DILLON CONSULTING

RANKIN INLET UTILIDOR REPLACEMENT

GOVERNMENT OF NUNAVUT

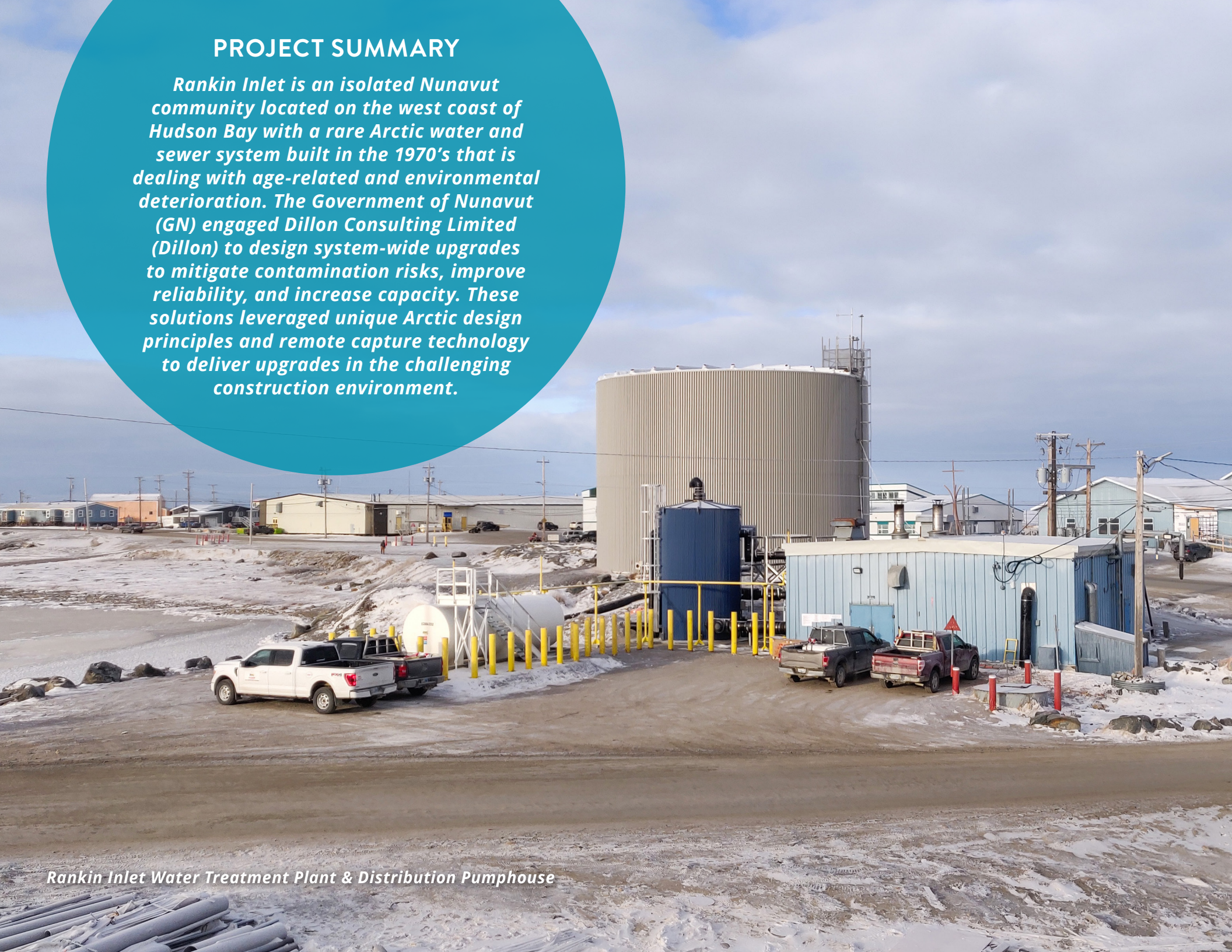
CATEGORY: WATER RESOURCES

ASSOCIATION OF CONSULTING ENGINEERING COMPANIES | CANADA

ASSOCIATION DES FIRMES DE GÉNIE-CONSEIL | CANADA

PROJECT SUMMARY

Rankin Inlet is an isolated Nunavut community located on the west coast of Hudson Bay with a rare Arctic water and sewer system built in the 1970's that is dealing with age-related and environmental deterioration. The Government of Nunavut (GN) engaged Dillon Consulting Limited (Dillon) to design system-wide upgrades to mitigate contamination risks, improve reliability, and increase capacity. These solutions leveraged unique Arctic design principles and remote capture technology to deliver upgrades in the challenging construction environment.



Rankin Inlet Water Treatment Plant & Distribution Pumphouse

INNOVATION

The Utilidor, a network of buried water/sewer mains with associated pumping facilities dating back to the 1970s, serves an isolated community situated 300 km North of Churchill. While the system has expanded over the years, many of its original components are still in use. Operations are further complicated by permafrost, necessitating continuous recirculation and heating to prevent freezing along with robust components such as insulated steel manholes which present their own unique operational and maintenance challenges.

