HEALTHY LAND, HEALTHY PEOPLE

INDIGENOUS-LED CLIMATE ACTION:
Links between carbon capture and storage and health

Prepared by Rebecca Zalaski and Denise Webb

Whitefish Lake First Nation #128 (WFL #128) is a vibrant and culturally rich First Nations community in Treaty Six territory within northeastern Alberta. WFL #128 is a self-governing community covering an area of over 50 square kilometres with a population of approximately 3,237 members, two-thirds of whom reside on reserve (WFL #128, personal communication, May 2025).

WFL #128 is a leader in environmental stewardship and sustainability for both current and future generations. Goodfish Lake Business Corporation, a development corporation within WFL #128 that employs much of the WFL #128 population, recognized the need for an environmental division to be created directly in the community. In response to this need, Mother Earth Environmental Services was established to work towards remediating and protecting the environment of WFL #128, while also establishing environmental career opportunities for both WFL #128 members and non-members within the community.

In 2024, WFL #128 commenced plans for a baseline assessment to forecast potential effects on environmental and human health from a large-scale and complex Carbon Capture and Storage (CCS) project that is proposed to take place within the WFL #128 territory.[1] This fact sheet summarizes WFL #128's plans for the baseline assessment, highlights links to human health and well-being, and looks to related research for potential next steps. Unless otherwise cited, the information presented in this fact sheet is sourced directly through personal communications with Mother Earth Environmental Services of WFL #128.

This resource is one in a series of fact sheets that showcases WFL #128's climate action and sees the climate crisis through a public health lens. These resources are intended for First Nations communities, policy- and decision-makers, and other readers interested in the vast connections between climate action and protecting and promoting the health and well-being of Indigenous Peoples[2] and communities.

[1] This project is in partnership between WFL #128, WSP Canada, and the University of Saskatchewan (USask) Toxicology Centre, with financial contributions from the Indigenous Services Canada (ISC) First Nations Baseline Assessment Program on Health and the Environment (BAPHE). The views expressed herein do not necessarily represent the views of WSP Canada, the USask Toxicology Centre, or ISC.

[2] The term 'Indigenous Peoples' is used here to refer to First Nations peoples, Inuit, and Métis peoples collectively.

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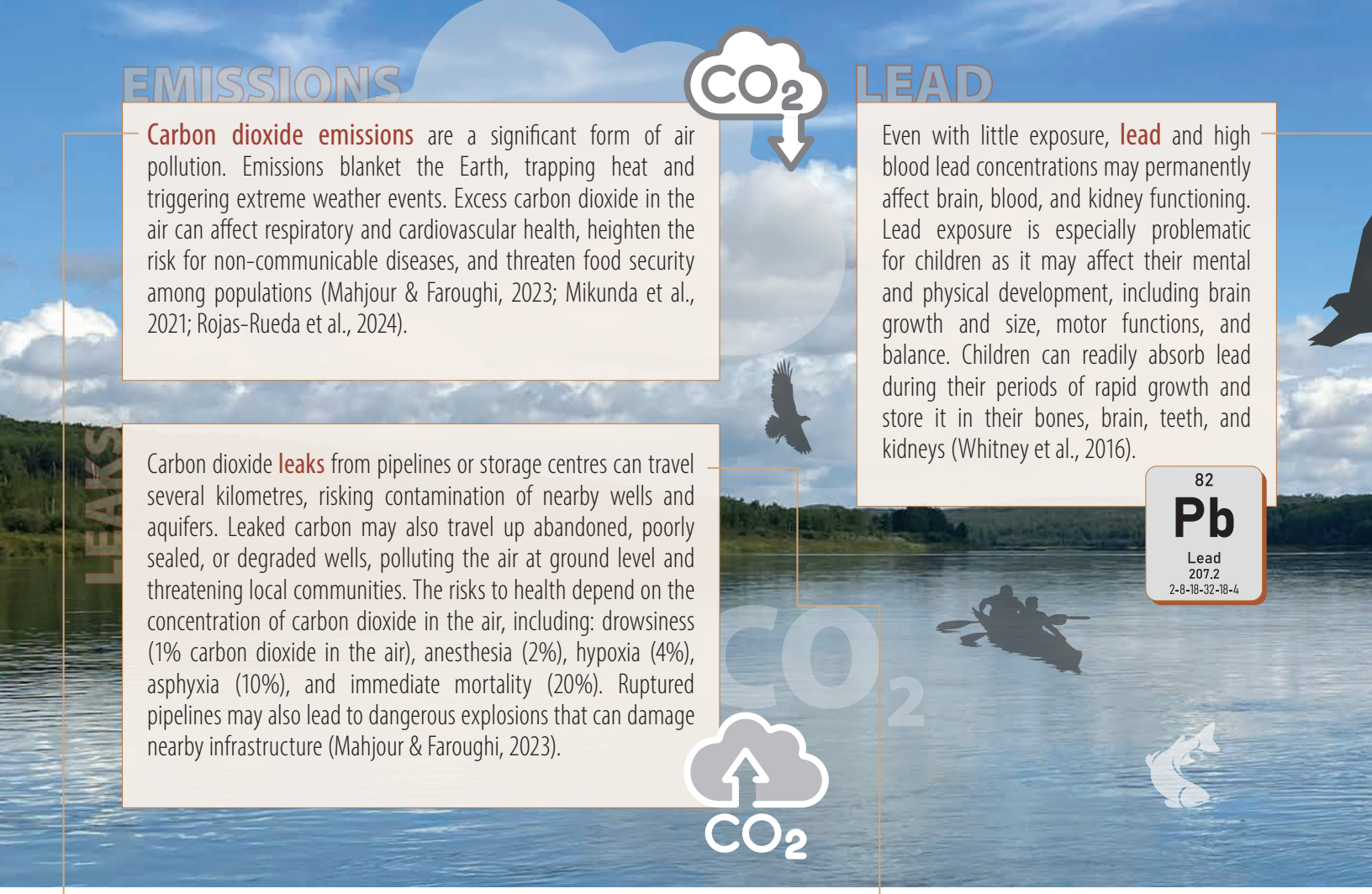
Centre de collaboration nationale de la santé autochtone
GOOD FISH
MOTHER EARTH ENVIRONMENTAL SERVICES
A FIRST NATION COMPANY
Whitefish Lake FIRST NATION #128



