REPORT (FINAL)

August 01, 2025

Phase I and II Environmental Site Assessment– Former Thorburn Mine Site, Thorburn, NS

DP Project No.: 24-750

SUBMITTED BY:

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EXECUTIVE SUMMARY

At the request of Build Nova Scotia (BNS) on behalf of the Nova Scotia Department of Natural Resources (NSDNR), DesignPoint Engineering & Surveying Ltd. (DesignPoint) completed Phase I and II Environmental Site Assessments (ESAs), a Class D cost estimate, and Level 1 schedule for Phase III ESA delineation, and a remedial options analysis of the historical Thorburn Mine Site (PID 00894162) located in Thorburn, NS (herein after referred to as the 'site'). The site is a 4- acres (16,187 m²) rectangularly shaped property located at the intersection of New Row Road and New Road Branch in the community of Thorburn, Pictou County. The Phase I and II ESA field work was focused on this site only; no third-party properties were intrusively investigated.

Summary of PID 00894162

Property Owner	Her Majesty the Queen in Right of The Province of Nova Scotia, Nova Scotia Department of Natural Resources and Renewables
Site Lessee	None
Site ID	Former Thorburn Coal Mine
Property Area (m^2)	16,187
Land Zoning	Residential
Groundwater Use	Potable
Property Use	Vacant, parkland, with a trail and reported (BNS) ATV use

Phase I Environmental Site Assessment

The Phase I ESA was carried out in accordance with DesignPoint's proposal dated October 10, 2024, and meets the Canadian Standards Association (CSA) Phase I ESA Standard (Standard Z768-01, R2022) and Nova Scotia Environment and Climate Change Contaminated Sites Regulations (NSECC CSR, 2021) Phase I ESA Protocol (PRO-300, R2019). The scope of work for this Phase I ESA consisted of a records review, interviews, and a site visit. The objective of the Phase I ESA was to identify potential or actual environmental concerns resulting from current or past activities on and adjacent to the site.

Based on the findings of this Phase I ESA and discussion with BNS (Kely Henderson), DesignPoint concludes that there is a medium potential for significant environmental liabilities to be associated with the site.

There were seven (7) APECs identified based on the document review:

1. APEC 1 - the single structure footprint along the new row: suspected heavy metal, PHC, and PAH impacts in soil and groundwater.
2. APEC 2 - 4 structures footprint in the center of the site: suspected heavy metal, PHC, and PAH impacts in soil and groundwater.
3. APEC 3 - the old access road turnaround in the southern corner of the site: suspected heavy metal, PHC, and PAH impacts in soil and groundwater.
4. APEC 4 - the fill pile in the center of the site: suspected heavy metal, PHC, and PAH impacts in surface water and sediment.
5. APEC 5 - the funnel-like wet area in the north-eastern potion of the site: suspected heavy metal, PHC, and PAH impacts in soil and sediment.

6. APEC 6 - the diversion channel for the former airshaft: suspected heavy metal, PHC, and PAH impacts in surface water and sediment.
7. APEC 7 - the southern portion of the site is slightly elevated, compared to the northern portion, it is suspected that at least some infilling occurred in the past there. Suspected heavy metal, PHC, and PAH impacts in soil and groundwater.

Based on the APECs identified during the Phase I ESA, it was recommended that a Phase II ESA soil, sediment, groundwater, and surface water sampling program be conducted at the site to determine if environmental impacts are present and/or potentially impacting nearby residences, recreational areas (ballpark), or potable water supplies.

Phase II Environmental Site Assessment

The Phase II ESA was carried out in accordance with DesignPoint's proposal dated October 10, 2024, and meets the CSA Phase II ESA Standard (Standard Z769-00, R2023) and NSECC Contaminated Sites Regulations (NSECC CSR, 2021) Phase I ESA Protocols (PRO-200 and PRO-300, R2019).

All APECs identified though the Phase I ESA were intrusively investigated accordingly to the scope of work approved by NSDND and BNS. No deviations were noted.

The Phase II ESA resulted in the following findings, conclusions, and recommendations:

Findings

In summary, it was found that:

- Surface soil across the site (APECs -1 ,2, 3, 4, 5, and 7) is impacted by a set of heavy metals, PHCs, and PAHs, generally similar for all locations. Based on the results of this Phase II ESA it was found that the site impacts could be represented by one (1) APEC-A, which would include surface soils, sediment, and groundwater, characterized by similar set of impacts. An average depth of these impacts was estimated to be 1.5 m.
- Surface water (APEC-6) is impacted by a heavy metal set distinct from soil impacts. Based on this conclusion surface water is concluded to represent a separate APEC-B with an unknown source.
- Stream sediment is impacted by PHCs and PAHs, like surface soils in the consolidated APEC-A.
- Groundwater is impacted by limited heavy metal (manganese) and select physical parameters. Although only manganese was the exceedance characteristic of APEC-A, groundwater impacts are concluded to be related to the APEC-A due to highly probable origin of this water on the site, as percolated precipitation.

Conclusions

Based on the information collected during the May 2025 Phase II ESA investigation, DesignPoint provides the following conclusions:

- It was concluded that the whole site soils, sediment, and groundwater represent one (1) APEC-A with similar set of impacts.
    - Surface soil on the site is contaminated above applicable guidelines with heavy metals, PHCs, and PAHs and requires further on-site horizontal and vertical delineation of these impacts.
    - Sediment on the site is contaminated above applicable guidelines with heavy metals, PHCs, and PAHs and requires further on-site vertical delineation of these impacts.
    - Groundwater flow was to the north, at an average velocity of 0.009 m/d. Only color, pH, TDS, and manganese exceed applicable guidelines. It is concluded that further detailed on-site delineation of the impacts and bi-annual (high and low flow events) monitoring of groundwater is required in 2025-2026 due to potential impacts on potable household wells around the site and suspected influence from off-site AMOs.
- Surface water on site is contaminated above applicable guidelines with heavy metals including mercury, by historical mining and requires further on-site monitoring for water levels, flow, water parameters, and water chemistry, including metals and mercury. It is concluded that further on-site delineation of the impacts and bi-annual (high and low flow events) monitoring of surface water is required in 2025-2026.
- Off-site AMOs and historical mining activities upgradient from the site to the east, south, and west could potentially affect the site by migrating surface and groundwater, as well as soil (dust) and sediment in the brook.

Recommendations

The following recommendations are based on the Phase II ESA conclusions:

1. It is recommended to complete a Phase III ESA, including on-site delineation of soil, sediment, and groundwater for the noted impacts, such as metals, PHCs, and PAHs within APEC-A. Approximate delineation locations are depicted in Figure 8, Appendix A, and described below. The delineation is primarily aimed at the site boundaries and vertical investigation, and intrusive locations are proposed accordingly.
    - Soil delineation is recommended to be completed at seven (7) locations along the site boundaries, of which two (2) would be boreholes and five (5) monitoring wells. To limit disturbance on the site this delineation is recommended to be completed using a drilling rig and manual auger, rather than an excavator.
    - Sediment vertical delineation is recommended to be completed at one (1) location, using the manual auger.
    - Two (2) samples for vertical delineation are recommended for each future soil and sediment sampling station. Samples to be collected: one (1) from the potentially most impacted and one (1) from lower, least impacted layers of soil. OVM to be used for aiding of sample field screening.
    - Groundwater delineation is recommended to be completed at five (5) locations using future soil delineation boreholes for monitoring well installations.

- The set of analytes for groundwater is recommended to additionally include VOCs to satisfy requirements for sampling of potable water. Potable household wells are located predominately to the north of the site. Organic parameters were not detected during the Phase II ESA; this should be confirmed through further monitoring in 2025 and 2026.

2. During Phase III ESA field work it is recommended to monitor surface water (APEC-B) on the site for water levels, flow, and water chemistry, including general chemistry, metals and mercury, PHCs, and PAHs. Organic parameters were not detected during the Phase II ESA; this should be confirmed through further monitoring in 2025 and 2026.
3. It is recommended to consider potential further delineation of impacts on third-party properties, if it will be determined that the site impacts could extend off-site. Please note that, while recommended, the off-site characterization and intrusive investigation are not parts of the proposed Delineation phase of this project.

Conclusions and recommendations regarding the current environmental condition of the former Thorburn Mine Site are based solely on the results of the Phase I/II ESA soil, groundwater, and surface water sampling program as described in this report.

1.0 INTRODUCTION

At the request of Build Nova Scotia (BNS) on behalf of the Nova Scotia Department of Natural Resources (NSDNR), DesignPoint Engineering & Surveying Ltd. (DesignPoint) completed Phase I and II Environmental Site Assessments (ESAs), a Class D cost estimate, and Level 1 schedule for Phase III ESA delineation, and a remedial options analysis of the historical Thorburn Mine Site (PID 00894162) located in Thorburn, NS (herein after referred to as the 'site'). The site is a 4- acres (16,187 m^2) rectangularly shaped property located at the intersection of New Row Road and New Road Branch in the community of Thorburn, Pictou County. The Phase I and II ESA field work was focused on this site only; no third-party properties were intrusively investigated.

Table 1: Summary of PID 00894162

Property Owner	Her Majesty the Queen in Right of The Province of Nova Scotia, Nova Scotia Department of Natural Resources and Renewables
Site Lessee	None
Site ID	Former Thorburn Coal Mine
Property Area (m^2)	16,187
Land Zoning	Residential
Groundwater Use	Potable
Property Use	Vacant, parkland, with a trail and reported (BNS) ATV use

The scope of this project was as follows:

- Phase I ESA: documents review; interviews, site visit; reporting; and work plan for the Phase II ESA.
- Phase II ESA: site clearance including bird nest sweeps and turtle surveys; borehole advancements; monitoring well installations; auger hole advancements; soil, groundwater, sediment, and surface water sampling; analysis and reporting; Phase III ESA delineation work plan; and preparation of a remedial options analyses with Class D cost estimate and Level 1 schedule.

The Phase I ESA is presented in Sections 2.0 to 6.0 and the Phase II ESA is presented in Sections 7.0 to 14.0, below. Remedial options are presented in a separate cover memorandum.

2.0 PHASE I ESA OBJECTIVES AND SCOPE

2.1 Phase I ESA Objectives

The purpose of the Phase I ESA was to identify any areas of potential environmental concern (APECs) related to the past or current use of the site and adjacent properties with an emphasis on the usage, handling, and storage of hazardous materials/chemicals that may have impacted soil and/or groundwater quality. A secondary objective of the ESA is to make recommendations to address any APECs identified during this study.

2.2 Phase I ESA Scope

The Phase I ESA was completed by DesignPoint in accordance with the Canadian Standards Association (CSA) Phase I ESA Standard (Standard Z768-01, R2022) and NSECC Contaminated Sites Regulations (NSECC CSR, 2022) Phase I ESA Protocol (PRO-300, R2019) and consisted of:

- Documents review
- A site visit
- Interviews
- Report preparation.

