



Infrastructure Maintenance Management Toolkit

Volume I

Guidance on Infrastructure Maintenance Management

March, 2022

Table of Contents

Abbreviations List.....	ii
1. Introduction & Overview.....	1
2. Overview – Maintenance Management Cycle	6
3. Links to Organizational Capacity for Infrastructure Management	10
4. Maintenance Management - Step by Step Approach.....	15
5. Critical Success Factors	16
APPENDIX A.....	17
Glossary of Infrastructure Service Delivery Terms.....	17
APPENDIX B.....	20
Good Infrastructure Management Practice – Life Cycle Approach	20
APPENDIX C	24
Preparing a Maintenance Management Plan (MMP).....	24
Step 1 – Develop Asset Inventory.....	25
Step 1.1 Develop Inventory for Existing Assets	25
Step 1.2 Add, Change or Delete Assets	28
Step 2 – Develop Maintenance Management Plan	29
Step 2.1 Summarise Assets.....	29
Step 2.2 Assemble Maintenance Work Orders.....	31
Step 2.3 Assemble Drawings and Maintenance Manuals	34
Step 2.4 Assemble Relevant Regulations, Policies, Procedures & Permits.....	35
Step 2.5 Develop Maintenance Budget	37
Step 2.6 Develop Maintenance Schedule.....	39
Step 3 – Implement Maintenance Management Plan.....	41
Step 3.1 Secure Qualified Staff & Contractors.....	41
Step 3.2 Adopt Necessary Policies & Procedures	43
Step 3.3 Adopt Maintenance Budget	45
Step 3.4 Implement Effective Information Management.....	47
Step 3.5 Implement and Follow Up on Maintenance Work Orders.....	49
Step 3.6 Update Maintenance Records	53
Step 3.7 Report on Maintenance Management	56

Abbreviations List

- ACRS = Asset Condition Reporting System
- CCP = Comprehensive Community Plan
- CISP = Community Infrastructure Services Plan
- Community of Practice = Naut'sa mawt Tribal Council (NmTC) Housing and Infrastructure Community of Practice
- FN = First Nation
- FNIIP = First Nation Infrastructure Investment Plan
- ICMS = Integrated Capital Management System (formerly CAIS)
- ISC = Indigenous Services Canada
- LCM = Life-cycle management
- Library of Maintenance Practices – a component of the Naut'sa mawt Toolkit for preparing and implementing Community Infrastructure Services Plans (CISPs)
- Library = Library of Maintenance Practices
- KPI = Key performance indicator
- LOS = Levels of Service
- MMP = Maintenance Management Plan
- MTSA = Municipal Type Service Agreement
- NmTC = Naut'sa mawt Tribal Council
- O&M = Operations and maintenance
- PW = Public Works or Public Works Department
- ROW = Rights of way

1. Introduction & Overview

Through the Naut'sa mawt Tribal Council (NmTC) Housing and Infrastructure Community of Practice, Naut'sa mawt Member First Nations are working to improve infrastructure management and operational practices. They communicate and share knowledge with each other and collaborate on initiatives. The Nations are working towards a structured, collaborative approach to capacity building, including ready access to relevant information, tools and benchmarks.

Effective maintenance is a key component of preparing and implementing Community Infrastructure Services Plans (CISPs). Readers should refer to the companion document entitled “Preparing a Community Infrastructure Services Plan – User Manual and Sample Plan – Naut'sa mawt Tribal Council – 2021” for more details on the CISP approach; typical service delivery terms used in the CISP and maintenance management processes are in Appendix A.

For context, Figure 1 shows the typical CISP structure and content. Key links between Maintenance Management and the CISP are highlighted in red.

To promote effective maintenance, Naut'sa mawt prepared the Infrastructure Maintenance Management Toolkit – see Figure 2.

The Toolkit provides a step-by-step “how to” method that can be applied to preparing and implementing effective Maintenance Management Plans (MMPs) for all types of community infrastructure, including: water and sewer systems; community buildings; roads; drainage systems; and (potentially) housing.

To demonstrate the step-by-step approach to preparing MMPs, NmTC has already prepared 3 Volumes as follows:

- Volume I** ➤ Guidance on Infrastructure Maintenance Management, which provides general guidance applicable to all types of infrastructure; **(This Manual)**
- Volume II** ➤ Guidance on Preparing a Maintenance Management Plan for Water and Wastewater;
- Volume III** ➤ Guidance on Preparing a Maintenance Management Plan for Community Buildings.

Volumes 2 and 3 apply the general approach set out in Volume 1 (this Manual) and expand scope and level of detail as needed to suit system specific requirements.

Over time, NmTC hopes to expand the Toolkit to include Volumes for other infrastructure systems such as roads, drainage systems and housing.



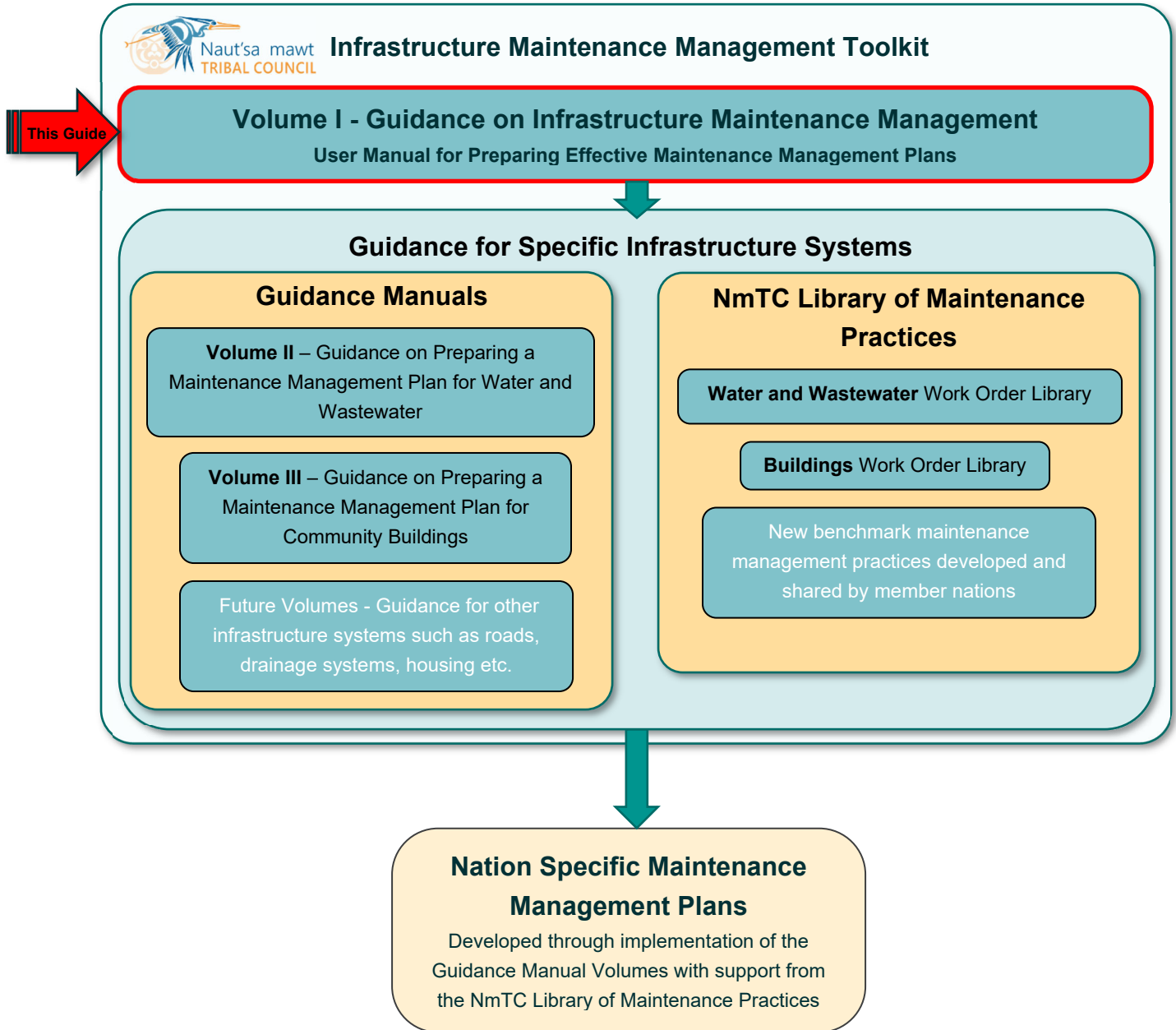
Effective maintenance is key to successful and efficient delivery of community infrastructure services. As such, key drivers for improving maintenance management include:

- Operations and maintenance (O&M), which usually represents over 80% of the total life-cycle cost of asset ownership – value for money in asset management is dependent on effective maintenance management;
- Detailed budgeting, accounting, and monitoring of maintenance management revenues and expenses;
- Maintenance funding requirements which will increase over time as infrastructure ages;
- More effective maintenance practices to comply with Financial Administration Laws (FALs). For example:
 - Improving Life Cycle Management (LCM) Practices that optimize capital and O&M costs over the service life of an asset; for example, paying more up-front for better construction standards can lead to lower O&M costs and, thereby, lower life-cycle costs;
 - A sustainable funding strategy is required for both capital and O&M which includes structured budgeting and funding for O&M, repairs, replacements, and/or upgrades;
 - There is usually insufficient financial information in a form suitable for effective financial management. To justify budgets and to manage performance, a more structured budgeting and accounting practice involving details on specific maintenance activities is required.
- First Nations and Indigenous Services Canada have many competing demands for limited funding; effective financial management, including good maintenance budgeting and cost control, will be critical to “making the case” for sufficient, sustainable funding.