Carbon dioxide emissions are a significant form of air pollution. Emissions blanket the Earth, trapping heat and triggering extreme weather events. Excess carbon dioxide in the air can affect respiratory and cardiovascular health, heighten the risk for non-communicable diseases, and threaten food security among populations (Mahjour & Faroughi, 2023; Mikunda et al., 2021; Rojas-Rueda et al., 2024).

Carbon dioxide **leaks** from pipelines or storage centres can travel several kilometres, risking contamination of nearby wells and aquifers. Leaked carbon may also travel up abandoned, poorly sealed, or degraded wells, polluting the air at ground level and threatening local communities. The risks to health depend on the concentration of carbon dioxide in the air, including: drowsiness (1% carbon dioxide in the air), anesthesia (2%), hypoxia (4%), asphyxia (10%), and immediate mortality (20%). Ruptured pipelines may also lead to dangerous explosions that can damage nearby infrastructure (Mahjour & Faroughi, 2023).

Even with little exposure, **lead** and high blood lead concentrations may permanently affect brain, blood, and kidney functioning. Lead exposure is especially problematic for children as it may affect their mental and physical development, including brain growth and size, motor functions, and balance. Children can readily absorb lead during their periods of rapid growth and store it in their bones, brain, teeth, and kidneys (Whitney et al., 2016).

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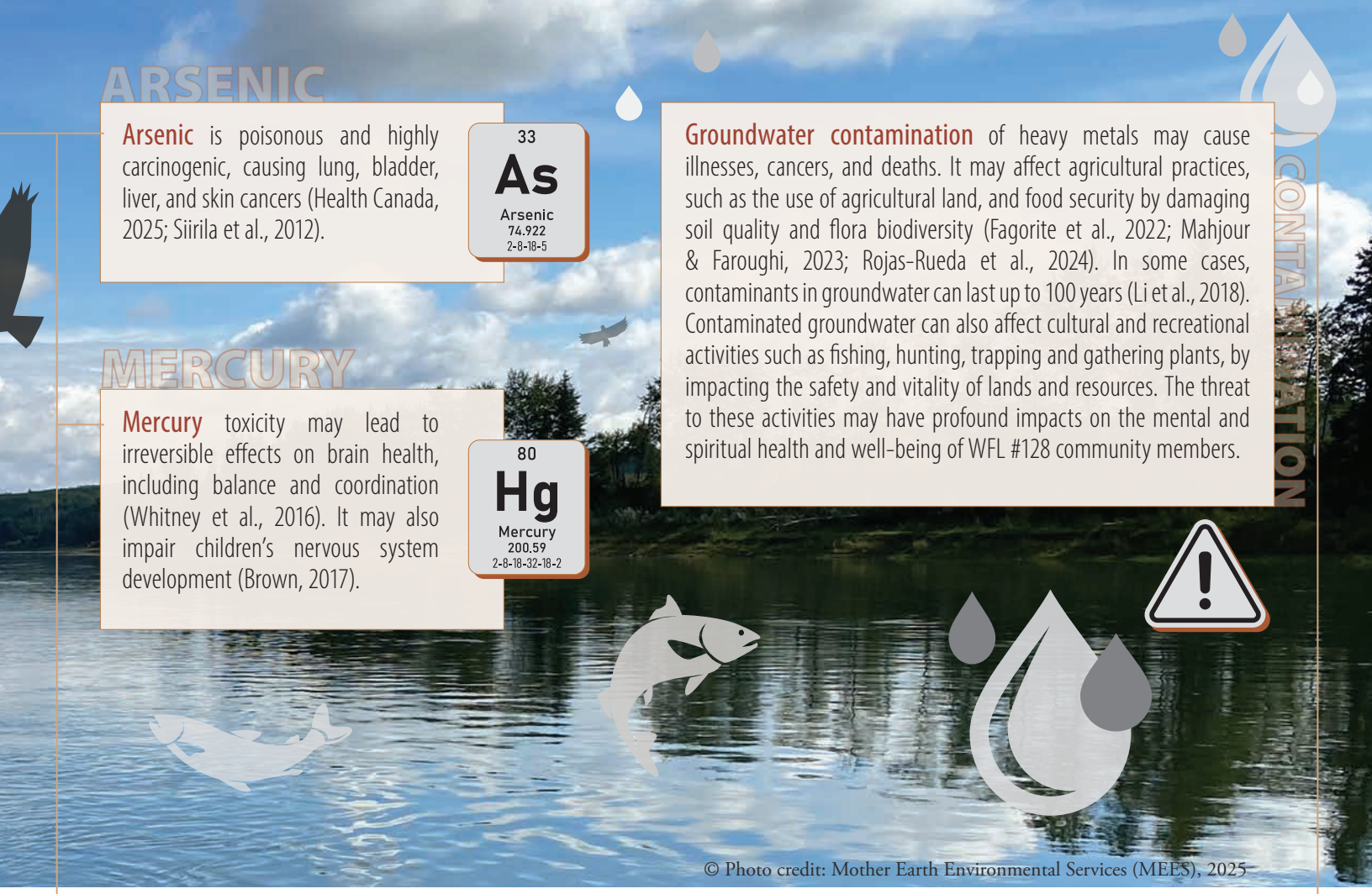
Context to WFL #128's baseline assessment: What is the proposed CCS project?

