

Survey of Recent Activity in Nova Scotia Pits and Quarries

E. W. Hennick, D. A. Khan and J. P. Whiteway

This paper describes recent work conducted by the Mineral Development and Policy Section related to construction aggregate production activity in the province at sites defined as ‘pits and quarries’. The two primary aggregate types produced in the province are crushed rock from quarries, and sand and gravel from pits. Nova Scotia Environment defines operations that include blasting to break rock to be quarries, and sites where the material is unconsolidated and dug without blasting to be pits.

In 2014, staff in the Mineral Development and Policy Section used the photo-interpretation methods described here to identify sites where current or recently operating pits and quarries exist. This was done to help understand the spatial distribution and scale of this industrial activity.

Pits and quarries have been operating in the province for centuries and are an essential part of modern society. Most of the aggregate produced is consumed within the province in residential, commercial and public construction projects. Large volumes of rock are needed for almost all construction projects and because transportation often is the highest cost component of the delivered product, locating sources close to a construction project is essential to minimize costs. The result is that thousands of pits and quarries have been created to meet demand. Currently, there is no single comprehensive provincial database available showing where all the pit and quarry sites are located. Many sites are short-term operations which may only be required for a specific project and then closed. Other operations are long-term (several decades) and supply aggregates year round as required.

Part of the mandate of the Nova Scotia Department of Natural Resources (DNR) is to track trends in mineral and non-mineral production in order to report to government and DNR management issues

related to the geological resources of the province. Periodically DNR commissions and releases economic impact studies related to mineral and non-mineral extraction and the value-added components of the mining sector. The most recent study was conducted by Gardner Pinfold Economic Consultants Inc. (2013). With respect to volume of product produced and the market value of saleable commodities, aggregates have always been a significant and steady sector of the mining industry. More recently this sector has become dominant as the result of the decline in other mineral production. In 2012 the value of aggregates produced was over \$105 million and represented 43% of the overall value of primary production in the province (Table 1). Figure 1 shows the value of mineral production from 1987 to 2012, comparing the major sectors of the mining industry. Figure 2 shows the annual production of aggregates from 1925 to 2012, which continues on a steep upward trend.

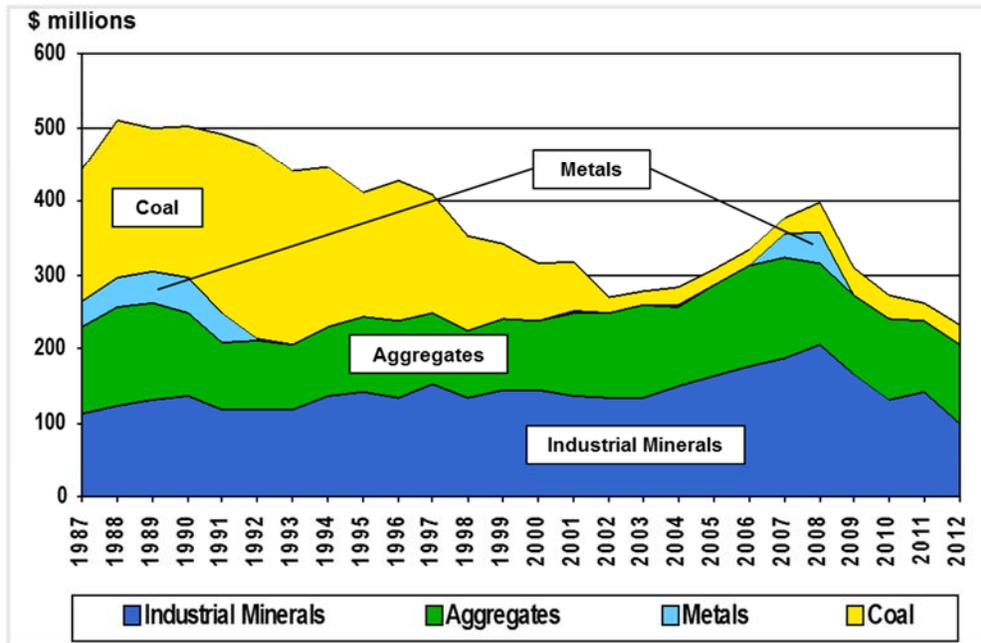
In August 2011 DNR released a new Natural Resources Strategy for the province. During public consultations for this strategy the issue of regulation of pits and quarries was brought to the department’s attention. One question that has been

Table 1. Value of mineral production in 2012 (Gardner Pinfold Economic Consultants Inc., 2013).

