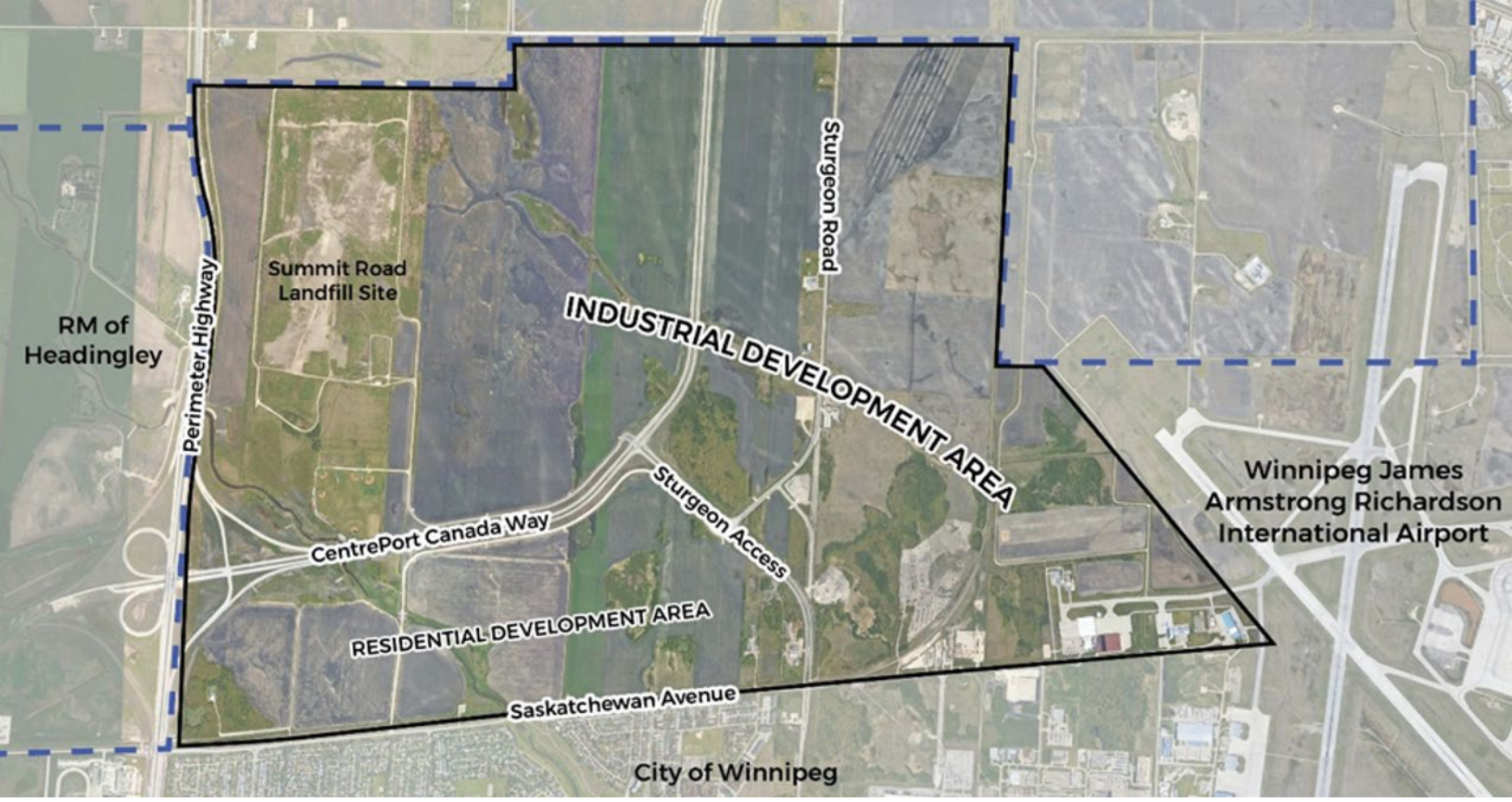


CITY OF WINNIPEG

Airport Area West Regional Water and Wastewater Servicing Preliminary Engineering – Final Report

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EXECUTIVE SUMMARY

This study presents the Class 3 cost estimate and supporting information for the future design and construction of regional water and wastewater servicing of the Airport Area West (AAW) lands, the study area.

The AAW study area includes 1,457 hectares of unserviced land in the northwest corner of Winnipeg. The study area boundaries include the RM of Rosser to the north, the Winnipeg James Armstrong Richardson International Airport to the east, Saskatchewan Avenue to the south and the Perimeter Highway to the west. This area, referred to as Airport Area West within the City of Winnipeg, represents the southern portion of CenterPort Canada, a tri-modal port shared with the RM of Rosser.

Regional water and wastewater infrastructure are required to facilitate future development of these lands. This study team considered the land use planning and anticipated water and wastewater flows to develop local and regional water and wastewater infrastructure that could support the development of the AAW lands from early stages through to complete buildout. The regional components of the infrastructure were advanced to preliminary design and considered the challenging geotechnical conditions that exist in the area, the anticipated phasing of the development, land acquisition needs, and other unique project constraints. A Class 3 cost estimate, with accuracy of -20% to +30%, was prepared based on the anticipated phasing of the proposed work.

Land Use Planning and Phasing

The study began with an analysis of the potential land uses to gain and understanding on the rate of development, the phasing of the potential development, the possible land use servicing classifications, and the resulting water demands and wastewater generation.

A shadow plan including anticipated future roads, parceling of land, and land development types was prepared for this study as the basis to the land use planning. The shadow plan was based in part on information from two independent draft secondary plans being prepared by the property owners, and on input received though engagement with the key stakeholders. The two draft secondary plans (land use plans) were under review by the City during the course of this study. The complete documents could not be shared; however, the general layout of roadways and anticipated land uses was shared with the project design team and steering committee. The draft plans represent two distinct zones that make up the overall study area. A residential development plan located south of Centerport Canada Way (CCW) and west of the Sturgeon Access, and an industrial development plan that covers the remaining portion of the study area. The residential land is anticipated to be developed as a lower-density residential neighborhood with a portion dedicated to mixed-use and higher-density residential development. The Industrial lands are anticipated to include a variety of industries as well as commercial development nodes at key locations throughout.

A conceptual phasing plan was then developed to determine the spatial and temporal impacts on the anticipated water demands and wastewater flows at varying stages of development. The following key assumptions form the conceptual phasing plan used in estimating when the future infrastructure would need to be in service:

- **General**
  - Development of the southern portion of the study area is generally expected to be constructed within the first 20 years of development, with full buildout estimated at 50 years.
- **Residential Development**
  - To be fully developed in the first 20 years of the 50-year buildout
  - Estimated to be constructed as three general developments covering the west, central and east portions of the land (based on land ownership)
  - Estimated to begin construction along the south border of the study area and trending northward.
- **Industrial Development**
  - Annual development for the industrial lands is estimated at approximately 12 net hectares/year
  - Airport Area 8 (belonging to the James Richardson International Airport) located in the southeast corner of the study area is estimated to be fully developed in the first 20 years of development.
  - The remaining portions of the industrial area are assumed to begin development in the southern portion of the study area and phasing northward.

The development phasing plan was split into sub-phases as presented below to address key spatial and flow impacts on the proposed regional infrastructure. Two general phases (Phase One and Phase Two) primarily cover the southern and northern portions, respectively. Phase One was divided into subphases in five-year increments over the first 20 years to capture the low flow conditions expected in the early years of development. These low flow conditions can have detrimental impacts on larger regional infrastructure designed for the full buildout. Phase Two was divided into 10-year increments over the remaining 30 years to get to the full buildout condition

Servicing Classification	Phase 1A 1-5 Years (ha)	Phase 1B 6-10 Years (ha)	Phase 1C 11-15 Years (ha)	Phase 1D 16-20 Years (ha)	Phase 2A 21-30 Years (ha)	Phase 2B 31-40 Years (ha)	Phase 2C 41-50 Years (ha)	Total Net Area (ha)
Total Net Area	117.97	127.07	122.91	125.47	86.37	86.37	86.37	752.53

Some form of regional water and wastewater infrastructure will need to be in-service to support the water and wastewater flows at the end of the first year of development. For the purpose of this report, the year that City of Winnipeg regional infrastructure is brought into service is referred to as Year Zero. This in-service year (Year Zero) is required for capital planning. The City of Winnipeg Basis of Estimate (BOE) template, used for the development of the Class 3 cost estimate, includes this in-service date to refer to the year that the asset will be available for use, and to determine when operations and maintenance budgets are to be applied to the estimate. For this project various regional infrastructure assets will come on-line at subsequent years to Year Zero to address the increasing water demands and wastewater generation in later development phases.

The shadow plan and conceptual phasing plan for this study was presented with other relevant information to the Key Stakeholders at an engagement event on November 5, 2019. During this event, our team presented key project assumptions associated with the rate and phasing of the development as well as the

land uses, to ensure that the project assumptions were validated prior to moving forward with further analysis.

Water and wastewater flows were developed based on our conceptual phasing plan and shadow plan to identify the water demand and sewage production over the course of the development of the study area. The land use information was translated to correspond with the servicing classifications used in the City of Winnipeg's Water Demand and Wastewater Flow Estimation Guidelines. These values were applied against anticipated densities to provide water and wastewater flows used in the design of the sewer and water systems

Wastewater Infrastructure

The preliminary design of the wastewater infrastructure includes a single Wastewater Lift Station (in conformance with the project intent) to collect the future gravity wastewater flows and direct them to the existing 1350 mm Inkster interceptor sewer which is terminated at the intersection of Inkster Boulevard and Brookside Boulevard. The preliminary design includes additional regional wastewater infrastructure including segments of gravity interceptor and intake sewer piping upstream of the wastewater lift station, and Force Mains between the lift station and the Inkster Interceptor Sewer.

A conceptual pipe network representing the future local gravity sewers was developed as part of this study in order to determine the capacity and location of the regional wastewater infrastructure. The local sewers were assumed to follow the future road alignment on our shadow plan. Pipe depths were developed from the existing ground elevations (based on a Lidar survey) using assumed depths for the different development types. A depth of 3.0 m below the upstream manholes was used for single family residential areas (to allow a sewer service line for typical basement depths). A depth of 4.0 m was used at the high-end manholes for the industrial areas to account for longer anticipated service lines in the large industrial parcels. Minimum pipe slopes were then applied along each pipe segment, as per City standards. The various local pipe network branches were then used to optimize the location of the wastewater lift station focusing on a central location with the shallowest invert elevation. The lift station location also considered other key project constraints including the variable geotechnical conditions, constructability, site access, land acquisition and adjacent land uses.

The selected regional infrastructure design includes two interceptor sewers collecting flows from the east and west sides of the study area that direct flows to a central lift station located just east of the intersection of Centerport Canada Way and the Sturgeon Access. Two Force Mains (600 mm and 750 mm) are used to convey the pumped flows from the lift station to the Inkster Interceptor.

A considerable amount of risk exists in constructing a single lift station for a development of this size without a guarantee that the wastewater flows would be achieved. Under the lower wastewater flows in the early years of development a lift station sized for full buildout would be oversized and the pumps would be operating outside of optimum levels. Furthermore, a significant capital investment would be required at Year Zero to support flows that might not be realized until years after construction. To mitigate these risks, the lift station was broken down into three separate contracts to support the various stages of development.

Contract	Support Development Year	Description
1A	1-5	By-pass Lift Station
1B	6-10	Lift Station sub/superstructure and associated mechanical and electrical to support development for years 6-10
1C	11-50	Lift Station Mechanical upgrades to support development for years 11 - 50

Contract 1A is for the development of a smaller lift station using the by-pass components of the future full-buildout lift station. The station would also include a small heated and insulated structure to support the mechanical, electrical and instrumentation needs throughout the operation of phase 1A.

At a later date, when the actual development rates are approaching the anticipated rates estimated for Phase 1B (year 5), construction of the primary lift station can occur. This design provides the flexibility to avoid expending capital for the lift station until the flows are actually required. If development slows after year 1 due to unforeseen economic drivers, the by-pass lift station will be able to support the wastewater flows until development resumes.

A third contract (1C) includes mechanical upgrades to support the final stages of development from years 11-50. This contract was established to defer capital costs for components that are not required until the flows warrant their installation.

The Force Main (FCM) was also sized to address design constraints associated with the various wastewater flows at different stages of development. A 600 mm FCM is required for development years 0-10 (Phases 1A and 1B). A 750 mm FCM is required to support flows for phases 1C and 1D in development years 11-20. In year 21 at phase 2 both Force Mains will need to operate concurrently to support the wastewater flows.

Water Infrastructure

The preliminary design of the water infrastructure includes a primary Feeder Main (FDM), a secondary supply main and various smaller connections to the existing water system south of Saskatchewan Avenue. Water modelling was used to design a FDM to provide required pressures and flows to a future local distribution system under maximum day plus fire flow and under peak hour conditions. Connections to the existing City water system south of Saskatchewan Avenue were included to address early development phasing needs, to provide circulation and supplement the local grid. And a secondary supply main was modeled to provide some level of redundancy in the event of a loss of the FDM.

A conceptual local distribution grid was designed along the road right-of-ways on our shadow plan to represent the future water infrastructure in our model. Modelling was run using the EPANET water distribution modelling software. The analysis consisted of investigating a variety of system configurations under three conditions:

- Maximum Day Demand plus Fire Flow, to determine maximum available fire flows while maintaining minimum residual pressures within the distribution system.
- Peak Hour Demand, to determine minimum pressures in distribution mains and FDMs in non-fire conditions.

- Average Day Demand, to determine the age of water within the distribution system during periods of low flow.

The above analyses were applied to a range of pipe configuration scenarios including the anticipated flows for the various development phases, the full buildout scenario, as well as various secondary water supply main options to identify the optimal solution.

The optimal solution for the FDM was a 750 mm extension of the Silver Avenue FDM from Moray Street to Sturgeon Road and then an extension north along Sturgeon into the AAW lands. The FDM includes offtake structures to the local distribution system.

A 400 mm secondary water supply line was selected extending from the Rouge Road FDM north from Hamilton Avenue to the intersection of Saskatchewan Avenue and Cavalier Drive. The secondary supply main does not have to equal the performance of the 750 mm FDM but rather is designed to provide sufficient water to meet residential needs and to maintain peak hour pressures in industrial areas to ensure that essential machinery requiring water pressure can operate. Portions of the local domestic pipe network will need to be upsized by the developers from 300 mm to 400 mm to meet the selected design outcomes. The regional components have been progressed through to preliminary design and are included in the Class 3 cost estimate.

Connections to the local domestic distribution system are also required to supplement the local distribution grid. These connections are all to existing 300 mm mains and are located at:

- Saskatchewan Avenue and Buchanan Boulevard.
- Saskatchewan Avenue and Cavalier Drive.
- Saskatchewan Avenue and Hamilton Avenue.
- Saskatchewan Avenue and Sturgeon Road.
- Saskatchewan Avenue and Moray Street.

The complete water distribution system is not required to be in service in Year Zero, but instead has been designed to be constructed as required to meet the development phasing of the project. The regional water distribution system was divided into three general contracts.

The first contract (described as 4A within the report) is for the installation of the 750 mm FDM from Silver Avenue to offtake structure 3. Contract 4A is required to be in service for the start of Phase 1A (Year Zero) to support any development in the industrial zone. Development within the residential subdivision can initially begin without a connection to the FDM by using the connections to the existing system south of Saskatchewan Avenue. As development progresses within the residential development zone the connection to the FDM will be required.

The second contract for the secondary supply main (termed contract 5) is required to be in service for phase 1C at the end of development year 10.

Lastly, the extension of the FDM from offtake structure 3 to offtake structure 4 is required to facilitate the development of the northern half of the industrial zone in Phase 2 at the end of development year 20.

Geotechnical Investigation

Geotechnical investigations were completed along the proposed infrastructure route to gain a better understanding of the stratigraphy and groundwater conditions for the purpose of developing cost estimates and assessing the geotechnical risks at the preliminary design phase.

The geotechnical investigations included a combination of sonic drilling, seismic refraction surveys and conventional drilling and instrumentation. Complex ground conditions including shallow bedrock and till and irregular changes in ground conditions were found to exist throughout the AAW lands. The geotechnical information was used in part to select optimal locations for the infrastructure, and also to determine the probable methods of installation of the various components of the regional infrastructure. Installation of pipelines in rock, till or mixed soil conditions appears unavoidable through portions of the study area. To demonstrate this, the variable rock and till profiles are shown on the preliminary design for each component of the sewer and water infrastructure. Appropriate construction equipment was selected for the various components, or portions of the regional infrastructure including horizontal directional drilling and tunneling equipment. Costs for these techniques were then included within the class 3 cost estimate to increase the accuracy of the estimate.

Schedule and Cost

The cost estimate was developed using the City's BOE template and provides the capital, engineering, and operations and maintenance costs to complete water and sewer regional servicing program. The estimate is based on a series of independent contracts that are phased to be in service to support the anticipated flows for the respective year of development.

The proposed regional infrastructure has been broken down into discrete contracts to phase the work as presented in this report. For consistency, specific numbers were provided to each asset as listed below, and then letters were used to identify the phasing of the particular asset.

- Contract 1 – Lift Station.
- Contract 2 – Force Main.
- Contract 3 – Interceptor and Intake Sewer.
- Contract 4 - Feeder Main.
- Contract 5 – Secondary Supply Main.
- Contract 6 – Upgrades to City Interceptor Sewer.

The below table demonstrates the breakdown of the work and the associated in-service year

The estimated capital cost of the proposed program excluding inflation is $112,574,000 in $2020.

Stage/Phase (In-service year)	Contract	Description	Construction Contract Value ($2020)	Engineering	Utility	Other	Contigencies	City PM Salary	Administrative Charges	TOTAL
Phase 1A (in-service year 0)	1A	By-pass Lift Station	$3,042,100	$6,649,987	$310,000	$389,000	$6,627,820	$396,000	$1,274,121	$59,980,171
	2A	600 mm Force Main	$14,872,812							
	3	Interceptor and Intake Sewers	$16,409,530							
	4A	750 mm Feeder Main (Silver to OS3)	$10,008,800							
Phase 1B (in-service year 5)	1B	Lift Station sub/superstructure and associated mechanical and electrical to support development for years 6-10	$9,071,955	$1,841,155	$0	$0	$1,835,018	$660,000	$332,211	$16,942,753
	5	400 mm Secondary Supply Main	$3,202,414							
Phase 1C (in-service year 10)	1C	Lift Station Mechanical upgrades to support development for years 11 – 50	$1,503,837	$2,420,664	$0	$0	$2,412,595	$660,000	$432,620	$22,063,642
	2B	750 mm Force Main	$14,633,924							
Phase 2 (in-service year 20)	4B	750 mm Feeder Main (from OS3 to OS4)	$3,564,058	$534,609	$0	$0	$532,827	$0	$92,630	$4,724,124
Phase 3 (in-service year 30)	6	Wastewater upgrades to the Interceptor Sewer	$6,686,569	$1,002,985	$0	$0	$999,642	$0	$173,784	$8,862,980
		Combined Sub-Total (Class 3)	**$82,996,001**	**$12,449,400**	**$310,000**	**$389,000**	**$12,407,902**	**$1,716,000**	**$2,305,366**	**$112,573,670**
									Total (Class 3) $2020 (Excluding Inflation)	**$112,574,000**

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STATEMENT OF LIMITATIONS AND CONDITIONS

Limitations

This report has been prepared for The City of Winnipeg (the "City") in accordance with the agreement between KGS Group and the City (the "Agreement"). This report represents KGS Group's and WSP Canada Group Limited ("WSP")'s professional judgment and exercising due care consistent with the preparation of similar reports. The information, data, recommendations and conclusions in this report are subject to the constraints and limitations in the Agreement and the qualifications in this report. This report must be read, and sections or parts should not be read out of context.

This report is based on information made available to KGS Group and WSP by the City and unless stated otherwise, KGS Group and WSP have not verified the accuracy, completeness or validity of such information, makes no representation regarding its accuracy and hereby disclaims any liability in connection therewith. KGS Group and WSP shall not be responsible for conditions/issues they were not authorized or able to investigate or which were beyond the scope of their work. The information and conclusions provided in this report apply only as they existed at the time of KGS Group and WSP's work.

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Any use a third party makes of this report or any reliance on or decisions made based on it, are the responsibility of such third parties. KGS Group and WSP accept no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions undertaken based on this report.

The original of the technology-based document sent herewith has been authenticated and will be retained by KGS Group and WSP for a minimum of ten years. Since the file transmitted is now out of KGS Group and WSP's control and its integrity can no longer be ensured, no guarantee may be given with regards to any modifications made to this document.

1.0 DEFINITIONS

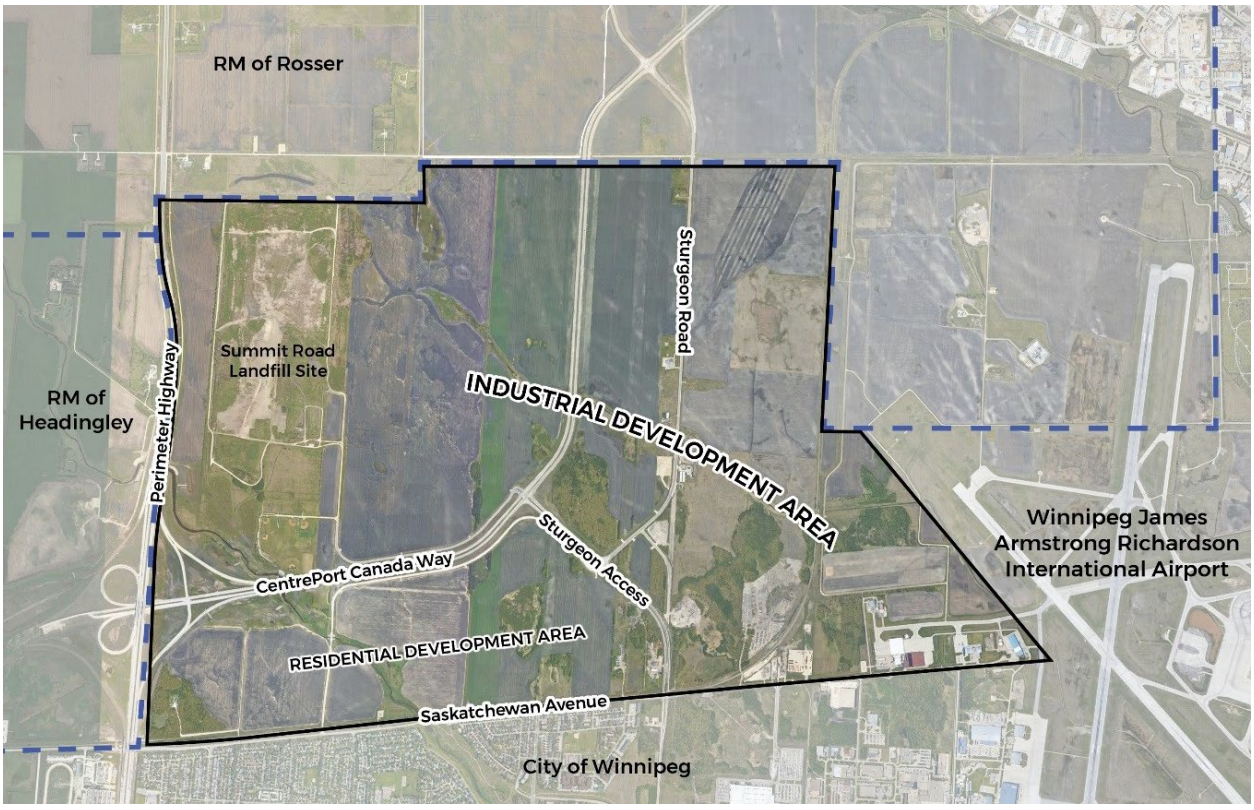
Word or Abbreviation	Definition (Meaning assigned for the purpose of this report)
AAW	Airport Area West
ATS	Automatic Transfer Switch
AWG	American Wire Gauge
CCW	CentrePort Canada Way
Collector Sewer	Sewer pipe used to convey wastewater from a lateral or branch sewer to a trunk sewer. Typically located within a public right-of-way. Classified as Local Infrastructure.
Common Sewer	Any sewer of any description vested in or under the control of The City of Winnipeg but does not include Interceptor Sewers.
CSTE	Customer Service Termination Enclosure
FCM	Force Main – a pressurized pipe used to convey wastewater from a Wastewater Lift Station to an Interceptor Sewer. Classified as Regional Infrastructure.
FDM	Feeder Main – a pressurized pipe with a diameter of 400 mm or larger used to convey potable water from a pump station to a local Water Main distribution network. Installation of service connections and fire hydrants are not permissible along Feeder Mains. Classified as Regional Infrastructure.
FVNR	Full voltage non-reversing
Intake Sewer	Large diameter sewer used to convey wastewater from a series of Interceptor Sewers to a wastewater lift station. Installation of connections along the interceptor pipe are not permissible. Classified as Regional Infrastructure.
Interceptor Sewer	Large diameter sewer pipe used to convey wastewater from Common Sewer mains to a sewage treatment plant or to a Wastewater Lift Station. An Interceptor is comprised of the most downstream links of the wastewater sewer system. Installation of connections or individual building services along the Interceptor Sewer pipe, or to intermediate manholes along the Interceptor Sewer pipe, are not permissible. The purpose of this sewer is to convey rather than to collect wastewater. Classified as Regional Infrastructure.
Lateral Sewer	Sewer pipe used to convey wastewater originating from private property to a Collector Sewer. Classified as Local Infrastructure.
LDWM	Large Diameter Water Main – a pressurized pipe with a diameter greater than 300 mm but less than 600 mm used to convey potable water. Installation of service connections and fire

Word or Abbreviation	Definition (Meaning assigned for the purpose of this report)
	hydrants are permissible along Large Diameter Water Mains. Classified as Local Infrastructure.
Local Infrastructure	Infrastructure that forms the distribution or collection networks between individual properties and Regional Infrastructure.
MCC	Motor Control Centre
MI	Manitoba Infrastructure
NEWPCC	North End Sewage Treatment Plant
PLC	Programmable Logic Controller
Service Connection	Water or sanitary sewer connection pipes between privately owned property and the local distribution or collection networks. Classified as Local Infrastructure.
Regional Infrastructure	Larger infrastructure that is required to distribute water or convey wastewater to/from smaller local networks.
RFP	Request for proposal
ROW	Right-of-way (singular or plural)
SSM	Secondary Supply Main – a Feeder Main extension with a pipe diameter greater than 300 mm but less than 600 mm used to convey potable water from a Feeder Main to the Local water distribution network. Installation intermediate connections, service connections and fire hydrants are not permissible along Secondary Supply Mains. Classified as Regional Infrastructure.
Trunk Sewer	Sewer pipe used to convey wastewater from a series of Collector Sewers to the Interceptor Sewer. Classified as Local Infrastructure.
VFD	Variable-frequency drive
WM	Water Main – a pressurized pipe with a size less than or equal to 300 mm in diameter used to distribute potable water from one or more Feeder Mains to water service pipes. Installation of fire hydrants are permissible. Classified as Local Infrastructure.
WAA	Winnipeg Airport Authority
WWLS	Wastewater Lift Station
WWS	Wastewater Sewer – a sewer pipe used to collect and convey wastewater. Typically, a Lateral (or Branch), Collector, or Trunk Sewer.
Year 0	The year that the first City of Winnipeg regional infrastructure asset in this program is brought into service.

2.0 INTRODUCTION

The City of Winnipeg is investigating regional servicing for the Airport Area West (AAW) region, an area bound by the Perimeter Highway to the west, Saskatchewan Avenue to the south, the Winnipeg James Armstrong Richardson International Airport to the east and the City of Winnipeg boundary to the north. The area is currently not serviced and in need of regional water and wastewater infrastructure to support future growth and development. The Study Area, shown in Figure 1, has an approximate gross size of 1460 ha. The actual gross developable area within this study area net of undevelopable areas such as landfills, creek floodplains, and major road rights of way is approximately 872 ha which is made up of 176 ha (gross) of residential and approximately 695.5 ha (gross) of industrial development.

FIGURE 1: AIRPORT AREA WEST STUDY AREA



The City retained KGS Group (KGS) and WSP Canada Group Limited (WSP) (sub-consultant) to provide professional consulting services in accordance with Request for Proposal (RFP) 289-2019 and develop preliminary designs to provide regional water and wastewater servicing to the AAW lands. Final deliverables for this project include the following key outcomes:

i. Preliminary designs for regional water and wastewater infrastructure that conform to City of Winnipeg standards to provide servicing through the anticipated 50-year buildout of the Study Area.
ii. A Class 3 cost estimate to understand the cost of the regional aspects of servicing in the context of overall land use planning for the City; and

iii. A high-level construction schedule for the future detailed design and construction phase of the project, identifying additional studies, permits and other requirements to support the project development.

In the process of developing these outcomes, our design team considered findings from the geotechnical investigation, land use and planning study, stakeholder engagement and risk analysis components that have been undertaken as part of this assignment. For context purposes, this report includes summaries of the geotechnical investigation and the land use planning and phasing components (separate documents describing the work and outcomes for each of these components in greater detail have previously been submitted to the City as deliverables for the project). Section 3.0 outlines the work that was completed as part of the geotechnical investigation, includes discussions related to the constructability of the proposed preliminary designs and concludes with recommendations for the future detailed design and construction phase.

Similarly, Section 4.0 of the report outlines the work that was completed as part of the land use and planning study which was informed by input from the City's steering committee (comprised of the various departments at the City of Winnipeg) and through consultation with key stakeholders and landowners associated with the AAW lands. The outcomes of the land use study included key assumptions that were carried through to the preliminary design stage of the project including land development rates and phasing, anticipated development land uses, and the associated sewer and water demands. These assumptions form the foundation for the anticipated development and phasing of the AAW lands and the preliminary designs presented herein.

Building on the information from the geotechnical investigation and the land use planning and phasing components, Section 5.0 of the report includes a discussion of the preliminary wastewater servicing design. The section outlines our methodology, design criteria and assumptions for the wastewater system analysis. It then discusses results and design solutions for each component of the regional wastewater system to provide effective servicing throughout various phases of the anticipated 50-year development plan. The section ends with conclusions and recommendations related to the preliminary wastewater servicing design. Section 6.0 follows a similar structure for the presentation of the preliminary water servicing design. Section 7.0 outlines easements and land acquisitions requirements for the preliminary design presented in this report. The report concludes with a Class 3 cost estimate (Section 8.0), a high-level project schedule (Section 9.0), project risks (Section 10.0) and a summary of key project directives (Section 11.0) that guided the development of the preliminary designs presented herein.

3.0 GEOTECHNICAL INVESTIGATION

Geotechnical investigations were completed along the assumed alignment of the linear infrastructure to gain a better understanding of the stratigraphy and groundwater conditions for the purpose of developing cost estimates and assessing the geotechnical risks at the preliminary design phase. Details from the geotechnical investigation are outlined in the *Airport Area West Water and Wastewater Servicing Preliminary Engineering 2019/2020 Preliminary Geotechnical Investigation Report*, Version 02, March 27, 2020 submitted to the City of Winnipeg.

3.1 Existing Geotechnical Data

A number of geotechnical and well investigations had previously been completed within the project area, which include:

- A geotechnical drilling and seismic survey investigation for Genstar Developments in 1988 (*Sewer Alignment Investigation and Property Investigation Lands North of Saskatchewan Ave*, December 1988),
- A geotechnical investigation completed by KGS Group in 2009 for the CCW Development (*CentrePort Canada Way Geotechnical Investigation Phase 1 Report*, July 2009), and
- Available well logs within the project site.

The available historical test hole and well log records were reviewed and incorporated in the development of the site stratigraphy and the associated till and bedrock models. Historical borehole logs along the proposed alignments are shown on Drawings C-201 to C-205 and C-209 to C-219.

3.2 Geotechnical Investigation

KGS Group reviewed the available geotechnical data within the project site and developed a geotechnical investigation program for the preliminary design phase with the City of Winnipeg. The geotechnical investigations that was completed for the preliminary design phase included seismic refraction surveys and sonic test hole drilling along the proposed Sturgeon Road and Inkster Boulevard alignment.

Geotechnical field investigations were completed in September and October 2019, and February 2020. The geotechnical field investigation completed in September and October 2019 consisted of advancing 22 test holes to bedrock using a sonic drill rig and completing approximately 5 km of seismic refraction surveys along the FCM and original Secondary Supply Main (SSM) alignment on Sturgeon Road (north of the Sturgeon Access Road) and Inkster Boulevard. Three standpipe piezometers were installed in at test holes locations drilled along the proposed alignment to provide groundwater monitoring data in the till and bedrock. The location and stratigraphy from the test holes and seismic refraction lines are shown on Drawings C-209 to C-219.

An additional geotechnical investigation was completed for the proposed gravity interceptor, and portions of the Feeder Main (FDM) alignment on the Sturgeon Access Road and Centreport Canada Way (CCW) to the west and south of the Sturgeon Road in February 2020. The geotechnical investigation included the advancement of 14 test holes to bedrock using a sonic drill rig. Two standpipes were installed to provide

groundwater monitoring data in the till and bedrock near the proposed Wastewater Lift Station (WWLS). The locations of the test holes are shown on Drawings C-201 to C-205.

In general, the soil stratigraphy was interpreted to consist of fill overlying clay, silt till and bedrock. A brief summary of the site stratigraphy is included below, and details of the site stratigraphy discussed in the 2019/2020 KGS Group Preliminary Geotechnical Investigation Report, Version 2 dated March 27, 2020.

Topsoil and asphalt were observed at the surface of some test holes depending on the location of the test hole.

Fill

Granular fill was observed in most of the test holes ranging in thickness from 0.2 to 2.7 m thick. The gravel fill was brown in colour, damp, loose to compact in density, and contained some fine to coarse grained sand, and trace till and clay.

Clay fill was observed in some test holes underlying the granular fill. The clay fill was mottled brown to grey in colour, damp, firm to stiff in consistency, low to high plasticity and contained trace to some fine to coarse grained gravel and coarse-grained sand. The clay fill ranged in thickness from 0.3 to 2.4 m.

Clay

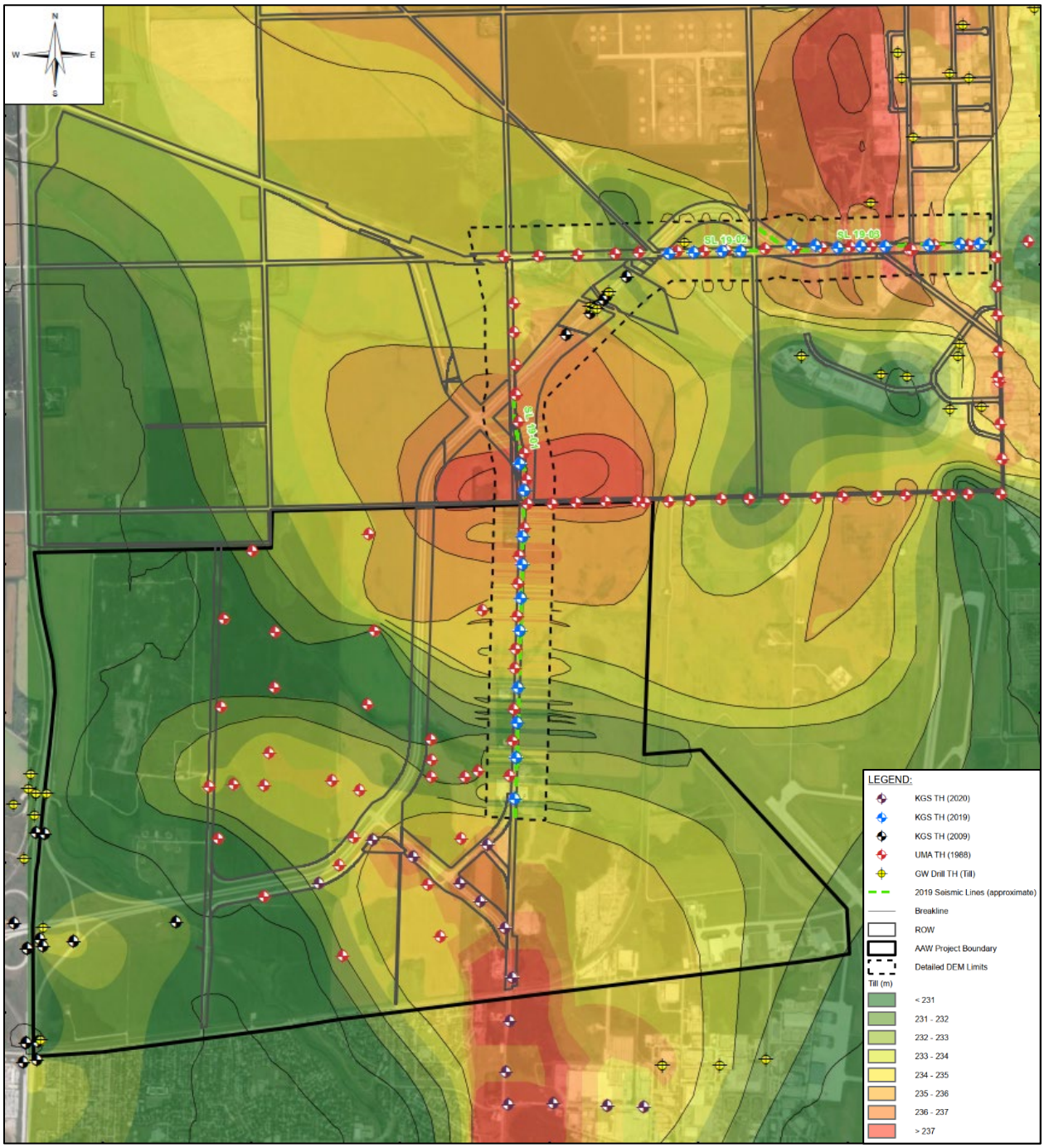
High plasticity clay was observed in all the test holes, ranging in thickness from 0.3 to 5 m. The clay was typically brown to grey in colour, damp to moist, firm to stiff in consistency, and of high plasticity. The undrained shear strength of the clay deposit, as determined using a field Torvane on disturbed samples, ranged from 30 to 80 kPa, generally decreasing with depth. Fine to coarse grained gravel, cobbles and boulders were encountered in the grey clay near the till interface.

Silt Till

Glacial silt till was encountered underlying the high plasticity clay at depths ranging from 0.9 to 9.1 m below grade. The silt till was tan in colour, damp to wet, compact to very dense with increasing density with depth and contained trace to some fine to coarse grained gravel, some fine to coarse grained sand and cobbles and boulders. Cobbles were observed within the silt till in the majority of the test holes at the site. The presence silt till at shallow depth along the proposed pipe alignment will affect the feasibility of the different installation methods.

Based on previous work completed by the City of Winnipeg in the vicinity of this project, it is understood that the installation of the gravity interceptors, Force Main (FCM), and FDM near the clay/till interface and within the silt till will encounter significant quantities of cobbles and boulders. Zones with increased cobbles and boulders were identified as part of the seismic refraction survey at the following stations: 3+690 to 3+790, 3+975 to 4+070, 9+550 to 9+640, 9+675 to 9+725, 10+020 to 10+070, and 10+240 to 10+320. The regional till model developed based on the historical data was updated with the seismic refraction and geotechnical drilling data to inform regional servicing infrastructure designs and is shown in Figure 2 below.

FIGURE 2: REGIONAL TILL MODEL

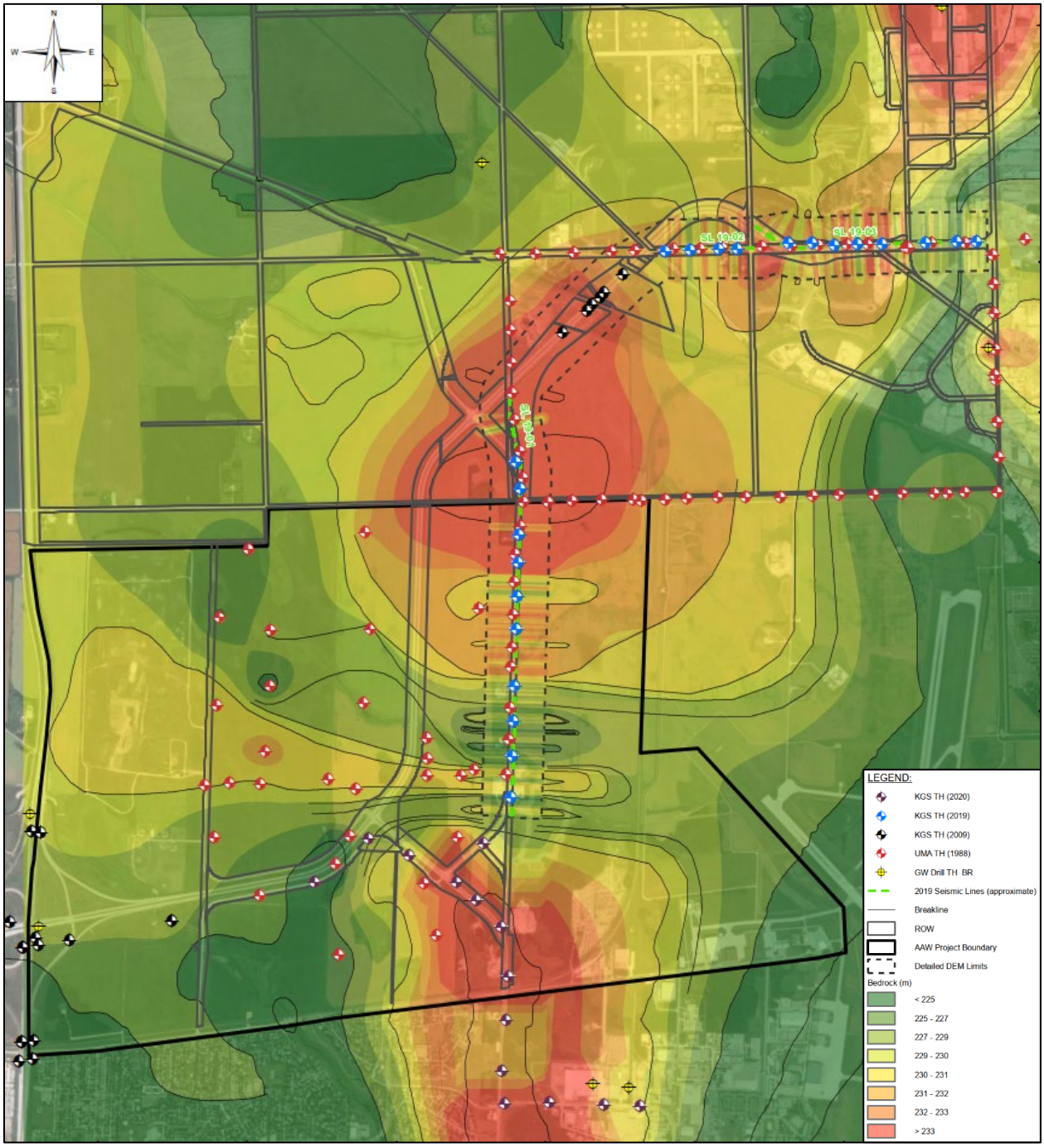


Bedrock

Bedrock was encountered underlying the silt till at depths ranging from 2.7 to 15.3 m below grade. The limestone bedrock was weak to strong, ranging in colour from white to red, with clay seams. There is the potential for karst topography, cavities and clay seams up to 1.5 m thick within the bedrock strata. The

regional bedrock model developed based on the historical data was updated with the seismic refraction and geotechnical drilling data to inform regional servicing infrastructure designs and is shown in Figure 3 below.

FIGURE 3: REGIONAL BEDROCK MODEL



3.3 Groundwater Monitoring

As part of the geotechnical investigations a total of five piezometers were installed within the silt till and bedrock. The results of the groundwater monitoring are shown on the table below. Details of the piezometer installation are shown on the logs included in the Preliminary Geotechnical Investigation Report.