The community faced several problems, including groundwater infiltration of wetwells, risks of cross-contamination within combined manholes, insufficient fire flow and water pressure due to tuberculation, and overcapacity within pumping systems.

Dillon undertook a comprehensive evaluation and risk assessment of the infrastructure, identifying upgrades for critical short-term failures and long-term expansion requirements. This entailed extensive financial projections and lifecycle analyses to determine optimal timelines, considering risks associated with a restricted contractor base, exorbitant material transport expenses, and unique stakeholder considerations in the remote Inuit community.

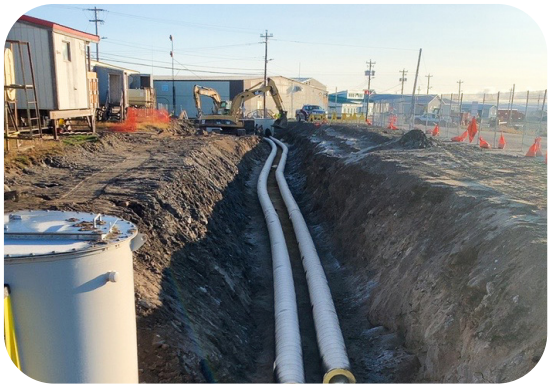
From this assessment, a series of expedited work packages were devised to address the major risks. Given Rankin Inlet's isolated location, accessible only by air and limited sealifts, project execution was complicated by logistical challenges, a short 4-month construction window, and the scarcity of skilled labor, equipment, and accommodations. Executing such a project in a remote location within accelerated timelines demanded innovative approaches.

Advanced technology was harnessed throughout the project lifecycle to maximize the limited site access. Dillon utilized 360 scans to create immersive digital walkthroughs of facilities, allowing for live collaboration with the Canada-wide client and design team. Community-wide scans using drone LIDAR and photogrammetry expediting the design process and substituted lack of accurate records.

