames River Conservation Authority, 1424 Clarke Rd., London, Ontario. N5V 5B9, (519) 451-2800.

Embro Dam Class EA

Public Information Centre #1, June 23, 2015

Sign Up sheet to receive notices and information during the EA project

Name (print)	Full Address	Mailing address (if different)	Phone #	Email (print)	Would like to receive: (please check mark)	
					Notices	PIC materials
Laura Green	[redacted]					✓
Kathryn Walton						—
Marcus Rya					✓	✓
John Langlois						
CLINT DUBUQUE						—

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Embro Dam Class EA

Public Information Centre #1, June 23, 2015

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ecosystem recovery inc.
PROFESSIONAL ENGINEERS

Name (print)	Full Address	Mailing address (if different)	Phone #	Email (print)	Would like to receive: (please check mark)	
					Notices	PIC materials
Tammy Hutson	[redacted]				✓	

Personal information on this form is collected under the authority of the Conservation Authorities Act and will be used for the purposes of the Embro Dam Class EA only. Questions about the collection of personal information should be directed to: General Manager, Upper Thames River Conservation Authority, 1424 Clarke Rd., London, Ontario. N5V 5B9, (519) 451-2800.

UPPER THAMES RIVER
CONSERVATION AUTHORITY

Upper Thames River Conservation Authority
Embro Dam
Class Environmental Assessment

ecosystem recovery inc.
PROFESSIONAL ENGINEERS

PUBLIC INFORMATION CENTRE – COMMENT FORM

Upper Thames River Conservation Authority (UTRCA), through their consultant Ecosystem Recovery Inc., is undertaking a Class Environmental Assessment (Class EA) for the Embro Dam in the Township of Zorra. The UTRCA commissioned a Dam Safety Review (DSR) of the Embro Dam which was completed in 2007. The DSR identified issues with the spillway capacity and embankment stability of the dam. This Class EA study was initiated to assess the existing site conditions and constraints, and to develop potential alternatives to address the identified issues at the dam.

The project will be carried out under the *Conservation Ontario Class Environmental Assessment for Remedial Flood and Erosion Control Works* document.

Public consultation is a key component of this study. Although the study is in an early stage, the project team welcomes public input and comments, and will incorporate them into the planning and design of this project. Please provide any comments in the space provided below.

Good visual exhibits + clear powerpoint.
Difficult to manage some questions but speakers remained polite + informative.
Thank you.
Perhaps draw eg. of Woodstock Pond where residents opposed suggestion to drain + pond + authorities listened. The pond remains.

Thank you for your participation.

Please print your name and address below, and leave your completed Comment Form in the box provided.

You may also email your comments to embro_dam@thamesriver.on.ca, or mail/fax your comments to:

Mr. Rick Goldt, C.E.T.
Supervisor, Water Control Structures
Upper Thames River Conservation Authority
1424 Clarke Road
London, Ontario, N5V 5B9
Tel: 519-451-2800 ext. 244
Fax: 519-451-1188
goldtr@thamesriver.on.ca

Mr. Wolfgang Wolter
Senior Project Manager
Ecosystem Recovery Inc.
550 Parkside Drive, Unit B1
Waterloo, Ontario, N2L 5V4
Tel: 519-621-1500
Fax: 226-240-1080
wolfgang.wolter@ecosystemrecovery.ca

Name: Carol Harrison

Address & Postal Code [redacted]

E-mail Address: [redacted]

UPPER THAMES RIVER CONSERVATION AUTHORITY

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Would be better served to restore creek to original condition. Brook trout are resident above Embro Pond. Thames River Anglers Catchem has raised and reintroduced them downstream of the pond supports some brook trout but no reproduction takes place due to water quality + temperature Removing the pond would remedy this

Thank you for your participation.

Please print your name and address below, and leave your completed Comment Form in the box provided.

You may also email your comments to embro_dam@thamesriver.on.ca, or mail/fax your comments to:

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Tel: 519-621-1500
Fax: 226-240-1080
wolfgang.wolter@ecosystemrecovery.ca

Name: RANDY BAILEY

Address & Postal Code: [redacted]

E-mail Address: [redacted]

Ministry of Aboriginal Affairs

160 Bloor St. East, 9th Floor
Toronto, ON M7A 2E6
Tel: (416) 326-4740
Fax: (416) 325-1066
www.aboriginalaffairs.gov.on.ca

Ministère des Affaires Autochtones

160, rue Bloor Est, 9e étage
Toronto ON M7A 2E6
Tél. : (416) 326-4740
Téléc. : (416) 325-1066
www.aboriginalaffairs.gov.on.ca

Ontario

Reference: EA #2015-182

Wolfgang Wolter
Ecosystems Recovery Inc.
B1 – 550 Parkside Drive
Waterloo, ON N2L 5V4

Re: Harrington Dam and Embro Dan Class Environmental Assessments
Notice of Intent and First Public Information Centre

Dear Mr. Wolter:

Thank you for informing the Ministry of Aboriginal Affairs (MAA) of your project. Please note that MAA treats all letters, emails, general notices, etc. about a project as a request for information about which Aboriginal communities may have rights or interests in the project area.

As a member of the government review team, the Ministry of Aboriginal Affairs (MAA) identifies First Nation and Métis communities who may have the following interests in the area of your project:

- reserves;
- land claims or claims in litigation against Ontario;
- existing or asserted Aboriginal or treaty rights, such as harvesting rights; or
- an interest in the area of the project.

MAA is not the approval or regulatory authority for your project, and receives very limited information about projects in the early stages of their development. In circumstances where a Crown-approved project may negatively impact a claimed Aboriginal or treaty right, the Crown may have a duty to consult the Aboriginal community advancing the claim. The Crown often delegates procedural aspects of its duty to consult to proponents. Please note that the information in this letter should not be relied on as advice about whether the Crown owes a duty to consult in respect of your project, or what consultation may be appropriate. Should you have any questions about your consultation obligations, please contact the appropriate ministry.

You should be aware that many First Nations and/or Métis communities either have or assert rights to hunt and fish in their traditional territories. For First Nations, these territories typically include lands and waters outside of their reserves.

In some instances, project work may impact aboriginal archaeological resources. If any Aboriginal archaeological resources could be impacted by your project, you should contact

your regulating or approving Ministry to inquire about whether any additional Aboriginal communities should be contacted. Aboriginal communities with an interest in archaeological resources may include communities who are not presently located in the vicinity of the proposed project.

With respect to your project, and based on the brief materials you have provided, we can advise that the project appears to be located in an area where First Nations may have existing or asserted rights or claims in Ontario's land claims process or litigation, that could be impacted by your project. Contact information is below:

Six Nations of the Grand River Territory P.O. Box 5000, 1695 Chiefswood Road OHSWEKEN, Ontario N0A 1M0	Chief Ava Hill (519) 445-2201 (Fax) 445-4208 Avahill@sixnations.ca
Oneida Nation of the Thames 2212 Elm Avenue SOUTHWOLD, Ontario N0L 2G0	Chief Sheri Doxtator (519) 652-3244 (Fax) 652-9287 Sheri.Doxtator@oneida.on.ca
Chippewas of the Thames First Nation 320 Chippewa Road R.R. #1 MUNCEY, Ontario N0L 1Y0	Chief Richard "Joe" Miskokomon (519) 289-5555 (Fax) 289-2230 chief@cottfn.com cdeleary@cottfn.com
Haudenosaunee Confederacy Chiefs Council 2634 6th Line Road RR 2 Ohsweken, ON N0A 1M0	Hohahes Leroy Hill Secretary to Haudenosaunee Confederacy Chiefs Council Cell 519 717 7326 jocko@sixnationsns.com

For your information, MAA notes that the following First Nation may be interested in your project given the proximity of their community or reserve lands to the area of the proposed project or because of your project's potential environmental impacts:

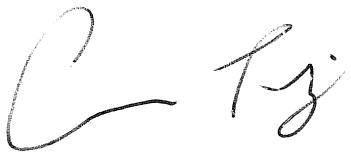
Munsee-Delaware Nation R. R. #1 MUNCEY, Ontario N0L 1Y0	Chief Roger Thomas (519) 289-5396 (Fax) 289-5156 Chief.thomas@munsee-delaware.org

The information upon which the above comments are based is subject to change. First Nation or Métis communities can make claims at any time, and other developments can occur that could result in additional communities being affected by or interested in your undertaking.

Through Aboriginal Affairs and Northern Development (AANDC), the Government of Canada sometimes receives claims that Ontario does not receive, or with which Ontario does not become involved. AANDC's Consultation and Accommodation Unit (CAU) established a "single window" to respond to requests for baseline information held by AANDC on established or potential Aboriginal Treaty and rights. To request information from the Ontario Subject Matter Expert send an email to: UCA-CAU@aadnc-aandc.gc.ca

Additional details about your project or changes to it that suggest impacts beyond what you have provided to date may necessitate further consideration of which Aboriginal communities may be affected by or interested in your undertaking. If you think that further consideration may be required, please bring your inquiry to whatever government body oversees the regulatory process for your project. MAA does not wish to be kept informed of the progress of the project; please be sure to remove MAA from the mailing list.

Yours truly,



Corwin Troje
Manager, Ministry Partnerships Unit
Aboriginal Relations and Ministry Partnerships Branch

Public Information Centre #2

Upper Thames River Conservation Authority

Embro Dam
Class Environmental Assessment

NOTICE OF SECOND PUBLIC INFORMATION CENTRE

THE STUDY

Upper Thames River Conservation Authority (UTRCA), through their consultant Ecosystem Recovery Inc., is undertaking a Class Environmental Assessment (Class EA) for the Embro Dam in the Township of Zorra. The study was initiated to address results of the 2007 Dam Safety Review of the Embro Dam which identified significant issues with the spillway capacity and embankment stability of the dam.

SECOND PUBLIC OPEN HOUSE

The first open house was held on June 23, 2015 to introduce the study and to receive comments from the public. A second Public Open House will be held on May 10, 2016 to present an overview of existing conditions, to introduce technically feasible potential alternative solutions for the future of the dam, to review the evaluation criteria for the alternatives, and to provide an opportunity for public comment and input. A third Public Open House will be held to present the preferred alternative for the dam; the expected date is June 2016.

The map on the reverse of this page shows the location of the study area.

WE WANT TO HEAR FROM YOU

Public consultation is a key component of this study. The Project Team invites public input and comments, and will incorporate them into the planning and design of this project. The second Public Information Centre will take place at the following time and location:

Public Information Center 2:

Date:	**May 10th, 2016**
Time:	**7:00 p.m. to 9:00 p.m.**
Place:	**Embro Community Centre** **355644 35th Line** **Embro, Ontario**

The evening will begin at 7:00 pm with a formal presentation that will be followed by a time for discussion and questions. Presentation boards will be displayed throughout the evening and comment forms will be provided to enable public feedback and input into the project. Further opportunity for questions and discussion with the project team will occur throughout the evening.

STUDY CONTACTS

To submit comments, request further information, or to join the project mailing list, please send an email to the project email address:

embro_dam@thamesriver.on.ca

Contact information for the project team leaders is listed below:

Mr. Rick Goldt, C.E.T.
Supervisor, Water Control Structures
Upper Thames River Conservation Authority
1424 Clarke Road
London, Ontario, N5V 5B9
Tel: 519-451-2800 ext. 244
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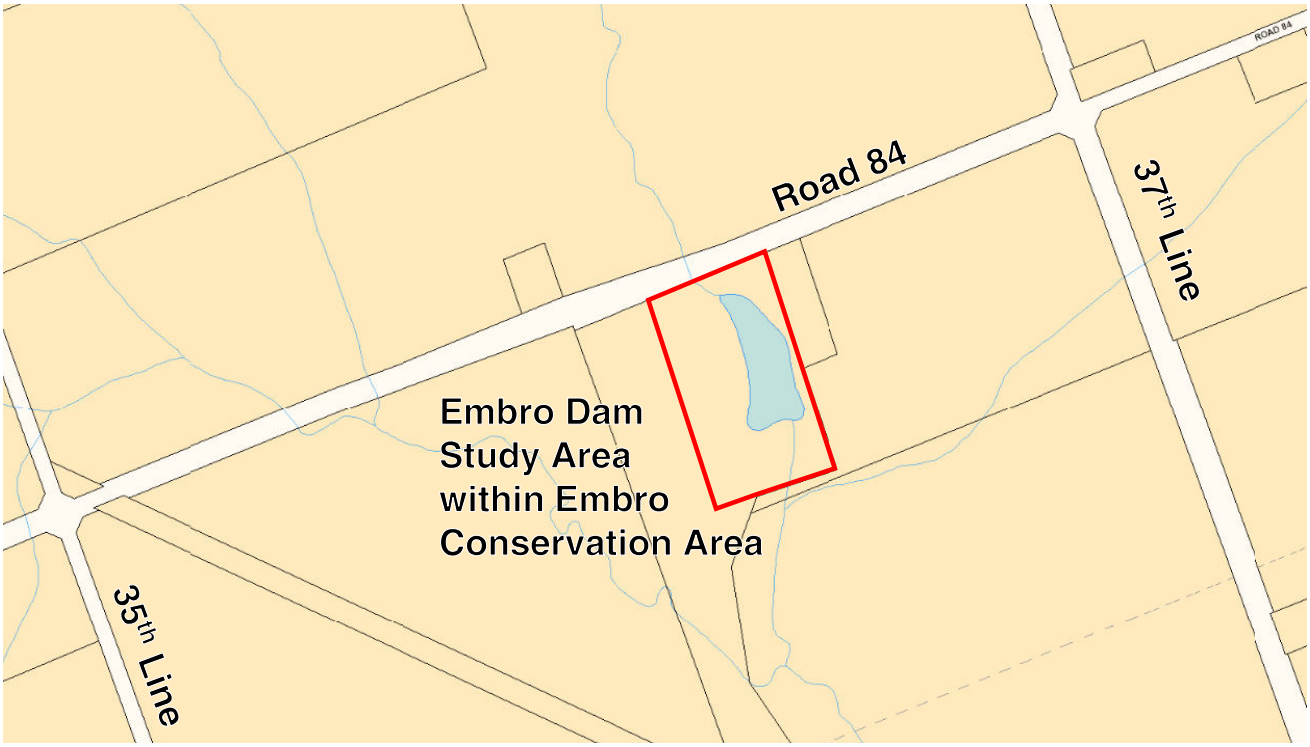

Road 84
37th Line
35th Line
Embro Dam
Study Area
within Embro
Conservation Area

Public Information Centre #2
PIC Presentation Slides

Embro Dam
Class Environmental Assessment

Public Information Centre #2

Upper Thames River Conservation Authority
Embro Community Centre
May 10th, 2016 7:00 p.m. to 9:00 p.m.

UPPER THAMES RIVER CONSERVATION AUTHORITY

ecosystem recovery inc. PROFESSIONAL ENGINEERS

Class Environmental Assessment Process and Problem Statement

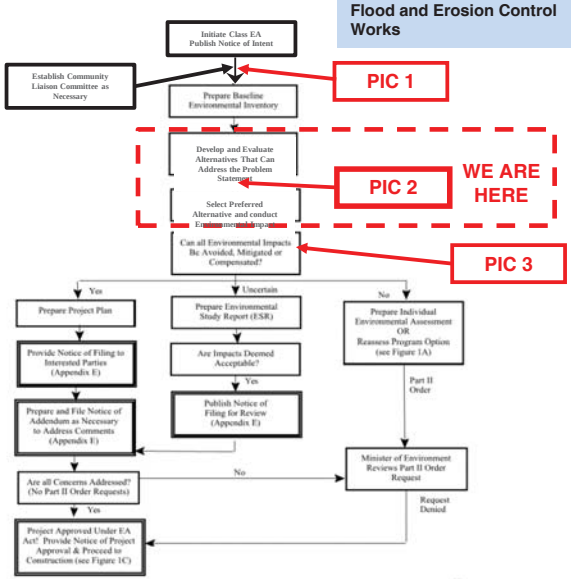
Problem Statement

Significant concerns related to the structural integrity and hydraulic capacity of the Embro Dam have been identified through recent engineering assessments.

- ***Acres International. July, 2007***. *Dam Safety Assessment Report for Embro Dam: Identified issues with insufficient spillway capacity, insufficient freeboard, embankment stability and conveyance of flood flows through the emergency spillway*
- ***Naylor Engineering Associates. September 2008***. *Geotechnical Investigation Embro Dam Embankment Stability Assessment: The dam does not meet current standards and is not considered stable under existing conditions.*

A Class Environmental Assessment has been initiated to evaluate a range of alternatives to address the identified issues in consideration of the environmental, social, economic, and technical aspects of the dam.

Class EA Process for Conservation Ontario Class Environmental Assessment for Remedial Flood and Erosion Control Works



Criteria and Evaluation

Information Highlights

Technical/Engineering	Natural Environment
Flooding Impacts/Enhancement Geomorphology/Sediment Transport Protection of Infrastructure Constructability Approvability	Aquatic Habitat Impacts/Enhancement Terrestrial Habitat Impacts/Enhancement Wildlife and SAR Impacts/Enhancement Groundwater Impacts/Enhancement Water Quality Impacts/Enhancement
Social/Cultural	**Economic**
Impact to Private Property Impact to Public Safety Impact to Cultural/Heritage Features Recreational Impacts/Enhancement	Construction Costs Maintenance/Future Costs Availability of Funding

Primary Areas of Site Characterization

Environmental	Technical	Social
Water Quality	Hydraulics and Hydrology	Cultural Heritage
Flow Characteristics	Geomorphology	Archaeology
Vegetation and Wildlife	Sediment	First nations
Aquatic Biology	Structural	

UPPER THAMES RIVER CONSERVATION AUTHORITY

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Public Information Centre

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Environmental

Information Highlights

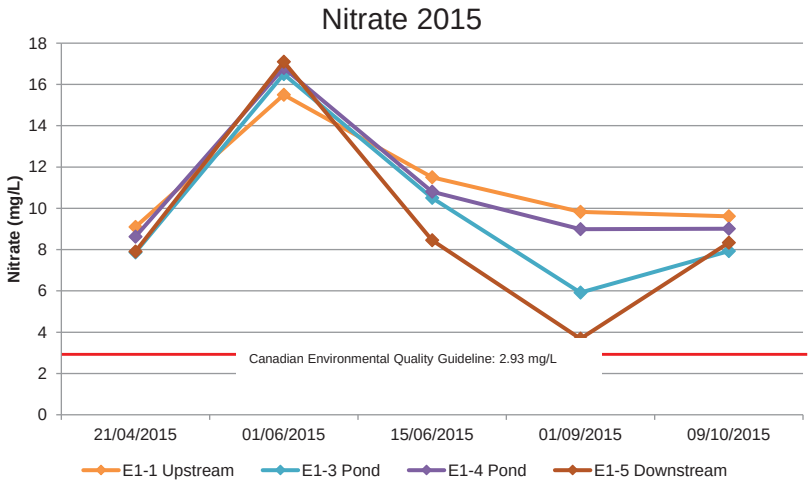
Water Quality

- 4 sampling locations (1 upstream of pond, 2 in pond, 1 downstream of pond), 5 samples were collected at each site

- Results (2015):
  - Lows levels of contaminants,
    - except Nitrate (i.e., above the Canadian Environmental Quality Guideline (CEQG), historically and currently, but similar to the rest of the Middle Thames River watershed)
  - Similar results to the historic data with E. coli

Environmental

Information Highlights



- Nitrate concentration is above MOE CEQG standard
- Concentration varies seasonally

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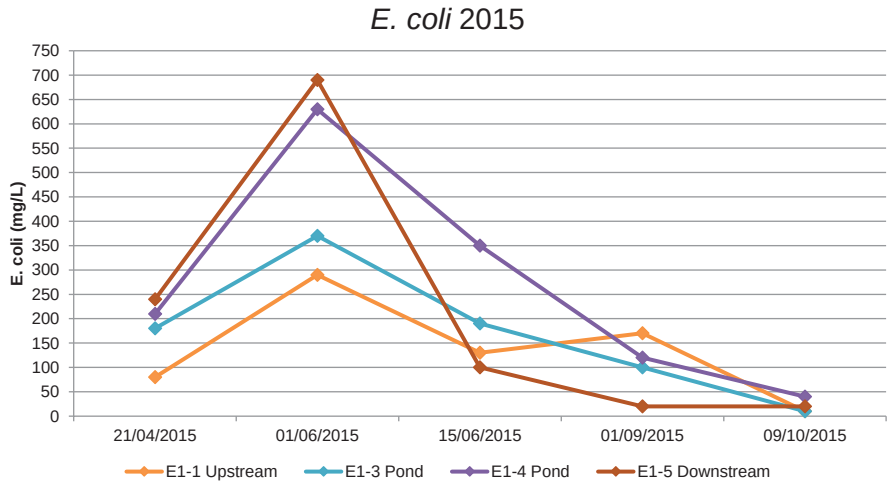
Environmental

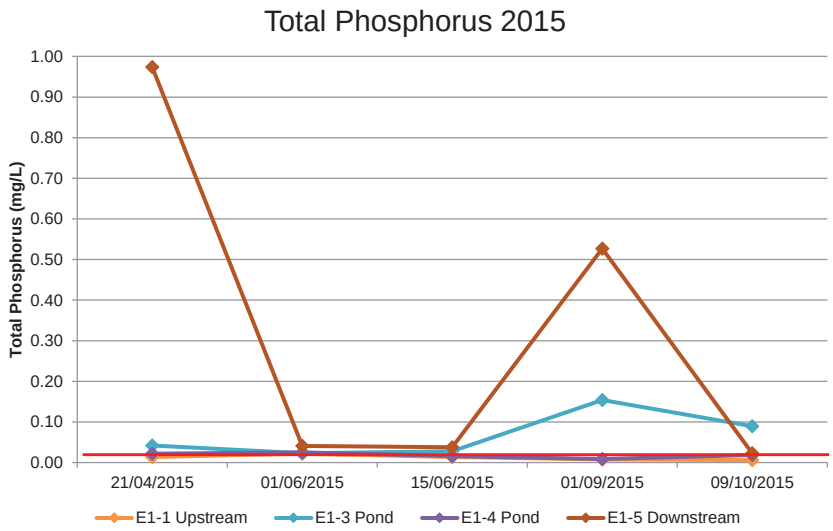
Information Highlights



- E. Coli levels increase downstream of dam in summer
- E.Coli levels are generally higher in pond than upstream or downstream

Environmental

Information Highlights



- Total Phosphorus is highest downstream of dam
- Levels are higher than Provincial objectives in and downstream of pond

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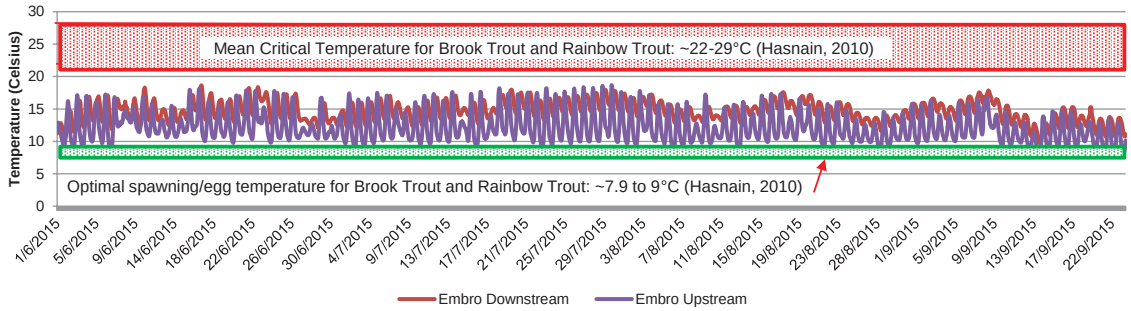
Environmental

Information Highlights

Water Temperature

- Continuous temperature measurements taken from June to September 2015
  - Water often warmer downstream than upstream of the pond:
    - Least temp. difference: 0.0^0C
    - Average temp. difference: 2.5^0C
    - Maximum peak difference: 7.0^0C
  - Temperatures are higher than optimal for Brook/Rainbow Trout spawning



Reference: Hasnain, Sarah, et. Al. 2010. Key Ecological Temperature Metrics for Canadian Freshwater Fishes. Prepared for the Ontario Ministry of Natural Resources.