TABLE 1: GROUNDWATER MONITORING

Test Hole ID	TH19-04		TH19-18	TH20-12	
Approx. Station (m)	4+502		9+107	2+502	
Ground Elevation (m)	238.39		239.60	239.7	
Piezometer No.	Standpipe 1	Standpipe 2	Standpipe 1	Standpipe 1	Standpipe 2
Tip Elevation (m)	230.3	227.9	230.34	235. 4	227.0
Monitoring Zone	Till	Bedrock	Till	Till	Bedrock
Groundwater Elevation (m) Oct-28-2019	236.44	236.33	236.44	-	-
Groundwater Elevation (m) Feb-28-2020	235.25	236.57	237.09	Dry	233.56

3.4 Geotechnical Design and Construction Considerations

Geotechnical design and construction considerations for this project are discussed in the following sections.

3.4.1 GRAVITY INTERCEPTOR PIPES

Gravity interceptor pipes will be installed upstream of the Wastewater Lift Station (WWLS) with a 750 mm diameter pipe extending to the west and a 900 mm diameter pipe extending to the east that connect to a 1,200 mm intake pipe at the WWLS. Based on the available geotechnical drilling data, the pipes will be installed within the dense silt till and bedrock layers. The pipes will be installed approximately 9 m below existing ground surface, making typical open cut pipe installation less practical. It is recommended the pipe installations be completed with an appropriately designed trenchless pipe installation method. Microtunneling and horizontal directional drilling (HDD) are viable installation techniques. Two-pass tunneling may not be feasible due to the small pipe size. Steering and grade control may be challenging for most trenchless methods in subsurface soils containing cobbles, boulders, or bedrock.

Microtunneling is a remotely controlled, guided, pipe jacking operation that provides continuous support to the excavation face by applying mechanical or fluid pressure to balance groundwater and earth pressure. Support at the excavation face is a key feature of microtunneling distinguishing it from traditional open-shield pipe-jacking. Microtunneling Boring Machines (MTBM) have been used extensively and successfully to install gravity flow sewer lines requiring precise lines and grades. Microtunneling requires a launch or jacking shaft from which the pipe installation starts and a retrieval shaft at the opposite end of the pipe to retrieve the MTBM which is used to excavate the soil/rock along the pipe alignment. The MTBM is pushed into the earth by hydraulic jacks mounted and aligned in the launch shaft. MTBM have a rotating cutting head to

excavate the ground material; the spoil is transported through a conveyor system back to the launch shaft. The cutting head is turned by a hydraulic or electric motor while a pressurized slurry mixing chamber behind the cutting head maintains the face stability. The cutting head of the MTBM for this work would need to be customized to excavate the different ground conditions that would be encountered including mixed ground conditions with cobbles and boulders, and bedrock.

For preliminary design and planning purposes we have assumed that that one launch shaft will be required near approximate station 2+200, and two receival shafts will be required at Stations 1+700 and 3+100. The proposed launch shaft is located southeast of the CCW and Sturgeon Access Road intersection. This proposed location should provide sufficient space for the contractor's laydown area during construction. The launch shaft location should be refined based on additional geotechnical investigations to be located at the approximate transition from bedrock to silt till at the pipe elevation. The location of the retrieval shaft at approximate station 3+100, will need to be selected, to minimize the impact on the adjacent intersection of Sturgeon Road and Sturgeon Access Road.

The shafts will be constructed through the clay and will extend into the silt till and bedrock. The base of the shafts should be designed to resist basal heave as required. Piezometers should be installed at the approximate shaft locations to provide groundwater monitoring data for the till and bedrock. Groundwater depressurization or dewatering may be required at the shaft locations to achieve the required factors of safety during construction.

3.4.2 WASTEWATER LIFT STATION

The Wastewater Lift Station is proposed, near the intersection of Sturgeon Road and Sturgeon Access Road. The WWLS is anticipated to be founded on bedrock at an approximate elevation of 229.5 The construction of the WWLS foundation will involve deep excavation of overburden and bedrock and require shoring.

Rock drilling and blasting techniques may be required for the excavation of the bedrock at the lift location. Controlled, smooth wall blasting techniques will be required to minimize disturbance to the rock mass.

The base of the excavations for the WWLS is expected to be below the groundwater level during construction. Groundwater levels measured in the piezometers are shown on Drawing C-203. A key geotechnical risk associated with the construction and long-term performance of the WWLS is the potential for high groundwater inflow. The rate of groundwater inflow will be dependent on the quality and permeability of the rock mass. To mitigate this risk, it is recommended that a 24-hour pump test be completed within the bedrock aquifer near the WWLS to quantify the requirements for construction dewatering and long-term bedrock pressure depressurization. The long-term groundwater management approach, and requirement for bedrock grouting will be determined based on the results of the pump test.

Depressurization and dewatering may be required for the construction of the WWLS. It will be important to have an effective drainage and sump pump system below the base of excavation, and to maintain a dry working surface. The drainage system would need to be designed to efficiently collect groundwater seepage and surface water drainage into the excavation so it can be pumped out, removed from site, and treated, as required. Surface run-off resulting from rainfall should be controlled and prevented from entering the excavation.

A similar drilling program is also recommended at the detailed design stage at the alternate WWLS locations identified in Section 5.1.2.2.

3.4.3 FORCE MAIN

Based on the proposed alignment of the FCM, the pipes will be installed through clay, silt till and bedrock. The following sections outline the proposed installation methodologies.

Open Cut

The FCM will be installed from the WWLS, north along Sturgeon Road, northeast on CCW and east on Inkster Boulevard to tie into the existing Interceptor Sewer at Inkster Boulevard and Brookside Boulevard. The FCM will be installed through clay, silt till and bedrock along the proposed alignment. The installation of the 600 and 750 mm FCM can be completed with a combination of open cut, HDD, microtunneling and tunneling installation methods.

Open cut pipe installation may be used for portions of the FCM installation in the areas where there is minimal infrastructural and sufficient space to allow for the excavation. Open cut is anticipated to be used from station 3+100 to 9+900 with some limitations. Open cut may be feasible from station 3+100 to 4+500 (with the exception of the Truro Creek crossing at approximate station 4+050) if there is a sufficient offset from Sturgeon Road and access to the private properties can be maintained during construction. From station 7+100 to 7+900, open cut may be used, with the exception of the CP rail lines and the provincial drain, provided the excavation is sufficiently offset from the CCW embankment fill. From station 7+900 to 9+900 open cut may be used, with the exception of the CCW crossing, provided a minimum offset can be maintained from the access roads.

Excavation completed within the silt till should expect to encounter cobbles and boulder. Additional geotechnical investigations should be completed in the regions with the areas of potential bedrock excavation to determine the bedrock quality, suitable excavation methods, and if blasting is required.

Temporary shoring may be required to facilitate the open cut construction especially adjacent to existing roadway or infrastructure. All excavation work will need to comply with the Workplace Safety and Health Act and Part 26 of the Manitoba Workplace Safety and Health Regulation, M.R. 217/2006. Excavations deeper than 4.5 m are required to be designed and approved prior to construction by an experienced professional engineer with an expertise in geotechnical engineering. Excavation support systems should be designed by the Contractor to control ground movement/subsidence around the perimeter of the excavation.

Stability analysis, with consideration of the site stratigraphy and ground water condition, should be completed as part of the detailed design of the pipe alignment to determine appropriate excavation side slopes for proposed open cut installation. As part of the slope stability analysis, the surrounding infrastructure including roads, structures, and utilities should be considered. In addition to slope stability analysis, ground settlement analysis should be completed for pipes installed by open cut methods.

Groundwater level will vary along the length of the pipe installation and is expected to fluctuate seasonally. Based on the available groundwater monitoring data, groundwater infiltration may be a concern when excavating near the till surface, and within the till. Groundwater inflow rates are expected to be relatively low within the low permeability clay layer, and higher rates are expected within the silt till and bedrock. Open cut excavations with minimal clay cover and high groundwater levels within the till and bedrock should consider

basal heave as part of the excavation design. Excavation within the silt till and bedrock, below the groundwater level, may require dewatering to ensure proper compaction of the sub-grade and backfill material.

Trenchless Installation

Portions of the FCM will need to be installed with trenchless methods due to limited space, existing infrastructure, or creeks. It is recommended the creek crossings (Truro Creek at station 4+050, Omands Creek at station 7+569, and East Branch Colony Creek at station 7+869) be completed using HDD or other suitable trenchless methods, as the pipes will be installed within the clay strata. The CP Rail Crossings (stations 7+540 to 7+590 and 7+855 to 7+885) and the CCW crossing will be completed through clay and till and may be completed using HDD, Pipe Jacking or microtunneling. The portion of the pipe installation along Inkster Boulevard, near Brookside Boulevard, Station 9+900 to 10+500 should be completed using either microtunneling or tunneling.

HDD is well suited for clay materials and can be successfully completed in saturated soils. The installation process uses a directional drill to advance drilling rods along the proposed alignment. The drill rods are guided by the drill head to ensure the angle, depth and exit point are maintained. A fly-cutting wheel will be attached to the front of the steel casing pipe by a swivel connection to displace the soil into the encasement pipe. As the drilling rods and encasement pipe are advanced, the excess soil cuttings will flow through the encasement pipe as its being pulled. This procedure minimizes the potential ground settlement along the installation length. The drilling rods are advanced to the exit pit and withdrawn from the encasement pipe. The FCM pipe will be installed within the cleared encasement pipe. Advancement of HDD through cobbles and boulders may be challenging and potentially impact the steering ability of the drill head. The use of this method through till or near the clay/till interface should be evaluated carefully during detailed design phase.

Microtunneling is discussed in Section 3.4.1 of this report and is appliable for the FCM crossings proposed within or near the silt till, and the portion of the pipe installation near Inkster and Brookside Boulevard.

Conventional tunneling, using the 2-pass installation method completed with an appropriately designed open-face rotary wheel Tunnel Boring Machine (TBM) may be used for the portion of the pipe installation near Inkster and Brookside Boulevard. An Earth Pressure Balance (EPB) TBM may also be used and operated in “open” or “closed” mode. If conventional tunneling is the selected installation method, a carrier pipe would be installed with the 750 mm and 600 mm FCM installed within it.

3.4.4 FEEDER MAIN AND SECONDARY SUPPLY MAIN

The location of the proposed FDM is shown on the attached drawings. Portions of the FDM along Sturgeon Road are parallel to the proposed FCM alignment, the geotechnical design and construction considered identified above for the installation of the FDM apply to these FCM in these locations. The remainder of the 750 mm FDM extends south along the Sturgeon Road from the Sturgeon Access Road to Saskatchewan Avenue.

Preliminary drilling was completed along this portion of the FDM alignment. As part of detailed design, it is recommended that additional drilling be completed along this proposed alignment to infill the existing data and develop the stratigraphy and groundwater information for the portions without geotechnical data.

Additional geotechnical drilling is also recommended to be undertaken during detailed design to determine the geotechnical conditions along the alignment of the 400 mm SSM. During the course of the project alternate alignments were considered for the SSM. The selected alignment of the SSM is connected to the Rouge Road FDM and extends north through a City of Winnipeg Right-of-way (ROW) to Saskatchewan Avenue where it turns west before terminating at the Saskatchewan Avenue-Cavalier Drive intersection. The drilling program as part of this Preliminary Design report did not collect data along this future asset and should be considered during detailed design.

3.5 Geotechnical Findings and Recommendations

The geotechnical drilling investigation and seismic refraction survey show that a variability in the till and bedrock surface elevations exist across the project site. At some locations where the FDM and FCM will be installed within the silt till, shallow till at less than 2 m depth was also encountered. In the preliminary design the proposed pipes travel through multiple soil strata including clay, till with cobbles and boulders and bedrock, which required consideration of various installation techniques. In regions where the pipes will be installed using trenchless installation methods, a mixed ground tunnelling face will be required. Mixed face ground conditions may impact the advancement rate of the tunnel as well was the alignment control. Mixed ground conditions and the presence of cobbles and boulders may impact the performance of some trenchless technologies including horizontal directional drilling and microtunnelling. Additional constructability review should be completed during detailed design phase to assess the suitability of various trenchless pipe installation method.

3.5.1 GRAVITY INTERCEPTOR AND INTAKE SEWER PIPE

As part of the preliminary geotechnical drilling investigation, three test holes were drilled along CCW and Sturgeon Access Road. It is recommended that additional geotechnical drilling be completed to delineate the till/bedrock interface along the proposed alignment. This geotechnical investigation will characterize the size and frequency of cobbles and boulders within the till. As part of the geotechnical investigation, triple tube bedrock coring should be completed along the portion of the alignment anticipated to be through bedrock to classify the bedrock quality, and strength and identify any clay or weak zones within the bedrock. Test holes should be drilled, and piezometers should be installed at the proposed shaft locations to provide groundwater monitoring results to be incorporated into the shaft design. A 24-hour pump test should also be completed to assess the need and extent of construction dewatering.

To simplify the installation of the pipe, considerations should be made during detailed design to harmonize the pipe diameters of the interceptor pipes and optimize the alignment of the pipe installation on Sturgeon Access Road. This would permit a single installation method to be used within the bedrock.

3.5.2 WASTEWATER LIFT STATION

It is recommended additional geotechnical investigations with triple tube bedrock coring be completed at the location of the proposed WWLS to gain a better understanding of the bedrock quality. The bedrock quality should be assessed to determine the feasibility of mechanical excavation, and the requirement for blasting if required. A pumping well should be drilling into the bedrock at the WWLS and a 24-hour pump test should be completed to assess the need and extent of construction dewatering and long-term foundation

depressurization or grouting. During the pump test, piezometers installed within the bedrock in the area should be monitored to determine the regional response of the bedrock pump test.

3.5.3 FORCE MAIN

Additional geotechnical investigations should be completed along the proposed FCM route, especially where bedrock excavation is required to determine the bedrock quality, suitable excavation methods, and if bedrock blasting is required. It is recommended additional groundwater monitoring be completed within the regions with till and bedrock excavation to gain a better understanding on the groundwater conditions and the requirements for dewatering if open trench excavation is utilized.

3.5.4 FEEDER MAIN AND SECONDARY SUPPLY MAIN

It is recommended that additional drilling be completed along these proposed alignments to supplement the existing data and develop the stratigraphy and groundwater information for the portions with limited geotechnical data.

4.0 LAND USE PLANNING AND PHASING

The project team was tasked with studying land uses proposed for the AAW lands, developing an understanding of the overall phasing for the area and capturing the findings in a Technical Land Use and Development Memo. The process of completing these tasks involved the review of existing plans for the region as well as extensive consultation with the City of Winnipeg and other AAW stakeholders including landowners, developers, and organizations such as the Winnipeg Airport Authority, CentrePort Canada and Economic Development Winnipeg. The Land Use Study (*Airport Area West Water and Wastewater Servicing Study Technical Land Use and Development Memo*, Rev 0, November 26, 2019) was submitted to the City on November 26, 2019.

This design report includes an overview of the project's Land Use Planning component below in Section 4.1. The land use planning for this project is discussed in detail in the Land Use Study but is also summarized in this report to illustrate how the findings from the land use analysis were used to inform the overall preliminary design process and provide context for our water demand and wastewater flow estimates.

The phasing section presented in Section 4.2 of this report expands on the phasing discussion presented in the final version of the Land Use and Development Memo. The Memo presented a high-level overview as to where development may commence and an anticipated rate of growth. Generally, the growth was assumed to occur in each of three key areas (residential, industrial, and lands owned by the Winnipeg Airport Authority), with growth initiating in the south and expanding northward. Refined assumptions are required to evaluate the impacts of phasing on, and from, the proposed Regional Infrastructure. Discussions with key stakeholders through our consultation process did not provide a clear phasing plan that addressed the specific needs of the preliminary design. Instead, it provided probable phasing trends based on past growth factors and anticipated future provincial needs. Furthermore, clarity was not provided based on exactly where development would begin but instead it was suggested that growth should be considered variable. The lands within the Study Area are owned by a significant number of different individuals, corporations and development firms that could not provide these details at this stage in their development plans. Phasing assumptions presented herein were developed based on our team's discussion with the City Steering committee, consultation with the key stakeholders and our professional judgment.

4.1 Land Use Planning

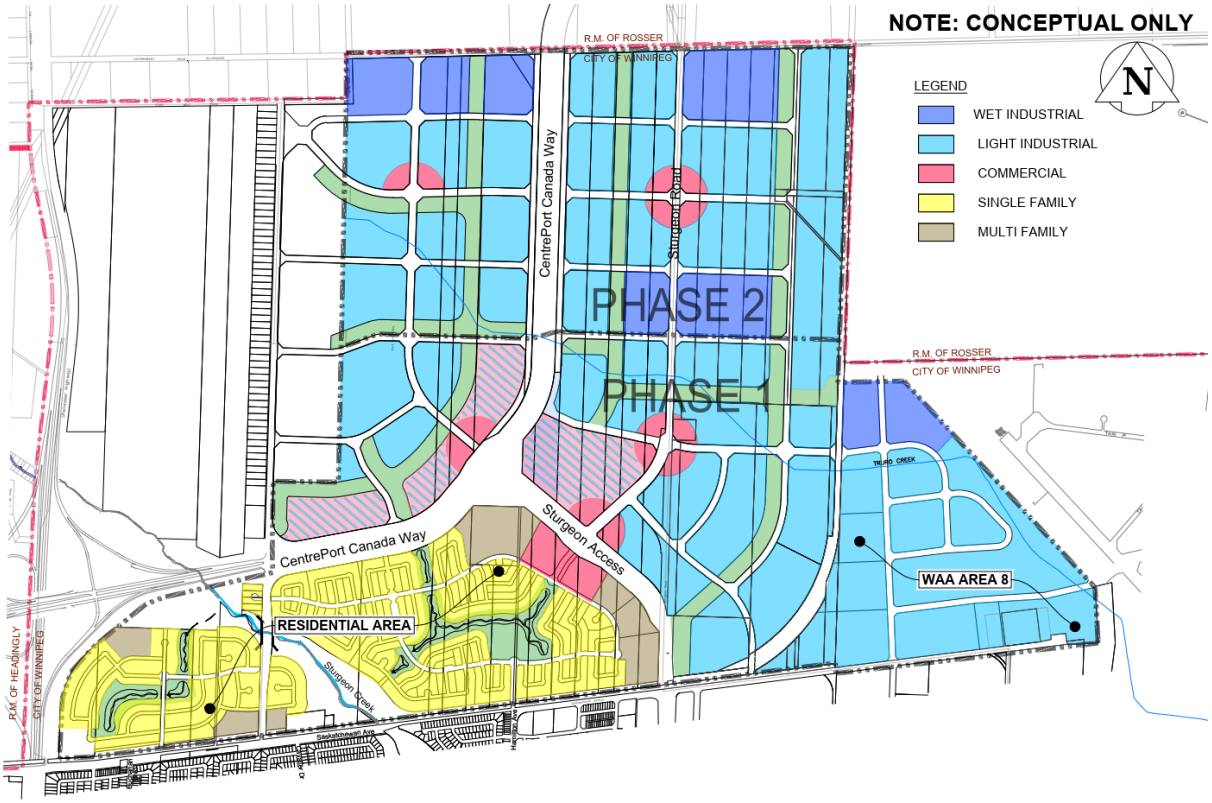
Findings from the land use planning portion of the assignment enabled us to assemble presumed land uses across the AAW Study Area as well as a conceptual shadow plan that shows major roadways through the future development. The presumed land uses were translated into the five servicing classifications: Single Family residential, Multi-Family residential, commercial, light industrial, and wet industrial. These classifications are used within the City's water demand and wastewater flow estimation guidelines. The development of this plan and the related project assumptions involved a complex approach that was reviewed and accepted by the City's steering committee through our Land Use Planning Workshop held on September 17, 2019. The approach is described in detail in the Land Use Study.

Completing the process of translating land uses to the City of Winnipeg's Water and Waste servicing classifications enabled our team to develop an informed estimate of the contributing areas for each of the City's servicing classifications. Based on the areas assigned to each of the servicing classifications, our design team estimated water demands and wastewater flows in accordance with the City's water and wastewater estimating guidelines. Demands and flows derived using this procedure are presented and discussed in Sections 5.1.1 and 6.3.1.2 of this preliminary design report.

4.1.1 SHADOW PLAN

The shadow plan developed for this project was largely based on information from AAW stakeholders and is shown in Figure 4 below.

FIGURE 4: SHADOW PLAN



Note:
The wet industrial development is not necessarily limited to the areas represented by the dark blue areas in the figure above. Rather, the analysis provides flexibility to allow the wet industrial development to move laterally or be split into several smaller sections. Provided that the total area of wet industrial development within each given sub-phase as shown in ***Table 2*** remains *unchanged.*

The shadow plan includes a conceptual road network for the region which was created by expanding the high-level transportation concepts presented in the existing residential and industrial secondary plans for the AAW lands. These plans were both under City review during the course of this project and are discussed in greater detail in the Land Use Study prepared for this project.

To expand the high-level transportation concepts from the secondary plans, our team added major roadways to the industrial area with a north-south and east-west orientation resulting in a rectangular grid layout, which is in line with planned development. The east-west rectangular grid layout provides a conservative assumption in terms of length of gravity sewers required to service the furthest limits of the study area. Efficiencies may be realized, in the future, if subdivision plans are developed with a more diagonal layout which could potentially shorten the length of the sewage collection pipes and their associated depths.

The shadow plan also provides a potential scenario of how the different servicing classifications could be distributed across the site at the full buildout horizon. At this point, it is important to note that the wet industrial development is not necessarily limited to the areas shown in dark blue. Areas shown to have the wet industrial servicing classification have been selected based on assumptions presented in the Land Use Study and were largely based on information gathered from the AAW stakeholders during our engagement activities. The analysis presented in this report provides flexibility to allow the wet industrial development to move laterally or be split into several smaller sections from the locations shown. One requirement, however, is that the total area of wet industrial development within each given sub-phase presented in Section 4.2 below, remains unchanged.

4.2 Phasing

In consultation with key stakeholders, our team developed a broad phasing concept that was outlined in the Land Use Study. The concept included two general phases and established a conceptual Phase 1/Phase 2 boundary based on information provided by stakeholders in the development area. The conceptual Phase 1/Phase 2 boundary included in our Land Use Study is shown on our shadow plan in Figure 4 above.

For the preliminary design, our initial phasing plan was refined to evaluate the impact of phasing on the proposed Regional Infrastructure, as well as the risks to the infrastructure based on the rate of development. Sub-phases were added to Phase 1 to discretize the first 20 years and Phase 2 for the remaining 30 years of a 50-year full development horizon. Specifically, Phase 1 was divided into 4 sub-phases (1A to 1D), each with a 5-year horizon, and Phase 2 was further divided into 3 sub-phases (2A to 2C), each with a 10-year horizon.

The following additional information obtained during the stakeholder consultation and land use analysis were considered in the development of the subphases:

- Three distinct primary landowners control the development of the residential portion of the Study Area, each owning approximately 1/3 of the land. It is assumed that development would commence in each of these 3 areas within the first 5 years; and that the full buildout of the residential developments would be completed within the first 20 years;
- Winnipeg Airport Authority (WAA) land designated as Area 8 would start development in the first sub-phase and complete development within the first 20 years. Consultation with the landowner suggested that the planning stage for development in this zone has progressed (though no information was formally provided to the project team); and
- The long linear nature of the land parcels in the industrial areas would allow most landowners to start development within the Phase 1 timeframe.

A linear rate of development was assumed to further break down the land components for each of the sub-phases. Table 2 includes the servicing classification distribution for each of the sub-phases within the assumed phasing plan shown in Figure 5.

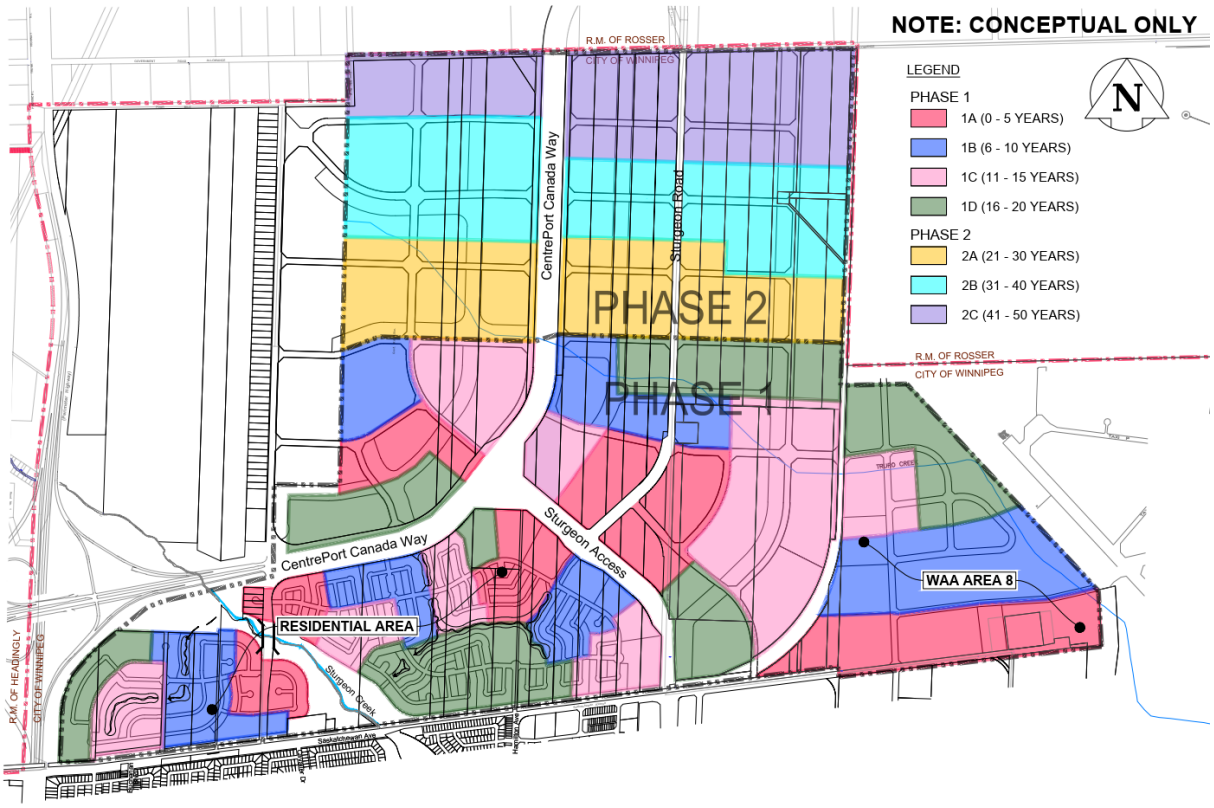
TABLE 2: SERVICING CLASSIFICATION DISTRIBUTION BY SUB-PHASE

Servicing Classification	Phase 1A 1-5 Years (ha)	Phase 1B 6-10 Years (ha)	Phase 1C 11-15 Years (ha)	Phase 1D 16-20 Years (ha)	Phase 2A 21-30 Years (ha)	Phase 2B 31-40 Years (ha)	Phase 2C 41-50 Years (ha)	Total Net Area (ha)
Single Family Residential	30.40	38.10	32.64	34.90	-	-	-	136.04
Multi-Family Residential	5.00	6.40	7.70	8.00	-	-	-	27.10
Business Park/ Commercial Mix	11.27	11.27	11.27	11.27	-	-	-	45.08
Commercial	5.05	5.05	5.05	5.05	2.80	2.80	2.80	28.60
Light Industrial	62.80	62.80	62.80	62.80	62.20	62.20	62.20	437.80
Wet Industrial	3.45	3.45	3.45	3.45	21.37	21.37	21.37	77.91
Total Net Area	117.97	127.07	122.91	125.47	86.37	86.37	86.37	752.53

*The net development area for each land use is presented in the above Table 2 and corresponds to the conceptual development shadow plan (*Figure 4*). This information was used to estimate water demands and wastewater sewer flows for each of the proposed development phases. It should be noted that our initial land use analysis presented in Land Use Study presents alternate development values as those initial calculations considered the gross development area.*

A refined phasing plan was developed based on the above information shown in Figure 5 below. For preliminary design purposes, this plan is used as a typical master plan to determine regional servicing requirements. It is difficult to predict the actual future phasing, take up rates, and locations of specific land uses for a project area of this size. It is strongly emphasized here that the phasing plan discussed in this section is strictly conceptual and actual development plans may vary. Our assumptions and water and wastewater modeling, presented in later sections of this report, provide a level of flexibility to address this concern. While each of the sub-phases are presented below in discrete colours with discrete years associated with them, the preliminary design considers these general blocks of land of approximately equal development that could be exchanged. In other words, if within one general area, if a developer begins with a different sub-phase (for example, exchanges sub-phase 1B for sub-phase 1A), the general impact on the Regional Infrastructure should be relatively similar to the information presented herein.

FIGURE 5: PHASING PLAN



5.0 WASTEWATER SERVICING

Regional wastewater infrastructure is required to support future development of the AAW lands. The preliminary design includes a single Wastewater Lift Station (WWLS) (in conformance with the RFP) to collect the future wastewater flows and direct them to the existing 1350 mm Inkster Interceptor Sewer which is terminated at the intersection of Inkster Boulevard and Brookside Boulevard. The preliminary design includes additional regional wastewater infrastructure including segments of gravity interceptor and Intake Sewer piping upstream of the Wastewater Lift Station, and Force Mains between the WWLS and the existing Inkster Interceptor Sewer. The preliminary wastewater design presented herein addresses the collection needs of the AAW lands for the anticipated future development (based on our land use assumptions) and provides additional considerations for the phased construction over an approximately 50-year buildout period. Specifically, the preliminary design addresses the following items identified in Section E7 of request for proposal 289-2019:

- Establish an optimum location for the proposed WWLS and develop the preliminary site layout, capacity, hydraulic design, pump selection and system curves for the station;
- Establish the pipe alignment, capacity, hydraulic design, and the connections to existing system for the proposed FCM and gravity sewer pipes;
- Identify where easements or property acquisitions are required to accommodate the proposed regional wastewater servicing infrastructure;
- Verify if there is sufficient capacity in the City's existing infrastructure to receive anticipated wastewater flows from the AAW development;
- Develop preliminary designs for all servicing infrastructure components to operate efficiently and cost effectively for flows in Phase 1 and are expandable to accommodate flows in Phase 2;
- Establish an estimate for yearly Operation and Maintenance costs for the WWLS as well as the proposed FCMs.

The methodology for developing our wastewater system analysis and our preliminary designs is outlined in Section 5.1 and includes discussions about our estimated design flows, assumed pipe network, design criteria, wastewater modeling, and sensitivity analysis. Sections 5.2 to 5.4 include discussions of the preliminary designs for the proposed Interceptor Sewers, WWLS and FCMs. Section 5.5 presents phasing consideration before the wastewater servicing portion of this report concludes with Section 5.6 which summarizes conclusions and recommendations, addressing key risk factors and design solutions for the 50-year buildout in line with our phasing plan.

5.1 Wastewater System Analysis

To aid the development of our preliminary regional wastewater servicing designs, our team undertook an in-depth wastewater system analysis to estimate wastewater flows; establish a conceptual pipe network; and develop regional wastewater servicing design criteria. Information from the analysis was then used in the InfoWorks ICM model to evaluate the performance of the proposed regional wastewater servicing system. The following sub-section includes a detailed discussion for each component included in our wastewater system analysis.

5.1.1 ESTIMATED DESIGN FLOWS

To estimate wastewater flows, our design team applied the City of Winnipeg design standards to the AAW lands based on the land use classifications as presented in the conceptual shadow plan. Wet weather flows for the residential component were developed by applying the following residential densities to actual areas measured on our shadow plan (and presented in Table 2).

Residential Areas:

- 14.8 dwelling units/ha (6 dwelling units/ac) for Single Family.
- 74.1 dwelling units/ha (30 dwelling units/ac) for Multi-Family areas.

To develop flows for the industrial and commercial areas, we applied standard non-residential wastewater generation unit rates as listed in the wastewater flow estimation and servicing guidelines. These rates are as follows:

Industrial and Commercial Components:

- 16,800 L/ha/day (ADWF) and 28,100 L/ha/day (PDWF) for Commercial.
- 22,500 L/ha/day (ADWF) and 37,600 L/ha/day (PDWF) for Light Industrial.
- 33,600 L/ha/day (ADWF) and 44,900 L/ha/day (PDWF) for Wet Industrial.

For our flow estimate calculations, we used net developable areas to determine land development capacities and corresponding dry weather flows. The net area calculations for Single Family only included local ROW. For all land uses, gross areas were used to establish the related wet weather components for infiltration into the wastewater system.

Gross areas for all wet weather calculations included local road rights-of-way (ROW) but not public reserve and stormwater facility areas. In addition, where wastewater sewers were located outside of the development boundaries, the areas used for wet weather calculations were increased accordingly.

The actual areas used in this analysis differed slightly from the net developable areas determined in the Land Use Study in the way that they were calculated. The design numbers presented here were taken from the actual conceptual development plan (shadow plan) whereas the areas presented in the Land Use Study were gross areas factored to net by applying a 25% reduction (typical industry value). Further, there were also some differences in what was included in the gross areas in terms of major ROW and creek areas. Using the actual areas from the shadow plan as we have done here results in improved accuracy for calculating the infiltration allowances.

Table 3 shows a breakdown of the calculated daily peak wet weather flows using the methods as described above for Phase 1 and Phase 2 as well as the individual sub-phases indicated.

TABLE 3: PEAK DAILY FLOWS

	Phase 1A 0-5 Years	Phase 1B 6-10 Years	Phase 1C 11-15 Years	Phase 1D 16-20 Years	Phase 2A 21-30 Years	Phase 2B 31-40 Years	Phase 2C 41-50 Years
Total Peak Day Wet Weather Flow (L/s)	95.50	196.07	292.51	389.64	451.70	513.76	575.83

A detailed spreadsheet used to calculate the peak daily flows presented in Table 3 is included in Appendix A.

5.1.2 PIPE NETWORK

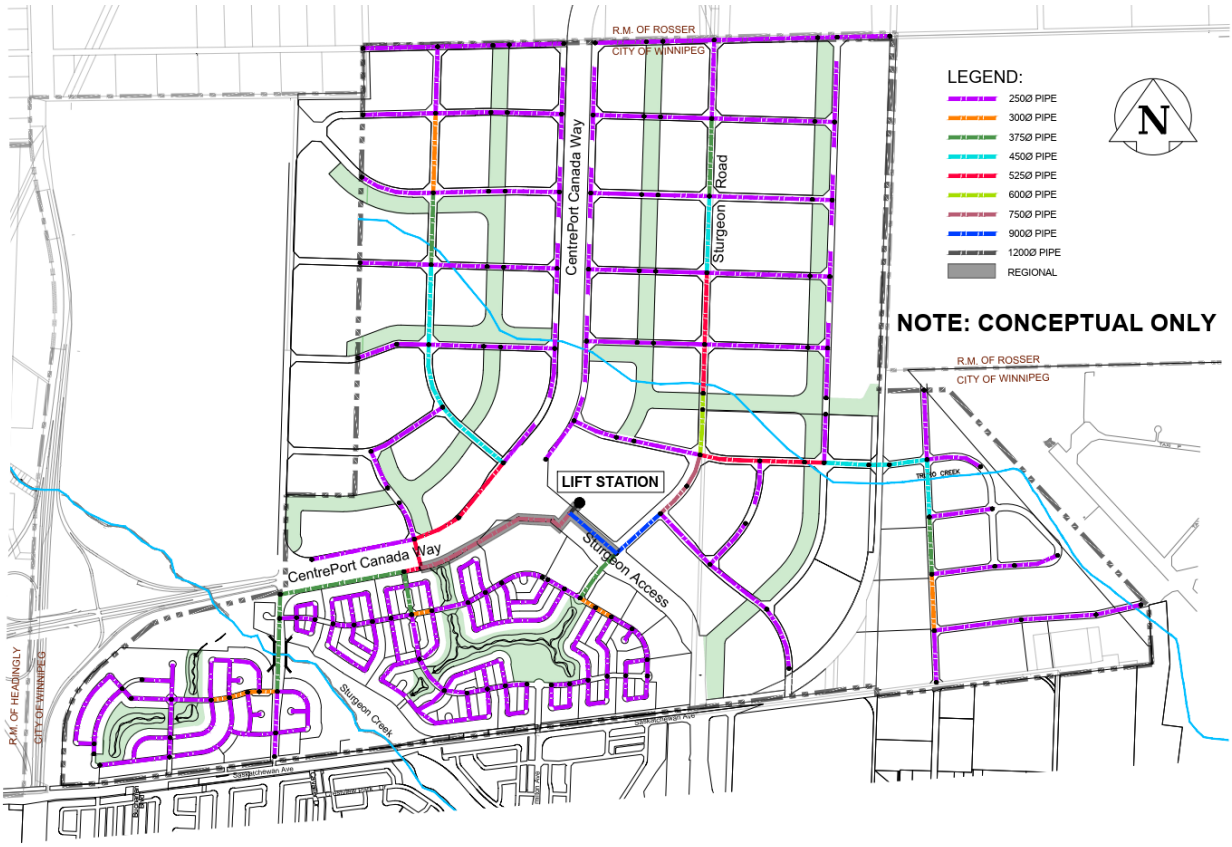
A conceptual pipe network estimating the future local gravity collection sewer system was developed as part of the preliminary design. The pipe network (shown in Figure 6 below) includes considerations from our land use planning, topographic survey and sub-surface investigation. The piping follows an east-west rectangular grid layout mimicking the proposed road alignments in the shadow plan. This grid layout provides a more conservative assumption to use at this stage, as it results in slightly lower grades at the downstream end than a diagonal layout (which could be considered in the future when the land is developed).

The following City directives were taken into consideration when developing the local wastewater collection network and the regional wastewater servicing concept (see Directive 1 in Section 11.0):

i. All of the collection sewers are to be gravity and flow to a single WWLS that is designed to service the entire AAW region (as identified in the Project Initiation Meeting); and
ii. The discharge FCM alignment should run north along the Sturgeon Road ROW to CCW before turning east and connecting to the existing 1350 mm Interceptor Sewer on Inkster Boulevard at Brookside Boulevard.

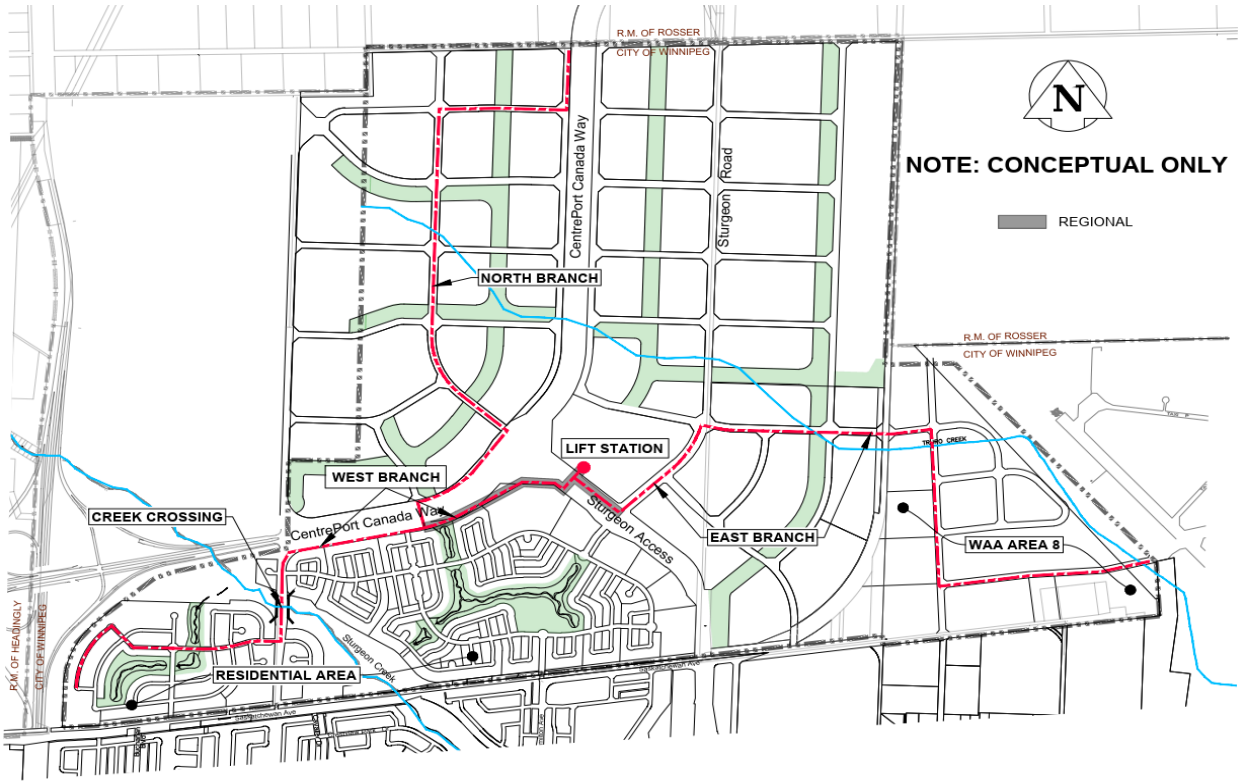
To determine the optimum location and depth requirements for such a WWLS, the development areas were discretized into sub areas to determine corresponding flows and related pipe sizing for the various lateral/branch sewers required to service each sub area. Depths and grades were then determined and applied to these sewer branches. Depths were based on first determining the existing ground elevations from the Lidar survey, and then applying a starting depth of 3.0 m below this elevation at the high-end manhole in the conceptual street for Single Family residential areas (to allow for a gravity sewer service line for typical basement depths) and 4.0 m at the high end for the industrial areas. While the industrial land uses typically do not have basements, the extra depth (at the street) will allow for longer anticipated service lines to be run into the properties for the potentially larger parcel sizes. From the high end manholes, minimum pipe grades of 0.30% (0.50% for first run of 100 m – 125 m) were applied to all of the 250 mm pipes with the intent that the slight increase over minimum would allow for improved flows in the early stages of development as well as increasing the safety allowance for WWLS depth. Minimum grades, as per City standards, were applied to all pipes 300 mm and over. The conceptual gravity collection system used in our sewer analysis is presented below in Figure 6

FIGURE 6: CONCEPTUAL WWS PIPE NETWORK



Several factors were considered in identifying an optimal location of the WWLS. Initially the positioning considered a central location within the servicing area to minimize the depths of the various branches of the incoming collector sewers. Critical sewer branches were identified that refined the location and associated depth of the WWLS. These branches are shown in Figure 7 below.

FIGURE 7: CONCEPTUAL WWS ROUTES



North Branch

The north branch collects flow from the industrial area and starts at the north limit of the study area on CCW and flows south. The grade of the north branch effectively drains into the west branch by gravity, due to the depth requirements imposed on the West Branch by the creek crossing. The North Branch is not the critical branch governing the depth of the WWLS.

West Branch

The west branch collects flows from the residential area west of Sturgeon Creek. The depth of the gravity sewer from this area is determined by the pipe crossing under Sturgeon Creek along Summit Road. This depth under the creek should provide protection for the sewer from potential future maintenance activities relating to the creek while not over taxing the depth requirements for the sewer. To reduce the chance of freezing or potential damage to the pipe, this section should be insulated as well as protected by an encasement pipe.

Several factors will determine a final design depth for this crossing. The creek elevation should be verified by actual survey, any changes to the residential development plan should be incorporated, and the various regulators requirements for clearance at this crossing should be confirmed at the detailed design stage as these factors could impact the overall lift station depth. A preliminary depth of 2.0 m below the lowest elevation of the creek bed was used for this report. This 2.0 m depth at the creek crossing equates to a pipe depth approximately 2.7 m lower than would be required if the creek was not present. This extra depth requirement is carried from that crossing point to the WWLS establishing a depth requirement for the west branch.

East Branch

The East Branch commences at the east limit of WWA Area 8. This branch follows the main road of the conceptual plan, crosses under the CP rail line, and connects to the main branch on Sturgeon Road that continues south then west to the WWLS.

The required depths of the WWLS to accommodate both the east and west branches are similar. The East Branch, originating in WAA Area 8, terminates approximately 0.3 m lower than the West Branch due to its longer length. The East Branch is therefore the controlling branch that ultimately determines the depth of the WWLS.

