Whiteshell Reactor #1 Organic Coolant Leak Fact Sheet

Summary

Whiteshell Reactor #1 (WR-1) was built in the 1960s at the Whiteshell Laboratories (WL) site in Pinawa, Manitoba, by Atomic Energy of Canada Limited (AECL). The reactor was shut down in 1985, all fuel was removed and all liquids were drained. Since then, the reactor has been in a state of storage with surveillance. Canadian Nuclear Laboratories (CNL) took over operation of the WL site in 2014.

WR-1 was used to research the use of organic coolants in reactors (replacing the heavy water used in conventional CANDU reactors with an oil-based substance for cooling purposes). The type of coolant used in WR-1, called HB-40 or OS-84, has a toxicity that is comparable to gasoline or diesel fuel. There were three coolant leaks at WR-1 over its lifetime. Two reached the Winnipeg River.

The first leak was in 1967. Approximately 300 litres of coolant reached the river through the outfall (the discharge point of the liquid waste) as a result of a pin-hole leak in one of the tubes in the heat exchanger.

The second leak took place in 1977. There was a slow, low-volume leak of coolant into the river, which settled into the riverbed up to 1 km downstream of the outfall. AECL tested drinking water, river water, and riverbed samples and found coolant only in the riverbed samples. The tests also found that there were no toxic effects on fish or bottom-dwelling invertebrates.

CNL continues to perform extensive site monitoring and reports the results annually to the Canadian Nuclear Safety Commission (CNSC). Summaries of these reports are posted on CNL's website. The reports show that the river and sediments are safe and that there is no contamination that would affect human health or the environment.

The third coolant leak occurred in 1978. The leaked coolant was cleaned up and stored on site. No coolant was released into the river.

Winnipeg River Task Force

In late 1994, the Winnipeg River Task Force was created. Representatives from Indian and Northern Affairs Canada, Environment Canada, Health Canada, and the Sagkeeng First Nation took part in the Task Force. The objective of the Task Force was to look at potential sources of Winnipeg River water quality degradation near the community of Sagkeeng. The Task Force report concluded that the drinking water quality met Canadian guidelines and that it was unlikely that the WL site had ever posed or would pose a significant threat to the health of Sagkeeng community members.

CNL does not currently plan to remediate the river sediments since tests have shown that they pose no risk to human health or the aquatic environment. As per CNL's Environmental Assessment Follow-Up Program, river sediment samples will be taken and analyzed in 2026, 2046 and 2066 to verify the conclusions of the environmental assessment.



Winnipeg River, courtesy of CNL

Details of the WR-1 organic coolant leaks

August 5 AND 6, 1967: Organic coolant leak [Ref. 1]

- Approximately 300 litres of coolant was released from the WL site into the Winnipeg River on August 5 and 6, 1967.
- AECL found that the leak was caused by a pinhole in one of the heat exchanger tubes.
- AECL took action to fix the situation and prevent any more leaks by making design changes, such as using additional valves and installing additional notification systems.
- At the time, no environmental monitoring for organic material in the river sediments or river water was done. Routine monitoring of organic content in the outfall effluent (liquid waste) began in 1971.

January to May 1977: Organic coolant leak [Ref. 2]

- About 1,450 kg of coolant was released from the WL site into the Winnipeg River between January 1977 and May 1977.
- AECL calculated that between 900 kg and 1,100 kg of coolant was deposited on the riverbed up to 1 km downstream of the outfall. Coolant was found in the sediment sampled near the east bank of the river as far as 14 km downstream of the outfall, and small amounts were found near the west bank of the river at Lac du Bonnet.
- AECL concluded that the incident was likely caused by slow, low-volume leaks from the WR-1 primary cooling circuits.
- River sediments will be monitored in 2026, 2046 and 2066 in accordance with CNL's Environmental Assessment Follow-Up Program.

November 1, 1978: Organic coolant leak [Ref. 3]

- About 3,270 kg of coolant leaked from WR-1 on November 1, 1978.
- ✤ AECL attributed the leak to a pump failure in WR-1.
- The loop system design was changed and the operating instructions were revised to prevent a recurrence.
- No coolant was released into the river.

- The bulk of the coolant was collected and placed in drums in the onsite waste management storage area. The remainder was mopped up and disposed of as active waste in the onsite waste management storage area.
- River sediments will be monitored in 2026, 2046 and 2066 in accordance with CNL's Environmental Assessment Follow-Up Program.

