APPENDIX A – FIGURES

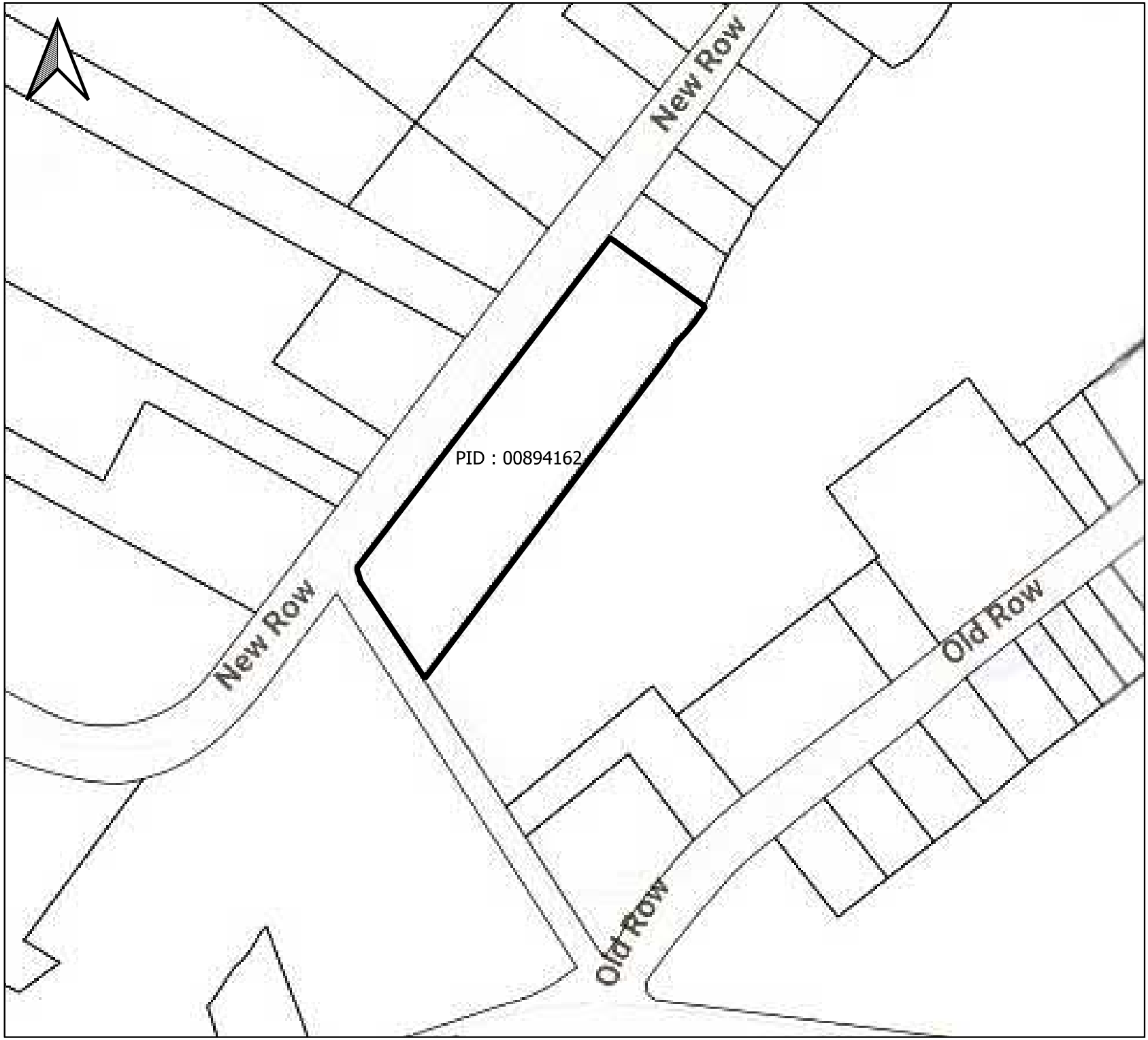

Figure 1
Site Location

Project #24-750
Build Nova Scotia
Phase I ESA Thorburn Mine

Legends

Site Area

PID: 00894162

0 10 20 30 40 m

1:2000 meters

DESIGNPOINT
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Figure 2
Detailed Site Plan

Project #24-750
Build Nova Scotia
Phase I ESA Thorburn Mine

Legends

Site Area

Neighbouring Property

0 10 20 30 40 m

1:2000 meters

DESIGNPOINT
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Figure 3
Proposed Intrusive Investigation Locations & APECS

Project #24-750
Build Nova Scotia
Phase I ESA Thorburn Mine

Legends

- Surface Soil Sample Locations
- Monitoring Well Locations and Soil sample Locations
- Surface Water Sample Locations and Sediment Sample Locations
- Abandoned Mine Openings
- Ephermeral Stream
- NSTDB Mapped Watercourses
- APEC Locations
- Study Area (PID 00894162)

0 10 20 30 40 m

1:1000 meters

DESIGNPOINT
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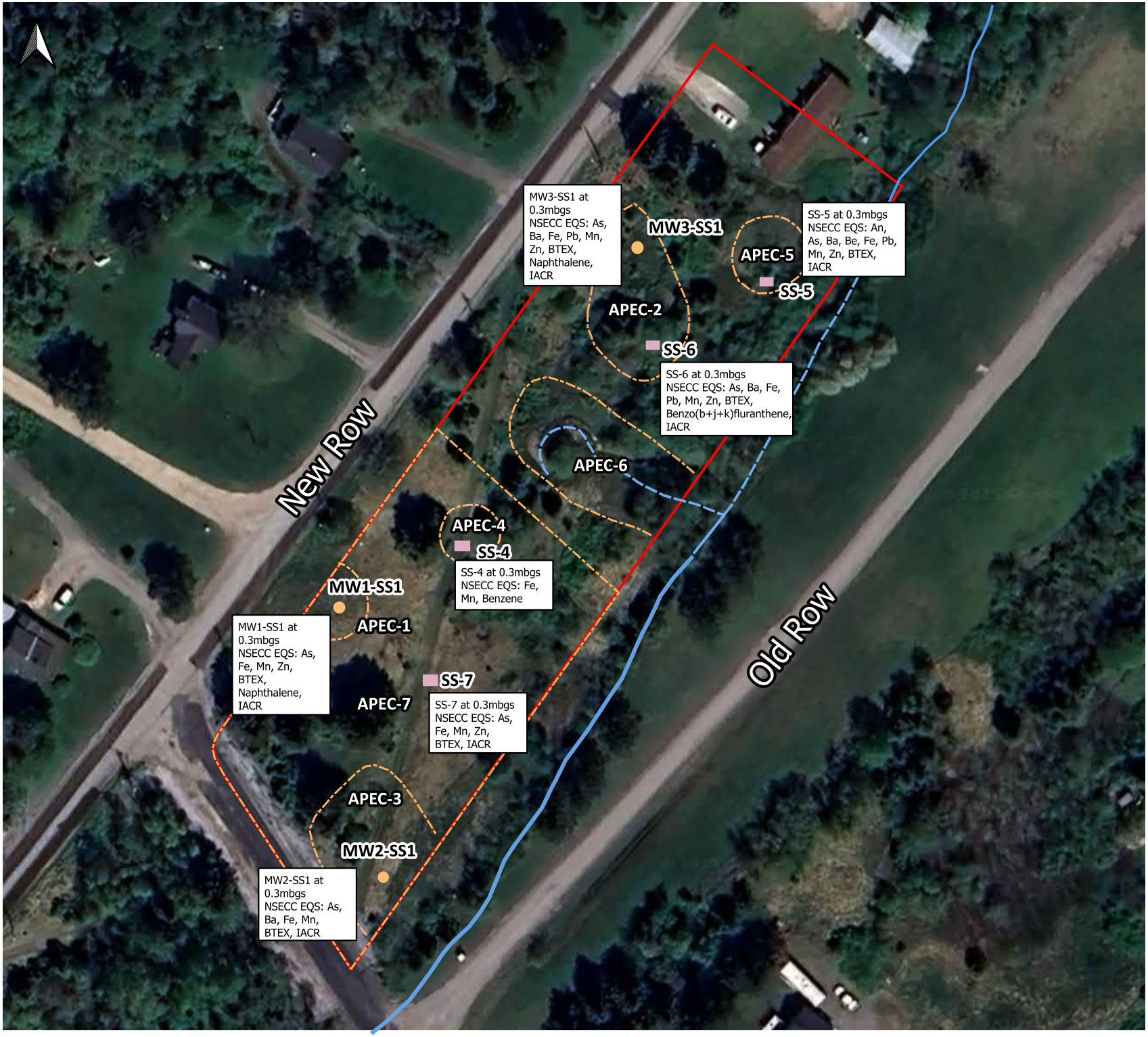


Figure 4
Exceedances in Soil

Project #24-750
Build Nova Scotia
Phase II ESA Thorburn Mine

Legends

- Surface Soil Sample Locations
- Soil Sample location
- Ephemeral Stream
- NSTDB Mapped Watercourses
- APEC Locations
- Study Area (PID 00894162)

Station
Sample/Depth
Guideline
Exceedances

0 10 20 30 40 m

1:1000 meters

DESIGNPOINT
engineering · surveying · solutions

Figure 5
Exceedances in Surface Water

Project #24-750
Build Nova Scotia
Phase II ESA Thorburn Mine

Legends

- Surface Water Sample Locations
- Ephemeral Stream
- NSTDB Mapped Watercourses
- APEC Locations
- Study Area (PID 00894162)

Station
Sample/Depth
Guideline
Exceedances

0 10 20 30 40 m

1:1000 meters

DESIGNPOINT
engineering • surveying • solutions

Figure 6
Exceedances in Sediment

Project #24-750
Build Nova Scotia
Phase II ESA Thorburn Mine

Legends

- Sediment Sample Locations
- Field Identified Channel
- NSTDB Mapped Watercourses
- APEC Locations
- Study Area (PID 00894162)

Station
Sample/Depth
Guideline
Exceedances

0 10 20 30 40 m

1:1000 meters

DESIGNPOINT
engineering • surveying • solutions

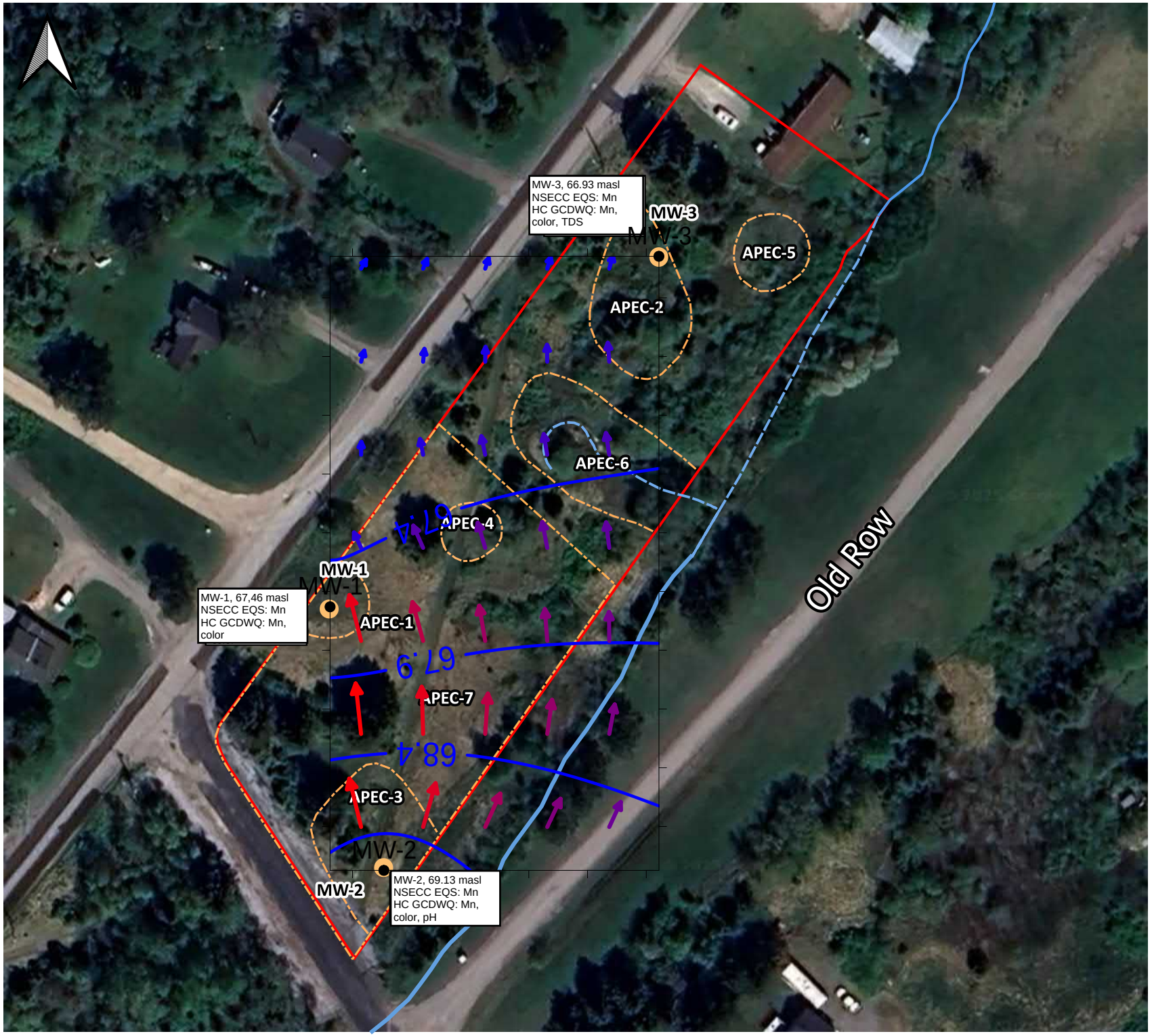


Figure 7
Exceedances in Ground Water

Project #24-750
Build Nova Scotia
Phase II ESA Thorburn Mine

Legends

- Monitoring Well Locations
- Ephemeral Stream
- NSTDB Mapped Watercourses
- APEC Locations
- Study Area (PID 00894162)

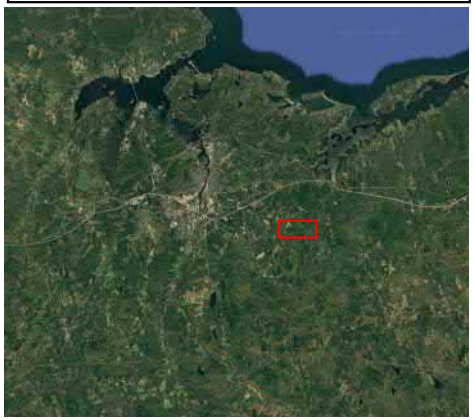
Station
WL Elevation
Guideline
Exceedances

GW Flow Direction and Gradients

0.00571 0.037

0 10 20 30 40 m

1:1000 meters



DESIGNPOINT
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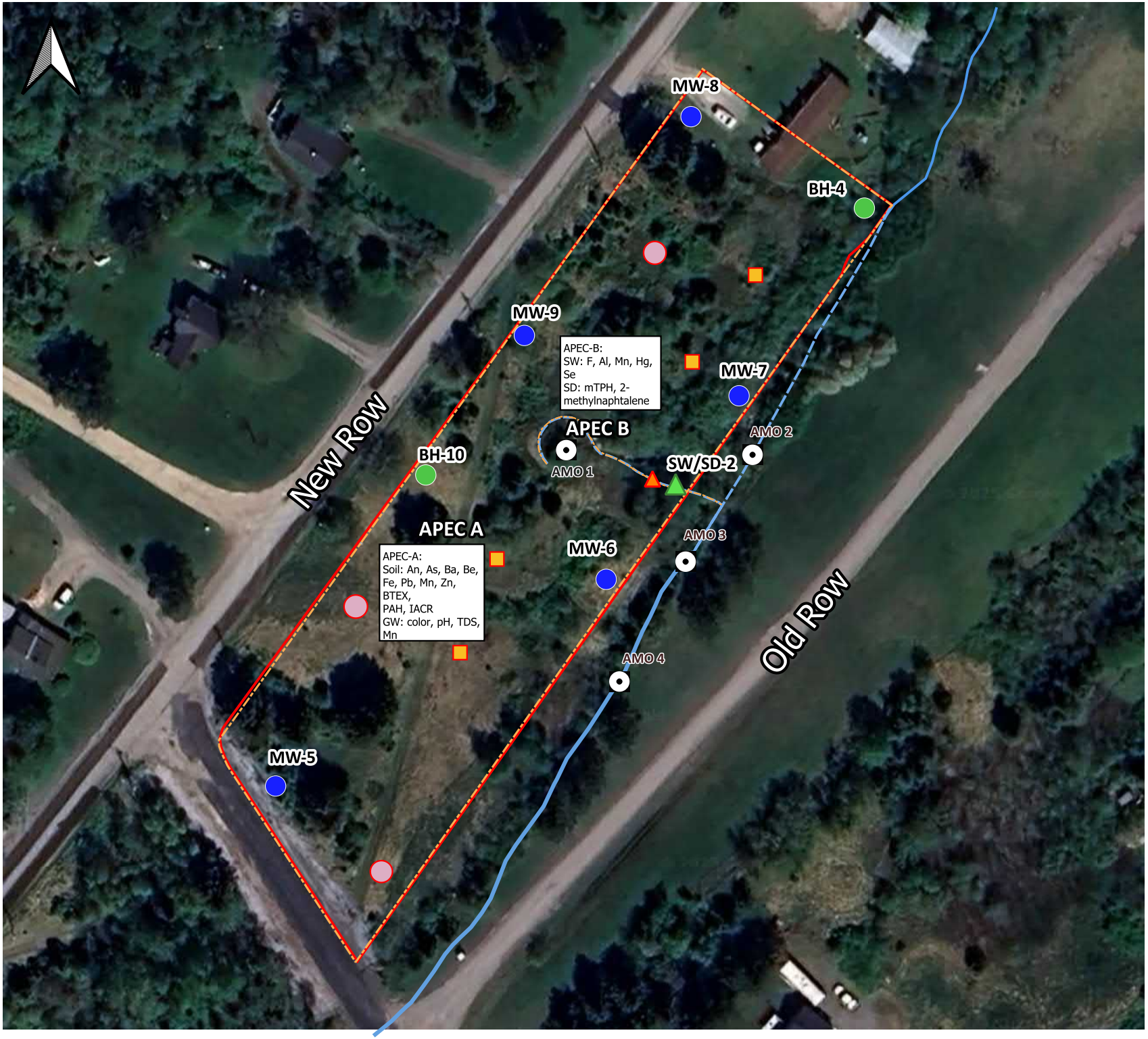

Figure 8
Phase III ESA Proposed Intrusive Locations

Project #24-750
Build Nova Scotia
Phase II ESA Thorburn Mine

Legends

- Ephemeral Stream
- NSTDB Mapped Watercourses
- AMO
- Sutdy Area (PID 00894162)

Existing stations

- Surface water and Sediment
- Surface Soil
- Soil and Groundwater

Proposed stations

- Sediment
- Soil
- Soil and Groundwater
- APECS

0 10 20 30 40 m

1:1000 meters

DESIGNPOINT
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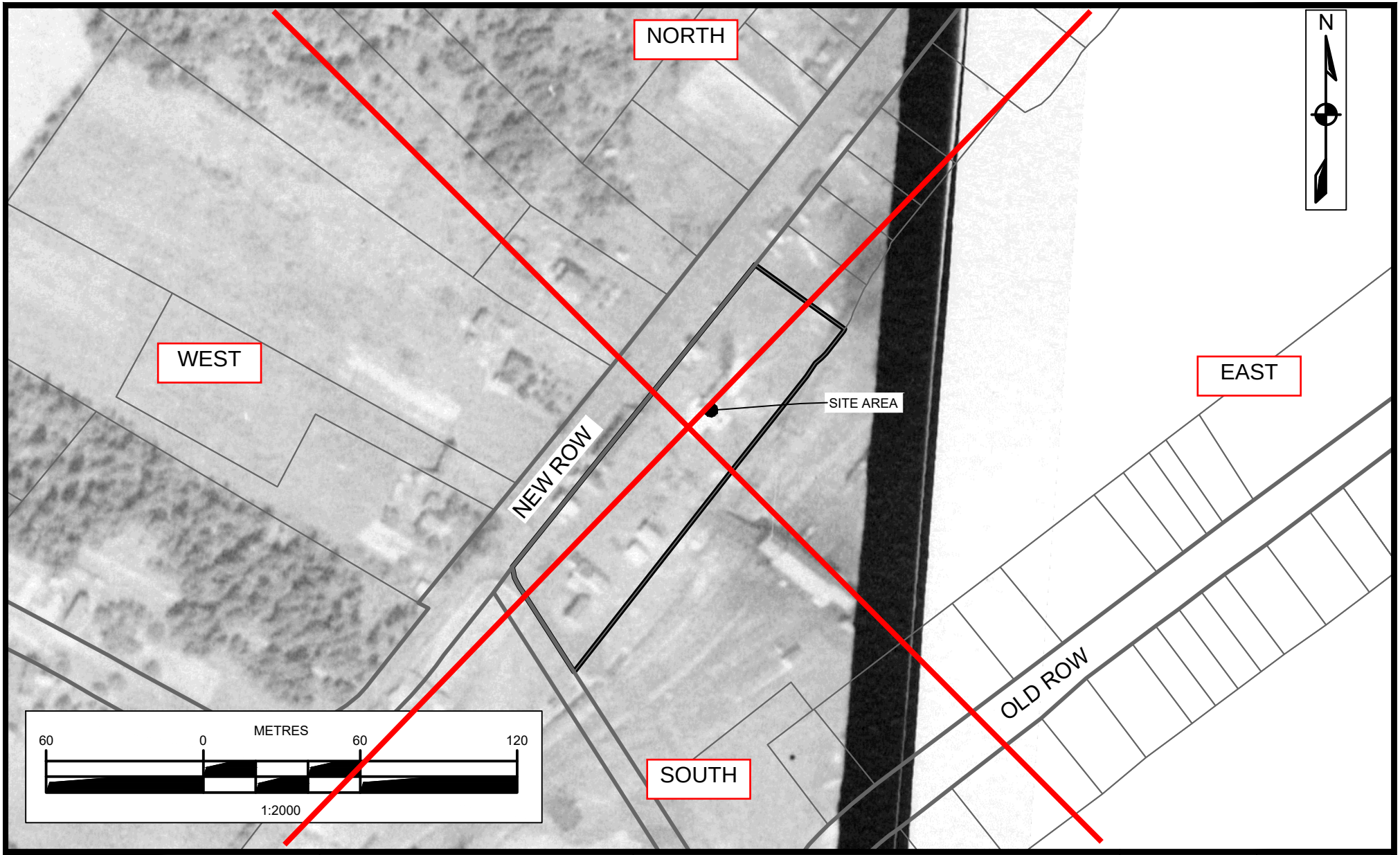
APPENDIX B – AERIAL PHOTOGRAPHS



PREPARED FOR	PREPARED BY	PROJECT		
BUILD NOVA SCOTIA	DESIGNPOINT engineering • surveying • solutions 902.832.5597 designpoint.ca	THORBURN MINE PHASE I: ENVIRONMENTAL ASSESSMENT THORBURN, NOVA SCOTIA DESCRIPTION AERIAL PHOTOGRAPH - 1931	Engineer: C. CLARK Scale: 1:2000 Project No.: 24-750 Filename: 24-750_FIGURES.dwg	Drawn: T. TRAN Date: Dec. 02, 2024 AERIAL PHOTO 1

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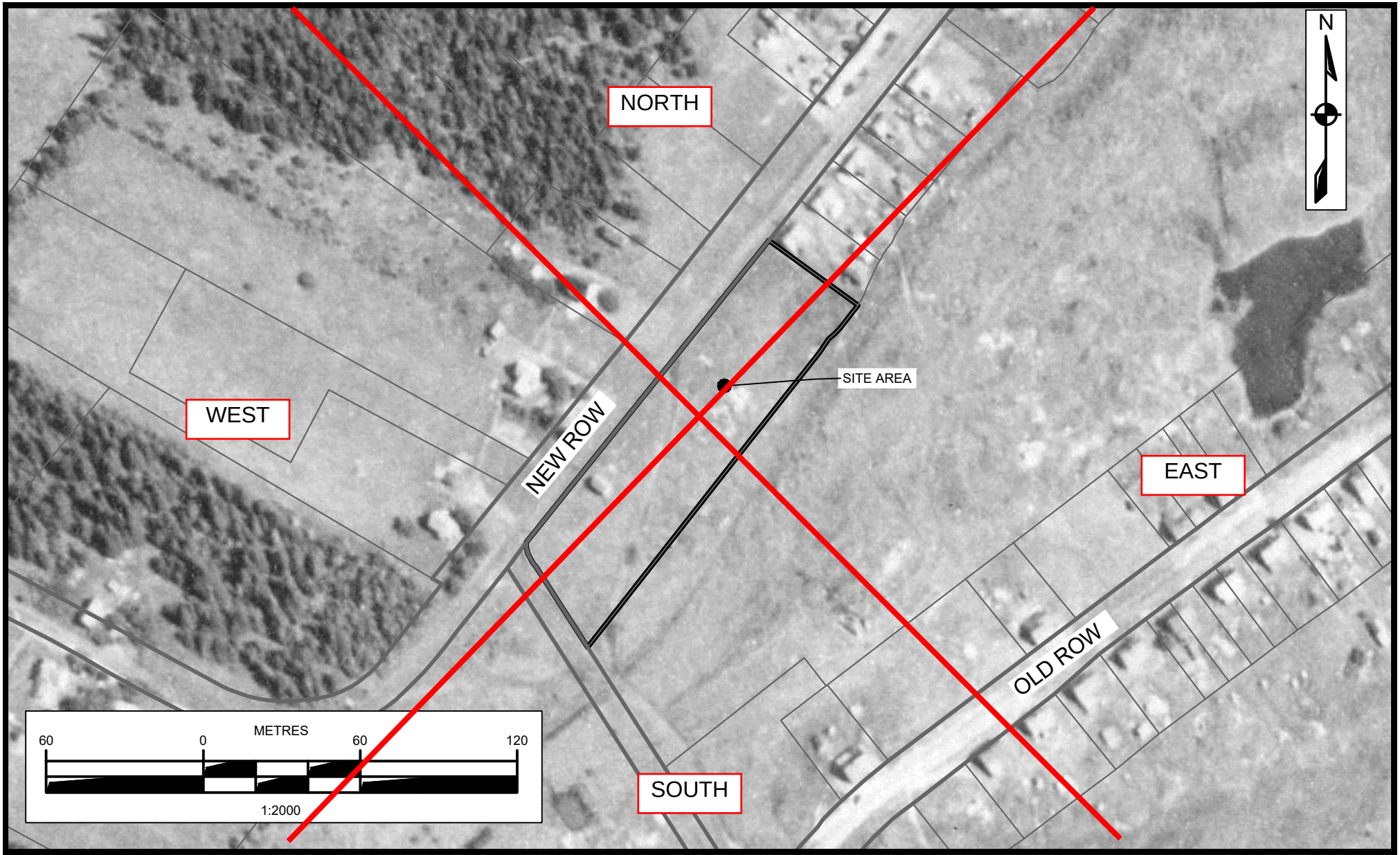
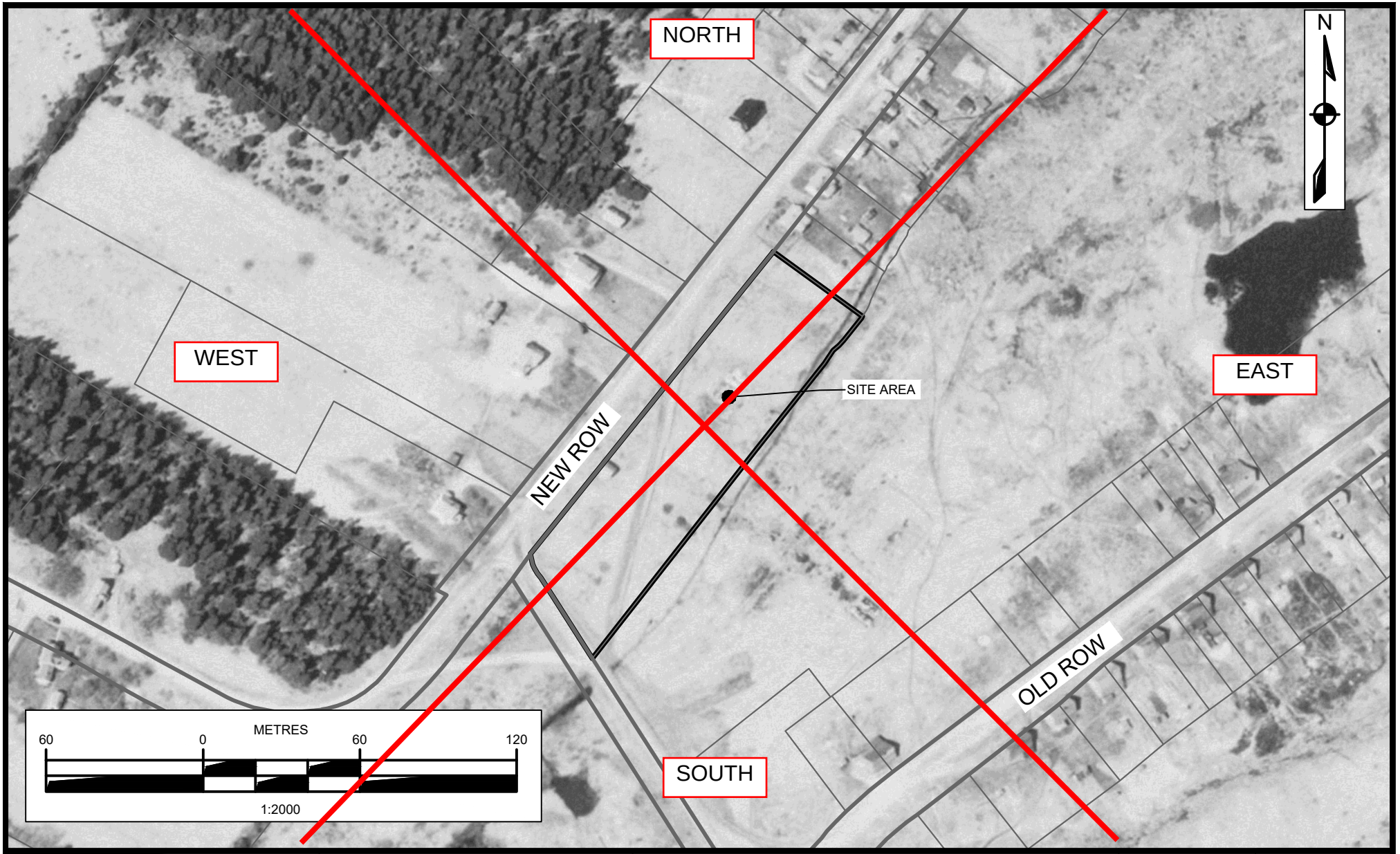


