

Developing Guidelines for the Rehabilitation of Aggregate Extraction Sites in Prime Agricultural Areas



Case
Study 3

Agricultural Rehabilitation in the Context
of an Application for a Pit Expansion





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Case Study 3: Agricultural Rehabilitation in the Context of an Application for a Pit Expansion

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Background

With urban and rural development on the rise, there is a growing need for aggregate resources, such as sand and gravel, to build public and private infrastructure.¹ At the same time, population growth and urbanization are putting pressure on agricultural production and agricultural land.² It is critical to protect and sustainably manage both aggregate and agricultural resources. However, high quality aggregate resources are often found within prime agricultural areas or specialty crop areas.³ As such, the aggregates and agriculture industries must work together to sustainably manage resources.

The Ontario Provincial Policy/Planning Statements (PPS) outline the provincial government's land use planning policies for both the aggregates and agricultural industries.⁴ While the PPS (2024) requires that prime agricultural areas be protected for long-term use, it also allows planning authorities to "permit non-agricultural uses in prime agricultural areas for extraction of minerals, petroleum resources, and mineral aggregate resources."⁵ In prime agricultural areas, on prime agricultural land, aggregate extraction is permitted as an interim land use, only if the impacts to the agricultural system are mitigated and minimized as recommended by an agricultural impact assessment (AIA), and the site is rehabilitated back to an agricultural condition upon the completion of extractive activities. The PPS (2024)

defines agricultural condition as "a condition in which substantially the same areas and *same average soil capability* for agriculture is restored."⁶ For specialty crop areas, the PPS (2024) requires that "the same range of specialty crops common in the areas can be achieved, and where applicable, the microclimate on which the site and surrounding area may be dependent for specialty crops will be maintained and restored".⁷ The only time that an aggregate extraction site does not have to be rehabilitated back to an agricultural condition is when the depth of aggregate extraction makes rehabilitation "unfeasible", typically due to extraction below the water table.⁸

The Aggregate Resources Act (ARA) includes requirements for the rehabilitation of aggregate

¹ Ministry of Natural Resources. (2025). Aggregate resources. *Government of Ontario*, <https://www.ontario.ca/page/aggregate-resources>

² Brooks, T. (2022). Ontario farmland under intense pressure. *Ontario Federation of Agriculture (OFA)*, <https://ofa.on.ca/newsroom/ontario-farmland-under-intense-pressure/>; Spoelstra, D. (2024). We must protect farmland for the sake of future generations. *Ontario Federation of Agriculture (OFA)*, <https://ofa.on.ca/newsroom/we-must-protect-farmland-for-the-sake-of-future-generations/>

³ Ontario Farmland Trust. (2020). The Impacts of Aggregate Mining on Farmland. *Ontario Farmland Trust*, <https://ontariofarmlandtrust.ca/2020/07/02/the-impacts-of-aggregate-mining-on-farmland/>

⁴ The Ontario Provincial Planning Statement was released in 2024, replacing the Ontario Provincial Policy Statement (PPS 2020) and the A Place to Grow: Growth Plan for the Greater Golden Horseshoe (2019). Previous versions of the Policy Statement include PPS 1997, 2005, 2014. Ministry of Municipal Affairs and Housing. (2024). Provincial Planning Statement. *Government of Ontario*, <https://www.ontario.ca/files/2024-10/mmah-provincial-planning-statement-en-2024-10-23.pdf> Ministry of Municipal Affairs and Housing. (2020). Provincial Policy Statement. *Government of Ontario*, <https://files.ontario.ca/mmah-provincial-policy-statement-2020-accessible-final-en-2020-02-14.pdf> Government of Ontario. (2020). A Place to Grow: Growth Plan for the Greater Golden Horseshoe. *Government of Ontario*, <https://files.ontario.ca/mmah-place-to-grow-office-consolidation-en-2020-08-28.pdf> Penaud, A., Holy, K., Lemay, M. A., Fullerton, C. (2026). Policy Timeline – the Intersection of Agriculture and Aggregates. VISTA Science and Technology.

⁵ Ministry of Municipal Affairs and Housing (2024). Provincial Planning Statement. *Government of Ontario*, <https://www.ontario.ca/files/2024-10/mmah-provincial-planning-statement-en-2024-10-23.pdf>

⁶ *Ibid.*

⁷ *Ibid.*

⁸ *Ibid.*



extraction sites including those in prime agricultural areas.⁹ The ARA states that every licensee/permittee has the duty to rehabilitate the site by performing “progressive and final rehabilitation of the site in accordance with the Act”.¹⁰ To ensure that effective and sustainable rehabilitation of aggregate extraction sites on prime agricultural land is carried out, aggregate producers must provide a rehabilitation plan as part of the site plan, in accordance with the Ministry of Natural Resources and Forestry (MNRF) site plan standards.¹¹ Rehabilitation plans include rehabilitation notes, which outline the steps that will be carried out to restore the site to an agricultural land use. Rehabilitation notes may also be included in the operational plan of the site plan, which describes progressive rehabilitation recommendations from technical reports such as an AIA. Aggregate producers must comply with all rehabilitation notes included in the approved site plan. Because of this, rehabilitation plans and notes are critical in holding the aggregates industry accountable to restoring agricultural land.

Detailed rehabilitation plans that incorporate best management practices are critical for effective rehabilitation. However, research and guidance

on best practices for rehabilitation of aggregate extraction sites in prime agricultural areas is limited. To increase clarity on best practices, it is important to understand industry norms and common concerns and recommendations from stakeholders and government agencies related to rehabilitation of aggregate extraction sites located in prime agricultural areas.

This case study report is the third in a series of case studies analyzing records related to licence applications for aggregate extraction sites located in prime agricultural areas that will be rehabilitated back to an agricultural condition. The case studies seek to identify rehabilitation norms, common challenges in preparing aggregate applications and rehabilitation plans and recurring recommendations regarding rehabilitation back to an agricultural condition as required by the PPS. The case studies are a part of a broader research project developing evidence-based guidelines for rehabilitation of aggregate extractions sites located in prime agricultural areas in Ontario (Appendix A). Common industry terms are defined in Appendix B - Glossary of Terms. 🌿

⁹ Government of Ontario. Aggregate Resources Act. (2021). *Government of Ontario, E-laws*, <https://www.ontario.ca/laws/statute/90a08>

¹⁰ *Ibid.*

¹¹ Ministry of Natural Resources and Forestry. (2020). *Aggregate Resources of Ontario: Site Plan Standards. Government of Ontario*, <https://files.ontario.ca/mnrf-aggregate-resources-of-ontario-site-plan-standards-2020-en-2021-03-18.pdf>





Case Study Introduction

This case study report focuses on the rehabilitation plan for a proposed aggregates site designated as a prime agricultural area in Ontario. The aggregate producer has been granted planning approval to re-zone the land for aggregate extraction. The Ontario Ministry of Natural Resources and Forestry (MNRF)¹² has withdrawn its objection to the licence application under the Aggregate Resources Act (ARA). The aggregate producer expects that the licence will be approved.¹³

Because the licence application has not been officially approved, this case study report draws upon records related to the licence application process, including comments on the application from relevant reviewing/commenting agencies. The following documents were analyzed:

- Initial site plans submitted with the application
- Revised site plans that incorporated recommendations from commenting agencies
- Agricultural Impact Assessment
- Comments and communications from the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA)¹⁴
- Comments and communications from the Ontario MNRF

Site plan documents approved by MNRF are legally-binding, meaning that aggregate producers must comply with all requirements detailed in the

plan. A critical part of the site plan is the notes pertaining to rehabilitation of the site following aggregate extraction. Rehabilitation of the site is typically discussed in the operational plan and rehabilitation plan; each of which represent separate elements of the site plan.

The AIA was prepared in accordance with the Growth Plan for the Greater Golden Horseshoe, which required that all applications for aggregate extraction on prime agricultural areas in the Greater Golden Horseshoe area be supported by an AIA.¹⁵ The AIA outlined site features and conditions, potential impacts to the agricultural system and provided recommendations for agricultural rehabilitation. While the AIA offered valuable insights on agricultural rehabilitation, it is not an enforceable document, which means that the aggregate operator was not required to include the recommendations in the site plan. The methodology used for the AIA is outlined in Appendix C.

¹² The Ministry of Natural Resources and Forestry (MNRF) was the official title of The Ministry at the time that this licence application was submitted, and therefore, MNRF was the commenting agency on this licence application. The Ministry's official title was changed to the Ministry of Natural Resources (MNR) in June 2024, and therefore, MNR will be the approval agency for this licence.

¹³ The licence application was prepared under the policy requirements of the Growth Plan for the Greater Golden Horseshoe published in 2019 and the Provincial Policy Statement (PPS) published in 2020.

¹⁴ The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) was the official title of The Ministry at the time that this licence application was submitted. The Ministry's official title was changed to the Ontario Ministry of Agriculture, Food, and Agribusiness (OMAF) in June 2024.

¹⁵ A Place to Grow: Growth Plan for the Greater Golden Horseshoe. (2019) *Government of Ontario*, <https://files.ontario.ca/mmah-place-to-grow-office-consolidation-en-2020-08-28.pdf>; Schedule 1: Greater Golden Horseshow Growth Plan Area. (2019). *Government of Ontario*, https://files.ontario.ca/schedule_1_greater_golden_horseshoe_plan_area.jpg; Ontario Regulation 416/05: Growth Plan Areas. (2005). *Government of Ontario*, <https://www.ontario.ca/laws/regulation/050416/v3>



Site Features and Conditions

The application is for a new Class A, Category 3 aggregate extraction licence under the ARA. If granted, the licence would allow the aggregate producer to extract more than 20,000 tons of mineral aggregate resources above the water table annually. The proposed licence area would be ~40 hectares, with 30 hectares of extraction land. The aggregate producer classified the site as a “pit expansion,” because they own and operate the surrounding lands. The proposed site extends the surrounding operations and will share processing and washing facilities and haul routes. The proposed pit would be rehabilitated comprehensively with the adjacent pits.