Environmental

Information Highlights

Flow Characteristics

- Flow downstream of the pond contributes between 3.5 – 6.5% of the total flow downstream of Thamesford
- Flow contribution to Mud Creek (downstream) could not be estimated (no monitoring stations)
- Flow rates downstream of the dam are resilient to drought
- Groundwater input to the increases baseflow from upstream to downstream of the dam by 8%

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Environmental

Information Highlights

Vegetation and Wildlife

- No Species at Risk or of Special Concern were found
  - No records of Species at Risk within a 2 km radius
  - No wetlands within 120 m
- Wooded areas of the Conservation Area are part of the Oxford Natural Heritage System
- Inventory Findings:
  - 198 plant species, 31% of species found are non-native
  - 40 species of birds, mostly common forest birds
  - Barn Swallow (Threatened) was seen but not found nesting in study area
  - Snapping Turtles (Special Concern) spotted in the reservoir

Environmental

Information Highlights

Aquatic Biology

- Classified as Shallow Aquatic (i.e., < 2 m depth)
- Very few wetland emergent plants (due to steep side slopes and consistent water levels)
- Duckweed and algae float on pond surface
- Four rooted aquatic species identified
- Vegetation does not provide good cover for fish species that are adapted to ponds

Environmental

Information Highlights

Fisheries Resources

- Electrofishing conducted in 2015 (April, July, October and November)

Brook Trout

Image Source: Mandrak and Crossman, 1992

Upstream of Dam (8 species recorded):

- Brook Trout in large numbers
- Habitat suitable for cold water species

Downstream of Dam (21 species recorded):

- Brook Trout
- Cold water species
- Permanent and seasonally present warm water species

Environmental

Information Highlights

Benthic Resources

- Sampling was conducted in the spring and fall of 2015
- Sample records with the calculated Family Biotic Index (FBI) are shown below:
  - Water quality indicators upstream/downstream of pond are FAIRLY POOR

Water quality ranges for FBI values

FBI Value	Water Quality
< 4.25	Excellent
4.25 5.00	Good
5.00 5.75	Fair
5.75 6.50	Fairly Poor
6.50 7.25	Poor
> 7.25	Very Poor

Comparison for FBI values for Embro CA, Mud Creek and UTRCA watersheds

Benthic Sample Location	Spring 2015 FBI	Fall 2015 FBI	Average FBI	Water Quality
Youngsville Drain upstream of Embro Pond	5.82	6.06	5.94	Fairly poor
Youngsville Drain downstream of Embro Dam	5.84	6.37	6.12	Fairly poor
Mud Creek watershed 2012	N/A	N/A	6.20	Fairly poor
UTRCA watershed 2015	N/A	N/A	5.68	Fair
Provincial Guideline (target only)	N/A	N/A	< 5.00	Good

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Technical

Information Highlights

Groundwater

- Soil is characterized as fill overlying silt and clay deposits, and native glacial till
- Groundwater generally occurs in the fill above the glacial till
- Groundwater flow gradient is towards the south side of the pond; a possible seepage zone is located on the south side of the dam
- Water level in the fill is ~ 0.4 m below the pond water level

Technical

Information Highlights

Well Information

- Approximately 13 wells exist in the vicinity of Embro Pond
- Installation dates range from 1959 to 2008
- Well depths range from 3.8 to 50.3 m
- Water depths range from 2 to 49 m below the top of well

Technical

Information Highlights

Geomorphology

- Air photo analysis:
  - 1955: creek is sinuous, no pond
  - 1972: pond is constructed, channel realignment
  - 1989-2010: minor planform changes in creek
- Three reaches have been delineated

Reach 1 (Downstream of dam):

- Relatively straight, slight meander
- Cross sections: symmetrical and trapezoidal and confined
- Bed morphology: riffles/runs with shallow pools
- Bed material: cobbles and gravel
- Riparian vegetation: dense grasses and herbaceous plants with some shrubs

Technical

Information Highlights

Geomorphology

Reach 2 (Backwater area (85 m long)):

- Straight channel with poorly developed bed forms
- Cross section: generally trapezoidal
- Bed material: silt and sand, some gravel
- Riparian vegetation: well vegetated with grasses and herbaceous plants

Reach 3:

- Riparian vegetation: grasses, herbaceous plants, and cedar trees
- Cross section: generally uniform in shape
- Bed morphology: riffles/runs with shallow pools
- Bed material: fine sand and silt with some large boulders/cobbles and gravel on riffles

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Technical

Information Highlights

Sediment Characteristics

Sediment testing was conducted in 2015 to investigate parameters including:

- metals and inorganics
- volatile organic compounds
- petroleum hydrocarbons
- conductivity
- pH
- grain size analysis

Sediment test results were compared to Ministry of the Environment (MOE) Table 2 and 3 Standard, O. Reg. 153/04

- One parameter is outside of the MOE limit: Cyanide (weak acid dissociable)
- Cyanide concentration was 0.092ug/g vs the MOE limit of 0.051ug/g
- Options for sediment: beneficial reuse (requires further investigation) or landfilling

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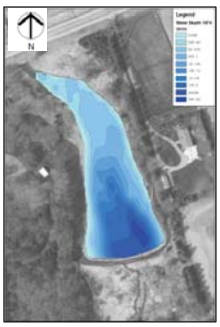
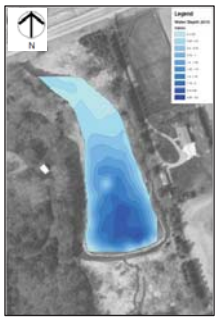
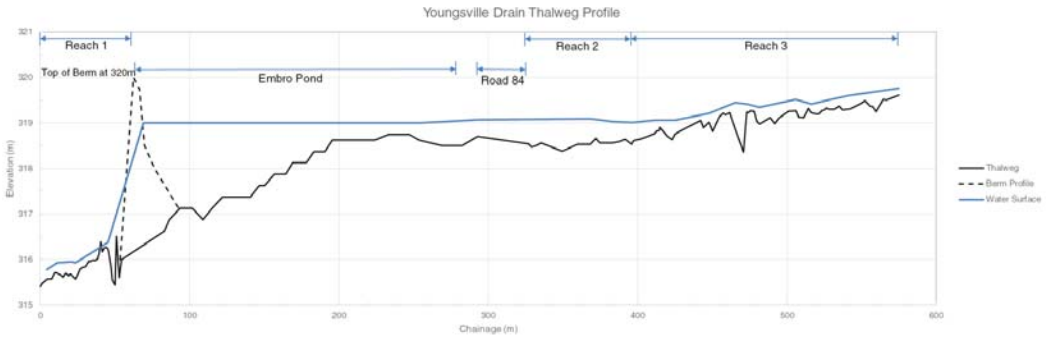
Sediment



Water Depth 1974



Water Depth 2015



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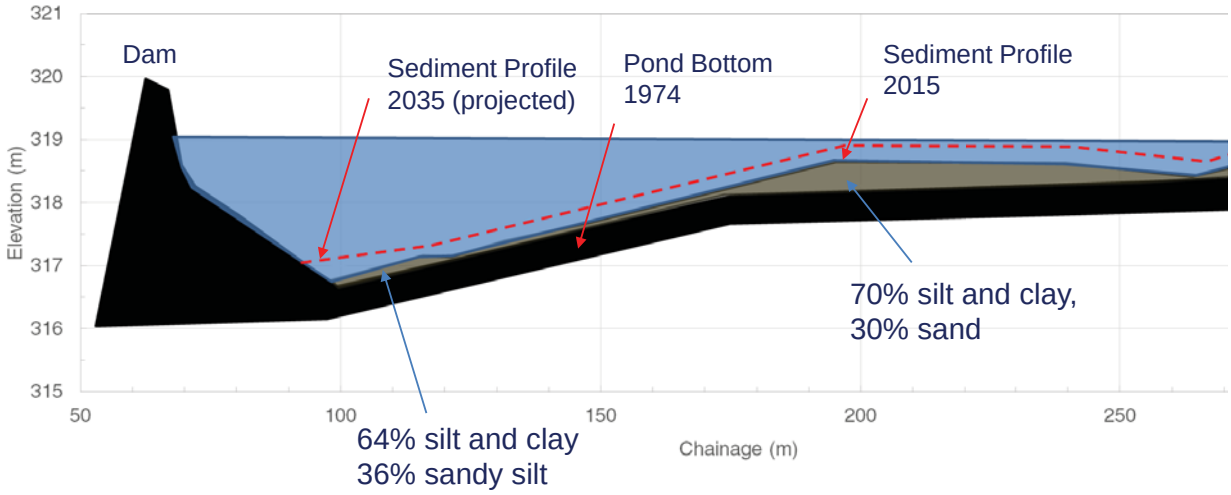
Technical

Information Highlights

Sediment Profile



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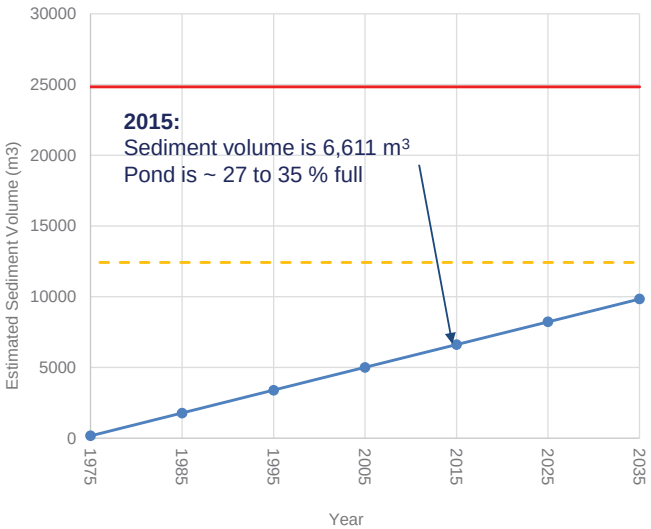
Estimated Sediment Volume (m3)

Technical

Information Highlights

Pond Capacity and Sediment Infilling Rate



100% of the Pond Volume

2015:
Sediment volume is 6,611 m³
Pond is ~ 27 to 35 % full

50% of the Pond Volume

Average sediment accumulation rate = 161 m³/year

UPPER THAMES RIVER CONSERVATION AUTHORITY

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Technical

Information Highlights

Structural

- Dam impounded volume: 30,000 m^3 (small dam based on storage volume)
- Dam height ~4.5 m
- 100 m long earth embankment
- Inflow design flood (IDF) criteria: 50 year, 8 day spring snowmelt event

Structural Condition (2002/2003 Dam Safety Assessment)

- Spillway does not have current capacity to pass the IDF
- Insufficient freeboard
- Upstream and downstream embankment slopes do not meet slope stability acceptance criteria
- Flood flows are not adequately conveyed by the emergency spillway
- Date of last repair is unknown

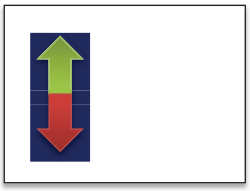
Technical

Information Highlights

Updated Hazard Classification

2007: Dam hazard potential classification (DHC) for Embro Dam was completed:

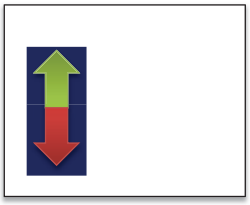
- Loss of Life: VERY LOW
- Economic and Social Losses: VERY LOW
- Environmental Losses: VERY LOW



2011: the Ministry of Natural Resources and Forestry updated the DHC criteria and procedure

2015: Update to the Embro dam hazard potential classification:

- Life safety: LOW
- Property Losses: LOW
- Environmental Losses: LOW
- Cultural-Built Heritage Losses: LOW



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Social

Information Highlights

Cultural Heritage

- Embro Conservation Area: 11.7 ha (28.9 acres) for passive recreation
- Includes hiking trails, cross-country skiing trails and picnic areas
- Memorial Tree Sign program run through the Township of Zorra
- The Embro Pond Association

Social

Information Highlights

Archaeology and First Nations

- Stage 1 Archaeological Assessment was completed
- No prior archaeological assessments within 50 m of the study area
- No prior identified archaeological sites within 1 km of the study area
- Archeological potential was assessed using soils, hydrology, and landform considerations

Findings: The study areas would have been attractive to both Pre-Contact and Euro-Canadian populations as a result of close proximity to water sources, well drained soils, and the diversity of local vegetation. The site was found to have archaeological potential.

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66.8% of the site has archaeological potential,

- requires test pit survey before any potential construction works in area

33.2% of the site has no archaeological potential (due to disturbance, permanent water features or steep slopes)

Criteria and Evaluation

Information Highlights

Technical/Engineering	Natural Environment
Flooding Impacts/Enhancement Geomorphology/Sediment Transport Protection of Infrastructure Constructability Approvability	Aquatic Habitat Impacts/Enhancement Terrestrial Habitat Impacts/Enhancement Wildlife and SAR Impacts/Enhancement Groundwater Impacts/Enhancement Water Quality Impacts/Enhancement
Social/Cultural	**Economic**
Impact to Private Property Impact to Public Safety Impact to Cultural/Heritage Features Recreational Impacts/Enhancement	Construction Costs Maintenance/Future Costs Availability of Funding

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Alternatives

Information Highlights

1) Do Nothing
2) Repair Dam
3) Remove Dam and Construct a Natural Channel
4) Remove Dam and Construct Offline Pond(s) or Wetland(s)
5) Lower Dam Crest and Outlet and Naturalize New Pond and Perimeter

Opportunities and Constrains of the Alternatives

Summarizes how each of the alternatives impacts elements of the evaluation criteria

Do Nothing

No intervention would be implemented

Opportunities	Constraints
No immediate cost	Does not meet dam safety guidelines
Maintains current aesthetic	Has a risk of failure – this can impact the channel by flood, erosion and sediment
Maintains current uses	Requires regular monitoring
	Imposes an impediment to fish passage
	Increases water temperatures seasonally
	Accumulates sediment, will fill over time
	Impedes sediment transport

Repair Dam

Construct Dam 'Shell', add rock protection, extend outlet pipe, provide emergency spillway

Opportunities	Constraints
Complies with Dam Safety Guidelines	Imposes repair costs (moderate)
Maintains current aesthetic	Imposes an impediment to fish passage
Maintains current uses	Increases water temperatures seasonally
	Accumulates sediment, will fill over time
	Impedes sediment transport

Remove Dam and Construct Natural Channel

Remove Dam, construct natural channel, provide landscape restoration

Opportunities	Constraints
Restores area to pre-existing conditions	Imposes restoration costs (moderate)
Provides diverse fish habitat	Does not reflect existing aesthetic (open water)
Provides sediment transport	Has the risk of impacting shallow wells
Maintains creek temperatures	
Removes risk of dam failure	

Remove Dam and Construct Offline Pond/Wetland

Remove Dam, construct offline pond with less surface area as existing, create natural channel, provide landscaping

Opportunities	Constraints
Restores area to pre-existing conditions	Imposes restoration costs (high)
Provides aquatic habitat diversity	Reduces pond surface area (water views)
Provides sediment transport	
Maintains creek temperatures	
Removes risk of dam failure	
Partially provide water views	

Lower Dam Crest and Outlet and naturalize pond area

Lowers height of dam, provided less surface area as existing, create natural channel, provides landscape enhancements

Opportunities	Constraints
Partially maintains current aesthetic	Imposes restoration costs (high)
Reduces solar heat gain compared to existing	Reduces pond surface area (water views)
Reduces magnitude of potential impacts in the event of breach/failure	Imposes an impediment to fish passage
Provides diversity in landscape	Imposed risk to Increases in water temperatures seasonally
	Accumulates sediment, will fill over time
	Impedes sediment transport

Watershed Initiatives

Information Highlights

Initiative	Approach
2010 Water Quality Monitoring Station Added	A new water quality monitoring station was added to Mud Creek just south of Embro along Highway 6
Clean Water Program Since 2001	26 Clean Water Program (CWP) projects (fragile land retirement, septic upgrades, wellhead protection) have been completed since 2001
UTRCA Community Nature Program	Over 80 trees and 2800 native wildflowers and grasses were planted by 75 students at Embro Conservation Area
2008-2009 Mud Creek Community-based Watershed Strategy	Technical information about the state of the watershed combine with concerns and priorities of watershed residents combine to produce a list of recommended actions
2010-2011 Hardwood Forest Regeneration in Embro Conservation Area	5 ha conifer plantation at Embro Conservation Area was thinned by UTRCA to encourage the regeneration of hardwood forest. 2100 native hardwood seedlings were planted. Project funding was by Oxford County and the CWP.

Next Steps and Contact Information

Next Steps for our project team include:

- **Compile and review feedback from this Public Information Centre**
- **Final criteria and alternatives evaluation completed based on public feedback**
- **Select 'Preferred Alternative' and evaluate environmental impacts**
- **Public Information Centre #3**
- **If impacts can be mitigated, work will proceed to completion and filing of Project Plan**

To provide feedback and comments to the project team, please send all correspondence to the project email address:

embro_dam@thamesriver.on.ca

For further information please contact:

Mr. Rick Goldt, C.E.T.
Supervisor, Water Control Structures
Upper Thames River Conservation Authority
1424 Clarke Road
London, Ontario, N5V 5B9
Tel: 519-451-2800 ext. 244
Fax: 519-451-1188
goldtr@thamesriver.on.ca

Mr. Wolfgang Wolter
Senior Project Manager
Ecosystem Recovery Inc.
550 Parkside Drive, Unit B1
Waterloo, Ontario, N2L 5V4
Tel: 519-621-1500
Fax: 226-240-1080
wolfgang.wolter@ecosystemrecovery.ca

UPPER THAMES RIVER CONSERVATION AUTHORITY

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Public Information Centre

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Public Information Centre #2
PIC Presentation Boards

Embro Dam
Class Environmental Assessment

Public Information Centre #2

Upper Thames River Conservation Authority
Embro Zorra Community Centre
May 10th, 2016 7:00 p.m. to 9:00 p.m.

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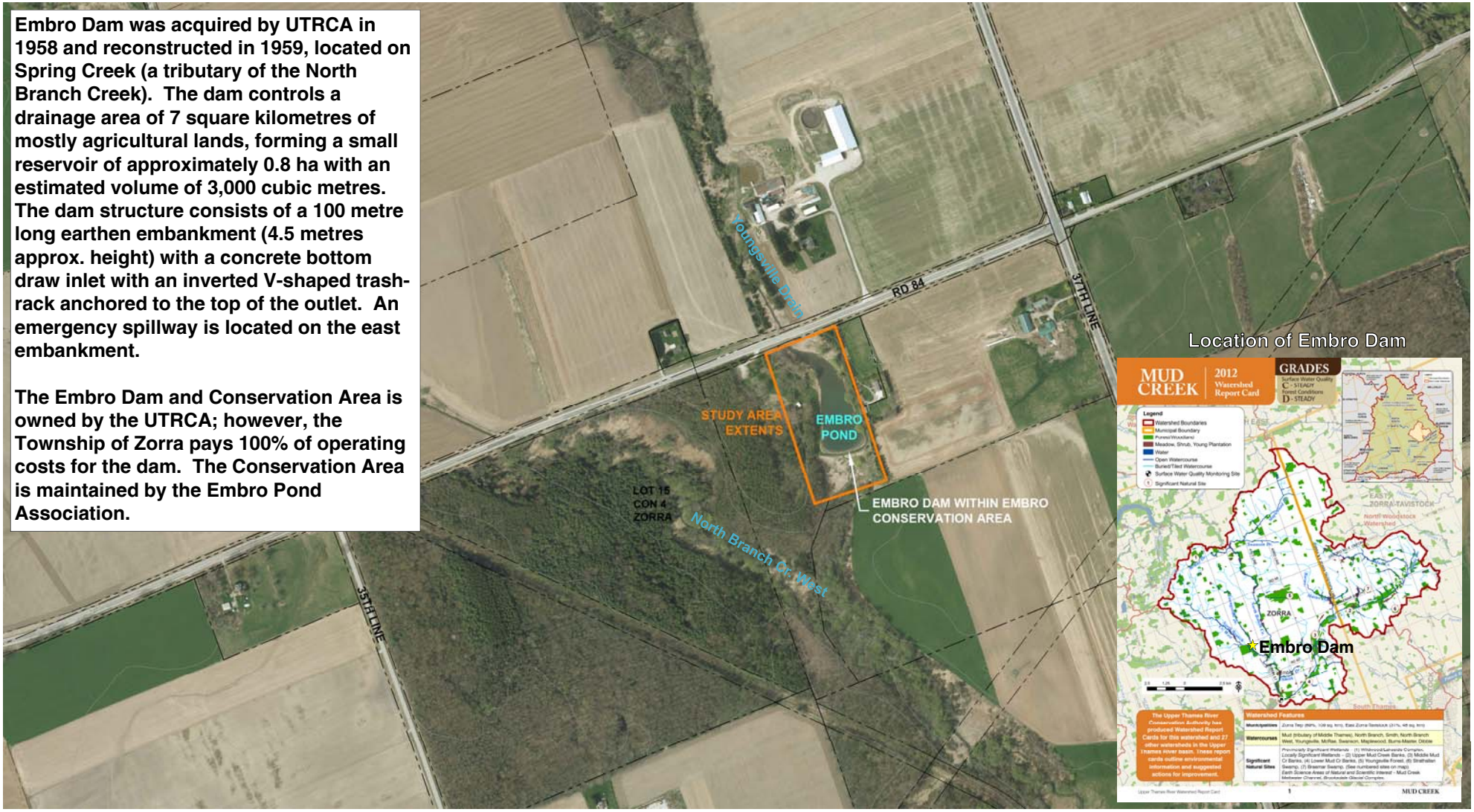
Embro Dam Study Area

Embro Dam was acquired by UTRCA in 1958 and reconstructed in 1959, located on Spring Creek (a tributary of the North Branch Creek). The dam controls a drainage area of 7 square kilometres of mostly agricultural lands, forming a small reservoir of approximately 0.8 ha with an estimated volume of 3,000 cubic metres. The dam structure consists of a 100 metre long earthen embankment (4.5 metres approx. height) with a concrete bottom draw inlet with an inverted V-shaped trash-rack anchored to the top of the outlet. An emergency spillway is located on the east embankment.

The Embro Dam and Conservation Area is owned by the UTRCA; however, the Township of Zorra pays 100% of operating costs for the dam. The Conservation Area is maintained by the Embro Pond Association.



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Upper Thames River Conservation Authority
Public Information Centre

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Class Environmental Assessment Process and Problem Statement

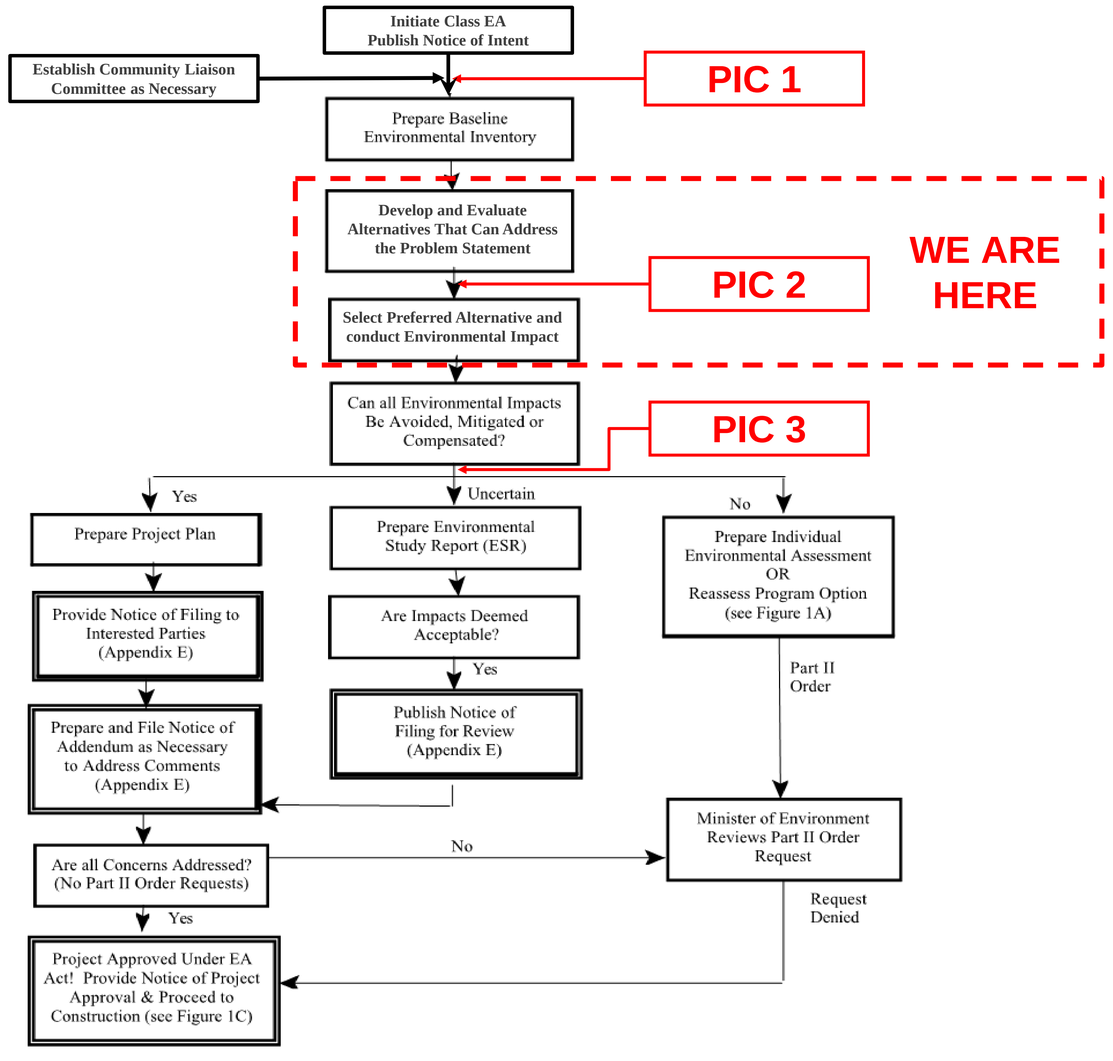
Class EA Process for Conservation Ontario Class Environmental Assessment for Remedial Flood and Erosion Control Works

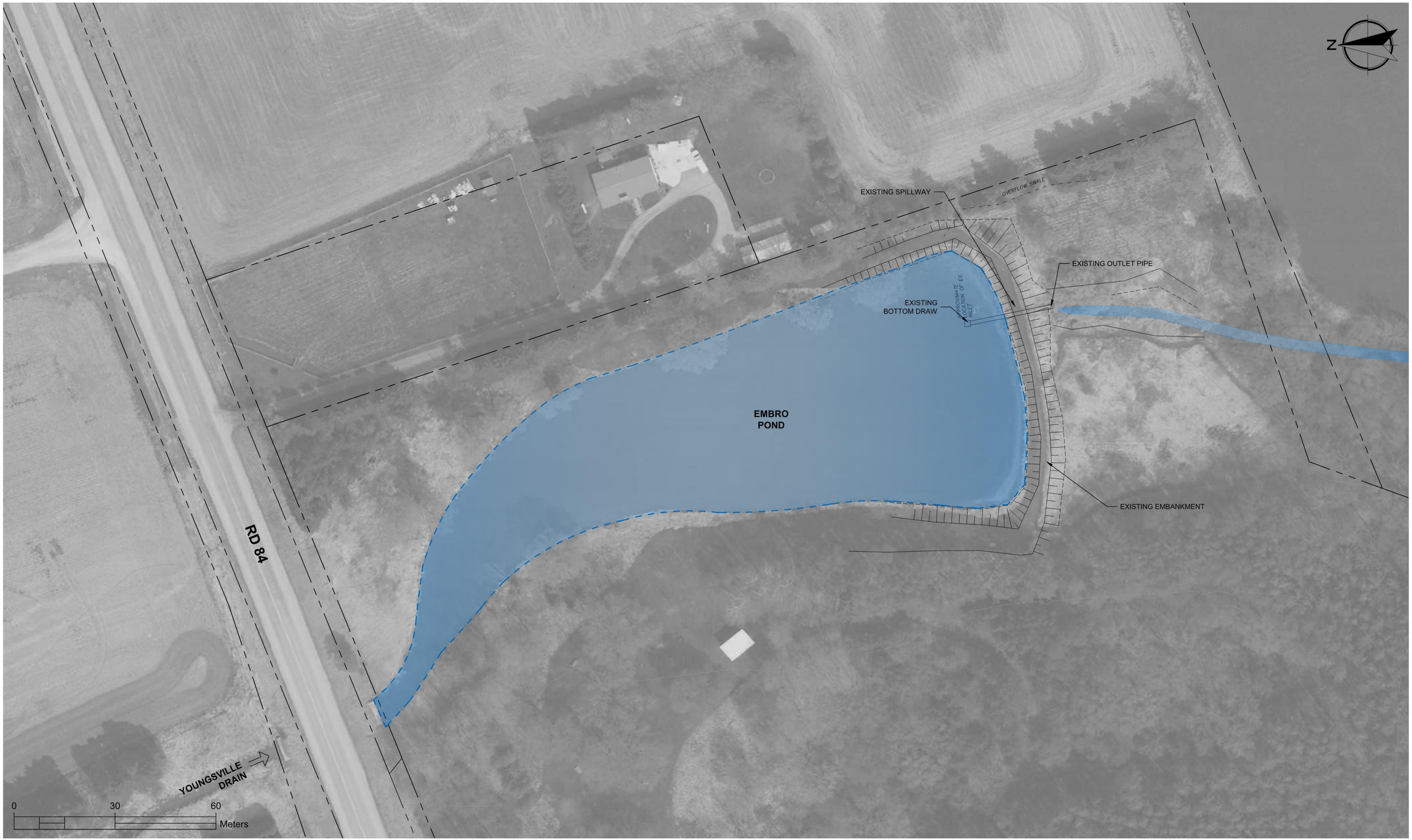
Problem Statement

Significant concerns related to the structural integrity and hydraulic capacity of the Embro Dam have been identified through recent engineering assessments.