2012 Value of Primary Production by Commodity (\$,000)

Aggregates	\$105,818	42.8%
Salt	\$72,000	29.1%
Coal	\$28,050	11.3%
Gypsum	\$26,299	10.6%
Limestone	\$4,000	1.6%
Anhydrite	\$1,000	0.4%
Other (includes: clay, barite, silica sand, dimension stone and limestone for cement)	\$10,000	4.0%
Total Mineral Production	\$247,167	100%

Value of Production 1987-2012 shows steady performance of industrial minerals and aggregates



Value of production fell from about \$400 million in 2009 to \$247 million in 2012.

Drop in gypsum production and the suspension of metal production accounted for decline.

Over the period 1995-2012 the value of salt and aggregate production has been relatively steady.

Figure 1. Value of mineral production from 1987 to 2012 (Gardner Pinfold Economic Consultants Inc., 2013).

challenging to answer is where the active pits and quarries are located. This survey helps to answer that question. With respect to industry regulation and approvals, the *Mineral Resources Act (MRA)* specifically excludes aggregates. Therefore, aggregates are owned by the landowner and are not considered Crown minerals, which are regulated under the *MRA*. DNR does, however, provide support to the aggregates industry through geoscience programs that help to identify geological formations with potential for aggregate production (e.g. Fowler and Dickie, 1978; Wright, 1985; Prime, 1991). The regulation of pit and quarry operations falls primarily under the authority of Nova Scotia Environment and the Department of Labour and Advanced Education, unless they are operating on DNR Crown lands.

DNR has been approached by staff at Transportation and Infrastructure Renewal (TIR) regarding opportunities for developing engineered

wetlands on Crown lands. These would compensate for natural wetlands, which may be impacted by construction of roads and other public infrastructure. Areas of Crown lands that have had aggregate extraction operations may be suitable to be reclaimed as wetlands following the depletion of the aggregate resource. The pit and quarry survey dataset developed here can now be used to respond to these inquiries more efficiently.

Methods

The Mineral Development and Policy Section used information from a variety of sources to develop a Geographic Information System (GIS) dataset of the possible location and size of current and recently active pit and quarry operations across Nova Scotia. The dataset created includes areas that have been interpreted to be currently operating pits and quarries, or may have been operated within

Construction Aggregate Production 1925 - 2012 Has followed a consistent upward trend

