

**Application for Approval to Store Hydrocarbons
in Salt Solution Mined Caverns
For
Pembina Infrastructure and Logistics LP
Corunna Storage Terminal**



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1.0 Introduction

Pembina Infrastructure and Logistics LP (“Pembina”), by its wholly-owned subsidiary and general partner 1195714 Alberta Ltd., owns and operates a natural gas liquids (“NGL”) storage and trans- loading facility in St. Clair Township – County of Lambton, Concessions XI (Part Lot 23, Lot 24, Lot 25 and Part Lot 26) and Concession XII (Lot 23, Lot 25 and Part Lot 26), known as the “Corunna Facility”. Currently, Pembina has 24 caverns at the Corunna Facility, with a current storage scheme of 10 solution mined caverns (the “Existing Caverns”). The remaining 14 caverns under the Corunna Facility are suspended solution mined caverns (the “Suspended Caverns”) and are not currently in service.

The Existing Caverns are in the “A-2” and “B-2” Salt Units located approximately 580 to 760 meters below ground surface, all of which are listed in the table below. The Existing Caverns range in size from 27,000 m³ to 268,000 m³ and store a variety of hydrocarbon liquids. Of the 10 Existing Caverns, one is a single entry, six are dual entry and three are triple entry.

Pembina Designated Storage Caverns the “Existing Caverns”				
Cavern Number	Well Name	License	Drilling Date	Storage Volume (m ³)
1	Dow HC No. 1, Moore 2 - 25 - XI	T003565	1973	32,000
	Dow BR No. 1, Moore - 25 - XI	T004909	1979	
3	Dow HC No. 3, Moore 2 - 25 - XI	T003912	1974	64,000
	Dow BR No. 3, Moore - 25 - XI	T004908	1979	
4	Dow HC No. 4, Moore - 25 - XI	T003913	1975	85,000
	Dow BR No. 4, Moore - 25 - XI	T005083	1979	
5	Dow HC No. 5, Moore - 25 - XI	T003914	1975	52,000
	Dow BR No. 5, Moore - 25 - XI	T005084	1979	
6	Dow HC No. 6, Moore - 25 - XI	T003915	1975	30,000
	Dow BR No. 6, Moore - 25 - XI	T005085	1979	
8	Dow HC No. 8, Moore - 25 - XI	T003917	1975	27,000
49	Dow No. 49, Moore 4 - 24 - XII	T003694	1974	112,000
	Dow HC No. 49A, Moore 4 - 24 - XII	T005537	1980	
	Dow No. 50, Moore 1 - 24 - XII	T003693	1974	
51	Dow Chemical No. 51, Moore - 23 - XII	T003801	1974	72,000
	Dow HC #51A, Moore - 23 - XII	T005355	1980	
	Dow No. 52, Moore 5 - 24 - XII	T003802	1974	
56	Dow 56B, Moore - 23 - XII	T004318	1977	84,000
	Dow Chem. No. 56, Moore - 23 - XII	T006979	1986	
59	Dow 59B, Moore - 24 - XII	T005054	1979	268,000
	Dow No. 59, Moore - 24 - XII	T006980	1986	
	Dow #60, Moore - 24 - XII	T005055	1979	
Existing storage volume (m ³)				826,000



After performing an assessment of all 14 Suspended Caverns at the Corunna facility, Pembina identified 11 Suspended Caverns (the "Proposed Caverns") as having good potential for conversion to storage. The Proposed Caverns range in size from 17,000 m³ to 260,000 m³ and are identified in the table below as "Proposed". The foregoing assessment took into consideration certain factors including the size, shape and roof salt thickness of the caverns and the physical location and proximity of the Proposed Caverns to other caverns and the Corunna Facility. Expansion by converting the Proposed Caverns into hydrocarbon service will use the same design and operate at the same pressures as the Existing Caverns and their related systems.

Pembina Suspended Brine Mining Caverns					
Cavern Number	Well Name	License	Drilling Date	Storage Volume (m ³)	Proposed Cavern (Y/N)
7	Dow HC No. 7, Moore - 25 - XI	T003916	1975	165,000	Y
9	Dow HC #9, Moore - 25 - XI	T006622	1985	65,000	Y
10	Dow HC #10, Moore - 25 - XI	T006620	1984	65,000	Y
11	Dow HC #11, Moore - 25 - XI	T006807	1985	29,000	Y
12	Dow HC #12, Moore - 25 - XI	T006809	1985	17,000	N
45	Dow #45, Moore - 25 - XII	T003426	1972	260,000	Y
61	Dow #61, Moore - 24 - XI	T005210	1980	55,000	N
62	Dow #62, Moore - 24 - XI	T005211	1980	115,000	N
65	Dow #65, Moore - 24 - XI	T005553	1981	250,000	Y
	Dow #66, Moore - 24 - XI	T005552	1981		
67	Dow #67, Moore - 24 - XI	T005218	1981	125,000	Y
	Dow #68, Moore - 24 - XI	T005217	1981		
69	Dow Chemical Canada Inc. #69, Moore - 24 - XI	T005781	1982	100,000	Y
70	Dow Chemical Canada Inc. #70, Moore - 24 - XI	T005782	1982	75,000	Y
71	Dow Chemical Canada Inc. #71, Moore - 23 - XI	T005783	1981	76,000	Y
72	Dow Chemical Canada Inc. #72, Moore - 23 - XI	T005784	1981		Y
Potential additional storage volume (m ³)				1,397,000	

All of the caverns currently located below the Corunna Facility were originally drilled and mined for salt by Dow Chemical Canada ULC ("Dow") between 1970 and 1986. The solution mining of the caverns ended in the late 1990's. The Existing, Suspended and Proposed Caverns are or were authorized by the MNR for hydrocarbon storage. Pembina will continue to use the Existing and Proposed Caverns for hydrocarbon storage in accordance with the Canadian Standards Association Z341 Storage of Hydrocarbons in Underground Formations ("CSA Z341").