3.0 PHASE I ESA DOCUMENTS REVIEW

The historical occupancy of the site and surrounding properties was reviewed using:

- Historical documentation provided by BNS in the RFP Scope of Work Appendix C, including:
    - 1979 aerial photographs with mark-ups
    - Maps of Locations of Mine Workings Captain, McKay, McBean, Foord, Cage, Third, McGregor, New, Acadia, Scott, Miscellaneous, and Six-foot Seams, Pictou County Coalfield, Pictou Co., NS
    - One of the Greatest Treasures; The Geology & History of Coal in Nova Scotia, information circular No.25, J. H. Calder, K. S. Gillis, D. J. MacNeil, R. D. Naylor and N. Watkins Campbell, 1993
    - NS Dept. Of Mines, Assessment of the Pictou County Coalfield, Westville, Stellarton and Thorburn, by J.D. Wright and C.F. Townsend, 1974
    - OFR-92-001, NS DNR. Report on Locations of Abandoned Mine Workings in the Pictou Coalfield, K.S. Gillis, J.D. Dewolfe, 1992
    - OFR-92-018, NS DNR. Report on Land Subsidence in the Pictou Coalfield, K.S. Gillis, 1992
    - Division of Fuel and Well Log records for Thorburn Mine
- Aerial photographs, obtained from the Geomatics Centre in Amherst, NS for the years 1931, 1954, 1960, 1972, 1979, 1990, 1997, 2003, 2007, and 2023 (included in Appendix B).
- Access Nova Scotia Property Online Deed records (1993, 1999, 2009).
- NSECC reply on the BNS request for environmental information (included in Appendix C).
- Fire insurance plans and city directories were not available for the site.

- Keppie, J.D. (compiler) 2000: Geological Map of the Province of Nova Scotia; Nova Scotia Department of Natural Resources, Minerals and Energy Branch, Map ME 2000-1, scale 1:500,000.

3.1 Site Description

3.1.1 Site Background

The history of mining in the Thorburn area dates back to the mid to late 19th century. From 1875-1976, 9.3 million tonnes of coal were reportedly mined in the Thorburn area.

Historical mining at the subject site is associated with the Acadia No. 3 mine operated by the Vale Iron and Manufacturing company which later became the Acadia Coal Company. The mine was operated from 1884 to 1938. Mining was temporarily abandoned between 1914 and 1918, and the mine was allowed to flood with water during this time. The first mine, the MacBean/Vale Colliery, opened in approximately the late 1860s and closed in 1971. Most recently, the Thorburn Mine was operated by Thorburn Mining Ltd. from 1997 to 2000. Thorburn Mining Ltd. reclaimed the site after operations ceased and removed old buildings and equipment from the site.

3.1.2 Site Location

The Thorburn site (PID 00894162) is a 4-acre rectangularly shaped property located in the community of Thorburn, Pictou County, and is a forested strip of land. The site borders a recreational field with an access road on its south side (PID 00920314), and a roadway New Row on its west side. New Row roadway borders the site along the entire northern perimeter. To the east is a residential property (PID 00894675) which is approximately 750 m^2.

The site can be accessed from any of the three (3) roads along its perimeter. Due to ease of access and neighboring residential properties, the site is frequented by pedestrians, and a crude walking trail appears to bisect the property.

A site location plan is presented on Figure 1 and a detailed site plan is presented on Figure 2 (both included in Appendix A).

3.1.3 Site Ownership and Occupancy

Property-use records indicate the transfer of the property in 1993 from the Sydney Steel Corporation (SYSCO) to the Province of Nova Scotia. SYSCO had previously acquired the property in 1968. No documentation could be found pertaining to property ownership prior to 1968. The site is currently owned by the Province of Nova Scotia. The ownership of the site is summarized in Table 2 below.

Table 2: Summary of Site (PID 00894162) Ownership

Date	Site Owner	Previous Owner
Feb. 1994	Her Majesty the Queen (Minister of Natural Resources)	SYSCO
1993	Her Majesty the Queen (Minister of Natural Resources)	SYSCO
1968	SYSCO	Potentially Vale Iron & Manufacturing Company (later became Acadia Coal Company)

Site and building plans of past and existing property use, including fire insurance records, municipal land use plans, other than the reports obtained from BNS are not known to exist for this site.

3.1.4 Site Buildings and Equipment

Historical surface infrastructure included the Bankhead, which was a wooden structure containing the scales, screens, and tipple. The hoist and two (2) compressors were operated on steam derived from four (4) sterling boilers. All other equipment, such as dewatering pumps and ventilation fans, were electrically powered. Based on an historical aerial photograph review, there were a maximum of nine (9) structures historically present at the site in 1931; however, all structures were noted to be removed from the site by the early 1990s. During the Phase I ESA site visit, all structures that may have existed on the property had been removed and no evidence remains on site. No structures are located on the site. A total of 305 buildings are located within 1 km of the site, the nearest building being 57.1 m from the former air shaft location and partially on the site's PID.

3.1.5 Site Property Features

The site is generally flat and covered with vegetation, grass, brushes, and mature trees. The south-western portion of the site is slightly elevated, compared to the north-eastern portion. Four (4) Abandoned Mine Opening (AMO) features are associated with the Acadia Coal Company No.3 Colliery, consisting of three (3) mine slopes and a vertical air shaft that have largely been backfilled and graded over; however, the backfilling may not have been completely filled the original excavations. Currently three (3) of the AMOs are located at or outside the property boundary to the south. Iron staining was reported near one (1) AMO feature, representing the former air shaft, it is thought to have been related to mine water weeping from the feature and converging with surface water on-site and the adjacent residential property.

The Acadia Coal Company Ltd. No.3 Air Shaft continues to weep the mine water. During a rain event in November 2013, accumulation of water associated with this feature reportedly flooded the immediate area on the property (DNR, 2014). In February 2014, additional work was carried out around the shaft which included further backfilling and increasing the height and length of the berm. This served to redirect water flow into the existing ditch which fed into the nearby stream, conveying water away from the adjacent residential property. Iron precipitates have been identified previously in the drainage water, prior to ditching. During the June 17, 2021, site visit by BNS, some localized red staining was visible; however, vegetation in and along the stream was vigorous and no red precipitates were noticed 80 m downstream or at the culvert under Marsh Road approximately 370 m downstream. The overflow water associated with this mine shaft may present an ongoing environmental issue.

3.1.6 Services

No electrical, gas, water or sewer services are currently on the site.

3.1.7 Aerial Photographs

Historical aerial photographs, obtained from the Nova Scotia Geomatics Center in Amherst (included in Appendix B) reviewed as part of this assessment include the following and are summarized in Table 3 below:

- A16823-050 (1931) black &white, no scale identified
- A4137-055(1954) black &white, no scale identified
- A14287-060 (1960) black &white, no scale identified
- 90320-049-021 (1990) colour, 1:10,000 scale
- 97001-105-020 (1997) colour, 1:10,000 scale
- 2003005-062-004 (2003) colour, 1:10,000 scale
- 2007410-035-016 (2007) colour, 1:10,000 scale
- 20230929-0258-059 (2023) colour, 1:10,000 scale

Table 3: Summary of Aerial Photographs

Date	Site	Surrounding Properties
1931	Site is grassed land with several structures, three (3) along the New Row, two (2) structures towards the center of the site, two (2) towards the northeast area, and two (2) along the connector road towards south corner of the site. A creek is present flowing through the eastern boundary of the site.	North: Grassed (potentially agricultural), forested land and some housing. Nearest structures are approximately 30 m off the north-western site boundary and immediately adjacent to the site in the north-east. South: Connection dirt road followed by wooded and grassed areas and some housing at the Old Row. East: Mainly open grassed land. A bigger industrial building is visible on the southeast area, potentially mine storage building. West: Mainly open grassed land (potentially former mine site) with some structures and housing along New Row.
1954	Structures in the site have been removed except - one (1) structure along the New Row and four (4) structures in a row along the centerline of the site towards the northeast area. A road/trail appeared crossing the site from the north to south direction providing access from New Row to the connector dirt road on southwest boundary and two areas with structures	North: Several structures seem to be upgraded with additions. South: Same as above. East: Same as above; however, the storage building has been removed, and the area is kept vacant. A pond is visible, which may have been present in 1931 but was not visible on the available aerial photograph. West: Same as above.
1960	Same as above	North: A building appeared on the previously empty lot. Open land overgrown. South: Same as above. East: the pond appears bigger than before, some wet areas and trails. West: In the place of a building a little pond appeared, close to connection road.
1972	The road across the site has changed with two (2) turnarounds now present at both ends. A potentially wet area is noted in the northeast corner of the property and around the four (4) structures.	North: Open land seems to start overgrowing, a residential home along New Row Road is removed, and land kept vacant. South: Same as above, the brook along the southern site boundary clearly visible. East: A few residential homes have been removed, and properties remain vacant. The pond appeared even bigger and has changed shape. West: Connection road is improved, trees started growing on the former mine site.

Date	Site	Surrounding Properties
1979	Structures same as above, grass and trees seem to start growing better and wet areas are still visible.	North: A small housing development is present across the New Row Road – added a mobile home. South: Same as above. The brook is less visible East: A mobile home has been added, and garbage is spread around. The pond appeared shrinking, exposed soil patch in the middle of the field, Development along Old Row with some houses demolished and some new built. West: Same as above.
1990	No structures are visible, although some squared footprints present in the southwestern portion. A pile of light-colored material is visible in the center of the site. The trail is grassed, and a new diversion channel is visible directing from the former air shaft to the brook. The site lawns are mowed, bushes and smaller trees within the southern portion are cut, only few bigger trees are left on the site. The northern portion has uncut bushes and smaller trees. The air shaft appears to be infilled with a pronounced diversion channel. No wet areas visible.	North: More housing development across New Row, two (2) bigger homes are added. A house added to former open land area. South: The dirt connection road was asphalted. New development present on Old Row Road. East: Landscaping, access road and ball field were completed. Decrease in housing with three (3) houses left, garbage not visible, and the pond is maintained at a smaller size. West: Same as above.
1997	No structures or footprints are visible, the site is partially mowed (north) trail is visible, air shaft and the channel are not visible, potentially covered with vegetation. No wet areas are visible.	North: New shed on the adjacent property, a mobile home two lots further northeast and a garage across the Old Row are added on this photo. South: Earth works (potentially reclamation) on the mine site started, earth works, water ponding. East: Same as above. West: Same as above.
2003	The channel and former air shaft are visible; the site appears to be covered with grass with some medium and bigger trees. No wet areas.	North: Same as above. South: Earth works continue. East: Two new mobile homes added along Old Row. West: Same as above.
2007	Vegetation is lush, northern portion and air shaft area overgrown with bushes and trees.	North: A bigger parking added to the housing across New Row. South: Reclamation (?) completed. East: The pond on adjacent ball field looks significantly smaller than ever. Three more mobile homes added along Old Row. West: Same as above.
2023	Mobile household in the northern portion is well established. Trees and bushed grew up significantly.	North: A mobile home added at the boundary with the site. New development across the former agricultural field – new cul-de-sac, two homes and a mobile. South: Trails established across and along the reclaimed area. East: The pond almost reached the original size. West: Same as above

3.1.8 Historical Review

To BNS's knowledge, there are no known subsurface utilities, hydraulic lift stations, records of chemicals used or stored on site, records of above ground storage tanks or underground storage tanks, or any details of oil/water separators at this site. There are no known vehicle and equipment maintenance areas, spills, liquid discharge points, process or property-use related documents related to potential or actual contamination (including waste management records, environmental monitoring data, or environmental management system records) available for this site that BNS is aware of. There are no known structures used for any previous environmental activity including monitoring wells, remediation wells, in situ treatment zones and vapour extraction systems, or previous remediation excavations and soil removal at this site.

3.1.9 Fire Insurance Plans

Fire insurance plans were not available for the site or surrounding area.

3.1.10 City Directories

City directories were not available for the site or surrounding area.

