DIAMETER SERVICES

City of Greater Sudbury

Automated Meter Reading / Advanced Metering Infrastructure / Advanced Metering Analytics (AMR / AMI/ AMA) Feasibility Study

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Implementation Report

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Table of Contents

City of Greater Sudbury

AMR / AMI / AMA Feasibility Study

Implementation Report

5.1 Introduction

This implementation report is an appendix to the AMR/AMI/AMA Feasibility Study and assumes the recommendation of a fixed network AMI technology is the approved technology. Some adjustments to this report if there is a modifications to these recommendations.

5.2 Procurement Strategy

A project of this nature has a number of components that need to be properly planned out to ensure the internal and external resources are available at the right time. The diagram below provides an overview of the components of the project that need to be planned.

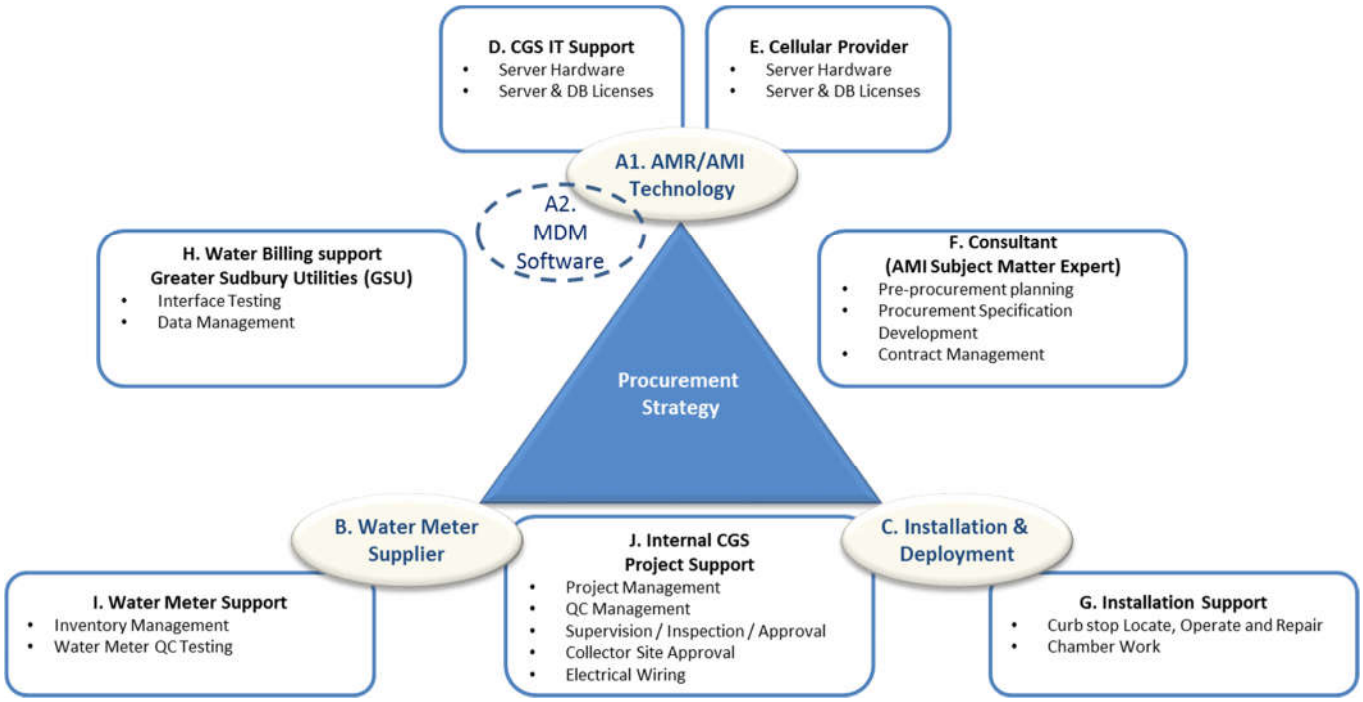


Figure 1

Some of these components will require a formal procurement process, other require sole sourcing and the remaining components may utilities existing contracts or City staff to perform the tasks. Where CGS

or GSU staff are required some form of backfill may be need to ensure the right staff with the right knowledge of existing system are able to participate in the project.

For those components that requires external resources the successful procurement strategy needs to answer a couple questions, first what components of the project should be grouped together, secondly what type of procurement is recommended (tender, RFP, sole source). The grouping of components can have a real effect on the competitiveness, price of the procurement and the mitigation of project risk.

