



Indigenous Economic Realities

Methodology



About the Research

This study asks four questions:

1. What share of major projects in Canada sit on or near (within 15 kilometres [km] of) Indigenous lands?
2. How are project-adjacent communities distributed by readiness?
3. How do those communities compare with the wider set of Indigenous communities?
4. What does this imply for engagement and capacity-building?

We combined spatial analysis, descriptive statistics, and unsupervised machine learning. From Natural Resources Canada's 2024 Major Projects Inventory,¹ we geolocated 377 active or planned projects. Using a 15-km radius around each project, we identified 172 Indigenous communities within likely influence. The 15-km threshold is a conservative screen aligned with common environmental assessment practices²—it understates broader cultural and jurisdictional ties that extend beyond fixed boundaries.

To profile readiness nationally, we assembled 1,141 geolocatable Indigenous communities (Statistics Canada Census Subdivisions [CSDs]) covered by the 2021 Community Well-Being Index (CWB)³ and 2021 Index of Remoteness (IR2021).⁴ Of these, 650 had valid CWB scores and entered the clustering model; 491 were data-limited (small populations or non-participation in the census). These data-limited communities remain rights-holders and are included in maps and narrative discussion even when statistics are unavailable.

To understand how readiness has changed over time, we applied the same clustering model to historical CWB scores from 2006 and 2016. Using a consistent framework across all three census years allowed us to track how communities moved between clusters and to distinguish long-term improvements in the core CWB components—such as rising educational attainment, stronger labour force participation, higher incomes, and gradual reductions in housing stress—from short-term fluctuations. This distinction is especially important for interpreting changes between 2016 and 2021, when COVID-19 and related service disruptions temporarily affected employment, schooling, and household conditions. By comparing movement across multiple time points, we can better determine whether shifts in cluster assignment reflect sustained socio-economic development or transient shocks that briefly influence CWB scores.

¹ Natural Resources Canada, "Major Projects Inventory."

² See, for example, Natural Resources Canada, *Trainer's Manual*.

³ Indigenous and Northern Affairs Canada, "Community Well-Being Index."

⁴ Statistics Canada, "Index of Remoteness 2021."



Detailed methods

Geospatial analysis

Our spatial analysis used several georeferenced datasets to identify project-affected communities and assess their location relative to major infrastructure investments and Indigenous governance areas.

We used:

- **Natural Resources Canada's 2024 Major Projects Inventory**: Point data for site-based infrastructure and line data for linear projects (e.g., pipelines, corridors). After excluding cancelled projects, **377** projects remained with an estimated capital investment of **\$505 billion**.
- **Indigenous Lands of Canada Legislative Boundaries**: Including reserves, settlement lands, and other recognized Indigenous lands under federal legislation or modern treaties.
- **2021 GeoSuite Census Subdivisions**: Community location data, population counts, and linkage with socio-economic indicators.

All spatial datasets were projected to **Lambert Conformal Conic**, the national standard for cartographic analysis.

To determine likely project exposure, we used a **15-km radius** around each project. Indigenous communities whose recognized land or settlement boundaries intersected this radius were flagged as **project-adjacent**. This approach provides a conservative estimate and likely under-represents broader cultural, environmental, and governance ties to land that extend beyond fixed jurisdictional boundaries.

Of the **1,141 Indigenous communities** included in our national profile:

- **172 communities** were located within 15 km of one or more major projects.
- **650 communities** had valid CWB scores and were included in the clustering model.
- **491 were classified as data-limited**, either due to small population size or census non-participation. Of these, 62 (13 per cent) belong to Nations that actively decline to participate in the census (e.g., Tsuut'ina, Kahnawà:ke, Akwesasne). The remainder includes micro-communities or land parcels without identifiable permanent residents. Many play vital roles in cultural stewardship, inter-Nation governance, or regional environmental protection. Including them in planning frameworks is crucial, despite the absence of statistical indicators.

Cluster analysis

This analysis used k-means clustering to group Indigenous communities into readiness segments based on their socio-economic conditions. The objective was to develop a typology of “economic readiness profiles” to assess how communities are positioned to engage with and benefit from major project activity across Canada.



Data and indicators

The clustering model used the 2021 CWB, a composite indicator based on census data. The CWB includes four equally weighted components: education, income, labour force participation, and housing. Scores range from 0 (low well-being) to 100 (high well-being).

We considered but excluded the Index of Remoteness (IR2021) from the clustering algorithm due to its dampening effect on model clarity. However, IR2021 was used for descriptive analysis and remains critical for understanding infrastructure and service access.