Pembina also has 3 monitoring caverns (Caverns 53, 55 and 82) under the Corunna Facility (the "Monitoring Caverns"), which monitor the pressure of the Enbridge Storage Area (as defined below) to ensure no down hole changes occur at the Corunna Facility (i.e. pressure changes). Please refer to section 4.4 for further information on the Enbridge Storage Area.

Accordingly, Pembina makes this application pursuant to Section 11 of the OGSRA for permits to:

- Convert Cavern 45 in 2015 by abandoning the current entry well and drilling two new entry wells; and



- Expand Pembina's current storage capacity in existing salt solution mined caverns, by converting 11 currently unused caverns (including Cavern 45) to hydrocarbon storage within the next fifteen years.

2.0 Existing Facility

Pembina's operation of its storage caverns meets the requirements of the *Oil, Gas and Salt Resources Act*, R.S.O. 1990, c P.12 (the "OGSRA") and its regulations (the "Regulations") and has all requisite approvals from the Ontario Ministry of Natural Resources and Forestry (the "MNR"). The Corunna Facility also meets the requirements of the Ontario Ministry of the Environment (the "MOE") under Certificate of Approval for Air 0054-8BRQA3 and Certificate of Approval for Industrial Sewage Works 4968-7LXU4M.

All caverns in Ontario are governed by the CSA Z341 series of standards and industry best practices to ensure that cavern safety and integrity is maintained to protect the public, the applicable facility and the environment. Pembina continues to operate the Existing Caverns within the prescribed area of the Corunna Facility in compliance with the requirements of the current edition of CSA Z341 and Pembina's own procedures, standards and requirements based on industry best practices. Pembina continually monitors changes in regulations and will ensure compliance with the requirements of revised versions of CSA Z341, as required.

As part of Pembina's compliance with CSA Z341 and industry best practices, Pembina has implemented a cavern Integrity Tracking Program ("ITP"), which develops a ten-year plan for workovers and Mechanical Integrity Tests ("MIT") to ensure compliance with CSA Z341. In 2014, the Corunna Facility completed two ten-year workovers, on Cavern 3 and Cavern 5, respectively. All caverns converted into storage by Pembina will adhere to CSA Z341 and be added to Pembina's cavern ITP. Pembina also continues to actively participate on the CSA Z341 technical committee.

2.1 Plot Plans of the Corunna Facility

Plot Plans for the Corunna Facility are attached hereto as Appendix A. The Existing Caverns are labeled in green, the Monitoring Caverns are labeled in blue, and the Suspended Caverns are in pink, with the first cavern slated for conversion (Cavern 45) shown in yellow.

3.0 Regulatory Requirement

Underground storage in Ontario is regulated by the OGSRA. The OGSRA provides the MNR the authority to regulate petroleum resources in Ontario, including exploration, drilling and production of oil and natural gas, production of salt using the solution mining method, underground storage of hydrocarbons in geological formations and disposal of oilfield fluids.

The Corunna Facility caverns meet the requirements of CSA Z341, which standard was developed for all of Canada and sets forth the standards for cavern well location, materials, drilling and construction, monitoring, operation, instrumentation, controls, integrity verification, plugging, abandonment and site restoration.

4.0 Expansion Scheme

Pembina proposes to convert 11 currently unused salt solution mined caverns to hydrocarbon storage within the next fifteen years, including conversion of Cavern 45 in 2015 by abandoning the current entry well and drilling two new entry wells.



The proposed expansion would increase on-site storage capacity at the Corunna Facility from the 10 Existing Caverns (826,000 m³) to a total of 21 caverns (2,223,000 m³). SONAR pictures of each Proposed Cavern are attached hereto as Appendix B.

For more detailed information on the Proposed Caverns, please see the spreadsheet outlining the Proposed Caverns attached hereto as Appendix C.

As part of the expansion, the Proposed Caverns will be converted to storage, tested and operated as required by and in accordance with CSA Z341. In accordance with Section 10.2.5.1 and Section 10.2.5.2 of the current version of CSA Z341, the planned integrity inspection workover shall include:

- verification of the integrity of wellheads, valves, and above-ground piping using representative non-destructive testing;
- integrity testing of casing and tubing;
- a production casing inspection log;
- leak testing of valves;
- a sonar survey of the cavern; and
- replacement of all seals and ring gaskets.

The integrity inspection workover of the Proposed Caverns will include a gas/brine interface MIT of each cavern that applies a pressure of 1.1 times the maximum operating pressure, which pressure will not be higher than 80% of the local formation fracture gradient at the casing seat or higher than 100% of the casing minimum yield pressure at any point along the casing. Although not required under the current version of CSA Z341 for a planned integrity inspection workover, Pembina also plans to include (as a part of the integrity inspection workovers) a cement evaluation log prior to introducing any hydrocarbon into each Proposed Cavern. This complete workover plan will ensure that Pembina is accurate with its cavern assessment and each Proposed Cavern meets the requirements for storage of product.