5.2.1 Main Components of Work

The highest cost components of this project are A. AMR/AMI Technology, B. Installation & Deployment and B. Water Meter Supply. How these components are grouped can have a real impact on the number of bidders who may be interested in the project. Grouping them all together in a single turn-key project is likely the lowest risk approach, but it limits the number of bidders who would likely be interested in the project. Procuring each of these component separately will likely maximize the number of bidders that would be interested in the project but there is significant risk in ensure all components work together.

After reviewing the benefits and drawbacks we are recommending two Request for Proposals (RFP) be developed.

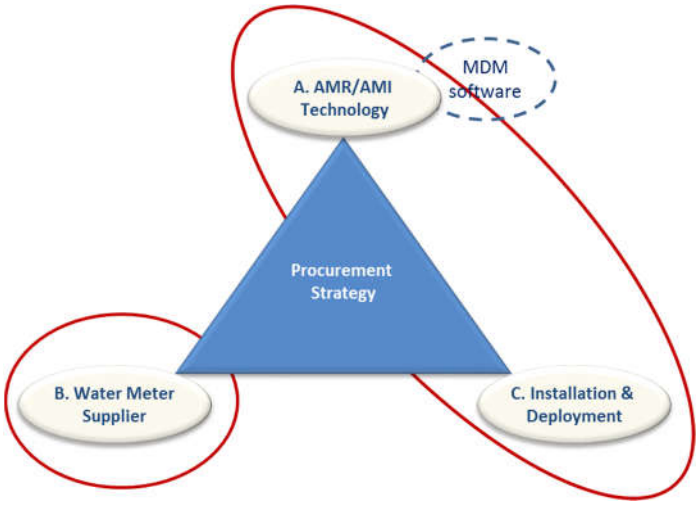


Figure 2

The first is for water meter and components supply, the second would group AMR/AMI together with installation and deployment. This approach puts the majority of the risk of the project on the AMI and Installation provider. The risk related to the water meter working with the AMR/AMI equipment selected is low and very manageable.

The MDM Software should be included as a part of the AMR/AMI and installation RFP but the procurement documents should allow this component to be separated and awarded separately. The reason we recommend this option is because some AMR/AMI vendors do not have a suitable and well develop MDM software. CGS evaluation team should be able to evaluate the merits of different providers MDM and award this components on how closely this software meets the business drivers.

MDM software providers may be able to submit a response to just the MDM component of the RFP. Although this may complicated the procurement, award and negotiation process we feel it will give CGS evaluation team the most flexibility to find a solution that meets the City needs.

5.2.2 Support Components

The table below summarized the recommended procurements and the estimated value of each component.

Component (Ref to Diagram 1)	Resource	Type of Procurement	Estimated Value	Comment
C. Installation & Deployment	External	Supply and Install RFP	$4.7M	
A1.AMR/AMI Supply			$4.8M	
A2.MDM Software	External	Included in AMR/AMI RFP	$300K	This could be separated and negotiated separately if a MDM solution is better what is proposed by the AMI Vendor
B.Water Meter Supply	External	RFP	$3.7M	
E. Cellular Provider	External	Negotiated	$45K / year	CGS should include this service with the existing CGS cellular contract.
F.Consultant	External	RFP	$785K	
G.Installation Support	Internal	None	N/A	Curb stop locates and repairs will be supported by existing CGS staff.
H.Water Billing Support	External	Negotiated	$140K	GSU will be required to provide water billing support during the testing and installation phases of the project.
I.Water Meter Support	Internal	None	N/A	Existing CGS will support her Quality assurance and inventory management functions as required.
D.CGS IT Support	Internal	None	$50K	Where the AMI vendor proposes an on-site software installation CGS will use their existing server network.
J.Internal CGS Project Support	Internal	None	$375K Existing	CGS has existing resources (PM and supervision) to perform certain

Component (Ref to Diagram 1)	Resource	Type of Procurement	Estimated Value	Comment
			$375K new staff	project support tasks but we do anticipate requiring new temporary hires to fill some positions (inspection and supervision).

Table 1

The priority would be to engage a consultant who will perform the detailed project task scheduling and critical path management.

5.3 Project Schedule

The table shows a high level project schedule. This plan is a snap shot in time and will provide the City of Greater Sudbury a benchmark to work towards achieving. The plan will continue to evolve as more information becomes known.