Comprehensive Community Plan (CCP) <ul style="list-style-type: none"> • A Community led Roadmap to sustainability, self-sufficiency, and improved governance • High level master plan that sets out Community vision, objectives, guiding principles and concepts for planning and development – including lifestyle, economic, social, environmental, and cultural expectations 		
Community Infrastructure Services Plan (CISP) <ul style="list-style-type: none"> • Strategic and high level business plan for delivering infrastructure services to enable the Community Plan; CISP projects: <i>“How much should a FN spend, on what, when and why to ensure sustainable delivery of enough, good quality infrastructure services for the Community at the lowest life cycle cost?”</i> 		
Service Delivery <i>What type, quantity & quality of services do we deliver & how?</i>	Financial Management <i>How much money do we need & when?</i> <i>Where will money come from & on what terms & conditions?</i>	Infrastructure Management <i>What infrastructure do we require, where & when?</i> <i>How will we manage our infrastructure?</i>
<ul style="list-style-type: none"> ✓ Services to be delivered ✓ Service policies & practices <ul style="list-style-type: none"> ✓ Levels of Service (LOS) ✓ In-house or contract out ✓ Service risk management ✓ Demand forecasts ✓ Service regulation ✓ Customer service ✓ Communications & education ✓ Capacity Building <ul style="list-style-type: none"> ✓ Organization structure ✓ HR policies & practices ✓ Staffing & contracting out ✓ Training ✓ Emergency response ✓ Insurance ✓ Service monitoring & reporting ✓ Service information management 	<ul style="list-style-type: none"> ✓ Financial policies & practices <ul style="list-style-type: none"> ✓ Financial Administration Law ✓ Tangible Capital Assets ✓ O&M expenditure projections ✓ Capital expenditure projections <ul style="list-style-type: none"> ✓ Existing assets ✓ Future assets ✓ Financing – amounts, sources, terms & conditions ✓ Revenues – amounts & sources ✓ Operating & capital reserves ✓ Financial risk management ✓ Financial monitoring & reporting <ul style="list-style-type: none"> ✓ Income ✓ Balance sheet <ul style="list-style-type: none"> ✓ Tangible Capital Asset report ✓ Cash flow ✓ Financial information management 	<ul style="list-style-type: none"> ✓ Infrastructure management policy <ul style="list-style-type: none"> ✓ Asset management policy <ul style="list-style-type: none"> ✓ Own vs. rent/contract-out ✓ O&M policies ✓ Safety & security policies ✓ Infrastructure standards ✓ Asset Management <ul style="list-style-type: none"> ✓ Asset inventory ✓ Asset monitoring, inspections ✓ Asset replacement forecast <ul style="list-style-type: none"> ✓ Service life forecasts ✓ Infrastructure O&M ✓ Projected infrastructure additions, deletions, alterations ✓ Infrastructure risk management ✓ Infrastructure monitoring & reporting ✓ Infrastructure information management <ul style="list-style-type: none"> ✓ O&M and capital ✓ Assets

Figure 1 - CISP Structure and Content. Note: Key links between Maintenance Management Plan and CISP are highlighted in red.

Figure 2 - Infrastructure Maintenance Management Toolkit



The Infrastructure Maintenance Management Toolkit addresses these key drivers by:

- Promoting efficiency and consistency through a comprehensive, common structure of infrastructure types and component categories that generally apply to all community infrastructure;
- Establishing a Library of benchmark, activity based maintenance practices that include details on scope, procedures, cost and schedule.
- First Nations can assemble MMPs that are specific to their local infrastructure needs by extracting relevant benchmark practices from the Library of Maintenance Practices. Essentially, Nations should select relevant practices from the Library and adjust them, if necessary, to suit their specific needs. Where a necessary practice is not already included in the Library, the Nation should develop such practice using the benchmark template/approach and should contribute the new practice to expand the Library. In that way, the Library is an evolving body of relevant maintenance management knowledge that is continuously refined and expanded over time based on needs and experience.
- Identifying technical competencies needed to carry out work – including identifying work that can reasonably be done by semi-skilled vs. skilled staff.

The Infrastructure Maintenance Management Toolkit represents the outcome of extensive input by relevant stakeholders including: Naut'sa mawt Members' staff; ISC Circuit Riders; and industry specialist consultants and contractors.

2. Overview – Maintenance Management Cycle

Value for money in infrastructure asset management depends on effective Life Cycle Management (LCM), including maintenance management – for context, operations and maintenance (O&M) usually represent over 80% of the total life-cycle cost of asset ownership. As such, experience shows that choosing the lowest capital cost may not be the least expensive approach over the long term. Also, when the cost of maintaining an asset is high (O&M expenditure), it may be more cost-effective to replace it (capital expenditure).

The Benchmark Maintenance Management Cycle in Figure 3 is geared to optimizing life-cycle costs. Key steps in the Cycle involve:



Step 1 - Develop, and keep up-to-date, a comprehensive Asset Inventory including all Nation assets – both ISC and non-ISC funded. The inventory should include key data on each asset and should be routinely updated to record new assets or changes to existing assets.

Key asset information such as coding, quantities, construction costs, replacement costs and depreciation (accumulated and annual) should be the same as recorded in the Tangible Capital Asset inventory used by Finance for financial reporting. Any differences should be reconciled.



Step 2 - Develop a comprehensive Maintenance Management Plan and Budget for all assets listed in the Asset Inventory – see Figure 4:

- Assemble relevant Practices from the NmTC Library of Maintenance Practices;
- Adjust NmTC Maintenance Practices as needed to reflect local conditions – e.g. local schedules, costs, staff, contractors, asset conditions;
- Develop – in conjunction with NmTC – new Maintenance Practices for activities not already included in the NmTC Library of Maintenance Practices; update NmTC Library to include new or amended practices;
- Develop and get approval for a relevant Maintenance Plan, Schedule and Budget;

Figure 3 - MMP Cycle

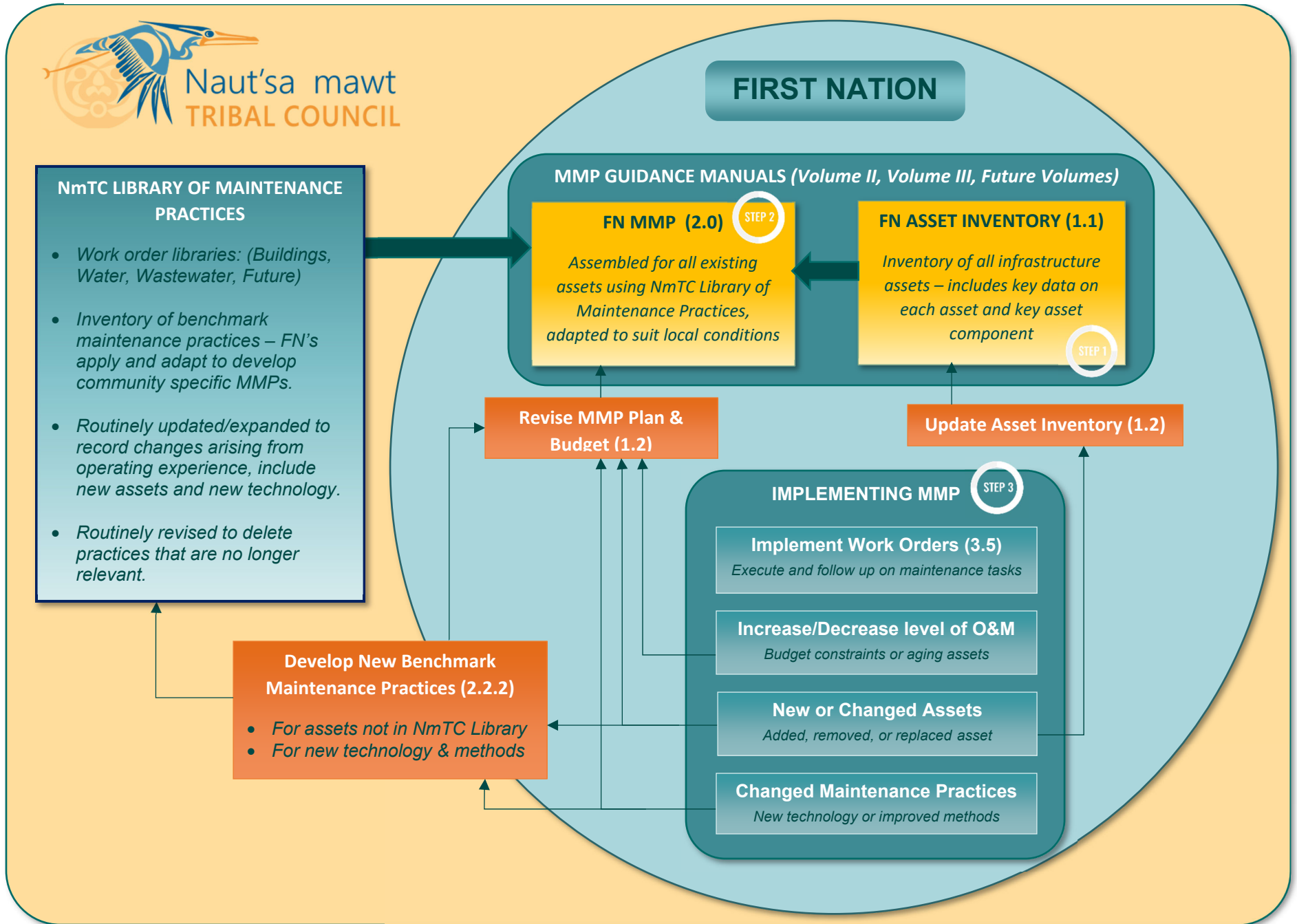
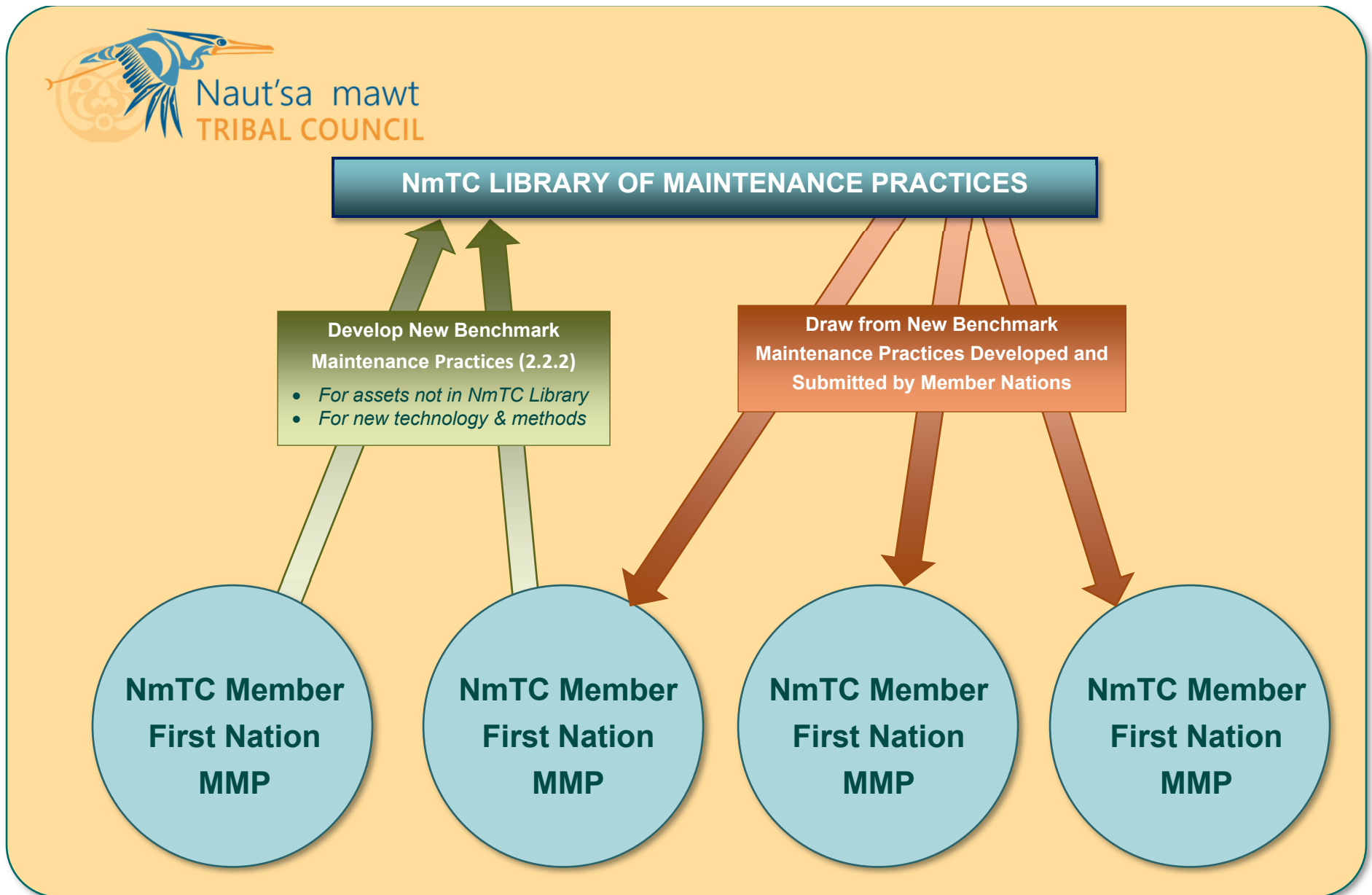