3.1.11 Previous Environmental Reports

Historical reports and records for the Thorburn Mine Site are limited. Historical reports that were deemed relevant for the subject site were provided by BNS and presented in Appendix C as well as summarized below:

Nova Scotia Department of Mines Assessment of the Pictou County Coalfield – Westville, Stellarton and Thorburn Districts (Wright & Townsend, 1974) - Regarding the Six-Foot seam, the report states: "This seam lies 607 feet below the McKay seam. It varies in thickness from 3 to 8 feet but were mined at the Acadia No. 3 mine averaged about 4 ½ feet. There were no distinct partings but there was a substantial quantity of pyrite occurring as balls, lenses and streaks. Practically all the mineable coal in the area where the seam occurred in sufficient thickness and quality to be economically workable has now been exhausted and there are no new areas in which the seam may be profitably mined. In the Marsh district and farther west the Six-Foot seam is represented by only an inch or two of coal and in places is absent. Only four boreholes intersected the complete interval between the Six-Foot and the next higher commercial seam in the Section, the McKay. The maximum thickness of 620 feet was measured in borehole 60 (N.S. Record No. 469) in the centre of the McLellan syncline. Several oil-shale horizons occur between the Six-Foot and McKay coal seams. One bed was mined in 1856, in Patricks slope and again in 1929."Regarding the McBean Seam, the report states: "The McBean was the most important seam in this area. The thickest coal was located at the outcrop on the east flank of the McLellan syncline. Towards the south the quality of the McBean deteriorated faster than that of the Six-Foot seam. The McBean seam lies 660 feet below the Six-Foot seam. It contains the Widow Chisholm seams, as a rule three seamlets in an interval of 100 feet averaging less than a foot in thickness each. The McBean seam was mined from 1946 to 1972 when all operations ceased."

Nova Scotia Department of Natural Resources Report on the Location of Abandoned Mine Workings in the Pictou Coalfield (Gillis & Dewolfe, 1992) - Mining has been carried out on 11 coal seams in the Pictou Coalfield. The centers of mining were in the vicinity of the towns of Westville, Stellarton and Thorburn. The coal seams mined in the three localities represent all the major organized coal mining attempts in the Pictou coalfields. The report presents mapped locations of mine workings associated with the Six Foot and McBean seams which overlap with the subject site.

Nova Scotia Department of Natural Resources Report on Mine Subsidence in the Pictou Coalfield (Gillis, 1992) - The report describes documented events of subsidence and probable locations of subsidence in the Pictou Coalfield including the following: "At Thorburn, a minor trough subsidence took place on the lawn of the Thorburn High School. The trough is linear, the direction of which corresponds to balance directions in the Acadia No. 3 mine. The section of the mine underlying this area had pillars extracted before abandonment with several balances left standing to permit the removal of coal. The last workings recorded for this section was in the 1920's.". Areas of Probable Subsidence Areas were delineated for the Thorburn area and overlap with the site footprint. The report identified three subsidence events associated with the Six-Foot Seam and one with the McBean Seam:

- September 1987: Lawn at Thorburn School. Slight subsidence, 0.5 m.
- August 1988: Across road from Thorburn High School some slight subsidence.
- June 1990: At Thorburn, on line with Acadia No. 3 (Vale) slopes; 2 m deep.
- Spring1: Near the Lanark Slope

Aerial Photograph of Benoit Property (1979) - An aerial photograph obtained of the Benoit property (adjacent to the north of the site; PID: 00894675) appears to show the outline of a rusty plume as well as the approximate location of an overflowing air shaft. The approximate locations of historical mine workings are superimposed on the photograph but do not overlap with the Benoit property.

June 2021 BNS Site Visit Report - Provided in Appendix B of the RFP indicated that the former coal mine site along New Row, Thorburn, was visited by BNS staff on June 17, 2021. The area consisted of a small strip of grown-up grass, brooks, and trees. Ground and aerial photography was captured. The site is surrounded by residential buildings and a well-maintained ball field. Weather conditions were fair, clear skies, temperate, and low winds. The site included a small number of AMO features. One feature of the old mine workings is an air shaft that had been known to be continually weeping water onto the property. A small ditch had been dug to divert this water into a nearby brook. There was evidence of public use of this parcel of land, in the form of a nearby walking trail, but there was no indication that the public interacted with this air shaft. The overgrown nature of the vegetation impedes access to the shaft. There was no indication of surface or airborne contamination and stressed vegetation. No features present on the property during the site visit were considered hazardous.

Based on the site representative, no other previous or historical environmental reports were available for the site.

3.1.12 Provincial Environmental Registry Response

On August 27, 2024, an online written request was forwarded to NSECC by BNS to obtain any available information contained in the Environmental Registry for the site and select surrounding properties. NSECC is the responsible agency for all such information and records in the Province of Nova Scotia. Information contained in the registry includes certificates of approvals and permits related to air emissions (including noise), waste disposal sites, septic systems, known contamination, petroleum storage tanks, and hazardous materials/waste storage. The correspondence received from NSECC identified information pertaining to site and surrounding properties and no information was located through the Environmental Registry with regards to the site.

The BNS request and NSECC response are included in Appendix C.

3.1.13 Summary of Historical Review

Based on a review of available historical information sources (i.e., geology and topographic mapping, aerial imagery, interviews with site representatives and previous environmental reporting), the following is a summary of the historical review findings for the site:

- The Thorburn coal mine site is a 4 acre (16,187 m2) rectangularly shaped property located in the community of Thorburn, Pictou County, and situated on PID 00894162. The subject property is a forested strip of land without any buildings. A surface diversion channel directs mine water overflow from the site's former air shaft into the brook that flows close to the site southern boundary.
- The site is owned by the Province of Nova Scotia.
- The mine was in operation from the 1860s to 1970s. No information is available if it was properly remediated following reclamation of the site building between the late 1970s and early 1990s.
- As per the information found from the BNS 2021 Site Visit Report, the Thorburn Mine was operated by Thorburn Mining Ltd. from 1997 to 2000. Thorburn Mining Ltd. reclaimed the site after operations ceased and removed old buildings and equipment from the site.
- Soil and water staining was reportedly observed in the northern portion of the site; it was also shown on a photograph taken by BNS during their June 2021 site visit, limited to a relatively small area around the former air shaft.
- NSDNR's report on the Location of Abandoned Mine Workings in the Pictou Coalfield (Gillis & Dewolfe, 1992) and NSDNR's report on Mine Subsidence in the Pictou Coalfield (Gillis, 1992), mine reclamation information (1997-2000), and BNS Site Visit Report (2021) are the most recent environmental reports dealing with the site.

3.2 Physical Setting

3.2.1 Regional Topography

As indicated by the Surficial Geology Map of the Province of Nova Scotia (Map 92-3 by Nova Scotia Department of Mines and Energy), the site is located within the Cumberland-Pictou Lowland, the regional topography is flat to rolling with few surface boulders, with till thick enough (30-40 m) to mask bedrock undulations; drumlins often with multiple tills. Elevations range from 72 m above sea level (asl) in the south-western portion of the site to 71 m asl in the north-eastern portion of the site.

3.2.2 Regional Geology

Surficial Geology

The surficial geology of the Thorburn site belongs to the Quaternary Wisconsinan glacial deposits of unknown age. These are described as ground moraine and streamlined drift of silty till plain and drumlins with material being released from the base of ice sheets by melting or lodgment. The till is silty, compact material derived from both local and distant sources and is 3 – 30 m in thickness.

Bedrock Geology

The bedrock geology is characterized by the Stellarton Formation of the Cumberland Group and is characterized by lacustrine-alluvial shale, sandstone, minor conglomerate, oil shale, and coal (early Westphalian C – early Westphalian D species).

3.2.3 Regional Hydrology

The site is located within the East/Middle/West Pictou primary watershed, and the secondary watershed East River Pictou, # 1DP-3-JJ.

A small brook flows just outside the south-eastern boundary of the site from the south-west to the north-east direction.

A water diversion channel cuts the site approximately at the center line, directing air shaft water outflow to the brook. Water at the site is expected to flow by sheet flow to the diversion channel and small brook

No road ditching exists along the New Row.

No wetlands or other open water bodies are located on the site.

3.2.4 Regional Hydrogeology

The site is located within the Glaciolacustrine/Till Plains/Colluvial surficial groundwater region. Water is characterised as a mixed calcium-sodium-bicarbonate-chloride type, fresh, with slightly acidic pH and soft, potentially with some seawater influence/mixing.

The bedrock hydrogeological region is Sedimentary. Water is characterised as a calcium-bicarbonate type, fresh, with sightly alkaline pH and hard. No significant mixing noted.

Regional groundwater flow direction is expected to the north-east, toward the Northumberland Straight.

Local Water Use

According to the Nova Scotia Well Log Database and Groundwater Atlas, there are a total of 177 domestic wells in the community of Thorburn. 155 of these wells are within 1 km of the site boundaries.

3.2.5 Adjacent Land Uses

Findings from a desktop review of current land use of properties adjacent to the Thorburn site are summarized in Table 4.

Table 4: Adjoining Property Descriptions

Boundary of the Site	Description	Potential Environmental Concerns
North-West PID(s): 65119091	Road owned by Province of Nova Scotia	None found
North-East PID(s): 00894675	Privately owned parcel containing a residential structure	None found
South and South-East PID(s): 00920314	District 13 Recreation and Planning Commission owned parcel containing a recreational facility	None found
South-West and West PID(s): 65119125	Road owned by Province of Nova Scotia	None found

North of the Site

Residential properties along the New Row Road, followed by forested areas.

East of the Site

Residential properties, followed by the ballpark, a pond, forested areas, and residential properties along Old Row Road.

South of the Site

Ball field access road and lawns, followed by residential areas along the Old Row Road.

West of the Site

Forested land is present to the west of the of the site, west of a connector road between New Row Road and Old Row Road residential properties are located further to the west.

3.2.6 Species at Risk

Habitat for Wood Turtle (Glyptemys insculpta) listed as Threatened under Schedule 1 of the Species at Risk Act (SARA; Environment Canada 2016) and is provincially designated as threatened under the Nova Scotia Endangered Species Act (NSESA; Nova Scotia Department of Lands and Forestry, 2020), exists within 1 km of the site.

4.0 PHASE I ESA SITE VISIT

A site visit was conducted on November 19, 2024, by DesignPoint representatives, Ryleigh Boudreau and Arman Polatbekov. P.Geo., to evaluate potential sources or substances that have, or may have caused contamination of the soil, groundwater, sediment, or surface water on-site and off-site on the adjacent properties. Then ground surface was noted to be wet, and weather was rainy and cool during the initial Phase I ESA site visit.

Pertinent photographs are presented in Appendix D.

4.1 Air Emissions

No air emissions were noted during the site visit.

4.2 Asbestos

No asbestos containing material was noted during the site visit.

4.3 Chemical Storage, Handling, and Spills

No active chemical storage, handling, or spills were noted on the site at the time of the site visit.

4.4 Dumps, Landfills, and Incinerators

No garbage or landfilling activities were noted during the site visit.

4.5 Lead-Based Products

No lead-based products were noted during the site visit.

4.6 Mechanical Equipment

No mechanical equipment was noted during the site visit.

4.7 Mercury

No mercury containing materials were noted during the site visit.

4.8 Methane

There is a potential for methane emissions on this historical coal mining site. No emissions were noted during the site visit.

4.9 Mould and Human Environment

Potential for mold exists in the mobile house partially located on the northern portion of the site's PID. There were no occupants residing in the mobile home at the time of the site visit and no further information is available.

4.10 Ozone Depleting Substances

No ozone depleting substances were noted during the site visit.

4.11 Pesticides

Pesticides, herbicides, and/or fungicides were not observed to be stored or used at the site. No issues of significant concern regarding pesticides, herbicides, or fungicides at the site were identified through this assessment.

4.12 Pipelines

No indication of existing or historic presence of pipelines was identified through this assessment, therefore there is no environmental concern with pipelines at the site.