WBS	Task Name	Duration	Start	Finish
1	**City of Greater Sudbury Implementation Schedule**	**802 days**	**Mon 17-03-06**	**Tue 20-03-31**
1.1	**Project Management**	**802 days**	**Mon 17-03-06**	**Tue 20-03-31**
1.1.1	Start	1 day	Mon 17-03-06	Mon 17-03-06
1.1.2	Project Management	801 days	Tue 17-03-07	Tue 20-03-31
1.2	**Pre-Procurement Task**	**120 days**	**Tue 17-03-07**	**Mon 17-08-21**
1.2.1	Develop and Award Consultant RFP	80 days	Tue 17-03-07	Mon 17-06-26
1.2.2	Compile Potential Data Collector Locations	60 days	Tue 17-03-07	Mon 17-05-29
1.2.3	**GSU Engagement**	**100 days**	**Tue 17-03-07**	**Mon 17-07-24**
1.2.3.1	Agreement with GSU for Joint use of Existing Pole Locations	20 days	Tue 17-03-07	Mon 17-04-03
1.2.3.2	Business Requirements for Data Interfaces	20 days	Tue 17-06-27	Mon 17-07-24
1.2.3.3	Project Support Discussions	20 days	Tue 17-06-27	Mon 17-07-24
1.2.4	Secure Project Team	20 days	Tue 17-07-25	Mon 17-08-21
1.3	**Procurement Phase**	**150 days**	**Tue 17-06-27**	**Mon 18-01-22**
1.3.1	**Water Meter Procurement**	**75 days**	**Tue 17-06-27**	**Mon 17-10-09**
1.3.1.1	Develop Specifications	10 days	Tue 17-06-27	Mon 17-07-10
1.3.1.2	Prepare Terms and Conditions	5 days	Tue 17-07-11	Mon 17-07-17
1.3.1.3	Prepare Procurement Documents	10 days	Tue 17-07-18	Mon 17-07-31
1.3.1.4	Conduct Proposal Period	20 days	Tue 17-08-01	Mon 17-08-28
1.3.1.5	Review Proposal and Evaluation	10 days	Tue 17-08-29	Mon 17-09-11