Figure 4 - FN MMP Development





STEP 3

Step 3 - Implement the approved Maintenance Management Plan and Budget:

- Consult maintenance work breakdowns to determine tasks and resource requirements including staff, contractors, tools, equipment, parts, materials and supplies;
 - Organize and schedule necessary resources (e.g. develop work orders) – confirm available budget; schedule staff; pre-order parts; hire contractors; secure necessary approvals; notify stakeholders;
 - Execute maintenance tasks – do scheduled work; record work done (scope and costs) vs. planned; identify issues and necessary follow up; identify any required changes in operating and maintenance procedures and records;
 - Schedule and execute follow up work – compile, scope and prioritize necessary follow up work and costs from completed work orders;
- Review/update Steps 1, 2 and 3 to keep the Asset Inventory and Maintenance Management Plan (MMP) up-to-date:
 - Routinely adjust MMP and Budget to reflect changing requirements – e.g. budget constraints, increased maintenance for aging assets, reduced maintenance when assets are replaced, new technology, improved methods;
 - Routinely adjust Asset Inventory and MMP to reflect additional or changed assets or to delete assets that are no longer operational.

3. Links to Organizational Capacity for Infrastructure Management

Effective maintenance is key to success in optimizing service delivery, financial management and infrastructure management (see red highlights in Figure 1). Appendix B further demonstrates that effectively involving maintenance at all stages in the life of an asset is critical to effective life-cycle based infrastructure management; for example, maintenance should be a key consideration during: design; commissioning and handover; operations and maintenance; financial management; business practices and systems; and council/senior management involvement.

As such, appropriate, specified roles and responsibilities for maintenance should be allocated throughout an organization, and at all levels, to ensure that maintenance is fully integrated into life-cycle management and decision making.

For context, Table 1 (see red highlights) illustrates allocation of responsibility for maintenance among the typical, key organizational roles and responsibilities for infrastructure management. For smaller communities, an individual can perform one or more of these roles if they have the full range of skills and experience required. Where in-house staff need capacity building to achieve necessary skills, they can support their role in the short term with suitable contract staff or consultants.

Table 1
Infrastructure Management – Key Roles & Responsibilities

Manager:
Responsible to Council and FN Administration for all matters related to infrastructure management including: <ul style="list-style-type: none">• Liaison with Council, FN Administration, the Community and with internal and external agencies• Strategic/Business planning and management using a life-cycle approach that involves effective, planned maintenance• System master planning, including operations and maintenance planning• Project leadership and control, including appropriate consideration of maintenance in project implementation• Operations and maintenance leadership and management• Financial management using a life-cycle approach that involves effective, planned maintenance• Capacity building including staffing and staff development• Performance management and reporting
Qualifications & Key Skills:



- Skill and knowledge usually attained by successful completion of a post-secondary degree or diploma in Engineering, Building/Utilities Trades Certificate, or Business Administration; or an equivalent combination of skill, knowledge and experience.
- Sound knowledge and experience in:
 - Civil, mechanical and electrical systems design, construction and **maintenance**;
 - Contracting for infrastructure design, construction, operations and **maintenance**;
 - Development and implementation of project proposals
 - Project management;
 - Development and implementation of financial plans and budgets;
 - Effective time management;
 - Human resources, including hiring and staff supervision;
 - Program delivery in the context of First Nations culture and history.
- Effective communicator, both orally and in writing.
- Demonstrated superior team building skills, including ability to engage effectively with internal and external stakeholders.

O&M Superintendent e.g. Utilities; Buildings; Roads and Bridges:

Reporting to the Manager, responsible for **all aspects of infrastructure** Operations and **Maintenance** including:

- Hiring and staff supervision
- **O&M planning and management**
- **O&M input to project planning and implementation**
- Stores – materials, supplies, parts and tools
- Operations and **maintenance** safety planning and management – safety policy and monitoring
- Day to day asset management
- Development (with support from Finance) and **management of O&M budgets**
- Management of related contractors and consultants
- **O&M quality management**
- Monitoring and reporting on compliance with environmental and contractual standards
- **O&M performance assessment and reporting**

Qualifications & Key Skills:

- Skill and knowledge usually attained by successful completion of a post-secondary diploma in Engineering, Building/Utilities Trades Certificate; or an equivalent combination of skill, knowledge and experience.
- Sound knowledge and experience in:
 - Civil, mechanical and electrical systems design, construction and **maintenance**;
 - Contracting for operations and **maintenance**;
 - Development and implementation of financial plans and budgets **using a life-cycle approach that involves effective, planned maintenance**;
 - Effective time management;
 - Reading and interpreting drawings and specifications;
 - Human resources, including hiring and staff supervision;
 - Record keeping and reporting;
 - Program delivery in the context of First Nations culture and history.
- Effective communicator, both orally and in writing.
- Demonstrated superior team building skills, including ability to engage effectively with internal and external stakeholders.

Technical Specialist:

Reporting to the Manager and liaising with the O&M Superintendent, **responsible for technical matters related to** infrastructure planning, design, construction and **maintenance**, including:

- Technical support for asset management
- Master planning **using a life-cycle approach that involves effective, planned maintenance**
- Condition and capacity assessments
- Service life assessment based on life-cycle factors, **including maintenance**
- Failure assessment
- Capital planning
- **Optimizing efficiency/effectiveness – capital and O&M**
- Project identification and appraisal
- Developing multi-year financial projections – capital and O&M
- Infrastructure monitoring and assessment
- Project management
 - Supervision of engineering
 - **O&M input to project planning and implementation**
 - Contract preparation and management

- Construction management
- Project liaison
- Provides technical leadership and quality control for consultants and others involved in infrastructure management; ensures that their inputs are appropriately integrated and comply with relevant FN plans and standards.

Qualifications & Key Skills:

- Engineer or Applied Science Technologist.
- Sound knowledge and experience in:
 - Civil, mechanical and electrical systems design, construction and **maintenance**;
 - Contracting for infrastructure design, construction, operations and **maintenance**;
 - Development and implementation of project proposals;
 - Project management;
 - Development and implementation of financial plans and budgets;
 - Applications for funding;
 - Time management;
 - Record keeping and reporting;
 - Program delivery in the context of First Nations culture and history.
- Effective communicator, both orally and in writing.
- Demonstrated superior team building skills, including ability to engage effectively with internal and external stakeholders.

Operations/Maintenance Staff:

Reporting to the O&M Superintendent, **responsible for all matters related to hands-on infrastructure operations, maintenance and minor repairs.**

O&M staff will **work according to approved operations and maintenance plans**, including:

- Operating, maintaining and repairing infrastructure systems
- Adhering to health and safety requirements
- Adhering to WHMIS and other environmental requirements
- Procuring materials, equipment and supplies
- Coordinating with contractors
- Keeping appropriate records of plans and work activities – scope, schedule and cost
- Contributing to work plans and budgets
- Providing O&M input to infrastructure planning, design and construction
- Day to day O&M liaison with the Community

- Preparing necessary reports

Qualifications & Key Skills:

- Sound knowledge and experience in:
 - Civil, mechanical and electrical system operations and maintenance;
 - Working with trades and contractors;
 - Time management;
 - Record keeping;
 - Occupational health and safety;
 - Program delivery in the context of First Nations culture and history.
- Effective communicator, both orally and in writing.
- Good ability to read and interpret drawings and specifications.
- Good initiative – a self-starter – able to work effectively with minimal supervision.

4. Maintenance Management - Step by Step Approach

The following provides a step by step approach to developing and implementing effective maintenance management using the NmTC Library of Maintenance Practices. Figure 2 depicts the overall maintenance management cycle. Appendix C describes, in detail, the purpose, approach, inputs and outputs involved in each Step as well as some Tips and Tricks for carrying them out.