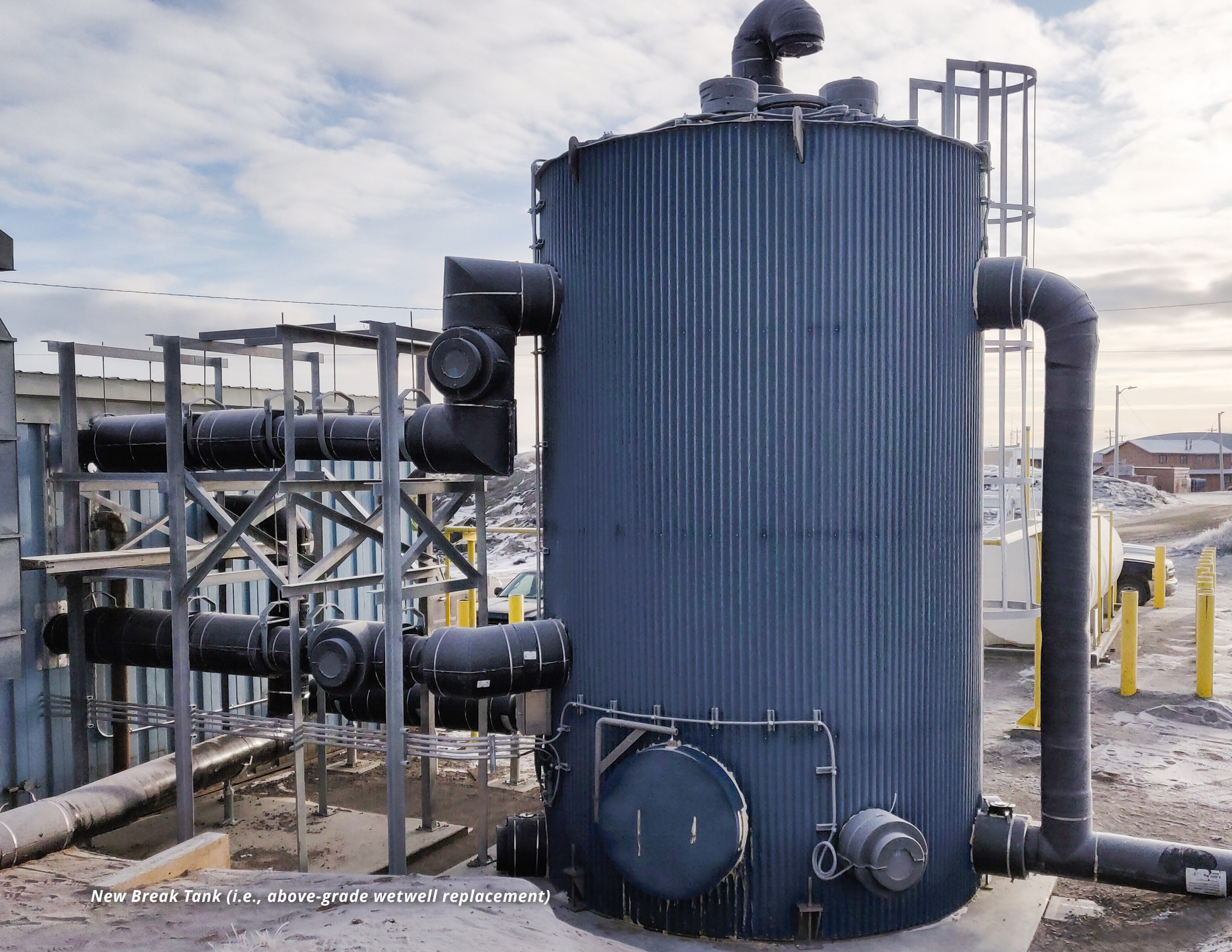
Creative engineering solutions were developed which included:

- Below-grade pump/wetwell replacement with an at-grade system within the existing building footprint while tying into an obsolete PLC system and aged pipes
- Design of innovative partitioned water/sewer manholes to prevent cross-contamination
- Water main design improvements to mitigate tuberculation, heat loss, and dynamic settlement
- Implementation of in-situ steel manhole refurbishment as opposed to typical replacement for greater cost efficiencies and waste reduction.

Dillons pioneering approach in the Utilidor Replacement Program establishes a blueprint for future water and wastewater endeavors in challenging Arctic environments.



Morning frost on new watermains



New Break Tank (i.e., above-grade wetwell replacement)

COMPLEXITY

Executing projects in Nunavut comes with difficulties not only from geographical constraints but also from risks associated with aging infrastructure. This was particularly evident in the scope to replace the potable water wetwells and pumps within the treatment plant constructed in the 1970s. Given the significant risks to the community and critical nature of these systems, Dillon worked closely with the GN to accelerate the design process, necessitating detailed planning and coordination to address several complex challenges.