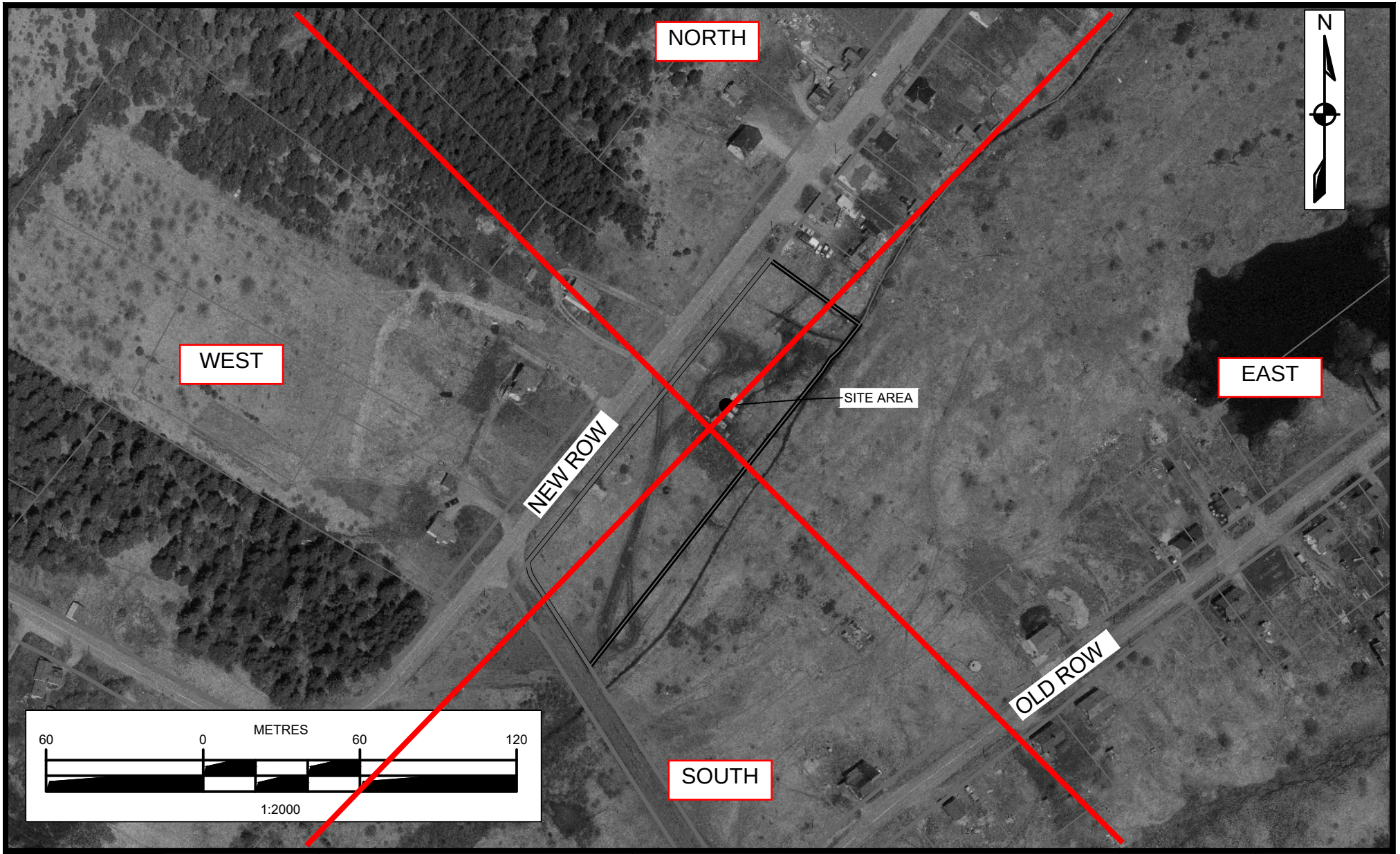
PREPARED FOR	PREPARED BY	PROJECT		
BUILD NOVA SCOTIA	DESIGNPOINT engineering • surveying • solutions 902.832.5597 designpoint.ca	THORBURN MINE PHASE I: ENVIRONMENTAL ASSESSMENT THORBURN, NOVA SCOTIA DESCRIPTION AERIAL PHOTOGRAPH - 1954	Engineer: C. CLARK Scale: 1:2000 Project No.: 24-750 Filename: 24-750_FIGURES.dwg	Drawn: T. TRAN Date: Dec. 02, 2024 AERIAL PHOTO 2

P:\2024\24-750 - BNS - Thornburn Phase I-II ESA\05 - Technical\Reports\Phase I ESA\Appendix A - Figures\24-750_FIGURES.dwg, PLOT DATE: 2024-Dec-2, PLOT SIZE: ANSI full bleed A (11.00 x 8.50 Inches), PLOTTED BY: Thomas Tran



PREPARED FOR	PREPARED BY	PROJECT		
BUILD NOVA SCOTIA	DESIGNPOINT engineering • surveying • solutions 902.832.5597 designpoint.ca	THORBURN MINE PHASE I: ENVIRONMENTAL ASSESSMENT THORBURN, NOVA SCOTIA DESCRIPTION AERIAL PHOTOGRAPH - 1960	Engineer: C. CLARK Scale: 1:2000 Project No.: 24-750 Filename: 24-750_FIGURES.dwg	Drawn: T. TRAN Date: Dec. 02, 2024 AERIAL PHOTO 3

P:\2024\24-750 - BNS - Thornburn Phase I-II ESA\05 - Technical\Reports\Phase I ESA\Appendix A - Figures\24-750_FIGURES.dwg, PLOT DATE: 2024-Dec-2, PLOT SIZE: ANSI full bleed A (11.00 x 8.50 Inches), PLOTTED BY: Thomas Tran



PREPARED FOR	PREPARED BY	PROJECT		
BUILD NOVA SCOTIA	DESIGNPOINT engineering • surveying • solutions 902.832.5597 designpoint.ca	THORBURN MINE PHASE I: ENVIRONMENTAL ASSESSMENT THORBURN, NOVA SCOTIA DESCRIPTION AERIAL PHOTOGRAPH - 1972	Engineer: C. CLARK Scale: 1:2000 Project No.: 24-750 Filename: 24-750_FIGURES.dwg	Drawn: T. TRAN Date: Dec. 02, 2024 AERIAL PHOTO 4

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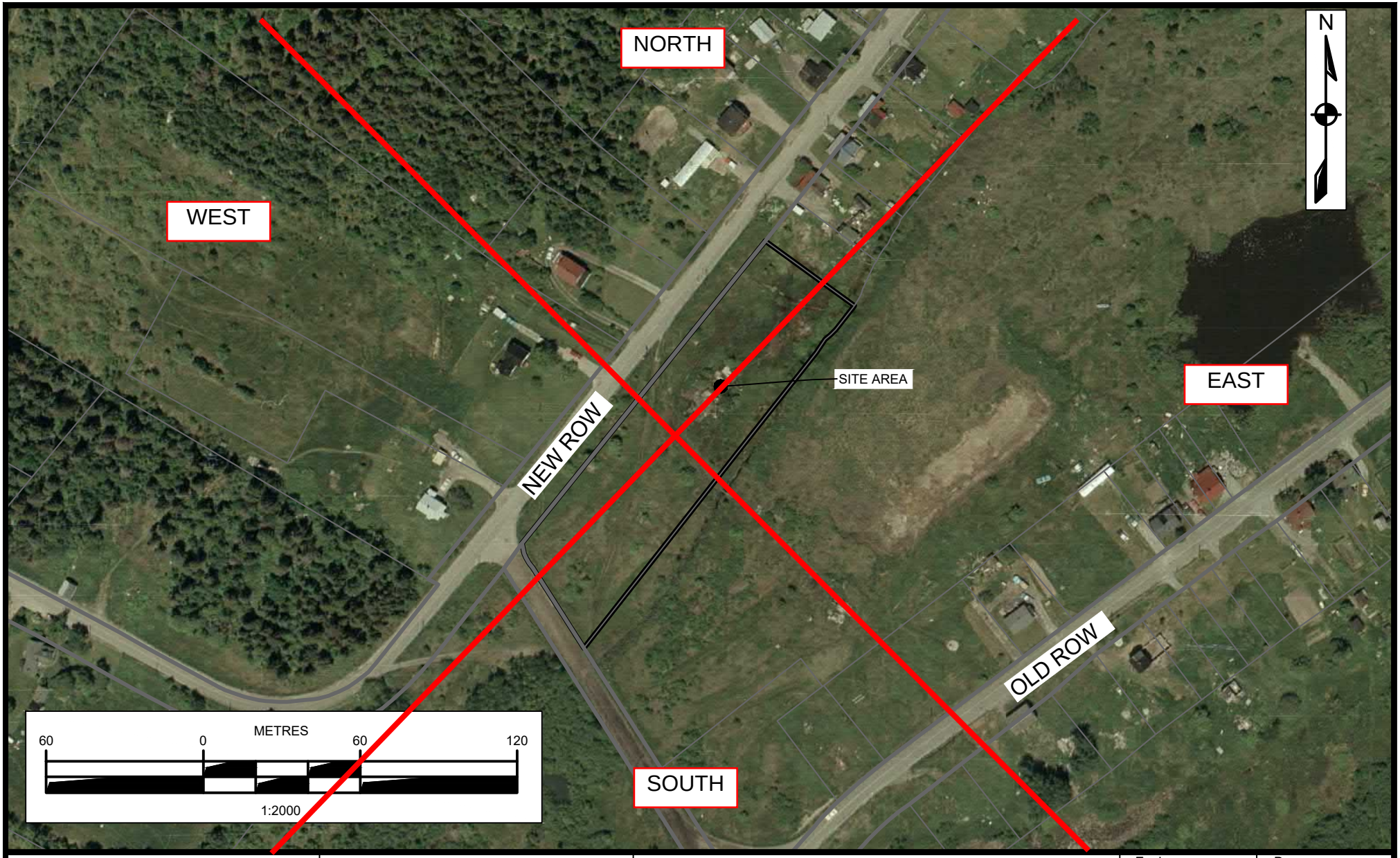

PREPARED FOR	PREPARED BY	PROJECT		
BUILD NOVA SCOTIA	DESIGNPOINT engineering • surveying • solutions 902.832.5597 designpoint.ca	THORBURN MINE PHASE I: ENVIRONMENTAL ASSESSMENT THORBURN, NOVA SCOTIA	Engineer: C. CLARK Scale: 1:2000 Project No.: 24-750 Filename: 24-750_FIGURES.dwg	Drawn: T. TRAN Date: Dec. 02, 2024 AERIAL PHOTO 5
		DESCRIPTION: AERIAL PHOTOGRAPH - 1979		

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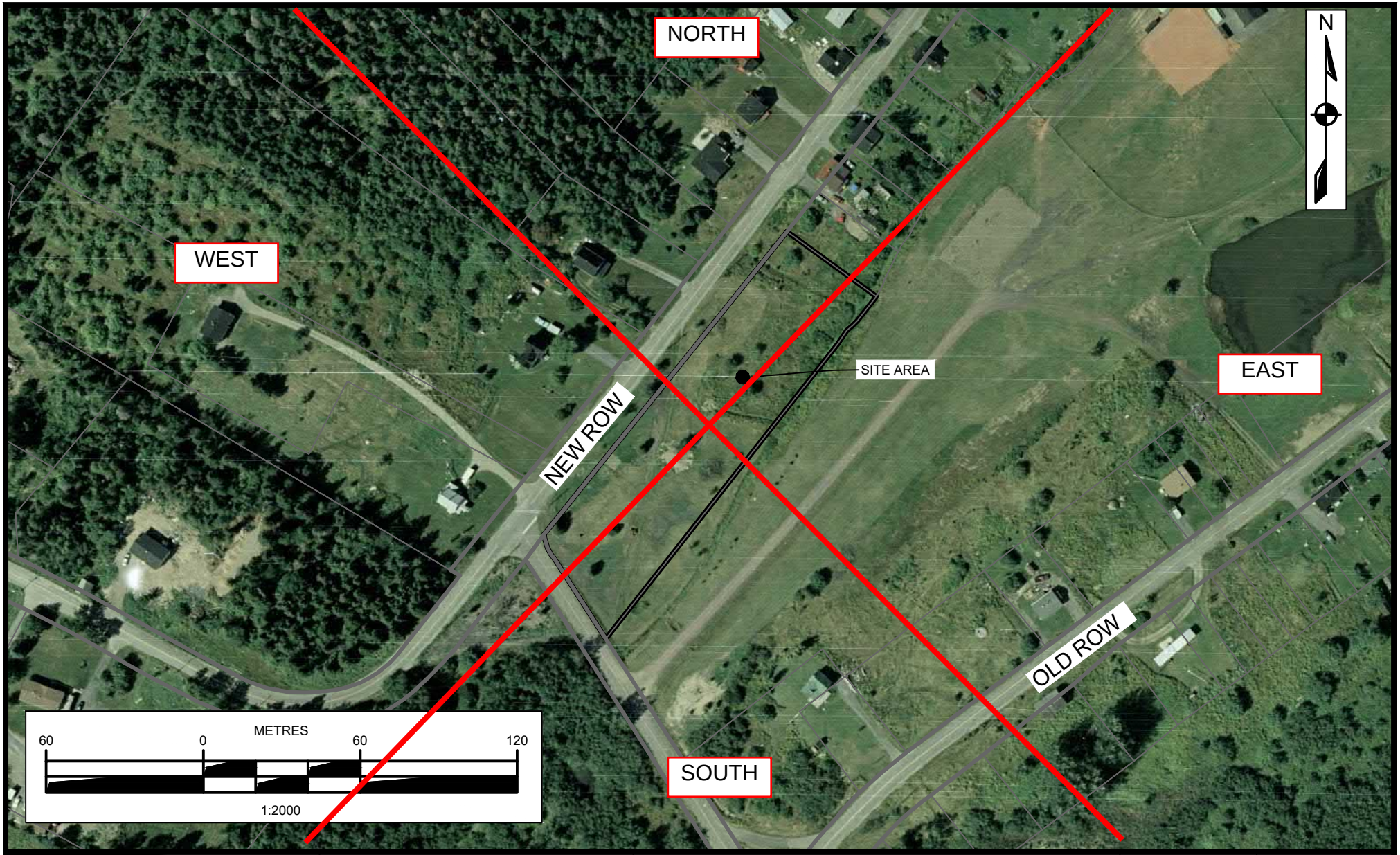

PREPARED FOR	PREPARED BY	PROJECT		
BUILD NOVA SCOTIA	DESIGNPOINT engineering • surveying • solutions 902.832.5597 designpoint.ca	THORBURN MINE PHASE I: ENVIRONMENTAL ASSESSMENT THORBURN, NOVA SCOTIA DESCRIPTION AERIAL PHOTOGRAPH - 1990	Engineer: C. CLARK Scale: 1:2000 Project No.: 24-750 Filename: 24-750_FIGURES.dwg	Drawn: T. TRAN Date: Dec. 02, 2024 AERIAL PHOTO 6

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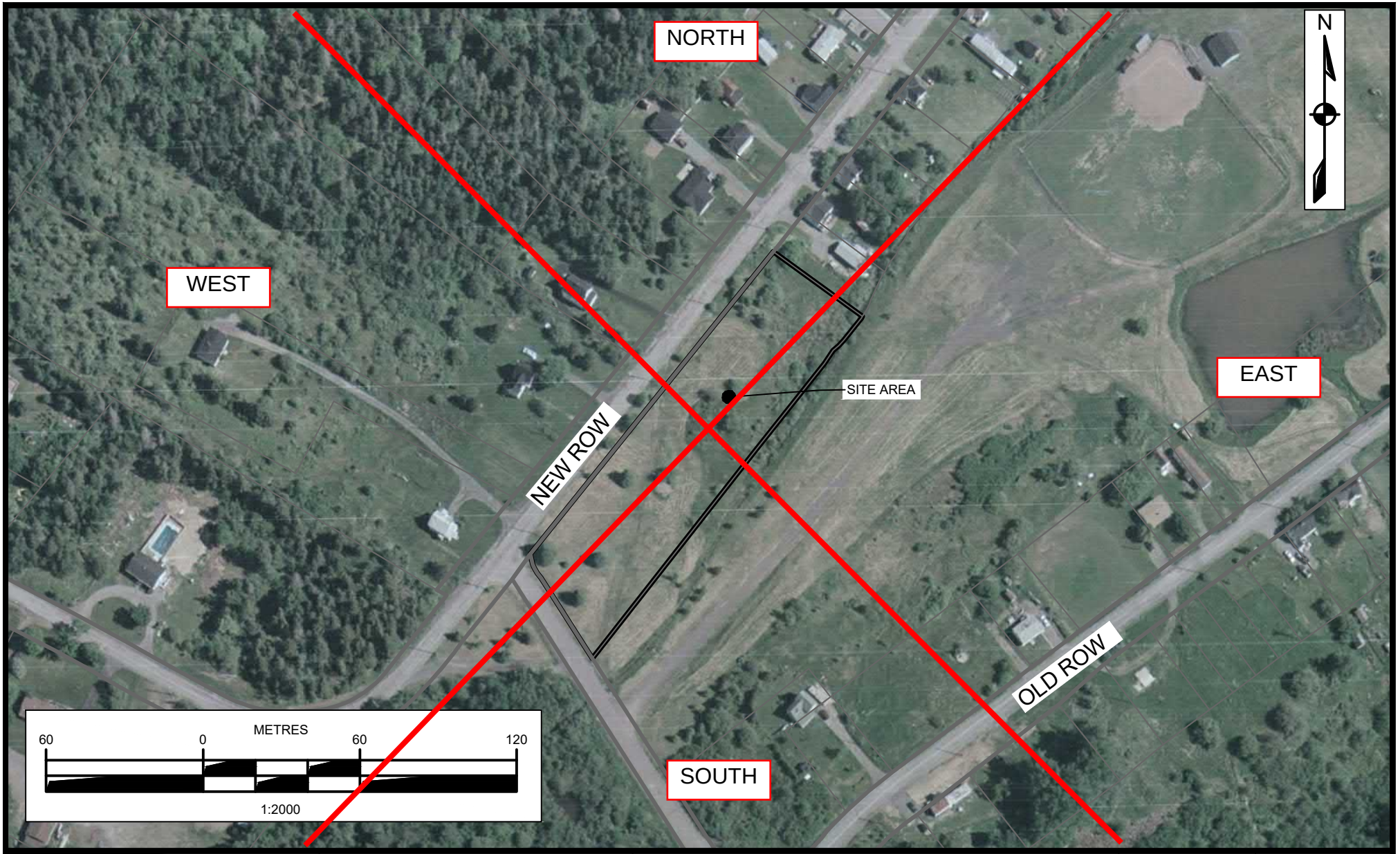

PREPARED FOR	PREPARED BY	PROJECT		
BUILD NOVA SCOTIA	DESIGNPOINT engineering • surveying • solutions 902.832.5597 designpoint.ca	THORBURN MINE PHASE I: ENVIRONMENTAL ASSESSMENT THORBURN, NOVA SCOTIA DESCRIPTION AERIAL PHOTOGRAPH - 1997	Engineer: C. CLARK Scale: 1:2000 Project No.: 24-750 Filename: 24-750_FIGURES.dwg	Drawn: T. TRAN Date: Dec. 02, 2024 AERIAL PHOTO 7

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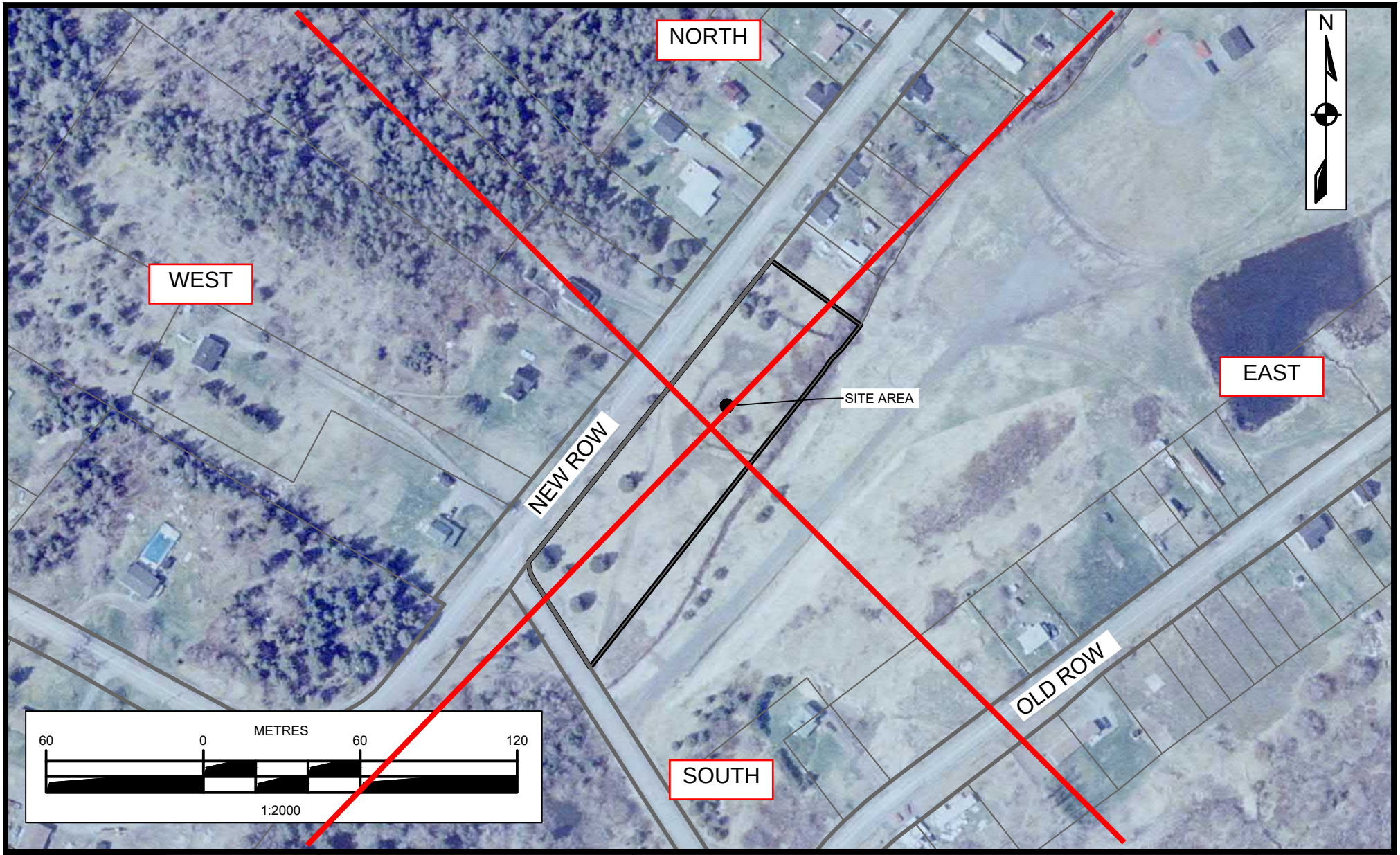

PREPARED FOR	PREPARED BY	PROJECT		
BUILD NOVA SCOTIA	DESIGNPOINT engineering • surveying • solutions 902.832.5597 designpoint.ca	THORBURN MINE PHASE I: ENVIRONMENTAL ASSESSMENT THORBURN, NOVA SCOTIA DESCRIPTION AERIAL PHOTOGRAPH - 2003	Engineer: C. CLARK Scale: 1:2000 Project No.: 24-750 Filename: 24-750_FIGURES.dwg	Drawn: T. TRAN Date: Dec. 02, 2024 AERIAL PHOTO 8

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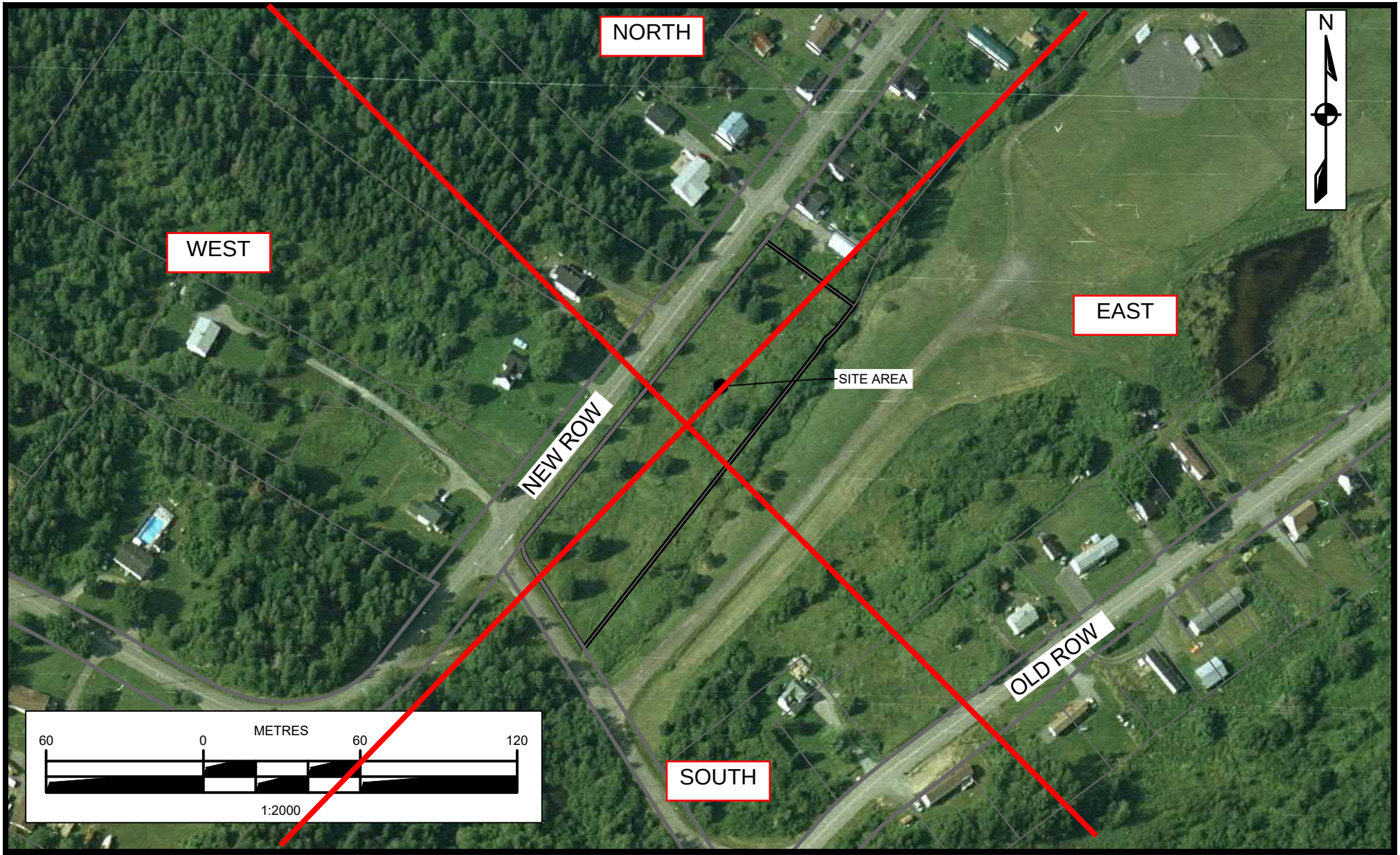

PREPARED FOR	PREPARED BY	PROJECT		
BUILD NOVA SCOTIA	DESIGNPOINT engineering • surveying • solutions 902.832.5597 designpoint.ca	THORBURN MINE PHASE I: ENVIRONMENTAL ASSESSMENT THORBURN, NOVA SCOTIA DESCRIPTION AERIAL PHOTOGRAPH - 2007	Engineer: C. CLARK Scale: 1:2000 Project No.: 24-750 Filename: 24-750_FIGURES.dwg	Drawn: T. TRAN Date: Dec. 02, 2024 AERIAL PHOTO 9

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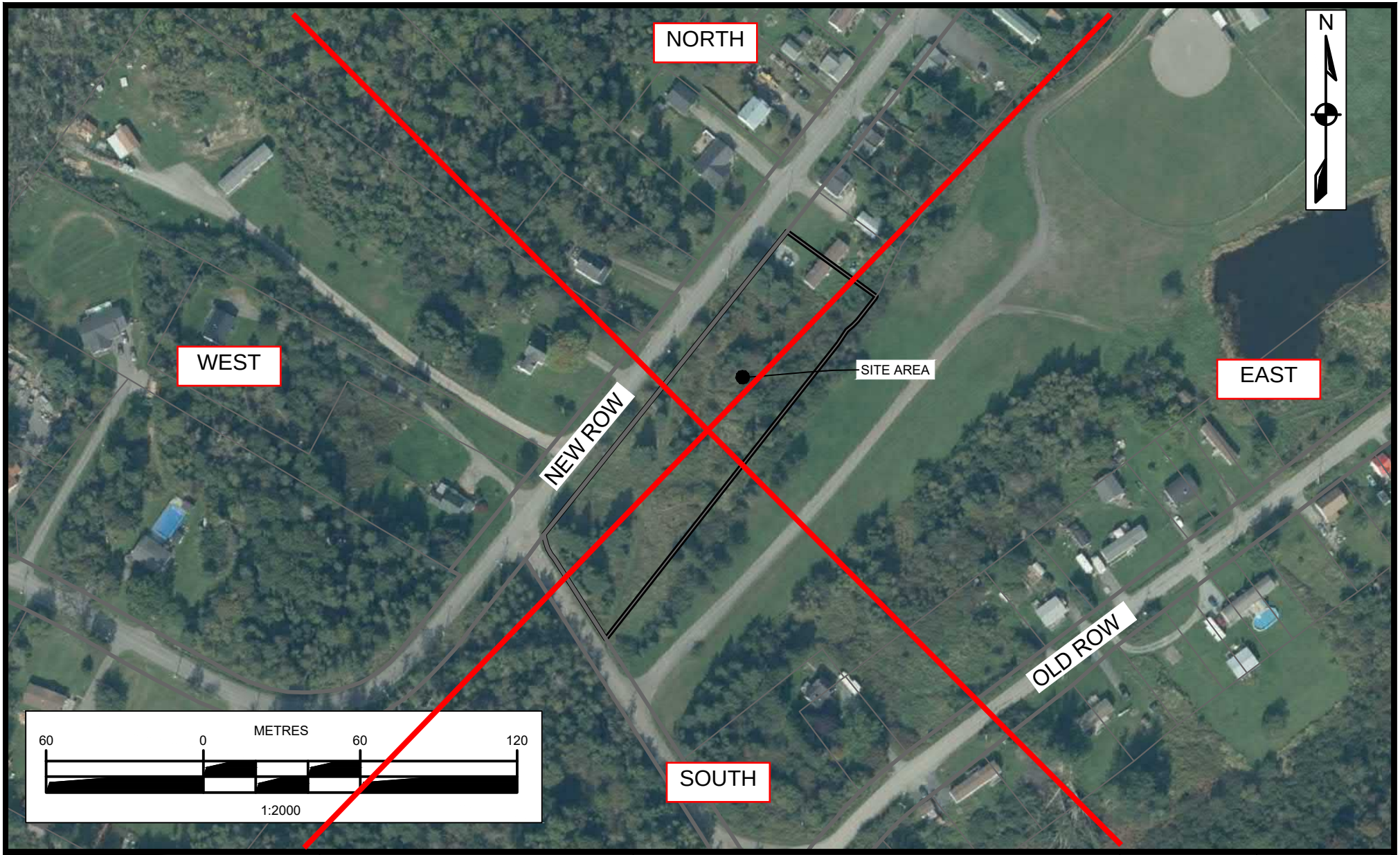

PREPARED FOR	PREPARED BY	PROJECT		
BUILD NOVA SCOTIA	DESIGNPOINT engineering • surveying • solutions 902.832.5597 designpoint.ca	THORBURN MINE PHASE I: ENVIRONMENTAL ASSESSMENT THORBURN, NOVA SCOTIA DESCRIPTION AERIAL PHOTOGRAPH - 2023	Engineer: C. CLARK Scale: 1:2000 Project No.: 24-750 Filename: 24-750_FIGURES.dwg	Drawn: T. TRAN Date: Dec. 02, 2024 AERIAL PHOTO 9

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APPENDIX C – HISTORICAL INFORMATION

Arman Polatbekov

From: ENV Access <ENVACCESS@novascotia.ca>
Sent: Tuesday, August 20, 2024 12:54 PM
To: Henderson, Kelly L; ENV Access
Cc: Williams, Stephen
Subject: RE: Environmental Information for Properties in Thorburn, NS

Hi Kelly,

No information was located for the properties listed below.

Tina Skeir
Information Access Officer
Dept. of Environment and Climate Change
PO Box 442
Halifax NS B3J 2P8
P: (902) 424-2549
F: (902) 424-6925

CONFIDENTIALITY NOTICE:

This message may contain privileged and / or confidential information. If you have received this transmittal in error or are not the intended recipient, you may not use, copy, disseminate or distribute it. Please destroy this message immediately and notify the sender by e-mail or telephone that you have done so. Thank you.