- ***Acres International. July, 2007****. Dam Safety Assessment Report for Embro Dam: Upstream and downstream embankment slopes do not meet stability acceptance criteria*
- ***Naylor Engineering Associates. September 2008****. Geotechnical Investigation Embro Dam Embankment Stability Assessment: The existing dam does not meet current standards and is not considered stable under existing conditions*

A Class Environmental Assessment has been initiated to evaluate a range of alternatives to address the identified issues in consideration of the environmental, social, economic, and technical aspects of the dam.





EMBRO DAM CLASS ENVIRONMENTAL ASSESSMENT

ALTERNATIVE 1
DO NOTHING

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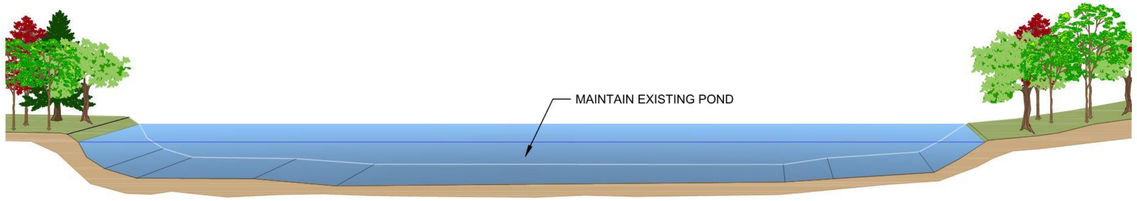
FIGURE 4-1



SECTION A-A

SECTION B-B

EMBRO DAM CLASS ENVIRONMENTAL ASSESSMENT

ALTERNATIVE 2
REPAIR/ RECONSTRUCT EXISTING DAM

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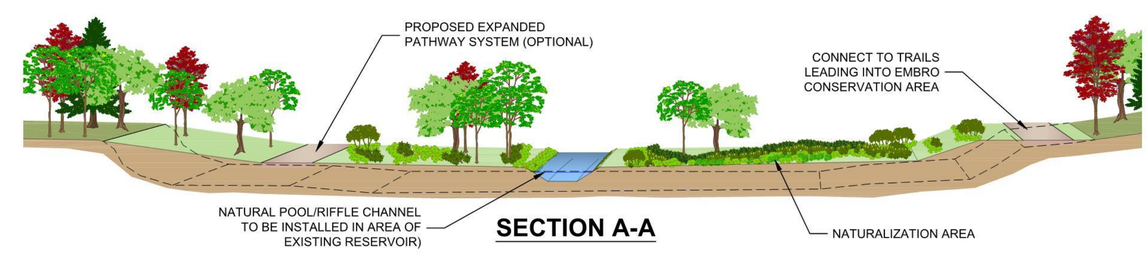
FIGURE 4-2



SECTION A-A

CREEK REALIGNMENTS

CORE FEATURES:
- NEW PATHWAYS/TRAIL CONNECTIONS
- NATURALIZE
- SAFE SLOPES
- NATURAL CHANNEL
- SHORELINE ENHANCEMENT

OPTIONAL FEATURES:
(subject to funding)
- PEDESTRIAN BRIDGE
- EXPANDED TRAIL
- LOOKOUT

EMBRO DAM CLASS ENVIRONMENTAL ASSESSMENT

ALTERNATIVE 3
REMOVE DAM AND CONSTRUCT NATURAL CHANNEL

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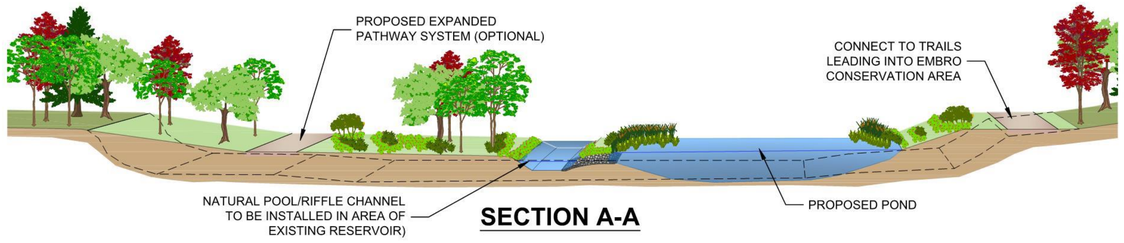
FIGURE 4-3



SECTION A-A

N

A

A

OVERFLOW SWALE

EMBANKMENT ENDS TO BE MAINTAINED AND INTEGRATED INTO SITE RESTORATION PLANS

DAM OUTLET WORKS TO BE REMOVED

FLOW CONNECTION TO NEW CHANNEL

PROPOSED EXPANDED PATHWAY SYSTEM (OPTIONAL)

INTEGRATE CHANNEL INTO DOWNSTREAM CHANNEL

BRIDGE (OPTIONAL)

PROPOSED OFFLINE POND OR WETLAND

WETLAND

POOL

RIFFLE

POND

EMBRO POND

PROPOSED LOOKOUT ON OLD DAM EMBANKMENT (OPTIONAL)

PROPOSED OFFLINE POND OR WETLAND

RESERVOIR TO BE DRAINED AND SEDIMENT REMOVED/REUSED AS REQUIRED TO ESTABLISH A NATURAL SLOPE IN THE NEW CHANNEL

RD 84

NATURAL POOL/RIFFLE CHANNEL TO BE INSTALLED IN AREA OF EXISTING RESERVOIR)

BIOENGINEERING BANK STABILIZATION

CONNECT TO TRAILS LEADING INTO EMBRO CONSERVATION AREA

YOUNGSVILLE DRAIN

0 30 60 Meters

POND WITH CREEK

CORE FEATURES:
- NEW PATHWAYS/TRAIL CONNECTIONS
- NATURALIZATION AREAS
- SAFE SLOPES
- NATURAL CHANNEL
- SHORELINE ENHANCEMENT
- OFFLINE POND/WETLAND

OPTIONAL FEATURES:
(subject to funding)
- PEDESTRIAN BRIDGE
- EXPANDED TRAIL
- LOOKOUT

EMBRO DAM CLASS ENVIRONMENTAL ASSESSMENT

ALTERNATIVE 4
REMOVE DAM AND CONSTRUCT OFFLINE POND(S) OR WETLAND(S)

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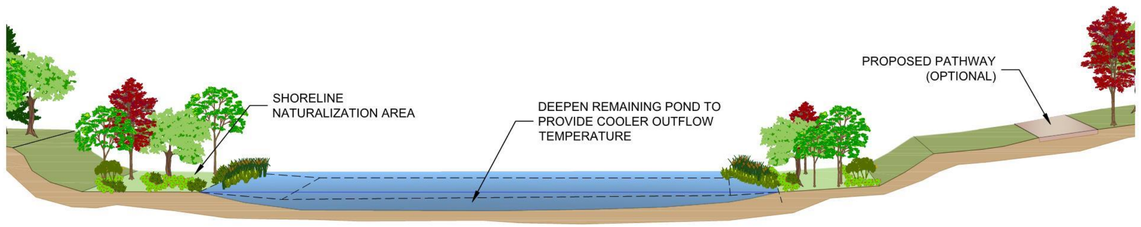
FIGURE 4-4

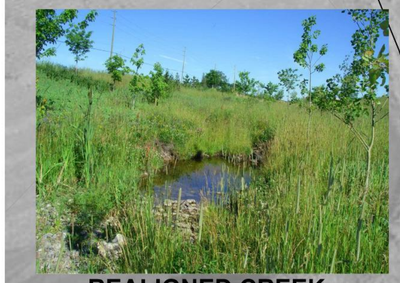


SECTION A-A

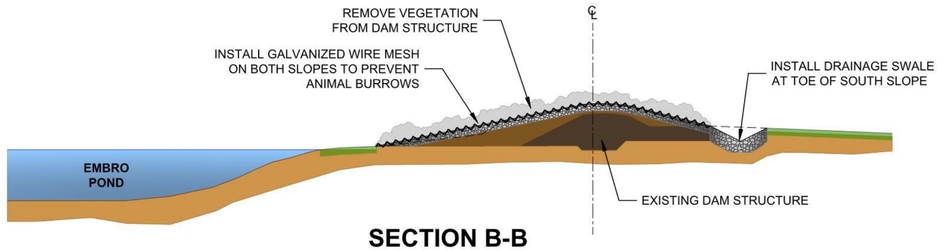
CORE FEATURES:
- NEW PATHWAYS/TRAIL CONNECTIONS
- NATURALIZATION AREAS
- SAFE SLOPES
- NATURAL CHANNEL
- SHORELINE ENHANCEMENT

OPTIONAL FEATURES
(subject to funding)
- EXPANDED TRAIL
- LOOKOUT

PROPOSED PATHWAY (OPTIONAL)
OVERFLOW SWALE
STABILIZE AND REPAIR EMERGENCY SPILLWAY TO MEET INFLOW DESIGN FLOOD CRITERIA
A
B
B
EMBRO POND
LOWER DAM CREST AND OUTLET BY APPROXIMATELY 1.0m
DEEPEN REMAINING POND TO PROVIDE COOLER OUTFLOW TEMPERATURE
EMBANKMENT TO MEET SLOPE STABILITY AND FREEBOARD CRITERIA
SHORELINE NATURALIZATION AREA
A
NATURAL POOL/RIFFLE CHANNEL TO BE INSTALLED IN AREA OF EXISTING RESERVOIR)
RIFFLE
POOL
RD 84
BIOENGINEERING BANK STABILIZATION
CONNECT TO TRAILS LEADING INTO EMBRO CONSERVATION AREA
YOUNGSVILLE DRAIN
0
30
60
Meters



REALIGNED CREEK



SECTION B-B

EMBRO DAM CLASS ENVIRONMENTAL ASSESSMENT

ALTERNATIVE 5
LOWER DAM CREST AND OUTLET AND NATURALIZE NEW POND PERIMETER

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FIGURE 4-5

Opportunities and Constraints

Alternative 1 - Do Nothing

No intervention would be implemented

Opportunities	Constraints
No immediate cost	Does not meet dam safety guidelines
Maintains current aesthetic	Has a risk of failure – this can impact the channel by flood, erosion and sediment
Maintains current uses	Requires regular monitoring
	Imposes an impediment to fish passage
	Increases water temperatures seasonally
	Accumulates sediment, will fill over time
	Impedes sediment transport

Alternative 2 - Repair Dam

Construct Dam 'Shell', add rock protection, extend outlet pipe, provide emergency spillway

Opportunities	Constraints
Complies with Dam Safety Guidelines	Imposes repair costs (moderate)
Maintains current aesthetic	Imposes an impediment to fish passage
Maintains current uses	Increases water temperatures seasonally
	Accumulates sediment, will fill over time
	Impedes sediment transport

Alternative 3 - Remove Dam and Construct Natural Channel

Remove Dam, construct natural channel, provide landscape restoration

Opportunities	Constraints
Restores area to pre-existing conditions	Imposes restoration costs (moderate)
Provides diverse fish habitat	Does not reflect existing aesthetic (open water)
Provides sediment transport	Has the risk of impacting shallow wells
Maintains creek temperatures	
Removes risk of dam failure	

Alternative 4 - Remove Dam and Construct Offline Pond/Wetland

Remove Dam, construct offline pond with less surface area as existing, create natural channel, provide landscaping

Opportunities	Constraints
Restores area to pre-existing conditions	Imposes restoration costs (high)
Provides aquatic habitat diversity	Reduces pond surface area (water views)
Provides sediment transport	
Maintains creek temperatures	
Removes risk of dam failure	
Partially provide water views	

Alternative 5 - Lower Dam Crest and Outlet and Naturalize Pond Area

Lowers height of dam, provides less surface area as existing, create natural channel, provides landscape enhancements

Opportunities	Constraints
Partially maintains current aesthetic	Imposes restoration costs (high)
Reduces solar heat gain compared to existing	Reduces pond surface area (water views)
Reduces magnitude of potential impacts in the event of breach/failure	Imposes an impediment to fish passage
Provides diversity in landscape	Imposes a risk to increase water temperatures seasonally
	Accumulates sediment, will fill over time
	Impedes sediment transport

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Meeting Minutes

B1-550 Parkside Drive, Waterloo, Ontario, N2L 5V4
Tel 519.621.1500 ■ Fax 226.240.1080

Project:	Harrington and Embro Dam EAs	**Meeting No.:**	PIC 2
		Meeting Date:	May 10, 2016
Project No.:	1505	**Meeting Time:**	7 – 9 pm
Recorder:	M. Pushkar	**Report date:**	May 26, 2016

Location:	Embro Community Centre – 355644 35th Line, Embro, ON
Attendees:	Rick Goldt, Bill Mackie, (UTRCA) Wolfgang Wolter, Mariëtte Pushkar (ERI) Marie Keasey, Doug Matheson, Marcus Ryan, Margaret Lupton (Zorra Township) Members of the public (2)
Purpose:	Public Information Centre 2 – Embro Dam

Item	Description	Action By
1.	**Presentation** • Presentation of study findings, evaluation criteria and alternatives was made by Wolfgang Wolter (ERI)	Info
2.	**Questions posed by members of the public and answers provided by team:** **1. How much effort was put into identifying salamander Species-at-Risk?** Incidental observations of salamanders were made during the field assessments by UTRCA staff. A specific field investigation for the presence of salamanders was not undertaken. **2. Can shallow wells be identified on the slide so that we can make a better informed evaluation?** Where possible, based on MOE data, shallow wells will be identified on the mapping. **Are there shallow wells?** There are at least three shallow wells (2 – provincial monitoring, 1 well on the dam for monitoring) **3. With regards to the offline pond, will it go stagnant or green with algae?** • Algal growth can be a concern and is a risk. There are various aspects that would decrease the likelihood of algal growth in the study area, within the proposed alternatives: • There will still be high groundwater inputs • In the alternatives, there will still be a connection between pond and creek to ensure some water augmentation and/or flushing. • Adaptive management could be implemented • An offline pond does not have same risk of sediment concentration of nutrients: o Contaminated material will be dredged o There will not be as much sediment/nutrient loading as existing conditions (i.e., upstream landuse changes etc.) **4. What is the issue if fish species upstream and downstream are different?** • Habitat fragmentation occurs due to the dam. • Diversity and health of the fish communities is affected by the dam.	ERI

	• Species numbers are important factors in assessing health of community. • Removal of the dam will gain ~ 2 km of upstream habitat for the fish that now occur downstream. • Dam removal will improve water temperatures that will benefit downstream water quality and habitat. **5. U.S. and Canada want to decrease total phosphorous loading to the Great Lakes. Fifty percent of contaminated sediment goes through with total phosphorous, why then do we want sediment movement?** • Phosphorous becomes a part of the biomass (i.e. consumed by fish etc.). • Sediment movement is required for river processes (i.e., loss of sediment load increases erosion potential of flows) • Issue of total phosphorous loading involves sediment from fields (landuse management); not just the creek. **6. Is there any issue with silt sediment? What can be done?** • The silt can be re-used on land and does not have to be landfilled. Only a small sample was taken for the sediment testing. **7. What was the cyanide from? Was it from Blue-green algae? What was the concentration?** • The sample was taken 1 m below the ground. • The origin of the cyanide is not known at this time. • The concentration levels and MOE standard will be identified before the presentation is posted on the UTRCA website. **8. Where does the money come from for implementing the preferred alternative? What is the risk and feasibility of finding funding source?** • Government funding – there is a table which indicates that more money is available for dam removal projects • Fundraising by public/friends of environment • Conservation Authority **9. Is the selection of the preferred alternative limited by funding?** • Funding is considered in the alternative evaluation process but does not define the preferred alternative. Funding may impact selection of the preferred alternative. **10. No weather data was provided; what happens if a catastrophic even occurs?** • UTRCA – risk of dam overtopping is based on the 50-year IDF. **(Residents have had 5" of rain in 24 hours)** The magnitude of the event depends on existing conditions at time of storm such as; pre-existing soil moisture, time of year, area over which storm occurs (was it local?), duration/intensity of storm etc. **11. Once decision is made, what will be the time span for taking action (e.g. 10 years)?** Action will take place as quickly as possible - although obtaining funding may take a few years. The EA process allows 5 years.	ERI

Upper Thames River Conservation Authority

Class Environmental Assessment

Embro Dam

Public Information Centre – Comment Form

The Environmental Assessment for the Embro Dam, in the Embro Conservation Area, is intended to address safety concerns identified as part of the Dam Safety Assessment (ACRES, 2007) including insufficient spillway capacity, insufficient freeboard, embankment stability and conveyance of flood flows through the emergency spillway. Through the study, potential alternatives will be evaluated to determine a course of action to mitigate dam safety concerns.

The project is being carried out in accordance with the requirements of the *Conservation Ontario Class Environmental Assessment.* The study is being undertaken by the Upper Thames River Conservation Authority (UTRCA).

Public consultation is a key component of this study. This Public Information Centre (PIC) is held to receive public input on the possible future alternatives for the Embro Dam. Any feedback and comments provided will become part of the public record for this project.

Please provide your comments in the areas that interest you.

Comments:

Considering the evaluation criteria required to be assessed through the Environmental Assessment process, what I like and/or dislike about each alternative for the Embro Dam is as follows :

Alternative 1 – Do Nothing

Alternative 2 – Repair Dam

Alternative 3 – Remove Dam and Construct a Natural Channel

Alternative 4 – Remove Dam and Construct Offline Pond(s) or Wetland(s)

Alternative 5 – Lower Dam Crest and Outlet and Naturalize New Pond Perimeter

The Alternative that I like the most is Alternative: 1 2 3 4 5 (Please Circle)

Other things that have not been discussed but which the study team should consider?

Please print your name and address below, and leave your completed Comment Form in the box provided. You may also email your comments to embro_dam@thamesriver.on.ca, or mail your comments to:

Rick Goldt C.E.T.
Supervisor, Water Control Structures
Upper Thames River Conservation Authority
1424 Clark Road, London, ON N5V 5B8
Tel.: 519-451-2800 ext. 244
goldtr@thamesriver.on.ca

Name: _____

Address & Postal Code: _____

E-mail Address: _____

Please submit comments by May 31, 2016
Thank you for your participation.

Personal information on this form is collected under the authority of the Conservation Authorities Act and will be used for the purposes of the Embro Dam Class EA only. Questions about the collection of personal information should be directed to: General Manager, Upper Thames River Conservation Authority, 1424 Clarke Rd., London, Ontario. N5V 5B9 (519) 451-2800.

Embro Dam Class EA

Public Information Centre #2, May 10, 2016

Sign Up sheet to receive notices and information during the EA project

Name (print)	Full Address	Mailing address (if different)	Phone #	Email (print)	Would like to receive: (please check mark)	
					Notices	PIC materials
MARIE KEASEY	[redacted]				✓	✓
DOUG MATHESON					✓	✓
Marcus Ryan					✓	✓
Margaret Lupton					✓	✓
DON CAMPBELL					✓	✓

Personal information on this form is collected under the authority of the Conservation Authorities Act and will be used for the purposes of the Embro Dam Class EA only. Questions about the collection of personal information should be directed to: General Manager, Upper Thames River Conservation Authority, 1424 Clarke Rd., London, Ontario. N5V 5B9 (519) 451-2800.

Embro Dam Class EA

Public Information Centre #2, May 10, 2016

Sign Up sheet to receive notices and information during the EA project

Name (print)	Full Address	Mailing address (if different)	Phone #	Email (print)	Would like to receive: (please check mark)	
					Notices	PIC materials
PHILIP KERR	[redacted]					

Personal information on this form is collected under the authority of the Conservation Authorities Act and will be used for the purposes of the Embro Dam Class EA only. Questions about the collection of personal information should be directed to: General Manager, Upper Thames River Conservation Authority, 1424 Clarke Rd., London, Ontario. N5V 5B9 (519) 451-2800.

From: "P. Hunter" [redacted]
To: Rick Goldt <goldtr@thamesriver.on.ca>, SOX Roger Boyd [redacted]
CC: [redacted]
Date: 6/15/2016 4:20 PM
Subject: CEA Embro PIC Comment Form

Hi Folks,

Rick,
Pls accept the following reply formatted from your earlier email -

From: Rick Goldt
Sent: Wednesday, June 15, 2016 12:14 PM
To: Pud Hunter ; Pud Hunter
Subject: Comment Sheets Harrington and Embro EA PIC2

- which I copied/ attached to this/ my email.

Thk you, Pud

****
Upper Thames River Conservation Authority Class Environmental Assessment

Embro Dam

Public Information Centre - Comment Form

The Environmental Assessment for the Embro Dam, in the Embro Conservation Area, is intended to address

safety concerns identified as part of the Dam Safety Assessment (ACRES, 2007) including insufficient spillway

capacity, insufficient freeboard, embankment stability and conveyance of flood flows through the emergency

spillway. Through the study, potential alternatives will be evaluated to determine a course of action to mitigate

dam safety concerns.

The project is being carried out in accordance with the requirements of the Conservation Ontario Class

Environmental Assessment. The study is being undertaken by the Upper Thames River Conservation Authority

(UTRCA).

Public consultation is a key component of this study. This Public Information Centre (PIC) is held to receive

public input on the possible future alternatives for the Embro Dam. Any feedback and comments provided will

become part of the public record for this project.

Please provide your comments in the areas that interest you.

Comments:

This submission is on behalf of Stewardship Oxford (SOX), an Oxford County based Council promoting sustainable resources management.

Such management are to be achieved through current environmental standards and science based information.

Considering the evaluation criteria required to be assessed through the Environmental Assessment process,

what I like and/or dislike about each alternative for the Embro Dam is as follows :

Alternative 1 - Do Nothing

Dislike: perpetuates status quo which is detrimental to sustainable recourse management and results in deteriorating environmental conditions.

Does not allow upgrading to current environmental standards.

Alternative 2 - Repair Dam

Dislike: perpetuates zero environmental standards of the 1964 construction; suggest cost-benefit analysis.

Alternative 3 - Remove Dam and Construct a Natural Channel

Like: upgrading to current environmental standards; enhancing watershed benefits.

Page 2 of 2

Alternative 4 - Remove Dam and Construct Offline Pond(s) or Wetland(s)

Like: preference for wetland prior to pond.

Dislike: artificial structure; management needs so pond or wetland does not negatively impact watercourse; suggest cost-benefits analysis.

Alternative 5 - Lower Dam Crest and Outlet and Naturalize New Pond Perimeter

Dislike: maintains status quo management; perpetuates degraded/ degrading environmental conditions.

The Alternative that I like the most is Alternative: 1 2 3 4 5 (Please

Circle) 3

Other things that have not been discussed but which the study team should consider?

Please print your name and address below, and leave your completed Comment Form in the box provided. You

may also email your comments to embro_dam@thamesriver.on.ca, or mail your comments to:

Rick Goldt C.E.T.

Supervisor, Water Control Structures

Upper Thames River Conservation Authority

1424 Clark Road, London, ON N5V 5B8

Tel.: 519-451-2800 ext. 244

goldtr@thamesriver.on.ca

Name: Submitted on behalf of Roger Boyd, Chair Stewardship Oxford (SOX)

Address & Postal Code: [redacted]

E-mail Address: [redacted]

By: P. Hunter, Director on Stewardship Oxford (SOX); [redacted]

Please submit comments by May 31, 2016

Thank you for your participation.

Personal information on this form is collected under the authority of the Conservation Authorities Act and will

be used for the purposes of the Embro Dam Class EA only. Questions about the collection of personal

information should be directed to: General Manager, Upper Thames River Conservation Authority, 1424

Clarke Rd., London, Ontario. N5V 5B9 (519) 451-2800.

From: "P. Hunter" <[redacted]>
To: Rick Goldt <goldtr@thamesriver.on.ca>, Robert Huber <[redacted]>
CC: Randy Bailey <[redacted]> <[redacted]>
Date: 6/15/2016 4:20 PM
Subject: CEA Embro PIC Comment Form

Hi Folks,
Pls note this is submitted on behalf of, & copied to, Thames River Anglers Association attn Rob Huber, President and Randy Bailey, Past President.

Rick,
Randy Bailey was the TRAA rep at the Embro Open House.

As well, pls accept the following reply formatted from your earlier email -

From: Rick Goldt
Sent: Wednesday, June 15, 2016 12:14 PM
To: Pud Hunter ; Pud Hunter
Subject: Comment Sheets Harrington and Embro EA PIC2

- which I copied/ attached to this/ my email.

Thk you, Pud

****
Upper Thames River Conservation Authority Class Environmental Assessment

Embro Dam

Public Information Centre - Comment Form

The Environmental Assessment for the Embro Dam, in the Embro Conservation Area, is intended to address

safety concerns identified as part of the Dam Safety Assessment (ACRES, 2007) including insufficient spillway

capacity, insufficient freeboard, embankment stability and conveyance of flood flows through the emergency

spillway. Through the study, potential alternatives will be evaluated to determine a course of action to mitigate

dam safety concerns.