STEP 1

Step 1 – Develop Asset Inventory

Step 1.1 – Develop Inventory for Existing Assets

Step 1.2 – Add, Change, or Delete assets

STEP 2

Step 2 – Develop Maintenance Management Plan

Step 2.1 – Summarize Assets

Step 2.2 – Assemble Maintenance Work Orders

Step 2.3 – Assemble Drawings and Maintenance Manuals

Step 2.4 – Assemble Relevant Regulations, Policies, Procedures and Permits

Step 2.5 – Develop Maintenance Budget

Step 2.6 – Develop Maintenance Schedule

STEP 3

Step 3 - Implement Maintenance Management Plan

Step 3.1 – Secure Qualified Staff and Contractors

Step 3.2 – Adopt Necessary Policies and Procedures

Step 3.3 – Adopt Maintenance Budget

Step 3.4 – Implement Effective Information Management

Step 3.5 – Implement and Follow Up on Maintenance Work Orders

Step 3.6 – Update Maintenance Records

Step 3.7 – Report on Maintenance Management



5. Critical Success Factors

The following factors are critical to achieving best results from the MMP process set out in this User Manual:

- Use the CISP and MMP daily to manage infrastructure services, including maintenance.
- Proactively engage in the CISP and MMP processes to improve overall understanding of cause-effect relationships that arise from their decisions.
- Adequately resource all key infrastructure functions, including maintenance, to realize lower life-cycle costs.
- Consider requirements for maintenance at all stages in the life of an asset to realize lower life-cycle costs.
- The MMP process should integrate and enhance existing activities vs. creating additional work for staff and Administration.
- The MMP should be considered a “living” process. Service and infrastructure status, assumptions, priorities and work plans should be regularly adjusted based on new information and circumstances.
- Refine and continually improve MMPs through capacity building based on results and experience.
- Look to achieve early wins, thereby enhancing commitment to the MMP process and providing incentive for continued efforts.
- There is much to be gained through collaboration. This includes pursuing appropriate opportunities for partnerships, knowledge sharing and joint capacity building – such as participating in the NmTC Community of Practice.



APPENDIX A

Glossary of Infrastructure Service Delivery Terms

Term	Definition
Action	An individual project or program, which implements a strategy to realize a specific result.
Asset	<p>A combination of components that have value and enable services to be provided.</p> <ul style="list-style-type: none"> ▪ <i>Dynamic assets</i> have moving parts (e.g. pumps, generators). ▪ <i>Passive assets</i> have no moving parts (sewers, water mains).
Asset management	Activities (e.g. technical, financial, policy, regulatory etc.) that use resources to develop, operate and maintain infrastructure to achieve the highest possible life cycle returns (economic, environmental, and social).
Asset management plan	A plan for managing one or more assets over their life cycle.
As-Built plan	Also referred to as “As-Constructed” drawings, “Record Drawings” or “Red Line” drawings, this refers to post-construction plans depicting location, size, and configuration of actual works installed. Generally As-Built plans are developed with the assistance of post-construction survey pickup of key components.
Backlog	The cumulative value of work, at a point in time, which is required to restore all assets in the inventory to their required level of service.
Condition monitoring	Periodic measurement and recording of asset condition.
Condition assessment	Periodic interpretation and evaluation of condition monitoring information to determine the need for preventative or remedial action, and to determine the asset’s remaining service life at its intended level of service.
Critical assets	Assets for which the financial, business or service level consequences of failure are severe. Critical assets have a higher priority for action than non-critical assets.
Deferred maintenance	<p>Maintenance that is conducted after the planned, optimal schedule.</p> <p>Maintenance conducted beyond the optimal schedule will generally cost more and will generally cause reductions in service quality.</p>
Economic service life	The length of time during which an asset performs efficiently at its planned level (quality) of service. For example, the time period until the cost for maintenance and repairs exceeds the cost of replacement.
Life cycle cost	The cumulative cost of an asset (capital and O&M) over its service life.
Maintenance	All actions necessary to keep an asset performing at its required level of service, but excluding repairs, rehabilitation or renewal. Sample types of maintenance are:

	<p><i>Planned maintenance:</i> Falls into three categories:</p> <ul style="list-style-type: none"> ▪ <i>Periodic</i> – necessary to ensure reliability or sustain the design life of an asset ▪ <i>Predictive</i> – condition monitoring activities used to predict failure ▪ <i>Preventative</i> – maintenance that can be initiated without routine or continuous checking and is not condition-based (e.g. using information from maintenance manuals, etc.). <p><i>Unplanned maintenance:</i> generally involves repairs under unplanned or emergency conditions</p>
Maintenance plan	A plan that sets out the optimum policies, practices and schedules for asset maintenance.
Objective	The intended outcome/result of specific strategies and actions
Operation	The active process of using assets to deliver a service.
Performance measurement	Quantitative and/or qualitative assessment of actual performance in terms of specific objectives, targets, or standards.
Rehabilitation	Actions that restore the condition of an asset and extend its service life. Rehabilitation is generally an option to asset replacement. Examples include: machining of rotating surfaces, comprehensive replacement of parts, resurfacing roads, slip-lining sewers).
Repair	Actions that restore the operability of an asset after failure. Repairs may include replacement of selected parts but generally do not significantly extend the asset's service life.
Replacement	Renewal of an asset that has reached the end of its economic service life; renewal provides the same type and quality of service but can incorporate alternative, more efficient or effective technologies and approaches.
Replacement cost	The total cost (direct and indirect) for asset replacement.
Service Life	The length of time during which an asset performs at its planned level (quality) of service. This includes: planning, designing, commissioning, operating and maintaining, repairing, decommissioning or disposal. Service life can be measured as time, number of cycles, distance intervals, etc.
Strategy	An overall approach involving multiple actions to achieve a specific objective.

APPENDIX B

Good Infrastructure Management Practice – Life Cycle Approach

Good Infrastructure Management Practice – Life Cycle Approach
Design – establishes scope of asset; materials, equipment and construction specifications
<ul style="list-style-type: none"> ▪ Scope & capital cost of assets are based on lowest life cycle cost ▪ Capital budgets include sufficient funds for commissioning and handover, including training ▪ O&M approach and costs are identified as part of design ▪ O&M efficiency is a significant factor in design and construction approach ▪ O&M staff are actively involved in design and construction – their input is valued & acted on ▪ Sufficient O&M budget and the necessary source(s) of ongoing funds are established when a capital project is approved ▪ Sufficient O&M budget is confirmed to be affordable when a capital project is approved ▪ Design specifications & complexity are geared to capacity of O&M staff ▪ O&M capacity gaps are identified and addressed in parallel with design ▪ O&M capacity building plans, including training, are identified, costed and delivered as part of design ▪ Post project audits are conducted to identify and implement process/practice improvements
Commissioning & Handover – ensures that the asset complies with and works according to specifications; ensures that O&M staff are fully familiar with new assets and are trained accordingly
<ul style="list-style-type: none"> ▪ Assets are tested to ensure compliance with specifications ▪ Original Equipment Manufacturer’s (OEM) manuals are compiled and transferred to O&M ▪ Task based O&M plans are established, including task based budgets ▪ Necessary O&M funds are calculated, planned and approved to match life cycle requirements ▪ FN confirms source and ongoing affordability of the non-ISC funded portion of O&M costs ▪ Necessary tools are supplied ▪ Suitable parts inventory is supplied ▪ As-built drawings are supplied and communicated to O&M staff ▪ Sufficient training is provided to ensure that O&M staff are prepared ▪ Warranties are delivered and adequately communicated to O&M staff ▪ Key contacts (e.g. suppliers, contractors) are provided to O&M staff for warranty, parts and O&M support ▪ Necessary specialized plans are delivered/updated – e.g. emergency, confined space, health & safety
Operations & Maintenance
<ul style="list-style-type: none"> ▪ Sufficient, qualified staff are available

<ul style="list-style-type: none"> ▪ Asset records – contracts, specifications, as-builts – are readily accessible
<ul style="list-style-type: none"> ▪ A structured asset inventory is developed and kept up to date; assets are tagged according to the inventory numbering system
<ul style="list-style-type: none"> ▪ Up to date and accurate maintenance records are available
<ul style="list-style-type: none"> ▪ Maintenance records are used for O&M work planning
<ul style="list-style-type: none"> ▪ Safety management practices are comprehensive and up to date
<ul style="list-style-type: none"> ▪ Suitable, up to date emergency plans are in place
<ul style="list-style-type: none"> ▪ Adequate tools are readily available
<ul style="list-style-type: none"> ▪ Adequate parts are readily available
<ul style="list-style-type: none"> ▪ O&M staff know the budget for and how to purchase adequate parts
<ul style="list-style-type: none"> ▪ Adequate technical support is readily accessible
<ul style="list-style-type: none"> ▪ O&M staff have sufficient budget for and know how to access technical support
<ul style="list-style-type: none"> ▪ Adequate O&M mentoring is readily accessible
<ul style="list-style-type: none"> ▪ Asset records are regularly updated based on O&M interventions – e.g. repairs, new equipment settings, replacement components, etc.
<ul style="list-style-type: none"> ▪ Adequate building/yard/storage space is available for O&M
<ul style="list-style-type: none"> ▪ Asset condition is routinely assessed
<ul style="list-style-type: none"> ▪ O&M procedures and budgets are regularly adjusted to suit asset condition
<ul style="list-style-type: none"> ▪ Asset risk/failure analysis is routinely done
<ul style="list-style-type: none"> ▪ O&M procedures are adjusted according to results of risk/failure analysis
<ul style="list-style-type: none"> ▪ Identified ACRS Group 1 and Group 2 repairs are done in a timely manner
<ul style="list-style-type: none"> ▪ FNs address identified ACRS Group 3 upgrades
<ul style="list-style-type: none"> ▪ O&M performance is routinely assessed and reported vs. Key Performance Indicators (KPIs) and suitable benchmark Maintenance Practices
<ul style="list-style-type: none"> ▪ FN staff know the applicable O&M KPIs and how to measure and compare performance
<ul style="list-style-type: none"> ▪ Staff know how poor maintenance impacts service outcomes and costs
<ul style="list-style-type: none"> ▪ Suitable, up to date capacity building plans are in place and implemented
<ul style="list-style-type: none"> ▪ Incentives are in place to promote good O&M performance
<p>Financial Management</p>
<ul style="list-style-type: none"> ▪ Accurate, multi-year financial projections for O&M are developed and kept up to date
<ul style="list-style-type: none"> ▪ Sufficient funds are available to sustain effective O&M, long term
<ul style="list-style-type: none"> ▪ O&M staff are knowledgeable on the O&M budget
<ul style="list-style-type: none"> ▪ O&M staff participate in developing and monitoring the O&M budget
<ul style="list-style-type: none"> ▪ O&M staff are accountable for financial performance
<ul style="list-style-type: none"> ▪ FNs request and receive adequate ISC funding for Group 2 repairs
<ul style="list-style-type: none"> ▪ FNs engage technical input and request funding from ISC/FN Council for new capital projects