March 1979: Report on organic coolant in Winnipeg River sediments [Ref. 2]

- In May 1977, AECL took samples of drinking water at Pinawa, Lac du Bonnet and Great Falls, as well as daily grab samples of river water at various distances downstream from the outfall. The concentration of coolant in the samples taken never exceeded detection limits (minimum concentration of a substance that can be measured and reported).
- Between May 1977 and May 1978, AECL took a series of riverbed samples, both upstream and downstream of the outfall. It found coolant in the riverbed downstream of the outfall.
- In June 1977, clams found by AECL in the substrate samples taken close to the outfall were found to have a film of coolant on the shell, but the flesh was clean.
- To assess the toxicity of the coolant on the riverbed for bottom-dwelling invertebrates, AECL caged crayfish on the riverbed upstream of the outfall and in areas downstream where the coolant was mainly deposited. AECL found no significant differences in mortality between the specimens collected upstream and those collected downstream.
- AECL found no evidence of fish kill after frequent inspections of the river between the WL site and Lac du Bonnet between May 1977 and September 1977.

November 1995: Winnipeg River Task Force final report [Ref. 4]

- In late 1994, the Winnipeg River Task Force was created. Representatives from Indian and Northern Affairs Canada, Environment Canada, Health Canada, and the Sagkeeng First Nation took part in the Task Force.
- The mandate of the Task Force was to review and make recommendations on the Sagkeeng First Nation's river-related concerns, including chemical spills from the Pine Falls paper mill, operation of Manitoba Hydro power dams, and coolant leaks from AECL's WR-1.
- ✤ In November 1995, the Task Force's final report was issued. The report concluded that:
 - up to that point, the Sagkeeng water treatment plants were producing water that met Canadian drinking water guidelines;
 - based on studies conducted between 1972 and 1992, Health Canada did not find evidence to suggest that Sagkeeng First Nation members living on the reserve were experiencing an increase in the incidence of cancer or an increase in cancers attributable to exposure to environmental contamination;
 - it was unlikely that the WL site had ever posed or would pose in the future a significant direct threat to the health of Sagkeeng residents.

March 2001: Comprehensive study report [Ref. 5]

- To support decommissioning activities at the WL site, Winnipeg River sediments were analyzed in 2000. In March 2001, AECL reported the results in its Comprehensive Study Report (CSR) and included a detailed characterization and assessment of the impacted area of the river.
- ✤ AECL concluded that the contamination levels of the river sediments were low and did not represent a risk to human health or the aquatic environment, and did not warrant remediation.
- CNSC staff agreed with AECL's conclusions, and the Commission approved the CSR.
- CNL will continue to monitor the river sediments as part of its Environmental Assessment Follow-Up Program during the remainder of the WL Closure Project. Following closure, river

sediment samples will be taken and analyzed in 2026, 2046 and 2066 to verify the conclusions of the environmental assessment.

2006: Analysis of river sediment core samples [Ref. 6]

- In 2006, AECL analyzed river sediment core samples at areas downstream of the site where deposits from the outfall were found. AECL concluded that there was no contamination of the river sediments that would have an ecological impact or affect human health.
- As a result, AECL recommended that remediation of the river sediments was not required.
- CNL will conduct additional river sediment core sampling in 2026 to re-confirm these results and conclusions.

Ongoing monitoring [Ref. 7]

- Until 2011, AECL tested river sediment surface samples and outfall discharge samples for coolant every year. These tests were discontinued in 2012 since no coolant had been detected for a number of years.
- However, AECL continued to routinely monitor river sediment surface samples and outfall discharge samples for other contaminants. Since 2014, CNL has continued this practice.
- The results of all analyses are compiled by CNL in annual environmental monitoring reports and are reviewed for acceptability by CNSC staff. Summaries are posted on CNL's website (www.cnl.ca).
- CNSC staff have concluded that CNL's environmental protection program at the WL site continues to meet CNSC requirements.

Health effects of organic coolants

- Organic coolants, such as HB-40 or OS-84, have a toxicity similar to fossil fuels (e.g., gasoline, diesel fuel), with a median lethal dose of between 10 and 20 mL/kg body weight.
- Given that the measured concentrations reported by AECL were significantly below the median lethal dose, CNSC staff have determined that the risk to human health is negligible.

References

[1] Gordon, J.B. (1967). Unusual Occurrence Report No. WR-1-67-1. Pinawa: AECL.

- [2] Guthrie, J., & Acres, O. (1979). Organic Coolant in Winnipeg River Sediments. Pinawa: AECL.
- [3] Remington, J. (1978). WR-1 Unusual Occurence Report: Organic Coolant Spill from WR-1L5 Loop. Pinawa: AECL.
- [4] Winnipeg River Task Force. (1995). Winnipeg River Task Force Final Report.
- [5] AECL et al. (2001). Whiteshell Laboratories Decommissioning Project: Comprehensive Study Report. Pinawa: AECL.
- [6] AECL (2006). WLDP-03702-REPT-007. Pinawa: AECL.
- [7] CNL website. *Performance Reporting*. <u>https://www.cnl.ca/en/home/environmental-</u> stewardship/performance-report/default.aspx