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City of Edmonton

Infrastructure Capacity Review

Utility Infrastructure

Prepared by:

AECOM Canada Ltd.
101 – 18817 Stony Plain Road NW
Edmonton, AB T5S 0C2
Canada

T: 780 486 7000
F: 780 486 7070
www.aecom.com

Prepared for:

City of Edmonton

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AECOM: 2015-04-13

Authors

Report Prepared By:

Cliff Kelsey, R.E.T.
(Shallow Utility Servicing)

PROFESSIONAL ENGINEER ALBERTA
KRISTIN J. ST. LOUIS
2022-03-03
77973

Kristin St. Louis, P.Eng.
(Water Servicing)

PROFESSIONAL ENGINEER ALBERTA
JODY J. CHERDARCHUK
2022-03-03
M77586

Jody Cherdarchuk, P.Eng.
(Drainage Servicing)

PROFESSIONAL ENGINEER ALBERTA
M. R. LEBLANC
36978
2022-03-03

Report Prepared By:

Marcel LeBlanc, P.Eng.

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1. Introduction

1.1 Background

The Infill Roadmap, adopted in 2018 by the Urban Planning Committee, set the path to redeveloping Edmonton's core and mature neighbourhoods. The 25 actions detailed in the Infill Roadmap mainly target barriers to the integration of medium density housing options, often referred to as the "missing middle," as well as mixed-use redevelopment. The overarching goal is to allow more people and new housing to thrive in the city's core and mature neighbourhoods. The Infill Roadmap is integral to the realization of The City Plan, which imagines a future with 2 million Edmontonians. A necessary step to house, employ, and move another 1 million people in Edmonton is urban intensification, for which higher density housing opportunities and mixed land uses, especially in central neighbourhoods, is key. One of the Plan's Big City Moves, A Rebuildable City, sets a target of 600,000 new residents welcomed in redeveloping areas.

The City Plan which was approved by City of Edmonton's Council on December 7, 2020, outlines a network of Nodes and Corridors where much of this intensification and densification is to take place. The City Plan replaces The Ways documents by setting strategic directions for the way Edmonton grows, its mobility systems, open spaces, employment and social networks, generally touching on most aspects of life in Edmonton.

The Review of Infrastructure Capacity project will provide an assessment of the development readiness for nine study areas (three nodes and six corridors) in light of current infrastructure and projected needs to meet target development scenarios. The high-level cost of recommended upgrades will be estimated as part of the project and approaches to sequencing the infrastructure investments will be presented. The assessment will include review of active transportation/mobility, water, drainage, and franchise/shallow utility infrastructure.

Toole Design was retained by the City of Edmonton to lead the overall Review of Infrastructure Capacity Project and to undertake the transportation/mobility scope of work. AECOM was retained by Toole Design to carry out the assessment of the utility infrastructure. This study will assist the City of Edmonton to gain a better understanding of the current infrastructure capacity, the ability to service future development, the required infrastructure upgrades, and associated high-level costs.

1.2 Study Area

As noted in the City Plan, nodes are centres of activity that feature a variety of land uses including diverse housing types and tenures and employment. Corridors are places for movement, living, and commerce that are anchored by the mobility systems that connect most nodes. In total, there are 6 major nodes, 21 district nodes, 9 primary corridors, and 29 secondary corridors identified in the City Plan.

This study focusses on the following nine nodes and corridors:

- Centre City Major Node;
- University-Garneau Major Node;
- Stadium District Node;
- 97 Street Primary Corridor;
- 118 Avenue Primary Corridor;
- 111 Avenue Primary Corridor;
- Stony Plain Road Primary Corridor;

- Whyte Avenue / 99 Street Primary Corridor; and
- 109 Street Secondary Corridor.

Even though the studies looked at the demands at a population of 2 million, the nodes and corridors selected for this study were chosen based on the highest anticipated growth defined by additional residential dwelling units. The selected nodes and corridors are anticipated to see up to 5000 new residential dwellings at the 1.25 million population threshold with varying activation approaches of Strategize, Invest and Nurture.

Figure 1.1 illustrates the location of the nine study nodes and corridors.

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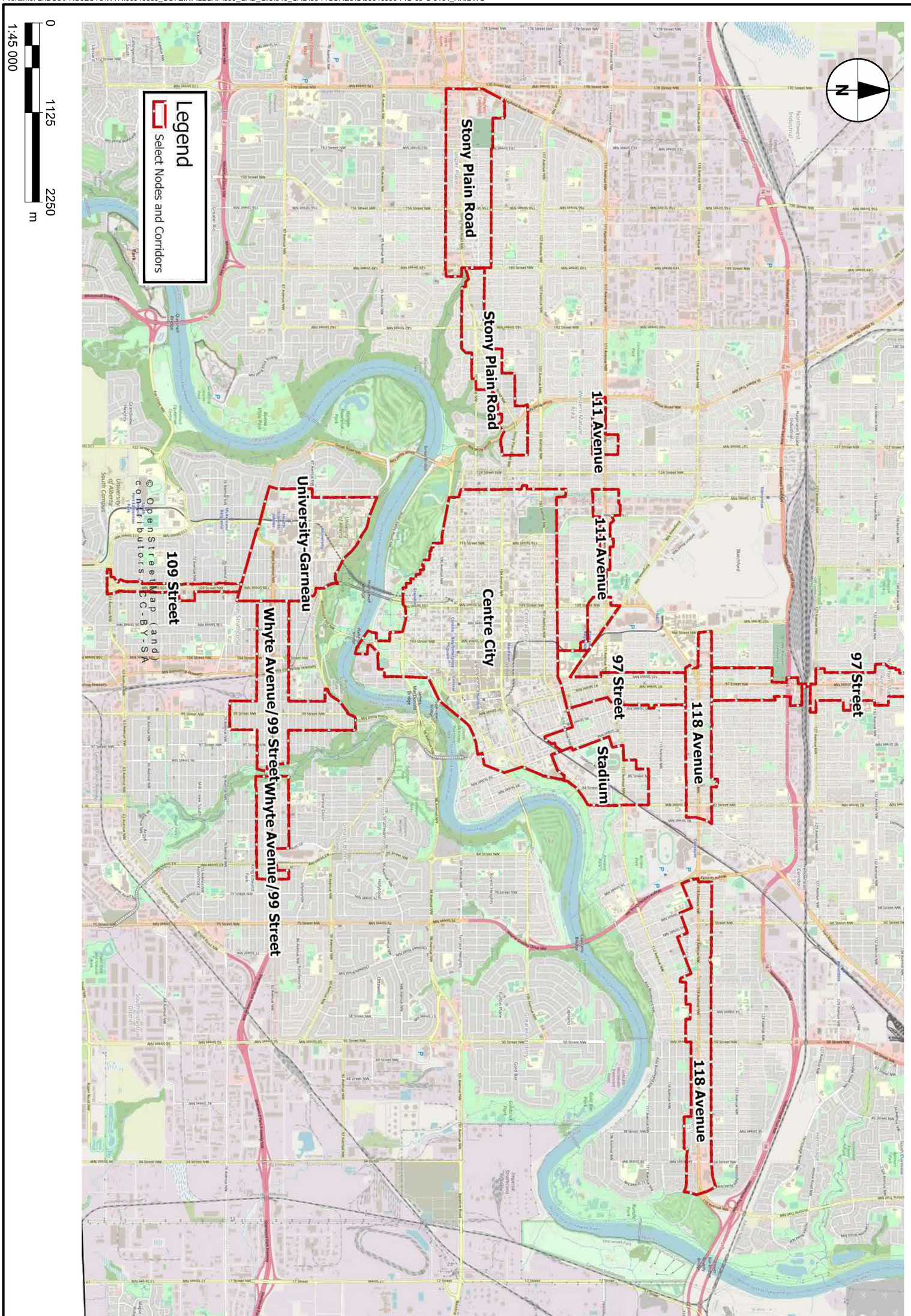

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STUDY NODES AND CORRIDOR LOCATIONS

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Figure: 1.1

2. Target Development Scenarios

The concept land use for the future scenario was provided by the City of Edmonton and illustrated in Figure 2.1. In general, the concept land use plan within the study nodes and corridors consists mostly of residential, commercial, institutional, and recreational lands. It should be noted that the concept land use data utilized in this study was developed by the City for the exclusive use of this study. The assumptions and inferences made in the development of the land use concept speak more effectively when considered in a holistic way and from a neighbourhood level of detail. This land use concept should be considered a projection only and the actual future land use plan may vary. The land use for the existing and future scenarios as provided by the City are also summarized in Table 2-1 and 2-2.

The total population and jobs at the existing and future scenarios were also provided by the City and summarized in Table 2-3 and 2-4. During the existing scenario, there are approximately 228,000 residents and jobs within the study nodes and corridors. This metric is more than doubled during the future scenario, where the project total population and jobs is approximately 545,000.

Roughly half of the population and jobs increase is located within the Centre City node, where the projected growth in the high density residential and the commercial and institutional land uses more than doubles. In the Centre City node, the dominate land use type in the concept land use for future scenario is high density residential and commercial and institutional developments. Some medium density residential developments are projected near the edges of the node boundary.

In the concept land use plan, the University – Garneau node consists mainly of the University of Alberta west of 112 Street and residential developments east of 112 Street. Commercial developments are along 109 Street and Whyte Avenue (82 Avenue). It should be noted that this study does not consider the effects of land use and population and jobs changes in areas under the Alternate Jurisdiction (AJ) zoning. AJ zoning is located within the University of Alberta Campus, bordered by the North Saskatchewan River to the north, 116/117 Street to the west, University Avenue (87 Avenue) to the south, and 112 Street to the east.

Gross density of the study nodes and corridors are summarized in Table 2-5. The minimum gross density, as prescribed in the City Plan, are achieved in the future scenario in all study nodes and corridors.

With regards to the rate of growth for infrastructure planning, an annual linear population growth rate of 2.5% was adopted. Population growth rate is the year over year increase of the total population. Table 2-6 provides a summary of the estimated full build out year for each node and corridor. As shown, the year for full build out does vary across the nodes and corridors.

Table 2-1: Land Use Area (ha) – Existing Scenario

Nodes & Corridors	Low Density Residential (LDR)	Medium Density Residential (MDR)	High Density Residential Mixed (HDR)	Commercial and Institutional Mixed	Parks	Total
109 Street	8	1	-	4	-	13
111 Avenue	18	5	1	13	3	40
118 Avenue	67	28	-	41	7	142
97 Street	60	11	1	31	11	114
Centre City	20	96	52	213	30	411
Stadium	8	11	3	5	24	51
Stony Plain Road	65	27	3	40	20	155
University-Garneau	26	10	7	101	5	149
Whyte Avenue/99 Street	61	29	2	34	2	128
Subtotal	***332***	***218***	***70***	***482***	***102***	***1,204***

Table 2-2: Land Use Area (ha) – Future Scenario

Nodes & Corridors	Low Density Residential (LDR)	Medium Density Residential (MDR)	High Density Residential Mixed (HDR)	Commercial and Institutional Mixed	Parks	Total
109 Street	1	8	0	4	-	13
111 Avenue	0	13	11	13	3	40
118 Avenue	19	68	11	41	7	146
97 Street	19	48	6	31	11	115
Centre City	4	66	113	213	30	425
Stadium	-	22	9	5	24	59
Stony Plain Road	25	57	25	40	20	167
University-Garneau	12	16	25	101	5	159
Whyte Avenue/99 Street	18	62	13	34	2	129
Subtotal	***98***	***360***	***213***	***482***	***102***	***1,254***

Table 2-3: Total Population and Jobs - Existing Scenario

Nodes & Corridors	Low Density Residential (LDR)	Medium Density Residential (MDR)	High Density Residential Mixed (HDR)	Commercial and Institutional Mixed	Total
109 Street	11	583	-	470	1,064
111 Avenue	-	1,026	365	1,122	2,513
118 Avenue	1,148	5,819	-	3,806	10,773
97 Street	1,532	3,316	553	3,186	8,586
Centre City	392	13,171	37,323	85,147	136,033
Stadium	-	3,076	1,146	501	4,723
Stony Plain Road	1,156	4,720	1,092	4,559	11,527
University-Garneau	944	2,057	5,499	30,480	38,980
Whyte Avenue / 99 Street	1,277	6,550	1,362	4,168	13,357
Subtotal	***6,460***	***40,318***	***47,340***	***133,439***	***227,557***

Table 2-4: Total Population and Jobs - Future Scenario

Nodes & Corridors	Low Density Residential (LDR)	Medium Density Residential (MDR)	High Density Residential Mixed (HDR)	Commercial and Institutional Mixed	Total
109 Street	89	3,583	153	1,811	5,636
111 Avenue	-	3,334	6,046	4,426	13,806
118 Avenue	1,262	16,808	7,302	8,811	34,183
97 Street	2,522	9,713	2,942	10,165	25,342
Centre City	580	20,109	96,202	173,547	290,438
Stadium	-	5,975	4,333	1,704	12,012
Stony Plain Road	1,655	12,467	15,165	7,424	36,711
University-Garneau	1,929	5,995	25,801	39,302	73,027
Whyte Avenue / 99 Street	3,252	22,304	10,995	17,450	54,002
Subtotal	***11,290***	***100,288***	***168,939***	***264,640***	***545,156***

Table 2-5: Gross Density Comparison

Nodes & Corridors	Designation*	Minimum Gross Density* (ppl+jobs/gr. ha)	Gross Density at Existing Scenario (ppl+jobs/gr. ha)	Gross Density at Future Scenario (ppl+jobs/gr. ha)
109 Street	Secondary Corridor	75	54	286
111 Avenue	Primary Corridor	150	53	294
118 Avenue	Primary Corridor	150	59	188
97 Street	Primary Corridor	150	56	166
Centre City	Centre City / Major Node	450	225	480
Stadium	District Node	150	64	162
Stony Plain Road	Primary Corridor	150	50	160
University-Garneau	Major Node	250	214	402
Whyte Avenue / 99 Street	Primary Corridor	150	79	318
Total			137	328

* As described in the City Plan.

Table 2-6: Estimate of Full Build-Out Year

Node or Corridor	Years to Full Build-out at a Rate of 2.5% Annually	Year of Full Build-out at a Rate of 2.5% Annually
109 Street	67	2088
111 Avenue	69	2090
118 Avenue	47	2068
97 Street	44	2065
Centre City	31	2052
Stadium	38	2059
Stony Plain Road	47	2068
University-Garneau	26	2047
Whyte Avenue / 99 Street	57	2078

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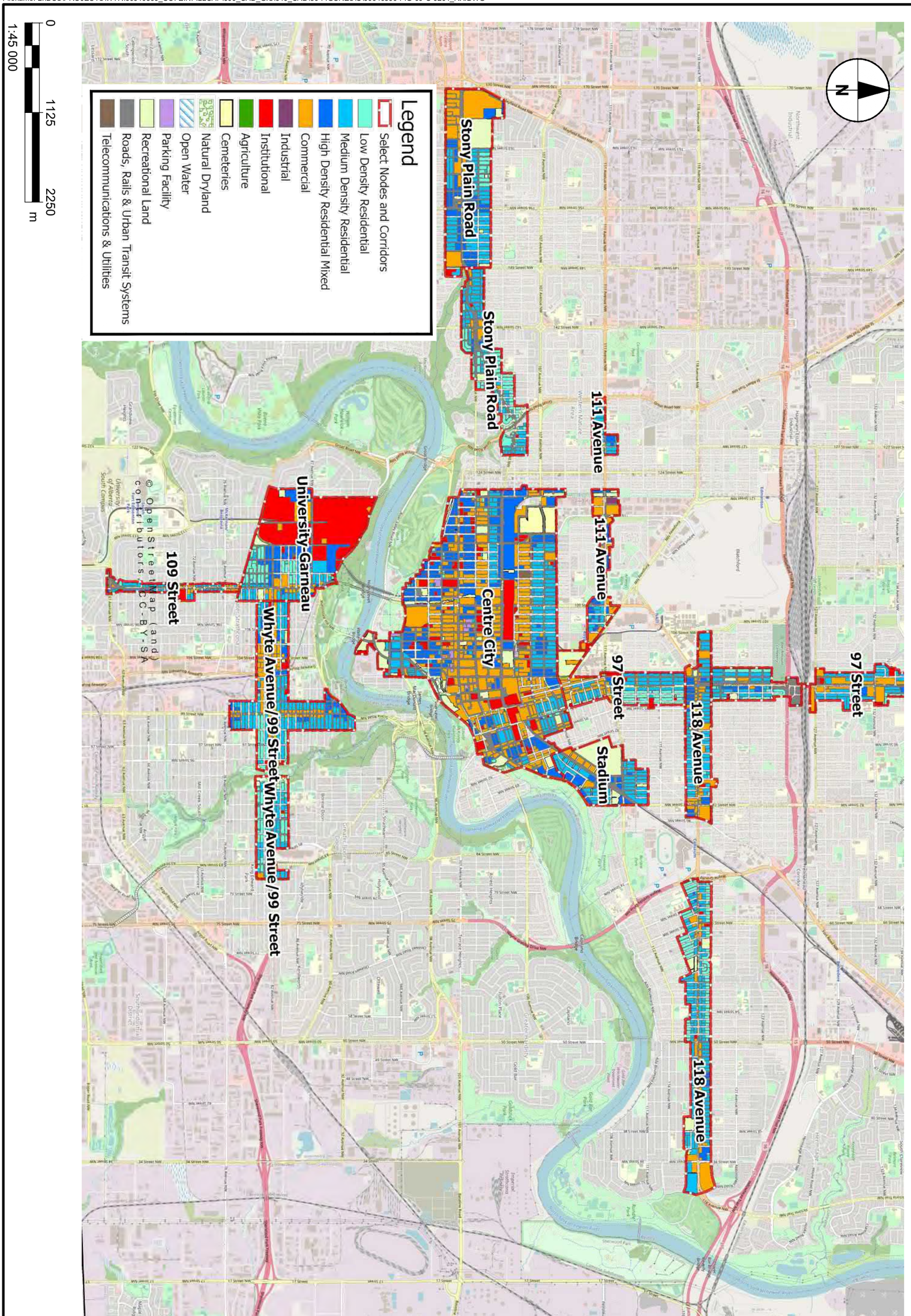

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FUTURE LAND USE

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Figure: 2.1

3. Utility Servicing

3.1 General

Urban intensification and densification will result in an increased demand on the existing utilities within these nodes and corridors. These effected utilities will include:

- Water supply, distribution and transmission system to provide both potable water for consumption and available capacity to address fire protection requirements.
- Stormwater collection, storage and conveyance system to properly handle the runoff resulting from both rainfall and snow melt events.
- Wastewater collection and conveyance system to properly handle the residential and non residential wastewater.
- Shallow Franchise Utilities including:
  - Power supply, transmission and distribution.
  - Natural Gas supply and distribution.
  - Telecommunications including telephone, cable and internet.

It is important to note that the majority of the areas withing the nodes and corridors are serviced using a combined sewer system, which coveys both stormwater and wastewater in a single pipe. All the wastewater from the nodes and corridors ultimately drain to a combined system while the Stony Plain Road, the 109 Street, 111 Avenue and 118 Avenue corridors have separate storm systems.

For each of the utilities, the following will be addressed:

- Available capacity within the existing system to accommodate the demands of the future scenario.
- Current relevant city policies and standards which will impact the approach to future servicing.
- Currently proposed system expansion and improvements.
- Recommended improvements and expansions to address the demands of the future scenario.
- An estimate of high-level costs to complete recommended improvements and expansions.
- Process for the implementation of utility improvements.

3.2 Water Servicing

Within the City of Edmonton, water servicing is provided by EPCOR Water Services Inc (EWSI). The water system is comprised of water treatment plants, storage reservoirs and pumphouses, watermains for transmission throughout the system, as well as watermains for distribution to customers. This assessment focused on the distribution network and was completed in collaboration with EPCOR Water Services Inc (EWSI). The water distribution network is used to provide water to customers and to provide fire protection. The required water flow rates for fire protection are much larger than the flow rates required for customer use and govern minimum service levels. The water distribution network is comprised of various pipe sizes and materials, depending on the scale of development being serviced and the age it was installed.

3.2.1 Existing System Capacity Assessment

The review of the existing water distribution system consisted of two separate assessments: review of available fire flows, and a review of hydrant spacing.

Required fire flows within the nodes and corridors are the governing factor in the sizing of the watermains. It was agreed upon through discussions with EWSI that domestic water consumption would not be considered for the hydraulic assessment. The flows for domestic water consumption are substantially lower than the targeted 300 L/s fire flow, consisting of an average of 7% of the total flow. The highest domestic water flows are in the Centre City node, for which domestic flows comprise 16% of the total flow. Additional details on the target fire flow rates are provided in Section 3.2.2.1. The domestic water flows for each node and corridor are provided with EWSI's memoranda in Appendix A.

The available fire flow review was based on information available through the City of Edmonton Open Data. The available data provides a fire flow range by area, broken down into hexagons 400 m x 400 m in size. The fire flow ranges, and corresponding colour coding are provided in Table 3-1.

Table 3-1: Available Fire Flow Ranges

Available Fire Flow (L/s)	Color Coding
0 – 59	Red
60 – 99	Yellow
100 – 179	Green
180 – 299	Cyan
>300	Blue

The boundaries for the nodes and corridors were overlain on the fire flow hexagons to graphically indicate the available fire flow ranges within each of the nodes and corridors. Figure 3.1 provides an overview of the available fire flow within each of the node and corridors; a summary for each area is provided below.

- **109 Street:** The majority of the 109 Street corridor have available fire flows of 300 L/s or greater, with the exception of the north and south boundaries. North of 77 Avenue the flow rate drops to the 180 – 299 L/s range, and 61 Avenue drops to the 100 – 179 L/s range.
- **111 Avenue:** Available fire flows are generally greater than 180 L/s. The available fire flows east of 106 Street drop to 100 – 180 L/s.
- **118 Avenue (West):** Available fire flows are generally in the range of 180 – 299 L/s. 300 L/s or greater is available west of 102 Street, along 94 Street north of 118 Avenue, and along 82 Street south of 118 Avenue. There are areas south of 118 Avenue where the fire flows drop to lower ranges, including the areas between 95 Street and 93 Street, and between 89 Street to 87 Street.
- **118 Avenue (East):** Available fire flows are generally in the range of 180 – 299 L/s. There are areas along 118 Avenue, from 56 Street to 54 Street, and from 47 Street to 42 Street where the available fire flows drop below 180 L/s.
- **97 Street:** Available fire flows are generally greater than 180 L/s, with small areas with lower available flows (100 – 180 L/s).
- **Centre City:** The majority of the Centre City node currently has fire flows of 300 L/s or greater, with pockets that fall into the 180 – 299 L/s range.
- **Stadium:** The majority of the Stadium node has fire flows of 300 L/s or greater. West of 86 Street the available flows are within the 180 – 299 L/s range.
- **Stony Plain Road (West):** The majority of the Stony Plain Road corridor, from 170 Street to 149 Street currently has fire flows of 300 L/s or greater, with pockets that fall into the 180 – 299 L/s range.

- **Stony Plain Road (East):** Along the Stony Plain Road corridor from 149 Street to 126 Street, currently has fire flows within the 180 – 299 L/s range, with pockets that fall into the 100 – 179 L/s range.
- **University / Garneau:** Available fire flows are generally in the range of 180 – 299 L/s. The areas east of 110 Street and north of 84 Avenue, and along 116 Street north of 87 Avenue have fire flows below 180 L/s.
- **Whyte Avenue/ 99 Street:** Available fire flows are generally in the range of 180 – 299 L/s, with two areas below 180 L/s and two areas above 300 L/s. The area along 99 Street between 84 Avenue and 88 Avenue drops into the 60 – 99 L/s range.

For the review of hydrant spacing, a similar exercise was completed. The hydrants were plotted on a map, with a 45 m radius (refer to Section 3.2.2.1 for design standards). Gaps in hydrant coverage were identified.

As detailed in Section 3.2.2.1, areas with low or medium density residential areas have a lower fire flow requirement and larger hydrant coverage radius than the proposed infill development. Therefore, existing areas that currently have lower fire flow requirements, generally will also require additional hydrants to meet the tighter hydrant spacing requirements. The hydrant locations and corresponding coverage required for high-value properties are shown on Figures A.1 through A.9 in Appendix A for each node and corridor.

3.2.2 Current Standards and Programs

3.2.2.1 Relevant Standards

Relevant standards that apply to the water servicing assessment are from the City of Edmonton / EPCOR Design and Construction Standards, Volume 4 Water (March 2017). It was assumed that the infill development will consist of high-value properties, including apartment buildings, schools, commercial and industrial areas, and mixed-use sites.

Targets for Fire Flow

The level of required fire protection, and the corresponding water flow rate required, varies depending on the type of development. For this assessment, the target fire flow for all areas is 300 L/s. Based on Volume 4 Section 12.4 Table 3 (excerpted below), a fire flow of 300 L/s is required for multi-family residential and high-value properties.

- Section 12.4, Table 3
  - Fire Flow for High-Value Multi Family Residential (RF6, RA7, RA8, RA9, UCRH): 300 L/s
  - Fire Flow for High-Value Properties (including school, institutional, commercial, industrial, mixed use sites – all zonings not including above): 300 L/s

Hydrant Spacing

A minimum hydrant spacing of 90 m (45 m radius) was considered to service the anticipated for high-value properties, as required in Volume 4 Section 7.1.11 (excerpted below).

- Section 7.1.11
  - The maximum allowable spacing between fire hydrants shall be 150 m in single-family and semi-detached residential areas and 90 m in all other areas (i.e. multiple-family residential, school, industrial/commercial areas).

3.2.2.2 Programs

Summaries of current programs that could apply to water servicing of infill development are provided below. Information on cost-sharing and relaxation of standards is provided for reference only, as those assessments would be done on a case-by-case basis and is outside the scope of this study.

Risk Based Cast Iron Water Main Renewal Program

The material of the water pipes varies depending on the age of the pipe. Older pipes generally consist of asbestos cement and iron, and newer pipes consisting primarily of PVC. EWSI's risk-based renewal program targets water main renewals based on risk (consequence of failure and probability of failure). Approximately 90% of all water main breaks occur on the cast iron portion of the distribution system, and since 1986, EWSI has replaced or rehabilitated approximately 50% of the cast iron mains within Edmonton. When a water main is selected for renewal, EWSI reviews the water network to meet current standards (i.e. pipe sizes, hydrant spacing & locations, etc.).

Infill Fire Protection Program

The Infill Fire Protection Program provides a methodology to fairly share the costs of upgrading fire protection infrastructure in older neighbourhoods to current standard amongst infill developers, EWSI water ratepayers and the City's Fire Rescue Services department. Prior to initiation of a pilot project for this program in 2020, infill developers paid for 100% of water infrastructure required to serve a new development or upgrade an existing area including costs related to fire protection upgrades to current standards set out in Volume 4 of the City of Edmonton Design and Construction standards.

The cost share approach recognizes that some fire protection upgrades to the water system that improve fire protection in established areas benefit the entire neighbourhood, including:

- Expansions: replacing existing water mains with larger mains or adding hydrants to improve fire protection; and
- Realignments: relocating existing water mains and hydrants from an alley to the street to provide mid-block fire protection.

The cost sharing approach will allow some infill projects to proceed that otherwise may have been deemed unviable by the infill developer. The cost share approach is not a subsidy for infill developers. EWSI has worked closely with the infill development industry and City of Edmonton to develop this program.

EWSI has forecast total program capital expenditures during 2022-2024 at $20 million for this new program.

Infill Fire Protection Assessment

Complementing the Infill Fire Protection Program, the City and EWSI have implemented a new review process to determine whether water infrastructure for on-street fire protection is needed for rezoning, subdivision and development permit applications. During the review of a development permit application, EWSI conditions water infrastructure upgrades based on the requirements of the City of Edmonton Construction and Design Standards which look at the highest use permitted under the Zoning Bylaw. Fire Rescue Services can complete a site-specific review to assess existing hydrant spacing and fire flows, using the methodology outlined in the Fire Underwriters Survey.

This assessment process provides a technical basis to relax the upgrades conditioned by EWSI should the existing fire flows and hydrant spacing be found to be sufficient as a result of the site-specific assessment for the subject site and can potentially eliminate or reduce the large financial barriers for projects posed by those upgrades.

As these are site-specific assessments, for the purposes of this study, upgrades have been identified to meet the design criteria provided in Section 3.2.2.1.

3.2.3 Currently Proposed Improvements/Expansion

There are no currently proposed improvement or expansions within the infill areas aside from ongoing renewal programs.

3.2.4 Recommended Capacity Expansions to Achieve the City Plan

Similar to the existing system assessment, recommended expansions were considered to address areas where the available fire flows and hydrant spacing does not currently achieve the guidelines set in the current Design and Construction standards. Through a combination of these components, the required 300 L/s can be provided to the infill areas.

The hydraulic assessment was completed by EWSI, with recommendations for hydraulic upgrades to meet the fire flow targets. The existing system assessment was provided back to EWSI, to help develop the scope of the required hydraulic assessments. EWSI then completed hydraulic modelling for each of the nodes and corridors. Results of the hydraulic assessments were provided to AECOM; the memoranda are included in Appendix A.

Improvements were identified for each area and were split between renewals and new pipes. As noted in Section 3.2.2.2, EWSI has an ongoing cast iron renewal program in which the aging cast iron watermains are removed and replaced with PVC watermains to help mitigate risk of pipe breaks in the system. At the time of renewal, the watermains can be replaced with a larger diameter watermain to provide increased flow rates as required. Improvements to system hydraulics that can be achieved by upsizing watermains identified for renewal are considered renewal upgrades.

In areas where there is currently a watermain not targeted for replacement through the cast iron renewal program, or no watermain at all, proposed watermains to improve system hydraulics are considered new pipe upgrades.

EWSI's recommended hydraulic upgrades were reviewed against the hydrant maps. Any new mains can have additional hydrants added as necessary to provide the required coverage. AECOM reviewed the remaining areas that do not currently achieve the guidelines set in the current Design and Construction standards. Additional water main upgrades were identified to allow for installation of new hydrants as required. For example, if the existing water main is located in a back alley, even if it is proposed for renewal, it would remain in the back alley. To provide sufficient hydrant coverage, additional water mains were proposed as needed.

For four of the areas (97 Street, 118 Avenue, University-Garneau, and Whyte Avenue) EWSI provided two options for providing hydraulic improvements. Option 1 primarily focused on watermain renewals gradually improving available fire flows within the area. Option 2 was developed for consideration by the City and EWSI to proactively upsize existing watermains or install additional new watermains to allow for development of high-value properties in the nodes and corridors, ahead of waiting for development requests and current gradual improvements through development and cast-iron renewal programs. A summary of the improvements for each area is provided below.

- **109 Street:** The majority of the improvements can be addressed through renewal programs, with one new main proposed for hydraulic improvement and one for hydrant coverage.
- **111 Avenue:** Hydraulic improvements are addressed through approximately 50% renewals and 50% new mains. For hydrant coverage, there are sections along 111 Avenue that require new mains, with new mains providing additional looping around the edges of the corridor for hydraulic improvements.

- **118 Avenue (West):** For Option 1, most of the improvements can be addressed through renewal programs. For Option 2, a combination of renewals and local loops are proposed to improve fire flows and hydrant coverage.
- **118 Avenue (East):** For Option 1, all hydraulic upgrades are proposed through the renewal program. For Option 2, the majority of the improvements can be addressed through renewal programs. There are local loops proposed to improve fire flows and a new main along 118 Avenue west of 34 Street to allow for additional hydrants.
- **97 Street:** For Option 1, all hydraulic improvements can be addressed through the renewal program. Option 2 considers the addition of a new main along portions of 97 Street combined with local improvements, for approximately a 50% split between renewal upgrades and new mains.
- **Centre City:** Within Centre City, over 90% of the upgrades are proposed through the renewal program. There are local areas where new mains are proposed to address gaps in hydrant coverage.
- **Stadium:** The majority of the Stadium node currently meets the required fire flows, and the areas identified for hydraulic improvements can all be addressed through renewals.
- **Stony Plain Road (West):** The upgrades proposed west of 149 Street are new water mains for both hydraulic improvements and hydrant coverage improvement, with some renewals adjacent to 149 Street.
- **Stony Plain Road (East):** The upgrades proposed east of 149 Street are primarily watermain renewals, with two localized new mains for hydraulic improvements. It should be noted that these upgrades will be triggered by rezoning for infill development, and will be in addition to watermain work occurring for the Valley Line West LRT construction.
- **University / Garneau:** All upgrades proposed are to provide hydraulic improvements. Option 1 considered approximately 95% of the upgrades to be completed through the renewal program, and Option 2 considered the addition of a new main along 108 Street which reduces the renewal length to be upsized by 50%.
- **Whyte Avenue/ 99 Street:** All upgrades proposed are to provide hydraulic improvements. Option 1 considered approximately 99% of the upgrades to completed through the renewal program. Option 2 considered the addition of a new main along 99 Street which reduces the renewal length to be upsized by 75%.

The recommended water main expansions are shown on Figures A.1 through A.9 in Appendix A for each node and corridor area, with the proposed lengths summarized in Table 3-2.

Table 3-2: Water Main Improvement Summary

Node/Corridor Area	Water Main Renewal Length (m)	Hydraulic Improvement New Water Main Length (m)	Hydrant Coverage Improvement New Water Main Length (m)	Total Length (m)
109 Street	1,350	210	280	1,840
111 Avenue	1,130	680	540	2,350
118 Avenue – Option 1	26,400	580	820	27,800
118 Avenue – Option 2	12,170	2,600	820	15,590
97 Street – Option 1	10,270	0	1,320	11,590
97 Street – Option 2	2,690	2,870	1,320	6,880
Centre City	30,370	90	2,110	32,570
Stadium	2,480	0	0	2,480
Stony Plain Road	10,520	860	400	11,780
University / Garneau – Option 1	9,900	320	0	10,220
University / Garneau – Option 2	4,090	1,130	0	5,220
Whyte Avenue/ 99 Street – Option 1	17,960	110	0	18,070
Whyte Avenue/ 99 Street – Option 2	4,180	1,450	0	5,630

3.2.5 High-Level Costs

Cost estimates were developed for the recommended water mains for hydraulic and hydrant coverage improvements.

If infill development does not occur or proceeds within the nodes and corridors without triggering a land use zoning change, EWSI would renew the water mains at their cost as dictated by risk, and the hydraulic capacity would improve over time with the ongoing renewals (Option 1). However, EWSI has noted that renewals will be implemented over a very long timeline and are unlikely to be completed prior to infill development . Therefore, it is very likely that the hydraulic improvements required to support infill development will be required in advance of the renewal program (Option 2). For Option 2, developers would be responsible for front-ending the cost of the renewal improvements if the mains do not qualify for the Water Main Renewal or the Infill Fire Protection Program.

Cost estimates for both Options 1 and 2 were developed for comparison purposes.

Unit costs of $1900 per lineal metre (l.m.) were provided by EWSI based on 2020 construction costs for water replacements, including water main installation with associated appurtenances and hydrants, as well as road restoration. It should be noted that average costs were considered for planning purposes; however, costs of water main installations within existing areas can be highly variable depending on local conditions and constraints such as utility congestion, mature trees, pedestrian and traffic impacts, road restoration requirements, and connections to the existing system. Cost estimates are in 2020 dollars, and include a 50% contingency, and are summarized in Table 3-3 below.

Table 3-3: Water Main Costs

Node/Corridor Area	Length of Improvement (m)		Total Cost (including 50% contingency)	
	Option 1	**Option 2**	**Option 1**	**Option 2**
109 Street	1,840		$5,244,000	
111 Avenue	2,350		$6,697,500	
118 Avenue	27,800	15,590	$79,230,000	$44,431,500
97 Street	11,590	6,880	$33,031,500	$19,608,000
Centre City	32,570		$92,824,500	
Stadium	2,480		$7,068,000	
Stony Plain Road	11,780		$33,573,000	
University / Garneau	10,220	5,220	$29,127,000	$14,877,000
Whyte Avenue / 99 Street	18,070	5,630	$51,499,500	$16,045,500
TOTAL	**116,560**	**84,340**	**$338,295,000**	**$240,369,000**

3.2.6 Process for Utility Improvements

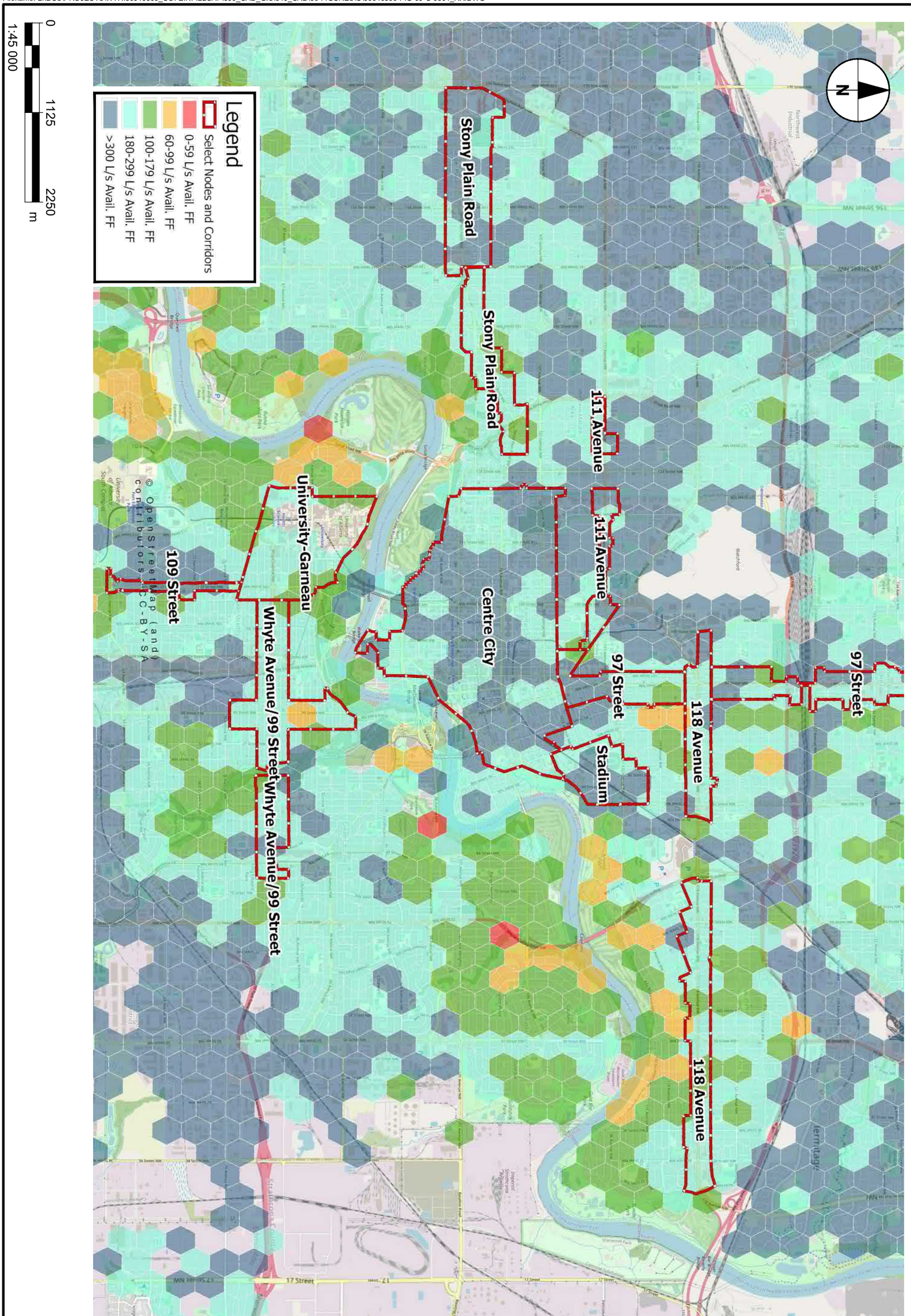
The proposed water main upgrades will be triggered by fire flow requirements as development progresses.