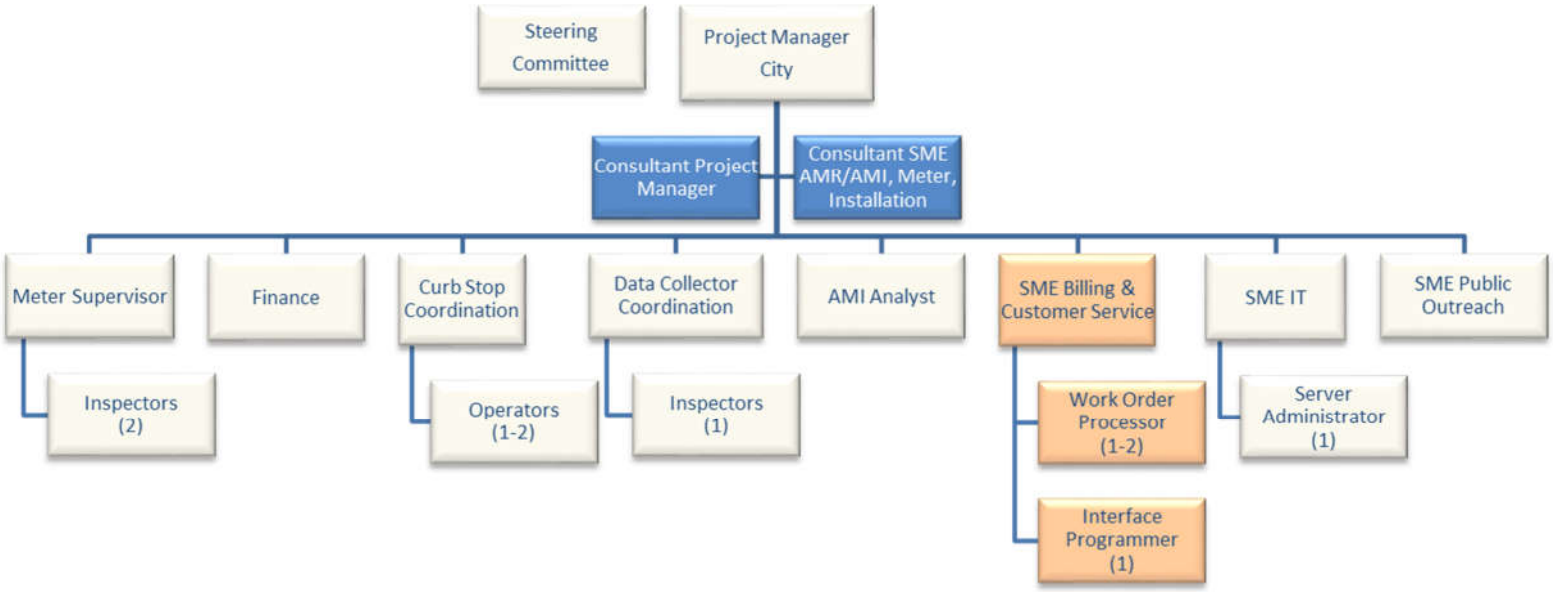
1.3.1.6	Negotiate Agreement	10 days	Tue 17-09-12	Mon 17-09-25
1.3.1.7	Meter Agreement Executed	10 days	Tue 17-09-26	Mon 17-10-09
1.3.2	**AMR / AMI and Installation Vendor Procurement**	**150 days**	**Tue 17-06-27**	**Mon 18-01-22**
1.3.2.1	Plan Data Collector Locations	40 days	Tue 17-06-27	Mon 17-08-21
1.3.2.2	Plan Communications	20 days	Tue 17-06-27	Mon 17-07-24
1.3.2.3	Plan IT and Data Management	30 days	Tue 17-06-27	Mon 17-08-07
1.3.2.4	Develop Specifications - AMR / AMI	20 days	Tue 17-06-27	Mon 17-07-24
1.3.2.5	Develop Specifications - Install	10 days	Tue 17-07-25	Mon 17-08-07
1.3.2.6	Develop Specifications - MDM	10 days	Tue 17-08-08	Mon 17-08-21
1.3.2.7	Prepare Terms and Conditions	5 days	Tue 17-08-22	Mon 17-08-28
1.3.2.8	Engage AMR / AMI Vendors	15 days	Tue 17-07-25	Mon 17-08-14
1.3.2.9	Prepare Procurement Documents	20 days	Tue 17-08-29	Mon 17-09-25
1.3.2.10	Conduct Proposal Period	40 days	Tue 17-09-26	Mon 17-11-20
1.3.2.11	Review Proposal and Evaluation	15 days	Tue 17-11-21	Mon 17-12-11
1.3.2.12	Negotiate Agreement	15 days	Tue 17-12-12	Mon 18-01-01
1.3.2.13	AMR / AMI Agreement Executed	15 days	Tue 18-01-02	Mon 18-01-22
1.4	**Start-up Phase**	**85 days**	**Mon 18-01-08**	**Fri 18-05-04**
1.4.1	Plan Business Process Changes	20 days	Mon 18-01-08	Fri 18-02-02
1.4.2	Plan Data Collector Sites	20 days	Mon 18-01-08	Fri 18-02-02
1.4.3	Vendor Mobilization	40 days	Tue 18-01-23	Mon 18-03-19
1.4.4	Install Initial Data Collectors for POC	20 days	Mon 18-02-05	Fri 18-03-02
1.4.5	Develop Communications	40 days	Mon 18-01-08	Fri 18-03-02
1.4.6	Prepare Computer Environments	20 days	Mon 18-01-08	Fri 18-02-02
1.4.7	Plan AMI Software Interfaces	15 days	Mon 18-02-05	Fri 18-02-23
1.4.8	Develop AMI Software Interfaces	20 days	Mon 18-02-26	Fri 18-03-23
1.4.9	AMI System and Installation (Initial User Acceptance Test)	20 days	Mon 18-03-26	Fri 18-04-20
1.4.10	Move AMS into Production	10 days	Mon 18-04-23	Fri 18-05-04
1.4.11	Release Initial Accounts for POC	10 days	Mon 18-04-23	Fri 18-05-04
1.5	**Installation / Deployment Phase**	**497 days**	**Mon 18-05-07**	**Tue 20-03-31**
1.5.1	**Proof of Concept Phase (POC)**	**110 days**	**Mon 18-05-07**	**Fri 18-10-05**
1.5.1.1	Install Residential Installations (~5,000)	80 days	Mon 18-05-07	Fri 18-08-24
1.5.1.2	Complete RSR and Network Performance Assessment	10 days	Mon 18-08-27	Fri 18-09-07
1.5.1.3	Complete Final User Acceptance Test (FUAT)	20 days	Mon 18-09-10	Fri 18-10-05
1.5.2	Issue Notice to Proceed with Installation	0 days	Fri 18-10-05	Fri 18-10-05
1.5.3	Install Remaining Data Collectors	120 days	Mon 18-10-08	Fri 19-03-22
1.5.4	Complete Meter and Endpoint Installations	387 days	Mon 18-10-08	Tue 20-03-31
1.5.5	Substantial Completion	0 days	Tue 20-03-31	Tue 20-03-31

5.4 Project Support

A project of this nature requires a dedicated team that remains actively involved in the project from its beginning to its end. Active involvement will include participation in the procurement process, installation and system acceptance. This project will require individuals with certain expertise to perform each role. Most roles will not require 100% of any single person's time for the full duration of the project, but they will require that certain stakeholders be engaged full time during certain stages of the project. Key members of the City of Greater Sudbury and Greater Sudbury Utilities will need to set aside some time to support this project.