The team successfully navigated multiple obstacles throughout the project, including:

- The absence of reliable drawings or detailed condition information, which necessitated thorough site reviews
- An obsolete PLC that required new standalone controls and careful integration into the existing SCADA system
- The building's structural limitations that prevented it from supporting large pipes, thus requiring the installation of ground-level supports in constrained spaces
- The limited space within the building's footprint, demanding meticulous planning to fit the pump skid and auxiliary systems with only inches to spare.

Further complications emerged during the construction phase, including unexpected asbestos discovery requiring immediate abatement, continuous breakages from old piping necessitating unexpected repair shutdowns, and the need for additional structural reinforcement. Dillon and the contractor worked closely to address these issues in a well-coordinated manner, ensuring safety and on-time completion.

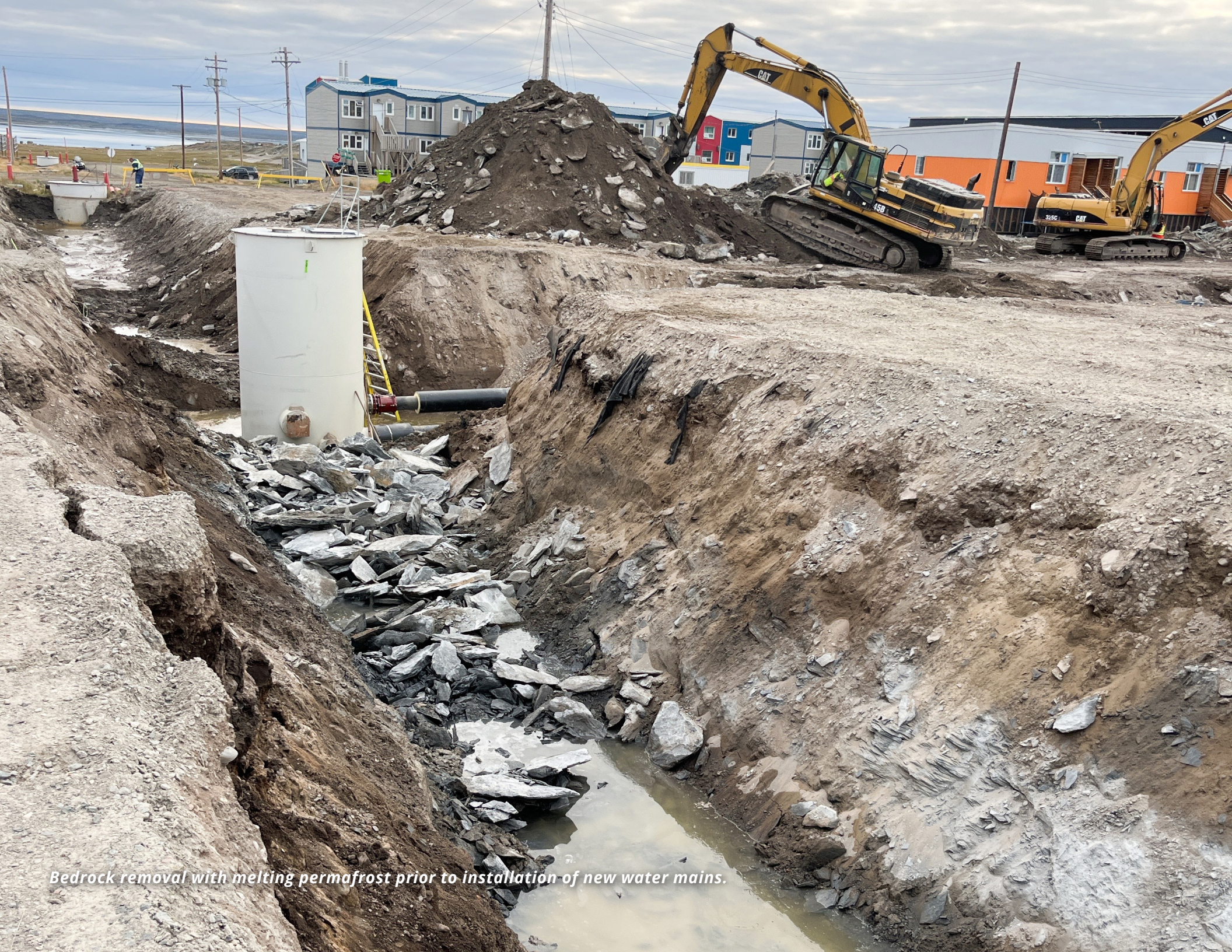
Dillon was also integrated within the GN's project management framework throughout the project which was crucial in maintaining project momentum and allowed for quick decision-making to address these complex challenges.