The costs of the improvements to meet fire flow and hydrant spacing requirements for infill redevelopment, will be the responsibility of the developer with two exceptions (refer to Section 3.2.2.2 for details):

- The project qualifies for the risk-based renewal program
- The project qualifies for the infill fire protection program

Costs for Option 2 have been identified for consideration by the City and EWSI to fund through one of the alternative programs noted above that would open up opportunities for development in these priority nodes and corridors. It is recommended that the options be reviewed at the time of infill development within each node and corridor. As the system hydraulics will improve over time through the renewal programs, if the majority of the renewals have occurred prior to infill development (Option 1) the fire flow targets may have been achieved.

New water mains are recommended to be completed in conjunction with other projects, where possible, to minimize disruption to residents and businesses.



INFRASTRUCTURE CAPACITY REVIEW STUDY
CITY OF EDMONTON
Project No.: 60640590 Date: 2022-03-02

AVAILABLE FIRE FLOW OVERVIEW

AECOM

Figure: 3.1

3.3 Drainage Servicing – Stormwater, Sanitary and Combined Sewer

Within the City of Edmonton, drainage servicing is provided by EPCOR. Drainage servicing includes the collection, conveyance, storage and treatment of both stormwater and wastewater. The current servicing within the City of Edmonton consists of a separated system which ultimately connects to the combined sewer system in the center of the City. A separated system includes the conveyance of stormwater and wastewater in dedicated and separate sewers. The combined system conveys both stormwater and wastewater in a single pipe.

Within the urban areas of Edmonton, stormwater drainage system is provided by a combination of surface drainage and buried storm sewers, consisting of both smaller local sewers and larger trunk sewers. In the separated systems, these trunks discharge directly to the river. Within the drainage system, stormwater ponds are provided to store runoff and control the flow to the available capacity of the downstream sewer system. Within the combined system, the stormwater drainage system ultimately connects to the combined sewers.

Within the urban areas of Edmonton, the wastewater drainage system, like the stormwater drainage system, consists of smaller local sewers and larger trunk sewers. Where the sewers cannot drain by gravity, pump stations and forcemains are provided. All the sanitary sewers whether in a separated or combined sewer system, ultimately connects to the combined sewers.

The combined sewers convey the combined stormwater and wastewater to the wastewater treatment plant. During dry weather, the combined sewer system conveys all flow to the wastewater treatment plant. During wet weather, when the stormwater runoff increases, the capacity of the combined sewers system and the wastewater treatment plant may be exceeded. In this case, the excess flow is discharged directly to the river, referred to as a combined sewer overflow or CSO.

3.3.1 Existing System Capacity Assessment

All the nodes and corridors, with the exception of the Stony Plain Road Corridor, 109 Street, 111 and 118 Avenue, lie within the combined sewer system as shown on Figure 3.2. For these exceptions, a portion is serviced by a separated sewer system.

Under existing conditions and the current urban form, there is adequate capacity in the combined system for dry weather flows and typical storm events. However, during major storm events there may be capacity issues in specific areas throughout the City. EPCOR initiatives including the Sanitary Integrated Resource Plan (SanIRP) and Stormwater Integrated Resource Plan (SIRP) are evaluating the system and exploring increasing capacity for major events.

For the purposes of the assessment of the existing system and identifying available capacity to service infill development within the proposed nodes and corridors, it was assumed that the existing system does not have additional conveyance capacity during extreme wet weather events. Storage of increased volumes or reduction of peak runoff into the drainage network will be required to accommodate infill development, and to offset the increase in both stormwater and wastewater flow and volume. It is important to note that a detailed capacity analysis of the existing drainage system was not undertaken as part of this study. The capacity of lateral sewers adjacent to the re-development will need to be reviewed on a case by case basis.

3.3.2 Current Standards and Programs

3.3.2.1 Relevant Standards

In development of the drainage system improvements, the following standards and design criteria is required:

- Sanitary sewage generation rates on a per capita (per person) basis to be applied to both the residential population and employment numbers.
- Rainfall runoff coefficients to be applied to areas proposed for redevelopment.

EPCOR's Design and Construction Standards - Volume 3 Drainage (August 2020) indicates the following:

- A sanitary sewage generation rate of 220 L/person/day.
- Rainfall runoff coefficients based on land use as shown in Table 3-4.
- Infiltration/inflow allowance of 0.28 L/s/ha plus 0.4 L/s/ha for manholes located in sags.

EPCOR's On-site Stormwater Management Guidelines

- This guideline applies to individual lot development areas between 0.16 to 3.0 ha and is intended to address stormwater discharge from developing or re-developing properties. Properties re-zoned to a higher density in most instances are required to control their stormwater outflow rate and provide detention facilities to temporarily store the excess storm runoff and gradually release to the sewer system. Storm flows are to be restricted to 0.035 m^3/s/ha or as required by EPCOR Drainage.

Table 3-4: Standard Runoff Coefficients

Land Use	Runoff Coefficient
Low Density Residential (LDR)	0.5
Medium Density Residential (MDR)	0.65
High Density Residential Mixed (HDR)	0.9
Commercial and Institutional Mixed	0.75
Parks	0.1

The runoff coefficient relates the amount of runoff to the amount of precipitation. A higher runoff coefficient is applied to areas with higher impervious areas such as buildings and pavement which do not allow for infiltration. Lower runoff coefficients are applied to more permeable, vegetated areas. These runoff coefficients were used to determine the increase in runoff due to the redevelopment within the nodes and corridors.

Through discussions with EPCOR, it was noted that water consumption and subsequent wastewater generation on a per capita basis is on the decline and is expected to continue to drop as water fixtures and appliances become more water efficient. It was concluded that a lower rate than the current standard of 220 L/person/d should be adopted for this study in lieu of the more conservative standards.

EPCOR reviewed the existing water use in each of the nodes and corridors. Due to the mix of commercial and residential uses the per capita demand varies but in general, as density increases, per capita (per person) residential water use decreases. Commercial water use however is less predictable and depends on the type of development. EPCOR recommended moving forward with a wastewater generation rate of 160 L/person/d or L/job/d to balance between existing water use and future trends towards water efficiency. However, water intensive businesses will need to be reviewed on a case by case basis.

EPCOR is currently reviewing their design standards as part of the Integrated Resource Planning (IRP) process and in co-ordination with the City's zoning bylaw initiatives. Additional consultation is planned with the City and development stakeholders as EPCOR continues to develop their IRPs and increase their system knowledge through the use of demographic and system monitoring data.

3.3.2.2 Stormwater Integrated Resource Plan

The Stormwater Integrated Resource Plan (SIRP) developed by EPCOR provides a risk-based approach to addressing stormwater flooding within the City of Edmonton. The program is based on the following fundamental themes:

- **Slow** the entry of stormwater into the drainage system through green infrastructure and dry ponds.
- **Move** excess water away from areas quickly and efficiently through the use of trunk sewers and the implementation of sewer separation.
- **Secure** individual properties in higher risk areas prone to sewer backup or flooding from overland drainage or river flooding through Inflow/infiltration reduction, flood proofing and outfalls and control gates.
- **Predict** the movement of stormwater to allow better management through the implementation of monitoring and controls.
- **Respond** quickly to protect life, safety and property through emergency response plans and equipment.

SIRP will guide how future stormwater management will proceed within the City of Edmonton, to address both existing drainage problems and accommodating increase flows resulting from infill and densification activities. One of the goals of SIRP is to provide an environmental benefit equivalent to sewer separation while reducing flood risk. While sewer separation is incorporated with improvement projects where it makes sense to do so, an equal benefit can be achieved by incorporating stormwater storage, green infrastructure and taking into account the environmental benefit of continuing to treat stormwater conveyed in the combined system.

3.3.2.3 Sanitary Integrated Resource Plan

The Sanitary Integrated Resource Plan (SanIRP) is currently being developed by EPCOR. EPCOR will be consulting with stakeholders and targeting end of 2022 for publication. Utilizing a One Water approach, the SanIRP will provide a holistic and integrated long range plan for the wastewater system to ensure the long term operational, environmental and financial sustainability of the utility. There are currently two objectives:

1. Develop a cost-effective and resilient wastewater infrastructure master plan based on current design assumptions to plan for the future growth and redevelopment of the City.
2. Through a One Water approach, develop an integrated long-term strategy to provide resilient and sustainable wastewater services. This includes focus on water conservation and sewage generation, optimize corrosion and odour reduction initiatives, optimize risk-based asset management to drive capital planning, implement inflow and infiltration reduction, develop climate change adaptation and mitigation strategies, develop a monitoring strategy and examine energy optimization.

3.3.3 Currently Proposed Improvements/Expansion

There has been a number of servicing and infrastructure studies associated with the nodes and corridors completed.

The following reports associated with the respective nodes and corridors were reviewed:

- Centre City Major Node
  - Servicing for Downtown Intensification Concept Plan, Sameng, 2012
  - Servicing for Downtown Intensification Project VE Report, SMA, 2014
  - Upgrading Study for Mature Neighbourhoods 2014A, ISL, 2014
  - 104 Avenue Corridor Drainage Servicing Concept, ISL, 2015
  - Downtown Intensification Drainage Design Project Preliminary Design Report, Stantec, 2015
  - McCauley Neighbourhood Upgrading Study, Stantec, 2013
  - Review of CSO Control Strategy Implementation, ISL, 2019
  - Sewer and Drainage Servicing Upgrading Plan for Infill Development in Downtown Edmonton and the Quarters, Stantec 2009
- University-Garneau Major Node
  - Upgrading Study for Mature Neighbourhoods 2015A, Stantec, 2015
- Stadium District Node
  - Stadium TOD Infrastructure Assessment, ISL, 2010
- 97 Street Primary Corridor
  - Upgrading Study for Mature Neighbourhoods, ISL, 2012
- 118 Avenue Primary Corridor
  - Upgrading Strategy for Mature Neighbourhoods 2014B, ISL, 2014
- 111 Avenue Primary Corridor
- Stony Plain Road Primary Corridor
  - TOD Infrastructure Capacity Study- Glenora, SMA, 2019
  - Area Redevelopment Plan, Stantec, 2014
- Whyte Avenue / 99 Street Primary Corridor
  - Plan Whyte Mobility and Infrastructure Study, Stantec, 2017
- 109 Street Secondary Corridor

All of the above listed reports were completed prior to the implementation of the IRP approach and emphasized traditional piped infrastructure. In general, the proposed upgrades identified within the reports, will be re-examined in the context of the SIRP and the upcoming SanIRP, and were not considered further in the evaluation of the nodes and corridors.

The SIRP includes the construction of a number of dry ponds and the incorporation of Low Impact Development (LID) facilities to address the increase in stormwater and flooding concerns across the developed part of the City due to climate change and increased development densities. The exact location of these ponds was not available for consideration in this study. SIRP also includes conveyance and trunks including localized sewer separation. It is also expected that the SanIRP will address the increase in wastewater across the developed area of the City by reviewing ways to mitigate peak stormwater flows in the wastewater system through storage and inflow and infiltration reduction.

3.3.4 Recommended Capacity Expansions to Achieve the City Plan

3.3.4.1 Proposed Concept

Infill development proposed within the nodes and corridors will result in the following impacts:

- An increase in wastewater associated with the increase in population residing and working within the proposed nodes and corridors.
- An increase in wastewater associated with the introduction of water intensive businesses such as breweries, car washes or other food processing facilities.
- An increase in stormwater runoff resulting from densification and an increase in impervious areas within the proposed nodes and corridors.

The proposed corridors are currently serviced through the combined sewer system or in an area that eventually drains to a combined system, where both the wastewater and stormwater are collected and conveyed in the same pipe. The available capacity for growth varies throughout the combined sewer system and the utilization of the system depends on the size of the rainfall event experienced. For the purposes of this study, the required improvements were based on the assumption that the existing system does not have significant excess capacity during rainfall events and that the redevelopment may not increase flows to the existing system during major storm events.

The increase in stormwater runoff will be accommodated through the provision of additional storage in the form of dry ponds, pocket storage or underground storage. The addition of low impact development (LID) facilities or green infrastructure which will also have a positive impact on reducing the total stormwater runoff, can also be considered when establishing the total storage. The provision of storage will be consistent with the SIRP and the overall theme of “Slow” regarding the entry of stormwater into the drainage system. The increase in wastewater can be accommodated by overcontrolling the stormwater runoff and providing additional stormwater storage equivalent to the increase in wastewater volume generated.

EPCOR is also exploring options including an inflow and infiltration reduction strategy to decrease extraneous flows in the sewer system to free up capacity for development and water conservation analysis opportunities to better understand projected wastewater flows for infill development.

Dry Ponds are ponds constructed within the drainage basin to store stormwater during the rainfall event while discharging at an allowable rate back into the storm sewer system. They are typically dry, as their name implies, and are only wet when the stormwater runoff resulting from a rainfall or snow melt event, exceeds the capacity of the storm sewer system. The dry pond would require both an inlet and outlet to the storm sewer system, and typically requires significant land to construct. However, when designed accordingly, dry ponds can be used as park areas and sports fields during dry weather.

If there is insufficient space provided to construct a dry pond, then underground storage would be an option. This is provided through oversized pipes or buried tanks, which typically require a pumping facility to drain the stored runoff back into the storm sewer system.

Pocket storage are small, constructed depressions within existing boulevards, roadway medians or green areas, which also provide storage.

LID Facilities currently included in EPCOR's design standards for implementation in the City of Edmonton include the following:

- Bioretention Basins
- Box Planters
- Soil Cells
- Bioretention Gardens

EPCOR may also accept other LID designs that provide storage and flow control. There are many options to provide storage and/or reduce stormwater runoff for infill development including incorporating green spaces and parks in the infill development planning, green or blue roofs on infill buildings or on-site stormwater reuse.

These LID facilities are designed to retain and store runoff from smaller rainfall events, which ultimately drain back into the storm sewer system once the soil media has become saturated. They also provide a water quality benefit.

The types of storage are illustrated in the following diagrams.

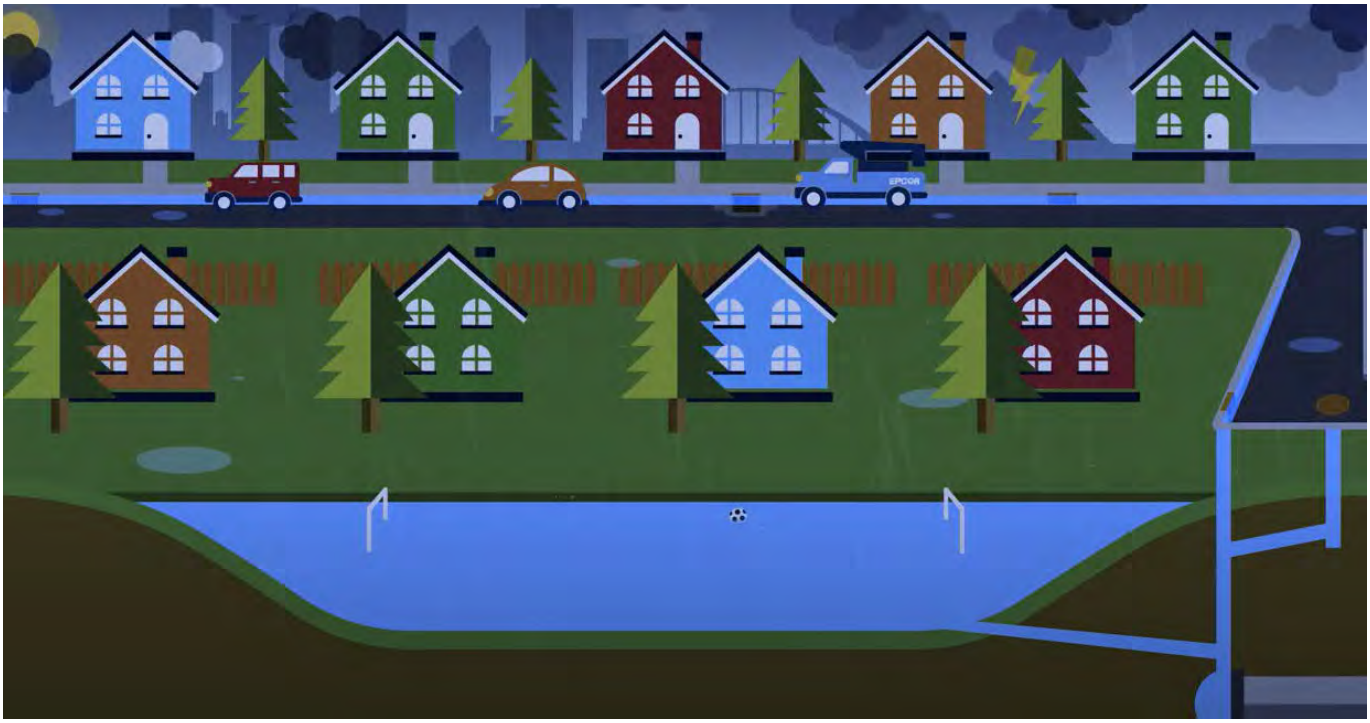


Diagram 1 - Dry pond (Source: EPCOR https://www.youtube.com/watch?v=qh3YiV8TMXU)

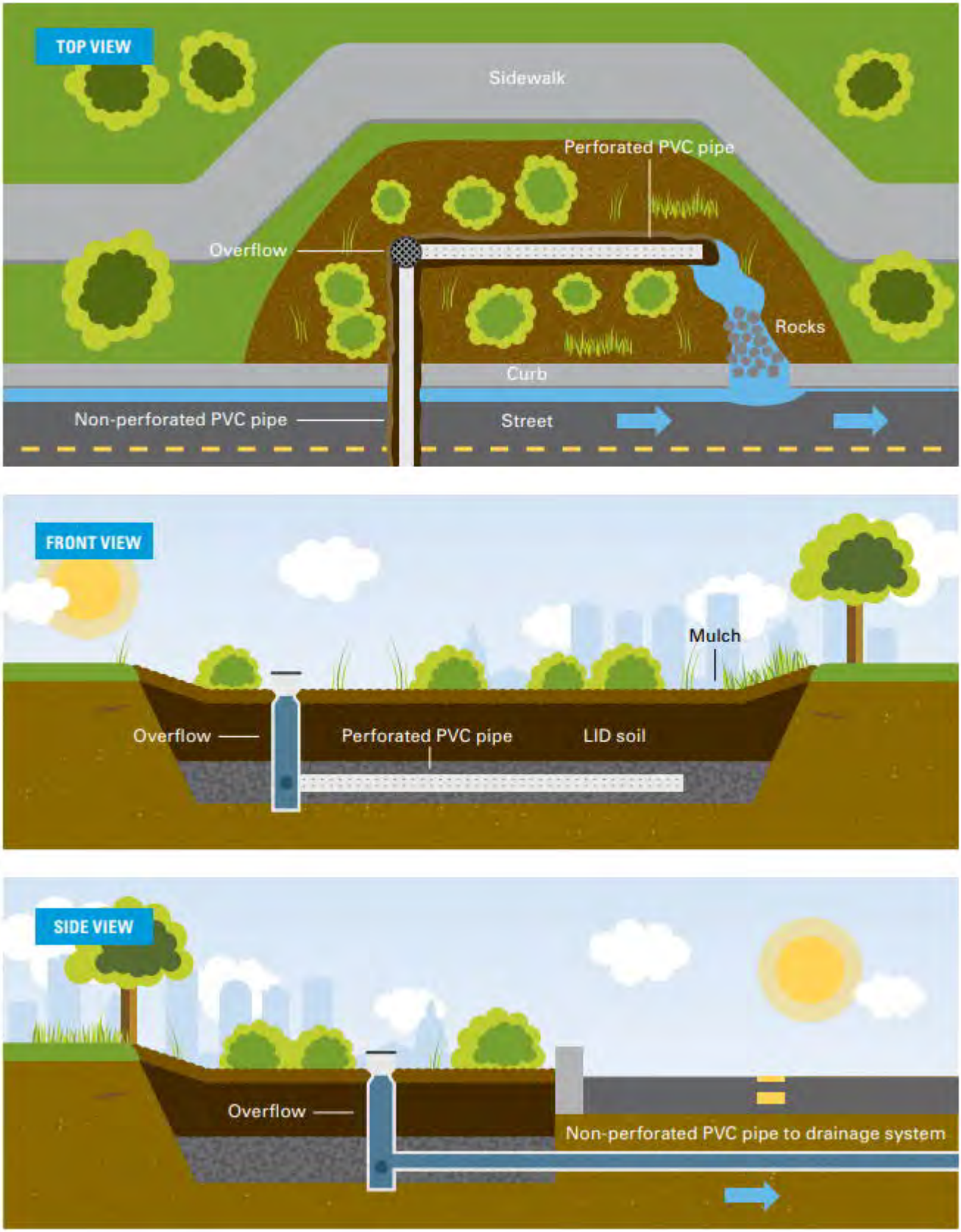


Diagram 2 - Bioretention Basins (Source: EPCOR https://www.epcor.com/products-services/drainage/flood-mitigation/PublishingImages/Bioretention%20Basin-illustration.pdf)

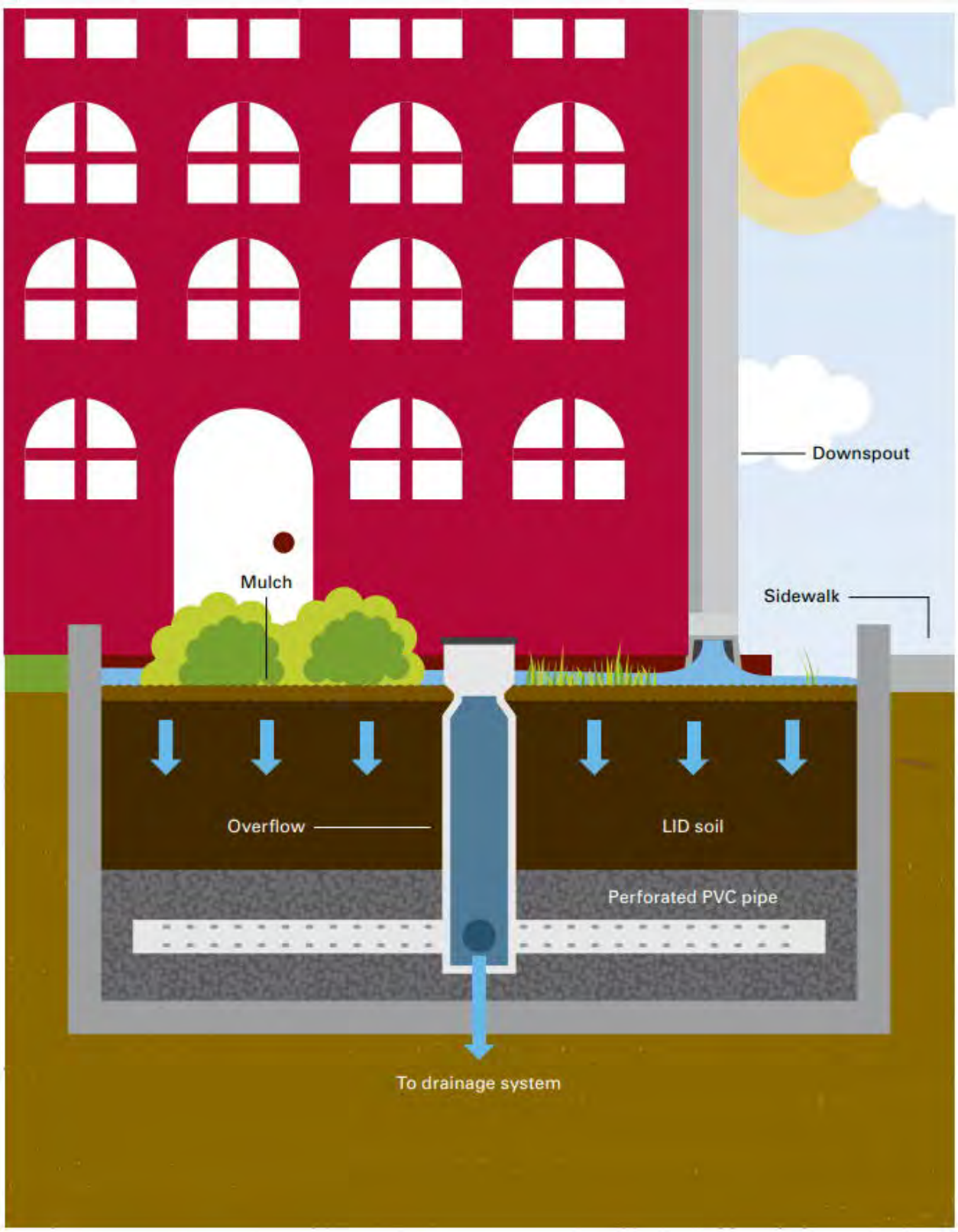


Diagram 3 -Box Planters (Source EPCOR https://www.epcor.com/products-services/drainage/flood-mitigation/PublishingImages/Box%20Planters-illustration.pdf)

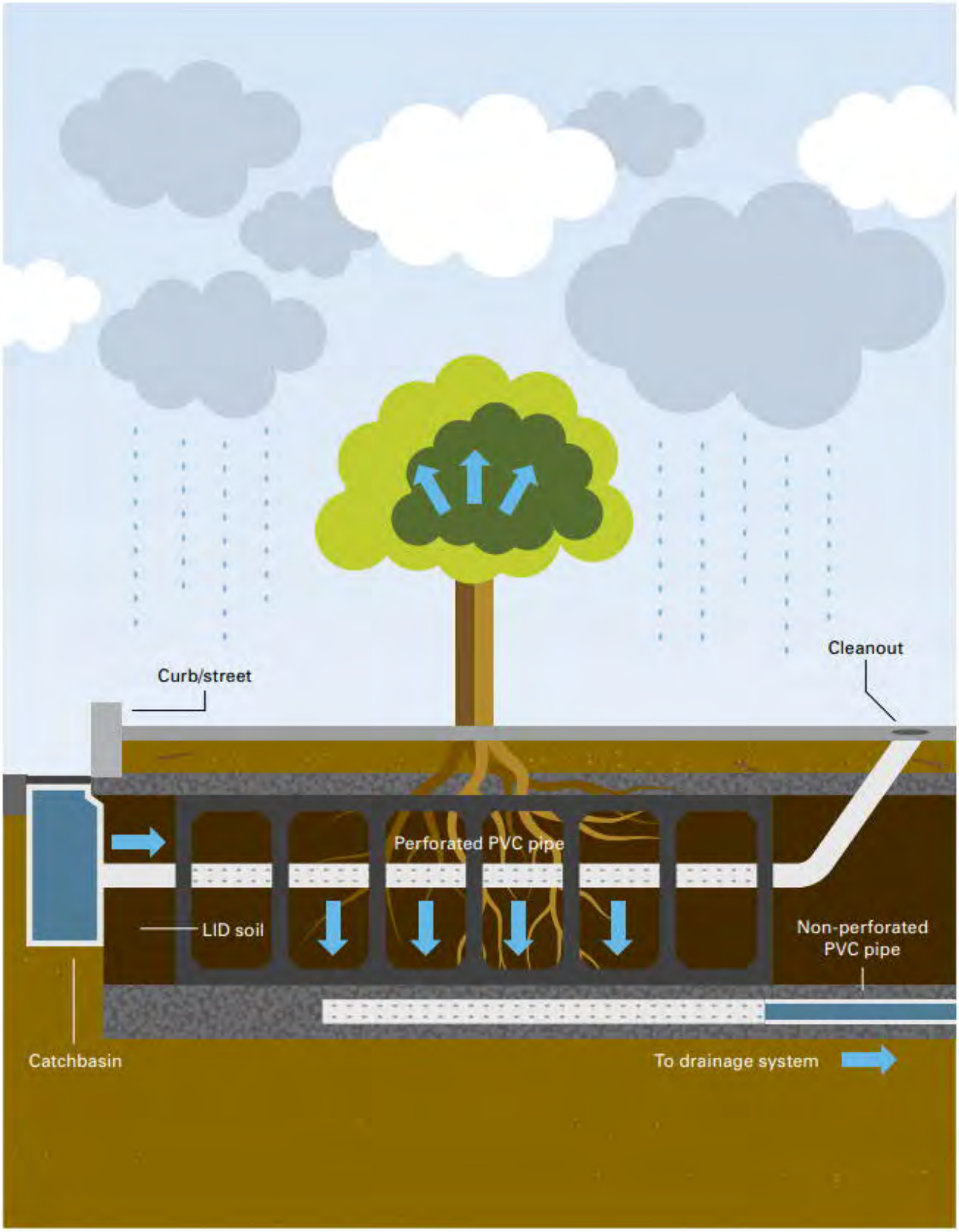


Diagram 4 - Soil Cells (Source EPCOR https://www.epcor.com/products-services/drainage/flood-mitigation/PublishingImages/Soil%20Cells-illustration.pdf)

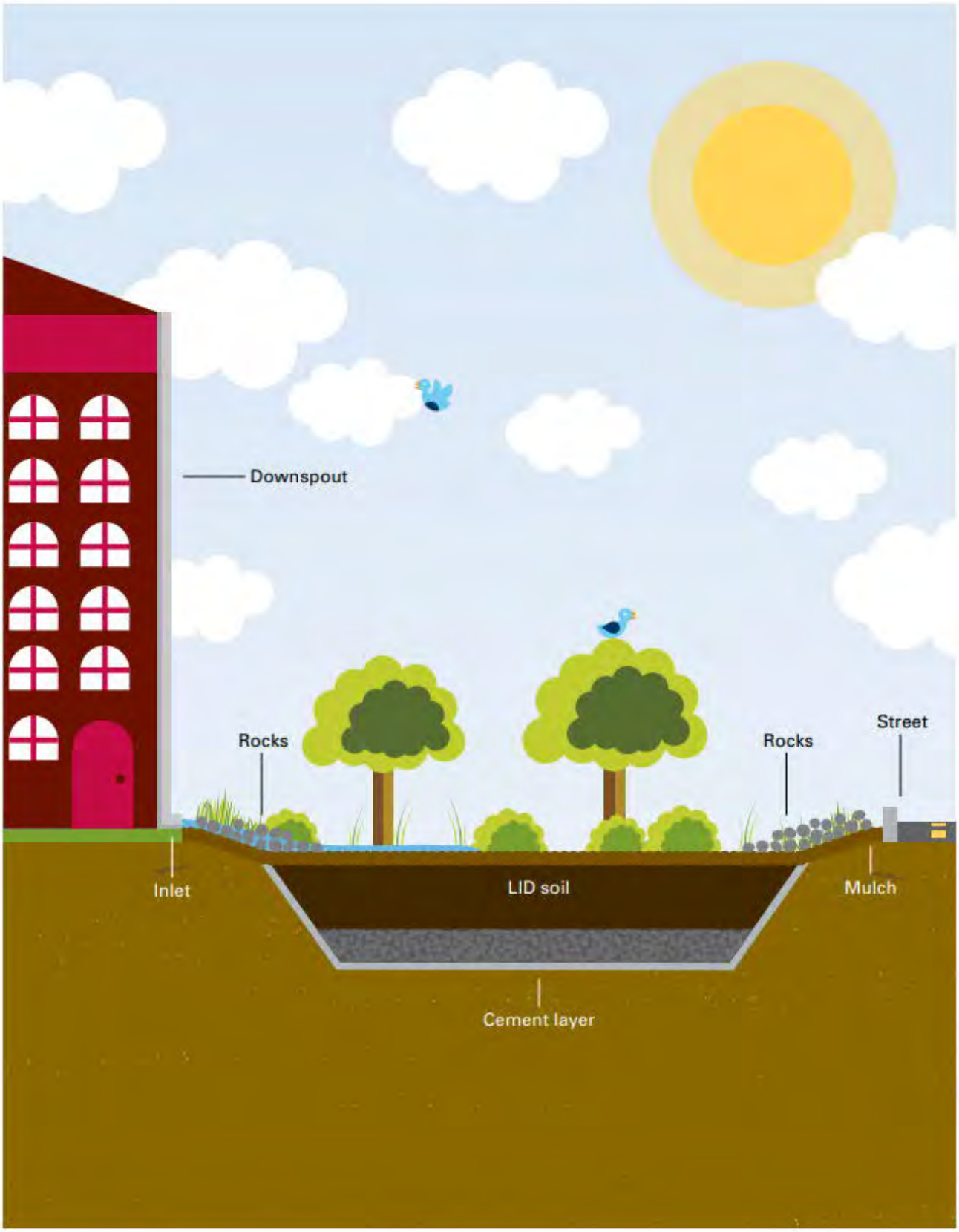


Diagram 5 - Bioretention Gardens (Source EPCOR https://www.epcor.com/products-services/drainage/flood-mitigation/PublishingImages/Bioretention%20Garden-illustration.pdf)

The type and actual location of the storage facility will be determined at the time of development and will depend on the sequencing of development, the area available to accommodate surface storage and the need to provide underground storage. LID facilities could also be implemented as a means to reduce the overall storage volume. The storage volumes could also be incorporated with other major dry ponds proposed under SIRP, provided the proposed dry ponds are within the same drainage basin.

To accommodate the increase in flows due to redevelopment within the Nodes and Corridors, both large scale storage and small scale storage including LID at the lot level will be required. This is consistent with the existing On-site Development Stormwater Guidelines which currently have requirements related to storage and release of runoff.

The impact of development on lateral and trunk sewers will need to be reviewed on a case by case basis as development proceeds and more information is available, however, the concept that increases in flows are mitigated through the use of storage, LID design and I/I reduction is intended to minimize the need for upgrades.

There are portions of the nodes and corridors including a portion of the Stony Plain Road corridor, 109 Street, 111 Avenue and 118 Avenue corridors which drains to a separate stormwater system. There is potential that this system may have some capacity for re-development which may reduce the need for storage. For the purposes of this study, stormwater storage has been applied equally to all nodes and corridors based on the proposed land use. A more detailed study could determine the precise need for storage based on the available capacity in the separate system. In addition, storage of stormwater in these corridors may not directly reduce flows in the down stream combined system. In these cases, storage would need to be incorporated downstream within the combined system where possible or other methods including inflow and infiltration reduction or water conservation measures implemented.

3.3.4.2 Stormwater

The additional stormwater runoff was estimated based on the following:

- the differences in land use from the exiting scenario to the future scenario
- rainfall runoff coefficients as follows:
  - Low Density Residential – 0.5
  - Medium Density Residential – 0.65
  - High Density Residential – 0.9
  - Commercial/Institutional – 0.75
  - Parks – 0.1
- the 1:100-year rainfall event equivalent to 103 mm of rain

The storage volume required to address the increase in stormwater runoff for each of the proposed nodes and corridors is summarized in Table 3-5. Storage can be provided anywhere in the same drainage basin and does not necessarily need to be within the node and corridor or the redeveloped property. It is anticipated that a combination of shared storage and on-site storage will be required. The storage volumes are based on the current 1 in 100 year rainfall event as per City of Edmonton Drainage Standards. Going forward, the rainfall event can be reviewed to assess any impacts due to climate change.

Table 3-5: Stormwater Storage Summary

Nodes & Corridors	Additional Storage Volume for Growth (m^3)
109 Street	1,200
111 Avenue	5,100
118 Avenue	12,900
97 Street	8,700
Centre City	27,700
Stadium	8,500
Stony Plain Road	20,100
University-Garneau	13,000
Whyte Avenue/99 Street	9,800
Total	**106,900**

3.3.4.3 Wastewater

The additional wastewater volume generated was estimated based on the following:

- the differences in population and jobs from the existing scenario to the future scenario
- wastewater generation rates for both residents and jobs based on L/person or job/d
- a 24 hour storage duration

The equivalent storage volume required to address the increase in wastewater volumes for each of the proposed nodes and corridors is summarized in Table 3-6. Wastewater will not be stored, rather, additional stormwater will be stored to offset the increase in wastewater flows. These reductions in volumes can occur upstream of the nodes and corridors as well and can incorporation inflow reduction and groundwater infiltration reduction which can occur during both dry and wet weather periods in some locations. The volume of storage may also be reduced if additional monitoring can confirm a lower wastewater generation rate and the effectiveness of any inflow and infiltration reduction programs.

Table 3-6: Wastewater Storage Summary

Nodes & Corridors	Storage Volume (m^3)
109 St	700
111 Ave	1,800
118 Ave	3,700
97 St	2,700
Centre City	24,700
Stadium	1,200
Stony Plain Rd	4,000
University-Garneau	5,400
Whyte Ave/99 St	6,500
Total	**50,800**

3.3.5 High Level Costs

The costs to provide storage to address both an increase in stormwater and wastewater resulting from infill development for each of the proposed nodes and corridors are summarized in Table 3-7. Cost were based on average unit costs provided by EPCOR for similar storage projects. The unit cost is highly variable and can depend on the size and location of the storage as well as other factors. Dry pond and pocket storage can range from $200 to $2,500 per m^3 while LID features such as bioretention areas can range from $2,000 to $5,000 per m^3 while soil cells can cost from $1,000 to $10,000 per m^3 depending on whether they are in a retrofit application or installed at the time of development Underground storage costs are in the order of $1000-10,000 per m^3. and are especially variable depending on the circumstances of the development.

EPCOR has allocated equal investment in dry pond storage and LID facilities in SIRP capital funding. Larger storage facilities are typically lower in cost per m^3, however, as LID becomes more widely used and implemented as part of the initial overall site design process, costs are expected to decrease. An average unit cost of $1,700/$m^3$ was used for stormwater storage including all types of facilities.

The unit cost represent an average and are for high level estimations only. The actual cost will be dependent on the type, size and location of the storage. Costs are expected to be reduced, if the storage can be accommodated as part of the storage constructed under SIRP and if storage is incorporated in the design of future developments.