Millions of tonnes

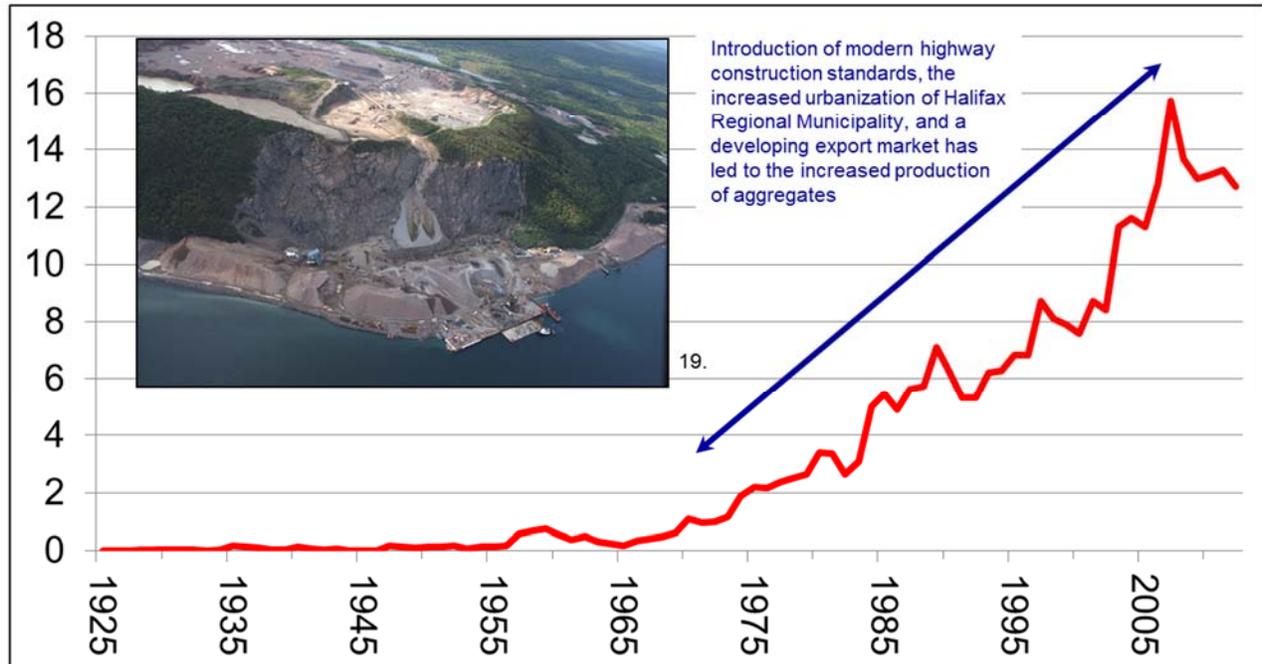


Figure 2. Construction aggregate production from 1925 to 2012 (Gardner Pinfold Economic Consultants Inc.,

the past 30 to 40 years. Sites older than this are often re-vegetated and are difficult, if not impossible, to identify as sites of past aggregate extraction strictly from aerial photographs.

Data and Information Sources and Limitations

Aerial imagery utilized for the project included:

- ESRI ArcGIS World Imagery (Bing Maps),
- Department of Natural Resources (DNR) forestry series color imagery,
- Google Earth imagery, and
- Service Nova Scotia and Municipal Relations (SNSMR) black and white ortho-photography.

Although the World Imagery (Bing Maps) and Google Earth colour imagery cover the entire province there are many instances where the resolution of the image made it difficult to interpret the presence of a pit or quarry. The result is that there are areas of the province where aerial photo interpretation is inconclusive and, therefore, the

interpretation may not accurately reflect the actual land use.

Past Compilations of Pit and Quarry Activities

Some of the uncertain locations were confirmed as past or current operations by using:

- Nova Scotia Geomatics Centre digital data, specifically the Designated Areas (DA) layer, and
- DNR databases of aggregate occurrences, pits and quarries (created mainly from departmental Open File Reports and Maps).

There are many locations, however, where ground-truthing or a comparison with Industrial Approvals issued by the Department of the Environment may be the only way to confirm if a pit or quarry currently exists or previously existed.

One issue with the aerial imagery is the age of the data. Google Earth imagery is usually the most up-to-date aerial imagery in most areas of the

province, but in many instances the resolution and time of year of the photography renders it unsuitable for interpretation. In summary:

- Google Earth imagery is generally no more than three years old;
- Black and white orthophotography pre-dates 2004;
- Bing Maps imagery is dated anywhere from 2007 to 2012; and
- DNR Forestry Series images are from 2004 to 2011.

Fortunately, most of the digital imagery used is no more than a few years old; therefore, it is believed that the great majority of operations have been identified. Some sites that were developed recently may not have been identified in this survey. Each area identified was digitized so that the area in hectares could be determined for each site.

Results

The results of the research indicate there are almost 2,700 existing or recently operated (within the past 30 or 40 years) pit and quarry sites in Nova Scotia, occupying about 5900 hectares of land (Table 2).

Discussion

DNR Uses of the Database

Monitoring abandoned mine openings on Crown land and responding to inquiries related to these past excavations has been a continuing program at

Table 2. Summary of pit and quarry activity in Nova Scotia.

Total number of sites digitized	2,679	5863 ha
Sites less than 2 ha in area	1,939	1436 ha
Sites between 2 and 4 ha	404	1139 ha
Sites larger than 4 ha	336	3288 ha
Total surface area of Nova Scotia		Approx. 5.3 million ha
Total area currently and recently used for aggregate production		5863 ha
Percentage of total province area used for aggregate production		0.11%

DNR for more than twenty years (Hennick et al., 2015). DNR develops an annual work program to remediate the most hazardous sites and conducts monitoring of known sites for changes in conditions. This public safety initiative has resulted in the elimination of the hazard posed by hundreds of mine openings across the province. DNR has a database of more than 7,400 mine openings related to more than 600 mine sites across Nova Scotia. The database is accessible through the Geoscience and Mines Branch web site.