WFL #128's baseline assessment is pre-emptive to a CCS project in northeastern Alberta that is proposed by Pathways Alliance, a consortium of the largest oil sands producers in Canada. Pathways Alliance's proposed CCS project (referred to hereafter as the proposed CCS project) seeks to address the effects of climate change by capturing **carbon dioxide emissions** from northeastern Alberta oil sands, pressurizing the carbon into liquid form and transferring this liquid through underground pipelines to a permanent storage centre that will be about 1,000-2,000 metres underground in central Alberta (Pathways Alliance, n.d.). Communities affected by the proposed project include WFL #128, as well as Cold Lake First Nations, Beaver Lake Cree Nation, Frog Lake First Nation, Heart Lake First Nation, Kehewin Cree Nation, Onion Lake Cree Nation, and Saddle Lake Cree Nation.

The proposed CCS project is expected to run below freshwater sources and is based on technologies designed to mitigate the effects of climate change (Mikunda et al., 2021). However, little research has investigated the effects of a CCS project of this size and magnitude, including the implications of long-term storage (such as up to 100 years or more) of underground carbon or the associated risks to health from potential leakages (Fagorite et al., 2022; Rojas-Rueda et al., 2024).

The proposed CCS project's pipeline is planned to be installed only 30 km outside of WFL #128. This close proximity poses significant risks for groundwater contamination and/or air pollution. When transporting carbon, **leaks** can



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occur to pipelines from vibrations or stress caused by, for example, earthquakes, severe weather events, natural disasters, or pressure fluctuations; or from degraded or corroded pipelines with faults or fractures (Mahjour & Faroughi, 2023; Siirila et al., 2012). Leaked carbon dioxide held underground creates an acidic environment from the formation of carbonic acid. This acidic environment can migrate to nearby aquifers – rock structures containing groundwater – and cause dangerous contaminants, including heavy metals such as lead, arsenic, and mercury, to leach out of aquifer rocks and into the groundwater. Other contaminants may also leak out depending on the rock composition.

Contaminated groundwater compromises water quality and safe and clean drinking water supplies, posing risks for humans, wildlife, livestock, and vegetation, including sacred medicines and traditional medicinal plants. Humans may be exposed to the contaminated groundwater by consuming vegetation, livestock, or fish that rely on the groundwater; ingesting tap water for drinking or cooking; or absorbing contaminants from washing or bathing (Siirila et al., 2012). Groundwater contamination is also a concern for younger and future generations, as researchers warn "storage for carbon dioxide could compromise not-currently-used aquifers on which future generations may depend for drinking water" (Fogarty & McCally, 2010, p. 68).

The risks to health from groundwater contamination can be far-reaching. WFL #128's baseline assessment will gather an evidence base to predict potential effects of the proposed CCS project and later evaluate its impact on human and environmental health.

What will WFL #128's baseline assessment entail?

WFL #128's baseline assessment will include two projects: groundwater sampling and monitoring, and in-person or online interviews with members of WFL #128. Groundwater samples will be taken from wells in the WFL #128 territory, in areas close to the proposed CCS project's pipeline. The samples will be analyzed for: in-situ parameters, such as temperature and dissolved oxygen; general water chemistry, such as pH, conductivity, turbidity, total alkalinity, total dissolved and suspended solids, hardness, major ions and ion balance; nutrients; total metals; dissolved metals; and biological parameters. The findings will then be compared to samples from previous years in the territory, as well as provincial and federal **regulatory guidelines**. Groundwater monitoring will continue annually, after the first groundwater sampling program, to ensure groundwater quality remains within regulatory guidelines and highlight any trends or patterns evident over the years.

Interviews with WFL #128 community members will explore self-reported physical health, including current health status and any known **medical conditions**, as well as **mental well-being** among women – including **pregnant and/or breastfeeding women** – **men**, Elders, and youth. The interviews will explore how participants predict the proposed CCS project may affect their health, as well as the **health of their family and fellow community members**. Participants will be asked about their willingness to provide biological samples such as hair, blood, or breast milk for the purpose of future baseline analyses and detecting biological changes from the proposed CCS project.