Table 3-7: Drainage Improvements – Summary of Costs

Nodes & Corridors	Total Storage Volume (m^3)	Total Cost ($)
109 Street	1,900	3,230,000
111 Avenue	6,900	11,730,000
118 Avenue	16,600	28,220,000
97 Street	11,400	19,380,000
Centre City	52,400	89,080,000
Stadium	9,700	16,490,000
Stony Plain Rd	24,100	40,970,000
University-Garneau	18,400	31,280,000
Whyte Avenue/99 Street	16,300	27,710,000
Total	**157,700**	**268,090,000**

3.3.6 Process for Utility Improvements

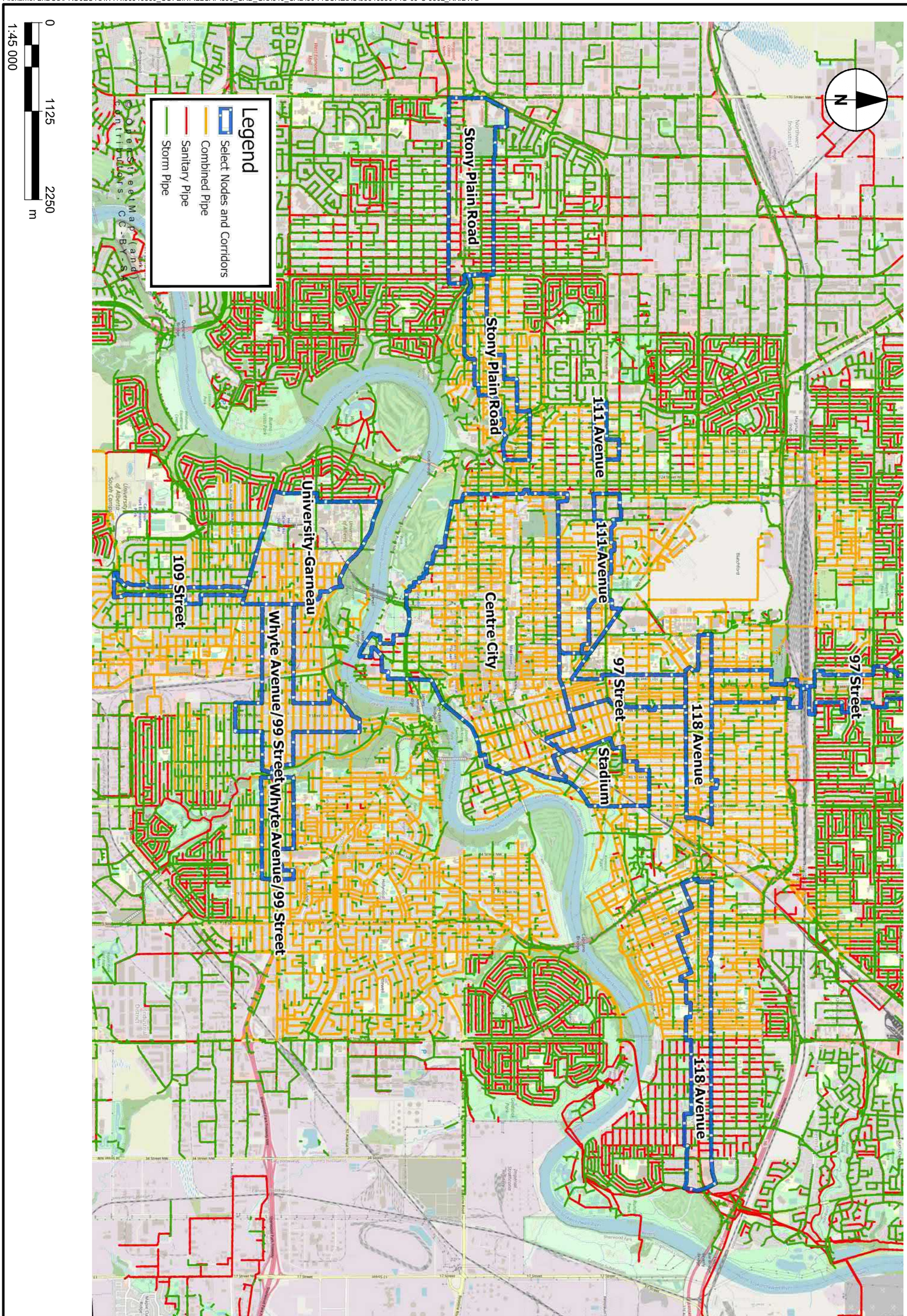
The storage requirements, and the type and location of storage facility can be determined during the development planning process. It expected that a mixture of options will be implemented including storage at various locations in the catchments, on-site stormwater management and low impact development strategies as well as water conservation and reduction in extraneous flows. It is expected that the costs of these improvements are the responsibility of the developer, as they are required to control both stormwater runoff and wastewater flows to current conditions by storing runoff to offset both stormwater and wastewater flow increases.

The opportunity of providing additional storage in the proposed storage being developed as part of the SIRP should be investigated at the time of development. Alternatively, designing and constructing these storage facilities with additional volume to offset the anticipated impact of the infill development ahead of development should be investigated.

As EPCOR manages expenditures through their performance based rates application, co-ordination with the City will be required to accommodate adjustments to drainage improvements. Cost sharing with developers for shared storage would require piloting of a new capital program and approval within the rate application. This is a similar approach to the cost sharing program for infill fire protection. The City and EPCOR may choose to explore different funding opportunities including a mix of investments from developers, the City and EPCOR

EPCOR also recommends the following:

- Allocate City of Edmonton owned lands or create parks/open space in infill developments to provide storage/reduce impervious area in the priority nodes/corridors.
- Encourage developers to use green or blue roofs for on-site stormwater management.
- Develop policies that encourage on-site runoff management and reuse.
- Investigate the potential for I/I reduction and water conservation in the sewershed to free up capacity in the sewer systems.
- Assess if SIRP/SanIRP investment could also be designed to accommodate increased density objectives of nodes/corridors.



INFRASTRUCTURE CAPACITY REVIEW STUDY
CITY OF EDMONTON
Project No.: 60640590 Date: 2022-03-02

EXISTING DRAINAGE SYSTEM

AECOM

Figure: 3.2

3.4 Shallow Utility Servicing

Shallow Utility Servicing includes:

- Power supply, transmission and distribution provided by EPCOR Distribution and Transmission Inc. (EDTI").
- Natural Gas supply and distribution provided by ATCO Gas.
- Telecommunications including telephone, cable and internet provided by either Telus or Shaw.

3.4.1 Power Servicing

3.4.1.1 Existing System Capacity Assessment

EDTI did not provide any specific information relative to the existing system capacity. Nonetheless, EDTI has responded quite positively to the City's infill growth objectives, as identified in this study.

It is evident that EDTI is not concerned about their ability to provide electricity service to the Nodes and Corridors as the growth occurs over time as anticipated by the City.

3.4.1.2 Current Standards and Program

Relevant Standards

EDTI uses as the relevant standard, the Alberta Utilities Commission (the "Commission"), which forms part of the Distribution Tariff of EPCOR Distribution & Transmission Inc. ("EDTI"), as well as the Customer Connection Guide (CCG).

Franchise Agreement

EDTI provides the necessary electrical infrastructure to service infill Nodes and Corridors under the Franchise Agreement between the City of Edmonton and EDTI. The Franchise Agreement defines how EDTI must operate in providing that infrastructure.

Entrance Bylaw for Beautification

The Entrance Bylaw for Beautification outlines how electricity and lighting is to be provided in a manner that addresses beautification, including the requirement to have power taken underground as redevelopment occurs.

3.4.1.3 Currently Proposed Improvements/Expansion:

EDTI continues to operate from a "Just-in-Time" delivery model. Expansions and Improvements are reactionary in nature, based upon demands for service. There are currently no proposed improvements and expansions planned for the proposed Nodes and Corridors. Nonetheless, it is clear that EDTI is well poised to react to the demand as it occurs.

3.4.1.4 Recommended Capacity Expansions to Achieve the City Plan

EDTI characterizes their planning and development of Electrical Utilities is a lot more "reactive" than for instance, deep utilities such as Water, Wastewater and Stormwater. As such, EDTI continues to operate from what they describe as a "Just-in-Time" delivery model. EDTI explained that this helps ensure protections for rate payers against misplaced, under-utilized and abandoned capital.

In the event that if the City is aware of specific projects and action plans that could provide more specific data, EDTI will gladly review and provide more detailed input. EDTI added that if the City is aware of specific projects with timelines and commitments and if the City were to share that information, then they can follow-up and provide insight as to what, if any, changes to a grid/circuit/lot would be required for accommodation.

EDTI considered the information with respect to the Nodes and Corridors and provided the following summary findings:

- EDTI characterizes their delivery model as a "Just-In-Time Utility ", meaning there is more responsiveness and a perceived "reactionary approach" as opposed to the proactive planning that deep utilities need.

- Edmonton's developer community has a clear understanding, and supports EDTI's traditional approach, as it best allows market demand to dictate where populations move, not infrastructure plans. This aspect helps protect rate payers as under-used capital placement is minimized and required capital is put into play as needed/where needed.

- EDTI suggests that if through the promotion of the nodes and corridors and a higher densification of population, the City of Edmonton is looking to change current development patterns, then the City of Edmonton can stimulate that growth and EDTI is prepared to respond.

- Based upon the population projections and the type of housing that is planned within these nodes and corridors, there is nothing to suggest that EDTI's process and "just-in-time model" would not be able to accommodate the anticipated growth, based on the existing infrastructure, development processes and typical growth and project timelines.

- EDTI has indicated that density and location are only part of the equation. Consumer habits impact the requirements as much as volume and density. Disruptors such as electric vehicles, pushes to public transit, the penetration of solar micro-generation etc. All of these carry considerations that can greatly impact what/how EDTI will need to evolve infrastructure in any section of the identified nodes/corridors.

- EDTI have confirmed that they can respond to the City's plan to promote infill as contemplated by this study.

- EDTI added that how end users intend to use the available capacity available to them is as important as the quantity of new end-users. Adding population is easy and requires only minor upgrades to the grid and shared assets. Adding end users with an expectation to include disruptors such as electric vehicle chargers is a more challenging scenario as it requires different upgrades on the developers/builders.

- Their transmission system is the longer/harder portion of the grid to respond. As such, EDTI monitors growth plans and patterns to ensure their transmission system is sized appropriately, as EDTI responds to every application, to ensure bulk power is available.

- Their distribution grid improvements are much simpler to perform within in their "just-in-time model", which insulates the rate payer from unnecessary expense and stranded assets.

EDTI has expressed confidence that they will be able to accommodate the City Plan and the infill growth that is the subject of this study, without altering their current planning process and infrastructure development modelling. As indicated by EDTI, they anticipate that their current processes will continue to insulate electricity rate payers by balancing the placement of needed electricity distribution assets in a timely fashion with ensuring that developers carry reasonable costs for increased and/or upgraded services.

3.4.1.5 High Level Costs

EDTI did not provide any specific information related to high level costs for electrical servicing for the nodes and corridors. It is evident that EDTI does not view the costs of providing electrical infrastructure as a constraint to the infill growth anticipated by this study, and those costs will not be borne by the City.

EDTI can and does make a contribution to new services as outlined in the current agreement. Items eligible for EDTI Investment include:

- Distribution three-phase and single-phase extensions.
- Transformers (or a share of a transformer if the transformer is shared by more than one customer.
- Standby Feeder where required by EDTI.
- Primary Cable to EDTI Transformer on Property (Existing Multi-Family sites).

EDTI added that costing for infill development is also very dependent on the planning on a lot-by-lot basis and on a case by case basis. For example, a lot split in an aerial distribution area may require minimal costs when compared to servicing a lot split in an underground distribution area. As well, the rezoning and development of a multi-family development can cost considerably more than a single family unit. However, a multi-family development may qualify for capital investment from EDTI. So while the cost may be considerably more, the net cost to the project developer could be equal to or less depending on particular situations

Incentives by different levels of government to change a user's profile may impact the type of service needed at the per resident level (if governments incent for electric vehicles as an example it increases the number of people investing in that purchase and can radically change what is needed for upgrades to a home, street or neighbourhood). So the cost range that EDTI could provide would vary so much as to bear no real value.

In summary, EDTI's biggest challenge depends less on where or how the population grows and more upon changes to how the end user changes their consumption needs. Examples include energy efficiency, micro-generation, electrification of heating, HVAC, and electric vehicles etc. As such, EDTI will continue to monitor growth plans, district development, developer trends and customer usage trends. They will combine all of these factors and do their best to anticipate needs in a timely manner and provide system development within their "just-in-time model."

EDTI indicated the following with respect to new Development:

- Developers design and build infrastructure then EDTI rebates some of those costs.
- Challenges include that most lots are serviced at 100 amps, whereas secondary suites need additional upgrade to service. That increases servicing timelines because the upgraded service cable is not ready for them at the property line to service the secondary suite.
- Transformers in back alleys can be in the way of rear driveways.

In terms of Densification Challenges, EDTI indicated the following:

- 200 amp upgrades are provided at no cost to customers if aerial services are in place. Typical needs for circuit upgrades include the need for two stoves, a secondary suite, a hot tub, an AC unit or electric car charging station.
- Poles and anchors in back alleys obstruct access and are costly to relocate and sometimes cannot be moved. This is mostly an issue with lot splits where a second driveway access is added in the alley.

- Electric Vehicle Penetration prompt the need for transformer replacement in underground serviced areas. Energy Management Systems are not available through EDTI, the builder or homeowner may be able to install an EMS by a qualified electrician. However, that cannot be used at the same time as charging the vehicle.
- Meeting Infill power demands: What can the City do to support infill without excessive upgrade costs depends on individual sites and areas. Converting Low Density Residential to Medium Density Residential would need 3 phase power, which is very costly. Typically the first development into an established area with MDR project pays to add 3 phase power. Redeveloping and developing neighborhoods have an opportunity to have 3 phase power installed to allow future intensification at a lower cost than future upgrades. This is especially relevant where power is underground.
- Infill developers should meet with EDTI at the initial stages of their project before completing a development application. Infill projects need to assess what the load would be for their power requirements in order for EPCOR to review and provide information on whether there is enough power available or if upgrades will be required to service the development.
- Additional costs to provide underground power service will be borne by the customer. In addition, the customer will be required to provide space for the associated electrical service equipment on their property per the requirements in the CCG.
- The amount that EDTI would contribute is calculated by EDTI's "Schedule A – Available EDTI Investment" which indicates a Maximum Available EDTI Investment that EDTI will make for service or expansions for Residential, General Service and Industrial Consumer classes as $269 per kVA of the contracted minimum demand for the service connection for the first 2,500 kVA and $121 per kVA thereafter. these investment rates are reviewed and adjusted annually.

As a specific example, if a developer is constructing "skinny homes "or "duplexes" on old lots, then typically 100% of the costs are charged to the developer. However, for larger projects, there may be an opportunity for EDTI to contribute as governed by EDTI terms & conditions, which are subject to change.

District Energy Systems may be an option of consideration within the Nodes and Corridors for non-electrical energy needs. Only EDTI can distribute electrical services in the City of Edmonton per the franchise agreement, so electrical DES systems that provide power across property lines are not permitted.

3.4.1.6 Process for Utility Improvements

EDTI has a proven method and process for accommodating new developments, including infill developments, which include both the technical and financial aspects. EDTI clarified that as approved by the Alberta Utilities Commission (the "Commission"), the Distribution Tariff of EPCOR Distribution & Transmission Inc. ("EDTI") was established pursuant to section 102 of the Electric Utilities Act 2003, c. E-5.1. EDTI, through EDTI, will provide all standard services pursuant to the Distribution Tariff. All additional, supplementary or extra non-discretionary services provided by EDTI to a Customer will be charged a separate rate or fee such as those included, without limitation, in the Fee Schedule. The Standard Connection Fee set out in the Fee Schedule will be charged to the Customer at the time of construction. Upon an applicant's request for a Service Connection, EDTI will prepare a proposal outlining the estimated cost of the Service Connection and Customer Contribution to be paid by the applicant. Further details are contained in EDTI's document, available online.

3.4.2 Natural Gas Servicing

3.4.2.1 Existing System Capacity Assessment

ATCO Gas did not elaborate on the capacity of their existing system beyond what is indicated below. However, it is evident that ATCO Gas is well positioned to react to the demands of the infill growth anticipated in this study.

Using the projected Land Use and Population projections provided to them, ATCO Gas has ranked the 9 nodes and corridors, based on each area's available capacity to take on increased natural gas demand (#1 has the most capacity and #9 has the least), as indicated in Table 3-8.

ATCO's ranking of the nodes or corridors was based upon a modelling analysis, whereby they added in the ultimate number of dwelling units based upon the City's infill growth projection for the full build-out of each node and corridor. They considered the drop in pressure results identified by their model and then ranked the nodes based on the magnitude of pressure drop. The nodes with the greatest pressure drops were deemed to need proportionally higher levels of upgrades.

Certain locations within each node or corridor may require higher level of upgrade than other locations within the same node or corridor. Without knowing specific locations within the nodes and corridors, ATCO is unable to identify specific costs of accommodating growth at those locations or any of the nodes or corridors.

As an example, typically demolishing an older single-family home and building a new home or duplex does not create any concerns for ATCO. However, if a few single-family homes are demolished and then replaced with a high-density apartment, then ATCO would likely need to upgrade the distribution pipe sizes in that location.

Generally, new homes and modern furnaces are much more energy efficient than homes and furnaces from the 1950's or earlier, when many of these node and corridors were developed. Typical household demand for natural gas has been dropping over the last few decades and continues to decline. When old homes are demolished and replaced by modern energy efficient homes and furnaces, the demand for natural gas per unit typically goes down. As such, ATCO expects that, even with the increase in density, the overall demand in these infill nodes and corridors will remain rather constant.

ATCO's natural gas distribution system is comprised of two main components. Their "Feeder System" (ATCO also refers to that as their "Backbone") operates at a higher pressure of 80 psi and delivers natural gas to the various neighbourhoods. ATCO does not expect any capacity problems with their "Backbone".

Their "Distribution System" operates at a lower pressure of 10-13 psi. If upgrades are required on a localized basis, it will most likely be to smaller older distribution lines.

Some distribution gas lines in the nodes and corridors were installed in the 1950's. Many of those old lines are being replaced as part of ongoing neighbourhood renewal project. ATCO expects that a large proportion of those older gas lines will be routinely replaced over the next 20 years.

In these infill areas ATCO intends to continue charging building developers flat rate standard Disconnection and Re-Connection Fees when older homes are demolished, and new homes are built.

Table 3-8: Ranking Of Available Gas Servicing Capacity

Nodes & Corridors	Capacity Ranking
109 Street	1
Stadium	2
97 Street	3
118 Avenue	4
Centre City	5
Whyte Avenue/99 Street	6
111 Avenue	7

Nodes & Corridors	Capacity Ranking
Stony Plain Road	8
University-Garneau	9

3.4.2.2 Current Standards and Programs

Relevant Standards

ATCO Gas adheres to the City's Servicing Standards, which defines the technical considerations that must be followed including the installation and spacing of natural gas infrastructure relative to other utilities and infrastructure in close proximity.

Franchise Agreement

The Franchise Agreement with the City defines how ATCO Gas must operate in providing natural gas servicing.

3.4.2.3 Currently Proposed Improvements/Expansion

ATCO Gas does not have any major improvement/expansion projects planned. They indicated that they have several smaller scale projects of this nature which they believe the City should be aware of, since all ATCO proposed projects are reviewed and approved by the City.

3.4.2.4 Recommended Capacity Expansions to Achieve the City Plan

Based on the rankings summarized in Table 3-8, ATCO Gas has determined that 109 Street will require the lowest number of upgrades while University-Garneau will require the highest number of upgrades to accommodate the projected growth in the system.

However, ATCO Gas indicated that they are unable to comment on the extent of the potential upgrades within each area without knowing more details on the timing and rate of growth.

ATCO Gas will be responsible for any growth-driven gas mains work (extensions and upgrades).

Developers will be responsible for any gas service work (installations, alterations, disconnects). As such ATCO Gas indicated that there should be no negative effect upon new infill project feasibility that could affect infill Developer's willingness to proceed and inhibit infill growth rates.

ATCO Gas indicated that the items above are a positive influence on the City's desire to facilitate and hopefully accelerate infill development rates.

In terms of challenges faced by ATCO in providing service to infill developments, there is really only one. Due to extreme congestion in older areas, it can be very challenging to get alignments and permits. These challenges are faced by ATCO, the developer and other utility providers when dealing with the congestion and attempting to meet safe separation distances between utilities. Sufficient utility spacing must be attained to facilitate the necessary permits. These challenges are inherent due to the congestion of infrastructure in existing areas.

3.4.2.5 High Level Costs

ATCO Gas will bear all-natural gas distribution costs for accommodating the anticipated growth within the subject nodes and corridors.

ATCO Gas will be responsible for any growth-driven gas mains work (extensions and upgrades). As is the present practice, Developers will be responsible for any gas service work (installations, alterations, disconnects). As such there should be no negative aspects that could affect the Developer's willingness to proceed and inhibit infill growth rates.

The City will not be expected to bear any cost of providing natural gas to any of the proposed infill growth nodes or corridors. Except for the typical service costs paid by Developers, ATCO Gas costs would be passed onto private infill project Developers.

ATCO Gas indicated that these items are a positive influence on the City's desire to facilitate and hopefully accelerate infill development rates.

3.4.2.6 Process for Utility Improvements

ATCO Gas did not provide any comments pertaining to the current process. For any major system upgrades, they require at least 2 years to plan, design, and construct. ATCO will react to specific infill demands as they occur.

3.4.3 Telecommunications – Telephone and Cable

Telus and Shaw, the telecommunication providers, often run parallel lines to their customers and compete to provide many of the same services.

3.4.3.1 Existing System Capacity Assessment

TELUS

TELUS continuously monitors the Telus plant and evaluates new product launch to ensure network sustainability.

SHAW

Similarly, SHAW also has a practice of continuously monitoring their plant and evaluating new product launches to ensure network sustainability.

3.4.3.2 Current Standards and Programs

TELUS

TELUS currently has a municipality access agreement with the City of Edmonton and operates under the Shallow Utilities City guidelines.

SHAW

Similarly, SHAW also has a municipality access agreement with the City of Edmonton and operates under shallow utilities City guidelines.

3.4.3.3 Currently Proposed Improvements/Expansion

TELUS

TELUS is continuously monitoring and improving their network, including their wireless coverage. The following has been recently completed and ongoing:

- Pure Fibre Build Program has been extended in these areas to satisfy current and future requirements.
- Relocates have been done to accommodate the LRT expansion.
- Fibre extension to accommodate new customers.
- Investigating “small cell” options on high rise apartment rooftops.

SHAW

SHAW is continuously monitoring and improving their network, including wireless coverage. The following has recently been completed and ongoing:

- Return Band Upgrade program to increase the network upload capacity.
- Fibre extension to accommodate new customers.
- Investigating ‘small cell’ options on high rise apartment rooftops.
- Exploring various options to increase the data carried over fibre.
- Relocates to accommodate the LRT expansion.

3.4.3.4 Recommended Capacity Expansions to Achieve the City Plan

TELUS

With regards to system improvements. TELUS is actively initiating projects to service new customers, both residential and businesses in the nodes and corridors. They are initiating projects to extend its infrastructure deeper into neighborhoods as demand increases and continue to utilize network assessment tools to highlight opportunities where they can upgrade and enhance their services.

SHAW

Similarly with regards to system improvements, SHAW also is actively initiating projects to service new customers, both residential and businesses in the nodes and corridors. They are also initiating projects to extend its infrastructure deeper into neighborhoods as demand increases and continue to utilize network assessment tools to highlight opportunities where they can upgrade and enhance their services.

3.4.3.5 High Level Costs

TELUS

TELUS indicated that they are unable to share any costing information.

SHAW

Table 3-9 provides the summary of high-level cost estimates for improvements within the nodes and corridors as provided by SHAW. From SHAW’s perspective, future plans are very dynamic and contingent on the timelines for the City’s infill development. As such, SHAW’s estimates below are subjected to change.

Table 3-9: Shaw Improvements – Summary of Costs

	Nodes and Corridors	Current Status Homes	Forecast Growth Homes	Future Forecast Homes	High Level Costs Estimate	Average Costs per New Home
1	109 Street	385	2,073	2,458	$ 640,000	$ 309
2	111 Avenue	1,206	4,054	5,260	$ 1,280,000	$ 316
3	118 Avenue	4,564	10,121	14,685	$ 2,640,000	$ 261
4	97 Street	3,297	5,728	9,025	$ 1,520,000	$ 265
5	Centre City	38,859	37,891	76,750	$ 10,080,000	$ 266
6	Stadium	2,914	3,003	5,917	$ 800,000	$ 266
7	Stony Plain Rd	4,447	10,917	15,364	$ 2,880,000	$ 264
8	University-Garneau	7,008	9,233	16,241	$ 2,480,000	$ 269
9	Whyte Avenue/99 Street	6,556	16,394	22,950	$ 4,320,000	$ 264
Total All Infill Areas		**69,236**	**99,414**	**168,650**	**$ 26,640,000**	**$ 268**

3.4.3.6 Process for Utility Improvements

TELUS

TELUS indicated that they have difficulty in obtaining city permits due to aerial and underground saturation.

With these areas being saturated, obtaining aerial/underground permits is difficult. Having joint use opportunities where utilities can collaborate to extend plant in the same trench to the development would be efficient for TELUS and will help alleviate this saturation issue.

SHAW

Similarly, SHAW indicated that they have difficulty in obtaining City permits due to aerial and underground saturation. Their main concern is getting permits approved in these congested areas when all infill areas are already very congested. With these areas being saturated, obtaining aerial/underground permits is difficult.

SHAW also indicated that having joint use opportunities where utilities can collaborate to extend plant in the same trench to the development would be efficient for SHAW and will help alleviate this saturation issue.

4. Conclusions and Recommendations

4.1 Water Servicing

Existing System Capacity

The study is based on the assumption that the nodes and corridors will all contain high-value property and require a fire flow of 300 L/s. It was also assumed that the fire flows will govern, and increases to domestic water use was not considered for this assessment as domestic use typically makes up less than 10% of the total flow. The ability of the existing system to provide fire flows was assessed, and areas where the available flows and hydrant coverage do not currently achieve the guidelines set in the current Design and Construction standards were identified.

Currently Proposed Improvements/Expansions

EWSI's risk-based renewal program targets water main renewals based on risk (consequence of failure and probability of failure). Approximately 90% of all water main breaks occur on the cast iron portion of the distribution system, and since 1986, EWSI has replaced or rehabilitated approximately 50% of the cast iron mains within Edmonton. When a water main is selected for renewal, EWSI reviews the water network to meet current standards (i.e. pipe sizes, hydrant spacing & locations, etc.).

There were no currently proposed improvement or expansions within the infill areas aside from ongoing renewal programs.

Recommended Capacity Expansions and Associated Costs

To provide the required fire flow to all areas within the nodes and corridors, hydraulic upgrades were identified by EPCOR Water Services Inc (EWSI), consisting of water main renewals and new water mains. For four of the areas (97 Street, 118 Avenue, University-Garneau, and Whyte Avenue) EWSI provided two options for providing hydraulic improvements. Option 1 primarily focused on watermain renewals gradually improving available fire flows within the area, while Option 2 developed options for consideration by the City and EWSI to proactively upsize existing watermains or install additional new watermains to allow for development of high-value properties in the nodes and corridors, ahead of waiting for development requests and current gradual improvements through development and cast-iron renewal programs.

New water mains required to address areas where hydrant coverage does not currently achieve the guidelines set in the current Design and Construction standards were identified by AECOM.

Table 4-1: Water Main Upgrades

Upgrade Type	Option 1 Length (m)	Option 2 Length (m)
Water Main Renewal	110,380	68,980
Hydraulic Improvement – New Water Main	2,850	9,890
Hydrant Coverage Improvement – New Water Main	5,470	5,470
Total	**118,700**	**84,340**

EWSI has noted that renewals will be implemented over a very long timeline, and infill development is likely to occur prior to renewals. Therefore, it is very likely that these hydraulic improvements will be required in advance of the renewal program and the developers would be responsible for front-ending the cost of the renewal improvements if the mains do not qualify for the Water Main Renewal or the Infill Fire Protection Program.

Costs are summarized in Table 4-2. Unit costs represent an average and are for high level estimations only. The actual cost will be dependent on the local conditions and constraints.

Table 4-2: Water Main Cost Summary

Upgrade Type	Option 1 Cost	Option 2 Cost
Water Main Renewal	$314,583,000	$196,593,000
Hydraulic Improvement – New Water Main	$8,122,500	$28,186,500
Hydrant Coverage Improvement – New Water Main	$15,589,000	$15,589,500
Total	**$338,295,000**	**$240,369,000**

Process for Utility Improvements

The proposed water main upgrades will be triggered by fire flow requirements as development progresses. New water mains are recommended to be completed in conjunction with other projects, where possible, to minimize disruption to residents and businesses. It is recommended that at the time of infill development within each node and corridor, the system hydraulics and required upgrades be re-reviewed, as available fire flows will improve over time through the risk-based cast iron renewal program.

Costs for both Options 1 and 2 have been provided. Option 2 have been identified for consideration by the City and EWSI to fund through an alternative program that would open up opportunities for development in these priority nodes and corridors. The costs of the improvements to meet fire flow and hydrant spacing requirements for infill redevelopment, will be the responsibility of the developer with two exceptions:

- The project qualifies for the risk-based renewal program
- The project qualifies for the infill fire protection program

The cost share approach of the Infill Fire Protection Program recognizes that some fire protection upgrades to the water system that improve fire protection in established areas benefit the entire neighbourhood, including:

- Expansions: replacing existing water mains with larger mains or adding hydrants to improve fire protection; and
- Realignments: relocating existing water mains and hydrants from an alley to the street to provide mid-block fire protection.

4.2 Drainage Servicing – Stormwater, Sanitary and Combined Sewer

Existing System Capacity

The study is based on the assumption that the nodes and corridors eventually drain to the combined sewer system and that the existing system does not have significant excess conveyance capacity during extreme wet weather, therefore, storage of the increase in stormwater and wastewater flow and volume is required.

Currently Proposed Improvements/Expansions

The SIRP includes the construction of a number of dry ponds and the incorporation of LID facilities to address the increase in stormwater across the developed part of the City. The exact location of these ponds was not available for consideration in this study. It is also expected that the SanIRP will address the increase in wastewater across the developed area of the City and may provide additional guidance once completed.

Recommended Capacity Expansions and Associated Costs

Stormwater storage volume was calculated based on the increase in runoff due to the change in land use. Standard runoff coefficients were used along with the 100-year rainfall event.

The increase in wastewater flow will be accommodated by providing additional stormwater storage to offset the increase. Wastewater flows were calculated based on a sewage generation rate of 160 L/person or job/day applied to both the increase in residents and jobs in each node or corridor.

Total storage is summarized in Table 4-3.

Table 4-3: Storage Requirement Summary

Storage Type	Volume (m^3)
Stormwater Storage	106,900
Wastewater Offset Storage	50,800
Total	**157,700**

The total cost of the storage is estimated at $268,090,000. The actual cost will be dependent on the type, size and location of the storage.

Process for Utility Improvements

The storage requirements, and the type and location of storage facility can be determined during the development planning process. It is anticipated that storage will be accommodated through a combination of shared storage within the catchment and on-site smaller scale storage and LID.

The opportunity of providing additional storage in the proposed storage being developed as part of the SIRP should be investigated at the time of development. Alternatively, designing and constructing these storage facilities with additional volume to offset the anticipated impact of the infill development ahead of development should be investigated.

As EPCOR manages expenditures through their performance based rates application, co-ordination with the City will be required to accommodate adjustments to drainage improvements. Cost sharing with developers for shared storage would require piloting of a new capital program and approved in the rate application. This is a similar approach to the cost sharing program for infill fire protection.

4.3 Shallow Utility Servicing

Existing System Capacity

Based upon the responses from EPCOR Distribution and Transmission Inc. (“EDTI”) , ATCO Gas (“ATCO”), TELUS and SHAW it is evident that all of the franchise utilities are confident that they can meet the demand for franchise utility infrastructure capacity that will result from the infill growth in all of the Nodes and Corridors that are the subject of this study. All of the franchise utility companies indicate they are continuously monitoring growth in demand and are able to adapt accordingly.

Currently Proposed Improvements/Expansions

All of the four franchise utility providers are reactionary and none of them provided any information pertaining to any significant proposed improvements or expansions to their systems.

Recommended Capacity Expansions and Associated Costs

None of the franchise utility companies identified significant specific upgrades that will be required. It is evident from their responses that the franchise utility companies all believe they are well pre-positioned to accommodate the infill growth anticipated by this study.

It is also apparent from the information provided by the franchise utility companies that the cost of providing any additional infrastructure to accommodate the proposed infill growth should not be a significant constraint to that growth. Generally, the costs of providing infrastructure upgrades are absorbed by the utility company, except for the specific site service and hook-up fees that are typically charged to the individual developer or applicant. There were no costs identified by any of the franchise utility companies that will be charged to the City of Edmonton.

Process for Utility Improvements

There is nothing to suggest that the existing agreements between the City of Edmonton and the franchise utility companies, the governing Legislation, or the applicable current standards or program swill inhibit the anticipated growth in the subject Nodes and Corridors. Since the period of this growth is anticipated to stretch over several decades, it is recommended that the agreements, and standards be open to review and update on a regular basis in anticipation of changing technology and circumstances.

Based upon the responses from the franchise utility companies, it is evident there is already infrastructure congestion in the subject areas and the utility companies do have difficulty obtaining the necessary permits. This should be considered a challenge but not a constraint to infill growth. In order to best encourage and facilitate the anticipated infill growth, it is recommended that as a future step, the City engage in a process with the franchise utility companies and the developers to gather more details about those challenges and discuss potential solutions and implementation strategies.

It is also recommended that future and ongoing discussions between the City and the franchise utility companies include further identification of any process/approval issues, potential solutions and implementation strategies.

Appendix A

Water Servicing – Proposed Upgrades

EWSI Memorandum:

1. 97 Street
2. 109 Street
3. 111 Avenue
4. 118 Avenue
5. Centre City
6. Stadium
7. Stony Plain Road
8. University – Garneau
9. Whyte Avenue / 99 Street

Figures:

Memorandum

DATE: 1/14/2021

TO: Kristin St. Louis (AECOM), Li Wang (AECOM)

CC: Ania Schoof (City of Edmonton), Sean Bohle (City of Edmonton)

FROM: Tahmina Hossain – EPCOR Water Services Inc.

SUBJECT: Infill Roadmap – 97 Street

PROFESSIONAL ENGINEER ALBERTA
TAHMINA HOSSAIN

PERMIT TO PRACTICE
EPCOR WATER SERVICES INC.
RM SIGNATURE: Tahmina Hossain
RM APEGA ID #: 82550
DATE: JANUARY 14, 2021
PERMIT NUMBER: P006368
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Disclaimer: This information is provided by EWSI One Water Modeling group based on conditions and information existing at the time this document was prepared. The information contained within this document is reliable based on the assumptions contained herein and does not take into account any subsequent variations or changes to such assumptions which may render the results unreliable, at any time, without notice. The all pipes water distribution steady-state model was run using Synergi Water software. EWSI does not guarantee any modifications made to this digital file by others after its transmission to the intended recipient.

1.0 Background

The City Plan, which imagines a future with two (2) million Edmonton residents, places a focus on urban intensification and densification in redeveloping areas through a network of nodes and corridors. To support the realization of The City Plan, the City of Edmonton Urban Planning Committee is looking to complete an infrastructure capacity review of nine (9) study areas within the City's core and mature neighborhood, helping establish the development readiness of these locations.

To assist in the completion of this review, EPCOR Water Services Inc. (EWSI) has been engaged to complete hydraulic modeling analysis to identify areas where the existing water distribution system is able and unable to deliver 300 L/s fire flows, which is the current City of Edmonton fire flow guideline for high density residential, industrial and commercial developments. The results of the modeling analysis are summarized in this memorandum and should be considered alongside the hydrant spacing analysis being completed by AECOM as part of the overall water infrastructure capacity review. Recommendations for infrastructure improvements are also provided for areas unable to currently achieve 300 L/s.

2.0 Initial Area Assessment

Figure 1 shows the current (2017) average available fire flow (AAFF) within the 97 Street Corridor area. The 400 m x 400 m hexagons are colored by the average water system capacity under fire flow conditions, and represent roughly two (2) City blocks. As illustrated in Figure 1, fire flows range from 100 L/s to above 300 L/s within 97 Street Corridor.

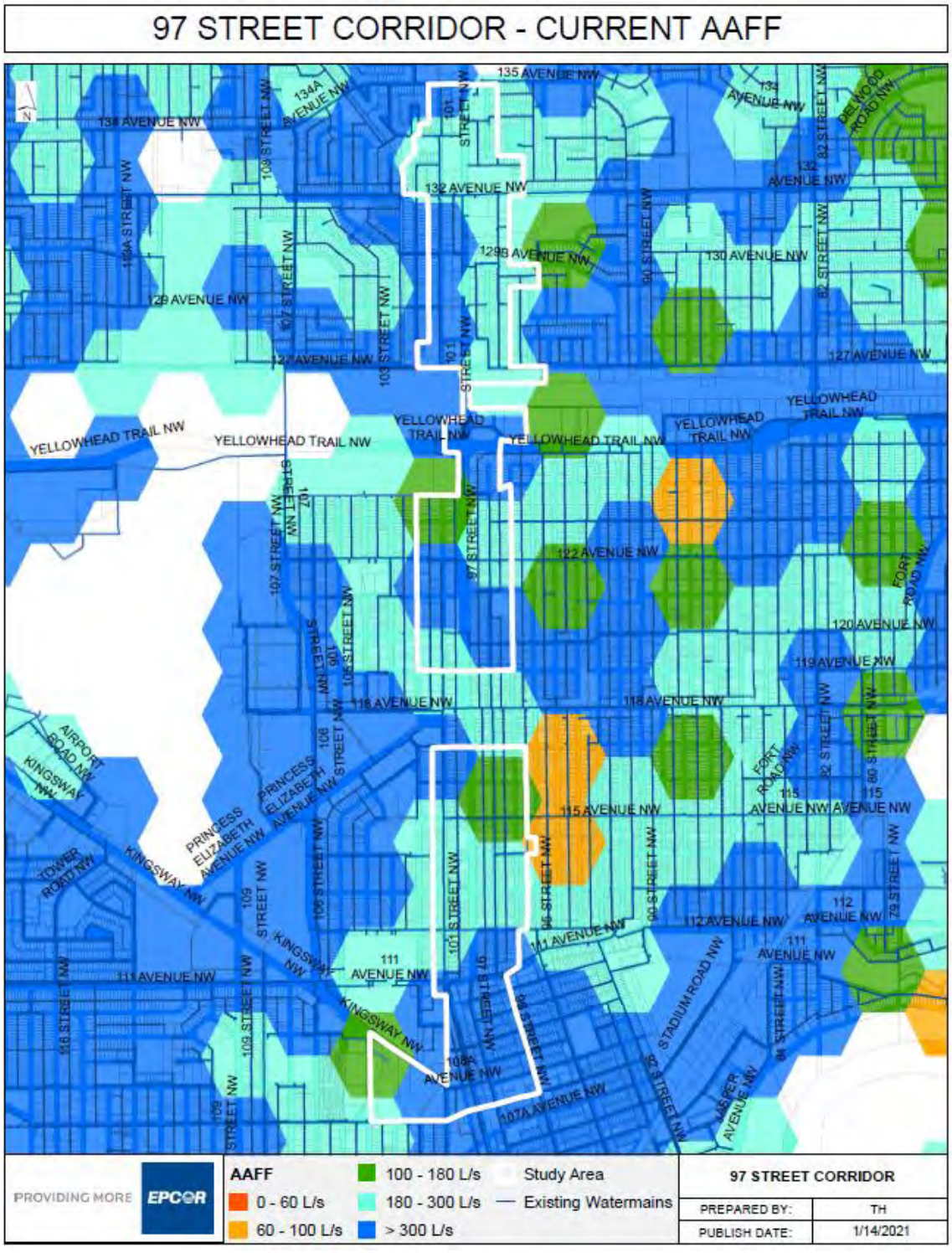


Figure 1: 97 Street Corridor – Current AAFF

EWSI's water distribution and transmission system is designed to provide fire protection throughout the City of Edmonton. Therefore, when investigating the development readiness of an area, focus is placed on the available fire flow rates, rather than the water consumption in that location. Figure 2 was developed to illustrate the magnitude of difference between flow rates required for maximum day demand (MDD) consumption, and fire events.