Recently there have been requests for information related to active and abandoned pits and quarries on Crown lands. These requests relate to wetland creation opportunities and future aggregate production. With the pits and quarries survey dataset created here, using photo interpretation, DNR can respond to inquiries regarding recently active pits and quarries on Crown lands more effectively. These are similar to queries related to the abandoned mine openings.

One clear use of the database is to help identify areas where future construction aggregates could be produced by overlaying surficial geology and other geological features to find similar conditions. As previously noted, transportation costs to the project sites where aggregate is used are significant and, therefore, identifying opportunities to reduce costs benefits both public and private construction projects.

Other Government Uses

The pits and quarries database described here has been provided to the Department of Labour and Advanced Education and Nova Scotia Environment as a Google Earth layer (.kmz files) for potential use by these government departments in monitoring industrial activity in the province. Eventually, it may be possible to cross-reference the active NSE Industrial Approvals with the photo interpreted locations to develop an accurate map of active pits and quarries.

Conclusions

DNR has created a GIS dataset that will be helpful in responding to inquiries from municipal planners,

urban developers and other government departments related to recently worked pits and quarries in the province. There are limitations on the accuracy and reliability of the information, however, due to challenges in using photo interpretation and the dates of the various photos used. Until such time as further ground-truthing has been applied to the dataset, the public release of the information will be delayed. Currently, there is no plan to update and verify information collected to confirm its accuracy as the goal of the survey has been achieved. It is likely that new pits and quarries will be added as information on those sites comes to the department's attention.

digitized boundaries that were created for each interpreted pit and quarry. Pits and quarries have been developed and operated in all areas of the province to meet local and regional demand for construction aggregates. This aggregate development activity is required to support the construction and maintenance of the local infrastructure and housing, which modern society depends upon. Mapping recently active sites allows government to understand the scale and scope of these activities in various parts of the province, which may be helpful for improved decision making in the future as further pits and quarries are being proposed for development and land-use decisions are made.

Figure 3 shows the locations where it appears that recent pit and quarry activity has taken place. Figure 4 and Figure 5 show examples of the

In comparison to the total land area of the province (approximately 5.3 million hectares) the 5,863 ha