4.13 Polychlorinated Biphenyls

No PCBs storages or equipment was noted during the site visit.

4.14 Radioactive Materials

No radioactive materials or storage was noted during the site visit

4.15 Site Infilling

The southern portion of the site is slightly elevated, compared to the northern portion, it is suspected that at least some infilling occurred in the past there. The quality and quantity of infilling material are unknown and potentially could exceed current standards and guidelines. Due to this uncertainty this infilling was suspected for the potential exceedances for heavy metal, PHC, and PAH impacts in soil.

4.16 Storage Tanks

Aboveground Storage Tanks (ASTs) and Underground Storage Tanks (USTs) were not noted during the site visit.

4.17 Sumps and Drains

A diversion channel was noted leading from the former airshaft to the brook, in southern direction.

4.18 Surface Staining and Stressed Vegetation

No surface soil or sediment staining was noted at the site, as well as no stressed vegetation.

4.19 Urea Formaldehyde Foam Insulation

UFFI was not observed during the site visit.

4.20 Waste Management

No waste is produced on the site.

4.21 Water Supply

No water supply is available for the site.

4.22 Adjacent Properties

Potential environmental concerns were noted on adjacent properties immediately to the south and south-east of the site, within the brook two (2) infilled AMOs with weeping water and orange staining and precipitate in the brook during the site visit, which may have the potential to impact the site. These areas were out of the scope of this project and were not investigated.

4.23 Other Environmental Concerns

No other environmental concerns were noted during the site visit that have the potential to impact the site.

4.24 Summary of the Site Visit

The southern portion of the site is slightly elevated, compared to the northern portion of the site. It is suspected that at least some infilling occurred historically in the southern portion of the site. The quality and quantity of infilling material are unknown and potentially could exceed current standards and guidelines.

5.0 PHASE I ESA CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of this Phase I ESA, DesignPoint concludes that there is a medium potential for significant environmental liabilities to be associated with the site.

A summary of the identified APECs is provided in Table 5 below.

Table 5: Summary of Identified APECs

APEC #	Location	Suspected Contaminants of Concern (CoCs)	Impacted Media	Proposed Analysis and Number of Samples	Recommendation
1	A single structure existed along the New Row	Suspected heavy metal, PHC and PAH impacts	Soil and groundwater	General water chemistry, metal scan, PHCs and PAHs: one (1) soil and one (1) groundwater sample	Borehole and monitoring well installation, soil and groundwater sampling.
2	Four (4) structures existed in the center of the site	Suspected heavy metal, PHCs and PAH impacts	Soil and groundwater	Metal scan, PHC and PAH, one (1) soil and one (1) groundwater sample	Borehole and monitoring well installation, soil and groundwater sampling.
3	The old access road turnaround in the southern corner of the site	Suspected heavy metal, PHCs and PAH impacts	Soil and groundwater	Metal scan, PHC and PAH, one (1) soil and one (1) groundwater sample	Borehole and monitoring well installation, soil and groundwater sampling.
4	The pile of light-colored material in the center of the site	Suspected heavy metal impacts, PHCs and PAHs	Soil	Metal scan, PHC, PAHs, one (1) soil sample	Surface soil sampling
5	The funnel-like wet area in the north-eastern potion of the site	Suspected heavy metal, PHCs and PAH impacts	Soil or sediment	Metal scan, PHC and PAH, one (1) soil and one (1) sediment sample	Surface soil and sediment sampling
6	The diversion channel for the former airshaft	Suspected heavy metal, PHCs and PAH impacts	Surface water and sediment	Metal scan, PHC and PAH, one (1) surface water and one (1) sediment sample	Surface soil or sediment sampling
7	The infilling in southern portion of the site	Suspected heavy metal, PHCs and PAH impacts	Soil	Metal scan, PHC and PAH, one (1) soil sample	Surface soil sampling

Based on the APECs identified in Table 5 above, it was recommended that a Phase II ESA soil, sediment, groundwater, and surface water sampling program to be conducted at the site to determine if environmental impacts are present.

6.0 PHASE I ESA LIMITATIONS

While this report provides an overview of significant potential environmental concerns, both past and present, it is limited by the availability of information at the time of the assessment and the scope of work authorized by BNS. It is possible other activities that may have affected the environmental status of the site have occurred which could not be identified. A search of the land title was not conducted as part of this assessment. Surrounding land uses were assessed from publicly accessible locations for potential sources that may have previously impacted and/or are currently impacting the environmental condition of the site.

7.0 PHASE II ESA OBJECTIVES AND SCOPE OF WORK

Based on the results of Phase I ESA, DesignPoint was retained by BNS to investigate the presence/absence of soil, groundwater, sediment, and surface water impacts at the site by conducting a Phase II ESA at the site in May 2025. The Phase II ESA is described in the following sections.

7.1 Phase II ESA Objectives

The purpose of the Phase II ESA was to perform an intrusive investigation to confirm the presence or absence of potential impacts to surface soil, subsurface soil, groundwater, surface water, and sediment at the site related to APECs identified in the March 2025 Phase I ESA memorandum.

7.2 Phase II ESA Scope of Work

The scope of work for this Phase II ESA was limited to APECs identified in DesignPoint's Phase I ESA. To assess the presence/absence of potential impacts to soil, groundwater, surface water, and sediment at the site, the Phase II ESA scope of work included the following tasks:

- Conducting public underground utility locates.
- Advancing three (3) drilled boreholes (BH), with all three (3) being completed as monitoring wells (MW-1, MW-2, and MW-3), collecting three (3) representative surface soil sample (SS) from BHs using a split spoon sampler or augured grab method, and submitting soil samples for laboratory analyses of PHCs including benzene, toluene, ethylbenzene, and xylene (BTEX), modified total petroleum hydrocarbons (mTPH), metals, and PAHs.
- Collecting four (4) surface soil samples from four (4) locations of the identified APECs and submitting surface soil sample for laboratory analyses for metals and PAHs.
- Collecting one (1) soil sample field duplicate.

- Developing and purging the three (3) newly installed monitoring wells, and performing fluid level monitoring (FLM) in each, noting depths to water and Light/Dense Non-Aqueous Phase Liquid (L/DNAPL), where present.
- Collecting groundwater samples from the three (3) newly installed monitoring wells using dedicated Waterra tubing and foot valves and submitting groundwater samples for laboratory analyses of PHCs, metals, and PAHs.
- Collecting one (1) surface water sample and one (1) sediment sample from the diversion channel for the former airshaft and submitting surface water sample and sediment sample for laboratory analyses for PHC, metals, and PAHs.
- Recording GPS coordinates (sub-metre) for all borehole/monitoring well and surface water sample locations. The locations of all samples and monitoring wells are shown on Figure 3 in Appendix A.
- Evaluating laboratory analytical results against the applicable federal and provincial criteria.
- Preparing a report to discuss findings of the Phase II ESA, complete with site figures, analytical summary tables, and analytical laboratory Certificates of Analysis (COAs).

8.0 SITE CLASSIFICATION AND GUIDELINES

The applicable regulatory criteria are determined, in part, by features of the site such as land use, soil grain size, presence of potable water supplies, and distance to possible receptors.

The land use is considered to be residential/parkland based on actual site and area land use.

The groundwater is considered to be potable based on potable water wells within 150 m of the site, predominantly to the north (water well #892653, #051790 - Highway no.104, #180951 – 194 New Row, #872120, #560099, #750300, #171018 – 86 Old Row, #550086, #710159).

The site soils are considered to be coarse-grained, based on soil descriptions recorded during this environmental investigation. The following sub-sections describe the applicable criteria used to evaluate laboratory analytical results in soil, groundwater, surface water and sediment.

8.1 Soil

Soil samples collected were submitted for laboratory analyses including PHCs, metals, and PAHs. Laboratory results were compared to the following criteria:

- NSECC Tier I Environmental Quality Standards (EQS) at a potable site (residential/parkland land use, coarse grained soil), July 2013, updated in October 2022 and accessed online May 2025.
- Environment Canada's Background Soil Database Summary Table 5 provided Regional Background values for all detectable metal and PAH concentrations. This summary table is used based on the database's recommendations, statistical analysis and limited background data presented in Table 10, Summary of Recommended Background Concentrations for Highland Soil Zone, although this Zone is more representative for the site location.

8.2 Groundwater

Groundwater samples collected were submitted for laboratory analyses including PHCs, metals, and PAHs. Laboratory results were compared to the following criteria:

- NSECC Tier I EQS for Groundwater at a Potable Site (residential/parkland land use, coarse-grained soil), July 2013, updated in October 2022 and accessed online June 2025.
- Health Canada Guidelines for Canadian Drinking Water Quality (HC GCDWQ) accessed online June 2025.

8.3 Surface Water

Surface water samples collected were submitted for laboratory analyses including PHCs, metals, and PAHs. Laboratory results were compared to the following criteria:

- NSECC Tier I EQS for Surface Water (fresh water), July 2013, updated in September 2021 and accessed online May 2025.

8.4 Sediment

Sediment samples collected were submitted for laboratory analyses including PHCs, metals, and PAHs. Laboratory results were compared to the following criteria:

- NSECC Tier I EQS for Sediment (mg/kg), Table 2, accessed online May 2025.

9.0 PHASE II ESA METHODOLOGY

9.1 Field Program

DesignPoint personnel conducted a site field investigation on April 30, 2024, May 1, 2025, and May 14, 2025, which included site clearance, borehole drilling, soil sampling, split spoon sampling, installing monitoring wells, groundwater sampling, surface water, and sediment sampling. Field investigation activities were conducted with appropriate personal protective equipment (PPE) and daily site safety forms were completed and toolbox meetings held with the drillers in advance of field investigation activities commencing onsite.

9.2 Locations Rationale

Intrusive investigation locations were selected in accordance with the Phase I ESA recommendations and NSDNR's Letter of Authority dated April 15, 2025.

9.3 Site Observations

The site was found to be vegetated land with trees and bushes growing along the northeastern area and a walking trail was present on the site stretching in a north-south direction. No soil staining, odours, or depressed vegetation were identified during the investigation. The following sections describe the field program methodology.

A potential void was noted underground at MW-2 location, approximately from 0.9 m to 1.20 m depth. No subsidence was noted immediately close to MW-2.

A sinkhole of 1 m wide and 1 m deep infilled with water was noted by DesignPoint in the center of the site on May 1, 2025. This sinkhole was found infilled with gravel by the site owner on May 14, 2025.

Soil was noted to be from brown to black in color, with coal particles, dry to moist and to saturated and from loose to dense with depth.

Groundwater had a substantial amount of suspended solids of black color, no odor, no sheen, and no free product.

Surface water was clear, with orange precipitate on the bottom and rotten egg odor. No sheen was noted.

Sediment had no to little orange staining, traces of coal, material was brown silty sand with some gravel, wet, loose to compact.

9.4 Species at Risk Survey

The field crew was trained by Sam Pratt, MSc., DesignPoint's biologist to perform SAR surveys and swipes. These were completed prior to any movement of heavy drilling equipment on the site. A two-person crew was deployed to complete a swipe along the heavy equipment route immediately prior to the moving the drill rig.

No SARs were detected during the May 1 and May 14, 2025 site visits.

9.5 Sampling Procedures

9.5.1 Soil Sampling Procedures

One (1) soil sample was collected from each borehole advanced during the investigation to evaluate for the presence of contaminants at the site, and four (4) surface soil samples were collected from the designated locations based on the identified APECs. Soil samples were submitted for laboratory analyses applicable to the Contaminants of Potential Concern (CoPCs), including PHCs, metals, and PAHs. Laboratory analytical results are summarized in Section 14.0.