At this time, Pembina has not confirmed a conversion schedule for the Proposed Caverns other than Cavern 45; however, Pembina kindly requests approval from the MNR to proceed with the conversion of the Proposed Caverns for future storage operations. The same due diligence and technical practices mentioned in this application will apply to each of the 11 Proposed Caverns and as part of this Application, Pembina will undertake to file with the MNR Pembina's Application for Conversion to Storage prior to the introduction of hydrocarbon and the bringing into service of each Proposed Cavern as they are required to be converted to meet business needs.

4.1 Cavern 45 Conversion

Currently, Cavern 45 has one entry well (Well BR-45), which Pembina intends to plug and abandon in accordance with CSA Z341. After this work is completed, Pembina intends to drill two new entry wells (Wells BR-45A and HC-45) into Cavern 45. One well will be used for injecting and removing brine while the other well will be used for injecting and removing hydrocarbons. The installation of two wells into a cavern provides for greater efficiencies in flow, pump horsepower and operation. Upon completion of drilling Wells BR-45A and HC-45, Cavern 45 is proposed to store hydrocarbons in accordance with CSA Z341.

Pending regulatory approval, Wells BR-45A and HC-45 would be drilled into the B-2 Salt Unit. Surface casing would be run and cemented on the circumference of Wells BR-45A and HC-45 to protect groundwater aquifers. Wells BR-45A and HC-45 would both be drilled to approximately 600 mKB with the production casing cemented from 600 mKB to surface to isolate all formations.

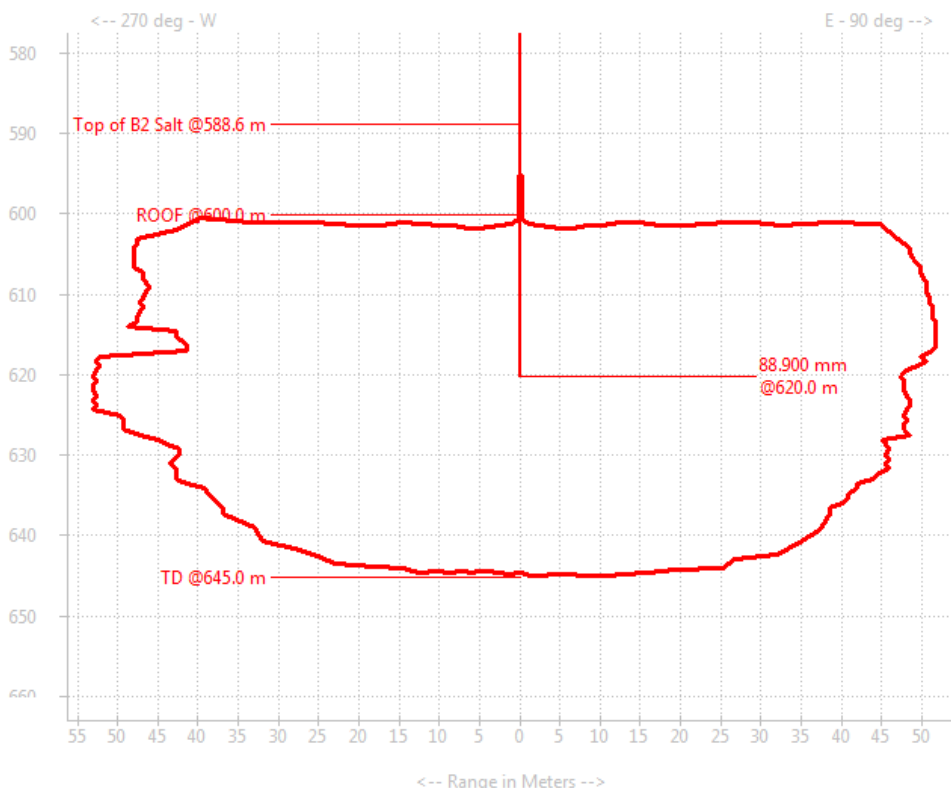


Cavern 45 is slated for conversion in April 2015. Pembina proposes that the drilling of Wells BR-45A and HC-45 would also occur in April 2015, and would last approximately 20 days per well. Pembina anticipates Cavern 45 becoming operational in late 2015.

DOW CHEMICAL CANADA INC.
SARNIA, BRINE FARM

SONARWIRE, INC
Vertical Cross Section

WELL No. 45
BW45-0706mg Sat, Jun 2, 2007



4.2 Referral of the Board

Since the proposed point of injection for Cavern 45 is within 1.6 kilometers of an area designated as a gas storage area under the *Ontario Energy Board Act 1998*, the Minister of Natural Resources will need to refer this Application to the OEB for a report. Accordingly, Pembina kindly requests that upon receipt of this Application, the MNR forwards it to the OEB for review and report with respect to the conversion of Cavern 45.

4.3 Expansion of Surface Brine Storage

Concurrent with Pembina increasing its cavern storage at the Corunna Facility, Pembina will also need to expand its surface brine storage capacity to support the increase in storage capacity as the surface brine will be used to displace hydrocarbons out of the caverns. Pembina presently has 70% of the downhole product storage capacity in the existing surface brine pond storage.

On December 10, 2014, Pembina received an Amended Certificate of Approval for Sewage Works from the MOE in support of the proposed increase of surface brine pond storage capacity for the Corunna Facility. A copy of this approval is attached hereto as Appendix D. This approval allows Pembina to build two new brine ponds that are required to facilitate the storage of surface brine that will be used in the displacement operation of hydrocarbons from the Corunna Facility's storage caverns. Pembina will build brine ponds "421" and "422" with a capacity of 1.2 and 1.8 MMbbls, respectively. The addition of these two new brine ponds will provide Pembina with a 100% downhole product storage capacity, up to and



including the addition of Cavern 45 into production. A copy of Pembina's Product and Brine Infrastructure Overall Layout Map showing these brine ponds can be found in Appendix D.