It should be emphasized here that this analysis and layout is based on the shadow plan developed for this assignment. With some refinement and strategic planning for street layout at the detailed design stage, potential savings could be realized by reducing the depth of these regional sewers and subsequently, the WWLS. It would be important to further coordinate planning with overall regional wastewater servicing design.

5.1.2.1 Gravity Interceptor and Intake Sewers

The first component of the regional wastewater infrastructure within the pipe network includes gravity interceptor and Intake Sewer pipes. The interceptors are required to collect the flows from the various local branches of the wastewater collection system and discharge them to the Intake Sewer at the WWLS. For the purposes of this assignment, we have limited the gravity interceptors to large sized gravity sewers that are located at the lower end of the system and have a single inflow at the upstream end with no connections in between. These sewers have been identified as “Regional” on Figure 6. Two separate Interceptor Sewers exist: the “West Interceptor” sewer, a 750 mm sewer that collects the flows from the residential zone and the northern component of the industrial zone; and the “East Interceptor” a 900 mm sewer that collects the flows from the Winnipeg airport owned lands of the industrial zone and portions of the residential zone. The two Interceptor Sewers connect to a 1,200 mm Intake Sewer that is connected to the WWLS. The Interceptor Sewers are deep and are located within the till and rock layers which will make installation challenging. Alternate alignments were evaluated to avoid these adverse subsurface conditions. However, due to the depth of the Interceptor Sewers, the pipes remain in the till layer and did not effectively avoid the bedrock layers, especially for the East Interceptor.

As part of detailed design, it is recommended that additional drilling be undertaken to the north of the proposed lift station in the east-west direction that coincides with station 3+700 along Sturgeon Road to finalize the Interceptor Sewer alignment, with focus on the East Interceptor. The bedrock contours presented on Figure 3 show elevations that suggest the East alignment could be redirected to potentially avoid the bedrock layer, however this alternate alignment could only accept flows from the industrial zone and the remaining portion of the residential zone would need to be redirected internally via gravity sewers to the West Interceptor Sewer. This option was not pursued at this stage for the following reasons:

A. The contours are extrapolated in this area and no actual geotechnical data exists to provide accuracy to the cost estimate.
B. The alignment along these lower bedrock contours passes through developable lands in the industrial secondary plan and not planned roadway (i.e., this land is not currently planned to be a future City right-of-way).

C. This alternate alignment would require negotiation with seven different property owners (see Figure 4) as opposed to the selected alignment that runs on existing City rights-of-way.

The selected design while potentially conservative, is based on firm data and achievable planning based on the current stage of the draft secondary plans. The alternate alignment should be pursued at the detailed design stage when the secondary plans have been adopted and further geotechnical investigations have been carried out to determine if these efficiencies can be achieved.

5.1.2.2 Lift Station

The selected location of the Wastewater Lift Station at the preliminary design stage was initially based on optimizing branch depths as discussed previously in Section 5.1.2.1. The general location based on the proposed branch depths is at the intersection of CCW and the Sturgeon Access as shown in Figure 7. Alternate locations were evaluated along the Sturgeon Access to Sturgeon Road, and north along Sturgeon Road, however, the optimal location was determined to be in the proximity of CCW and the Sturgeon Access road. The intersection of CCW and the Sturgeon access road is a planned location for a future grade separated interchange by the Province of Manitoba. A location immediately to the east of the future interchange extents was selected based on several key considerations.

The selected location is well suited for a WWLS based on the anticipated development. The proposed WWLS is in the industrial portion of the AAW lands and is not immediately adjacent to residential properties. From a development perspective it is considered well situated.

Alternate lift station locations further to the east along the Sturgeon Access Road and north along Sturgeon Road were also eliminated due to growing costs. The cost of longer, deeper, large diameter gravity Interceptor Sewers entering the alternate station locations from the west exceed the cost of the reduced length of the shallower FCMs exiting the station to the east. Additionally, the till and bedrock elevations along the Sturgeon access road become significantly shallower as you travel further to the east. The high cost and complexity of installing the gravity sewers and lift station in the bedrock made these alternate locations impractical.

The selected location of the WWLS for the preliminary design stage considered the optimal depths of the various branches, costs of the deep Interceptor Sewers and shallower FCMs, the surrounding geotechnical conditions, and the future development in the area.

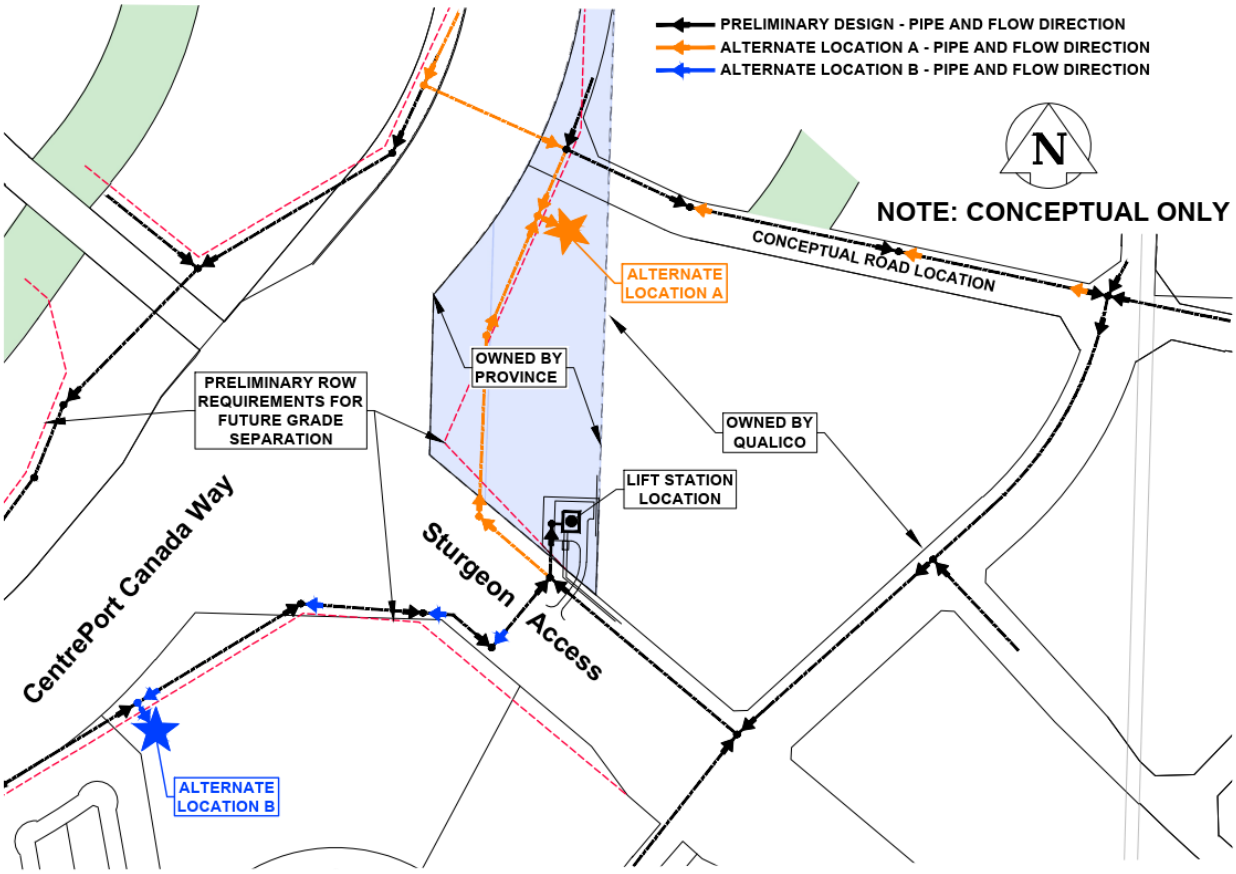
The proposed location of the WWLS is on parcel 7569135790 which is currently owned by the Province of Manitoba. If this location is ultimately selected, the City should purchase this land from the Province. Construction needs for the future grade separated interchange and/or changes to the road alignment of the Sturgeon Access may impact the proposed access to the WWLS at this location. As such, it is recommended that the City consult with the Province as the team advances the design to future stages of this project. If the impacts of the future interchange require the station to be moved further to the east, then land takings would be required as the adjacent property is privately owned.

It should be noted that while the selected location is optimal for the single WWLS concept, geotechnical issues exist that pose risks to the project. The bedrock is shallow in this general area which will make construction of the WWLS and the associated deep Interceptor Sewers challenging. Further, there are indications that portions of the bedrock may be weak, and that adverse groundwater conditions may exist.

These subsurface conditions will be problematic throughout the AAW lands to varying degrees for the underground infrastructure installations. Further geotechnical investigations specific to final locations and alignments of infrastructure and a review of constructability issues will be required at the detailed design stage to confirm the suitability of the locations identified.

The recommendations for the geotechnical drilling and investigation program for the WWLS are provided in Section 3.4.2. It is recommended that this same drilling program also be undertaken at the alternate WWLS locations presented below in Figure 8. These alternate locations, in the general vicinity of the future interchange, are proposed to provide flexibility should adverse geotechnical conditions be identified in the selected preliminary design location.

FIGURE 8: PROPOSED AND ALTERNATE LIFT STATION LOCATION



ALTERNATE LOCATION A: Located in the same parcel as the selected location for preliminary design (Parcel 7569135790), but further to the north. The existing geotechnical data suggests that the till and bedrock elevations drop within this property as you move northward. The depths to till and bedrock within this parcel should be verified to identify the best overall location for the WWLS. It should be noted that as the location is shifted to the north, the station will become lower and the 1,200 mm Intake Sewer will need to be

extended. The cost of the longer Interceptor Sewer and deeper WWLS will need to be compared against any potential cost savings for the WWLS.

ALTERNATE LOCATION B: Located at the northern limit of parcels 7569100300 and 7569100000. This land is immediately south of the future grade separated interchange but is designated for Single Family and Multi-Family residential development and is thus not as optimal from the development perspective. A WWLS at this location would be approximately 1 m deeper and would require the extension of the 600 mm and 750 mm FCMs which would increase the capital costs of the infrastructure. However, the available geotechnical data suggests that the till and bedrock elevations may be deeper at this location which could result in project benefits at the detailed design stage.

None of these WWLS sites are in proximity to readily available gas and hydro servicing. These utilities will be brought in as required to service any new development in the area. The extent and location of the first stages of development will also determine the availability of these services to the proposed WWLS sites. At the time of development applications, the exact requirements and timing for extending gas and electrical power to these sites can be determined.

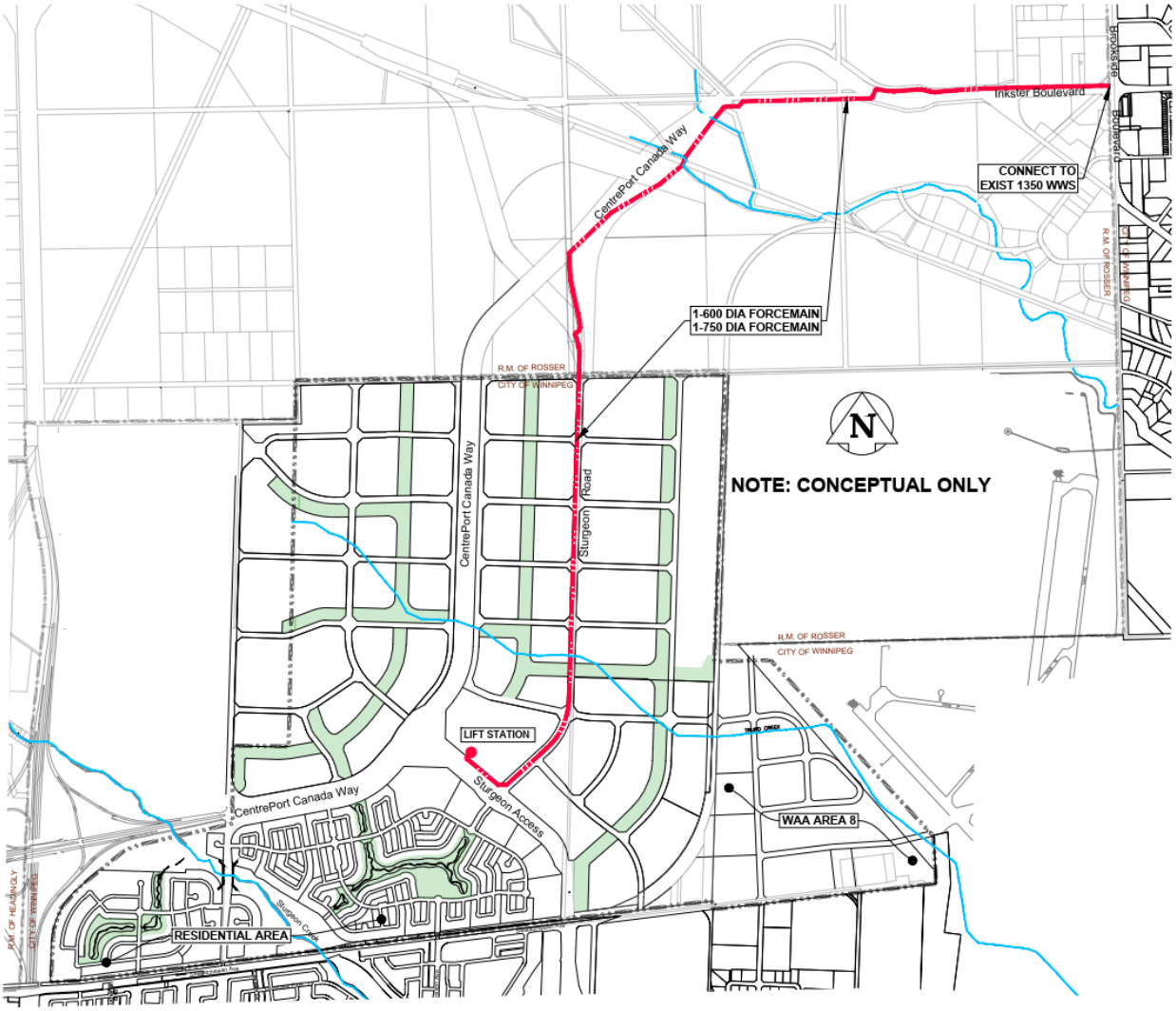
5.1.2.3 Force Mains

Force Mains are required to redirect the pumped flows from Wastewater Lift Station to the existing Inkster Interceptor Sewer. The location of the FCM alignment follows the City's recommended route which is north along Sturgeon Road to CentrePort Canada Way and then east to the intersection of Inkster Boulevard and Brookside Boulevard as indicated in Figure 9. The FCM alignment within the AAW lands falls within the City ROW which will be beneficial when planning out the future design and construction phases of the project. The geotechnical investigation undertaken as part of this study effectively identified the depths to till and rock along the alignment in both the City of Winnipeg and the RM of Rosser. This information will reduce the risk associated with unknown ground conditions during construction. However, the investigation also identified that the installations of the FCMs will be within challenging subsurface conditions in some locations along the alignment, as identified in Section 3.4.3. At minimum depth of cover for frost protection, the FCMs are in mixed ground conditions passing primarily between the clay and till layers. Appropriate installation methods will be required to address the mixed soil conditions and to address the large rocks that are anticipated within the till layer. In some instances, bedrock extends into the path of the FCMs creating further challenges. Insulated pipes with reduced depth of cover should be considered at the detailed design stage to avoid the bedrock zones.

The general alignment for the FCM was recommended by the City early in the preliminary design stage to stay with the Sturgeon Road right of way within the AAW lands. However, some minor optimization is recommended to be undertaken at the detailed design stage once the development plans are adopted by the City. Specifically, the portions of the FCMs exiting the WWLS and travelling west along the Sturgeon Access road should be reviewed. The depth to till in this zone is quite shallow. An alternate alignment could be considered at the detailed design stage beginning at the WWLS and heading north to a future east-west roadway. Ideally this roadway would be at an approximate northing in line with station 3+700 on Drawing C-210. The existing geotechnical data suggests that lower till elevations would exist along this alignment and the FCMs could be installed primarily within the clay layer, however insufficient geotechnical information exists in this location to determine if the till layer could be avoided.

Alternate considerations for the remainder of the FCM are limited, as the alignment passes through the RM of Rosser. The FCM alignment within the RM of Rosser from the northern limit of the AAW lands and the connection to the Inkster Interceptor Sewer at the east limit of the City of Winnipeg is primarily along existing Provincial and rural road ROW to facility the future planning of this work.

FIGURE 9: CONCEPTUAL FORCE MAIN ROUTE



5.1.3 DESIGN CRITERIA

The City of Winnipeg wastewater flow estimation and servicing guidelines were followed to determine sewage flows for the wastewater collector sewer design. All gravity sewers were sized to carry peak daily flows without surcharging. Lift station pumps were designed to provide operating efficiencies throughout the various phases of buildout. Force Main sizes were determined based on providing minimum scour velocities during operation of all phases.

The targeted design conditions for the FCM was 0.76 m/s to 1.2 m/s velocity under all flow (sub-phase conditions). This velocity range provides enough turbulence to prevent the settling of solids, allows for re-suspension of solids between pump cycles and maintains head loss at a reasonable level. All velocity and head loss calculations were completed using PVC pipe hydraulic parameters, though HDPE could also be considered for this application. Any design utilizing HDPE would need to ensure that the cyclic nature of pump starts/stops is included in the consideration of wall thickness design. Further, wall thickness requirements may be governed by the proposed installation methods.

The FCM profile approximately follows the surface contours (with some smoothing) below frost depth (minimum 2.5 m to the pipe obvert). A total dynamic head between 12.9 m and 24.7 m was selected to optimize the number of possible pumps appropriate for the installation (most common range for sewage pumps).

Peak instantaneous flows were used to determine the WWLS firm pumping capacity. These flows were calculated by factoring the daily dry weather flows for the residential, commercial and industrial areas, combining the resulting flows and then adding infiltration flows resulting in the peak instantaneous design flows presented in Table 4 below. For the residential areas, peak instantaneous flows were calculated by applying a factor of 1.67 to the daily peak dry weather flows. For the commercial and industrial areas, peak instantaneous flows were calculated by applying a factor of 2.75 to the average dry weather flows. A detailed spreadsheet used to calculate the peak instantaneous flows presented here is included in Appendix B.

TABLE 4: PEAK INSTANTANEOUS FLOWS

	Phase 1A 0-5 Years	Phase 1B 6-10 Years	Phase 1C 11-15 Years	Phase 1D 16-20 Years	Phase 2A 21-30 Years	Phase 2B 31-40 Years	Phase 2C 41-50 Years
Total Peak Instantaneous Flow (L/s)	135.79	277.78	413.91	550.55	642.42	734.30	826.17
Pump Operation Stage	Stage 1.1 and 1.2		Stage 2		Stage 3		
Force Main Configuration	1 x 600 mm		1 x 750 mm		1 x 600 mm & 1 x 750 mm		

One of the key design considerations for the pumping system (WWLS and FCMs) was to support the anticipated capacities at the various development phases presented above in Table 4. The terminology “Stages” is used to refer to required changes to pumping rates, flows, and pipe sizing to accommodate the downstream wastewater design through specific phase and sub-phases of development

5.1.4 WASTEWATER MODELING

A model of the proposed wastewater system was developed using InfoWorks ICM computer modelling software to further analyze and confirm the pipe system design and lift station capacity. The model for the AAW wastewater system was developed based on the proposed shadow plan with a servicing classification distribution as outlined in Section 4.2 and the proposed pipe network as outlined in Section 5.1.2. The

proposed pipe network was imported into InfoWorks ICM, and sub-catchments were added to represent each service classification inflow at key locations.

The wastewater inflow for the model corresponds to the servicing classifications defined in Table 2. An additional servicing classification was defined within our model for the mixed Commercial/Light Industrial area shown in Figure 4. The residential land uses for Single Family and Multi-Family were defined using a population density of 45.14 persons/hectare and 170.50 persons/hectare, a daily wastewater generation of 270 L/person/day, and a peaking factor of 2.95 based on Harmon's equation. Commercial, Light Industrial, and Wet Industrial areas were defined in the model with a population density of 1 but the per capita flow defined as the corresponding PDWF values, resulting in the PDWF per hectare corresponding to the City's defined standard. Although the model software is capable of simulating diurnal patterns with peak flows varying throughout the day, a steady flow simulation using peak values was adopted to provide a reasonable representation of the system for the accuracy of this study, given the uncertainty of development scenarios and timelines. The model setup with a representation of the sub-catchment areas indicating the various land use types is shown on Plate 5.01, and a table outlining the subcatchment properties and generated flows is included in Appendix C.

Extraneous flow contributions (wet weather components for infiltration into the wastewater system) were defined as a baseflow to each of the wastewater sub-catchments in the model. These range from 0 L/s to 4.5 L/s based on groundwater infiltration and manhole infiltration flows calculated for each manhole receiving inflow from a sub-catchment.

Multiple scenarios were then defined with the model for each of the sub-phases of development by working backwards from the full buildout and removing sub-catchments (and therefore inflows) for the future development phases and sub phases. To compare the flow generation between the model simulations and the flow calculations, a free outfall condition at the downstream boundary (lift station) was set. Table 5 outlines the comparison of the modelled peak flows to the calculated values at the WWLS. The percent difference shown in Table 5 represents the difference in the modelled results versus the calculated flows which is generally less than 1.5%, indicating excellent representation within the model of the calculated flow values.

TABLE 5: COMPARISON OF FLOWS – CALCULATED VS MODELLED

	Phase 1A 0-5 Years	Phase 1B 6-10 Years	Phase 1C 11-15 Years	Phase 1D 16-20 Years	Phase 2A 21-30 Years	Phase 2B 31-40 Years	Phase 2C 41-50 Years
Total Peak Day Wet Weather Flow (L/s)	95.50	196.07	292.51	389.64	451.70	513.76	575.83
Model Simulation Peak Flows (L/s)	100.69	194.01	294.9	386.19	444.96	506.46	567.45
% Difference	5.43%	1.06%	0.82%	0.89%	1.49%	1.42%	1.46%

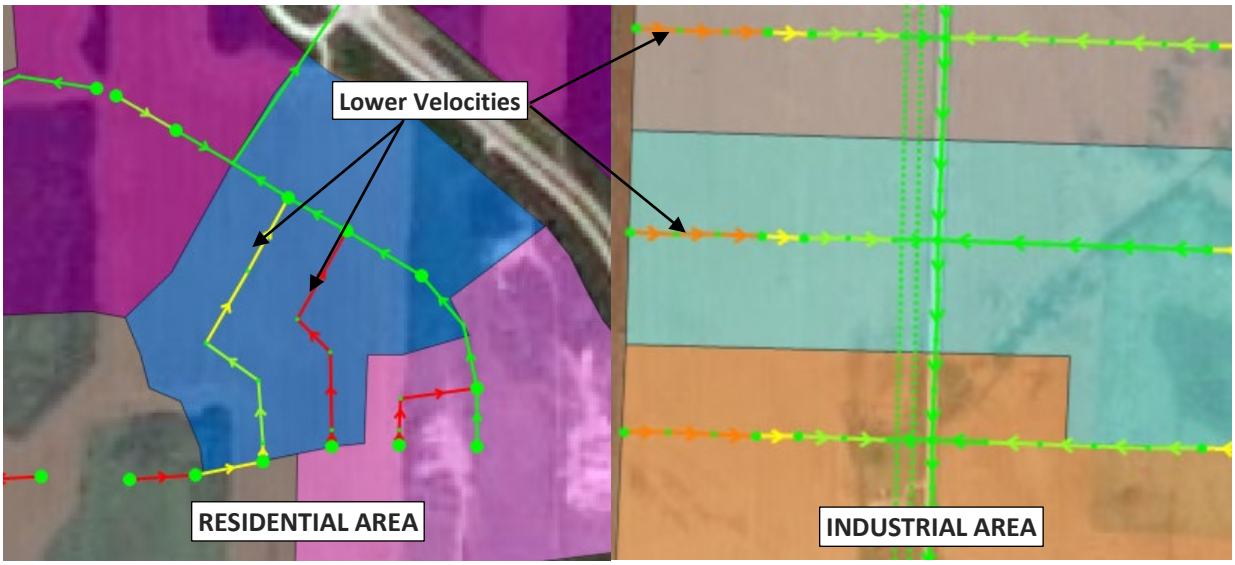
The three stages of pump capacities were added to the model phasing simulations to determine potential deficiencies or concerns with the system design during specific phases of development. As a result of the timeline for development over a period of 50 years, the system must be able to accommodate a broad variety of inflows and flow conditions while attempting to eliminate the need for intermediate installations of wastewater sewer that would be required to be replaced and upsized as the development progresses. For the preliminary design phase of this study, the pump head/flow curves were not discretized in the model, rather a steady pump capacity with start/stop elevations were set such that the system does not surcharge and the pumps do not cycle excessively. The pump start and stop elevations and actual pump head/discharge curves should be further refined during detailed design.

Plates 5.02 to 5.10 presented at the back of the report show the hydraulic model results of the various phasing and staging configurations. The figures indicate the areas being developed, the minimum velocities within the pipes (green indicating the minimum velocity is above the 0.6 m/s required to avoid sediment accumulation, and red indicating the minimum velocity is less than 0.3 m/s), and segments where a pipe or manhole is under surcharge conditions are indicated by a dashed line and a red coloured node.

The model simulation results were used to confirm various design parameters of the wastewater sewer, namely pipe capacity or surcharging, and minimum velocities for sediment accumulation. The simulation results generally confirm the wastewater sewer design, with no surcharging occurring under various phasing and sub phasing conditions.

In general, the velocities within the wastewater trunk sewers are acceptable, with most achieving sedimentation velocities above 0.6 m/s in later phases of development. Through the earlier phases the minimum velocities in the upstream portions of the arterial pipes are below the minimum velocity specification and may require periodic monitoring and flushing until the development has progressed. Throughout the development, the most upstream segments of the lateral and collector sewers (which will form part of the Local Infrastructure) indicate velocities below the 0.6 m/s standard, despite being smaller pipe (generally 250 mm or 300 mm) and often designed with slopes ranging from 0.3% to 0.5%, which is above the minimum specification of 0.245% for a 250 mm pipe. These segments may also require periodic flushing to remove sediments, depending on the level of development and resulting peak wastewater inflows that may actually occur in those areas.

FIGURE 10: WASTEWATER SEWER MODEL RESULTS - VELOCITIES



5.1.4.1 Northwest Interceptor Sewer/ North End Sewage Treatment Plant (NEWPCC) Model

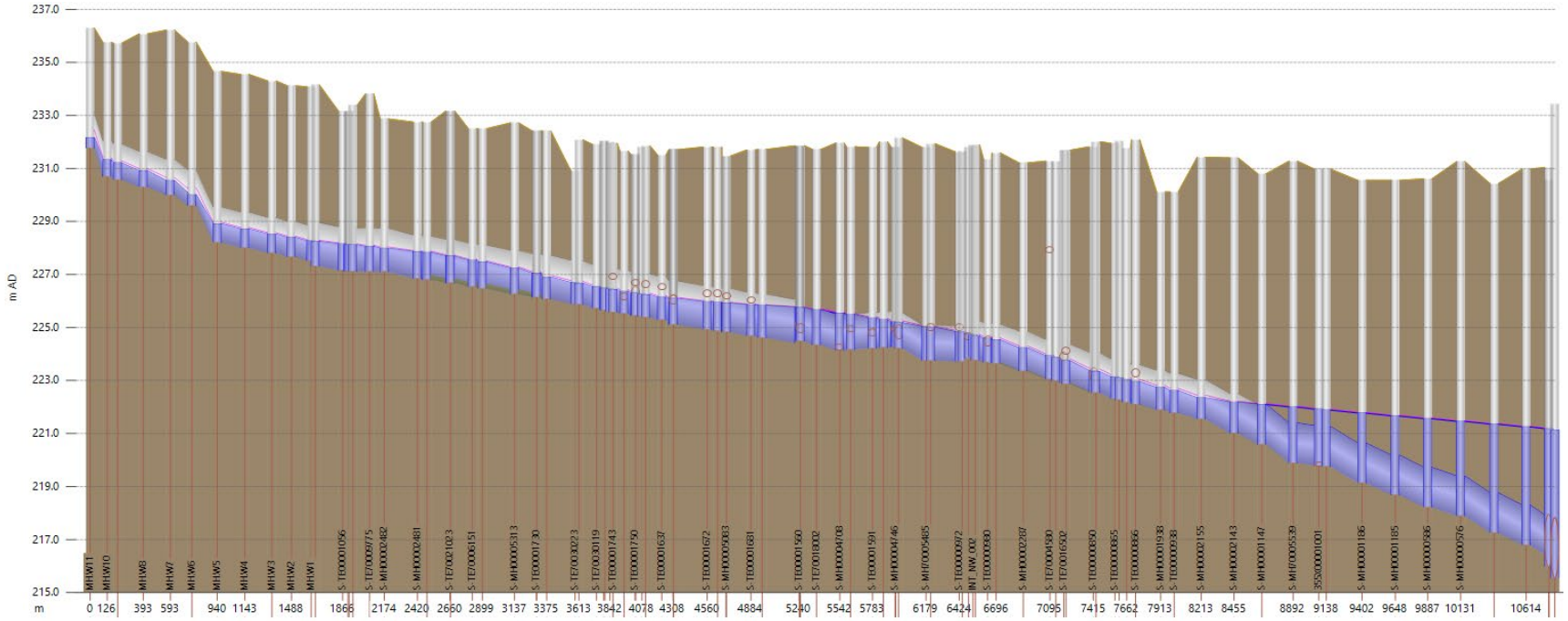
To evaluate the available capacity within the NEWPCC Northwest Interceptor Sewer and examine the impact with respect to the additional flows from the AAW development, a model consisting of the main interceptor pipes draining to the NEWPCC was developed from the City's overall system model. Due to the size of the City's overall model and InfoWorks ICM licensing restrictions, the sewer network was broken into 18 smaller models representing one or more sewer districts that drain into the three main interceptor pipes. Downstream levels were set as boundary conditions representing the water level in the interceptors, and the district networks were then simulated for dry weather flow in addition to a 5-year MacLaren Summer Storm Event. The outflows from each of the district models were then used as inflow conditions to the NEWPCC interceptor model. The resulting water levels along the interceptor trunks were then used to re-simulate the district models and iterate them until there was agreement between the model simulation results. This procedure results in a much smaller and more manageable model of the interceptor trunk sewers that reasonably represents a design flow condition.

It should be noted that, as directed by the City, inflows from any developments located outside of the City limits were not included in this review (see Directive 2 in Section 11.0). Other developments, both current and future, that were not included in the existing model provided by the City were not added for this analysis, also by direction from the City (see Directive 3 in Section 11.0). The only modifications to the Interceptor Sewer model that were included in this analysis, is the most recent extension of the Northwest Interceptor Sewer from King Edward Street at Inkster Boulevard to Inkster Boulevard at Brookside Boulevard. This extension was added to the model from the bid opportunity design drawings; however, no additional inflows were included along this section. Therefore, the representation of the Northwest Interceptor Sewer and its relative capacity may be somewhat liberal and should be refined as part of further phases of study in this area.

To evaluate the available capacity in the Northwest Interceptor Sewer through each of the three main stages of the Airport Area West development, an inflow was specified at Brookside Boulevard corresponding to the peak pumping capacity of the proposed pump station for that stage. A steady inflow of 278 L/s for Stage 1, 551 L/s for Stage 2, and 826 L/s for Stage 3 were added to the interceptor pipe at the furthest upstream point (Brookside Boulevard). The model results show that the Northwest Interceptor Sewer, as it has been modelled for this study, would have capacity to accept flows from Stages 1 and 2 of the AAW development without surcharging. However, at Stage 3 the Interceptor Sewer shows surcharging through a 1300 m section between Jefferson Avenue at Adsum Drive to Leila Avenue (between Simkin Drive and Watson Street), as shown in Figure 11. This section of the interceptor reduces from a 1,650 mm diameter pipe upstream to 1,350 mm and increases again to 1,500 mm downstream of the section. In addition, it appears that the gradient of the pipe through this area is also not consistent. Plates 5.11 to 5.13 appended to the back of the report show the profiles along the northwest interceptor with the peak flow rates from the three pumping stages at AAW.

A model check of a potential upgrade to this section was carried out. An additional pipe was modelled adjacent to this section to increase capacity, using the existing upstream and downstream invert elevations. The model simulations show that a 1,050 mm pipe running parallel with this deficient section will increase capacity such that the existing and newly installed twin pipe do not have any surcharging under the modelled conditions. It should again be noted that the model used for this check is potentially missing additional sources of inflow, and this should be rectified at later stages of design and rechecked prior to the any upgrades being designed. This process and assumptions undertaken as part of this study is effective in representing the impacts of the AAW wastewater flows on the City's existing downstream infrastructure so the associated costs may be captured within the Class 3 cost estimate.

FIGURE 11: NORTHWEST INTERCEPTOR CAPACITY - STAGE 3



5.2 Preliminary Design of Interceptor and Intake Sewers

The preliminary design for the Interceptor and Intake Sewer pipes is based on the final pipe sizes output from our modelling results. Two interceptor pipes, 860 m of 750 mm and 260 m of 900 mm collect the gravity flows from the future developments, and flow into a 70 m long 1,200 mm Intake sewer which terminates at the WWLS. The preliminary designs for the regional gravity interceptor pipes are presented in the drawings that are included in the Drawings section at the end of this report. Sub-sections 5.2.1 and 5.2.2 below elaborate on the horizontal alignment selection, highlight the potential installation method, and briefly discuss potential operational concerns that might arise during the early years of the development.

5.2.1 DESIGN COMPONENTS

The location and alignments for the regional wastewater Interceptor Sewers were developed to minimize the requirements for land acquisition. Where possible, existing ROW were utilized. One potential conflict (noted above) is the future grade separated intersection at CCW and Sturgeon Road. The anticipated location of the interchange as shown on our drawings is based on information obtained from the Province. The wastewater sewer alignment along CCW adjacent to the south service road parallels the conceptual future property line for the interchange. In the short term, some of this land is privately owned and easements or land acquisition will be required to facilitate the future pipe installation.

Further coordination with the Province of Manitoba will be required as part of detailed design to optimize the final alignment to ensure that it is not in conflict with their future planned interchange.

The depth of the sewer in this area, proximity to existing roadways and subsurface conditions (bedrock and till) limit the pipe installation methods as discussed above in Section 3.4.1. Tunnelling and HDD methods are recommended to accommodate the installation challenges of these pipes. Further refinement should be considered as part of detailed design to address the trenchless installation methods for this work. Specifically, considerations for harmonized pipe sizes and a curved alignment that crosses the Sturgeon Access road should be entertained to permit all or part of the east and west Interceptor pipes to be installed with the minimum number of shafts and least impact to the active roadways.

5.2.2 OPERATIONAL COMPONENTS

During the early sub-phases of the development, flows within the Interceptor and Intake Sewers may not be sufficient to generate velocities that are self scouring. It is recommended that these components of the system be monitored more frequently in Phase 1A and 1B of development to determine if more frequent flushing is required to minimize sludge buildup within the pipes.

5.3 Preliminary Design of Wastewater Lift Station

This section of the report outlines the preliminary design of the Wastewater Lift Station. The following sub-sections present a description of major preliminary design components (site development, structural, mechanical, and electrical) as well as our design solution to support the operation of the station through the proposed development phases.

5.3.1 DESIGN COMPONENTS

The following sub-sections describe and discuss each of the key WWLS design components.

5.3.1.1 Site Development

The station will require permanent all-weather access off the Sturgeon Access road. The access for this location would likely take the form of a right in/right out as access approach will be located along a divided roadway which may also at some point be along the leg of a grade separated interchange. Enhancements to this configuration, such as providing access through the roadway separation, could be explored as part of the future detailed design and construction phase to make the station more accessible. The specific location and approach design will require coordination with Public Works and Manitoba Infrastructure.

Site grading and stormwater management for the site would be in the form of surface drainage to perimeter swales and controlled discharge via outlets to the existing ditch on Sturgeon Road. The stormwater management plan for the site and culvert sizing for the approach will require Manitoba Infrastructure review and approval at the detailed design stage.

Access to the site and vehicle movement within the site have been designed to accommodate both a large commercial truck and a pumper fire truck with tandem rear axles. The access road is 7.0 m wide with 9.0 m corner radii at Sturgeon Access. The design section will be rural based, raised above prairie, with center crown and 4:1 side slopes. Within the site, laneways are 7.0 m wide with 7.5 m to 10.0 m internal radii. Six parking stalls measuring 2.74 m x 6.1 m are provided, one of which will be designated as accessible. All pavement will be heavy duty asphalt, designed for commercial vehicle loading. The main floor of the WWLS will be slightly raised above the proposed ground level. The paved surface surrounding the building will be sloped at a minimum of 2.0% to direct runoff positively away from the building, across a permeable landscaped strip, and into the perimeter swales. These swales will serve as temporary storage for runoff by restricting the discharge at the outlets to the adjoining watercourse.

5.3.1.2 Sub and Super-Structure

A preliminary structural review was completed of the above-ground, control building, and underground wet and dry wells. The above-ground WWLS control building is conceptualized to be a typical lift station building structure, similar to recently constructed lift station buildings across the City. Building walls are to incorporate typical 200 mm thick concrete blocks, a rigid exterior insulation and brick veneer. The superstructure roof is to be constructed using prefabricated wood trusses and plywood decking with standing seam metal roofing. The conceptual design places more than half of the building over the dry well concrete structure, while the remaining part of the building could be founded on deep grade beams, over strip footings, or piles down to bearing stratum. It should be emphasized that the building foundation design will largely depend on the design of the underground concrete walls and the excavation support system chosen, and thus will be driven by geotechnical recommendations so as to limit the differential settlements of the building.

As such, a detailed geotechnical investigation is recommended to both investigate subsurface conditions and further evaluate the aspects of constructability. Considering this, the structural design of the control building with foundations is expected to be in line with standard practises.

Excavation

The excavation support system to facilitate the construction will need to overcome several project specific challenges. The excavation will be passing through several subsurface layers includes till containing cobbles and boulders, and bedrock and will likely need to contend with water bearing layers.

Given the depth and subsurface condition of the proposed WWLS, it is unlikely that the conventional use of steel sheet piles will be able to be driven through the cobbles and boulders noted. As such, an alternative for consideration is the use of secant pile walls, drilled shafts with temporary casing. Drilled shafts could be 900 mm or 1200 mm in diameter with the secant piles overlapped and socketed into the bedrock to enable the proposed deep shaft excavation.

Straight secant pile walls of 18 m to 20 m in length and 18 m in height would require lateral supports at three distinct elevations. Installation of ground anchors and tiebacks are expected to be a significant challenge in these soils to provide sufficient lateral support for a secant pile wall. Construction of the reinforcing ring beams within the excavated shaft would also contribute to the enlargement of the shaft dimensions beyond expectations.



DEEP EXCAVATION TECHNIQUE, SECANT PILES. PRIMARY PIPES INSTALLED FIRST (GRAY) AND THEN SECONDARY PILES ARE CONSTRUCTED IN BETWEEN PRIMARY PILES WHEN SUFFICIENT CONCRETE STRENGTH HAS BEEN GAINED.

Furthermore, bedrock at the bottom of the excavated shaft may be weak, fractured, or contain clay layers, and thus socketed secant piles may not sufficiently cut off the inflow of the groundwater into the excavated shaft. This could pose a major risk or challenge to construction, complicating, accessibility, and impacting construction schedules. Note that, secant pile walls if successfully installed with required lateral supports, would be a sacrificial structure to enable construction and will increase the overall construction cost of the WWLS.

Alternatively, installing secant piles in a circular configuration to form a compression ring may be a more efficient approach for a structure of this size and depth. Furthermore, the secant pile circular configuration could be incorporated as a supporting element into the permanent well structure wall. Following additional geotechnical investigations, this option should be considered in the well shaft structure design stage. It is expected that shafts of up to 14 m in diameter could be excavated with secant pile walls without any additional reinforcing rings.

Considering these initial structural constructability observations, the selected WWLS site requires a thorough geotechnical investigation which would provide soil design loads for the well shaft design, as well as recommend a foundation design based on the bedrock quality, properties, and the design of an excavations support system

Configuration

The underground concrete well structures as proposed, have an approximate overall combined dimension of 10.5 m by 14.7 m in plan view and extend down to 17.7 m below grade. Wet and dry wells will be separated by a shared internal concrete wall. The proposed well configuration with straight, relatively thin walls, and

large free wall spans in horizontal (up to 14.7 m), and vertical (up to 17.7 m) orientations are a favourable configuration from a mechanical, process, and operational perspective. This configuration is a product of design considerations such as: the incoming estimated design flows; conceptual infrastructure pipe network; and operational requirements. However, it will require scrutiny and careful consideration of the significant lateral loads placed on the walls.

Structurally, the exterior well walls will be exposed to very high external design pressure, and the walls as proposed will require significant shear and bending capacities to resist the resulting pressure loads. Furthermore, consideration for much thicker wall's without additional reinforcing elements will still require a diligent structural design to support the large spans proposed.

This situation is exacerbated when considering that the well shaft will extend through different soil layers, including a water-bearing layer. The specified lateral pressure at the bottom of the shaft could be as high as 240 kPa. Structurally, vertical, and horizontal wall reinforcing elements for consideration can include webs or diaphragms to create wall panels with shorter free spans. Note that the use of webs or diaphragms constructed within the well may interfere and affect operational requirements, and if constructed exterior to the well, will increase the excavation footprint.

5.3.1.3 Mechanical Design

Mechanical components for the station include pumps and process piping, wet well level instrumentation, the internal HVAC system, internal plumbing, equipment hoists and bypass provisions for the WWLS. Each of these components is discussed in more detail below.

General WWLS Configuration

The lift station will receive influent from the sanitary network via an isolation manhole located upstream of the WWLS. The wet well is divided into two sumps allowing for isolation of either half of the sump for maintenance. There are two pumps taking suction out of each wet well sump, or four pumps in total. The pumps discharge into a common header and isolation valve before exiting the lift station. A valve chamber located outside of the station allows for bypassing the lift station if required as well as connecting and/or isolating either FCM.

Pump Selection and Hydraulics

The WWLS will utilize vertical mount centrifugal pumps installed in the station dry well, with driveshaft coupling to electric motors installed on the next floor up, above station flood level. The pumps will be non-clog design, with impeller designed for sewage pumping and handhole ports on the suction elbow and pump casing for inspection and cleanout. Pumps will be designed to run in reverse mode for anti-clogging operation. It is highly recommended that drywell submersible pumps and the potential constructions cost savings be investigated further during the detailed design phase.

The WWLS will ultimately be equipped with four identical pumps. The pumps have been selected to operate within the Preferred Operating Range (POR) in accordance with the Hydraulic Institute Standard ANSI/HI 9.6.3-2017. The POR is between 70% and 120% of flow at Best Efficiency Point (BEP); between 190 L/s and 330 L/s at full speed.