Sample collection methods included a split-spoon sampling via a track-mounted drill rig, which is described further below or by grab method directly from augured borings. Each soil sample was placed directly into pre-cleaned laboratory-supplied glass jars and stored in a cooler on ice. Soil descriptions were recorded for each sample, including the sample ID, collection method, sample depth, colour, grain size, observations of staining or odour, depth to water table (if encountered). Soil sample locations are shown on Figure 3 in Appendix A.

Split Spoon Sampling

Under the supervision of DesignPoint personnel, Logan Drilling advanced boreholes at three (3) locations (MW1, MW2, and MW3) using a track-mounted drill rig equipped with a split spoon sampler. Boreholes were drilled to depth ranging from approximately 5.1 to 6.0 meters below ground surface (mbgs), depending on groundwater conditions, to evaluate geologic conditions, potential vertical distribution of soil impacts, and to install groundwater monitoring wells. A total of three (3) surface soil samples (MW1-SS1, MW2-SS1, MW3-SS1) were collected at depth of 0.3 mbgs from drilled boreholes on May 1st, 2025. Soil samples were collected using a two-inch (51 mm) diameter split spoon sampler and samples were typically collected continuously in 0.6 m intervals. One (1) sample from each borehole was selected and stored in two (2) 40 ml vials containing a methanol preservation agent, as well as 60 ml laboratory-supplied glass sample container, using new nitrile gloves. Samples from intervals not selected for analysis were placed in Ziploc bags and reviewed for logging. Note that all boreholes drilled as part of the investigation were completed as monitoring wells, and therefore soil samples collected from boreholes use the naming convention MW# associated with monitoring wells. Detailed monitoring well logs were recorded for each location, and are provided in Appendix E.

Shallow Surface Soil Sampling

A total of four (4) shallow soil surface samples and one (1) duplicate (SS-4, SS-5, SS-5 Dup, SS-6, and SS-7) were collected at a depth of 0.3 m from the designated locations of the site on May 1, 2025. The surface soil samples were collected using grab-auger hand tool. Surface soil samples were collected directly from the tool and placed immediately in laboratory supplied containers and then placed in coolers containing ice. The hand tool used for surface soil sampling was decontaminated between each location and rinsed with potable water. Surface soil samples were submitted for laboratory analyses applicable of the CoPCs: metals, PHCs, and PAHs.

9.5.2 Monitoring Well Installation Procedures

Three (3) boreholes were completed as groundwater monitoring wells (MW1, MW2, and MW3), immediately following borehole drilling at each location on May 1, 2025. Monitoring well locations are shown on Figure 3 in Appendix A. The monitoring wells were constructed using 51 mm PVC screen and casing, with silica sand filter pack and bentonite seal, and all were installed with flush mount protective covers.

9.5.3 Monitoring Well Development and Groundwater Sampling Procedures

Each newly installed monitoring well was developed on May 1st, 2025, by bailing all three (3) wells dry. On May 14, 2025, fluid level monitoring (FLM) was performed in each of the monitoring wells. Depth measurements were recorded from top of casing (TOC) to water and L/DNAPL product (where present), as well as the total well depth. After the FLM, a rising head slug test was completed using a 1 litre bailer and stop-watch method on all wells. All monitoring wells were purged dry for sampling; however, groundwater did not recover in monitoring well MW-1 in sufficient quantity to collect a full groundwater sample for laboratory analysis. MW-2 and MW-2 Dup metal samples were filtered in the field, while MW-1 and MW-3 were filtered in the laboratory. Use of peristaltic pump was deemed insufficient due to low recovery in all wells and instead, dedicated bailers were used instead. FLM data is summarized below in Table 6 below:

Table 6: Fluid Level Monitoring Summary

Well ID	Depth to L/DNAPL (mbtoc)	Depth to Water (mbgs)	L/DNAPL Thickness (m)
MW1	---	2.53	0.000
MW2	---	0.58	0.000
MW3	---	2.00	0.000

NOTE: "---" indicates no L/DNAPL was observed.

Groundwater samples were submitted for laboratory analyses of PHCs, general chemistry plus metals, and PAHs.

9.5.4 Surface Water Sampling Procedures

One surface water sample was collected from a small stream located down-gradient of the historical AMO-1 (Figure 3 in Appendix A) on May 1st, 2025. The surface water sample was collected by submerging the laboratory supplied bottles within the water stream and allowing the bottle to fill, without losing any necessary preservative. Surface water sample was stored and transported on ice to the analytical laboratory for PHCs, metal, and PAH analysis. The Flow (Q) of surface water sample location was calculated to be 3,888 cubic meter/day (m^3/day) or 0.045 meter per second (m/s), using the velocity area method, where the average velocity and the cross-sectional area and the frictional coefficient (0.9) are multiplied together and divided by two (2). Average velocity of the selected area was measured using a stopwatch to be 1 m/s and the area was measured by multiplying width (0.5) and depth (0.2) of the selected area.

$$Q = \{Velocity\ X\ Depth\ X\ Width\ X\ 0.9\}/2$$

$$Q = \{1\ m/s\ X0.5\ m\ X\ 0.2\ m\ X\ 0.9\}/2$$

$$Q = 0.045\ m^3/s \text{ or } Q = 0.045\ m^3/s\ X\ 86400 = 3888\ m^3/day$$

9.5.5 Sediment Sampling Procedures

One (1) sediment sample was collected from a small stream located down-gradient of the historical AMO-1 (Figure 3 in Appendix A) on May 1st, 2025. The sediment sample was collected by hand auger at the depth of approximately 0.2 m. The sediment sample was stored and transported on ice to the analytical laboratory for PHCs, metal, and PAH analysis.

9.5.6 Relative Elevation Surveying

Following completion of monitoring well installation, DesignPoint conduct an elevation survey of the monitoring well locations into the current NAD83 vertical datum CGVD2013 geodetic system using Topcon GPS unit and Magnetic Field software.

9.6 Quality Assurance and Quality Control

9.6.1 Field Quality Assurance and Quality Control Program

To minimize cross contamination during sampling, a field quality assurance and quality control (QA/QC) program was followed which included the following measures:

- Disposable gloves were used to collect each sample and discarded following collection of each sample.
- Samples were collected in pre-cleaned laboratory-supplied sample containers.
- Dedicated and/or disposable sampling equipment was used.
- Non-disposable sampling instruments and equipment were decontaminated before and after the collection of each sample. Equipment was decontaminated by rinsing with methyl hydrate, rinsing again with potable water, and then allowing the equipment to air dry.
- Field duplicate samples were collected and submitted for laboratory analysis to assess the validity of the data received from the analytical laboratory.
- Samples were stored in coolers with ice during storage and transported to the laboratory with the appropriate Chain of Custody documentation for tracking purposes.
- Precautionary measures were implemented to avoid introducing contaminants from external sources into the soil samples.

Field duplicates were collected for approximately 10% of parameters that were analyzed for groundwater and soil. The analytical results of these were used to evaluate the reliability of the sampling.

9.6.2 Field Duplicate Sampling

Field duplicate samples are generally collected at a frequency of approximately one in ten (10%). Blind field duplicate analytical data are then compared as relative percent differences (RPDs), which are given by the absolute difference in two results multiplied by 100, divided by the arithmetic mean of the two results:

$$RPD = \frac{(\text{Original Concentration} - \text{Duplicate Concentration}) * 100}{(\text{Original Concentration} + \text{Duplicate Concentration}) / 2}$$

These evaluations are applicable only when both results are at least five times the RDL. For soil, where there is no theoretical reason for the samples to be equivalent, RPDs of 60% or less are considered to be acceptable proof of equivalency; for water, RPDs of 40% or less are considered to be acceptable. RPDs were calculated for one original groundwater sample and its corresponding blind field duplicate, including the following:

- Soil: Original sample SS-5 and its duplicate sample SS-5 Dup
- Groundwater: Original sample MW-2 and its duplicate sample MW-2 Dup

RPD calculation tables for soil and groundwater are presented in Tables F-2 and F-11 in Appendix F and are summarized below in Table 7.

Table 7: Blind Field Duplicate RPD Summary

Media	Maximum Acceptable RPD	No. of Field DUPS	Analysis	Range of RPDS	No. of RPDS in Acceptable Range	Total RPDS Able to be Calculated [1]	Acceptable Duplicate Correlation
Soil	60%	1	Metals	0-91%	30	31	Yes
Groundwater	40%	1	Metals	0-38%	29	29	Yes
				Total	59	60	Yes

1 – Total RPDs able to be calculated is equal to the number of analytes where both the original sample and field duplicate concentrations were at least five times the RDL.

Table 7 shows that for soil blind duplicate sampling of the 31 RPDs that were able to be calculated, 30 RPDs were within the acceptable range, while one (1) RPD exceeded the maximum acceptable value of 60% in soil. For groundwater blind duplicate RPDs of the 29 RPDs calculated all of them are on acceptable limit. The following discusses the soil RPD exceedances:

- Metals: RPD calculated for lead (91%) in soil sample SS-5 and its duplicate sample SS-5 Dup, which exceeded the maximum acceptable RPD of 60% in soil.

Although the RPD for lead in soil exceeded the acceptable limit, the remaining 30 of 31 soil RPDs (ranging from 0-57%) were within the maximum acceptable value of 60%, indicating an acceptable correlation between analytical results for the soil samples and their corresponding blind field duplicates. Hence, these elevated RPDs are not considered to affect the results of the investigation.

9.6.3 Laboratory QA/QC Program

All samples were submitted to ALS Global in Dartmouth, NS. ALS is accredited by the Standards Council of Canada for each of the analysis methods utilized and has in-house QA/QC programs to govern sample analysis, including replicates, to ensure that reliable results are consistently obtained. Specific laboratory QA/QC measures include the following:

- Chain of Custody and sample integrity inspection
- Documentation control and files
- Trained personnel prepare and analyze samples according to Standard Operating Procedures
- All analytical methods are based on industry-wide accepted procedures and are fully validated prior to use
- Precision is monitored by performing replicated analysis of samples within each batch
- Instrument calibration integrity is ensured by analyzing calibration check standards within each run sequence
- Matrix effects in organic analysis are assessed with surrogate fortification of each sample
- Extensive use is made of blank spikes, matrix spikes and certified reference material for routine procedure evaluation
- Highest available purity analytical standards
- Predefined analytical sequences ensure all results are traceable to calibrate QC data
- Hard copy reports displaying all the required data are generated for each instrument
- Analytical QC performance must be demonstrated prior to data authorization (data area subject to three levels of QC review: chemist, supervisor and manager)

- On-going method and instrumentation performance records are maintained for all analysis
- Records containing all pertinent data are securely archived for 3 years
- ALS Global is accredited to ISO 17025 standards by the Canadian Association for Laboratory Accreditation Inc. (CALA), formerly known as CAEAL, for specific tests at specific locations
- ALS Global employs continuous improvement procedures including internal audits, external audits, and management review meetings
- A full-time Quality Assurance Scientist evaluates the QA program on an on-going basis

The results of the laboratory QA/QC program are listed below. Laboratory QC standard samples were analysed with the samples to assess the reliability of the analysis. The QA/QC results are reported on the Certificates of Analysis are included in Appendix G. ALS Laboratories summarized the following outliers for the soil sample analysis:

- No method blank value outliers occurred
- No test sample surrogate recovery outliers existed
- No reference material sample outliers occurred
- No analysis holding time outliers existed
- No quality control sample frequency outliers occurred

ALS did identify two (2) laboratory control samples outlier for volatile organic compounds (VOCs) and PAHs in soil (recovery less than lower control limit). ALS also identified one (1) laboratory control sample outlier for VOCs in water (recovery greater than upper control limit). It was identified that the data quality objective was marginally exceeded (by <10% absolute) for <10% of analytes in a multi-scan which is considered acceptable as per the Ontario Ministry of Environment and the CCME. A matrix spike was also noted for dichlorodifluoromethane, which is also considered acceptable as the objective was marginally exceeded.