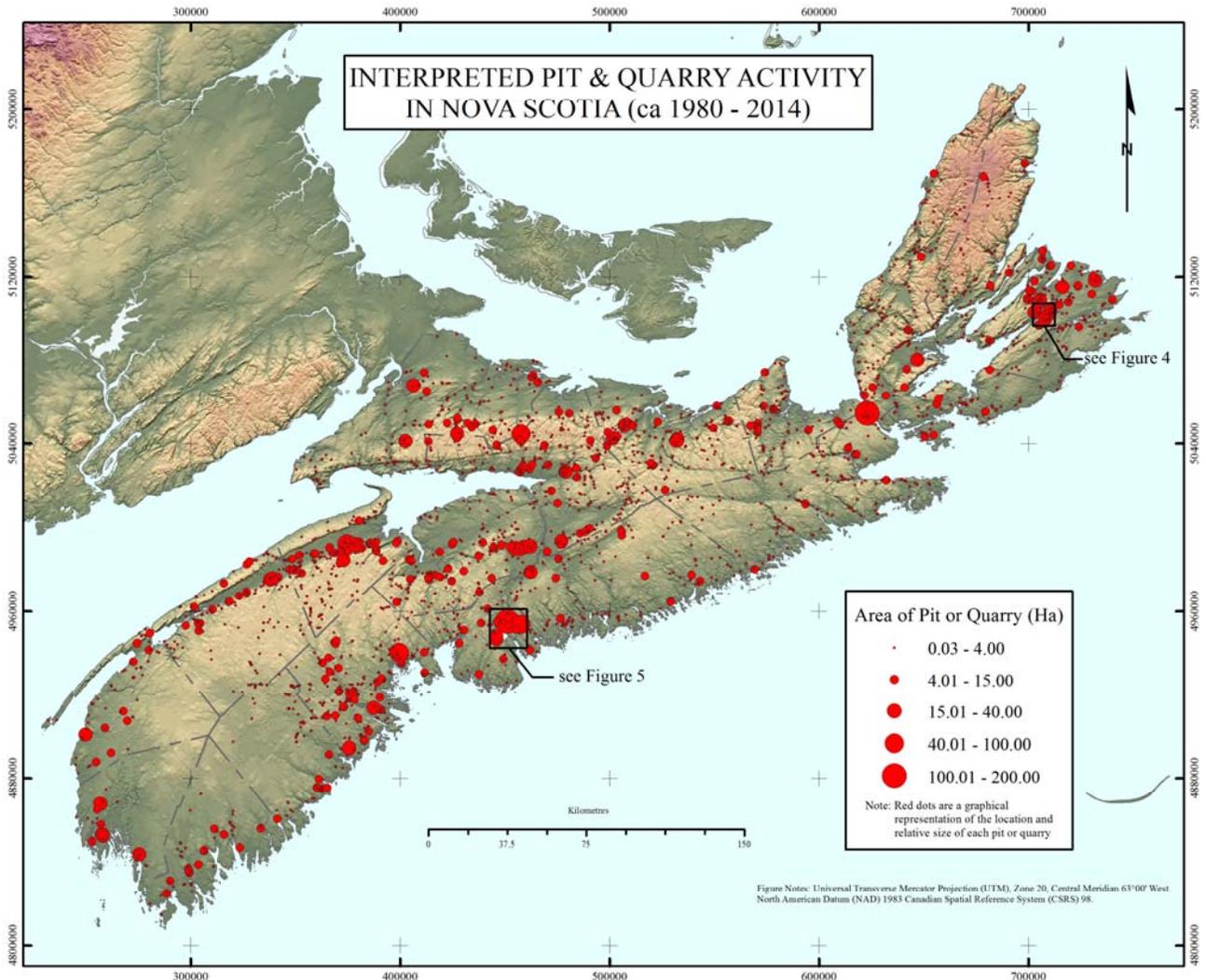


Figure 3. Interpreted pit and quarry locations in Nova Scotia (ca. 1980-2014).