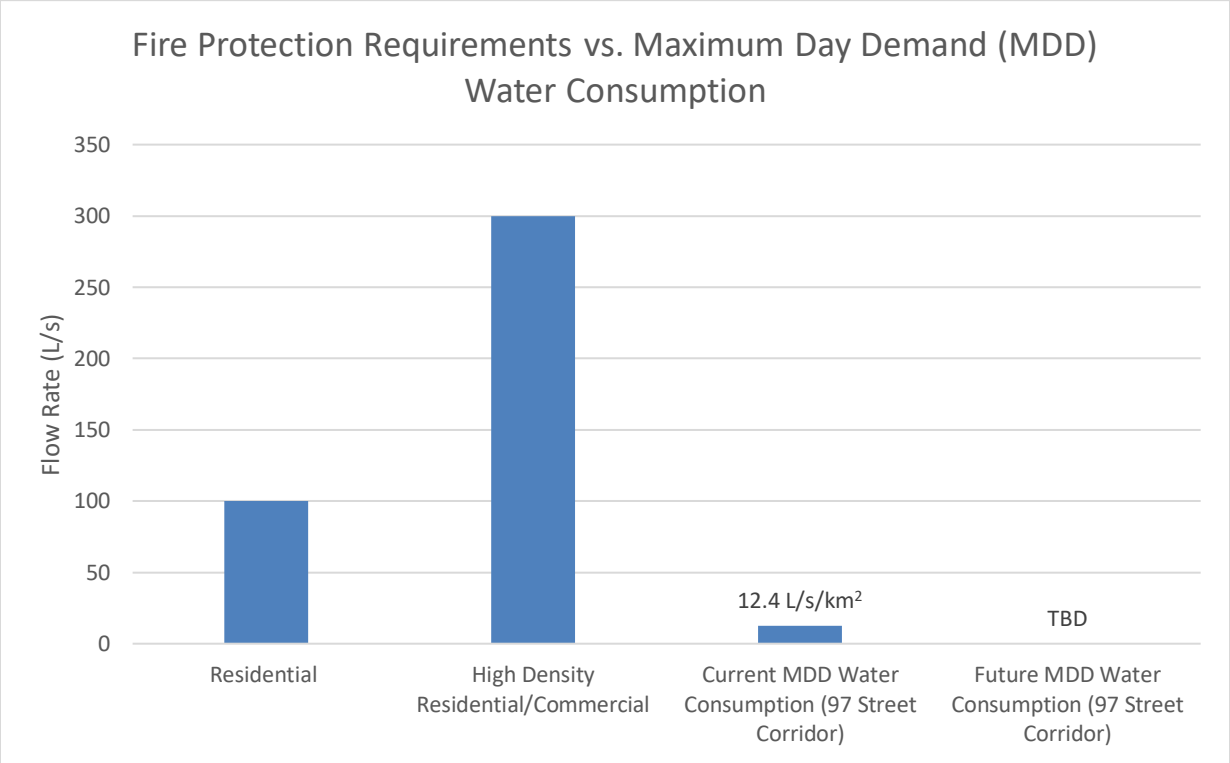


Figure 2: Fire Protection Requirements vs. Maximum Day Demand Water Consumption in 97 Street Corridor

3.0 Analysis Assumptions

To complete the modeling analysis, Synergi Water (version 4.9) software was used and the following assumptions were applied:

- 2020 MDD scenario base model used to run the fire flow analysis.
  - Model calibrated to 2015 demands, and updated with 2020 pipes.
- Fire flow analysis run at hydrants within 97 Street Corridor and hydrants within a 200 m buffer of the node boundary (to view the effect of improvements on the surrounding areas).
- Hydrant leads within 97 Street Corridor and the 200 m buffer modified to ensure hydrant nodes better represent system capacity.
- When the City reaches two (2) million Edmontonians, all mains within the study area are PVC/PVC-equivalent.

4.0 Area Improvements

EWSI modeled two future improvement options to increase fire flows in areas within Whyte Ave./99 St. Corridor not currently achieving 300 L/s. These options utilized a combination of water main addition and water main renewal to increase fire flow capacity to the area. Depending on the time of development/densification, one option may be favored over the other.

4.1 Option 1

Option 1 for increasing fire flows within 97 Street Corridor focuses primarily on organic renewal of water mains. Water main renewals are expected to occur through EWSI's various water main renewal programs. At the time of renewal, EWSI will ensure the renewed infrastructure is capable of achieving the required fire flows at that time.

Table 1 summarizes the approximate length of pipe size recommended for improvements to 97 Street Corridor to achieve 300 L/s throughout the area if Option 1 is pursued.

Table 1: Summary of Option 1 Area Improvements

Improvement Type	Approx. Length of Improvement (m)
Renewal	10,268

Figure 3 shows the AAFF within 97 Street Corridor, after the recommended improvements were applied in Option 1. In yellow, Figure 3 shows the locations of cast iron mains that will in time require renewal. As the focus of this study was 97 Street Corridor, EWSI is not recommending improvements for the surrounding hexagons not achieving AAFF of ≥ 300 L/s. While these hexagons may slightly overlap the study area, the hydrants within them do not impact the fire flow capacity within the study area. It is expected that with additional water main renewals in the future, the average system capacity of these hexagons will improve. The hexagon just south west of the corridor has private water mains and the system was not looped to EPCOR's system. And thus options to increase fire flows in that location was not investigated as a part of this analysis.

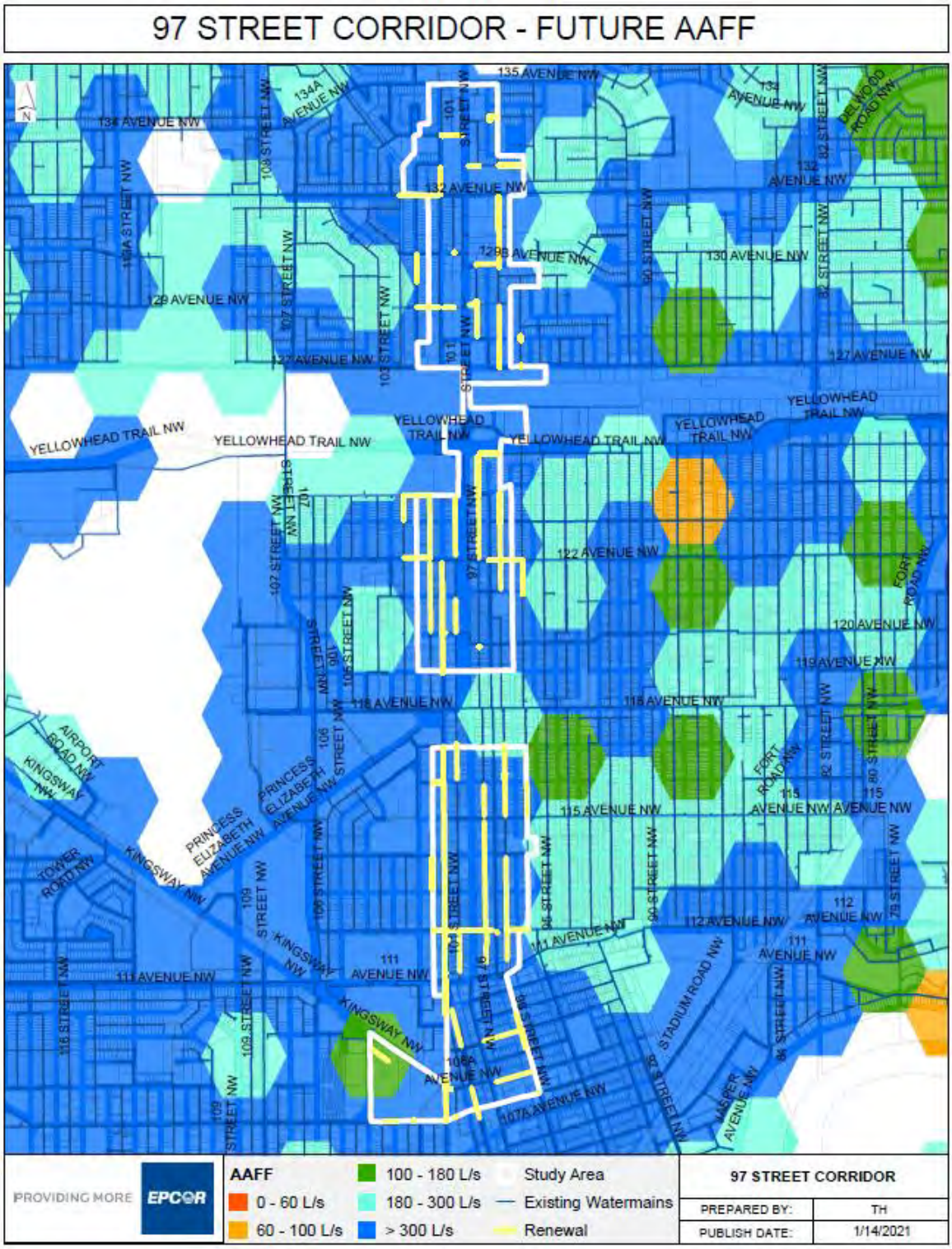


Figure 3: 97 Street Corridor - Future AAFF (Option 1)

4.2 Option 2

Option 2 looks at construction of a new main along 97 Street to increase fire flows within 97 Street Corridor along with some additional east west connection. While some areas the cast iron main renewal was also recommended to achieve the fire flow.

Table 2 summarizes the approximate length of pipe size recommended for improvements to 97 Street Corridor to achieve 300 L/s throughout the area if Option 2 is pursued.

Table 2: Summary of Option 1 Area Improvements

Improvement Type	Approx. Length of Improvement (m)
Renewal	2,686
New main	2,861

Figure 4 shows the AAFF within 97 Street Corridor, after the recommended improvements were applied in Option 2. The recommended new water main, and the diameter, are shown in red on Figure 4. In yellow, Figure 4 also shows the locations of cast iron mains that will in time require renewal. As the focus of this study was 97 Street Corridor, EWSI is not recommending improvements for the surrounding hexagons not achieving AAFF of ≥ 300 L/s. While these hexagons may slightly overlap the study area, the hydrants within them do not impact the fire flow capacity within the study area. It is expected that with additional water main renewals in the future, the average system capacity of these hexagons will improve. The hexagon just south west of the corridor has private water mains and the system was not looped to EPCOR's system. And thus options to increase fire flows in that location was not investigated as a part of this analysis.

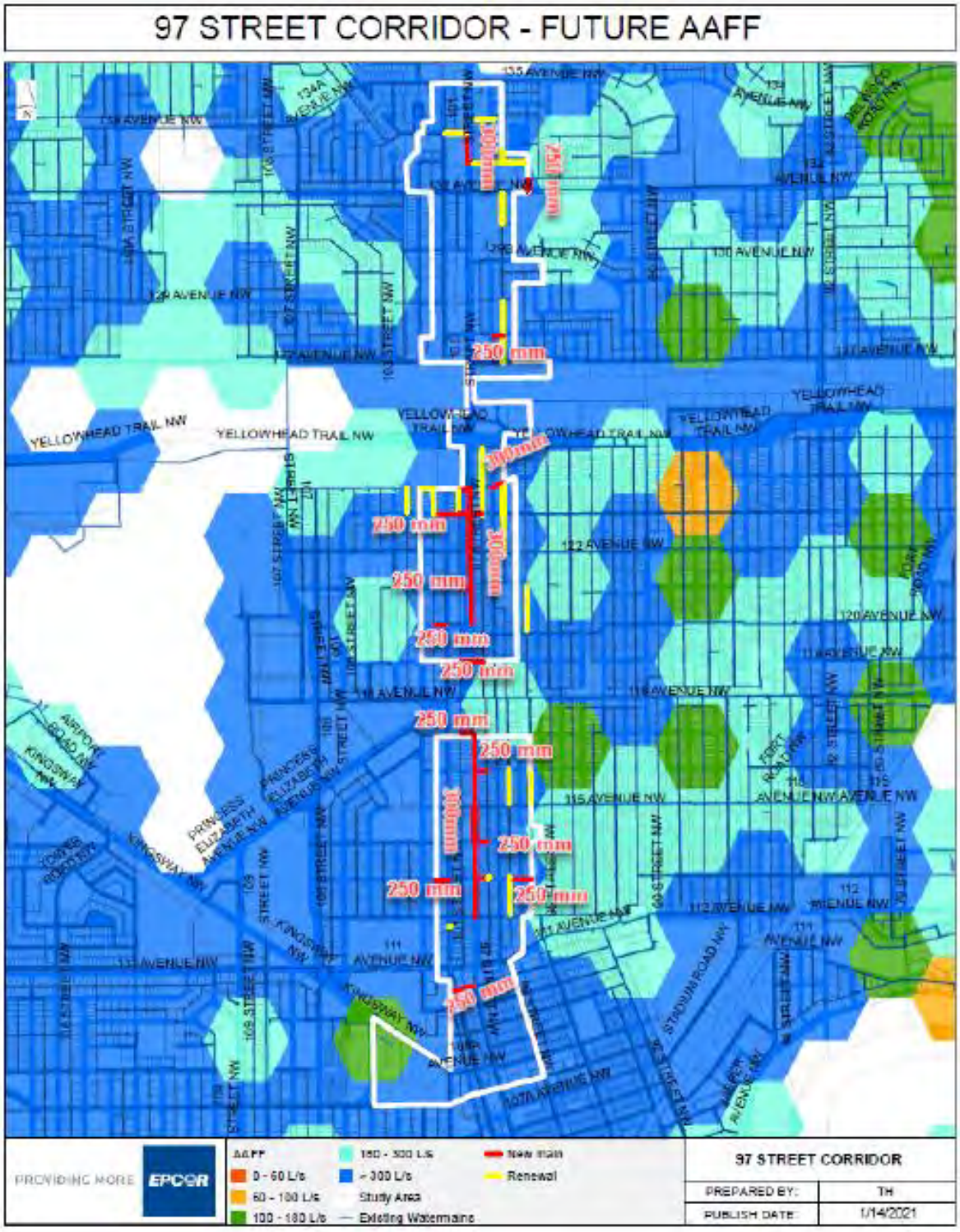


Figure 4: 97 Street Corridor - Future AAFF (Option 2)

Memorandum

DATE: 12/4/2020

TO: Kristin St. Louis (AECOM), Li Wang (AECOM)

CC: Ania Schoof (City of Edmonton), Sean Bohle (City of Edmonton)

FROM: Nathalie Hajek – EPCOR Water Services Inc.

SUBJECT: Infill Roadmap – 109 Street

PROFESSIONAL ENGINEER TAHMINA HOSSAIN ALBERTA

PERMIT TO PRACTICE
EPCOR WATER SERVICES INC.
RM SIGNATURE:
RM APEGA ID #: 82550
DATE: JANUARY 14, 2021
PERMIT NUMBER: P006368
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

1.0 Background

The City Plan, which imagines a future with two (2) million Edmonton residents, places a focus on urban intensification and densification in redeveloping areas through a network of nodes and corridors. To support the realization of The City Plan, the City of Edmonton Urban Planning Committee is looking to complete an infrastructure capacity review of nine (9) study areas within the city's core and mature neighbourhood, helping establish the development readiness of these locations.

To assist in the completion of this review, EPCOR Water Services Inc. (EWSI) has been engaged to complete hydraulic modeling analysis to identify areas where the existing water distribution system is able and unable to deliver 300 L/s fire flows, which is the current City of Edmonton fire flow guideline for high density residential, industrial and commercial developments. The results of the modeling analysis are summarized in this memorandum. Recommendations for infrastructure improvements are also provided for areas unable to currently achieve 300 L/s.

2.0 Initial Area Assessment

Figure 1 shows the current (2017) average available fire flow (AAFF) within the 109 St. Corridor area. The 400 m x 400 m hexagons are coloured by the average water system capacity under fire flow conditions, and represent roughly two (2) city blocks. As illustrated in Figure 1, fire flows range from 100 L/s to above 300 L/s within 109 St. Corridor.

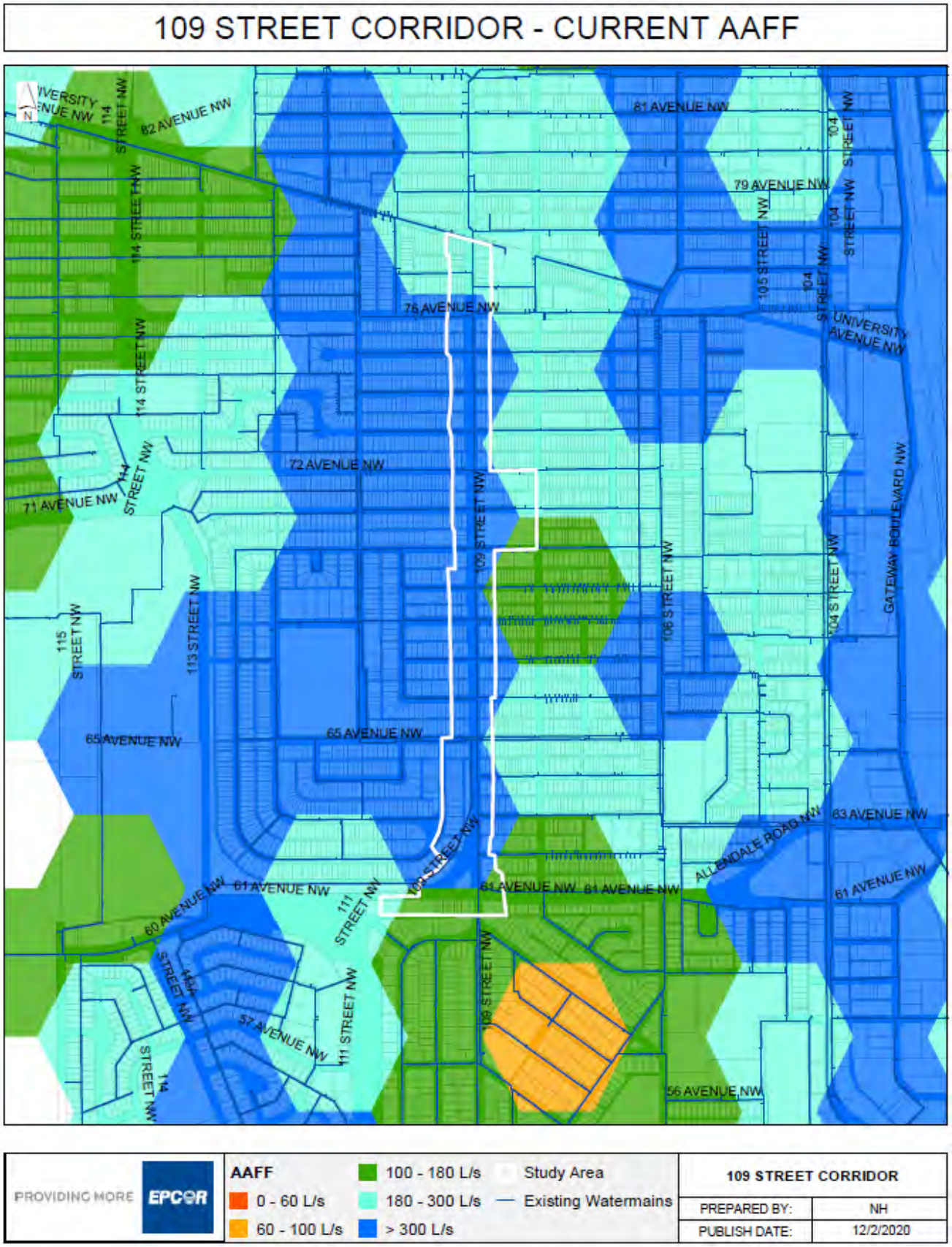


Figure 1: 109 Street Corridor – Current AAFF

EWSI's water distribution and transmission system is designed to provide fire protection throughout the City of Edmonton. Therefore, when investigating the development readiness of an area, focus is placed on the available fire flow rates, rather than the water consumption in that location. Figure 2 was developed to illustrate the magnitude of difference between flow rates required for maximum day demand (MDD) consumption, and fire events.

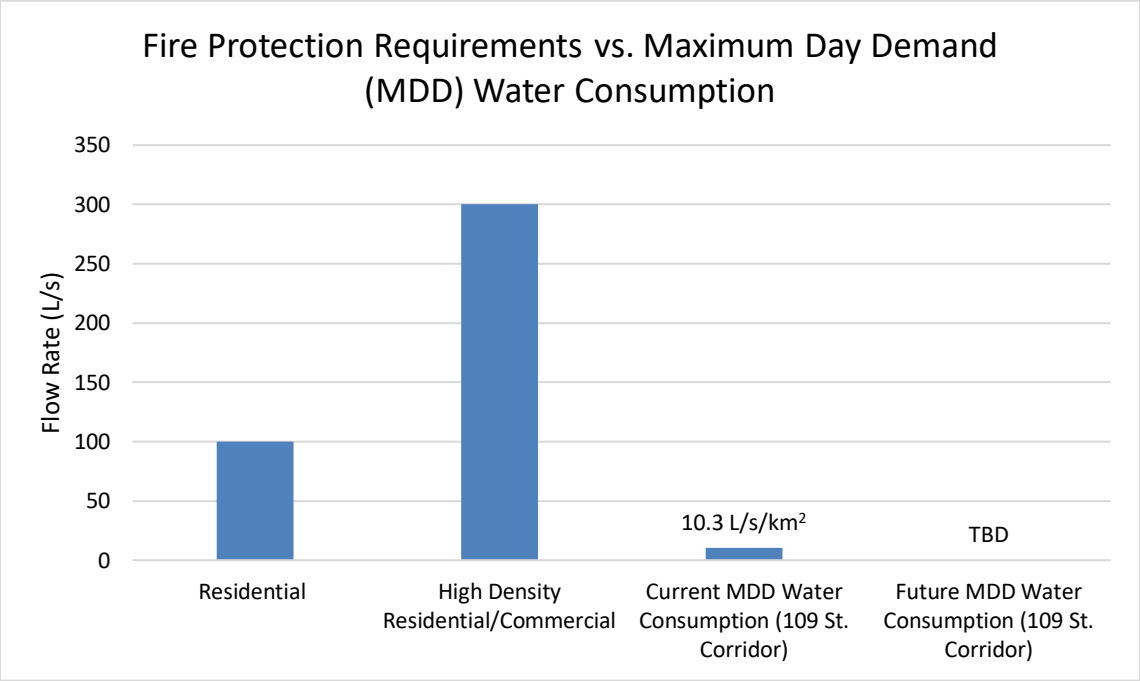


Figure 2: Fire Protection Requirements vs. Maximum Day Demand Water Consumption in 109 St. Corridor

3.0 Analysis Assumptions

To complete the modeling analysis, Synergi Water (version 4.9) software was used and the following assumptions were applied:

- 2020 MDD scenario base model used to run the fire flow analysis.
  - Model calibrated to 2015 demands, and updated with 2020 pipes.
- Fire flow analysis run at hydrants within 109 St. Corridor and hydrants within a 200 m buffer of the corridor boundary (to view the effect of improvements on the surrounding areas).
- Hydrant leads within 109 St. Corridor and the 200 m buffer modified to ensure hydrant nodes better represent system capacity.
- When the City reaches two (2) million Edmontonians, all mains within the study area are PVC/PVC-equivalent.

4.0 Area Improvements

EWSI modeled future improvement options to increase fire flows in areas within 109 Street Corridor not currently achieving 300 L/s, and utilized a combination of water main addition and water main renewal to increase fire flow capacity to the area.

Water main renewals are expected to occur through EWSI's various water main renewal programs. At the time of renewal, EWSI will ensure the renewed infrastructure is capable of achieving the required fire flows at that time.

Table 1 summarizes the approximate length of improvements to 109 Street Corridor to achieve 300 L/s throughout the area.

Table 1: Summary of Area Improvements

Improvement Type	Approx. Length of Improvement (m)
Renewal	1,342
New Main	207

Figure 3 shows the AAFF within 109 Street Corridor, after the recommended improvements were applied. The recommended new water mains, and their diameters, are shown in red on Figure 3. In yellow, Figure 3 also shows the locations of cast iron mains that will in time require renewal. As the focus of this study was 109 Street Corridor, EWSI is not recommending improvements for the surrounding hexagons not achieving an AAFF of ≥ 300 L/s, such as the hexagon just south of the corridor. While these hexagons slightly overlap the study area, the hydrants within them do not impact the fire flow capacity within the study area, and thus options to increase fire flows in these locations were not investigated as part of this study. It is expected that with water main renewals in the future, the average system capacity of these hexagons will improve.

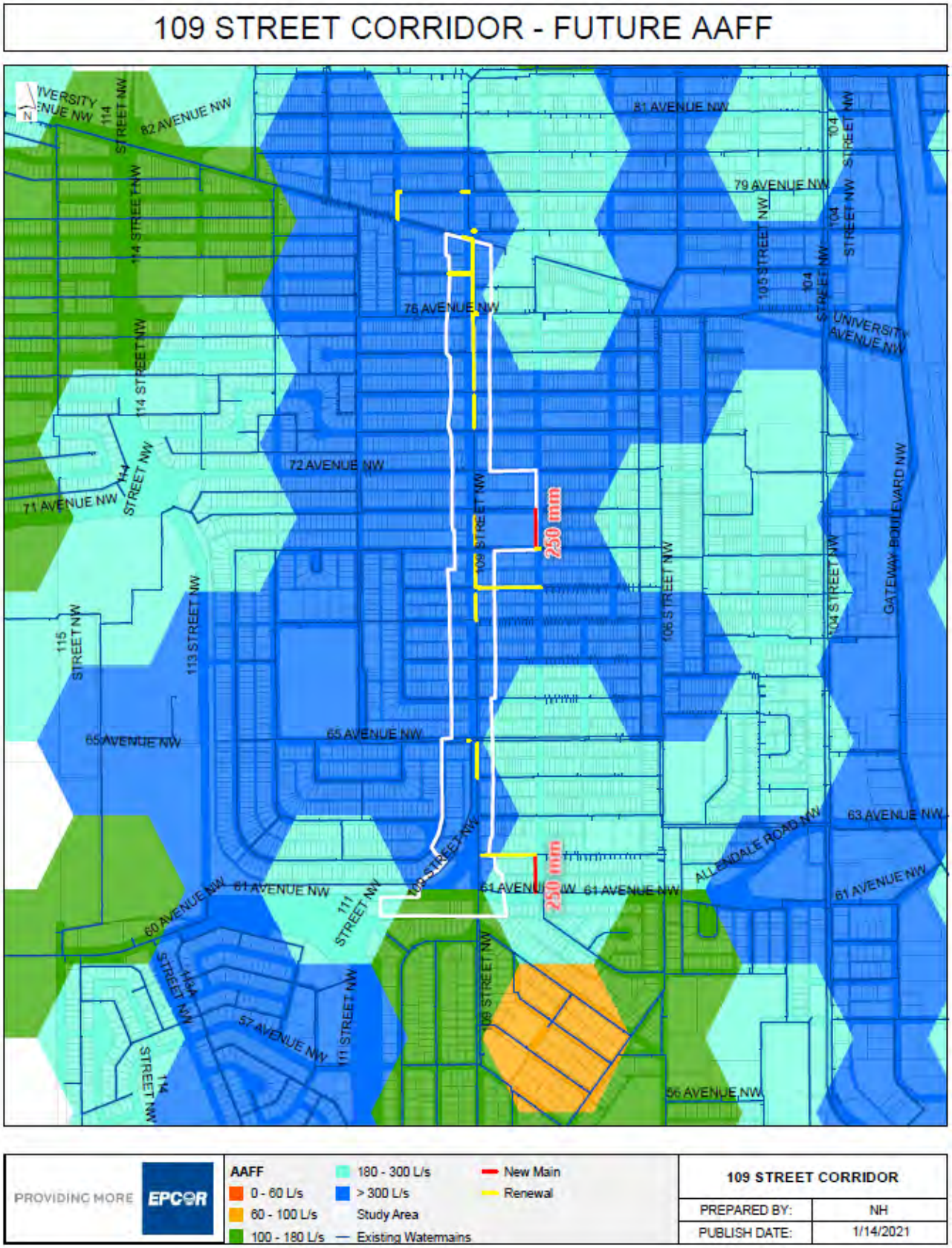


Figure 3: 109 Street Corridor - Future AAFF

EPCOR

Memorandum

DATE: 1/12/2021

TO: Kristin St. Louis (AECOM), Li Wang (AECOM)

CC: Ania Schoof (City of Edmonton), Sean Bohle (City of Edmonton)

FROM: Tahmina Hossain – EPCOR Water Services Inc.

SUBJECT: Infill Roadmap – 111 Avenue

PROFESSIONAL ENGINEER ALBERTA
TAHMINA HOSSAIN

PERMIT TO PRACTICE
EPCOR WATER SERVICES INC.
RM SIGNATURE:
RM APEGA ID #: 82550
DATE: JANUARY 14, 2021
PERMIT NUMBER: P006368
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Disclaimer: This information is provided by EWSI One Water Modeling group based on conditions and information existing at the time this document was prepared. The information contained within this document is reliable based on the assumptions contained herein and does not take into account any subsequent variations or changes to such assumptions which may render the results unreliable, at any time, without notice. The all pipes water distribution steady-state model was run using Synergi Water software. EWSI does not guarantee any modifications made to this digital file by others after its transmission to the intended recipient.

1.0 Background

The City Plan, which imagines a future with two (2) million Edmonton residents, places a focus on urban intensification and densification in redeveloping areas through a network of nodes and corridors. To support the realization of The City Plan, the City of Edmonton Urban Planning Committee is looking to complete an infrastructure capacity review of nine (9) study areas within the city's core and mature neighbourhood, helping establish the development readiness of these locations.

To assist in the completion of this review, EPCOR Water Services Inc. (EWSI) has been engaged to complete hydraulic modeling analysis to identify areas where the existing water distribution system is able and unable to deliver 300 L/s fire flows, which is the current City of Edmonton fire flow guideline for high density residential, industrial and commercial developments. The results of the modeling analysis are summarized in this memorandum and should be considered alongside the hydrant spacing analysis being completed by AECOM as part of the overall water infrastructure capacity review. Recommendations for infrastructure improvements are also provided within this memorandum for areas unable to currently achieve 300 L/s.

2.0 Initial Area Assessment

Figure 1 shows the current (2017) average available fire flow (AAFF) within the 111 Avenue Corridor area. The 400 m x 400 m hexagons are colored by the average water system capacity under fire flow conditions, and represent roughly two (2) City blocks. As illustrated in Figure 1, fire flows range from 100 L/s to above 300 L/s within 111 Avenue Corridor.

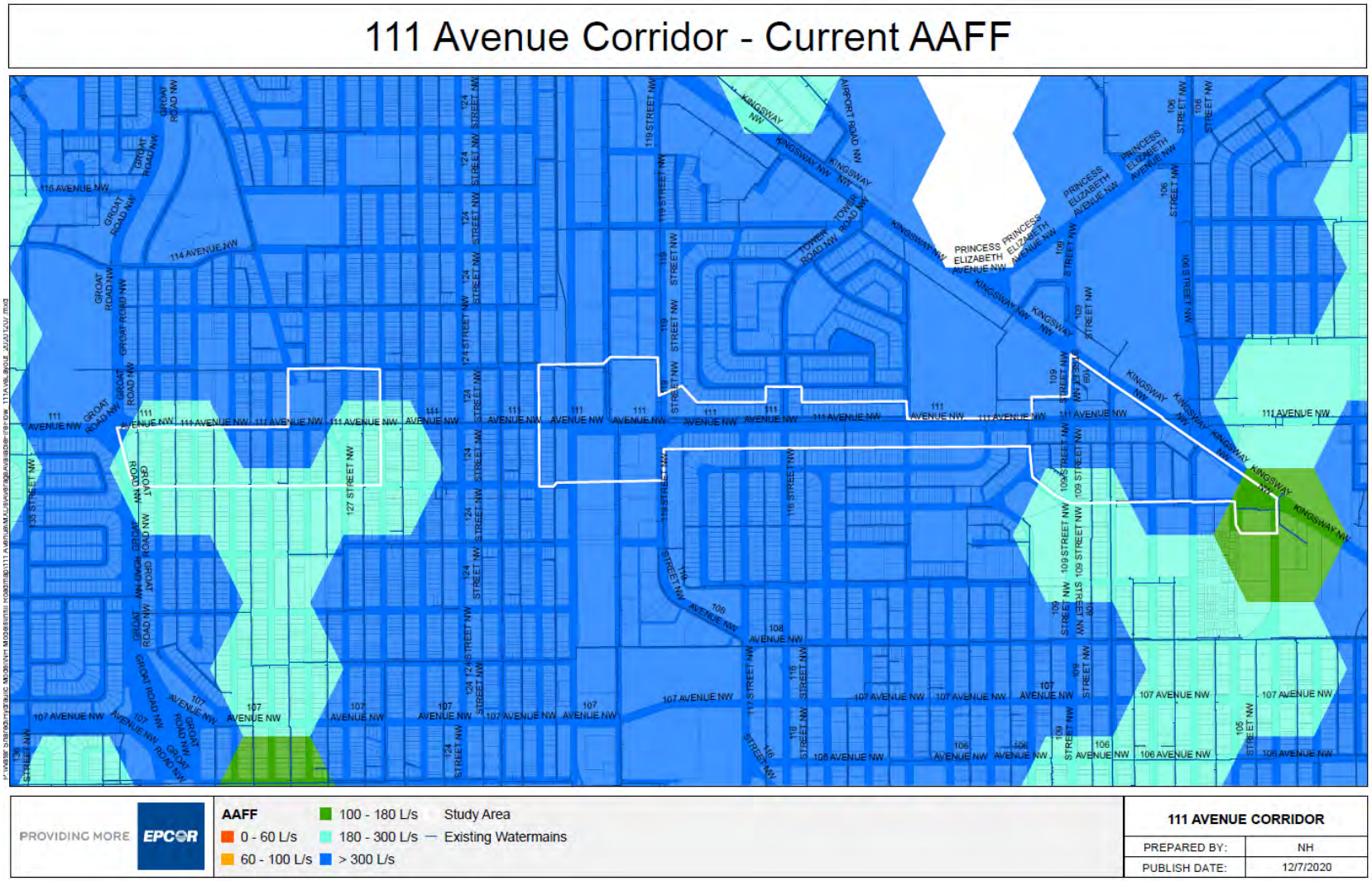


Figure 1: 111 Avenue Corridor – Current AAFF

EWSI's water distribution and transmission system is designed to provide fire protection throughout the City of Edmonton. Therefore, when investigating the development readiness of an area, focus is placed on the available fire flow rates, rather than the water consumption in that location. Figure 2 was developed to illustrate the magnitude of difference between flow rates required for maximum day demand (MDD) consumption, and fire events.

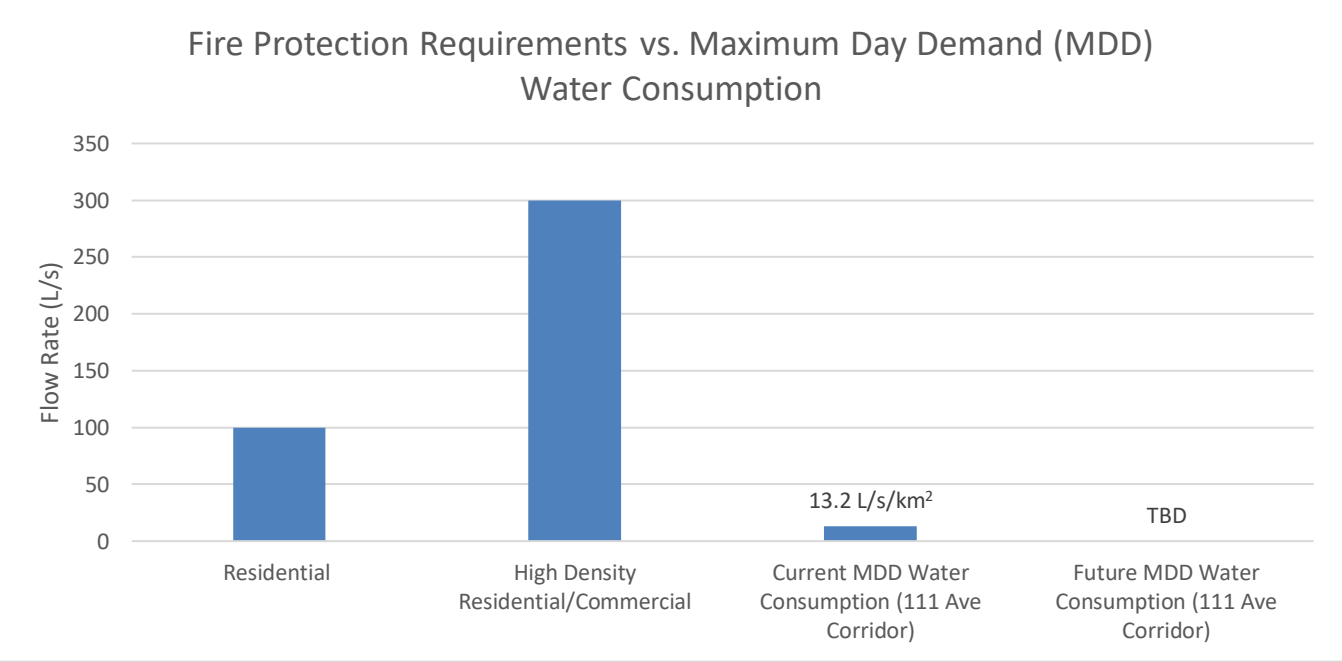


Figure 2: Fire Protection Requirements vs. Maximum Day Demand Water Consumption in 111 Avenue Corridor

3.0 Analysis Assumptions

To complete the modeling analysis, Synergi Water (version 4.9) software was used and the following assumptions were applied:

- 2020 MDD scenario base model used to run the fire flow analysis.
  - Model calibrated to 2015 demands, and updated with 2020 pipes.
- Fire flow analysis run at hydrants within 111 Avenue Corridor and hydrants within a 200 m buffer of the corridor boundary (to view the effect of improvements on the surrounding areas).
- Hydrant leads within 111 Avenue Corridor and the 200 m buffer modified to ensure hydrant nodes better represent system capacity.
- When the City reaches two (2) million Edmontonians, all mains within the study area are PVC/PVC-equivalent.

4.0 Area Improvements

EWSI modeled future improvement options to increase fire flows in areas within 111 Avenue Corridor not currently achieving 300 L/s, and recommends a combination of water main addition and water main renewal, to increase fire flow capacity to the area.