The proposed licence area is designated as protected countryside¹⁶ and prime agricultural area¹⁷, with most of the property (~80%) used to produce agricultural crops. A tenant farmer currently grows winter wheat and common field crops on the site. The remainder of the property includes a woodlot (~18%) and disturbed areas (~2%), including barns and a residential unit. While the primary land use of the site is currently agricultural, the regional municipality has identified that the site also contains sand and gravel resources of primary and secondary significance. The municipality has granted the aggregate producer planning approval to proceed with the pit expansion, so long as the land is returned to an agricultural condition following aggregate extraction.

The AIA conducted for the licence application assessed soil capability for agriculture utilizing the Canada Land Inventory (CLI) soil classifications.

Approximately 10% of the site was identified as Class 1, 65% of the site was identified as Class 2 and 10% of the site was identified as Class 3 soils.¹⁸ The AIA further assessed soil capability by calculating the Hoffman Productivity Index (HPI) and relating HPI values to CLI classes. This calculation identified that the site had a soil productivity rating of ~0.75, which is equivalent to Class 2 lands. A small portion of the site (~10%) ranged from Class 4 - 7 lands and an even smaller portion of the site (~5%) was not rated in the CLI database because it was a woodland environment.

The AIA noted that the area surrounding the proposed site was primarily agricultural, with nearly 50% of the land within a one km radius being utilized to farm common field crops, including winter wheat, corn, hay and soybeans. A smaller percentage of the land within a one km radius was identified as forage and pasture lands and as wooded areas for the production of maple syrup. The other common land use in the area was identified to be aggregate extraction, with two active pits located adjacent to the proposed pit. Adjacent pits were zoned as prime agricultural areas and are planned to return to agricultural use following extraction.

According to the AIA, “there is limited investment in agricultural buildings, facilities, and structures” at the site and in the surrounding areas within a one-kilometer radius of the site. The AIA did not find evidence of artificial drainage systems or irrigation systems, ponds or areas of standing or flowing water, or landforming on the site.

¹⁶ Ministry of Municipal Affairs and Housing. (2024). General policies for the Protected Countryside. *Government of Ontario*, <https://www.ontario.ca/document/greenbelt-plan/general-policies-protected-countryside>

¹⁷ Ministry of Agriculture, Farms and Rural Affairs. (2025). Prime Agricultural Areas. *Government of Ontario*, <https://www.ontario.ca/page/prime-agricultural-areas>

¹⁸ Based on OMAFRA’s Soil Capability for Agriculture document, Class 1 soils are “well to imperfectly drained and have good nutrient and water holding capacity and can be managed without difficulty.” Class 2 and Class 3 soils similarly have high agricultural capability for common field crops, with moderate limitations that may reduce the choice of crops or require moderate conservation practices.; Ontario Ministry of Agriculture, Food and Agribusiness. (2024). Soil Capability for Agriculture in Ontario. *Government of Ontario*, <https://www.ontario.ca/files/2024-08/omafa-soil-capability-for-agriculture-in-ontario-en-2024-08-15.pdf>



Impacts to Agriculture

The AIA concluded that the proposed aggregate extraction site would have “minimal” impacts to the surrounding agricultural system. Although there would be an “interim loss of agricultural lands during the extraction process, there would be no permanent loss of agricultural lands”. The AIA described that a phased extraction and rehabilitation approach would allow for parts of the site to remain in agricultural use, thus reducing impacts to agricultural production. The AIA also found that there would be no fragmentation of agricultural lands within the broader agricultural system, in part because the proposed site was planned to be rehabilitated to an agricultural condition alongside adjacent pits. The AIA explained that there would be “no loss in future farming opportunities, [because] the existing site will be used for agricultural production of common field crops again on completion of the rehabilitation process”.

While aggregate extraction will alter the site, the AIA determined that the rehabilitation process would ensure that impacts would be minimized, mitigated, or avoided. For example, the AIA stated that the change in landform would create “long, simple, and uniform slopes which would be well suited to mechanized farming and would provide more controlled surface drainage than the existing rolling and steep topography”. The AIA concluded that impacts to surrounding agricultural operations would be minimized by “berms for visual and sound attenuation, a traffic plan, and the lack of offsite surface runoff potential”. 🌾





Agricultural Rehabilitation

The proposed rehabilitation plan outlined how the site would be returned to an agricultural condition with “ecological enhancements” including a woodland environment. The site plan detailed a phased extraction and rehabilitation approach. This included extracting aggregate resources in a sequential and phased manner. Once the aggregate resource has been depleted in the first phase of the site, progressive rehabilitation will be carried out.

This section compares the rehabilitation notes in the initial site plan with the rehabilitation notes in the revised site plan, which incorporated recommendations from reviewing and commenting agencies. It also provides an analysis of the extent to which recommendations in the AIA were implemented in the initial and/or revised site plans.

Phased Rehabilitation

The site is intended to be rehabilitated comprehensively with two adjacent sites. However, the AIA stated that an official site plan amendment to the adjacent licence would be required to allow for all three sites to be rehabilitated together. Rehabilitation of the adjacent pit is not discussed in this case study report as it falls under a separate ARA licence.

Phased rehabilitation was outlined in the operational notes of the site plan and included the following steps, repeated over three operational areas of the site:

- Licence boundary and fencing shall be installed prior to site preparation.
- Topsoil and overburden shall be stripped and stored separately. Topsoil and overburden shall be stored in visual and acoustic berms at the perimeter of the site, used in progressive rehabilitation or stored in temporary stockpiles/berms.
- Commence extraction in the area (e.g., Phase 1). Bank materials may be crushed and stockpiled at the pit face so the material can be transported to the adjacent licence for further processing and shipment.

- The remainder of the site remains in agricultural use.
- Complete extraction in Phase 1 and commence extraction in Phase 2.
- Commence progressive rehabilitation of Phase 1 after berms are built and as space and final faces are reached and if areas are not required for processing.

The above steps will be repeated for the three phases outlined on the site plan. The phases “do not represent any specific or equal time period.” The site plan stated that the direction of extraction (north to south, east to west) from one phase to another “may vary slightly” and that the “demand for certain bank materials for blending may require some deviation in phasing”. The site plan stated that “any major deviation in the phasing and direction in extraction shall require a site plan amendment,” but did not define what constitutes a “slight variation” compared to a “major deviation”.

The site plan also stated that concurrent extraction of phases with the adjacent licences is permitted for blending purposes, “provided the overall maximum combined disturbed area of the three licences does not exceed ~40 hectares to ensure that progressive rehabilitation of the sites is being undertaken as required by the site plans”.





Initial and Revised Site Plans

In addition to phased rehabilitation notes, the site plan also included a rehabilitation plan, which expanded upon rehabilitation practices during each phase of rehabilitation. This section provides a comprehensive summary of rehabilitation notes

in the initial site plan and rehabilitation notes in the revised site plan (Table 1). The revised site plan was amended to address concerns raised by commenting agencies, such as MNRF and OMAFRA, during the review process.

Table 1. Comparison of rehabilitation notes in the initial and revised site plans. Certain information is paraphrased for better readability. Some rehabilitation notes are bolded to highlight specific changes made to the final site plan.

Initial Rehabilitation Notes		Additions or Changes in the Revised Rehabilitation Notes
General Rehabilitation Notes	Progressive rehabilitation will consist of: • Deep ripping of overburden to alleviate compaction. • Rough grading. • Placement of topsoil to a min. depth similar to pre-extraction (0.15 m). • Stone picking. • Establishing crops. Crops may include hay/pasture, beans, wheat, corn, etc. • Organic matter or fertilizer may be used when planting crops.	Except for “rough grading” and “stone picking” all of the general rehabilitation notes were updated in the revised site plan to include the following: • Prior to the placement of the final topsoil layer, the overburden shall be ripped with a dozer, chisel plough or similar equipment to alleviate compaction. • Topsoil and subsoil shall be replaced at the same pre-extraction depth, as confirmed through the monitoring of stripping. • Where agricultural rehabilitation is required, the lands shall be seeded to a cover crop of oats and rye grasses (or other appropriate grass mixture) to control surface erosion. Cover crops shall be disc plowed or incorporated by a similar agricultural practice in the spring to add organic matter. A grass/legume mixture shall be established to improve soil structure and add fertility. Grass and legume cropping shall continue for several years based on a suggested cropping sequence detailed in Vegetation Information (see below). • Best management practices are encouraged with respect to the storage and application of fertilizers and pesticides. • Conduct agricultural soil testing and implement agricultural monitoring program.



Slope

Notes related to slope stated that:

- The site plan included an override of operational standards so that the grading of final rehabilitation side slopes may vary from a 2:1 to a 10:1 slope for diversity of the final grades.¹⁹
- A 0.15 m minimum depth of topsoil will be placed on side slopes.

All information listed in the initial site plan remained, with the addition of the following statement:

- The slopes will be constructed using backfill methods.