Watermain installation

SOCIAL AND ECONOMIC IMPACT

Rankin Inlet, the major commercial hub of Nunavut's Kivalliq region and the territory's second-largest settlement, is poised for significant growth necessitating robust water and sewer infrastructure to support expanding development. This includes critical areas like a new airport, residential subdivisions, and a future mining/heavy equipment training center which are key drivers of local economic sustainability. The project aligns with the ambitious Nunavut 3000 plan, which targets the construction of 3,000 housing units across the territory with a $2.6 billion investment, specifically of which 310 units are expected locally. Enhancing Utilidor capacity and reducing maintenance risks are central to the success of these projects.

A key part of this strategy is prioritizing local labour, ensuring that the economic benefits of development are felt directly within the community. This approach builds a sense of ownership and pride among residents, fostering local empowerment. Nunavut Tunngavik Incorporated (NTI), in partnership with the Government of Nunavut, established the Nunavummi Nangminiqaqtunik Ikajuuti (NNI) regulations which were a key piece



Bedrock removal with melting permafrost prior to installation of new water mains.

of the project procurement strategy and contracts. These regulations support economic growth by favoring Inuit-owned firms, local businesses, and contractors that hire locally or from within Nunavut in public procurement processes.

By adhering to NNI regulations, the Rankin Inlet project has ensured that approximately 25%-38% of the labour costs per phase are directed locally, channeling over $500k back into the local hands. This investment enhances the local economy, promotes skill development, generates employment opportunities, and strengthens community resilience.

ENVIRONMENTAL IMPACT

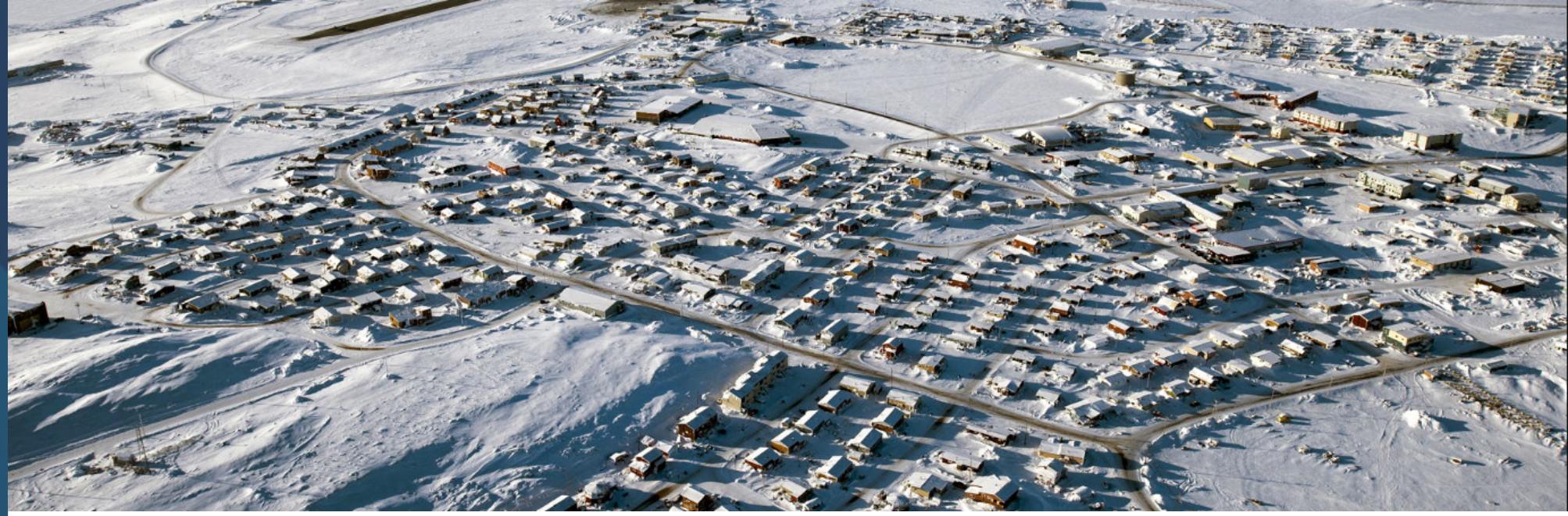
In Nunavut's unique Arctic climate, where the environment is fundamentally linked to cultural identity and tradition, an approach that centers on environmental sustainability was crucial. Climate change has intensified issues such as housing shortages, inadequate telecommunications, and strained health and water/wastewater services, underscoring the need for sustainable solutions.