5.4.1 Project Organizational Chart

The diagram below illustrates the project organizational chart. The organizational chart assumes there will be resources available with the right skill to fill the role. Where this is not the case, additional roles can be added to the consultant's engagement. (SME – Subject Matter Expert)



5.4.2 Description of Roles

The following tables provide an explanation of the duties and responsibilities for each role and the estimated time (or % of a full time equivalent – FTE) that will be required during each phase of the project.

Role:	Project Manager	Organization:	City of Greater Sudbury

Tasks:	• Main point of contact for all project entities
	• Accountable for project timeline, scope and cost
	  • Contract Compliance supports the PM
	  • PM does not need to be an AMR/AMI expert
	• Sign off on all invoices and additional resource requests		

Effort / Time Estimate	• Pre-Procurement, Procurement
	  • 50% - 100% of an FTE
	• Project Startup, POC and Installation
	  • 100% FTE – first year
	  • 50% - 80% FTE - after that
	• Bad contractor – will require more time		

Role:	Contract Compliance	Organization:	AMR/AMI Subject Matter Expert (Consultant)
Tasks:	• Main point of contact with Prime Contractor (AMR/AMI and Installation) • Lead Progress Meetings (Agenda's, Scheduling, Minutes) • Specification Compliance • Progress Claim review and recommendation for approval • Project Documentation (either directly or ensure others produce it accurately) • Project Schedule review and approval (the installation contractor plan) • Establish and monitor key project metrics		

Effort / Time Estimate	• Procurement
	  • Document creation
	• Project Start up, POC
	  • 1 – 50% FTE Consultant Project Manager
	  • 1 – 50% FTE Consultant AMR/AMI, Meter and Installation SME
	• Installation and Deployment
	  • 50% – 75% FTE
	• Bad contractor – may require more time		

Role:	Meter Supervisor	Organization:	City of Greater Sudbury
Tasks:	• Review installation specification documents • Review 5% to 10% of post installation photographs • Resolve non-compliance or "Tasks" that prevent an installation • Potentially take on Curb Stop Coordination tasks		

Effort / Time Estimate	• Procurement
	  • 25% FTE
	• Project Start up and POC
	  • Business requirements review and approval
	  • 25% - 50% +
	• Installation and Deployment
	  • Post installation review
	  • 5% - 10% of 48,000 = 2,400 – 4,800 picture review
	  • 5% - 10% of 48,000 = 2,400 – 4,800 inspections
	  • Task Resolution
	  • 2.5 - 5% of 48,000 = 1,200 – 2,400 Task resolution		

Role:	SME - Billing and Customer Service	Organization:	Greater Sudbury Utilities

Tasks:	• Assist in the design of the interfaces
	• Business Requirements review and approval
	• Data Review and Exception Management
	• Lead and perform testing
	  • CIS Testing (processing work orders, interfaces)
	  • AMI User Acceptance Testing
	• AMI training		

Effort / Time Estimate	• Procurement
	  • 25% of an FTE
	• Project Startup and POC
	  • Start up meetings 100%
	• Installation and Deployment
	  • Data processing
	  • 1-2 people 25% - 50%		

Role:	Data Collector Coordination	Organization:	City of Greater Sudbury
Tasks:	• Review and approved changes to propagation study • Site inspections • Approve data collector sites • Often requires working with outside organizations • Approve and coordinate work to be performed at each site (in conjunction with the AMI installation contractor).		

Effort / Time Estimate	• Project Startup and POC (4 to 10 months)
	  • 1 – Supervisor 100% FTE; 100% inspector
	• Installation and Deployment ¾ to 1 year (depends on how easy collector approvals are)
	  • 75% Supervisor
	  • 75% of field inspector		

Role:	AMI Data Analyst	Organization:	City of Greater Sudbury
Tasks:	• Business Requirements review and approval • Data Review and Exception Management • AMI User Acceptance Testing • AMI training		

Effort / Time Estimate	• Project Startup and POC
	  • Start up meetings 50%
	• Installation and Deployment
	  • 1 person 25% - 50%		

Role:	Curb Stop Coordination	Organization:	City of Greater Sudbury
Tasks:	• Coordinate the curb stop locates and repairs		

Effort / Time Estimate	• Procurement
	• Project Start up and POC
	  • 10% - 25% of a supervisor
	• Installation and Deployment
	  • 25% - 50% of a supervisor		

Role:	IT Server hardware and OS setup	Organization:	City of Greater Sudbury
Tasks:	• Set up the servers (hardware) • Purchase of any additional OS and DB software (Licenses) • Load and configure the OS software • Coordinate any security reviews (threat assessment, risk assessment, penetration test) • Applying new versions and patches.		