From: Henderson, Kelly L <Kelly.Henderson@novascotia.ca>
Sent: Wednesday, August 7, 2024 11:57 AM
To: ENV Access <ENVACCESS@novascotia.ca>
Cc: Williams, Stephen <Stephen.Williams@novascotia.ca>
Subject: Environmental Information for Properties in Thorburn, NS

Good morning,

Can you please send me all the environmental information outlined below for the properties listed in Table 1:

- Contaminated Sites Files
- Enforcement Files
- Petroleum Storage Tank Files
- Motive Fuel Retailers
- Industrial Approvals

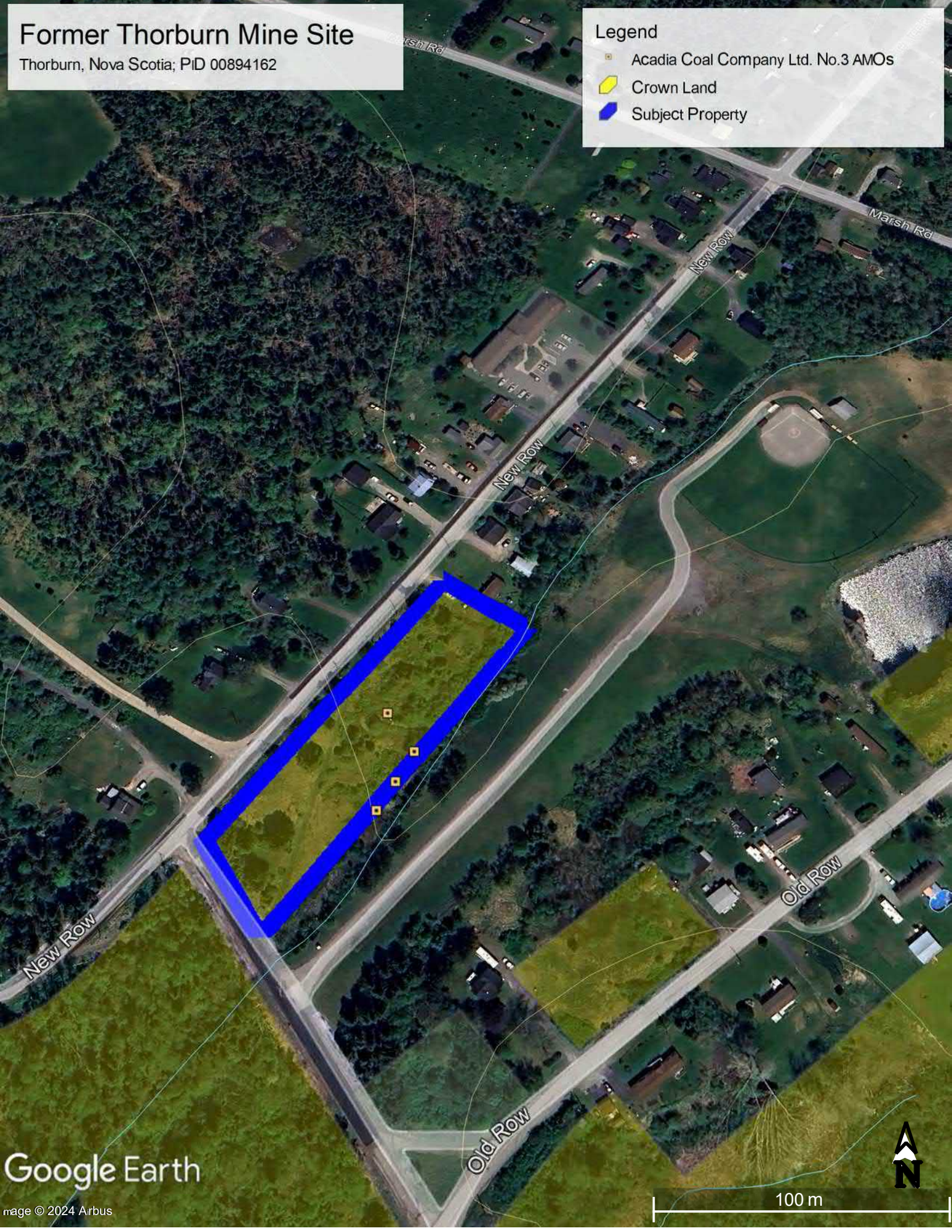
PID	Location	Owner
00894162	New Row, Thorburn	HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF NOVA SCOTIA

		NS DEPARTMENT OF NATURAL RESOURCES (IN CARE OF)
00894675	154 NEW ROW THORBURN	MARY DOROTHY BENOIT CATHERINE JANE BENOIT
00920314	20 NEW ROW BRANCH THORBURN	DISTRICT 13 RECREATION AND PLANNING COMMISSION
65119125	OFF MARSH ROAD THORBURN	ROAD PARCEL OWNER UNDETERMINED
00894758	PIT ROAD THORBURN	HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF NOVA SCOTIA N S NATURAL RESOURCES
65119091	KRICKETFIELD ROAD THORBURN	ROAD PARCEL OWNER UNDETERMINED
65013716	101 NEW ROW THORBURN LOT 1	JEANETTE CATHERINE SIM HOWARD ALLEN SIM
00895185	135 NEW ROW THORBURN LOT 2	JEANETTE CATHERINE SIM HOWARD ALLEN SIM
00968768	137 NEW ROW THORBURN PARCEL A1 & A2	BONITA LOUISE FENTON
65201766	141 NEW ROW THORBURN LOT 11-2	STEPHEN ZANE FRASER
65201774	145 NEW ROW THORBURN LOT 11-1	JAMES H FRASER
65169567	151 NEW ROW THORBURN	SUSAN VALERIE DASHWOOD
00895169	NEW ROW THORBURN	SUSAN VALERIE DASHWOOD
00895144	159 NEW ROW THORBURN	SHARON LORGE ARMAND J LORGE

Thank you,
Kelly

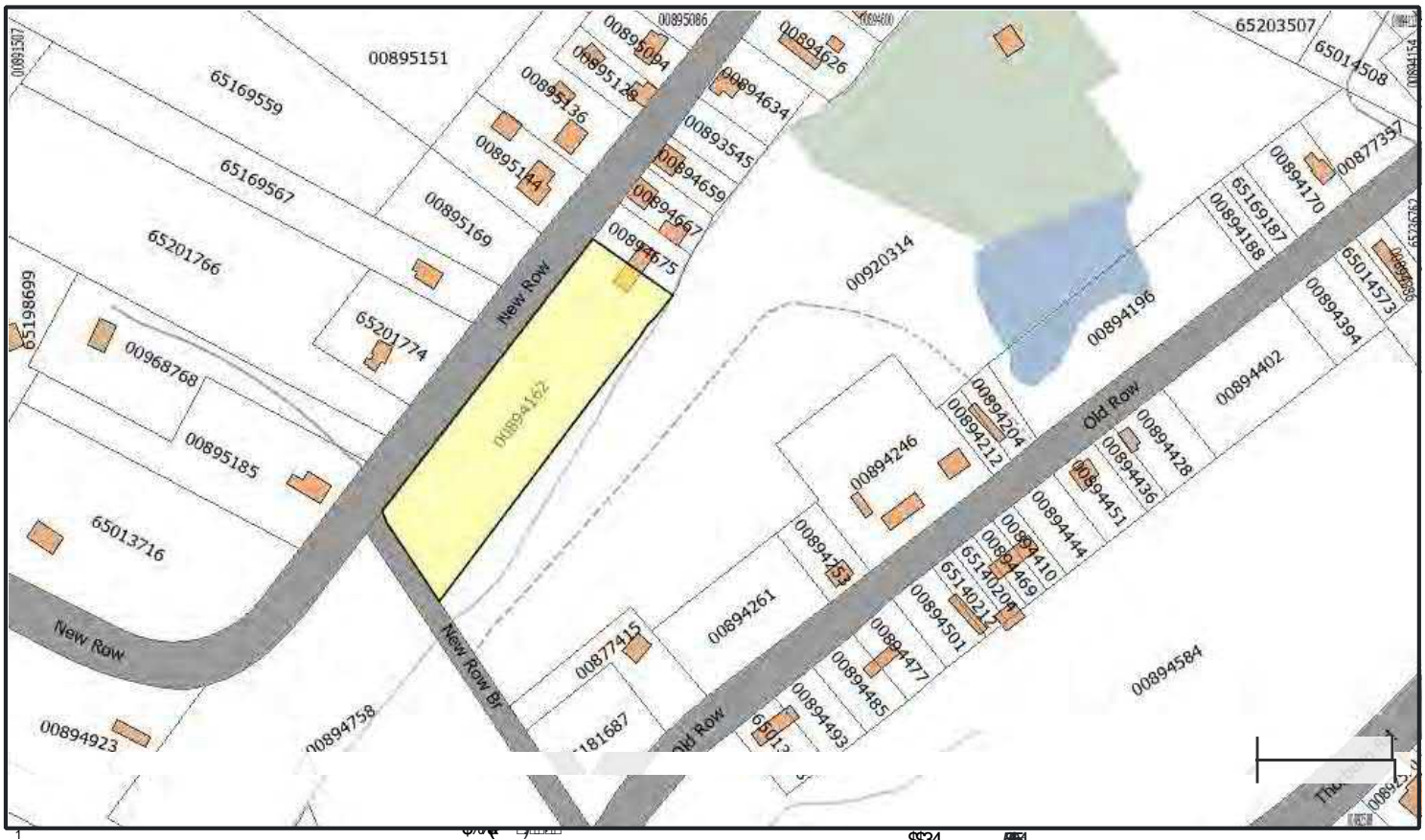
Kelly Henderson, B. Tech. (Env), EP
Environmental Analyst – Environmental Group
Strategic Infrastructure and Development Division

Build Nova Scotia
Old Red Store
1875 Upper Water Street, Suite 301
Halifax/Kjipuktuk, Nova Scotia, B3J 1S9
902.717.6853
Kelly.Henderson@novascotia.ca


Former Thorburn Mine Site
Thorburn, Nova Scotia; PID 00894162
Legend
Acadia Coal Company Ltd. No.3 AMOs
Crown Land
Subject Property
Marsh Rd
New Row
New Row
New Row
Old Row
Old Row
Google Earth
Image © 2024 Airbus
N
100 m

PROPERTY Online

NOVA SCOTIA
Service Nova Scotia



1

4 2

4

$34

64 5

4

1

2

Table of Contents

1 Site Description....1
1.1 Adjoining and Neighbouring Properties....2
1.2 Regional Geology, Hydrogeology and Topography....3
2 Records Review....4
2.1 Aerial Photographs....4
2.2 Property-Use Records....4
2.3 Water Well Database....4
2.4 Historical Reports and Records....4
3 Site Visit....6
4 References....14

Attachments

Attachment A – Site Location and Mapping
Attachment B – Aerial Imagery
Attachment C – Historical Documentation

1 Site Description

The Thorburn site is a 0.65 ha rectangularly shaped property located in the community of Thorburn, Pictou County, and situated on PID 00894162. The subject property is a wooded strip of land bordering New Row, approximately at the location where New Row intersects with New Row Branch which connects to Old Row and Thorburn Road. The site borders an access road to a recreational field on its south side (PID 00920314). Adjacent to the west of the property is New Row Branch. New Row borders the site along the entire northern perimeter. To the east is a residential property (PID 00894675) which is approximately 750 m^2. The vegetation is primarily characterized by trees and brush. A small stream runs through the area, but it is quite shallow and easily traversed. The site can be accessed from any of the three 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.

The history of mining in the Thorburn area dates back to the mid to late 19th century. 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 1997-2000. Thorburn Mining Ltd. reclaimed the site after operations ceased and removed old buildings and equipment from the site. From 1875-1976, 9.3 million tons of coal were 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. Surface infrastructure included the Bankhead, which was a wooden structure containing the scales, screens and tipple. The hoist and two compressors were operated on steam derived from four sterling boilers. All other equipment, such as dewatering pumps and ventilation fans, were electrically powered. The average production was 450 tons per day and the colliery produced over 3.5 million short tons during the life of the mine (Ellerbrok, 1998).

All structures that may have existed on the property have been removed and no evidence remains on site. Four Abandoned Mine Opening (AMO) features are associated with the Acadia Coal Company No.3 Colliery, consisting of three mine slopes and a vertical air-shaft that have largely been backfilled and graded over; however, the backfilling may not have completely filled the original excavations. The Acadia Coal Company Ltd. No.3 Air Shaft continues to weep 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.

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.

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.

1.1 Adjoining and Neighbouring Properties

Findings from a desktop review of current land use of properties adjacent to the Thorburn site are summarized in Table 1.

Table 1 Adjoining Properties - Description.

Boundary of the Site	**Description**	**Potential Environmental Concerns**
North PID(s): 65119091	Road owned by Province of Nova Scotia	None found
West PID(s): 65119125	Road owned by Province of Nova Scotia	None found

Boundary of the Site	Description	Potential Environmental Concerns
East PID(s): 00894675	Privately owned parcel containing a residential residence	None found
South PID(s): 00920314	District 13 Recreation and Planning Commission owned parcel containing a recreational facility	None found

1.2 Regional Geology, Hydrogeology and Topography

To describe the regional physiography and expected hydrogeologic conditions beneath the subject property, the following documents were reviewed:

- Stea, R.R., Conley, H., and Brown, Y. (compilers) 1992: Surficial Geology of the Province of Nova Scotia; Department of Natural Resources, Map 92-3, Scale 1:500,00.

- 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.

Surficial geology of the Thorburn site is described as silty till plain. Till is silty, compact material derived from both local and distant sources and 3 – 30 m in thickness. The site is situated within 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).

2 Records Review

2.1 Aerial Photographs

BNS obtained aerial photographs for each decade in which aerials were recorded, 1960s – 2020s (Attachment C). The aerial photographs show that small structures and roads were located on the property in the 1970s but were removed sometime between the 1970s-1990s. The site has remained predominantly vegetated and relatively unchanged since the 1990s.

2.2 Property-Use Records

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.

Site and building plans of past and existing property use, including fire insurance records, municipal land use plans, or any other information other than the reports obtained as referenced in Section 3.4 below do not exist for this site to BNS's knowledge.

2.3 Water Well Database

According to the well log database, there are a total of 177 wells in the community of Thorburn. 155 of these wells are within 1 km of the former mine site (both site locations considered). 305 buildings are within 1 km of the site, the nearest building being 57.1 m from the shaft collar.

2.4 Historical Reports and Records

Historical reports and records for the Thorburn mine site are limited. Historical reports that were deemed relevant for the subject site are provided in Attachment C and 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 where 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 (Figure 5 of document). The report identified three subsidence events associated with the Six Foot Seam and one with the McBean Seam:

Six Foot 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.*

McBean Seam

- Spring[1]: *Near the Lanark Slope*

Aerial Photograph of Benoit Property (1979)

An aerial photograph obtained of the Benoit property (adjacent to the east 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.

3 Site Visit

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.

[1] No date provided.

Figure 1 *Aerial image of subject property obtained during site visit. June 17, 2021.*

Figure 2 *Aerial image of subject property showing New Row to the north of the property and New Row Branch to the west. June 17, 2021.*

Figure 3 *Backfilled air shaft that was noted to be experiencing water overflow. June 17, 2021.*

Figure 4 *View of subject property looking towards New Row from recreational property. June 17, 2021.*

Figure 5 *Drainage which runs approximately adjacent to southern perimeter of the subject property showing staining of substrate near the air shaft. June 17, 2021.*

Figure 6 *Drainage which runs approximately adjacent to southern perimeter of the subject property, approximately 80 m northeast from location shown in Figure 5. Evidence of staining was not observed at this location. June 17, 2021.*

Figure 7 *Drainage which runs approximately adjacent to southern perimeter of the subject property at the culvert located on Marsh Road. The culvert is located approximately 370 m northeast of the location pictured in Figure 5. No evidence of staining was observed at this location. June 17, 2021.*

4 References

Ellerbrok, G.W. 1998. The Louis Frost Notes 1685 to 1962 – Acadia Coal Company Limited. Available at: https://www.mininghistory.ns.ca/lfrost/lfpi16.htm

Environment Canada. 2016. Recovery Strategy for the Wood Turtle (Glyptemys insculpta) in Canada [Proposed]. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. v + 48 pp.

Gillis, K. S. 1992. Nova Scotia Department of Natural Resources Report on Mine Subsidence in the Pictou Coalfield.

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Nova Scotia Department of Natural Resources [DNR]. 2014. Advice to Minister [Confidential] – Branch Note on Flooding in Thorburn.

Stea, R.R., Conley, H., and Brown, Y. (compilers). 1992. Surficial Geology of the Province of Nova Scotia; Department of Natural Resources, Map 92-3, Scale 1:500,00.

Wright, J. D., & Townsend, C. F. 1974. Nova Scotia Department of Mines Assessment of the Pictou County Coalfield – Westville, Stellarton and Thorburn Districts.

Attachment A – Site Location and Mapping

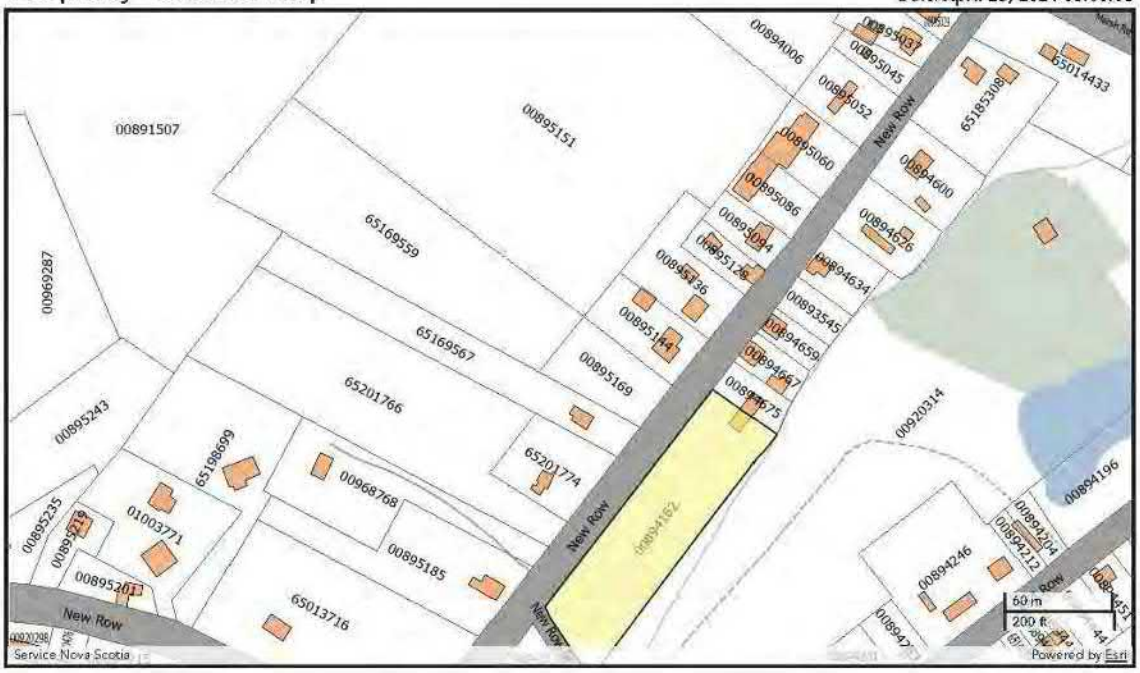
Map 1 *Crown Land map showing subject property in blue. The locations of abandoned mine openings (AMOs) associated with the Acadia Coal Company Ltd. No.3 are shown as yellow circles.*

PROPERTY Online

NOVA SCOTIA
Service Nova Scotia

Property Online Map

Date: **April 23, 2024 09:00:08**



PID:	00894162	**Address:**	NEW ROW THORBURN	**AAN:**	04517725
County:	PICTOU COUNTY			**Value:**	$5,400.00 (2024 RESOURCE EXEMPT)
LR:	LAND REGISTRATION	**Owner:**	HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF NOVA SCOTIA NS DEPARTMENT OF NATURAL RESOURCES		

The Provincial mapping is a graphical representation of property boundaries which approximate the size, configuration and location of parcels.Care has been taken to ensure the best possible quality, however, this map is not a land survey and is not intended to be used for legal descriptions or to calculate exact dimensions or area.The Provincial mapping is not conclusive as to the location, boundaries or extent of a parcel [Land Registration Act subsection 21(2)]. THIS IS NOT AN OFFICIAL RECORD.

Property Online Version 1.0

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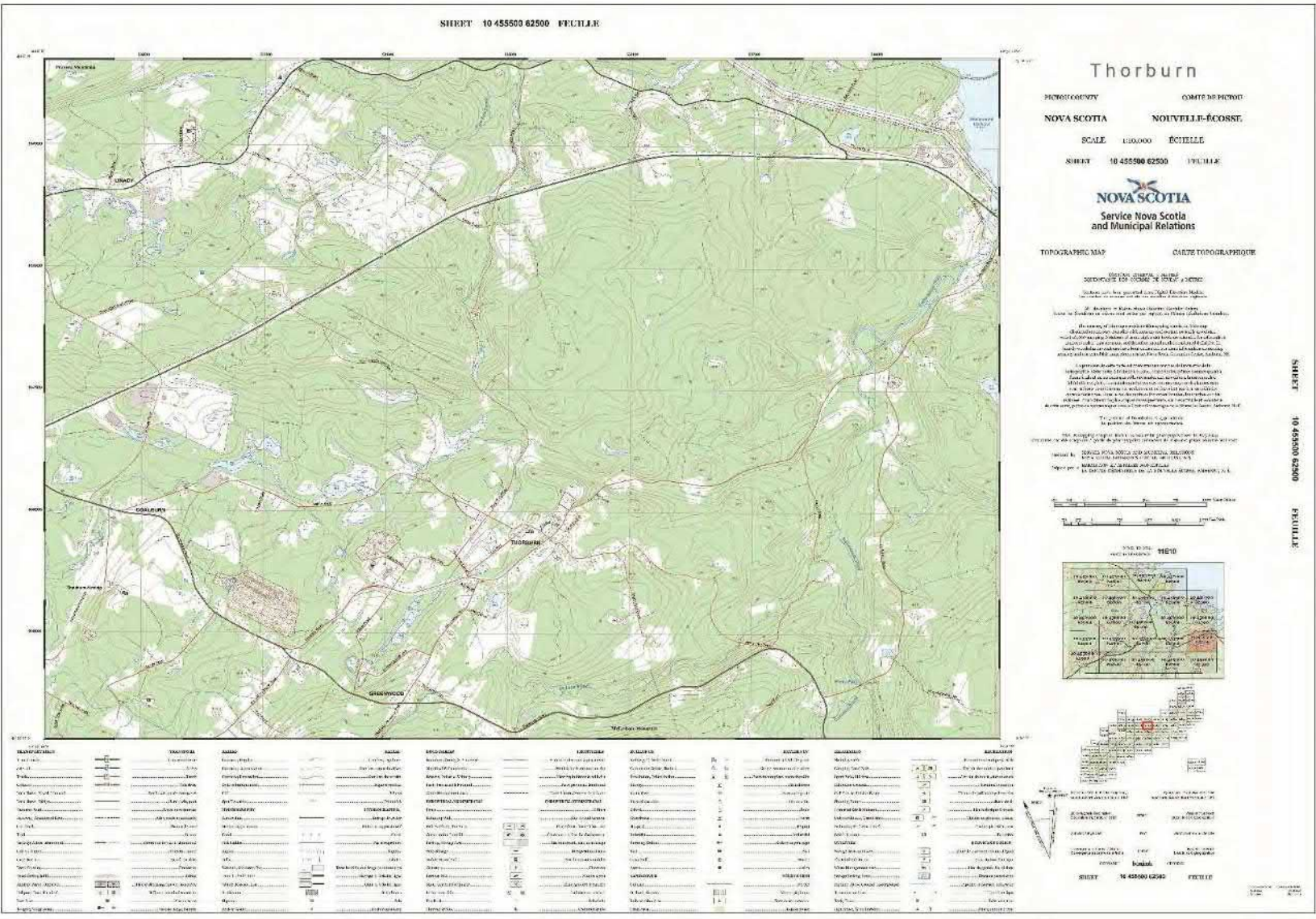
If you have comments regarding our site please direct them to: propertyonline@novascotia.ca
Please feel free to Submit Problems you find with the Property Online web site.

Map 2 *Subject property map retrieved from Property Online.*



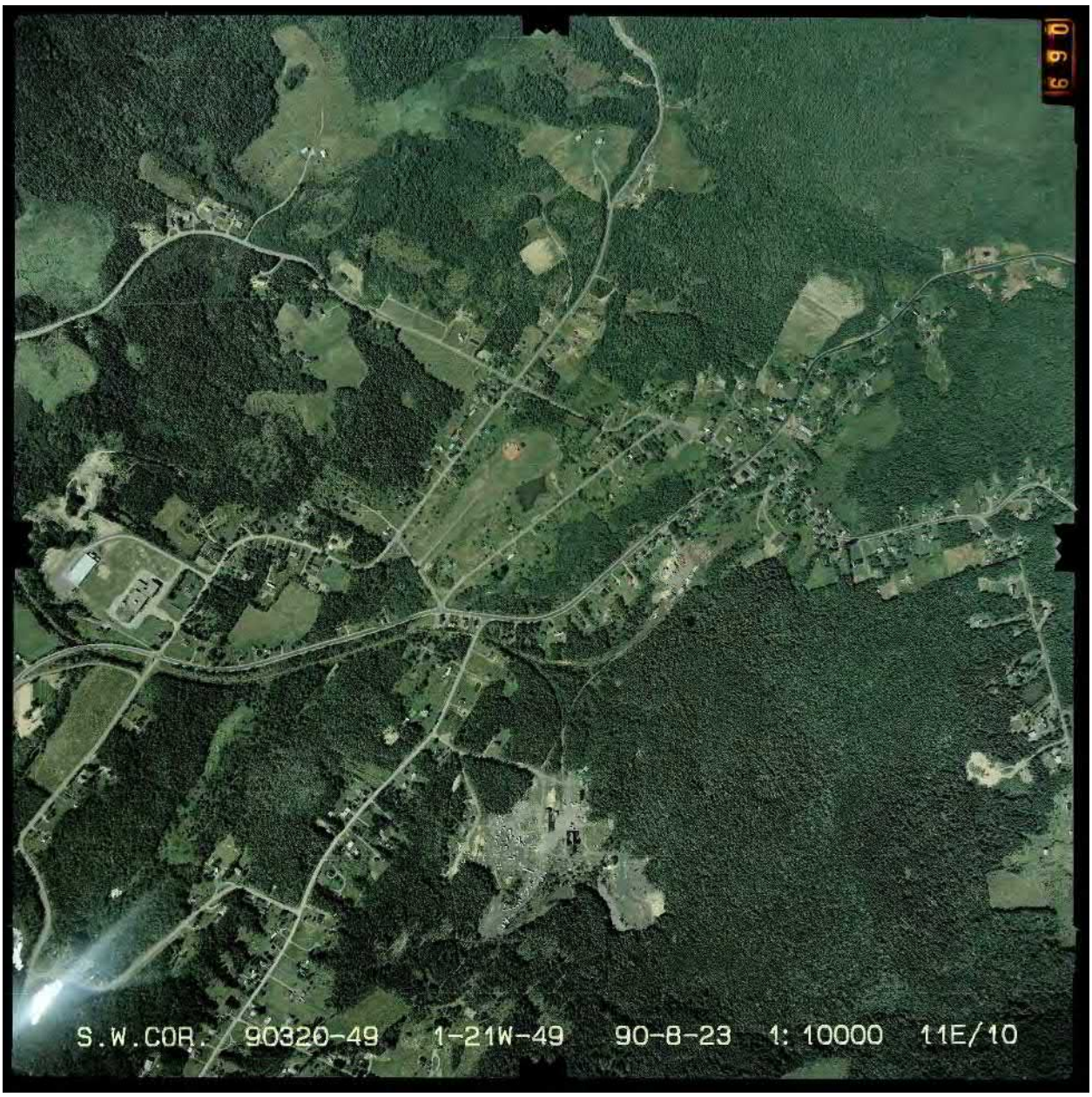
Map 3 *Topographic map of Thorburn.*

Attachment B – Aerial Imagery

Aerial 1 *Aerial image of the site ca. 1970s.*

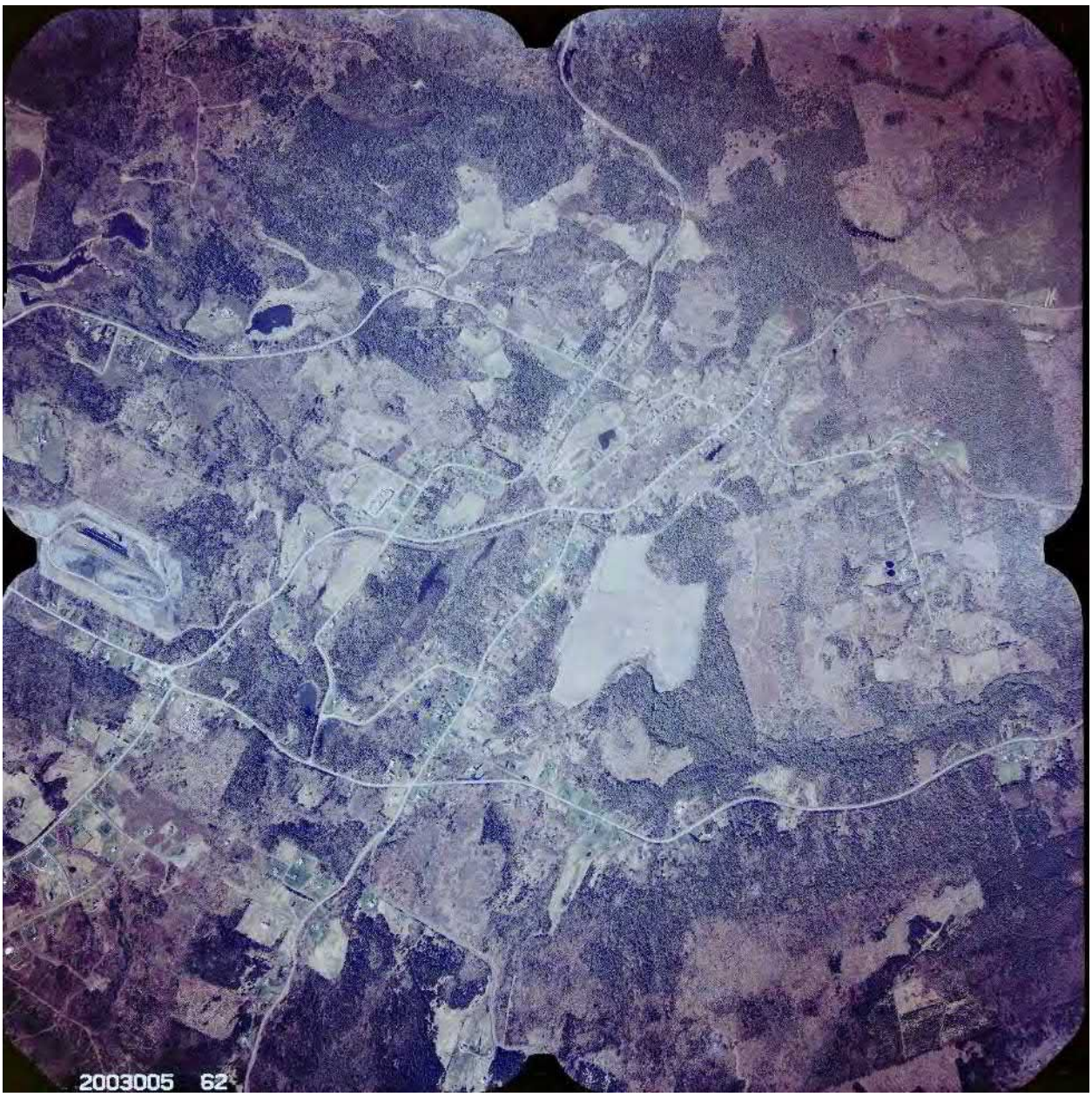
Aerial 2 *Aerial image of the site ca. 1970s.*

Aerial 3 *Aerial image of the site ca. 1970s.*



Aerial 4 *Aerial image of the site, August 1990.*

Aerial 5 *Aerial image of the site, June 1997.*



Aerial 6 *Aerial image of the site ca. 2000s.*

Aerial 7 *Aerial image of the site, September 2018.*

Year: 2021
Source: MAXAR
Scale: 10,000
Comment:

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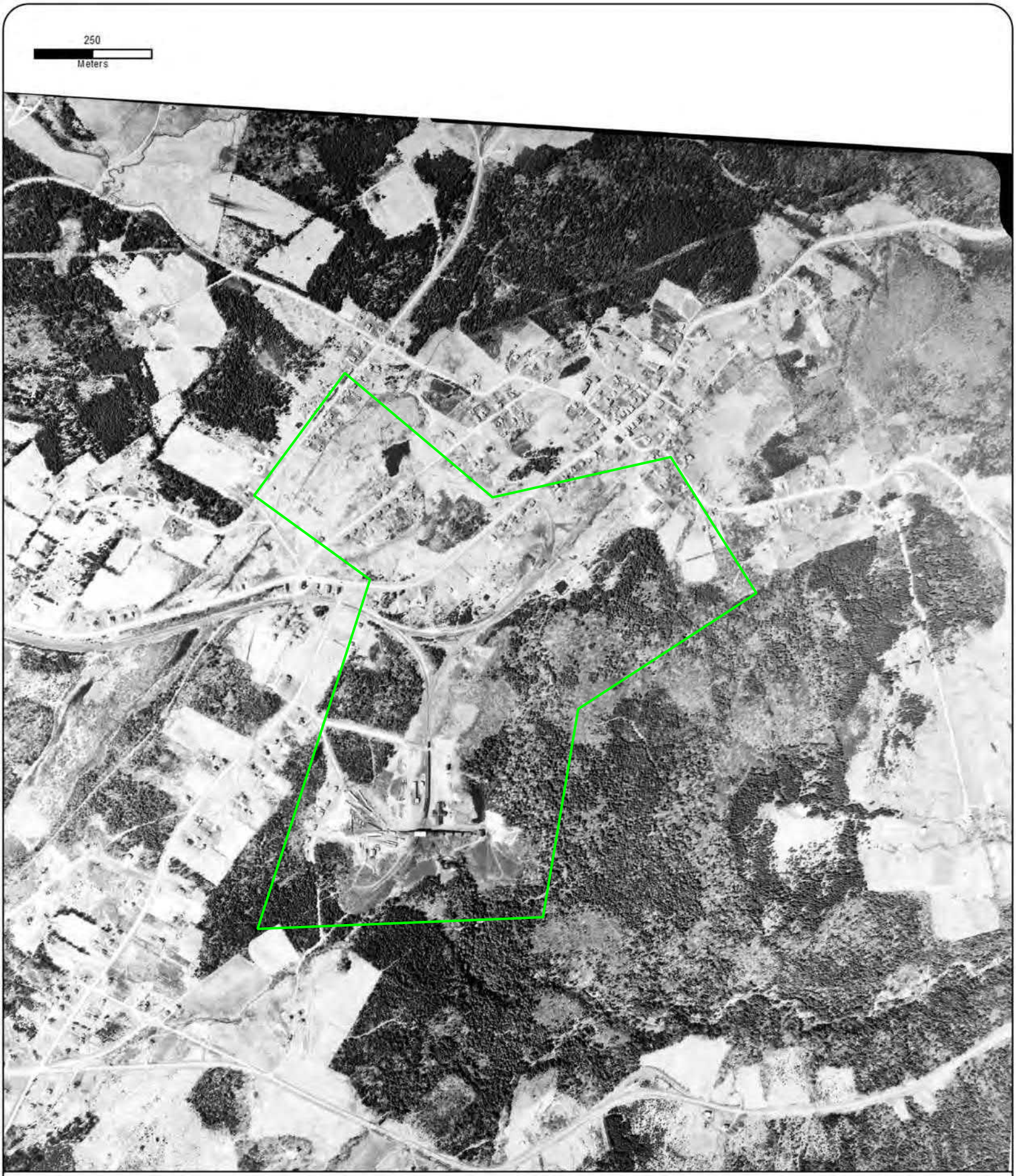
Approx Center: -62.55100358,45.56022364