10.0 ANALYTICAL RESULTS

This section provides a summary of the laboratory analytical results for soil, groundwater, surface water, and sediment, samples collected by DesignPoint at the site in May 2025, compared to the available federal and provincial guidelines. Summary of analytical data tables are presented in Tables F-2 through F-13 in Appendix F. Results were compared to the soil Atlantic Regional Background, Summary Table 5, and NSECC Tier 1 EQS. Those parameters that exceeded both guidelines were considered as environmental impacts. It should be noted that PHCs have no background values.

10.1 Soil Analysis

A total of eight (8) soil samples including one (1) duplicate were collected during the Phase II ESA investigation and submitted for metals, seven (7) samples for PHC, and PAH to the ALS laboratory to analyses. One (1) surface soil sample was collected from each of APEC's-1, 3, 4, 5, and 7 and two (2) surface soil samples were collected from APEC-2. The following subsections summarize the laboratory analytical results for soil at a potable site (residential /parkland use, coarse-grained soil).

Soil results are presented below and in Tables F-2 though F-4 in Appendix F. Sample locations, exceedances, and environmental impacts in soil are illustrated on Figure 4 in Appendix A. These exceedances are summarized in Table 8 and described below.

Table 8: Exceedances in Soil

Exceedances in Soil Summary	NSECC Tier 1 EQS	Atlantic Region Background	MW1 - SS1 (APEC-1)	MW2 - SS1 (APEC-3)	MW3 - SS1 (APEC-2)	SS-4 (APEC-4)	SS-5 (APEC-5)	SS-5 Dup	SS-6 (APEC-2)	SS-7 (APEC-7)
Metals										
Antimony	7.5	0.77					16.1	23.4		
Arsenic	10	4.27	21.7	24.8	35.6		54.9	32.6	31.3	33.4
Barium	350	41.4		624	513		357		476	
Beryllium	1	0.36					1.31	1.4		
Iron	11000	22961	21100	22500	16300	33100	33500	28900	31000	12800
Lead	120	13.7			151		341	127	170	
Manganese	360	709	423	453	750	970	724	418	842	377
Zinc	200	45	247		491		297	205	301	290
PHCs										
Benzene	0.021	NA	4.22	1.26	3.78	0.0383	1.18		1.78	3.7
Toluene	0.35	NA	16.8	6.34	16.4		6.6		9	15.3
Ethylbenzene	0.043	NA	0.809	0.363	1.18		0.454		0.549	0.679
Xylenes, total	0.73	NA	15.9	7.84	18.4		7.34		10.3	13.6
PAHs										
Benzo(b+j+k) fluoranthene	1.2	--							2.18	
Naphthalene	2.2	0.03	2.52		2.37					
IACR (CCME)	1	--	6.21	1.03	5.38		1.81		21.8	1.2

Bold	Exceeds both the Background and Tier 1 EQS, indicates an impact
Normal	Not exceeds the Background, exceeds Tier 1 EQS, not an impact

10.1.1 Soil Metals

A total of eight (8) soil samples including one (1) duplicate sample were collected from pertinent APECs (one (1) sample per APEC) and analyzed for metals. Of these, all eight (8) samples were reported to have at least one (1) metal concentration exceeding the Atlantic Regional Background and NSECC Tier 1 EQS soil guidelines. Almost all parameters that exceeded NSECC Tier 1 EQS also exceeded the regional background, except for iron in MW-1-SS1, MW3-SS1, and SS-7 and manganese in MW1-SS1, MW2-SS1, SS-5 Dup, and SS-7.

Metals environmental impacts were as follows:

- Antimony concentration in one (1) soil sample and its duplicate (APEC-5, SS-5– 16.1 mg/kg, SS-5 Dup – 23.4 mg/kg) exceeded both the Atlantic Regional Background of 0.77 mg/kg and NSECC Tier 1 EQS of 7.5 mg/kg.

- Arsenic concentration in six (6) soil samples plus one (1) duplicate (APEC-1 MW1-SS1- 21.7 mg/kg, APEC-3 MW2-SS1- 24.8 mg/kg, APEC-2 MW3-SS1 – 35.6 mg/kg, APEC-5 SS-5 - 54.9 mg/kg, SS-5 Dup – 32.6 mg/kg, APEC-2 SS-6 - 31.3 mg/kg, APEC-7 SS-7 - 33.4 mg/kg,) exceeded both the Atlantic Regional Background of 4.27 mg/kg and NSECC Tier 1 EQS of 10 mg/kg for arsenic.
- Barium concentration in four (4) soil samples (APEC-3 MW2-SS1- 624 mg/kg, APEC-2 MW3-SS1 – 513 mg/kg, APEC-5 SS-5 - 357 mg/kg and APEC-2 SS-6 – 476 mg/kg) exceeded both the Atlantic Regional Background of 41.4 mg/kg and NSECC Tier 1 EQS of 350 mg/kg.
- Beryllium concentration in one (1) soil sample and its duplicate (APEC-5 SS-5– 1.31 mg/kg, SS-5 Dup 1.4 mg/kg) exceeded both the Atlantic Regional Background of o.36 mg/kg and NSECC Tier 1 EQS of 1 mg/kg for beryllium.
- Iron concentrations in all seven (7) soil samples (APECs-1, 2, 3, 4, 5, and 7) plus one (1) duplicate (12,800 mg/kg to 33,500 mg/kg) exceeded the NSECC Tier 1 EQS guideline of 11,000 mg/kg and four (4) soil samples plus one (1) duplicate (MW2-SS1 – 22,500 mg/kg, SS-4 – 33100 mg/kg, SS-5 – 33,500 mg/kg, SS-5 Dup – 28,900 mg/kg and SS-6 – 31,000 mg/kg) exceeded the Atlantic Regional Background of 22,961 mg/kg.
- Lead concentration in three (3) soil samples plus one (1) duplicate (APEC-2 MW3-SS1 – 151 mg/kg, APEC-5 SS-5- 341 mg/kg, SS-5 dup – 127 mg/kg, APEC-2 SS-6 - 170 mg/kg) exceeded both the Atlantic Regional Background of 13.7 mg/kg and NSECC Tier 1 EQS of 120 mg/kg.
- Manganese concentration in all seven (7) samples (APECs-1, 2, 3, 4, 5, and 7) plus one (1) duplicate (377 mg/kg to 842 mg/kg) exceeded the NSECC Tier 1 EQS of 360 mg/kg and four (4) soil samples (MW3-SS1- 750 mg/kg, SS-4- 970 mg/kg, SS-5- 724 mg/kg and SS-6- 842 mg/kg) exceeded the Atlantic Regional Background of 709 mg/kg.
- Zinc concentration in five (5) soil samples plus one (1) duplicate (APEC-1 MW1-SS1 - 247 mg/kg, APEC-2 MW3-SS1- 491 mg/kg, APEC-5 SS-5- 297 mg/kg, SS-5 Dup – 205 mg/kg, APEC-2 SS-6- 301 mg/kg, APEC-7 SS-7-290 mg/kg) exceeded both the Atlantic Regional Background of 45 mg/kg and NSECC Tier 1 EQS of 200 mg/kg.

It should be noted that aluminum, barium, cadmium, chromium, cobalt, copper, molybdenum, nickel, selenium, strontium, tin, and uranium concentrations found in many soil samples exceeded the Atlantic Regional Background concentration, across the site. All other metal concentrations were reported to be either less than the laboratory RDLs or below the Atlantic Regional Background and NSECC Tier 1 EQS guidelines.

10.1.2 Soil Petroleum Hydrocarbons

A total of seven (7) soil samples were analyzed for PHCs. No Atlantic Regional Background values were available for PHCs.

- Benzene concentration in all seven (7) soil samples plus one (1) duplicate (APEC-1 MW1-SS1 – 3.78 mg/kg, APEC-3 MW2-SS1 – 1.26 mg/kg, APEC-2 MW3-SS1 – 4.22 mg/kg, APEC-4 SS-4 – 0.0383 mg/kg, APEC-5 SS-5 – 1.18 mg/kg, APEC-2 SS-6 – 1.78 mg/kg, and APEC-7 SS-7 – 3.70 mg/kg) exceeded the NSECC Tier 1 EQS of 0.021 mg/kg for benzene.
- Toluene concentration in six (6) soil samples plus one (1) duplicate (APEC-1 MW1-SS1 – 16.4 mg/kg, APEC-3 MW2-SS1 – 6.34mg/kg, APEC-2 MW3-SS1 – 16.8 mg/kg, APEC-5 SS-5 – 6.60 mg/kg, APEC-2 SS-6 – 9.0 mg/kg and APEC-7 SS-7 – 15.3 mg/kg) exceeded the NSECC Tier 1 EQS of 0.35 mg/kg for toluene.

- Ethylbenzene concentration in six (6) soil samples plus one (1) duplicate (APEC-1 MW1-SS1 – 1.18 mg/kg, APEC-3 MW2-SS1 – 0.363 mg/kg, APEC-2 MW3-SS1 – 0.809 mg/kg, APEC-5 SS-5 – 0.454 mg/kg, APEC-2 SS-6 – 0.549 mg/kg and APEC-7 SS-7 – 0.679 mg/kg) exceeded the NSECC Tier 1 EQS of 0.043 mg/kg for ethylbenzene.
- Total xylenes concentration in six (6) soil samples plus one (1) duplicate (APEC-1 MW1-SS1 – 18.4 mg/kg, APEC-3 MW2-SS1 – 7.84 mg/kg, APEC-2 MW3-SS1 – 15.9 mg/kg, APEC-5 SS-5 – 7.34 mg/kg, APEC-2 SS-6 – 10.3 mg/kg and APEC-7 SS-7 – 13.6 mg/kg) exceeded the NSECC Tier 1 EQS of 0.73 mg/kg for total xylene.
- No exceedances were noted for mTPH.

10.1.3 Soil Polycyclic Aromatic Hydrocarbons

A total of seven (7) soil samples were analyzed for PAHs.

- Benzo(b+j+k) fluoranthene concentration in one (1) soil sample (SS-6 - 2.18 mg/kg) exceeded the NSECC Tier 1 EQS of 1.2 mg/kg.
- Naphthalene concentrations in two (2) soil samples (MW1-SS1 - 2.52 mg/kg and MW3-SS1 - 2.37 mg/kg) exceeded the NSECC Tier 1 EQS of 2.2 mg/kg.
- Index of Additive Cancer Risk (IACR) concentration in six (6) soil samples (MW1-SS1, MW2-SS1, MW3-SS1, SS-5, SS-6, and SS-7 ranging 1.2 mg/kg to 21.8 mg/kg) exceeded NSECC Tier 1 EQS of 1 mg/kg.
- Benzo(a)pyrene total potency equivalent (B(a)P TPE) was not exceeded in any of the samples.

10.2 Surface Water Analysis

The flow (Q) of surface water at the sample location was calculated to be 3,888 cubic meter/day (m^3/day) or 0.045 meter per second (m/s), using the stopwatch and cross section method. One (1) surface water sample was collected from the diversion channel (APEC-6) for the former air shaft location AMO1 (shown in Figure 3 in Appendix A) during the Phase II ESA investigation and submitted for general water chemistry, metals, PHC, and PAH laboratory analysis. The following subsections summarize the laboratory analytical results compared to the available federal and provincial guidelines for surface water. It should be noted that a rotten egg odour was noted during the sample collection.

