Planning for the Future:
Infrastructure Risk Assessment in GIS

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SPIRIT IN SERVICE FOR VIBRANT COMMUNITIES
Together we will develop vibrant communities!
WHAT MAKES A VIBRANT COMMUNITY?

- Trees trimmed annually
- Sanitary main budgeted for replacement in 2025
- Road resurfaced as part of 2015 roads program
- Hydrant inspected and flushed
QUESTION:

How does a *community* deliver services in a *socially*, *economically*, and *environmentally* responsible manner, in a way that sets up future generations for success?
Overview

How does a community deliver services in a socially, economically, and environmentally responsible manner, in a way that sets up future generations for success?

- Asset Management
- Risk Assessment
- Case Study
  - City of Cranbrook, BC
  - Model Builder
  - Web Application
Asset Management

The **process** of bringing together the skills and activities of **people**; with **information** about the community’s physical **infrastructure assets** and **financial resources** to ensure long term **sustainable service delivery**.

*Asset Management for Sustainable Service Delivery, A BC Framework*
# Asset Management Investment Plan

## City of Cranbrook Asset Management Investment Plan (AMIP)

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<tbody>
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<td><strong>WATER SYSTEM</strong></td>
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<td>Fire Hydrants</td>
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<td>Culverts</td>
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<td>Roadways</td>
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<tr>
<td>Irrigation Systems</td>
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<td><strong>RECREATION SYSTEMS</strong></td>
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<td>Campgrounds</td>
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<td><strong>TRANSPORTATION SYSTEMS</strong></td>
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<tr>
<td>Bridges</td>
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<td><strong>INFRASTRUCTURE TOTAL</strong></td>
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</table>

**Notes:**
- The table above represents various capital assets categorized under different systems such as Water, Recreation, and Transportation.
- Each category lists the replacement value, loan value, existing value, remaining loan, capital replacement, and projected capital improvement.
- The infrastructure deficit/excess is calculated based on these values.
- The fund sources and uses are not directly listed in the table but are mentioned as $15 Million Annual Investment Required for Roads/Drainage, Water and Sewer and $9.1 Million for Roads/Drainage, Water and Sewer.

**Total Investment Required:**
- $15 Million for Roads/Drainage, Water and Sewer
- $9.1 Million for Roads/Drainage, Water and Sewer

**Source:** City of Cranbrook Asset Management Investment Plan (AMIP)
Risk Assessment

- Able to **prioritize** projects using defensible method
- Allows community to be **intentional** about level of risk
- Helps **align** annual investments with available resources
Risk Assessment – Cranbrook, BC

- 20,000 people
- 32 km²
- 140 km of Sanitary Mains
- 173 km of Water Mains
- 74 km Storm Mains
- 198 km of Roads
Risk Assessment

- Primary Factors
  - Asset Condition
  - Asset Capacity

- Secondary Factors
  - Likelihood of Failure
  - Consequence of Failure
CRANBROOK ASSET RISK EVALUATION PROCESS - a combination of condition & capacity, consequence & likelihood

SANITARY SYSTEM RISK ANALYSIS METHODOLOGY*

Capacity – Consequence of Failure

**QUESTION**
How many people would be affected by failure?

**QUESTION**
Are there any other factors that need to be considered?

**MODIFICATION TABLE**

<table>
<thead>
<tr>
<th>Original Score</th>
<th>Criteria</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<td>3</td>
<td>4</td>
<td>5</td>
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**PROCESS**
Rank Consequence based on Land Use Designation

**CONDITION**

**Capacity – Likelihood**

**QUESTION**
Does the pipe have excess flow capacity?

**PROCESS**
Determine Hydraulic Capacity and HGL

**Priority**

1. ((Existing Capacity >= 3 or Future Capacity >= 4) and Existing Condition >= 4)

2. Condition or Capacity Combined Risk Score >= 4

3. Condition or Capacity Likelihood of Failure >= 4

**TABLE**

<table>
<thead>
<tr>
<th>Likelihood of Failure</th>
<th>Criteria</th>
<th>Velocity</th>
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<tbody>
<tr>
<td>5</td>
<td>0.3 m/s</td>
<td>&lt;= 1</td>
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<tr>
<td>4</td>
<td>0.7 m/s</td>
<td>&lt;= 0.75 m/s</td>
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<tr>
<td>3</td>
<td>1.0 m/s</td>
<td>&lt;= 0.75 m/s</td>
</tr>
<tr>
<td>2</td>
<td>0.7 m/s</td>
<td>&lt;= Crown</td>
</tr>
<tr>
<td>1</td>
<td>1.0 m/s</td>
<td>&lt;= Crown</td>
</tr>
</tbody>
</table>

**RESULT**

Capacity Likelihood of Failure Ranking

**Figure 1**
Risk Assessment – Model Builder

1 – Condition Consequence of Failure

- Environmental
- Sanitary Data
- Roads
- Modification Factors
- Condition CoF Scoring (Existing Scenario)
- Condition CoF Scoring (Future Scenario)
2 – **Condition** Likelihood of Failure

**Asset Expected Life (Material, Install Date)**

**Sanitary Data**

**CCTV**

**Condition LoF Scoring (Existing / Future Scenarios)**
Risk Assessment – Model Builder

3 – **Capacity** Consequence of Failure

- **Environmental**
- **Land Use**
- **Sanitary Data**

**Modification Factors**

**Capacity CoF Scoring** (Existing Scenario)

**Capacity CoF Scoring** (Future Scenario)

**Modification Factors** (Future)

**Sanitary Data**

**Modification Factors** (Future)
Risk Assessment – Model Builder

4 – Capacity Likelihood of Failure

Pipe Capacity Calculations
Capacity LoF Scoring (Existing Scenario)
Capacity LoF Scoring (Future Scenario)
Risk Assessment Results

- *Asset Management Investment Plan* (AMIP) recommended annual investment of **$9.1 Million** for Roads, Drainage, Water and Sewer
- *Risk Assessment*, Priority 1 infrastructure recommended annual investment of **$3.7 Million**
  - Focused, intentional
  - Defensible
  - Flexible to balance desired level of service and risk
  - Comprehensive for smart decision making (san, wat, storm, roads)
“We now have an **Integrated Asset Management Plan** which identifies the condition of all roads and the infrastructure beneath them,” Mayor Pratt notes. “With this information we are able to make an **educated assessment** of the life expectancy of all of these assets. This will help us **prioritize** which roads and water and sewer lines should be replaced first. Council and staff are working on solutions to complete as much of this as we can each year while focusing on spending taxpayer dollars wisely.”
Web Map - for viewing results and making decisions
QUESTION:

How does a community deliver services in a socially, economically, and environmentally responsible manner, in a way that sets up future generations for success?