Elders who hunt, trap, fish, and/or gather plants on the land will be interviewed to better understand how the health of the land is intimately connected to emotional, mental, physical, social, and spiritual health and well-being of individuals and communities. A second interview with Elders is planned to learn about how widespread major **industry projects** in the territory have historically changed and impacted environmental and human health.

The Government of Canada establishes and regularly updates drinking water quality standards in Canada, including maximum acceptable concentrations of chemicals such as for lead, arsenic, and mercury. For more information about **regulatory guidelines** see: Health Canada (2025).

Stress and uncertainties related to CCS projects can yield negative **mental health impacts** on populations living nearby carbon pipelines and storage centres (Rojas-Rueda et al., 2024).

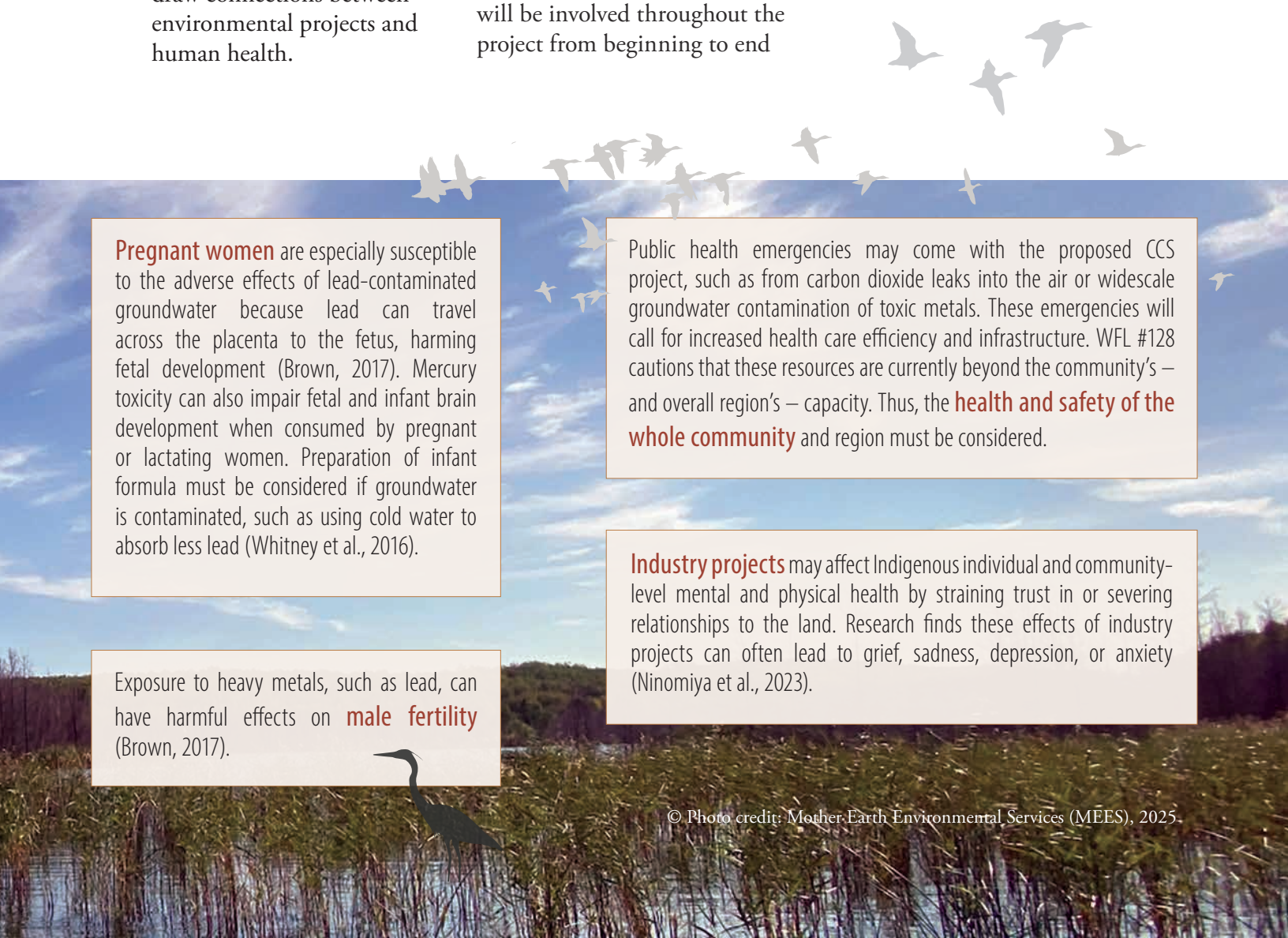
Immunocompromised persons and persons living with **pre-existing health conditions** can experience increased susceptibility to the health impacts of air pollution, such as cardiorespiratory illnesses (Rojas-Rueda et al., 2024). Moreover, persons with pre-existing iron deficiency are more susceptible to lead poisoning from groundwater contamination because iron deficiency "weakens the body's defenses against lead absorption" and subsequently, the body will absorb more lead (Whitney et al., 2016, p. 570).