<ul style="list-style-type: none"> ▪ O&M activity based accounting is practiced
<ul style="list-style-type: none"> ▪ Finance provides timely information on financial performance
<ul style="list-style-type: none"> ▪ Financial records are useful and meaningful for O&M management
<ul style="list-style-type: none"> ▪ O&M costs are actively tracked and assessed for efficiency
<ul style="list-style-type: none"> ▪ O&M initiatives are business cased to ensure best value for money
<ul style="list-style-type: none"> ▪ At least quarterly variance assessment is reported; variances are proactively addressed
<p>Business Practices and Systems</p>
<ul style="list-style-type: none"> ▪ Suitable asset and O&M work planning/management systems are in place
<ul style="list-style-type: none"> ▪ Asset and O&M systems are actively used for work planning and record keeping
<ul style="list-style-type: none"> ▪ Asset, O&M and financial management systems are linked and aligned
<p>Council/Senior Management (SM) Involvement</p>
<ul style="list-style-type: none"> ▪ Council and SM know how poor maintenance impacts service outcomes and costs
<ul style="list-style-type: none"> ▪ Council and SM routinely monitor service quality in terms of KPIs
<ul style="list-style-type: none"> ▪ Staff routinely report to Council and SM on O&M performance and ACRS results (e.g. identified repairs and other recommended improvements); variances are proactively addressed
<ul style="list-style-type: none"> ▪ Council and SM establish O&M budgets by balancing (and trading off) service quality and costs

APPENDIX C

Preparing a Maintenance Management Plan (MMP) Step-by-Step Approach



[Note: This provides a high-level, step by step approach for preparing a MMP for all types of community infrastructure. For system specific details, readers should refer to relevant, companion “how to” documents for each system.]

Step 1 – Develop Asset Inventory

Step 1.1 Develop Inventory for Existing Assets

Purpose:

A comprehensive, up to date record of all infrastructure assets grouped by key asset type – e.g. water, sewer, buildings, roads, drainage

Approach:

The asset inventory is the backbone of the MMP. As such, compiling the asset inventory is the first step in developing the MMP.

For all Nation assets (ISC and non-ISC funded):

- List all relevant Nation asset groups – e.g. water, sewer & drainage systems; roads, bridges & street lights; community buildings;
- Establish a relevant asset coding structure that clearly differentiates asset groups and sub-groups; FN’s should establish a Nation specific coding structure that covers all assets (both ISC and non-ISC funded); it’s also helpful to cross reference Nation and ISC ICMS codes for specific assets to streamline interpretation of ICMS funding and ACRS reporting and to ensure that the maintenance of all ISC-funded assets is actually being funded by ISC;
- For each asset group
 - List asset sub-groups
 - For each asset sub-group, list key asset components

Table C 1.1 provides an example of this structure for water and wastewater systems.

Asset Group	Asset Sub-group	Asset Component
Water	Supply	Well
Water	Supply	Reservoir
Water	Supply	Mains
Water	Treatment	Chlorination Unit
Water	Distribution	Boost Station
Water	Distribution	PRV
Water	Distribution	Air Valve
Water	Distribution	Mains
Wastewater	Collection	Gravity Main

Wastewater	Collection	Forcemain
Wastewater	Collection	Lift Station
Wastewater	Treatment	Lagoon
Wastewater	Treatment	Sewage Treatment Plant
Wastewater	Treatment	Community Septic Tank
Wastewater	Treatment	Community Septic Field
Wastewater	Disposal	Sewage Outfall

- For each asset group, sub-group and asset component, record relevant data such as: asset code; asset description; asset type; year built; quantity (sq.m, length); material; construction cost; replacement cost; expected service life; condition; estimated remaining service life.

Asset inventories can range from basic to complex and should be continually refined as more information becomes available. They should also be routinely updated to incorporate changes to existing assets, new assets or deletion of assets.

Key asset information such as coding, quantities, construction costs, replacement costs and depreciation (accumulated and annual) should be the same as recorded in the Tangible Capital Asset inventory used by Finance for financial reporting. Any differences should be reconciled.

Inputs:

- “As built” construction records
- Asset Condition Reporting System (ACRS) reports
- ICMS records
- Field surveys and measurements
- Financial records, including budget
- Maintenance records
- Design briefs & specifications
- Tender documents
- Procurement records
- “As built” construction records
- Commissioning records, including operating manuals

Outputs:

- Comprehensive record of all FN infrastructure assets (both ISC and non-ISC funded) grouped by key asset group – e.g. water, sewer, buildings, roads, drainage;
- Key data on each asset including:
 - Asset description & location
 - Asset code – based on overall, FN specific asset management numbering/coding structure (and ICMS code, if applicable)
 - Asset type
 - Quantity – e.g. size, area, length, volume
 - Construction date
 - Age
 - Condition
 - Estimated service life
 - Estimated construction cost
 - Current replacement cost
- Information for Tangible Capital Asset reporting.

Tips and Tricks:

- A unique Nation asset code should be created for each asset based on location, type, size and material. ISC ICMS asset codes are not well suited to effective asset management - for example, ISC codes typically reflect a “project”, which includes multiple assets and asset types; also, ISC codes only apply to ISC funded assets and link primarily to ISC vs. FN information systems and procedures.
- If as-constructed drawings for assets are not available through First Nation records, they can often be obtained through ISC (for ISC registered assets) and sometimes through the engineering firm that designed the asset.
- Where asset information is lacking, document gaps and their implications for the MMP; where necessary (e.g. replacement cost), make assumptions and state them clearly.
- Where the condition of assets is unknown, make assumptions and clearly state them and their implications for the MMP; recommend implementing appropriate condition assessments to confirm status.
- Where practical, identify the different service lives and costs for key asset components – e.g. surface, base and sub-base of roads; mechanical, electrical and civil components of treatment plants; various building components and systems.

Step 1.2 Add, Change or Delete Assets

Purpose:

- *Update the Asset Inventory to include new assets, changes to existing assets and/or decommissioning of existing assets.*
- *Applies to all Nation assets (ISC and non-ISC funded).*

Approach:

- New Assets – include details on the new asset in the Asset Inventory according to normal conventions for Inventory content and format – see Step 1.1;
- Modified Assets – update Asset Inventory information to record changes/modifications to existing assets;
- Decommissioned Assets
 - Delete Inventory data for assets that are decommissioned;
 - Keep separate record of all decommissioned assets with details on decommissioning – e.g. were assets removed or left in place;
 - Consider status of any applicable rights-of-way or other obligations related to decommissioned assets – e.g. release ROWs that are not longer required.

Inputs:

- As built” construction records
- Asset Condition Reporting System (ACRS) reports
- ICMS records
- Field surveys and measurements
- Financial records, including budget
- Maintenance records
- Design briefs & specifications
- Tender documents
- Procurement records
- Commissioning records, including operating manuals and tenure records

Outputs:

- Up-to-date Asset Inventory

Tips and Tricks:

- Make timely changes to Asset Inventory records – an accurate, up-to-date Asset Inventory is key to effective maintenance and financial management.
- Make timely changes to asset “as-built” records, including record drawings – incorrect asset information represents a serious operational, safety and financial risk.

Step 2 – Develop Maintenance Management Plan

Step 2.1 Summarise Assets

Purpose:

- *Foster a clear understanding of:*
 - *Individual assets and how they should perform*
 - *How individual assets fit within an overall system and how that system should perform*

Approach:

For each infrastructure system – e.g. water system, sewer system, road system – develop an overview description including:

- System scope – area served, asset types, asset sizes, materials, key components (e.g. # of manholes and valves) and other relevant, high-level details
- System performance - high-level details on how the system should perform, key performance issues and constraints and other information relevant to managing the system and to assessing current vs. design performance
- Key risks and risk mitigation strategies
- Key assets and how they contribute to overall system functions and performance

Inputs:

- Design briefs & specifications
- Tender documents
- Procurement records
- “As built” construction records
- Commissioning records
- Original equipment specifications and operating manuals
- Manufacturer and supplier recommendations
- Field surveys and measurements
- Asset Condition Reporting System (ACRS) reports
- NmTC Library of Maintenance Practices

Outputs:

- A high-level description of each infrastructure system that clearly explains its scope, how it should perform, key operating parameters, key risks and mitigation strategies and other information relevant to managing the system and to assessing current vs. design performance.

Tips and Tricks:

- Take the time and involve all key people (staff, planners, designers, contractors, operators, regulators, etc.) needed to accurately develop this overview and, once developed, communicate it among all relevant parties; having clarity and a common understanding on each system promotes efficiency, reduces errors, reduces response times and costs and reduces risks.

Step 2.2 Assemble Maintenance Work Orders

Purpose:

- *Develop an effective, task-based workplan for maintaining all infrastructure assets.*

Approach:

Work orders set out details on the scope and working methods for specific maintenance tasks. When used regularly, work orders can be a useful tool for planning and tracking maintenance costs and for generating evidence-based budgets. Figure C 2.2 is a sample work order for context.

FN LOGO

WORK ORDER S01

ASSET	Administration Building / Community Sanitary Main	ORDER DATE	DD/MM/YYYY
ASSET GROUP	BUILDINGS / SANITARY	PO#	N/A or ###
ASSET SUBGROUP	Structure / Sanitary Mains	START DATE	END DATE
ASSET COMPONENT	Roof / Manholes	DD/MM/YYYY	DD/MM/YYYY
COMPONENT CATEGORY	2-Ply SBS Membrane		
ORDER RECEIVED BY			
KEY CONTACTS			
ASSET DESCRIPTION			
WORK LOCATION	XX#1		
WORK DESCRIPTION	Annual inspection of sanitary main, manhole and sewer flow		
TYPICAL OPERATING CONDITION			
COMMUNICATIONS REQUIRED	<input type="checkbox"/> Inform Homeowners <input type="checkbox"/> Inform Agencies <input type="checkbox"/> Inform Staff		
EQUIPMENT REQUIRED	PPE, Maintenance Truck, Traffic Cones, Safety Harness, Spotlight, Mirrors		
MATERIALS REQUIRED	Yellow Epoxy Paint, Cement/Grout		
LABOR DESCRIPTION	HOURS	RATE	AMOUNT
Maintenance Supervisor			\$ -
Maintenance Assistant			\$ -
Truck			\$ -
Contractor			\$ -
Equipment			\$ -
Parts + Materials			\$ -
LABOR TOTAL			\$ -
REFERENCE DOCUMENTS			
<input type="checkbox"/> (Applicable Drawings) <input type="checkbox"/> (Worksafe and Health & Safety Regulations) <input type="checkbox"/> (Warranty)			



Each Work Order typically includes:

- Details on the asset to be worked on, including: asset name and code; asset location; and a general description of work to be done;
- The work schedule;
- The safe number of persons required, and the equipment, tools and materials needed;
- Communications procedures – who to contact before, during and after the work;
- Step by step, simple instructions on how to carry out routine and special maintenance tasks;
- Estimated person-hours and costs for each task;
- Contracted services required, if any;
- Safety measures required to complete the task.