Pembina remains committed to expansion of its brine system to facilitate the growth of our downhole storage capacity. Future applications to convert to storage for individual cavern additions will also include an application for review of Pembina's surface brine capacity and how addition of the requested cavern could affect the downhole product capacity percentage.

The proposed expansion of Pembina's Corunna Facility uses developed caverns and does not require mining of new caverns, which eliminates the production of new brine and only requires the storage of brine for the displacement theory of hydrocarbons in and out of storage caverns.

4.4 Enbridge Natural Gas Storage Reef

Pembina is adjacent to an Enbridge natural gas storage reef that was designated as a gas storage area (the "Enbridge Storage Area") by *Ontario Regulation 313/88*, filed on May 13, 1988 and published in the Ontario Gazette on May 28, 1988, which has been labeled as critical infrastructure for the Province of Ontario.

Prior to 1987, Dow (as predecessor in interest to Pembina) was a lessee under valid petroleum and natural gas leases and gas storage lease agreements and was a party to certain related unit operating agreements (collectively, the "Storage Agreements"). For use in connection with the Storage Agreements, Dow drilled, constructed and erected certain wells, gathering facilities, a production plant and associated equipment (the "Facilities") on its owned lands.

On July 31, 1987, Dow and Tecumseh Gas Storage Limited ("Tecumseh") (as predecessor in interest to Enbridge Gas Distribution Inc. ("EGDI")) entered into an agreement in which they agreed to enter into a storage lease (the "Storage Lease") and a petroleum and natural gas lease. Dow also agreed to assign and transfer to Tecumseh all of its rights, title and interests in the Storage Agreements and Facilities (the "Original Agreement"). Under the Original Agreement, Dow and Tecumseh also agreed to grant certain rights and assume certain obligations in respect of each other in relation to the lands that comprise the Enbridge Storage Area. Pursuant to the Original Agreement, Dow, on or about August 31, 1987, entered into the Storage Lease, assigned to Tecumseh the Storage Agreements and sold the Facilities to Tecumseh.

On January 26, 2009, Dow and EGDI replaced the Original Agreement and amended the Storage Agreement and related petroleum and natural gas lease with a pair of subsurface leases that set forth all of the terms related to the demise and lease of the subsurface lands that comprise the Enbridge Storage Area. The general nature of the current agreements between Pembina and EGDI requires the cooperation of the parties as it relates to new or the expansion of existing subsurface facilities in and around the lands that comprise the Enbridge Storage Area. A copy of a letter of non-objection provided by Enbridge Inc. ("Enbridge") in respect of the proposed scheme is attached hereto as Appendix F.

5.0 Justification for Expansion

5.1 Public Interest

The Corunna Facility uses underground caverns to store propane and butane, also known as liquefied petroleum gases ("LPGs"). In addition to being used as feedstock for refineries and petrochemical facilities, LPGs are also used throughout North America for home heating and cooking. Increased production from North American shale gas plays has created an abundance of LPGs which in turn has led to a direct impact on local refineries and petrochemical facilities. Despite recent increases in LPG production, demand for LPGs has increased and current supplies are often depleted during the winter



heating season. One such example of this scenario occurred during the winter of 2013/14 when a North American-wide phenomena of extended cold depleted winter storage supplies and ultimately led to households and business not being able to secure timely supplies of LPGs.

5.2 Business Development

It is Pembina's intention to further develop caverns not presently in LPG service in order to expand our storage footprint and serve our clients needs both currently and for future anticipated growth. In addition to providing greater supplies of LPGs, the Corunna Facility expansion is also likely to benefit surrounding areas with additional employment opportunities and increased spending on construction and related materials. It is Pembina's intention to use all of the cavern space over the next 15 years to the mutual benefit of our shareholders, the general public, and local communities.

From a business perspective, expansion of the facility will increase on-site storage and will support continued and additional demand for products, as follows:

1. The Corunna Facility is the primary ethane storage facility for two major local petrochemical facilities, and is also used for seasonal storage of butane and propane which are typically in high demand during the winter months. Incremental storage is also critical during summer months as it allows storage constrained facilities in producing regions to continue to operate without the fear of inadequate storage forcing them to curtail their operations, further pressuring the need for winter inventory builds; and
2. It will support continued demand for NGL products from both local industry and new project development, which will be accomplished through the conversion of existing brine storage caverns into underground hydrocarbon storage.

5.3 Impacts to the Area

Pembina does not expect any adverse impacts to the area as a result of the conversion of the Proposed Caverns.

CSA Z341 limits the maximum allowable casing shoe pressure to 18.1 kPa/m ($580 \times 18.1 = 10,500$ kPa). The normal operating pressure for the Existing Caverns is between 8,000 and 8,500 kPa. The minimum operating pressure of 7,000 kPa will occur when the Existing Caverns are empty of product and "0" brine pressure at surface. The maximum allowable downhole operating pressure of 9,500 kPa is controlled by Emergency Shutdown Valves ("ESVs").