The project is being carried out in accordance with the requirements of the Conservation Ontario Class

Environmental Assessment. The study is being undertaken by the Upper Thames River Conservation Authority

(UTRCA).

Public consultation is a key component of this study. This Public Information Centre (PIC) is held to receive

public input on the possible future alternatives for the Embro Dam. Any feedback and comments provided will

become part of the public record for this project.

Please provide your comments in the areas that interest you.

Comments:

This submission is on behalf of the Thames River Angling Association (TRAA).

TRAA is a Thames River Watershed based Association promoting wise resources management and benefits associated with the Thames River Watershed.

Considering the evaluation criteria required to be assessed through the Environmental Assessment process,

what I like and/or dislike about each alternative for the Embro Dam is as follows :

Alternative 1 - Do Nothing

Dislike: perpetuates status quo which is detrimental to sustainable recourse management and results in deteriorating environmental conditions.

Does not allow upgrading to current environmental standards.

Alternative 2 - Repair Dam

Dislike: perpetuates zero environmental standards of the 1964 construction; suggest cost-benefit analysis.

Alternative 3 - Remove Dam and Construct a Natural Channel

Like: upgrading to current environmental standards; enhancing watershed benefits.

Alternative 4 - Remove Dam and Construct Offline Pond(s) or Wetland(s)

Like: preference for wetland prior to pond.

Dislike: artificial structures; management needs so pond or wetland does not negatively impact watercourse; suggest cost-benefits analysis.

Alternative 5 - Lower Dam Crest and Outlet and Naturalize New Pond Perimeter

Dislike: maintains status quo management; perpetuates degraded/ degrading environmental conditions.

The Alternative that I like the most is Alternative: 1 2 3 4 5 (Please

Circle) 3

Other things that have not been discussed but which the study team should consider?

Please print your name and address below, and leave your completed Comment Form in the box provided. You

may also email your comments to embro_dam@thamesriver.on.ca, or mail your comments to:

Rick Goldt C.E.T.

Supervisor, Water Control Structures

Upper Thames River Conservation Authority

1424 Clark Road, London, ON N5V 5B8

Tel.: 519-451-2800 ext. 244

goldtr@thamesriver.on.ca

Name: Submitted on behalf Robert Huber, President, Thames River Anglers Association

Address & Postal Code: London, Ontario

E-mail Address: [redacted]

Addition: Randy Bailey; [redacted]

By: P. Hunter, Thames River Anglers Association; < [redacted]

Please submit comments by May 31, 2016

Thank you for your participation.

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Clarke Rd., London, Ontario. N5V 5B9 (519) 451-2800.

EA Process:
Might help to use layman's terms for spillway and freeboard.

Alternative 1 – Do nothing

- Don't like that it doesn't support the needs of the EA (Including insufficient spillway capacity, insufficient freeboard, embankment stability and conveyance of flood flows etc.).
- Don't like that it postpones safety issues and re-investment financially into an asset that requires attention now

- Like – That there is no loss to end users.

Alternative 2 – Repair dam

- Don't like cost (what is the cost)
- Don't like missing the opportunity to re-connect fish species and improve water quality by taking the dam off-line/out.

- Like no loss/change to end users

Alternative 3- Remove Dam and Construct a natural channel

- Don't like cost (what is the cost?)
- The "loss" of pond feature will cause some heritage impact, a community feature that has been in place since the development of the community.

- With suggested changes can we also reinforce/support bird species community?
- Would a wetland type restoration be a more true representation of what features would have existed before the dam? (cedar trees, some skunk cabbage, cattail etc. exist there already) plus the benefits of water retention (upstream of the dam)
- Can we retain a serene escape area with trail which supports fish and bird species in the most naturally congruent way?
- Perhaps a heritage feature that is water-fall sounding as tribute. A lot of the serenity of the area is created from the current water cascade feature.
- Like that it takes the opportunity to re-connect fish species and improve water quality by taking the dam out.

Alternative 4 –

- Don't like additional cost?

- Like - similar to alternative 3 but reconciles "boat" users losses

Alternative 5 – Lower Dam Crest and Outlet and Naturalize New Pond Perimeter

- Don't like missing opportunities to re-connect fish species and improve water quality
- Cost?

- Like less heritage impact – change to end users would be felt by the "water craft" community if there is one.
- Like that it maintains possible community functions like skating and peaceful waterfall feature etc.

Other thing that have not been discussed but which the study team should consider?

Has the question been asked: What does the community treasure about the dam area specifically?

- Bird watching?
- Skating?
- Water fall (sound)
- Trail?
- Fishing?
- Tourist attraction?

- If there is a way to gear the outcome so some needs of the community are still met? To minimize loss and show investment from the side of the "management" (while still navigating the financial costs carefully).

- Wetland feature seems like a good way to reintroduce some water retention feature and eco-community structure
- Is there any concern of the carp in the pond being reconnected to brook trout downstream?
- Is there any mitigation planned to reduce the effects of carp downstream if re-connection is decided upon?

Name: Anonymous
Address and Postal Code: London, Ontario
Email Address:

Comments on the Considerations for the Embro Dam Environmental Assessment.

By

Donald Campbell, M. Sc., Landowner, [redacted] (not in the watershed but a taxpayer)

21 May 2016

Introduction:

We were told the undertaking of the Class Environmental Assessment has been by The Upper Thames River Conservation Authority and The Township of Zorra.

There have been two public meetings regarding this Environmental Assessment for the Embro Dam. At the first, June 23, 2015, the subject of Dam safety and stability was addressed and the existence of two engineering reports that were both in agreement that the Embro Dam did not meet current safety and stability specifications for earthen dams were made known with no details given. (Acres International, 2007 and Naylor Engineering Associates, 2008). The liability of the owner was also discussed briefly with no real understanding given of the gravity of the liability, as outlined by Rylands v. Fletcher, 1868 (LR 3 HL 330), the standard for strict liability in this country, and with very direct application because it is about liability and negligence of a dam that gave way. The balance of the meeting was taken to describe the process of Environmental Assessments and the methodology that would be undertaken by the Upper Thames River Conservation Authority (UTRCA) and Ecosystems Restoration Inc., (ER) a consultant.

At the second meeting, May 10, 2016, the results of the study for alternative suggestions with what to do with the Embro Dam site were presented by an employee of Ecosystems Restoration, Mr. Wolfgang Wolter. Results were presented from 2 draft reports from 2015: one on existing environmental conditions including 4 appendices, A, B, C, D, (by UTRCA) and one on existing geomorphic conditions (by ER), augmented by several poster boards and power point slides, not all illustrated in the reports. It was evident that the presenter knew very little about the data collected by UTRCA and its implications on his work for solutions on dam safety. As two examples, he did not know the data for a 50 year, 8 day snowmelt event, the standard that he or the company was apparently working to. Nor did he know any details about the cyanide levels that were above provincial guidelines. The details on the Cyanide concentrations have since been added to the presentation slides and the levels of Cyanide are almost double the MOE standard. In my opinion, at that level, it ought to have raised eyebrows to determine the source. The concentration of 0.092 ug/g is an equivalent concentration to 0.092 mg/kg. The LD_{50} for cyanide compounds vary from 5 to 11mg/kg orally and from 11 to 100 mg/kg for inhalation or dermal exposure. (Science Lab.com, MSDS information). Data for Hydrocyanic acid is available from the Center for Disease Control at http://www.atsdr.cdc.gov/toxprofiles/tp8-c3.pdf and this can be lethal at dosages of 100 ppm when breathed for as little as 10 minutes.

At the second meeting, several topics that had not been mentioned in the first were brought forward: as examples, the possibility of extending a cold water creek for some distance, possibly 2 kms, downstream, and increased accessibility for fish to the upper levels of the watercourse without the obstruction of the dam.

No mention of the liability, or summary of the engineering reports, or meteorological data were brought forward at the second meeting and no mention of the usage of this conservation area facility was made.

Only two questions regarding costs were asked by the Mayor of Zorra: how much, and who pays? The estimates of costs were given verbally as the estimate from the engineering company in 2007-8 of $200,000, and so a probable $300,000 today, with additional costs if one of the more sophisticated schemes were selected.

I asked several other questions at the time, including the effort put into looking for Jefferson's salamanders, a species at risk, cyanide concentrations, liability, shallow well location, and others.

My overall analysis:

In determining a course to take on the analysis of this project, I have read both engineering reports by Acres International and Naylor Engineering Associates and the draft reports and appendices of 2015. I have copies of the two draft reports and have attended both meetings. I also have firsthand knowledge of the effects of Rylands v. Fletcher, the law case.

There does not seem to be any conflict that there is either maintenance required to upgrade the Embro Dam to current standards or its removal to end an unsafe dam. The question of liability is the top priority for my analysis. The second priority for my analysis is total cost of the project and then how the cost is reconciled with a cost/benefit to the community.

To locate this pond, Acres says in at least 3 instances in their report that the pond is south of the village of Embro, Naylor says it is north of the village. Acres is not correct. Both engineering reports say the dam is on Spring Creek while the UTRCA calls the watershed the Youngsville Drain. The creek in the watershed immediately west of the Youngsville Drain is called the Embro Creek in the UTRCA report. I will use the nomenclature of the UTRCA in this report.

To make a good recommendation on Liability, one needs good facts on which to base the risk of a failure of any kind, and some understanding of the facts that might provoke a catastrophic failure with all of the water behind the dam set free.

None of the 2015 reports including appendices have any weather data in them, and there is no mention of what the storm event is, in numerical terms, for their standard or whether we are experiencing more frequent, or more severe weather events, although those of us who do live in the area know that, in fact, we are experiencing heavier rainfalls in shorter time spans, more frequently. This is confirmed in the Acres report in a comparison of Tables 6.1 and 6.2. The liability of this project ought to be determined by accepting the simulation data of the chosen rainfall events in the Acres' report with ensuing run-off and watershed loading into the dam catchment area, the rate of rise into the catchment basin and the rate of water exit from the catchment basin. That material shows that in only two incidents of historical weather events does the dam overflow the crest by simulation. It ought to be noted that in Figures 6.5, 6.6 and 6.7 of the same chapter of the Acres' report, the simulation calibration curve is higher than actual in each event modeled. This model could now be run with both the current weather data and proposed systems to estimate differences in downstream water flow and potential damage to downstream property. Without such a mathematical approach, all else is but a guess. It ought

to behoove the UTRCA, as owner, that there might be at least an educated guess, rather than a blind faith approach with regards to their liability. However, there is the shoe on the other foot that might argue that the removal of the dam facilitated immediate runoff and damage that would have been less had the reservoir been maintained, and so the owner could be deemed negligent for its removal. See the last paragraph of page 6-23 of the Acres' report.

The application of Rylands v. Fletcher in this country is well known and I have used the principle and case against the Township of Zorra for the loss of trees to their roadside spray programme. The principle of Strict Liability is forthrightly set out in this case.

To illustrate how difficult it is to attempt to quantify risk from these reports (as measured by the volume of water withheld by the dam) consider the data regarding the surface size of the pond. Without the surface size, it is virtually impossible to define volume withheld in the dam catchment.

In the executive summary of the Acres study, the area of the pond is stated as 0.008 km^2 or 0.08 hectares. In Figure 1 of the same executive summary the area is stated as 0.005 km^2. In section 3.1 of the Naylor Engineering report, the area is considered to be 6500 m^2. On page 3 of the Existing Environmental Conditions report the area is given as 0.8 hectares, and the site is further expanded on Page 17 as a structure of 91 meters and a lake 183 m long by 91 m wide. Then to complicate things even further, Appendix F of Appendix D suggests that in 1959, "the new structure is 300 feet and a lake (600 feet at the dam narrowing to 200 m x 300 feet long)". On May 17, 2016, I went and measured the pond with a Golf Buddy, a laser device claimed by the manufacturer, Deca Systems Corp., to be accurate to within 1 yard or 0.9144 m. My measurements were as follows: the dam is 91 m. from outside lateral edge to outside lateral edge. The distance within the pond from the dam to the inlet (a large granite boulder on the east shore) was 183 m. (See photo on panel 12 of the Environmental Highlights powerpoint presentation : http://thamesriver.on.ca/wp-content/uploads//FloodStructures/OtherStructures/Embro-PIC2-UTRCApresentation-2016-05-10.pdf. There was a further 45 m to the culvert at the road. The narrowest point of the pond was 137 m. from the dam, and at that point, the pond was 40 m wide. The water width at the outlet structure was 77 m. There is additional surface area at the same level as indicated in the Existing Geomorphic Conditions report in Figure 1-3, but in this figure, they have a rise of about 0.1 to 0.15 m from the culvert on road 84 to about the station XS11 at 400 m. on their scale of chainage with no reason in the Thalweg to have a rise in water level.

There are considerable differences in the description of the pond, and the closest to my measurements, although it overstates the area of water at the existing overflow level, is that of the UTRCA at 91m x 183m. or 16,653 m^2. My measurements indicate that it would be 9,934 m^2 if I treat the area as a rectangle and triangle attached. Both of these methods overestimate area due to the narrowing of the pond on both sides and so for convenience sake, 10,000 m^2 might be reasonable considering the area above the 183 m distance with the same surface level. In any event 10,000 m^2 is one hectare so the errors in the various reports are substantial and make quantifying the volume of water in the catchment nearly impossible and verifying it no better. That ER has calculated the volume of 30,000 m^3 as the possible catchment volume as reported in the second presentation, would mean that the current pond would have sides at 90° vertically for the whole of the area and that the dam would be overridden for the whole of the length. From their Figure 1-3, this is not the case. Once again, this significantly overestimates the potential liability.

With respect to costs, the presenter, Mr. Wolfgang Wolter, a senior project manager of ER, said at the meeting, that the estimates from the engineering reports were in the neighbourhood of $200,000.00 and that inflation from 2007-8 to now meant that that would be $300,000.00. Mr. Wolter considered that as moderate in the descriptions on the slides that considered costs. Only Acres estimated costs for rehabilitation and at less than $81,000. 00, (Table 11.5 in Acres' report) and therefore the verbal estimates of costs were not particularly accurate, given Mr. Wolter's formula for inflation, unless things have become much worse than he projected or the designs are incredibly cost intensive.

At some time in the past, and within the last 25 years, this pond has been drained and the silt cleaned from the pond floor, although this was not recognized in the questionnaire in Appendix E of the Acres' report. It is the recollection of both Mr. Fred Munro (personal communication) and me that the excavated silt was all deposited on the south and west face of the dam. On inspection by the author on May 17, 2016, it was observed that there was considerable earthen support for the back slope that extended to almost half the length of the dam or about 44 meters from the west. It also appeared that the fill on the backside was higher than the water level in the pond at the level of the current overflow, although I had no way of measuring that easily. This surface sloped off down the hill but was considerably less steep than the 1V:4H recommended in the engineering reports and for a much greater distance than was suggested in those reports. What may need to be incorporated, may be the seepage layer and drain that, in all probability, was not installed at the time, because that fill was placed prior to the engineering reports. This silt removal may also make the predictions by ER of the silting rate moot, because the rate with the current silt levels appears slower than it really is.

At the second meeting, it was stated that 3 shallow wells (that were unable to be identified but were of concern for effects if the pond were drained), as discussed in the meeting would be indicated on the Figure 7 of the Environmental Conditions report once posted on the website for general distribution. In fact there are 5 noted on the updated Figure 7 of the UTRCA. Further to my discussion with Mr. Fred Munro, Ornum Farms now rely on two drilled wells for the farmstead on Lot 16 Conc.4. that are both artesian and overflow constantly. The blue dot in the upper left corner of Figure 7, may be a well bore, but it is on top of the hill and is the exit for a manure transmission line that is below the creek bed, as some security to avoid spills. All the shallow wells marked are on the property of the UTRCA and therefore only impact the owner of the dam. However, the flow from the wells may have biased the conclusions for recharge mentioned in Appendix A of the UTRCA report.

There are several other areas that require comment. The first is the suggestion that a cold water creek could be continued below the dam for up to two kms. At no time has the measurement of water temperature or flow been considered from the Embro Creek to the west, which joins the Youngsville Drain, estimated at 400 m south of the overflow of the Dam.

It should be noted that the diurnal temperature of the upstream flow in Figure 9 of the Existing Environmental Condition study and again as Figure 2 in Appendix B, is such that daytime upstream water temperatures are nearly the same as those downstream of the dam, and if plotted as Daily Maxima against each other, the difference would not be very great. Figure 3 shows that the upstream water temperatures are higher than the downstream temperatures at some times in the day, but if both curves in Figure 3 were integrated, it is obvious that there is more area under the downstream curve than the upstream curve so, there is more heat energy in the water downstream than in the upstream water. It is the night time minima that remain

different. This suggests that the water mixing in the pond would be different from day to night. The daytime mixing would occur on the surface of the pond because the water is of similar temperatures and the night time mixing would have the colder water subsiding as it entered the pond. Therefore, at night the flow exiting the pond would be surface water pushed up and out by water entering and staying low, and the water exiting will be warmer than the inflow from the calorimetric effects of the past day. Daytime overflow would also be surface water exiting but a mixture of old and new water if the currents managed to get new water to the overflow structure in the day. It would appear as if cooler water temperatures in the upper part of the watershed might be maintained more effectively with more tree cover. During the early 1980's, I did own the west part of lots 17 and 18, conc. 4, which did include this drain, and there was almost no tree cover on the creek on that 150 acres at that time.

With regard to fish and the effects of the dam on their accessing the upper reaches of the drain, the species count above and below differs by 13, with more below, as shown in Appendix C. No mention was made of those species that were cold water fish and those that were not. Thus the benefit for extending the range or the accessibility of the cold water creek is not well defined in this report.

Without the temperature data and flow rates from the Embro Creek, no estimate of the calorimetric data can be ascertained from this report and therefore no real estimate of how far below the dam the cold water creek might realistically extend. It is unlikely that it would be much past the confluence of the Embro Creek.

A further area for comment is the water flow data in the Environmental Conditions report and Appendix A .There were no HOBO measuring devices or any flow meters of any kind on any part of this water system within a reasonable distance to measure water flows. On page 11 it is assumed that the weather patterns for Embro and Harrington are similar. That is not a particularly good assumption. Mr. Charles Munro kept weather records while he was alive and in a discussion with him, he said that his farm at lot 16, conc. 4, immediately north of the pond on Road 84, received 2" (5 cms) more rainfall a year than Braemar, a small hamlet just 4 miles (about 6 kms) east of the Embro Road (County Road 6) on road 84. Harrington gets more snow than the Youngsville drain as the nominal southerly limit of a snowfall line is about Brooksdale. (It was pointed out to Mr. Wolter and Mr. Goldt at the meeting in June of 2015 that there was a good dataset of precipitation near the Harrington water shed with Mr. Robert Matheson on the 31st Line. Whether that dataset was obtained is not known.)

Thus comparisons made by extrapolations made this way of apparent water flows between the Youngsville Drain and Harrington watershed are not reproducible in any scientific way. There is no scientific reason to join the data points in Figure 9 of Appendix A, because these are one day measurements not continuous measurements, and it would appear as if the readings on 11 June 2016 indicate a difference in weather pattern. Unlike section 6 of the Acres' report, there was no detailed calibration to observed measurements over time to attempt to justify this method. As well, although shallow aquifers are mentioned in both water sheds, no mention was made of artesian wells overflowing within 300 meters of the Embro Pond inlet. In any event, the flows measured and reported do not come anywhere near the 50 year, 8 day snowmelt that is the standard. Nor do they represent a rainfall event like the one in 2000, or the one in the mid to late 80s when we received more than 180 mms (7 inches) of rain in less than 36 hours in early June. When the method for estimating flows and water level rises was so clearly laid out in the Acres Report at 6.2, the reason for not using that is not understood.

There are other minor errors in the text of the Geomorphic report. In table 1-1 section 1, there is no separation of the drain from Private property by trees. All of that land including the Youngsville Drain is on that farm, which has been in the Munro family for 5 generations now, and it has been private for all five generations.

Within the Environmental Conditions report, it is not really reasonable to present data in charts with the lines joining the points because all data reported are taken on a particular day with 4 sample dates, and amount to "snapshots", rather than peaked, continuous curves as shown.

As a plant physiologist by training, the comments about orthophosphorus availability and uptake on page 5 of Appendix B, are of questionable accuracy. Normally phosphorus is absorbed by specific root clusters in the top few centimeters of soil while the plant is in the juvenile stage for most grasses and cereals. This occurs well before mid to late summer, as Winter wheat absorbs 90% of its phosphorus by the time it has reached 25% of its growth. In maize, the uptake continues past anthesis but at a declining rate, with almost no uptake at or beyond physiological maturity in the fall. In a study on phosphorus loading into Holiday Creek by researchers from the Canada Center of Inland Waters in Burlington, results showed that 50% of the phosphate that entered the stream was adsorbed onto soil particles. That experiment centered on my home farm at Lot 16, conc.1, less than 3 miles west of the Dam. This effect is illustrated by comparing suspended solids in Figure 9 with the phosphorus data in Figure 6 of this same appendix. With the current undertaking by Canada and the United States to reduce nutrient loading into watercourses emptying into Lake Erie, particularly phosphorus, more emphasis ought to be given to remediation that does cause settling out of suspended solids with the associated clean-outs over time, than has been suggested in this report. At the very least, the terms of this international undertaking ought to be known before implementing any changes to this watercourse. It is a chance to lead, not redo once things are better understood. Within the last few slides of the second meeting that outline pros and cons of each choice put forward, silt deposition and impedance of silt transport are always considered as negative effects. These two processes do have the advantage of decreasing Phosphorus runoff and ought to be reconsidered as positives within the new phosphorus control initiative between Canada and the United States.

To conclude the second meeting, Mr. Wolter said that the data from all of the reports and public input would be used in a "risk matrix" to come up with the best solution. This would include the cultural, economic, technical and environmental material and suggestions put forward, mostly by the UTRCA and ER.

The current science to deal with weather simulations is an iterative approach because of the number of possibilities that arise to predict weather. The same sort of approach ought to be undertaken here because each of the four main criteria have several divisions within each group and so every choice offers a different outcome. Using a linear or non-iterative approach will bias the results to the method of input of choices. For a description of the weather prediction process, it is described in the lecture given by Dr. Tim Palmer of Oxford University in Waterloo, Ontario on May 4, 2016 that is available on the website of The Perimeter Institute in the Video Library. The title of the lecture is Climate Change, Chaos and Inexact Computing.

The second presentation includes comments about building a natural watercourse in some options suggested. I would like to point out that in the case of the Van Mannen Drain

heard before the Provincial Drainage Referee, The Township of Zorra's lawyer argued that any improved watercourse was no longer a natural watercourse and that was accepted by that Referee. This watercourse cannot be re-established as a natural watercourse, unless the dam is removed and everyone just walks away. The proposals are anything but natural watercourses.

Conclusions:

It is particularly discouraging to see the lack of quality in a report of this kind. It has very little data on which to make decisions that significantly impact both owners of dams and taxpayers. There have been major oversights not to include weather data of any kind when there is data available. There have been some considerable overestimations and underestimations in pond volumes and underestimations of dam profiles on the south west surface. There has been some misrepresentation of data by presenting graphs with continuous lines rather than points, because there is no continuity to the dataset used. And there has been a great amount of disinterest on getting the facts accurately reported for the meetings by Mr. Wolfgang Wolter. He has not had the information when he ought to have. It makes for very discouraged tax payers who foot the bill for such so called experts or consultants.

To my mind, there are only two choices for the future of the dam. Both engineering reports say the risk of failure of the Embro Dam is very low, even if the dam is topped by overflow. While the nomenclature of the wording has been changed by the Ministry, (the lowest class of risk is now "low") a dam that meets safety and stability codes still might be an acceptable risk. The choice ought to be the cheaper of only two projects: to take out the dam completely and fashion a simple watercourse to take the 50 year event as outlined by Acres at 6.3.5 for the spillway with the additional 3 m^3 capacity for the normal drop inlet volume, or follow the Acres and Naylor reports and refurbish the dam. By adding the shell as Naylor Engineering Associates Limited describes it, some additional height will be added, and from the data in Tables 6.8 a and b and 6.12 of the Acres' report, it would appear as if that may prevent the dam from being overtopped. I suspect that the fall between the culvert on Road 84 and the current dam outlet is some of the steepest on the immediate watercourse, and so the construction of the 230 m of watercourse to withstand the 50 year event, may be the more expensive option of these two. Any other choice is not warranted from the current reports because of the lack of good data on which to base choices.

I realize that part of the decision process will rest with the owner, their outlook to liability and the purpose of having such a small holding for day use and how they want to manipulate the environment to suit their mandate of the Conservation Authority Act. In any event, the cost incurred for the benefit of the few day users, or cold water access for a fish population will be high when stated as a cost per use per day. That cost can only be offset by the decrease in liability of either of these two choices when compared to the present risk and liability. Having two engineering reports that agree that the dam is not up to current specifications does document negligence if neither report is acted upon, and the dam fails. It is a wonder that no report is included from the Risk Management Advisor of UTRCA, when such a position exists, because risk is also a part of the environment at this site.

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Material Safety Data Sheet, Potassium Cyanide:
http://www.sciencelab.com/msds.php?msdsId=9927707

Material Safety Data Sheet: Sodium Cyanide:
http://www.sciencelab.com/msds.php?msdsId=9927711

Toxicological Data for Hydrocyanic Acid: http: //www.atsdr.cdc.gov/toxprofiles/tp8-c3.pdf

Rylands v. Fletcher URL: http://www.bailii.org/uk/cases/UKHL/1868/1.html

From: "Don Campbell" <[redacted]>
To: "Goldt Rick" <goldtr@thamesriver.on.ca>
Date: 5/25/2016 8:09 PM
Subject: Embro Dam
Attachments: Report on the considerations for the Embro Dam Safety Considerations.docx

Hi Rick:
I seemed to have a problem with saved files on the weekend and realized that you did not get the complete file. I hope this sorts that out. I ought to have commented that the option with the pond beside the creek would leave the area subject to mosquito production if there were no flow through that pond, and hence the very real probability of West Nile Virus and possibilities for both Malaria and Zika if there is any movement in the mosquito population that harbours that virus. In any event, that pond offers some real risks for the UTRCA. There ought to be 7 pages in the attached file.
Don

Comments with regards to the Class EA for the Dam holding the Embro Pond

From Donald Campbell, [redacted]

Two engineering studies in the hands of the Upper Thames Conservation Authority have apparently shown that there are problems with the integrity of the dam holding the Embro Pond. It was stated that the construction of this dam in 1958 or 59 is now not up to "current standards" and therefore this Class EA has been undertaken.