¹⁹ Operational standards require that “all excavation faces are slopes to three horizontal metres for every vertical metre or flatter.”; Ontario Regulation 466/20 made under the Aggregate Resources Act. *Government of Ontario*, <https://www.ontario.ca/laws/regulation/r20466?utm>





Topsoil/Subsoil Storage and Management

Notes on topsoil/subsoil stated that:

- Topsoil and overburden shall be stored separately in perimeter berms for visual and/or acoustic purposes or used for progressive rehabilitation. If necessary, temporary stockpiles or berms no higher than 5m may be permitted. All berms and stockpiles shall be graded and seeded with a mixture of perennial grasses and legumes during the next appropriate planting season after they have been established. The vegetation on the berms shall be maintained to control erosion.
- In areas where agricultural rehabilitation is required, topsoil will be placed on the pit floor in a similar depth that existed on site prior to extraction, (minimum 0.30 m).
- Prior to the placement of the final topsoil layer, the overburden will be ripped with a dozer to alleviate compaction.
- The site shall be rehabilitated back to substantially the same areas and same average soil capability.

Notes on topsoil/subsoil management remained, with the addition of the following statements and edits:

- Topsoil and overburden shall be stored separately in perimeter berms for visual and/or acoustic purposes.
- Areas remaining in agricultural production shall be maximized until needed for extraction. Soil materials intended to be used for agricultural rehabilitation (e.g., topsoil) shall be stripped and moved under appropriate weather conditions (dry and unfrozen soil conditions). Overburden may be stripped and moved year round.
- In areas where agricultural rehabilitation is required, **topsoil and subsoil shall be replaced at the same pre-extraction depth, as confirmed through the monitoring of stripping.**
- Topsoil, subsoil and remaining overburden shall be stripped and stored separately.
- Depths of soil being removed during stripping shall be monitored and compared to the pre-extraction depths as found in the soil survey to facilitate agricultural rehabilitation. Based on the soil survey, the depth of topsoil is approximately 0.15 – 0.2 m and the depth of subsoil is 0.3 m. Topsoil and subsoil shall be replaced at the same pre-extraction depth, as confirmed through the monitoring of stripping.
- Prior to the placement of the final topsoil layer, the overburden shall be ripped with a dozer, **chisel plough or similar equipment** to alleviate compaction.



Soil Testing

There were no notes pertaining to soil testing in the initial site plan.

The following notes were added to the revised site plan:

- Prior to commencement of stripping, agricultural baseline conditions shall be established by a qualified professional for the entire extraction area, using an accredited lab for any analytical testing. Soil inspections shall be conducted at a density to allow for sufficient coverage of the area.
- Random soil testing shall be completed at the beginning of each growing season by a qualified professional to analyze soil conditions, using an accredited lab for any analytical testing. Soil inspections shall be conducted at a density to allow for sufficient coverage of the area.
- The parameters for the soil testing shall be determined by the qualified professional and shall include items such as soil macro and micronutrients, soil chemistry (pH), organic matter, soil texture and structure and bulk density.
- Adjustments to cropping practices and/or soil amendments may be required based on the results of the soil testing.





Vegetation Information	Notes pertaining to vegetation included: Where agricultural rehabilitation is required, these areas shall be seeded using a mixture of perennial grasses and legumes to establish a self-sustaining cover crop and/or the pit floor and side slope will be used for agricultural crops.	Notes pertaining to vegetation were changed to include the following information: - Where agricultural rehabilitation is required, the lands shall be seeded to a cover crop of oats and rye grasses (or other appropriate grass mixture) to control surface erosion. - Cover crops shall be disc plowed or incorporated by a similar agricultural practice in the spring to add organic matter. - A grass/legume mixture shall be established to improve soil structure and add fertility. - Grass and legume cropping should continue for several years based on the following suggested cropping sequence, where in Year 1, cover crops are established (oats and rye grass mixture) to control for erosion; in Years 2 - 4, a legume or legume/ grass mixture is established to improve soil conditions (structure, organic matter), in Years 5+, row crops in rotation with legume, legume/grass mixture is established to continue to improve soil conditions.
Hydrological Information	Hydrological notes included: - Extraction shall remain 1.5 m above the water table. - Surface drainage shall be directed to the infiltration areas illustrated in the site plan.	There were no changes in hydrological information made to the revised site plan.





Clean Fill Importation

Notes pertaining to clean fill importation included:

- Clean inert fill (topsoil, overburden, peat) may be imported to facilitate pit rehabilitation. Only sufficient material to create landform may be imported.
- At the request of the MNRF, the licensee shall conduct random sampling of the imported material. Off-site fill will be accepted in accordance with an off-site acceptance protocol. This protocol shall be filed with MNRF prior to acceptance of any off-site overburden, topsoil and/or peat.

Notes pertaining to clean fill importation were updated:

- Excess soil, as defined in Ontario Regulation 244/97²⁰ shall be imported to this site to facilitate the final contours and sloping as shown on the rehabilitation plan.
- Liquid soil, as defined in Ontario Regulation 406/19²¹ under the Environmental Protection Act, is not authorized for importation to the site.
- The quality of excess soil imported to the site for final placement shall be equivalent to or more stringent than the applicable excess soil quality standards as determined in accordance with Ontario Regulation 244/97, as amended from time to time, and shall be consistent with the site conditions and the end use identified on the approved rehabilitation plan.
- Where a qualified person is retained or required to be retained in accordance with Ontario Regulation 244/97, the quality, storage, and final placement of excess soils shall be done according to the advice of the qualified person.
- The cumulative total amount of excess soil that may be imported to this site for rehabilitation purposes is x,xxx,xxx m³.²²

²⁰ Ontario Regulation 244/97 under the Aggregate Resources Act. (2024). *Government of Ontario*, <https://www.ontario.ca/laws/regulation/970244>

²¹ *Ibid.*

²² The exact volume of excess soil that may be imported to the site for rehabilitation purposes has been excluded to ensure anonymity.



Agricultural Monitoring Program	There was no information in the initial site plan pertaining to agricultural monitoring.	A formal agricultural monitoring program was added to the revised site plan by way of the following notes: • An agricultural rehabilitation monitoring program shall be undertaken by a qualified professional once rehabilitation has commenced within the agricultural rehabilitation area. The purpose of the monitoring program is to inform and document how the site shall be progressively rehabilitated back to substantially the same area and same soil capability for agriculture that existed pre-extraction. A summary of the agricultural rehabilitation monitoring program shall be completed annually and appended to the annual compliance assessment report. The monitoring program shall include details on matters such as the following: • Evaluate the rehabilitation and soil capability, relative to the baseline soil conditions documented. • An overview of the status of the current extraction and progressive rehabilitation phases. • Description of annual soil removal and storage methods. • Description of any land that has been progressively rehabilitated. • Documentation of the alleviation of any soil compaction, drainage provisions, erosion control. • Description of how the soil has been replaced and any amendments added (fertilizer, organic matter). • Description of any seeding or planting that has occurred. • A review of previous rehabilitation management activities and observations regarding field conditions.
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		• Report of agricultural activity (crops grown, annual yields) and any anecdotal feedback from the farmer. • Review of drainage issues and recommend mitigation measures as necessary. • Summary of soil test results and post rehabilitation soil capability. • Summary of monitoring data. • Make recommendations on future agricultural rehabilitation activities and any needed adjustments to best management practices.
Final Rehabilitation Information	Final rehabilitation notes included: • Final rehabilitation shall be deemed complete when the area has been planted with cash crop.	Final rehabilitation notes were revised to state the following: • Final rehabilitation in the agricultural area shall be deemed complete when the area is restored to substantially the same area and same soil capability for agriculture that existed pre-extraction, as determined by the agricultural rehabilitation monitoring program.

The initial site plan submitted with the Aggregate Resources Act (ARA) licence application was relatively general. It discussed approaches to soil replacement and crop establishment, including deep ripping to alleviate soil compaction, rough grading, topsoil replacement and seeding with crops such as wheat, beans and corn. While the initial site plan included most of the required information listed the site plan standards developed by MNRF,²³ it lacked specific procedures for soil testing and long-term monitoring and management. The initial site plan also contained minimal detail on cover crop establishment to rebuild soil organic matter, soil structure and soil fertility. Importantly, the initial site plan did not provide evidence-based methodologies for ensuring that the same average soil capability was established following rehabilitation.

Interestingly, the initial site plan prepared for the licence application included numerous rehabilitation monitoring programs, including an annual ecological monitoring report and an annual hydrological monitoring report submitted to the local conservation authority and an annual noise audit submitted to MNRF and to the local township. The initial site plan also specified that the aggregate producer would meet with the local township annually to review performance of the operation. The aggregate producer was required to submit a formal summary report to MNRF following each annual meeting between the aggregate producer and the local township. The only component of the initial site plan that did not include a monitoring plan was agriculture, with no mention of how progressive agricultural rehabilitation would be monitored or reported on.

²³ Ministry of Natural Resources and Forestry. (2020). Aggregate Resources of Ontario: Site Plan Standards. Government of Ontario, <https://files.ontario.ca/mnrf-aggregate-resources-of-ontario-site-plan-standards-2020-en-2021-03-18.pdf>



In comparison, the revised site plan, 1) incorporated comments from MNRF and OMAFRA, 2) was significantly more detailed and 3) incorporated a comprehensive agricultural rehabilitation monitoring program. The monitoring program was designed to inform and document how the site would be progressively rehabilitated back to substantially the same area and same soil capability for agriculture that existed pre-extraction. Results from the monitoring program would be reported to MNRF in annual compliance assessment reports (CARs).