The Proposed Caverns, which are currently full of brine, are monitored for pressure and controlled between 7,000 and 9,000 kPa. If the Proposed Caverns are approved and converted to store liquid hydrocarbons, they will operate at the same conditions as the Existing Caverns. Further, no additional stresses will be added to the Enbridge Storage Area as a result of additional storage caverns, as no new caverns will be created. Pembina is currently monitoring the pressure of Monitoring Caverns and will continue this monitoring program throughout the implementation of the proposed scheme.

6.0 Notification Requirements

Peter Miles, Supervisor – Land (Operations and Integrity) and Melissa Lundy, Advisor, Regulatory of Pembina contacted Jug Manocha, Operations Engineer at the MNR to inquire about notification requirements for this Application. After discussion, it was determined that Pembina would undertake to notify all landowners immediately adjacent to the Corunna Facility prior to Pembina submitting this Application.

The majority of these notifications were sent out via registered mail. The Aamjiwnaang First Nation was notified in person, as well as via registered mail. A copy of the landowner linelist is attached hereto as



Appendix E and details the stakeholders who were notified. The linelist includes industry participants located near the Corunna Facility, as well as mineral rights holders. With respect to mineral rights, Pembina notified Babcock and Wilcox Canada Limited by registered mail.

In addition to stakeholder notifications, a letter of non-objection to Pembina's Scheme Approval Application was obtained from Enbridge. As noted on page 8 of this Application, a copy of Enbridge's letter of non-objection is attached hereto as Appendix F. Once this Application has been filed with the MNR, Pembina will endeavor to receive a second letter of non-objection from Enbridge and will forward it to the MNR as soon as Pembina receives it.

6.1 Public Notification

In addition to the documents provided in respect of Pembina's notification requirements, please find attached hereto:

- Appendix G - Pembina's Notification Letters for all Pembina deemed stakeholders;
- Appendix H - Pembina's Project Specific Information Package, which was provided with each Notification Letter.

7.0 Geology

7.1 Regional Geology

Southern Ontario is underlain by a succession of Paleozoic sedimentary rocks up to 1475 m thick, and ranging in age from late Cambrian to late Devonian and locally Mississippian. These strata thin, pinch out, or have been eroded away over the crest of a basement structural high known as the Algonquin Arch. The Algonquin Arch is a northeastern extension of the Findlay Arch and separates the Michigan Basin from the Appalachian Basin (See Figure 1).

All underground salt solution mining in Ontario is confined to strata of Silurian age. The combined thickness of the Silurian Salina Group varies from 95 m in the Niagara area to over 400 m in the Sarnia area, thickening to 680 m in the centre of the Michigan Basin. Salt occurs within four of the Salina units in Ontario; the A-2, B, D, and F Units, at depths ranging from 300 m to 720 m below the surface. The total combined salt thickness in these four units exceeds 215 m in the Sarnia area and thickens westward into Michigan.

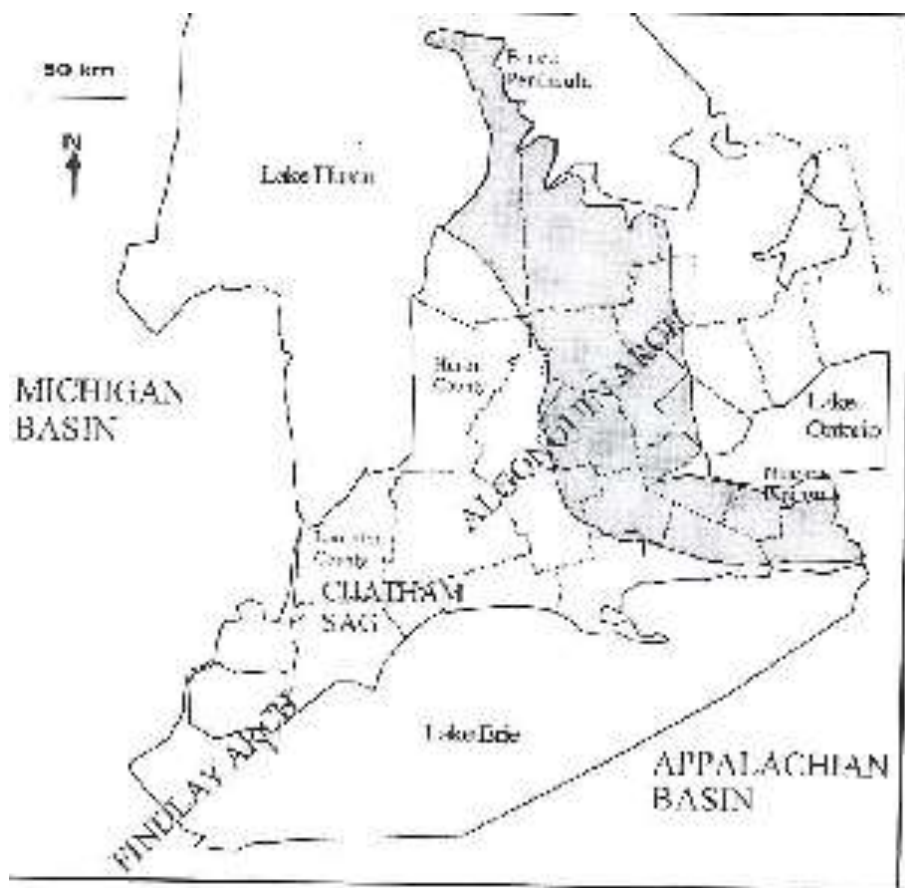


Figure 1: Major structural features and location of Silurian subcrop in Southern Ontario. Silurian strata dip west and south from the subcrop.