Surface water metals results are presented below and in Tables F-5 to F-7 in Appendix F. Surface water metals exceedances are shown on Figure 5 in Appendix A. These exceedances are summarised in Table 9 and described below.

Table 9: Exceedances in Surface Water

SW Exceedances, Summary	Nova Scotia Tier I EQS	SW-1 (APEC-6)
Fluoride	0.12	0.184
Aluminum, total	0.005	0.0156
Iron, total	0.3	1.32
Manganese, total	0.43	0.687
Mercury, total	0.000026	0.000095
Selenium, total	0.001	6.44

Exceeded Nova Scotia Tier I EQS for Surface Water, impact

10.2.1 Surface Water General Water Chemistry

Water was found to be of a sodium/potassium-bicarbonate type, fresh, moderately hard, slightly corrosive, and slightly alkaline. No exceedances were noted. Ion balance was acceptable at 105%.

10.2.2 Surface Water Metals

APEC-6: One (1) surface water sample was analyzed for metals. Aluminum, boron, iron, manganese, mercury, and selenium exceedances of the NSECC Tier 1 EQS in surface water were found in the stream located of the former air shaft (SW-1) as summarized below.

- Fluoride concentration in the surface water sample, SW-1 (0.184 mg/L) exceeded the NSECC Tier 1 EQS of 0.12 mg/L.
- Aluminum concentration in the surface water sample, SW-1 (0.0156 mg/L) exceeded the NSECC Tier 1 EQS of 0.0005 mg/L for aluminum.
- Iron concentrations in surface water sample, SW-1 (1.32 mg/L) exceeded the NSECC Tier 1 EQS of 0.3 mg/L for iron.
- Manganese concentrations in surface water sample, SW-1 (0.687 mg/L) exceeded the NSECC Tier 1 EQS of 0.43 mg/L for manganese.
- Mercury concentration in surface water sample, SW-1 (0.000095 mg/L) exceeded the NSECC Tier 1 EQS of 0.000026 mg/L of mercury.
- Selenium concentrations in surface water sample, SW-1 (6.44 mg/L) exceeded the NSECC Tier 1 EQS of 0.001 mg/L for selenium.

10.2.3 Surface Water Petroleum Hydrocarbons

APEC-6: One (1) surface water sample was analyzed for PHCs. The surface water sample SS-1 was reported to have PHCs concentrations either less than laboratory RDLs or less than the CCME and NSECC Tier 1 EQS for surface water.

10.2.4 Surface Water Polycyclic Aromatic Hydrocarbons

APEC-6: One (1) surface water sample was analyzed for PAHs. The surface water sample SS-1 was reported to have PAH concentrations either less than laboratory RDLs or less than the NSECC Tier 1 EQS for surface water.

10.3 Sediment Analysis

APEC-6: One (1) sediment sample SD-1 was collected from the diversion channel for the former air shaft location AMO1 (shown in: Figure 3 in Appendix A) during the Phase II ESA investigation and submitted for metals, PHC, and PAH laboratory analysis. The following subsections summarize the laboratory analytical results compared to the available federal and provincial guidelines for sediment. Sediment sampling location is shown on Figure 6 in Appendix A. Sediment chemistry results are presented below and in Tables F-8 through F-10 in Appendix F.

These exceedances are summarised in Table 10 and described below:

Table 10: Exceedances in Sediment

Sediment Exceedances Summary	NSECC Tier 1 EQS[2]	SD-1 (APEC-6)
PHCs		
mTPH Lube Oil Fraction	43	100
hydrocarbon resemblance	--	LOF
PAHs		
2-Methylnaphthalene	0.201	0.217

Exceeded Nova Scotia Tier I EQS for Sediment, impact

10.3.1 Sediment Metals

APEC-6: One (1) sediment sample SD-1 was analyzed for metals. All metal concentrations were reported to be either less than laboratory RDLs or less than the CCME ISQG and NSECC Tier 1 EQS for sediment.

10.3.2 Sediment Petroleum Hydrocarbons

APEC-6: One (1) sediment sample SD-1 was analyzed for PHC. The sediment sample SD-1 was reported to have PHC concentrations either less than laboratory RDLs or less than the NSECC Tier 1 EQS for sediment, except:

- Modified TPH at SD-1 (100 mg/kg) exceeded NSECC Tier 1 EQS (43 mg/kg) for lube oil fraction

No other exceedances were noted.

10.3.3 Sediment Polycyclic Aromatic Hydrocarbons

APEC-6: One (1) sediment sample SD-1 was analyzed for PAHs.

- 2-Methylnaphthalene (0.217mg/kg) exceeded NSECC Tier 1 EQS of 0.201 mg/kg

No other exceedances were noted.

10.4 Groundwater Analysis

10.4.1 Groundwater Flow

The general direction of the groundwater flow was determined by measuring water levels in monitoring wells and calculation water elevations, based on the surveyed well elevations, using Surfer 11 ® software.

The general groundwater flow direction is to the north, from the brook and MW-2 toward the New Row and residential properties.

Hydraulic gradients were calculated as follows:

- MW-1: 0.02
- MW-2: 0.037
- MW-3: 0.005

Figure 7 in Appendix A reflects the groundwater flow.

10.4.2 Well Slug-Test

Prior to commencement of the water sampling program a slug test was completed on all monitoring wells.

These tests were completed using the rising head method, a 1 Litre bailer and stopwatch. Calculations were based on the Hvorslev's method. These calculations are presented in Appendix E.

Results indicated the following:

- MW1: hydraulic conductivity (K), 0.0128 m/day, local Darcy flux (waterfront velocity) 0.000256 m/d
- MW2: hydraulic conductivity (K), 0.486 m/day, local Darcy flux 0.018 m/d
- MW3: hydraulic conductivity (K), 0.00346 m/day, local Darcy flux 0.00002 m/d

10.4.3 Groundwater Sampling

A total of four (4) groundwater samples, including one (1) duplicate groundwater sample, were collected from three (3) of the newly installed monitoring wells during the Phase II ESA investigation, and submitted for metals, three (3) samples for PHC, and PAH laboratory analysis.

The depth to groundwater and L/DNAPL in each well was then measured using the Solinst oil-water interface probe. Water level measurement in MW-1 was at a depth of 2.53 meters, MW-2 at 0.58 meter, and MW-3 at 2.00 meters from the surface level.

No L/DNAPL was detected in any well.

The following subsections summarize the laboratory analytical results compared to the available federal and provincial guidelines for groundwater at a potable site with residential land use, and coarse-grained soil. Groundwater exceedances are shown on Figure 7 in Appendix A. Groundwater chemistry results are presented below and in Tables F-11 through F-13 in Appendix F. These exceedances are summarised in Table 11 below:

Table 11: Groundwater Exceedances

Client Sample ID	HC GCDWQ		NSECC Tier I EQS [2]	MW-1 (APEC-1)	MW-2 (APEC-3)	MW-3 (APEC-2)	MW-2 Dup
	MAC/AO						
Color, apparent	--	15	--	4220	373	464000	786
Solids, total dissolved [TDS]	--	500	--	188	136	699	112
pH	--	7.0 - 10.5	--	7.48	6.4	7.71	6.24
Manganese, dissolved	0.12	--	0.12	1.92	0.176	0.948	0.176

Exceeded NSECC Tier 1 EQS

Exceeded HC GCDWQ, impact

Exceeded both NSECC and HC GCDWQ, impact

10.4.4 General Groundwater Chemistry

A total of four (4) including one (1) QA/QC duplicate groundwater samples were analyzed for general water chemistry:

- APEC-1 MW-1: water was found to be of a mixed calcium-sodium/potassium-bicarbonate type, fresh, moderately hard, encrusting, and slightly alkaline. Colour exceeded the HC GCDWQ. Ion balance was reported by the laboratory acceptable at 97.9%.
- APEC-3 MW-2 and its duplicate: water was found to be of a sodium/potassium-bicarbonate type, fresh, soft, slightly encrusting, and slightly alkaline. Colour and low pH exceeded the HC GCDWQ. Ion balance was acceptable at 96%.
- APEC-2 MW-3: water was found to be of a sodium/potassium-bicarbonate type, slightly brackish, hard, encrusting, and slightly acidic. Colour and TDS exceeded the HC GCDWQ. Ion balance was acceptable at 93.3%.

10.4.5 Groundwater Metals

A total of four (4) groundwater samples were analyzed for metals, including one (1) duplicate sample.

Manganese exceedances of the NSECC Tier 1 EQS were noted within groundwater at monitoring well locations APEC-1 MW-1, APEC-3 MW-2, APEC-2 MW-3, and MW-2 Dup.

No other metal exceeded the guidelines.

10.4.6 Groundwater Petroleum Hydrocarbons

A total of three (3) groundwater samples (APECs-1, 2, and 3) were analyzed for PHCs. Of these, all groundwater samples were reported to have PHC concentrations either less than lowest detection limit, and/or less than the HC GCDWQ and NSECC Tier 1 EQS for groundwater.

10.4.7 Groundwater Polycyclic Aromatic Hydrocarbons

A total of three (3) groundwater samples (APECs-1, 2, and 3) were analyzed for PAHs. Of these, all groundwater samples were reported to have PAH concentrations either less than laboratory RDLs or less than Health Canada GCDWQ and NSECC Tier 1 EQS for groundwater.

11.0 SITE SURVEY

During the Phase II ESA the site sampling locations were surveyed into geodetic NAD83 system using Topcon instrument and MagneticField software able to measure coordinates and elevation at 0.001 m accuracy.

This data is presented in Table 1 in Appendix F and mapped in Figures 4 through 8 in Appendix A.

12.0 PHASE II ESA FINDINGS

All APECS identified though the Phase I ESA were intrusively investigated accordingly to the scope of work approved by NSDND and BNS. No deviations were noted.

Elevated heavy metals, PHCs, and PAHs concentrations above the Table 5 of the Atlantic Regional Background and NSECC Tier 1 EQS for a parkland/residential land use, potable water use, coarse-grained soils site were identified as environmental impacts. These were found in surface soils at all locations and Phase I ESA's APECs.

12.1 Soil Findings

Based on the results of this investigation the preliminary estimated depth of impacts of 1.5 m would result in approximately 40,500 m^3 or 81,000 tonnes of soil impacted by heavy metals, PHCs, and PAHs.

These impacts were concentrated as follows:

- Metal impacts were found to be concentrated around APEC-5 SS-5 (eight (8) exceedances), in the east portion of the site.
- Petroleum hydrocarbon impacts as benzene, ethylbenzene, toluene and xylene (BTEX) were concentrated around APEC-1 MW1-SS1 and APEC-2 MW3-SS1 in the western and eastern portions of the site. Although BTEX compounds are volatile and could be expected to be evaporated over decades passed since the mine closure, these compounds are not easy to dissipate to the atmosphere. For example, benzene concentrations in soils within the North of Coke Ovens (NOCO) area in Sydney are still exceeding guidelines and background for over 50 years since the Coke Ovens closure. Moreover, BTEX compounds on the Thorburn Mine Site is related to lube oil, as per lab ID, and most likely are trapped withing the lube oil matrix, which would slow down the evaporation.
- PAH impacts were more or less evenly spread over the site, with some concentration around APEC-2 SS-6 (six [6] exceedances). Of note Index of Additive Cancer Risk (IACR) impacts in all soil samples, except for APEC-4 SS-4.
- The distribution of the total number of impacts in surface soils (metals, BTEX, PAHs) was as follows:
    - APEC-1 MW-1: ten (10)
    - APEC-3 MW-2: nine (9)
    - APEC-2 MW-3: twelve (12)
    - APEC-4 SS-4: three (3)
    - APEC-5 SS-5: thirteen (13)
    - APEC-2 SS-6: twelve (12)
    - APEC-7 SS-7: nine (9)

To illustrate the impacts distribution a Plate 1 is summarizing all impacts per station.