Effort / Time Estimate	• Project Start up and POC
	  • 1 hardware person 10% -25% of a FTE
	  • 1 security person 10% - 25% of a FTE
	• Installation and Deployment
	  • 5% - 10% of a FTE		

Role:	Public Outreach	Organization:	City of Greater Sudbury
Tasks:	• Coordinate the design and development of the Public Outreach program • Design brand, logo etc. • Approve materials and website • Support media relations		

Effort / Time Estimate	• Project Start up and POC
	  • 1 Communications person 10% - 25% of a FTE
	• Installation and Deployment
	  • 1 Communications person 10% of a FTE		

5.5 Fixed based AMI Data Collector Preparation

Our recommendation to deploy an AMI fixed network will require data collectors to be allowing the entire CGS service territory to be covered. To do this successfully, there are a number of considerations that need to be taken prior to procurement documents being released.

During procurement AMI Vendors will need to need to perform a propagation study to ensure they are planning enough data collector equipment to collect. A Propagation Study is a Vendors forecast on how well their network will collect transmissions. The model relies on a number of assumptions and the more “real” they can be, the better the models prediction.

- Assumption that are made in a Propagation Study are:

- Read Success Rate (RSR)
- Redundancy
- Indoor vs. Outdoor Installation

Topography and Density of Buildings

- Location of Data Collectors
- Height of Data Collectors
- Strength and Frequency of the Radio and Collectors

The more information and decisions the utility can provide prior to procurement the less risk the propagation model will be. The project key's performance indicator will be read success rate (RSR). If 99.5% of the radio transmitters are able to pass the RSR then we are confident:

- the right amount of network collector are installed across the territory;
- the radio transmitters are operating as designed; and
- the installation and radio transmitter setup processes into Northstar are successful.

Read Success Rate (RSR) is the key performance standard of the network that puts the onus on the AMI and Installation Vendors to figure out the details and requirements around the system to ensure that it meets or exceeds the measurable outcome. It is usually defined as follows:

- % of hourly readings to be captured by the network (usually 98.5%) of the last 30 days.
- % of daily readings to be captured by the network over the last 30 days.
- Redundancy Rate – Each radio transmitter must be heard by two data collectors.

5.5.1 Propagation Risk Assessment

The table below details the assumptions a Vendor needs to make in performing a propagation study. The risk level indicates the impact each can have on the deployment of the network. A low risk, is something that the specifications can easily address; no risk mitigation is required. A medium risk, indicates a factor that may have an impact on procurement or the total project cost. Mitigating a medium risk factor may require the City to get more detailed information or make a specification decision that will lead to higher cost. A high risk, is one that will have an impact on the viability of the propagation and will lead to an unknown higher cost or will prevent the City from measuring radio transmitter performance during installations. To mitigate these risks the procurement documents need significantly better information and procedures need to be put in place to secure locations for data collectors. Another option for mitigation would be to lower the expectations on where a fixed network may be deployed, allowing vendors to submit mobile AMR or AMI cellular technology for certain areas.

Fixed Network Propagation Study Risk Factors

Factor	Risk Level	Risk Assessment
Read Success Rate (RSR)	Low	• RSR is easily defined • Industry standard is 98.5% of hourly readings over the last 30 days.
Redundancy	Low	• Industry standard is a redundancy of 2 collectors per radio transmitter
Strength and Frequency of the endpoints and collectors	Low	• Manufacturers design their radio transmitter and data collectors with specific transmission frequency and strength so the only risk would relate to implementing a network whose manufacturer has never designed this type of system before.
Topography	Low	• This does not change and is known to the vendor • Building infill development is slow and usually redundancy allows endpoints to be heard by a second collector.
Indoor vs. Outdoor Endpoint Location	Med	• Installation challenges may prevent some endpoints from being installed outside (finished basement and commercial) • **Mitigation:** allow some residential endpoints to be installed inside, and provide strict specifications that would allow it. • **Mitigation:** allow hourly or per foot wire runs to be charged for commercial properties

Location of Data Collectors	High	• Potential sites are often not known
		• Sites that are known are often eliminated as not suitable (no power, no approval, being demolished)
		• Approval process can be very long
		• Sites are not always available where they are required
		• **Mitigation:** Prepare prior to procurement:
		  • A validated list of buildings, poles, towers that can be used.
		  • Make sure approval processes are worked out
		  • New poles need to be an acceptable solution for some areas (although they can be a last resort)

Factor	Risk Level	Risk Assessment

Height of Data Collectors	Med	• Building heights are not always known for all sites
		• Poles heights need to be assumed at 25 feet; vendors typically want to higher poles to reduce the number of collectors
		• Some systems require much higher data collectors (cell towers, water towers, etc.). Not having these can skew some vendors' studies and therefore their proposed network cost.
		• **Mitigation:** Prepare prior to procurement.
		  • Get the height of as many locations as possible (even if only the number of floors).
		  • Assume the poles are lower rather than higher, it is easier to eliminate equipment due to better than predicted performance.