This appears to be a problem of insurance risk based on Rylands vs Fletcher (1868) LR3 HL330. This does not seem to be an environmental or ecosystem choice, nor a flood control choice. The fact that engineering reports have shown definite weakness within this dam is a cause for a duty to care. That means the choices for that duty to care are that either the dam and spill way are made sufficient to withstand a current big rain event, or the structure is removed and the rain event is now an act of God and so damage exempt from insurance claims.

While the public was invited to comment on a presentation by the Ecosystem Recovery employees, they really did not define the problem in definite, clear terms. I asked the question and received no defined answer for the problem to be solved. There was no definition of what aspects did not fit current construction standards, except to say some angles were wrong and perhaps the materials and core were not proper, but no criteria for data selection were given.

Without the problem being specifically defined, there can be no assurance that data collection that Ecosystem Recovery undertake are relevant to the real problem, however they may relate to an undefined problem and bigger report and consulting fee. In discussions after their presentations, I suggested to Mr. Wolfgang Wolter that many of these studies must have been because of pressure from insurance companies and the strict liability imposed by the historical definition of that in Rylands vs Fletcher. Mr. Wolters agreed that insurance companies played a big part in especially American studies on dams, and the risk of payouts by them, although he had, as far as I could gather, never heard of, or read the court's decision in this case (which is a case involving dams).

For that I submit that the decision can be found at the following web address: http://www.bailii.org/uk/cases/UKHL/1868/1.html

It is somewhat disconcerting to think that The UTRCA has not defined the problem before hiring another engineering firm to do research on the solutions for the dam's conditions when they have two engineering reports in hand on which to base a defined problem. I for one have never seen a problem resolved without the problem well and narrowly defined because collecting and analyzing any data may not be relevant and only relevant data need be collected and analyzed.

The original dam apparently held 3000 cu. m. and the pond has since silted in. The angles of repose of the dam are apparently not what they would be if built today. The mapping of the silt in the pond had been done but no calculation on volume change had been made. Whatever the volume of water held now, it is less than 3000 cu. m. because of silting and so all the pressures on the dam are reduced from the initial build. It would seem that the challenge now is to consider the effect of a big rain event on the overflow capacity, because the effect of a rain event will be to raise the water level at a rate that will be determined by the rate of inflow less the rate of outflow. If the spillway is sufficient, there should be no more water force on the dam than with a full pond. If the inflow is greater than

the outflow, the water will rise and pressures on the dam will increase for at least the duration of the rain event, or until the outflow is equal to or greater than the inflow. This is a fairly simple calculus to determine those changes. While the angles of repose may not be correct, the only changes that can be made are with materials added to the current structure and that will entail either working under water or drain the pond to add and shape the wet side of the dam. Adding more to the berm will not change the core weakness if that is contained in the current reports.

It would seem that if the dam is to be maintained, the safety of the spill way is the most important aspect. That would entail sufficient capacity to take the overflow and sufficient protection to avoid any and all erosion from that flow, since any wear on the backside of the dam will be subject to massive erosion and dam failure. While the watershed for this project was measured at some 7 or 8 square kilometers, the actual watershed of the creek that flows into the Embro Pond is more like 325 to perhaps 500 hectares, and while the runoff from the whole watershed would affect downstream owners, there would only be the additional volume currently held by the pond should it fail catastrophically. If that one time surge is too great a risk for damage to houses on the north edge of Embro, then there is no option but to remove the structure to avoid failure.

The silt currently in the reservoir is only a problem if there is a catastrophic failure and it would leave the site relatively quickly in that failure. By definition, silt is highly erodible and easily carried by water. This material in the base of the pond has all been washed away once, so there will be no effort required to have it move again. Therefore, if the dam is removed, this silt needs to be removed so it will not change ecosystems downstream in a big rain event.

If the dam is to be removed, then it would seem to be wise to contract the silt removal for sale, hopefully with the possibility of silt sales equaling dredging costs. I have removed materials from the pond on Lot 16 in the first concession, and we had Higgs Construction remove the materials from the pond with a 2 cu. yard bucket dragline and then let those piles dry out before trucking. They had no trouble reaching 100' out into the pond for collection of materials. There are a number of contractors selling soils, so there is opportunity for competitive bids for the sale of this material.

The restoration or rehabilitation or additional construction to upgrade to current standards for this dam is only justified if there are ecological, habitat, or flood control benefits that outweigh insurance risk. It will incur costs to remove the dam or shore up the system, but the major risk is the liability. Please be straight with whatever solutions are proposed and the liability ought to be first on the list. My feeling is that not much data need be analyzed for that, beyond what the insurance companies have already told you.

Donald Campbell

From: Rick Goldt [mailto:goldtr@thamesriver.on.ca]
Sent: October-16-16 11:37 AM
To: Don Campbell [redacted]
Subject: Embro Dam EA - Your comments

Dear Sir:

We would like to provide information in return for your comments forwarded to us by email May 21, 2016 following the Public Information Centre #2. While you have not requested a response, we feel it would be appropriate to provide an information update.

First, thank you for the effort you have undertaken in looking through the background documentation we had provided on our website or provided at the PIC. We appreciate your attention to this important matter.
Relevant updates to reports will be posted as completed.

Following in the general order of items noted in your email:

Introduction:

Problem Statement: A summary of the Dam Safety Report (DSR) considerations relevant to the problem statement was presented at all Public Information Centres. The problem statement and presentation indicated the issues to be resolved and particularly the issue that the dam was not safe. Technical data was available in the DSR and was available for download from the UTRCA website.

Flood Standard: Details of flood analysis were contained in the DSR.
Further information is noted below.

Sediment Chemistry: The purpose of sediment sampling and analysis will be clarified in project reports. Sampling of pond sediment was completed to provide a preliminary assessment of sediment quality for the context of potential sediment management needs in the event of dredging. The analytical results are based on one sediment sample collected in the downstream end of the pond. The cyanide (weak acid dissociable) concentration is double the recommended threshold (0.051 mg/kg) when considering reuse of the material for agricultural, residential or Industrial/commercial/community property use. Further investigation will be required to determine if dredged sediment could be landfilled; such investigation would occur during detailed design/maintenance planning.

The threshold values for exposure as you indicated (5 -11 mg/kg for oral ingestion; 11 -100mg/kg for inhalation or dermal exposure) are much higher than the threshold value for sediment reuse (0.051 mg/kg) as defined by MOECC under the Environment Protection Act. Hence, there is minimal concern for health risk, for inhalation or dermal exposure due to cyanides.

Species at Risk: Field wildlife inventory work was completed to make incidental observations for any potential Species at Risk (SAR) identified species, which is an appropriate level of detail for a Class EA study. UTRCA maintains SAR information as up to date as possible in conjunction with the Ministry of Natural Resources and Forestry (MNRF).

SAR was not identified in the vicinity of Embro Dam. We would encourage you to provide a record of observance for your own property as you indicated, to the MNRF to assist them in documenting SAR information if that is the case.

Analysis:

For information we have noted in the 2007 Dam Safety Report name or location description changes required in future for various sections.

Report Graphs: Further to your comments UTRCA has revised the presentation of water quality and hydrology information in the report on existing conditions. Relevant 2015 and other climate data was documented where it may be useful.

Climate Change: We acknowledge the likelihood of more intense local rainfalls anticipated under climate change and are gradually pursuing such research for the Upper Thames watershed as funding permits. This is a point that acknowledges overall that whether a dam remain or be replaced, the risks to existing and future dams may increase under these expected changing conditions.

Flood Standard (continued): The design standard climate event was developed in the DSR prepared by Acres based on existing climate information up to the early 2000's. Section 6 of the DSR develops the critical design events simulated to develop critical hydrology flows and hydrographs. There were many types of flood hydrology scenarios tested.
The Consultant indicated the most critical condition for the Embro Dam for dam safety assessment purposes. Climatic information could be updated for the modeling from 10 - 15 years earlier however in our experience the additional data to date has not yet resulted in any significant change to precipitation statistics. In addition, a local streamgauge is not available to improve calibrations if at all warranted. Regional inferences of hydrologic model inputs, flow information, and type of calibration for the DSR are sufficient to characterize the risk aspects for the Embro Dam at this time. The DSR sufficiently demonstrates that the Embro Dam is not a flood control structure. However, should an alternative which includes a dam then potential climate change conditions would be considered in the detailed design process as much as practical.

Pond Areas - Volumes: We acknowledge that there are differences in the documentation of pond area estimates. We note some of the notations are from historical documentation. There was one typographical error. Values at those times may have been based on other information sources. We have noted that the Acres values in some instances are due to misplaced decimal place. A typo was found in a reference to Embro Pond historical reference and changed. We re-measured the pond area from aerial photos as 0.98 ha which is close to your area of 0.99 ha. More critical are estimates of pond volume. The purpose of estimates through the DSR were to estimate the water storage volume to determine the hazard classification for the dam and to verify sufficiently the flood routing and flood passing capacities. For the EA, the purposes of new volume estimates were to evaluate the potential sedimentation rates of the pond and was based on information developed after the DSR. UTRCA found that the normal level pond volume estimates are comparable between Acres and Ecosytsem Recovery Inc. estimates. A substantial increase in Acres volumes would be required to improve major floods routing capability and potential for reduced flow discharge capacity requirement.
Estimates of storage loss may be a trend indicator that may affect future flood discharge capabilities. Non- archival plans from 1974 found in 2015 provided some information on pond contours at that time and that may have been the time that dredging was last done, however we have no specific records of

dredging that may have taken place. Pond sediment estimates were based on a comparison of pond bottom elevations obtained by bathymetric surveys completed in 1974 and 2015. There may have been other arrangements . If you have more specific information on dredging if 25 years ago as you noted we would appreciate copies for review. If sediment had been removed some time after 1974 then that would indicate that the rate of sedimentation is a more serious problem.

Costs: At PIC#3 updated estimated costs for all options will be presented.

Wells: The well locations are based on MOECC well data. Review of this data indicates that the particular well mentioned is a 'deep' well.
Any discussion regarding recharge potential were based on a smaller scale/regional study results as depicted on UTRCA mapping. Conceptually, groundwater within the shallow aquifer would could contribute to Embro flows, which may account for the apparent resiliency of these flows during drought conditions. Well locations and classifications will be confirmed during the detailed design process if well function may be affected by the design.

Fisheries: Improvements in reports have been made indicating specific coldwater species.

Embro Creek: Existing conditions reports are intended to provide baseline environmental information; the effects of alternatives is provided within the overall EA report. We did a check on information we had available for comparison of Embro Creek and the Drain. The stream length from the Dam to Embro Creek confluence is about 350 metres and further length from the confluence to North Branch Creek of approximately 1600 metres. Water temperature information was collected coincident for both tributaries only in one past period in 2011 indicated over summer and fall that the average temperature difference at Road 84 on both tributaries was about 7 degrees C. This is not necessarily an indicator for the confluence as seeps and shading below the Road 84 for Embro Creek (County Forest) could ameliorate temperatures towards the confluence. Noted by our fisheries biologist is that brook trout have been sampled on Embro and North Branch Creek although not as abundant as on Youngsville Drain. From an overall perspective any potential for reducing stream temperatures may be a benefit.

Graphs: Air Temperature information is now overlain over the water temperature information presented.

Streamflow: The purposes of flow measurement at Embro was in the interest of attempting to collect representative flow information that might be useful in characterizing the change in flow from upstream to downstream of the dam, and to assist with information relative to geomorphology for evaluation and design purposes. Low flow characterization was the main benefit derived from the field monitoring program. Flow monitoring for the purposes of detailed flood management could take a number of years at significant cost before sufficient representative information could be assembled. UTRCA attempted to contact the references you provided for additional rainfall information, however the information was not at the level desired for the report.

Riparian Vegetation: We appreciate your comments on the riparian vegetation. Text has been modified to indicate that a hedgerow occurs east of the creek.

Phosphorus: We appreciate your comments on phosphorus management.
Overall preferred scientific and practice direction as we understand it
is towards management at source.

Alternatives Evaluation: At the PIC#3 the consultant will be presenting their analysis of the alternatives with respect to the evaluation criteria required as part of the EA process. The methodology is in general accordance with guidelines of practice for environmental assessments provided by the Ministry of Environment and Climate Change and is common practice. We encourage your further participation as this work is further presented.

Natural Channels: The term natural channel design refers to the
alteration of a watercourse into one that replicates the form and functions, from a geomorphologic perspective, of a natural channel.
Although the channel would be 'constructed', flows will modify and maintain elements of the channel so that the watercourse becomes a natural channel again. The intent of natural channel design is to speed up the process of planform and profile development to avoid an increase in sediment delivery to the downstream watercourse, and to more quickly establish favourable aquatic habitat conditions. To our knowledge there is nothing that impedes designated municipal drainage with an appropriate configuration from functioning in many respects as a natural watercourse. A fully functional natural watercourse with flood plain could be possible particularly where a larger corridor is available as on the Embro Conservation Area lands . As you indicated the existing dam impedes a natural watercourse option in the vicinity of it's influence unless removed.

Again, thank you for your comments. If you have further questions or information on this project contact me.

Rick Goldt C.E.T.
Supervisor, Water Control Structures
Upper Thames River Conservation Authority
1424 Clarke Rd.
London ON
N5V 5B9
ph. 519-451-2800 X244
C 519-719-4192
goldtr@thamesriver.on.ca

Public Information Centre #3

Upper Thames River Conservation Authority

Embro Dam
Class Environmental Assessment

NOTICE OF THIRD PUBLIC INFORMATION CENTRE

THE STUDY

Upper Thames River Conservation Authority (UTRCA), through their consultant Ecosystem Recovery Inc., is undertaking a Class Environmental Assessment (Class EA) for the Harrington Dam in the Township of Zorra. The study was initiated to address results of the 2007 Dam Safety Review of the Embro Dam which identified significant issues with the spillway capacity and embankment stability of the dam.

THIRD PUBLIC OPEN HOUSE

The first open house was held on June 23, 2015 to introduce the study and to receive comments from the public. A second Public Open House was held on May 10, 2016 to present an overview of existing conditions, to introduce technically feasible potential alternative solutions for the future of the dam, to review the evaluation criteria for the alternatives, and to provide an opportunity for public comment and input. A third Public Open House will be held on October 17, 2016 to discuss the evaluation process and to present the preferred alternative for the dam.

The map on the reverse of this page shows the location of the study area.

WE WANT TO HEAR FROM YOU

Public consultation is a key component of this study. The Project Team invites public input and comments, and will incorporate them into the planning and design of this project. The third Public Information Centre will take place at the following time and location:

Public Information Center 3:

Date:	**Monday October 17th, 2016**
Time:	**7:00 p.m. to 9:00 p.m.**
Place:	**Embro Community Centre** **355644 35th Line** **Embro, Ontario**

The evening will begin at 7:00 pm with a formal presentation that will be followed by a time for discussion and questions. Presentation boards will be displayed throughout the evening and comment forms will be provided to enable public feedback and input into the project. Further opportunity for questions and discussion with the project team will occur throughout the evening.

STUDY CONTACTS

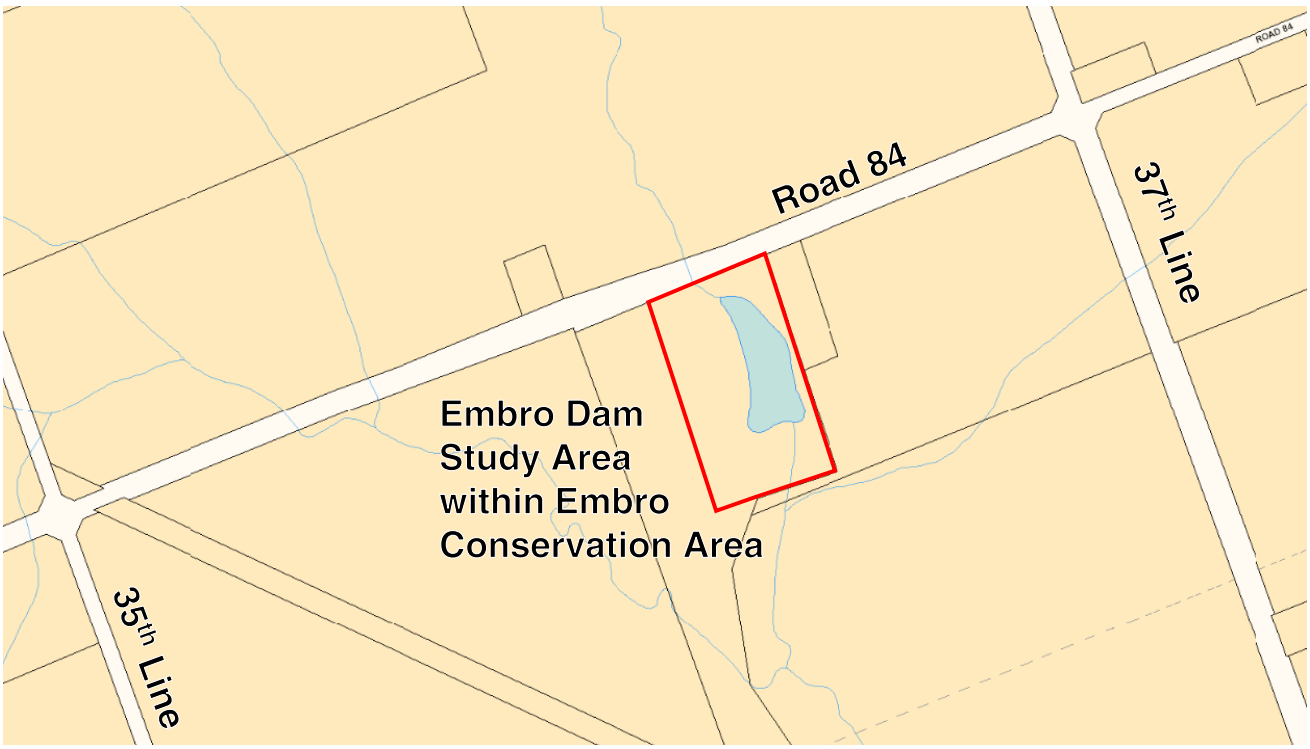
To submit comments, request further information, or to join the project mailing list, please send an email to the project email address:

embro_dam@thamesriver.on.ca

Contact information for the project team leaders is listed below:

Mr. Rick Goldt, C.E.T.
Supervisor, Water Control Structures
Upper Thames River Conservation Authority
1424 Clarke Road
London, Ontario, N5V 5B9
Tel: 519-451-2800 ext. 244
Fax: 519-451-1188
goldtr@thamesriver.on.ca

Mr. Wolfgang Wolter
Senior Project Manager
Ecosystem Recovery Inc.
550 Parkside Drive, Unit B1
Waterloo, Ontario, N2L 5V4
Tel: 519-621-1500
Fax: 226-240-1080
wolfgang.wolter@ecosystemrecovery.ca


Road 84
37th Line
35th Line
Embro Dam
Study Area
within Embro
Conservation Area

Public Information Centre #3
PIC Presentation Slides

Embro Dam
Class Environmental Assessment

Public Information Centre #3

Upper Thames River Conservation Authority
Embro Community Centre
October 17th, 2016 7:00 p.m. to 9:00 p.m.

UPPER THAMES RIVER CONSERVATION AUTHORITY

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Overview

- Impetus of project
- Class EA process
- PIC 2 feedback
- Evaluation process
- Embro dam evaluation
- Preferred alternative

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Introduction and Background

- UTRCA acquired dam in 1959
- Significant concerns related to the structural integrity and hydraulic capacity of the Embro Dam based on:
  - *Acres International. July, 2007.*
  - *Naylor Engineering Associates. September 2008.*

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Study Process

- In addition to repair, other options are available that require study
- As a public body, UTRCA must plan any activities associated with the dam according to the Environmental Assessment Act
- Under the Act, UTRCA is required to undertake a *Class Environmental Assessment for Remedial Flood and Erosion Control*

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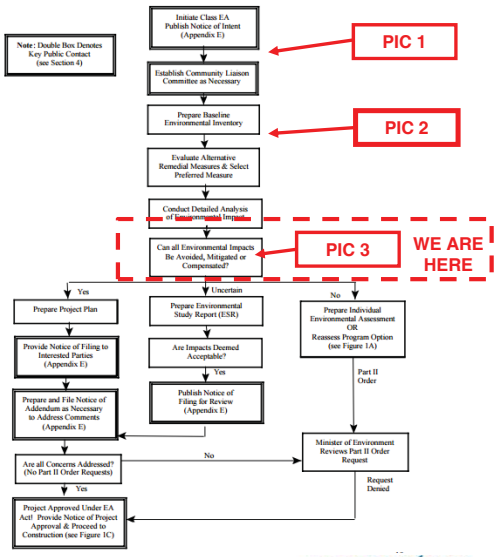
Class EA Process for Conservation Ontario Remedial Flood and Erosion Control Works

- Environmental Assessment Act, RSO 1990, chapter E.18.
- Code of Practise: Preparing, Reviewing and Using Class Environmental Assessments in Ontario. (MOE, 2014)
- Class Environmental Assessment for Remedial Flood and Erosion Control Projects (Conservation Ontario, 2012)



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Class EA Process

- Problem Identification – PIC 1
  - Structural integrity and hydraulic capacity of dam
- Baseline Inventory – PIC 2
  - Background review and field assessments
- Alternative Identification – PIC 2
  - Methods that can be used to address problem, mitigate impacts
- Alternative Evaluation – PIC 3
- Preferred Alternative – PIC 3
  - Identify measures to further avoid, mitigate, and/or enhance

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Alternatives

1) Do Nothing
2) Repair Dam
   - construct dam ‘shell’, add rock protection, extend outlet pipe, provide emergency spillway
3) Remove Dam and Construct a Natural Channel
   - provide landscape restoration
4) Remove Dam and Construct Offline Pond(s) or Wetland(s)
   - create natural channel, provide landscape enhancement
5) Lower Dam Crest and Outlet and Naturalize New Pond and Perimeter
   - provide landscape enhancement

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Alternative 1 – Do Nothing

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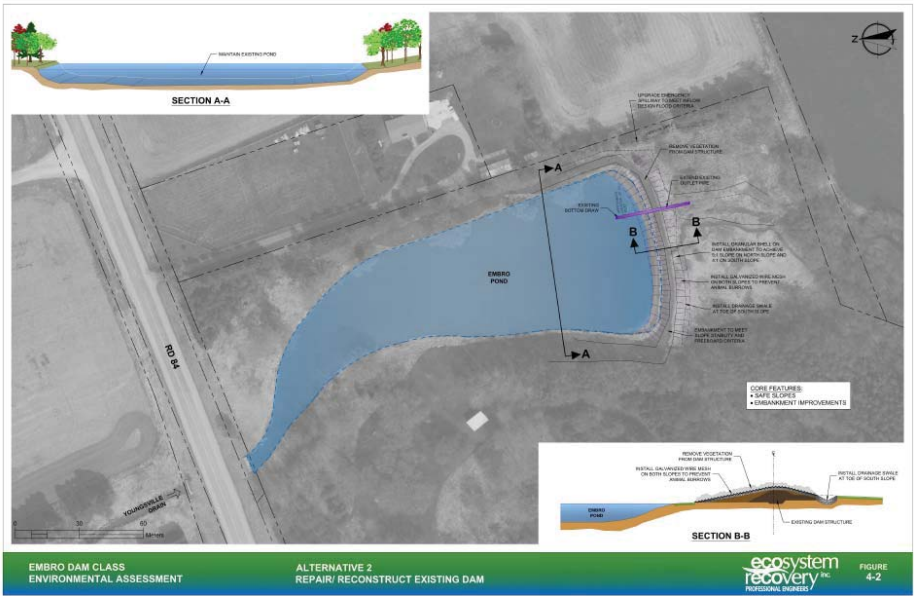
Alternative 2 – Repair Dam



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Alternative 3 – Remove Dam, Natural Channel

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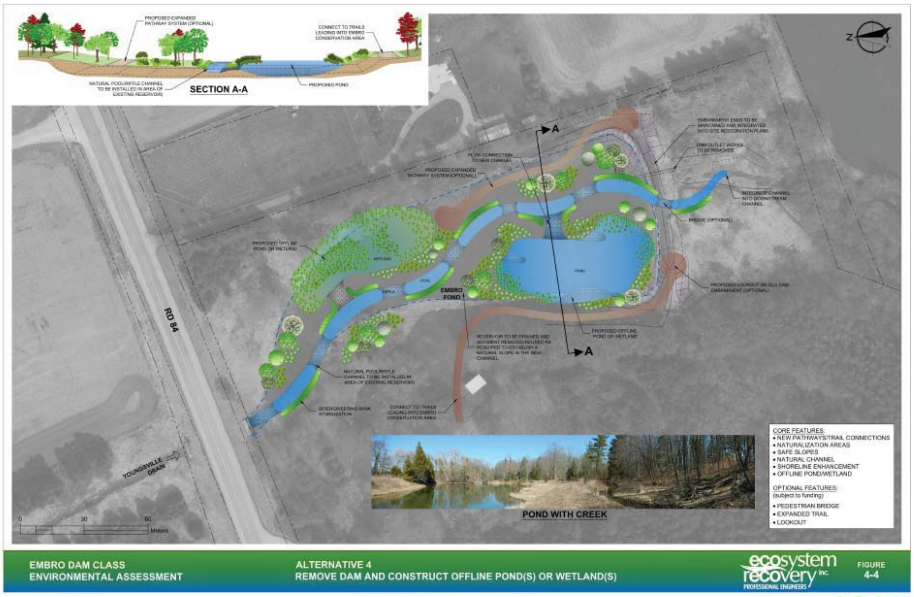
Alternative 4 – Remove Dam, Natural Channel and Offline Pond