Pump curves and datasheets are included in Appendix D. The pump curves also show the system curves established from the preliminary hydraulic analysis. The pump selection for the preliminary design is as follows:

Type		Line-shaft driven dry well installation
Motor[1]		120 kW, 6-pole, 60 Hz, 600 V
Pump Speed[2]	Maximum	1189 RPM
	Minimum	793 RPM
Design Duty Point	Initial	136 L/s @ 12.9 m TDH
	Ultimate	272 L/s @ 24.7 m TDH
Maximum Power on Curve		84.88 kW
$NPSH^3_{required}$		4 m at flow of 330 L/s @ 1189 RPM
Model		KSB Sewatec 300-505 G V with 414 mm diameter impeller

Notes:

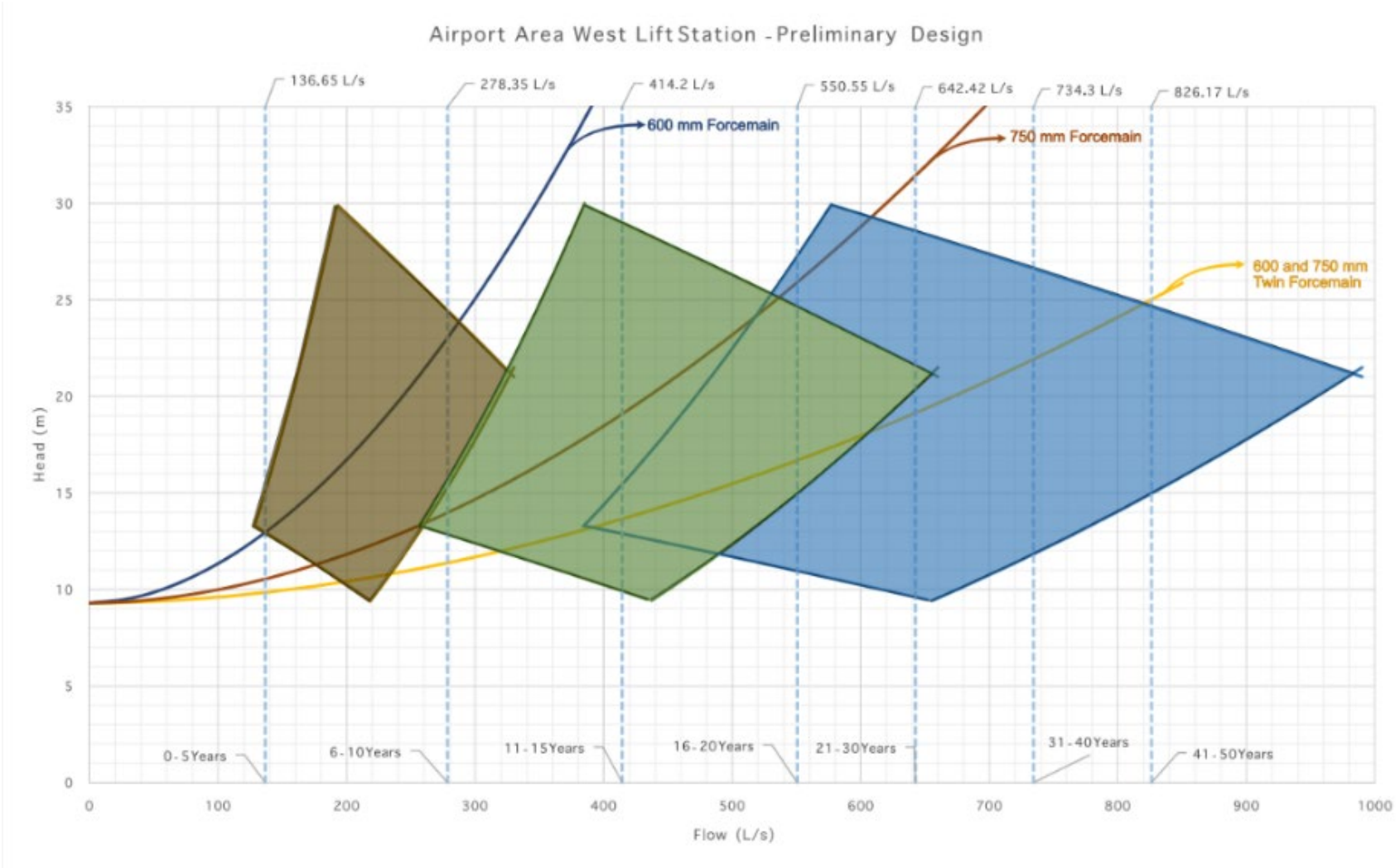
1. *The pump selection requires 110 kW motor, provision has been made to allow for 120 kW motor corresponding to a drywell submersible pump.*
2. *Pump speed to meet the minimum and maximum design flow, respectively.*
3. *The value corresponds to maximum NPSH within the POR*

An NPSH margin ratio of greater than 1.2 is maintained as recommended by Hydraulic Institute Standard ANSI/HI 9.6.1-2017. and a motor reserve margin of 34% is achieved.

The pump operation will be based on the sewage level within the wet well. The pump start levels will be adjusted between buildout phases to minimize the retention time within the wet well. Lower wet well levels will be used during pump operation Stage 1.

The following Figure 12 illustrates the pump curves with POR and system curves. The various design stages and flows can also be seen on the figure.

FIGURE 12: PUMP CURVE WITH POR AND SYSTEM CURVE



Wet well and Upstream Manhole

The preliminary design of the Wastewater Lift Station includes an inlet manhole containing a gate to isolate incoming flows. The manhole also permits mobile pumps to be lowered in for temporarily bypassing the WWLS. If ragging and clogging of the pumps is found to be a prevailing problem, a grinder can be installed in the manhole. The invert of the manhole is below the invert of the incoming sewer and the connection between the manhole and wet well will be under full flow. An air duct will be located between the manhole and wet well to convey odorous gasses between the sanitary network and wet well.

The wet well has been sized to have an active volume of approximately 60 m^3, including a factor of safety of 50%. This calculates to a maximum active sump depth of 1.4 m. The active volume allows each duty pump to start six (6) times per hour on average. The wet well sump is divided into two equal cells, and the volume is shared between both wet well cells. Each cell can be individually isolated by means of isolation sluice gates.

The wet well is sloped towards the pump suction to promote self-cleaning of the sump. To protect the concrete from corrosion and aid in cleaning the structures, the wet well and upstream manhole will be coated with a special coating. The cleaning of the wet well will be assisted by the wet well washer that periodically washes down the wet well walls.

Due to the depth of the wet well below grade, a vacuum truck connection for emptying the sump is not feasible. Provision has been made for lowering a free-standing submersible pump into the wet well. It should be noted that due to the infrequent operation of a drainage pump and a high propensity for stringy material to clog to prevent seating of a submersible pump lowered by guide rail, that a permanent installation has not been pursued at this stage.

Process Piping

Pump suction piping into the wet well trench will have downturn elbows with flared inlet bells to provide recommended inlet velocities in accordance with Hydraulic Institute Standard ANSI/HI 9.8-1998. While the inlet to the pump has been designed in accordance with Hydraulic Institute Standard ANSI/HI 9.6.6-2016.

Piping within the station will be flanged 304 stainless steel, suitable for the WWLS environment. Wet well vent piping will be stainless steel.

Each pump suction is 500 mm diameter with a bell mouth diameter of 700 mm. A 500 mm diameter isolation knife gate valve is provided on each suction pipe to isolate the pump. The suction pipework will be equipped with and isolation valve, allowing the pipework to be drained to the dry well sump.

The discharge pipe is 300 mm diameter. Each pump discharge is fitted with a 300 mm diameter magnetic flowmeter, a 300 mm diameter swing check non-return valve and finally a 300 mm diameter isolation valve. The magnetic flowmeter and non-return valve upstream and downstream lengths are in accordance with the manufacturer recommendations. The discharge pipework will be equipped with an isolation valve allowing the pipework to be drained to the dry well sump.

The discharge header of 600 mm is routed to the mezzanine level. The discharge header will be equipped with an isolation valve allowing the pipework to be drained to the wet well sump.

Drywell

The dry well design allows for multiple levels for access to all major equipment. The dry well will have two sump drainage pumps, each pump's ON levels will be adjusted to allow for a staged draining of the dry well if it occurs.

Instrumentation

WET WELL – Level control within the wet well will be provided by pressure sensors (one in each sump) located within the dry well section of the building. High Level Alarm switches will be located within the dry well. The level switches will provide another level of redundancy to the pressure sensors. No maintenance requiring equipment or electronics will be located within the wet well.

A hydrogen sulfide (H_2S) sensor, as well as methane sensor, will sample the wet well atmosphere. The H_2S sensor will provide input to the odour control system to reduce the H_2S levels in the wet well. The H_2S sensor sampling point will be located approximately 500 mm above maximum water level while the methane sensor sampling point will be located approximately 500 mm below the wet well top slab.

PROCESS – Each pump set will have a suction and discharge pressure gauge. A magnetic flow meter will be provided for each pump. These will be used to monitor and troubleshoot the system if required.

WWLS Bypass Provision

A valve chamber will be located outside of the lift station. The chamber will have a cross-over valve as well as provision for bypass pumping and FCM isolation valves. The valves and pipework up to this point will remain 600 mm diameter. A total of four 300 mm bypass connections with isolation valves and blank flanges will be provided. The FCMs will increase in diameter, namely 600 mm and 750 mm, at the valve chamber location.

WWLS Equipment Hoists

All levels of the WWLS will be equipped with manual hoists designed to lift and manoeuvre equipment and large components for maintenance. Transfer of equipment and materials between the main floor and lower levels will be done by hoist through a hatch opening (with suitable guardrails) in each floor.

5.3.1.4 Odour Control

As the WWLS will be in a jointly commercial and industrial area, effective odour control is essential. During Phase 1 of the development, the station is expected to receive low flows in comparison to the full buildout station capacity and therefore minimal pump cycle times are expected. This will lead to very long detention times within the sanitary sewage network, wet well and FCM. The long detention times can lead to odorous compound formation; and as water cascades into the pump station or the interceptor tie-in on Inkster Boulevard at Brookside Boulevard, volatile aromatic compounds will be released from suspension resulting in unwanted gaseous odours. Given the above, effective odour control measures are essential, and it is recommended that consideration should be given to:

i. the location of the WWLS due to odour control concerns, and
ii. the odour control methods and an odour control study are performed.

The odour control for the concept design will comprise of two distinct methods, namely: Odour Removal and Odour Prevention. Both odour removal and suppression will take place at the WWLS. Odour removal will remove odorous gasses from the WWLS wet well which have been released from suspension. This method will

also keep the upstream gravity network under slightly negative pressure to prevent odorous gasses from escaping the piping immediately upstream of the lift station. The odour prevention system may consist of either a chemical or biological process that prevents the formation of odour causing gasses.

Various odour control methods and systems are commercially available for the treatment of gaseous odours and odour causing constituents including dispersion, chemical treatment, biological treatment, chemical filtration:

DISPERSION – this method dilutes the gaseous air stream resulting in lower odour concentrations that are below the general odour detection threshold.

CHEMICAL TREATMENT – this technique includes oxidation, precipitation, pH elevation and prevention. Each of these techniques is a discrete method within chemical treatment and can be further divided into sub-categories.

BIOLOGICAL TREATMENT – uses biological mass to treat odorous air with low concentrations. This method is most suitable at large and central odour treatment facilities.

CHEMICAL FILTRATION – this method includes dry scrubbers, photo-ionization and wet scrubbers. The most popular methods are wet chemical scrubbers and dry activated carbon scrubber.



TYPICAL OZONE/OXYGENATION UNIT (COURTESY OF ANUE WATER TECHNOLOGIES)

Since the specific development and expected industries have not yet been established, the composition of the future odour profile cannot be determined at the preliminary design stage. Since the methods for odour control vary significantly and the design parameters cannot be finalised, the conceptual design is preliminary, and the odour treatment technology should be re-evaluated based on the findings of an odour study.

Odour Removal

As the location of the WWLS is potentially sensitive, a complex odour profile has been assumed. The odour composition can be described as:

- H_2S being the most prevalent with characteristic rotten egg smell and 35 ppm concentration.
- This is followed by ammonia (NH_3) with a strong ammonia-like smell and less than 3ppm.
- The total Odour Units (OU) is estimated at 500 – 2,500 OU.

Given the site location, an assumed target OU equal to or less than 10 greater than 99.9% of the time as well as the odour profile above, an activated carbon scrubber is most suitable for the lift station. The dry scrubber method with simplistic operating method with a low complexity, and removal efficiency of up 99.9% has been preliminarily selected over a wet scrubber system which is more complex to operate and has a removal efficiency of 95% for a single-stage system.

The odour scrubber system will be housed in a separate room with access only from outside the building in anticipation that the room will be classified as a hazardous area, especially when the scrubber system is bypassed. The wet well area will be treated as a Class 1, Zone 1 area with a 100% fresh air continuous ventilation at 6 air changes per hour (ACH) which will be provided by the make-up air unit for odour control. The relief air from the wet well will normally be exhausted outdoor via ducting through an odour scrubber with dry activated carbon media.



TYPICAL ACTIVATED CARBON SCRUBBER (COURTESY OF APPLIED CONTAMINATED CONTROL)

The system will be controlled by the Programmable Logic Controller (PLC) with a manual override switch. The maximum capacity of the makeup air system will be 12 ACH. Under normal operating conditions, the ventilation airflow rate and the odour scrubber shall be turned down to 6 ACH by the variable speed fan. A direct outside discharge bypass will be provided by a separate exhaust fan with Variable-frequency drive (VFD) when the odour scrubber is either off-line; the required ACH exceeds the capacity of the scrubber; or the scrubber is scheduled for maintenance.

An explosion-proof, electric makeup air unit (rated for the hazardous classification of the space - such as a Dexon type blower) will be located inside the pump room. An outdoor air duct will be provided with the unit, which will supply air from the unit into the wet well and provide ventilation to the wet well. The supply air heated by the electrical heater in the make air unit and will be sized to be sufficient to maintain the wet well at a design temperature of 7°C discharging at 150 mm above the high-water level inside the wet well. There will be no terminal heating devices provided in the wet well as the heating is supplied by makeup air unit.

The outdoor air intake louver for the makeup air unit is completed with an insulated motorized damper. A bubble-tight motorized damper will be installed on the supply air duct at the point where the duct passes through the exterior walls to prevent the air backing up from the wet well into the pump room when the system is not operating. The bubble-tight motorized dampers will also be installed on the inlet air duct of the odour scrubber and the bypass air duct of the exhaust fan to prevent any backflow from the wet well into the odour control room when the system is not operating.

If elevated gas levels are detected in the wet well or in preparation for entry into the wet well, the ventilation system can be switched to 12 ACH by PLC or an outdoor manual switch until the gases levels are acceptable. A further provision, a flange connection will be provided to allow a portable blower unit to be connected for increased ventilation prior to entry to the space. When the required ACH exceeds 6 ACH, the odourous air will bypass the scrubber and will be vented to atmosphere via an odour dispersion fan/blower.

The above design considerations results in one 304 stainless steel vessels. The vessel contains approximately 1,760 kg of catalytic carbon and 585 kg of phosphorous impregnated carbon for the adsorption of hydrogen sulfide and ammonia respectively. The media has an estimated hydrogen sulfide adsorption capacity of 335 kg and 52 kg of ammonia. The vessel is approximately 2,000 mm in diameter and 2,000 mm high. The media in the vessel is protected by inline filter from solids particles, which is a major source of media plugging. The air is supplied by a 20 HP fan-driven via variable speed drive.

Odour Suppression

Two odour suppression methods are considered: oxygenation and pH elevation. These methods inhibit the formation of odour causing constituents and also prevent corrosion at the same time. It should be noted that regardless of the chemical or method used for pH elevation; chemical odour suppression has varying success in similar applications; while oxygenation does not indefinitely inhibit the formation of odour causing constituents it merely delays the formation:

- The most common chemical used for pH elevation is Sodium Hydroxide (NaOH). The chemical is used to increase the pH of the sewage to keep the H_2S in suspension and prevent it from being released and then causing corrosion and unwanted odours. Generally, for each gram of H_2S, 2 to 4 grams of NaOH is required. Although this method of odour prevention is effective, it relies on increasing the pH of the wastewater to approximately 12 or greater. Since the nature of the industrial activities is unknown, the influent pH could be extremely low resulting in excessive chemical usage or intermittent odour issues.
- `The method of oxygenation injects compressed air or ozonated air into the FCM thus increasing the amount of dissolved oxygen in the FCM. As the FCM pressure is considerably higher than atmospheric pressure, the dissolved oxygen capacity of the sewage is considerably higher than in the wet well. The increased dissolved oxygen levels in the system prevent the sewage from going septic and thus prevents the formation and release of the primary odour causing constituent, namely H_2S.



WET WELL WASHER (COURTESY OF BIOMAXX ENVIRONMENTAL)

Since no further data on the characteristics of the influent is available, provision for the system is made in terms of space and a capital allowance.

In addition to the methods proposed, the WWLS includes a wet well washer system. The wet well washer system continuously washes down the wet well walls, reducing the build-up of Fats, Oils and Grease (FOG) while the spray from the system oxygenates the water also preventing the formation of odour causing H_2S.

5.3.1.5 Plumbing, Heating and Ventilation

The proposed building mechanical systems have been selected with consideration being given to initial capital costs, operating costs, energy efficiency, reliability, maintenance, and good engineering practice.

Building mechanical systems design and installation will conform to the following codes and standards (most recent version):

- NBC: National Building Code,
- ANSI: American National Standard Institute,

- ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers,
- ASTM: American Society for Testing and Materials,
- CSA: Canadian Standards Association,
- MSS: Manufacturers Standardization Society of the Valve and Fittings Industry,
- NECB: National Energy Code of Canada for Buildings,
- NFC: National Fire Code,
- NFPA: National Fire Protection Association,
- NPC: National Plumbing Code,
- SMACNA: Sheet Metal and Air Conditioning Contractors National Association Inc., and
- ULC: Underwriter's Laboratories of Canada.

The building's mechanical system selected for the lift station will not need manned supervision.

Outdoor design conditions are based on the National Building Code Climatic Conditions (1% Design Conditions in the winter and 2.5% in the summer) for Winnipeg.

Outdoor Air Design:

Summer:	30°C (dry bulb) and 23°C (wet bulb)
Winter:	-35°C

Indoor Room Design Temperature:

Wet well:	Min. 7°C
Drywell:	Min. 7°C
Odour Control Room:	Min. 7°C (Unoccupied); 21°C (Occupied)
Control Room/MCC/VFD Room:	Min. 18°C and max. 25°C
Generator Room:	Min. 7°C (Unoccupied); 21°C (Occupied)
	Max. 35°C (without the generator in operation)

Heating and Ventilation Systems

Heating and ventilation will be provided by various terminal heat transfer units, fans, and make-up air units as described below. All mechanical systems will be controlled by the SCADA System for the sanitary lift station. Refer to mechanical drawing for the proposed ventilation and heating layout.

WET WELL – The wet well area will be ventilated with two makeup air units, MUA-1 and MUA-2, for 6 ACH and 12 ACH (Air Changers per Hour). During normal operation, one makeup air will be in operation to provide continuous 6 ACH. The second unit will be enabled by SCADA system should there be detection of elevated gas level in the wet well.

The relief air from the wet well will normally be exhausted via below-grade ductwork through the dry well to the odour scrubber and then to outdoor. The odour scrubber is to process the relief air at 6 ACH.

A direct outside discharge bypass will be provided by a separate exhaust fan (EF-1) with VFD when the odour scrubber is off or when the ventilation rate is at 12 ACH.

The makeup air units are explosion-proof, electric units rated for the hazardous classification of the space (such as a Dexon type blower). They will be located outside of the pump station. The supply air heated by the electric heater in the makeup air units will be sufficient to maintain the wet well at a design temperature of 7°C discharging at 150 mm above the high-water level inside the wet well.

Bubble tight motorized dampers will also be installed on the inlet air duct of odour scrubber and the bypass air duct of exhaust fan to prevent any back flow from the wet well into the odour control room when the system is being switched between the odour scrubber and bypass exhaust fan.

The system will be controlled by the station's SCADA system with manual switch override. There will be no terminal heating devices provided in the wet well as the heating is supplied by the makeup air units.

A sensing system to verify the operation of the makeup air system will be provided. Trouble alarm will be sent to the pump station's overall alarm system as part of the SCADA system. See electrical design for the trouble alarm system and remote-control panel for this system.

DRYWELL – Two indirect natural gas fired 100% outdoor air make-up air unit (MUA-5 and MUA-6) will serve the drywell. The make-up air units will be located inside the station at grade level. Outdoor air will be ducted to the unit, and the supply air will be distributed from the units into the drywell.

The makeup air units (MUA-5 and MUA-6) are 100% duty and 100% backup. They will provide continuous ventilation air into the drywell at a rate of minimum of 6 ACH. The indirect gas-fired heat exchanger in makeup air units shall be modulated to maintain the temperature of the drywell at the minimum of 7°C. The air will be discharged at 500 mm above bottom of the drywell.

The air inside the drywell will be exhausted directly by the exhaust fans (EF-2 and EF-3) to the outdoor via a duct extending through the roof. The air flow of the exhaust fan will be adjusted by VFD to maintain the drywell under negative pressure of 10Pa.

ODOUR CONTROL ROOM – 100% outdoor air makeup air units (MUA-3 and MUA-4) will provide continuous ventilation air into the odour control room at 6 ACH. The air flow rate can be raised up to 12 ACH by the SCADA system or an outdoor manual switch upon detection of elevated gas level or prior to entry to the space. The air will be exhausted directly to the outdoor via a VFD exhaust fan (EF 4 and EF-5) ducted through the roof. The temperature of discharged supply air from MUA-3 and MUA-4 will be at minimum of 7°C.

Explosion proof electric makeup air units (such as a Dexon type blower, rated for the hazardous classification of the space) will be located inside the odour control room to provide ventilation.

An electric explosion proof unit heater (UH-5) controlled by the SCADA system will maintain a minimum room temperature of 7°C under the unoccupied condition. The unoccupied room temperature set point can be raised to 21°C by the SCADA system.

A sensing system to verify the operation of the makeup air system will be provided. Trouble alarm will be sent to the lift station's overall alarm system as part of the SCADA system. See electrical design for the trouble alarm system and remote-control panel for this system.

PUMP OUT ROOM – A supply fan in a distribution system complete with recirculation and relief will provide ventilation to the space. When the pump out room is not used, ventilation will be provided to maintain minimal air circulation (up to 3 ACH). When the pump out room is used, the ventilation system will provide up to 12 ACH.

An explosion proof unit heater will be provided to maintain the design space temperature of 7°C (unoccupied) and 21°C (occupied).

The unit heater and ventilation system will be controlled by the SCADA system such that heating and cooling systems will not be on at the same time.

CONTROL ROOM/VFD/ MOTOR CONTROL CENTRE (MCC) ROOM – The ventilation for Control Room/VFD/MCC Room will be supplied by two air handing units (AHU-1 and AHU-2). The system will provide cooling to dissipate the heat generated by the VFDs and electrical equipment. The air handling units will be equipped with DX (direct expansion) coils to provide cooling air during summer. When the ambient temperature is below 13°C, the air handling units can use outdoor to provide cooling to the space. This strategy will provide energy savings as the amount of mechanical cooling required during the year is reduced.

Two electric unit heaters are provided for heating to the space. The space will be maintained between 18°C and 25°C with the option for space temperature set point adjustment through the SCADA system.

The heating, cooling, and ventilation systems will be controlled by the SCADA system such that heating and cooling systems will work together, and both will not be in operation at the same time

GENERATOR ROOM – A supply fan in a distribution system complete with recirculation and relief will provide ventilation to the space. The supply fan and air dampers (intake, recirculation, and relief) will modulate via SCADA control to maintain the space temperature at maximum 30°C without the generator in operation. When the supply fan is started, the outdoor air damper and recirculating/return air dampers shall be opened and modulated to bring the outdoor/mixed air into the space and cool down the room temperature to the set-point. The exhaust air will be exhausted to outdoor through a wall mounted louver with insulated motorized relief dampers.

The exhaust (vent) pipe from the generator engine will be piped through the roof or wall to the exterior of the building. A critical-grade muffler (for superior high sound-attenuation) will be used. The exhaust pipe and muffler will be insulated to provide safety from hot surfaces and to reduce heat transmitted to the space inside the building.

Airflow required to discharge heat from the engine's radiator will be exhausted from the building via discharge plenum and wall louvre. The SCADA controls will modulate the recirculating damper and exhaust damper on the discharge plenum connected to the radiator to maintain the temperature of the room within the generator manufacturer's temperature range.

Air for fuel-combustion by the engine and for engine cooling will be drawn into the building as natural draft through two separate louvers on the wall of the generator room. The combustion air intake louver will be completed with an insulated two position motorized damper. The outdoor air intake louver will be completed with insulated modulated motorized dampers. All dampers will be closed and seal the room when the engine is not operating.

An electrical unit heater will heat the generator room at its set-point of 7°C. It is controlled by the SCADA system with the temperature sensor located in the generator/electrical room. The space temperature can be raised up to 21°C by the SCADA system prior to the space being occupied. The unit heater will not be allowed to operate concurrently with the generator engine.

Plumbing System

The proposed plumbing system for the pump station will be as follows:

SITE SERVICES – The building's domestic water service will connect to the utility's main domestic water system. A reduced pressure backflow preventer will be installed inside the building, directly downstream of the water meter, to serve the lift station.

Roof drainage will be splashed to grade and directed away from the building. The splash points will be located away from people and vehicle traffic areas to minimize dangerous icy patches from occurring in the winter.

BUILDING SERVICES – A completely new system of sanitary, drains, vents, and supply piping will be provided in accordance with the applicable plumbing codes and good engineering practice to suit the layout.

Two hose bibs will be provided inside the drywell. A non-freeze hose bib will be provided on the building's exterior wall above the wet well.

Two floor drains will be provided inside the drywell at the lower level and two floor drains will be provided on the at grade level. The sanitary drain (floor drains) will discharged into the wet well. The plumbing vent stack will extend through and beyond the roof. Drain traps will be primed from the water supply system using solenoid valves and electronic timers.

Fire Protection

Portable fire extinguishers will be installed in accordance with the requirements of the National Building Code, the Fire Code of Canada, and the National Fire Protection Agency NFPA 10 1998 "Standard for Portable Fire Extinguishers." Portable fire extinguishers will be mounted on brackets affixed to the walls in all areas.

Natural Gas

The gas supply line will be extended into the building for the natural gas generator and make-up air unit. In addition to the shut-off valve required at the meter, a shut-off valve will be provided inside the generator room. A gas meter with regulator will be located outside of the building. A concrete pad is required for the installation of the gas meter. Bollards will also be provided to protect the gas meter from physical damage. We recommend consultation with CentraGas during the detailed design stage with regards to the length of gas main extension and/or service connection that is feasible in advance of development in the vicinity of the WWLS.

5.3.1.6 Electrical Design

Preliminary designs for all electrical components of the proposed Wastewater Lift Station have been developed in accordance with the Electrical Design Guide (Document Code 510276-0000-47ER-0001 Revision 05) published by the City of Winnipeg Water and Waste Department. Individual components of the larger electrical system are discussed in more detail below.

Electrical Service

The proposed location for the WWLS currently does not have a Manitoba Hydro power line available. According to Manitoba Hydro, the service will be run underground from the south along Sturgeon Road for approximately 1.25 km. Manitoba Hydro will install a pad mounted transformer outside near the station building which will feed a Customer Service Termination Enclosure (CSTE). The CSTE will supply the WWLS switchboard in the control room through a service entrance rated breaker and meter socket.

The electrical service will enter the switchboard main breaker through an underground conduit. The electrical distribution system within the WWLS will also require a 600/120-208 V 45 kVA step-down dry type transformer to provide power for lighting, receptacles, and miscellaneous loads.

Table 6 below is a load calculation which provides an estimated kW demand load for each pump operation stage.

TABLE 6: LOAD CALCULATION

Load Description	Duty/ Standby	Installed Power (kW)	Voltage	Phase	Demand	Adjusted (kW)	Starter Type	Emergency
Stage 1 (0-10 Years)								
Distribution Pump #1	Duty	110	600	3	0.74	81.4	VFD	yes
Distribution Pump #2	Standby	110	600	3	0	0	VFD	yes
Sump pump #1	Duty	3.7	600	3	0.8	2.96	FVNR	yes
Sump pump #2	Duty	3.7	600	3	0.8	2.96	FVNR	yes
Building Mech'l Load[1]	Duty	495	600	3	0.69	341.80		yes
Basic Lighting and Power load		30	600	3	0.7	21		yes
					Demand Load (kW)	**450.12**		
					Demand Load (Amps) @.95pf	**455.94**		
					Recommended Size of Electrical Service (Amps)	**600**		
Stage 2 (11-20 Years)								
Distribution Pump #1	Duty	110	600	3	0.74	81.4	VFD	Yes
Distribution Pump #2	Duty	110	600	3	0.74	81.4	VFD	Yes
Distribution Pump #3	Standby	110	600	3	0	0	VFD	Yes
Distribution Pump #4	Standby	110	600	3	0	0	VFD	Yes
Sump pump #1	Duty	3.7	600	3	0.8	2.96	FVNR	Yes
Sump pump #2	Duty	3.7	600	3	0.8	2.96	FVNR	yes
Building Mech'l Load[1]	Duty	495	600	3	0.69	341.80		Yes
Basic Lighting and Power load		30	600	3	0.7	21		yes
					Demand Load (kW)	**531.52**		
					Demand Load (AMPS) @.95pf	**538.39**		
					Recommended Size of Electrical Service (Amps)	**800**		
Stage 3 (21-50 Years)								
Distribution Pump #1	Duty	110	600	3	0.74	81.4	VFD	Yes
Distribution Pump #2	Duty	110	600	3	0.74	81.4	VFD	Yes
Distribution Pump #3	Duty	110	600	3	0.74	81.4	VFD	Yes
Distribution Pump #4	Standby	110	600	3	0	0	VFD	Yes
Sump pump #1	Duty	3.7	600	3	0.8	2.96	FVNR	Yes
Sump pump #2	Duty	3.7	600	3	0.8	2.96	FVNR	yes
Building Mech'l Load[1]	Duty	495	600	3	0.69	341.80		Yes
Basic Lighting and Power load		30	600	3	0.7	21		yes
					Demand Load (kW)	**612.92**		
					Demand Load (AMPS) @.95pf	**620.84**		
					Recommended Size of Electrical Service (Amps)	**800**		

Note:

1. *Refer to Table 7 for List of Mechanical Loads*

TABLE 7: MECHANICAL BUILDING LOAD LIST

Load Description	Duty/ Standby	kW	Voltage	Phase	Demand	Adjusted (kW)	Starter Type	Emergency
WW Odour Control Fan	Duty	15.00	600	3	0.80	12.00	VFD	yes
WW MUA-1 fan	Duty	7.50	600	3	0.85	6.38	FVNR	yes
WW MUA-1 Heating	Duty	91.00	600	3	0.70	63.70		yes
WW MUA-2 fan	Duty	7.50	600	3	0.85	6.38	FVNR	no
WW MUA-2 Heating	Duty	91.00	600	3	0.70	63.70		no
WW EF-1	Duty	11.20	600	3	0.85	9.52	FVNR	yes
DW MUA-5 fan	Duty	5.60	600	3	0.82	4.59	FVNR	yes
DW MUA-5 Heating (Gas)	Duty					0.00		
DW MUA-6 fan[1]	Standby	0.00	600	3			FVNR	no
DW MUA-6 Heating (Gas) [1]	Standby							
DW EF-2	Duty	3.70	600	3	0.85	3.15	FVNR	yes
DW EF-3[1]	Standby		600	3			FVNR	no
DW UH-1	Duty	22.70	600	3	0.70	15.89		yes
DW UH-2	Duty	22.70	600	3	0.70	15.89		yes
DW UH-3	Duty	22.70	600	3	0.70	15.89		no
DW UH-4	Duty	22.70	600	3	0.70	15.89		no
Odour Scrubber Room								
MUA-3 fan	Duty	3.70	600	3	0.85	3.15	FVNR	yes
MUA-3 Heating	Duty	8.40	600	3	0.70	5.88		yes
MUA-4 fan[1]	Standby	3.70	600	3			FVNR	no
MUA-4 Heating[1]	Standby	8.40	600	3				no
EF-3	Duty	3.70	600	3	0.85	3.15	FVNR	yes
EF-4	Standby	0.00	600	3			FVNR	no
UH-5	Duty	22.70	600	3	0.70	15.89		yes
MCC/Control Room								
AHU-1 fan[3]	Duty	5.20	600	3	0.85	4.42	FVNR	yes
AHU-1 cooling[2,4]	Duty	12.40	600	3	0.00	0.00		yes
AHU-2 fan[3]	Duty	5.20	600	3	0.85	4.42	FVNR	yes
AHU-2 cooling[2,4]	Duty	12.40	600	3	0.00	0.00		yes
UH-6	Duty	22.70	600	3	0.70	15.89		yes
UH-7	Duty	22.70	600	3	0.70	15.89		no
Generator Room UH -8	Duty	22.70	600	3	0.70	15.89		yes
Generator Room Supply Fan for Mixing Box	Duty	3.70	600	3	0.85	3.15	FVNR	yes
Auxiliary Pump Room UH-9	Duty	22.70	600	3	0.80	18.16		yes
Auxiliary Pump Room Supply Fan for Mixing Box	Duty	3.70	600	3	0.80	2.96	FVNR	yes
					Demand Load (kW)	**341.80**		

Notes:

1. *Demand for standby equipment is not indicated as it is the to the duty equipment.*
2. *Control system to be interlocked to only allow for cooling when heating is not active.*
3. *Fan runs continuously even if cooling is off.*
4. *Demand for cooling equipment for summer is not indicated as winter season load is greater than the summer load.*

Area Classification

All areas within the lift station main floor control room and generator room would be considered Non-hazardous Areas as per Manitoba Electrical Code (MEC section 18) as these rooms will be heated, ventilated, and suitably sealed from other areas. The intermediate levels as well as the lower level would be considered Non-hazardous and Category 1 Area due to the moisture that will likely be present in those areas.

System Configuration

The WWLS electrical system will consist of a separate 600 V distribution switchboard and a Motor Control Center (MCC) for non-essential and essential loads, respectively. The system configuration that will be employed for pump operation Stage 1 is shown in Figure 13 whereas the system configuration employed for Stage 2 and 3 is shown in Figure 14.

FIGURE 13: SINGLE LINE DIAGRAM FOR STAGE 1

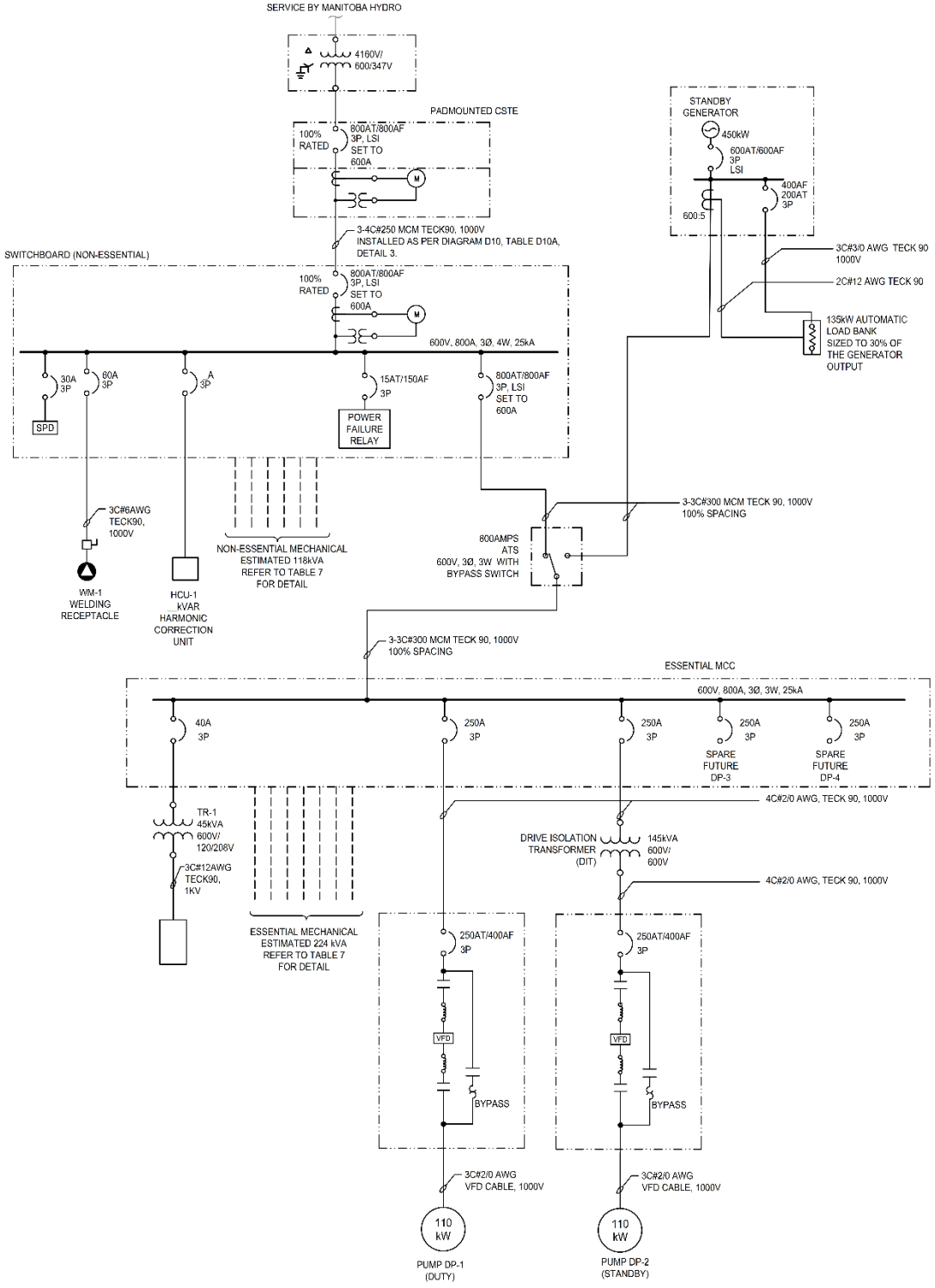
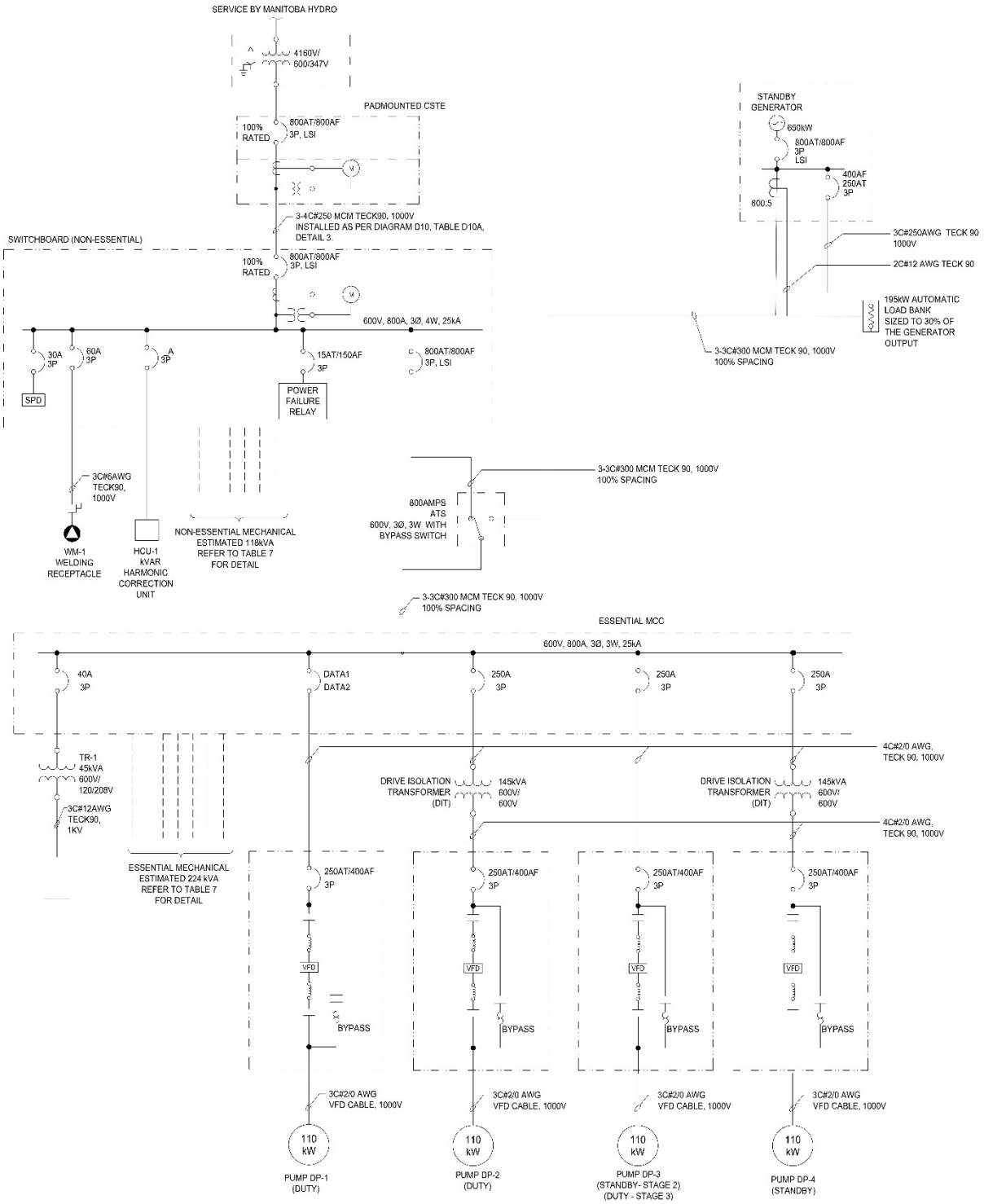


FIGURE 14: SINGLE LINE DIAGRAM FOR STAGE 2 AND 3



The switchboard will house the main circuit breaker, branch circuit breakers, digital power meter and a surge protection device. The switchboard will be powered from the pad mounted transformer through a CSTE as described in the Electrical Service component.

The Essential MCC will house the Variable Speed Drives (VFD) and circuit breakers for essential and standby loads. The Essential MCC will be powered from the non-Essential Switchboard and will switch between normal power to generator power through an Automatic Transfer Switch (ATS) during a power failure. The ATS will be provided with an integral bypass switch.

Pump Motor Starter

The pumps will be provided with a variable speed drives installed within the essential MCC. According to the City of Winnipeg Electrical Design Guide, a full voltage non-reversing (FVNR) starter is required for this application to by-pass the VFD. This should be provided with isolation contactors to allow the motor start in the event of a failure of the VFD. Motor starters will be monitored by the PLC control panel.

Each motor starter will include but is not limited to:

- A front door mounted display keypad;
- Manual-Auto (M-A) switch and Start-Stop buttons;
- Green pilot light to indicate run status;
- Blue pilot light to indicate ready status;
- Amber pilot light to indicate VFD failure;
- E-Stop mushroom pushbutton;
- Potentiometer for Manual mode speed control.

Standby Generator

A natural gas engine standby generator will be provided in the generator room. The generator will be installed on a concrete pad complete with all associated muffler system and accessories. The generator will provide adequate capacity to operate the essential loads including pumps, lighting, mechanical loads, and the plant control system. The generator is complete with an automatic transfer switch (ATS) and an automatic 30% load bank. In the event of a utility failure, the ATS transfers plant power to the Generator. When utility supply is re-established, the ATS transfers plant power back to the utility supply. The load bank is required to provide a fully controlled load to ensure the generator load is maintained above 30% of its rated capacity when operating during a utility power outage.

The generator and load bank will be located outdoors on a concrete pad complete with a suitable enclosure. A remote annunciator for the generator will be provided within the electrical room, and a remote-control panel for the automatic load bank.

Table 8 below shows the generator size on various pump start scenarios.

TABLE 8: GENERATOR SIZE

Stage	Pump kW Rating	Duty Pump Quantity	Pump Starter Quantity and Type	Required Generator Capacity (kW)	Fuel Type	Design Basis
1.1	40 kW	1	1-VFD	80	Diesel	Cummins
	40 kW	1	1-FVNR	80	Diesel	Cummins
1.2	110 kW	1	1-VFD	450	Natural gas	Cummins
	110 kW	1	1-FVNR	450	Natural gas	Cummins
2	110 kW	2	2-VFD	500	Natural gas	Cummins
	110 kW	2	1-VFD 1-FVNR	550	Natural gas	Cummins
3	110 kW	3	3-VFD	600	Natural gas	Cummins
	110 kW	3	2-VFD 1-FVNR	650	Natural gas	Cummins

In conclusion, the generator size will be much larger when pump starts on FVNR compared to pumps on VFD. The larger the generator size will impact the size of the generator room and the overall cost. With all stages equipped with redundant pumping capacity, the likelihood that multiple VFD's will fail simultaneously when generator power is required is assumed to be a very rare possibility, however not impossible. Therefore, the generator capacity will be based on one FVNR type starter and all other pumps on VFD, and the FVNR starter energized before the VFD controlled pumps.