Clustering procedure

We applied k-means clustering to 172 project-adjacent Indigenous communities, standardizing CWB scores using z-scores. Of these, 124 communities with valid CWB scores—greater than zero—were included in the algorithm. The number of clusters ($k = 3$) was selected based on elbow plot inspection, silhouette analysis, and policy interpretability. Clusters were interpreted as:

- **Anchor communities (min. CWB = 73):** Strongest socio-economic outcomes, low remoteness, and high business/employment capacity.
- **Bridge communities (min. CWB = 61):** Moderate outcomes with wide variation in remoteness and capacity.
- **Emerging partners (min. CWB = 44):** Lower socio-economic conditions and higher remoteness, often facing infrastructure and service gaps.

Data-limited communities ($n = 48$) were analyzed separately.

Evaluation metrics—Project-adjacent communities

Clustering quality was assessed using three standard evaluation metrics, with results indicating strong statistical performance. (See Table 1.)

Table 1

Evaluation metrics: Cluster analysis of project-adjacent communities

Silhouette Score	0.6011	High cohesion and separation between clusters
Calinski-Harabasz Score	241.21	Strong inter-cluster separation and internal consistency
Davies-Bouldin Score	0.4799	Low intra-cluster variance (values < 1 reflect good fit)

Source: Signal49 Research.

These results confirm that the CWB-only model produces a valid and interpretable segmentation of economic readiness among project-affected communities.

Application to the national profile

To assess representativeness and extend findings, we applied the same clustering model to a national reference group of 650 Indigenous communities with valid CWB scores. Each was assigned to a cluster based on proximity to the original cluster centroids in Euclidean space. Evaluation metrics for the national clustering confirmed the model’s generalizability. (See Table 2.)



Table 2

Evaluation metrics: Cluster analysis of national profile

Metric	Value	Interpretation
Silhouette Score	0.5332	Strong cohesion and separation at national scale
Calinski-Harabasz Score	1175.48	Excellent inter-cluster separation
Davies-Bouldin Score	0.5453	Low intra-cluster dispersion across the broader universe

Source: Signal49 Research.

Context variables and robust statistics

To describe differences within and across clusters, we link each CSD to a common set of indicators drawn from the 2021 Census and 2022 Canadian Business Counts. Because several of these indicators were collected during or immediately after the COVID-19 period, some descriptive statistics may reflect temporary conditions—such as disrupted employment patterns, delayed training, or pandemic-related reporting effects—rather than longer-term structural traits. On the business side, we track the number of goods-producing enterprises by size class, distinguishing micro-enterprises from small and medium-sized enterprises (SMEs). On the labour side, we use employment counts in project-relevant occupations, grouped to align with major project value chains: mining (National Occupation Classification [NOC 21]), utilities (NOC 22), construction (NOC 23), business/finance/administration (NOC 1), trades and transport (NOC 7), and natural resources (NOC 8). Education is measured for people aged 15+ across five credential levels—no certificate/diploma/degree, high school, post-secondary, apprenticeship or trades, and bachelor's degree or higher—to show both foundational attainment and advanced qualifications. We also include age structure, focusing on the youth share (ages 0–19), because the size of the upcoming cohort shapes training pipelines and labour force growth. Finally, we report housing suitability pressure, defined as the share of households living in overcrowded dwellings under the National Occupancy Standard, since overcrowding directly affects training uptake, mobility, and retention.

Our reporting uses robust statistics, so findings are stable and easy to interpret. Throughout the profiles, the median represents the typical community. We describe spread using quartiles in plain language: the bottom quarter refers to communities at or below the first quartile, the top quarter to communities at or above the third quartile, and the middle range to the middle half (from the first to the third quartile). Where illustrations help, we name communities closest to the bottom or top quartile for a given metric. These are examples within that metric's own distribution; being in the top quarter on one measure does not imply the same position on others.

Earlier drafts tested trimmed means, standard deviations, and a robust coefficient of variation to summarize variation. For the final report we rely on medians and quartiles. This choice reduces sensitivity to outliers and very small cell counts, keeps comparisons consistent across clusters and geographies, and improves readability for decision-makers who need clear ranges rather than averages that can be skewed by a few large communities.



A few safeguards and caveats apply. Employment and business figures come from administrative and census sources; very small numbers may reflect rounding, suppression, or seasonality, and a zero can mean “none reported” rather than “none possible”. IR2021 is used descriptively—to characterize geographic context and logistics—not as an input to clustering. The 15-km proximity screen is intentionally conservative and will under-identify communities whose cultural, ecological, or jurisdictional ties extend beyond that radius. Lastly, data-limited and micro-communities—including Nations that do not participate in the census—are treated as rights-holders; a lack of statistics should never be read as a lack of authority, capacity, or interest.



Methodology bibliography

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