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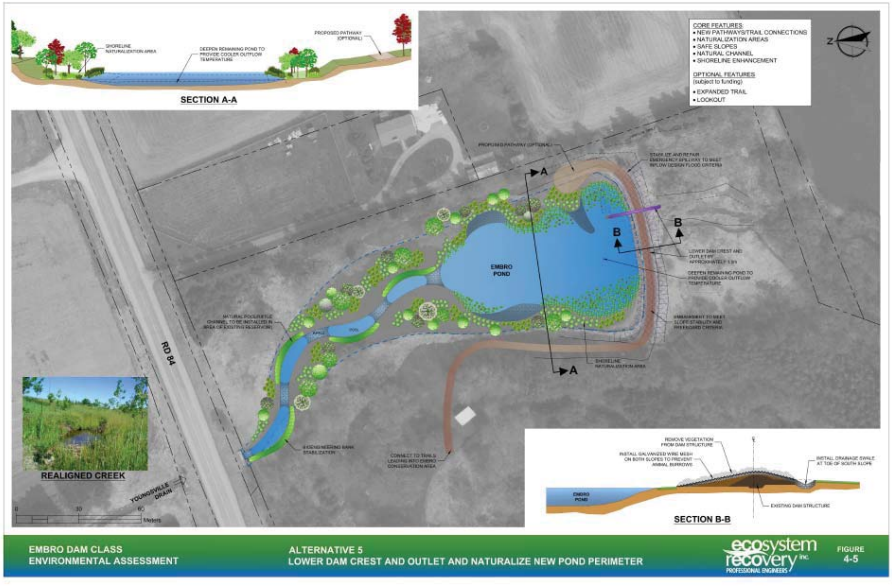
Alternative 5 – Lower Dam Crest, Naturalize Perimeter



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Overview of PIC 2 Feedback

- Comments provided by three representatives of public
  - Alternatives that perpetuate status quo, deteriorating environmental conditions, or lack upgrade to current environmental status not preferred.
  - Technical input – climate change effects, consideration of liability, further documentation and review of conditions (water temperature, fish species)

Alternative	Number of individuals who liked this alternative most
1. Do nothing	
2. Repair dam	1
3. Remove dam and construct a natural channel	3
4. Remove dam and construct offline ponds or wetlands	
5. Lower dam crest and outlet and naturalize new pond perimeter	

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Criteria and Evaluation

Technical/Engineering	Natural Environment
Flooding Impacts/Enhancement Protection of Infrastructure Constructability Implementability Approvability	Aquatic Habitat Impacts/Enhancement Pond Habitat Impacts/Enhancement Terrestrial Habitat Impacts/Enhancement SAR Impacts/Enhancement Geomorphology/Sediment Transport Groundwater Impacts/Enhancement Water Quality Impacts/Enhancement
Social/Cultural	**Economic**
Impact to Private Property Impact to Public Safety Impact to Public Access Impact to Cultural/Heritage Features Recreational Impacts/Enhancement	Construction Costs Maintenance/Future Costs Availability of Funding

Scoring: *1) least positive benefit --> 5 = most positive benefit*

Estimated Costs for Alternatives

Alternatives	Primary elements/ factors influencing costs	Initial Costs (1 to 5 years)	Operation and Maintenance
Alternative 1 Do Nothing	Repairs to concrete structures, site restoration in the event of failure (assumed)	$3,000 to $15,000	$1,500 to $5,000 per year, Site /sediment restoration ($80,000)
Alternative 2 Repair Dam	Improve dam embankment and outlet, construct emergency spillway, rock protection	$150,000 to $200,000	$1,500 to $20,000 per year, Dam retirement (75 yrs) costs $80,000[1]
Alternative 3 Remove dam and construct natural channel	Dam removal, channel construction, sediment removal, site restoration	$250,000 to $320,000	$1,500 to $3,000 per year
Alternative 4 Remove dam and construct offline pond / wetland	Dam removal, channel construction, sediment removal, offline pond construction, site restoration	$350,000,to $450,000	$1,500 to $5,000 per year
Alternative 5 Lower dam crest and outlet, naturalize pond	Dam crest reconstruction, replace outlet bottom draw structure, sediment removal	$500,000 to $600,000	$3,000 to 20,000 per year. Dam retirement (75 yrs) costs $80,000[1]

[1] dam retirement cost is based on 2016 estimate

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Criteria	Description	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
TECHNICAL/ENGINEERING						
Dam Safety/Integrity	Effectiveness of the alternative to address dam safety requirements, reduce risk of failure	1	4	5	5	4
Protection of Properties	Effectiveness of the alternative in mitigating risk (flooding, failure) to adjacent properties	1	2	5	5	3
Constructability	Potential to construct the project using conventional, accepted construction and engineering practices	5	5	5	5	5
Implementability	Potential to implement the alternative, based on common accepted management practise	3	3	5	5	3
Approvability	Potential for regulatory agencies to grant approval for implementation	1	3	5	4	3
	TOTAL CATEGORY SCORE	11	17	25	24	18
	NORMALIZED CATEGORY SCORE (25% WEIGHTING)	11	17	25	24	18
	CATEGORY RANKING (1 most preferred; 5 least preferred)	5	4	1	2	3

UPPER THAMES RIVE CONSERVATION AUTHORIT

1 – Do Nothing
2 – Repair Dam
3 – Remove Dam, Natural Channel
4 – Remove Dam, Natural Channel and Off-line Pond
5 – Lower Dam Crest and Outlet, Naturalize New Pond Perimeter

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Criteria	Description	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
NATURAL ENVIRONMENT						
Aquatic (Creek) Habitat Impacts/Enhancement	Effectiveness of the alternative to enhance fisheries resources; fish diversity, food source, and fish passage	1	1	5	5	1
Aquatic (Pond) habitat Impacts/Enhancements	Effectiveness of the alternative to enhance pond habitat (fish, fowl, wildlife) resources, diversity, food source	3	4	1	3	5
Terrestrial Habitat Impacts/Enhancement	Potential for impact and/or enhancement to connectivity and terrestrial habitat (amphibian, avian, mammal) due to implementation of the alternative	1	1	4	5	4
SAR Impacts/Enhancement	Potential for impact and/or enhancement to potential SAR in the project area	1	1	4	5	3
Geomorphology/Sediment Transport	Effectiveness of the alternative to promote dynamic stability of channel processes and mitigate sediment impacts	1	1	5	5	2
Groundwater Impacts/Enhancement	Potential for impact and/or enhancement to groundwater regimes in the project area (baseflow, recharge, water table, etc.)	3	4	4	3	3
Water Quality Impacts/Enhancement	Effectiveness of the alternative to improve water quality, temperature, TSS, phosphorous, nutrient uptake	1	2	5	4	3
	TOTAL CATEGORY SCORE	11	14	28	30	21
	NORMALIZED CATEGORY SCORE (25% WEIGHTING)	8	10	20	21	15
	CATEGORY RANKING (1 most preferred; 5 least preferred)	5	4	2	1	3

UPPER THAMES RIVE CONSERVATION AUTHORIT

1 – Do Nothing
2 – Repair Dam
3 – Remove Dam, Natural Channel
4 – Remove Dam, Natural Channel and Off-line Pond
5 – Lower Dam Crest and Outlet, Naturalize New Pond Perimeter

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Criteria	Description	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
SOCIAL / CULTURAL ENVIRONMENT						
Impact to Private Property	Measure of the impact to adjacent private property (i.e., loss of property, access to property)	4	4	4	3	3
Impact to Public Access	Measure of impact to public access (e.g., trails, recreation - picnic, fish, boat)	3	4	3	3	4
Impact to Public Safety	Measure of the impact to public safety in the surrounding area resulting from the alternative	1	3	4	3	3
Impact to Cultural/Heritage Features	Potential impact to existing cultural and/or heritage features in the project area	5	5	1	1	4
Recreational Impacts/Enhancement	Measure of the impact to existing recreation and opportunities to enhance recreational activities in the project area	3	3	3	4	4
	TOTAL CATEGORY SCORE	16	19	15	14	18
	NORMALIZED CATEGORY SCORE (25% WEIGHTING)	16	19	15	14	18
	CATEGORY RANKING (1 most preferred; 5 least preferred)	3	1	4	5	2

UPPER THAMES RIVE CONSERVATION AUTHORIT

1 – Do Nothing
2 – Repair Dam
3 – Remove Dam, Natural Channel
4 – Remove Dam, Natural Channel and Off-line Pond
5 – Lower Dam Crest and Outlet, Naturalize New Pond Perimeter

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Criteria	Description	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
ECONOMIC						
Construction Costs	Relative measure of the initial costs to install/construct the proposed works, including environmental mitigation, sediment management, etc.)	5	4	3	2	1
Maintenance/Future Costs	Relative measure of the ongoing maintenance costs following implementation (or continued maintenance)	1	3	4	4	3
Availability of Funding	Estimate of the availability for funding to implement the alternative	3	3	5	4	2
	TOTAL CATEGORY SCORE	9	10	12	10	6
	NORMALIZED CATEGORY SCORE (25% WEIGHTING)	15	17	20	17	10
	CATEGORY RANKING (1 most preferred; 5 least preferred)	4	2	1	2	5

1 – Do Nothing
2 – Repair Dam
3 – Remove Dam, Natural Channel
4 – Remove Dam, Natural Channel and Off-line Pond
5 – Lower Dam Crest and Outlet, Naturalize New Pond Perimeter

UPPER THAMES RIVER CONSERVATION AUTHORITY

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Preferred Alternative

Criteria	Description	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
	OVERALL NORMALIZED CATEGORY SCORE (100% WEIGHTING)	50	63	80	76	61
	PREFERRED OVERALL RANKING (1 most preferred; 5 least preferred)	5	3	1	2	4

1 – Do Nothing
2 – Repair Dam
3 – Remove Dam, Natural Channel
4 – Remove Dam, Natural Channel and Off-line Pond
5 – Lower Dam Crest and Outlet, Naturalize New Pond Perimeter

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Potential Impacts and Mitigation

- Technical
  - Complete shallow well inventory/assessment
  - Drill new wells,
- Environmental
  - Loss of open water feature

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Potential Impacts and Mitigation

- Social and Cultural
  - Loss of open water feature – replace with trails
  - Stage 2 Archaeological study may be required
- Financial
  - Conservation authority funds
  - Township/Municipal contribution
  - Provincial funding sources
  - NGO funding

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Preferred Alternative

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Clair Creek, Waterloo

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CONSERVATION AUTHORITY

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Next Steps and Contact Information

Next Steps for our project team include:

- Compile and review feedback from this Public Information Centre
- Further refine the 'Preferred Alternative'
- Proceed to completion and filing of Project Plan

To provide feedback and comments to the project team, please send all correspondence to the project email address:

embro_dam@thamesriver.on.ca

For further information please contact:

Mr. Rick Goldt, C.E.T.
Supervisor, Water Control Structures
Upper Thames River Conservation Authority
1424 Clarke Road
London, Ontario, N5V 5B9
Tel: 519-451-2800 ext. 244
Fax: 519-451-1188
goldtr@thamesriver.on.ca

Mr. Wolfgang Wolter
Senior Project Manager
Ecosystem Recovery Inc.
550 Parkside Drive, Unit B1
Waterloo, Ontario, N2L 5V4
Tel: 519-621-1500
Fax: 226-240-1080
wolfgang.wolter@ecosystemrecovery.ca

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Public Information Centre

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Public Information Centre #3
PIC Presentation Boards

Embro Dam
Class Environmental Assessment

Public Information Centre #3

Upper Thames River Conservation Authority
Embro Zorra Community Centre
October 17, 2016 7:00 p.m. to 9:00 p.m.

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Class Environmental Assessment Process and Problem Statement

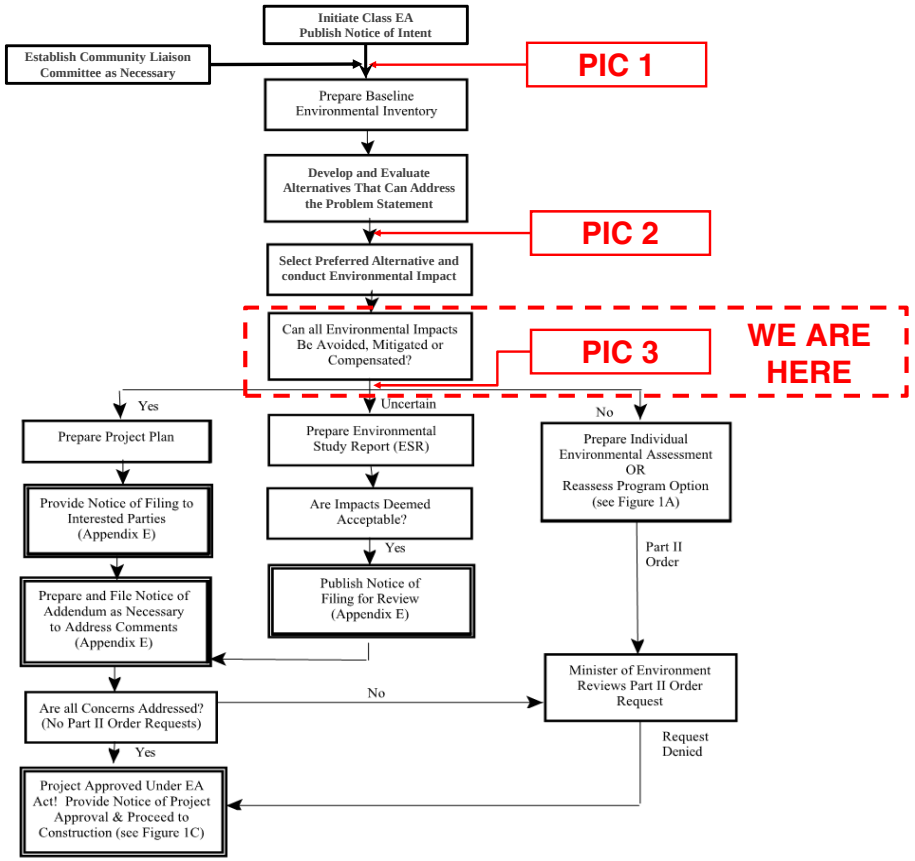
Problem Statement

Significant concerns related to the structural integrity and hydraulic capacity of the Embro Dam have been identified through recent engineering assessments.

- ***Acres International. July, 2007****. Dam Safety Assessment Report for Embro Dam: Upstream and downstream embankment slopes do not meet stability acceptance criteria*
- ***Naylor Engineering Associates. September 2008****. Geotechnical Investigation Embro Dam Embankment Stability Assessment: The existing dam does not meet current standards and is not considered stable under existing conditions*

A Class Environmental Assessment has been initiated to evaluate a range of alternatives to address the identified issues in consideration of the environmental, social, economic, and technical aspects of the dam.

Class EA Process for Conservation Ontario Class Environmental Assessment for Remedial Flood and Erosion Control Works



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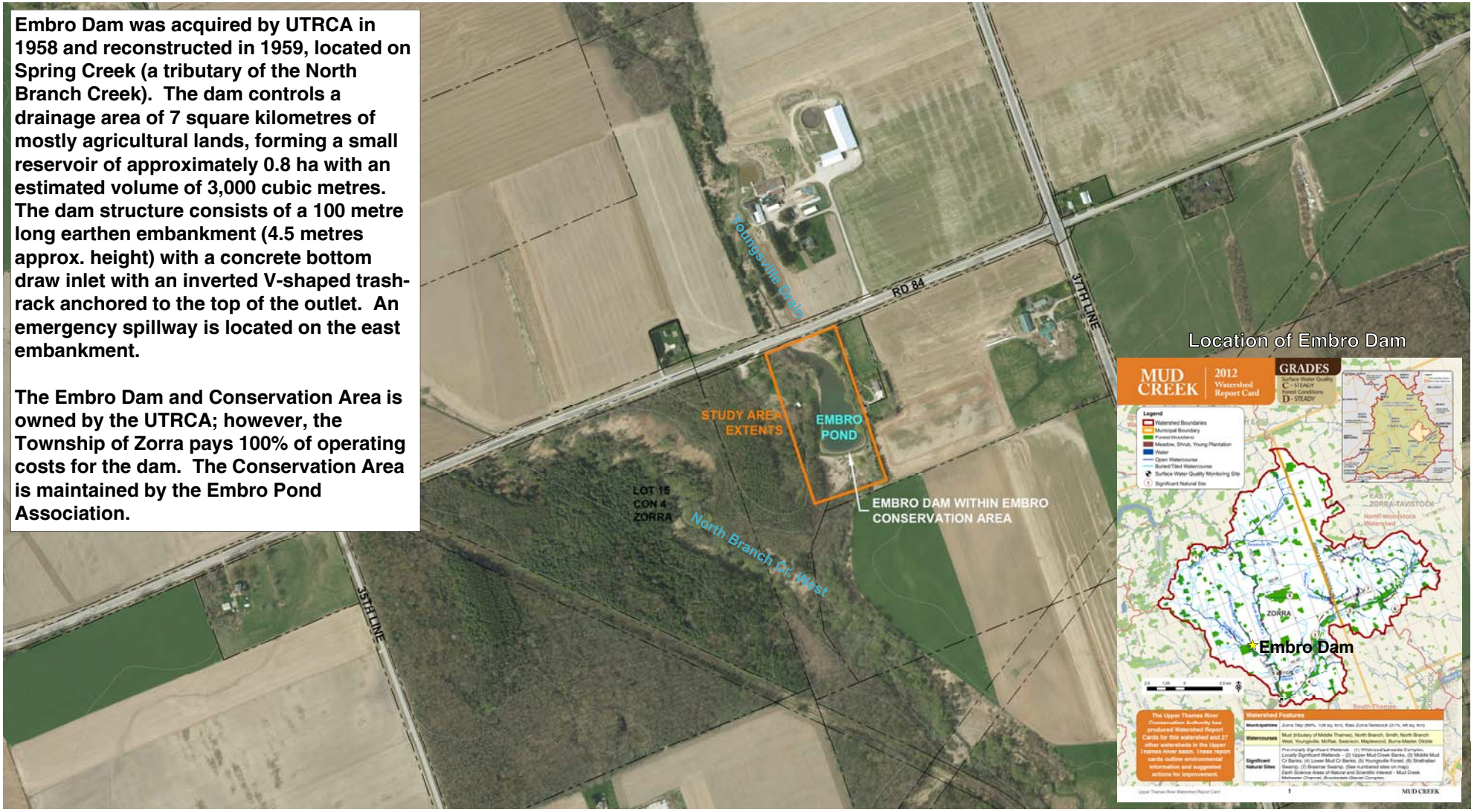
Embro Dam Study Area

Embro Dam was acquired by UTRCA in 1958 and reconstructed in 1959, located on Spring Creek (a tributary of the North Branch Creek). The dam controls a drainage area of 7 square kilometres of mostly agricultural lands, forming a small reservoir of approximately 0.8 ha with an estimated volume of 3,000 cubic metres. The dam structure consists of a 100 metre long earthen embankment (4.5 metres approx. height) with a concrete bottom draw inlet with an inverted V-shaped trash-rack anchored to the top of the outlet. An emergency spillway is located on the east embankment.

The Embro Dam and Conservation Area is owned by the UTRCA; however, the Township of Zorra pays 100% of operating costs for the dam. The Conservation Area is maintained by the Embro Pond Association.



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Cost Estimates

Alternatives	Primary elements/ factors influencing costs	Initial Costs (1 to 5 years)	Operation and Maintenance
Alternative 1 Do nothing	Repairs to concrete structures, site restoration in the event of failure (assumed)	$3,000 to $15,000	$1,500 to $5,000 per year
Alternative 2 Repair dam	Improved dam embankment and outlet, construct emergency spillway, rock protection	$150,000 to $200,000	$1,500 to $20,000 per year. Dam retirement (75 yrs) costs $80,000[1]
Alternative 3 Remove dam and construct natural channel	Dam removal, channel construction, sediment removal, site restoration	$250,000 to $320,000	$1,500 to $3,000 per year
Alternative 4 Remove dam and construct offline pond / wetland	Dam removal, channel construction, sediment removal, offline pond construction, site restoration	$350,000 to $450,000	$1,500 to $5,000 per year
Alternative 5 Lower dam crest and outlet, naturalize pond	Dam crest reconstruction, replace outlet bottom draw structure, sediment removal	$500,000 to $600,000	$3,000 to $20,000 per year. Dam retirement (75 yrs) costs $80,000[1]

[1] dam retirement cost reflects today's (2016) cost

Alternative Evaluation

Criteria	Description	Alternative 1 Do Nothing	Alternative 2 Repair Dam	Alternative 3 Remove Dam and Construct a Natural Channel	Alternative 4 Remove Dam and Construct Offline Pond(s) or Wetland(s)	Alternative 5 Lower Dam Crest and Outlet and Naturalize New Pond Perimeter
TECHNICAL/ENGINEERING						
Dam Safety/Integrity	Effectiveness of the alternative to address dam safety requirements, reduce risk of failure	1	4	5	5	4
Protection of Properties	Effectiveness of the alternative in mitigating risk (flooding, failure) to adjacent properties	1	2	5	5	3
Constructability	Potential to construct the project using conventional, accepted construction and engineering practices	5	5	5	5	5
Implementability	Potential to implement the alternative, based on common accepted management practise	3	3	5	5	3
Approvability	Potential for regulatory agencies to grant approval for implementation	1	3	5	4	3
	TOTAL CATEGORY SCORE	11	17	25	24	18
	NORMALIZED CATEGORY SCORE (25% WEIGHTING)	11	17	25	24	18
	CATEGORY RANKING (1 most preferred; 5 least preferred)	5	4	1	2	3
NATURAL ENVIRONMENT						
Aquatic (Creek) Habitat Impacts/Enhancement	Effectiveness of the alternative to enhance fisheries resources; fish diversity, food source, and fish passage	1	1	5	5	1
Aquatic (Pond) habitat Impacts/Enhancements	Effectiveness of the alternative to enhance pond habitat (fish, fowl, wildlife) resources, diversity, food source	3	4	1	3	5
Terrestrial Habitat Impacts/Enhancement	Potential for impact and/or enhancement to connectivity and terrestrial habitat (amphibian, avian, mammal) due to implementation of the alternative	1	1	4	5	4
SAR Impacts/Enhancement	Potential for impact and/or enhancement to potential SAR in the project area	1	1	4	5	3
Geomorphology/Sediment Transport	Effectiveness of the alternative to promote dynamic stability of channel processes and mitigate sediment impacts	1	1	5	5	2
Groundwater Impacts/Enhancement	Potential for impact and/or enhancement to groundwater regimes in the project area (baseflow, recharge, water table, etc.)	3	4	4	3	3
Water Quality Impacts/Enhancement	Effectiveness of the alternative to improve water quality, temperature, TSS, phosphorous, nutrient uptake	1	2	5	4	3
	TOTAL CATEGORY SCORE	11	14	28	30	21
	NORMALIZED CATEGORY SCORE (25% WEIGHTING)	8	10	20	21	15
	CATEGORY RANKING (1 most preferred; 5 least preferred)	5	4	2	1	3
SOCIAL / CULTURAL ENVIRONMENT						
Impact to Private Property	Measure of the impact to adjacent private property (i.e., loss of property, access to property)	4	4	4	3	3
Impact to Public Access	Measure of impact to public access (e.g., trails, recreation - picnic, fish, boat)	3	4	3	3	4
Impact to Public Safety	Measure of the impact to public safety in the surrounding area resulting from the alternative	1	3	4	3	3
Impact to Cultural/Heritage Features	Potential impact to existing cultural and/or heritage features in the project area	5	5	1	1	4
Recreational Impacts/Enhancement	Measure of the impact to existing recreation and opportunities to enhance recreational activities in the project area	3	3	3	4	4
	TOTAL CATEGORY SCORE	16	19	15	14	18
	NORMALIZED CATEGORY SCORE (25% WEIGHTING)	16	19	15	14	18
	CATEGORY RANKING (1 most preferred; 5 least preferred)	3	1	4	5	2
ECONOMIC						
Construction Costs	Relative measure of the initial costs to install/construct the proposed works, including environmental mitigation, sediment management, etc.)	5	4	3	2	1
Maintenance/Future Costs	Relative measure of the ongoing maintenance costs following implementation (or continued maintenance)	1	3	4	4	3
Availability of Funding	Estimate of the availability for funding to implement the alternative	3	3	5	4	2
	TOTAL CATEGORY SCORE	9	10	12	10	6
	NORMALIZED CATEGORY SCORE (25% WEIGHTING)	15	17	20	17	10
	CATEGORY RANKING (1 most preferred; 5 least preferred)	4	2	1	2	5
	OVERALL NORMALIZED CATEGORY SCORE (100% WEIGHTING)	50	63	80	76	61
	PREFERRED OVERALL RANKING (1 most preferred; 5 least preferred)	5	3	1	2	4

Preferred Alternative

Next Steps and Contact Information

Next Steps for our project team include:

- **Compile and review feedback from this Public Information Centre**
- **Update preferred alternative**
- **Complete and file project plan**

To provide feedback and comments to the project team, please send all correspondence to the project email address:

embro_dam@thamesriver.on.ca

For further information please contact:

Mr. Rick Goldt, C.E.T.
Supervisor, Water Control Structures
Upper Thames River Conservation Authority
1424 Clarke Road
London, Ontario, N5V 5B9
Tel: 519-451-2800 ext. 244
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Meeting Minutes

B1-550 Parkside Drive, Waterloo, Ontario, N2L 5V4
Tel 519.621.1500 ■ Fax 226.240.1080

Project:	Harrington and Embro Dam EAs	**Meeting No.:**	PIC 3
		Meeting Date:	October 17, 2016
Project No.:	1505	**Meeting Time:**	7 – 9 pm
Recorder:	M. Pushkar	**Report date:**	October 18, 2016

Location:	Embro Community Centre – 355644 35th Line, Embro, ON
Attendees:	Rick Goldt, Bill Mackie, (UTRCA) Wolfgang Wolter, Mariëtte Pushkar (ERI) Marie Keasey, Doug Matheson, Marcus Ryan (Zorra Township) Members of the public (8)
Purpose:	Public Information Centre 3 – Embro Dam

Item	Description	Action By
1.	**Presentation** • Presentation of study process, evaluation criteria, evaluation process, preferred alternative, impacts and mitigation made by Wolfgang Wolter and Mariëtte Pushkar (ERI)	Info
2.	**Questions posed by members of the public and answers provided by team:** **1. For Alternatives 2 and 3, why did you not look at the IDF?** At the EA stage, actual design flow values are not necessary to enable an evaluation of the alternatives. During detailed design stage, however, the flows that need to be accommodated for dam function, or for the creek design, will need to be determined; this will require further analysis. **2. How will sediment load affect the downstream watercourse, will there be a delta?** Under the preferred alternative, sediment is expected to be conveyed downstream. Currently, the creek downstream of the dam is sediment starved. There may be some increase in sediment deposition, but this is not expected to be excessive and to result in delta formation. Sediment will be deposited onto the floodplain during periods of high flow. **3. Was sediment considered in the cost evaluation?** Yes, sediment removal was considered in the cost evaluation. The cost for operation and maintenance includes sediment removal costs pro-rated on an annual basis; actual sediment removal work would occur on a zero to ten year frequency. **4. On what data sources was the sediment accumulation rate based? Did it consider sediment removals completed in the 1980s** Bathymetric surveys of the pond were compared, as outlined presented at PIC 2. Yes, the sediment volumes did consider sediment removals. The rate of sedimentation within the pond changes through time in response to landuse practices. The estimated volume is appropriate for planning purposes.	