The revised site plan also added specific requirements for soil management and soil testing. Site plan notes were added to ensure that clean fill imported to the site complied with Ontario Regulation 244/97²⁴,

that topsoil would be stripped under dry, unfrozen conditions to minimize soil compaction and that subsoil and topsoil would be reestablished at pre-extraction soil depths. The revised site plan also included a multi-year cropping sequence to gradually rebuild soil organic matter, soil structure and soil fertility. Formal methodologies for soil testing were included to establish pre-extraction soil parameters, including macro and micronutrients, soil chemistry (pH), organic matter, soil texture and bulk density. Annual soil would inform cropping practices and/or soil amendments in progressive agricultural rehabilitation. In all, revisions to the site plan incorporated an adaptive rehabilitation strategy that aligned with best practices presented in OMAFRA's Draft AIA Guidance document.²⁵

Agricultural Impact Assessment Recommendations

Recommendations made in the AIA included best practices to preserve and restore soil structure and soil capability (Table 2). Most of these best practices were not included in the initial site plan but were adopted or partially adopted in the final site plan.

While the AIA outlined these best practices, they were implemented into the revised site plan in response to comments and concerns raised, mainly by OMAFRA, during the commenting and review process carried out as part of the licence application.

Table 2. Extent of adoption of AIA agricultural rehabilitation recommendations in the site plan.

Agricultural Rehabilitation Recommendation	Description of the Recommendation	Adoption of the Recommendation
Minimize Soil Storage	Ideally, topsoil materials, which are naturally high in organic matter, should be stripped from a natural area and moved directly to an area of rehabilitation, without a significant amount time spent in stockpile formation. The quality of topsoil materials deteriorates over time in storage, due to changes in soil organisms (fungal and bacterial).	Not adopted.
Minimize Soil Mixing	Topsoil and overburden should be stripped, moved and stored separately.	Adopted in the initial and revised site plans.

²⁴ Ontario Regulation 244/97 under the Aggregate Resources Act. (2024). *Government of Ontario*, <https://www.ontario.ca/laws/regulation/970244>

²⁵ Ontario Ministry of Agriculture, Food, and Rural Affairs. (2018). Draft Agricultural Impact Assessment (AIA) Guidance Document. *Government of Ontario*, <https://www.ontario.ca/files/2024-04/omafra-agricultural-impact-assessments-en-2024-04-03.pdf>



Minimize Soil Compaction	• The reapplication of soil materials should be accomplished in dry soil conditions and through the use of equipment that does not cause excessive soil compaction. Ideally, the soil materials should be reapplied with wide tracked crawler bulldozers. Rubber tired equipment should be avoided as it causes significant soil compaction as compared to tracked equipment. • Soil materials should be moved under appropriate weather conditions. There should be no stripping of topsoil between December 1st and March 1st. Overburden may be stripped and moved year-round.	Partially adopted in the revised site plan. The revised site plan specified that topsoil would only be stripped and moved under dry and unfrozen soil conditions and that overburden material would be moved year-round. However, the site plan did not provide specifications for the type of equipment that would be used to reapply soil materials during rehabilitation.
Stone Picking and Plowing	• Once the soil materials have been replaced, it may be necessary to chisel plow and stone pick the field prior to seeding the first crops.	Partially adopted in the initial site plan and fully adopted in the revised site plan. The initial site plan included stone picking but did not include ploughing. The revised site plan included both.





Plant Cover Crops	• The area should be seeded with a cover crop to control surface soil erosion. Oats or rye grasses are appropriate cover crops to use while establishing a legume/grass cover. Cover crops should be disc plowed in the spring to add organic matter to the surface soils. Grass and legume cropping should continue for 3 - 4 years to improve soil structure and add fertility. When dealing with poorly structured or compacted soil horizons by attempting to improve soil structure and soil fertility, it is important to use a cropping program that initially includes a leguminous crop such as alfalfa, or legume/grass mixtures. Alfalfa is often preferred due to its deep penetrating taproots. • It is recommended that the following cropping sequences and crop types be used for the rehabilitation to agricultural use. • Year 1: Plant cover crop (oats or rye grass) to control erosion. • Years 2 – 4: Plant legume or legume/ grass mixture to improve general soil conditions. • Years 5+: Plant row crops in rotation with legume/grass mixtures.	Adopted in the revised site plan.
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Commenting and Review Process

The initial site plans and AIA were circulated for comment and review by relevant stakeholders. Agencies that commented on agricultural rehabilitation of the site included MNRF and OMAFRA.

Comments, concerns and recommendations raised by MNRF and OMAFRA were grouped into the following themes and are expanded upon below:

- Lack of Detail and Ambiguous Language
- CLI Soil Classes
- Recommendations to Improve Soil Management
- Cropping Sequence for Agricultural Rehabilitation
- Monitoring Agricultural Rehabilitation
- Rehabilitated Side Slopes
- Comprehensive Rehabilitation

Lack of Detail and Ambiguous Language

Both MNRF and OMAFRA stated that the site plan lacked important details and direction as to how rehabilitation would be accomplished. Both ministries stated that the site plan included many qualifying terms like “should” and “recommend” and requested that these terms be replaced with prescriptive terms such as “shall” or “will be.” MNRF noted that vague language such as “approximately” can make the site plan challenging to regulate and recommended that the aggregate producer remove approximations (i.e., +/-) from numerical measurements and areas. The aggregate producer responded to OMAFRA and MNRF by removing vague and ambiguous language throughout the site plan. This included replacing terms like “should” with “shall” and removing estimations and approximations throughout the site plan.

In addition to general comments regarding vague language, MNRF and OMAFRA also pointed out specific areas of the application that required more detail. For example, the initial site plan stated that the operational and rehabilitation phases *“do not represent any specific or equal time period. The direction of*

extraction illustrated may vary slightly, [and] the demand for certain bank materials for blending may require some deviation in phasing... any major deviation in the phasing and direction in extraction shall require a site plan amendment”. MNRF requested that the aggregate producer quantify what would constitute a “slight variation” versus a “major deviation”. MNRF also requested that the aggregate producer remove ambiguous wording such as “vary slightly” and “major deviation”. In response, the aggregate producer quantified the maximum combined disturbed area in hectares for the site and the adjacent pits and included this in the site plan. The site plan was also revised to state that *“the direction of extraction and phased boundaries may vary slightly for access to certain bank material for blending. Any major deviation in the phasing and direction in extraction will require a site plan amendment”*. While this revision added slightly more detail to the site plan, it did not clearly define “major deviation” or “slight variation,” nor did it remove these ambiguous terms. Despite this, MNRF was ultimately satisfied with the additional details, and the comment was resolved. OMAFRA also flagged specific areas that could benefit from additional detail, including establishing soil testing, monitoring agricultural rehabilitation, establishing cover crops and managing and conserving topsoil. The details that OMAFRA recommended adding to the site plan are expanded upon in the following key themes.





Canada Land Inventory Soil Classes

The AIA included an overview of the CLI soil classes at the proposed aggregate extraction site. CLI classes were determined through a review of OMAFRA AgMaps,²⁶ a soil survey and a calculation of the Hoffman Productivity Index (HPI) (see Appendix C, AIA Methodology). While the AIA stated that the site was primarily comprised of CLI Class 2 lands based on OMAFRA AgMaps²⁷ and the soil survey, the CLI class assigned to the site based on HPI values was different. When presenting results from HPI calculations, the AIA stated that the soil productivity rating at the site was ~0.43, corresponding with CLI Class 4. However, later in the AIA, the HPI soil productivity rating was listed as approximately 0.73, which corresponds with Class 2 lands. This inconsistency was raised by OMAFRA, stating that the HPI rating of 0.73 corresponds with Class 2 not Class 4 soils. In response, the aggregate producer stated that *“a detailed review of the geographic information system (GIS) data from the on-site soil survey has revealed that that actual HPI value is 0.73, which reflects an equivalent CLI Class 2... The value 0.43 corresponding with CLI Class 4 equivalent, is incorrect”*. OMAFRA was satisfied with the aggregate producer’s response.

Recommendations to Improve Soil Management

In addition to clarifying the CLI soil classification prior to aggregate extraction, OMAFRA made further recommendations to improve soil management and enhance rehabilitation outcomes. This included asking the aggregate producer to clarify the depths of topsoil and subsoil pre- and post-extraction, recommending that the aggregate producer perform soil testing and suggesting best management practices for handling and storing soil. MNRF also provided comments related to soil management as it pertains to clean fill importation for use in agricultural rehabilitation.

Key comments pertaining to soil management are discussed below.

OMAFRA flagged that the operational plan and the rehabilitation plan (which represent different pages of the site plan) contained differing direction related to the depth of topsoil to be reapplied to the site. One part of the site plan stated that soil would be reapplied at 30 cm in depth, while another part of the site plan stated that soil would be reapplied at 15 cm in depth. OMAFRA recommended the site plan be reviewed for consistency and recommended that the soil depths reapplied during rehabilitation align with baseline soil depths at the site. The aggregate producer responded by clarifying that the site includes ~15 cm of topsoil and 30 cm of subsoil as identified through a soil survey. The aggregate producer changed the wording of the site plan to: *“in areas where agricultural rehabilitation is required, topsoil shall be replaced at the same pre-extraction depth, as confirmed through monitoring and stripping”* and specified the depths for topsoil (15 cm) and subsoil (30 cm) reapplication to the site (Table 1).

To preserve topsoil for agricultural rehabilitation, OMAFRA also recommended that topsoil only be stripped and moved under dry and unfrozen soil conditions to alleviate soil compaction. OMAFRA highlighted that this was recommended in the AIA but was not included in the site plan. In response, the aggregate producer added wording to the site plan to state that topsoil would only be moved under dry and unfrozen conditions. OMAFRA was satisfied with the revised site plan language.