One major issue was the vulnerability of below-grade potable water wetwells from groundwater infiltration and spills from adjacent fuel tanks. Addressing these risks involved developing at-grade alternatives and constructing containment berms around fuel tanks with enhanced spill response measures, aligning with the latest Environmental and Climate Change Canada standards.

Another key issue is presence of permafrost around the buried water/sewer mains which introduces freezing risks, necessitating the continual heating of the potable water. Furthermore, mains and associated steel manholes, face challenges from differential settlement over time, exacerbated by the melting permafrost. To mitigate these issues, Dillon enhanced the insulation standards for all buried piping, aiming to minimize heat loss and reduce the demand on boilers. Additionally, Dillon widely adopted the use of flexible restraint couplings at junctions with steel manholes. This improvement is designed to accommodate differential settlement, thereby decreasing the likelihood of leaks and breaks in the system.

Recognizing the challenges of waste disposal in remote communities, where normal construction often involves complete material replacement, Dillon pioneered a in-situ water main refurbishment program in Nunavut. This innovative method significantly reduced waste and enhanced the project's cost-effectiveness, demonstrating a deep commitment to sustainable engineering solutions.

Installed steel manhole



MEETING AND EXCEEDING THE CLIENT'S NEEDS

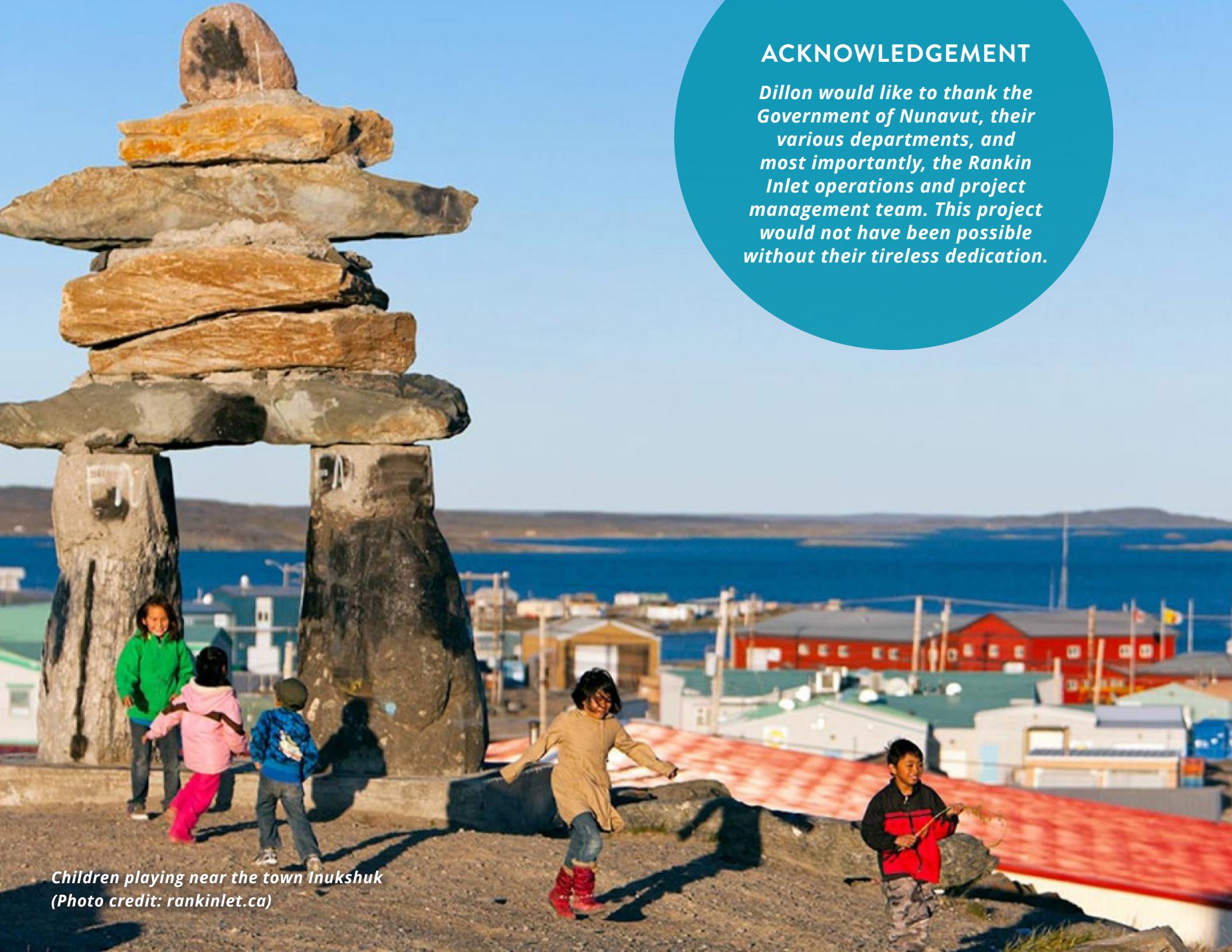