Lighting

Interior lighting will consist of LED luminaires. The control and generator room luminaires will include an IP65 rated, non-metallic, corrosion-resistant enclosure. Lower level luminaires include moisture proof LED luminaires. All luminaires in lower level shall be accessible by a ladder for maintenance. Interior lighting control will consist of standard switches, a master switch, and a master switch partial delay off as per the Electrical Design Guide. Exterior lighting will consist of LED wall packs with integral photocell controls.

Exit luminaires will be provided on the control and generator room which will be equipped with two LED emergency lighting heads, and a battery bank with a sufficient capacity to supply additional dual remote LED lighting heads.

The Wastewater Lift Station lighting intensities will be designed as per Table 9 below.

TABLE 9: LIGHTING INTENSITIES

Area Name	Luminaire Type	Average Maintained Lux	Voltage (V)
Main Floor	LED	300-350	120
Generator Room	LED	300-350	120
Intermediate Level	LED	250-300	120
Motor Room	LED	150-250	120
Pump Room	LED	150-250	120
Exterior	LED	50	120

Receptacles

Convenience receptacles will be provided in the control, main area, and generator rooms. All convenience receptacles shall be wired to one circuit per level. A 600 V welding receptacle complete with disconnect switch will be provided in the main area.

Fire Detection/Alarm

A fire detection and alarm system are not required and will not be installed for this building. However, a building smoke detector and flammable gas detector will be provided and will be wired and connected to control system for monitoring.

Security System

Specific requirements for the security system will need to be confirmed by the City. As a minimum, a basic security system will be provided consisting of door contacts for all exterior doors and a motion sensor. The security system will be connected to the control system.

Communication System

The WWLS will be provided with a wireless cellular as a first level of communication and a hardwired underground telephone service for redundancy. A wireless cellular modem will be provided for wireless communication, wired, and connected to a dedicated BMX NOR 0200H communication module through ethernet cable. A PSTN modem will be provided for hardwired telephone line, wired, and connected to a dedicated BMX NOR 0200H communication module through a serial cable. An underground conduit, typically 75 mm diameter PVC, will be provided from the telephone backboard in the control room to the property line complete with pull wire. The telephone backboard will be installed as per Bell MTS requirements with a dedicated power receptacle and a grounding conductor connected to a wall mounted ground bus.

A service application was submitted to Bell MTS to determine the routing and source location for the Bell MTS telephone service. The response received stated the Bell MTS will not proceed with the telephone service design until the finalized civic address is determined, an electrical site plan showing the building footprint, and the construction start date & anticipated in-service date have been submitted along with the application form. Consequently, the routing and source location of Bell MTS telephone service is to be determined as part of the future detailed design for the project, at a time when the requested information can be supplied along with the application.

Minor Electrical Requirements

Wiring within the station would be provided within surface mounted PVC conduits, or via armoured cables with a PVC jacket such as TECK90. A wall mounted ground bus bar connected to the exterior ground grid will be provided to permit all equipment requiring a bond to ground a simple bond connection point. All ground electrodes will be connected via an underground #2/0 American Wire Gauge (AWG) bare copper conductor that encircles the station. This ground grid will be extended around the Utility supplied pad mounted transformer which will also include three copper clad ground rods, each 3 m long installed in an equilateral triangle with minimum separation of 3 m.

A risk analysis for lighting protection will be performed as per NFPA 780, submitted for review and acceptance by the City. Statistical or statutory meteorological data will be consulted to properly determined the degree of protection required. The building and structures will be adequately grounded to prevent damage from a lightning strike. The grounding system for the lightning protection will be segregated from the electrical safety ground and only interconnected as required by electrical codes. The lightning protection design will be as per NFPA 780 and CSA B72.

Electrical Engineering Studies

A coordination study and an arc flash study will be provided using SKM PTW and will be submitted to the City for acceptance at a design time. All equipment will need to be labeled with the correct potential arc flash energy and personnel working in the facility will be required to wear personal protective equipment to limit arc flash hazards.

Controls and Instrumentation

The automation and communication design will be based on the City of Winnipeg's Automation Design Guide (Doc. 612620-0013-40ER-0001). A main PLC control panel will be provided complete with Schneider Electric M580 programmable logic controller (PLC) platform as described in the Automation Design Guide. The control panel will be a free-standing type in NEMA 12 enclosure installed in the Control room. The main PLC control panel will be provided with two level of communication for remote monitoring. The first level will be by a cellular modem. The second will be by a hardwired MTS line with a PSTN modem. Each of the communication type will be provided with a dedicated BMX NOR 0200H card module as described in previous section.

All discrete I/O such as status and alarm points, as well as start/stop and open/close control will be hardwired to I/O modules installed on the PLC backplane. All analog I/O such as motor speed, motor speed command, flow, level, and pressure will also be hardwired to I/O modules installed on the PLC backplane.

Intrinsically safe barriers will be provided for all instruments as required.

The method of pump control is based on water level measurements in the wet well. The level is measured with a differential pressure transmitter with 4-20 mA signal to the PLC, which compares the current water level to the desired setpoint and starts/stops the pumps and varies their speed based on that comparison. High level alarm switches will provide another level of redundancy if pressure sensor malfunctions. The differential pressure transmitter will be provided with a Digital Precision Display as a backup pump control if the PLC fails as the Precision Digital display can also provide pump control.

The Mechanical system described in Sub-section 5.3.1.3 will be monitored and controlled by the main PLC.

5.4 Preliminary Design of Force Mains

The design for the Force Mains is presented in the preliminary design drawings that are included in the Drawings section at the end of this report. Sub-sections 5.4.1 and 5.4.2 below elaborate on the design components as well as operation and maintenance considerations included in our preliminary design.

5.4.1 DESIGN COMPONENTS

The following sub-sections describe and discuss key Force Main design components.

Pipe Alignment and Configuration

The Force Main designs follow the prescribed alignment along the Sturgeon Road ROW to the City limit. From there the alignment continues into the RM of Rosser along CCW, and ultimately connects to the existing 1350 m Interceptor Sewer which currently terminates on Inkster Boulevard at Brookside Boulevard.

Two FCMs are required to support the anticipated wastewater flows through the various stages of development as presented above on Table 4. A 600 mm FCM is required to satisfy Stage 1, a 750 mm FCM is required to achieve Stage 2 and the two FCMs working in concert (600 mm and 750 mm) will satisfy the full building out at the end of Stage 3. The selection of multiple FCMs provides a degree of versatility to respond to alternate actual rates of development during the early phases of construction while providing a level of long-term redundancy. At the early stages of development when wastewater flows are low, the smaller diameter pipe sizes provide increased velocities reducing the settlement of solids, grit and debris, and the associated operation and maintenance costs.

The FCMs are proposed to be installed at a minimum of 2.5 m to obvert below existing grade to provide sufficient frost cover.

Pressure Relief Chambers

Air release valves are incorporated at strategic locations along the FCM discharge lines for operating purposes; the final locations of these chambers are to be determined by hydraulic transient analysis at the detailed design stage. These valves will be incorporated in a concrete chamber that will also allow access for maintenance purposes. The valving contained in the structures will consist of air release or combination air valves that will be determined to match operational requirements at the detailed design stage. Gate valving installed on both FCMs at two locations will provide the option of isolating sections of FCM pipes for repair and maintenance purposes. Operation and maintenance considerations are further discussed below in Sub-section 5.4.2.

Valve and Force Main Access Chambers

Main line valves and concrete valve chambers are proposed to be installed at two locations along the FCM route. This valving and access will provide a means of isolating sections of each FCM for maintenance purposes. The proposed locations will effectively divide each of the two FCM runs into thirds located at approximately 2,400 m and 4,800 m from the WWLS. Within the chambers the tees provided will have a removable blind flange that will allow the connection of a vacuum line or pumper line as required to clean and flush the lines, check for pressure losses, or install/retrieve maintenance devices. Drain chambers will be required at low points in the force main profile. Three locations have been identified for such a purpose. These

locations will also suit as access points to the pipes for inserting or retrieving pipeline monitoring devices such as a “SmartBall”, a pigging device, or other devices used for maintenance and inspection purposes. At the detailed design stage, the exact nature of the maintenance requirements should be confirmed and the mechanical components in these various chambers should be designed as necessary.

Chambers and Road Access

Each chamber, whether a valve/access or pressure relief, will be accessible by vehicle from the adjacent roadway via an approach road that will be installed at each chamber location. The valve and FCM access chambers will be located adjacent to a pressure relief chamber so that an access approach can be shared to access both chambers. These approaches will be designed using a width, geometry, and structure suitable for use by a heavy-duty maintenance vehicle. Each approach will have a gravelled surface and a culvert.

Downstream Connection

At the connection point to the existing manhole in the intersection on Inkster Boulevard at Brookside Boulevard, both FCMs will be connected directly to the manhole. The connection will be made using a thrust restraining spool piece cast into the manhole with a flanged connection to the FCM outside of the manhole. If required, flow diverters could be installed to direct the flow within the manhole to reduce turbulence.

Materials

The preliminary design of the FCMs considers material parameters and specifications for PVC C-905 pressure pipes. High density polyethylene (HDPE) material would likely be an optimal alternative product for this application; however, it is not currently on the City of Winnipeg Approved Products List. Consideration for the use of HDPE is to support the proposed installation methods through the rock and till sections recommended at the detailed design stage

Pipe Encasement

Six locations are currently identified where the FCMs will require installation in an encasement pipe. Initially, the FCM crosses the upper reach of Truro Creek located within the industrial portion of the AAW. Outside of the City limits within the RM of Rosser, the FCMs require two railway crossings (CP) and two additional creek crossings (Omand’s Creek and East Branch Colony Creek). Near the end of the alignment, both FCMs cross CCW to continue along the north side of the roadway. Each of these crossing will require installation in an encasement pipe.

Railway crossings will be governed by the railway regulations which currently require pressurized lines to be installed in a steel encasement pipe across the full width the to railway ROW and mainline valves on both ends of the crossing.

Creek and drainage channel crossings will be governed by DFO requirements for protecting riparian zones of watercourses. Specific requirements for the creek crossing however will not be known until a proposed construction drawing is submitted in advance of construction.

The crossing of CCW will be governed by Manitoba Infrastructure regulations for utility crossings under provincial highways. Encasement piping is also required under Provincial Regulations if the pipe is less than 3.0 m from the shoulder of a provincial highway. This situation does not currently exist along the proposed

FCM alignment but may arise if adjustments to the proposed alignment are necessary at the detailed design stage.

All of the aforementioned crossings, complete with proposed encasement pipe lengths, are identified on the preliminary design drawings that are included in the Drawings section at the end of this report.

5.4.2 OPERATION AND MAINTENANCE

Valving located at the WWLS allows either FCM to be isolated. Drain down valves are included on each FCM to allow it to be drained back to the wet well. Along the FCM route, isolation valves are provided as mentioned in Section 5.4.1. This will allow for smaller sections of the FCMs to be isolated for maintenance or repair and will allow draining of each section of FCM, either by connection to a vac truck, or by using a mobile pump to drain from one FCM by pumping the discharge into the other. Potentially, these tees could be incorporated into the air valve chambers with a similar separate connection to be provided at the low points in the FCM.

The benefits of pipeline pigging should be explored during detailed design. Pigs can be used to brush-off any biological growth/scale/deposits from the pipeline, measure wall thickness, detect cracks, pinhole leaks and detect ovality. Modification to the FCM valve chamber at the pump station site will be required to accommodate a pig launching station and the discharge locations required a pig catching basket and hatch allowing for retrieval of the pig.

5.5 Phasing

As the Study Area is currently not serviced, significant capital investments for Regional Infrastructure will be required to initiate development of the AAW lands. The 750 mm, 900 mm and 1200 mm gravity pipes upstream of the WWLS, as well as the first stage of the WWLS temporary pumping facilities and the 600 mm discharge FCM will need to be constructed at the beginning of Phase 1A before significant development in the region can occur.

5.5.1 INTERCEPTOR AND INTAKE SEWERS

The Interceptor and Intake Sewers, that are proposed to be installed by the City as part of the Regional Infrastructure, are required at the start of the development. Under early stages of development, the flows generated may be insufficient to provide minimum scour velocities in the pipes. This condition will vary in terms of extent and location and generally will be eliminated over time as development reaches certain points in each branch of the system. This condition is not unique to this development. Should this become problematic in terms of preventing proper flow, a pipe flushing program could be instituted on an as needed basis.

There are other options to address this situation by considering different pipe geometry such as an egg-shape pipe section or a section that includes a low flow channel that would promote increased velocities under low flow conditions. For the purposes of this report, it was assumed that a sewer flushing program would be the preferred method of dealing with the potential for sludge build up during early stages of development. There are no additional capital costs due to specialized pipe material and the system could be monitored and cleaned on an as needed basis. The estimated costs for such a program are included in the Class 3 cost estimate.

As noted in Section 5.1.4, the model of the wastewater system was modified to represent several stages of development to observe the impact of partial development on the flows in the system. The Interceptor Sewers that are proposed to be installed by the City as part of the Regional Infrastructure are listed in Table 10 below with corresponding velocities shown at the various stages of development.

TABLE 10: MINIMUM VELOCITIES THROUGH VARIOUS DEVELOPMENT STAGES

Development Stages	750 mm Residential Interceptor	900 mm Sturgeon Access Interceptor	1200 mm Intake Sewer
Phase 1A - Stage 1 (0-5 Years)	0.48	0.96	0.87
Phase 1B - Stage 1 (6-10 Years)	0.59	1.03	1.08
Phase 1C - Stage 2 (11-15 Years)	0.64	1.19	1.28
Phase 1D - Stage 2 (16-20 Years)	0.71	1.22	1.36
Phase 2A - Stage 3 (21-30 Years)	0.71	1.25	1.43
Phase 2B - Stage 3 (31-40 Years)	0.71	1.26	1.48
Phase 2C - Stage 3 (41-50 Years)	0.71	1.34	1.537

The timing of construction for the Interceptor Sewers should be further evaluated at the detailed design stage to see if potential efficiencies can be realized by coordinating the construction of a given Interceptor Sewer branch with subdivision and rezoning applications for the adjacent lands.

5.5.2 WASTEWATER LIFT STATION

For the Wastewater Lift Station, the site development as well as the actual station structure will be required in the early phases of the development. Some of the mechanical and electrical components within the station however can be adapted to effectively service gradually increasing wastewater flows expected from continuous development of the AAW lands. The following sub-sections describe solutions developed by our team to effectively stage the mechanical, power and communications, as well as the control and instrumentation equipment for the WWLS.

5.5.2.1 Structure and Mechanical

During the initial phase of the development, low flows are expected at the WWLS. This is of particular concern during the 0-5 year period when little development has taken place in the area. During this period, the station

will receive a fraction of the flows expected during the ultimate buildout resulting in exceptionally long retention times. The result of this would be that the pumps would not cycle on/off frequently enough to flush any solids or grit down the FCM, resulting in compaction and solidification of the solids and grit which dramatically increasing the operation and maintenance costs of the FCMs. Therefore, an interim solution is required which is provided in the following staging plan with regards to the WWLS, FCM, mechanical and electrical equipment.

STAGE 1: This stage will consist of a temporary WWLS bypass pump station, the construction of the WWLS sub- and super-structure, and will cover the 0-10 year period of the buildout horizon. We have identified the following key benefits associated with this approach:

- ✓ Initial upfront capital expenditure by the City of Winnipeg is reduced and staged.
- ✓ The installation of the gas service to site can be delayed, possibly resulting in the service brought into the area by another party.
- ✓ Groundwater pumps during the construction of the WWLS would not require truck hauling from site and can be pumped via temporary pumping infrastructure.
- ✓ Provision for redundant lift station bypass equipment.
- ✓ Reduced utility costs during the 0-5 year period as a result of significantly reduced installed loads.

Stage 1 is divided into Stage 1.1 and Stage 1.2.

STAGE 1.1: To mitigate the low turnover of sewage in the wet well it is proposed to delay the construction of the complete WWLS and utilise the upstream manhole as a temporary pumping manhole. The manhole would be equipped with two submersible pumps directing flow from the upstream manhole to the valve bypass chamber and to the NEWPCC via the 600 mm diameter FCM.

To further mitigate the low turnover in the wet well it is proposed to supplement the influent with groundwater which will result in more frequent pump operation and flushing of solids and grit from the FCMs. The groundwater will result in an a slightly higher hydraulic load to the NEWPCC than would have been anticipated during Phase 1A of Stage 1, but the same biological load.

The following primary components have been identified for implementation before flows can be conveyed from the site to the NEWPCC:

Upstream Manhole – the manhole will be constructed and an isolation sluice gate to the WWLS will be installed allowing for seamless diverting of flows to the lift station when it is constructed and commissioned as part of Stage 1.2. The manhole will serve as a temporary sump allowing for a delay in construction of the main WWLS structure.

Bypass Valve Chamber – the bypass valve chamber and provided bypass connections will be utilised to access the FCMs and allow pumping to the NEWPCC.

Pumping Well Installation – The depressurization wells will serve as source for supplementary groundwater. The pumping well discharge will be directed to the upstream manhole – allowing for the water to be pumped off site instead of being hauled off site.

Temporary Pump Control Building – A control building housing the temporary pump controls and diesel generator will be constructed above the bypass valve chamber. This will serve multiple

purposes: housing critical equipment and generator during Stage 1.1; storage of the temporary pumps after the WWLS is commissioned (serving as emergency bypass pumps); and providing unrestricted operator access to the bypass valve chamber.

STAGE 1.2: The main WWLS construction will take place during this stage; as this approach will ensure that sufficient flows are generated by the time the station is commissioned to ensure more reasonable turnover times of the wet well volume.

The stage will require the installation of two pumps, two complete sets of suction pipework, two sets of suction pipework terminating after the suction isolation valve, two complete sets of discharge pipework, two sets of partial discharge pipework with isolation valve at the common discharge header as well as common discharge header.

STAGE 2 & 3: This stage will cover the remainder of the design horizon, namely 11-50 years. It is proposed that the installation of the remainder of the equipment is consolidated due to the limited scope of installation, i.e. two pumps and associated suction and discharge pipework.

5.5.2.2 Power and Communication

As discussed in previous Sub-section 5.5.2.1, Stage 1 is divided into Stage 1.1 and Stage 1.2. During Stage 1.1, a temporary pump control building will be constructed to house the power and control electrical equipment and diesel generator. The electrical service for the temporary pump control building will be a 200 ampere, three phase four wire, 600 volt. The building will be provided basic security, power receptacles and LED lighting system. Stage 1.1 will have two 40 kW pumps (duty-standby), each pump will draw 32 kW. The pump will be provided with VFD starters complete with line and load reactors. 80 kW diesel generator and associated day tank for fuel, automatic transfer switch and automatic load bank will be provided. The load bank will be installed outside the building. Temporary pump control building would be considered an ordinary (non-hazardous) location as these rooms will be heated, ventilated, and suitably sealed from other areas.

A wireless cellular as primary and hardwired telephone line as secondary communication will be provided for communication the main SCADA.

During Stage 1.2, the electrical system will be sized to accommodate the future Stage 2 and Stage 3 loads. Stage 2 and Stage 3 will use an 800 ampere, 100% rated breaker, with an LSI trip unit as the demand loads for the three phases do not have a significant difference due the large mechanical loads.

Stage 1.2 will have two 110 kW pumps (duty-standby), each pump will draw 81.6 kW. The main breaker trip setting for Stage 1 will be adjusted to 600 amps to provide a better protection for the electrical system. During this stage, a 450 kW generator and associated load bank will be provided.

Stage 1.2 electrical upgrades will include but not be limited to:

- Installation of the WWLS electrical system;
- Installation of 450 kW generator and associated load bank;
- Demolition of temporary lift station electrical system and control system.

During Stage 2, two additional 110 kW pumps will be added. The four pumps will operate duty-duty-standby-standby, each pump will draw 81.6 kW. The trip setting of the main breaker at this stage can be set back to

800 amperes. Emergency power for the 10-year Stage 2 will be supplied by a 650 kW generator which exceeds the 550 kW generator requirement listed in Table 8. The 650 kW generator will remain in service for Stages 2 and 3 and therefore eliminates the need to upgrade the generator after a relatively short service life of only 10-years. Stage 2 electrical upgrade will include but is not be limited to:

- Demolition of existing 450kW generator and the associated load bank;
- New 650kW generator and associated load bank;
- New 110kW VFD motor starters complete with Bypass FVNR starters and associated accessories;
- New power cables and circuit breakers for the pumps.

In Stage 3 (21-50 Years), the existing four (4) 110 kW pumps operation duty-duty-standby-standby will be revised to duty-duty-duty-standby.

5.5.2.3 Controls and Instrumentation

The PLC control for Stage 1.1 will be designed and dedicated only for temporary lift station. A PLC control panel will be provided complete with Schneider Electric M580 platform. The method of pump control is based on water level measurements in the pump manhole using an ultrasonic transducer (Milltronics). A level float switches will also be provided as backup. The ultrasonic transducer controller (Milltronics Siemens Multiranger) installed on the PLC panel door pump will provide back pump control if the PLC fails as this can also provide pump control. The pump control panel will be provided with BMX NOR 0200H card module for wireless communication to City main SCADA system.

The PLC control panel for Stage 1.2 will be designed to accommodate the future VFD signals for Stage 2 and Stage 3.

Upgrades to the controls and instrumentation systems to accommodate the Stage 2 configuration will include but is not limited to:

- Wiring of the additional two (2) VFD discrete and analog signals to PLC control panel.
- Integration and programming.
- New wiring for the two new 110kW VFD's to the existing PLC control panel.

Upgrades to the controls and instrumentation systems to accommodate the Stage 3 configuration will include but not be limited to:

- Integration and re-programming the pump operation from duty-duty-standby-standby to duty-duty-duty-standby.

5.5.3 FORCE MAINS

The pump and FCM configurations, selected to stage the overall wastewater servicing throughout all phases of the development, requires only the 600 mm FCM for the first 10 years (Stage 1) of the buildout. For the subsequent 10 years (Stage 2) the system will require the 750 mm FCM. After another 10 years of operation, the system will require transition to Stage 3 which uses both the 600 mm and the 750 mm FCMs in parallel for the full buildout horizon. The staging plan for the FCMs will therefore be as follows.

STAGE 1: Construct 600 mm FCM complete with nine air control valve chambers, two isolation valve chambers and three drain down chambers as well as 11 granular maintenance access pullouts. This phase will also

require the construction of one tie-in connection to the existing Inkster Interceptor at the intersection of Inkster Boulevard and Brookside Boulevard.

STAGE 2: Construct 750 mm FCM with connections to all chambers constructed as part of Stage 1. This stage will also require the construction of one tie-in connection to the existing Inkster Interceptor at the intersection of Inkster Boulevard and Brookside Boulevard.

STAGE 3: This stage will initiate the use of both FCMs (600 mm and 750 mm) in parallel but will not require the construction of any new Force Main infrastructure.

Securing the proposed FCM alignments at the start of the project will be critical as ongoing development in the RM of Rosser, and within the AAW lands, will bring in additional underground infrastructure that may take up portions of the selected FCM alignment if the pipe is not already installed at that time. This could lead to expensive re-design, land acquisition, and utility relocation requirements. Forming easement agreements for both FCM pipes at the beginning of the project however would effectively secure the alignment and reduce these risks.

5.6 Conclusions and Recommendations

5.6.1 INTERCEPTOR AND INTAKE SEWERS

- Approximately 860 m of 750 mm and 260 m of 900 mm of Interceptor Sewers as well as 70 m of 1200 mm Intake Sewer required as gravity sewer for Regional Infrastructure.
- All components required at initial stage of development.
- Due to extreme depth and subsurface conditions, detailed design will require further investigations and recommendations for constructability issues.
- Alignments will require coordination with Manitoba Infrastructure and construction may depend on timing to determine exact land requirements and configuration of grade separated interchange.

5.6.2 WASTEWATER LIFT STATION

- One Wastewater Lift Station at a location suitable to service entire area as identified in the Project Initiation Meeting.
- The general location has been identified in the vicinity of CCW and the Sturgeon Access where a future grade separated interchange is planned.
- A geotechnical investigation is required at the Detailed Design stage to refine the location for optimal subsurface conditions.
- The WWLS is recommended to be constructed using a staged approach to address the low flows in the early stages of development and the general uncertainty of the rate of development. This approach includes:
  - **STAGE 1.1 (FOR START OF DEVELOPMENT):** Construct the by-pass component of the WWLS and make them operational for Phase 1A (0-5 years) when anticipated flows are below the optimal levels for the full buildout lift station, and pump these flows via the 600 mm FCM.
  - **STAGE 1.2 (START OF YEAR 5 – YEAR 10):** Construct the remainder of the WWLS and pump wastewater via the 600 mm FCM. This staging allows the City to hold off with the capital investment for the

complete WWLS until the actual development flows warrant the need. i.e. if development is stalled for economic reasons not considered as part of this study, the City can continue to provide sanitary service the Stage 1.1 development using the by-pass system and invest the capital for the WWLS when development continues.

- **STAGE 2 (YEAR 11 TO YEAR 20):** Use of WWLS with the 750 mm FCM.
- **STAGE 3 (START OF YEAR 21 TO FULL BUILDOUT):** use of WWLS with both FCMs (750 mm and 600 mm).

5.6.3 FORCE MAINS

- Dual Force Mains, each approximately 7,200 m long. One 600 mm diameter and one 750 mm diameter.
- Nine air control valves contained in chambers for access and maintenance purposes.
- Two isolation valves on each FCM along with cleanout access points contained in chambers for maintenance and repair purposes.
- Three drain down chambers located at low points along the FCM.
- Each FCM connected directly to the existing manhole at the gravity sewer on Inkster Boulevard.
- All components required for Phase 1 of development.
- One FCM (600 mm) required for first 10 years of development. Switch to 750 mm FCM for years 11-20, then switch to use both FCMs for years 21-50 (full buildout of AAW lands).

6.0 WATER SERVICING

Regional water infrastructure is a necessary component of the future water distribution grid within the AAW lands to provide the fire and domestic flows necessary for future development. In this section, we examine the extension of regional water servicing into the AAW lands to meet these goals. The specific intent of the examination is to develop a preliminary design of the phased and full buildout scenarios of Water Main infrastructure throughout the AAW lands meeting the minimum water pressure criteria for fire and domestic flows. This overall plan will then form the basis of the Water and Feeder Main infrastructure required to service the study area. The report identifies the portion of the water servicing infrastructure to be designated as Regional Infrastructure (for which the City will be responsible), and the remaining local water infrastructure that will be the responsibilities of the future developers. The report also identifies the proposed phased construction of the Regional and Local Infrastructure to meet pressure, fire flow and potability requirements.

To undertake this examination, a digital water distribution system hydraulic model was created to develop and analyze a variety of water servicing alternatives. In this section then we include the following:

- A description of the overall regional Water Main (WM) system.
- A description of the water network analysis model.
- A description of the analyses performed with the water model.

6.1 Overall Servicing Concept Tasks

To develop the preliminary water servicing plan for the AAW, a number of tasks were undertaken as follows:

- Evaluate the surrounding existing City of Winnipeg water distribution system and identify connection points between the existing and proposed systems, both to the local domestic residential water distribution system south of Saskatchewan Avenue, and to the existing Feeder Main network. The Silver Avenue FDM is understood to be the main source of water supply for the AAW.
- Develop a digital water distribution system hydraulic model to analyze a variety of configurations, alternatives, and scenarios for the extension of water servicing into the site. Tasks required to develop the model include:
  - Acquire water supply flow capacity rating curves from the City of Winnipeg for tie-in locations to the existing regional WM and FDM systems.
  - Acquire ground elevations used in the City's water model for the same tie-in locations to the regional water system.
  - Develop demand flows through the site representing: Average Day Demands (ADD); Maximum Day Demands (MDD); Peak Hour Demands (PHD); and Maximum Day Demands plus Fire Flow Demands.
  - Construct the proposed domestic and FDM piping grid throughout the AAW in accordance with the ROW layout established in the shadow plan.
- Evaluate the performance of the proposed system under a variety of scenarios including:
  - Full buildout scenario.
  - Phase 1 scenario including initial first sub-phases of Phase 1.

  - The above scenarios operating with alternate water supplies in the event that the Silver Avenue FDM is taken out of service.
- Evaluate pressure and flow conditions of the above scenarios for the following:
  - Domestic Peak Hour Demand.
  - Maximum Day Demand plus Fire Flow.
- Design of FDM, valve chambers, offtake structures and other appurtenances and other system components to support the ability of the future domestic WM grid to meet domestic and fire protection water flows at or above minimum operating pressures in accordance with the City's Water Demand Estimation and Design Guidelines.

6.2 Existing Regional Water Main and Feeder Main System

The existing regional water supply servicing plan for the northwest portion of the City of Winnipeg consists of the construction of a 750 mm FDM through the AAW lands connected to the 900 mm Silver Avenue FDM. Secondary connections to either the 600 mm Rouge Road FDM near Hamilton Avenue and Cavalier Drive to the south or the 600 mm Inkster Boulevard FDM at Brookside Boulevard to the north east were also considered. The locations of these components of the proposed Regional Infrastructure is shown in Plate 6.01.

The proposed 750 mm FDM begins as an offtake from the 900 mm Silver FDM at Moray Street and heads west through the undeveloped Silver Avenue right-of-way to Sturgeon Road where it connects to the 600 mm Rouge FDM. From here it extends north along Sturgeon Road, across Saskatchewan Avenue to the intersection of the Sturgeon Access Road. Lastly the FDM continues north along Sturgeon Road to the northern portion of the AAW lands.

A secondary supply from the Rouge Road FDM would begin at Hamilton and Cavalier, head due north to CentrePort Canada Way, and then follow CCW to connect to the 750 mm FDM at Sturgeon Road and Sturgeon Access Road. Alternatively, a secondary supply from the Inkster Boulevard FDM would extend westward along Inkster from Brookside into the RM of Rosser to Sturgeon Road, and then follow Sturgeon southward to re-enter the City of Winnipeg and connect at the northern terminus of the proposed 750 mm FDM.

For the purpose of servicing the AAW lands, it is shown within the report that the 750 mm diameter Sturgeon Road FDM is sufficient to support the ability of the future domestic WM grid to provide domestic and fire protection water flows at or above minimum operating pressures in accordance with the City's Water Demand Estimation and Design Guidelines. A secondary supply line, whether from the Rouge or from the Inkster FDM is not intended to act a distribution main. Its purpose is to act as a secondary water supply to AAW during any circumstance where the Sturgeon Road FDM is closed.

6.3 Water Network Analysis Model

To assist in evaluating various Water Main infrastructure development concepts within the AAW lands, EPANET 2 was used to create the AAW model. EPANET is a water distribution system hydraulic modelling software platform developed by the United States Environmental Protection Agency. It was developed more than 20 years ago and does not have some of the analytical and graphical abilities of other similar softwares,

however it is the same platform used by the City of Winnipeg for their existing water distribution system model. We have chosen to use EPANET for this assignment to allow for an easy transfer of our model to the City for inclusion in their City-wide water network model.

Despite some limitations, EPANET is capable of performing most of the analyses required, however it does not support area-wide fire flow analyses. To perform these analyses and to produce the graphical representation of our results, the various scenarios presented herein were converted into .inp network files from EPANET and exported to WaterCad version 8i by Bentley. For consistency, in addition to the area-wide fire flow simulations, we used the WaterCAD software to perform all the simulations and produce all the graphics herein.

6.3.1 MODEL CONSTRUCTION AND LAYOUT

Before any analyses can be performed, various inputs into the model are required, as are certain decisions into the layout of the model to ensure the graphical depictions of results are clear and understandable. These are described in the following sections.

6.3.1.1 Pipe System Configurations and Parameters

The water distribution grid within the model follows the proposed Shadow Plan for both the industrial and residential portions of the AAW lands. The scaled Shadow Plan is imported into the model and then the pipes are located within all proposed collector and regional street rights-of-way. In the industrial area this includes all streets of the shadow plan while in the residential area this only includes collectors: bays and cul-de-sacs are not modelled with one exception as will be discussed.

Parameters assigned to each pipe include length, diameter, and the hydraulic roughness coefficient or "C" value. Lengths are calculated by the model itself as the network is drawn. Pipe diameters and their corresponding "C" values correspond to the following Table.

TABLE 11: MODELING PIPE SIZES AND PARAMETERS

Nominal Pipe Size	Internal Diameter (mm)[1]	Hydraulic Roughness "C" Value[2]
150	154	120
200	202	120
250	248	130
300	295	130
400	**393**	**130**
600	**578**	**130**
750	**717**	**130**
900	863[3]	**130**

Notes:

1. *We have used internal pipe diameters for all new pipes in the model. This allows the model to use the actual cross-sectional area of the pipe when calculating flows and velocities. We understand the City uses nominal pipe sizes in their model and conduct yearly flow tests of the system so that their model can be adjusted to align calculated flows with measured flows from these tests. In the case of AAW, the area is so large that we believe the internal diameters of the proposed pipes are necessary to get*

accurate results within the modelled area. Internal diameters are based on C900 DR 18 for pipe sizes up to 300 mm and C905 DR 18 for larger pipe diameters.

2. *Hydraulic roughness coefficients as per the City of Winnipeg Water Demand Estimation and Design Guidelines.*
3. *Internal diameter provided by IPEX. This pipe size is not yet in production but is currently undergoing certification.*

6.3.1.2 Flow Demands

Nodal demands, representing Average Day Demand water usage throughout the area, were based on the net areas shown in Table 2 of Section 4.2. Residential and non-residential design water demands from the City of Winnipeg's "Water Demand Estimation and Design Guidelines" were applied to the net developable area associated with each node in the model to produce the initial Average Day Demand at every node. In general, the initial average day demand derived from the City's water guidelines will be approximately equal to sewage flows developed from the City's corresponding wastewater flow estimation guidelines. In practice however, water demands are likely to be greater than the sewage flows, particularly at industrial sites. Excess water flows supplied to an industrial site that do not eventually enter the wastewater system can be due to line losses within the distribution system and a variety of causes related to particular industries, including steam and evaporation losses from industrial processes and loss of water as a product such as in bottling plants.

To test the sensitivity of the model as well as to investigate cases where water demands may be greater than wastewater flows, we have applied a series of 10% multipliers to the Maximum Day and Peak Hour flows calculated from the Average Day Water Demands. Maximum Day and Peak Hour Demands were initially obtained by multiplying the ADD by factors of 1.6 and 2.5 respectively. Simulations were then run in the model using MDD or PHD 100%, 110%, 120% and 130% of the value first calculated from the ADD.

6.3.1.3 System Curves

Our analysis includes 10 different connection scenarios to the City's water distribution and FDM system. For each scenario we obtained system rating curves from the City which simulated available simultaneous flows and pressures for the connection points in question. A description of each connection scenario and its purpose is as follows:

Connection Scenario 1

- 750 mm FDM at Sturgeon and Silver (including 750 between Moray/Silver and Sturgeon/Silver).
- 300 mm domestic main at Buchanan and Saskatchewan.
- 300 mm domestic main at Cavalier and Saskatchewan.
- 300 mm domestic main at Hamilton and Saskatchewan.
- No connection to the Inkster or Rouge FDMs.

This scenario was used to perform initial sizing of the larger diameter water main network within the residential portion of the AAW.

Connection Scenario 2

- 600 mm FDM at Cavalier/Hamilton.
- 300 mm domestic main at Buchanan and Saskatchewan.
- 300 mm domestic main at Cavalier and Saskatchewan.
- 300 mm domestic main at Hamilton and Saskatchewan.
- 300 mm domestic main at Sturgeon and Saskatchewan.
- 300 mm domestic main at Moray and Saskatchewan.
- No connection to the Sturgeon or Inkster FDMs.

This scenario was used to assess the capacity available to the AAW in the event that the Sturgeon FDM is shut down and only the Rouge FDM is available.

Connection Scenario 3

- 750 mm FDM at Sturgeon and Silver (including 750 between Moray/Silver and Sturgeon/Silver).
- 300 mm domestic main at Buchanan and Saskatchewan.
- 300 mm domestic main at Cavalier and Saskatchewan.
- 300 mm domestic main at Hamilton and Saskatchewan.
- 300 mm domestic main at Sturgeon and Saskatchewan.
- 300 mm domestic main at Moray and Saskatchewan.
- No connection to the Rouge or Inkster FDMs.

This is the main scenario. It was used to assess the AAW system assuming that secondary water supplies from Inkster or the Rouge FDMs were unavailable.

Connection Scenario 4

- 750 mm FDM at Sturgeon and Silver (including 750 between Moray/Silver and Sturgeon/Silver).
- 600 mm FDM at Inkster.
- 300 mm domestic main at Buchanan and Saskatchewan.
- 300 mm domestic main at Cavalier and Saskatchewan.
- 300 mm domestic main at Hamilton and Saskatchewan.
- 300 mm domestic main at Sturgeon and Saskatchewan.
- 300 mm domestic main at Moray and Saskatchewan.
- No connection to the Rouge FDM.

This scenario was used to assess the capacity of the AAW system with the Inkster FDM as a secondary supply to the Sturgeon FDM.

Connection Scenario 5

- 300 mm domestic main at Buchanan and Saskatchewan.
- 300 mm domestic main at Cavalier and Saskatchewan.
- No FDM connections or other domestic connections.

This scenario was used to assess the capacity of the system in the western third of the residential subdivision in the event that it is constructed before the Sturgeon FDM.

Connection Scenario 6

- 300 mm domestic main at Buchanan and Saskatchewan.
- 300 mm domestic main at Cavalier and Saskatchewan.
- 300 mm domestic main at Hamilton and Saskatchewan.
- No FDM or other domestic connections to the system.

This scenario was used to assess the capacity of the system of the entire residential subdivision in the event that it is constructed before the Sturgeon FDM.

Connection Scenario 7

- 750 mm FDM at Sturgeon and Silver (including 750 between Moray/Silver and Sturgeon/Silver).
- 300 mm domestic main at Moray and Saskatchewan.
- No other FDM or domestic connections to the system.

This scenario was used to assess the capacity of the system in the WAA lands in the event that it is constructed before any other commercial/industrial.

Connection Scenario 8

- 600 mm FDM at Inkster.
- 300 mm domestic main at Buchanan and Saskatchewan.
- 300 mm domestic main at Cavalier and Saskatchewan.
- 300 mm domestic main at Hamilton and Saskatchewan.
- 300 mm domestic main at Sturgeon and Saskatchewan.
- 300 mm domestic main at Moray and Saskatchewan.
- No connection to the Sturgeon or Rouge FDMs.

This scenario was used to assess the capacity available to the AAW in the event that the Sturgeon FDM is shut down and only the Inkster FDM is available.

Connection Scenario 9

- 300 mm domestic main at Buchanan and Saskatchewan.

- 300 mm domestic main at Cavalier and Saskatchewan.
- 300 mm domestic main at Hamilton and Saskatchewan.
- 300 mm domestic main at Sturgeon and Saskatchewan.
- 300 mm domestic main at Moray and Saskatchewan.
- No FDM or secondary connections

This scenario was used to assess the capacity available to the AAW in the event that the Sturgeon FDM is shut down and no secondary connections exist. These results were then used to better understand the effectiveness of various secondary options.

Connection Scenario 10

- 750 mm FDM at Sturgeon and Silver (including 750 between Moray/Silver and Sturgeon/Silver).
- 600 mm FDM at Cavalier/Hamilton.
- 300 mm domestic main at Buchanan and Saskatchewan.
- 300 mm domestic main at Cavalier and Saskatchewan.
- 300 mm domestic main at Hamilton and Saskatchewan.
- 300 mm domestic main at Sturgeon and Saskatchewan.
- 300 mm domestic main at Moray and Saskatchewan.
- No connection to the Inkster FDMs.

This scenario was used to assess the capacity of the AAW system with the Rouge Road FDM as a secondary supply to the Sturgeon FDM.

6.4 Water System Modelling Analysis

The following sub-section includes detailed descriptions of the modelling analysis intent, performance requirements and of the model construction.

6.4.1 INTENT

The intent of the modelling analysis of the AAW water distribution and Feeder Main system is to verify that the proposed FDM system within the area is sufficient to provide required pressures and flows to the domestic distribution system grid under maximum day plus fire flow and under peak hour conditions. The detailed design of the domestic distribution grid itself is not within the scope of this report. As individual properties are developed; the layout of ROW, the location of heavy/wet and light industrial users and required fire flows for the actual industrial plants constructed will all vary from the assumptions in the Shadow Plan. The design of the water distribution system within the AAW will be undertaken by individual developers to suit the needs and requirements of their individual development plans and the overall condition of the AAW system at the time of the development.

As an example of the potential variability within the development, water main grid in the industrial zones of AAW have been modelled to correspond with the Shadow Plan, part of which consists of roads running along the north periphery of AAW, as well as parallel roads running along the edge of CCW. Sewer and water mains located within such road R.O.Ws would be inefficient as they would only be servicing one half of the street. We expect that the actual road network will consist of a similar grid but with roads offset enough from any such peripheries or boundaries so as to ensure that serviceable lots exist on both sides of any street. By keeping the model correlated with the servicing plan however, we add a slight degree of conservativeness to our result be modelling pipes that are slightly longer than are likely to be constructed on site. This produces pressure and flow results that will be slightly to negligibly less than actual.

To determine that the FDM system is sufficient to meet the City's performance requirements identified in the Water Demand Estimation and Design Guidelines, we have assumed worst case conditions throughout the final buildout: larger water users along the periphery of the site; industrial plants all requiring a maximum fire flow of 383 L/s, initial phasing constructed away from the FDM, etc. A variety of 300 mm and 400 mm pipe size configurations for the domestic water supply grid have been examined to show that there do exist domestic system designs that can service the AAW without a need to upsize or change the location of the 750 mm Sturgeon FDM.

6.4.2 PERFORMANCE REQUIREMENTS OF THE DISTRIBUTION SYSTEM

The performance requirements of the various configurations of pipe sizes and pumping conditions analyzed are to meet the following conditions:

i. Maximum Day Demand plus Fire Flows.

   Maintain a minimum residual pressure of 20 psi in the system under MDD during the following fire flow conditions:

   - Residential Single Family: 100 L/s.
   - Residential Multi-Family: 200 L/s.
   - Street-side Commercial: 250 L/s.
   - Elementary Schools: 167 L/s.
   - Junior and Senior High Schools: 267 L/s.
   - Institutional: 250 L/s.
   - Industrial: 383 L/s.

ii. Peak Hour Demand.

   Under PHD maintain the following minimum residual pressures:

   - Water distribution piping: 30 psi.
   - Feeder Main piping: 45 psi.

iii. Average Day Demand.

   Under ADD the water distribution grid should be sufficiently interconnected and travel routes from the FDM source to every node of short enough length that the age of the water (travel time) within the AAW system is never more than 72 hours, preferably less than 48 hours.

This condition applies to the movement of water within AAW only and serves as an initial check prior to detailed design. During detailed design, the total age of the water to travel from one of the City reservoirs to any point within AAW should be verified using the complete city model.

For our analyses, we have established 25 psi as the required minimum residual pressure for the Maximum Day plus Fire condition, 5 psi greater than 20 psi. This provides an allowance for unaccounted minor head losses due to flow through bends and other fittings of the AAW distribution grid; flow through hydrant assemblies; and, since the pressures provided by the City's System Curves represent the pressure in the system at ground level, a pressure adjustment between ground elevation and the hydrant nozzle elevation.

For the Peak Hour condition, the system's minor head losses are much smaller. The peak hour flow is less than the MDD plus fire so the head loss through bends and fittings of the AAW grid is reduced, and with no fire demand there is no need to account for losses associated with fire hydrants. We have established required minimum pressures of 32 psi in the water distribution grid and 47 psi in FDMs, representing a 2 psi allowance for unaccounted minor head losses during the peak hour condition.