Each step of the baseline assessment will honour traditional ecological knowledge (TEK) shared by WFL #128 Elders and community members. The research team will engage Elders and youth throughout the assessment, transferring and protecting TEK across generations.

- TEK will be transferred through health and wellness interviews between WFL #128 Elders and youth. WFL #128 youth will be trained by the research team to conduct these interviews, providing an opportunity to learn from their Elders and draw connections between environmental projects and human health.
- TEK will be protected by following consent processes. TEK shared by WFL #128 Elders will be held confidentially within the research team and only shared with the broader community and public with the prior informed consent of the knowledge holder.

One WFL #128 youth community member (under 25 years old) will also be trained by environmental scientists and biologists on the research team to conduct groundwater sampling and monitoring, and complete data analysis and reporting. Through this key role, the youth community member will be involved throughout the project from beginning to end and gain skills and a deeper understanding of how mass-scale industry projects such as the proposed CCS project can impact their community.

The project results of the baseline assessment (community member interviews and initial groundwater sampling data) will be communicated and presented to the WFL #128 Chief and Council and community members. WFL #128 will be able to use this data to make informed decisions, including determining next steps for their community to address the proposed CCS project, should it be approved in the future and implemented.

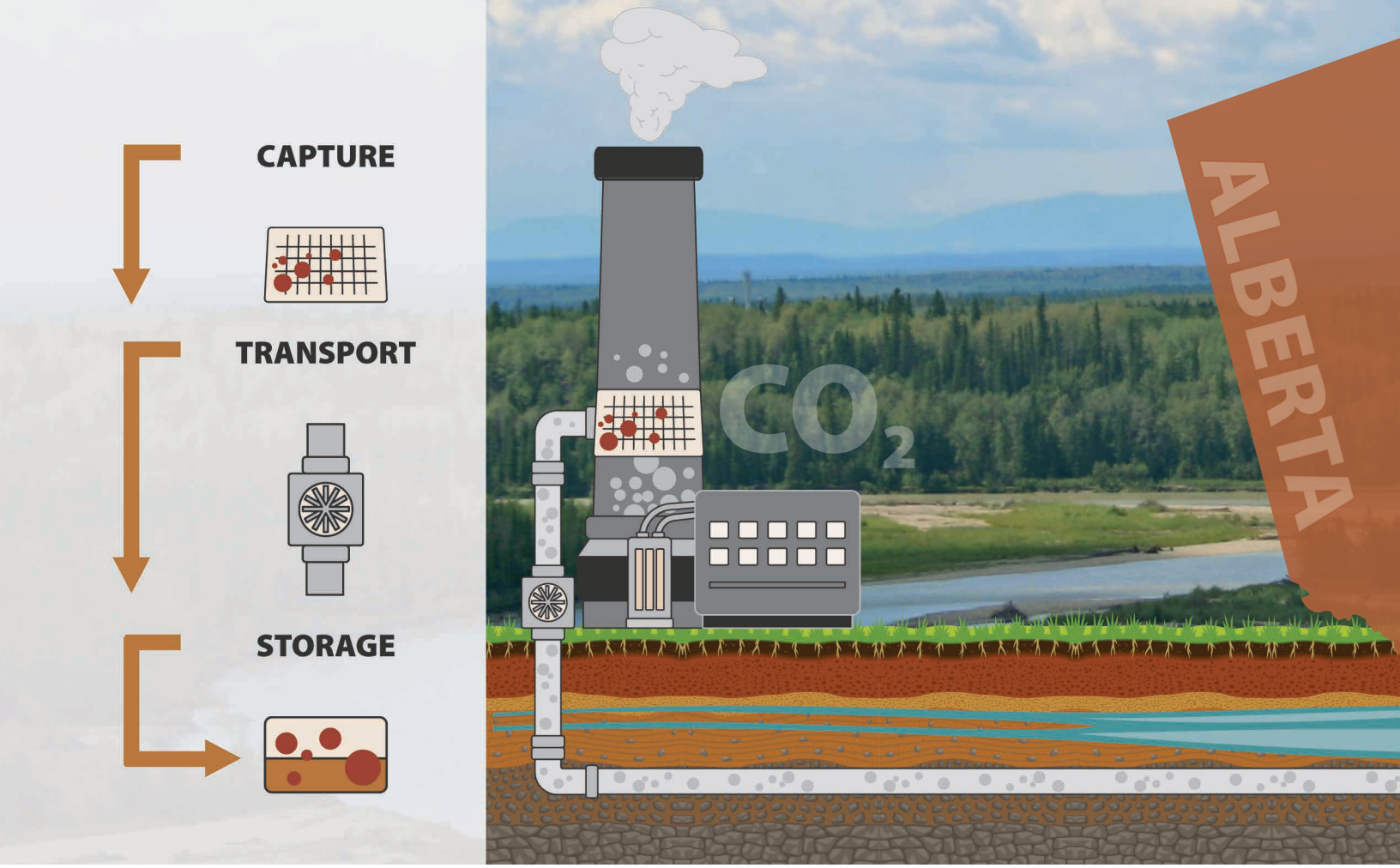


Pregnant women are especially susceptible to the adverse effects of lead-contaminated groundwater because lead can travel across the placenta to the fetus, harming fetal development (Brown, 2017). Mercury toxicity can also impair fetal and infant brain development when consumed by pregnant or lactating women. Preparation of infant formula must be considered if groundwater is contaminated, such as using cold water to absorb less lead (Whitney et al., 2016).