Order No: 23101600399

ERIS



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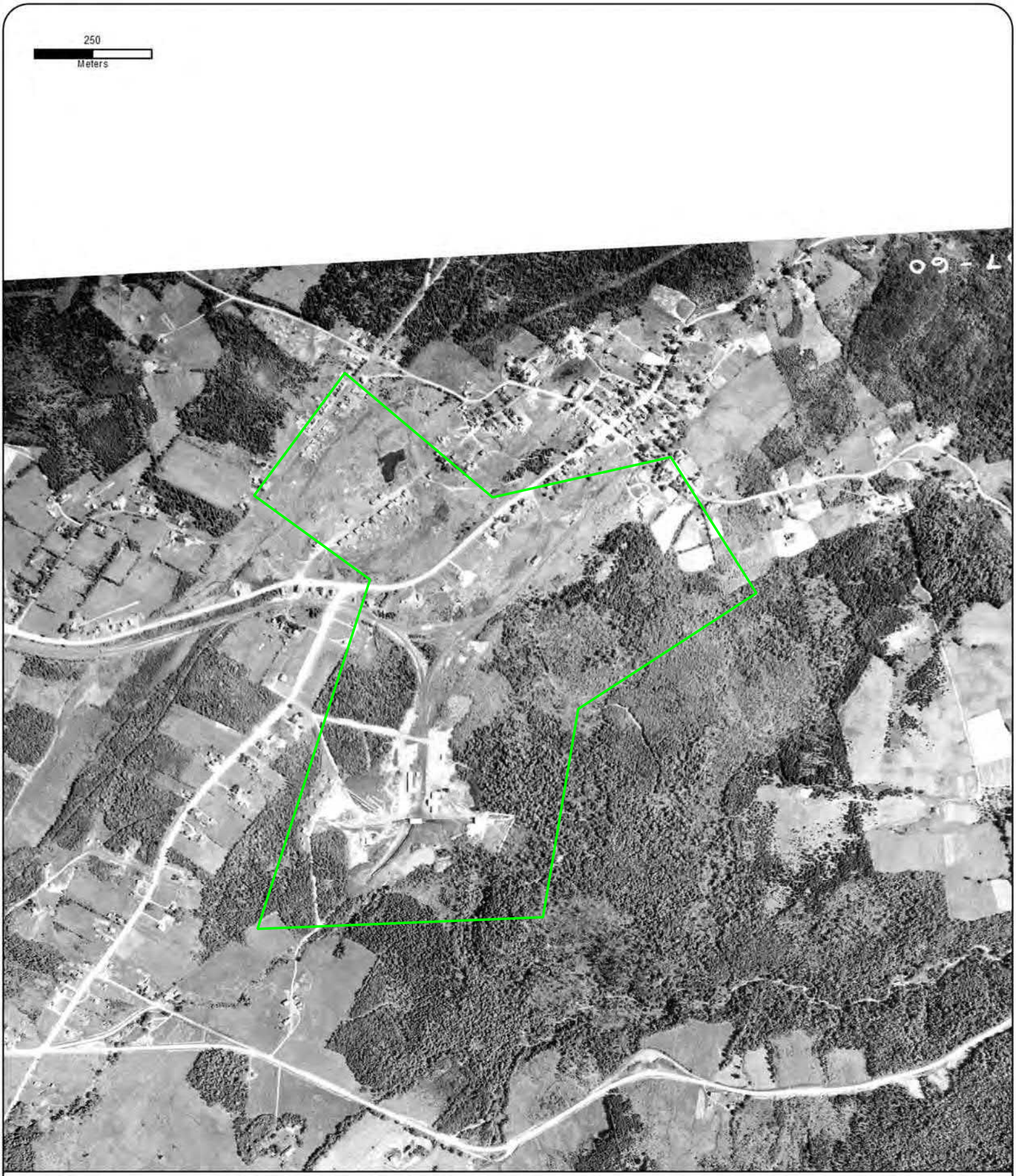

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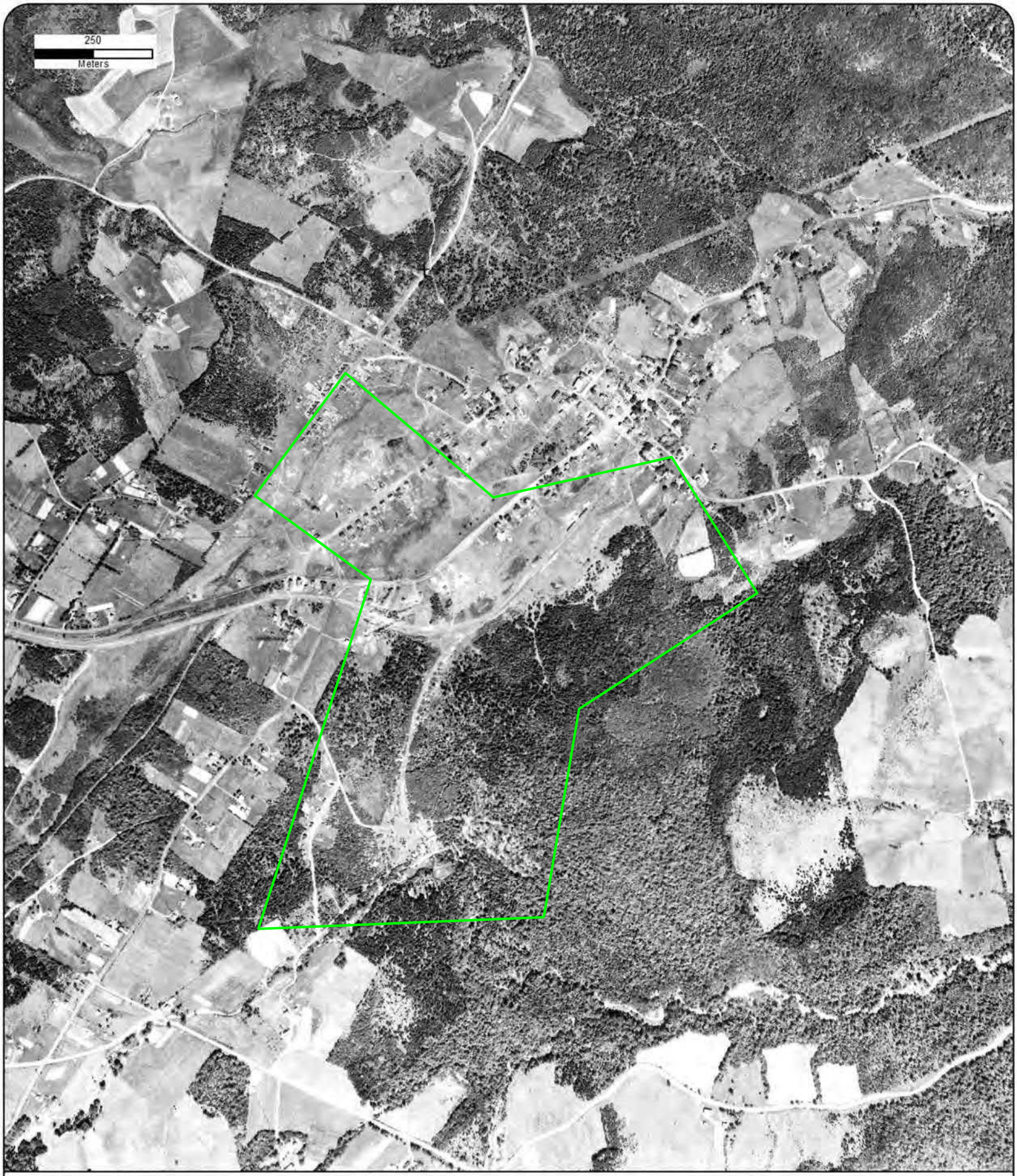

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Scale: 10,000
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Address: Thorburn, Pictou County, NS
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Order No: 23101600399

ERIS

Build NOVA SCOTIA

Attachment C – Historical Documentation

NEW ROW
J. Benoit Property
Crown Land
Outline of rusty plume
Approximate location of overflowing air shaft
Approximate location of underground mine workings (stippled pattern)
NOTE: Based upon available mine plans, there are no documented mine workings beneath the Benoit Property. However, an eight-foot thick coal seam is likely no more than 15 to 30 feet deep below the property and the possibility of illegal 'bootleg' coal mining does exist.
1979 Aerial Photograph
0 10 20 30 40 Meters

T.C.H. 104

EXIT 26

SAINT MARY RD.

Marsh Br.

Shale Br.

McLellans Br.

McLellans Mountain Road

McLELLANS BROOK

McLellans Brook Road

PINE TREE RD.

SIXFOOT SEAM

THORBURN RD.

THORBURN

MacPHERSONS MILLS RD.

Acadia No. 3

THORBURN ROAD

HOLLOW RD.

GREENWOOD

Greenwood Mine

McLELLANS MOUNTAIN

WHITBURN

McLean Br.

ROUTE 247

PARKS FALLS

Sutherlands R.

E4,413,000

E4,414,000

E4,415,000

E4,416,000

E4,417,000

E4,418,000

E4,419,000

Note: Elevations indicated in metres

WARNING

Accuracy cannot be guaranteed. Mine workings and information are based on archival material.

Grid reference 3° MTM (ATS-77)

PROVINCE OF NOVA SCOTIA
DEPARTMENT OF MINES AND ENERGY

LOCATION OF MINE WORKINGS
SIXFOOT SEAM
PICTOU COALFIELD, PICTOU CO., N.S.

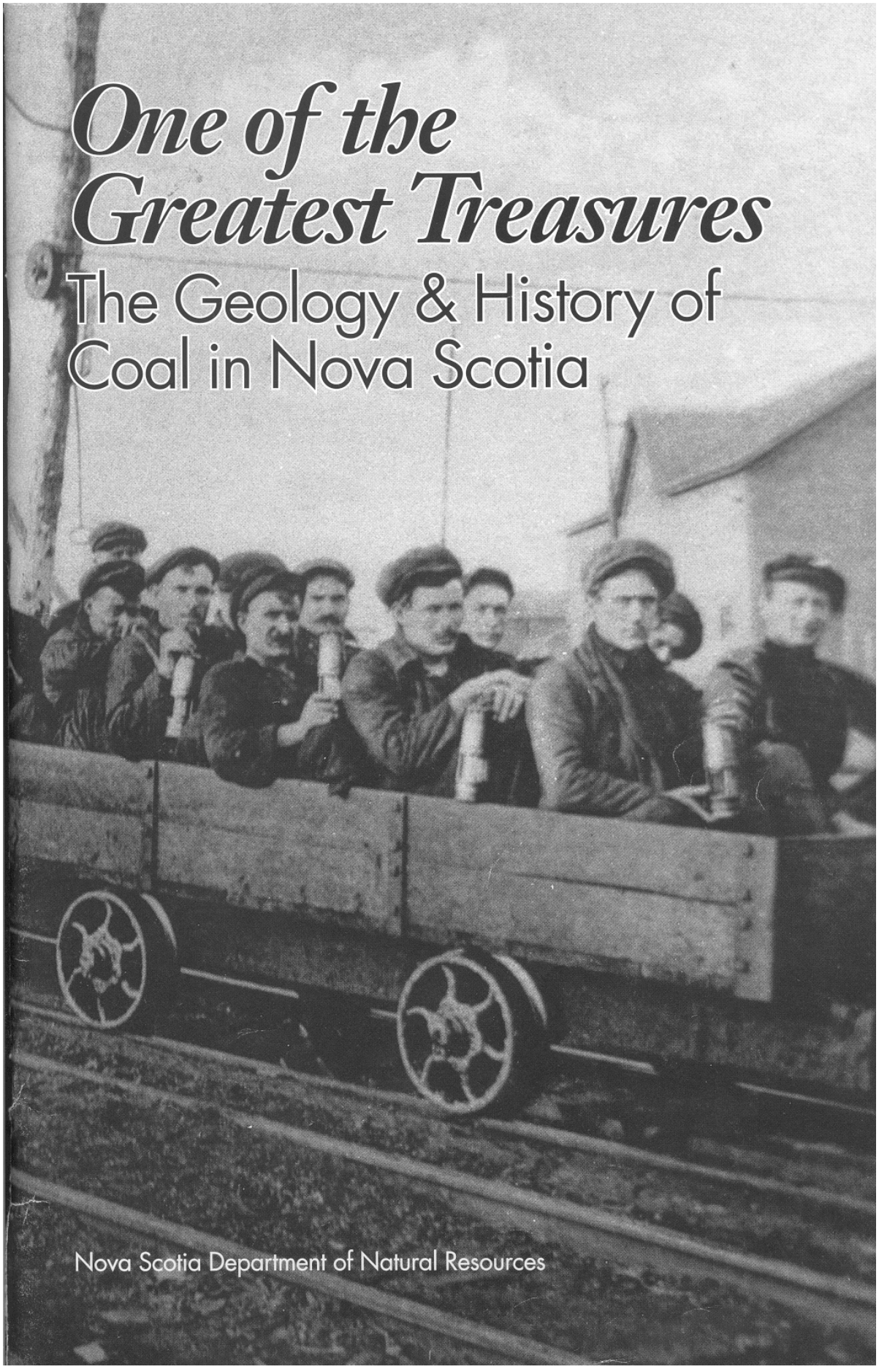
Metres 250 0 250 500 750 1000 Metres

1991

K. Gillis, J. DeWolfe

One of the Greatest Treasures

The Geology & History of Coal in Nova Scotia



Nova Scotia Department of Natural Resources

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

Nova Scotia Department of Natural Resources

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IV. Series: Information circular
(Nova Scotia Dept. of Natural Resources) ; 25

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Designed and produced by the Department of Supply and Services
Information and Communication Services.

Cover: Miners, safety lamps in hand, are seated on the rake that will carry them to work underground in the old Donkin Mine, Cape Breton, in 1918. (Owen Fitzgerald Collection)

Dedicated to the coal miners of Nova Scotia

Acknowledgements

The text of this book may not have been read If not for the creative design abilities of graphic designer Paul Chenard. The publication is enriched by the mining photographs of Owen Fitzgerald and wood block prints from Sir William Dawson's Acadian Geology. The writers thank all those who helped in the preparation of the book, including typist Jill Cumby; staff of NSDNR Cartographic Services, in particular, photographer Reg Morrison; our colleagues in the Coal Resources Section; Debra MacNabb, Museum of Industry; and staff of the Public Archives of Nova Scotia. JHC would like to thank Jim Nodwell of Springhill for the wisdom that every single miner's death was in itself a mining tragedy.

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in the Morien Group. Later peatlands were more extensive resulting in seams (Harbour, Hub; Lloyd Cove, and Point Aconi) that are well developed across most of the basin. Throughout Morien time, about 300 million years ago, individual peatlands existed for the longest time in the easterly Donkin--Morien area and, therefore, these seams attained the greatest thickness.

The coal-bearing rocks of the Sydney coalfield are gently folded; faults bound the basin on the west and southwest. The northeast-trending folds probably represent draping and compaction of the sediments over the large faulted blocks of buried rocks that originally formed the basin floor . These "basement" rocks are underlying extensions of the present day Coxheath Hills and the Boisdale Hills.

The rook of the Sydney coals increases toward the east and as they dip deeper into the earth. They are classified generally as High Volatile A Bituminous but in the deep parts of the basin in the Donkin area, they reach a higher rank (Medium Volatile Bituminous), suited for use in steel making. Most of Nova Scotia's electricity is generated from the coal mined in the Sydney coalfield. Two underground mines, the Prince at Point Aconi and the Phalen mine near New Waterford, each bring between one million and two million tonnes of coal to the surface each year. Smaller reserves of coal that lie near the surface are mined by open-pit, such as the Pioneer mine near Reserve Mines. More on the mining and use of Nova Scotia coal is found in a series of brochures dealing with the mining and use of coal in Nova Scotia.

Pictou Coalfield (Stellarton Basin)

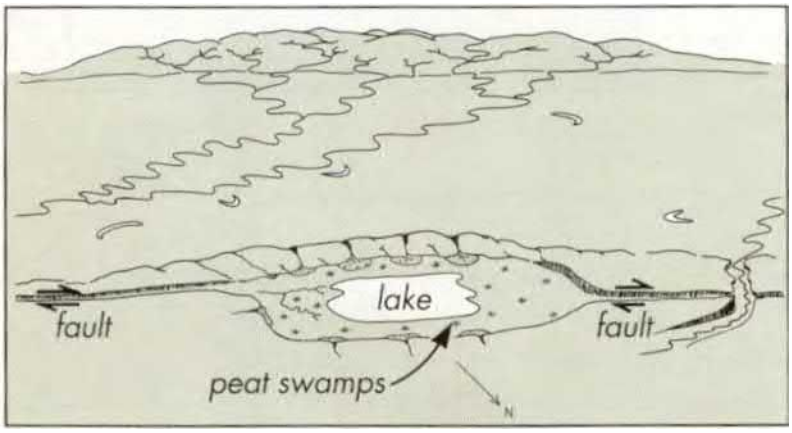
The Stellarton Basin or Pictou Coalfield, by which it is commonly known, is located in central northern Nova Scotia, underlying the towns of Stellarton, New Glasgow, Westville, and Thorburn. Although small in size, measuring only 18 km east-west and 6 km north-south, it contains the thickest coal seams in Eastern Canada. The Pictou coalfield is quite different from other coalfields in Nova Scotia because of the very thick coal seams and numerous oil shales, which were formed in a lake basin.

The Foord Seam, at 13.4 m, is the thickest coal seam in Nova Scotia.

The basin is bounded to the north and to the south by two major faults. When these two faults were active, approximately 310 million years ago, they pulled apart the earth's crust, forming a topographic low, or basin, as the land area between them subsided, or settled. Not surprisingly, the Stellarton Basin is an example of what geologists term a pull-apart basin. The rate at which the land surface between the two faults subsided influenced the nature of the basin f1oor, and in particular, the peat or coal-forming wetlands.

When the land subsided rapidly, the basin floor remained significantly below the: level of the regional water table and

a deep lake covered much of the basin. When the land subsided more slowly, the basin floor stayed closer to the elevation of the regional water table and a shallow lake formed. Surface waters carrying sediment drained from highland areas Into the Stellarton Basin. The supply of sediment to the basin was often enough to infill a shallow lake, but insufficient to infill a deep lake. If a shallow lake became infilled, plants colonized the basin floor and a basin-wide swamp often formed. Swamps also periodically formed along the margins of deeper lakes. Under special conditions (see Origin of Coal) swamps became peat-forming and the initial process of coal formation began. A peat swamp existed until the basin floor subsided and fell below the regional water table. Repeated cycles of lake formation and infilling followed by the development and



The thick coals of the Stellarton Basin formed in a small lake basin that was being pulled apart by two faults moving in opposite directions.

eventual drowning of a swamp continued for at least two million to five million years. Today the lake and swamp deposits which accumulated during this period form a 2 600 m thick sequence of sedimentary rocks and coals known as the Stellarton Formation.

Historically, the coalfield has been described in terms of three mining districts: Westville, Albion Mines (now called Stellarton), and Thorburn. The largest number of coal seams occur in the Westville and Stellarton areas. One of these, the Foord seam, at 13.4 m is the thickest coal seam of Carboniferous age in North America. The thinner seams of the Thorburn area are associated with numerous oil shale beds. Oil shales are essentially dull coals that formed from small plant fragments that sett1ed out on the ancient lake bottom. The town of Stellarton owes its name to one of these oil shales, mined in the 1850s and called "stellarite" because of the "stars of fire" given off by its sparky flame.

The coals of the Stellarton Basin are of a rank and quality suitable for generating electricity .A notable exception is the Acadia seam of the Westville area, which, deep in the basin, is of high enough rank to be used in steel making. The seams of the Stellarton district, including the Foord, have the lowest sulphur content of any Nova Scotia coals.

Mining has taken place in this basin since the beginning of the nineteenth century and, for its size, it has been one of the most productive coal basins in Canada. Approximately 55 million tonnes of coal have been mined from the Pictou Coalfield to date (read the chapter on history which follows for further details). Even so, significant potential for both small- and large-scale mining operations still exists in the Stellarton Basin because of the great thickness and number of coal seams.

RECEIVED
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ASSESSMENT OF THE PICTOU COUNTY

COALFIELD

WESTVILLE, STELLARTON AND THORBURN

DISTRICTS

Property of:

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Nova Scotia Department of Mines
Halifax, N. S.

BY

J. D. WRIGHT, Ph.D.

C. F. TOWNSEND, M.E.

HALIFAX, NOVA SCOTIA

MARCH 1974

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S U M M A R Y

1. The Pictou coalfield lies in the north-central part of Pictou County, centering about the Town of Stellarton. The coalfield is approximately 10 miles long by 3 miles broad.

2. The coal measures are folded into a number of open anticlines and synclines. They are cut by several major and minor faults.

3. Workable coal seams are confined to the Stellarton Group, which is of Carboniferous age, and are localized to parts of the Westville, Albion and Thorburn members of the group.

4. The area has been divided into three districts, namely, from west to east, Westville, Stellarton and Thorburn, these districts being separated from each other by strata of barren rock.

5. The Westville district contains the coals of the lowest member of the group, whereas the Thorburn district contains the coals of the youngest member, these being eroded away from the other two districts.

6. In the Westville area there are at least 4 seams, two of these, the Acadia and Scott seams, having thicknesses of 17 and 12 feet, were the main coal reserves in the area. The Third and Fourth underlying the Scott seam, each having an average thickness of 6 feet appear to be of inferior quality and have remained largely undeveloped. Coal reserves in the two lower seams have been estimated at 3,000,000 tons of possible recoverable coal.

7. The Acadia coal seam deteriorated going southeastward as indicated from underground work and boreholes. A similar deterioration took place going northwestward towards the Black Diamond Mine.

8. The existence of coal in the Acadia seam underneath Stellarton was indicated by a borehole. An 11-foot thick seam was struck at a depth of 2,832 feet. Information available is not sufficient to make an estimate of the coal resources.

9. In the Stellarton area there are at least 10 seams, 5 of which have been mined. They have thicknesses ranging from 8 to 40 feet and have been the main source of production in the Pictou field. The other 5 are known only from a few drill holes put down from the mine workings on the Acadia No. seam.

10. In the Thorburn area there are 5 seams, 4 of which are over 3 feet in thickness. All of these have been extensively mined. At present there is no production from the Thorburn area.

11. The Thorburn area is well-defined, being a separate shallow structural basin in which the coal seams outcrop on the eastern and western rims, but are cut off by faults on the south and north.

12. As a result of extensive mining, most of the readily accessible coal has been removed from all areas. The remaining possible reserves in the area may be found in the Foord seam of the Stellarton area, west of the Forster pit and in the Acadia No. 1 seam underlying the Town of Stellarton at a depth varying from 1,950 to 2,950 below sea-level.

13. Consideration must be given to gathering more data on the Third and Fourth Seams at depth in the Westville area; also the westward extension of the McGregor seam in the Stellarton area.

14. No coal reserves are sufficiently well defined at present to be placed in the measured (proven) category.

15. From our study it is apparent that all the easily recoverable coal has been mined in the Thorburn basin. No exploratory drilling is being recommended in this coal basin. It is very probable that some coal seams exist in the eastern portion of the Thorburn basin that might support a small coal production in the range of 75 to 100 tons per day, for a short period.

RECOMMENDATIONS

A detailed study of the data available on the various coal seams in the Pictou coalfield indicates that there are a few seams that may hold economic potential for defining commercial deposits of coal. Some of the seams suggested for investigation are extensions of coal seams previously mined; others have not been explored to any great extent. The areas with individual coal seams suggested for further investigation are listed below:

STELLARTON-WESTVILLE AREA

1. Acadia Seam
2. Foord Seam
3. G. Group
4. McGregor Seam
5. Third and Fourth Seam

ACADIA SEAM

The existence of coal in the Acadia seam underneath Stellarton was proved in former drilling. An 11-foot thick coal seam was encountered at a depth of 2,832 feet. A fair estimate of the acreage of probable workable coal, lying beyond any old mine levels and at depths between 1,900 and 2,950 feet below sea-level is 500 acres.

To define the continuity and quality of the Acadia seam under Stellarton, it is proposed that a minimum of six (6) boreholes be drilled to intersect this coal horizon. The total footage of this program will be about 15,000 feet.

FOORD SEAM

A block of coal west of the Forster pit was partially outlined by three (3) boreholes in 1966. It is proposed to explore the Foord seam in the area west of the Forster Pit, along strike and down-dip to the Bridge fault. The preliminary drilling program will consist of a minimum of 15 boreholes for a total of 12,000 feet of drilling. It is important to note that this drilling program will be well outside of the area of the old mine workings.

"G" GROUP

Several coal seams are known to occur underlying the Norah seam in the Stellarton area. Dr. W. A. Bell several years ago made reference to these seams as a potential reserve of coal. Bell referred specifically to the "G" Group of coal seams.

To properly investigate the "G" Group it is recommended that 8 boreholes be put down. The maximum depth of the holes will be 600 feet. A total of approximately 4,800 feet of drilling will be required to thoroughly investigate the coal seams underlying the main productive seams in the Stellarton area.

MCGREGOR SEAM

Based on a study of the underground plans it is quite evident that a block of coal may exist in the area west of the Acadia No. 1 slope. To determine if this coal reserve exists, it is suggested that 5 boreholes be put down west of the Acadia No. 1 slope. The total footage for this investigation will be around 4,000 feet.

THIRD AND FOURTH SEAMS

These seams have been little explored. It is probable that a fairly large tonnage of good coal exists in these seams going northward and at depth. To explore this assumption it is suggested that 5 boreholes be drilled, totalling around 4,500 feet.

PICTOU COUNTY COALFIELD

GENERAL

The Pictou coalfield is comparatively small, centering about the Town of Stellarton. It is approximately 10 miles long and about 3 miles wide. The field contains three series of coal seams, around which developed three separate mining areas. The area is served by the main line of the Canadian National Railway from Truro to Sydney.

The coalfield is bounded by faults of large displacement and consists of three separate mining areas, which from west to east are the Westville, Stellarton and Thorburn areas. Faults separate these from one another, but the displacement between the Thorburn and Stellarton coal areas is not so pronounced as that which separates the Stellarton and Westville areas.

Workable coal seams are confined to the Stellarton Group as defined by Bell, (1940, p. 21 (1)). He subdivided the group into two divisions, each consisting of three members. Those occurring at Westville are the older and belong to the Westville formation; those at Stellarton belong to the intermediate formation known as the Albion formation; and those at Thorburn belong to the youngest formation in the field designated the Thorburn formation.

NORAH COAL SEAM

The Norah seam occurs 35 feet below the Oil Coal seam. It was prospected by a slope from its outcrop and by a pit, both south of the McGregor slope. The only data available on the seam in the Albion area are the results of three drill holes. Borehole 39 cut 3'4" of coal and shale and 4'2" of coal at a vertical depth of 260 feet. Borehole 30 drilled from No. 6 level in the McGregor mine cut 5'2" of coal at 247 feet. The thickest coal seam was obtained from borehole 55, drilled from the bottom of the basin in the McGregor mine, and gave coal with shale 3'8" and coal 7'3".

The coal seam disappears northwest of the Albion mine, for no coal was intersected at corresponding horizons in boreholes Nos. 28 and 29. Correlation of the Norah seam southeast of the Albion is uncertain.

COAL GROUP G

Below the Norah coal horizon in the vicinity of Coal Brook six coal seams occur in 345 feet of strata. They were differentiated as seam B to G, in descending stratigraphic order. It is evident that Group G has the most important reserve of coal as regards quantity and areal distribution. It will be necessary to determine by drilling if there is sufficient marketable coal in the G Group to warrant sinking a slope to permit exploration.

THE THORBURN COALFIELD

COAL SEAMS OF THE THORBURN MEMBER

The Thorburn area contains several coal seams bent into a synclinal basin, along a northeasterly axis, measuring about three miles across. This series of seams is believed to belong to a higher series than those contained in the Albion area (Stellarton), the thickness of strata intervening being estimated at about 1,600 feet, containing beds of oil-shale, but

no coal, so far as is known. The area between the East River and the lowest seam in the Thorburn synclinal basin, measures roughly 2 miles.

A generalized section of the distribution of coals, 2 feet or more thick, is as follows:

Strata		100'-200'	
Captain coal	3'5"	to	4'6"
Strata		24'-34'	
Coal	1'3"	to	3'0"
Strata		38'-41'	
Millrace seam	2'8"	to	4'4"
Strata		52'-65'	
MacKay seam	2'5"	to	4'4"
Strata		53'-61'	
Coal	0'5"	to	5'6"
Strata		504'-525'	
Six-foot Seam	0'5"		
Strata	580'-765'		
McBean Seam	0'9"		

CAPTAIN SEAM

This seam was mined from the Acadia No. 4 slope in the Marsh syncline and by some prospecting on the outcrop in the McLellan syncline. These are two subordinate synclines in the Thorburn syncline. The mean thickness of the seam in both districts is about 4 feet and its areal extent is small due to the seam being tightly folded in the two synclines.

There are two narrow coal seams lying between the Captain and the underlying Millrace seam. In borehole 62 (N. S. Record 470) 3'8", and in borehole 60 (N.S. Record 469) 1'3" of coal were intersected at a vertical depth of 183 feet. It is apparent that the seam is of minor economic importance.

MILLRACE SEAM

This seam occurs in the Marsh and McLellan synclines and in the intervening low anticlinal area. It also outcrops on Potter Brook in the northeastern end of the Allan syncline and is labelled the Lawson, or Kirby seam. It has a thickness of 3 to 4 feet in the Marsh and Potter Brook areas. It has a band of cannel coal 4 to 6 inches thick at the top. The quality of the coal is too poor to justify development work.

MCKAY SEAM (MILFORD MINE)

This was the best quality coal in the Thorburn area and was mined extensively in the Marsh syncline. Slopes of the old Marsh colliery reached the bottom of the synclinal basin about 2,800 feet from the slope mouth. The thickness of the seam in the Marsh syncline averaged 4 feet. The seam was also explored to some extent in the Potter Brook area of the Allan syncline by the Acadia Coal Company in Acadia No. 5 mine where it was 3'6" thick.

Proximate analyses of McKay coal seam:

	%	%	%
Moisture as received	3.9	1.62	.90
Volatile matter	29.3		29.89
Fixed carbon	53.8	61.5	57.42
Ash	16.9	7.34	11.32
Sulphur	0.9	.53	1.72
BTU/lb.	11,705		

This seam appears to have been mined out in the Marsh syncline.

SIX-FOOT SEAM

This seam lies 607 feet below the McKay seam. It varies in thickness from 3 to 8 feet but where mined at the Acadia No. 3 mine averaged about 4 1/2 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.

Proximate analyses of Six-Foot seam:

	%	%
Moisture as received	3.1	1.22
Ash	18.6	10.21
Volatile Matter	28.6	25.87
Fixed Carbon	52.8	65.61
Sulphur	0.7	Tr.
BTU/lb.	11,915	--

MCBEAN SEAM

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.

Proximate analysis of McBean seam:

	Percent
Moisture as received	.86
Volatile matter	20.95
Fixed Carbon	64.95
Ash	13.24
Sulphur	.85

STEWART SEAM

In the vicinity of Chisholm Pond on Potter Brook, pits were sunk on the Stewart and Richardson seams and 4 to 5 feet of fairly good coal was reported. Bell (1940, p. 90) states "that these two seams are one and the same and that they probably represent the McBean seam".

In 1961 the Stewart seam was intersected by eleven boreholes. This drilling outlined a coal seam with an average thickness of 3.1 feet with a reserve of 347,900 tons of good quality coal. Since the date of drilling the area has been completely developed and access to this coal is difficult.