For the Average Day condition we ran an extended period analysis to determine the age of the water passing through the model, determining the length of time at each node for water to travel from the modelled connections to the City water distribution system to that node. The 72-hour allowance is somewhat arbitrary as it ignores the travel time of the water within the FDM network before it reaches the AAW lands. Most jurisdictions allow a minimum of five to seven days for the water within their systems. Three days within the FDM network and another two to three days within the AAW distribution grid was accepted as a reasonable allowance.

6.4.3 MODEL CONSTRUCTION

The model was constructed in three stages. Preliminary analyses after each of the first two stages identified certain characteristics in each stage that needed to be maintained during the analysis of the next stage. The third stage is the final model configuration used for all subsequent analyses.

First Stage: Residential

The residential portion of the AAW lands was modelled first. Residential fire flow requirements are generally less than industrial, so the minimum sizing requirements within the residential area could therefore be established without relying on the anticipated larger piping in the adjoining industrial lands.

A skeletonized model was created consisting of 300 mm pipe along the residential collector streets and connections to existing 300 mm WMs at Buchanan, Cavalier, and Hamilton. The 750 mm FDM was also modelled extending to the intersection of Sturgeon Road and the Sturgeon Access Road and included a 300 mm connection to the residential subdivision. This analysis was conducted both with and without the 750 mm FDM connection.

Plates 6.02 and 6.03 show the residential water distribution system under MDD plus fire and under PHD conditions. The results are shown for the case with no connection to the 750 mm FDM.

While the eventual subdivision plan for the residential area may change from the Shadow Plan, there are some aspects to the distribution system design which apply to the area regardless of the actual final plan.

These aspects do not affect the sizing or design of the 750 mm FDM, but will be of interest to the eventual designers of the residential water distribution system, as follows:

- It is possible for the entire residential development to meet Fire Flow and PHD pressure and flow requirements without a connection to the 750 mm FDM.
- A 300 mm "backbone" WM, running the length of the residential development and connecting to the existing 300 mm WMs at Buchanan, Cavalier and Hamilton, is required to achieve required pressures and flows. An eventual 300 mm connection to the 750 mm Sturgeon Road FDM is recommended for redundancy but is not necessary in the early stages of development.
- The extension of the 300 mm WM on Sturgeon at Saskatchewan was not originally modelled, however if any Multi-Family properties require servicing off Sturgeon, the existing 300 mm pipe should be extended northwards and into the residential development.
- Pressures and flows were at their lowest in the westernmost portion of the residential subdivision backing against the Perimeter Highway. This is partly due to being the furthest distance from the existing FDMs in the existing neighborhood, and partly due to the Shadow Plan in this region consisting of long, sweeping Bays and Crescent type streets with little WM interconnectivity. Additional pipes were modelled in this area to verify fire flows and it was required to upsize these pipes into the 200-250 mm range to achieve minimum residual pressures under fire flow conditions

Second Stage: Industrial/Commercial

After a working configuration of WMs was determined for the residential subdivision, the model was expanded to include the commercial/industrial portion of the site. The 750 mm FDM was extended northwards along Sturgeon Road to the road two blocks south of the north limit of the AAW. Offtake Structures were located at:

- Offtake Structure 1 Moray Street and Silver Avenue.
- Offtake Structure 2 Sturgeon Road and the extension of the Silver Avenue right of way.
- Offtake Structure 3A [1] Sturgeon Road and the road access into the residential development.
- Offtake Structure 3B [1] Sturgeon Road and the extension of Moray Street from Saskatchewan north and then west (the fifth road south of the northern city limit).
- Offtake Structure 4 Sturgeon Road and the second road south of the northern city limit.

Note:

1. *It was later determined that only one of these structures was necessary. OS 3A was deleted from the model and OS3B became simply OS3. This is discussed in selection of the Secondary Supply Main, Section 6.5.1.*

Water distribution piping within the remaining streets of the Shadow Plan were modelled as either 300 mm or 400 mm diameter. Distribution piping for servicing along Sturgeon Road was included running parallel to the FDM. Service Roads on either side of CCW were also assigned distribution piping so that no individual services would cross CCW.

We simulated various combinations of 300 mm and 400 mm distribution piping within the commercial/industrial area which are described in the next section. As was noted for the modelling of the residential subdivision, while the actual future plan developed for the commercial/industrial area may vary from the Shadow Plan there are some aspects to the distribution system design which will apply to the area

regardless of the actual final plan. These aspects do not affect the sizing or design of the 750 mm FDM, but will be of interest to the eventual designers of the residential water distribution system, as follows:

- Dead-end WM should be avoided. Although most industrial plants may require less fire flow than the 383 L/s listed in the City Guidelines, when the maximum fire flow of 383 L/s is travelling within a dead-end pipe, the pressure loss per length of pipe travelled is considerable. A long dead-end main will not be capable of providing large fire flows.
- Long street blocks on the periphery of the system with no interconnecting WMs experience large head losses at their midpoints under fire flow conditions, in some cases falling below minimum residual pressures.
- Long street blocks with no interconnecting WMs, but NOT on the periphery of the system, experience similarly large head losses at their midpoints, but generally start with greater pressures at their start and end nodes due to the greater number of pipe connections at these nodes.
- While the Shadow Plan shows the periphery roads running along the edge of the AAW lands and the City boundary, it is expected that the roads will actually be offset towards the interior of the site so that services can be double loaded, i.e. services on both sides of the street/WM.
- In the Shadow Plan, the WAA lands i.e. those lands east of the northward projection of Moray Street, are supplied from only two water sources: the 300 Moray Street WM and the future 750 mm FDM on Sturgeon Road. To provide the maximum fire flow 383 L/s in this area requires some combination of installing 400 mm water distribution mains throughout most of the WAA area; installing 400 mm water distribution mains to connect the 750 mm FDM to the WAA lands; and developing at least one more connecting WM between the WAA lands and the water distribution grid to the west.

Third Stage: Initial Full Network Model

To construct the initial full network model, a two-step process was undertaken.

First the physical interconnectivity of the WM network was finalized. Based on the initial analyses of the residential and commercial/industrial portions of the AAW, additional piping was added to the model to address initial dead-ends and improve interconnectivity where required. Additional piping was primarily located along the western boundary of the industrial street grid, and within the WAA lands to eliminate dead-end mains. This then became the working pipe configuration of the model and remained unchanged other than for the eventually deletion from the model of Offtake Structure 3A.

The final configuration included:

- Connections between the 750 mm FDM and the water distribution grid at Offtake Structure 3A (Sturgeon and the entry road into the residential subdivision), Offtake Structure 3B (Sturgeon and the fifth block south of the north limit of the AAW), and Offtake Structure 4 (Sturgeon and the end point of the FDM at the second block south of the north limit of the AAW).
- Water Main connections to the existing 300 mm WMs at the intersections of Saskatchewan Avenue with: Buchanan Boulevard; Cavalier Drive; Hamilton Avenue; Sturgeon Road; and Moray Street.
- The final configuration did not include connections to either the Inkster or the Rouge Road FDMs. These connections act as a secondary source of water into the site. At this point they were excluded so as to

analyze the model for the condition where the secondary water supply is shut down or otherwise unavailable.

Second, after the final physical interconnectivity was finalized, the pipe diameters of the WM grid within the commercial/industrial area were analyzed. We modelled two initial alternatives for the grid: the entire grid of streets developed with 300 mm, and with 400 mm water distribution mains. In both cases a maximum industrial fire flow of 383 L/s was assumed. Fire flow analyses for both these cases are shown in Plates 6.04 and 6.05.

With a 300 mm grid there are some mid points in the long street blocks, particularly along the northernmost street, where a fire flow of 383 L/s cannot be achievable while maintaining a residual pressure of 20 psi. In the case of a 400 mm WM grid, maximum fire flows are achievable throughout while maintaining a 20 psi residual pressure.

With regard to the intent of the modelling discussed in Section 6.4.1, Plate 6.05 shows that with 400 mm water distribution piping throughout the industrial lands, the fire flow requirement throughout the AAW lands can be achieved and that no extension or upsizing of the 750 mm FDM as modelled is required. The actual sizing of the WM grid will depend on the specific layout of the actual road rights-of-way and the actual demands and fire flows of the specific industrial developments which are developed on site.

From these two grids we then developed a third alternative to reduce the amount of 400 mm pipe required to meet the 383 L/s industrial fire flow condition. This is the Initial Full Buildout Scenario, and consists of a grid of mainly 300 mm water distribution piping with 400 mm branches as follows:

- From Offtake Structure 3A along the Sturgeon Access Road, across Centerport Canada Way and continuing to the second block south of the north limit of AAW, then east to the north end of the 750 mm FDM at Offtake Structure 4. This provides additional pressure along the long street blocks between the 400 mm pipe and Sturgeon Road.
- A loop across the road along the northern limit of the AAW. This provides additional pressure along the entirely of the northern periphery, particularly at the mid-block points.
- A loop from Offtake Structure 3B through the WAA lands, looping back through a second WM connection between AAW and the WAA lands, and returning to the 750 mm FDM at Offtake Structure 3A. This provides additional pressure to the WAA lands and addresses dead-end WMs in southeast corner of the Shadow Plan.

We suspect it will be likely that many developments within the AAW lands will require fire flows less than the maximum value of 383 L/s and that many of the 400 mm water distributions mains in the Finished Network Model could be downsized to 300 mm in diameter once firm development plans have been determined. Further, since development of the full buildout will generally begin in the south and proceed northwards, it will not be possible to size the early, southern WM installations to accommodate the future northern system requirements which will be unknown at that time. Just as under sizing the southern WMs will result in reduced fire flows and pressures in the north, oversizing the southern WMs would result in increased travel time of water within the system, risking stagnation, particularly if future developments in the north are delayed and/or require less water than anticipated. Given the anticipated multiple decade development period for full buildout, it would be prudent to develop the industrial area with primarily a 300 mm WM grid and allow for zoning restrictions in the north to limit developments to those with fire flow requirements of some lesser

amount than 383 L/s. Developments with high fire flow requirements will have ample time to locate in the southern portion of AAW.

For the purpose of showing that the 750 mm FDM to be developed by the City is in fact sufficient to meet all potential fire flow needs, the performance of the Initial Full Buildout Scenario, with a mixed grid of both 300 mm and 400 mm WMs as described above is shown in Plates 6.06, 6.07 and 6.08. There is a substantial amount of 400 mm WM which is only required for meeting the 383 L/s maximum fire flow along the northern periphery of the site and within the WAA lands. For subsequent analyses, the industrial grid was reduced to 300 mm throughout AAW with the exception of the WM along the extension of Moray Street northwards to the connecting road crossing the railway tracks and tying in to the 750 mm FDM on Sturgeon. This is referred to as the Modified Full Network Model.

6.5 Analysis

In this Section the full analysis of the AAW water network is discussed. This analysis consist of three main components: the selection of a Secondary Supply Main for the AAW lands which resulted in a Complete Full Network Model; an analysis of the full buildout of the Final Full Network Model complete with a sensitivity analysis of the results; and lastly a phasing analysis to determine system performance over the course of the gradual buildout of the system.

6.5.1 SECONDARY SUPPLY MAIN SELECTION

The Secondary Supply Main analysis consists of modeling the system under the assumption that the 750 mm FDM on Sturgeon Road is out of service and the water sources to AAW consist of only the five domestic local mains (Buchanan, Cavalier, Hamilton, Sturgeon 300, and Moray) and the secondary supply.

Three options for a Secondary Supply Main were initially investigated as follows:

ROUGE 300 – extending from the Rouge Road FDM northward from near the intersection of Cavalier Drive and Hamilton Avenue into and through the proposed residential subdivision within AAW until reaching Centerport Canada Way, at which point it connects to the local domestic WMs at Node J-310. The FDM extension is 300 mm in diameter and has no connections to services or any other WMs other than at its two end points.

INKSTER 300 – extending from the Inkster Boulevard FDM westward from Brookside Boulevard and following Inkster Boulevard/Centerport Canada Way to Sturgeon Road and then continuing south along Sturgeon and connecting to the 750 mm FDM at OS4. The FDM extension is 300 mm in diameter and has no connections to services or any other WMs other than at its two end points.

ROUGE 600 – extending the Rouge Road FDM northward from near the intersection of Cavalier Drive and Hamilton Avenue into and through the proposed residential subdivision within AAW until reaching Centerport Canada Way, at which point the FDM follows CCW and Sturgeon Access Road and connects to the 750 mm FDM at OS3A. The FDM extension is 600 mm in diameter and has no connections to services or any other WMs other than at its two end points.

Note that in the above options one of either Offtake Structures 3A or 3B was deleted from the model. It was established in the initial analyses of the system that the 750 mm FDM connection to the residential portion of

AAW was not necessary to meet system requirements within the subdivision. Therefore, it was preferred to keep OS3B and delete OS3A as this would not adversely affect the residential subdivision but would provide a very slight increase in pressures to the WAA Area 8 lands and the northern portion of the site. In the case of the Rouge secondary options however, the Rouge Secondary was connected to OS3A and OS3B was eliminated so as to reduce the length and cost of the secondary main to be installed.

In addition to modeling these three options, two other cases were also modeled to allow for a full understanding of the comparative performances of these options. The two additional cases were:

- No Feeder Main or Secondary Supply

  This case assumes both the 750 mm FDM and any SSM were both out of service and the only water sources available to the AAW system was the five residential WM connections.

- 750 Sturgeon Feeder Main with no Secondary Supply

  This case assumes that the 750 mm FDM is operating but that the SSM is out of service. This case is very similar to the Initial Full Network Model analysis shown in Plates 6.06, 6.07 and 6.08 but with the revised grid used in the Modified Full Network Model.

Results for the secondaries are shown in Plates 6.09 – 6.13 (peak hour demand analysis) and Plates 6.14 – 6.18 (maximum day plus fire analysis).

A Secondary Supply Main is not expected to provide the same level of service as the primary FDM which it is temporarily replacing. It should provide sufficient water to meet residential needs and to maintain peak hour pressures in industrial areas to ensure that essential machinery requiring water pressure can operate. Under this criterion it was evident that two cases (No Secondary Supply, and Rouge 300) were clearly inadequate to provide sufficient service at times when the 750 FDM was out of service. Inkster 300 was an improvement and is perhaps at the low end of acceptability. Rouge 600 on the other hand, while not matching the level of service that the 750 mm FDM provided on its own, performed far better than necessary for a secondary supply. However, due to the length and the cost of the 600 mm pipe for Rouge 600, and the potential issues associated with operating a water supply main outside of the City's jurisdiction in the RM of Rosser for Inkster 300, a fourth secondary supply option was analyzed as follows:

> **ROUGE 400** – extending from the Rouge Road FDM northward from near the intersection of Cavalier Drive and Hamilton Avenue to Saskatchewan Avenue and then west along Saskatchewan to connect with the 300 mm local main at Cavalier Drive. From this point the 400 mm continues as a Large Diameter Water Main (LDWM) replacing the 300 mm WMs originally modeled. The LDWM proceeds west on Saskatchewan to the first road access into the AAW residential subdivision, north through the subdivision to the north service road paralleling Centerport Canada Way and then following CCW east and north to the extension of the road from OS3B where it then proceeds to OS3B. The main is 400 mm in diameter throughout its entire length and is classified as a LDWM with all crossing WMs and building services along its path connecting to it directly.

Rouge 400 performs similarly to Inkster 300 at the north end of the system but provides better performance through the rest of the system and allows more flexibility in how the overall development proceeds. This option is also located entirely within the City of Winnipeg, avoiding potential complications associated with a

city water main outside of the city boundaries. Results for the Rouge 400 option are shown in Plates 6.19 and 6.20. The results for all of these scenarios are summarized below:

750 Sturgeon Feeder Main with no Secondary (Plates 6.09 and 6.14)

All system requirements are met under this scenario. For this analysis, a **minimum** fire flow of 320 L/s was deemed acceptable for Industrial developments. Should there be developments that require a greater fire flow, flows of 383 L/s or more are available throughout most of the site other than the north periphery and a couple of isolated nodes at the mid-points of long blocks and the WAA lands.

A summary of the general results are as follows:

- Under the Peak Hour condition minimum system pressures in the residential subdivision are 45-48 psi.
- Under the Peak Hour condition system pressures in the WAA Area 8 lands are 47-50 psi.
- Under the Peak Hour condition system pressures in Phase 1 (south) of the industrial lands are 44 - 49 psi.
- Under the Peak Hour condition system pressures in Phase 2 (north) of the industrial lands are 43 - 49 psi.
- Under the Peak Hour condition minimum system pressure in the 750 mm FDM is 47 psi.
- Minimum fire flow in the residential subdivision is 142 L/s for Single Family and 200 L/s for Multi-Family. Upsizing of local small diameter WMs will increase these flows if desired.
- Minimum fire flow in the WAA lands is 320 L/s.
- Minimum fire flow in Phase 1 (south) of the industrial lands is 340 L/s.
- Minimum fire flow in Phase 2 (north) of the industrial lands is 289 L/s in the northeast corner and 322 L/s otherwise.

No Feeder Main or Secondary Supply (Plates 6.10 and 6.15)

This scenario performs quite poorly and confirms the need for an SSM in the event that the 750 FDM is out of service. Minimum peak hour pressures are met throughout most of the residential subdivision and nowhere in the industrial lands. Single family fire flows are also achievable within the residential subdivision, but in the industrial lands the maximum fire flow is 132 L/s.

A summary of the general results are as follows:

- Under the Peak Hour condition minimum system pressures in the residential subdivision are 28 -29 psi, although most nodes are above the minimum of 30 psi.
- Under the Peak Hour condition system pressures in the WAA Area 8 lands are 23 -26 psi throughout, below the minimum requirement of 30 psi.
- Under the Peak Hour condition system pressures in Phase 1 (south) of the industrial lands are 23 - 24 psi throughout, below the minimum requirement of 30 psi.
- Under the Peak Hour condition system pressures in Phase 2 (north) of the industrial lands are 19 - 24 psi throughout, below the minimum requirement of 30 psi.
- The Peak Hour condition for the 750 FDM does not apply as it is assumed to be out of service for this scenario.
- Minimum fire flow in the residential subdivision is 122 L/s for Single Family and 145 L/s for Multi-Family. Other than the immediate extension of the Cavalier Drive WM north of Saskatchewan, the 200 L/s Multi-Family fire flow is not achieved within the residential subdivision.
- Fire flows in the WAA lands range from 120 L/s to 124 L/s.

- Fire flows in Phase 1 (south) of the industrial lands range from 117 L/s to 134 L/s.
- Fire flows in Phase 2 (north) of the industrial lands range from 99 L/s to116 L/s.

Rouge 300 only with no 750 Feeder Main (Plates 6.11 and 6.16)

This scenario performs poorly and is only a slight improvement over the no FDM or secondary case. Minimum system pressures under peak hour condition are at or just above the required minimum of 30 psi with approximately half of Phase 2 sees minimum peak hour pressures below 30 psi. Other than one node in the industrial area and approximately 10 nodes in the residential subdivision, fire flows are below 200 psi.

A summary of the general results are as follows:

- Under the Peak Hour condition minimum system pressures in the residential subdivision are 31 -32 psi.
- Under the Peak Hour condition system pressures in the WAA lands are 32 -33 psi.
- Under the Peak Hour condition system pressures in Phase 1 (south) of the industrial lands are 28 - 32 psi.
- Under the Peak Hour condition system pressures in Phase 2 (north) of the industrial lands are 27 - 31 psi. Approximately one half of Phase 2 has peak hour pressures below the minimum of 30 psi.
- The Peak Hour condition for the 750 FDM does not apply as it is assumed to be out of service for this scenario.
- Minimum fire flow in the residential subdivision is 120 L/s for Single Family and 169 L/s for Multi-Family. There are some areas within the residential subdivision where Multi-Family could be established in different locations than proposed in the shadow plan which do achieve fire flows greater than 200 L/s.
- Fire flows in the WAA lands range from 182 L/s to 196 L/s.
- Fire flows in Phase 1 (south) of the industrial lands range from 180 L/s to 200 L/s.
- Fire flows in Phase 2 (north) of the industrial lands range from 141/s to184 L/s.

Inkster 300 with no 750 Feeder Main (Plates 6.12 and 6.17)

This scenario performs better than the previous two and approaches acceptability as a secondary supply. The residential subdivision generally meets minimum system requirements or can be made to meet those requirements with some upsizing of select smaller diameter mains. In the industrial area however, peak hour pressures on the three northernmost streets are below the minimum requirement of 30 psi, and only half of the entire industrial achieves fire flows greater than 200 L/s, with the maximum being 209 L/s.

A summary of the general results are as follows:

- Under the Peak Hour condition minimum system pressures in the residential subdivision are 34-35 psi.
- Under the Peak Hour condition system pressures in the WAA lands are 31 -34 psi.
- Under the Peak Hour condition system pressures in Phase 1 (south) of the industrial lands are 30 - 32 psi.
- Under the Peak Hour condition system pressures in Phase 2 (north) of the industrial lands are 28 - 32 psi. Approximately one third of Phase 2 has peak hour pressures below the minimum of 30 psi.
- The Peak Hour condition for the 750 FDM does not apply as it is assumed to be out of service for this scenario.
- Minimum fire flow in the residential subdivision is 132 L/s for Single Family and 194 L/s for Multi-Family. Upsizing of local small diameter WMs should increase these flows for Multi-Family areas to 200 L/s.
- Fire flows in the WAA lands range from 190 L/s to 209 L/s.
- Fire flows in Phase 1 (south) of the industrial lands range from 190 L/s to 218 L/s.

- Fire flows in Phase 2 (north) of the industrial lands range from 154 L/s to197 L/s.

Rouge 600 no 750 Feeder Main (Plates 6.13 and 6.18)

This scenario provided results greater than required for an SSM. An SSM is not expected to provide the same level of service as the primary FDM which it is temporarily replacing. It should provide sufficient water to meet residential needs and to maintain near peak hour pressures in industrial areas to ensure that essential machinery requiring water pressure can operate. This scenario performs for better than that. Minimum peak hour pressures are comfortably met and are only 2 – 3 psi below what the 750 FM alone provides. Similarly, fire flow requirements are met in the residential subdivision and in the industrial area range between 241 L/s to 430 L/s, with almost all industrial nodes achieving fire flows over 300 L/s. For the very rare anticipated occasions where the system might have to rely on the SSM only, this option is over designed.

A summary of the general results are as follows:

- Under the Peak Hour condition minimum system pressures in the residential subdivision are 42 -43 psi.
- Under the Peak Hour condition system pressures in the WAA lands are 43 - 45 psi.
- Under the Peak Hour condition system pressures in Phase 1 (south) of the industrial lands are 40 – 441 psi.
- Under the Peak Hour condition system pressures in Phase 2 (north) of the industrial lands are 39 – 44 psi.
- The Peak Hour condition for the 750 FDM does not apply as it is assumed to be out of service for this scenario.
- Minimum fire flow in the residential subdivision is 140 L/s for Single Family and 201 L/s for Multi-Family.
- Fire flows in the WAA lands range from 276 L/s to 384 L/s.
- Fire flows in Phase 1 (south) of the industrial lands range from 298 to 430 L/s.
- Fire flows in Phase 2 (north) of the industrial lands range from 241 L/s to 418 L/s.

Rouge 400 with no 750 FM (Plates 6.19 and 6.20)

This scenario performs to the extent that would be expected of an SSM. With the exception of the periphery road at the north limit of AAW the minimum pressure under peak hour condition is 30 psi or above. Residential fire flows are achieved. Industrial fire flows are only in the 176 L/s to 237 L/s range (one node is 152 L/s) and very likely below the required fire flow requirement for whatever industrial developments locate within the site, but the flows are no worse than what would be expected under a nearby WM break.

A summary of the general results are as follows:

- Under the Peak Hour condition minimum system pressures in the residential subdivision are 33 -34 psi.
- Under the Peak Hour condition system pressures in the WAA lands are 31 - 34 psi.
- Under the Peak Hour condition system pressures in Phase 1 (south) of the industrial lands are 31 - 34 psi.
- Under the Peak Hour condition system pressures in Phase 2 (north) of the industrial lands are 28 - 33 psi. South of the north periphery road all pressures are 30 psi or greater.
- The Peak Hour condition for the 750 FDM does not apply as it is assumed to be out of service for this scenario.
- Minimum fire flow in the residential subdivision is 133 L/s for Single Family and 194 L/s for Multi-Family. Upsizing of local small diameter WMs should increase these flows for Multi-Family areas to 200 L/s.
- Fire flows in the WAA lands range from 194 L/s to 212 L/s.

- Fire flows in Phase 1 (south) of the industrial lands range from 194 L/s to 237 L/s.
- Fire flows in Phase 2 (north) of the industrial lands range from 152 L/s to 201 L/s.

The results summarized above are presented in the following Table 12

TABLE 12: PERFORMANCE OF SECONDARY SUPPLY OPTIONS

	750 FDM No Secondary	No 750 FDM No Secondary	Rouge 300 No 750 FDM	Inkster 300 No 750 FDM	Rouge 600 No 750 FDM	Rouge 400 No 750 FDM
Residential PHD	45 - 48 psi	28 – 40 psi	31 – 41 psi	34 – 44 psi	42 – 47 psi	33 – 42 psi
WAA AREA 8 PHD	47 – 50 psi	25 – 26 psi	32 – 33 psi	31 – 34 psi	43 – 45 psi	31 – 34 psi
Phase 1 south PHD	44 – 49 psi	23 – 24 psi	28 – 32 psi	30 – 32 psi	40 – 44 psi	31 – 34 psi
Phase 1 north PHD	43 – 48 psi	19 – 24 psi	27 – 31 psi	28 – 32 psi	39 – 44 psi	28 – 33 psi
750 FM PHD	47 psi	n/a	n/a	n/a	n/a	n/a
Residential Single Family Fire Flow	142 – 388 L/s	122 – 166 L/s	120 – 253 L/s	132 – 298 L/s	140 – 366 L/s	133 – 346 L/s
Residential Multi-Family Fire Flow	200 – 361 L/s	145 – 174 L/s	169 – 202 L/s	194 – 229 L/s	201 – 344 L/s	194 – 224 L/s
WAA AREA 8 Fire Flow	320 – 515 L/s	120 – 124 L/s	182 – 196 L/s	190 – 209 L/s	276 – 384 L/s	194 – 212 L/s
Phase 1 south Fire Flow	340 – 531 L/s	117 – 134 L/s	180 – 200 L/s	190 – 218 L/s	298 – 430 L/s	194- 237 L/s
Phase 1 north Fire Flow	289 – 530 L/s	99 – 116 L/s	141 – 184 L/s	154 – 197 L/s	241 – 418 L/s	152 – 201 L/s

The No Feeder Main or Secondary Supply option clearly shows the need for a secondary supply. With no secondaries there are many locations throughout the AAW lands that do not meet the minimum 30 psi pressure under PHD conditions; minimum fire flows can not be achieved for Multi-Family developments; and fire flows are inadequate for industrial development.

The results indicate that the Rouge 600 secondary option performs almost as well by itself as does the 750 mm FDM. The Rouge 600 option provides a much higher level of service than would normally be expected and given the high cost of the option due to the length and size of the secondary pipe, a smaller diameter option is preferred.

The Rouge 300 option, like the No 750 FDM No Secondary option is also inadequate. Under PHD condition the residential subdivision meets the 30 psi minimum pressure requirement, however approximately one half of Phase 2 of the industrial lands do not. Further, while both the WAA lands and Phase 1 of the industrial

development do meet the 30 psi requirement throughout, these pressures are only just achieved; a substantial number of nodes only meet 30 or 31 psi.

Both the Inkster 300 and the Rouge 400 options provide similar levels of service and improve upon the Rouge 300 option. They both meet all system requirements in the residential subdivision, although depending on the specific location of Multi-Family development some upsizing of smaller diameter WMs may be necessary to achieve the Multi-Family fire flow. They both also provide slightly better than the minimum 30 psi PHD pressure throughout most of the industrial lands. In both cases they only achieve 28-29 psi along north periphery of the site, and Inkster 300 has a few nodes at exactly 30 psi elsewhere in the industrial lands while Rouge 400 does not. They both provide similar fire flows throughout the industrial lands, although again Rouge 400 provides slightly better flows.

While both Inkster 300 and Rouge 400 could function as an SSM we recommend that Rouge 400 be selected and have proceeded with the remainder of our analysis based on this option. Both options provide similar performance at the north end of AAW, but Rouge 400 performs slightly better than Inkster 300 elsewhere in the system and allows for better flexibility in how the development proceeds. Rouge 400 also avoids any potential jurisdictional issues since the Inkster 300 route is significantly longer, crosses through the RM of Rosser and requires several railway and creek crossings which would result in greater encased pipe lengths and associated costs. The Inkster 300 also passes through areas of shallow till and bedrock that would cost more to install on a linear meter basis than the Rouge 400 which is anticipated to be constructed primarily in the clay strata. The Rouge 400 secondary option with the 750 mm FDM in-service and active thus becomes the Final Full Network Model.

6.5.2 FULL BUILDOUT ANALYSIS FINDINGS

Using the Final Full Network Model, we performed a variety of simulations to analyze the capabilities and capacities of the water distribution system under various conditions.

With the Final Full Network Model including the Rouge 400 SSM we first analyzed the three main analysis conditions: system pressures under PHD; available fire flow with a 20 psi residual under MDD; and travel time/age of water in the system under ADD.

6.5.2.1 Full Buildout – Fire Flow Analysis

Plate 6.21 shows the available fire flow throughout AWW while maintaining a 20 psi residual pressure in the system. This shows that fire flows for all land uses can be achieved at all nodes except one. Minimum Fire Flows are as follows:

TABLE 13: FULL BUILDOUT MINIMUM FIRE FLOWS

Servicing Classification	Required Minimum Fire Flow (L/s)	Actual Minimum Fire Flow (L/s)	Model Node
Single Family Residential	100	149	J-530
Multi-Family Residential	200	219	J-531
Commercial	250	514	J-705
Industrial[1]	320	332 317 293	J-789 J-900 J-781

Note:

1. *The minimum required fire flow was revised to 320 L/s from 383 L/s to suit a predominantly 300 mm grid as discussed in Section 6.4.3 under "Third Stage: Initial Full Model Construction"*
   Nodes J-900 and J-781 are the only two industrial nodes with fire flows less than 320 L/s. Fire flows at either node could be increased, if necessary, by upsizing the local Water Mains connecting to the node.

6.5.2.2 Full Buildout – Peak Hour Analysis

Plate 6.22 shows available system pressures under the Peak Hour Demand condition. In all non-Feeder Main water distribution piping the pressures are above 40 psi, comfortably above the minimum pressure of 30 psi. In the 750 mm FDM pressures range from 47 psi to 48 psi, above the minimum pressure requirement of 45 psi for FDMs.

We also simulated this scenario with the Sturgeon Road FDM upsized to a 900 mm diameter pipe (not shown). At the north end of the FDM, OS4, the increase in pressure was approximately one psi. At nodes further south along the FDM the increase in pressure was less than one psi. Essentially, upsizing to a 900 mm FDM produces a negligible increase in system pressure.

6.5.2.3 Full Buildout – Average Day – Water Age Analysis

Plate 6.23 shows the age of the water as it is drawn from each node in the system under an Average Day condition. The age represents the travel time from the model's connection points to the City distribution system and the nodes in question. It does not include the travel time between the water leaving a City reservoir and travelling along a FDM to the edge of the AAW lands.

With one exception, the maximum travel time for this simulation is 27.9 hours at Node J-788. The City indicates that they have performed similar analyses of travel times for water in large neighborhoods and developments and found the time from water leaving a FDM and entering a development to the time when it is drawn from the system to be between a few hours to up to three days. These results are therefore in line with typical City findings elsewhere in their system.

Note the results at Nodes J-40 and J-527 where the age of the water is 72 hours. This is not the actual age of the water at these nodes, rather it is the cut-off limit used by the model for this analysis. The Buchanan system rating curve is much weaker than the curves at other connection points to the City system, and therefore, along the Buchanan WM, the ADD flow would actually flow out of AAW and into the existing City system if the model allowed. However, the model is set up to treat Buchanan, and indeed all the connection points, as sources of water flowing into AAW and so cannot duplicate the reverse direction of flow. As a result, since the model cannot push water into the network through Buchanan, it treats Buchanan as a stagnant WM

with no flow at all and with all water into the network coming from the other modeled input locations. This does not mean that the Buchanan connection is unnecessary. It functions as an alternate source of water in the event of pipe breaks elsewhere, particularly if the Cavalier connection is out of service. Also, while it is not required to meet the requirements for the average day condition, it does supply pressure and flow to AAW under fire flow and peak hour conditions.

This 72 hour cut-off is seen in one or more connection points in most of the travel time analyses presented herein and in each case does not represent stagnation within the system, but merely that the flows in these pipes would in reality being flowing south out of AAW under the ADD condition.

Water age in the city is 4-5 days at the extremities of the system. The anticipated travel times indicated by the current model, whether for the full buildout scenario or for a half developed first stage, are not expected to exceed 48 hours are further anticipated to not cause the overall travel time from reservoir to service node in AAW to exceed city norms. However, during detailed design, the Average Day condition should be re-analysed using the city's complete water model to determine the total travel time of water beginning at the city reservoir system, through the feeder main network, and finally to the individual nodes of the AAW. This analysis should consider both the full buildout scenario and the initial stages proposed at that time.

6.5.2.4 Full Buildout – Sensitivity Analysis

It is unknown exactly what industries will locate within the developed AAW lands, and therefore what their exact water usages will be. To test the sensitivity of the model and have some understanding of what effect increases in water usage may have on the system, we used the Final Full Network Model to simulate both the Maximum Day plus Fire and the Peak Hour Conditions for flows based on 100%, 110%, 120% and 130% of the Average Day Demands multiplied by the MDD and PHD peaking factors. An analysis for the age of water travelling in the system under an Average Day condition was also investigated. In this case we used the Final Full Network model to simulate the Average Day Demand Condition for 100%, 75% and 50% of the average day flows.

Plates 6.24 through 6.27 show the Maximum Day plus Fire results, Plates 6.28 through 6.31 show the results for Peak Hour Demand, and Plates 6.32 through 6.34 show the Average Day travel time results.

Results from some typical nodes are shown below:

TABLE 14: FULL BUILDOUT MAXIMUM FIRE FLOW

Model Node	100% Fire Flow (L/s)	110% Fire Flow (L/s)	120% Fire Flow (L/s)	130% Fire Flow (L/s)	% Change in Fire Flow (100% to 130%)
J-530 Residential	149	147	144	141	5.4%
J-505 Residential	341	332	324	314	7.9%
J-720 WWA Area 8	384	374	363	352	8.3%
J-900 WWA Area 8	317	309	300	291	8.2%
J-704 Industrial (south)	537	519	501	483	9.9%
J-737 Industrial (south)	623	603	583	562	9.8%
J-788 Industrial (north)	381	369	357	344	9.7%
J-781 Industrial (north)	293	283	274	264	9.9%
J-120 750 Feeder Main	664	634	604	574	13.3%

For every 10% increase in the Maximum Day Demand the maximum fire flow available is reduced by approximately 1.4-2.0% in the residential area, 2.5-3.5% in the industrial area, and 4.5-5.0% in the 750 mm FDM. Very generally, for the points selected, this can also be viewed as a reduction of 1.5% in 200 mm and 250 mm residential pipe, 2.5% in 300 mm pipe, 3.5% in 400 mm pipe, and 4.5% in 750 mm pipe. These reductions per pipe size do not hold true everywhere in the model as evidenced by the results shown in Plates 6.24 through 6.27, but do show a general trend. In the smaller diameter pipe of the residential area the overwhelming portion of the flow in these mains is the fire flow; increases in the maximum day demand will have a lesser effect on the fire flows here than it will in larger dimeter pipes. In the larger diameter piping in the commercial/industrial areas, the maximum day demand forms a greater part of the total flow in the pipe and therefore variations in the demands will have a greater impact on the flows, even fire flows.

TABLE 15: FULL BUILDOUT PEAK HOUR PRESSURE

Model Node	100% PHD Pressure (psi)	110% PHD Pressure (psi)	120% PHD Pressure (psi)	130% PHD Pressure (psi)	% Change in PHD Pressure (100% to 130%)
J-530 Residential	49	48	47	46	6.1%
J-505 Residential	47	46	44	43	8.5%
J-720 WWA Area 8	49	48	46	45	8.1%
J-900 WWA Area 8	49	48	46	44	10.2%
J-704 Industrial (south)	45	44	42	41	8.8%
J-737 Industrial (south)	48	47	46	44	8.3%
J-788 Industrial (north)	46	45	43	42	8.7%
J-781 Industrial (north)	44	43	41	40	9.1%
J-120 750 Feeder Main	47	46	44	43	8.5%

For every 10% increase in the Peak Hour Demand the pressure in the pipe decreases by approximately 1.0 to 1.3 psi, or about 3%. Should the PHD increase by 20%, the pressure in the FDM at OS4 drops to 44 psi, below the minimum FDM pressure of 45 psi.

There are three means which can be employed to control, or guard against a 120% PHD condition:

- The 750 mm FDM could be upsized to 900 mm, but this is not realistic or recommended. The cost would be prohibitive for the sake of gaining at most one psi in the FDM. Additionally, the larger diameter pipe would result in lower pipe velocities which, while likely not exceeding the 48-72 hours age limit for water in the system, would certainly increase travel times to some nodes beyond the current maximum of 27.9 hours.
- Portions of the pipe grid within the industrial area could be upsized to 400 mm from 300 mm, but again this is also not cost effective. The most needful locations of the effects of pipe upsizing would be in the northern portion of the AAW, while the most effective location for the upsizings are in the southern portion. The Initial Full Buildout Scenario, with analyses shown earlier on Plates 6.06, 6.07 and 6.08 illustrate this concept. There is a great deal of additional 400 mm water main in this scenario which is only necessary to improve conditions at isolated nodes around the northern periphery of the site and some points mid-points along the longer east-west streets. While the cost to design and

construct these oversized mains would be the responsibility of the developers, it would be impossible to predict and design for the future demands of the northern portion of AAW while the southern portion is under construction.

- A more structured and reliable way to control overall water demands is through zoning and the development permit process so as to ensure that the combined water usage of all developments does not exceed the overall demands of this Study. In its simplest form, the high water using wet industrial developments and those developments requiring high fire flows would be confined to the southern portions of AWW and along the FM between OS3 and OS4 in the northern portion. Developments with lower water usage and fire flow requirements would be located further away from the 750 FM. In this fashion, the highest flow rates would be confined to the 750 FM itself and the local water main network immediately adjacent to the FM. The outlying portions of the water main grid would have lesser flow requirements.

  In the early years of development, the proportion of higher water using versus the lower water using industries could be markedly different from the anticipated overall ratio in the full buildout scenario, which could complicate the development of the first few industrial stages. If a fixed total allotment for heavy water users is established, with some in the Phase 1 southern portion and some in the Phase 2 northern portion of AAW, then portions of this allotment could be shifted between Phase 1 and Phase 2 depending on the initial industries developing within Phase 1.

TABLE 16: FULL BUILDOUT AVERAGE DAY TRAVEL TIMES

Model Node	100% ADD Travel Time (hours)	75% ADD Travel Time (hours)	50% ADD Travel Time (hours)	% Increase in Travel Time (100% to 50%)
J-530 Residential	25.8	33.0	47.6	84.5%
J-505 Residential	5.8	8.0	10.7	84.5%
J-720 WWA Area 8	7.7	10.0	14.5	88.3%
J-900 WWA Area 8	21.2	27.9	40.1	89.2%
J-704 Industrial (south)	3.0	4.1	6.3	110.0%
J-737 Industrial (south)	3.3	4.1	5.5	66.7%
J-788 Industrial (north)	27.9	34.8	45.0	61.3%
J-781 Industrial (north)	13.9	17.7	25.6	84.2%
J-120 750 Feeder Main	5.4	6.8	9.5	75.9%

There is no strong correlation between the percentages shown, however in all cases when the ADD is reduced by half, the travel time within the network is below 48 hours.

6.5.3 PHASE 1 STAGING

AAW is divided into Phase 1 in the south and Phase 2 in the north. All the prior analyses to this point were of the full buildout scenario. We now use the Final Full Network Model to analyze the staged buildout of just Phase 1 of the AAW, to determine system performance over the course of the gradual buildout of the Phase and if there should be any restrictions on the sequence or locations of the initial phasing of the development.

Phase 1 can be divided into three distinct sectors: the residential neighborhood, the WAA lands west of the extension of Moray Street, and the Commercial/Industrial lands constituting the remainder of the Phase. We approached the staging of Phase 1 in two ways. We first analyzed an arbitrary initial first stage in each of the three sectors. We then analyzed the whole of Phase 1 at the 25%, 50% and 100% complete construction intervals (assuming a similar percentage of development within each sector), representing approximately the 5, 10 and 20-year time periods of the development. These are each discussed below:

6.5.3.1 Residential Subdivision

Plates 6.35, 6.36 and 6.37 show Maximum Day plus Fire, Peak Hour and Average Day Demand conditions with an arbitrary first stage located in the westernmost portion of the residential subdivision. This particular stage is the furthest removed from existing City water supply sources and so would exhibit the lowest level of performance of any stage in the residential subdivision.

Connections to the City water distribution system are at Buchanan and Cavalier only. Fire flows are sufficient for both single and Multi-Family family dwellings throughout the phase. Of interest is that fire flows in this scenario are slightly greater than the same fire flows for the full buildout scenario. This indicates that for this particular location as a first stage, 100% of the Cavalier flow obviously flows into this stage, whereas under the full buildout, a portion of the flow from Cavalier travels through the subdivision and into the industrial area. For this first stage then, Cavalier operates at a higher starting pressure on its flow/pressure system curve then it would for full buildout as the demands for the stage do not include the additional demands from the full buildout to which Cavalier would contribute. This increase in operating pressure results in the slightly higher fire flow for the single first stage scenario. Pressures during Peak Hour Demand are greater than 50 psi, well above the 30 psi minimum required.

Under the Average Day condition, the maximum age of the water in the system is 27.4 hours. As was noted in Section 6.5.2.3, the 72 hours listed at Nodes J-40 and J-527 do not indicate the actual travel time at these nodes but is rather the cut-off time used in the analysis. In this scenario, flows would flow out of AAW into the City system south of Saskatchewan, but the model assumes Buchanan is a source of water into AAW and can not duplicate this flow. Instead the model treats Buchanan as a stagnant WM and assigns the cut-off limit of 72 hours to the age of water at these two nodes. While Buchanan is not required to meet the requirements for the average day condition, it does function as a secondary source of water and supplies pressure and flow to the stage under fire flow and peak hour conditions.

6.5.3.2 WAA Area 8 Lands

Plates 6.38, 6.39 and 6.40 show Maximum Day plus Fire, Peak Hour and Average Day Demand conditions with the very first sub-stage within AAW located along the northward projection of Moray Street in the WAA lands. The Sturgeon Road FDM is extended past the residential subdivision to Offtake Structure 3 with a 400 mm WM extending from the FDM back to the City water distribution system at Moray Street.

Fire flows range from 327 L/s to 396 L/s along the Moray Street extension. Peak Hour Demand pressures are all above 50 psi, and the maximum age of water in the system is 19.4 hours.

Similar to the previous case where the first phase is located in the west portion of the residential subdivision, the flow during the average day condition is one way, flowing from the Sturgeon Road FDM in to, and then out of, the WAA lands and back into the City's existing water distribution system at Moray Street. While not

providing any flow under the average day condition, the Moray Street connection is necessary to provide pressure and flow under fire flow and peak hour conditions, and as a secondary supply to the stage.

6.5.3.3 Commercial/Industrial Lands

Plates 6.41, 6.42 and 6.43 show Maximum Day plus Fire, Peak Hour and Average Day Demand conditions with the very first development located in the industrial area around the WWLS and Offtake Structure 3.

Fire flows range from 388 L/s to 732 L/s. Peak Hour pressures are all above 50 psi and the maximum age of water in the system is 35.3 hours

Note that this stage does not include a secondary water source, but otherwise meets all system requirements. To develop this stage as a first industrial stage, a secondary supply would need to be developed. In Section 6.5.4 we revisit this stage with a secondary line from Moray included to investigate the potential of stagnation in the line.