A Maintenance Management Plan is a compilation of multiple work orders: one for each maintenance activity – e.g. pump station inspections; manhole task.

To get First Nations started, Naut'sa mawt (NmTC) has established a Library of benchmark work orders that include typical details on scope, procedures, cost and schedule. The Library contains many work orders, only some of which will be relevant to a particular First Nation.

NmTC has also established detailed User Manuals to guide FNs in preparing MMPs for specific types of Community Infrastructure; User Manuals are already available for Water and Sewer Systems and for Community Buildings. Over time, NmTC plans to add Manuals for other infrastructure types.

Based on their asset inventory, and following the relevant NmTC User Manual, First Nations can assemble MMPs that are specific to their local needs by extracting relevant, benchmark work orders from the NmTC Library of Maintenance Practices. Essentially, Nations should select and compile in their MMP, relevant work orders from the Library and adjust them, if necessary, to suit their specific needs.

Where a necessary work order is not already included in the Library, the Nation should develop such practice using the benchmark template/approach. Once developed, the Nation should contribute the new work order to expand the NmTC Library. In that way, the Library is an evolving body of relevant maintenance management knowledge that is continuously refined and expanded over time based on needs and experience.

Inputs:

- Relevant NmTC User Manual for preparing MMPs;
- FN asset inventory;
- NmTC Library of Maintenance Practices;
- Design briefs & specifications
- Tender documents
- Procurement records
- "As built" construction records
- Field surveys and measurements
- FN health & safety plan and procedures;
- Asset commissioning records;
- Relevant original equipment specifications and operating manuals;
- Relevant manufacturer and supplier recommendations;
- Unit costs for labour, equipment and materials;

Outputs:

- MMP, incorporating a compilation of relevant work orders;
- (Potentially) new work orders for inclusion in the NmTC Library of Maintenance Practices

Tips and Tricks:

- When preparing or updating their MMPs, FNs should tap into the body of knowledge already available through the NmTC Community of Practice;
- NmTC benchmark work orders represent a good starting point for FNs with limited resources; they streamline the process and cost of preparing and implementing MMPs. FNs can expand and/or refine their MMPs and work orders based on experience gained over time;
- Where necessary information is lacking, document gaps and their implications for the MMP and specific work orders. Where necessary, make assumptions and state them clearly; refine assumptions over time based on operating experience.

Step 2.3 Assemble Drawings and Maintenance Manuals

Purpose:

- *Foster a clear understanding of:*
 - *Individual assets and how they should perform*
 - *How individual assets fit within an overall system and how that system should perform*

Approach:

For each infrastructure system – e.g. water system, sewer system, road system – develop an overview description including:

- System scope – area served, asset types, asset sizes, materials, key components (e.g. # of manholes and valves) and other relevant, high-level details
- System performance - high-level details on how the system should perform, key performance issues and constraints and other information relevant to managing the system and to assessing current vs. design performance
- Key risks and risk mitigation strategies
- Key assets and how they contribute to overall system functions and performance

Inputs:

- Design briefs & specifications
- Tender documents
- Procurement records
- “As built” construction records
- Commissioning records
- Original equipment specifications and operating manuals
- Manufacturer and supplier recommendations
- Field surveys and measurements
- Asset Condition Reporting System (ACRS) reports
- NmTC Library of Maintenance Practices

Outputs:

- A high-level description of each infrastructure system that clearly explains its scope, how it should perform, key operating parameters, key risks and mitigation strategies and other information relevant to managing the system and to assessing current vs. design performance.

Tips and Tricks:

- Take the time and involve all key people (staff, planners, designers, contractors, operators, regulators, etc.) needed to accurately develop this overview and, once developed, communicate it among all relevant parties; having clarity and a common understanding on each system promotes efficiency, reduces errors, reduces response times and costs and reduces risks.

Step 2.4 Assemble Relevant Regulations, Policies, Procedures & Permits

Purpose:

- *Identify all relevant regulatory and policy requirements that apply to maintenance management*

Approach:

- Assemble and review all relevant regulations, policies, procedures & permits that apply to asset maintenance;
- Identify and follow up on issues and gaps to clarify requirements and how they apply to maintenance (e.g. scope of maintenance required and how to carry it out);
- Include pertinent information in relevant work orders, including sources of documents and how requirements impact maintenance scope and methods;
- Develop, and keep up to date, a comprehensive list of relevant key contacts – an important tool for addressing operating and maintenance issues when they arise;
- List all relevant information, and how to access it, in the MMP and relevant work orders;
- List all key contacts in the MMP and relevant work orders for easy reference;
- Develop and apply key performance indicators (KPIs) as part of the MMP to ensure compliance with regulations, policies, procedures & permits.

Inputs:

Regulations, policies, procedures & permits are typically set by FNs (internal requirements) and external agencies such as ISC and the federal, provincial and municipal governments; for example:

- FN financial administration laws and procedures/
- FN human resources policy and procedures
- FN archaeological requirements
- FN communication policy
- Drinking water quality requirements
- Building and sewage discharge permits
- Air quality permits
- Design and construction codes and standards
- Procurement policy and procedures
- Health and Safety requirements, including Worksafe B.C.
- Environmental standards
- Fisheries regulations
- Hazardous goods regulations, including WHMIS

Outputs:

- Details on regulatory and policy requirements that apply to maintenance management and their implications for maintenance methods, staffing and costs.

Tips and Tricks:

- When preparing or updating MMPs, FNs should tap into the body of knowledge already available through the NmTC Community of Practice;
- Consultant design briefs and procurement documents can be a good source of applicable regulations and permits.

Step 2.5 Develop Maintenance Budget

Purpose:

- *To confirm the amount of funds required to implement effective maintenance according to the adopted Maintenance Management Plan*
- *To confirm revenue sources and amounts*

Approach:

The Annual Budget is an estimate of labour and other expenses, and related revenues, for scheduled annual maintenance tasks as follows:

- For each infrastructure system (e.g. water, sewer, drainage, roads and buildings):
 - Estimate costs for carrying out each work order - labour hours, labour costs (including benefits) and other expenses (equipment, materials, supplies, contractors, permits, energy, etc.)
 - Develop the total maintenance budget for each system by totalling costs for all work orders
- Develop the combined maintenance budget for all systems by totalling costs for all infrastructure systems (e.g. water + sewer + drainage + roads + buildings)
- Develop budget for maintenance administration including:
 - Relevant central costs allocated to maintenance – e.g. HR, finance, legal and information management
 - Costs allocated for managing the maintenance program – e.g. a proportion of costs for the Public Works Director and Administrative Assistant; travel and training; insurance; office equipment and supplies; and telephones
 - Costs for contractors and consultants to assist on technical issues and/or studies related to maintenance
- Develop total maintenance budget = combined maintenance budget for all systems PLUS budget for maintenance administration – i.e. the total of items (b) and (c) above
- Develop revenue sources and amounts to cover all costs, including, for example:
 - ISC contributions through MTSA's and ICMS
 - User fees
 - Contributions from property taxation
 - Contributions from the Nation's housing program
 - Subsidies from the Nation's internal funds

Inputs:

- Prior year's budget, actual costs and revenues
- Current local costs, including for labour, equipment, materials, supplies, contractors, etc.
- Current work orders for all maintenance tasks for all infrastructure systems – including estimated labour hours, labour costs and all other expenses related to each work order
- Current policy and amounts for allocated administration costs – item (c) above
- MTSA agreements (if any)
- ISC ICMS contributions
- Other relevant ISC funding agreements
- User fee agreements

Outputs:

- Annual budget – revenues and costs – for each infrastructure system and for all infrastructure systems combined

Tips and Tricks:

- When preparing or updating MMPs and budgets, FNs should tap into the body of knowledge already available through the NmTC Community of Practice;
- NmTC benchmark work orders represent a good starting point for FNs with limited resources; estimates of labour hours and costs in the benchmarks represent good-practice experience combined with typical costs for Vancouver Island; FNs can start with these and refine them over time based on actual experience;
- Where necessary budget information is lacking, document gaps and their implications for the MMP, specific work orders, and the budget. Where necessary, make assumptions and state them clearly; refine assumptions over time based on operating experience.
- FNs should seriously consider using “full-cost-accounting” practice whereby all relevant costs and revenues related to maintenance are booked to the maintenance budget - including “indirect” costs such as HR, Finance, IT, Legal and central administration that often budget and fund separately. Full-cost-accounting ensures that all relevant costs are included when negotiating revenues, including funding agreements, subsidies and users fees.
- FNs should budget and account for revenues and expenditures by specific infrastructure system and, within each system, by key maintenance category or task; only then can the Nation reasonably know the true cost of maintenance and the amount, if any, of gaps in maintenance funding.

Step 2.6 Develop Maintenance Schedule

Purpose:

- *Establish a formal schedule of maintenance activities according to the adopted Maintenance Management Plan and to availability of staff and other necessary resources.*

Approach:

The Annual Maintenance Schedule is a calendar of routine, scheduled maintenance tasks involved in maintaining all community infrastructure assets. Fundamentally, each work order is recorded on the calendar according to its frequency – daily, weekly, monthly, quarterly, annually.