	5. How does the overall rank include cost, doesn't cost drive everything? Cost is specifically included as one criteria within the economic evaluation category. Cost does not determine the evaluation result since it is only one component of the evaluation process. **6. Did you know that there is potential Federal Funding available? It is the Recreational Fisheries Conservation Partnerships Program** Thank you, this will be noted in the report. **7. Please describe the iteration process of the evaluation table** The evaluation table was first developed by ERI. The table was reviewed and updated through review by several UTRCA staff. Additional input to the table and rankings was obtained through a Technical Steering Committee meeting in which UTRCA staff and Township staff participated. **8. Brook Trout and the potential for habitat creation should be considered in the evaluation** Brook Trout are considered in the aquatic (river) criteria, under the Natural Environment category.	

Upper Thames River Conservation Authority

Class Environmental Assessment

Embro Dam

Public Information Centre – Comment Form

The Environmental Assessment for the Embro Dam, in the Embro Conservation Area, is intended to address safety concerns identified as part of the Dam Safety Assessment (ACRES, 2007) including structural integrity, hydraulic capacity, insufficient freeboard, embankment slope instability and inadequate conveyance capacity for flood flows through the emergency spillway. Through the study, potential alternatives will be evaluated to determine a course of action to mitigate dam safety concerns.

The project is being carried out in accordance with the requirements of the *Conservation Ontario Class Environmental Assessment.* The study is being undertaken by the Upper Thames River Conservation Authority (UTRCA) in partnership with the Township of Zorra.

Public consultation is a key component of this study. This Public Information Centre (PIC) is held to receive public input on the preferred alternative for the Embro Dam. Any feedback and comments provided will become part of the public record for this project.

Please provide your comments regarding the preferred alternative.

Comments:

Please print your name and address below, and leave your completed Comment Form in the box provided. You may also email your comments to embro_dam@thamesriver.on.ca, or mail your comments to:

Rick Goldt C.E.T.
Supervisor, Water Control Structures
Upper Thames River Conservation Authority
1424 Clark Road, London, ON N5V 5B8
Tel.: 519-451-2800 ext. 244
goldtr@thamesriver.on.ca

Name: _____

Address & Postal Code: _____

E-mail Address: _____

Please submit comments by October 31, 2016

Thank you for your participation.

Personal information on this form is collected under the authority of the Conservation Authorities Act and will be used for the purposes of the Embro Dam Class EA only. Questions about the collection of personal information should be directed to: General Manager, Upper Thames River Conservation Authority, 1424 Clarke Rd., London, Ontario. N5V 5B9 (519) 451-2800.

Upper Thames River Conservation Authority

Class Environmental Assessment

Embro Dam

Public - 8
Town - 3

Sign-in Sheet

PUBLIC INFORMATION CENTRE 3
October 17, 2016

Name	Address	Contact Number
Carl Hansen	[redacted]	
D K Campbell		
BRIAN MACGOWAN		
Town DOUG MATHESON.		
ROBERT HUBER (ONTARI		
PAUL Holmes		
Pud Hunter		
Town MARIE KEASEY		
Town Marcus Ryan		
Tammy Hutson		
Katherine Grieve		

Personal information on this form is collected under the authority of the Conservation Authorities Act and will be used for the purposes of the Embro Dam Class EA only. Questions about the collection of personal information should be directed to: General Manager, Upper Thames River Conservation Authority, 1424 Clarke Rd., London, Ontario. N5V 5B9 (519) 451-2800.

The Thames River Anglers Association
[redacted]

October 31st, 2016

Rick Goldt – Upper Thames Conservation Authority

Re: Comments Regarding Embro Dam Preferred Solution

Rick

The Thames River Anglers has been dedicated to protecting and sustaining a viable multi-species fishery within the watershed for over 25 years through education, environmental advocacy and grassroots projects that help to rehabilitate the river. In particular our club has been working closely with the Upper Thames Conservation Authority during the last 5 years to reestablish wild brook trout in the headwaters of Embro Creek. The results of this program has exceeded our expectations.

http://thamesriver.on.ca/2016/05/12/new-record-7500-brook-trout-reintroduced-may-12-2016/

We are strongly in support of the preferred approach to decommission Embro Dam and create a naturalized channel. If approved and financially supported this decision would be yet another great example of a municipality, conservation authority, organizations and residents working together to improve and protect ecosystems for future generations.

Thanks again,
Paul

Paul Holmes
Stream Restoration Committee Lead and Chairman
Thames River Anglers Association

ONTARIO RIVERS ALLIANCE

[redacted]

OntarioRiversAlliance.ca

31 October 2016

By email:

Re: Embro Dam

Dear Rick:

Ontario Rivers Alliance (ORA) is a Not-for-Profit grassroots organization acting as a voice for several stewardships, organizations, and private and First Nation citizens who have come together to protect, conserve and restore healthy river ecosystems.

Embro Dam:
On behalf of the ORA, we would like to make our comment publicly available that we support the preferred option to decommission Embro Dam and rehabilitate the former reservoir to a natural channel.

Our organization felt that the Environmental Assessment process was delivered extremely well by Ecosystem Recovery Inc., and their efforts to present the alternatives in a clear manner while engaging the community was very evident. ORA did not have any concerns with the information presented in the community feedback sessions.

Robert Huber
Vice-Chair Ontario Rivers Alliance
[redacted]

Comments regarding the choices for the Embro Dam site put forward in the third public meeting.

Donald Campbell

[redacted]

This project to repair or remove the Embro dam is a study in liability and risk. Liability is a legal responsibility and risk is a measure of how that liability will affect the owner. It also ought to be a study in the best outcome for the money spent to reduce or control that liability. Because the cause of the liability in this project is not fixed but occurs on a graduated scale, the solutions ought to reflect that graduation.

There are three things that occur in nature that Mankind is not able to control very well, Wind, Water, and Seismic Vibrations that we call earthquakes. As a society, both in law and from a risk analysis in insurance assessments, we have recognized the events that involve these natural inputs at levels that exceed normal and that occur infrequently as outliers to the normal and call them “Acts of God”. While God is not defined, we do recognize that these events are beyond Man’s control, and those in the path of the event have to accept the consequences. However, there are analyses of risk, both in Law and in insurance protocols to evaluate these three natural factors, and that ought to be of some help in such a situation as the repair or removal of this dam. But in every case of such an event, the result is from an outlier to normal, and as such, the analysis of a project like this one ought to embrace outliers, not normalize data as we were told was done in this “mathematical “ approach in this case. The test done to suggest performing a normalized treatment of data is usually undertaken to confirm that the data at hand are an estimate of the true mean, and thus the data collected as a sample represents a sample of that mean, so that a statistical procedure will be relevant. No such statistical procedure was discussed in the presentation of this project, although normalized data was.

Because there are varying levels of damage that depend upon how much of an outlier the event might present, the only way to realistically analyse the problem is with an iterative approach, so that as the event becomes more abnormal and approaches a value that might be outside twice the standard deviation of a mean on a normal curve, both the risk and the damages increase. This has been done in the Acres report where they have been able to run their simulation model with a 50 year, 100 year and 250 year outlier to provide an estimate of possible water flow and associated damages for each event. No such analysis has been done in this EA, and as such no estimate of damage or risk or liability has been discussed for events beyond the 50 year event. No outside opinion, either legal or insurance related, was apparently sought out or considered in this report, even for the 50 year event.

There were five choices proposed in the third meeting and there were no changes among these proposals and the five put forward in the second public meeting. The only difference was that the matrix “mathematical” procedure for choosing the desired option was put forward at this time. I have indicated some very real concern over the term mathematical, because, from the discussion presented at the meetings, all of the inputs to the matrix appear to be subjective and not based on mathematics at all, which reduces the method to a numerical approach, but is not at all mathematical or objective in its results. It was also very obvious at the meeting that the method used was confusing for most of those that were there. At the PIC3, it was said that the

determination of the matrix numbers were done on an iterative process, which included going back to the CA for further input. If there were to be an iterative process, it ought to have been done on the choice among options because that might have offered some objective separation of the proposals and included more options with gradations, when unintended consequences arise, like further liability or cost issues that vary as the project changes occur. The logic and reasoning with the chosen method has been subject to the most subjective review and when the expert has asked for further input from the CA in mid process, he has abdicated his unbiased approach to all solutions. It makes him no expert at all. As expected from my comments after the second meeting, the criteria put forward as the evaluation parameters were such that only the removal of the dam and replacement by a reconstructed stream and flood plain were reasonable for consideration.

The relevance of these five proposals deserves some comment. The public has no information on the exact particulars of the terms of the hiring of Ecosystems for whatever job or expertise they have or bring to the problem. Because of that, the public has no way of determining how well these 5 approaches measure up to the requirements of the letter of transmittal. Ecosystems' presentation showed other work they have either designed or supervised some 2 to 5 months after construction. That is no time for evaluation. The time for evaluation is after the design maximum has been overstepped, and that was not considered. We were told the site would contain recreational opportunities, with the highlights to be trails. Most walkers use trails to walk, and usually some distance like 10 kilometers, which cannot be achieved here on the base of the reservoir. For these reasons, it means that the framing of the question is of major importance for determining the proposals.

In the first meeting, the consideration of liability was paramount and the liability lay with the lack of stability of the dam. There are two engineering reports, by Acres and Naylor, two engineering firms, defining the terms of the problem and there are two main factors that determine the Atterberg limits for stability: Soil Type including particle size, and Water Content of that soil. As the water content approaches the limit of plasticity, the stability decreases and the greater the force on the unstable soil from water pressure in the reservoir, the more likely a failure. In the third meeting another main factor was revealed, and that was financial support from sources other than the Upper Thames River Conservation Authority, (CA), and the Municipality, Zorra Township.

The proposed costs were also introduced in this presentation, with the proviso that the five proposals were all subjective, and so costs could only be guessed at without final designs. It was highly intimated that the cost of final designs for more than one proposal were out of the question financially. This limitation is justification for using an iterative process with reasonable costs and proposals so that the choice is as carefully reasoned as possible, and less biased than this report has been. Since it was said that input on the numerical evaluation process included further information and iteration by members of the CA, it is clear that the results presented were not at arm's length and were biased to the desires of the CA. In any event, the proposal for the dam removal and reconstruction of a stream has been the choice and it was obvious from the beginning that this was the preferred choice of the CA before the EA process was undertaken. Thus the EA process appears to be a sham, and a fairly expensive one at that.

At this third meeting, there were no supporting facts or updates on the work done over the past year that might have been an addition to the work presented at the second meeting, and from

personal communication with Mr. Goldtof the CA, there were changes to some of that information that did occur over the past summer.

The option of choice is not just the apparent reduction of the liability issue or the applicability of costs supported by other funding sources. We were told Provincial monies are only available for dam removal or flood control systems. This preferred option includes far more than just the reduction of liability, and the preliminary costing was so vague that it was impossible to tell what portion of the $250,000 to $325,000 were for reduction of liability and what was considered for the esthetic stream reconstruction which would morph into Brook Trout habitat.

I have said in prior comments that there were only two options for consideration if liability were the criteria for decision making: repair the dam and spillway as suggested by the engineering reports of Acres and Naylor, or remove parts of the dam so there is no impediment to water flow. I still maintain that those are the only two options, but at a reasonable cost, especially to taxpayers who have very little say in how the CA levies assessments for water control within its jurisdiction. There is a very clear duty of care from a legal sense when the CA is as powerful in its ability to assess costs as it sees fit. I think that the CA has forsaken some of that Duty to care with the process of this EA.

The estimate for costs for the proposal to remove the dam and build a watercourse and flood plain were $250,000 to $320,000. The estimate for the proposal to repair the dam and overflow, was $150,000 to $200,000. Maintenance costs were also estimated for these two choices at $1,500 to 3000 for the watercourse and $1,500 to $20,000 for the repair with an additional $80,000 for dam removal at 75 years. The estimates for maintenance were far greater for the repair than for the stream. While the author of the report may have seen the billing history for maintenance at the Embro pond area, it was not evident to the public that there has been much maintenance on the actual dam or pond itself. In fact, the pond maintenance has been reduced. As an example, the pond used to be drained every year before winter, but has not been since about 2000. This has, in effect, increased the liability of the owner, because water has been allowed to remain in the berm over the winter, rather than recede when the reservoir drained and the effect of internal and external water forces and gravity work away over the fall and winter to lower the water levels within the berm. Thus the history of maintenance costs would appear to be on tree management and grass cutting, which is not going to change with a change from pond to stream. The report boards for the PIC3 indicate that the township pays all of the operating costs for the dam and the Embro Pond Association maintains the Conservation Area. The owner has abdicated his responsibility for his liability with a lack of overseeing the changing conditions of the dam on a regular basis.

Up to now, there has been no report made public from the risk assessment officer within the CA so there is no quantified risk for liability, nor any measure of how well the liability is defined or whether any option satisfies such a risk analysis. There have been no reports from outside sources, either legal or insurance based, brought forward either. There may also be a liability problem that is not well defined among the Municipality, the CA, and the Embro Pond Association, and that would rest with the legal agreements among these three parties. However, in law, the landowner has the responsibility of the liability and it is his responsibility to do maintenance if the Municipality or Pond Association is not doing the agreed upon work, or the liability is beyond the agreements among those three identities. <u>The worst case is that the Municipality and the Pond Association have liability but don't know they have, so can take no action to mitigate their risk!</u> It is unlikely the owner would ask either the Municipality or the Pond

Association to remove the logs for draining the reservoir, as that is a specialized task that they have done in the past, so know the system, its dangers, and have the tools to do that task.

Other ways of using the resources that do exist at this site ought to have been considered. Because the availability of funds from sources other than the CA and Municipality were not mentioned until the third meeting, no opportunity for the input of this factor by the public existed until now. If the goal is to reduce liability, it can be done in more ways than by removing the dam. There is a third proposal that ought to merit consideration, given that funding is available for flood control as well as dam removal, and that is to drain the pond, repair only the overflow and perhaps consider a small fish ladder from the current outflow pipe to the creek level above. I am not an engineer but from the Acres report, with an inflow design of 9.4 m^3 per second for a flood situation, which the current consultant refuses to consider because he says the design for creeks is different than for dammed ponds, there is a standpipe that with three logs removed will allow for a flow of 3 $m.^3$ maximum at full dam capacity, and the pond basin would act as some flood control provided the overflow is repaired. Having the pond drained as the normal course of events will reduce the wetness factors and the seepage factors in the berm, so influence the stability factors and make the repairs suggested by Naylor unnecessary. Adding a way to make the system so that fish can travel through the system ought to be possible even if a small concrete pad needs to be added at the base of the standpipe and a small pool exist there. The cost for the overflow repair in the Acres Report is $8,000.00. The current consultant has chosen to double the values of this report in his current cost estimates. Thus to repair the overflow would be $16, 000.00 and that included moving 420 m^3 of materials.

At this third meeting, the question was asked about the age of this dam. No answer was given, except to say the CA ‘s involvement began in 1958. I have consulted the historical atlas of Oxford County for 1876 and there is a grist mill located on this creek at that time, and so there would have been some dam in place then. The building of the first dam would have preceded that date. Therefore whatever flaws are in the current dam, some part of the foundation of this dam has withstood the weather and storms from 1875 to now, in spite of the concerns of today’s requirements and standards. In all probability, there is a good chance that this dam was originally constructed with horses and slush scrapers as the only means available to bring soil to the site. Compaction and consolidation of materials would not have been a high item on the list of necessary conditions to be met. It has been sufficient until now. If there have been failures of the dam, there is not much record of damage from that failure, probably because it was not major, and our society was much more tolerant and less litigious than it seems to be at present, in spite of the fact that Rylands and Fletcher, the standard for Strict Liability is a law case from 1868 (most of the life of this dam). It also needs to be said that the estimates of sedimentation were 161 m^3 per year. This number was determined without consideration of the fact that there had been a clean out of the pond bottom in the 1980’s that the CA cannot document, but at least three people at the PIC3 meeting could remember. Thus this value is probably underestimating the rate of sediment deposition.

Further on the subject of sediment, while it is a natural process and streams need some sediment flow to stay healthy, there will be increased pressure on landowners to reduce sediment loading to comply with phosphorus run-off into watercourses within the Great Lakes basin, and the possible loss of a settling pond for phosphorus management has been completely disregarded in this process. The area of 7 $kms.^2$ ought to be a reasonable test watershed for research on phosphorus loading within all of the Thames River watershed, and if

this dam is removed, then the settling pond will be removed for research options. The soil in this water shed is part of Oxford County , the only county in Canada with a rating of 95% class 1 soils for agricultural production and because it is soil of relatively large particle size, very subject to erosion. The high productivity of this soil increases the chances for heavy use of fertilizers and so this resource is one that would be most sought after for research purposes. As well, our highways seem to include catchment ponds in the current construction methods, so there is a lack of co-ordination with overall water policy here. This option of a research study area has been overlooked.

There was one proposed option to add an off watercourse pond to the design. It was more expensive than preferred proposal. It also did not give any regard to possible mosquito breeding and the four big mosquito borne diseases have not been considered: Malaria, Zika virus, West Nile virus and Dengue fever. The species that carries Zika has been found at Windsor, Ontario in 2016, so the mosquito can survive in this climate, at least in the summer. No virus was found on or in these insects but the ominous sign is there that transmission is possible. Malaria was a major killer in the 1820's in Ontario when the feeder canal was being built for the Welland Canal, particularly in the area of Stromness and the marshes of the Grand River delta, so we have records of this disease in Ontario. West Nile virus is now an annual event in Ontario. Such ponds as the one proposed ought to be avoided completely if liability is a concern for the CA. This design ought to be considered off the matrix grid, because a negative score of 1 to 5 for one social factor is not damaging enough to the proposal, given the gravity of the liability not thus far considered.

The fifth proposal was to lower the dam height and landscape the surrounding area to fit the lower level. The cost estimates were in the neighbourhood of $500,000 to $600,000. This is a highly exaggerated cost because the lowering of the water surface and hence the effective top of the dam would merely require the overflow to be lowered and the logs to be removed from the standpipe. This would lower the top of the water curve in the dam as well. The estimated costs in Acres for the overflow were $8,000, and the bare soil remaining by lowering the water level would be less than the bare soil remaining if the whole reservoir were drained, so less remedial work needs be done, especially on the length of the stream. Such over estimations reflect poorly on the expert and more so because of the over-exaggeration compared with the practical ways to lower the reservoir height, repair the overflow and change the standpipe. There is no need to take the top off the berm for relocation, it is only necessary to make it redundant and leave it in place.

It makes no sense to me that there is no design flow in these proposals. It would seem that if the run-off from a storm event is projected at 9.4 m^3 per second, (based on calibrated simulation data from the Acres report), the flow will be the same entering the proposed constructed stream, and that this ought to be the design flow for the creek and flood plain. Since there has been a mill on this creek since the 1870's, the site and design was chosen by a miller who needed power and his estimate was that the required power could be supplied by the flow, and the fall at this site which is about 3.1 m. in the length of the reservoir of 200 m. from the road culvert at road 84 to the current dam. Acres suggests the total fall in the creek is about 15 m. and so the fall here is 20 % of the total. This will mean that the water coming in will accelerate for this 200 m distance with this much fall and no dam. Nowhere in this report has an energy balance been estimated or undertaken, and unless energy is considered, there will be mistakes from unintended consequences within the final design. I suspect that the actual final design for a

creek to take this much flow without liability for erosion or added maintenance to rebuild the stream after a 50 year event will not resemble the meandering course shown in the presentation materials but will more nearly be the concrete blocks cabled together that Acres has suggested for the overflow of 60 m. length rather than the 200 m of the reservoir bottom.

A further comment about the considered costs of the current five proposal is warranted. In the dam repair proposal, suggested annual maintenance costs are estimated to be as high as $20,000 and include a further $80,000.00 (2016 dollars) for dam removal at the end of the projected life of 75 years. It is not obvious how these costs are arrived at. Even if costs are incurred on an irregular basis, maintenance of the dam, including clean out of sediments (which, so far, has been once in the time the CA has owned the dam), ought not be this great. To remove the dam with a profile that allows for the flow in the Acres report means that a stream bed of some 5 to 6.5 m, (from Acres) or 10 m at the most, needs to be dug into the current embankment. Since there is a requirement to remove considerably more fill from the west side of the current outlet, because there is more fill there, much of the fill will be removed from the side east of the outlet. It was inconceivable to many who were at the PIC3 meeting that the costs could be as projected and that would include that the dam removal will be $80,000, because good operators on a dozer and hydraulic shovel ought to be able to move enough to vacate the dam, accommodate the required flow and place it to the east of the creek in a few days. One member of the public thought biological design was far superior to the geomorphological one suggested by the consultant because of superior results at less cost. In any event, higher estimated costs at this stage means that if the actual design comes in at less, then things appear better than they were. This is merely presentation of false information to bias the results and embellish the reputation of the consultant when final designs are not as expensive as first thought.

There was no mention of timing on the aging of the dam. If the age were to be taken from the initial date of CA ownership of 1958, then much of the 75 years has passed. If the 75 years were to begin after the Acres and Naylor repairs were made, then there is no understanding today of the wear on the dam by that date and no necessity to include those sorts of unknown factors and costs in a decision making process to-day. This sort of biased view not only clouds clear thinking, but also makes for an impression that dam repair is not effective to reduce liability. Thus far, that dam has weathered for 145 years and still holds water! At the same time, if the costs for dam removal in the preferred case do not include removal costs of the same $80,000.00, and we were not told that they were that, then the costs have been estimated differently for different proposals and that is not a fair test of objectivity for the choice of options. The presented cost data was so gross that this sort of detail was not available. However, it allows for the implication of faulty logic and faulty science, neither of which is a good base on which to build any project.

Within this whole process, there is no method to evaluate how well money has been suggested to be spent. This was questioned at the meeting and the response was that all the proposals were subjective and as such the consultant was unable to be specifically quantify either costing, (capital costs and maintenance costs) or effectiveness. However, careful spending of funds to give value for money spent, to achieve specified purposes, is still a requirement for taxpayers who really want to see the value received. The feedback thus far from the public is such a small sample (with only 4 comments on removal or repair after the second meeting and only a very small turn out for PIC3) that the decision must fall on the shoulders of the CA and Municipal

Council to evaluate money well spent ONLY TO REDUCE THE OWNER'S LIABILITY WITH AN OPTION FOR OUTSIDE FUNDING. Any further expenditure of funds is unwarranted to achieve the goals of reduced liability and financial support. "While we are at it, we might as well do _____ (Fill in the blank with "a trout creek") is only an attempt to seek funds for projects not covered by the purpose of the Acres and Naylor reports or current outside funding and as such ought **not** to be undertaken as part of this project. There is nothing wrong with a trout creek but not as a solution for the liability problem. While Brook Trout habitat was being looked forward to by some few individuals, the costs for this are not reasonable as proposed, at a $100,000.00. difference between dam removal and stream construction estimates. Better use of funds needs to be made and decisions made only with non-biased, objective processes, and they are not evident within this process here.

The other parameter that has not been considered is the standard to which things are measured. The Acres report states that the CA uses a 250 year storm in their own simulation model and the standard here is only a 50 year, 8 day snowmelt (from the first two meetings). No estimate is given for the repairs on any of these options if conditions exceed this weather event, and it is a given that they will be exceeded. The process of this EA has failed such testing for examining the reasonableness of any of the five options put forward in this study.

In conclusion, the recommendation by the consultant for the option to remove the dam and reconstruct a creek has been chosen with a very problematic processes that cannot be evaluated for effectiveness because of lack of disclosure of the terms of the hiring and their stating that the CA has had input on the iterations of the matrix numbers as the process was evaluated. Such a process only allows for errors in logic to determine a valid option, whether the errors are from clouded, misapplied or ill-defined purpose, biased inputs from the CA, lack of disclosure of the importance of funding from outside sources, or grossly distorted estimates of probable costs. All of these failures do exist in this presentation this far. They skew the results for choosing an unbiased selection of an option that ought to be based on science and good cost estimates. The result is that the choice of the best option at the best cost is not possible. This process as it has occurred here only offers the pubic a sham of what is reasonable, at a very high cost, given the CA's desire to remove the dam before the EA was undertaken. That the CA and the Ausable Bayfield Conservation Authority have 15 dams between them to have to undergo this process is a tremendous financial stress across both watersheds when the results are determined with such low quality workmanship.

If there were any question on the reasonableness of the report thus far, one might ask and answer two questions: The first is what will the project look like five days after the 100 year storm, or the 250 year storm, and were the maintenance costs estimated reasonably for the aftereffects of those events? The second question to ask is would this expert and his technique stand up to a rigourous cross-examination in a court to provide the explanation of the preferred choice by an unbiased expert providing advice based on science, and reasonable, uniform costing to come up with the results proposed at this time. I am sure the answer to both questions is negative.

My feeling is that the money for this EA has not been spent well, that there is little value for the monies expended thus far, and that the choices are not well fit to only the liability reduction

requirements. This sort of low value, high volume spending ought not continue into the final design process.

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Mariëtte Pushkar

From: Marcus Ryan <mryan@zorra.on.ca>
Sent: October-31-16 11:19 AM
To: Rick Goldt
Subject: Fwd: PIC#3 comments

Rick, I have responded to Don (see below) and just wanted to ask that his concerns be reviewed against the EA to date to see if they can be either integrated or addressed in some way?