Since 2017, Dillon has collaborated closely with the GN, emphasizing a trust-based relationship aimed at not only meeting, but exceeding the client' needs. This partnership was pivotal in addressing the critical demand for reliable water/sewer services essential for the expansion and health of the Hamlet. Initially focusing on only two phases of the Utilidor Replacement, upgrading a single lift station and sewer trunkline in 2021, the scope expanded as Dillon's insights into additional community risks were trusted by operations and maintenance staff.

The simultaneous Iqaluit Water Crisis underscored the urgency to address these risks, propelling Dillon to conduct an exhaustive system review and risk assessment. This led to a new accelerated project phase, focused the most critical risks (i.e., overcapacity issues, reducing contamination risks, and improving fire flow and water pressure). Through extraordinary project delivery methods, Dillon expedited design in 2022 to deliver commissioned systems in the 4-month 2023 season. Despite challenges like obsolete controls, asbestos, and structural issues, the construction concluded on time and within a narrow 8% variance from the original order of magnitude estimate.

Looking ahead, Dillon is improving upon initial Utilidor designs in collaboration with the GN to include cost-effective solutions like partitioned steel manholes alongside a refurbishment program that promises condition improvement at a fraction of replacement costs. **This commitment to continuous improvement and cost efficiencies, alongside strict adherence to the schedule despite the project's complexity and high public interest, showcases the highest standard of engineering consulting practices employed by the team.**

ACKNOWLEDGEMENT

Dillon would like to thank the Government of Nunavut, their various departments, and most importantly, the Rankin Inlet operations and project management team. This project would not have been possible without their tireless dedication.



Children playing near the town Inukshuk (Photo credit: rankinlet.ca)

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