OMAFRA continued to stress the importance of conserving topsoil for agricultural rehabilitation. In one comment, OMAFRA reiterated information presented in the AIA, which stated that when topsoil is stripped and stored in berms or stockpiles for prolonged periods of time, the quality of the soil may begin to deteriorate due to soil compaction and a reduction in soil fertility. OMAFRA stressed

²⁶ Ministry of Agriculture, Food, and Agribusiness. AgMaps. Government of Ontario, <https://www.lioapplications.lrc.gov.on.ca/AgMaps/Index.html?viewer=AgMaps.AgMaps&locale=en-CA>

²⁷ Ministry of Agriculture, Food, and Agribusiness. AgMaps. Government of Ontario, <https://www.lioapplications.lrc.gov.on.ca/AgMaps/Index.html?viewer=AgMaps.AgMaps&locale=en-CA>



the importance of understanding underlying soil conditions in order to adequately assess whether soil quality was deteriorating, and how to manage and restore soil capability for agriculture following agricultural rehabilitation. OMAFRA recommended that the aggregate producer adopt robust soil testing. OMAFRA suggested that soil testing be conducted by a qualified individual at an accredited lab prior to extraction, during progressive rehabilitation, before final rehabilitation and when the licence was surrendered. OMAFRA recommended that the aggregate producer refer to OMAFRA's Agronomy Guide for Field Crops²⁸ and OMAFRA's draft AIA guidelines²⁹ for guidance on soil testing. The aggregate producer responded by adding detailed information on soil testing that would be carried out at the site to prior to extraction to establish baseline soil conditions and at the beginning of each growing season to continuously monitor soil parameters, including macro and micronutrients, soil chemistry, organic matter, soil texture, soil structure and bulk density (Table 1). OMAFRA was satisfied with the revised site plan language regarding soil testing.

The initial site plan stated that the importation of fill for the purposes of rehabilitation would be required. MNRF stated that this activity would not be approved by the Ministry without adding additional details to ensure that excess soil imported to the site would comply with Ontario Regulation 406/19 under the Environmental Protection Act. This included requiring that imported soils be compliant with the Rules for Soil Management and Excess Soil Quality Standards published by the Ministry of Environment, Conservation and Parks (MECP), which requires testing soil at the source to prior to importation to ensure that soil quality is compliant with MECP guidelines.³⁰ This information was added to the revised site plan and the comment from MNRF was resolved.

Cropping Sequence for Agricultural Rehabilitation

The AIA outlined a specific cropping sequence to help build soil organic matter and restore soil capability during agricultural rehabilitation. More specifically, the AIA recommended that cover crops be established in Year 1 to control erosion, a legume/grass mix be established in Years 2 - 4 to improve soil conditions and row crops in rotation with legume/grass mixtures could be planted in Years 5+. The AIA also provided specific varieties and species of legumes, grasses and grains to be used in the cropping sequence. Despite the AIA clearly outlining a cropping sequence for agricultural rehabilitation; these recommendations were included in the initial site plan. OMAFRA stated that rehabilitation notes in the site plan should align with recommendations made in the AIA and stressed that the cropping sequence be included in the site plan. In response, the aggregate producer added the recommended cropping sequence to the site plan and the comment from OMAFRA was resolved.

Monitoring Agricultural Rehabilitation

OMAFRA emphasized the importance of monitoring the rehabilitation process and recommended that the aggregate producer establish a formal monitoring program to evaluate the effectiveness of progressively returning the site to an agricultural condition. OMAFRA stated that the program could monitor rehabilitation progress and efficacy through evaluating rehabilitated soil capability compared to baseline soil conditions and adjusting rehabilitation approaches as required to improve outcomes. In response, a formal agricultural rehabilitation monitoring program was added to the site plan. The requirements of the monitoring program were edited and revised by OMAFRA to align with best management practices detailed in

²⁸ Ontario Ministry of Agriculture, Food, and Rural Affairs. (2017). Agronomy Guide for Field Crops. *Government of Ontario*, <https://www.ontario.ca/files/2022-10/omafra-agronomy-guide-for-field-crops-en-2022-10-13.pdf>

²⁹ Ontario Ministry of Agriculture, Food, and Rural Affairs. (2018). Draft Agricultural Impact Assessment (AIA) Guidance Document. *Government of Ontario*, <https://www.ontario.ca/files/2024-04/omafra-agricultural-impact-assessments-en-2024-04-03.pdf>

³⁰ Ministry of the Environment, Conservation and Parks. (2025). Rules for soil management and excess soil quality standards. *Government of Ontario*, <https://www.ontario.ca/page/rules-soil-management-and-excess-soil-quality-standards>



OMAFRA's Draft AIA Guidance³¹, which resulted in significant site plan revisions. For example, instead of the site plan stating that "final rehabilitation shall be deemed complete when the area has been planted with cash crops," the revised site plan stated that *"final rehabilitation in the agricultural rehabilitation area will be deemed complete when the area is restored to substantially the same area and same soil capability for agriculture that existed pre-extraction, as determined by the Agricultural Rehabilitation Monitoring program"* (Table 1).

Rehabilitated Side Slopes

The site plan stated that rehabilitated slope gradients would vary from a 2:1 to 10:1 ratio. This represented an override of site plan standards, which require side slopes to be a maximum of a 3:1 ratio.³² MNRF requested that the aggregate producer clarify why a 2:1 slope gradient was being proposed. The aggregate producer explained that the 2:1 side slopes would only be found in the ecological enhancement area and that the range in side slopes from 2:1 to 10:1 would provide diversity to the site and maximize the remaining areas for agricultural rehabilitation. The aggregate producer stated that this would *"offer a more natural look and provide better conditions for cropping some of the side slopes not used for ecological enhancement"*. MNRF was satisfied with the producer's response and granted site plan override but requested that the aggregate producer provide further detail regarding how side slopes would be constructed. In response, the revised site plan stated that *"the slopes will be constructed using back fill methods."* MNRF was satisfied with the site plan revisions, and the comment was resolved.

Comprehensive Rehabilitation

While the proposed pit is planned to be operated and rehabilitated comprehensively with adjacent pits, the initial site plan submitted with the licence application included few details about how this would be accomplished. Both OMAFRA and MNRF

suggested that the site plan would benefit from additional details describing how comprehensive agricultural rehabilitation with the adjacent pits would be achieved.

OMAFRA flagged that the final rehabilitated ground profile of the proposed site appeared to be 1.5 m above the water table but the site plan did not explain how this ground profile would be integrated with the elevation of the adjacent pits. OMAFRA requested a better description of the comprehensive rehabilitation, including implications for final elevation and drainage across the sites. In response, the revised site plan stated that rehabilitation would be coordinated with the adjacent pits *"to help facilitate a comprehensive landform for agriculture (e.g., elevations) across the licences"*. No information was added regarding best management practices for drainage across the proposed site or the adjacent pits.

MNRF expressed similar concerns with the lack of detail regarding the coordination of operational phasing and rehabilitation between the proposed site and the adjacent pits. MNRF requested that the maximum disturbed area, the combined tonnage and the maximum area for processing across all sites be included. Moreover, MNRF stated *"a progressive rehabilitation approach for operating two phases at once for the purpose of blending will need to be proposed in order for the site to remain in compliance with rehabilitation."* In response to MNRF's comments, the site plan was revised to include the maximum disturbed area and the maximum area of extraction and stripping for the proposed site and the adjacent pits. The aggregate producer did not add additional language regarding the maximum area for processing. Furthermore, the aggregate producer stated that requests for site plan amendments to the adjacent licences have been submitted to ensure that the operational phasing and rehabilitation plan of the adjacent pits were aligned with the proposed site.

³¹ Ontario Ministry of Agriculture, Food, and Rural Affairs. (2018). Draft Agricultural Impact Assessment (AIA) Guidance Document. *Government of Ontario*, <https://www.ontario.ca/files/2024-04/omafra-agricultural-impact-assessments-en-2024-04-03.pdf>

³² Ministry of Natural Resources. (2020). Aggregate Resources of Ontario: Site Plan Standards. *Government of Ontario*, <https://files.ontario.ca/mnrf-aggregate-resources-of-ontario-site-plan-standards-2020-en-2021-03-18.pdf>



Discussion

The analysis of the site plan, the AIA and comments from OMAFRA and MNRF highlighted the challenges faced by stakeholders in developing, reviewing, approving and implementing rehabilitation plans. It also identified inconsistencies and misalignments between industry priorities, public policy and best practices for rehabilitation of aggregate extraction sites in prime agricultural areas.

This section discusses the findings of the analysis in the context of four key themes:

- Inconsistencies and Errors
- Importance of Soil Testing and Monitoring
- Unclear Guidelines as a Driver of Ambiguous Language
- Complexities of Comprehensive Rehabilitation

Inconsistencies and Errors

This case study identified inconsistencies and errors in the site plan and AIA. The initial site plan included discrepancies in the depths at which soil would be reapplied to the site during rehabilitation, with the operational notes stating 30 cm in depth and the rehabilitation notes stating 15 cm in depth. This inconsistency was clarified and revised in response to comments from OMAFRA. Another inconsistency was found in the AIA regarding CLI soil classifications for agricultural capability. The AIA calculated the Hoffman Productivity Index (HPI) and associated CLI soil classes with HPI values. In doing so, the AIA reported differing results, with one section stating that the HPI value of the site was equivalent to Class 4 soils, which have lower agricultural capability, and another section of the AIA stating that the HPI value of the site was equivalent to Class 2 soils, which have higher agricultural capability. After OMAFRA identified this discrepancy, the aggregate producer noted that the HPI value associated with Class 4 soils were incorrect, and that the HPI values were associated with Class 2 soils.