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INDEX TO MINES

JOGGINS SEAM

Joggins No. 7
Joggins No. 1
Spud
Casey
Joggins Mine
Beech Grove
Maple Leaf No. 3 (bench)
Maple Leaf No. 3 (fall)
Maple Leaf No. 1
Maple Leaf No. 2 (fall)
Maple Leaf No. 2 (bench)
Maple Leaf No. 4
Beech Hill
Victoria No. 2
William Patrick
Victoria No. 4
Wass slope
Central Mine
Boston Mine
Riverside
Wm. Taylor (Upper workings)
Phoenix
Cannel Pit

QUEEN SEAM

1 Arseneau slope
2 Victoria No. 3
3 Victoria No. 1

KIMBERLY SEAM

1 Sterling No. 2
2 Sterling No. 3
3 Sterling No. 1
4 Kimberly (Minudie)
5 Riverside
6 Cumberland Fuel and Trading
7 Marsh
8 Strathcona No. 2 (Standard)
9 Strathcona No. 3 (Ward)
10 Filor (Sutherland)
11 Barnes

FORTY BRINE SEAM

1 Bayview No. 8
2 Fundy No. 5 (Green Crow)
3 Hillcrest
4 Bett's Pit
5 Milner No. 1
6 Milner No. 2
7 R. J. Bell
8 River Hébert Mine
9 Strathcona No. 1
10 Old Pugsley slope
11 Old Slope
12 Burnnite
13 Shaw Mine

FUNDY SEAM

Seashore
Cumberland
Fundy No. 1
Fundy No. 6
Trestle Brook
National
Arseneau pit

RECTOR-LAWSON AND JUBILEE SEAMS

1 Wm. Taylor (Lower Workings)
2 Rector
3 Carter
4 Black Diamond
5 Long's No. 2
6 Lawson
7 Jubilee Mine

CHIGNECTO SEAM

1 Long's No. 1
2 Eastern Coal Co.
3 Fife and Taylor
4 H. Quinn
5 D. McKinnon
6 G. N. Field
7 Great Northern
8 Scotia
9 Maritime (Chignecto)
10 No. 3 slope
11 No. 4 slope
12 St. George's mine
13 No. 9 Crown
14 Fenwick mine
15 Ladysmith mine
16 Seaman mine
17 Rambutte mine
18 North Springhill mine
19 Styles Brook mine

Workings, slope, adit and mine number:
Joggins seam
Joggins seam (upper leaf)
Queen seam
Kimberly seam
Forty Brine seam
Fundy seam
Rector-Lawson and Jubilee seam
Chignecto seam

Note: Mine numbers read from West to East on each seam

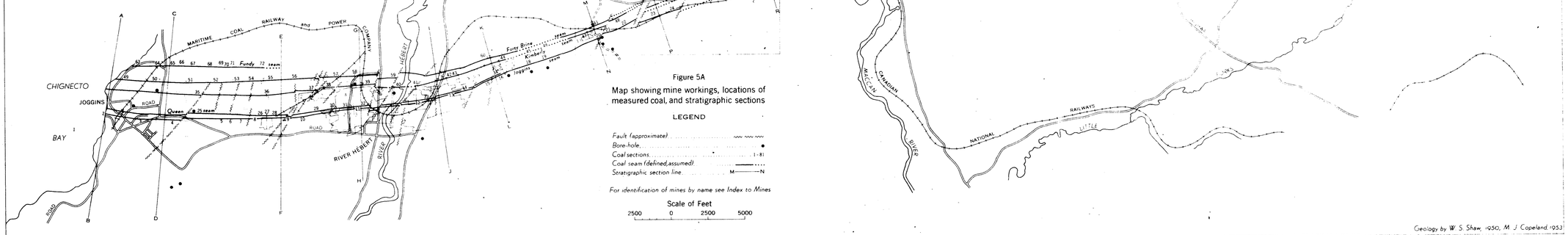


Figure 5A
Map showing mine workings, locations of measured coal, and stratigraphic sections

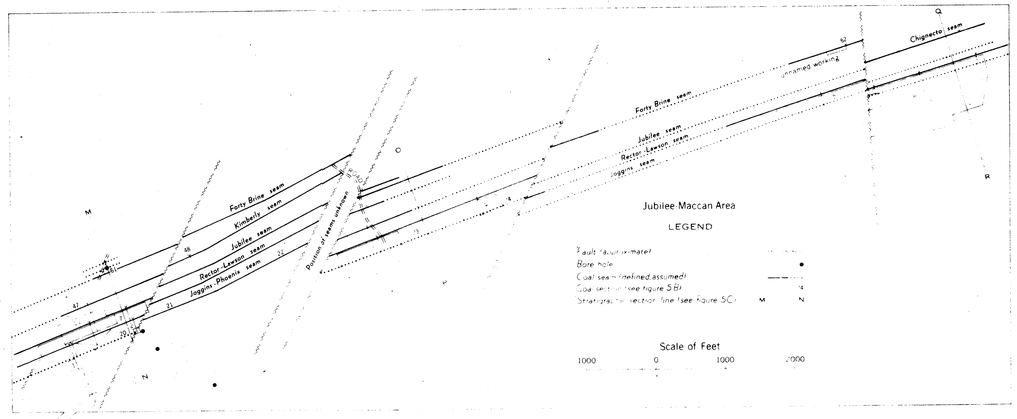
LEGEND

Fault (approximate)
Bore-hole
Coal sections 1-81
Coal seam (defined, assumed)
Stratigraphic section line M—N

For identification of mines by name see Index to Mines

Scale of Feet
2500 0 2500 5000

NORTH



Jubilee Maccan Area

LEGEND

Fault (approximate)
Bore hole
Coal seam (defined, assumed)
Coal section (see figure 5B)
Stratigraphic section line (see figure 5C) M N

Scale of Feet
1000 0 1000 2000

Geology by W. S. Shaw, 1950, M. J. Copeland, 1953

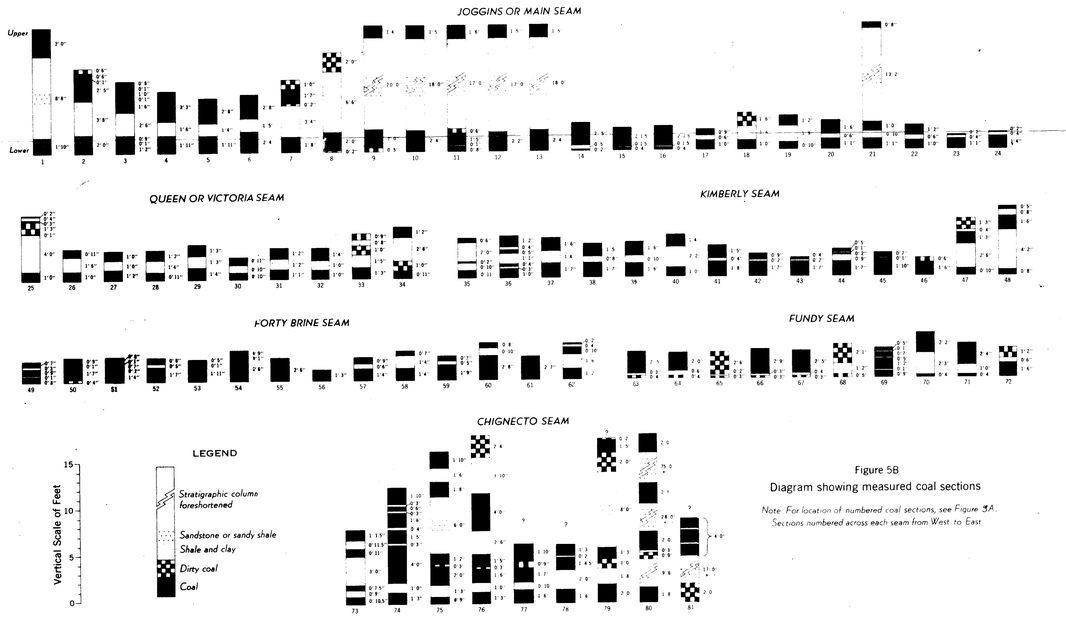


Figure 5B
Diagram showing measured coal sections

Note: For location of numbered coal sections, see Figure 5A. Sections numbered across each seam from West to East

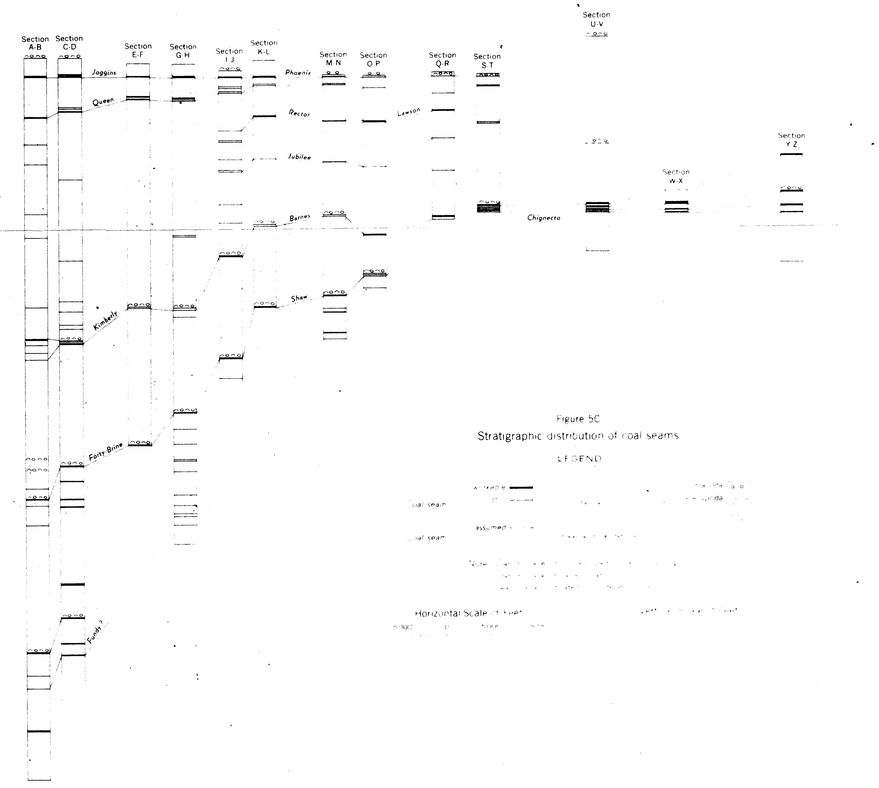


Figure 5C
Stratigraphic distribution of coal seams

LEGEND

Horizontal Scale

To accompany Memoir 298 by M. J. Copeland

Compiled by M. J. Copeland

Cartography by the Geological Cartography Unit, 1958
Published, 1959

Figure 5 Joggins-Chignecto Coalfield, Nova Scotia, showing mine workings, thickness and structure of coal seams

482489
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GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SERIES

PART OF SHEET 21H (East Half)

LEGEND

PALÆOZOIC

CARBONIFEROUS
CUMBERLAND GROUP (4-7)

- 7 — Upper fine facies; red sandstone and silt
- 6 — Upper coarse facies; red conglomerate, red and grey sandstone
- 5 — Lower fine, coal-bearing facies; grey sandstone, red and grey shale
- 4 — Lower coarse facies; red conglomerate, shale, and sandstone

CARBONIFEROUS AND PRE-CARBONIFEROUS
PRE-CUMBERLAND GROUP

- 1-3 — 1. Pre-Carboniferous Cobequid complex to south; 2. Carboniferous Riversdale and Windsor groups to east; 3. Carboniferous Riversdale group to north

Bedding (inclined, horizontal)
Anticlinal axis
Synclinal axis
Fault (defined, approximate, assumed)
Coal seam (defined, approximate)
Bore-hole

Geology by F. A. Kerr, 1924; I. W. Jones, 1928; W. A. Bell, 1935; W. S. Shaw, 1949, 1950; and M. J. Copeland, 1953.

Main highway
Other roads
Trail
Power transmission line
Post Office
Lighthouse
County boundary
Game sanctuary boundary
Intermittent stream
Marsh
Contours (interval 100 feet)
Height in feet above mean sea-level

Cartography by the Geological Cartography Unit, 1958

Base-map compiled from published Federal Government maps

Air photographs covering this map-area may be obtained through the National Air Photographic Library, Topographical Survey, Ottawa, Ontario

Approximate magnetic declination, 22° 57' West

INDEX MAP

65°00' 50' 40' 30' 20' 10' 64°00'
45°45' 40' 30' 20' 45°15'

PUBLISHED, 1959
COPIES OF THIS MAP MAY BE OBTAINED FROM THE DIRECTOR, GEOLOGICAL SURVEY OF CANADA, OTTAWA

PRINTED BY THE SURVEYS AND MAPPING BRANCH

MAP 1070A

CUMBERLAND COUNTY

(WEST PART)

NOVA SCOTIA

Scale: One Inch to Two Miles = $\frac{1}{126{,}720}$

Miles 2 1 0 2 4 6

OFR100

OFR 92-001

NOVA SCOTIA DEPARTMENT OF NATURAL RESOURCES REPORT ON THE LOCATION OF ABANDONED MINE WORKINGS IN THE PICTOU COALFIELD

BY

K. S. GILLIS AND J. D. DEWOLFE

1992

OFR-92-001

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REPORT ON THE LOCATION
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Conclusion
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Figure 3 Location of Mine Workings in the Pictou Coalfield

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Location of Mine Workings on the Captain Seam
Location of Mine Workings on the McKay Seam
Location of Mine Workings on the Six Foot Seam
Location of Mine Workings on the McBean Seam
Location of Mine Workings on the Foord Seam
Location of Mine Workings on the Cage Seam
Location of Mine Workings on the Third Seam
Location of Mine Workings on the McGregor Seam
Location of Mine Workings on the New Seam
Location of Mine Workings on the Acadia Seam
Location of Mine Workings on the Scott Seam
Location of Mine Workings - Miscellaneous Seams

SUMMARY

Surface instability as a result of coal mining is a matter of concern to development in the urbanized areas of Pictou County.

The location of mine workings has been established for 11 coal seams in the Pictou Coalfield. The plans indicate spot elevations relative to sea level and the location of coal extraction within the coal seams in relation to present day topography.

Care has been taken to accurately portray the mine workings.

INTRODUCTION

Organized coal mining began in the Pictou Coalfield in 1827 when the General Mining Association began active mining operation on the Foord seam. Mining operations from their inception to the present day have caused large areas to be undermined due to the extraction of coal. The stability of the ground surface over these areas of extraction is a focus of concern for urban and industrial planners. The location and depth to mine workings and to some degree, the type of mining is important as former mine leases are turned over for urban expansion.

The purpose of this report is to outline the areal extent and location of the mine workings and their relationship to present day topography.

The maps that have been prepared are the results of research, interpretation and collation of the archival mine blueprints and line drawings in the possession of the Nova Scotia Department of Natural Resources. Attempts have been made to accurately portray the mine workings; however, the accuracy cannot be guaranteed as it could not be determined that all information pertaining to the mines had originally been recorded or submitted or that the original surveys were accurate in all aspects. The possibility of error also exists when transposing numerical data and in blueprint reductions.

ESTABLISHMENT OF BASE MAP AND GRID SYSTEM

Map coverage at a scale of 1:10,000 was selected as a base map for this project. It was adapted from a 1:10,000 scale base map of the Pictou coalfield that displayed two existing grid co-ordinate systems, the NAD-27 and the ATS-77. The reference grid selected for the mine base maps is the ATS-77 co-ordinate system. The original mine grids, used by the Acadia Coal Company and the Intercolonial Coal Company, could not be located. Therefore, the old mine grids were re-established at a 1:10,000 scale.

The single surveyed point existing in two grid systems was a brass plug on the portal of the Scott seam slope. The co-ordinates of this plug were,
International Coal Company Grid: 41:54 ft. W; 16.01 ft. S.
NAD-27 3° MTM Grid: E210,645.0 m; N5,046,156.0 m

A second point established was the location of the spillway on the dam across McLean brook that acted as a water reservoir for the McBean mine in Thorburn. The co-ordinates, taken from the Acadia Coal Company mine blueprint indicating the location of the dam, are 27068 ft. E.; 3720 ft. S. The same location could easily be identified on the 1:10,000 base map. The distance between the two points is approximately 12 kilometers.

The original mine grid orientation was re-established by pinning the surveyed points on the Scott seam portal and rotating the dam co-ordinates point until they coincided with the equivalent point on the 1:10,000 base map. No discrepancy was observed in the alignment of the two points and so it is assumed that the orientation of the original mine grid is accurate.

Mine blueprints containing the coal company grids were photographically reduced to a scale of 1:10,000 and superimposed on the base map, thus establishing the position of the mine workings.

Mine Workings Outlined

Mining has been carried out on 11 coal seams in the Pictou Coalfield (Figures 1 and 2). The centres of mining activity were in the vicinity of the towns of Westville, Stellarton and Thorburn (Figure 3). The coal seams mined in the three localities represent all the major organized coal mining attempts in the Pictou coalfields.

The locations of mine workings have been outlined on the base maps for the Acadia and Scott seams in Westville, the Foord, Cage, Third, McGregor and New seams in Stellarton and the Captain, McKay, Six Foot and McBean seams in Thorburn. The base maps are identified by the seam name (Appendix).

Areas of limited mining activity are found on a map sheet designated as Miscellaneous. Included on this map are the workings on the Third seam in Westville (also known as the Clay mine) and the Purvis and Four Foot seams in Stellarton. Other minor prospects include the Sproull slope, the Poole Mine and Stellar slope on the Oil Coal seam, and the location of Stewart and Dawson slopes on the Stewart seam in New Glasgow.

Several mining sites are found outside of the major mining blocks but are not included in this report. The sites included the Haliburton Shaft, the workings along the Merigomish Road and workings in the vicinity of Priestville. The mining operations in these areas were very small and localized.

The plan views of the mine workings are shown in relation to the present day topography. Within the boundaries of the workings, spot elevations have been recorded. The elevations have been taken from mine blueprints. Where spot elevations were lacking, elevations were obtained from structure contours of the coal seams.

Conclusion

The mine workings outlined in this report indicate the areal extent of organized coal mining activity in the Pictou Coalfield. This information will aid in the proper utilization of our land resources, in particular that of urban planning.

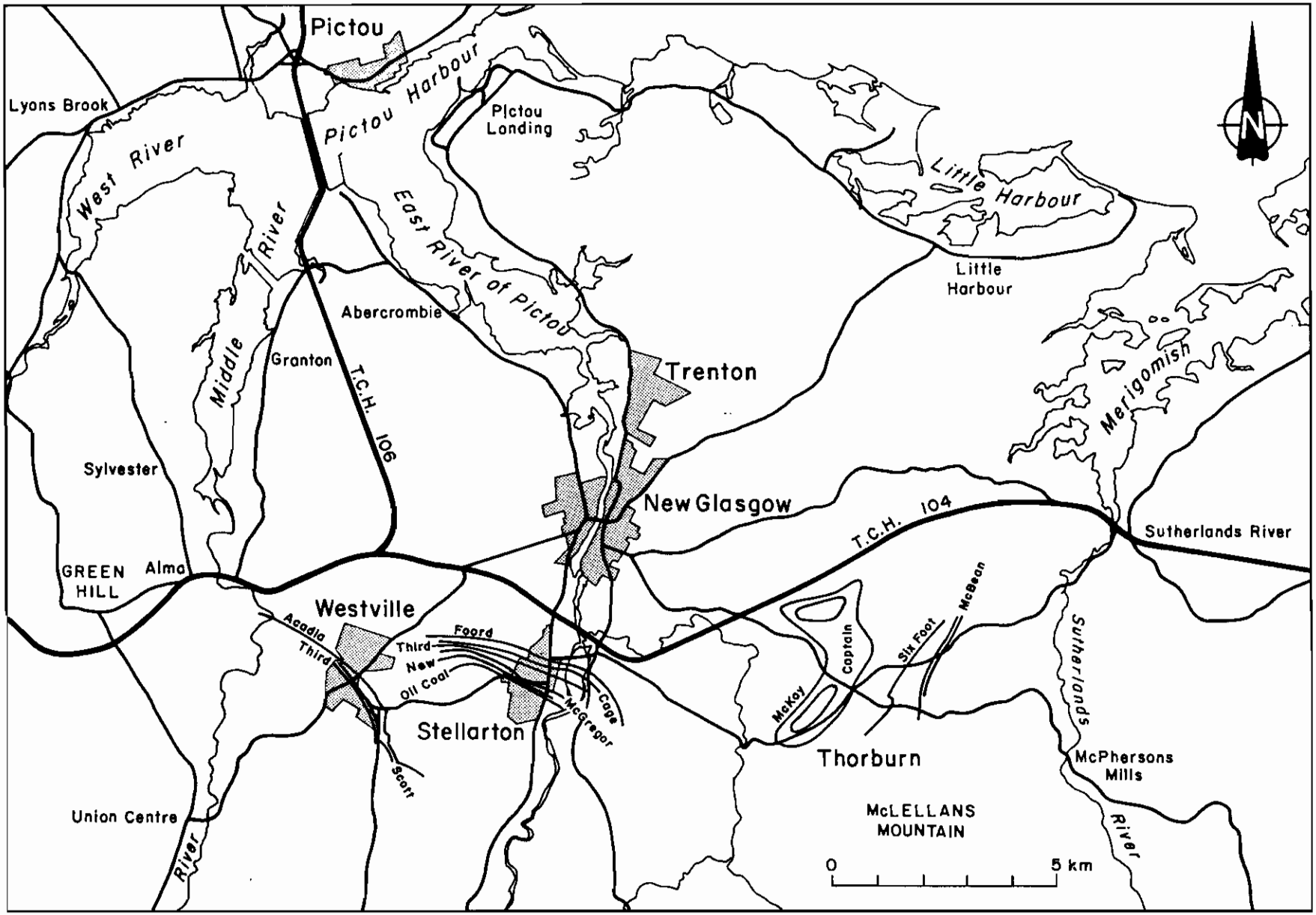


Figure 1. Location of Coal Seams in the Pictou Coalfield

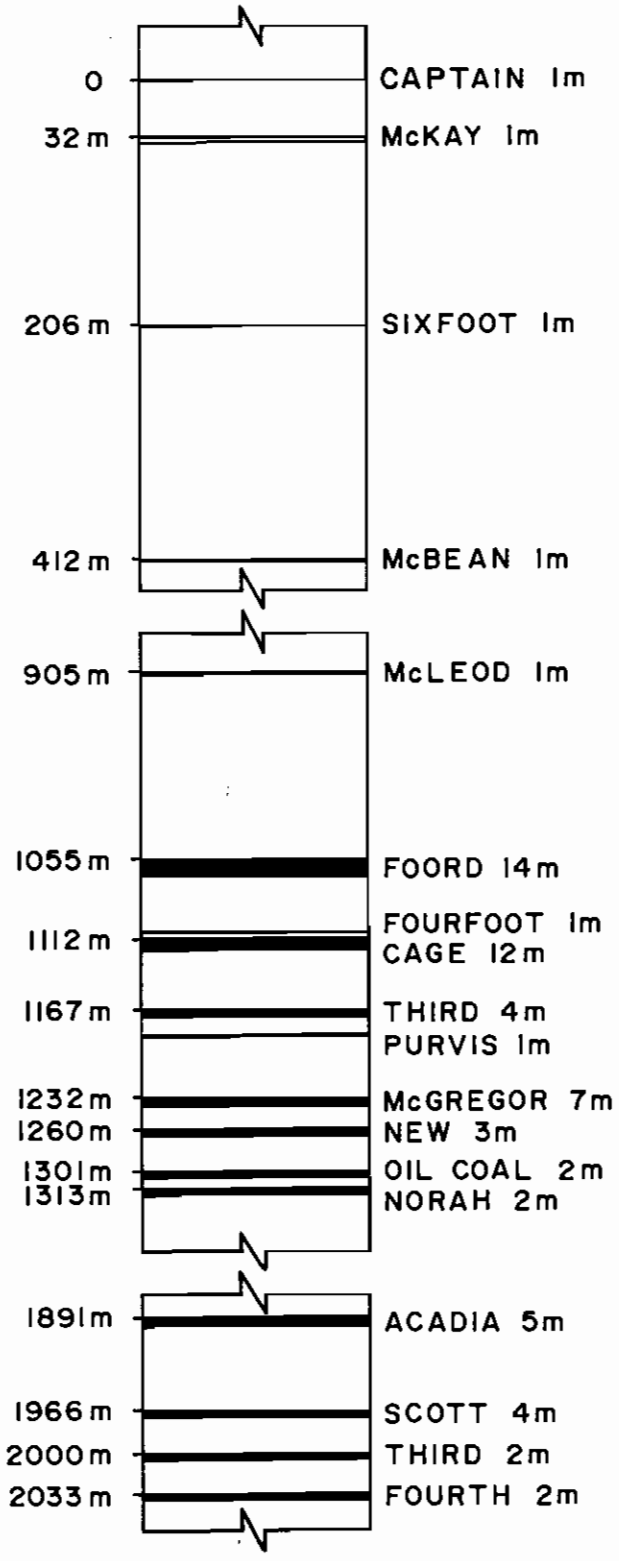


Figure 2. Stratigraphy of Coal Seams in the Pictou Coalfield

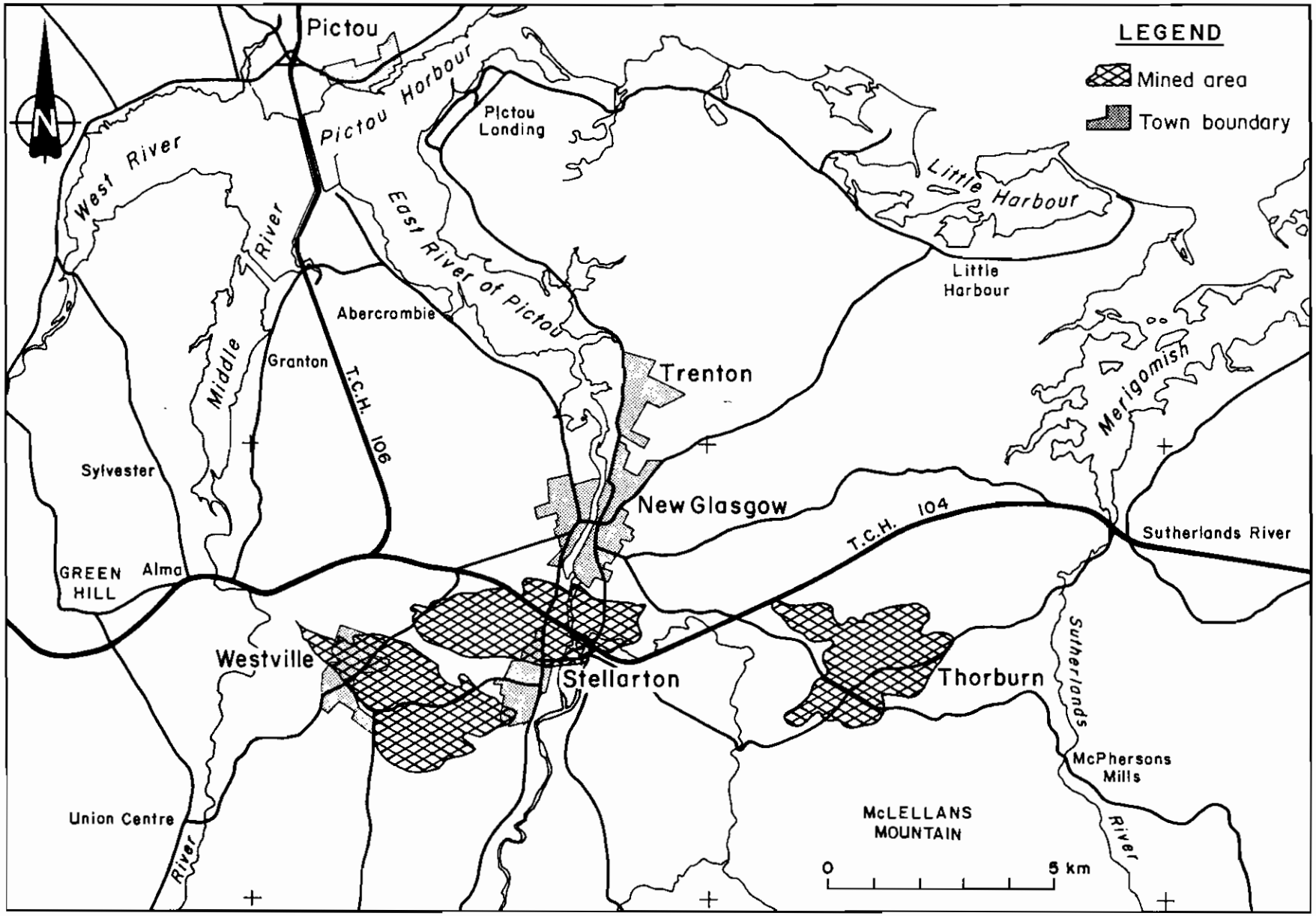
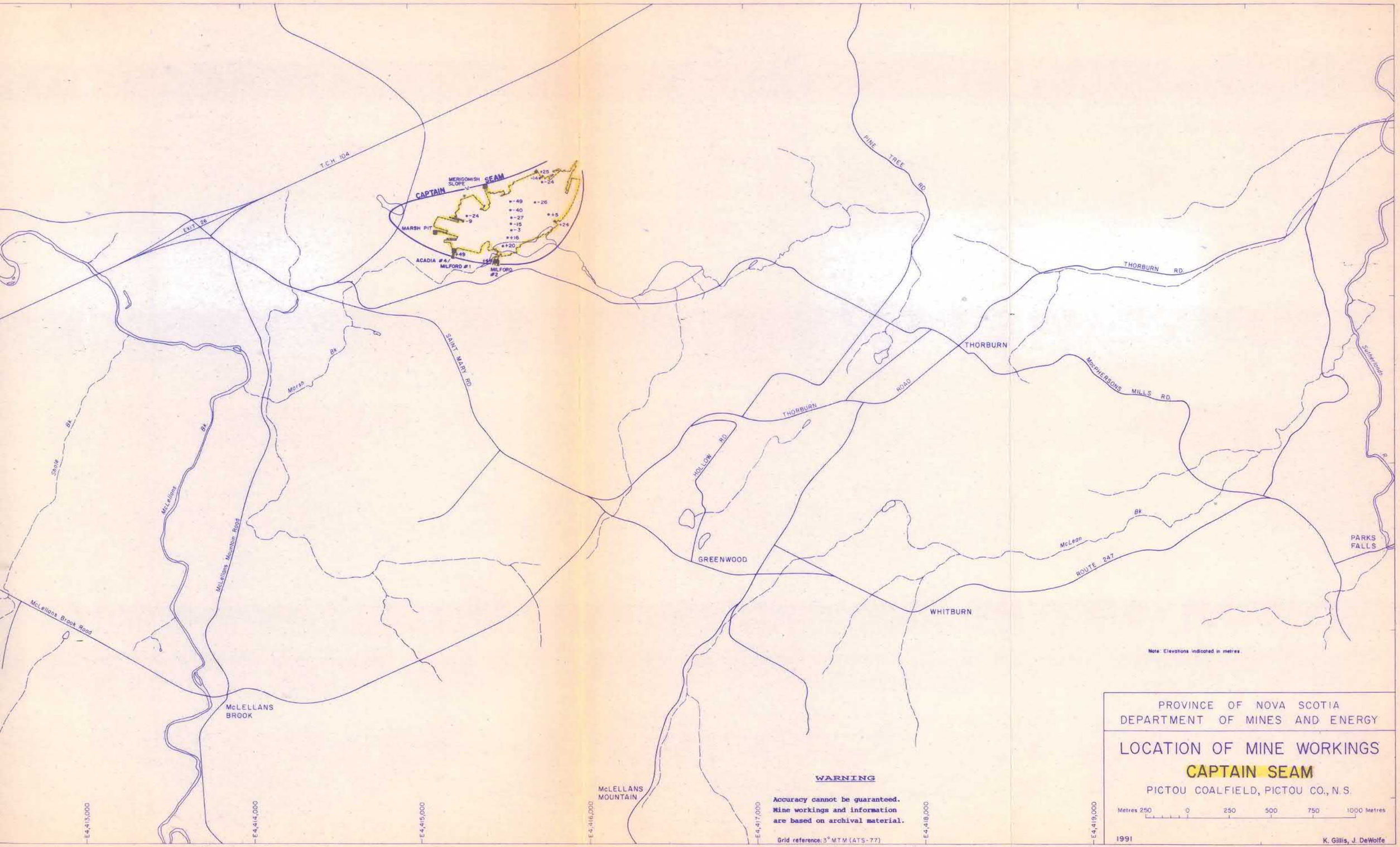


Figure 3. Location of Mine Workings in the Pictou Coalfield



Note: Elevations indicated in metres.

WARNING

Accuracy cannot be guaranteed. Mine workings and information are based on archival material.

Grid reference: 3° M.T.M. (ATS-77)

PROVINCE OF NOVA SCOTIA
DEPARTMENT OF MINES AND ENERGY

LOCATION OF MINE WORKINGS
CAPTAIN SEAM

PICTOU COALFIELD, PICTOU CO., N.S.

Metres 250 0 250 500 750 1000 Metres

1991

K. Gillis, J. DeWolfe

T.C.H. 104

EXIT 25

ACADIA No. 5 AIR SHAFT

McLEOD PIT

MAIN SLOPE

MARSH COLLIERY

SAINT MARY RD.

Marsh Bk.

Shale Bk.