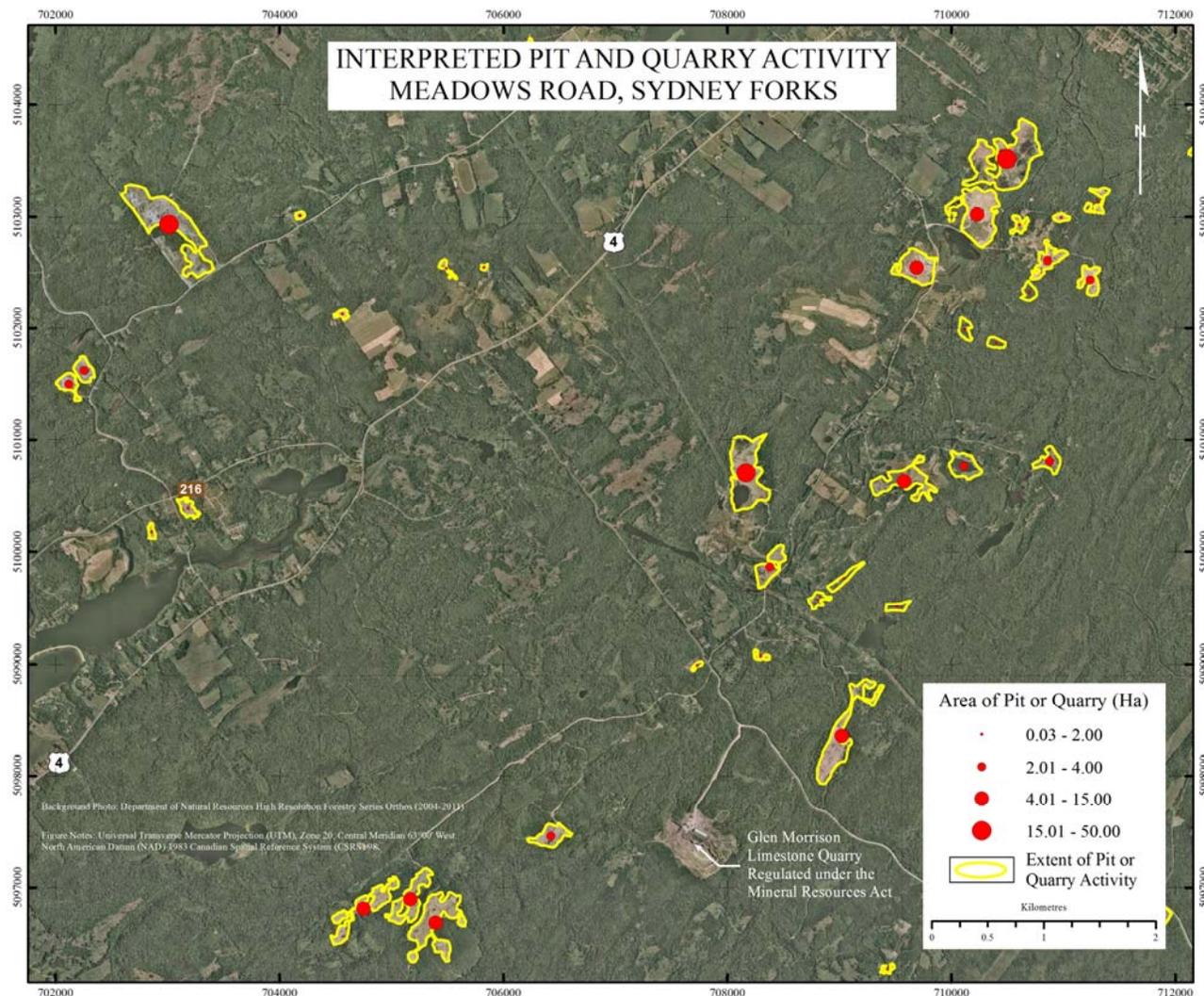


Figure 4. Interpreted pit and quarry activity locations (Meadows Road, Sydney Forks area, Cape Breton)

currently and recently used for aggregate production is relatively small, representing 0.11% of the entire area of the province. Meanwhile, societal benefits from these operations are relatively large. The benefits come from direct and indirect employment and the value-added products that are created, such as concrete, concrete bricks, playground sand and pebbles, and stone for paths and trails.

Recommendations

Beyond the original goal to map and quantify the spatial distribution of recent pit and quarry operations, the GIS survey dataset has the potential to be used for a number of different purposes, many of which relate to sustainable use of the land. Pits

and quarries are temporary uses of the land and there are opportunities to re-purpose these lands for many beneficial uses following extraction of the valuable aggregate. Beneficial uses can range from returning areas to wilderness, including ponds, lakes and other wetlands, to creating new housing and recreation developments and commercial spaces. Almost any other future use could be accommodated if careful planning is established and community support is present.

As pits and quarries are developed, depleted and re-integrated into the landscape, the current survey dataset may quickly become outdated and less reliable for planning purposes. There are currently no plans for future maintenance and checking of the data to help confirm its accuracy, or adding