Steps in developing the schedule include:

- Assemble all work orders by infrastructure system – water, sewer, drainage, roads, buildings
- Review all work orders and identify task frequency and labour hours required for each task
- List and map all work orders onto the calendar according to task frequency - daily, weekly, monthly, quarterly, annually – record labour hours for each task on the calendar
- “Tune” schedule to balance, to the extent practical, labour hours with available staff throughout the schedule – if more hours are required in a week than staff are available then move some tasks forward or back to fit available staff hours:
 - Determine total labour hours for each week for all tasks allocated to that week – totals for each of 52 weeks
 - For each week, divide total labour hours by the average hours per day per staff member to determine number of staff required for that week – compare to number of available staff
 - If required hours are greater than available staff move some tasks forward or back – note that some tasks are seasonally dependent
 - Repeat (i) to (iii) until hours and available staff are reasonably balanced
 - Identify scope and timing of any staffing issues and gaps
- Address staffing issues and gaps – e.g. allocate overtime, hire contractors, hire additional staff, train staff
- Monitor and refine schedule monthly
 - Monitor actual hours worked vs. planned hours according to the schedule
 - Repeat steps (i) to (v) in (d), above, each month for remaining tasks to be done through the balance of the year
 - Where tasks take longer or shorter than planned, consider updating estimated labour hours in applicable work orders – e.g. if experience shows that the work will consistently take more or less hours than planned, change the work order estimates
- At least annually:

- Assess overall staffing requirements – number and type of staff, skill levels, productivity, availability of qualified contractors, etc,
- Update staffing plans – mix of in-house staff vs. contractors and number of staff to match requirements
- Develop and implement capacity building programs, including training, to improve staff skills and performance

Inputs:

- Current work orders for all maintenance tasks, including task frequency and labour hours required for each task
- Seasonal requirements for maintenance – some work can only be done at certain times of the year
- Relevant FN HR policies and job descriptions
- Available labour hours for staff
- List of qualified, available contractors

Outputs:

- Comprehensive work schedule that provides for conducting all work orders, when required, and that balances workload with available, qualified resources (staff and contractors)

Tips and Tricks:

- Start simply and make assumptions. It'll take some time to master the approach and to fine tune estimated vs. required labour hours
- Spreadsheets and other software tools can streamline the scheduling process
- Available labour hours for staff = annual paid hours less vacation, statutory holidays, average sick days, training days and other non-“hands on” work time – for context, only 80% to 85% of paid hours are typically available for “hands on” maintenance
- Always allow sufficient time in the schedule to follow up on regular work orders – e.g. where routine maintenance identifies repairs or replacements to be done that are not already in the schedule

Step 3 – Implement Maintenance Management Plan

STEP 3

Step 3.1 Secure Qualified Staff & Contractors

Purpose:

- *Secure sufficient, qualified staff and contractors to implement the adopted Maintenance Management Plan according to the adopted Schedule.*

Approach:

Effective maintenance requires an appropriate combination of skilled and semi-skilled labour. For example, some electrical and mechanical tasks must be done by qualified trades; water systems and sewage treatment systems require operators that are qualified under the Environmental Operators Certification Program (EOCP); Worksafe B.C. requires that staff be qualified for confined space entry.

The approach to securing qualified staff and contractors generally involves:

- Review each work order and determine the skills and qualifications required to perform each task;
- Accumulate labour hours for each skill category;
- For work to be done by in-house FN staff:
 - Determine if the FN has sufficient staff with the right skills to do necessary work when required - identify and quantify gaps in available skills and staff hours
 - Decide if skill gaps can be sufficiently addressed by skill development and formal training; also, can skill development occur in time to suit the maintenance schedule;
 - if yes to both, proceed with skill development
 - If yes, but not in sufficient time, proceed with skill development for future work; in the meantime, issue short term contracts
 - If no to both, include scope in work to be contracted out
- For work to be done by contractors:
 - Where practical, package work to be contracted-out according to key skill requirements - e.g. qualified mechanic, electrician or plumber; EOCP certified operator; general labour (semi-skilled); labourer (unskilled);
 - Prepare scope and terms of reference for each package to be contracted out - each package should have a clear, well defined scope of work and specifics on the Nation's expectations in terms of skills, qualifications and work procedures;
 - Secure and evaluate proposals from qualified contractors; ask for and contact relevant references;
 - Award work to the preferred, qualified contractor.

Inputs:

- Maintenance work orders;
- Relevant regulations, policies, procedures & permits that apply to skills and qualifications for asset maintenance;
- FN HR policy and requirements;
- FN records on staffing – skills, working hours, relevant job descriptions;
- List of qualified contractors for typical maintenance work.

Outputs:

- A team of sufficient, qualified staff and contractors to implement the adopted Maintenance Management Plan according to the adopted Schedule.

Tips and Tricks:

- When reviewing work orders, apply consistent skill categories and accumulate labour hours for each category – e.g. qualified mechanic, electrician or plumber; EOCP certified operator; general labour (semi-skilled); labourer (unskilled) – this will make it easier to determine internal staffing and to issue contracts for packages of work, thereby saving time and reducing costs;
- Available labour hours for staff = annual paid hours less vacation, statutory holidays, average sick days, training days and other non-“hands on” work time – for context, only 80% to 85% of paid hours are typically available for “hands on” maintenance;
- The lowest cost contractor is not necessarily the best contractor – FN's should consider a variety of factors including quality of work, efficiency, ability to “get along” with staff and community members and communication skills;
- Where appropriate, long term relationships with contractors can improve efficiency through accumulated knowledge of the FN and its systems; “known faces” can also streamline interactions with residents and businesses.

Step 3.2 Adopt Necessary Policies & Procedures

Purpose:

- *Put policies and procedures in place to enable effective implementation of the adopted Maintenance Management Plan and Schedule.*
- *Promote clarity, consistency and transparency on maintenance management roles, responsibilities, plans and activities.*

Approach:

The Community Infrastructure Services Planning (CISP) process is geared to integrating all aspects of infrastructure management, including identifying necessary policies and procedures – e.g. technical, financial and operational. In particular, the CISP is geared to achieving the lowest life-cycle cost for asset management; effective maintenance is key to that process.

As such, establishing appropriate policies and procedures for maintenance should be considered as an integral part of the overall process to ensure that requirements for maintenance are appropriately considered with other aspects of asset management. For example, policies could include:

- Decision making – e.g. what decisions can be made directly by operations staff vs. seeking approval from management
- Amount of work to be done in-house vs. by contractors
- What to include in the maintenance vs. capital budgets – normally an expenditure limit (e.g. anything over \$5,000 would be in the capital vs. maintenance budget)
- Procurement policies – e.g. purchasing limits for operations vs. management staff
- Service life assumptions for assets and asset components

To that end:

- Review all work orders, related tasks and procedures – identify policy guidance, if any, required from FN leadership;
- Through discussions with FN leadership. determine if there is already relevant, existing policy:
 - If so, reference it in the MMP and relevant work orders and apply it to work procedures;
 - If not, agree the process (who, what and when) to develop and apply appropriate policies;
 - Agree how to handle policy requirements in the short term while appropriate policy is developed.

Inputs:

- MMPs and maintenance work orders;
- Relevant existing regulations, policies, procedures & permits that apply to asset maintenance;
- Current FN CISP

Outputs:

- Relevant policies and procedures that apply to all maintenance work.

Tips and Tricks:

- Appropriate policies and procedures can improve clarity and consistency among stakeholders (leadership, staff, contractors, residents); they can also reduce conflict and costs by avoiding misunderstandings and confusion;
- FNs should have an appropriate Asset Management Policy that covers all aspects of infrastructure management, including maintenance – a sample Policy is available in the NmTC Community of Practice Toolkit.

Step 3.3 Adopt Maintenance Budget

Purpose:

- *Establish necessary revenues and expenditures to implement the adopted Maintenance Management Plan.*

Approach:

Step 2.5 describes how to prepare the draft annual maintenance budget. Once developed, the Nation must submit the draft to its normal process for budget approval – typically as set out in the Nation's Finance Administration Law (FAL). Such process usually involves input by appropriate FN Council Committees, FN Council and FN members.

The budget process usually involves:

- Submitting the draft maintenance budget for consideration by Council and Committees
- Adjusting the draft budget according to Council and Committee direction, including:
 - Budget increases or reductions to address requests for expanded or reduced scope of work;
 - Budget adjustments to accommodate Nation-wide financial requirements – e.g. reduced revenues expected; re-allocation of funds to programs of higher priority
- Approval of the adjusted scope of work and budget, including any adjustments to staffing and related resources

Inputs:

- FN Finance Administration Law (FAL) and related FN budget policies and procedures
- Draft maintenance budget – see Step 2.5
- Relevant regulations, policies, procedures & permits that apply to asset maintenance;
- Prior year's budget, actual costs and revenues
- MTSA agreements (if any)
- Other funding agreements
- User fee agreements

Outputs:

- Approved maintenance budget
- Approved scope of maintenance to be carried out during the fiscal year

Tips and Tricks:

- Be specific when communicating the impact of requested budget adjustments. For example, if Council requests a 5% reduction, specify the work that won't get done if that reduction is approved and the impact on overall infrastructure performance and costs – for example, reduced maintenance leads to increased wear and tear and higher costs for breakdowns vs. planned maintenance.
- Be sure to get approval for any staff adjustments at the time of budget approval – don't get caught with either too many or too few staff to do the approved work;
- Be clear with Council that, just because the current year budget wasn't fully spent, it doesn't mean that next year's budget should be any less – for example, while typical maintenance budgets are based on estimates, actual requirements can vary from year to year due to weather, staffing issues and availability of parts – when submitting the draft budget, be clear and specific on any current year budget variances and their impact on next year's budget.
- Adjust all relevant work orders – scope and schedule – according to the approved budget. For example, due to budget reductions, inspections may have to be done annually vs. monthly; some maintenance work may have to be deferred to future years.
- Monitor and report on infrastructure performance – operational and cost; in particular, highlight any changes in performance arising from budget increases or reductions such that Council becomes aware of the cause-effect of budget decisions.

Step 3.4 Implement Effective Information Management

Purpose:

- *Implement effective systems and practices for recording and managing asset and maintenance information.*
- *Promote effective implementation of maintenance work orders and follow up.*
- *Enable effective links between maintenance and related asset management and financial management activities – e.g. capital planning and tangible capital asset reporting.*

Approach:

The Community Infrastructure Services Planning (CISP) process integrates requirements for information management processes and systems to support the technical, financial and operational aspects of asset management. As such, establishing appropriate information management for maintenance should be an integral part of the overall process to ensure that all requirements are appropriately considered.