Public health emergencies may come with the proposed CCS project, such as from carbon dioxide leaks into the air or widescale groundwater contamination of toxic metals. These emergencies will call for increased health care efficiency and infrastructure. WFL #128 cautions that these resources are currently beyond the community's – and overall region's – capacity. Thus, the **health and safety of the whole community** and region must be considered.

Industry projects may affect Indigenous individual and community-level mental and physical health by straining trust in or severing relationships to the land. Research finds these effects of industry projects can often lead to grief, sadness, depression, or anxiety (Ninomiya et al., 2023).

Exposure to heavy metals, such as lead, can have harmful effects on **male fertility** (Brown, 2017).

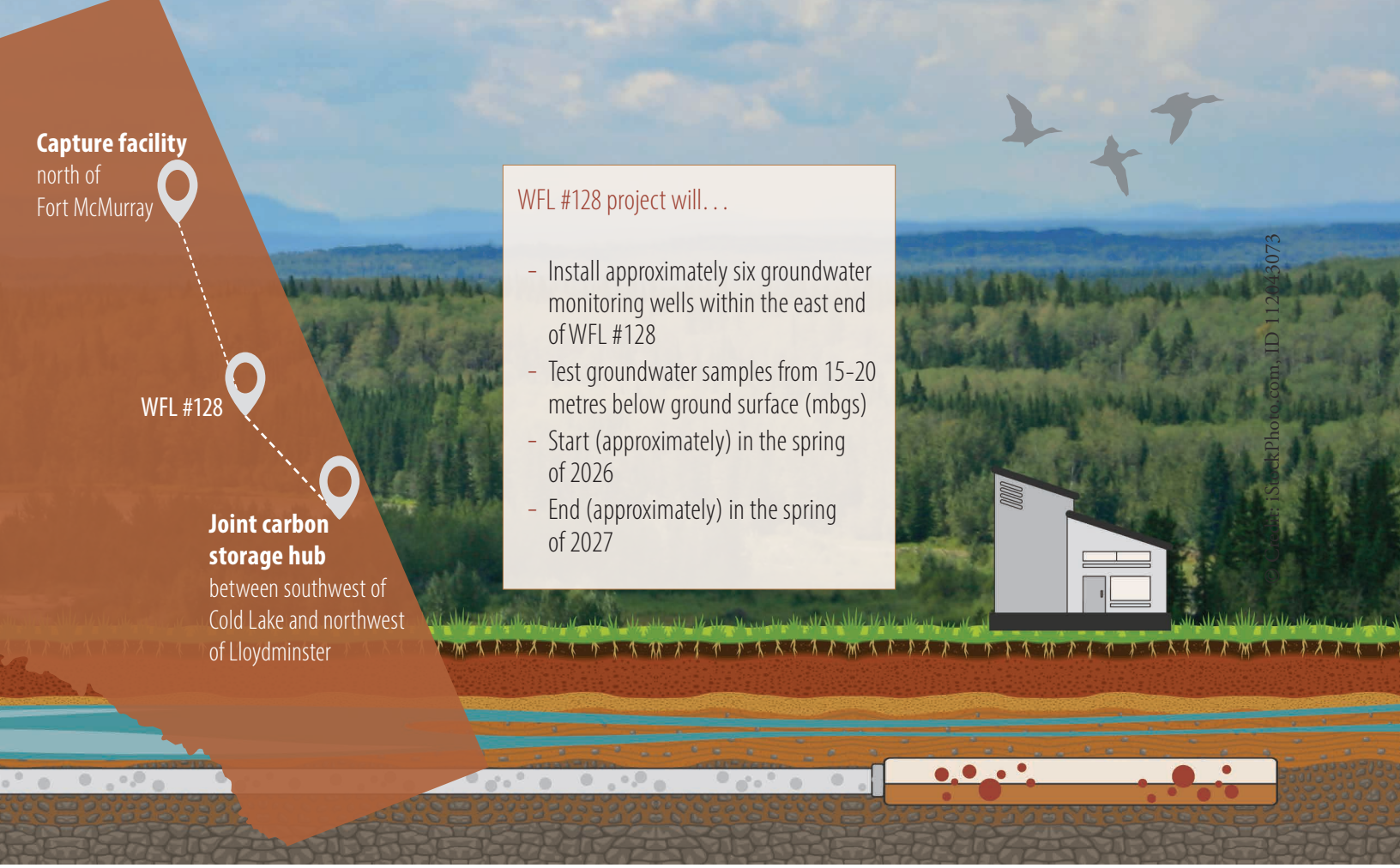


Potential solutions to address the effects of CCS projects: Insights from related research

CCS technologies are gaining traction around the world as potential methods to reduce greenhouse gas emissions from fossil fuels, despite the possible adverse links to health. Relying on CCS also risks sustaining the use of fossil fuels and averting additional action on climate change by creating "a sense of guilt relief, reducing the motivation [to] transition to renewable energy sources or decrease energy consumption" among businesses and populations (Mahjour & Faroughi, 2023, p. 12). Some CCS projects consume more energy and water, depending on their distinct CCS technology. Differences in energy and water use are particularly a concern for cooling processes during the CCS. Research warns that CCS projects must ensure they do not produce more carbon than their intended reduction and that water use is sustainable (Eldardiry & Habib, 2018; Mikunda et al., 2021). Potential solutions to address the effects of CCS projects may range from deliberate community consultation to strategies to protect groundwater quality. These solutions may help to identify, understand, and combat the risks and impacts on health associated with CCS.