Table 2

5.5.2 Propagation Study Importance

The deployment of the network and the utilization of RSR are key components of a successful implementation. Tying payment of both the meter and transmitter installations to passing RSR provides great leverage in a contract and ensures installation issues get resolved by the vendor in a timely manner. If the network is delayed in any way that is not related to the vendor, they will start to put pressure and request to get paid for installations prior to meeting RSR. This has a number of follow on impacts including; Installation issues that will not be resolved and it lowers the incentive to resolve any issues within the propagation model. The diagram below depicts a common scenario with regards to a deployment of a network starting with a list of potential sites prior to the procurement propagation and illustrates what actually happens during a deployment.

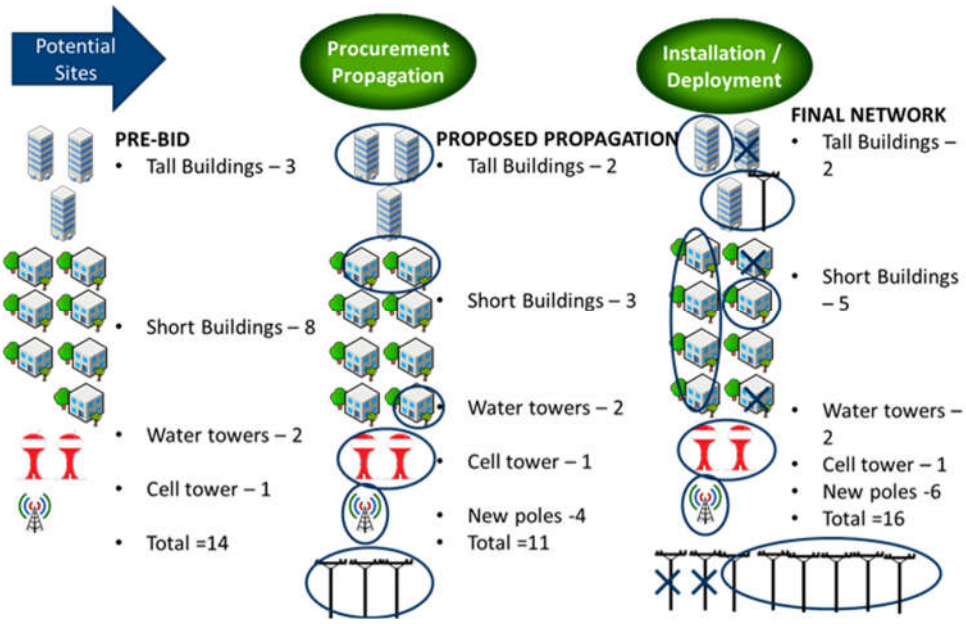


Figure 3 Propagation Study at Procurement compared to Final Installation

Notice the total number of collection devices increased from 11 during the procurement phase to 16 at the installation/deployment phase. Because three sites were eliminated after the procurement phase, five sites needed to be added during the installation/deployment phase resulting in a 45% increase in the network cost. This cost would be the Utility's responsibility to cover. It is easy to understand not having the correct list of viable addresses where collectors can be installed can have a big impact on the project cost.

The reality is that a deployment of a network typically has heavy utility involvement and the more upfront preparation that can be done, the chances of a successful deployment greatly improve.

If the propagation is altered during a deployment due to approval status changes and there are restrictions as to where a Data Collector can be installed, some meters may not be able to be read under the network. These holes in coverage could be blamed on the utility and would result in significant increases in deployment coordination time. Although, a project of this size is complex the majority of complications can be mitigated through the following:

- Have a qualified list of installation locations prior to procurement
    - Need to know the following attributes:
        - Type of Facility
            - Building
            - Water Tower
            - Communications Tower

        - Right of Way Property
        - Pole
        - Etc.
    - Owned / Leased
        - May not be able to place equipment on leased sites
    - Heights of Buildings and Towers
    - Access to backhaul (fiber, intranet, cell coverage, etc.)
    - Contact person
- Understand the approval process and who is involved
- Dedicate full time resource(s) to coordinate the network deployment
- Put onus on the installation contractor but provide additional support where required.

CGS Implications:

CGS should start to put together a list of CGS facilities that could be used as a location for data collector equipment. This list should be in GIS and able to download and group by the above mention attributes.

5.5.3 Data Collection Equipment Installation Locations

Options for locations to site data collection equipment are evaluated in the following table.