Water main renewals are expected to occur through EWSI's various water main renewal programs. At the time of renewal, EWSI will ensure the renewed infrastructure is capable of achieving the required fire flows at that time.

Table 1 summarizes the approximate length of pipe size recommended for improvements to 111 Avenue Corridor to achieve 300 L/s throughout the area.

Table 1: Summary of Area Improvements

Improvement Type	Approx. Length of Improvement (m)
Renewal	1130
New Main	680

Figure 3 shows the AAFF within 111 Avenue Corridor, after the recommended improvements were applied. The recommended new water mains, and their diameters, are shown in red on Figure 3. In yellow, Figure 3 also shows the locations of cast iron mains that will in time require renewal. As the focus of this study was 111 Avenue Corridor, EWSI is not recommending improvements for the surrounding hexagons not achieving AAFF of ≥ 300 L/s. The hexagon just east of the corridor has private water mains and the system was not looped to EPCOR's system. And thus options to increase fire flows in that location were not investigated as part of this study.

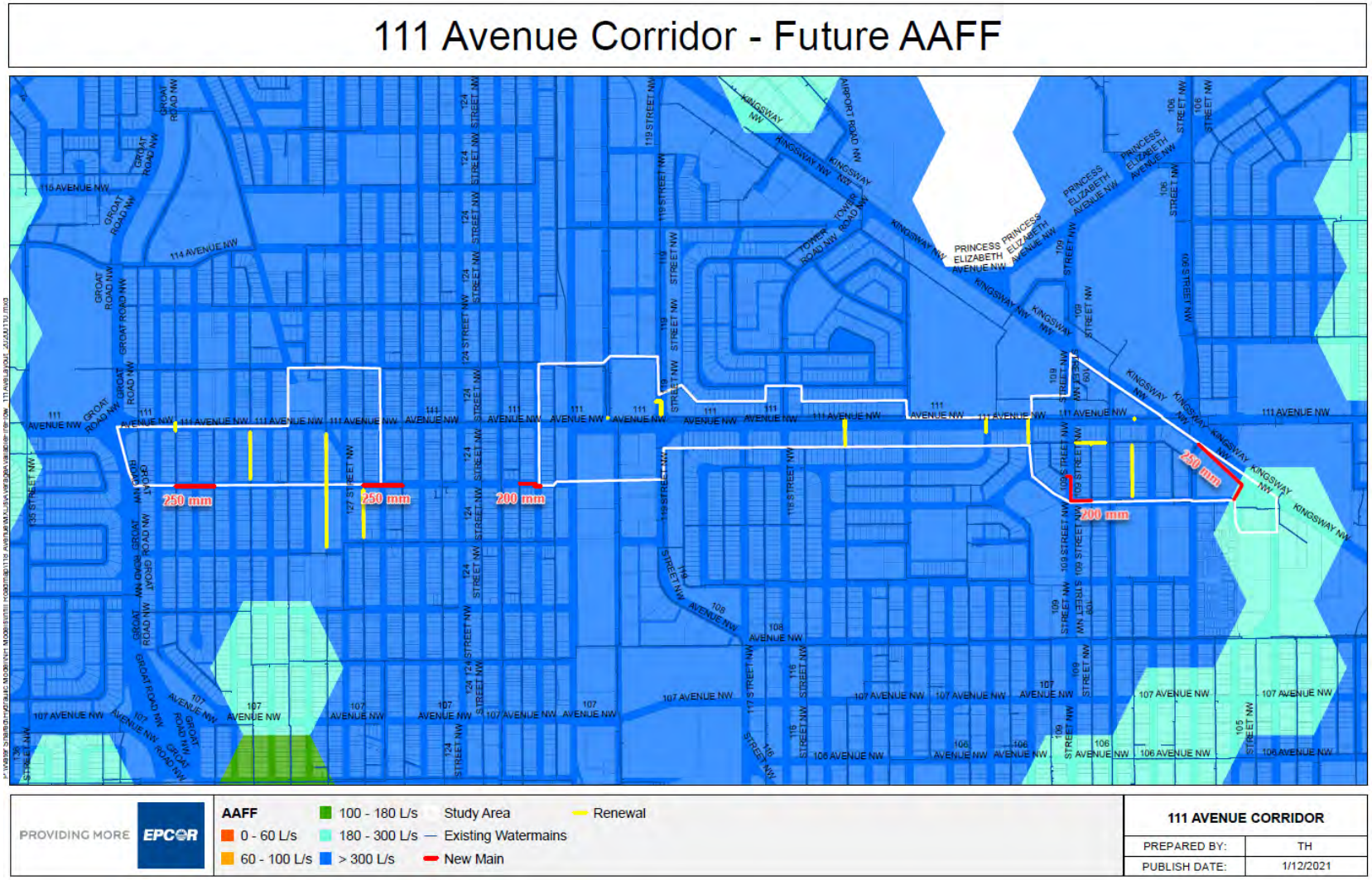


Figure 3: 111 Avenue Corridor - Future AAFF

Memorandum

DATE: 1/20/2021

TO: Kristin St. Louis (AECOM), Li Wang (AECOM)

CC: Ania Schoof (City of Edmonton), Sean Bohle (City of Edmonton)

FROM: Tahmina Hossain – EPCOR Water Services Inc.

SUBJECT: Infill Roadmap – 118 Avenue

PROFESSIONAL ENGINEER ALBERTA
TAHMINA HOSSAIN

PERMIT TO PRACTICE
EPCOR WATER SERVICES INC.
RM SIGNATURE: Tahmina Hossain
RM APEGA ID #: 82550
DATE: JANUARY 21, 2021
PERMIT NUMBER: P006368
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Disclaimer: This information is provided by EWSI One Water Modeling group based on conditions and information existing at the time this document was prepared. The information contained within this document is reliable based on the assumptions contained herein and does not take into account any subsequent variations or changes to such assumptions which may render the results unreliable, at any time, without notice. The all pipes water distribution steady-state model was run using Synergi Water software. EWSI does not guarantee any modifications made to this digital file by others after its transmission to the intended recipient.

1.0 Background

The City Plan, which imagines a future with two (2) million Edmonton residents, places a focus on urban intensification and densification in redeveloping areas through a network of nodes and corridors. To support the realization of The City Plan, the City of Edmonton Urban Planning Committee is looking to complete an infrastructure capacity review of nine (9) study areas within the City's core and mature neighborhood, helping establish the development readiness of these locations.

To assist in the completion of this review, EPCOR Water Services Inc. (EWSI) has been engaged to complete hydraulic modeling analysis to identify areas where the existing water distribution system is able and unable to deliver 300 L/s fire flows, which is the current City of Edmonton fire flow guideline for high density residential, industrial and commercial developments. The results of the modeling analysis are summarized in this memorandum and should be considered alongside the hydrant spacing analysis being completed by AECOM as part of the overall water infrastructure capacity review. Recommendations for infrastructure improvements are also provided for areas unable to currently achieve 300 L/s.

2.0 Initial Area Assessment

Figure 1 shows the current (2017) average available fire flow (AAFF) within the 118 Avenue Corridor area. The 400 m x 400 m hexagons are colored by the average water system capacity under fire flow conditions, and represent roughly two (2) City blocks. As illustrated in Figure 1, fire flows range from 100 L/s to above 300 L/s within 118 Avenue Corridor.

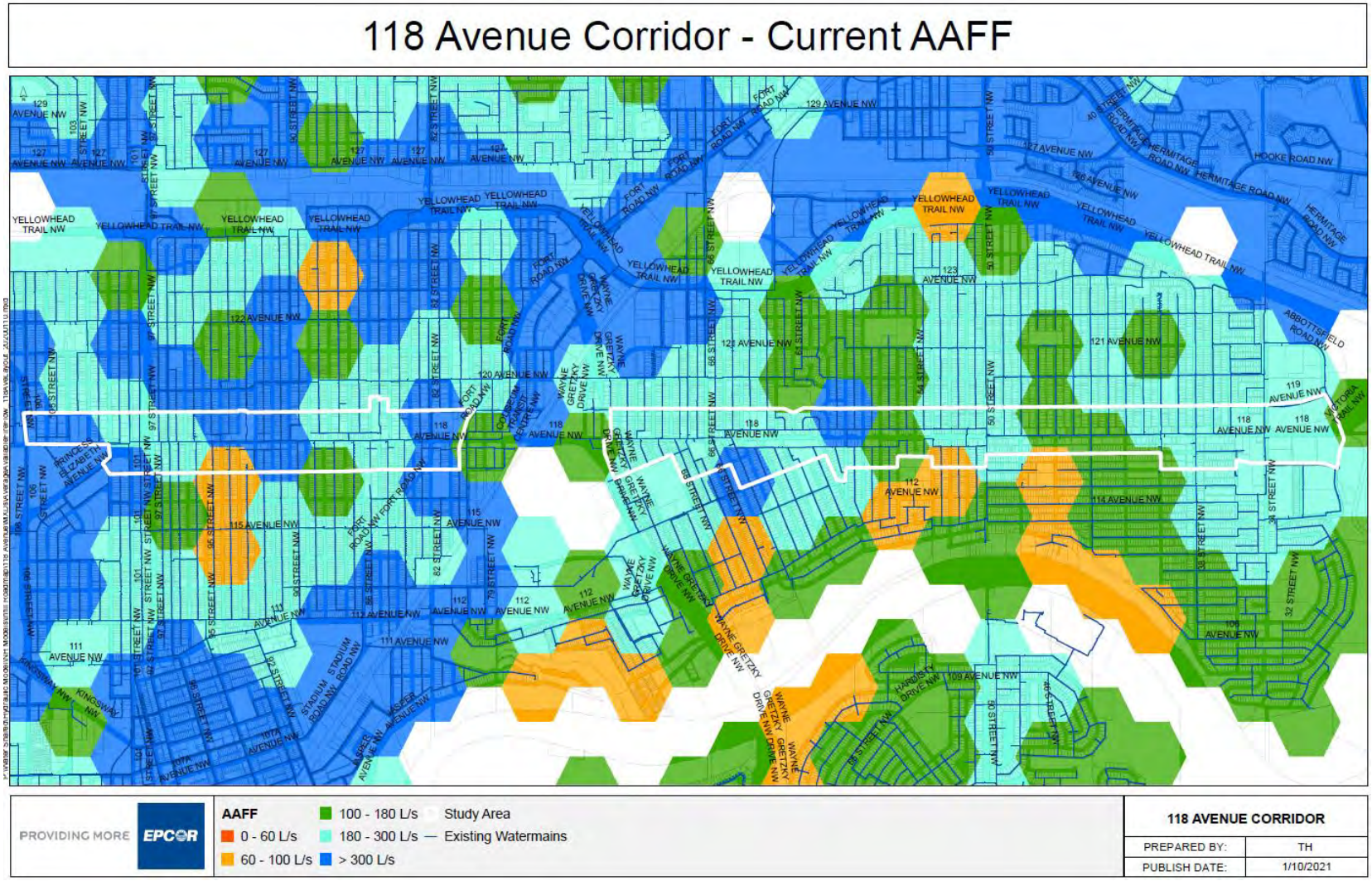


Figure 1: 118 Avenue Corridor – Current AAFF

EWSI's water distribution and transmission system is designed to provide fire protection throughout the City of Edmonton. Therefore, when investigating the development readiness of an area, focus is placed on the available fire flow rates, rather than the water consumption in that location. Figure 2 was developed to illustrate the magnitude of difference between flow rates required for maximum day demand (MDD) consumption, and fire events.

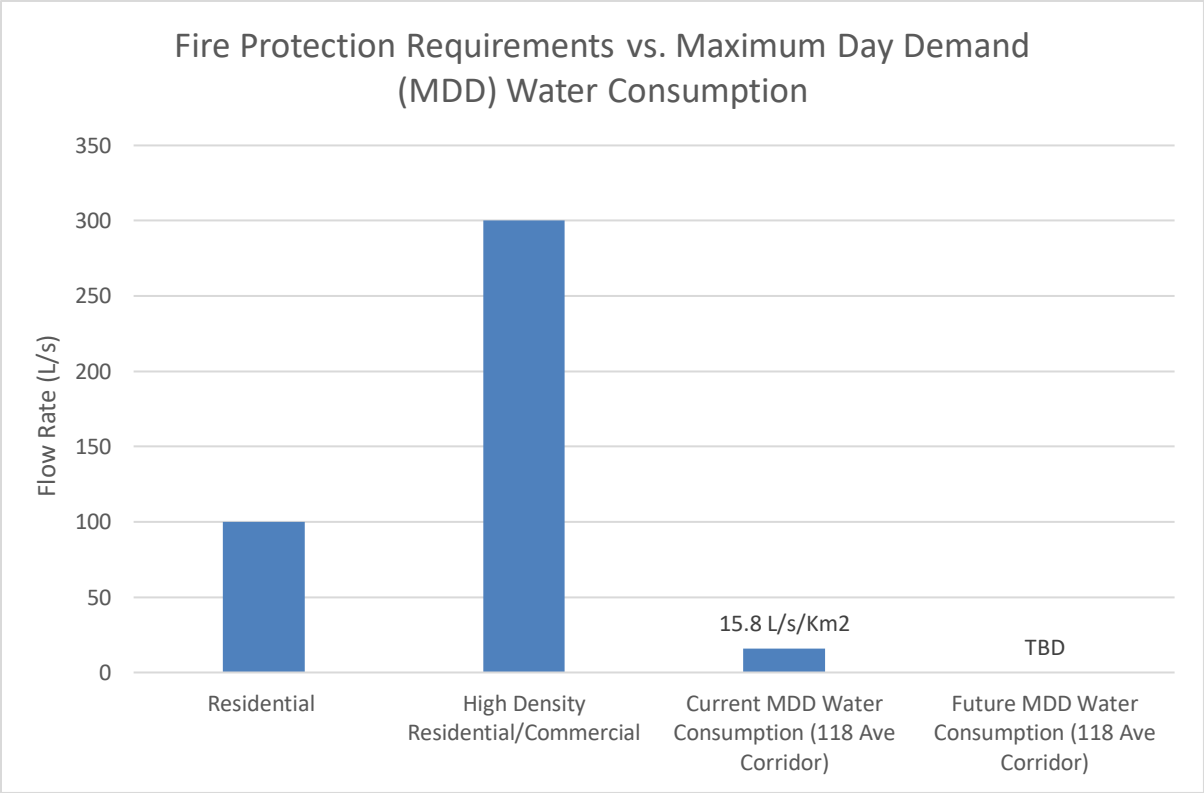


Figure 2: Fire Protection Requirements vs. Maximum Day Demand Water Consumption in 118 Avenue Corridor

3.0 Analysis Assumptions

To complete the modeling analysis, Synergi Water (version 4.9) software was used and the following assumptions were applied:

- 2020 MDD scenario base model used to run the fire flow analysis.
  - Model calibrated to 2015 demands, and updated with 2020 pipes.
- Fire flow analysis run at hydrants within 118 Avenue Corridor and hydrants within a 200 m buffer of the node boundary (to view the effect of improvements on the surrounding areas).
- Hydrant leads within 118 Avenue Corridor and the 200 m buffer modified to ensure hydrant nodes better represent system capacity.
- When the City reaches two (2) million Edmontonians, all mains within the study area are PVC/PVC-equivalent.

4.0 Area Improvements

EWSI modeled future improvement options to increase fire flows in areas within 118 Avenue Corridor not currently achieving 300 L/s. These options utilized a combination of water main addition and water main renewal to increase fire flow capacity to the area. Depending on the time of development/densification, one option may be favored over the other.

4.1 Option 1

Option 1 for increasing fire flows within 118 Avenue Corridor focuses primarily on organic renewal of water mains and also few places for the installation of new water mains. Water main renewals are expected to occur through EWSI's various water main renewal programs. At the time of renewal, EWSI will ensure the renewed infrastructure is capable of achieving the required fire flows at that time.

Table 1 summarizes the approximate length of pipe size recommended for improvements to 118 Avenue Corridor to achieve 300 L/s throughout the area if Option 1 is pursued.

Table 1: Summary of Area Improvements

Improvement Type	Approx. Length of Improvement (m)
Renewal	26,394
New Pipe	580

Figure 3-1 and Figure 3-2 show the AAFF within 118 Avenue Corridor, after the recommended improvements were applied. The recommended new water mains, and their diameters, are shown in red on Figure 3-2. In yellow, Figure 3-1 and Figure 3-2 also show the locations of cast iron mains that will in time require renewal along with some asbestos cement (AC) water main renewal to satisfy the fire flow requirements in future. As the focus of this study was 118 Avenue Corridor, EWSI is not recommending improvements for the surrounding hexagons of the project boundary not achieving AAFF of ≥ 300 L/s. While some of these hexagons slightly overlap the study area, the hydrants within them do not impact the fire flow capacity within the study area, and thus options to increase fire flows in these locations were not investigated as part of this study. It is expected that with water main renewals in the future, the average system capacity of these hexagons will improve.

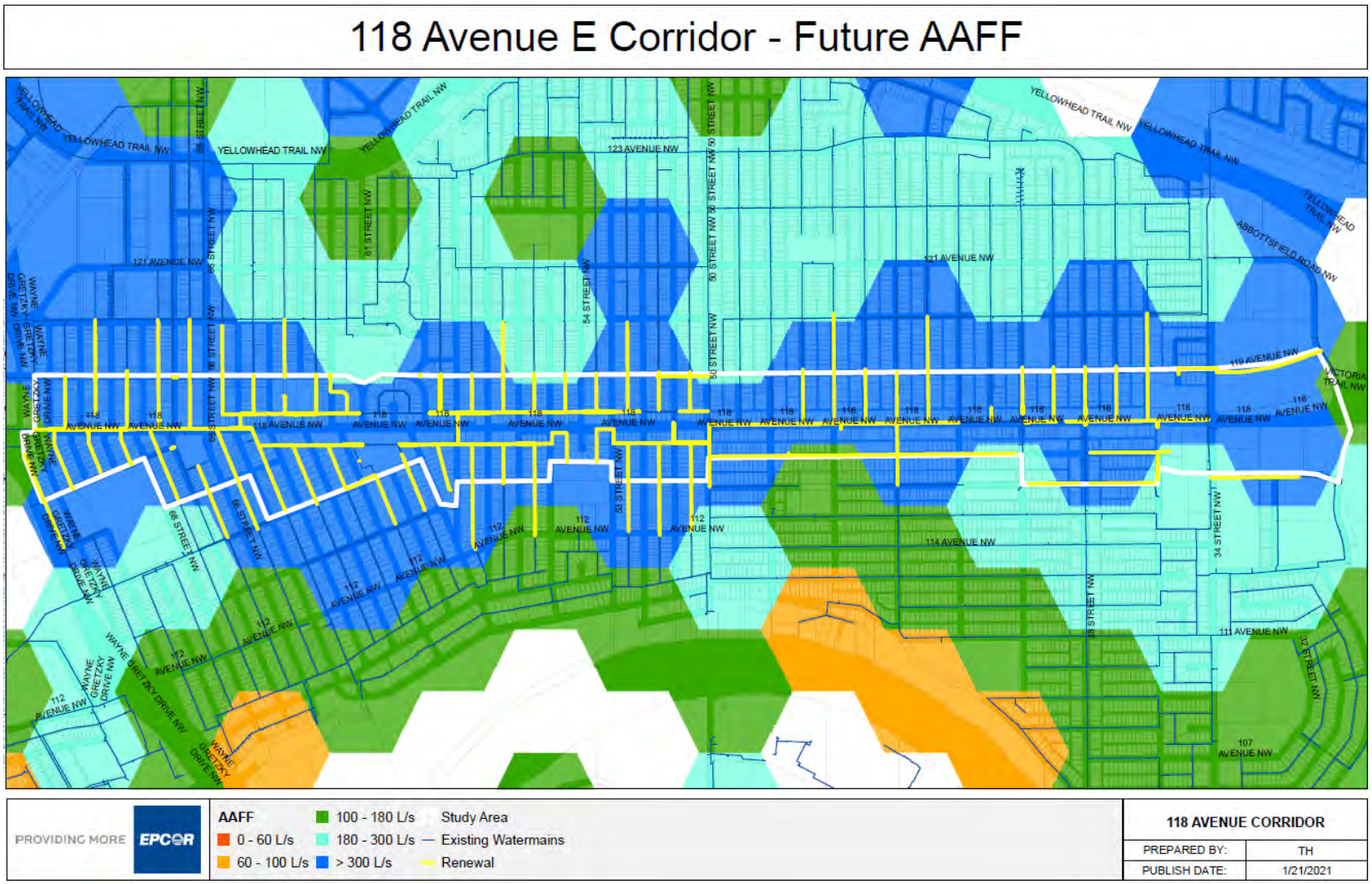


Figure 3-1: 118 Avenue East Corridor - Future AAFF (Option 1)

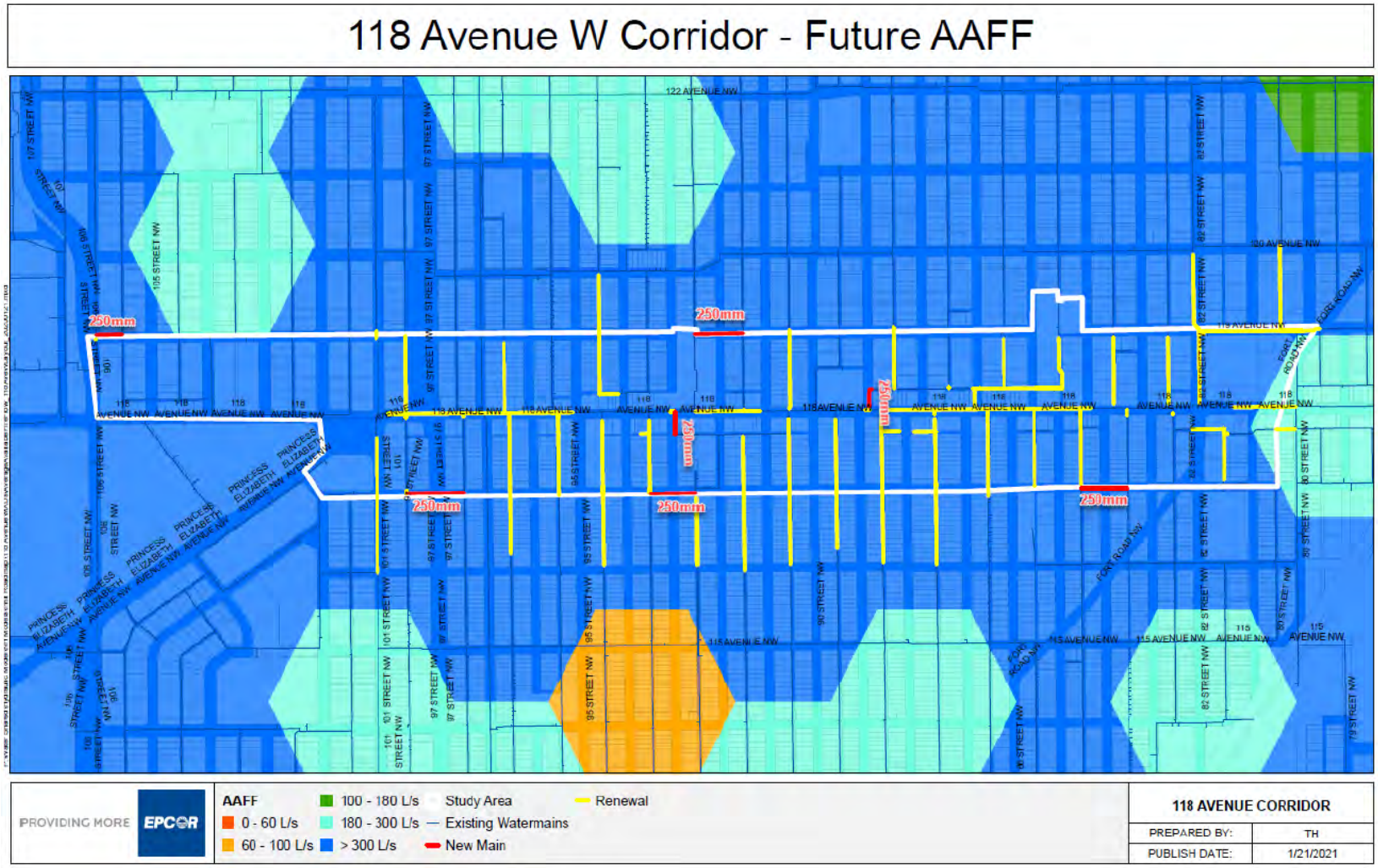


Figure 3-2: 118 Avenue West Corridor - Future AAFF (Option 1)

Option 2

Option 2 looks at construction of a new main along 118 Avenue corridor to increase fire flows within 118 Corridor along with some additional north south connections. While some areas the cast iron main (CI) and asbestos cement (AC) renewal were also recommended to achieve the fire flow.

Table 2 summarizes the approximate length of pipe size recommended for improvements to 118 Avenue Corridor to achieve 300 L/s throughout the area if Option 2 is pursued.

Table 2: Summary of Option 2 Area Improvements

Improvement Type	Approx. Length of Improvement (m)
Renewal	12,162
New main	2,592

Figure 4-1 and Figure 4-2 show the AAFF within 118 Avenue Corridor, after the recommended improvements were applied in Option 2. The recommended new water main, and the diameter, are shown in red on Figure 4-1 and Figure 4-2. In yellow, Figure 4-1 and Figure 4-2 also show the locations of cast iron mains that will in time require renewal along with some asbestos cement (AC) water main renewal to satisfy the fire flow requirements in future. As the focus of this study was 118 Avenue Corridor, EWSI is not recommending improvements for the surrounding hexagons of the project boundary not achieving AAFF of ≥ 300 L/s. While some of these hexagons slightly overlap the study area, the hydrants within them do not impact the fire flow capacity within the study area, and thus options to increase fire flows in these locations were not investigated as part of this study. It is expected that with water main renewals in the future, the average system capacity of these hexagons will improve.

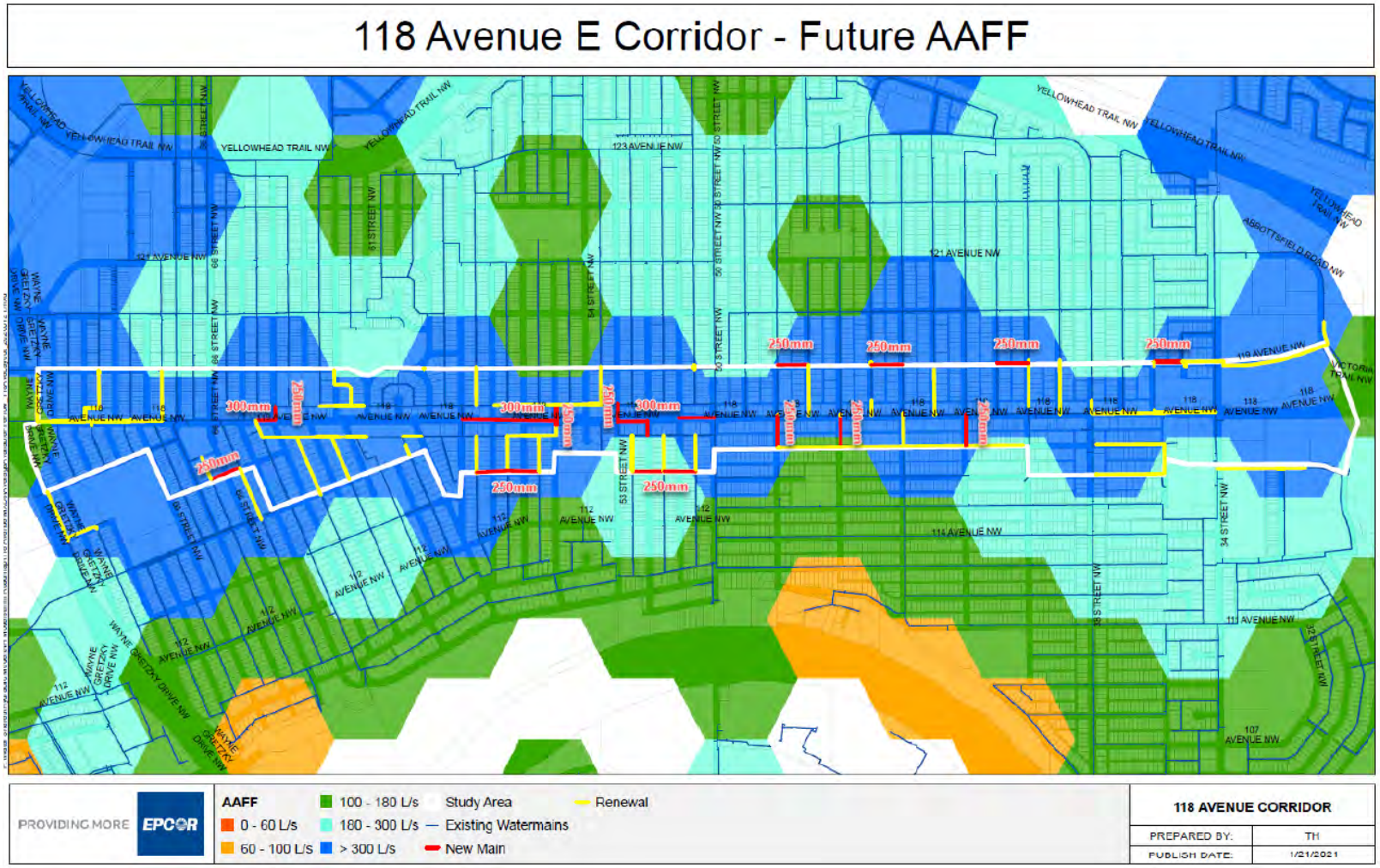


Figure 4-1: 118 Avenue East Corridor - Future AAFF (Option 2)

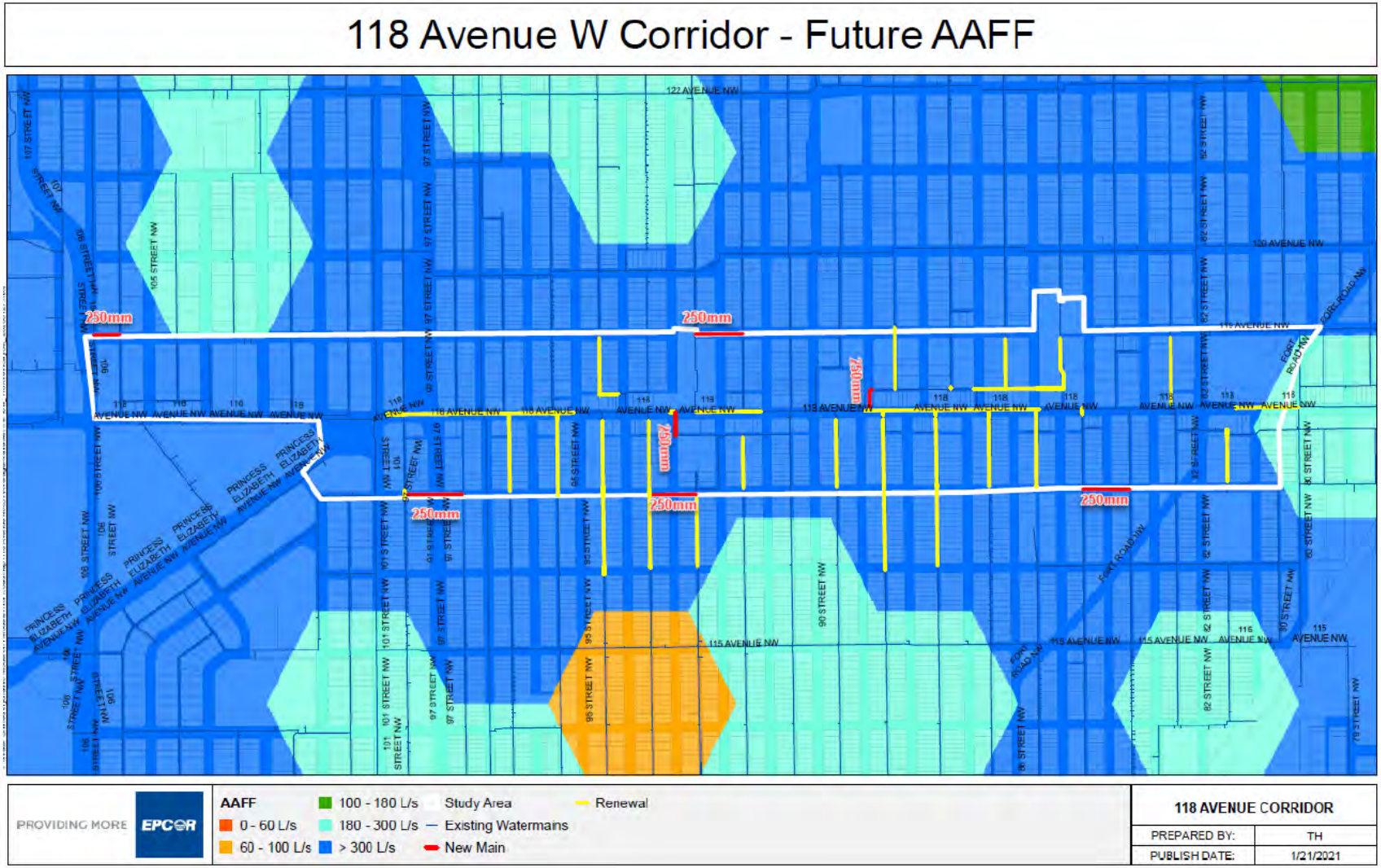


Figure 4-2: 118 Avenue West Corridor - Future AAFF (Option 2)

Memorandum

DATE: 12/14/2020

TO: Kristin St. Louis (AECOM), Li Wang (AECOM)

CC: Ania Schoof (City of Edmonton), Sean Bohle (City of Edmonton)

FROM: Tahmina Hossain – EPCOR Water Services Inc.

SUBJECT: Infill Roadmap – Centre City

PROFESSIONAL ENGINEER TAHMINA HOSSAIN ALBERTA

PERMIT TO PRACTICE
EPCOR WATER SERVICES INC.
RM SIGNATURE: Liliane Mallmann
RM APEGA ID #: 68166
DATE: December 16th 2020
PERMIT NUMBER: P006368
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

1.0 Background

The City Plan, which imagines a future with two (2) million Edmonton residents, places a focus on urban intensification and densification in redeveloping areas through a network of nodes and corridors. To support the realization of The City Plan, the City of Edmonton Urban Planning Committee is looking to complete an infrastructure capacity review of nine (9) study areas within the City's core and mature neighborhood, helping establish the development readiness of these locations.

To assist in the completion of this review, EPCOR Water Services Inc. (EWSI) has been engaged to complete hydraulic modeling analysis to identify areas where the existing water distribution system is able and unable to deliver 300 L/s fire flows, which is the current City of Edmonton fire flow guideline for high density residential, industrial and commercial developments. The results of the modeling analysis are summarized in this memorandum and should be considered alongside the hydrant spacing analysis being completed by AECOM as part of the overall water infrastructure capacity review. Recommendations for infrastructure improvements are also provided for areas unable to currently achieve 300 L/s.

2.0 Initial Area Assessment

Figure 1 shows the current (2017) average available fire flow (AAFF) within the Center City Node area. The 400 m x 400 m hexagons are colored by the average water system capacity under fire flow conditions, and represent roughly two (2) City blocks. As illustrated in Figure 1, fire flows range from 100 L/s to above 300 L/s within Centre City Node.

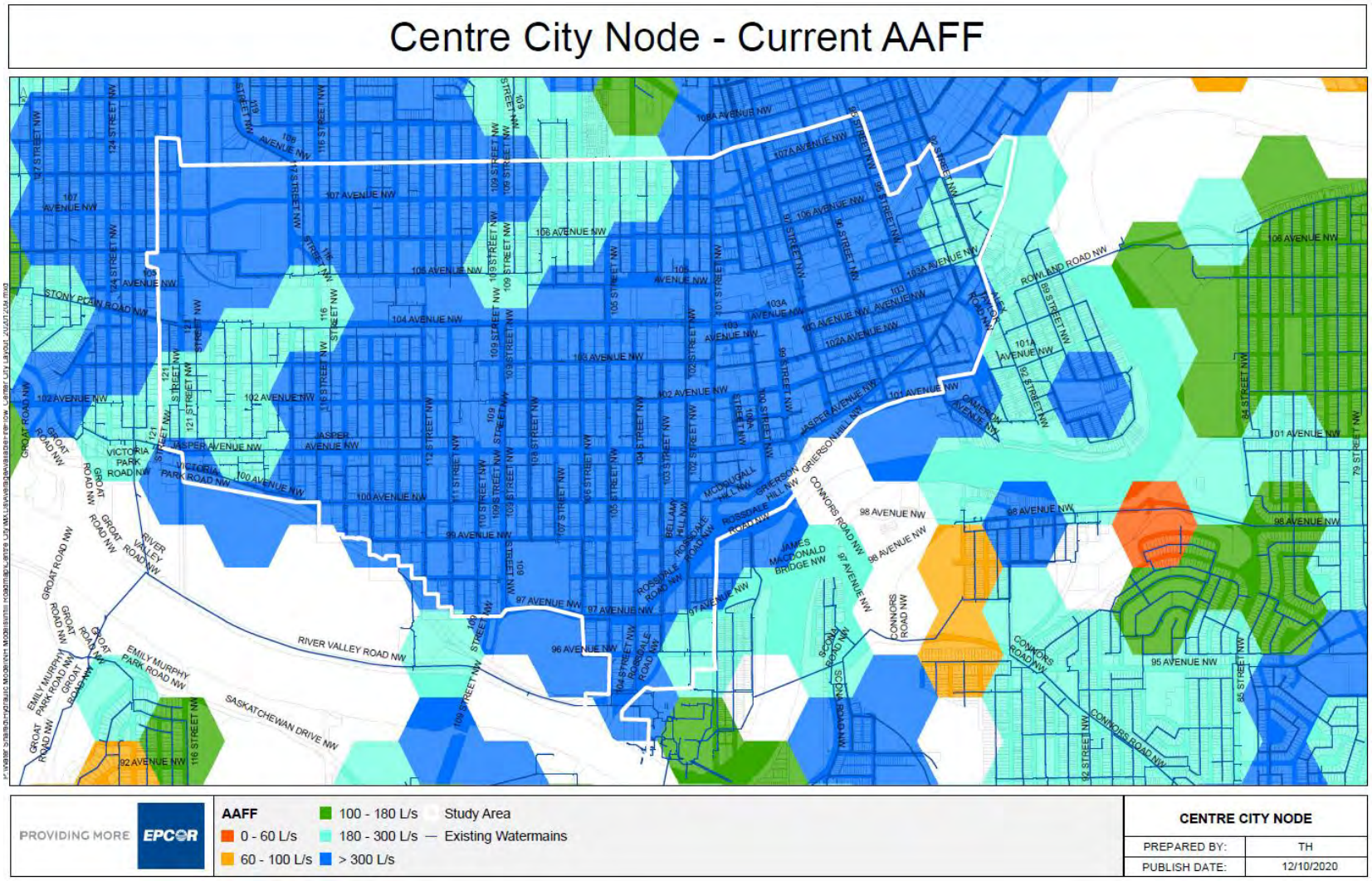


Figure 1: Centre City Node – Current AAFF

EWSI's water distribution and transmission system is designed to provide fire protection throughout the City of Edmonton. Therefore, when investigating the development readiness of an area, focus is placed on the available fire flow rates, rather than the water consumption in that location. Figure 2 was developed to illustrate the magnitude of difference between flow rates required for maximum day demand (MDD) consumption, and fire events.