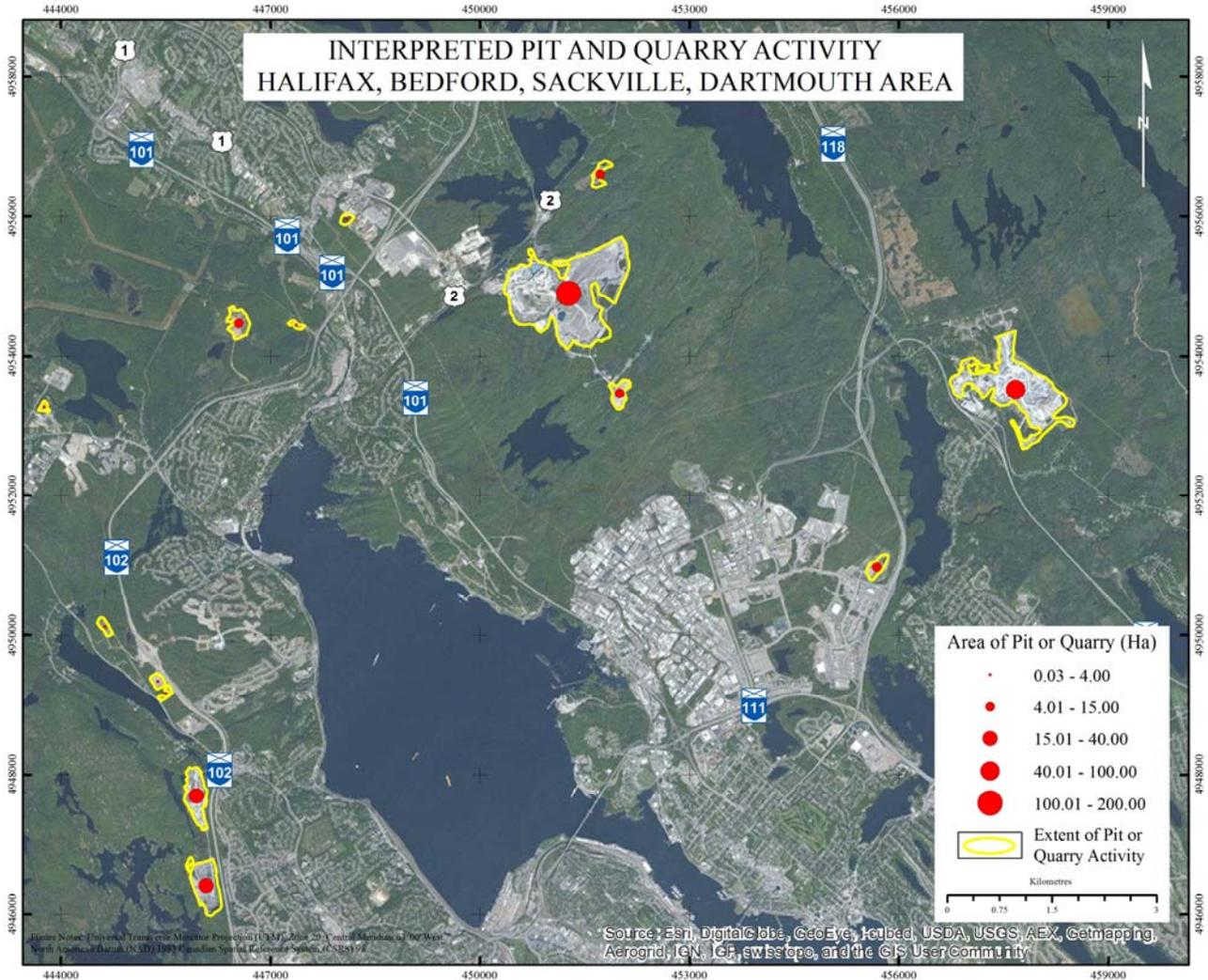


Figure 5. Interpreted pit and quarry activity locations (Halifax, Bedford, Sackville and Dartmouth area, Halifax)

new sites; however, the survey has confirmed that pits and quarries exist in all areas of the province and for the most part are readily integrated into communities.

References

Fowler, J. H. and Dickie, G. B. 1978: Sand and gravel occurrence maps of Nova Scotia, scale 1:50 000; Nova Scotia Department of Natural Resources, Open File Report ME 378, 89 maps.

Gardner Pinfold Economic Consultants Inc. 2013: Economic impact of the mineral industry in Nova Scotia—2012 update; Nova Scotia Department of Natural Resources, Open File Report ME 2013-003, 53 p.

Hennick, E. W. 2015: Remediation of abandoned mine openings in 2014; *in* Geoscience and Mines Branch Report of Activities 2014; Nova Scotia Department of Natural Resources, Report ME 2015-001, p. 29-31.

Prime, G. A. 1991: Aggregate maps of Cumberland and Colchester Counties, Nova Scotia; Nova Scotia Department of Natural Resources, Open File Maps ME 1991-005 to 1991-018, scale 1:50 000.

Wright, W. J. 1985: Aggregate resources of southeastern, southwestern and northern Cape Breton Island, Nova Scotia; Nova Scotia Department of Natural Resources, Open File Maps ME 1985-004 to 1985-006, scale 1:125 000.