Table 3: Location Options for Data Collectors

Data Collector Location	Benefits	Drawbacks

CGS-owned Buildings and Structures	• Usually no monthly cost for space
	• Access to electric power (avoiding solar panels)
	• Potential access to network (avoiding backhaul costs)
	• Multi-story buildings increase coverage for data collectors.
		• Maintenance of power and network connections
		• More susceptible to
		  • Power being turned off
		  • Intranet going down

Other City-owned Buildings and Structures	• Multi-story buildings increase coverage for data collectors.	• May have concerns mounting equipment on their roof • Separate agencies (Schools, Police, Fire, Water, Facilities) • Each may have different approval processes and conditions.

Data Collector Location	Benefits	Drawbacks
GSU's existing power poles	• $22.35 to 41.28 per pole per year • Initial install fee: $331 one-time fee	• Accessibility can be an issue when maintenance is required. Although this drawback is low on City owned poles. •
New Poles	• Poles can be installed anywhere. • Vendor has the ability to ensure no holes exist in the network	• Approval process may include politicians • Resident's don't like new poles installed in the residential neighbourhoods • Installation is more costly
Private Locations	• Communication towers may have capacity for additional antennas, particularly for public networks • Multi-story buildings increase coverage for data collectors.	• Need to negotiate leases • Monthly charges

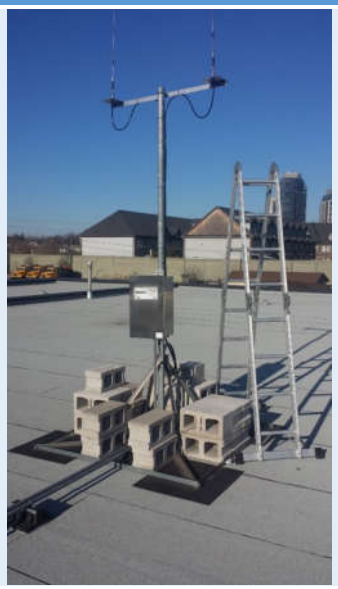
CGS Implications:

The City should plan to mount equipment on all the above locations with priority given to existing CGS buildings, GSU poles and either Hydro One poles or new poles in CGS service territory not covered by GSU. It is likely that new poles will be required.

5.5.4 Types of Data Collector Installations

The table below shows the types of data collector installations that will be required. The procurement specifications need to allow for all the different types of work for each of these, including by not limited to running electric and Ethernet wiring.

Table 4: Data Collector Mounting Options

Data Collector Location	Picture	Benefits
Rooftop Mount		• No roof penetration is required • Vendor is responsible for wind testing • Easy to relocate for roof maintenance • Can be located so that it is not noticeable from the ground
Wall Mount	 	• Antenna can be installed at the highest point on the building • Collector can be installed inside in a secure location • Usually short electric and WAN wire runs during installation

Data Collector Location	Picture	Benefits
Pole Mount		• Able to fill in coverage if there are gaps in the network.

5.5.5 Backhaul

Backhaul is the type of technology that is used to get the data from the data collectors back to the headend software. There are a number of different options on how this can be done and some may be more costly than others. These options are defined in the chart below:

Backhaul Methods

Backhaul Type	Ease of Installation	Install Cost	On-going Cost	Availability
Ethernet	Wiring Required	$$	$0	Limited to City buildings
Cellular	Cellular card installed by Vendor	$	$/year	Unlimited – can be used for any type of collectors.
Fiber Optic	Requires a connection point. This point may not be anywhere near the roof where the collector would be installed.	$$$	$0	Limited to City buildings that have a connection point.
Point-to Point	Has had limited use in water AMI	$$$	$0	Unlimited

Legend

$0 - no additional cost per site
$ - between $250 and $500
$$ - between $500 to $2,500
$$$ - over $2,500

5.5.6 Data Collector Approval Process

Understanding and vetting out the Approval Process for each type of installation is an important step to be completed prior to procurement. For each type of installation a number of questions should be answered. These questions are included below.

City Building Installations

- Is there a facilities management division within the City?
- What is the Approval process?
- What is required?
    - Are there specific forms that have to be completed?
    - Are as built drawings required?
    - Is there a specific format of the drawings?
    - Are there any labelling requirements (Data Collectors, Wire / Conduit)?
- Who would approve a collector for each building?
- Who would approve where wiring should be run?
- Who would install and test secure router?
- Is there a specific type of router that should be used?
- Who would provide access to each building?
- Are there facility management Electricians that would perform this work or would wire runs need to be outsourced?

Pole Installations

- What is the Approval Process?
- Are new poles a viable option?
- Who approves mounting equipment on lighting poles?
- Who approves mounting equipment on power poles?
- What is the timeline for Approvals?

- Are there any costs involved?
- Are there specific forms that have to be completed?

Once the project has been approved these questions will provide a starting point for the discussions with the various departments and organizations.