7.2 B-Salt Unit

Thick salt beds in the Salina A-2 Unit and B Unit are used for storage of LPG and petrochemicals in solution-mined caverns. Figure 4 shows the distribution of the B Unit. The B Unit is the thickest of the salt units in Ontario, reaching a maximum of 90 m at Sarnia, 75 m in the Windsor area, and an average of 45 m where preserved in the Chatham Sag. The B Unit consists principally of salt, with numerous interbeds of dolomite, anhydrite, and dolomitic shale, some of which are up to several metres in thickness. In Southwestern Ontario, the bedded salt formations are relatively stable and predictable and at depths suitable for extraction of salt and for development for hydrocarbon storage.

Geological Cross Sections of Pembina's caverns at the Corunna Facility are attached hereto as Appendix I.



EPOCH	Lambton County	Niagara Peninsula
SILURIAN	Bass Islands	Bertie
	G Unit	G Unit
	F Unit	F Unit
	E Unit	E Unit
	D Unit	C Unit
	C Unit	B Unit
	B Unit ☉	A-2 Unit
	A-2 Unit ☉ ☼	A-1 Unit
	A-1 Unit ● ☼	Guelph ☉ ● ☼
	Guelph ☉ ● ☼	Goat Island
	Goat Island	Gasport
	Gasport	Rochester
	Rochester	Irondequoit ☼
	Reynales	Reynales ☼
		Thorold ☼
	Cabot Head	Grimsby ☼
	Manitoulin	Cabot Head
		Manitoulin
		Whirlpool ☉ ☼
U. ORD.	Queenston	

☉ Natural gas storage
 ☉ Cavern storage
 ☼ Natural gas
 ● Crude oil

Figure 2: Stratigraphic column showing the salt formations and the areas used for storage

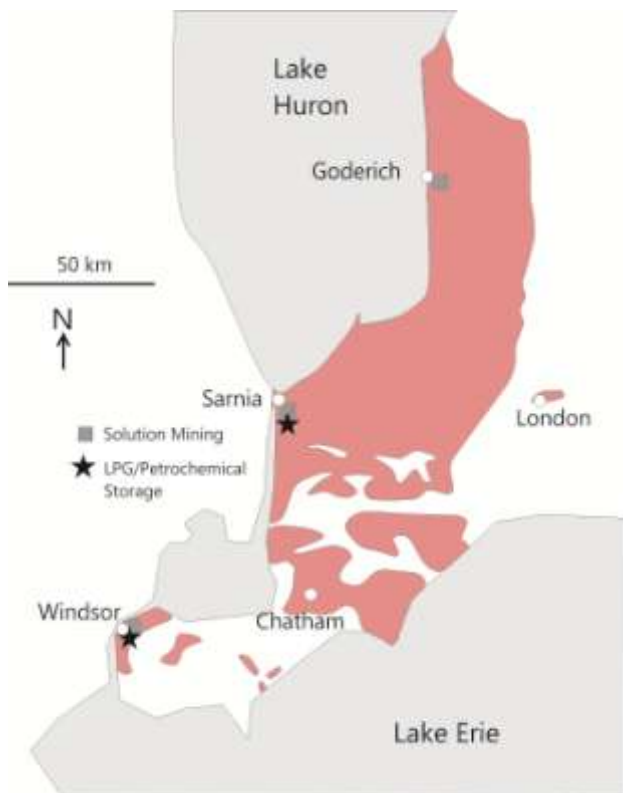


Figure 3: Limits of the distribution of bedded salt (shaded areas) in the subsurface of Ontario and location of salt solution mining and hydrocarbon/ petrochemical cavern storage operations.

Reference: SMRI paper "Operational and Regulatory Opportunities in Brine Mining and Underground Storage Facilities" – Jug Manocha