Also note that should the development of WAA Area 8 not have begun at this point, other secondary water sources could be developed. These could be the Rouge 400 SSM and corresponding 400 LDWM, or a parallel 400 LDWM installed within the Sturgeon Road R.O.W. back to Saskatchewan Avenue.

6.5.3.4 Phase One - General

In Section 4.2, a 20-year development plan was created for Phase 1 of AAW. The plan is not a fixed recommendation or requirement but is rather intended to show what a typical development roll out would be at the 5, 10, 15 and 20-year marks. It was developed under the assumption that development would proceed simultaneously in the residential subdivision, the WAA lands, and the remaining commercial/industrial lands and that the entire Phase One would be constructed over the 20-year period. We have therefore modelled and evaluated the development at the 5, 10 and 20-year stages.

Phase One – Year Five (25% developed)

Plates 6.44, 6.45 and 6.46 show Maximum Day plus Fire, Peak Hour and Average Day Demand conditions after five years of development and assumes approximately one quarter of Phase One has been developed.

Fire flows range from 222 L/s to 404 L/s in the residential subdivision and from 158 L/s to 739 L/s in the industrial lands. Note that the 158 L/s fire flow is at the end point of a very long cul-de-sac road in the WAA Area 8. In practise, this long road would not be constructed until there was other development within Area 8 allowing for interconnectivity within the local system through a grid network. Other than along this one long road, the minimum industrial fire flow is 324 L/s.

Further to the phased development within WWA Area 8, available fire flows along the side streets branching eastwards off of the extension of Moray will decrease as development moves further away from Moray. Compared with the results of the simulation showing a first phase in WAA lands running north south along Moray (Plate 6.37), it is evident that developing WWA Area 8 in interconnected north-south strips moving gradually east from Moray will result in better overall performance of the water distribution system than development in east-west strips moving gradually north from Saskatchewan Avenue.

Peak Hour pressures and the Average Day age of the water in the system are both well within acceptable limits.

Note that under Average Day Demand water flows out of AAW along Cavalier and along the 300 mm Sturgeon domestic main as reflected by the cut-off time of 72 hours at nodes on these mains.

Phase One – Year 10 (50% developed)

Plates 6.47, 6.48 and 6.49 show Maximum Day plus Fire, Peak Hour and Average Day Demand conditions after ten years of development and assumes approximately one half of Phase One has been developed. It is also assumed that a third WM has been developed under the railway and into the WWA Area 8 area of Moray Street.

At this point there is sufficient interconnectivity within the water distribution system to meet all system needs. Fire flows are achievable in all areas to suit their land use classification (although in WWA Area 8 this requires development to proceed west to east in north south strips instead of developing south to north as shown). Peak Hour pressures are all above 50 psi, and the maximum age of water in the system is 45.2 hours near the Buchanan connection in the residential subdivision. As is the case in previous simulations, the Buchanan connection is treated as a stagnant main under the Average Day Demand condition as under this condition water would actually flow south, out of AAW.

Phase One – Year 20 (100% developed)

Plates 6.50, 6.51 and 6.52 show Maximum Day plus Fire, Peak Hour and Average Day Demand conditions after twenty years of development and assumes the full development of Phase One.

At the completion of Phase One, the model shows that fire flows are achievable throughout (assuming a maximum required industrial fire flow of 320 L/s), peak hour pressures are all above 50 psi and that the age of the maximum age of the water under the average day condition is 31.3 hours.

Again, during average day conditions, water flows out of AAW through Buchanan as noted in previous ADD simulations.

6.5.3.5 Summary of Phasing Analysis

A number of phasing scenarios have been reviewed including alternate arbitrary year one single stages constructed in each sector of Phase 1 (residential subdivision, WAA Area 8, and the industrial lands near the proposed WWLS), as well as snap shot analyses of Phase 1 at the projected 5, 10 and 20 year time frames corresponding to the approximate 25%, 50% and 100% completion levels. In each of these cases the distribution system is capable of meeting minimum fire flow requirements for residential and a minimum fire flow of 320 L/s in industrial areas if the development proceeds without long single dead-end WMs with no interconnections. Peak Hour Demand pressures are consistently above 50 psi, and travel times of the water in the system are generally less than 24 hours and never more than 48 hours.

While this analysis supports the conclusion that the proposed FDM and water network is capable of meeting the operational requirements for a potable water distribution system it must be noted that each of the phasing scenarios analyzed assumes the full development of the stage, or combination of stages, under consideration within any given scenario. In the next Section we return to consideration of the first initial stage of AAW and what the effects of only a partially developed stage may be on travel time within the water system.

6.5.4 STAGNATION CONCERNS IN FIRST STAGE

This section looks at the case where the first stage of Phase 1 may be recently constructed, only one or two industries have developed their lots and then, whether due to an economic downturn or some other reason, further development stalls. In this case fire flows and peak hour pressures will certainly remain at acceptable minimum levels within the stage. With less demand being drawn from the system, fire flows would be increased by a perhaps one or two L/s and peak hour pressures would be a fraction of a psi larger than the flows and pressures anticipated for the full development of the stage. However, with less demand, average day flows and velocities within the stage would decrease, which in turn would increase the travel time of water flowing through the network This raises the concern that in an extreme case travel time could exceed 72 hours raising the risk of contaminating the water through stagnation.

For this analysis we return to two analyses undertaken previously: a very first stage located in the industrial lands near the proposed WWLS, (Section 6.5.3.3), and a first stage located in WAA Area 8, (Section 6.5.3.2). We have not considered a residential subdivision first stage for a number of reasons:

- Residential stages are generally smaller in area, with shorter travel routes through the piping to the far points of the stage, resulting in reduced travel times compared to industrial areas.
- Residential stages generally use smaller diameter pipe which will result in greater velocities and reduced travel times of water for a given flow than in industrial stages.
- Residential stages in AAW are located closer to the existing City water distribution system then industrial stages, again resulting in reduced travel lengths and times.

The two scenarios examined in this section both include the extensions of the 750 mm FDM and the 400 mm Moray Street WM to Offtake Structure 4. The industrial scenario assumes development around the intersection of Sturgeon Road and the Sturgeon Access Road with the remainder of the stage and the extension of Moray Street undeveloped, while WAA Area 8 scenario assumes development of only the first two blocks of the Moray extension with no development elsewhere.

Plate 6.53 shows the results of the travel time analysis for the industrial stage. The total average day demand for the scenario is 8.0 L/s whereas the total ADD for the full stage is 16.2 L/s. Moray functions only as a second WM connection to the stage with no development along its length. Travel times range between 36 hours and 55 hours, which is less than the 72-hour maximum limit, but also close enough to that limit to cause concern if flows were to be reduced further.

As in previous travel time simulations, the model encounters the 72 hour cut-off limit, this time on Moray Street, indicating that the entire flow in this scenario is being delivered through the 750 mm FDM and that if the model allowed, water would flow from WAA Area 8 back into the City's distribution network along Moray. The water takes 36 hours to travel through the FDM to Node J-730, where it then disperses through the stage, taking a further 19 hours to reach Node J-700.

Plate 6.54 shows the result of the travel time analysis for the WAA Area 8 stage. The total average day demand for the scenario is 8.5 L/s whereas the total ADD for the full stage is 18.6 L/s. Again the 72-hour cut-off can be seen at Node J-80, indicating that the entire flow travels through the 750 mm FDM and then into WAA Area 8 from the west. Travel time is 34 hours to Offtake Structure 3, and another 8 hours to Node J-727 for a maximum travel time of 42 hours.

Both of these scenarios are within the 72-hour limit for the age of water within the system. In each case, the water demand due to development within the corresponding stage was assumed to be just less than half the anticipated demand for the full development of the stage. When development in the first industrial stage results in a minimum initial average day flow of 8-9 L/s representing 50% of the average daily demand within a compact stage, then stagnation of water within the FDM and the AAW distribution system is not anticipated to be a concern. If subsequent stages are developed so as to maintain some degree of compactness, i.e. constructed adjacent to previous stages, then as shown in the 25% and 50% development scenarios the water distribution will be capable of meeting the PHD, Fire Flow, and ADD requirements as outlined within this report.

While it is realistic to expect that no stage of the development would proceed without a clear expectation that at least half the stage would be developed immediately, this cannot be completely guaranteed. If possible, the installation of WMs associated with any stage could be delayed until construction of the buildings, factories, facilities, and offices on some percentage of the lots were begun, as the WM installation could be completed much more quickly than the development of the individual lots, and water would be available once the buildings are complete. This is however unrealistic as the normal order of construction; underground first, followed by roads, followed by building and surface development exists for good reasons: roads are necessary to get machinery and materials to building sites, and the underground is constructed before the roads so as to not damage the road afterwards. This is pertinent as the first industrial stage outside of WAA Area 8 will require the construction of the 750 mm FDM to Offtake Structure 3.

Development in the industrial lands will require two water supply mains into the first stage. If the 750 mm FDM is not constructed, these would have to be two of: the Moray Street extension to OS3, the LDWM from Rouge Road which would require a series of completed residential stages in the western subdivision, or a series of completed residential stages in the eastern subdivision that extend to the first industrial phase. In either case, a series of residential stages would have to first be constructed. It is unrealistic to expect that industrial developments will be willing to wait for residential development to bridge the gap between Saskatchewan Avenue and the industrial site. Therefore, construction of the 750 mm FDM will be required for the first industrial stage.

The first industrial stage outside of WAA Area 8 should be located along Sturgeon Road and include the location of the proposed WWLS, essentially conforming to the stage shown on Plate 6.53. This will minimize the amount of sewer to be constructed to service the individual lots and also provide an existing road to allow access to the building sites. Most of the 750 mm FDM can be constructed far enough away from the Sturgeon Road pavement that major road damage can be avoided, and minor damage reduced. This would allow for a later start on the FDM construction with completion timed to just prior to the developer beginning the construction of the local domestic WM grid to service the first stage.

Finally, as evidenced by the social and economic effects of the pandemic response in 2020, however well planned and however well committed to the first Stage a developer and his proposed industrial tenants may be, an unforeseeable situation could arise where the water main and feeder main systems are installed, tested, charged with water, and then development comes to a halt. Consideration should be given to requiring the developer to periodically maintain the water system until such time as development within the Stage results in water usage in the previously discussed 8-9 L/s range. Maintenance would consist of periodic

bacteriological testing of the system and if no services are connected re-chlorinating as necessary, or if some services are connected, flushing the main periodically.

6.6 Construction Sequencing

To provide water servicing to AAW, construction of the following regional infrastructure is required:

- the 750 mm FDM between and including Offtake Structures 1 to 3.
- the 400 SSM between and including Offtake Structures R1 and R2.
- the 750 mm FDM between and Offtake Structures 3 to 4 and including OS4.

The proposed timing to construct each of these components is shown in the following Table. This schedule will likely vary depending upon economic and other conditions in the coming years.

TABLE 17: REGIONAL WATER SERVICING CONSTRUCTION SEQUENCING

Time	Component
Year 0	750 mm FDM from OS 1 to OS 3, Offtake Structures 1, 2, and 3
Year 5	400 SSM from OS R1 to OS R2, Offtake Structures OS R1 and OS R2
Year 20	750 mm FDM from OS 3 to OS 4, Offtake Structure OS 4

It is anticipated that the first industrial stage outside of WAA Area 8 will proceed in Year 1. The 750 mm FDM must therefore be completed in Year 0 to provide water for the stage.

Portions of the LDWM extension from the Rouge Road secondary to Offtake Structure 3 will likely be constructed in the first few stages of the industrial lands and the western residential subdivision. It is anticipated that by Year 5 that over half of the LDWM will be completed. At that point the 400 mm Rouge Road Secondary Water Supply Main should be scheduled for construction so as to provide full service to the LDWM when completed shortly thereafter.

The 750 mm FDM to Offtake Structure 4 is scheduled for Year 20 when construction of Phase 2 begins.

6.7 Preliminary Design of Feeder Main and Secondary Supply Main

At the present time, the design of the 750 mm Sturgeon Road Feeder Main and Secondary Supply has been developed to a preliminary design stage and is shown on the plan-profile drawings. The overall concepts are in place, and essential details identified and brought to a similar preliminary stage. A discussion of the various design component that have been considered for the FDM and Secondary Supply Main are presented below:

6.7.1 PIPE DIAMETERS

The Sturgeon Road Feeder Main is sized as 750 mm in diameter along its entire length from Moray and Silver to the northern terminus of the FDM within the AAW lands. The Secondary Supply Main and the Large

Diameter Water Main are 400 mm in diameter along their entire lengths, both between the take-off from the existing 600 FDM at Hamilton and Cavalier to the intersection of Cavalier and Saskatchewan, and from this intersection to and through AWW to Offtake Structure 3. The hydraulic model and analysis for the AAW lands as previously presented shows that with these sizes, a WM distributions system can be developed in the commercial/industrial and residential portions of the AAW lands that meets the various fire flow, peak hour, and average day design requirements for FDMs and distribution systems.

6.7.2 PIPE MATERIAL

All Water Main piping was modelled as C900 PVC for diameters 300 mm or less, and C905 PVC for diameters greater than 300 mm.

6.7.3 ROUTE/ALIGNMENT

The route for the Feeder Main travels primarily along Sturgeon Road (the first leg, between Offtake Structures 1 and 2 travels along the undeveloped right-of-way of the future Silver Avenue extension). The existing cross-section along most of Sturgeon Road ROW is 36.6 m wide including a paved two-lane road. Future development of the AAW land will likely necessitate a widening of the existing Sturgeon Road ROW. These changes would likely be developer driven. At this stage of the project planning however, the City does not have any plans to upgrade or change the existing Sturgeon Road configuration within the Study Area which was confirmed through RFI No. 5. Specific alignments relative to the existing road and property lines as shown on the plan-profile drawings were therefore developed using the best available information for the existing conditions.

Silver Avenue ROW

The Feeder Main begins at the proposed Offtake Structure 1 on the 900 mm Silver Avenue FDM at Silver and Moray. It then travels west through the undeveloped Silver Avenue ROW to Sturgeon Road. This is a protected natural area, abutting the Living Prairie Museum. The alignment shown on the plan-profiles drawings attempts to minimize the length of the FDM and the associated amount of prairie disturbance by paralleling the existing asphalt bicycle and walking path through the field. Once the alignment intersects the heavily forested western half of the ROW it bends to intersect Sturgeon Road at a right angle and minimize the amount of tree removal. This alignment will be subject to change pending the investigation of construction requirements within these lands. At Sturgeon Road, the FDM connects to the Rouge Road FDM at Offtake Structure 2.

Sturgeon Road – Offtake Structure 2 to Offtake Structure 3

At Sturgeon Road and Silver the route turns north and heads to the AAW lands along the east side of Sturgeon Road. To avoid installation through the roundabout at Murray Park Road and to also avoid intruding too far eastward into the protected natural area, the proposed FDM alignment is currently established at 3 m east of the extension of the east property line of Sturgeon Road. This alignment also avoids locating the FDM under pavement along Sturgeon Road north of Saskatchewan Avenue where Sturgeon expands to a four-lane road. This alignment then continues north to the intersection of Sturgeon and the Sturgeon Access Road where it turns right and follow Sturgeon Road for two blocks where it connects to Offtake Structure 3.

Sturgeon Road – Offtake Structure 3 to north limit of the City of Winnipeg

Offtake Structure 3 is a major WM connection in AAW. The 750 mm FDM from the south extends through the structure and continues north for three more blocks where it terminates two blocks south of the City boundary at Offtake Structure 4, connecting to a 300 mm crossing main.

At Offtake Structure 3, the crossing main is 400 mm in diameter both to the east and to the west. The eastern 400 mm WM is the extension of the Moray Street WM and is sized to allow for the anticipated fire flows within the WAA Area lands. This sizing will ultimately be developer driven and will depend upon the actual fire flow requirements of the industries that are planning to locate within WAA Area 8.

The western 400 mm connection is the northern terminus of the LDWM beginning at Saskatchewan and Cavalier.

As noted at the start of this section, the existing Sturgeon Road ROW will likely need to be widened to accommodate the full development of above and below ground infrastructure to service the full buildout of AAW. Currently however there are no plans to widen the ROW and therefore the FDM is shown on the plan-profile drawings on an alignment suitable to the existing two-lane road.

Rouge Road Secondary Supply Line

The existing 600 mm Rouge Road FDM extends north from across the Assiniboine River to the south. A portion of the FDM's route runs alongside Cavalier Drive. At some point north of Portage Avenue, Cavalier swerves to the west and the FDM continues north along a back lane parallel to Cavalier. Near the intersection of Cavalier and Hamilton, the FDM turns right and runs along Hamilton eastwards. At this point a connection to the existing 600 mm FDM will be made and a 400 mm SSM will continue northward within an existing established right-of-way. The SSM will continue north to Saskatchewan Avenue and then turn west in the southern boulevard of Saskatchewan. At Cavalier and Saskatchewan, the SSM will connect to the 300 mm Cavalier WM.

At this point further, the main is reclassified as a Large Diameter Water Main. While it will provide a route for a secondary supply of water into AAW, it will also function as a local domestic main which will include connections to crossing WMs, services, and hydrant connections. Its size remains as 400 mm for the entirety of its length.

The Large Diameter Water main portion of the secondary is not shown on the preliminary design drawings as it will be incorporated into the various developer driven development stages as they proceed but is described below.

From Cavalier, the LDWM continues west along the south side of Saskatchewan to the unnamed north south road of the Shadow Plan that connects to Saskatchewan. The LDWM heads north within the right-of-way of the unnamed road, travels through the residential subdivision, crosses to the north side of Centerport Canada Way, then heads east and north along the road paralleling CCW. The LDWM continues along this alignment past the intersection with the Sturgeon Access Road to the road extension from Offtake Structure 3. It then turns east to follow this road and terminates with a connection to the Offtake Structure.

The LDWM is located on the north and west side of CCW to avoid the Interceptor Sewer on the south side of CCW which services the residential subdivision. At the intersection of CCW with the Sturgeon Access Road consideration was given to crossing CCW and connecting the LDWM to the 750 mm FDM at the Sturgeon Road

entrance to the residential subdivision, however the crossing itself would be through the elevated grade separation at CCW and Sturgeon Access Road, and it had been previously determined that the OS3B location was better situated than OS3A as it connects directly to the extension of Moray Street and slightly improves pressures and flows within WAA Area 8. The selected route also avoids the Interceptor Sewer to, and the FCMs from, the proposed WWLS along the Sturgeon Access Road.

6.7.4 ENCASEMENT PIPES

The 750 mm FDM will require installation in an encasement pipe where it crosses under the railway tracks just north of Saskatchewan Avenue. It also crosses the upper reach of Truro Creek between Offtake Structures 3 and 4.

The Railway crossing will be governed by railway regulations which currently require water supply lines to be installed in a steel encasement pipe across the full width of the railway ROW and to have mainline valves on the main at both ends of the crossing.

The creek crossing will be governed by DFO requirements for protecting riparian zones of watercourses. Specific requirements for the creek and drainage channel crossing however will not be known for certain until a proposed construction drawing is submitted in advance of construction.

All of the aforementioned crossings, complete with proposed encasement pipe lengths, are identified on the preliminary design drawings that are included in the Drawings section at the end of this report.

Note that the 400 mm Large Diameter Water Main will also crosses both the railway on the north side of Saskatchewan and Sturgeon Creek and will therefore require suitably sized encasement pipes. These crossings are not shown on the preliminary design drawings as they will be incorporated into the various developer driven development stages as they proceed.

6.7.5 OFFTAKE STRUCTURES / VALVE CHAMBERS

Six Offtake Structures are included in the preliminary design. Four are located on the 750 mm FDM and two on the Rouge Road SSM. The location of these structures is shown on Plate 6.01. The design of the Offtake Structures will typically include:

- A rectangular concrete vault with the 750 mm FDM (or 400 mm SSM) and crossing mains inside connecting with a tee or cross as appropriate.
- A concrete support pedestal to support the FDM and the tee or cross.
- Each pipe will be valved, with each valve also supported by a concrete base with an adjustable valve support.
- Feeder Main valves will be 750 mm AWWA C504 Butterfly Valves with manual actuator and actuator neck extension.
- Water distribution main valves will be 300 mm or 400 mm AWWA C509 gate valves.
- Removable roof panels for access to the FDM and valves.
- An air release valve.
- A sump and drain. The drain will connect to the existing City sewer in the case of Offtake Structures 1 and 2 as well as R1 and R2, and will connect to a rock filled drainage pit in the case of Offtake Structures 3 and 4. Once gravity sewer is constructed up to the structure, the drain will be connected to the sewer.

- Minimum stub lengths with blind flanges will be included at the offtake locations to permit the future connections to be undertaken without impacting the structures.
- Offline hydrants will be installed on the stub to permit flushing of the lines.

In addition to the above, one Offtake Structure will include a pressure monitoring station consisting of a water pressure monitor complete with an external, pole-mounted data recorder with wireless transmission capabilities and a broadcast antenna located at the top of the pole. We recommend the station be located at Offtake Structure 3 where it will be in the best position to most quickly detect changes in system pressure. Pressure losses due to WM breaks will be most quickly detected at this location, allowing for an early response.

Offtake Structure 2 is not preferred for the station location as it generally would not as quickly detect pressure fluctuations that could indicate a problem with the water distribution system within the industrial areas of AAW, and Offtake Structure 4 would not be constructed until Phase 1 is complete and Phase 2 is underway, likely at least 20 years after the construction start of Phase 1.

Of further note is Offtake Structure R2, located at Saskatchewan and Cavalier. The maximum pipe size at this structure is 400 mm, while all other Offtake Structures have maximum pipe diameters of between 600 mm and 900 mm. During detailed design, consideration should be given to converting this structure into a simple 400x400x300 tee.

6.7.6 PROFILES

The profiles shown on the plan-profile drawings maintain a minimum cover of 2.5 m above the 750 mm FDM and the 400 SSM. Offtake Structures are located at high points in the profile where possible so that air can be bled from the FDM through the air release valves in the Structures. It is not feasible however to establish a single low point between two Offtake Structures allowing air anywhere within the pipe to be bled out through an Offtake Structure, due to the lengthy distance between Offtake Structures. The ground profile can generally rise a couple of meters or more somewhere between structures, resulting in a considerable depth of cover over the FDM. To reduce the depth of cover and to better avoid, or at least reduce, encounters with bedrock or till, intermediate highpoints are established in the profile where necessary to keep the depth of cover between 2.5 to 3.5 m.

6.8 Conclusions and Recommendations

6.8.1 SUMMARY

Using the EPANET water distribution modelling software, the development of a water distribution and FDM network within the AAW was analyzed. The analysis consisted of investigating a variety of system configurations under three conditions:

- Maximum Day Demand plus Fire Flow, to determine maximum available fire flows while maintaining minimum residual pressures within the distribution system.
- Peak Hour Demand, to determine minimum pressures in distribution mains and FDMs in non-fire conditions.

- Average Day Demand, to determine the age of water within the distribution system during periods of low flow.

The above analyses were applied to a range of pipe configuration scenarios including:

- Full buildout scenario.
- Various secondary water supply main options.
- Various construction phasing options.

Results and conclusions from these analyses are provided in the following section.

6.8.2 CONCLUSIONS AND RECOMMENDATIONS

6.8.2.1 Full Buildout

- For the development of the Airport Area West lands, an extension of the Silver Avenue FDM from Moray Street to Sturgeon Road and then an extension north along Sturgeon into the AAW lands is necessary to provide pressures and flows to the future local water distribution system for a variety of operating conditions. A 750 mm FDM as shown on Plate 7.01 is sufficient to meet these requirements.
- In the event of the 750 mm FDM being out of service, a secondary water supply line should also be included as part of the water servicing infrastructure. The secondary does not have to equal the performance of the 750 mm FDM but should provide sufficient water to meet residential needs and to maintain peak hour pressures in industrial areas to ensure that essential machinery requiring water pressure can operate. The recommended secondary supply line is a 400 mm extension of the Rouge Road FDM north from Hamilton Avenue to the intersection of Saskatchewan Avenue and Cavalier Drive as shown on Plate 6.01. This line should then be supplemented with a 400 mm LDWM main extension from Saskatchewan and Cavalier, through the residential subdivision to CCW and then on to connect to the 750 mm FDM at Offtake Structure 3.
- A grid of water distribution mains with a minimum diameter of 300 mm, supplemented with some 400 mm mains and connected to the FDM at a small number of Offtake Structures is required to deliver potable water throughout the AAW development. The actual servicing development plan (right-of-way layout) and individual site development plans (specific industries and individual water usage requirements) will determine the optimum location of 400 mm WMs within the grid. The various private developers should develop a mutual overall development plan to identify where WM upsizing above 300 mm may be required.
- To meet the maximum industrial fire flow of 383 L/s requires an inordinate amount of 400 mm WM included in the grid. Reducing the minimum fire flow requirement to 320 L/s reduces the amount of 400 mm pipe required and still provides greater than 383 L/s fire flows throughout most of the industrial area.
- Locations where 400 mm WM is required/recommended:
  - A water distribution main from Saskatchewan Avenue and Cavalier Drive into and through the residential subdivision of AAW and along Centerport Canada Way to Offtake Structure 3. This Large Diameter Water Main will act as a local distribution main with connections to crossing mains, hydrant, and building services, but will also supplement the secondary supply as a connection between the 750 mm FDM and the Rouge Road Supplementary Main.

  - A WM connecting the Sturgeon Road FDM at Offtake Structure 3 to the City's existing water distribution system at Saskatchewan and Moray, to boost pressures in the WWA lands which are otherwise isolated from the AAW lands.
- Connections to the local domestic distribution system are required to supplement the 300/400 mm grid. These connections are all to existing 300 mm mains and are located at:
  - Saskatchewan Avenue and Buchanan Boulevard.
  - Saskatchewan Avenue and Cavalier Drive.
  - Saskatchewan Avenue and Hamilton Avenue.
  - Saskatchewan Avenue and Sturgeon Road.
  - Saskatchewan Avenue and Moray Street.
- Minimum pressures under peak hour demand are well above required minimums in all water distribution piping. However, these pressures are at, or only a couple of psi above, the higher minimum pressure requirement in the Sturgeon Road FDM itself.
- Water in the AAW system takes at most 26 hours or less from the time it leaves the existing City distribution system to when it is consumed at a node.
- Upsizing the Sturgeon Road FDM from 750 mm to 900 mm diameter provides negligible improvements to the system.

6.8.2.2 Residential Subdivision

- A 300 mm "backbone" WM is required within the residential subdivision connecting the existing WMs along Saskatchewan Avenue at Buchanan Boulevard, Cavalier Drive and Hamilton Avenue to the WM grid at the entry to the subdivision along Sturgeon Road. The Sturgeon Road FDM is not required to meet minimum system requirements in the residential subdivision.
- The extension of the 300 mm WM on Sturgeon at Saskatchewan does not significantly contribute to the residential subdivision. The purpose of this main is to service any properties along Sturgeon Road between Saskatchewan and Offtake Structure 3 to the subdivision and act as secondary supply if other connections to the existing water distribution system are out of service.
- Pressures and flows are at their lowest in the westernmost portion of the residential subdivision backing against the Perimeter Highway, partly due the distance from Sturgeon Road, and partly due to the Shadow Plan consisting of long, sweeping Bays and Crescent type streets with little WM interconnectivity. Depending on the finalized plan for this area, some domestic mains may have to be upsized into the 250-300 mm range to achieve minimum residual pressures as was done in the model.
- Under Average Day Flow conditions, water can flow from the residential subdivision south to the existing City system through the Buchanan WM. The Buchanan connection to AAW does however contribute to the system in Peak Hour and fire flow conditions.

6.8.2.3 WAA Area 8 Lands

- In the Shadow Plan as developed there are only two streets into the WAA Area 8 lands east of the extension of Moray Street with poor interconnectivity between the streets. As a result, the industrial fire flow of 383 L/s cannot be realized without adjustments.
- Greater fire flows can be achieved in WAA Area 8 level of protection but requires a combination of upsizing the local Area 8 WM grid above 300 mm in diameter, particularly the extension of Moray Street

to Offtake Structure 3; additional interconnections within the local Area 8 grid; and the development of a third WM across the railway to provide an additional interconnection between the WAA Area 8 and the western portion of AAW.

- Alternatively, the land could be developed for industries or commercial ventures with a lesser fire flow requirement.
- WAA Area 8 should be staged in a series of north-south strips begin at Moray and developing eastward, as opposed to a series of east-west strips developing north from Saskatchewan.

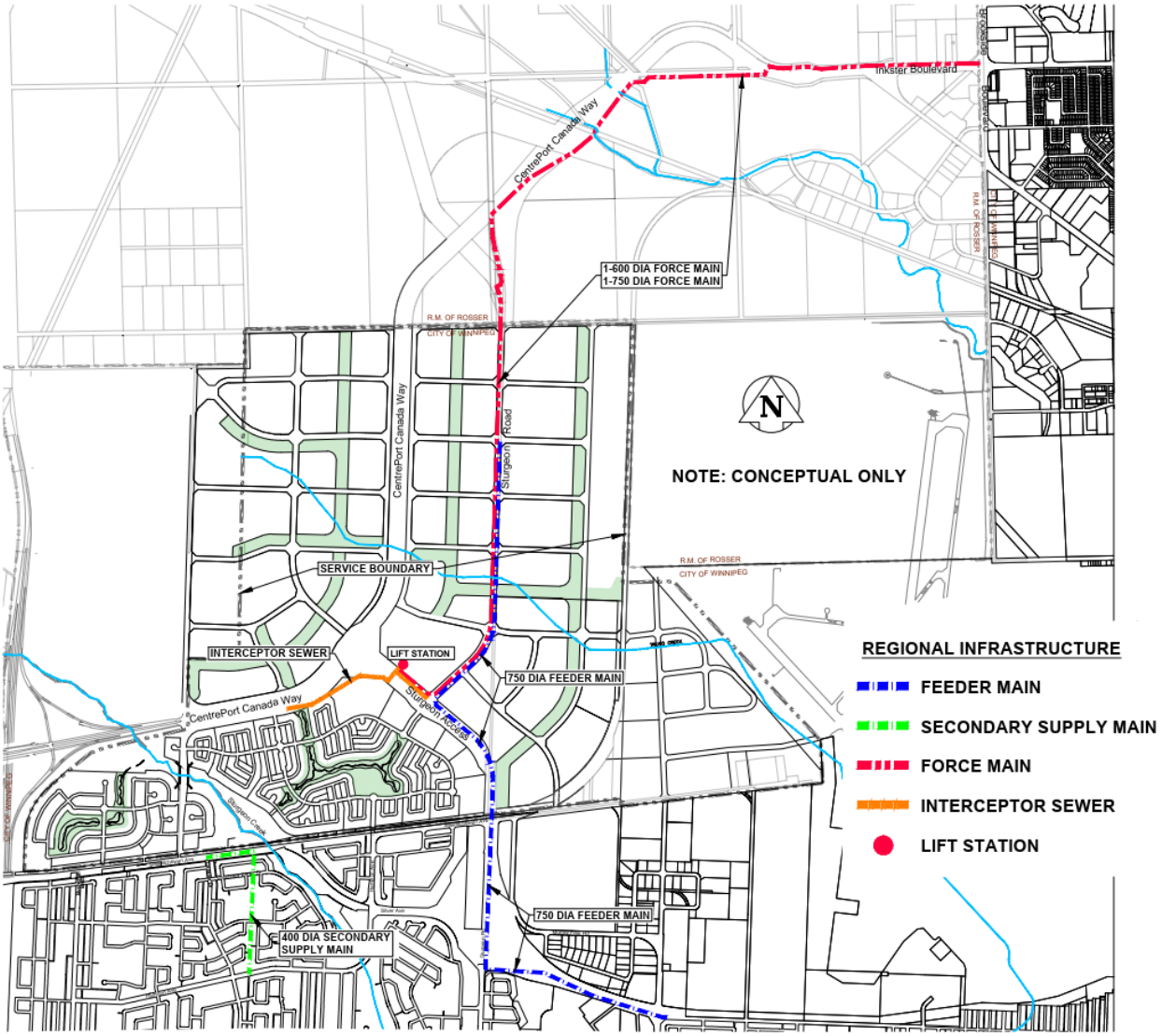
6.8.2.4 Phasing

- Development within Phase 1 could begin anywhere south or east of CentrePort Canada Way.
- Development within the residential subdivision does not require a connection to the 750 mm FDM although it would be a benefit to the subdivision. The subdivision could proceed in advance of the FDM.
- Development of the first industrial stage outside of WAA Area 8 should be located along Sturgeon Road near the proposed WWLS.
- Development of the first stage within WAA Area 8 would be best suited along Moray Street in a north-south strip and include the extension of the Moray WM to Offtake Structure 3.
- Rather than expand outward from one initial starting stage, development is expected to be somewhat scattered with industrial stages in WAA Area 8 and the north and western portions of Phase 1, and up to three stages in the residential subdivision representing the three landowners of the subdivision. Interconnecting WM between these various starting stages are recommended to ensure the system as a whole meets minimum system requirement.
- To avoid water stagnation due to underdevelopment, the installation of the WM distribution system for any isolated industrial stage should not begin until users representing 50% of the water demand for that stage have been identified and are prepared to begin construction.
- Development should preferably expand in such a fashion that the 750 mm FDM, the Moray Street WM extension, and the Large Diameter Water main from Saskatchewan and Cavalier are all constructed to Offtake Structure 3 by Year 5.
- Anticipated construction timing for regional components of the distribution system are:
  - **YEAR 0:** 750 mm FDM and Offtake Structures between OS1 and OS3.
  - **YEAR 5:** 400 mm Rouge Road SSM and Offtake Structures between OS R1 and OS R2.
  - **YEAR 20:** 750 FDM between OS3 and OS4 and Offtake Structure 4.

7.0 EASEMENT AND LAND ACQUISITION

Throughout the development of the preliminary design presented in this report, our team has made every effort to place Regional Infrastructure (shown in Figure 15 below) within public ROW or on City of Winnipeg owned land.

FIGURE 15: REGIONAL INFRASTRUCUTRE



To inform future land agreements required for the proposed designs, our team built on the property boundaries and land ownership information presented in the Land Use Study. Our team supplemented cadastral information obtained from the Manitoba Land Initiative for the City of Winnipeg and the RM of Rosser with 2020 Assessment data and Roll Numbers as well as purchased road and easement plans. We used this information to develop a snapshot of the public ROW available for the proposed servicing infrastructure and to develop a table of future crossing, easement and land acquisition requirements which is

included in Appendix E of this report. Based on our study, we anticipate that only minimal land acquisitions will be required from private landowners to accommodate the proposed Regional Infrastructure for water servicing. Easements may be required along the proposed alignment within Provincial and RM of Rosser ROW however a review of the preliminary design and a discussion related to easement requirements was not undertaken with the Province or the RM of Rosser as part of this study (see Directive 4 in Section 11.0). Consequently, discussions below are mostly restricted to crossing and land acquisition requirements for the proposed Regional Infrastructure.

Feeder Main and Secondary Supply Main

Most of the 750 mm FDM alignment is located within City of Winnipeg ROW. The only instance where the alignment enters another jurisdiction is when crossing the railway ROW north of Saskatchewan Avenue at Sturgeon Road. To complete the crossing, a pipeline crossing application form will need to be submitted to, approved by, the appropriate railway. The 400 mm SSM alignment on the other hand is entirely located in City of Winnipeg ROW and no crossing, easements or land acquisitions will be required for this piece of Regional Infrastructure.

Force Mains

The proposed FCM alignment south of Selkirk Avenue is located within the City's Surgeon Access and Saskatchewan Avenue ROW. North of Selkirk Avenue and through the RM of Rosser however, the alignment encroaches on private properties as well as Provincial and RM of Rosser ROW, before terminating within City limits at the Inkster Boulevard – Brookside Boulevard intersection. In the RM of Rosser, the alignment crosses two separate CP Railway ROW for which crossing applications will be required. The table in Appendix E identifies which portions of the proposed FCM alignment are outside of City of Winnipeg jurisdiction will therefore require crossing, easement or land acquisition agreements with the appropriate owner or authority. Consultation with each of these owners and authorities will be necessary as part of the detail design and construction phase to confirm the proposed alignments and determined if and what type of agreements will be required prior to construction. Using assumptions listed in the Notes under the table in Appendix E, we estimate the approximately 0.7 ha of land will need to be acquired from private landowners to accommodate proposed FCM alignment.

Interceptor Sewer

The proposed interceptor alignments are predominantly contained within the CentrePort Canada Way and the Sturgeon Access Road ROW. On the south side of the CentrePort Canada Way – Sturgeon Access Road intersection however, we have aligned the gravity sewer pipe to run along the inside edge of a region identified by Manitoba Infrastructure as potentially required to construct a grade separated intersection. By following this alignment, the pipe runs through privately owned land which may necessitate easement or land acquisition agreements for this portion of the Interceptor Sewer. Additional discussions with the Province as part of the detailed design stage are required to get a better sense of the timing for the potential intersection upgrades, the acceptability of our proposed pipe alignments and therefore a better understanding of the type of agreements that will actually be required in the future.

Wastewater Lift Station

Based on our analysis, the City of Winnipeg currently does not own any property within the AAW lands that would be a suitable location for the construction of the proposed WWLS. The proposed station location as presented in this preliminary design report is situated on a parcel of land owned by the Province. We estimate that construction of the proposed lift station will require approximately 1.1 ha of land to be purchased.

8.0 CLASS 3 COST ESTIMATE

The following table presents a summary of the estimated costs (in $2020) to provide regional water and wastewater servicing to the AAW region as presented in this design report. Costs are presented for each phase of the project with costs for construction, engineering, external utilities, other costs (such as land acquisition), Contingency, and City staffing and administration charges. The specific construction contracts presented are discussed further in Section 9.3

Stage/Phase (In-service year)	Contract	Description	Construction Contract Value ($2020)	Engineering	Utility	Other	Contigencies	City PM Salary	Administrative Charges	TOTAL
Phase 1A (in-service year 0)	1A	By-pass Lift Station	$3,042,100	$6,649,987	$310,000	$389,000	$6,627,820	$396,000	$1,274,121	$59,980,171
	2A	600 mm Force Main	$14,872,812							
	3	Interceptor and Intake Sewers	$16,409,530							
	4A	750 mm Feeder Main (Silver to OS3)	$10,008,800							
Phase 1B (in-service year 5)	1B	Lift Station sub/superstructure and associated mechanical and electrical to support development for years 6-10	$9,071,955	$1,841,155	$0	$0	$1,835,018	$660,000	$332,211	$16,942,753
	5	400 mm Secondary Supply Main	$3,202,414							
Phase 1C (in-service year 10)	1C	Lift Station Mechanical upgrades to support development for years 11 – 50	$1,503,837	$2,420,664	$0	$0	$2,412,595	$660,000	$432,620	$22,063,642
	2B	750 mm Force Main	$14,633,924							
Phase 2 (in-service year 20)	4B	750 mm Feeder Main (from OS3 to OS4)	$3,564,058	$534,609	$0	$0	$532,827	$0	$92,630	$4,724,124
Phase 3 (in-service year 30)	6	Wastewater upgrades to the Interceptor Sewer	$6,686,569	$1,002,985	$0	$0	$999,642	$0	$173,784	$8,862,980
		Combined Sub-Total (Class 3)	**$82,996,001**	**$12,449,400**	**$310,000**	**$389,000**	**$12,407,902**	**$1,716,000**	**$2,305,366**	**$112,573,670**
									Total (Class 3) $2020 (Excluding Inflation)	**$112,574,000**

The BoE Capital Cost Detail, Operating Cost Detail and Rational tables used to develop the above costs are provided in Appendix F of this report. Based on the preliminary design presented in this report, we are of the opinion that the Class 3 estimated cost to provide regional water and wastewater servicing to the AAW lands in accordance with RFP 289-2019 is $112,574,000 (-20% to +30%).

8.1 Additional Costs

The following additional costs should be considered as risk items that are not currently in the class 3 cost estimate:

Upsizing of local pipe network

The secondary supply main is designed to provide partial redundancy to the AAW lands in the event that the feeder main is out of service. A complete separated secondary supply main is not proposed as part of the preliminary design. Instead, portions of the local pipe network that are anticipated to be 300 mm to support the local distribution needs would be upsized to 400 mm to assist in providing the redundant flows in the event of a loss of the feeder main. The total length of upsizing for proposed in the preliminary design is 3627 m. An assumed cost increase for the upsizing is $272/m. The total cost risk for this item is $986,544. Preliminary designs have not been undertaken for the local water system and thus these costs are at a Class 5 level.

9.0 SCHEDULE

A project schedule for the design and construction of the regional infrastructure is included in Appendix G of this report. The following key assumptions were used in the preparation of the schedule:

9.1 Development Schedule

Regional infrastructure is required to service the AAW lands. At this time, the capital funding and associated timelines have not been established. The current report has been prepared to identify the Class 3 costs to assist in the future capital planning. The cost estimate (presented in Section 8.0) was developed using the City's Basis of Estimate (BOE) template. An estimated construction schedule is required to complete the BOE.

For the purposes of this report, we have assumed that the design and construction of the regional infrastructure are being advanced to support the progressing development schedule. The date referred to as Year 0, is used to describe when the initial components of the regional water and sewer infrastructure would be in-service to support the connection of the local sewer and water infrastructure at the end of the first year of development.

To identify Year 0, a schedule was assumed that addresses the key stages of development, which included: Secondary Plan Stage; Rezoning/Conceptual Plan Stage; Development Agreement Stage; Procurement; and Construction. Assumed dates have been provided here for the purpose of this study and can be refined by the City as the project progresses. It should be noted that the assumed timelines to establish Day 0 are somewhat arbitrary and are not necessarily a fair representation of the rate at which the project would be accepted by the City. Based on the assumption, the first component of the regional infrastructure that comes into service to support the development is the 750 mm feeder main that is connected to the local water system supporting the industrial development in the year 2023.

9.2 Detailed Design

For the purposes of this report, it is assumed that the City is advancing the project to the detailed design and construction phase following review of the Class 3 cost estimate. However, any future stages of the work are to be determined by Council.

9.3 Design and Construction Schedule

The proposed regional infrastructure has been broken down into discrete contracts to phase the work as presented in this report. For consistency, specific numbers were provided to each asset as listed below, and then letters were used to identify the phasing of the particular asset.

- Contract 1 – Lift Station.
- Contract 2 – Force Main.
- Contract 3 – Interceptor and Intake Sewer.
- Contract 4 - Feeder Main.
- Contract 5 – Secondary Supply Main.

- Contract 6 – Upgrades to City Interceptor Sewer.

The design and construction of the specific contracts are scheduled with in-service dates to support the respective water demands and wastewater generation at specific years of development. The in-service year for each regional infrastructure contract in the program is presented below in Table 18.

TABLE 18 – STAGING PLAN FOR CONSTRUCTION CONTRACTS

Stage/Phase (In-service year)	Contract	Description
Stage 1.1/Phase 1A (In-service year 0)	1A	By-pass Lift Station
	2A	600 mm Force Main
	C3	Interceptor and Intake Sewers
	4A	750 mm Feeder Main (Silver to OS3)
Stage 1.2/ Phase 1B (In-service year 5)	1B	Lift Station sub/superstructure and associated mechanical and electrical to support development for years 6-10
Stage 2/ Phase 1C (In-service year 10)	1C	Lift Station Mechanical upgrades to support development for years 11 - 50
	2B	750 mm Force Main
	5	400 mm Secondary Supply Main
Phase 2 (In-service year 20)	4B	750 mm Feeder Main (from OS3 to OS4)
Stage 3 (in-service year 30	6	Wastewater upgrades to the Interceptor Sewer.

10.0 RISK ANALYSIS

Throughout the project, our team identified risks related to the future detail design, construction, and operation of the AAW Regional Infrastructure for water and wastewater servicing. Identification of risks also included consideration of potential mitigation measures. Risks and mitigation measures identified were recorded in the Risk Management Plan (RMP) and were reviewed with the City's steering committee over the course of two Risk Workshops which were held on October 24, 2019 and May 21, 2020. The updated RMP is appended to this report in Appendix H.