Consultation, engagement, and building community partnerships

Pathways Alliance's proposed CCS project has gained provincial support from the Government of Alberta, despite little consultation with WFL #128 or other affected Nations and minimal regard for WFL #128 Treaty rights or the potential environmental risks to WFL #128's reserve lands. Worldwide, respecting Indigenous Peoples' territorial governance and decision-making authority in carbon-related projects is an ongoing issue; however, there are potential solutions and avenues to follow (Redvers et al., 2025). All First Nations community members must be consulted (e.g., Duty to Consult) prior to any



proposed industry projects in their territory, including CCS. International human and Treaty rights affirm this requirement, which is also entrenched in Canadian law. The United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) states projects that may affect Indigenous lands or territories – such as to develop, utilize, or exploit minerals, water, or other resources – must first obtain free, prior, and informed consent from affected Nations.

UNDRIP also affirms Indigenous Peoples' rights to control their lands, territories, and resources, as bound by Treaties (United Nations, 2007). The UNDRIP Act (2021) holds Canada accountable for achieving the UNDRIP objectives, while Section 35 of the *Constitution Act* (1982) recognizes and protects Treaty rights in Canada, including WFL #128 community members' Treaty Six rights (the territory in which the proposed CCS project is planned to take place). Consultation with WFL #128 community members ahead of any environmental projects is thus legally required.

Promising practices to build community partnerships

Research highlights promising practices to build and nurture partnerships and foster effective collaboration with Indigenous community partners in CCS projects, including:

- designating sufficient and ample time for interactive, face-to-face community engagement;
- implementing transparent co-risk-management and co-decision-making;
- following co-leadership from and engaging with local knowledge experts;
- creating accessible, plain-language, and visual tools for project information;
- involving youth – future leaders – in research and engagement activities;
- planning and carrying out culturally responsive community engagement based on local concerns, protocols, cultures, and sociocultural histories; and
- respecting local community environmental worldviews and perspectives (Coyle, 2016; Steinthorsdottir et al., 2024).

In addition to respecting WFL #128's Treaty rights, CCS projects need a "social license to operate" (Coyle, 2016, p. 233) and effective communication may help achieve this. For instance, community engagement may start several months to over a year before a project is officially proposed (Steinthorsdottir et al., 2024). Adequate time is needed to understand preferred community engagement protocols; build relationships; identify local experts on the land and waters, environment, and peoples; and include all residents to ensure deliberations are driven by community priorities and questions (Steinthorsdottir et al., 2024). As reflected by researchers of one CCS project, "when a [CCS] facility was in close proximity to people's homes, everyone became a stakeholder, and hence needed to be informed" (Coyle, 2016, p. 239).

Strategies to protect groundwater quality

In CCS, groundwater contamination may be prevented by adopting "robust safety protocols and regulations" and "continuous monitoring and mitigation measures" (Mahjour & Faroughi, 2023, p. 17), as well as reporting mechanisms to monitor health and safety risks. Some studies have developed frameworks to evaluate and respond to potential risks associated with specific CCS projects – a similar objective to the WFL #128 baseline assessment explored in this fact sheet – and may be used to better understand contamination scenarios and best practices to mitigate associated health risks (see for example Li et al., 2018; Siirila et al., 2012).

For insight into reactive, more responsive strategies for industry members to take to protect groundwater quality, Esposito and Benson (2012) examined three strategies to counteract carbon dioxide leakages from CCS projects and protect groundwater aquifers from contamination. One strategy involved plugging a leaking well to stop carbon dioxide from travelling to nearby aquifers and drilling an additional well to extract excess carbon dioxide. Depending on the leak, this process can take five to 15 years to complete. A second method involved injecting water into a contaminated aquifer to dilute carbon dioxide concentrations and prevent heavy metals from leaching out of aquifer rocks. This process can take several months or up to a year to complete. Finally, a third method combined the two strategies by injecting water into the carbon dioxide leakage area, then extracting excess carbon dioxide, using multiple wells for each step. This third method was found to be the most effective in rapidly removing mobile carbon dioxide and reducing the risk of groundwater contamination (Esposito & Benson, 2012).

Conclusion

While CCS projects are innovative methods to capture and sequester carbon dioxide emissions driving global climate change, their novelty warrants further study in environmental sciences to better understand the risks to health and sustainability of the local environment. What is known about the risks to health from groundwater contamination of heavy metals to air pollution of leaked carbon dioxide suggests long-term perils that pose uncertainties for future generations. WFL #128's baseline assessment will provide a guiding framework to protect the health of WFL #128 community members. Environmental developmental projects, including the proposed CCS project, will be accountable to the evidence base gathered through WFL #128's baseline assessment, as per international human rights affirmed in UNDRIP and constitutionally protected Treaty Six rights. In any case, the land governance and sovereignty of WFL #128 community members must be central to proposed environmental projects in their territory, including for the health of the lands, waters, and peoples.