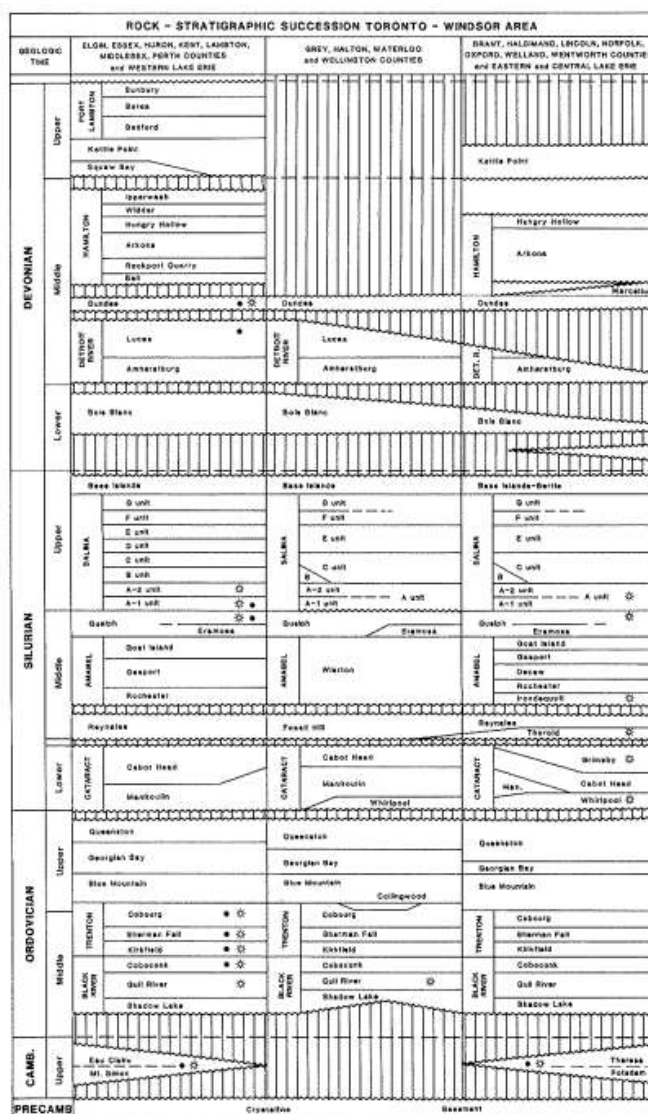


7.3 Hydraulic Isolation

The Corunna Facility caverns were developed within the Salina B-Salt Unit, which is found at approximately 580 m True Vertical Depth (“TVD”), and are on average in excess of 50 m into the B-Salt Unit; however some are a little as 11 m into the B-Salt Unit. The base of the caverns is typically 20-30 m above the base of the B-Salt Unit which is approximately 680 m TVD. The salt itself is tight and impermeable, providing competent upper, lower and lateral caprock/seal and isolation for each cavern.

The B-Salt Unit is overlain by the Salina C-Shale Formation which, in the area, is typically approximately 20-25 m thick. The Salina C-Shale Formation is green dolomitic tight impervious shale and provides additional competent caprock above the B-Salt Unit.

The B-Salt Unit overlies the Salina B-Anhydrite and A-2 Carbonate units, which, when combined, are approximately 45 m in thickness. In the area, these units are a combination of tight impervious anhydrites, limestones and dolostones. These units also provide an additional competent lower seal to caverns developed within the B-Salt Unit.



Subsurface stratigraphy of southwestern Ontario.



8.0 Drilling and Compellation

Attached hereto is the following information with respect to drilling and compellation of the Proposed Caverns:

- Appendix J - Form 7s for all of Pembina's Suspended Brine Mining Caverns
- Appendix K - Wellbore Schematic Diagrams for Pembina's Suspended Brine Mining Caverns
- Appendix L - Well Cards for all of Pembina's Suspended Brine Mining Caverns

9.0 Groundwater Protection

There are 28 water wells drilled within a radius of 1000 m of the Corunna Facility. A review has been completed of each available water well in an area of 7.5 km² surrounding the Pembina Corunna Facility. Copies of each Water Well Data Sheet, which were acquired from the Ontario Groundwater website, are attached hereto as Appendix M. A Water Wells Google Earth Map is also attached hereto as Appendix N.

Fresh water encounters have been reported at 10 of the 28 wells at depths ranging from 37 m (121 ft) to 47 m (153 ft). The remainder of the wells had no reported water zones. The fresh water zone encountered in this area needs to be protected from contamination of waters from other geological formations while drilling, completing and operating of each cavern well. This is achieved through a MNR approved casing program. The casing program is discussed in detail in the Section 7.0 Drilling and Completion of this Application.

Nine wells in the study area remain as water supply wells and the remaining 19 wells are either abandoned, abandoned test wells, or abandoned observation wells.



10.0 Operating Procedures

The following procedures for the safe operation of the storage caverns are in place at the Corunna Facility:

Operations					
CSA Z341	Procedure name	Req'd	Recmd'd	Generic	Specific
Clause		Y/N	Y/N	Y/N	Y/N
10.1	Procedures				
10.1.1	Use of Procedures Procedure	Y		Y	
	Product Injection Procedure	Y			Y
	Product Withdrawal Procedure	Y			Y
	Startup-Shutdown Procedure	Y			Y
	Return to Operation Procedure	Y		Y	
	Investigate Alarms Procedure	Y		Y	
10.1.5	Isolation and Depressuring				
10.1.5 (a)	Depressure Equipment for Maintenance Procedure	Y			Y
	Hydrate Plug Removal Procedure	Y		Y	
10.1.5 (b)	Equipment Isolation Procedure	Y		Y	Y
	Prep Wells for Maintenance Procedure	Y		Y	
11	Monitoring and Measurement				
11	Meter Proving Procedure	Y		Y	
	Metering Procedure	Y		Y	
	Continuous Balance Procedure	Y		Y	
	Fluid Level Changes Procedure	Y		Y	
10.1.6	Records				
10.1.6	Records Retention Procedure	Y		Y	
10.1.7	Changes				
	Management of Change Procedure	Y		Y	
10.1.8	Operating and Maintenance Procedure Audits				
	Auditing Procedure	Y		Y	
7.1	Risk Assessment				
	Risk Assessment Procedure	Y		Y	
10.2.3	Wellhead and Casing Vents				
10.2.3 (a)	Surface Casing Vent Inspection Procedure		Y	Y	
10.2.3 (b)	Wellhead Inspection Procedure		Y	Y	

11.0 Emergency Response Plan

Pembina currently has an Emergency Response Plan (“ERP”) in place for its Corunna Facility. A hazard area will be modeled for each Proposed Cavern, starting with Cavern 45, and this information will be added to the existing ERP.

Identified area stakeholders will be notified of the project, including mapping of the new hazard area, and will also be advised of emergency response procedures and public protection measures. Information regarding contacts and any specific requirements will be gathered and added to the existing



Emergency Response Plan to best address the requirements of the community. Area stakeholders will also be notified in the same manner as to when Pembina intends to operate each Proposed Cavern.