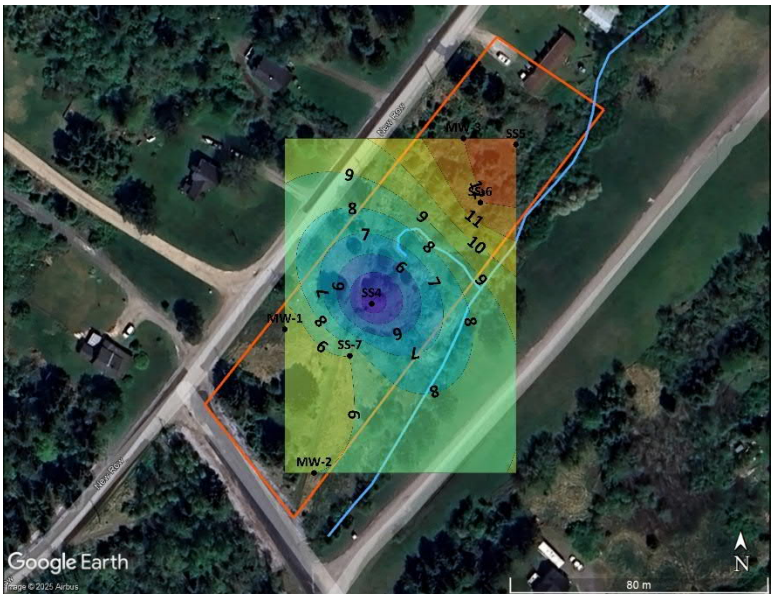


Plate 1: Summarized Impacts in Soil, red color indicates higher concentrations

The exact source of the widespread BTEX impact is unknown but potentially is related with the historical site use, rather than due to import of an impacted fill material. Of note, there are no signs of active site infilling on the historical aerial photographs since 1931.

These impacts above were considered anthropogenic due to the historical site mining activities.

All these impacts were identified within the site's fill material, which extends to 2 m depth on the western portion and to 3 m depth in the eastern portion over the site area of 16,187 m^2. It is assumed that impacts are extended to 1.5 m depth of the fill material.

12.2 Surface Water Findings

APEC-6: surface water exhibited only metal (aluminum, iron, manganese, mercury, and selenium) impacts over the NSECC Tier 1 EQS. The Flow (Q) of surface water sample location was calculated to be 3,888 cubic meter/day (m^3/day) or 0.045 meter per second (m/s), using the velocity area method.

This set of impacts is not characteristic for the site's groundwater.

Of this set of metals, elevated mercury and selenium are not characteristic for the natural Nova Scotia soil or rock and are concluded to be related to the former human mining activities.

12.3 Sediment Findings

APEC-6: the most concern for the sediment on the site is mTPH and PAH, as shown below:

- PHCs exceeded the NSECC Tier 1 EQS for mTPH in lube oil range.
- PAHs 2-methylnaphthalene exceeded also the NSECC Tier 1 EQS.

12.4 Groundwater Findings

- Groundwater flow was noted to be from the south to the north, Darcy velocities ranged from 0.00002 m/d to 0.018 m/d.
- Some physical parameters in APECs -1, 2, and 3 (low pH, colour, total dissolved solids) exceeded the HC GCDWQ.
- Manganese in APECs -1, 2, and 3 (0.176 mg/L to 1.92 mg/L versus guidelines of 0.12 mg/L) exceeded both the HC GCDWQ and NSECC Tier 1 EQS. Elevated manganese is naturally present in Nova Scotia groundwaters and at relatively low concentrations is considered as a background.
- No other exceedances were noted.

12.5 Summary of Findings

In summary, it was found that:

- Surface soil across the site (APECs -1 ,2, 3, 4, 5, and 7) are impacted by a set of heavy metals, PHCs, and PAHs, generally similar for all locations. Based on the results of this Phase II ESA it is found that the site impacts could be represented by one (1) APEC-A, which would include surface soils, sediment, and groundwater, characterized by similar set of impacts. An average depth of these impacts was estimated to be 1.5 m.
- Surface water (APEC-6) is impacted by a heavy metal set distinct from soil impacts. Based on this conclusion surface water is concluded to represent a separate APEC-B with an unknown source.
- Stream sediment is impacted by PHCs and PAHs, like surface soils in the consolidated APEC-A.
- Groundwater is impacted by limited heavy metal (manganese) and select physical parameters. Although only manganese was the exceedance characteristic of APEC-A, groundwater impacts are concluded to be related to the APEC-A due to highly probable origin of this water on the site, as percolated precipitation.

13.0 DISCUSSION

13.1 Further Investigations

It is thought that further vertical delineation as well as aerial delineation of soils and sediment impacts in heavy metals, PHCs, and PAHs, inside the site boundaries is required for understanding of the future remediation or reclamation liabilities.

No or little anthropogenic, mining-related impacts (color, pH, manganese) were noted in groundwater, which is still regarded as a portion of APEC-A.

Of note are three (3) potentially related to APEC-B and infilled AMOs located immediately upgradient from the site to the south, within the brook, potentially discharging like APEC-B impacts, and potentially affecting the site's groundwater and of-site surface water in the brook. It is expected that these AMO impacts could be possible to detect on the site during a detailed groundwater investigation along the southern, upgradient boundary.

As such, it is thought that detailed aerial delineation of noted and suspected impacts in groundwater is required for development of detailed plans for future remediation or reclamation.

Surface water represents the second APEC-B, with impacts of a different character and potential source. It is possible that these impacts could be originated off-site, traveling with groundwater and discharging on the site. As no source could be identified or suspected at this time, a long-term on-site monitoring of surface water would be required, as well as potential remedial actions.

14.0 PHASE II ESA CONCLUSIONS AND RECOMMENDATIONS

14.1 Conclusions

Based on the information collected during the May 2025 Phase II ESA investigation, DesignPoint provides the following conclusions:

- Based on the results of this phase II ESA it was concluded that the whole site soils, sediment, and groundwater represent one (1) APEC-A with similar set of impacts:
    - Surface soil on the site is contaminated above applicable guidelines with heavy metals, PHCs and PAHs and requires further on-site horizontal and vertical delineation of these impacts.
    - Sediment on the site is contaminated above applicable guidelines with heavy metals, PHCs and PAHs and requires further on-site vertical delineation of these impacts.
    - Groundwater flow was to the north, at an average velocity of 0.009 m/d. Only color, pH, TDS and manganese exceed applicable guidelines. It is concluded that further detailed on-site delineation of the impacts and bi-annual (high and low flow events) monitoring of groundwater is required in 2025-2026 due to potential impacts on potable household wells around the site and suspected influence from of-site AMOs.
- Surface water on site is contaminated above applicable guidelines with heavy metals including mercury, by historical mining and requires further on-site monitoring for water levels, flow, water parameters and water chemistry, including metals and mercury. It is concluded that further on-site delineation of the impacts and bi-annual (high and low flow events) monitoring of surface water is required in 2025-2026.
- Off-site AMOS and historical mining activities upgradient from the site to the east, south and west could potentially affect the site by migrating surface and groundwater, as well as soil (dust) and sediment in the brook.

14.2 Recommendations

The following recommendations are based on the Phase II ESA Conclusions:

1. It is recommended to complete Phase III ESA, including on-site delineation of soil, sediment and groundwater for the noted impacts, such as metals, PHCs and PAHs within APEC-A. Approximate delineation locations are depicted in Figure 8 in Appendix A and described below. The delineation is primarily aimed at the site boundaries and vertical investigation, and intrusive locations are proposed accordingly.
    - Soil delineation is recommended to be completed at seven (7) locations along the site boundaries, of which two (2) would be boreholes and five (5) monitoring wells. To limit disturbance on the site this delineation is recommended to be completed using a drilling rig and manual auger, rather than an excavator.
    - Sediment vertical delineation is recommended to be completed at one (1) location, using the manual auger.
    - Two (2) samples for vertical delineation are recommended for each future soil and sediment sampling station. Samples to be collected one (1) from the potentially most impacted and one (1) from lower, least impacted layers of soil. OVM to be used for aiding of sample field screening.
    - Groundwater delineation is recommended to be completed at five (5) locations using future soil delineation boreholes for monitoring well installations.
    - The set of analytes for groundwater is recommended to additionally include VOCs to satisfy requirements for sampling of potable water. Potable household wells are located predominately to the north of the site. Organic parameters were not detected during the Phase II ESA, this should be confirmed through further monitoring in 2025 and 2026.
2. During Phase III ESA field work it is recommended to monitor surface water (APEC-B) on the site for water levels, flow, and water chemistry, including general chemistry, metals and mercury, PHCs, and PAHs. Organic parameters were not detected during the Phase II ESA, this should be confirmed through further monitoring in 2025 and 2026.
3. It is recommended to consider potential further delineation of impacts on third-party properties, if it will be determined that the site impacts could extend off-site. Please note that, while recommended, the off-site characterization and intrusive investigation are not parts of the proposed Delineation Phase III ESA of this project.

Conclusions and recommendations regarding the current environmental condition of the former Thorburn Mine Site are based solely on the results of the Phase I/II ESA soil, groundwater, and surface water sampling program, as described in this report.

15.0 CLOSURE

This report was prepared by Arman Polatbekov, P.Geo. (NS, NL, NB), Hydrogeologist, CSP and Navomi Thuruthel James, B.Tech. The report was reviewed by Charlotte Clark, P.Eng., Senior Environmental Engineer and Project Manager. This report was prepared for the exclusive use of BNS for evaluating the environmental condition of the site at the time of the site visits. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of the third party. Should additional parties require reliance on this report, written authorization from DesignPoint will be required. With respect to third parties, DesignPoint has no liability or responsibility for losses of any kind whatsoever, including direct or consequential financial effects on transactions or property values, or requirements for follow-up actions and costs.

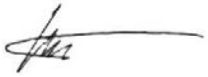
The report is based on data and information collected during the Phase I/II ESA of the site conducted by DesignPoint. It is based solely on the conditions of the site encountered at the time of the site visits on between November 2024 and May 2025. Except as otherwise maybe specified, DesignPoint disclaims any obligation to update this report for events taking place, or with respect to information that becomes available to DesignPoint after the time during which DesignPoint conducted the Phase I/II ESA. In evaluating the property, DesignPoint has relied in good faith on information provided by other individuals noted in this report. DesignPoint has assumed that the information provided is factual and accurate. In addition, the findings in this report are based, to a large degree, upon information provided by the prospective purchaser, the purchasers agent, and the current managers of the property. DesignPoint accepts no responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of omissions, misinterpretations or fraudulent acts of persons interviewed or contacted.

DesignPoint makes no other representations whatsoever, including those concerning the legal significance of its findings, or as to other legal matters touched on in this report, including, but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation and change. Such interpretations and regulatory changes should be reviewed with legal counsel. We trust that the information contained in this report is adequate for your present purposes. If you have any questions about the contents of the report or if we can be of any other assistance, please contact us at your convenience.

Thank you,

DesignPoint Engineering & Surveying Ltd.

Navomi Thuruthel James, B.Tech.
Environmental Technologist



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