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References

Brown, J. E. (2017). *Nutrition through the life cycle* (6th ed.). Cengage Learning.

Constitution Act, 1982. c. 11. (Canada)

Coyle, F. J. (2016). 'Best practice' community dialogue: The promise of a small-scale deliberative engagement around the siting of a carbon dioxide capture and storage (CCS) facility. *International Journal of Greenhouse Gas Control, 45*, 233-244.

Eldardiry, H., & Habib, E. (2018). Carbon capture and sequestration in power generation: Review of impacts and opportunities for water sustainability. *Energy, Sustainability, and Society, 8*(6), 1-15.

Esposito, A., & Benson, S. M. (2012). Evaluation and development of options for remediation of CO2 leakage into groundwater aquifers from geologic carbon storage. *International Journal of Greenhouse Gas Control, 7*, 62-73.

Fagorite, V. I., Chijioke, C. F., Opara, A. I., Onyekuru, S. O., & Oguzie, E. E. (2022). Environmental and safety issues associated with geological carbon storage: A review. Euro-*Mediterranean Journal for Environmental Integration, 7*, 445-461.

Fogarty, J., & McCally, M. (2010). Health and safety risks of carbon capture and storage. *Journal of the American Medical Association, 303*(1), 67-68.

Health Canada. (2025). *Guidelines for Canadian drinking water quality - Summary tables*. Government of Canada. https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality/guidelines-canadian-drinking-water-quality-summary-table.html

Li, Z., Fall, M., & Ghirian, A. (2018). CCS risk assessment: Groundwater contamination caused by CO2. *Geosciences, 8*(397), 1-27.

Mahjour, S. K., & Faroughi, S. A. (2023). Risks and uncertainties in carbon capture, transport, and storage projects: A comprehensive review. *Gas Science and Engineering, 119*, 205117.

Mikunda, T., Brunner, L., Skylogianni, E., Monteiro, J., Rycroft, L., & Kemper, J. (2021). Carbon capture and storage and the sustainable development goals. *International Journal of Greenhouse Gas Control, 108*, 103318.

Ninomiya, M. E. M., Burns, N., Pollock, N. J., Green, N. T. G., Martin, J., Linton, J., Rand, J. R., Brubacher, L. J., Keeling, A., & Latta, A. (2023). Indigenous communities and the mental health impacts of land dispossession related to industrial resources development: A systematic review. *Lancet Planet Health, 7*, 501-517.

Pathways Alliance. (n.d.). *Carbon capture and storage (CCS)*. https://pathwaysalliance.ca/foundational-project/carbon-capture-and-storage-ccs

Redvers, N., Chan, J., Odochao, S., Pratt, V., Sim, J., Gougsa, S., Kobei, D. M., & Willetts, L. (2025). Carbon markets: A new form of colonialism for Indigenous Peoples? *Lancet Planet Health, 9*, 421-430.

Rojas-Rueda, D., McAuliffe, K., & Morales-Zamora, E. (2024). Addressing health equity in the context of carbon capture, utilization, and sequestration technologies. *Current Environmental Health Reports, 11*, 225-237.

Siirila, E. R., Navarre-Sitchler, A. K., Maxwell, R. M., & McCray, J. E. (2012). A quantitative methodology to assess the risks to human health from CO2 leakage into groundwater. *Advances in Water Resources, 36*, 146-164.

Steinthorsdottir, K., Pete, S., Dipple, G. M., Truman, R., & Snæbjörnsdóttir, S. O. (2024). Early engagement with First Nations in British Columbia, Canada: A case study for assessing the feasibility of geological carbon storage. *EGUsphere, [preprint]*, 1-20.

United Nations. (2007). *United Nations Declaration on the Rights of Indigenous Peoples*. https://www.un.org/development/desa/indigenouspeoples/wp-content/uploads/sites/19/2018/11/UNDRIP_E_web.pdf

United Nations Declaration on the Rights of Indigenous Peoples Act, S.C. 2021, c. 14. (Canada)

Whitney, E., Rolfes, S. R., Hammond, G., & Piché L. A. (2016). *Understanding nutrition* (2nd Canadian ed.). Nelson Education.

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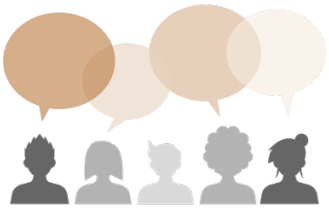
REFLECT

Talk to others in your community, reflect on the content of this fact sheet, and contemplate how you could make a difference in the health and well-being for yourself, your family or your community.



ENGAGE

Find local friendship centers, community organizations or groups where you can volunteer or participate in healthy positive actions. You too can share knowledge and make a difference in the health and well-being of First Nations, Inuit, and Métis Peoples' of Canada.

sharing knowledge · making a difference
partager les connaissances · faire une différence
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