The dispersion radius of the Existing Caverns at the Corunna Facility range from 470 m to 240 m and Pembina expects that dispersion modeling calculations currently being completed for the Proposed Caverns would be within the same range. If our dispersion modeling calculations show that the Proposed Caverns have a dispersion radius beyond that of the Existing Caverns, Pembina would engage and consult with stakeholders within the new dispersion radius as well as confirm if any additional stakeholders need to be consulted.

The Corunna Facility is a registered vessel site and meets Environment Canada E2 requirements for storage vessels. Volumes added upon conversion of the Proposed Caverns will be updated in the Corunna Facility's registration, as required. The ERP may be provided to other regulatory agencies, as requested.

12.0 Risk Assessment

Pembina uses the hazard and operability study ("HAZOP") method of risk assessment. A risk assessment will be completed as part of the design process for any installation of new and upcoming Proposed Caverns.

Cavern installation will include all of the necessary surface equipment to ensure the safe operation of each Proposed Cavern, and will include the following:

- Piping has been designed to B31.3 ASME code and registered with the Technical Standards and Safety Authority.
- ESVs installed on the product and brine lines are designed to American National Standards Institute Class 1500, and each ESV is stroked daily to ensure the operation of this safety system.
- The pressure envelope is protected by a triple redundant pressure sensor system incorporated into Pembina's distributed control system and monitored 24 hours per day (365 days per year) with automatic closure.
- Wellheads are designed to the American Petroleum Institute's Specification for Wellhead and Christmas Tree Equipment (API 6A).
- Caverns have been developed as per the CSA Z341 Storage of Hydrocarbons in Underground Formations series of standards.
- Monitoring of the fluid flow into and out of the cavern is recorded.

13.0 Geomechanical Assessment

Pembina has completed three geomechanical assessments (each a "Study", collectively, the "Studies") of caverns near the Enbridge Storage Area. The geomechanical assessments were completed by Serata Geomechanics Inc. The following is a summary of the studies. Although Pembina has not submitted these assessments in our application, we can provide full reports upon request.

Completed in 1987, the first Study examined the interactions of Cavern 55 and Cavern 56. Cavern 55 is currently a monitoring cavern for the Enbridge Storage Area and Cavern 56 is in hydrocarbon storage service. This Study concluded that the system formed by Cavern 55 and Cavern 56 is stable.

Completed in 1992, the second Study examined Cavern 65 for brine storage service by first evacuating Cavern 65 with compressed air. This Study concluded that the roof of Cavern 65 would be stable as long as the minimum and maximum operating pressures were adhered to.



Completed in 1995, the third Study examined the geomechanical stability of Dow's Caverns 61, 62, 69 and 70 with respect to a prospective high deliverability gas storage operation for St. Clair Pipelines Limited. This Study examined five major operating parameters, including (1) range of cavern pressure, (2) maximum cavern pressure limit, (3) minimum cavern pressure, (4) gas transfer rate, and (5) number of gas transfer cycles. This Study concluded that based on computer predicted cavern behavior, Caverns 61, 62, 69 and 70 can be operated as high deliverability gas caverns.

14.0 Suitability Discussion

Prior to conversion, the Proposed Caverns will be proven suitable for storing high vapor pressure products and will meet the requirements of the current edition of CSA Z341.

During the conversion to storage workover, new seals and ring gaskets will be installed in each Proposed Cavern and a sonar log of each Proposed Cavern will be completed along with a cement integrity log and casing inspection log. A brine string with premium threads will also be installed. Each cement integrity log will prove hydraulic isolation from zones above and the casing integrity log will prove the production casing to be suitable to withstand the pressure that will be exerted on the casing during storage operations.

After the conversion of a Proposed Cavern to storage workover and before the introduction of hydrocarbons, a MIT (nitrogen/brine interface test) will be conducted at 110% of the maximum allowable storage pressure in order to prove that each cavern cavity is tight and suitable for hydrocarbon storage. The nitrogen/brine interface will be established below the casing shoe and be held for 24 hours.

Custody grade metering will be used to monitor the inventory of each Proposed Caverns in storage operations and any major discrepancy will be investigated. Continuous pressure monitoring with interlock to emergency shutdown valves will be used to control cavern operations.

Long term cavern structure integrity will be maintained by prudent and safe operations by keeping the cavern roofs protected with hydrocarbons and minimizing cavern growth by using saturated brine to displace stored product.

Each Proposed Cavern will be retested every 5 years to re-verify its integrity.



List of Attachments

- Appendix A: Pembina Infrastructure and Logistics LP Facility Plot Plans
- Appendix B: PDF Pictures of SONARS
- Appendix C: Pembina Infrastructure and Logistics LP Cavern Overview
- Appendix D: Certificate of Approval for Sewage Works from the Ontario MOE
- Appendix E: Landowner Linelist
- Appendix F: Letter of Non-Objection from Enbridge Inc.
- Appendix G: Pembina Infrastructure and Logistics LP's Notification Letters for all Pembina Deemed Stakeholders
- Appendix H: Pembina Infrastructure and Logistics LP's Project Specific Information Package
- Appendix I: Geological Sections for Pembina's caverns at the Corunna Facility
- Appendix J: Form 7s for all of Pembina's Suspended Brine Mining Caverns
- Appendix K: Wellbore Schematic Diagrams for Pembina's Suspended Brine Mining Caverns
- Appendix L: Well Cards for all of Pembina's Suspended Brine Mining Caverns
- Appendix M: Water Well Data Sheets for each Well
- Appendix N: Water Well Google Earth Map