McLellans Bk.

McLellans Mountain Road

McLellans Brook Road

McLELLANS BROOK

GREENWOOD No. 3

GREENWOOD No. 2

UPPER McKAY SEAM

LOWER McKAY SEAM

PINE TREE RD.

THORBURN RD.

THORBURN

MacPHERSONS MILLS RD.

THORBURN ROAD

HOLLOW RD.

GREENWOOD

McLean Bk.

ROUTE 247

WHITBURN

PARKS FALLS

McLELLANS MOUNTAIN

E4,413,000

E4,414,000

E4,415,000

E4,416,000

E4,417,000

E4,418,000

E4,419,000

Note: Elevations indicated in metres.

WARNING

Accuracy cannot be guaranteed. Mine workings and information are based on archival material.

Grid reference: 3° MTM (ATS-77)

PROVINCE OF NOVA SCOTIA
DEPARTMENT OF MINES AND ENERGY

LOCATION OF MINE WORKINGS

McKAY SEAM

PICTOU COALFIELD, PICTOU CO., N.S.

Metres 250 0 250 500 750 1000 Metres

SCALE 1:10000

1991

K. Gillis, J. DeWolfe

T.C.H. 104

EXIT 26

SAINT MARY RD.

Marsh Br.

Br.

Trib.

McLellans

McLellans Mountain Road

McLellans Brook Road

McLELLANS BROOK

McLELLANS MOUNTAIN

PINE TREE RD.

THORBURN RD.

SIXFOOT SEAM

THORBURN

MacPHERSONS MILLS RD.

Acadia No.3

THORBURN ROAD

HOLLOW Br.

GREENWOOD

Greenwood Mine

WHITBURN

McLean Br.

ROUTE 247

PARKS FALLS

Sutherlands

E4,413,000

E4,414,000

E4,415,000

E4,416,000

E4,417,000

E4,418,000

E4,419,000

Note: Elevations indicated in metres

WARNING

Accuracy cannot be guaranteed. Mine workings and information are based on archival material.

Grid reference 3° MTM (ATS-77)

PROVINCE OF NOVA SCOTIA
DEPARTMENT OF MINES AND ENERGY

LOCATION OF MINE WORKINGS

SIXFOOT SEAM

PICTOU COALFIELD, PICTOU CO., N.S.

Metres 250 0 250 500 750 1000 Metres

1991

K. Gillis, J. DeWolfe

T.C.H. 104

EXIT 25

PINE TREE RD.

THORBURN RD.

MITCHELL PITS

THORBURN

McPHERSONS MILLS RD.

SAINT MARY RD.

Marsh Br.

Shore Br.

McLellans Br.

McLellans Mountain Road

McLellans Brook Road

ROAD

OLD McBEAN MINE

McBEAN SEAM

ACADIA No.2 MINE

HOLLOW

GREENWOOD

McLean Br.

ROUTE 247

WHITBURN

PARKS FALLS

Sutherlands

McLELLANS BROOK

McLELLANS MOUNTAIN

E 4,413,000

E 4,414,000

E 4,415,000

E 4,416,000

E 4,417,000

E 4,418,000

E 4,419,000

Note: Elevations indicated in metres.

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Grid reference: 3° M T M (ATS-77)

PROVINCE OF NOVA SCOTIA
DEPARTMENT OF MINES AND ENERGY

LOCATION OF MINE WORKINGS
McBEAN SEAM

PICTOU COALFIELD, PICTOU CO., N.S.

Metres 250 0 250 500 750 1000 Metres

1991

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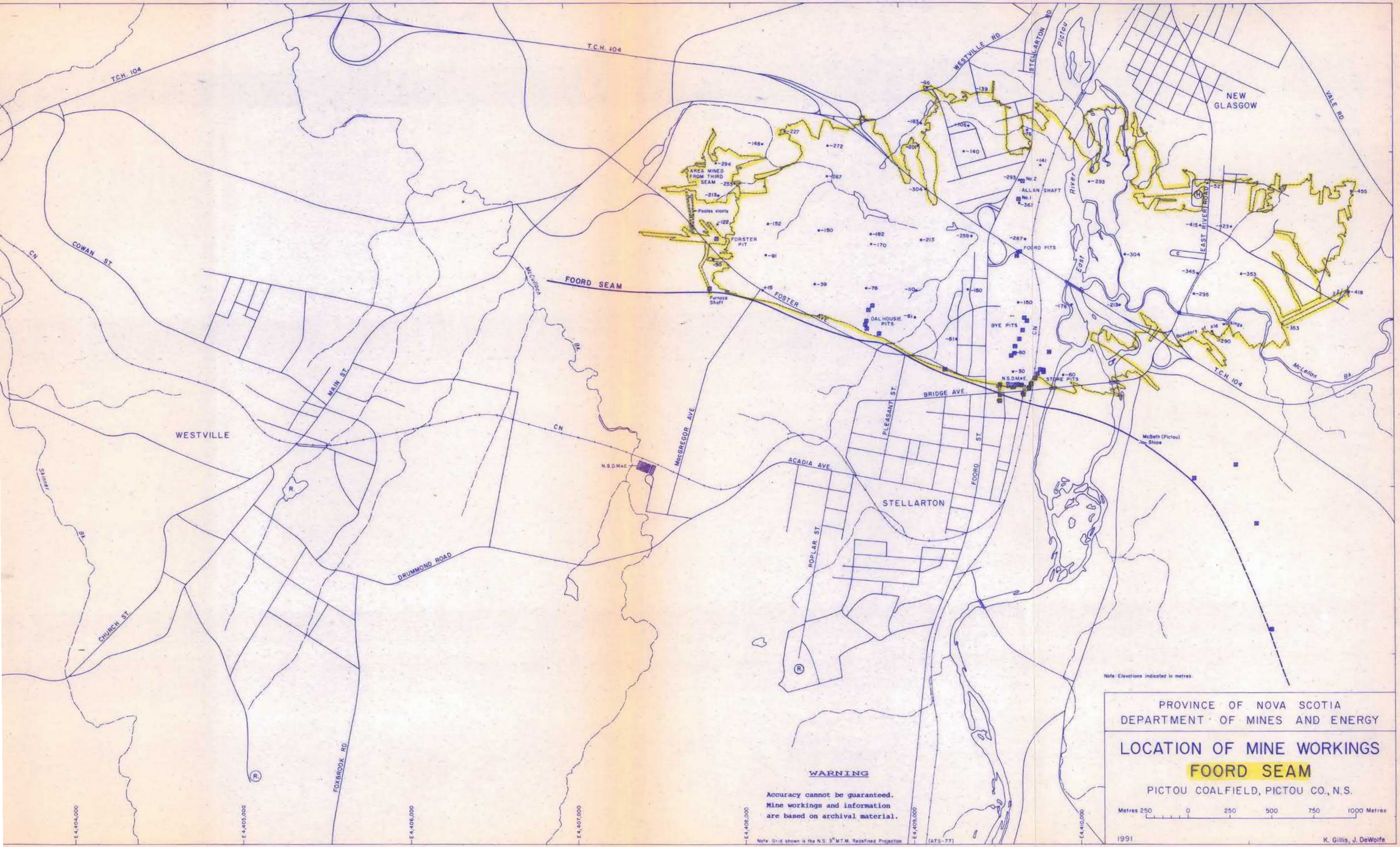

Note: Elevations indicated in metres

WARNING

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Note: Grid shown is the N.S. 3° M.T.M. Redefined Projection (ATS-77)

PROVINCE OF NOVA SCOTIA
DEPARTMENT OF MINES AND ENERGY

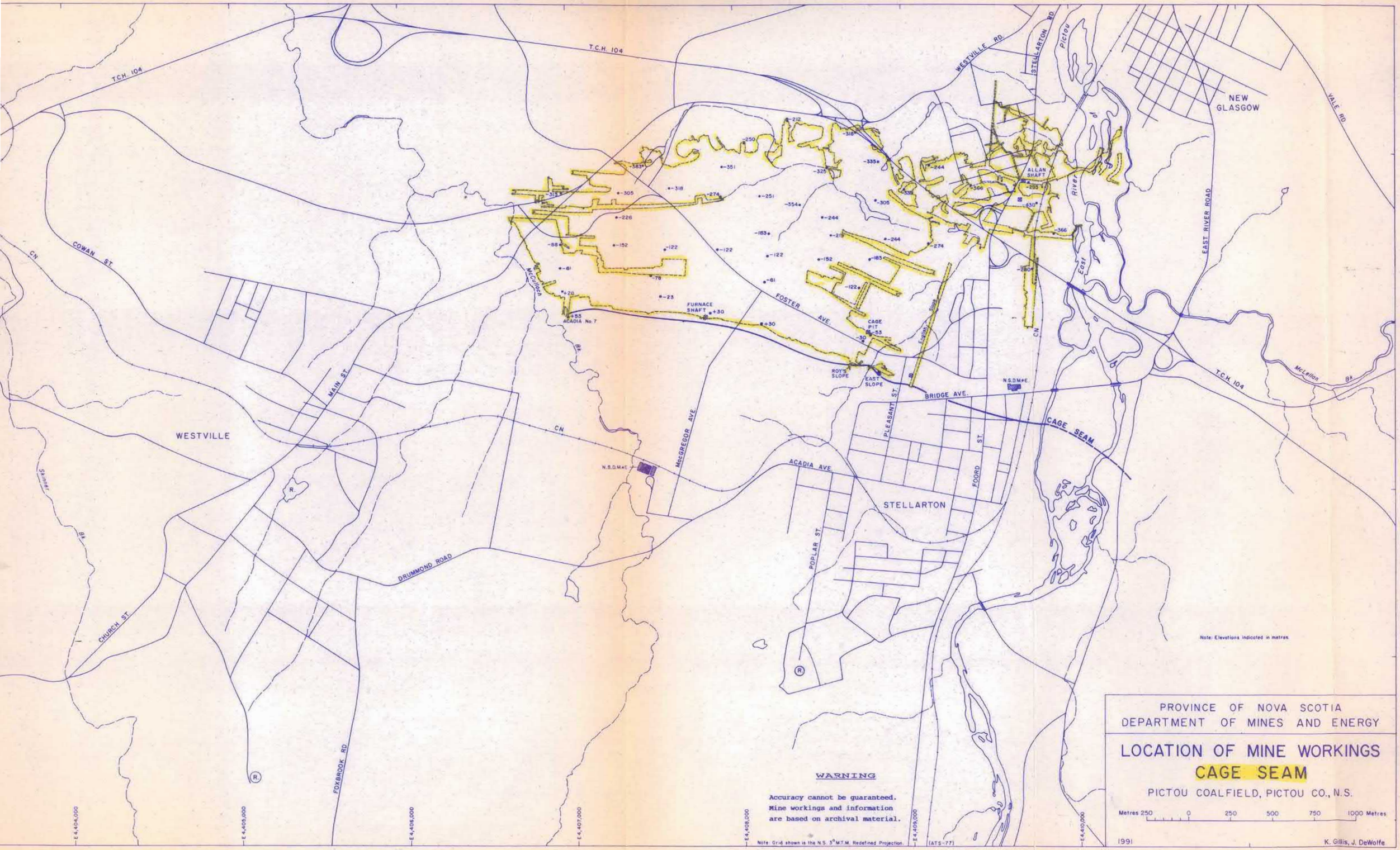
LOCATION OF MINE WORKINGS
FOORD SEAM

PICTOU COALFIELD, PICTOU CO., N.S.

Metres 250 0 250 500 750 1000 Metres

1991

K. Gillis, J. DeWolfe



WARNING

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Note: Grid shown is the N.S. 5° M.T.M. Redefined Projection. (ATS-77)

Note: Elevations indicated in metres.

PROVINCE OF NOVA SCOTIA
DEPARTMENT OF MINES AND ENERGY

LOCATION OF MINE WORKINGS
CAGE SEAM

PICTOU COALFIELD, PICTOU CO., N.S.

Metres 250 0 250 500 750 1000 Metres

1991

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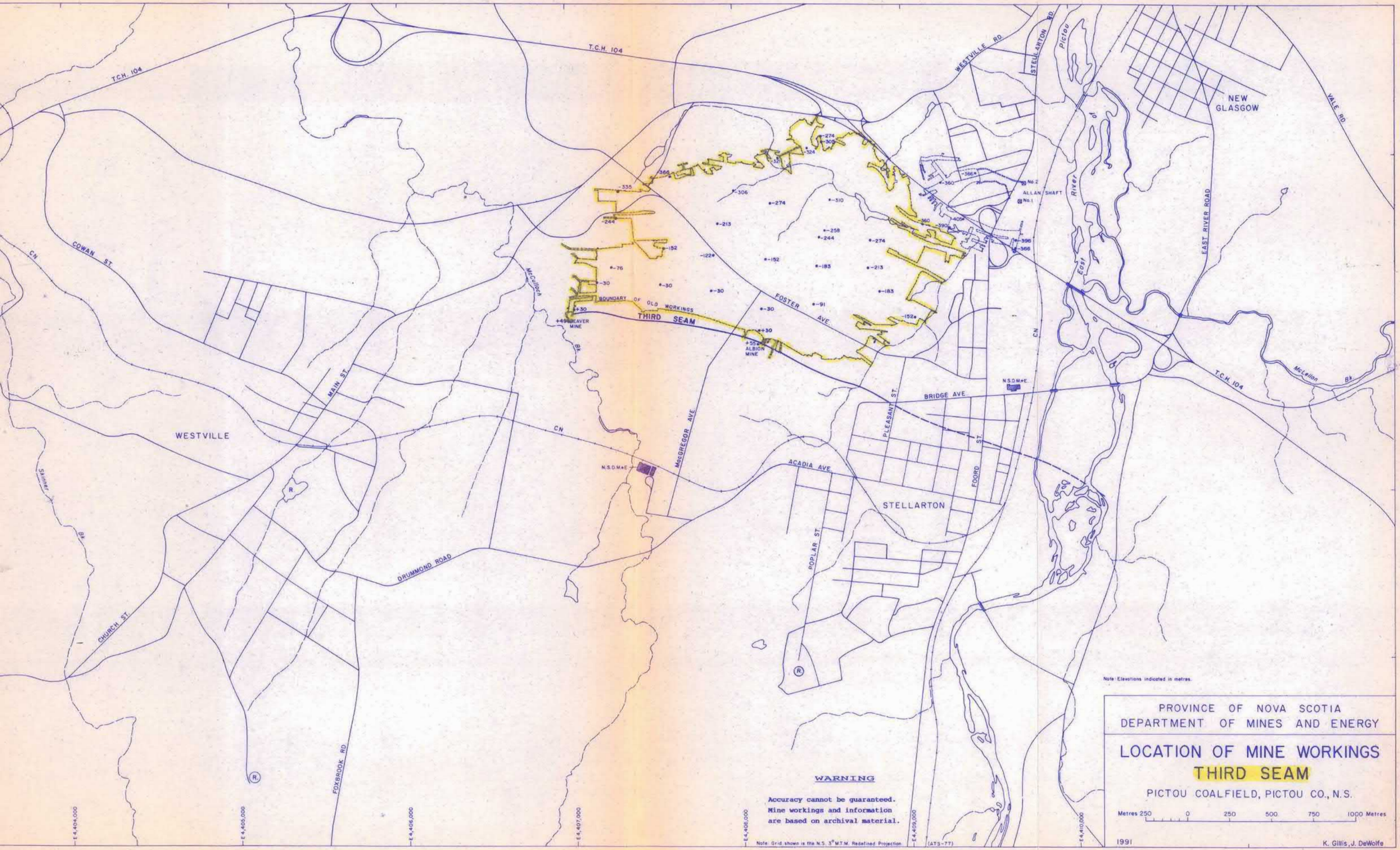

WARNING

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Note: Grid shown is the N.S. 3° M.T.M. Redefined Projection (ATS-77)

Note: Elevations indicated in metres.

PROVINCE OF NOVA SCOTIA
DEPARTMENT OF MINES AND ENERGY

LOCATION OF MINE WORKINGS
THIRD SEAM

PICTOU COALFIELD, PICTOU CO., N.S.

Metres 250 0 250 500 750 1000 Metres

1991

K. Gillis, J. DeWolfe

T.C.H. 104

WESTVILLE RD

STELLARTON RD

Pictou River

NEW GLASGOW

VALE RD

EAST RIVER ROAD

CN

COWAN ST

McCulloch Br.

MAIN ST

McGREGOR SEAM

FOSTER AVE.

-335 -504 -244 -213 -152 -61 +30

-433 -420 -435 -462 -429 -415 -393 -354 -350 -400 -431 -455 -425 -480 -424 -378 -343 -315 -270 -274 -215 -183 -107 -30

+57 McGREGOR MINE

N.S.D.M&E

McGREGOR AVE.

PLEASANT ST.

BRIDGE AVE.

FOORD ST.

McLellan Br.

T.C.H. 104

WESTVILLE

ACADIA AVE.

STELLARTON

POPLAR ST.

James Br.

CHURCH ST.

DRUMMOND ROAD

FOXBROOK RD.

E 4,404,000 E 4,405,000 E 4,406,000 E 4,407,000 E 4,408,000 E 4,409,000 E 4,410,000

WARNING

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Note: Grid shown is the N.S. 3° M.T.M. Redefined Projection (ATS-77)

PROVINCE OF NOVA SCOTIA
DEPARTMENT OF MINES AND ENERGY

LOCATION OF MINE WORKINGS
McGREGOR SEAM

PICTOU COALFIELD, PICTOU CO., N.S.

Metres 250 0 250 500 750 1000 Mètres

1991

K. Gillis, J. DeWolfe

T.C.H. 104

WESTVILLE RD.

STELLARTON RD.

Pictou River

NEW GLASGOW

VALE RD.

EAST RIVER ROAD

McLellan Br.

COWAN ST.

CN

MAIN ST.

McGregor Br.

WESTVILLE

Skinner Br.

CHURCH ST.

DRUMMOND ROAD

FOXBROOK RD.

N.S.D.M&E

MacGREGOR AVE.

NEW SEAM

ACADIA No. 7

FOSTER AVE.

BRIDGE AVE.

L'LEASANT ST.

FOORD ST.

ACADIA AVE.

POPLAR ST.

STELLARTON

437 409 458 425 431 383 388 364 361 397 411 268 282 294 272 505 544 342 232 237 240 271 172 183 79 10 20 62

E 4,404,000 E 4,405,000 E 4,406,000 E 4,407,000 E 4,408,000 E 4,409,000 E 4,410,000

(ATS-77)

Note: Grid shown is the N.S. 3° M.T.M. Redefined Projection.

Note: Elevations indicated in metres.

WARNING

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PROVINCE OF NOVA SCOTIA
DEPARTMENT OF MINES AND ENERGY

LOCATION OF MINE WORKINGS

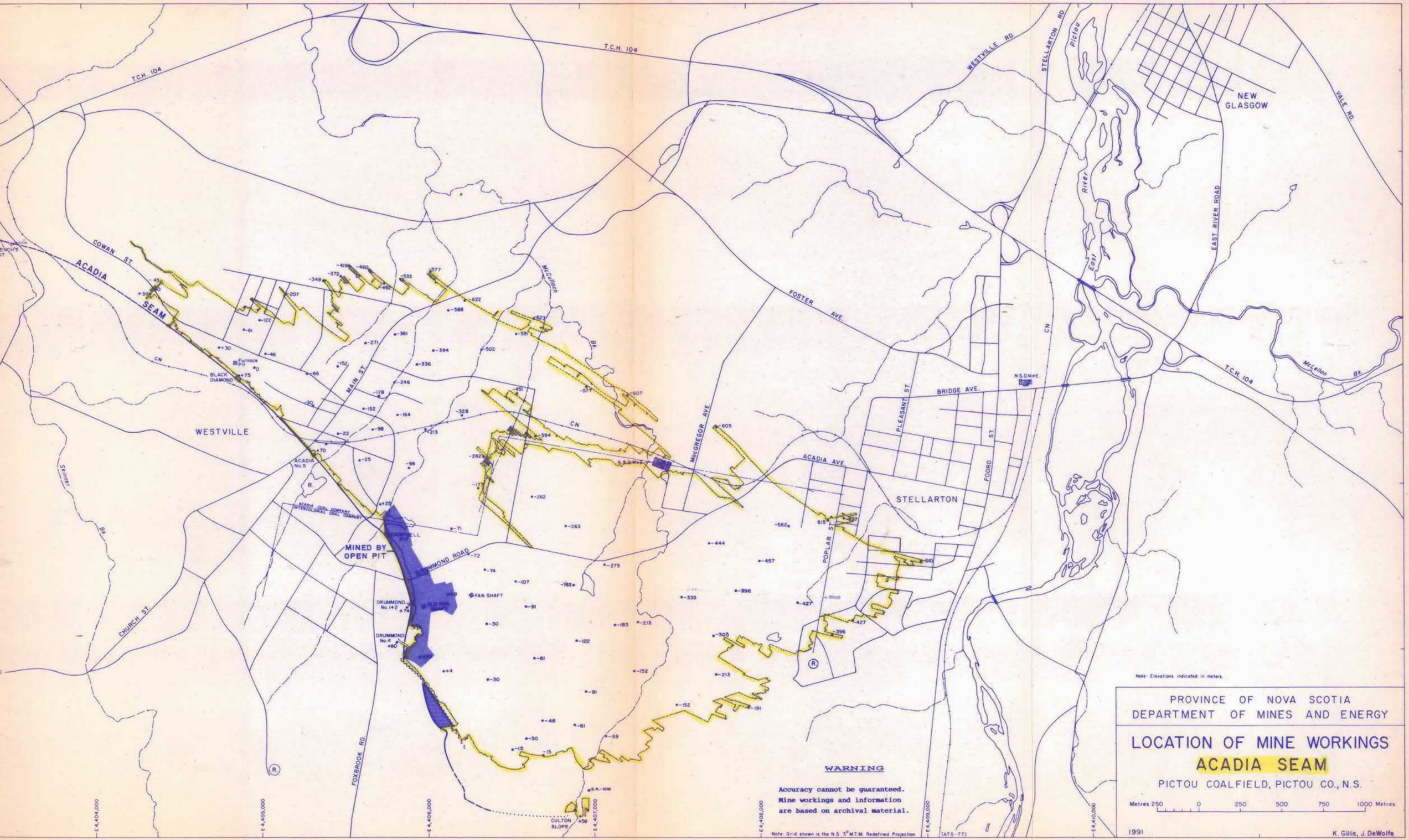
NEW SEAM

PICTOU COALFIELD, PICTOU CO., N.S.

Metres 250 0 250 500 750 1000 Metres

1991

K. Gillis, J. DeWolfe



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Note: Grid shown is the N.S. 3°M.T.M. Redefined Projection (ATS-77)

Note: Elevations indicated in meters.

PROVINCE OF NOVA SCOTIA
DEPARTMENT OF MINES AND ENERGY

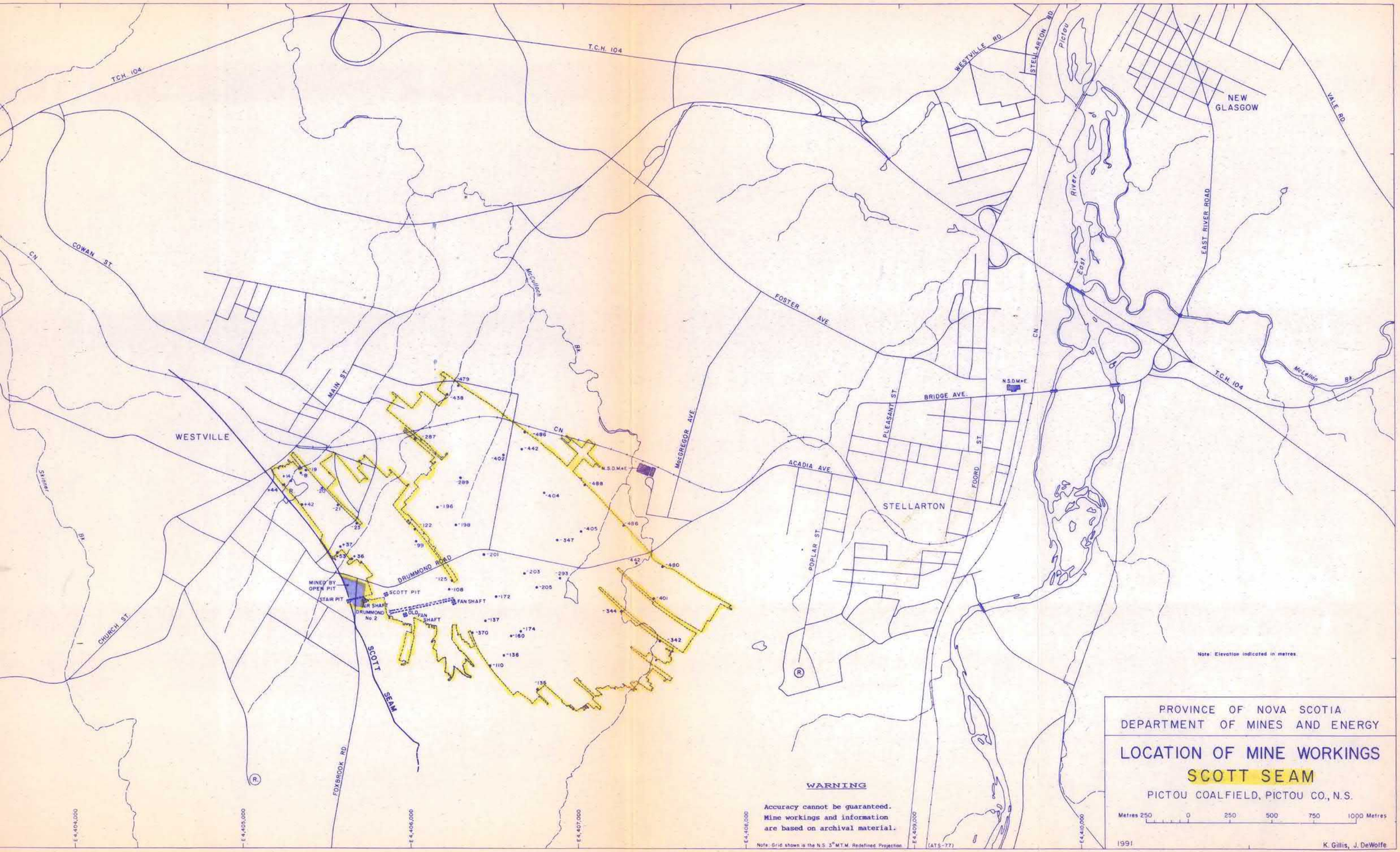
LOCATION OF MINE WORKINGS
ACADIA SEAM

PICTOU COALFIELD, PICTOU CO., N.S.

Metres 250 0 250 500 750 1000 Metres

1991

K. Gillis, J. DeWolfe



Note: Elevation indicated in metres.

WARNING

Accuracy cannot be guaranteed. Mine workings and information are based on archival material.

Note: Grid shown is the N.S. 3° M.T.M. Redefined Projection

PROVINCE OF NOVA SCOTIA
DEPARTMENT OF MINES AND ENERGY

LOCATION OF MINE WORKINGS
SCOTT SEAM

PICTOU COALFIELD, PICTOU CO., N.S.

Metres 250 0 250 500 750 1000 Metres

1991

K. Gillis, J. DeWolfe

T.C.H 104

WESTVILLE RD

STELLARTON RD

Pictou River

VALE RD

Dawson Slope

NEW GLASGOW

Stewart Slope

STEWART SEAM

EAST RIVER ROAD

T.C.H 104

McLellan Br.

COWAN ST

CN

MAIN ST

McCULLOCH Br.

WESTVILLE

Four-Foot Seam workings (Little Cage) entered from Cage Seam.

Cage

Shaft

Cage

FOSTER AVE

Purvis Seam workings.

CN

BRIDGE AVE.

N.S.D.M&E

PLEASANT ST

FOORD ST

OIL COAL SEAM

MacGREGOR AVE

Poole Mine

Stellar Slope

ACADIA AVE

STELLARTON

POPLAR ST

N.S.D.M&E

Sproull Slope

CLAY MINE

Third Seam workings (Westville)

Stewart Lower Seam

DRUMMOND ROAD

CHURCH ST

FOXBROOK RD

R.

E 4,404,000

E 4,405,000

E 4,406,000

E 4,407,000

E 4,408,000

E 4,409,000 (ATS-77)

E 4,410,000

WARNING

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Note: Grid shown is the N.S. 3°M.T.M. Redefined Projection

PROVINCE OF NOVA SCOTIA
DEPARTMENT OF MINES AND ENERGY

LOCATION OF MINE WORKINGS

MISCELLANEOUS SEAMS

PICTOU COALFIELD, PICTOU CO., N.S.

Metres 250 0 250 500 750 1000 Metres

1991

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OFR-92-018

NOVA SCOTIA DEPARTMENT OF NATURAL RESOURCES
REPORT ON MINE SUBSIDENCE
IN THE
PICTOU COALFIELD

BY
K. S. GILLIS

1992

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NOVA SCOTIA DEPARTMENT OF NATURAL RESOURCES

REPORT ON MINE SUBSIDENCE

IN THE

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1992

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- -forms of subsidence
- -subsidence occurrences

Probable Subsidence Areas

Conclusion

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Introduction:

Mining in the Pictou Coalfield began in 1827 when the General Mining Association started organized mining operations on the Foord seam.

Extensive underground extraction of coal from that time onward has resulted in a large portion of the Pictou coalfield being undermined (Figure 1). Associated with underground operations is the inevitable occurrence of subsidence of the ground surface over the mined areas. This is a concern to urban and commercial planners and is a particular concern to the private sector in that underground mining has restricted land use and sale of existing dwellings.

The purpose of this report is to give a general outline on subsidence, the forms of subsidence encountered in the Pictou Coalfield and the prediction of areas susceptible to future subsidence.

Nature of Subsidence:

Strictly speaking, any lowering of the ground surface, due to soil behaviour can be termed subsidence. However, for this report, subsidence includes only those movements that involve large volumes of ground material. Subsidence usually refers to vertical displacement of a point, and implies some horizontal movement of adjacent points due to the downward movement of the ground (Whittaker and Reddish, 1989).

Subsidence can be due to natural or man-made causes. Subsidence in the natural order include landslides, ground lowering as a result of seismic activity or collapse into cavities from groundwater solution of gypsum, limestone and salt deposits. Man-made subsidence usually is the result of underground extraction of

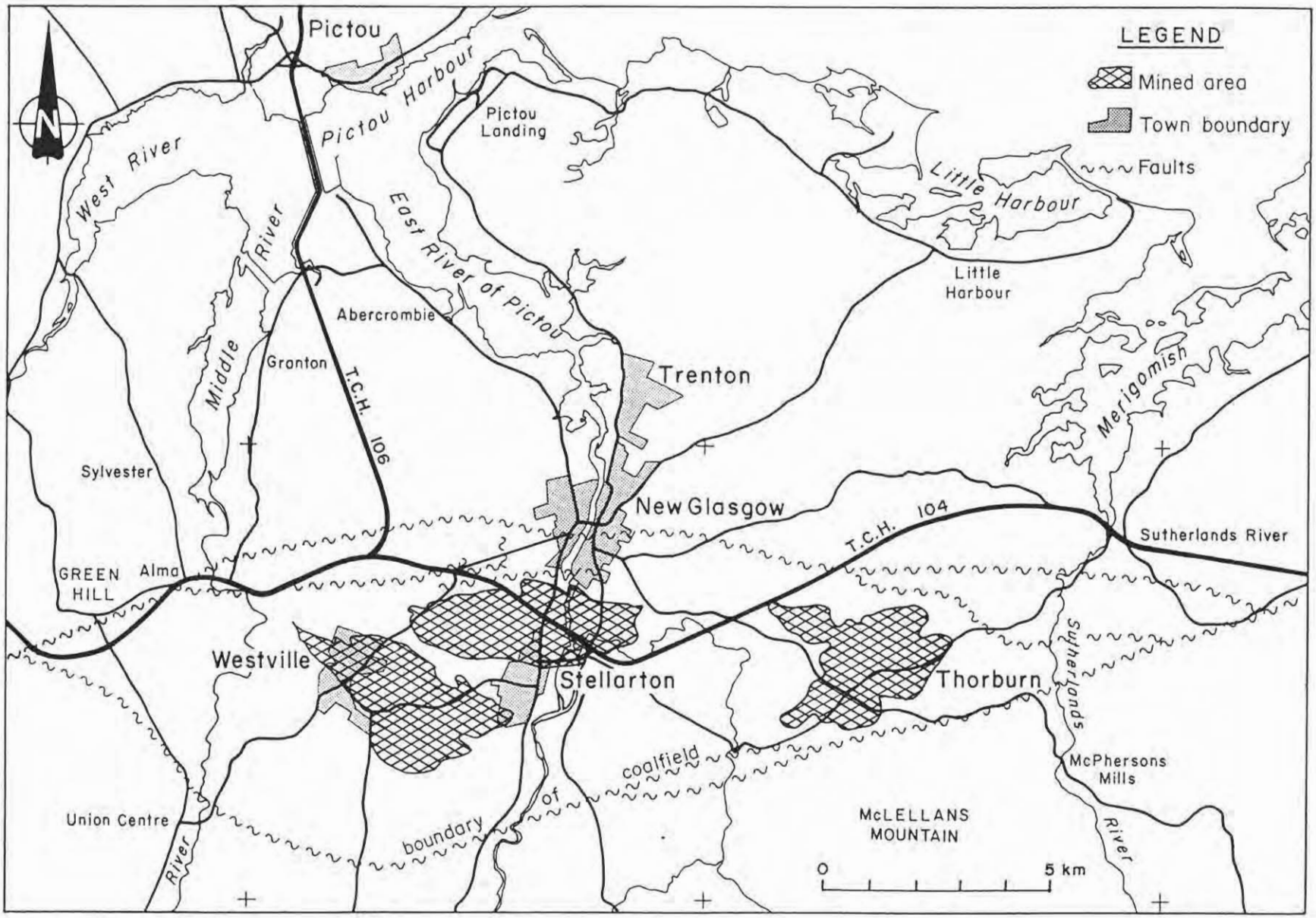


Figure 1. Location of Mine Workings in the Pictou Coalfield.

rock either as a result of mining activity or public utility operations such as underground storage, pipelines, or water conduits.