Had OMAFRA not flagged these errors and discrepancies, the rehabilitation process could have been adversely impacted. For example, the errors could have resulted in confusion regarding the final depth of topsoil to be reapplied to the site. The inconsistencies could have also resulted in regulatory challenges, making it difficult for MNRF to assess whether the aggregate producer was in compliance with the site plan. Importantly, the PPS (2024) currently directs that aggregate extraction sites must be restored to an agricultural condition, whereby “substantially the same areas and same average soil capability for agriculture will be maintained, restored or enhanced”.³³ Pre-extraction soil capability is largely assessed based on CLI land classifications. Discrepancies and errors in the pre-extraction CLI classifications presented in the AIA could have resulted in the site being rehabilitated to the wrong CLI classification, including a classification with lower agricultural capability. Such errors and inconsistencies pose significant risks to achieving policy requirements of the PPS.

³³ Ministry of Municipal Affairs and Housing (2024). Provincial Planning Statement. Government of Ontario, <https://www.ontario.ca/files/2024-10/mmah-provincial-planning-statement-en-2024-10-23.pdf>



Importance of Soil Testing and Rehabilitation Monitoring

Establishing an agricultural rehabilitation monitoring program that integrates quantitative data, including robust soil testing, is recommended in OMAFRA's Draft AIA Guidance document.³⁴ The draft AIA guidelines were published in 2018, prior to the licence application for the proposed site. Despite this, the AIA omitted to recommend soil testing or agricultural monitoring, and neither of these best practices were included in the initial site plan. Interestingly, the initial site plan included monitoring programs for every major component of the site plan (e.g., annual hydrological monitoring report, annual noise audit, annual ecological monitoring report and annual meetings to review operational performance), except rehabilitation. OMAFRA flagged this and requested that soil testing and agricultural rehabilitation monitoring be included in the site plan. The aggregate producer added soil testing pre-extraction, during progressive rehabilitation and following final rehabilitation. A formal rehabilitation monitoring plan, which would "inform and document how the site shall be progressively rehabilitated back to substantially the same area and same soil capability for agriculture that existed pre-extraction," was also added to the site plan.

Importantly, the site plan did not include pre-extraction CLI classes, despite being identified in the AIA. Without the pre-extraction CLI classes, the rehabilitation monitoring program would not have a baseline for comparison, or for assessing whether the site has truly been restored to the same average soil capability for agriculture as per the PPS.³⁵ Furthermore, establishing baseline soil characteristics through soil testing and continued monitoring of critical soil parameters throughout progressive and final rehabilitation offers an evidence-based path for quantifying and verifying rehabilitation

to an agricultural condition. Had OMAFRA not insisted on the inclusion of these best practices, rehabilitation to an agricultural condition may have been compromised.

Unclear Guidelines as a Driver of Ambiguous Language

The initial site plan contained numerous instances of vague and ambiguous language, including subjective language, such as "should" and "recommend". Both MNRF and OMAFRA requested that subjective terms be replaced with prescriptive terms like "shall" and "will". MNRF went further to request that broad statements be clarified and defined. While the revised site plans addressed the subjective language, it did not clarify or define the broad statements. Both ministries accepted the revised site plan. Difficulty defining vague terms may be linked to unclear and vague guidelines. While site plan standards developed by MNRF require that site plan notes be "comprised of clear unambiguous language," the standards for rehabilitation offer limited direction to help guide aggregate producers in preparing "clear and unambiguous" site plans.³⁶ Moreover, the site plan standards do not include clear definitions or standard rehabilitation indicators that an aggregate producer could reference when preparing site plans.

Complexity of Comprehensive Rehabilitation

While the proposed site represents an application for a new licence under the ARA, the aggregate producer proposed to operate and rehabilitate the site with existing adjacent pits. Although the initial site plan indicated that comprehensive rehabilitation would be carried out across all three sites, little information was provided as to how the proposed site would be physically and operationally integrated with the adjacent pits.

³⁴ Ontario Ministry of Agriculture, Food and Rural Affairs. (2018). Draft Agricultural Impact Assessment (AIA) Guidance Document. *Government of Ontario*, <https://www.ontario.ca/files/2024-04/omafra-agricultural-impact-assessments-en-2024-04-03.pdf>

³⁵ Ministry of Municipal Affairs and Housing (2024). Provincial Planning Statement. *Government of Ontario*, <https://www.ontario.ca/files/2024-10/mmah-provincial-planning-statement-en-2024-10-23.pdf>

³⁶ Ministry of Natural Resources and Forestry. (2020). Aggregate Resources of Ontario: Site Plan Standards. *Government of Ontario*, <https://files.ontario.ca/mnrf-aggregate-resources-of-ontario-site-plan-standards-2020-en-2021-03-18.pdf>



OMAFRA raised concerns regarding the final elevation of the proposed site in comparison to the adjacent pits and recommended that provisions be made to ensure adequate drainage management between the sites. MNRF similarly requested additional details describing how phased operations and rehabilitation would be coordinated with the adjacent licences. The aggregate producer revised the site plan, specifying that rehabilitation would be “coordinated to help facilitate a comprehensive landform for agriculture (e.g., elevations)”. The aggregate producer also noted that requests for site plan amendments had been submitted for the adjacent licences to allow for comprehensive rehabilitation. However, the aggregate producer provided minimal explanation

as to how comprehensive rehabilitation would be coordinated and completed.

This case study highlights the complexity of comprehensive rehabilitation across multiple licences. Because each licence remains legally distinct, variations in approval timing, operational sequencing and approved rehabilitation plans may create uncertainty as to how comprehensive rehabilitation would be carried out on the ground. The absence of detailed methodologies or shared monitoring provisions makes it difficult to assess whether outcomes across adjoining licences will align. 🌾





Conclusions

This case study report examined the rehabilitation plan included in a licence application for a proposed aggregate pit located within a prime agricultural area in Ontario. The analysis drew upon documents prepared for the licence application, including site plans (initial and revised), the AIA prepared under policy requirements of the Growth Plan for the Greater Golden Horseshoe and comments from MNRF and OMAFRA regarding the proposed progressive and final rehabilitation plan. The aggregate producer has been granted planning approval from the local municipality, and MNRF has withdrawn its objection to the proposed licence. It is expected that the proposed site will be licenced under the ARA.

The proposed site is located on land designated as a prime agricultural area, with ~10% Class 1, 65% Class 2 and 10% Class 3 soils, indicating overall high soil capability for common field crops. The site is leased to a farmer producing winter wheat and common field crops. The area surrounding the proposed pit is similarly designated as a prime agricultural area with several licensed pits and quarries, some of which lie directly adjacent to the proposed site and by the same aggregate producer. The proposed site would be operated and rehabilitated comprehensively with the adjacent licences, returning all lands to an agricultural condition following extraction.

The initial site plan followed the majority of MNRF's basic site plan standards³⁷, but did not incorporate best practices for rehabilitation in prime agricultural areas.³⁸ The initial rehabilitation plan omitted several best practices, including soil testing, monitoring and cover crop and cropping sequence guidance (Table 2). Through the commenting and review process, both MNRF and OMAFRA recommended that the site plan exceed minimum requirements to ensure that the site would be effectively rehabilitated to an

agricultural condition. These recommendations led to significant revisions to the site plan, including the addition of best management practices such as handling topsoil only under dry and unfrozen conditions, separating topsoil and subsoil during stripping and storage, conducting regular soil testing, establishing an agricultural monitoring program and adopting a multi-year cropping sequence to rebuild soil organic matter, soil structure and soil fertility. The revised site plan also replaced suggestive language (e.g., "should") with prescriptive language (e.g., "shall") to strengthen compliance with the ARA and PPS.

Despite significant improvements to the revised site plan, vague and ambiguous language remained, which may be the result of unclear guidance within existing site plan standards.³⁹ This case study also highlighted some practical and operational complexities of comprehensive rehabilitation, with the aggregate producer struggling to clearly explain how the proposed pit would be integrated comprehensively with the adjacent pits. These findings highlight how even when rehabilitation plans are strengthened through the commenting and review process, persistent ambiguities and

³⁷ Ministry of Natural Resources and Forestry. (2020). *Aggregate Resources of Ontario: Site Plan Standards*. Government of Ontario, <https://files.ontario.ca/mnrf-aggregate-resources-of-ontario-site-plan-standards-2020-en-2021-03-18.pdf>

³⁸ Ontario Ministry of Agriculture, Food, and Rural Affairs. (2018). *Draft Agricultural Impact Assessment (AIA) Guidance Document*. Government of Ontario, <https://www.ontario.ca/files/2024-04/omafra-agricultural-impact-assessments-en-2024-04-03.pdf>

³⁹ Ministry of Natural Resources and Forestry. (2020). *Aggregate Resources of Ontario: Site Plan Standards*. Government of Ontario, <https://files.ontario.ca/mnrf-aggregate-resources-of-ontario-site-plan-standards-2020-en-2021-03-18.pdf>



a lack of detail on comprehensive rehabilitation
can continue to impact agricultural rehabilitation
outcomes following aggregate extraction. 🌿





Appendix A: Project Information

This case study report is a part of a broader research project: **Developing Evidence-based Guidelines for the Rehabilitation of Aggregate Extraction Sites in Prime Agricultural Areas in Ontario**. The overall goal of this project is to develop practical, evidence-based guidelines for rehabilitating aggregate extraction sites on agricultural land. Specifically, the project will:

- Identify key soil health properties and indicators that support rehabilitation to agricultural land uses.
- Evaluate evidence-based rehabilitation best practices for building and maintaining soil health that supports productive agricultural land.
- Assess recurring challenges related to rehabilitation in licence applications, site plans, rehabilitation plans and agricultural impact assessments for sites on agricultural land.
- Develop standard protocols for demonstrating and confirming rehabilitation measures are in place.

