The Adams Mine Landfill Proposal

An Independent Review and Critical Analysis of Hydrogeological Investigations and Recent Monitoring Data

EXECUTIVE SUMMARY

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In this report, I present the results of an independent, scientific review of the hydrogeological investigations conducted at the Adams Mine site. I focus on the database, the methodology used for analysis (including numerical modeling), and the scientific credibility of the interpretations.

Technical studies for the Environmental Assessment for the Adams Mine Landfill were instigated in 1995 by the Municipality of Metropolitan Toronto (Metro Toronto) with much of the hydrogeological work conducted by Golder Associates. Gartner Lee was appointed the main technical peer reviewer. When Metro Toronto decided not to proceed as proponents of the landfill project, Notre Development Corporation (Notre) took over and completed the Environmental Assessment using Metro Toronto's original team. Documents were formally submitted in December, 1996.

In December, 1997, the Ontario Ministry of the Environment (MOE) made the controversial announcement that only a very small part of the project – the effectiveness of the landfill's hydraulic containment design – would be subjected to the scrutiny of the Environmental Assessment Board (EAB). The "scoped" hearing commenced February 24, 1998 and ended April 29, 1998 with only 15 hearing days. In June, 1998, the EAB issued a 2 to 1 majority decision approving the Adams Mine Landfill hydraulic containment design *subject to 26 conditions*. Condition #10 was one of the more critical stipulations. It required installation and testing of two deep boreholes (later known as DH 98-1 and DH 98-2) to supplement the one existing deep borehole (DH 95-12). The Board insisted that no waste be placed in the South Pit until the Director (as appointed by the Minister of the Environment) had evaluated the results of the tests and determined, *without reservation*, that the recorded groundwater levels would sustain hydraulic containment throughout the pumping and gravity drainage phases of the project. The drilling and testing were carried out in November, 1998 and the results were released in December, 1998. Four months later, the Director issued a Certificate of Approval (CofA). The primary issue I address in this report is whether the Director's momentous decision is adequately justified by the hydrogeological data, including data collected as recently as July, 2003.

My key findings are listed below. They are presented in chronological order to acknowledge the long history of the Adams Mine Landfill approval process and the fact that the scientific objectives, methodologies and database have evolved considerably over time.

1) The EAB Decision. Based on a detailed review and analysis of the data that existed at the time, I believe the Board's decision (in effect, a "stay of execution" for the landfill proposal) was appropriate. Certainly, head data (water levels) from the lone deep borehole that existed at the time (DH 95-12) were persuasive with 25 out of 26 head measurements well above 325 masl (metres above sea level), the elevation of the proposed outlet that would control the level of the leachate during the gravity drainage phase. This demonstrated extremely high pressure gradients for upward flow into the pit. Only a single measured head value indicated

the potential for outward flow and this could easily have been dismissed as "anomalous". In stipulating Condition #10, the Board acted prudently. On one hand, the Board was impressed by the preponderance of favourable head measurements, yet on the other, it was clearly concerned by the very serious lack of reliable field data.

2) DH 98-1, DH 98-2 and the Modeling Studies. Head data from the two new boreholes must have sent "shockwaves" through the proponent's camp. The vast majority of heads were unexpectedly low and simply failed to confirm the strong inward gradients that had been implied previously by DH 95-12. Under the conditions of its agreement with the MOE, Golder had no choice but to invoke the use of numerical modeling tools in an attempt to show that the low groundwater heads, deep in the aquifer, would rise dramatically as the leachate level in the pit rose towards its final resting level of 325 masl. I examined the Golder models in detail and found them all *seriously deficient,* notably with respect to calibration. In particular, the models developed to convince the Director that heads in DH 98-1 and DH 98-2 would recover sufficiently to sustain hydraulic containment, have virtually no scientific merit and are effectively worthless for predictive purposes. The outcome of these models was entirely predetermined by the models' unverified boundary conditions, such that none of the data observed in any of the boreholes would have had the slightest bearing on the model result.

3) Issuance of a Certificate of Approval. The Director's decision was patently premature and scientifically unjustified. At the EAB hearing, Notre acknowledged that numerical models suffer from inherent uncertainties, and indicated that "no important decisions would be based on modeling predictions". The Director, it appears, had no such qualms, making a crucial decision based on the findings of two seriously flawed models that his scientific advisors should have rejected without hesitation. I do not criticise Golder for presenting its client's data in the best possible light but I do fault the Ministry of the Environment for failing to conduct a thorough scientific review of the model results.

4) Through-flow Lakes. In September 2000, Gartner Lee seriously misled the Mayor and Council for the Town of Kirkland Lake when it issued a report stating "*claims by some individuals to the media that groundwater enters one side of the pit and exits the other are factually incorrect because they contradict the principals of ground water flow which are based on the fundamental law of gravity*". This statement has no scientific foundation. Lakes that both receive and lose groundwater are known as through-flow lakes. Such lakes are common and well documented. The statement may have been designed to reassure the public but it was misguided and irresponsible.

5) Recent Data. Much of the debate in recent years has concerned water levels in the pit lake. Based on just three measurements of pit lake level in over four years, the proponents claim that an overall rise in water level supports their contention that no leakage occurs. Others argue that the pit water levels often stabilise or decline for extended periods of time, thus suggesting the pit leaks. After close

examination of the data, I am unable to endorse either position. A lowering of pit water level could indicate leakage but may also reflect high evaporation rates which, during some periods, may significantly exceed the net flow of water into the pit. The term "net flow" is very important. A rise in water level simply means that the amount of water entering the pit as runoff and shallow groundwater flow, exceeds the amount of water lost by evaporation and leakage. Rising pit water levels do not constitute evidence for zero leakage.

In conclusion, I find that hydraulic containment has never been adequately proven at the Adams Mine site. Long term containment was certainly never "proved" at the EAB hearing. Through Condition #10, the Board effectively reserved judgment until considerably more field data could be made available. Neither was long term containment subsequently "proved" to the Ministry of the Environment – the Director issued his decision on the basis of two seriously flawed groundwater flow models. Modeling can be a valuable hydrogeological tool; however, it is not, and never was, an appropriate solution for the task at hand. Given the hydrogeological complexity of the site, the integrity of the hydraulic containment design can only be reliably demonstrated by good field data.

On the basis of my work, *I strongly believe that the Certificate of Approval for the Adams Mine Site should be suspended until such time as hydraulic containment can be demonstrated by field (not modeled) data*. To provide the appropriate data I recommend that:

1) One deep angled borehole be constructed on the south side of the pit where deep data are seriously lacking.
2) Westbay Multiport Systems (or similar) be installed in all four deep boreholes, thus allowing heads beneath the pit to be monitored at discrete intervals.
3) A pressure transducer (water level recorder) and data logger be installed in the pit lake.
4) A simple weather station be installed for the collection of meteorological data including daily precipitation and Class "A" pan evaporation.
5) A comprehensive monitoring program be established as follows:
    - Hourly measurements of lake water levels
    - Daily measurements of precipitation and pan evaporation
    - Monthly measurements of head in the Westbay Multiports

    all for a minimum of three years or until such time as heads measured in the subsurface either consistently exceed 325 masl or demonstrate rates of recovery that show, with a high degree of statistical certainty, that a level of 325 masl would be exceeded by the time the lake recovers to 325 masl.

If this program of work were implemented immediately, and the pit lake water level were allowed to recover naturally with no disturbance, the issue of hydraulic containment could be resolved with a high level of confidence within a matter of three to five years.

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