Subsidence occurrences in the Pictou coalfield are generally the result of underground mining activity.

Prediction of Mine Subsidence:

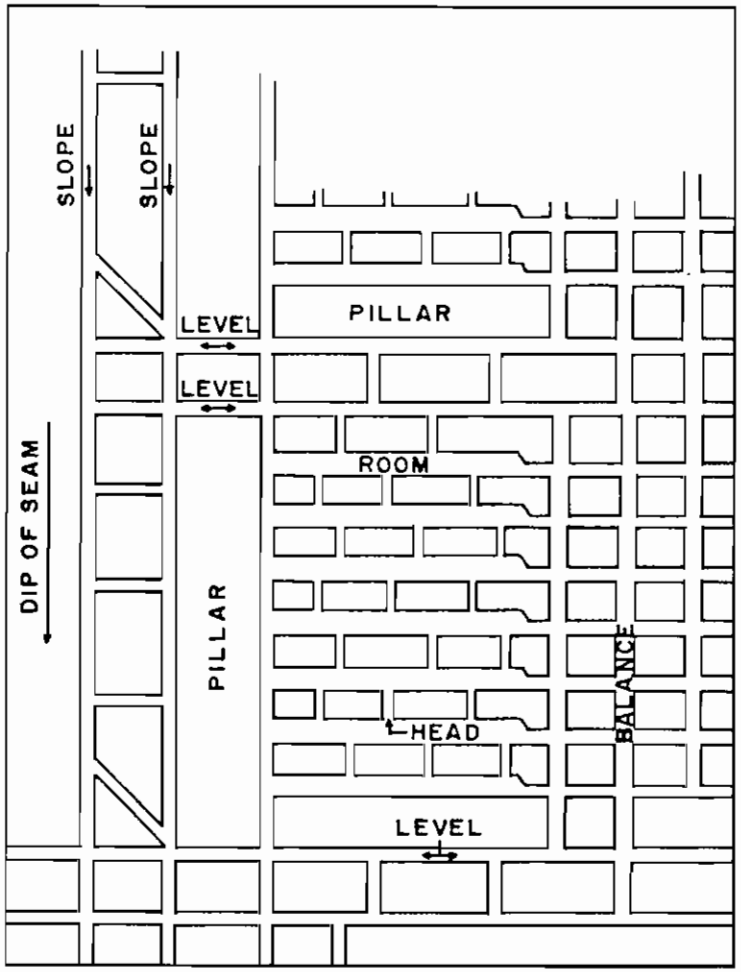
Surface subsidence related to mining activity is caused by underground collapse as a result of material extraction.

The effect of a subsidence on the ground surface is related to the form of mining, the areal extent of the mined area and the geological nature of the associated strata. Movement resulting from mining activity is caused by the re-distribution of the stress field and the tendency of the strata to seek equilibrium.

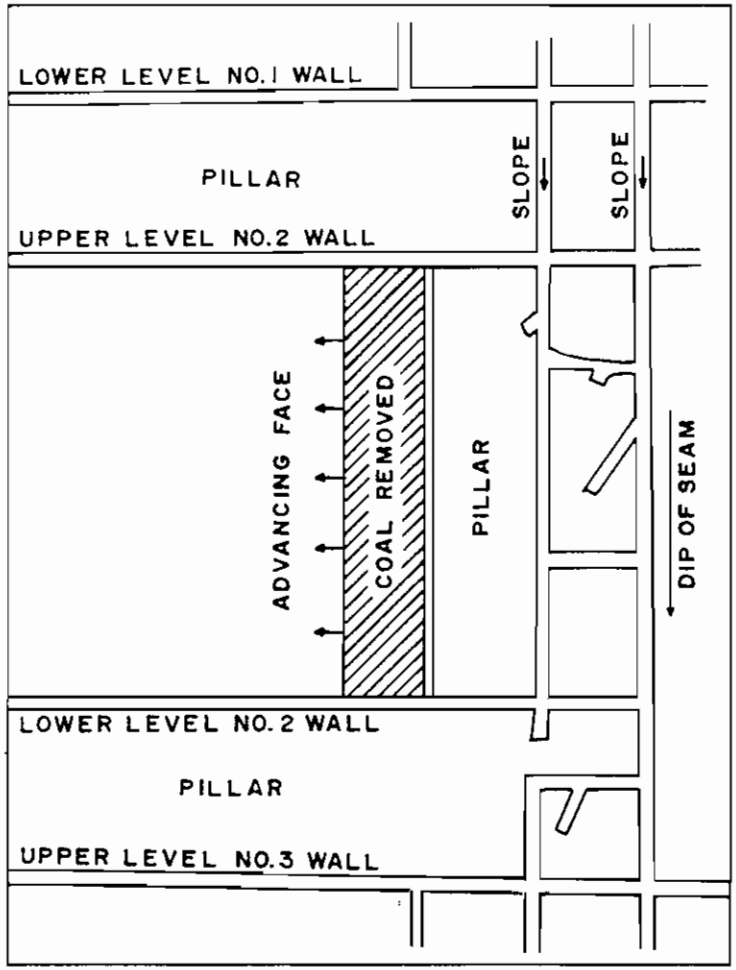
The two most common mining methods used in coal mining are the room and pillar method and the longwall method (Figure 2).

In room and pillar mining, the coal is mined in rooms and the weight of the overlying strata is supported by coal pillars that are left for that purpose.

Room and pillar mining was designed with short term stability in mind. It is most susceptible to surface subsidence over areas where room extraction took place or where the pillars collapse due either to stress buildup over time or to insufficient size in the first instance. As room and pillar operations are generally not deep, from surface to less than 300 metres, illegal mining or "bootlegging" can take place resulting in an additional weakening of strata, especially where pillars are withdrawn.



ROOM AND PILLAR METHOD
(Distance between levels 90-125 metres)



LONGWALL METHOD
(Distance between levels 125-225 metres)

Figure 2. Mining Methods in the Pictou Coalfield

Collapse of strata overlying room and pillar workings takes a characteristic dome shape. The height of the dome is dependent upon three factors (ibid):

1. strength of the immediate roof,
2. the bulking property of the fractured rock within the collapse dome,
3. the dimensions of the mine excavation.

The strength of the roof rock determines whether collapse takes place. The presence of strong beds such as sandstone will prevent or lessen the formation of a collapse dome whereas a soft rock such as mudstone will yield readily and a collapse dome will form rather quickly.

Bulking refers to the ease with which the overlying strata breaks, and fills the mined-out area. Rocks of low bulking factor such as sandstone tend to be strong and impede roof collapse. High collapse domes are usually found in rocks such as mudstone which have high bulking factors, and tend to break readily with increase in volume over their "in situ" volume.

The dimensions of width and extraction height are the principal factors in the formation of a collapse dome although rock strength, geology and mining depth can also play a role.

The width of extraction will determine the potential height of any resulting collapse dome. When the width of an excavation is wide enough for the induced stress to overcome the natural strength of the roof strata, collapse occurs. The extraction height is the major factor in causing a collapse dome to form. The height must be sufficient enough to allow a shearing movement to take place.

The effect on ground surface from collapse related to room and pillar operations is usually that of a sinkhole localized in area and conical in shape. The factors governing the formation of a collapse dome dictate that the closer the workings are to ground surface, the greater is the possibility of subsidence to reach that surface. Another subsidence form is a saucer shaped depression resulting from the collapse of a mine pillar.

In longwall mining, parallel levels are driven in the seam and connected to each other by a balance at the end of the levels. The connection is either at the beginning or end of the levels depending on whether the longwall is to be mined on an advancing or retreating system. As mining proceeds, the entire block of coal is removed between the levels and the roof is allowed to collapse into the void created. Longwall operations are generally carried out at greater depths (>300 M) than those of room and pillar.

Collapse of strata overlying longwall operations takes the form of a natural arch as the void is filled.

The creation of a surface depression over the area of extraction is dependent upon three conditions (ibid):

1. subcritical extraction
2. critical extraction
3. supercritical extraction

Sub-critical extraction takes place when the width to depth (w/h) ratio is less than 1.2-1.4. Width (w) refers to panel width or face width on the longwall and depth (h) refers to the depth of the workings below surface. Subsidence would not occur under these conditions.

Critical extraction occurs when w/h ratio = 1.2-1.4. Potential subsidence is possible under these conditions.

Supercritical subsidence allows for full potential subsidence to take place. The w/h ratio >1.2-1.4.

An assumption made for the above conditions is that the surface subsidence cannot exceed the extracted height (M). The maximum value of surface subsidence is about 0.9 M where extraction conditions permit its development.

Complications to the above conditions can arise where multiple extractions have taken place or where longwall operations take place under areas that had previously been worked by room and pillar mining.

The effect on surface from longwall extraction is that of a trough shaped depression in which maximum subsidence occurs near the center of the mined out section.

Time Factor in Subsidence:

The result of underground extraction is that large voids can be created depending upon the method of mining. It can be assumed that with time strata will collapse into the void leading to the possibility of surface instability. The time interval, from extraction to collapse, is variable.

In room and pillar operations, the timing of subsidence is very difficult to determine due to the numerous variables that must be addressed. Some of the variables are: the competency of the overlying strata, effects of groundwater in the strata, method of room and pillar extraction, dimensions of pillars and depth of mining, the type of coal, and the interaction of water on the coal pillars and on the roof and floor strata in flooded workings.

Subsidence related to room and pillar mine workings takes place not only during the life of the mine but has been recorded well over 100 years after mining has ceased.

In longwall operations, subsidence begins immediately upon extraction and is essentially complete within the first year of operation with residual subsidence taking place up to 5 years after mining operations have ceased.

Subsidence in the Pictou Coalfield:

General Geology:

The Pictou coalfield is located in north-central Nova Scotia in a synsidimentary pull-apart basin 9 km wide by 18 km long. The sediment that filled the slowly subsiding basin is collectively known as the Stellarton Formation. The Stellarton Formation comprises a thick sequence (>2600 m) of coal and oilshale bearing, grey and red mudstones, sandstones and minor conglomerate. The coal bearing sections generally consist of grey to black mudstone and fine to medium grained sandstones.

The dip of the coal seam is generally to the north at approximately 21 degrees but steepens on the margins of the basin. In Thorburn, the Captain and McKay seams lie in a synclinal trough and so have dip to the north and south (Figure 5).

Eleven seams were mined extensively in the Pictou coalfield. The seam thickness ranged from 1 metre to 13.4 metres.

Mining Method:

The mining method employed in the Pictou Coalfield from the inception of mining in 1827 to cessation of underground mining in 1984 was that of room and pillar. Around the year 1925, longwall operations were introduced on a limited scale into some of the mines (Figure 2).

Forms of Surface Subsidence:

Three forms of subsidence observed in the Pictou coalfield (Figure 3) are:

1. trough shaped depressions that cover a generally large area.
2. a sinkhole depression that is localized.
3. shaft collapse.

Trough shaped depressions have been observed in two locations; one on the Acadia Seam in Westville (Figure 4, loc. 3), and the other on the Six Foot seam in Thorburn (Figure 5, loc. 1).

At both localities, the mine extraction method was room and pillar. The depth from surface to the old workings on the Acadia seam in approximately 50 metres while the depth to the Six Foot seam in Thorburn is approximately 120 metres.

In Westville (Acadia Seam, Loc. 3), subsidence caused damage to four houses that eventually had to be removed from the site. A combination of factors led to this subsidence. The subsidence occurred in an area where there was a very large mine junction with very narrow support pillars. The dip of the strata was high at approximately 30 degrees, and the possibility existed that some of the pillars had been "bootlegged". The combination of all of the above coupled with the fact of very soft ground conditions due to spring break-up and much rain caused subsidence.

At Thorburn (Figure 5, Six Foot Seam, Loc. 1), 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.

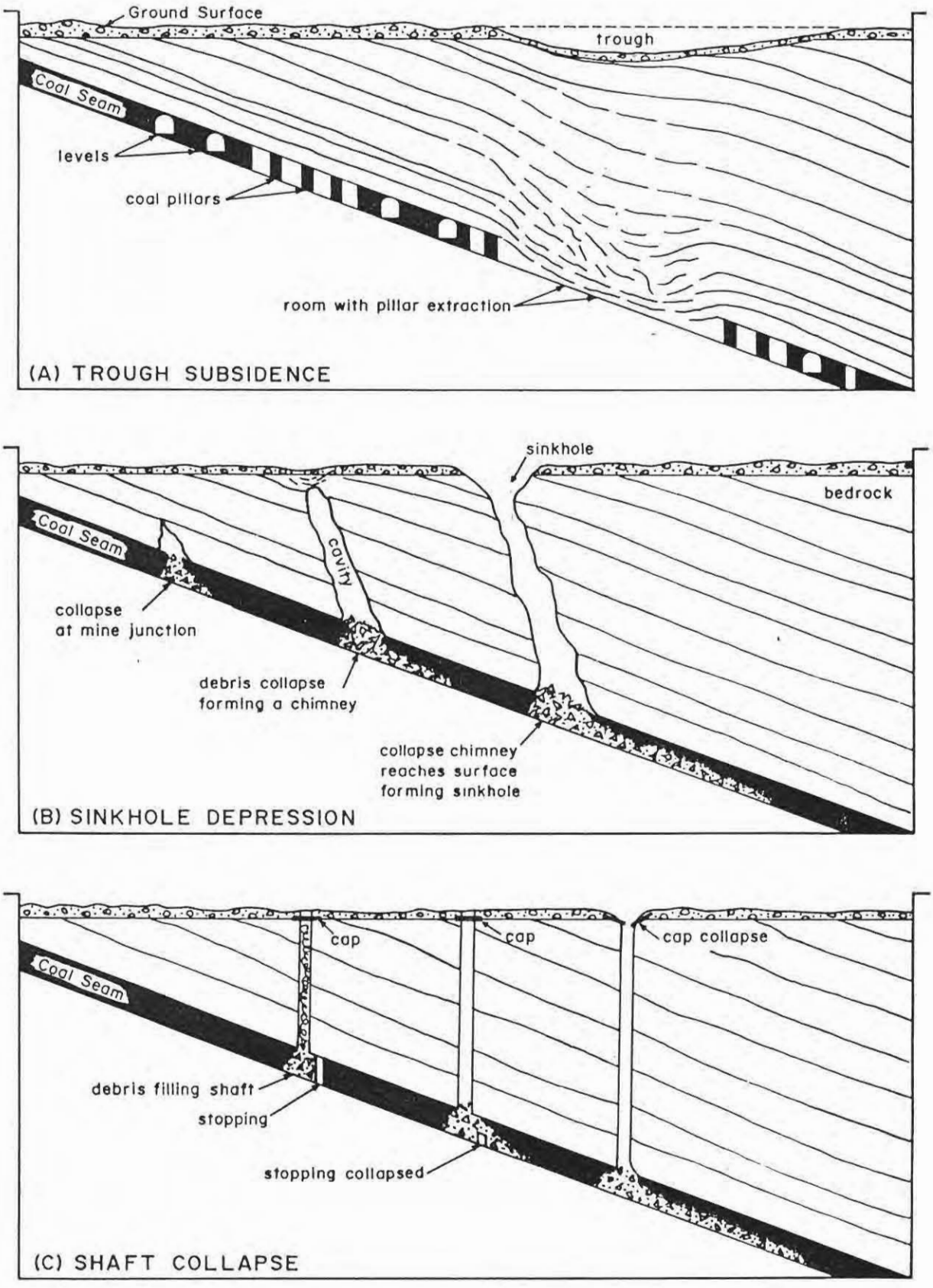


Figure 3. Subsidence Features in the Pictou Coalfield

Sinkhole depressions are a common form of subsidence in the Pictou Coalfield. The sinkholes result from collapse of the overlying strata into the area of excavation, and subsequent migration of the broken zone toward surface. The resulting feature is termed a collapse chimney. Sinkholes form at surface by either a steep conical depression or an open hole generally with vertical walls.

A dramatic example of a sinkhole took place on the Cage seam (Figure 4, loc. 3) when a collapse chimney reached surface. A circular hole approximately 4 metres in diameter, and 10 metres deep appeared on surface with vertical walls. Trees that had been on surface fell in the hole and were still standing upright with only the very top protruding from the hole. From the time of collapse to backfilling a period of 5 days elapsed. In that period of time, the coal began to combust.

Shaft collapse is also relatively common in the Pictou coalfield especially in areas mined in the mid-1800's. The ground surface overlying the shaft subsides due to the disintegration of the original cap. A consistent method of shaft sealing and abandonment was probably not followed and so different abandonment procedures may have resulted for each shaft.

The collapse of the Forster Pit (Figure 4, Foord Seam, loc. 8), abandoned in 1869, is a good example of a shaft collapse. The surface material collapsed suddenly and left an opening that was approximately 4mx3m and to be approximately 130 metres deep. The original cap consisted of steel I-beams laid across the mouth of the shaft. The I-beams were overlain by a gridwork of steel rails, covered by metal sheeting and then by rough timber. The cap was then buried with 2 to 3 metres of clay and aggregate. If the original shaft had been filled with debris little remained after 120 years since abandonment as it took 1400 cubic metres of aggregate to fill the hole.

Subsidence Occurrences:

Subsidence occurrences dating back approximately 50 years have been catalogued with information pertaining to each site recorded (Appendix I). This list includes only subsidence in which a site locality could be identified. Other subsidences have occurred but the site localities are now forgotten. Also recorded is the time of year in which the subsidence took place and information concerning the extent of the subsidence (Appendix II). The site locations are found on accompanying maps and numbered according to each seam (Figures 4 and 5).

Twenty nine sites are recorded and cover the years from 1946 to 1991.

Approximations of depth to mine workings, distance to seam crop and distance to mine limit are tabulated in Appendix II.

It is noted that 26 of the 29 subsidences recorded took place in either the Spring or Fall of the year when the ground was waterlogged due to Spring break-up and the increase in rainfall in the Fall of the year. One subsidence on the Foord seam (Loc. 9) is believed to have resulted from effects of ground water lowering during the dry summer of 1987.

The Acadia seam in Westville recorded subsidences with the greatest average depth to mine workings. This depth probably is a result of the high dip of strata in the area (30°) and the effect of gravity on falling debris.

The majority of subsidences have taken place where the depth to mine workings is less than 60 metres (Table I). If the five shafts are excluded from the calculation, subsidences in areas where vertical distance from surface to the mine workings is less than 60 metres account for 87% of the recorded occurrences.

TABLE 1

Depth to Mine Workings	Number of Occurrences	Percentage
<30 M	10	35
>30 M < 60 M	10	35
>60 M < 90 M	1	3
>90 M	2	7
Shafts	6	20

The average distance of the subsidence sites from the crop of the coal seam is 76 metres while the distance to the upper mining limit is somewhat less at 55 metres.

Several sites are susceptible to repeated subsidence. The Acadia seam (Figure 4, loc. 2) has had repeated subsidence two of which caused extensive property damage. The probability is high that subsidence will take place in this area again. Location 5 in Westville, in an area of pillar withdrawal, has had several collapses. On the Purvis seam in Stellarton (Figure 4, loc. 1) the old slope has caved in on several occasions. The digging of a channel from the water reservoir on the old Acadia Coal Mine property into this slope is the probable cause of the repeated subsidence.

Several shafts such as the Cage furnace shaft (Figure 4, loc. 2) continue to slowly subside.

Probable Subsidence Areas:

The depth of mine workings recorded from the subsidences, excluding the shaft subsidences, has an indicated range from 5 to 120 metres with an average of 37 metres. Subsidences, where cover is less than 30 metres tend to be catastrophic in nature i.e. there is a very sudden collapse of the ground surface. Where ground cover is greater than 30 metres subsidence is generally gradual.

The above figures are to be used as a "rule of thumb" and not to be strictly interpreted for it is possible that a catastrophic subsidence could take place where there is 50 metres of vertical cover.

A single zone has been outlined on the subsidence location maps (Figures 4 and 5). This zone corresponds to a 50 metre vertical depth to the workings and represents the zone where the probability for catastrophic subsidence is high. The influences of overburden and topography have not been considered in outlining the boundary of the zone.

The area of influence for the depth indicated is measured from the assumed positions of the seam outcrops. In areas where a barrier pillar remains between the upper limit of the mine workings and the seam outcrop, that area is considered to have been mined as the actual position of the outcrop is not known with certainty.

Conclusion:

Subsidence occurrences in the Pictou coalfield result from the collapse of old coal mine workings that date back 150 years. The subsidences are generally restricted to areas where the depth to the old workings is less than 50 metres. As most of the coal seams dip northward at an angle of 21° , the zone of subsidence is restricted to the vicinity of the seam crop.

Subsidence is found in three forms namely trough shaped depressions, sinkhole depressions and shaft collapses.

Subsidence locations have been plotted on base maps and cover a time frame of 50 years from the present.

Areas of probable subsidence representing a vertical depth of 50 metres to the old workings have also been outlined on the base maps.

REFERENCE

Whittaker, B. N. and Reddish, D. J. (1989) Subsidence; Occurrence, Prediction and Control; Developments in Geotechnical Engineering, 56; Elsevier Science Publishing Company Inc., New York.

ACKNOWLEDGEMENTS

The author would like to express appreciation to Watson MacLeod, John W. Thompson, and Fred Doucette, all ex-miners, who donated their time and gave valuable assistance in explaining past mining practices and details on past subsidence locations.

APPENDIX I

SUBSIDENCE OCCURRENCES IN THE PICTOU COALFIELD

FOORD SEAM

REFERENCE NUMBER	DATE	REMARKS
1	1960?	At intersection of Foster Avenue and Pleasant Street.
2	1964	Collapse of part of Foster Avenue 60 metres from Foord Street intersection. Head from old workings collapsed.
3	May, 1962	Collapse near graveyard of Anglican cemetery on Bridge Avenue - 6 m deep.
4	1975?	In vicinity of old No. 1 shaft at NSPC building on Bridge Avenue.
5	Spring, 1979	North end of King Street in Stellarton at Ultramar bulk plant. Probable collapse in vicinity of old shaft. Emitted large volumes of water. Appears to be recurring at time of writing.
6	April, 1980	Collapse in yard of house on Foster Avenue, west of Anglican Church graveyard, old bootleg working? - 2 m deep.
7	April, 1981	Gordon pit, collapse behind NSPC on Bridge Avenue, 3 m deep.
8	July, 1987	Forster pit collapsed. Very deep, 137 m.
9	September, 1987	Subsidence immediately west of Dalhousie pits - 5 m deep.

CAGE SEAM

REFERENCE NUMBER	DATE	REMARK
1	Spring, 1974	Collapse in the Evansville area
2	Spring, 1986	Old furnace shaft collapsed, not the first time.
3,4	May, 1989	3. Collapse into old workings-10 m deep. Beginning to smoulder. 50 metres from similar collapse (4) in 1964 when seam caught fire and was extinguished only after great effort.
5	April, 1991	Catastrophic collapse 3 m diam., 7 m deep into old workings.

PURVIS SEAM

REFERENCE NUMBER	DATE	REMARK
1	May, 1989	Fan drift on Purvis Seam to Albion Mine on Third Seam Filled in again in October, 1989. Collapse again in April, 1991. Hole 3 m deep. 4 m diam.

MACGREGOR SEAM

REFERENCE NUMBER	DATE	REMARK
1	April, 1991	Small subsidence-2 m deep near slopes into MacGregor near intersections of Maple Street and Pleasant Avenue.

ACADIA SEAM

REFERENCE NUMBER	DATE	REMARK
1	February, 1988	Subsidence of road on Drummond path - 1 m subsidence
2	March, 1989	Corner of Grant and Diamond Street, Westville
3	April, 1989	Subsidence on Oliver Street. Four houses damaged. Same area that subsided in 1944. Subsidence also occurred at the intersection of Duff Street and College Street in 1944.
	May, 1989	After heavy rain more damage to houses on Oliver Street when ground began to subside. Ground in the area settled 2 m.
4	1946?	Subsidence at intersection of High Street and Drummond Path. Foundation of two houses cracked.
5	November, 1990 April, 1985, 1986,	At ballfield on Diamond Street
6	Nov.9,	After heavy rain, near mouth of and on line with Acadia No. 5 slope. 2 m drop. Again on March, 1991, 5 m drop, cavity contained water.
7	November, 1990	At the end of Office Street and Diamond Street 30 m southwest.
8	March, 1991	100 m west of Porter's Lane 15 m southside of Cowan Street
9	April, 1991	Vicinity of old furnace shaft, 120 yards material to fill hole.

SIX FOOT SEAM

REFERENCE NUMBER	DATE	REMARK
1	September, 1987	Lawn at Thorburn School. Slight subsidence, 0.5 metre
2	August, 1988	Across road from Thorburn High School some slight subsidence.
3	June 7, 1990	At Thorburn, on line with Acadia No. 3 (Vale) slopes; 2 m deep.

MCBEAN SEAM

REFERENCE NUMBER	DATE	REMARK
1	Spring	Near the Lanark Slope

APPENDIX II

SEAM	SITE	DEPTH TO MINE WORKINGS (metres)	DISTANCE TO SEAM CROP (metres)	DISTANCE TO UPPER MINING LIMIT (metres)
Foord	1	±8	±1	±10
	2	±13	±30	±10
	3	±6	±1	±20
	4	N/A Old No. 1 Shaft	220	N/A
	5	N/A Stair Shaft	40	N/A
	6	±8	±1	±20
	7	N/A Gordon Pit	330	N/A
	8	N/A Forster Pit	320	N/A
	9	±23	±60	±1
Cage	1	±35	±90	±20
	2	N/A Furnace Shaft		N/A
	3	±23	±60	±1
	4	±35	±90	±30
	5	±36	±95	±50
Purvis	1	±5	±1	±1
MacGregor	1	±5	±1	±1
Acadia	1	±40	±100	±65
	2	±60	±115	±80
	3	±50	±90	±30
	4	±87	±220	±190
	5	±38	±55	±30
	6	±38	±55	±55
	7	±38	±60	±60
	8	±38	±70	±60
	9	N/A Furnace Pit	±70	N/A
Six Foot	1	±120	±315	±290
	2	±110	±265	±240
	3	±28	±25	±1
McBean	1	±9	±28	±1
			Range 1M-315M	Range 1 M-290M
	29	Avg. 37 M	Avg. 76 M	Avg. 55 M

PROVINCE OF NOVA SCOTIA
DEPARTMENT OF NATURAL RESOURCES

PROBABLE SUBSIDENCE AREAS STELLARTON – WESTVILLE

PICTOU COALFIELD, PICTOU CO., N.S.

Metres 250 0 250 500 750 1000 Metres

Scale 1:20 000

1992 K.S. GILLIS

Figure 4

LEGEND

Area of probable subsidence (influence of 50m vertical depth)

Coal seam outcrop

■2, ×4 Abandoned shaft, subsidence location (number indicates subsidence recorded)

T.C.H. 104

Exit 26

CAPTAIN SEAM

SAINT MARY RD

Marsh Br.

Shale Br.

McLellans Br.

McLellans Mountain Road

McLellans Brook Road

McLELLANS BROOK

UPPER McKAY SEAM

LOWER McKAY SEAM

PINE TREE RD

THORBURN RD

THORBURN

MACPHERSONS MILLS RD

HOLLOW RD

THORBURN SEAM

ROAD

SIXFOOT

McBEAN SEAM

GREENWOOD

McLeod Br.

ROUTE 247

WHITBURN

PARKS FALLS

McLELLANS MOUNTAIN

E4,413,000 E4,414,000 E4,415,000 E4,416,000 E4,417,000 E4,418,000 E4,419,000

Grid Reference: 5° M.T.M. (A.T.S. 77)

PROVINCE OF NOVA SCOTIA

DEPARTMENT OF NATURAL RESOURCES

PROBABLE SUBSIDENCE AREAS THORBURN

PICTOU COALFIELD, PICTOU CO., N.S

Metres 250 0 250 500 750 Metres

Scale 1:20 000

1992

K.S. GILLIS

Figure 5

10-M-3100

430388

RE GEORGE W. McKAY LEASE AT THORBURN

TO J. P. MESSERVEY

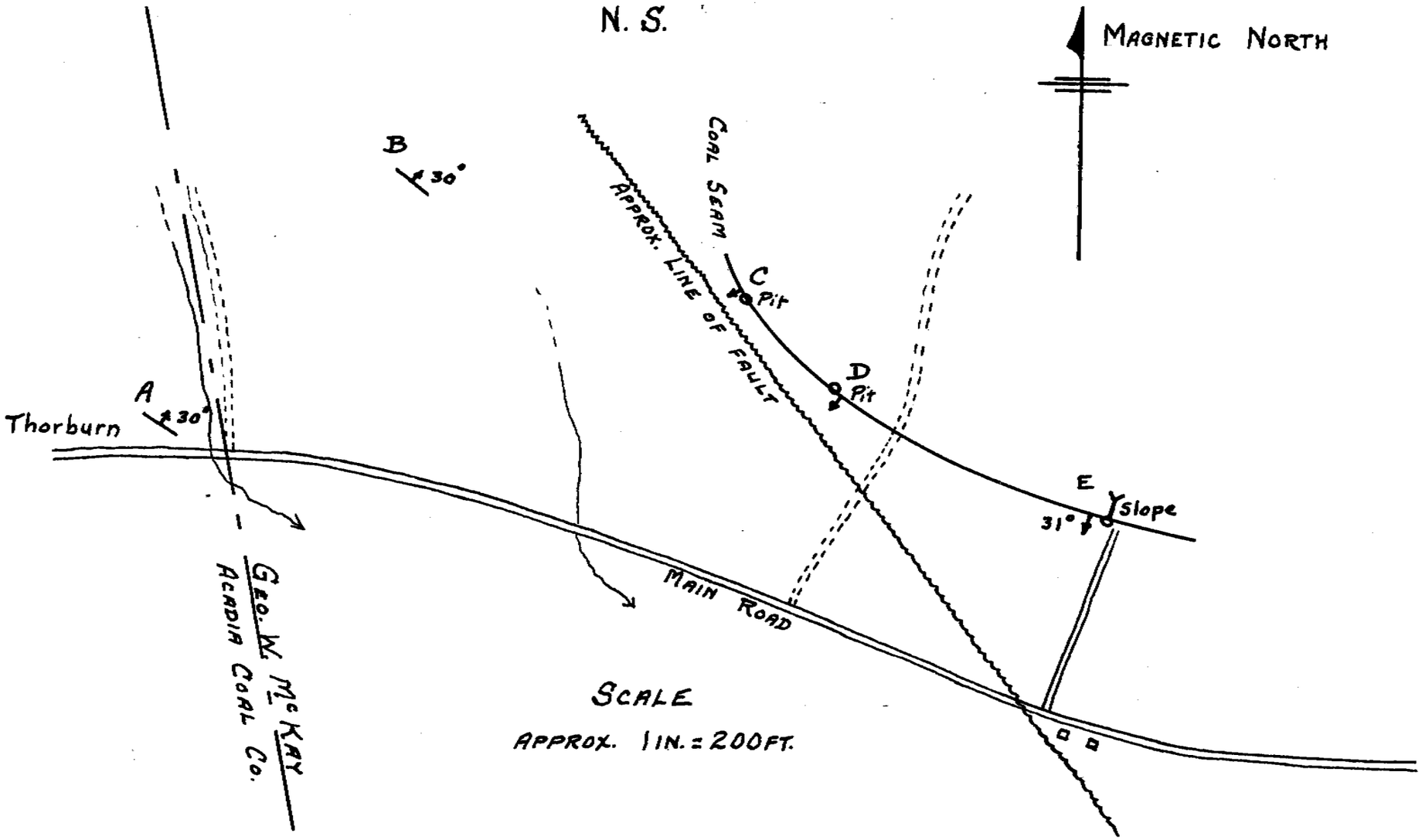
FROM M. G. GOUDGE

On June 7th, accompanied by Mr. G. W. McKay I visited Thorb and went over the ground covered by his lease for coal. As all the p were water filled and few outcrops showing I was unable to determine for myself the exact geological stmucture of this vicinity. However, from what outcrops I could see, together with the location of the pits and the direction of their slopes I gather there is at least a portion of an inverted basin of coal. On the attached sketch, A and B show the strike and dip of the normal strata in the district. The pit at C dipping southerly had the seam cut off by a fault about 40 feet west of the mouth of the slope, but the extension of its outcrop north has not been traced. Pit D was shallow and did not extend to the fault while the workings at slope E were reported to have extended under the road before reaching the fault. This fault or break is stated to be a badly mixed up and shattered zone rather than a clean break. It is also interesting to note that the thickness of the coal seam varied from 11 feet at C to 6 feet at D and 5 feet or less at E. The extension of this seam was picked up approximately 100 feet eastwards by pits but beyond that it has not been proved. Another fault shown on Hugh Fletcher's map a short distance eastwards probably cuts off its extension, unless it pinched out before reaching it as the fast dwindling seam indicated. As far as I could ascertain no attempt has been made to prove the existence of another inverted seam to the north, which seam would be the extension of the western end of the seam around the dome. Due to lack of outcrops here it would be necessary to carry out this work by pits and trenches. Mr. Fletcher also shows a fault located in this section, and I am of the opinion that no north leg of this seam exists. The vicinity is so cut up by faults that profitable mining in this area would be practically impossible due to the lack of any extensive seam of coal.