On this basis, the approach for information management usually involves:

- Establishing an information “needs assessment” - review the MMP and related work orders to identify and document information needs, including the type and format of information required for developing and implementing: MMPs and work orders; the asset inventory; asset and maintenance records; the maintenance budget; compliance reporting; and maintenance reporting;
- Engaging FN leadership to address information needs for maintenance as part of integrated information management systems – pro-actively participate in planning and design discussions to ensure that maintenance needs are appropriately met;
- “Piloting” information management processes and systems and providing input on required adjustments to achieve efficient and effective results;
- Actively applying information management processes and systems at full scale to ongoing maintenance; identifying, through operating experience, issues and gaps to be addresses through system refinements; pro-actively participating in the ongoing process for refining and improving information management.

Inputs:

- Current MMP and work orders for all maintenance tasks for all infrastructure systems
- Current FN CISP
- Relevant regulations, policies, procedures & permits that apply to asset maintenance, including FN policies for HR, payroll, accounting and information management (e.g. archive requirements)
- FN Finance Administration Law (FAL) and related FN financial policies and procedures
- MTSA agreements (if any)
- Other ISC funding agreements
- User fee agreements
- "As built" construction records
- Asset Condition Reporting System (ACRS) reports
- ICMS records
- Field surveys and measurements
- Financial records, including budget
- Maintenance records
- Design briefs & specifications
- Tender documents
- Procurement records
- "As built" construction records
- Commissioning records, including operating manuals

Outputs:

- Effective information management systems and practices for managing maintenance
- Effective links between maintenance and related asset management and financial management activities

Tips and Tricks:

- Take the time needed to develop and implement effective information management, including involving all key people (FN leadership, staff from all relevant FN departments, contractors, operators, etc) to ensure that the systems work well for all affected parties
- Accurately document information management policies and procedures and, once developed, communicate them to all relevant parties; provide necessary training; having clarity and a common understanding on information management promotes efficiency and reduces errors, response times, costs and risks.

Step 3.5 Implement and Follow Up on Maintenance Work Orders

Purpose:

- *Implement the adopted Maintenance Management Plan and Schedule through a formal, priority based work order system and procedures.*
- *Establish formal procedures for following up on issues identified through execution of maintenance work orders.*

Approach:

Implementing the MMP through work orders is a continuous cycle of planning the work, doing the work and then updating work programs and plans based on the results of doing the work as follows:

- Plan for and organize maintenance work:
 - Review all work orders to be done in the upcoming period – say 1 week or 1 month – identify necessary resources including labour, equipment, materials, contractors and external agency (e.g. Hydro, Tel) inputs
 - Contact and organize necessary resources according to the adopted maintenance schedule; confirm availability, costs and delivery times for materials
 - If resources are available on time and on budget, proceed with maintenance as planned
 - If resources are not available on time, adjust maintenance schedule by re-arranging and proceeding with maintenance tasks accordingly – see Step 2.6
 - If resources cost more than budgeted, adjust work scope and priorities, as needed, to keep overall maintenance program within budget – or, request additional funds – see Step 2.5; proceed with maintenance tasks accordingly;
- Perform maintenance according to work orders and schedule:
 - Conduct maintenance according to procedures and methods in the work orders
 - Submit completed work orders to the maintenance planning and records system; each completed work order should:
 - Document and scope any issues for follow up – e.g. pump needs to be replaced; cracks need to be sealed; motors need major, non-routine servicing
 - Document and scope any variances between planned and actual labour hours, materials or other resources required for routine maintenance as set out in the work order
 - Document any other issues for follow up

- Update maintenance plan and schedule
 - Routinely – say each week or each month – review all completed work orders and identify follow up such as:
 - Update routine labour hours, skills and other resource requirements to reflect experience from executing work orders – see Step 2.2
 - Scope and document requirements for follow up on issues identified while executing work orders, as documented on completed work orders, including: parts replacement; maintenance and replacements not covered by the regular maintenance program; follow up studies to assess issues and recommend solutions
 - Refine the budget and work priorities to reflect experience in executing work orders and to accommodate scope and cost of following up on work orders – see Step 2.5
 - Update the maintenance schedule (see Step 2.6) to:
 - Reflect additional or less time required for routine maintenance tasks as identified on completed work orders
 - Provide time to follow up on work identified on completed work orders
 - Routinely adjust work orders to reflect changes in regulations and standards – e.g. updated health and safety requirements; updated permit or regulatory requirements
 - Routinely add, delete or amend work orders to reflect asset additions, deletions and changes.
 - At least annually, review and update the entire maintenance program including adjustments to: work orders, schedule, budget, staffing and other resource requirements; address such updating in following year's maintenance budget.

Inputs:

- Current MMP and work orders for all maintenance tasks, including task frequency and labour hours required for each task
- Seasonal requirements for maintenance – some work can only be done at certain times of the year
- Relevant regulations, policies, procedures & permits that apply to maintenance;
- Maintenance records
- Budget and financial records
- Relevant FN HR policies and job descriptions
- Available labour hours for staff
- List of qualified, available contractors

Outputs:

- Completion of maintenance according to approved plans and budgets
- Identification of issues for follow up
- Recommendations for future budgets and capital plans

Tips and Tricks:

- Take time to plan maintenance and to organize materials, supplies and contractors; lack of availability, long lead times and or conflicting schedules can increase costs and service disruptions significantly;
- Be sure to record follow up issues in the maintenance plan and to appropriately plan and execute follow up work to ensure that systems operate reliably;
- When preparing or updating MMPs, FNs should tap into the body of knowledge already available through the NmTC Community of Practice;
- Start simply and make assumptions. It'll take some time to master the approach to maintenance planning and scheduling and to fine tune estimated vs. required labour hours
- Spreadsheets and other software tools can streamline maintenance planning and scheduling
- When reviewing work orders, apply consistent skill categories and accumulate labour hours for each category – e.g. EOCP certified operator; general labour (semi-skilled); labourer (unskilled) – this will make it easier to determine internal staffing and to issue contracts for packages of work, thereby reducing costs;
- Available labour hours for staff = annual paid hours less vacation, statutory holidays, average sick days, training days and other non-“hands on” work time – for context, only 80% to 85% of paid hours are typically available for “hands on” maintenance;
- Always allow sufficient time in the maintenance schedule to follow up on regular work orders – e.g. where routine maintenance identifies repairs or replacements to be done that are not already in the schedule. Use maintenance history to estimate time allocation; otherwise, assume a percentage of total available time (e.g. 20%) and allocate it to follow up; allocate other resources accordingly; refine assumptions based on experience over ..

Step 3.6 Update Maintenance Records

Purpose:

- *Establish and sustain an accurate, up-to-date record of all maintenance practices and findings.*

Approach:

The form and content of:

- The Asset Inventory, including asset additions, changes and deletions, is established through Step 1.0
- Maintenance records are established as part of developing overall information management processes and systems – see Step 3.4 – including requirements for “As built” construction records and reports.
- Work orders are established through Step 2.2.

On this basis, the updating process usually involves:

- Reviewing completed work orders to identify and document necessary changes, if any, to maintenance plans and records including: the Asset Inventory, record drawings, work orders and other relevant documents that record details of infrastructure assets and how they work
- Submitting details on necessary updates to an individual(s) authorized to execute the updates
- Recording that the updates have been executed – what, when, how and by whom
- Ensuring that all prior records are handled according to the FN's document handling policy – for example, destroying unnecessary documents, archiving documents and recording that documents have been superseded and referencing the up-to-date version; in any event, the document management process should ensure clarity on current status.

Inputs:

- Current MMP and work orders for all maintenance tasks for all infrastructure systems
- Current FN CISP
- Relevant regulations, policies, procedures & permits that apply to asset maintenance, including FN policies for HR, payroll, accounting and information management
- FN Finance Administration Law (FAL) and related FN financial policies and procedures
- MTSA agreements (if any)
- Other ISC funding agreements
- User fee agreements
- "As built" construction records
- Asset Condition Reporting System (ACRS) reports
- ICMS records
- Field surveys and measurements
- Financial records, including budget
- Maintenance records
- Design briefs & specifications
- Tender documents
- Procurement records
- "As built" construction records
- Commissioning records, including operating manuals

Outputs:

- Up to date records on all aspects of assets and their maintenance

Tips and Tricks:

- This is truly a “garbage in, garbage out” situation – records are only truly valuable if they can be trusted as accurate;
- Much energy, time and money is spent unnecessarily as a result of faulty records;
- Conflicts and confusion also arise as a result of faulty records, thereby undermining relationships
- The importance of updating records should be enshrined in the FN's organizational culture. FNs should allocate sufficient time, resources and checks and balances to ensure that records are up to date and accurate.
- It's usually wise to limit errors and to improve currency and accuracy, by limiting authority to make changes in asset and maintenance information; for example, authorize a single individual to do all information updates; alternatively, allocate authority among staff, with appropriate security clearances, according to their roles and responsibility and to the risks associated with data accuracy.

Step 3.7 Report on Maintenance Management

Purpose:

- *Clearly and routinely communicate with key staff and decision makers on maintenance activities and findings and their implications for asset performance and life-cycle costs.*

Approach:

Routine and effective reporting is critical to engaging leadership and necessary support for maintenance. On this basis, maintenance managers should routinely report to FN leadership, at least quarterly, on, for example:

- Infrastructure performance – are assets performing as designed – if not, why not and what needs to be done to restore performance;
- Extent of compliance with regulations and permits;
- Maintenance performed vs. planned – reasons for variances; performance and cost implications of variances;
- Breakdown incidents – what, when and why? What needs to be done to improve reliability;
- Actual costs vs. budget - reasons for variances; what needs to be done to resolve variances;
- Maintenance staffing and resources – are there sufficient, qualified staff; skill development and training needs; are sufficient, qualified contractors available; are sufficient equipment, parts and supplies readily available; what should be done to address resourcing issues;
- Necessary adjustments to planned maintenance – what, why, when, how and at what cost;
- Impacts on the capital plan - necessary repairs and replacements

Inputs:

- MMP and maintenance records, including planned and completed work orders
- Operational performance assessment – actual vs. target performance according to CISP key performance indicators (KPIs)
- Compliance monitoring and reporting records
- Service interruption and/or asset breakdown records
- Actual vs. budget costs and revenues
- HR records
- Capital Plan

Outputs:

- ❑ Relevant reports to FN leadership and stakeholders

Tips and Tricks:

- Take the necessary time to monitor and report on maintenance performance and to link it to overall infrastructure performance according to the CISP; engaging FN leadership by improving their overall understanding of the cause-effect relationships arising from their decisions can improve support for maintenance programs and funding