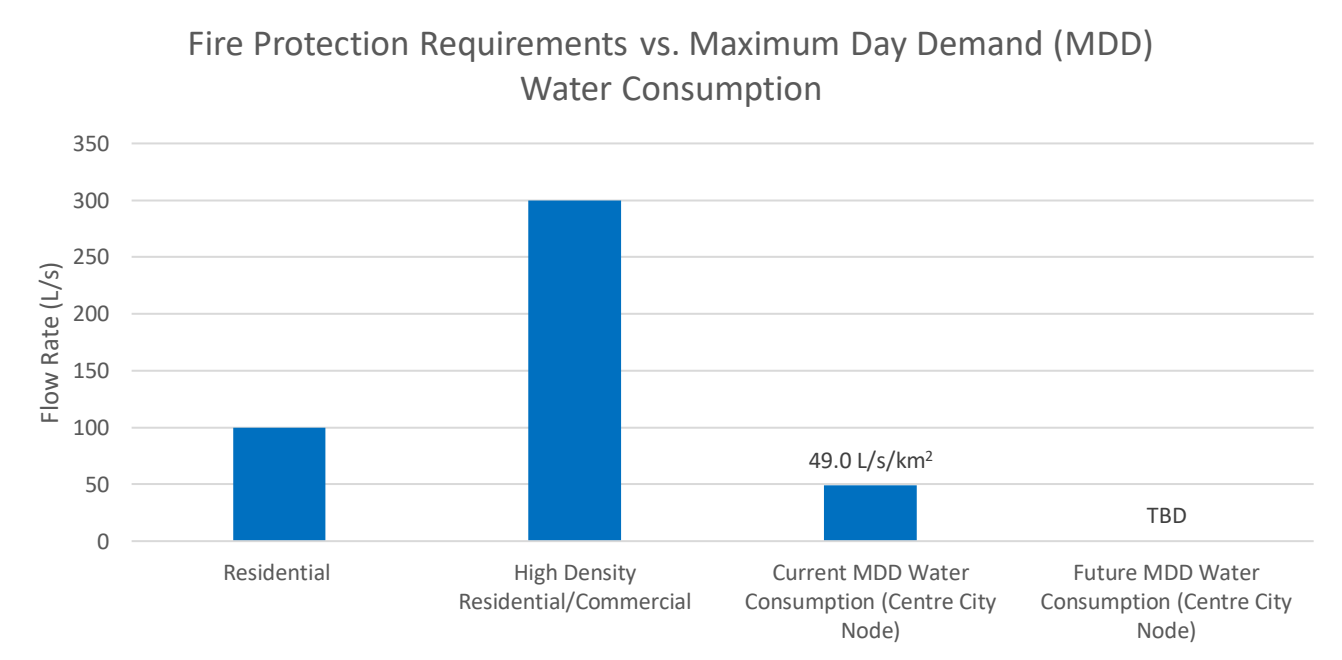


Figure 2: Fire Protection Requirements vs. Maximum Day Demand Water Consumption in Centre City Node

3.0 Analysis Assumptions

To complete the modeling analysis, Synergi Water (version 4.9) software was used and the following assumptions were applied:

- 2020 MDD scenario base model used to run the fire flow analysis.
  - Model calibrated to 2015 demands, and updated with 2020 pipes.
- Fire flow analysis run at hydrants within Centre City Node and hydrants within a 200 m buffer of the node boundary (to view the effect of improvements on the surrounding areas).
- Hydrant leads within Centre City Node and the 200 m buffer modified to ensure hydrant nodes better represent system capacity.
- When the City reaches two (2) million Edmontonians, all mains within the study area are PVC/PVC-equivalent.

4.0 Area Improvements

EWSI modeled future improvement options to increase fire flows in areas within Centre City Node not currently achieving 300 L/s, and recommends a combination of water main addition and water main renewal, to increase fire flow capacity to the area.

Water main renewals are expected to occur through EWSI's various water main renewal programs. At the time of renewal, EWSI will ensure the renewed infrastructure is capable of achieving the required fire flows at that time.

Table 1 summarizes the approximate length of pipe size recommended for improvements to Centre City Node to achieve 300 L/s throughout the area.

Table 1: Summary of Area Improvements

Improvement Type	Approx. Length of Improvement (m)
Renewal	30,368
New Main	84

Figure 3 shows the AAFF within Centre City Node, after the recommended improvements were applied. The recommended new water main, and the diameter, are shown in red on Figure 3. In yellow, Figure 3 also shows the locations of cast iron mains that will in time require renewal. As the focus of this study was Centre City Node, EWSI is not recommending improvements for the surrounding hexagons not achieving AAFF of ≥ 300 L/s. Due to this area with some hydrants located at the long dead ends some of the hydrants could not achieve the AAFF of 300L/sec. Due to the nature of those locations extra looping option was not feasible either. When development happens further analysis is required for those specific hydrants.

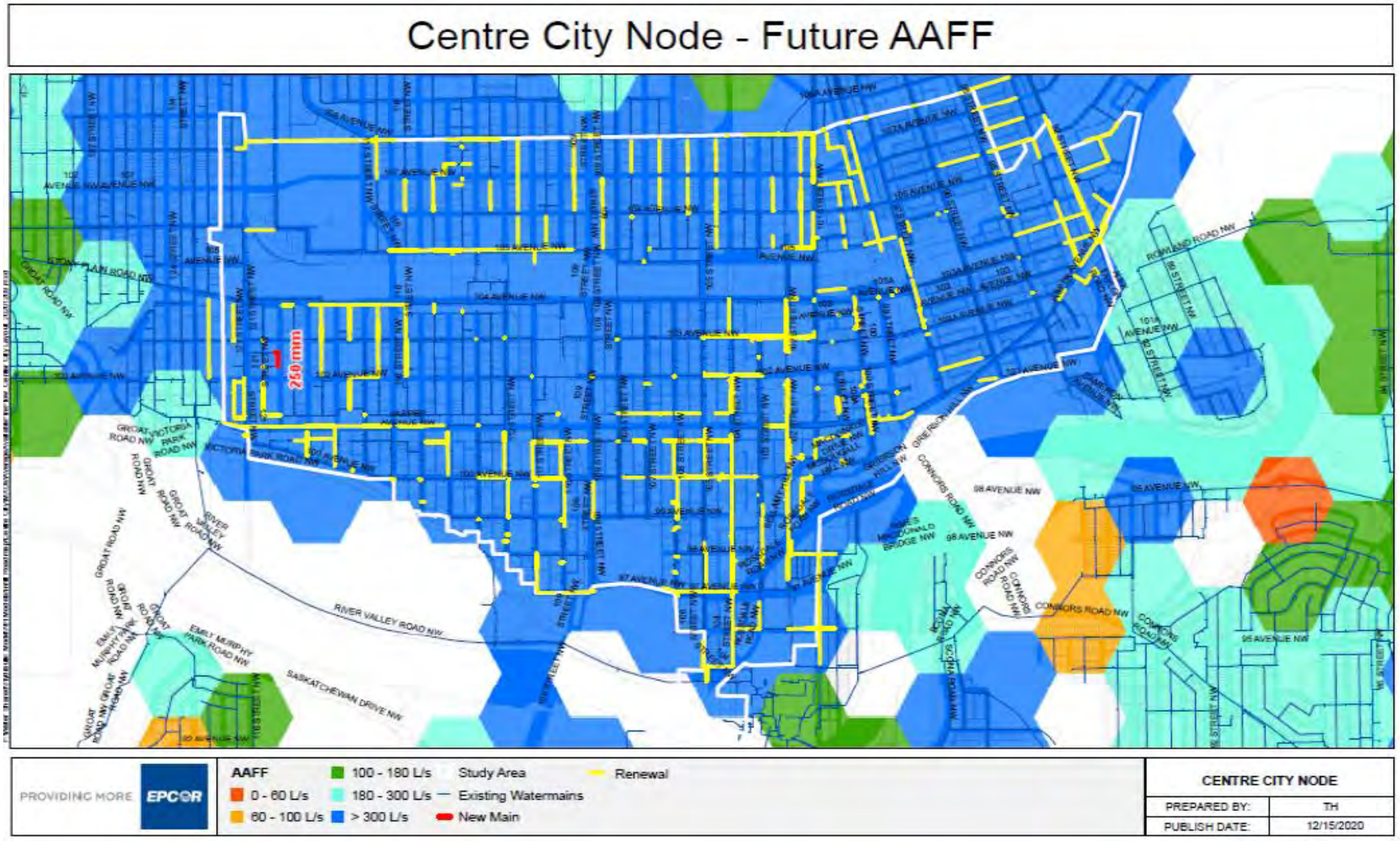


Figure 3: Centre City Node - Future AAFF

Memorandum

DATE: 12/10/2020

TO: Kristin St. Louis (AECOM), Li Wang (AECOM)

CC: Ania Schoof (City of Edmonton), Sean Bohle (City of Edmonton)

FROM: Nathalie Hajek – EPCOR Water Services Inc.

SUBJECT: Infill Roadmap – Stadium

PROFESSIONAL ENGINEER ALBERTA TAHMINA HOSSAIN

PERMIT TO PRACTICE
EPCOR WATER SERVICES INC.
RM SIGNATURE: Liliane Mallet
RM APEGA ID #: 68166
DATE: December 16th 2020
PERMIT NUMBER: P006368
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

1.0 Background

The City Plan, which imagines a future with two (2) million Edmonton residents, places a focus on urban intensification and densification in redeveloping areas through a network of nodes and corridors. To support the realization of The City Plan, the City of Edmonton Urban Planning Committee is looking to complete an infrastructure capacity review of nine (9) study areas within the city's core and mature neighbourhood, helping establish the development readiness of these locations.

To assist in the completion of this review, EPCOR Water Services Inc. (EWSI) has been engaged to complete hydraulic modeling analysis to identify areas where the existing water distribution system is able and unable to deliver 300 L/s fire flows, which is the current City of Edmonton fire flow guideline for high density residential, industrial and commercial developments. The results of the modeling analysis are summarized in this memorandum and should be considered alongside the hydrant spacing analysis being completed by AECOM as part of the overall water infrastructure capacity review. Recommendations for infrastructure improvements are also provided within this memorandum for areas unable to currently achieve 300 L/s.

2.0 Initial Area Assessment

Figure 1 shows the current (2017) average available fire flow (AAFF) within the Stadium area. The 400 m x 400 m hexagons are coloured by the average water system capacity under fire flow conditions, and represent roughly two (2) city blocks. As illustrated in Figure 1, fire flows range from 180 L/s to above 300 L/s within Stadium Node.

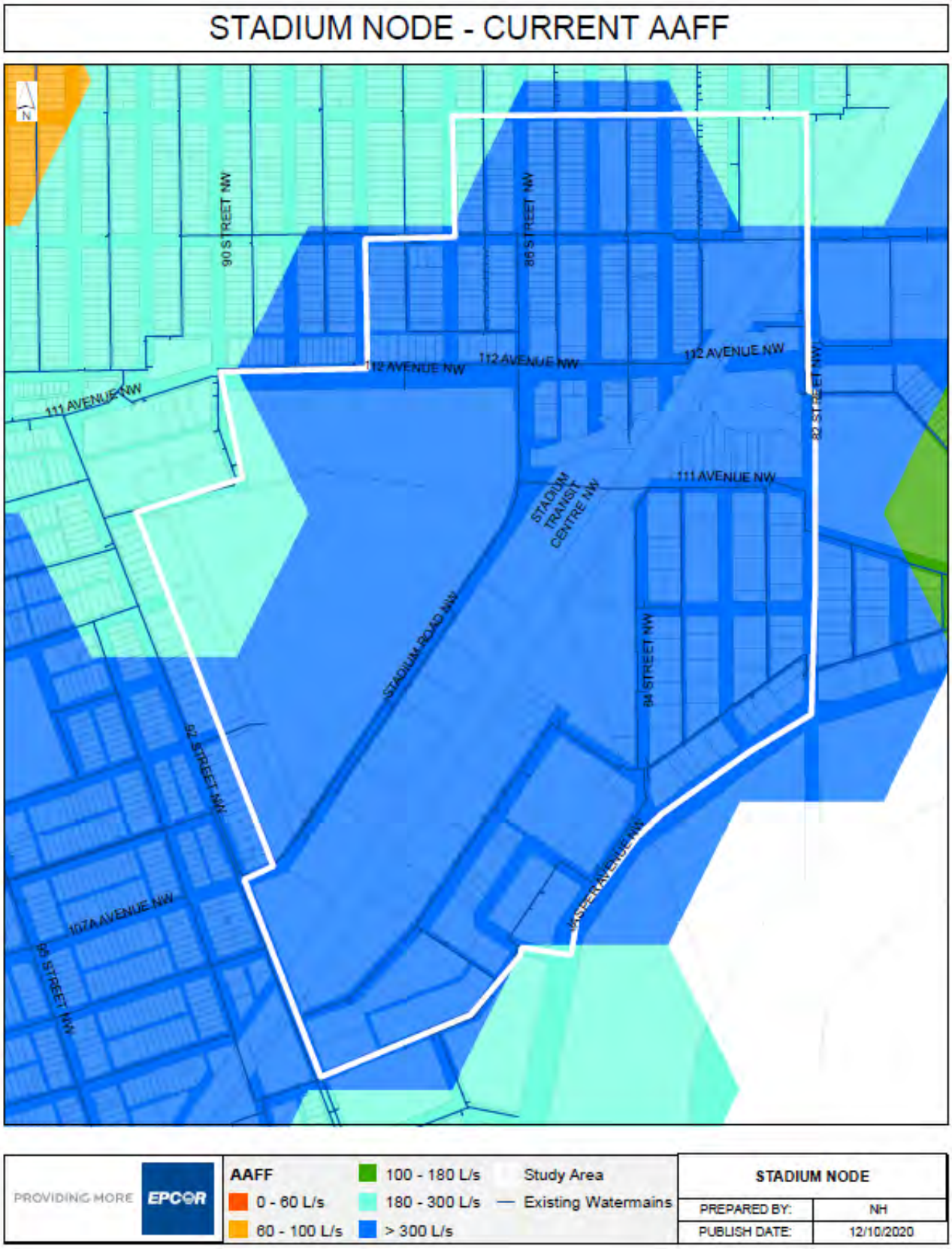


Figure 1: Stadium Node – Current AAFF

EWSI's water distribution and transmission system is designed to provide fire protection throughout the City of Edmonton. Therefore, when investigating the development readiness of an area, focus is placed on the available fire flow rates, rather than the water consumption in that location. Figure 2 was developed to illustrate the magnitude of difference between flow rates required for maximum day demand (MDD) consumption, and fire events.

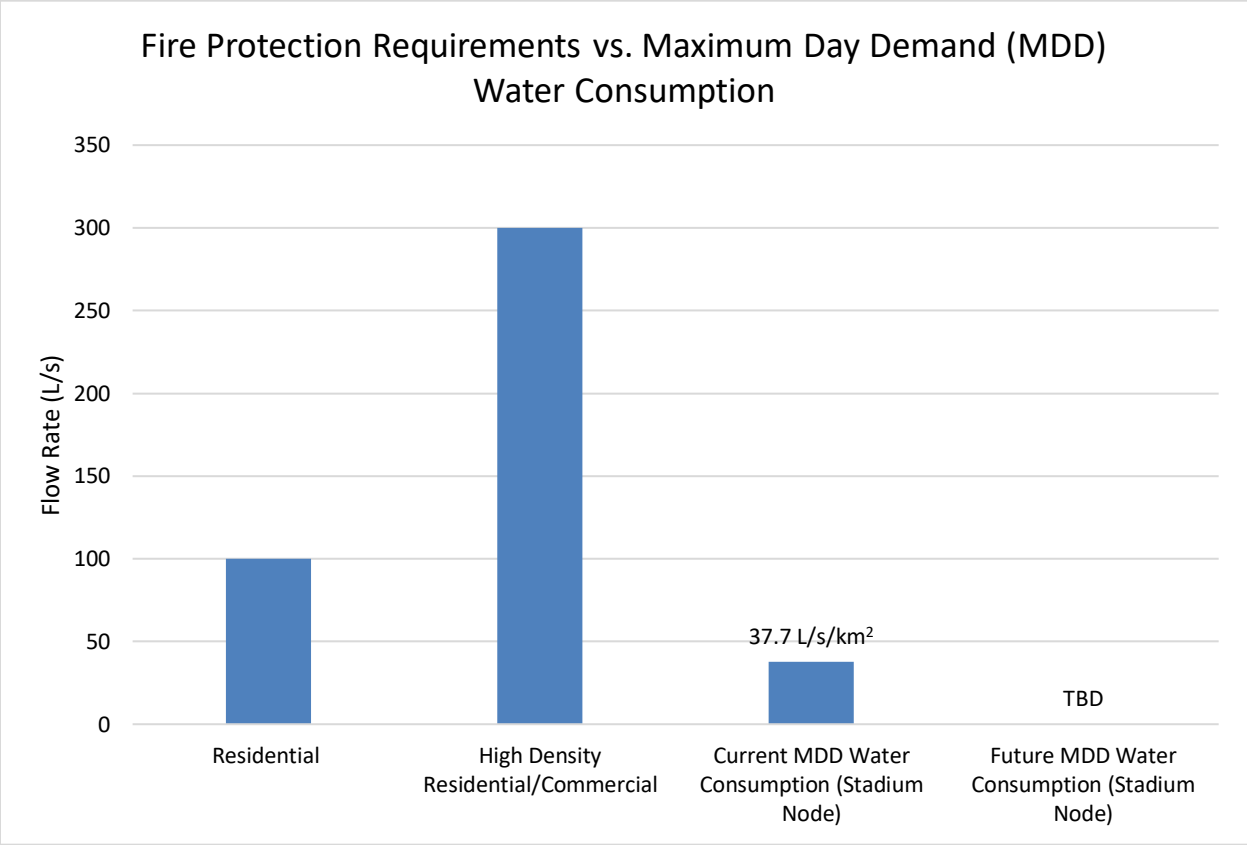


Figure 2: Fire Protection Requirements vs. Maximum Day Demand Water Consumption in Stadium Node

3.0 Analysis Assumptions

To complete the modeling analysis, Synergi Water (version 4.9) software was used and the following assumptions were applied:

- 2020 MDD scenario base model used to run the fire flow analysis.
  - Model calibrated to 2015 demands, and updated with 2020 pipes.
- Fire flow analysis run at hydrants within Stadium Node and hydrants within a 200 m buffer of the corridor boundary (to view the effect of improvements on the surrounding areas).
- Hydrant leads within Stadium Node and the 200 m buffer modified to ensure hydrant nodes better represent system capacity.
- When the City reaches two (2) million Edmontonians, all mains within the study area are PVC/PVC-equivalent.

4.0 Area Improvements

EWSI modeled future improvement options to increase fire flows in areas within Stadium Node not currently achieving 300 L/s, and utilized water main renewal to increase fire flow capacity to the area.

Water main renewals are expected to occur through EWSI's various water main renewal programs. At the time of renewal, EWSI will ensure the renewed infrastructure is capable of achieving the required fire flows at that time.

Table 1 summarizes the approximate length of renewals within Stadium Node to achieve 300 L/s throughout the area.

Table 1: Summary of Area Improvements

Improvement Type	Approx. Length of Improvement (m)
Renewal	2,479

Figure 3 shows the AAFF within Stadium Node, after the water main renewals were applied. The locations of these cast iron mains, that will in time require renewal, are shown in yellow on Figure 3. No further improvements are recommended by EWSI at this time to increase fire flows within the Stadium Node area.

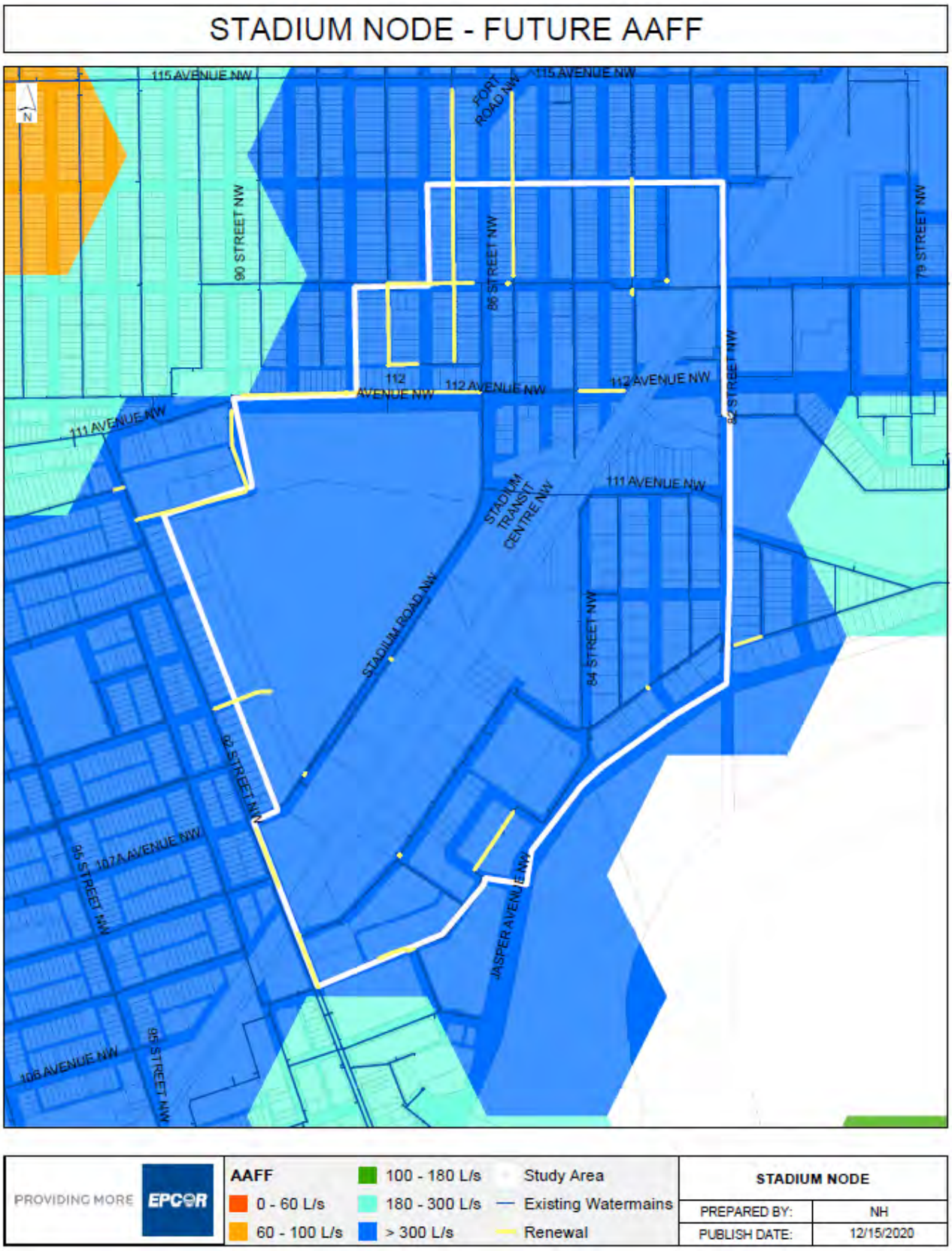


Figure 3: Stadium Node - Future AAFF

Memorandum

DATE: 12/9/2020

TO: Kristin St. Louis (AECOM), Li Wang (AECOM)

CC: Ania Schoof (City of Edmonton), Sean Bohle (City of Edmonton)

FROM: Nathalie Hajek – EPCOR Water Services Inc.

SUBJECT: Infill Roadmap – Stony Plain Road

PROFESSIONAL ENGINEER ALBERTA
TAHMINA HOSSAIN

PERMIT TO PRACTICE
EPCOR WATER SERVICES INC.
RM SIGNATURE: Liliane Moleski
RM APEGA ID #: 68166
DATE: December 16th 2020
PERMIT NUMBER: P006368
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

1.0 Background

The City Plan, which imagines a future with two (2) million Edmonton residents, places a focus on urban intensification and densification in redeveloping areas through a network of nodes and corridors. To support the realization of The City Plan, the City of Edmonton Urban Planning Committee is looking to complete an infrastructure capacity review of nine (9) study areas within the city's core and mature neighbourhood, helping establish the development readiness of these locations.

To assist in the completion of this review, EPCOR Water Services Inc. (EWSI) has been engaged to complete hydraulic modeling analysis to identify areas where the existing water distribution system is able and unable to deliver 300 L/s fire flows, which is the current City of Edmonton fire flow guideline for high density residential, industrial and commercial developments. The results of the modeling analysis are summarized in this memorandum and should be considered alongside the hydrant spacing analysis being completed by AECOM as part of the overall water infrastructure capacity review. Recommendations for infrastructure improvements are also provided within this memorandum for areas unable to currently achieve 300 L/s.

2.0 Initial Area Assessment

Figure 1 shows the current (2017) average available fire flow (AAFF) within the Stony Plain Road area. The 400 m x 400 m hexagons are coloured by the average water system capacity under fire flow conditions, and represent roughly two (2) city blocks. As illustrated in Figure 1, fire flows range from 100 L/s to above 300 L/s within Stony Plain Road Corridor.

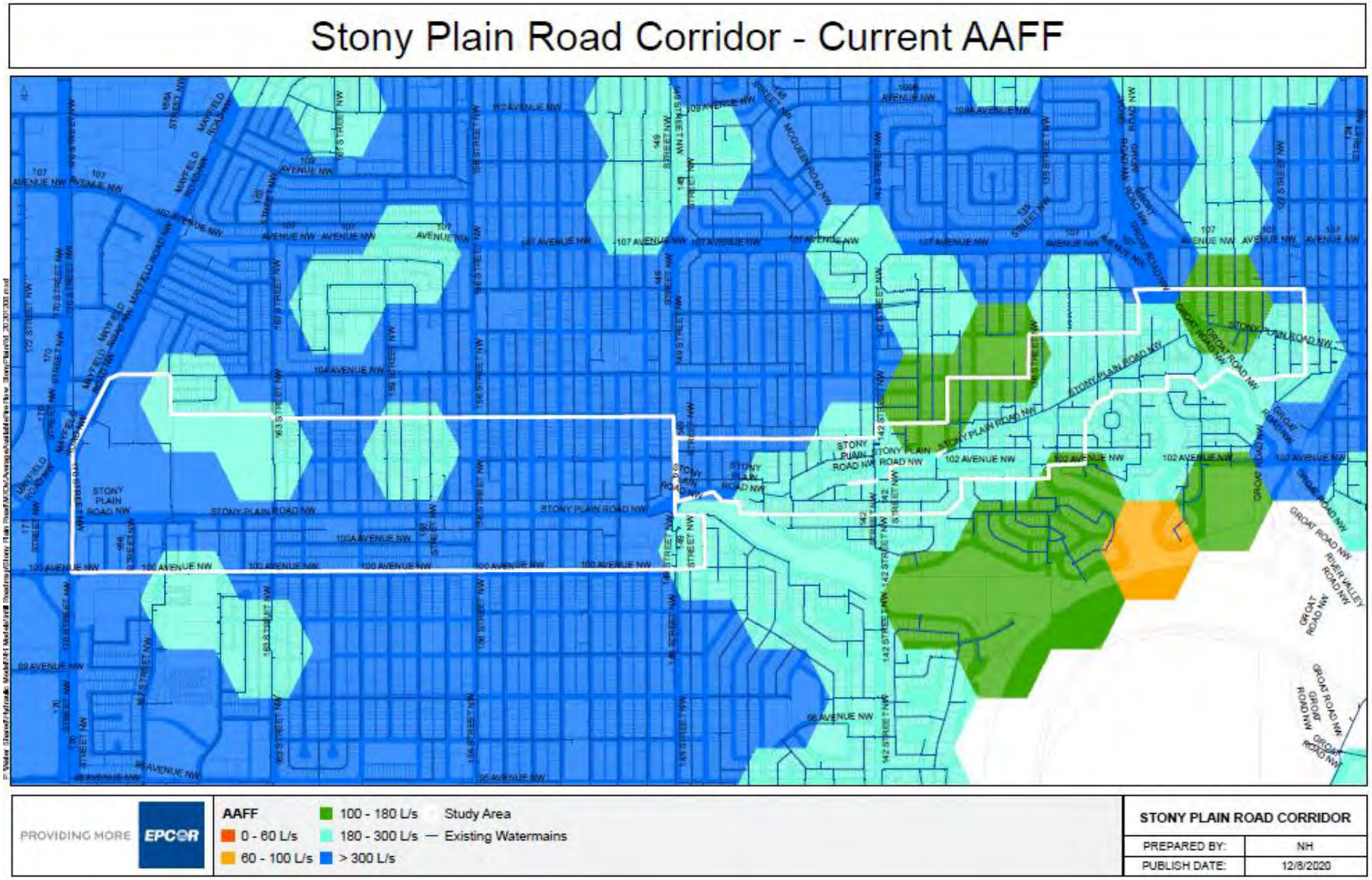


Figure 1: Stony Plain Road Corridor – Current AAFF

EWSI's water distribution and transmission system is designed to provide fire protection throughout the City of Edmonton. Therefore, when investigating the development readiness of an area, focus is placed on the available fire flow rates, rather than the water consumption in that location. Figure 2 was developed to illustrate the magnitude of difference between flow rates required for maximum day demand (MDD) consumption, and fire events.

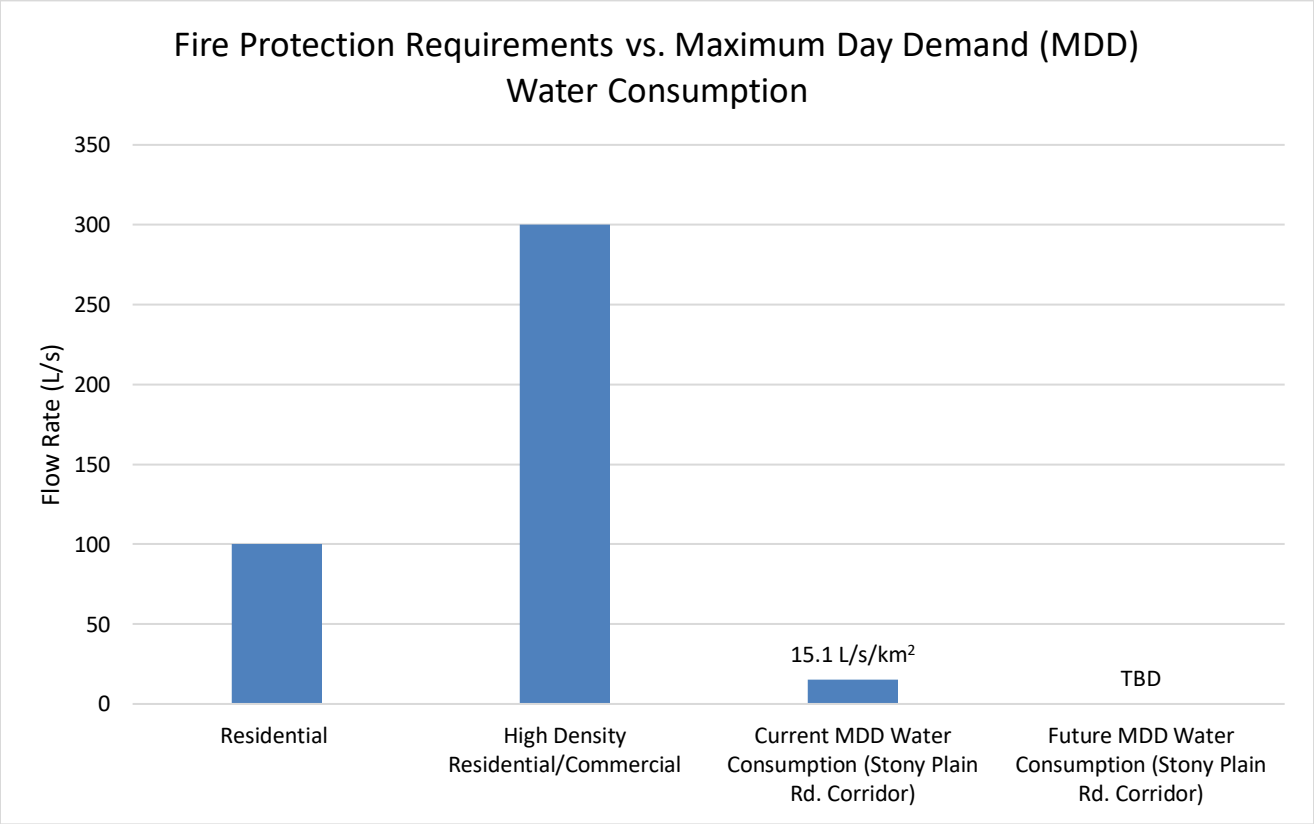


Figure 2: Fire Protection Requirements vs. Maximum Day Demand Water Consumption in Stony Plain Rd. Corridor

3.0 Analysis Assumptions

To complete the modeling analysis, Synergi Water (version 4.9) software was used and the following assumptions were applied:

- 2020 MDD scenario base model used to run the fire flow analysis.
  - Model calibrated to 2015 demands, and updated with 2020 pipes.
- Fire flow analysis run at hydrants within Stony Plain Rd. Corridor and hydrants within a 200 m buffer of the corridor boundary (to view the effect of improvements on the surrounding areas).
- Hydrant leads within Stony Plain Rd. Corridor and the 200 m buffer modified to ensure hydrant nodes better represent system capacity.
- When the City reaches two (2) million Edmontonians, all mains within the study area are PVC/PVC-equivalent.

4.0 Area Improvements

EWSI modeled future improvement options to increase fire flows in areas within Stony Plain Rd. Corridor not currently achieving 300 L/s, and utilized a combination of water main addition and water main renewal to increase fire flow capacity to the area.

Water main renewals are expected to occur through EWSI's various water main renewal programs. At the time of renewal, EWSI will ensure the renewed infrastructure is capable of achieving the required fire flows at that time.

Table 1 summarizes the approximate length of improvements to Stony Plain Road Corridor to achieve 300 L/s throughout the area.

Table 1: Summary of Area Improvements

Improvement Type	Approx. Length of Improvement (m)
Renewal	10,516
New Main	853

Figure 3 shows the AAFF within Stony Plain Road Corridor, after the recommended improvements were applied. The recommended new water mains, and their diameters, are shown in red on Figure 3. In yellow, Figure 3 also shows the locations of cast iron mains that will in time require renewal. As the focus of this study was Stony Plain Road Corridor, EWSI is not recommending improvements for the surrounding hexagons not achieving an AAFF of ≥ 300 L/s, such as the hexagons on the far east side of the corridor. While these hexagons slightly overlap the study area, the hydrants within them do not impact the fire flow capacity within the study area, and thus options to increase fire flows in these locations were not investigated as part of this study. It is expected that with water main renewals in the future, the average system capacity of these hexagons will improve.

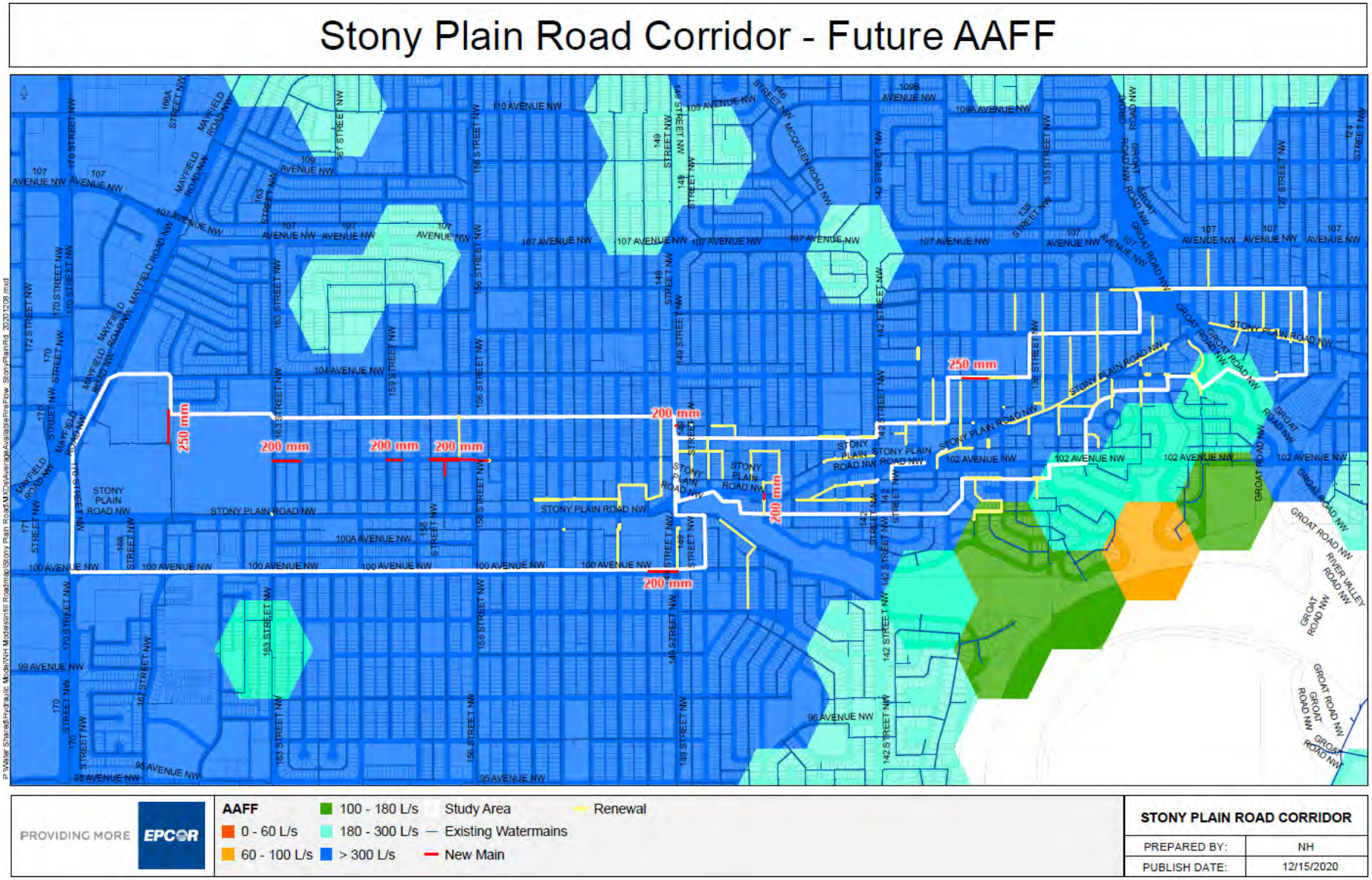


Figure 3: Stony Plain Road Corridor - Future AAFF

Memorandum

DATE: 1/21/2021

TO: Kristin St. Louis (AECOM), Li Wang (AECOM)

CC: Ania Schoof (City of Edmonton), Sean Bohle (City of Edmonton)

FROM: Nathalie Hajek – EPCOR Water Services Inc.