Thanks

Marcus Ryan
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Begin forwarded message:

From: Marcus Ryan <mryan@zorra.on.ca>
Subject: Re: PIC#3 comments
Date: October 31, 2016 at 11:17:41 AM EDT
To: Don Campbell <dk.campbell@xplornet.ca>

Don, I just wanted to get back to you with some specific feedback.

I have responded to UTRCA with your concerns and asked that they be reviewed against the EA to date to see if they can be either integrated or addressed in some way.

I have to disagree with your assertion that "the EA process appears to be a sham" since "it was obvious from the beginning that this was the preferred choice of the CA before the EA process was undertaken". I have spoken to UTRCA Staff about this concern as I know this is the opinion of many in the community. The EA process is a Provincially mandated one that the UTRCA, Zorra, and EcoSystems Recovery are bound to follow (flaws and all). Also, it is an ***Environmental*** Assessment, not a general decision making or risk assessing tool; and as such is just one (very big)

part of the overall decision making process. In my opinion UTRCA Staff (and EcoSystems Recovery) have a great deal of experience with the EA process and Provincial Government Policy with respect to dams and this experience may have given the impression that they had a good idea what the outcome would be. I think this has been interpreted by some as ***preferring*** a particular outcome, but in my opinion it was experience and knowledge ***predicting*** the outcome.

With respect to cost estimates I share your concern that "the proposals were subjective and as such the consultant was unable to be specifically quantify either costing, (capital costs and maintenance costs) or effectiveness. However, careful spending of funds to give value for money spent, to achieve specified purposes, is still a requirement for taxpayers who really want to see the value received." However, there are limited funds available to fund the EA and that does not allow for the preparation of full detailed RFPs or Tenders. In my opinion this will HAVE to be done before a final decision is made.

Overall I agree that the liability is the main concern and should be the first consideration in alternatives.

If you want to talk more about this please don't hesitate to contact me. I am usually at the Township Office on Monday mornings.

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> On Oct 27, 2016, at 4:36 PM, Don Campbell <dk.campbell@xplornet.ca> wrote:
>
> Hi Rick:
> Attached, please find my comments on the EA after the third PIC meeting. It is such a shame that you have to spend big dollars on such poor quality stuff as this on all of your dams to get to do a project.
> I have tried to offer some alternatives that still fall within the two main criteria that I see as necessary –reduce liability and have additional outside funding. I will be more than happy to come in to talk this sort of thing over in an effort to get better results for you at a reasonable cost which I think has been lost in the work so far. If such a discussion would be better at the site, I am happy to do that too. At some point in the process practicality needs to

be considered, and that is non-existent in the discussion so far with the admission that all is subjective in the current project.
Don Campbell
<Embro Dam 3rd meeting good.docx>

From: Don Campbell [redacted]
Sent: November-11-16 9:21 AM
To: Goldt Rick <goldtr@thamesriver.on.ca>
Subject: Fw: Embro Dam

Hi Rick:
Marcus Ryan responded to my letter to you which I copied to three council members. In his reply he attempted to defend Ecosystems Recovery Inc. as experienced and knowing of the process of Environmental Assessments. The public has the idea that there has been too much collusion between your wanting no dams and the capability to predict the outcome by Ecosystems prior to the PIC#3. I suggest that the ability to predict is a done deal by the criteria chosen and the units with the criteria, given the numerical outcome of their normalization and 25% valuation method. I do not disagee that Ecosystems may be an experienced Company, except that I think the system is flawed so that the costs are poorly spent, when the justification for a preferred choice is done with such sloppy means as has been done for your Embro Dam case. This is my reply to Marcus's comments to me. I do hope that you can ask for an evaluation of a more reasonable choice than he has put forward.
As an owner, it is imperative that you consider the maintenance costs after a storm bigger than the 50 year snow melt and the liability that may accrue from that, and I have tried to suggest a means of coping with more than the 50 year event. Clearly, since this dam has been in place since before 1876, it has withstood the 100 year event somewhere along the way and since it was there for Hurricane Hazel , it has withstood that, although the damage this far west was not nearly what occurred in Toronto on the Humber and Don rivers particularly.
Don Campbell

From: Don Campbell
Sent: Thursday, November 10, 2016 2:09 PM
To: [redacted]
Subject: Embro Dam

Hi Marcus:
I am sorry that I cannot make it in to the office on Monday mornings at the moment. We are down to one vehicle and my wife needs it on Mondays to do her preparation work for her Early Childhood learning programme.

As you know, I have been very critical of the personnel working on this project because he has not told us the truth about costs in the engineering reports accurately and so I have real questions about his capabilities if he is that loose with facts and trust. I do want to illustrate the folly of Ecosystems Recovery and their method of determining the preferred choice, based on their choices of criteria for evaluation and their methods of calculations. With their choices of criteria, and an understanding on their part that there is no mathematical or scientific basis for the assignment of values, and that arithmetic appears to be mathematical and unbiased (which it is not) their system appears to be valid. What is very evident, is that they know the system for EAs and how to work that to appear to be reasonable.

In the case of the Embro Dam, there is a definite liability by having a dam because there is always the possibility of a failure.(Rylands and Fletcher). Due diligence by UTRCA has provoked two engineering reports that illustrate scientific reasons from Atterberg limit tests of increases in risk to the owner because the water content of the earthen dam is approaching the plastic levels for that soil type. Thus a prudent owner would take steps to make the dam safer from a liability standpoint. This means changing the water levels in the dam so that the Atterberg limits for plasticity are not met. The engineering report by Acres details how that can be achieved, and the Naylor report offers specifics for construction so that the risk is reduced and the liability is minimal. Because of these reports and f construction were to be done to the standards within these reports, the liability then shifts from the owner to the engineer and his stamp.

In this case, the owner has reduced the maintenance that it has undertaken in the past and has discontinued to drain the pond annually, so that the water contents have stayed high in the berm for the full year, with no opportunity to drain by gravity over half the year if the pond were drained for the winter. In this respect, the owner has been more negligent than in the past, and has in fact increased its liability and risk by not draining this pond annually.

In the Acres report, there is the step that the project does need to undergo an Environmental Assessment. And thus an outside consultant is hired to do that: in this case Ecosystems Recovery Inc. In my experience, a consultant is hired as an unbiased professional to do the work prescribed. In this case, the public is not privy to the letter of transmittal for the hiring of Ecosystems, but you should have that as one of those doing the hiring. In my discussions with Mr. Goldt at the first meeting, it was very evident that the CA wanted no dam in place as the end result. (I have known Mr. Goldt from the sailing club at Fanshawe many years prior to this, so it is not as if I did not know who I was talking to at this point).

If one looks at this problem from the two main factors that have emerged to the public over the three meetings, but should have been evident from the start for those involved, they are liability and outside funding, Neither are really a part of the natural environmental situation that occurs at any site involving geography and an ecosystem on the surface of the planet. However, within the broad picture, the environment includes all things including risk which has not been well addressed by the consultant and which is a main factor in determining the liability of the CA for any given choice of project. Further, that the CA has specifically asked for enhancements of the environment to change fish habitat and have an unbiased professional comment on those is biased from the start. (I do fully understand that fish habitat is a part of outside funding though, and that the provincial government and their MNR are far more likely to agree if there is apparent enhancement of particularly fish habitat at the present time. I have seen this happen in other EAs recently.)

When one looks at the methodology of the consultant, he has chosen 4 main criteria on which to evaluate the environment : Technical, Social, Natural Environment, and Economic. He has chosen to arithmetically weight these criteria equally. Within each of these four, he has chosen several units to use for defining and evaluating the criteria. His choice of the 4 main criteria and their subsequent units within can be chosen such that the outcome is predictable before any data is collected, because there is no scientific reason stated to include or exclude any of his choices made or any of his choices not included. In those choices omitted, I would suggest that the simulation programme in the Acres Report ought to be included to establish the degree of severity of weather events, but that has clearly been left out, thus far. As a scientist, I expect a consultant working on an environmental assessment to have and to declare his reasons for choosing and reasons for not choosing his methods and inputs, and we have been shown nothing concrete on this and have a summary that everything from inputs to costs is subjective. To me that is very suspicious and only smacks of someone who knows how to use the system for his employment. That is as close to a sham as one can get, by my definition of sham. I have found the same sort of problem in the two other EAs that I have been involved with, so it is not just Ecosystems but the process which exacerbates this sort of work.

I we look at the overall weighting of the 4 main criteria that have been chosen, there are 5 units in Dam Safety, 7 units in Natural Environment, 5 units in Social/Cultural and 3 units in Economic. Once the wonderful normalization and 25% factor are done, any category with 5 units in it has the same score before and after, those with more than five are reduced , and those that have less than five are enhanced. Thus the technical and social are at their given score, the natural environment reduced and the economic is greatly increased because it has only three units in it. The consultant is very well aware of the system to promote things by his choices of more or less units within a criteria to dramatically change weighting and final outcome. Again, I see this as the work of not an unbiased professional.

Within the units I can criticize almost every one as not representative of the description given on the 5th page of the Boards presented at the PIC3. Unfortunately, the pages are not printable as shown, so it is a bit of a task to do them one by one. As an example, the first unit under dam safety is the effectiveness of achieving dam safety and reduce the risk of failure. The score for repairing the dam is less than the score for removing the dam. The risk of the liability if the dam were to be repaired to the standards of Naylor and Acres is completely off set to the engineers and so is exactly the same for the owner as if the dam were not there. Obviously, no legal advice has been sought on a question of legality. Protection of property is about the risk of flooding property adjacent to the CA. No mention of any volume or flow was ever made and so this is totally subjective. In any event, with the flow determined by Acres of 9.4 m^3/sec., that flow will be present with no dam or once the dam is full, so the flow will be 9.4 m^3/sec below the dam and above it, thus the dam will have no effect on flooding. There is little reason to include this factor in an evaluation but by doing so, there is a gradation of values and so a bias towards dam removal based on the scoring chosen (without a flow rate given!). There is no real value in the constructability factor as all are equal.The

implementability factor is based on management practice and the numerical evaluation appears to say it will be more difficult to manage the repair of the dam – which is not complicated, as the engineering reports outline, than to remove the dam and build all the associated watercourse. If this is a factor of maintenance costs, it ought to be in the economic unit and so the arithmetic distortion is again brought to the fore. As for the approvability factor, the owner can go ahead with the repair with no approvals because it is negligent to not do so. This approvability may include outside financing so is a duplicate factor already in the Economic criteria which again distorts the arithmetic output in both this and the economic unit. In summary, if the two economic units are removed from this criteria and the constructability factor deleted so that only 2 units remain in this criteria, the risk properly evaluated for removal and repair, and the flooding determined realistically, it would increase the weight substantially for this criteria and there ought to be no difference for dam repair or removal.

Within the natural environment units much the same can be said. The aquatic habitat enhancement is divided into creek and pond in the first to units. The difference in total for the sum of these two units is one point for the creek, entirely due to the fish passage from below to above the dam. However, no data were presented to us to define the species below as warm or cold water fish, or the consideration of whether any species would remain in the creek that is to traverse the current pond bed. The third unit is based on enhancement and if the dam is repaired, the status quo is maintained. The costs for the enhancement are considerable as projected. Regarding species at risk, the reports we had been given were that there are no species at risk in this area and so this is a trumped up category because there was no suggestion that any SAR would be introduced. The 5th unit talks about dynamic stability and that is an oxymoron. If things are stable there is nothing dynamic about it and if things are dynamic they are not stable. Sedimentation is going to be a much discussed topic over Phosphorus and Nitrogen loading into the Great Lakes. The consultant has chosen to disregard this current and upcoming topic to the detriment of us all, even though there have been vey recent international undertakings on the topic. The unit on groundwater is non-descript. There has been a concern over shallow wells and the effect on them. From my investigations, the owner has all of the shallow wells in this project and most were for test holes for engineering reports, not water sources. The last item in this criteria is the water quality and while the quality of the pond water now is not good, there is nothing in this report to say how it will improve with a change from pond to creek. Having no sediment catchment will mean it is only more difficult to remove phosphate especially, because from experimental work done by Canada Center for Inland Waters on Holiday Creek, with the base station on my farm, 50% of the phosphate in creeks is adsorbed onto soil particles. Undoubtedly the water quality may improve, but the effects of the nutrient loading will then be washed down further without any attempt to control it. As for the temperature of the water, the data presented earlier showed that the daytime temperature of the creek above the pond was higher than the pond water temperature and that it was only night time temperature that was cooler. The balance of the energy system has not been investigated by this consultant on this project and so the only thing

for sure is that subjective results are only supposition and without basis in fact, hence no reason for conclusions, except erroneous ones.

The social criteria are similarly in contention. The first unit is loss of property or access to property. The evaluation is that there will be some loss or lack of access in the removal and pond rebuild and lowering of the level of the current pond alternatives. It seems to me that all the effects of either of these proposals will be on the owner's land and there ought not be any loss or restricted access. There is no real difference between the first and second units except for boating, which is not a big factor in the current pond. The Embro cubs used the pond to do some canoeing but the last year they tried it they could not get across the pond to the edges for lack of water close to shore, the slope was so gentle. (My wife happened to be a cub leader at the time.) As for a measure of public safety, the liability of the dam is paramount for that and has already been included in the first criteria. The liability with access to any water body by the public is always a liability concern and so are trails, creeks and open fields. That is the cost of ownership and if that is too great, then the owner should re-evaluate this property in the CA. As for the impacts to the heritage features, there is no mill remaining and while there is a water surface there, and there are a number of waterfowl species that do alight on this pond in migration times, (more than was mentioned in the appendix on birds from personal experience and observations), it should not be a big factor in the liability and cost decision making process. As for the last unit, why removing a big pond and making a smaller pond ought to increase recreation is not logical. There is less opportunity to boat, and there is no mention of fishing. Any trails would be short and not for exercise as in rail trails, so their scoring is suspect in this criteria as well, in that it is all subjective and without documentation of fact.

As for the economic criteria, the first unit is the relative measure of initial costs and this is a straight line, again, without merit because there is not an equal cost difference among the alternatives.The second is ongoing maintenance costs. These were spelled out as subjective and there is no measure of consistency in them, for example, the dam removal cost in 2016 dollars in the repair project, for the dam removal in 75 years. Was this cost included in the removal project in 2106 as an initial capital cost? If so there is not a big difference between removal and making a creek and so the creek has been over priced or the repair under priced. There is also no realization that there is no necessity to remove all of the dam berm but only to remove enough to allow the flow through the berm. However, the level of storm event matters here and the use of the 50 year snowmelt is much less than the 100 year storm or the 250 year storm, both of which the CA relies on for other calculations and projects. Thus there is a real problem with applicability of the standard and hence the liability and damage that may ensue in a bigger storm event. This is not a good report for the effects of the possibilities that may happen at this site.

There has been no energy balance done on this project because there has been no consideration for a flow rate and slope that has been shown to us. All I can say is from past experience, when energy is not considered carefully, the base on which to build a case for naturally occurring environments is not going to work out the way it was thought to be. This will be a classic case of failure if this is not considered.

As a reasonable alternative, I would suggest that the case be evaluated for the pond be drained, that the overflow be constructed as in the Acres and Naylor reports, that some fish ladder be evaluated on the upside of the culvert through the berm, and that the standpipe be re-designed to allow for the pond to automatically fill under storm conditions, and with a way to manually release the water entrapped after the storm event. Such a system would reduce the energy in the system initially and offer a buffer to the flow throughout the storm event, maintain a catchment for sediment control, and reduce the liability for the failure of the dam to very low levels, not just for a 50 year event but across the board. There still ought to be outside funding for this as storm water controls, but in any event, it would remove the $80,000 cost for dam removal now in these projects as a beginning. Since the Acres report had the cost of the spillway at about $8,000 and they added a 25% contingency, this ought not be an huge value now. This project does not need to cost $250,000 to $325,000 to achieve the goals set out in the beginning, even without outside funding!

Don Campbell

Bradley Burrows

From: Rick Goldt <goldtr@thamesriver.on.ca>
Sent: January-02-17 8:43 AM
To: Don Campbell
Cc: Mariëtte Pushkar; Wolfgang Wolter
Subject: Embro Dam EA PIC#3

Dear Sir,

Thankyou for your recent email correspondence following the Public Information Centre #3 for the Embro Dam Class EA. Your correspondence brings forward many of the comments from earlier PIC that we responded to by email dated Oct 16, 2016. The consultant will consider these comments in preparing their reports.

We would like to respond to a number of new issues you have raised.

1. Conservation Authority Involvement

Ecosystem Recovery Inc. was hired through a request for proposal process whereby experience with the subject matter was weighted with the cost proposed. A consultant was hired as the Authority does not have the staffing dedicated to undertake similar work. Class Environmental Assessment projects under the Conservation Authorities of Ontario Class Environmental process are not frequently called for. The Authority as a normal function does have the expertise and opportunity to contribute to EA study matters regularly through planning advisory roles and Regulations applied under the Conservation Authorities Act. UTRCA staff and Zorra township through representation on a project team (not just the Authority) had the opportunity to contribute to the consultant's work. Evaluations are best a collaborative effort.

2. Normalizing the Evaluation

You have highlighted a concern with "normalizing" of data through a "mathematical" approach. We would like to reiterate that the focus of the presentation of material at PIC#3 was on the evaluation of alternatives for Embro Dam and that "normalizing" of the various element or issue scores under each criteria of Technical, Natural Environment, Social / Cultural, and Economic was undertaken so that the 4 criteria were weighted equally, which is common practice. As example where 7 issues under the Environment criteria were evaluated the scores of 1 to 5 as noted for each of the 7 issues and for each alternative were added and factored lower based on a maximum potential score of 5 issues, which is the average number of issues under the 4 criteria. If there were 3 issues under a criteria they were factored higher in total score to ensure equal weighting across the 4 criteria. These aforementioned mathematical steps then contributed to normalizing the scores. The process may be explained many different ways but the intent is to present a balanced assessment.

The public has been given the same information and opportunity to comment as provided to the project team and the consultant. Checking back on the original draft evaluation by the consultant it was found that following the input of the project team the relative rankings between alternatives had not changed. As a result of the fair evaluation of the alternatives with inputs from the consultant and the project team as noted above, the preferred alternative has been put forward.

All alternatives were evaluated with respect to economic factors based on experience with various funding opportunities whether government or non- government. It was stated that our experience with provincial government funding for dams was that priority was for repairs to existing flood control infrastructure and some opportunities for funding for dam removal. There is also interest in funding dam removal from the non government side. The government funding

opportunities are not guaranteed and are merit based against all other applications from conservation authorities for very limited funding.

3. New Alternative

You describe an alternative on the basis that funding would be available for flood control as well as for dam removal. Your alternative description of altering the control of the dam to reduce liability is similar in intent to the Alternative 5 presented.

The alternative you have put forward would permanently increase inflow to the stand pipe - culvert system. It is suggested that fish passage could be added. The effect of implementing the alternative would be that a pond feature would be normally drained and function without the pond or stream environment attributes put forward with Alternative 1 through 5. The former pond area would be utilized for storm event surcharge conditions and would rise and fall with storm runoff events. The pond bottom would for some time be exposed and there would be a permanent loss in fish habitat. As the dam would remain, maintenance would still be required.

The flood control function that would be enhanced would be entirely for the purpose of protecting the structure from failure as much as is reasonably required. Alternatives 2 and 5 address this also and fall under the same funding limitations. The repair would not provide any additional flood control benefit to downstream areas as non are threatened or protected through the current dam. An alternative proposal to provide for a new flood control function as suggested is not funded by the Province.

The consultant will consider the proposal in the report being prepared.

4. Costs

Costs developed by the consultant reflect experience with many similar and ongoing projects. Their estimates are current and have considered the costs for various measures brought forward from the HATCH (Acres) studies in the early 2000's and the additional costing provided by Burnside in 2009.

The economic evaluations considered common elements required for each alternative. The primary objective of developing cost estimates and cost ranges is to account for the variability in effort between alternatives. The costs are an estimate for completing a project in a reasonable time frame (usually one contract and one fiscal year) to achieve the results intended.

Various aspects of the preferred alternative will be further evaluated as to the best means towards implementation. You as we are concerned with the potential costs overall and the Authority does look for ways to reduce costs as evidenced in some of our dam removal projects to date. Ultimately for Embro Dam through the process of implementing the preferred alternative, external and local funding will be explored and would be intended to be utilized in the most effective way possible.

Again, thank you for your comments. The consultant will consider them towards completion of the reports and they will be documented in the reports as part of the record.

Rick Goldt C.E.T.
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Bradley Burrows

From: Don Campbell <dk.campbell@xplornet.ca>
Sent: January-18-17 12:57 PM
To: Goldt Rick
Subject: Further to our meeting today
Attachments: catchbasin for dam.docx

Hi Rick:

Between my awkward drawing and trying to get things on paper, I have come up with this. Figure A is a top view and Figure B is a side view from the north. I did not do an end view because there would be very little added information. I could not manage to figure out how to add dimensions to these figures. Thus the following descriptions:

Figure A

I imagine the box to be concrete of suitable strength to support the weight of water above it when the pond is full. The outlet is on the left and it would exactly match the current diameter of the culvert currently below the dam with the box placed as close to the culvert as possible. The standpipe is on the right and I would leave an opening on the south side of the pipe so that it always will accept overflow, once above a chosen height, so that the top of the box may be buried with 30 or 40 cms or so of soil. That opening could taper so it is more open at the top, similar to the fixed structure at the golf course on Highway 5 about 1.5 kms west of Highway 6 at Clappison's Corners. The standpipe ought to be the same diameter as the current one in place now and be shielded as it is now, but the shielding should increase to include the slit. The reason I have put the opening at the south is so that any detritus that is washed up against the structure may be removed without working over the stream entrance. This also forces the flow in a reverse direction to normal inflow so combats momentum in the flow pattern. I suggest the stream entrance be of suitable diameter to include the normal flow for a 2.5 to 3.5 cm /24 hour rain event. I suggest that this inlet be a u trough to attempt to prevent sediment washing in straight from the pond bottom. Such a shape would allow for the fabrication and placement of a trash gate that could go to the bottom of the trough and both sides as well. Otherwise a 45 degree slant top catch basin could be put on top of the U tube and the grate fabricated accordingly.

Figure B

This figure shows the side view of Figure A and illustrates that the bottom of the inlet is the same as the bottom of the outlet. This would mean that fish could move from below the culvert opening at low flow to the stream above the catch basin and have access to the above berm territory with fair ease. The blue rectangle in the standpipe indicates an opening in the circle of the standpipe. I do not think this ought to be too difficult to get since I see all sorts of holes in concrete pieces from J.D. Oakes that are on construction sites.

My reasons for this suggestion is twofold. Firstly, I believed that your main priority was to reduce liability, particularly a failure of the dam in an abnormal weather event. At the same time, I believe that there is a liability exposure to letting the watercourse run through this berm without maintaining the energy balance that now exists because this berm has been here for at least 145 years and there is building and road engineering on or near Oxford Road 6 based on the momentum of the flow as it is now with the berm in place. In my estimation, the momentum of this creek starts again at the base of the berm because the spillway overflow meets the stream at about 90 degrees now, the momentum (M) (M = mv, where M is momentum, m is mass and v is velocity, a directed distance) approaches 0 because the velocity in the stream direction approaches 0. Any water coming from the standpipe also has low momentum because the velocity of that flow is perpendicular to the flow in the culvert and is only propelled by the hydraulic head of the water in the standpipe and air pressure above that column if the pond level is above the standpipe. Acres has said their calculated flow from their simulation is 9.4 m^3 /sec under the culvert on Road 84. The momentum of that flow is taken out by the effects of the mass of the water in the pond, and the lack of fall that remains once there is a pond surface in place. Thus, the velocity of the

water going into the standpipe is low and in any event, the velocity of the resulting current in the pond is at right angles to the flow in the standpipe so Momentum approaches 0 again.

Whatever the design is for the streambed in the current pond basin, there are two main problems to overcome. The first is to control the acceleration that will occur across this 200 m and the second is to control the momentum as well. Meanders will do this for normal flow but the difference in flow from normal to the 50 year event or more is what has to be considered. In my estimation, that you consider the 100 year storm as a base for much of your work and the 250 year storm in the simulation work that you do, the standard of a 50 year snow melt (with decreasing snow falls but increasing variability and magnitude in rain events) is poor planning. Regardless of the design of the flood plain, water will go where it has the least resistance. I suspect it will inundate the meander system and begin to erode things as it goes or deposit silt where it can. At that point, it will override the design and cause damage to the plan as designed. I am skeptical that there was any maintenance allowance for this sort of damage in the projections put forward at PIC3.

I believe my suggestion to solve both the liability issues, and the momentum and acceleration problems of a major storm event in a cheaper and more effective option than removing the dam, even after the present overflow has the repairs that the Naylor report proposed for just the spillway. This will reduce the liability of the dam failure to very low levels, because it will allow the berm to dry out and only rewet under significant weather events. The concerns of both Naylor and Acres were that the moisture levels in the dam were approaching the plastic level, and at that point, even the ice on a full pond could move the structure significantly. I have raised this maintenance issue in previous notes to you that I thought the pond level ought to be lowered for the winter to allow the berm to drain. The controlled fill of the pond will offset the momentum and acceleration on the flood flow. Even with a meander system in place for normal flows, I suggest that the damage to that system with a controlled pond fill will be less than without the pond fill.

Secondly, the issue is costs. When it comes to the fish, I have no issues with trying to include a way to have fish able to get through the berm, until the prime purpose of dam removal becomes fish habitat in a 200 m stretch of the creek and the cost approaches $300,000. I have suggested a way fish can move through the berm at low flows, and I am fairly sure they would not be moving through that 200 m when the creek is in flood regardless of the openness of the watercourse. I am sure my suggestion is not in the cost realm of $300,000.00

You mentioned in your letter of Jan 2 this year that the normalizing was to treat all four categories equally. There are some issues that are so overwhelming, they ought not to be treated equally, and that includes liability, costs, cost /benefit result, disease potential, safety for users and I would add water quality, including phosphates. Since all of the criteria in all of the 4 areas were selected subjectively, treating them equally does not really pick the best option, but merely allows for the desired option to be advanced apparently objectively. One cannot get truly objective results from subjective data.

Don Campbell

Figure A