The rehabilitation of pits and quarries is not only mandated; it is a vital step in the sustainable management of aggregate resources in the province. Moreover, the quick return of these sites to an agricultural condition post-extraction is critical for minimizing the loss of productive farmland. This loss not only affects food security directly but also underscores the importance of expedited rehabilitation efforts.

The PPS (2024) requires that prime agricultural areas be protected for long-term use.⁴⁰ It allows the extraction of aggregates in prime agricultural areas, on prime agricultural land and specialty crop areas as an interim land use, stipulating that extraction sites must be returned to an agricultural condition. For prime agricultural areas, agricultural condition is defined as “a condition in which substantially the same areas and same average soil capability for agriculture is restored”. For specialty crop areas, the PPS (2024) requires that “the same range of specialty crops common in the areas can be achieved, and, where applicable, the microclimate on which the site and surrounding area may be dependent for specialty crops will be maintained or restored”. The PPS (2024) further requires that both progressive and final rehabilitation must be carried out.

For sites where rehabilitation to an agricultural condition is required, the collective results of this project will:

- Reduce delays and uncertainty in the approval process and minimize revisions of applications, site and rehabilitation plans and technical reports by adding clarity and transparency to the commenting and approval process.
- Lead to enhanced consistency and efficiency of the licence commenting and approval process.
- Provide all stakeholders with access to an evidence-based set of parameters/ indicators and common/standard language and approaches for inclusion in site and rehabilitation plans and technical reports.

⁴⁰ Ministry of Municipal Affairs and Housing (2024). Provincial Planning Statement. Government of Ontario, <https://www.ontario.ca/files/2024-10/mmah-provincial-planning-statement-en-2024-10-23.pdf>; Penaud, A., Holy, K., Lemay, M. A., Fullerton, C. (2025). Policy Timeline – the Intersection of Agriculture and Aggregates. VISTA Science and Technology.



- Allow OMAFA (and other review and commenting agencies) to provide timelier, more consistent reviews and enhanced guidance to applicants on, 1) what constitutes rehabilitation to an agricultural condition and same average soil capability for agriculture and; 2) the details to include in applications, site and rehabilitation plans and relevant technical reports to fully describe how sites will be returned to an agricultural condition.
- Lead to improved, more consistent rehabilitation of sites in prime agricultural areas and specialty crop areas and increased compliance.





Appendix B: Glossary of Terms

Aggregate Resources Act (ARA): Legislation that directs the management of aggregate resources in Ontario; controls and regulates aggregate operations on Crown and private lands; enforces the rehabilitation of land from which aggregates have been extracted; and works to minimize adverse impacts to the environment in respect to aggregate operations.⁴¹ Mechanisms utilized to enforce the ARA include aggregate licences and site plan documents. The Ministry of Natural Resources (MNR) is responsible for the administration of aggregate licences and enforcing the ARA. While the ARA governs aggregate extraction, the aggregate industry must also comply with provincial planning policies (i.e., the PPS and the Greenbelt Plan) and municipal policies.

Agricultural Condition: In prime agricultural areas, agricultural condition is defined as “a condition in which substantially the same areas and same average soil capability for agriculture will be maintained, restored or enhanced”.⁴² In specialty crop area, agricultural condition is defined as “a condition in which substantially the same areas and same average soil capability for agriculture are restored, the same range and productivity of specialty crops common in the area can be achieved, and, where applicable, the microclimate on which the site and surrounding area may be dependent for specialty crop production will be maintained, restored or enhanced”.⁴³

Agricultural Impact Assessment (AIA): An “evaluation of potential impacts of non-agricultural uses on the agricultural system. The assessment recommends ways to avoid or if avoidance is not possible, minimize and mitigate adverse impacts.”⁴⁴

Canada Land Inventory (CLI) for Agriculture: An inventory and “interpretative system used to assess the effects of climate and soil characteristics on the limitations of land for growing common field crops.”⁴⁵ The system evaluates soil productivity, the range of common field crops that can be grown on specific soil classes and best management practices to support the conservation of soils for field crop production.⁴⁶

Comprehensive Rehabilitation: A “rehabilitation of land from which mineral aggregate resources have been extracted that is coordinated and complementary, to the extent possible, with the rehabilitation of other sites in an area where there is a high concentration of mineral aggregate operations”.⁴⁷ Comprehensive rehabilitation is often proposed for pit expansions, which enables adjacent licenced pits to be rehabilitated to a uniform post-extraction land-use (e.g., agriculture).

⁴¹ Government of Ontario. (2021). Aggregate Resources Act. *Government of Ontario, E-laws*, <https://www.ontario.ca/laws/statute/90a08>

⁴² Ministry of Municipal Affairs and Housing (2024). Provincial Planning Statement. *Government of Ontario*, <https://www.ontario.ca/files/2024-10/mmah-provincial-planning-statement-en-2024-10-23.pdf>

⁴³ *Ibid.*

⁴⁴ *Ibid.*

⁴⁵ Ministry of Agriculture, Food, and Agribusiness. (2024). Soil capability for agriculture in Ontario. *Government of Ontario*, <https://www.ontario.ca/page/soil-capability-agriculture-ontario#:~:text=The%20soil%20capability%20class%20represents%20the%20potential,are%20generally%20feasible%20on%20similar%20soils%20elsewhere>

⁴⁶ Ministry of Agriculture, Food, and Agribusiness. (2024). Soil capability for agriculture in Ontario. *Government of Ontario*, <https://www.ontario.ca/files/2024-08/omafa-soil-capability-for-agriculture-in-ontario-en-2024-08-15.pdf>

⁴⁷ Ministry of Municipal Affairs and Housing (2024). Provincial Planning Statement. *Government of Ontario*, <https://www.ontario.ca/files/2024-10/mmah-provincial-planning-statement-en-2024-10-23.pdf>



Greenbelt Plan: The Greenbelt Plan (2017) is a land-use planning framework established under the Greenbelt Act to provide protection to agricultural lands, natural heritage sites and water resources in Ontario's Greater Golden Horseshoe region.⁴⁸ The plan includes the Protected Countryside, Urban River Valleys and lands within the Niagara Escarpment Plan, Oak Ridges Moraine Conservation Plan and Parkway Belt West Plan areas. The plan works alongside the PPS to ensure sustainable resource use and environmental and agricultural preservation.

Growth Plan for the Greater Golden Horseshoe: Growth Plan for the Greater Golden Horseshoe (2019), was a provincial plan for the Greater Golden Horseshoe region of Ontario, which spans much of Southern Ontario, including the western boundaries of Lake Ontario, Lake Simcoe, the Georgian Bay area of Lake Huron and the eastern boundary of Lake Erie. Under the Growth Act, this provincial plan set out the regulatory framework for land-use planning policies in the Greater Golden Horseshoe. The plan worked alongside the Provincial Policy Statement (2020), until the PPS came into effect in 2024.⁴⁹

Maximum Disturbed Area: A calculation of "all areas within the boundaries of a licenced site which have been altered from their original condition and where final rehabilitation in accordance with the [Aggregate Resources] Act, the regulations, and the site plan has not been completed".⁵⁰ This includes any area on the site that has been impacted by non-agricultural land-uses and has not been rehabilitated back to an agricultural condition. MNR includes guidelines for calculating a maximum disturbed area.⁵¹ Establishing a maximum disturbed area is a requirement under the Greenbelt Plan.

Mineral Aggregates Resources: Gravel, sand, clay, earth, shale, stone limestone, dolostone, sandstone, marble and granite suitable for construction, manufacturing and maintenance purposes.⁵²

Overburden: All material laying between the subsoil and the workable mineral aggregate deposit. "Many sand and gravel deposits in Ontario do not contain overburden material – engineers often use the term to refer to material lying above the workable deposits, including topsoil and subsoil."⁵³

Prime Agricultural Areas: Regions where prime agricultural lands predominate, including specialty crop areas and associated Canada Land Inventory Class 4 through 7 lands, and additional areas with a local concentration of farms which exhibit characteristics of ongoing agriculture. "Prime agricultural areas may be identified by a planning authority based on provincial guidance or informed by mapping obtained from the Ontario Ministry of Agriculture, Food and Agribusiness and the Ontario Ministry of Rural Affairs or any successor to those ministries."⁵⁴

Prime Agricultural Land: Land with high capability for agriculture, including specialty crop areas and Canada Land Inventory Class 1, 2, and 3 lands.⁵⁵

⁴⁸ Government of Ontario. (2017). Greenbelt Plan. *Government of Ontario*, <https://files.ontario.ca/greenbelt-plan-2017-en.pdf>

⁴⁹ Government of Ontario. (2020). A Place to Grow: Growth Plan for the Greater Golden Horseshoe. *Government of Ontario*, <https://files.ontario.ca/mmah-place-to-grow-office-consolidation-en-2020-08-28.pdf>

⁵⁰ Ministry of Natural Resources. Establishing Maximum Disturbed Area for Existing Aggregate Operations in the Protected Countryside of the Greenbelt Plan Area. *Government of Ontario*, <https://files.ontario.ca/environment-and-energy/aggregates/269499.pdf>

⁵¹ *Ibid.*

⁵² Government of Ontario. (2021). Aggregate Resources Act. *Government of Ontario, E-laws*, <https://www.ontario.ca/laws/statute/90a08>

⁵³ Mackintosh, E. E. and Mozuraitus, E. J. (1982). Aggregates and the Aggregate Industry: Industrial Mineral Background Paper 3. *Ministry of Natural Resources*, https://toarc.com/wp-content/uploads/2019/02/Agri_Aggre.pdf