M. G. Goudge

Halifax, N. S.,
June 17, 1938

GEO. W. McKAY LEASE
THORBURN
N. S.



SCALE

APPROX. 1 IN. = 200 FT.

June 1938
M.G.G.

430383

DIVISION OF FUELS

Report of Analyses* of Commercial Coal Samples

Acadia Coal Co. Ltd. - McBean

Sampled by: T.L. Tibbetts — Date of Sampling: July 15, 19

Size	Fines -3/16" T.	Run of Washer + 3/16" T.	Washed Splint
Lab. No.	2266-55	2271-55	2267-55
Proximate Analysis			
Moisture ..... %	3.0 (3)	1.7	1.0
Ash ..... %	10.6	10.9	15.3
Volatile Matter ..... %	30.8	28.4	30.6
Fixed Carbon ..... %	55.6	59.0	53.1
Sulphur ..... %	0.6	0.3	0.4
Calorific Value ..... Btu/lb.	12,825	13,190	12,225
Ash Softening Temp. .....°F.	2420	2500	2250
Caking properties (1)	Poor	Fair	Poor
Free Swelling Index (ASTM)	2.0	2.5	1.0
Grindability (2)	61	55	57
Bulk density ..... lb./cu. ft.	48.5	50.0	51.0
Calorific Value: Dry mineral matter free-Btu/lb.	15,040	15,290	14,690
Screen Analysis (Round-hole screens)			
Plus 6 in. %			
6 x 5 in. %		0.7	1.0
5 x 4 in. %		3.6	3.1
4 x 3 in. %		4.6	11.4
3 x 2-1/2 in. %		6.3	16.3
2-1/2 x 2-in. %		9.7	13.7
2 x 1-1/2 %		11.6	15.1
1-1/2 x 1-1/4 %		8.3	9.9
1-1/4 x 1 in. %		10.0	8.7
1 x 3/4 in. %		12.1	7.2
3/4 x 1/2 in. %		11.9	5.4
1/2 x 3/8 in. %		7.1	2.5
3/8 x 1/4 in. %	8.6	6.5	1.3
1/4 x 1/8 in. %	37.1	3.6	1.3
1/8 x 1/16 in. %	19.9	4.0	3.1
1/16 x 1/32 in. %	15.9		
1/32 x 0 in. %	18.5		

(1) By Volatile at 950°C.
(2) Hardgrove Index.
(*) On as received basis unless noted otherwise.
(3) From special moisture sample prepared at time of sampling.

Date of Report: May 18, 1955

Reported by: E. Swartzman, Senior Technologist.

1.0 - M - 3 1/0 0

430383

DIVISION OF FUELS

Report of Analyses* of Commercial Coal Samples

Acadia Coal Co. Ltd. - [illegible] Mine

Sampled by: T.F. Tibbutt — Date of Sampling: July 15, 1

Size	[illegible] 1¼"sq.x7"rd.	[illegible] 6"x1¼"sq.	[illegible] 3/16"T. [illegible]"sq.	[illegible] Or[illegible]"sq.
Lab. No.	2270-55	2269-55	2268-55	2272-55
Proximate Analysis				
Moisture ..... %	1.7	2.8 (3)	3.4 (3)	2.6 (
Ash ..... %	11.3	10.8	10.5	11.8
Volatile Matter ..... %	28.6	28.9	29.5	27.8
Fixed Carbon ..... %	58.2	57.5	56.6	57.8
Sulphur ..... %	0.3	0.4	0.4	0.4
Calorific Value ..... Btu/lb.	13,010	12,870	12,784	12,835
Ash Softening Temp. .....°F.	2470	2500	2460	2420
Caking properties (1)	Fair	Poor	Poor	Fair
Free Swelling Index (ASTM)	2.5	2.5	3.0	2.5
Grindability (2)	55	55	55	60
Bulk density ..... lb./cu.ft.	47.5	46.5	46.5	51.5
Calorific Value: Dry mineral matter free-Btu/lb.	15,155	15,085	15,040	15,220

Screen Analysis (Round-hole screens)

	Plus	6 in.	%	1.6			
6	x	5 in.	%	1.3			
5	x	4 in.	%	6.7			
4	x	3 in.	%	14.2			
3	x	2-1/2 in.	%	21.4			
2-1/2	x	2-in.	%	29.2	2.0		
2	x	1-1/2	%	9.4	17.2		
1-1/2	x	1-1/4	%	2.6	16.4		
1-1/4	x	1 in.	%	2.2	24.6		
1	x	3/4 in.	%		24.0	6.7	3.0
3/4	x	1/2 in.	%		7.2	39.8	19.2
1/2	x	3/8 in.	%			21.7	9.3
3/8	x	1/4 in.	%			19.9	13.1
1/4	x	1/8 in.	%	11.4	8.6	7.6	22.7
1/8	x	1/16 in.	%				11.1
1/16	x	1/32 in.	%			4.3	9.6
1/32	x	0 in.	%				12.2

(1) By Volatile at 950°C.
(2) Hardgrove Index.
* Tyrod screen

(*) On as received basis unless noted otherwise.
(3) From special moisture sample prepared at time of sampling.

Date of Report: May 18, 1955

Reported by: E. Swartzman, Senior Technologist.

10-M-3 1(0 0)

430383

DIVISION OF FUELS

Report of Analyses* of Commercial Coal Samples

Acadia Coal Co., Ltd. - McBean Mine

Thorburn, Nova Scotia

Sampled by: T.E.Tibbetts — Date of Sampling: Aug. 16, 195

Size	EGG 6" x 1 3/4" sq.	NUT 1 3/4 x 3/4" sq.	STOKER PEA 3/4"sq. x 3/16"T.	3/16'
Lab. No.	3219-56	3220-56	3221-56	3222
Proximate Analysis				
Moisture .....%	1.5	1.9	1.8	2.5
Ash .....%	12.2	10.9	12.4	12.4
Volatile Matter.....%	28.6	28.9	29.2	28.3
Fixed Carbon .....%	57.7	58.3	56.6	56.8
Sulphur .....%	0.4	0.3	0.5	0.5
Calorific Value .....Btu/lb.	13,005	13,220	12,970	12,750
Ash Softening Temp .....F	2500	2510	2470	2450
Caking properties (1)	Fair	Fair	Fair	Fair
Free Swelling Index (ASTM)	3.5	4.0	4.0	3.5
Grindability (2)	-	-	58	62
Calorific Value: Dry mineral matter free-Btu/lb.	15,295	15,365	15,335	15,220

Screen Analysis (Round-hole screens)

	Plus	2-in.	%	1.6		
2	x	1-1/2	%	18.3		
1-1/2	x	1-1/4	%	17.3		
1-1/4	x	1 in.	%	25.0		
1	x	3/4 in.	%	29.4	5.2	
3/4	x	1/2 in.	%	6.4	41.8	
1/2	x	3/8 in.	%	1.4	22.5	0.3
3/8	x	1/4 in.	%	1.1	20.3	7.1
1/4	x	1/8 in.	%	1.0	6.4	40.5
1/8	x	1/16 in.	%	)	1.3	16.3
1/16	x	1/32 in.	%	) 2.5	0.7	15.5
1/32	x	0 in.	%	)	1.8	20.3

* Analyses on "as received" basis.
(1) By Volatile at 950°C .
(2) Hardgrove Index.

Reported by: T.E. Tibbetts,
Scientific Officer.

Date of Report: Dec. 11, 1956.

10-M-31(0)

DIVISION OF FUELS 430383

Report of Analyses of Commercial Coal Samples

Acadia Coal Co., Ltd., - McBean Mine
Thorburn, Pictou County, Nova Scotia.

Sampled by: T. E. Tibbetts. Date of Sampling: June 24, 195

Size	Washed Egg 6 x 1¾" sq.	Washed Nut 1¾ x ¾" sq.	Washed Stoker ¾" sq. x 3/16" T.	Fin -3
Lab. No.	2927-57	2928-57	2929-57	2
Proximate Analysis				
Moisture .....%	3.4 *	3.0*	4.7*	
Ash .....%	14.3	14.4	14.5	
Volatile Matter.....%	27.8	27.6	27.0	27.7
Fixed Carbon .....%	54.5	55.0	53.8	54.5
Sulphur .....%	0.5	0.4	0.5	0.6
Calorific Value ....Btu/lb.	12,300	12,540	12,205	11,825
Ash Softening Temp .....°F	2430	2440	2450	2430
Caking properties (1) ...	Poor	Poor	Poor	Poor
Grindability (2)	-	60	59	63
Calorific Value: Dry mineral matter free-Btu/lb.	15,225	15,465	15,395	15,015

Screen Analysis (Round-hole screens).

	+	3/8 in	%	0.8
3/8	x	1/4 in.	%	2.5
1/4	x	1/8 in	%	35.0
1/8	x	1/16 in	%	20.0
1/16	x	1/32 in	%	18.3
1/32	x	0 in.	%	23.4

* Moisture from special moisture samples.

\+ In accordance with the volatile matter and Specific Volatile Index it would appear that coal from which this sample was taken had suffered some oxidation.

(1) By Volatile at 950°C.

(2) Hardgrove Index.

Date of Report: Oct. 10, 1957.

Reported by: T. E. Tibbetts.

E. Swartzman,
Senior Technologist.

10-M-3(10)

420388

10-M-3100

DIAMOND DRILL RECORD

PROPERTY ..... HOLE No. 1

SHEET NUMBER ..... SECTION FROM ..... TO ..... STARTED Greenwood

LATITUDE ..... DATUM ..... COMPLETED September 26, 1961

DEPARTURE ..... BEARING ..... ULTIMATE DEPTH .....

ELEVATION ..... DIP ..... PROPOSED DEPTH .....

DEPTH FEET	FORMATION	SAMPLE NO.	FROM	TO	WIDTH	ASSAY VALUES			
0-21'10"	Overburden and lost core						5° @28'		
21'10"-35'0"	Shale gray with ironstone bands						15° @39')		
35'0"-40'9"	Shale gray sandy						15° @57')	not very	clear
40'9"-41'2"	Shale dark soft crumbling								
41'2"-41'9"	Shale gray								
41'9"-42'3"	Shale dark crumbling								
42'3"-63'6"	Shale gray sandy in places								
63'6"-63'10"	Shale dark								
63'10"-64'9"	Splint and stone								
64'9"-65'7"	Shale gray (65'7"-67'6" splint								
65'7"-68'7"	Splintry coal (67'6"-68'0" Stone (68'0"-68'7" Splint								
68'7"-78'4"	Shale dark a little sandy, soft in places								
78'4"-78'0"	Shale gray soft nearly clay								

NORTHERN MINER FORM 505 REV./54

DRILLED BY ..... SIGNED .....

DIAMOND DRILL RECORD

PROPERTY Thorburn Area Picton Co. HOLE No. 1

SHEET NUMBER SECTION FROM TO STARTED Greenwood

LATITUDE DATUM COMPLETED

DEPARTURE BEARING ULTIMATE DEPTH

ELEVATION DIP PROPOSED DEPTH

Dept. of Mines
DRILL

10 - M - 31(0 0)

DEPTH FEET	FORMATION	SAMPLE NO.	FROM	TO	WIDTH	ASSAY VALUES		
78'0"-86'0"	Shale gray sandy					11° @74'		
86'0"-86'4"	Clay dark					9° @81'		
86'4"-97'2"	Shale gray sandy					10° @94'		
97'2"-97'7"	Clay gray					16° @98'		
97'7"-104'6"	Shale gray					17° @112'		
104'6"-112'8"	Shale gray sandy					11° @133'		
112'8"-124'8"	Shale gray ironstone bands							
124'8"-125'4"	Shale black some slickensides							
125'4"-125'8"	Splint							
125'8"-129'1"	Coal							
129'1"-131'2"	Shale black a little carbon							
	END OF HOLE							

NORTHERN MINER FORM 505 REV./54

DRILLED BY SIGNED

DIAMOND DRILL RECORD

PROPERTY Pictou Co. HOLE No. Thorburn - 1 (3447)

SHEET NUMBER SECTION FROM 0.0' - 85'0" TO STARTED April 27, 1961

LATITUDE DATUM COMPLETED

DEPARTURE BEARING ULTIMATE DEPTH

ELEVATION DIP PROPOSED DEPTH

DEPTH FEET	FORMATION	SAMPLE NO.	FROM	TO	WIDTH	ASSAY VALUES			
0-30	Overburden and lost core						26° @38'		
30'-33'	Shale dark soft in places, fragmented						16° @48'		
33'-35'9"	Shale red						16° @55'		
35'9"-37'6"	Shale dark with small patches of red						13° @63'		
37'6"-42'5"	Shale red						19° @78'		
42'5"-67'10"	Shale gray and dark interbedded fragmented								
67'10"-68'4"	Shale gray sandy								
68'4"-82'4"	Shale dark to black, patches of impure oil shale								
82'4"-82'5"	(Band of coal)								
82'5"-85'0"	Shale black (oil shale)								

NORTHERN MINER FORM 505 REV./54

DRILLED BY SIGNED

DIAMOND DRILL RECORD

PROPERTY ..... HOLE No. Thorburn 1

SHEET NUMBER ..... SECTION FROM 85'0" TO 149'8" STARTED April 27, 1961

LATITUDE ..... DATUM ..... COMPLETED .....

DEPARTURE ..... BEARING ..... ULTIMATE DEPTH .....

ELEVATION ..... DIP ..... PROPOSED DEPTH .....

DEPTH FEET	FORMATION	SAMPLE NO.	FROM	TO	WIDTH	ASSAY VALUES			
85'0"-86'7"	Breccia sandy					17°	@95'		
86'7"-95'10"	Shale dark					16°	@104'		
95'10"-97'2"	Shale gray					22°	@112'		
97'2"-97'8"	Sandstone gray fine grained					20°	@130'		
97'8"-102'8"	Shale gray								
102'8"-103'4"	Shale sandy								
103'4"-105'0"	Shale dark								
105'0"-109'5"	Shale gray								
109'5"-125'0"	Shale gray and red in patches								
125'0"-127'0"	Shale gray								
127'0"-133'7"	Shale gray very sandy to fine grained sandstone								
133'7"-149'8"	Shale dark fragmented crumbling to clay at 137', 145' and 150'								

NORTHERN MINER FORM 505 REV./54

DRILLED BY ..... SIGNED .....

DIAMOND DRILL RECORD

PROPERTY ..... **HOLE No.** Thorburn 1

SHEET NUMBER ..... **SECTION FROM** 149'8" **TO** 226'1" **STARTED** .....

LATITUDE ..... **DATUM** ..... **COMPLETED** .....

DEPARTURE ..... **BEARING** ..... **ULTIMATE DEPTH** .....

ELEVATION ..... **DIP** ..... **PROPOSED DEPTH** .....

DEPTH FEET	FORMATION	SAMPLE NO.	FROM	TO	WIDTH	ASSAY VALUES			
149'8"-150'0"	Clay dark from the dark shale						20°	@137'	
150'0"-177'10"	Shale black, slickensided from 152'8"-153'11" - has a lot of						15°	@147'	
	impure oil shale through it - more slickensides at 162'						18°	@151'	
177'10"-180'5"	Shale dark fragmented						14°	@156'	
180'5"-191'1"	Shale gray						14°	@171'	
191'1" - 193'4"	Shale dark soft and crumbly						18°	@188'	
193'4"-196'1"	Shale gray						20°	@204'	
196'1"-199'3"	Shale dark						14°	@221'	
199'3"-223'3"	Shale gray to dark								
223'3"-223'10"	Coal poor grade)								
223'10"-225'1"	Shale black some carbon)								
225'1"-226'1"	Coal poor)								

NORTHERN MINER FORM 505 REV./54

DRILLED BY ..... **SIGNED** .....

DIAMOND DRILL RECORD

PROPERTY ..... HOLE No. Thorburn 1

SHEET NUMBER ..... SECTION FROM 226'1" TO 291'6" STARTED .....

LATITUDE ..... DATUM ..... COMPLETED .....

DEPARTURE ..... BEARING ..... ULTIMATE DEPTH .....

ELEVATION ..... DIP ..... PROPOSED DEPTH .....

DEPTH FEET	FORMATION	SAMPLE NO.	FROM	TO	WIDTH	ASSAY VALUES			
226'1"-227'8"	Shale black crumbling to clay						6° @235'		
227'8"-228'5"	Clay black						12° @255'		
228'5"-231'10"	Shale dark soft in places a little carbon showing						14° @257'		
231'10"-232'2"	Splint or low grade coal						14° @265'		
232'2"-232'5"	Shale black, a little carbon						15 @279'		
232'5"-232'9"	Shale gray soft crumbling to clay								
232'9"-255'0"	Shale gray								
255'0"-265'7"	Shale dark								
265'7"-275'3"	Sandstone gray fine grained								
275'3"-280'0"	Shale dark								
280'0"-282'0"	Shale light gray								
282'0"-291'6"	Shale dark								

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DIAMOND DRILL RECORD

PROPERTY ..... **HOLE No.** Thorburn 1

SHEET NUMBER ..... **SECTION FROM** 291'6" **TO** 310'0" **STARTED** .....

LATITUDE ..... **DATUM** ..... **COMPLETED** .....

DEPARTURE ..... **BEARING** ..... **ULTIMATE DEPTH** .....

ELEVATION ..... **DIP** ..... **PROPOSED DEPTH** .....

DEPTH FEET	FORMATION	SAMPLE NO.	FROM	TO	WIDTH	ASSAY VALUES			
291'6"-293'0"	Shale dark sandy						14° @292'		
293'0"-294'2"	Sandstone gray fine grained						11° @303'		
294'2"-295'7"	Shale dark						8° @310'		
295'7"-296'6"	Sandstone gray fine grained								
296'6"-310'0"	Shale dark								
	END OF HOLE								

NORTHERN MINER FORM 505 REV./54

DRILLED BY _____ **SIGNED** _____

DIAMOND DRILL RECORD

PROPERTY ..... HOLE No. T-3

SHEET NUMBER ..... SECTION FROM ..... TO ..... STARTED August 25, 1961

LATITUDE ..... DATUM ..... COMPLETED .....

DEPARTURE ..... BEARING ..... ULTIMATE DEPTH .....

ELEVATION ..... DIP ..... PROPOSED DEPTH .....

DEPTH FEET	FORMATION	SAMPLE NO.	FROM	TO	WIDTH	ASSAY VALUES			
0-20'	Overburden and lost core					18° 021'			
20-55'0"	Shale almost black, fragmented (low grade oil shale), soft and crumbling in places					21° 038' 21° 048' 23° 054'			
55-65'6"	Sandstone gray fine grained					21° 068'			
65'6"-68'6"	Shale gray sandy					17° 069' 17° 072'			
68'6"-76'8"	Shale dark and gray interbedded					20° 082'			
76'8"-76'11"	Clay gray					18° 094'			
76'11"-80'3"	Shale dark soft fragmented								
80'3"-80'6"	Clay dark								
80'6"-84'5"	Shale dark								
84'5"-85'0"	Clay dark								
85'0"-91'4"	Shale dark								
91'4"-93'2"	Shale dark soft largely fragmented								

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DIAMOND DRILL RECORD

PROPERTY ..... HOLE No. T-3

SHEET NUMBER ..... SECTION FROM ..... TO ..... STARTED .....

LATITUDE ..... DATUM ..... COMPLETED .....

DEPARTURE ..... BEARING ..... ULTIMATE DEPTH .....

ELEVATION ..... DIP ..... PROPOSED DEPTH .....

DEPTH FEET	FORMATION	SAMPLE NO.	FROM	TO	WIDTH	ASSAY VALUES			
93'2"-114'7"	Shale dark to black (oil shale) a couple of thin partings ~~within~~ less than 1/4" width coal at 114'0"					19° @102' 14° @117'			
114'7"-116'5"	Shale gray sandy					21° @123'			
116'5"-116'8"	Clay gray					22° @143'			
116'8"-135'2"	Shale gray sandy					19° @131'			
135'2"-135'5"	Mudstone					20° @147'			
135'5"-145'	Shale gray sandy					18° @167'			
145'0"-152'3"	Shale gray					22° @177'			
152'3"-152'8"	Shale gray soft almost clay					22° @187'			
152'8"-160'0"	Shale gray sandy								
160'0"-170'0"	Shale gray								
170'0"-197'0"	Shale gray sandy								
197'0"-212'2"	Shale gray								
212'2"-217'8"	Shale and black oil shale								

NORTHERN MINER FORM 505 REV./54

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DIAMOND DRILL RECORD

PROPERTY ..... HOLE No. T-3

SHEET NUMBER ..... SECTION FROM ..... TO ..... STARTED .....

LATITUDE ..... DATUM ..... COMPLETED .....

DEPARTURE ..... BEARING ..... ULTIMATE DEPTH .....

ELEVATION ..... DIP ..... PROPOSED DEPTH .....

DEPTH FEET	FORMATION	SAMPLE NO.	FROM	TO	WIDTH	ASSAY VALUES
217'8"-221'0"	Shale gray					20° @197'
221'0"-242'0"	Shale gray sandy					18° @209'
242'0"-245'0"	Shale gray					18° @217'
245'0"-250'0"	Sandstone gray fine grained					18° @229'
250'0"-256'6"	Shale dark gray					19° @236'
256'6"-256'10"	Clay dark gray					21° @244'
256'10"-258'4"	Shale dark gray					
258'4"-258'6"	Shale black slickensided					
258'6"-258'11"	Coal splinty					
258'11"-270'0"	Shale dark gray					15° @251'
270'0"-280'8"	Shale gray sandy					19° @256'
280'8"-285'3"	Shale gray					16° @264'
285'3"-289'5"	Shale gray dark					16° @267'
289'5"-295'10"	Shale gray and dark interbedded					18° @273' 19° @289' 19° @293'

NORTHERN MINER FORM 505 REV./64

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DIAMOND DRILL RECORD

PROPERTY ..... HOLE No. T-3

SHEET NUMBER ..... SECTION FROM ..... TO ..... STARTED .....

LATITUDE ..... DATUM ..... COMPLETED .....

DEPARTURE ..... BEARING ..... ULTIMATE DEPTH .....

ELEVATION ..... DIP ..... PROPOSED DEPTH .....

DEPTH FEET	FORMATION	SAMPLE NO.	FROM	TO	WIDTH	ASSAY VALUES			
295'0"-310'11"	Sandstone gray fine grained					20° @295'			
310'11"-313'0"	Shale gray sandy					22° @313'			
313'0"-320'0"	Shale gray dark					17° @317'			
320'0"-325'10"	Sandstone gray fine grained					20° @329'			
325'10"-328'0"	Shale dark gray					19° @339'			
328'0"-335'9"	Shale dark sandy					15° @342'			
335'9"-337'0"	Sandstone gray fine grained					20° @349'			
337'0"-348'3"	Shale dark gray ironstone bands					19° @358'			
348'3"-348'6"	Shale dark slickensided								
348'6"-361'11"	Shale gray dark with ironstone bands								
361'11"-362'1"	Shale slickensided								
362'1"-365'5"	Shale black oil shale								
365'5"-366'5"	Coal splinty								
366'5"-384'4"	Shale dark gray with ironstone bands								

NORTHERN MINER FORM 505 REV./64

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DIAMOND DRILL RECORD

PROPERTY ..... HOLE No. T-3

SHEET NUMBER ..... SECTION FROM ..... TO ..... STARTED .....

LATITUDE ..... DATUM ..... COMPLETED .....

DEPARTURE ..... BEARING ..... ULTIMATE DEPTH .....

ELEVATION ..... DIP ..... PROPOSED DEPTH .....

DEPTH FEET	FORMATION	SAMPLE NO.	FROM	TO	WIDTH	ASSAY VALUES			
384'4"-387'6"	Mudstone almost black					24° @373'			
387'6"-401'7"	Shale light and dark interbedded sandy in places					20° @382'			
						20° @394'			
						15° @398'			
	END OF HOLE								

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DIAMOND DRILL RECORD

PROPERTY ..... HOLE No. T-5

SHEET NUMBER ..... SECTION FROM ..... TO ..... STARTED September 18, 1961

LATITUDE ..... DATUM ..... COMPLETED .....

DEPARTURE ..... BEARING ..... ULTIMATE DEPTH .....

ELEVATION ..... DIP ..... PROPOSED DEPTH .....

Dept. of Mines
RECEIVED
SEP 28 1961
NO ASSAY VALUES

DEPTH FEET	FORMATION	SAMPLE NO.	FROM	TO	WIDTH				
0-12'2"	Overburden					13° @27'			
12'2"-154	Sandstone gray medium grained					5° @33'			
15'4"-16'2"	Coal very splinty					4° @46'			
16'2"-18'0"	Clay gray dark					8° @56'			
18'0"-19'0"	Shale gray					7° @71'			
19'0"-19'6"	Clay or soft shale gray					4° @82'			
19'6"-30'0"	Shale gray sandy								
30'0"-39'0"	Shale gray soft and crumbling								
39'0"-39'4"	Clay gray								
39'4"-45'0"	Shale gray dark very soft								
45'0"-55'0"	Shale gray								
55'0"-60'0"	Shale gray sandy								
60'0"-73'11"	Shale dark fractured								
73'11"-75'0"	Shale crumbling to clay								

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DIAMOND DRILL RECORD

PROPERTY ..... HOLE No. T-5

SHEET NUMBER ..... SECTION FROM ..... TO ..... STARTED .....

LATITUDE ..... DATUM ..... COMPLETED .....

DEPARTURE ..... BEARING ..... ULTIMATE DEPTH .....

ELEVATION ..... DIP ..... PROPOSED DEPTH .....

DEPTH FEET	FORMATION	SAMPLE NO.	FROM	TO	WIDTH	ASSAY VALUES			
75'0"-85'0"	Shale dark fractured					5° @ 88'			
85'0"-102'2"	Shale dark					6° @98'			
102'2"-112'4"	Shale dark to black - low grade oil shale					5° @108'			
112'4"-120'0"	Shale dark to black fragmented and soft in places					4° @114'			
120'0"-132'2"	Shale black close to oil shale, slickensided over several					4° @123'			
	feet, greatly fragmented					4° @127'			
132'2"-135'0"	Shale grey					5 @135'			
135'0"-138'3"	Shale gray sandy					6° @136'			
138'3"-141'10"	Shale gray and dark interbedded strong bedding planes					5° @147'			
141'10"-143'5"	Shale gray sandy					4° @158'			
143'5"-153'4"	Shale gray to dark interbedded					5° @163'			
153'4"-155'4"	Shale dark					6° @178'			
155'4"-156'0"	Mudstone					5° @186'			
156'0"-160'0"	Shale dark to black some slickenside					8° @202'			
						9° @211'			

NORTHERN MINER FORM 506 REV./54

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DIAMOND DRILL RECORD

PROPERTY ..... HOLE No. T-5

SHEET NUMBER ..... SECTION FROM ..... TO ..... STARTED .....

LATITUDE ..... DATUM ..... COMPLETED .....

DEPARTURE ..... BEARING ..... ULTIMATE DEPTH .....

ELEVATION ..... DIP ..... PROPOSED DEPTH .....

DEPTH FEET	FORMATION	SAMPLE NO.	FROM	TO	WIDTH	ASSAY VALUES			
160'0"-166'7"	Shale black (oil shale)								
166'7"-166'9"	Coal Sample T-5-2								
166'9"-173'9"	Sandstone fine grained								
173'9"-183'6"	Shale gray								
183'6"-190'9"	Shale gray sandy								
190'9"-216'3"	Sandstone gray								
	END OF HOLE								

NORTHERN MINER FORM 505 REV./54

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APPENDIX D – SITE PHOTOLOG

Photo Log

Photograph 1 view of west portion of site (note: New Row Road)

Photograph 2 View of northeast portion of site

Photograph 3 View of the path from center of the site towards south connection road

Photograph 4 View of east portion of the site

Photograph 5 View of northeast portion of the site

Photograph 6: AMO, diversion channel

Photograph 7: AMO, diversion channel

Photograph 8 View of southeast portion of site (note Ball park)

Photograph 9: Diversion channel

Photograph 10- View of the brook flowing through the eastern boundary of the site

Photograph 11: View of the east portion of the site (note: creek flowing through the boundary)

Photograph 12: View of walking trail extending towards north New Row Road

Photograph 13 Potential sinkhole

Photograph 14 View of northwestern neighboring property

Photograph 15- View of southwestern neighboring property

Phase II Photos

Photograph 16 View of central portion of the site

Photograph 17 View of northeast portion of site

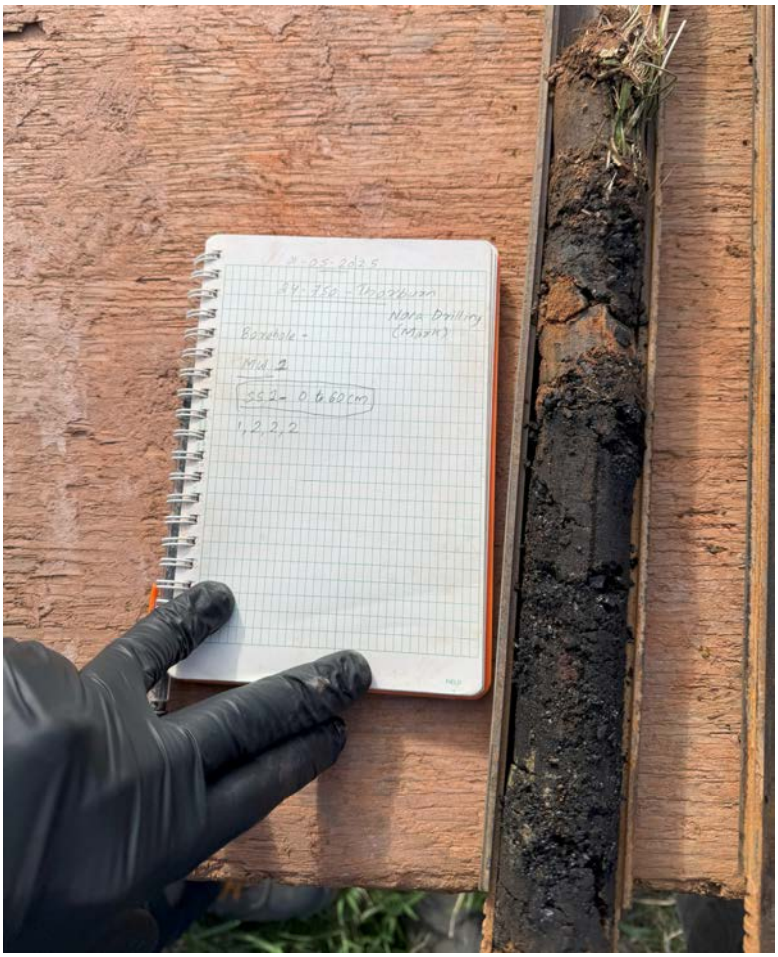
Photograph 18 View of trail from center of the site extending towards north

Photograph 19 View of trail from center of the site extending towards south

Photograph 20 View of south portion of the site

Photograph 21 Small sinkhole found in the central portion of the site

Photograph 22 View of the location of the first monitoring well (MW-1) and drill rig towards center of the site



Photograph 23- View of the Split spoon soil sample (MW1-SS1) collected from first borehole at 2 inches depth

Photograph 24 – View of the monitoring well drilling (MW-1)

Photograph 25- View of the monitoring well placement (MW-1)

Photograph 26- Second monitoring (MW-2) well location towards south of the site

Photograph 27- View of split spoon soil sample (MW2-SS1) collected from second borehole at 2 inches depth

Photograph 28- View of the surface water and sediment sample (SW-1 and SD-1) location towards northeast of the site

Photograph 29- Location of third monitoring well (MW-3) towards north of the site

Photograph 30- View of split spoon sample (MW3-SS1) collected from the third bore hole at 2 inches depth

Photograph 31- View of the soil sample (SS-5) collection location towards northeast corner of the site

Photograph 32 View of Groundwater sampling at monitoring well (MW-2)