SUBJECT: Infill Roadmap – University-Garneau

PROFESSIONAL ENGINEER ALBERTA
TAHMINA HOSSAIN

PERMIT TO PRACTICE
EPCOR WATER SERVICES INC.
RM SIGNATURE:
RM APEGA ID #: 82550
DATE: JANUARY 21, 2021
PERMIT NUMBER: P006368
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

1 Background

The City Plan, which imagines a future with two (2) million Edmonton residents, places a focus on urban intensification and densification in redeveloping areas through a network of nodes and corridors. To support the realization of The City Plan, the City of Edmonton Urban Planning Committee is looking to complete an infrastructure capacity review of nine (9) study areas within the city's core and mature neighbourhood, helping establish the development readiness of these locations.

To assist in the completion of this review, EPCOR Water Services Inc. (EWSI) has been engaged to complete hydraulic modeling analysis to identify areas where the existing water distribution system is able and unable to deliver 300 L/s fire flows, which is the current City of Edmonton fire flow guideline for high density residential, industrial and commercial developments. The results of the modeling analysis are summarized in this memorandum and should be considered alongside the hydrant spacing analysis being completed by AECOM as part of the overall water infrastructure capacity review. Recommendations for infrastructure improvements are also provided within this memorandum for areas unable to currently achieve 300 L/s.

2 Initial Area Assessment

Figure 1 shows the current (2017) average available fire flow (AAFF) within the University/Garneau area. The 400 m x 400 m hexagons are coloured by the average water system capacity under fire flow conditions, and represent roughly two (2) city blocks. As illustrated in Figure 1, fire flows range from 100 L/s to above 300 L/s within University/Garneau Node.

Figure 1 also shows a large area (white with a grey border) within University/Garneau Node that does not contain EPCOR-owned water mains. This area is the University of Alberta campus which has its own privately-owned water infrastructure. While the hexagons encroach on this area, the University of Alberta campus water infrastructure is not included in the scope of this analysis.

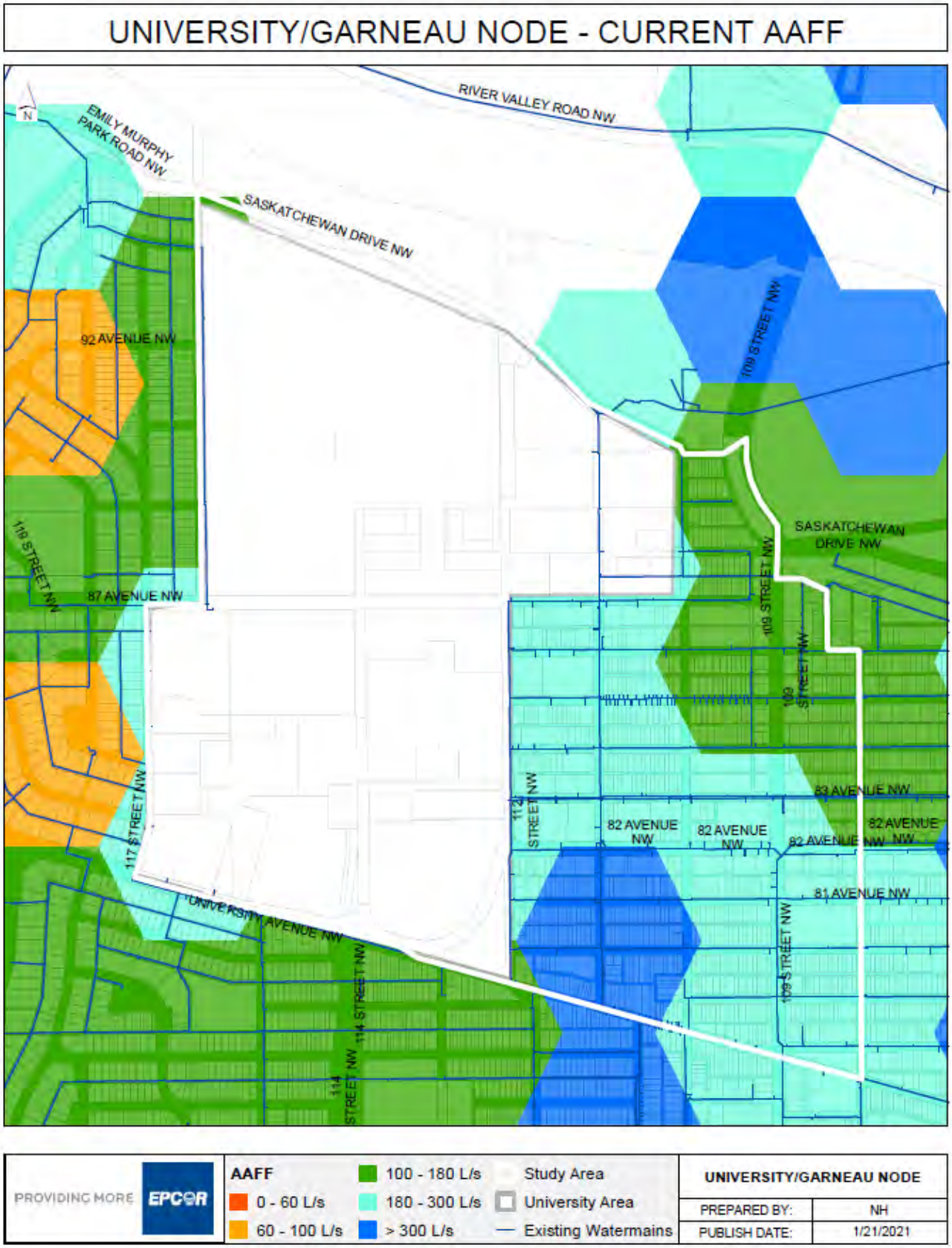


Figure 1: University-Garneau Node – Current AAFF

EWSI's water distribution and transmission system is designed to provide fire protection throughout the City of Edmonton. Therefore, when investigating the development readiness of an area, focus is placed on the available fire flow rates, rather than the water consumption in that location. Figure 2 was developed to illustrate the magnitude of difference between flow rates required for maximum day demand (MDD) consumption, and fire events.

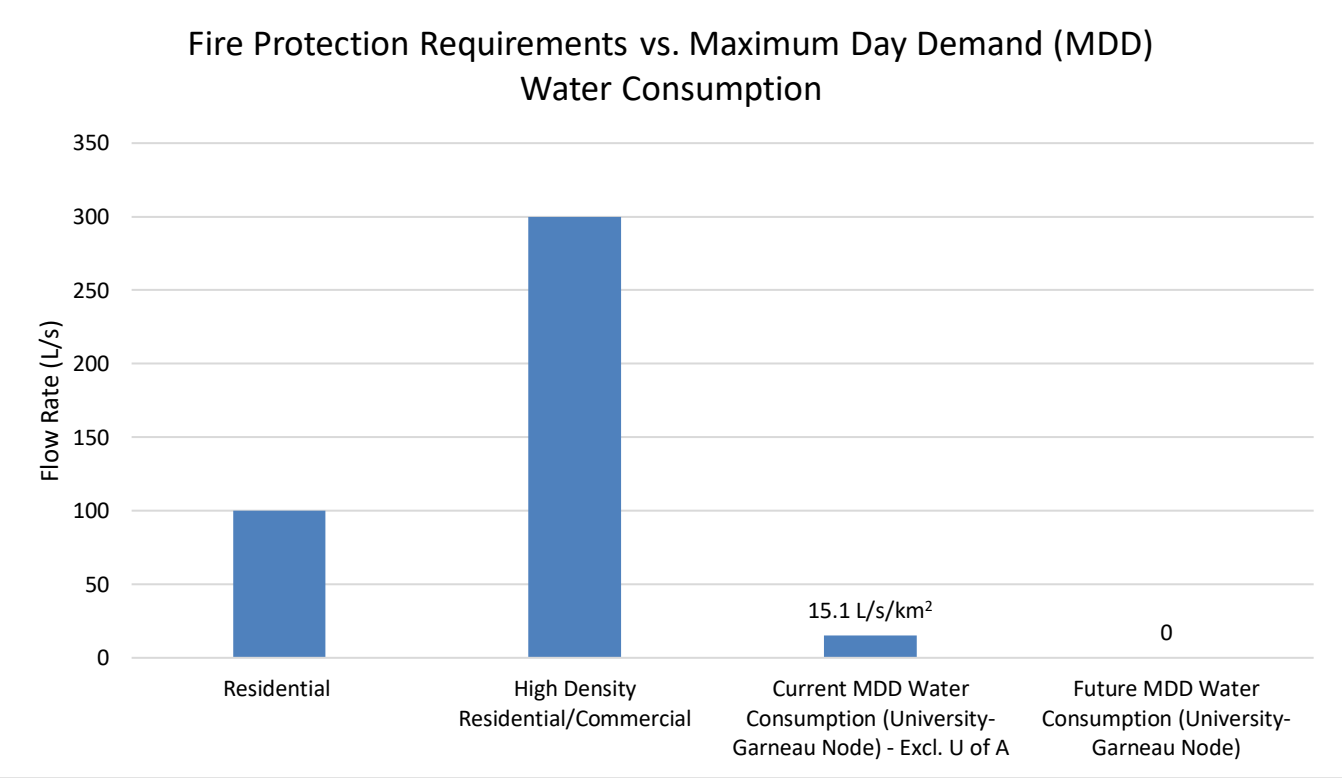


Figure 2: Fire Protection Requirements vs. Maximum Day Demand Water Consumption in University-Garneau Node

3 Analysis Assumptions

To complete the modeling analysis, Synergi Water (version 4.9) software was used and the following assumptions were applied:

- 2020 MDD scenario base model used to run the fire flow analysis.
  - Model calibrated to 2015 demands, and updated with 2020 pipes.
- Fire flow analysis run at hydrants within University/Garneau Node and hydrants within a 200 m buffer of the corridor boundary (to view the effect of improvements on the surrounding areas).
- Hydrant leads within University/Garneau Node and the 200 m buffer modified to ensure hydrant nodes better represent system capacity.
- When the City reaches two (2) million Edmontonians, all mains within the study area are PVC/PVC-equivalent.

4 Area Improvements

EWSI modeled future improvement options to increase fire flows in areas within University/Garneau Node not currently achieving 300 L/s. These options utilized a combination of water main addition and water main renewal to increase fire flow capacity to the area. Depending on the time of development/densification, one option may be favored over the other.

4.1 Option 1

Option 1 for increasing fire flows within University/Garneau Node focuses primarily on organic renewal or water mains. Water main renewals are expected to occur through EWSI's various water main renewal programs. At the time of renewal, EWSI will ensure the renewed infrastructure is capable of achieving the required fire flows at that time.

Table 1 summarizes the approximate length of improvements to University/Garneau Node to achieve 300 L/s throughout the area, if Option 1 is pursued.

Table 1: Summary of Area Improvements

Improvement Type	Approx. Length of Improvement (m)
Renewal	9,896
New Main	320

Figure 3 shows the AAFF within University/Garneau Node, after the Option 1 recommended improvements were applied. The recommended new water mains, and their diameters, are shown in red on Figure 3. In yellow, the locations of cast iron mains that will in time require renewal are shown. As the focus of this study was University/Garneau Node, EWSI is not recommending improvements for the surrounding hexagons not achieving an AAFF of ≥ 300 L/s. While these hexagons may slightly overlap the study area, the hydrants within them do not impact the fire flow capacity within the study area, and thus options to increase fire flows in these locations were not investigated as part of this study. It is expected that with water main renewals in the future, the average system capacity of these hexagons will improve.

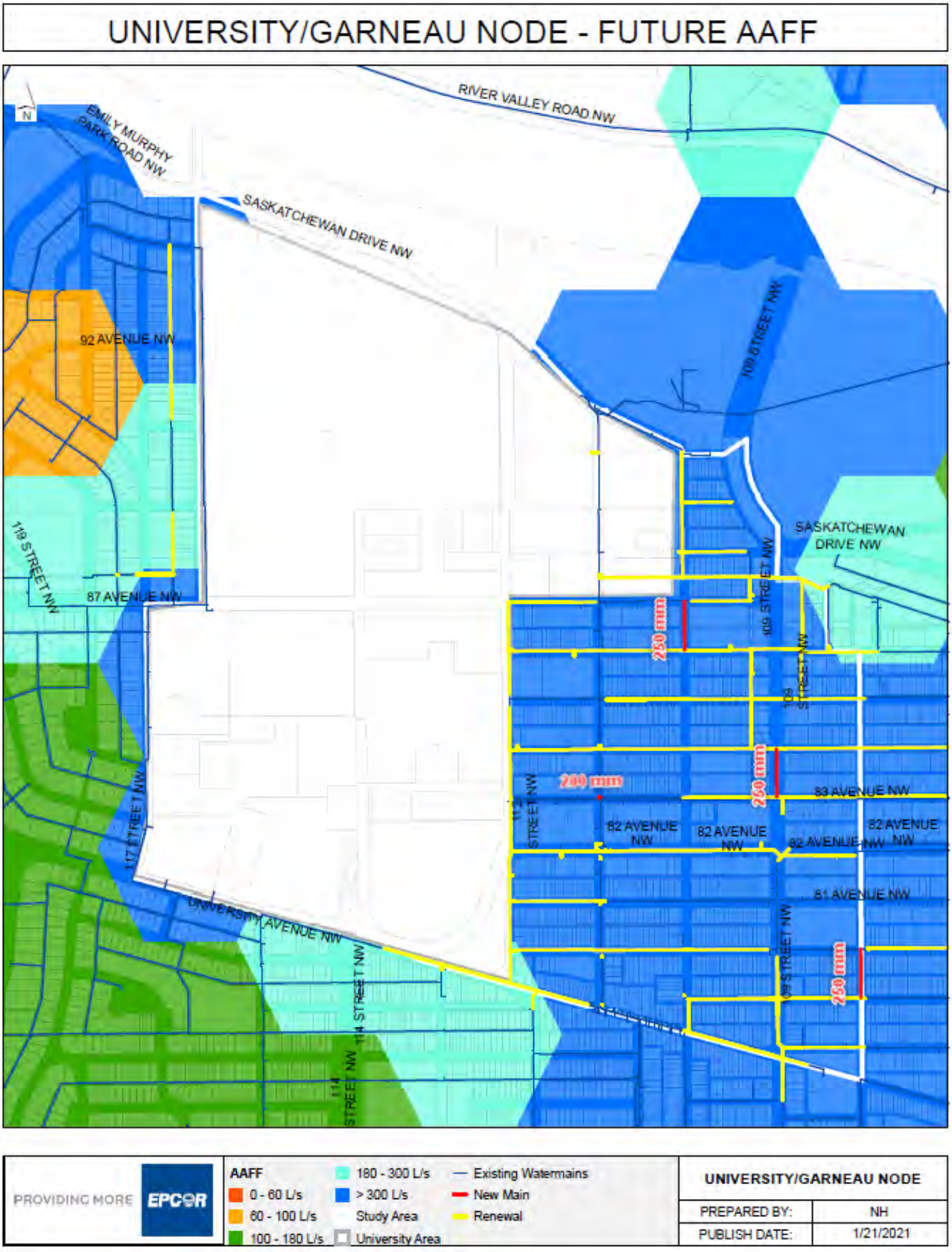


Figure 3: University-Garneau Node – Option 1 Future AAFF

4.2 Option 2

Option 2 looks at construction of a new mains along 108 Street and 109 Street to increase fire flows within University/Garneau Node. The addition of mains along 108 and 109 Street is not currently included within the EWSI capital budget, and so the earliest this option could be considered would be in the next PBR period (2027-2031).

Table 2 summarizes the approximate length of improvements to University/Garneau Node to achieve 300 L/s throughout the area, if Option 2 is pursued.

Table 2: Summary of Option 2 Area Improvements

Improvement Type	Approx. Length of Improvement (m)
Renewal	4,089
New Main	1,127

Figure 4 shows the AAFF within University/Garneau Node, after the Option 2 recommended improvements were applied. The recommended new water mains, and their diameters, are shown in red on Figure 4. In yellow, the locations of cast iron main renewals are also indicated. As the focus of this study was University/Garneau Node, EWSI is not recommending improvements for the surrounding hexagons not achieving an AAFF of ≥ 300 L/s. While these hexagons may slightly overlap the study area, the hydrants within them do not impact the fire flow capacity within the study area, and thus options to increase fire flows in these locations were not investigated as part of this study. It is expected that with water main renewals in the future, the average system capacity of these hexagons will improve.

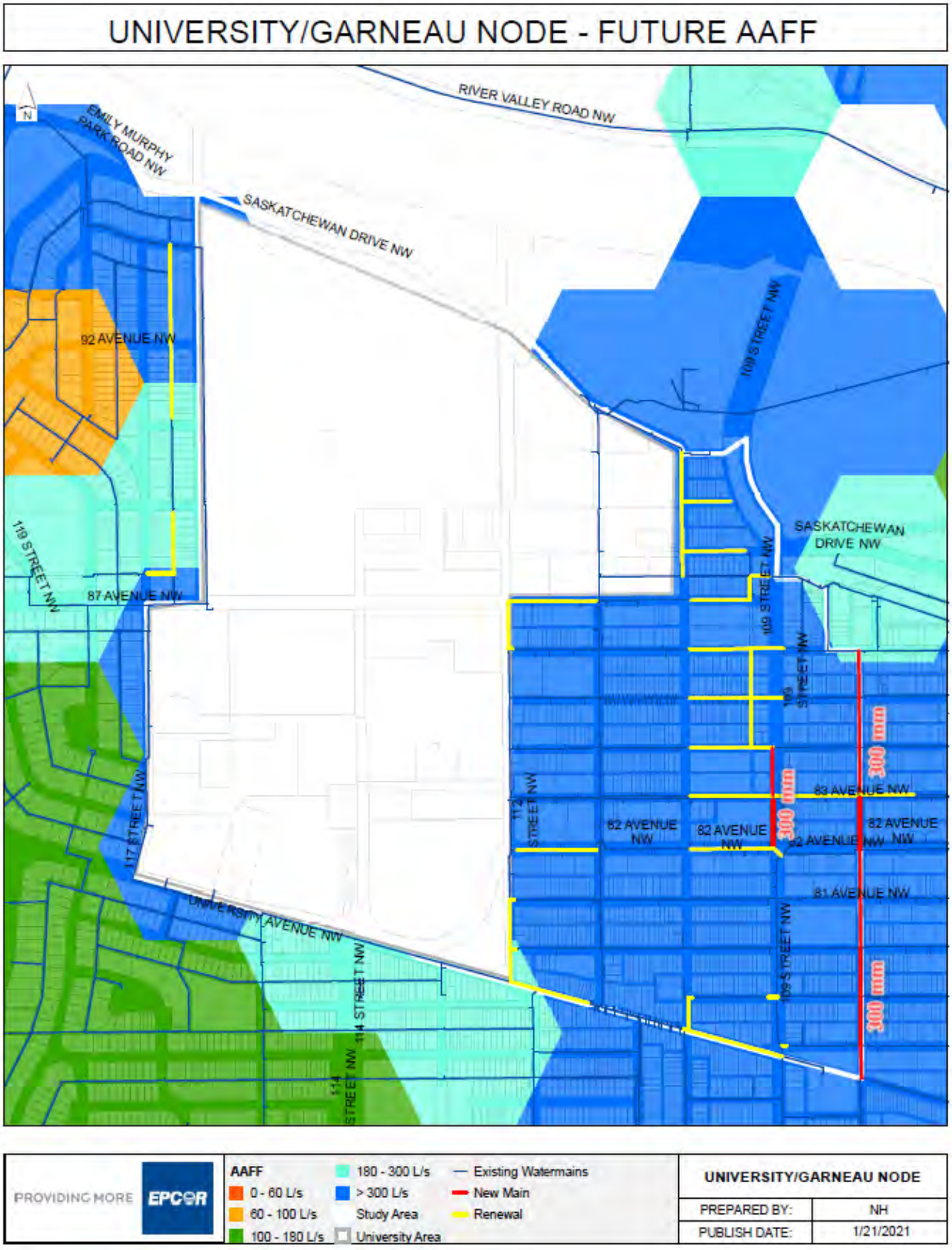


Figure 4: University-Garneau Node – Option 2 Future AAFF

Memorandum

DATE: 1/8/2021

TO: Kristin St. Louis (AECOM), Li Wang (AECOM)

CC: Ania Schoof (City of Edmonton), Sean Bohle (City of Edmonton)

FROM: Nathalie Hajek – EPCOR Water Services Inc.

SUBJECT: Infill Roadmap – Whyte Avenue/99 Street

PROFESSIONAL ENGINEER ALBERTA
TAHMINA HOSSAIN

PERMIT TO PRACTICE
EPCOR WATER SERVICES INC.
RM SIGNATURE: Tahmina Hossain
RM APEGA ID #: 82550
DATE: JANUARY 14, 2021
PERMIT NUMBER: P006368
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Disclaimer: This information is provided by EWSI One Water Modeling group based on conditions and information existing at the time this document was prepared. The information contained within this document is reliable based on the assumptions contained herein and does not take into account any subsequent variations or changes to such assumptions which may render the results unreliable, at any time, without notice. The all pipes water distribution steady-state model was run using Synergi Water software. EWSI does not guarantee any modifications made to this digital file by others after its transmission to the intended recipient.

1 Background

The City Plan, which imagines a future with two (2) million Edmonton residents, places a focus on urban intensification and densification in redeveloping areas through a network of nodes and corridors. To support the realization of The City Plan, the City of Edmonton Urban Planning Committee is looking to complete an infrastructure capacity review of nine (9) study areas within the city's core and mature neighbourhood, helping establish the development readiness of these locations.

To assist in the completion of this review, EPCOR Water Services Inc. (EWSI) has been engaged to complete hydraulic modeling analysis to identify areas where the existing water distribution system is able and unable to deliver 300 L/s fire flows, which is the current City of Edmonton fire flow guideline for high density residential, industrial and commercial developments. The results of the modeling analysis are summarized in this memorandum and should be considered alongside the hydrant spacing analysis being completed by AECOM as part of the overall water infrastructure capacity review. Recommendations for infrastructure improvements are also provided within this memorandum for areas unable to currently achieve 300 L/s.

2 Initial Area Assessment

Figure 1 shows the current (2017) average available fire flow (AAFF) within the Whyte Ave./99 St. area. The 400 m x 400 m hexagons are coloured by the average water system capacity under fire flow conditions, and represent roughly two (2) city blocks. As illustrated in Figure 1, fire flows range from 60 L/s to above 300 L/s within Whyte Avenue/99 Street Corridor.

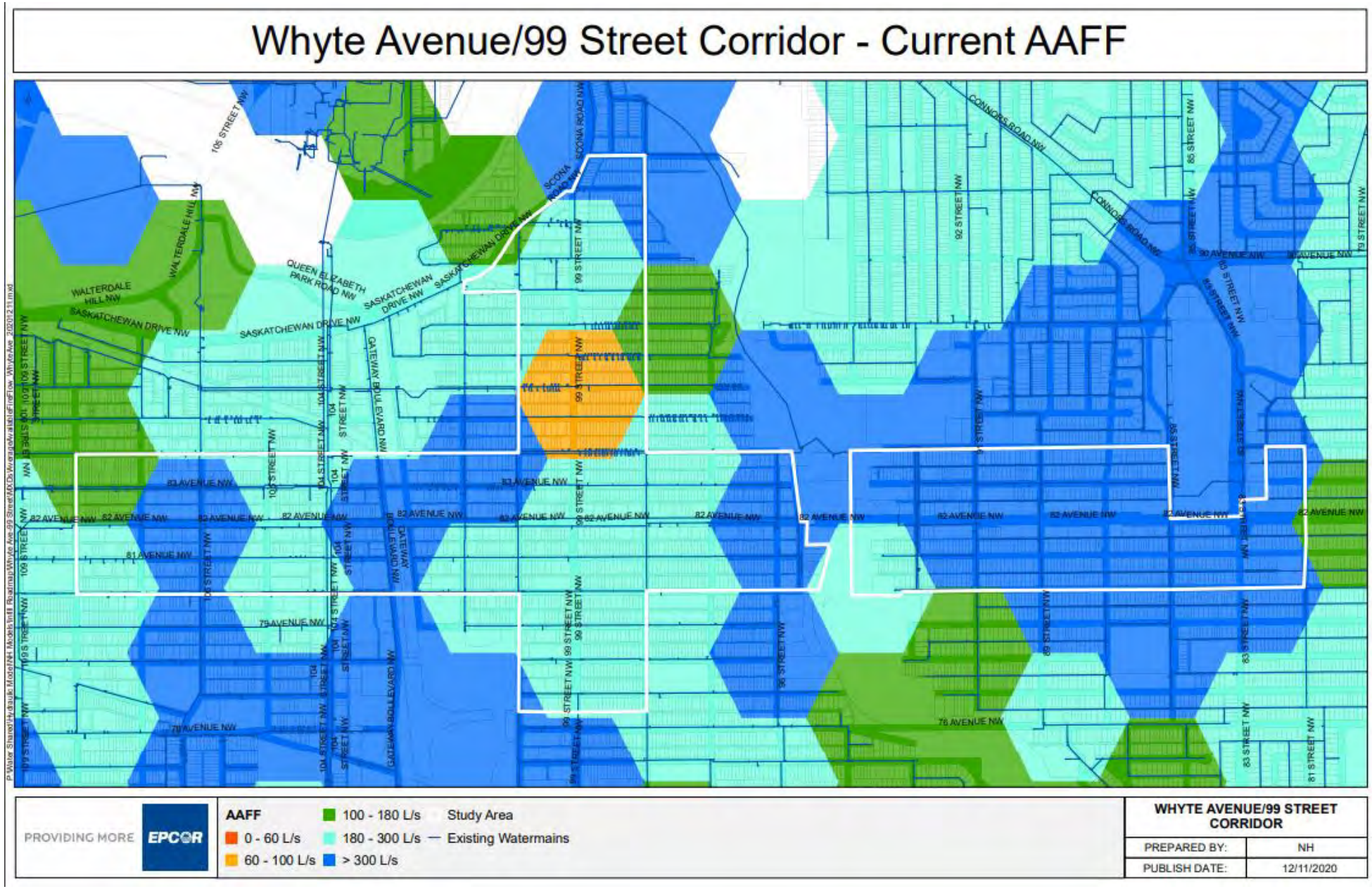


Figure 1: Whyte Avenue/99 Street Corridor – Current AAFF

EWSI's water distribution and transmission system is designed to provide fire protection throughout the City of Edmonton. Therefore, when investigating the development readiness of an area, focus is placed on the available fire flow rates, rather than the water consumption in that location. Figure 2 was developed to illustrate the magnitude of difference between flow rates required for maximum day demand (MDD) consumption, and fire events.

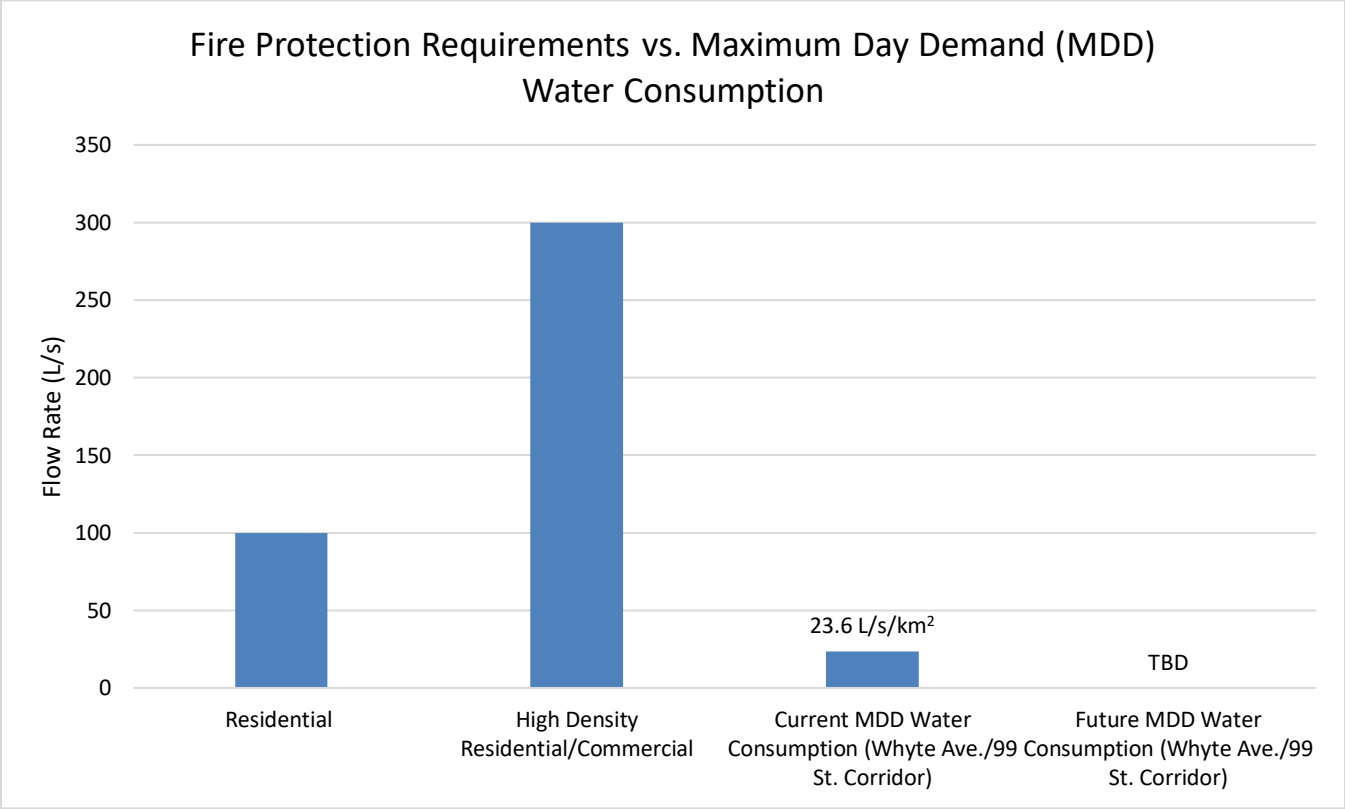


Figure 2: Fire Protection Requirements vs. Maximum Day Demand Water Consumption in Whyte Ave./99 St. Corridor

3 Analysis Assumptions

To complete the modeling analysis, Synergi Water (version 4.9) software was used and the following assumptions were applied:

- 2020 MDD scenario base model used to run the fire flow analysis.
  - Model calibrated to 2015 demands, and updated with 2020 pipes.
- Fire flow analysis run at hydrants within Whyte Ave./99 St. Corridor and hydrants within a 200 m buffer of the corridor boundary (to view the effect of improvements on the surrounding areas).
- Hydrant leads within Whyte Ave./99 St. Corridor and the 200 m buffer modified to ensure hydrant nodes better represent system capacity.
- When the City reaches two (2) million Edmontonians, all mains within the study area are PVC/PVC-equivalent.

4 Area Improvements

EWSI modeled two future improvement options to increase fire flows in areas within Whyte Ave./99 St. Corridor not currently achieving 300 L/s. These options utilized a combination of water main addition and water main renewal to increase fire flow capacity to the area. Depending on the time of development/densification, one option may be favored over the other.

4.1 Option 1

Option 1 for increasing fire flows within Whyte Ave./99 St. Corridor focuses primarily on organic renewal of water mains. Water main renewals are expected to occur through EWSI's various water main renewal programs. At the time of renewal, EWSI will ensure the renewed infrastructure is capable of achieving the required fire flows at that time.

Table 1 summarizes the approximate length of improvements to Whyte Avenue/99 Street Corridor to achieve 300 L/s throughout the area, if Option 1 is pursued.

Table 1: Summary of Option 1 Area Improvements

Improvement Type	Approx. Length of Improvement (m)
Renewal	17,953
New Main	103

Figure 3 shows the AAFF within Whyte Avenue/99 Street Corridor, after the Option 1 recommended improvements were applied. The recommended new water main, and its diameter, is shown in red on Figure 3. In yellow, the locations of cast iron mains that will in time require renewal are shown. As the focus of this study was Whyte Avenue/99 Street Corridor, EWSI is not recommending improvements for the surrounding hexagons not achieving an AAFF of ≥ 300 L/s. While these hexagons may slightly overlap the study area, the hydrants within them do not impact the fire flow capacity within the study area, and thus options to increase fire flows in these locations were not investigated as part of this study. It is expected that with water main renewals in the future, the average system capacity of these hexagons will improve.

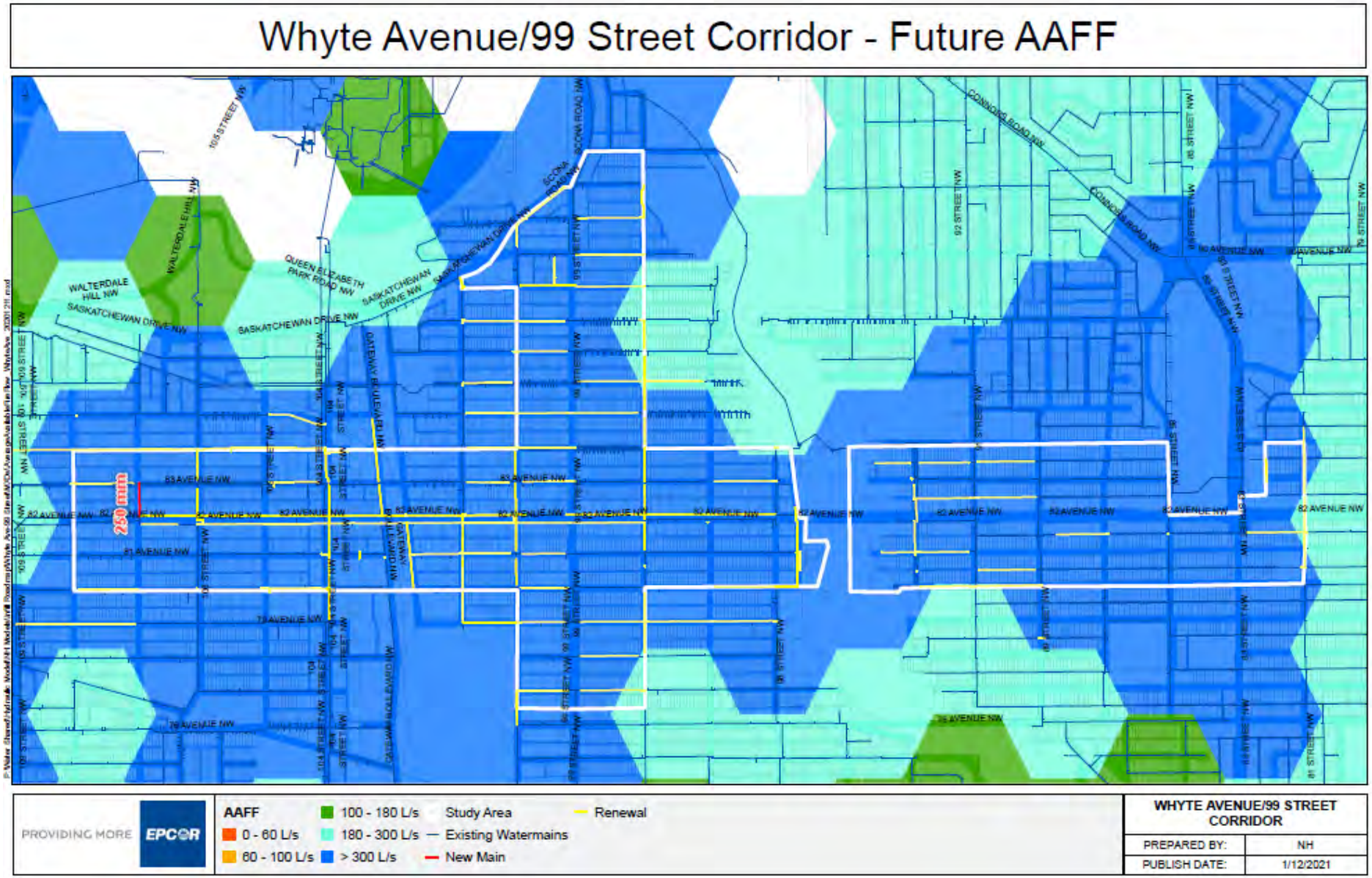


Figure 3: Whyte Avenue/99 Street Corridor – Option 1 Future AAFF

4.2 Option 2

Option 2 looks at construction of a new main along 99 Street to increase fire flows within Whyte Ave./99 St. Corridor. The addition of a main along 99 Street is not currently included within the EWSI capital budget, and so the earliest this option could be considered would be in the next PBR period (2027-2031).

Table 2 summarizes the approximate length of improvements to Whyte Avenue/99 Street Corridor to achieve 300 L/s throughout the area, if Option 2 is pursued.

Table 2: Summary of Option 2 Area Improvements

Improvement Type	Approx. Length of Improvement (m)
Renewal	4,174
New Main	1,450

Figure 4 shows the AAFF within Whyte Avenue/99 Street Corridor, after the Option 2 recommended improvements were applied. The recommended new water mains, and their diameters, are shown in red on Figure 4. In yellow, the locations of cast iron main renewals are also indicated. As the focus of this study was Whyte Avenue/99 Street Corridor, EWSI is not recommending improvements for the surrounding hexagons not achieving an AAFF of ≥ 300 L/s. While these hexagons may slightly overlap the study area, the hydrants within them do not impact the fire flow capacity within the study area, and thus options to increase fire flows in these locations were not investigated as part of this study. It is expected that with additional water main renewals in the future, the average system capacity of these hexagons will improve.