⁵⁴ Ministry of Municipal Affairs and Housing (2024). Provincial Planning Statement. *Government of Ontario*, <https://www.ontario.ca/files/2024-10/mmah-provincial-planning-statement-en-2024-10-23.pdf>

⁵⁵ *Ibid.*



Provincial Planning/Policy Statement (PPS): The Provincial Planning/Policy Statement, is issued under the authority of the Ontario Planning Act. The PPS consists of policies that stipulate the use and development of land, including agricultural and aggregate land uses. The PPS (2024) replaced PPS (2020) and A Place to Grow: A Growth Plan for the Greater Golden Horseshoe (2019). Previous version of the PPS include 1997, 2005 and 2014.⁵⁶

Ripping: A remedial approach utilized to alleviate soil compaction and promote root penetration, infiltration and development of soil structure on rehabilitated lands.⁵⁷ It is recommended that ripping be constrained to the depth of each soil horizon (e.g., topsoil or subsoil) to minimize mixing soil layers.⁵⁸

Soil Capability: The suitability of soils for growing field crops. Higher soil capability aligns with higher CLI classes.⁵⁹

Soil Health: The “ability of soil to support crop growth without becoming degraded or otherwise harming the environment”. Soil health includes physical chemical and biological components, as outlined by OMAFA.⁶⁰

Specialty Crop Area: Areas within the agricultural system whereby specialty crops, such as tender fruits (i.e., peaches, cherries, plums), grapes, vegetable crops, greenhouse crops and crops from agriculturally developed organic soil predominate.⁶¹ According to

the PPS (2024), specialty crop areas are typically the result of:

- “Soils that have suitability to produce specialty crops, or lands that are subject to special climatic conditions, or a combination of both;
- Farmers skilled in the production of specialty crops; and
- A long-term investment of capital in areas such as crops, drainage, infrastructure and related facilities and services to produce, store, or process specialty crops.”⁶²

Stripping: A process of removing the topsoil, subsoil and overburden material located above mineral aggregate deposits. Prior to extraction, soil studies can be utilized to identify the depths of each soil zone and inform a stripping plan to minimize mixing of soil layers.⁶³

Subsoil: The zone immediately beneath the topsoil, which may extent to a depth of 1 m or more. “Under natural conditions, the subsoil is often well structured, and contains numerous plant roots... In summer drought periods, plants may obtain much of their moisture requirements from this zone.”⁶⁴

Topsoil: The uppermost zone of the soil, often darker in colouration due to the accumulation of organic matter. “On arable agricultural lands, it is normally restricted to the depth of cultivation, which is about 15 to 30 cm.”⁶⁵

⁵⁶ Open Council. (2024). Ontario Provincial Planning Statement (PPS) tells municipalities how to handle growth and development. (2024).

Open Council. <https://opencouncil.ca/provincial-planning-statement/> Penaud, A., Holy, K., Lemay, A., Fullerton, C. (2025). Policy Timeline – the Intersection of Agriculture and Aggregates. VISTA Science and Technology.

⁵⁷ Ontario Ministry of Agriculture, Food, and Rural Affairs. (2018). Draft Agricultural Impact Assessment (AIA) Guidance Document. *Government of Ontario*, <https://www.ontario.ca/files/2024-04/omafra-agricultural-impact-assessments-en-2024-04-03.pdf>

⁵⁸ *Ibid.*

⁵⁹ Ontario Ministry of Agriculture, Food, and Agribusiness. (2024). Soil Capability for Agriculture in Ontario. *Government of Ontario*, <https://www.ontario.ca/files/2024-08/omafra-soil-capability-for-agriculture-in-ontario-en-2024-08-15.pdf>

⁶⁰ Ontario Ministry of Agriculture, Food, and Agribusiness. (2024). New Horizons: Ontario’s Agricultural Soil Health and Conservation Strategy. *Government of Ontario*, <https://www.ontario.ca/files/2024-04/omafra-new-horizons-ontarios-agricultural-soil-health-and-conservation-strategy-en-2024-04-04.pdf>

⁶¹ Ministry of Municipal Affairs and Housing (2024). Provincial Planning Statement. *Government of Ontario*, <https://www.ontario.ca/files/2024-10/mmah-provincial-planning-statement-en-2024-10-23.pdf>

⁶² *Ibid.*

⁶³ Ontario Ministry of Agriculture, Food, and Rural Affairs. (2018). Draft Agricultural Impact Assessment (AIA) Guidance Document. *Government of Ontario*, <https://www.ontario.ca/files/2024-04/omafra-agricultural-impact-assessments-en-2024-04-03.pdf>

⁶⁴ Mackintosh, E. E. and Mozuraitus, E. J. (1982). Aggregates and the Aggregate Industry: Industrial Mineral Background Paper 3. *Ministry of Natural Resources*, https://toarc.com/wp-content/uploads/2019/02/Agri_Aggre.pdf

⁶⁵ *Ibid.*



Appendix C: Agricultural Impact Assessment Methodology

An AIA was prepared for the licence application of the case study site under the policy requirements of the Growth Plan for the Greater Golden Horseshoe (2019), which mandated the completion of an AIA for new aggregate extraction applications within prime agricultural areas.⁶⁶ The AIA was conducted by a qualified professional retained by the aggregate producer.

Based on the recommendations provided by OMAFRA's Draft AIA Guidance,⁶⁷ the AIA assessed impacts to agricultural operations and the agricultural system through two separate study areas: the "Primary Study Area" and the "Secondary Study Area". The Primary Study Area included: "the area immediately adjacent to the subject lands that has the potential to be directly impacted by the aggregate extraction operation," with the "subject lands" defined as the proposed pit expansion. The AIA did not specify the exact size (e.g., radius) of the Primary Study Area. The Secondary Study Area included "a zone of potential impact extending a minimum of 1000 m (1.0 km) beyond the boundary of the subject lands" to assess potential impact of the proposed aggregate extraction site on the agricultural system, land use patterns and agricultural viability.

The methodology included a review of policy documents, supporting technical reports and spatial datasets, including:

- Relevant provincial, regional and municipal land-use planning policies,
- Reports prepared in support of the licence application, including the hydrogeological study, the natural environment study, the transportation study, the noise impact study and the planning justification report,

- Draft site plans,
- OMAFRA's Artificial Drainage Map,
- Aerial photography and satellite imagery,
- Soil data sources, including provincial soil survey reports, the *CLI* agricultural capability mapping and provincial digital soil databases.

The AIA incorporated both roadside and field surveys, as well as on-site investigations. These included:

- A land use survey using recent satellite imagery and roadside observations to identify existing agricultural operations, crop types, and non-farm uses within the study area,
- A "detailed soil survey" following OMAFRA's Guidelines for Detailed Soil Surveys for Agricultural Land Use Planning,⁶⁸
- A review of published CLI ratings and aerial photographic interpretation to soil polygons, disturbed areas and landscape features (e.g., streams, boulder pavements, pits), and
- Preparation of mapping to illustrate the location of soil polygons and corresponding CLI capability ratings on the site.

⁶⁶ A Place to Grow: Growth Plan for the Greater Golden Horseshoe. (2019) *Government of Ontario*, <https://files.ontario.ca/mmah-place-to-grow-office-consolidation-en-2020-08-28.pdf>

⁶⁷ Ontario Ministry of Agriculture, Food, and Rural Affairs. (2018). Draft Agricultural Impact Assessment (AIA) Guidance Document. *Government of Ontario*, <https://www.ontario.ca/files/2024-04/omafra-agricultural-impact-assessments-en-2024-04-03.pdf>

⁶⁸ Ontario Ministry of Agriculture, Food and Rural Affairs. (2004). Guidelines for Detailed Soil Surveys in Ontario. *Government of Ontario*, <https://www.ontario.ca/page/guidelines-detailed-soil-surveys-ontario>



The soil survey used “a Dutch Soil Auger to extract the soil material to a minimum depth of one meter (or to refusal) [and] a hand-held clinometer to assess present slope characteristics”. Each soil profile was examined for “soil texture, drainage class, topography (position and slope), and depth to free water within one meter of the soil surface”. Soils were classified according to the Canadian System of Soil Classification,⁶⁹ published in 1998, and correlated with the Field Manual for Describing Soils in Ontario,⁷⁰ published in 1993.

To supplement the CLI soil capability ratings, the AIA calculated the Hoffman Productivity Index (HPI). The HPI provides an index value representing the overall productivity of the soil resource at the site. The calculation followed methodologies outlined in ARDA Report No. 4: The Assessment of Soil Productivity for Agriculture,⁷¹ published in 1971, which correlates soil productivity to CLI classes through crop yield data. The HPI “assumes equal management intensity across soil classes and applies a productivity coefficient to each class”, with Class 1 soils representing the highest productivity and Class 7 the lowest. 

⁶⁹ Agriculture and Agri-Food Canada. (1998). The Canadian System of Soil Classification (Third Edition). *Government of Canada*, <https://sis.agr.gc.ca/cansis/publications/manuals/1998-cssc-ed3/index.html>

⁷⁰ Denholm, K. A., Irvine, D. E., Schut, W., Guelph Agriculture Centre., Ontario Centre for Soil Resources Evaluation. (1993). Field Manual for Describing Soils in Ontario. *Soil Surveys*, 93(1), https://books.google.com/books/about/Field_Manual_for_Describing_Soils_in_Ont.html?id=0zjAAQAACAAJ

⁷¹ Hoffman, D. W. (1971). The Assessment of Soil Productivity for Agriculture. ARDA Report No. 4. Department of Land Resource Science. *University of Guelph*.





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