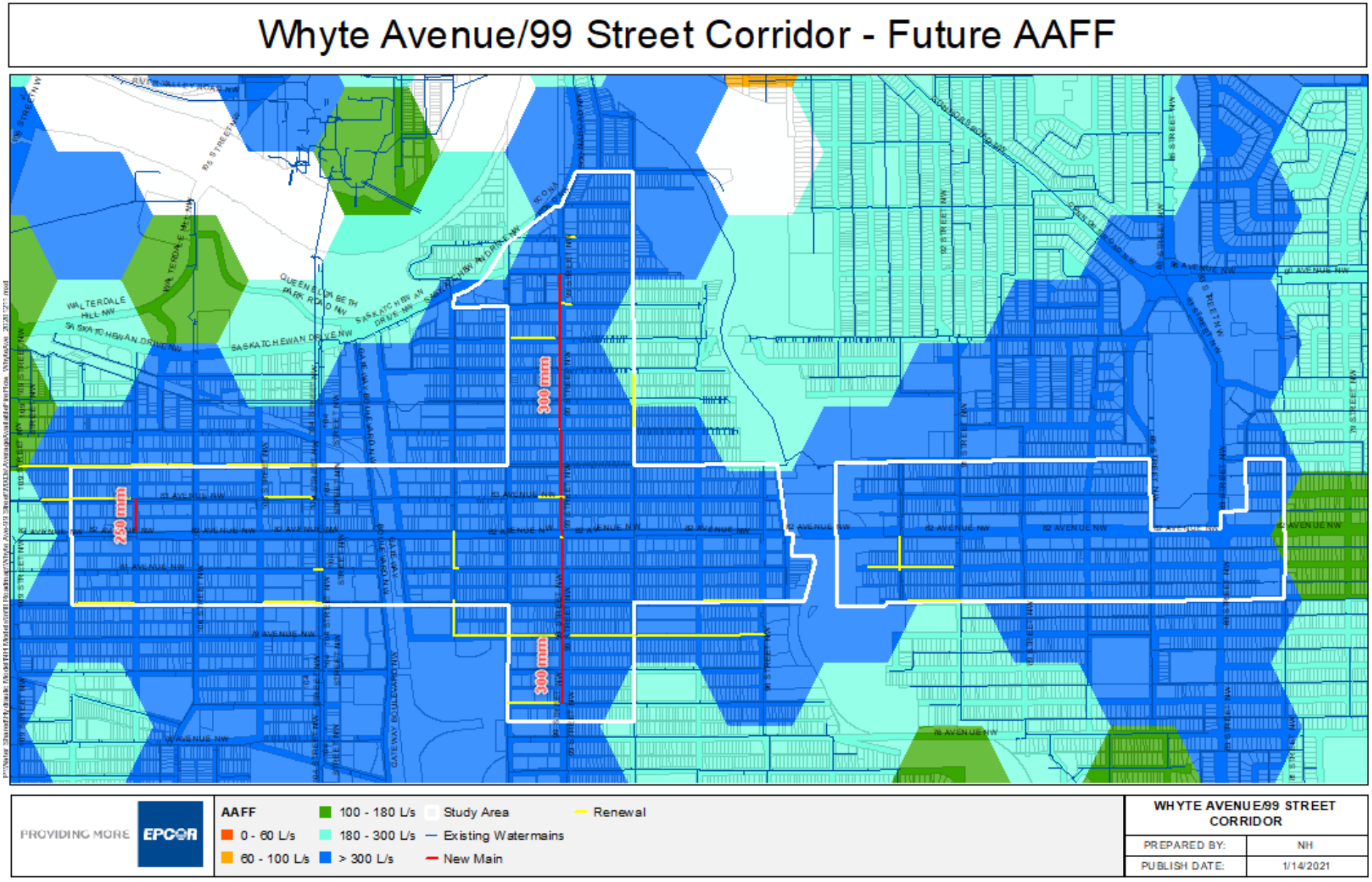


Figure 4: Whyte Avenue/99 Street Corridor – Option 2 Future AAFF

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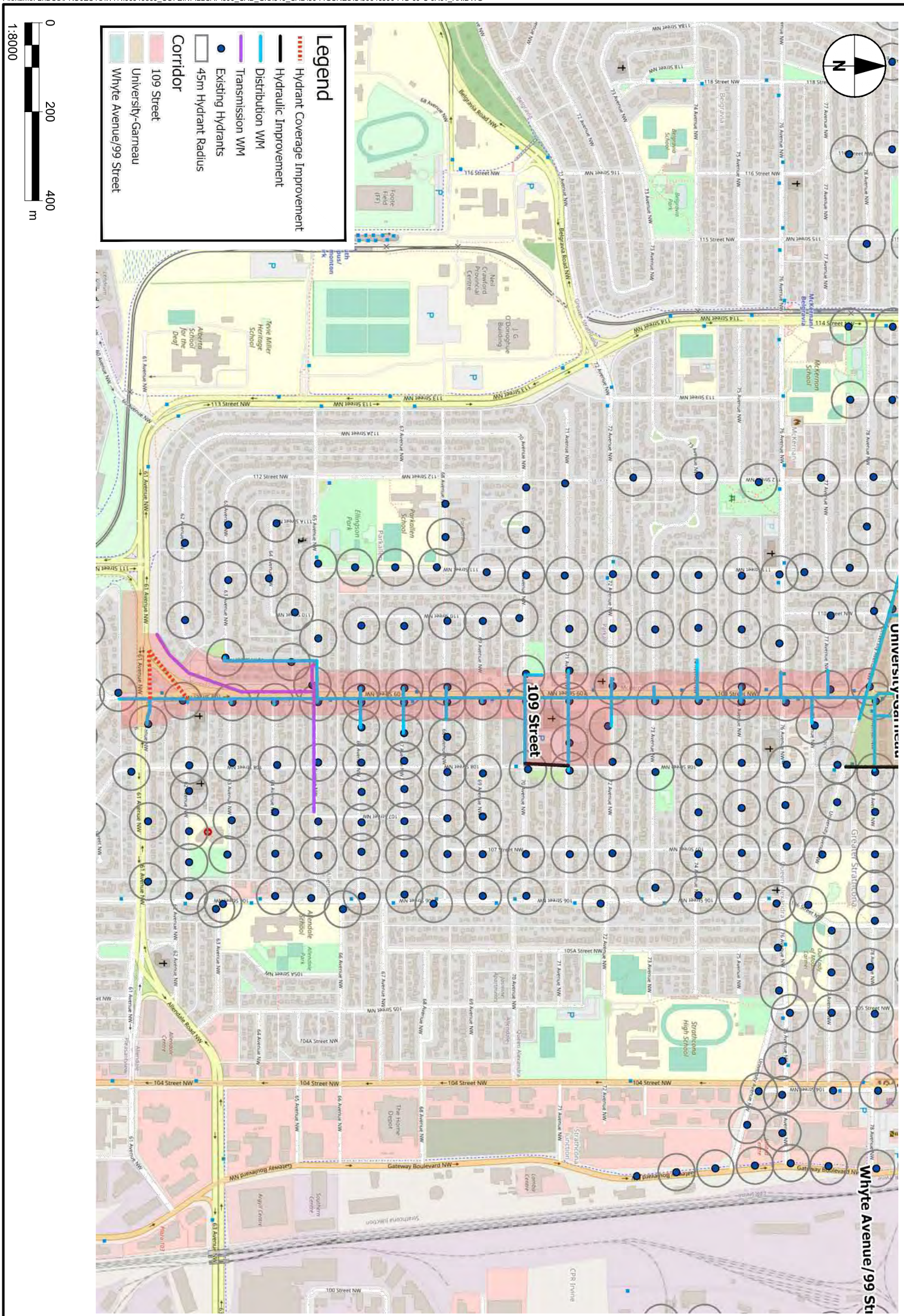

INFRASTRUCTURE CAPACITY REVIEW STUDY
CITY OF EDMONTON
Project No.: 60640590 Date: 2022-03-02

109 STREET PROPOSED WATERMAINS

AECOM

Figure: A.1

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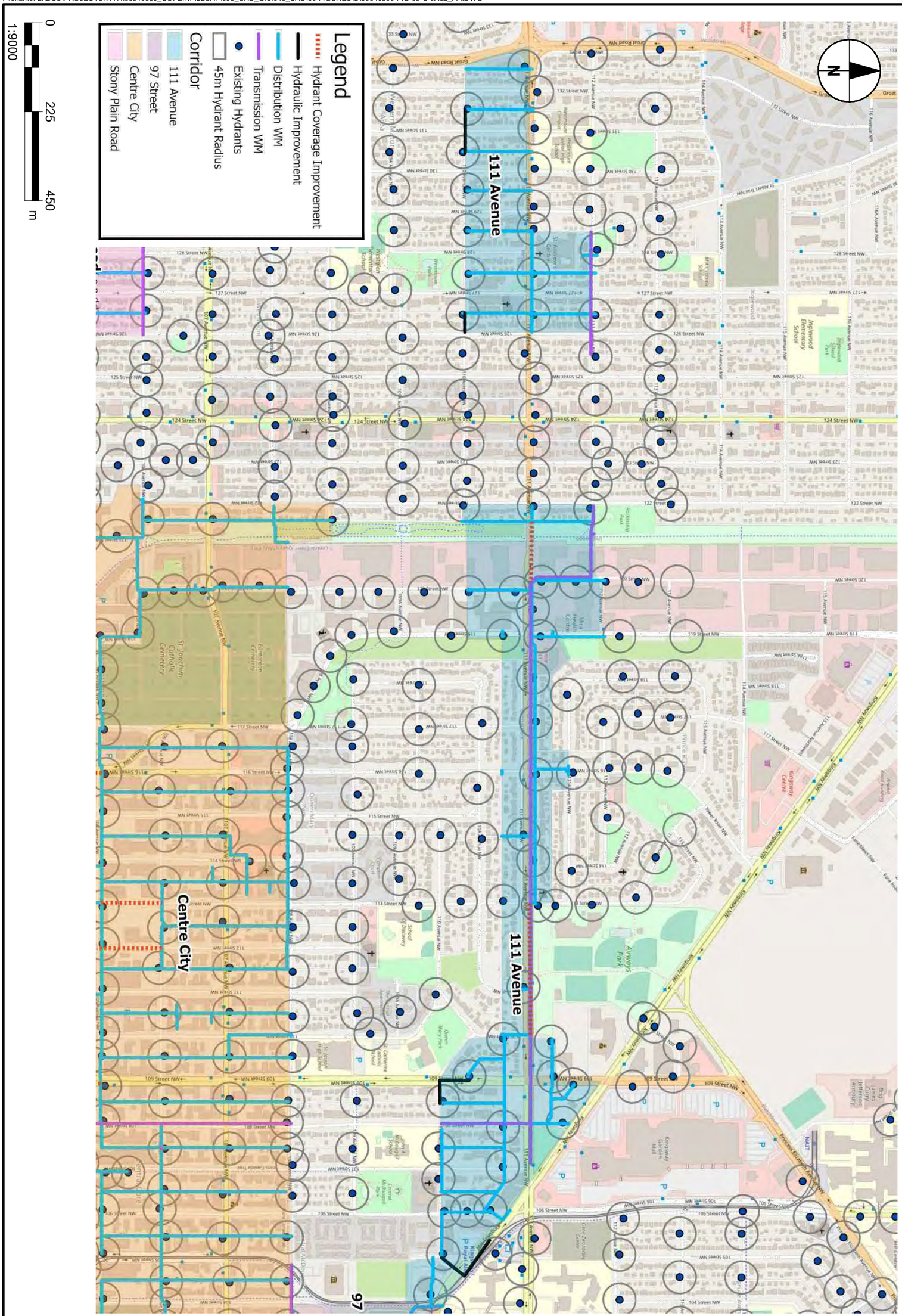

INFRASTRUCTURE CAPACITY REVIEW STUDY
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111 AVENUE PROPOSED WATERMAINS

AECOM

Figure: A.2

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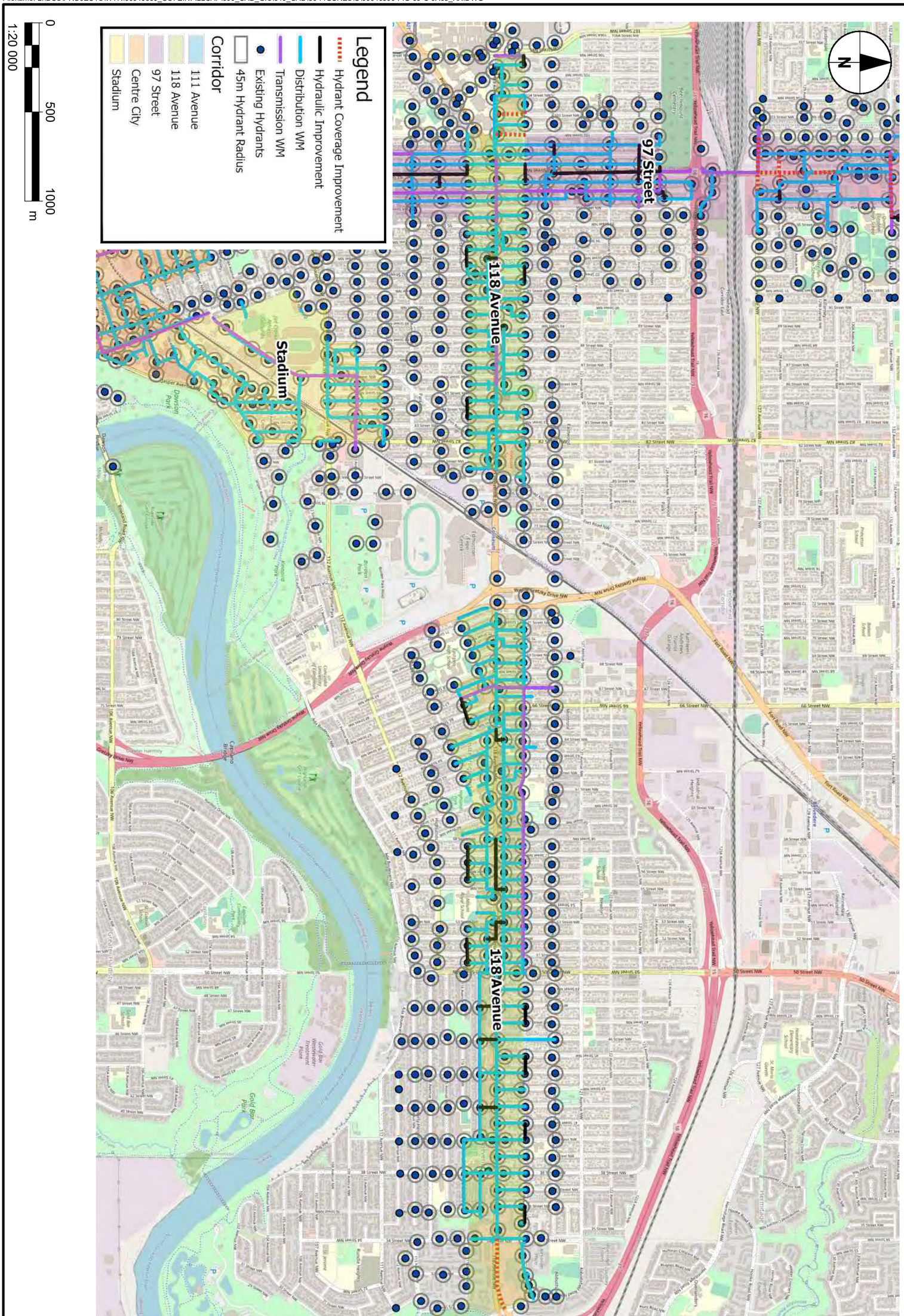

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118 AVENUE PROPOSED WATERMAINS

AECOM

Figure: A.3

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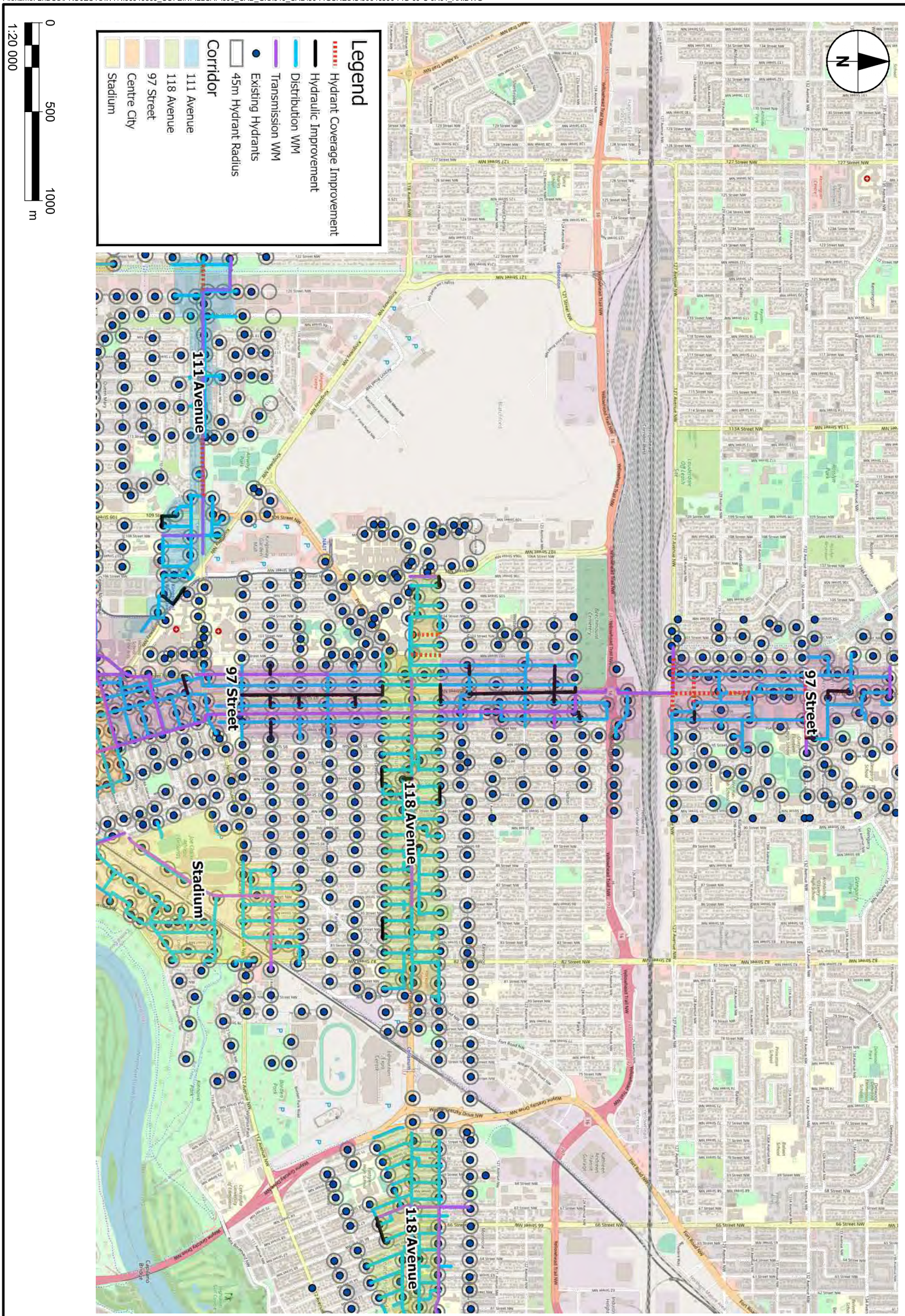

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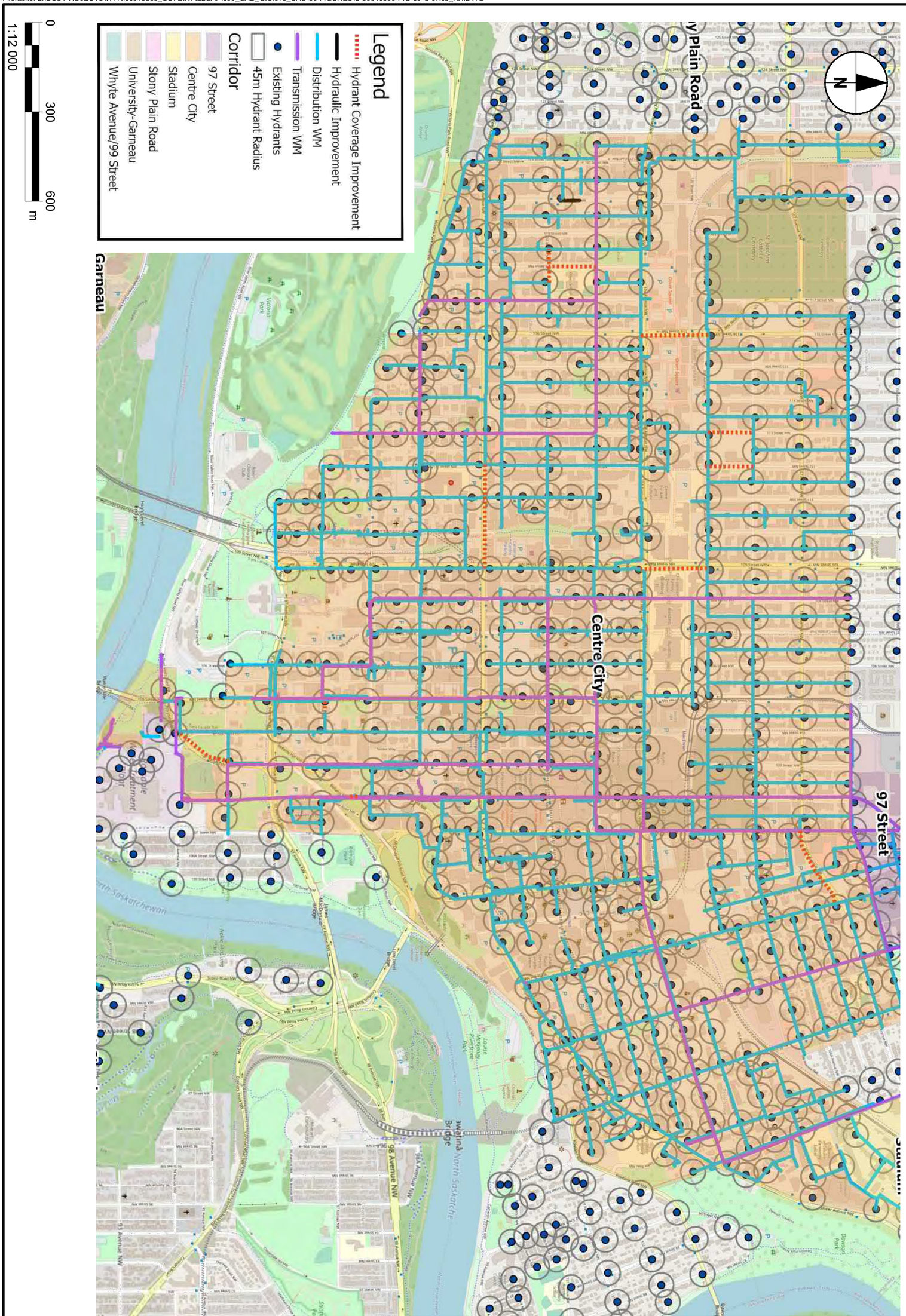
97 STREET PROPOSED WATERMAINS

AECOM

Figure: A.4



INFRASTRUCTURE CAPACITY REVIEW STUDY
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CENTRE CITY PROPOSED WATERMAINS

AECOM

Figure: A.5

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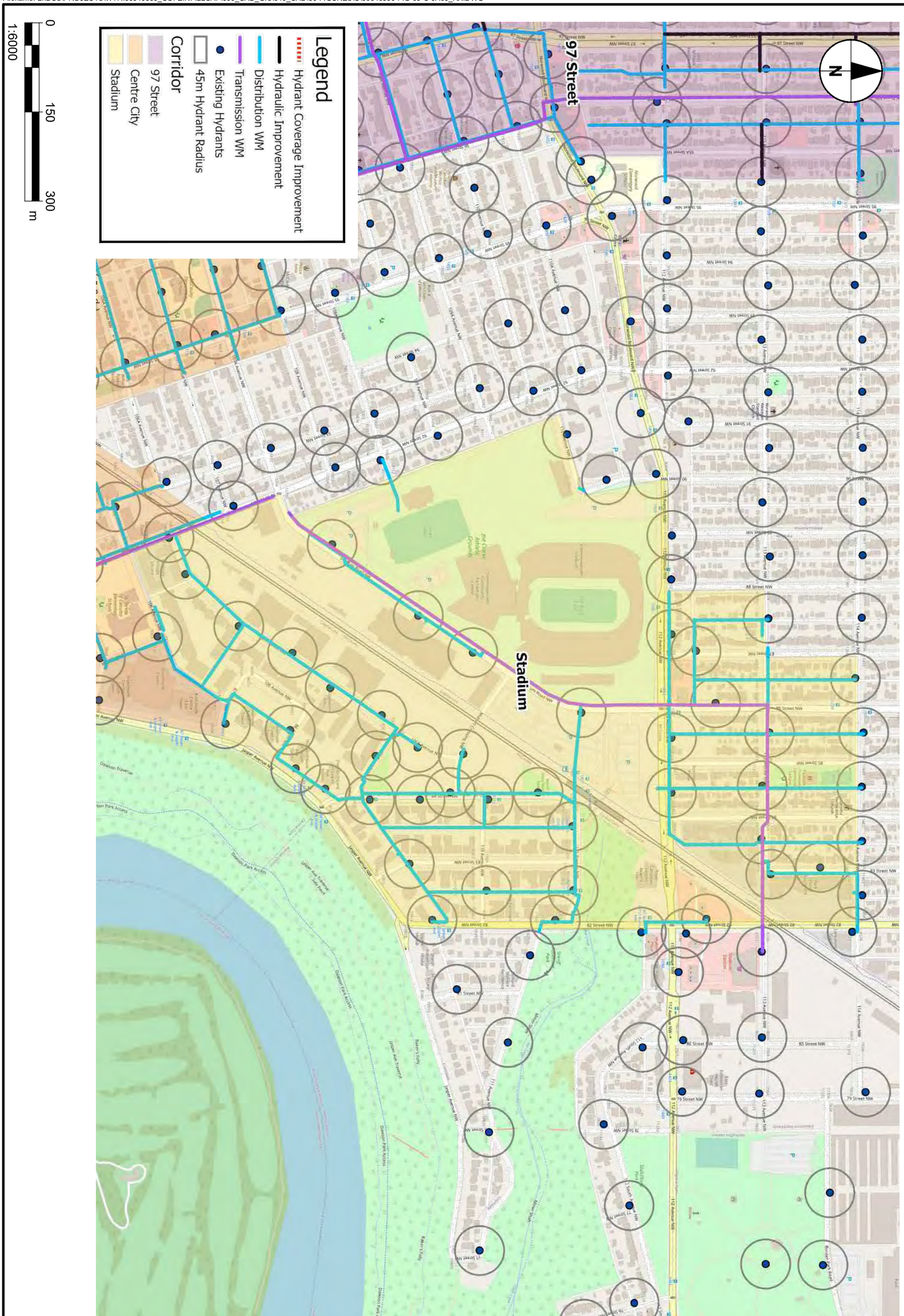

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STADIUM PROPOSED WATERMAINS

AECOM

Figure: A.6

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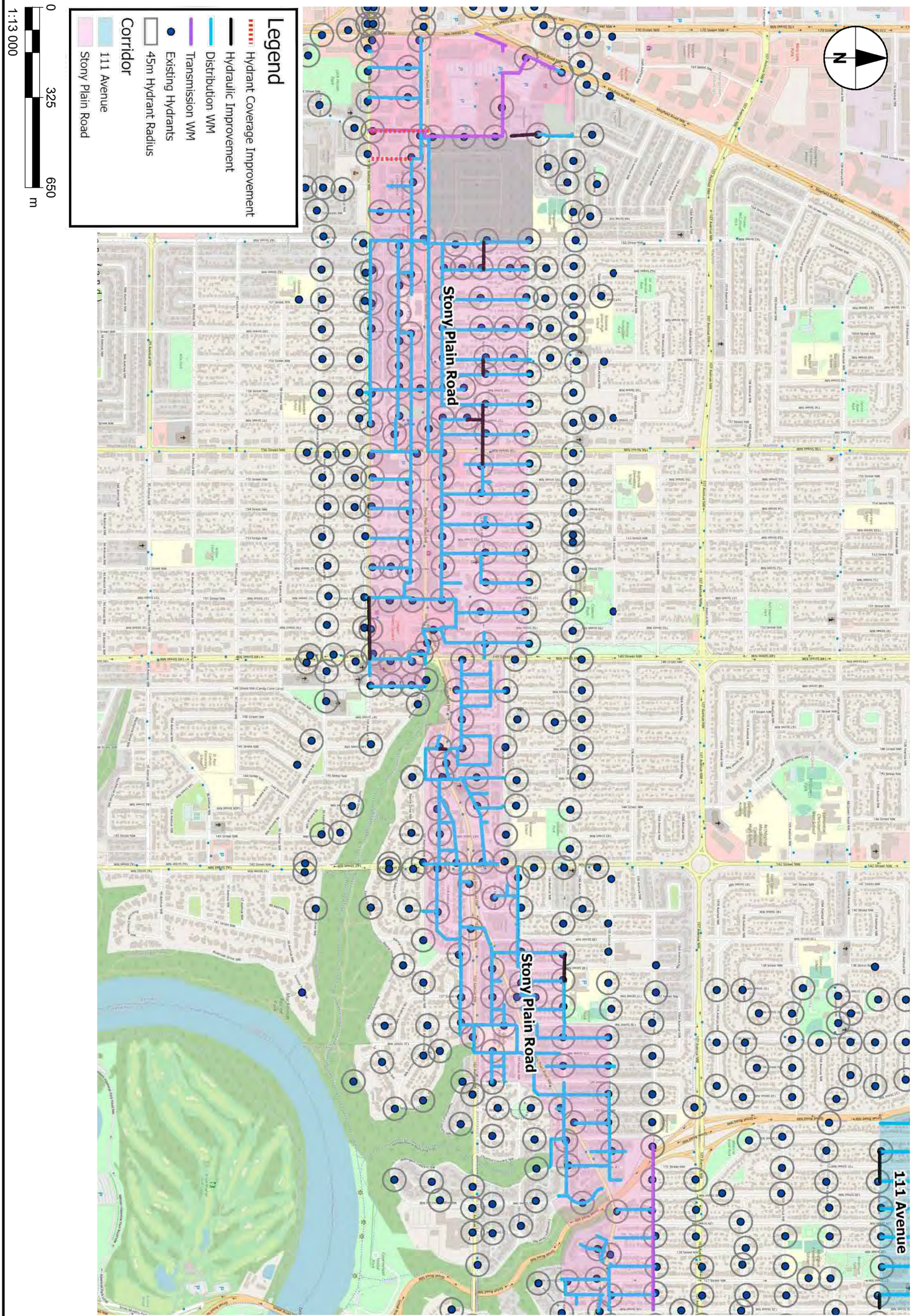

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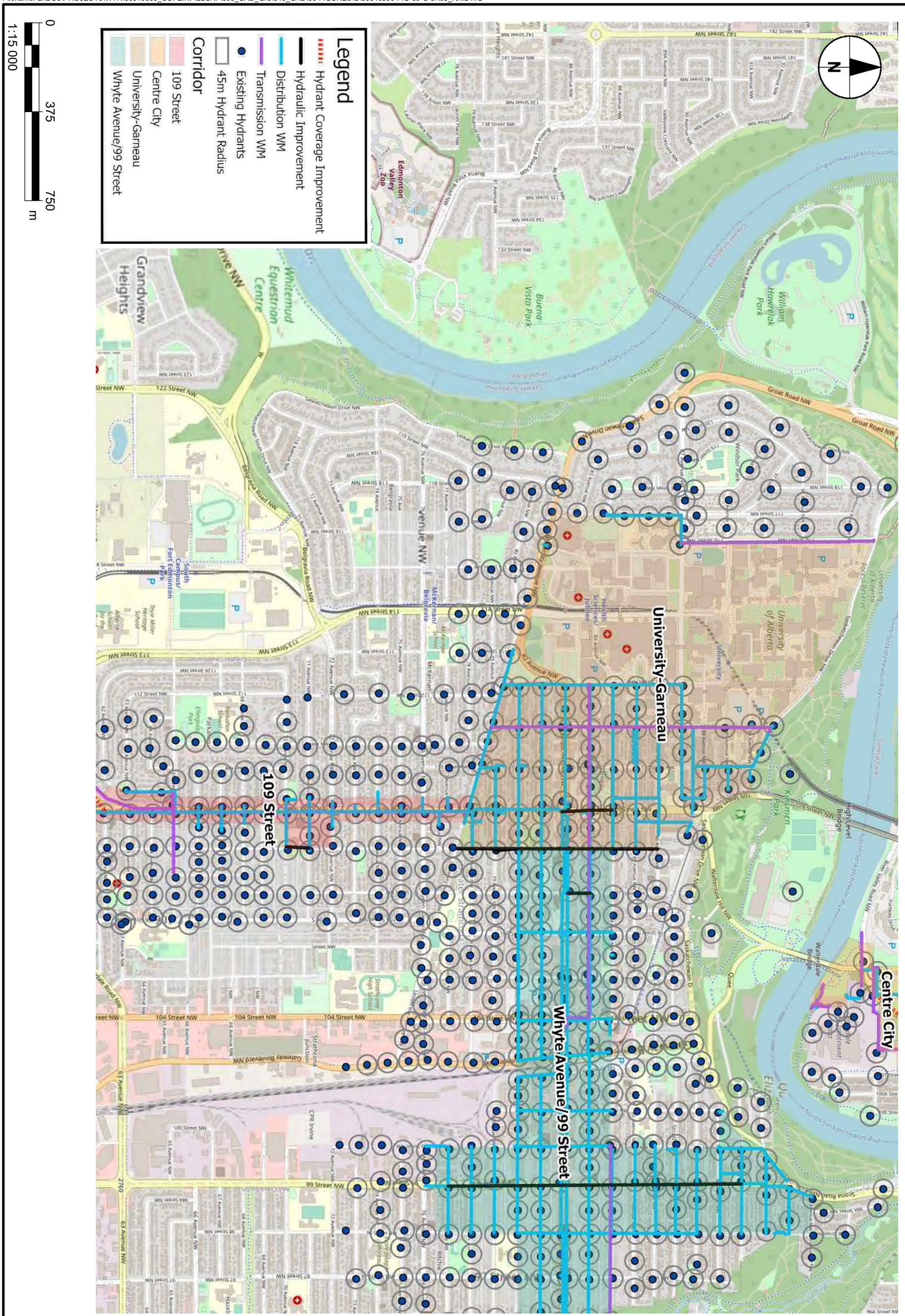
STONY PLAIN ROAD PROPOSED WATERMAINS

AECOM

Figure: A.7



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UNIVERSITY-GARNEAU PROPOSED WATERMAINS

AECOM

Figure: A.8

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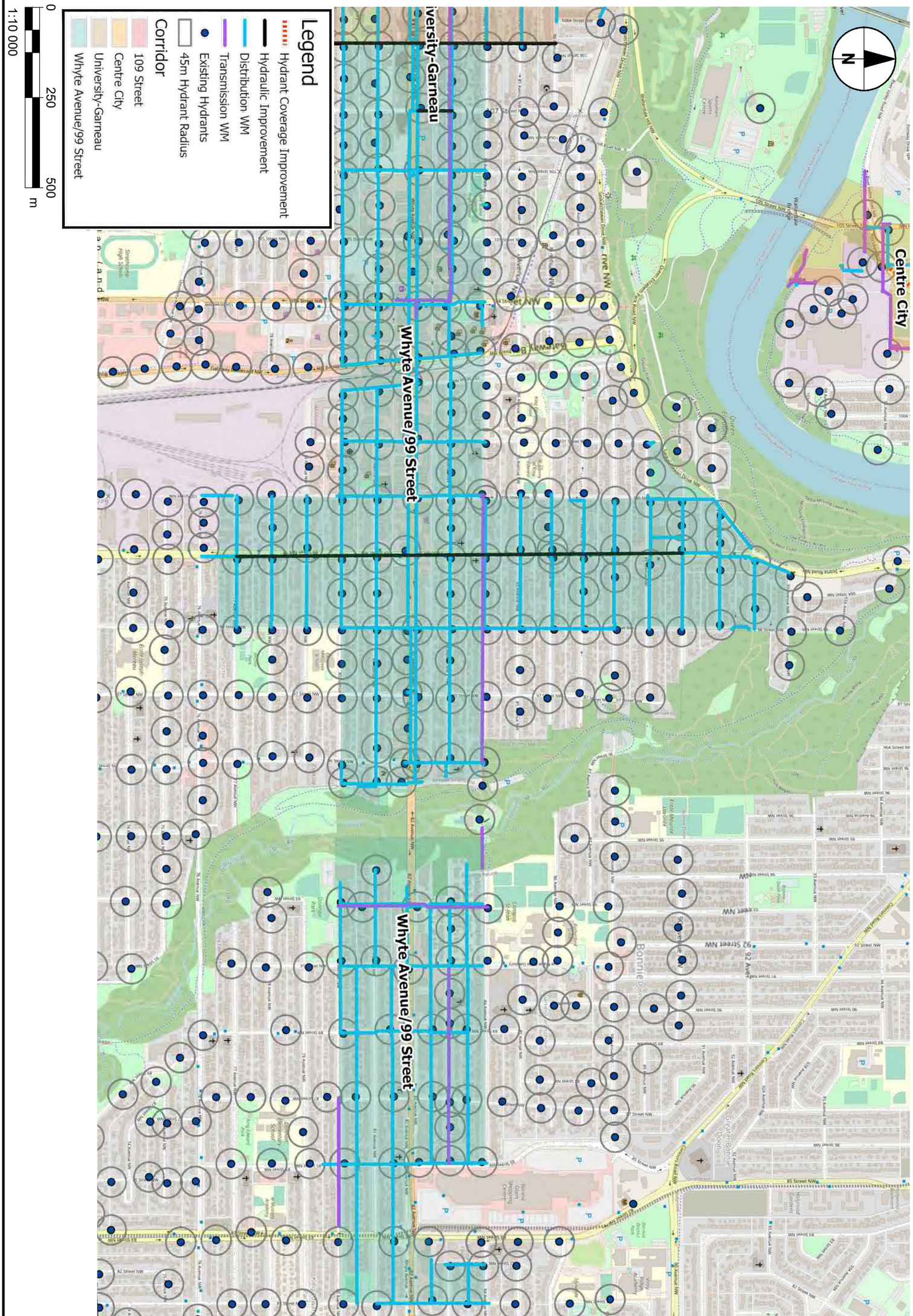

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Project No.: 60640590 Date: 2022-03-02

WHYTE AVENUE / 99 STREET PROPOSED WATERMAINS

AECOM

Figure: A.9

AECOM Delivering a better world

Appendix B

The City Plan Scenario Land Use Concept and Density Data Assumptions, Limitations and Recommendations

The City Plan Scenario Land Use Concept and Density Data Assumptions, Limitations and Recommendations

The City Plan scenario land use concept and accompanying density assumptions were developed exclusively for the development of The City Plan in 2019. The purpose of the data was to inform technical studies and the establishment of The City Plan citywide policies and strategies. The assumptions and inferences made in the development of these data speak more effectively when considered in a holistic way.

Adhering to the required evidence-based approach of the project, The City Plan Concept scenario land use, housing, population and employment assumptions were developed at parcel-level geometry by integrating computer modelling and geo-spatial analytics. Policy planners and transportation modelling engineers were engaged in multi-round reviews of the approach and analytic results. The use of parcel-level geometry does not translate into parcel-level accuracy of the data due to the coarser resolution of modelling inputs.

Although a significant amount of effort was made to verify data results and assumptions, they are valid for The City Plan project exclusively. The preferred land use concept and density data assumptions reflect one of the possible distributions of population, housing and employment as the city reaches the 2 million population threshold. They do not represent how the city is going to be built in future.

It is not recommended that the data be used directly for detailed:

- Urban planning at the neighbourhood and community level.
- Infrastructure capacity study and planning.
- City capital investment, budget and financial analysis.
- Or other neighbourhood (and below) level city planning and city-building activities.

In favour of facilitating the implementation of The City Plan, the following guidelines are suggested to be followed in the use of the data:

- Ideally, keep the use of the data above the neighbourhood level.
- Focus on the citywide vision instead of local details.
- Generalize the land use input to a coarse level of geography to allow relative comparisons rather than absolute values.
- Consult the district planning team for more information on local details.
- Invite area planners and engineers to review results so as to verify the viability of the outcomes.

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