11.0 DESIGN DIRECTIVES

This section summarizes directives that have shaped the preliminary design development. These directives were provided by the City's steering committee during meetings and through request for information (RFI) responses. The listing below is not a comprehensive summary, but rather details directives that influenced investigations for this assignment and led to key assumptions for the analysis and design.

1. **FORCE MAIN ALIGNMENT**

   Our alignment for the Force Mains runs north along the Sturgeon Road ROW to CentrePort Canada Way before turning east and connecting to the existing 1350 mm Interceptor Sewer on Inkster Boulevard at Brookside Boulevard. This alignment was prescribed by the City in a September 6, 2019 meeting (as recorded in the Minutes) to discuss the proposed geotechnical investigation for this assignment.

2. **NO CONSIDERATION OF EXISTING OR FUTURE FLOWS FROM THE RM OF ROSSER INTO THE EXISTING 1350 INTERCEPTOR:**

   We assume within our wastewater analysis that the capacity available within the 1350 mm NEWPCC Interceptor from the tie-in located at the Inkster Boulevard-Brookside Boulevard intersection is as represented in the InfoWorks Model provided. That is, there is no consideration for inflow currently servicing the RM of Rosser, or additional developments that are not modelled. This assumption regarding the capacity of the NEWPCC Northwest Interceptor has been made in accordance with the City's response to RFI No. 1 which was issued to the City to request an estimate of existing/and future sewage flows into the 1350 mm interceptor on Inkster Boulevard for consideration in our wastewater analysis. We deemed this information to be critical in order to accurately evaluate the available flow capacity with the 1350 mm Interceptor Sewer on Inkster Boulevard.

3. **USE THE INFOWORKS ICM MODEL FOR ANALYSIS AS PROVIDED BY THE CITY**

   Two areas of concern were identified by our team upon our initial review of the InfoWorks model that was provided by the City. These concerns are:

   1. Future potential development areas (within the City of Winnipeg) are not identified in the model.
   2. Existing inflow flows from the extension of the 1350 mm pipe from King Edward west to Brookside Boulevard (from work completed by Nelson River Construction as part of Bid Opportunity 481-2014), are not in the model.

   Requests were made in meetings and via and RFI for an updated version of the wastewater model that may better represent the existing and future inflows into the Interceptor Sewer. These requests were made under RFI 20. The basis from the response to this RFI was to use the model as is.

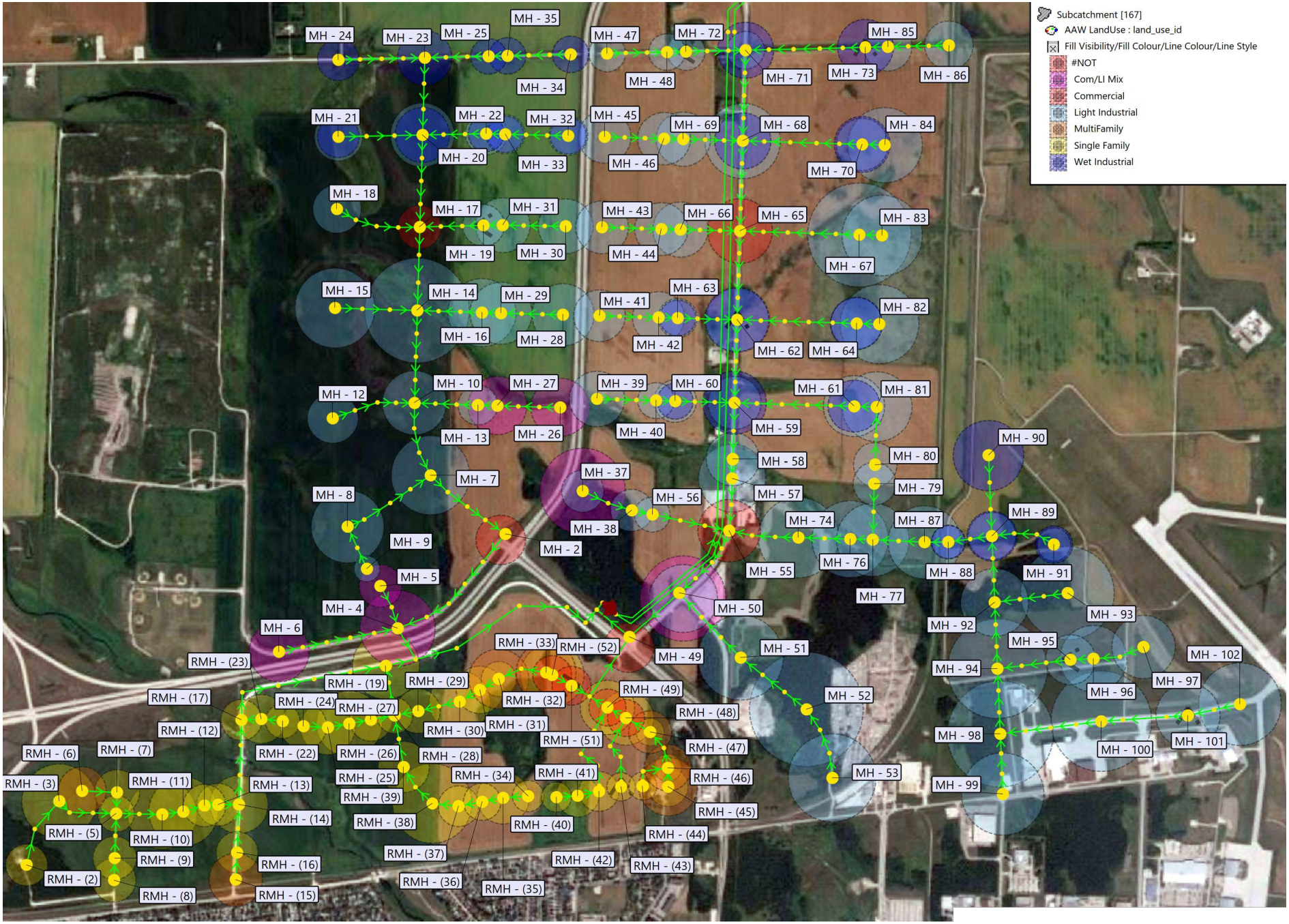
   Note however that our team did extend the pipe network to Brookside (and subsequently to the AAW FCM) within the model so we could undertake our analysis. The pipe extension was based on the record drawings and design drawings from Bid Opportunity 481-2014 (provided by the City). While we have updated the model to address the pipe network, we have not updated the model to reflect any potential inflows along Inkster Boulevard that may have been added as part of the work (if any).

4. Preliminary Design Review with Manitoba Infrastructure and the RM of Rosser

The preliminary design for regional wastewater servicing infrastructure includes several kilometers of FCMs that passes through land owned by either the Province of Manitoba or the Rural Municipality of Rosser. At the 60% design stage the project team agreed that there are project risks associated with a lack of consultation with these authorities and that some level of consultation would be appropriate to determine specific design requirements and generally gain a better understanding of potential land agreements and approval processes that may be required in the future for detail design and construction. Direction related to this matter was sought with RFI 24. The City's response to this RFI directed the design team to follow known Manitoba Infrastructure standards and deferred consultation with these authorities to some point beyond the completion of this current assignment.

PLATES

Wastewater and Water Servicing Plates



CLIENT: Winnipeg

KGS GROUP | WSP

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY ENGINEERING

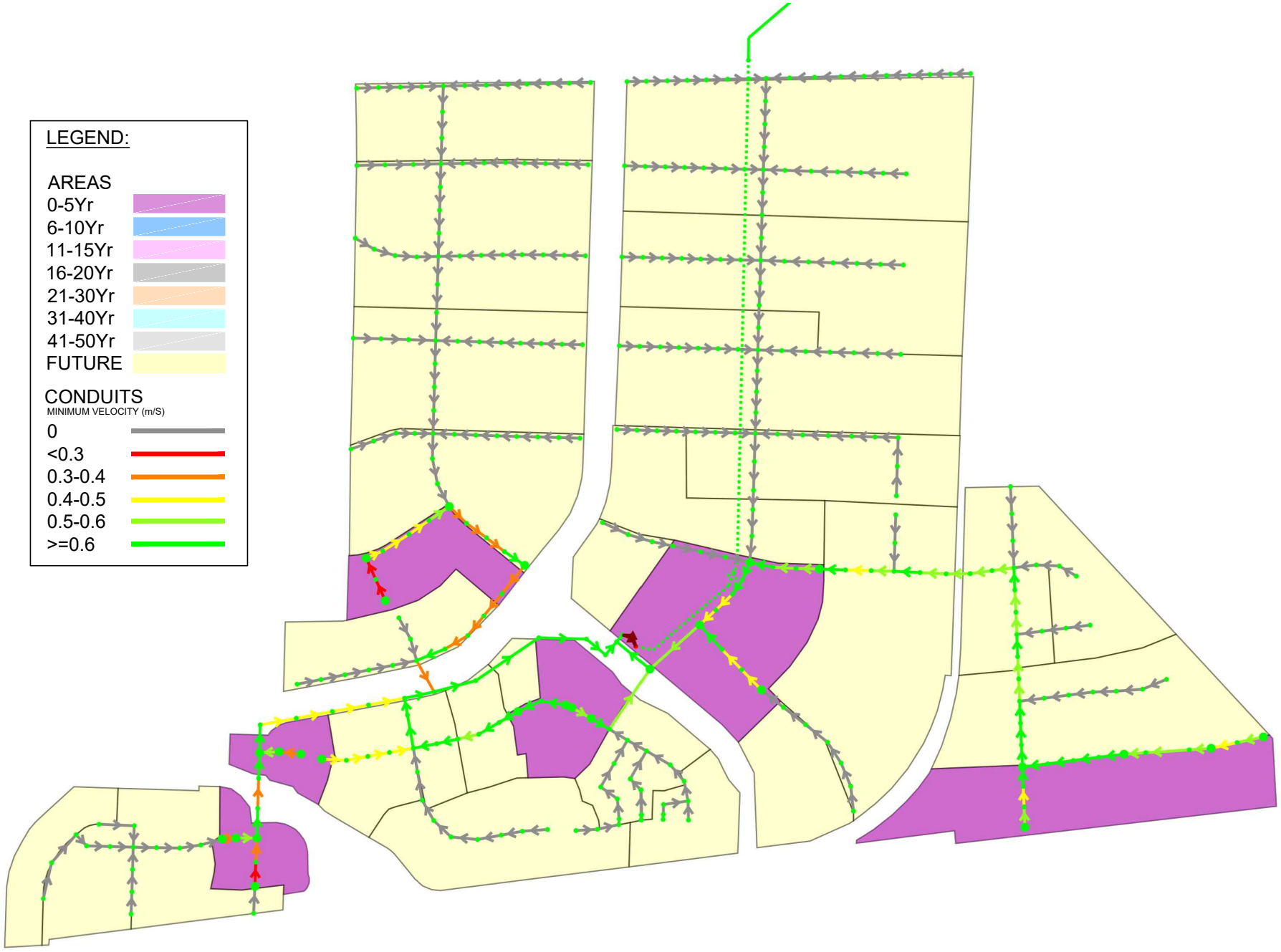
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WASTEWATER NETWORK
MODEL SETUP

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
0	20/06/18	ISSUED WITH REPORT	DW	RBO

REVISIONS / ISSUE

DWG. NO.
MAR 2020 PLATE 5.01

REV: 0



CLIENT: Winnipeg

KGS GROUP | WSP

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY ENGINEERING

DWG. DESCRIPTION:
WASTEWATER NETOWRK PHASING
STAGE 1
0-5YRS

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
0	20/06/18	ISSUED WITH REPORT	DW	RBO

REVISIONS / ISSUE

DWG. NO.
MAR 2020 PLATE 5.02

REV:
0



CLIENT: Winnipeg

KGS GROUP | WSP

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY ENGINEERING

DWG. DESCRIPTION:
WASTEWATER NETOWRK PHASING
STAGE 1
6-8YRS

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
0	20/06/18	ISSUED WITH REPORT	DW	RBO

REVISIONS / ISSUE

DWG. NO.
MAR 2020 PLATE 5.03

REV:
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CLIENT: Winnipeg

KGS GROUP | WSP

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY ENGINEERING

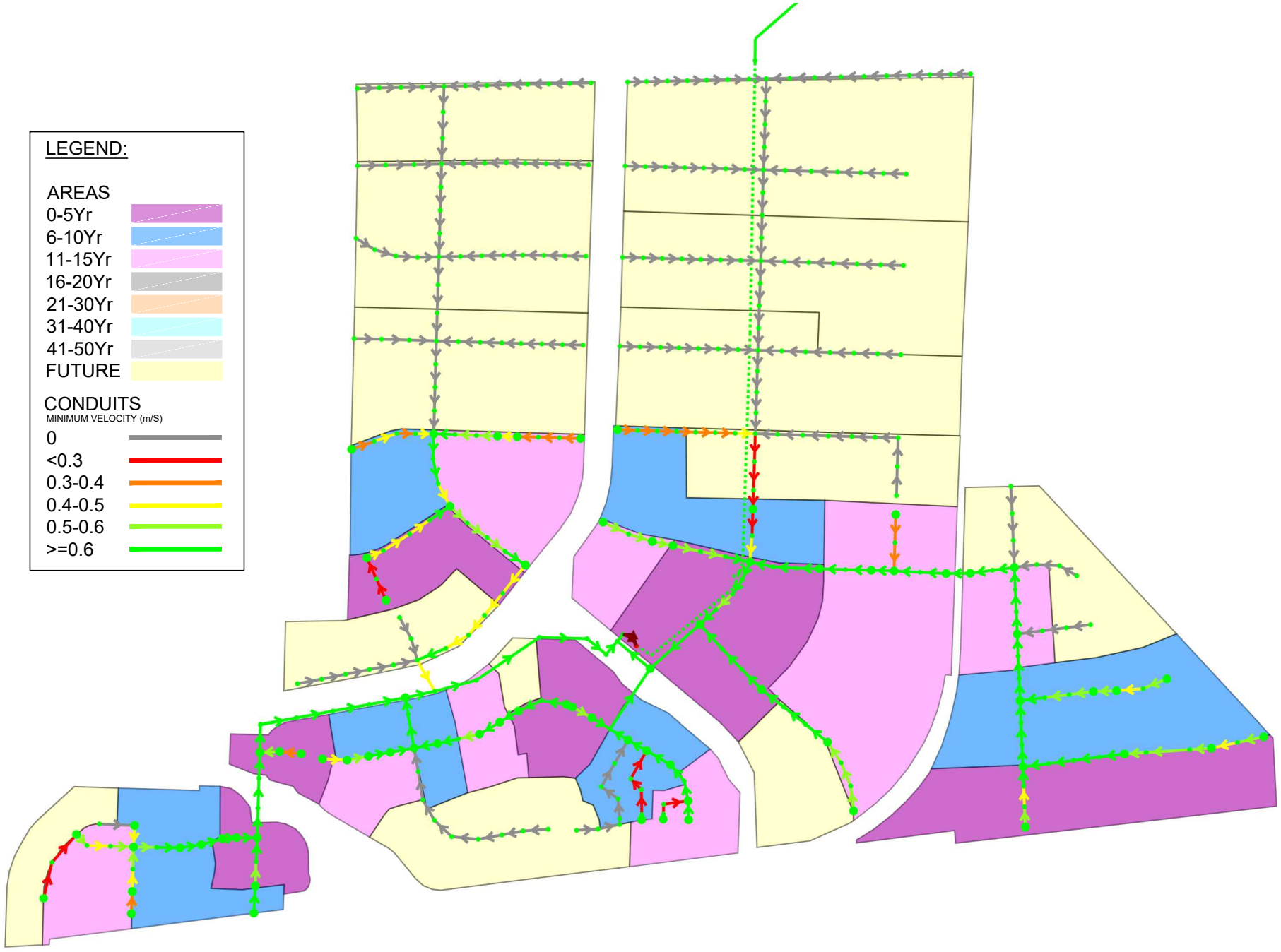
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STAGE 2
9-10YRS

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REVISIONS / ISSUE

DWG. NO.
MAR 2020 PLATE 5.04

REV:
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CLIENT: Winnipeg

KGS GROUP | WSP

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY ENGINEERING

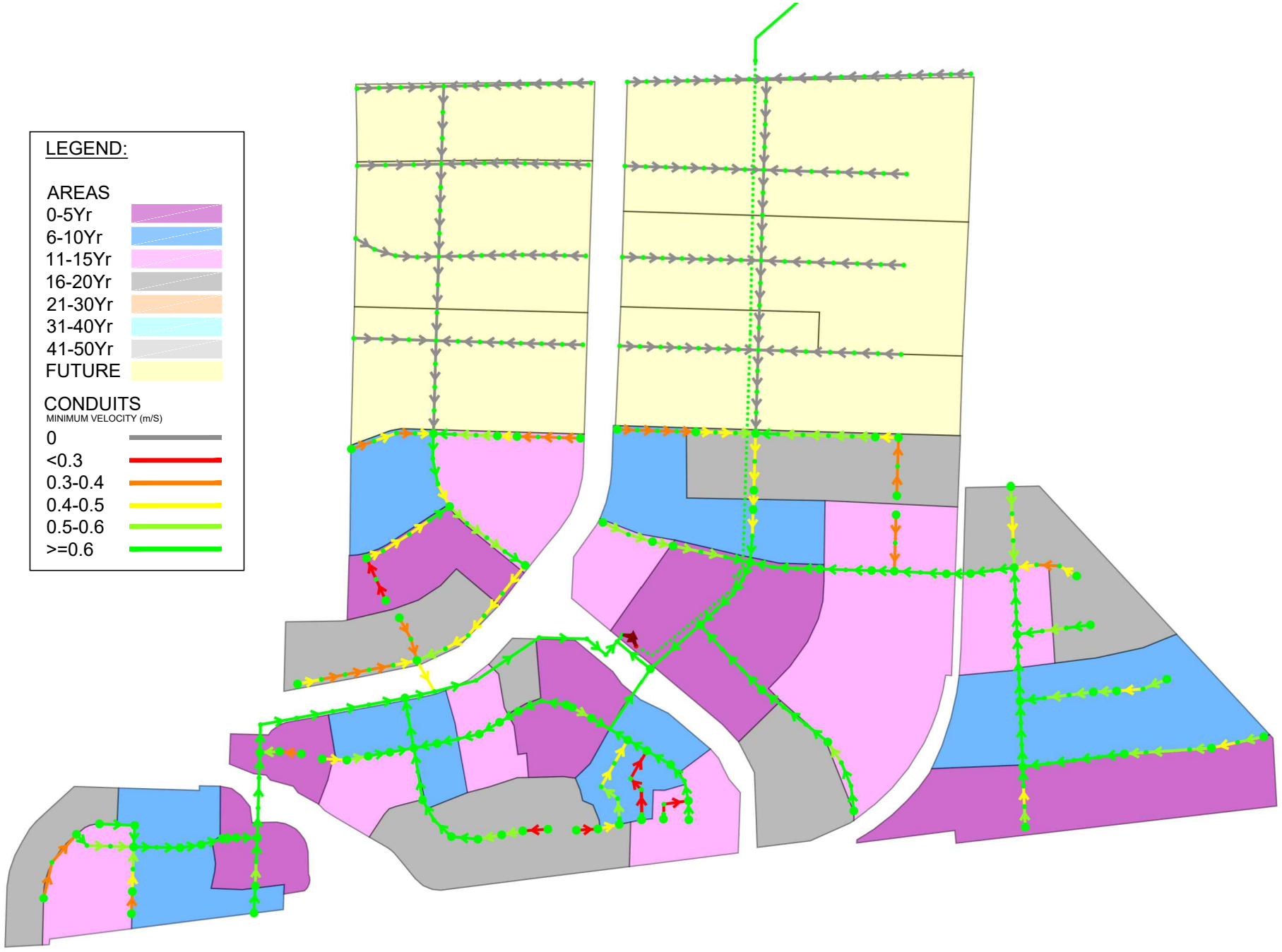
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STAGE 2
11-15YRS

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0	20/06/18	ISSUED WITH REPORT	DW	RBO

REVISIONS / ISSUE

DWG. NO.
MAR 2020 PLATE 5.05

REV:
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CLIENT: Winnipeg

KGS GROUP | WSP

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY ENGINEERING

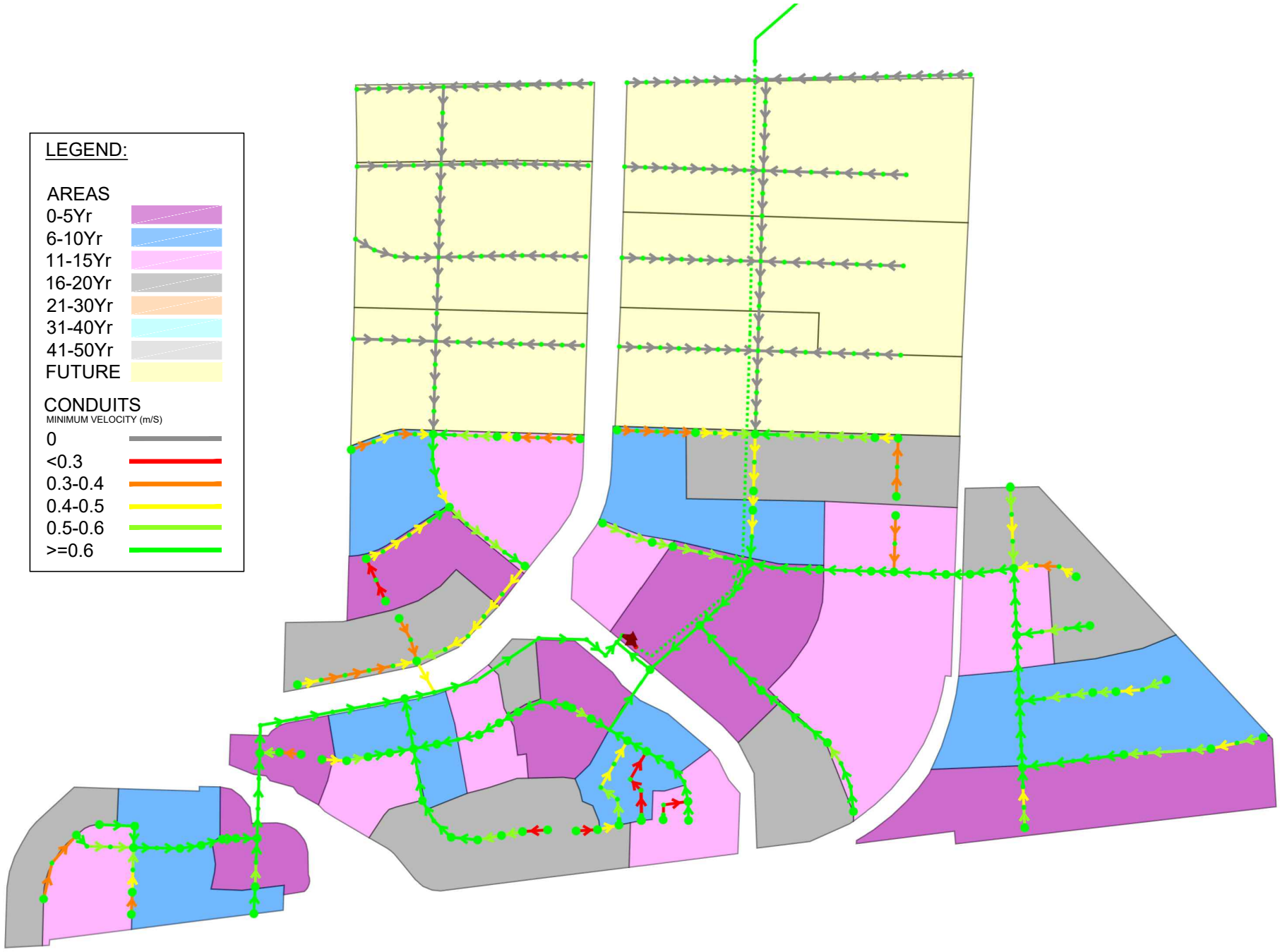
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STAGE 2
16-18YRS

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
0	20/06/18	ISSUED WITH REPORT	DW	RBO

REVISIONS / ISSUE

DWG. NO.
MAR 2020 PLATE 5.06

REV: 0



CLIENT: Winnipeg

KGS GROUP | WSP

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY ENGINEERING

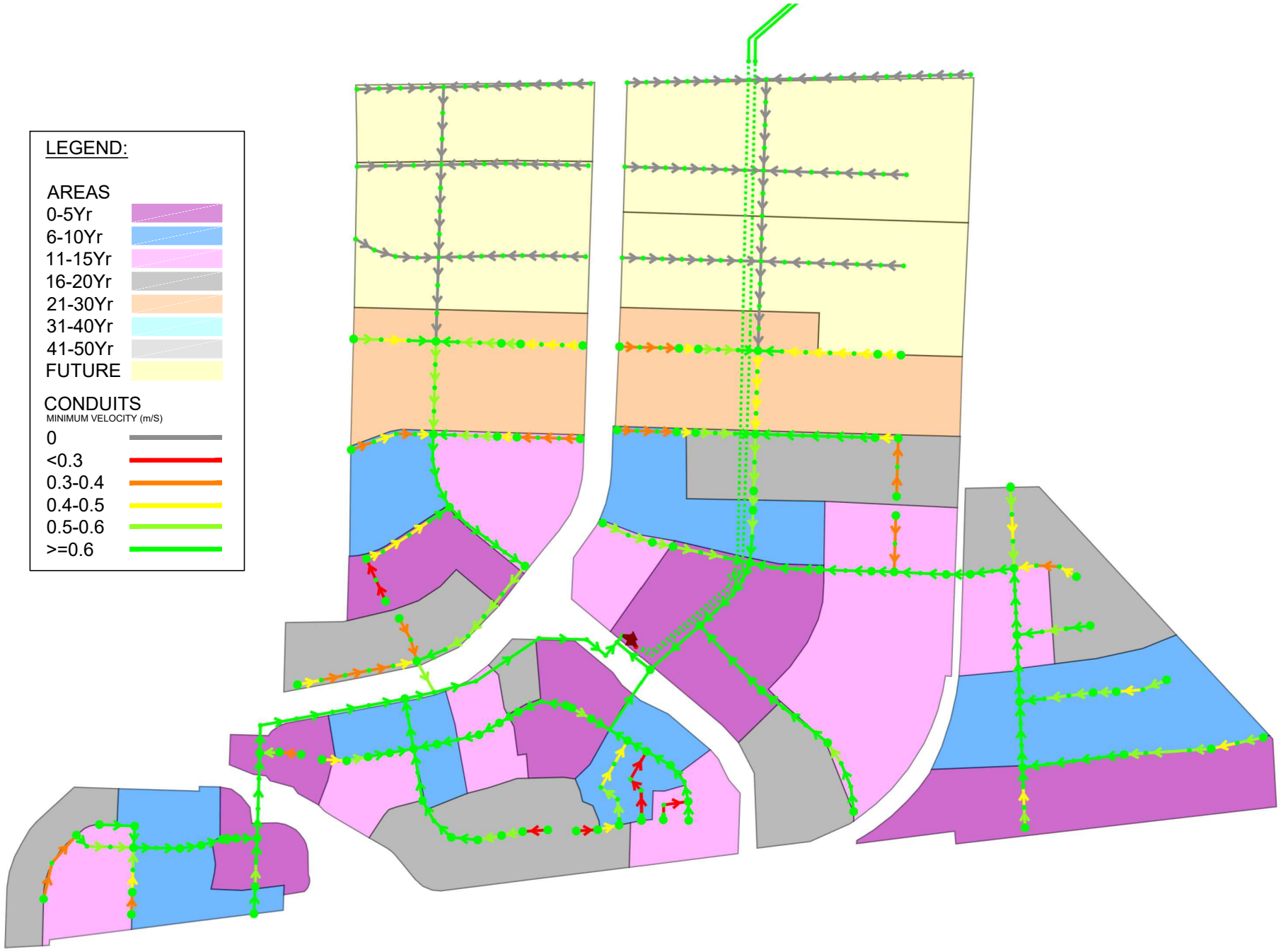
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WASTEWATER NETOWRK PHASING
STAGE 3
18-20YRS

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
0	20/06/18	ISSUED WITH REPORT	DW	RBO

REVISIONS / ISSUE

DWG. NO.
MAR 2020 PLATE 5.07

REV:
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CLIENT: Winnipeg

KGS GROUP | WSP

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY ENGINEERING

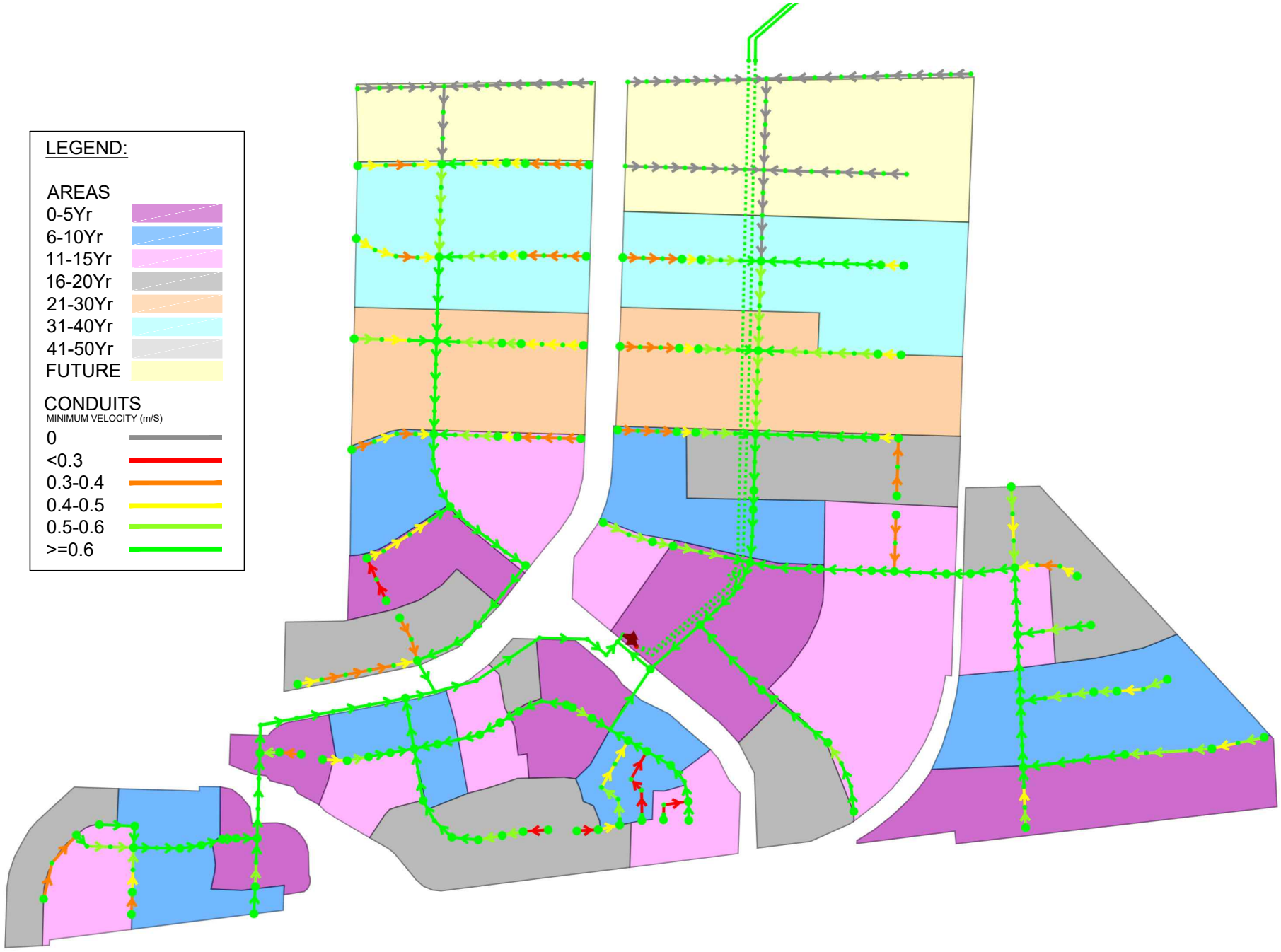
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STAGE 3
21-30YRS

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0	20/06/18	ISSUED WITH REPORT	DW	RBO

REVISIONS / ISSUE

DWG. NO.
MAR 2020 PLATE 5.08

REV: 0



CLIENT: Winnipeg

KGS GROUP | WSP

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY ENGINEERING

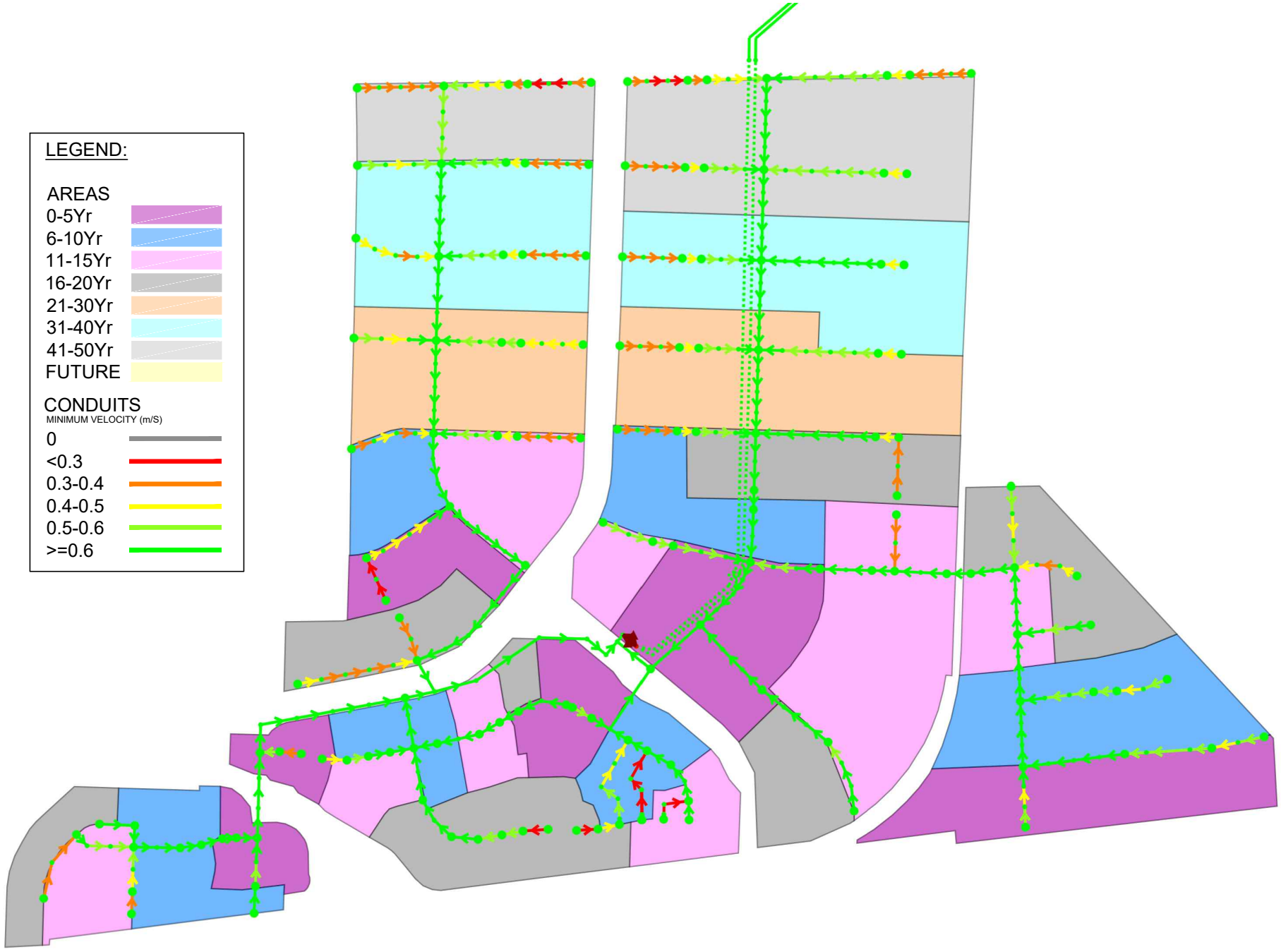
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STAGE 3
31-40YRS

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
0	20/06/18	ISSUED WITH REPORT	DW	RBO

REVISIONS / ISSUE

DWG. NO.
MAR 2020 PLATE 5.09

REV:
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CLIENT: Winnipeg

KGS GROUP | WSP

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY ENGINEERING

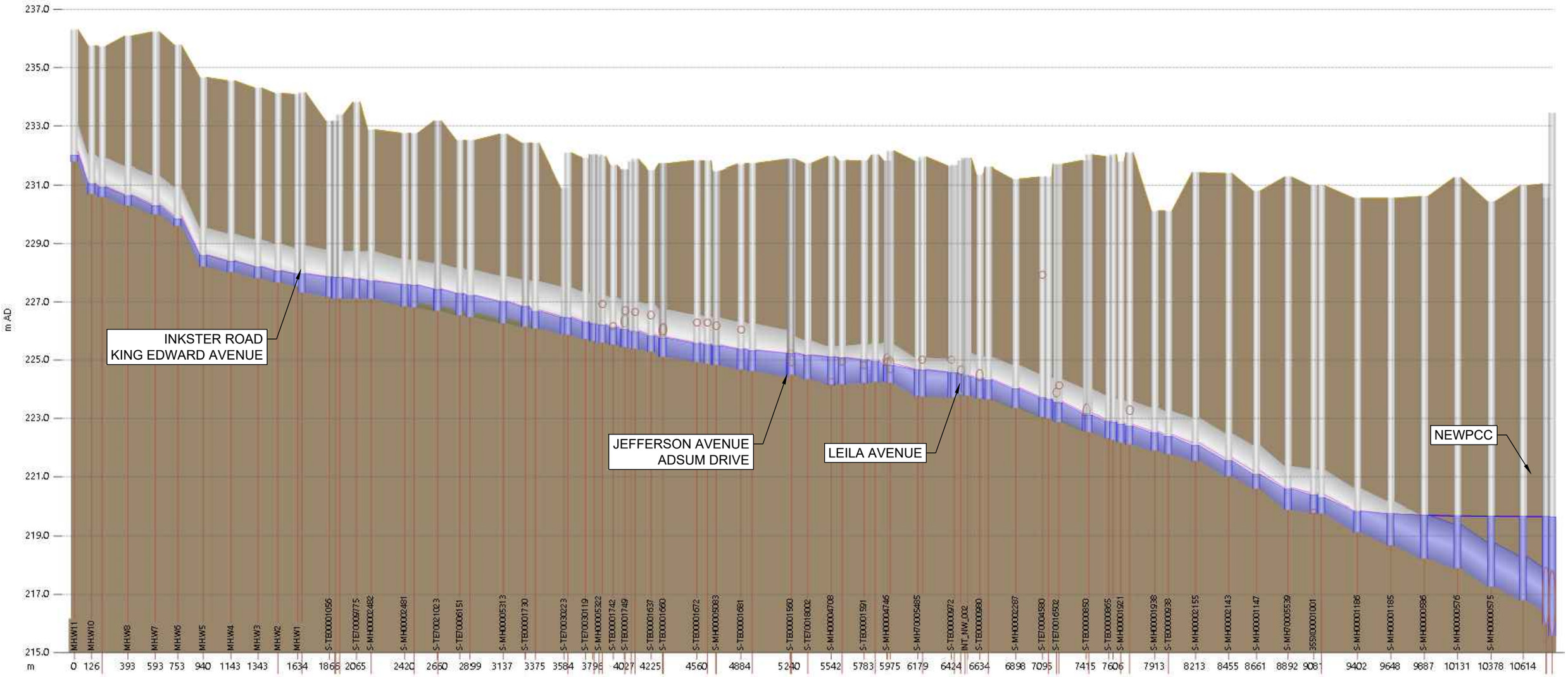
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WASTEWATER NETOWRK PHASING
STAGE 3
41-50YRS

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
0	20/06/18	ISSUED WITH REPORT	DW	RBO

REVISIONS / ISSUE

DWG. NO.
MAR 2020 PLATE 5.10

REV:
0



NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
0	20/06/18	ISSUED WITH REPORT	DW	RBO

REVISIONS / ISSUE

KGS GROUP

wsp

CLIENT:

Winnipeg

PROJECT:

AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY ENGINEERING

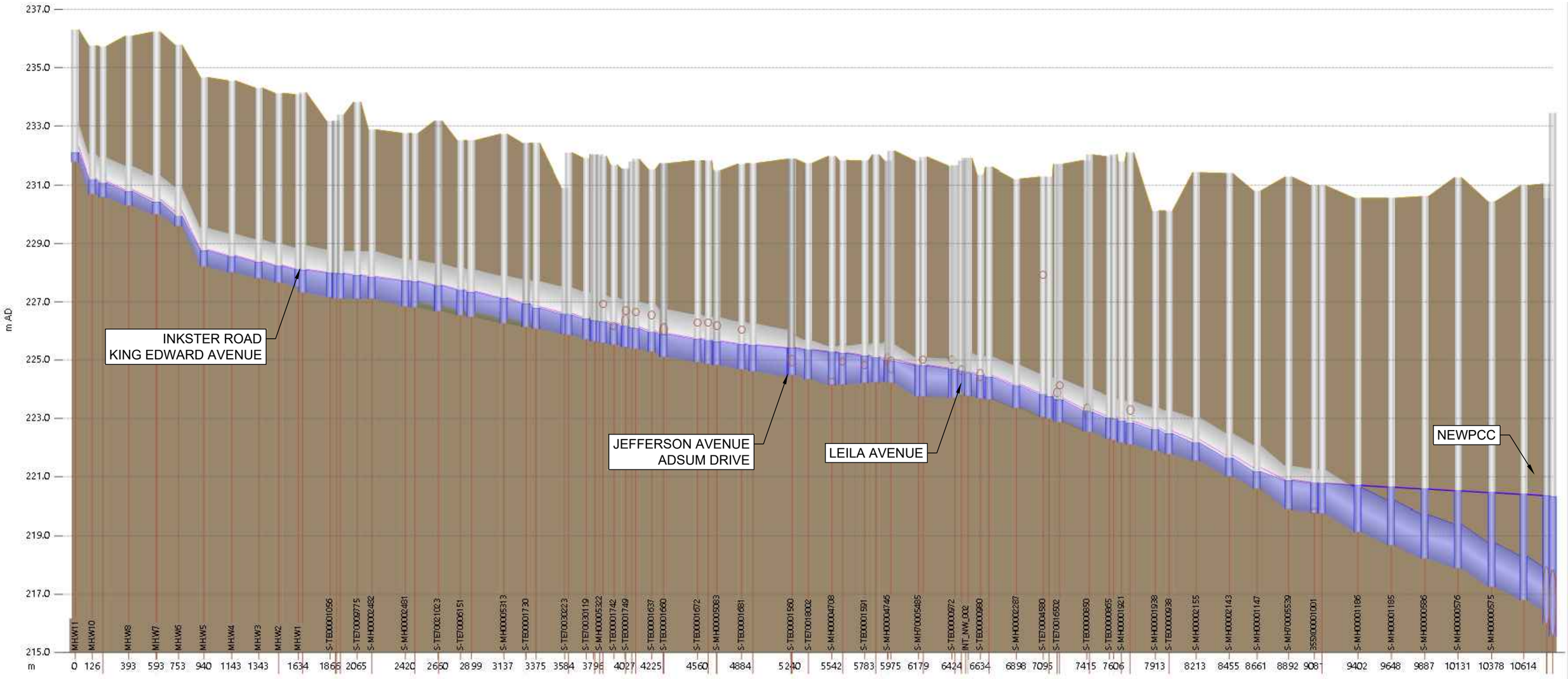
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NORTHWEST INTERCEPTOR
PROFILE STAGE 1

DWG. NO.

MAR 2020 PLATE 5.11

REV: 0



NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
0	20/06/18	ISSUED WITH REPORT	DW	RBO

REVISIONS / ISSUE

KGS GROUP

wsp

CLIENT:

Winnipeg

PROJECT:

AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY ENGINEERING

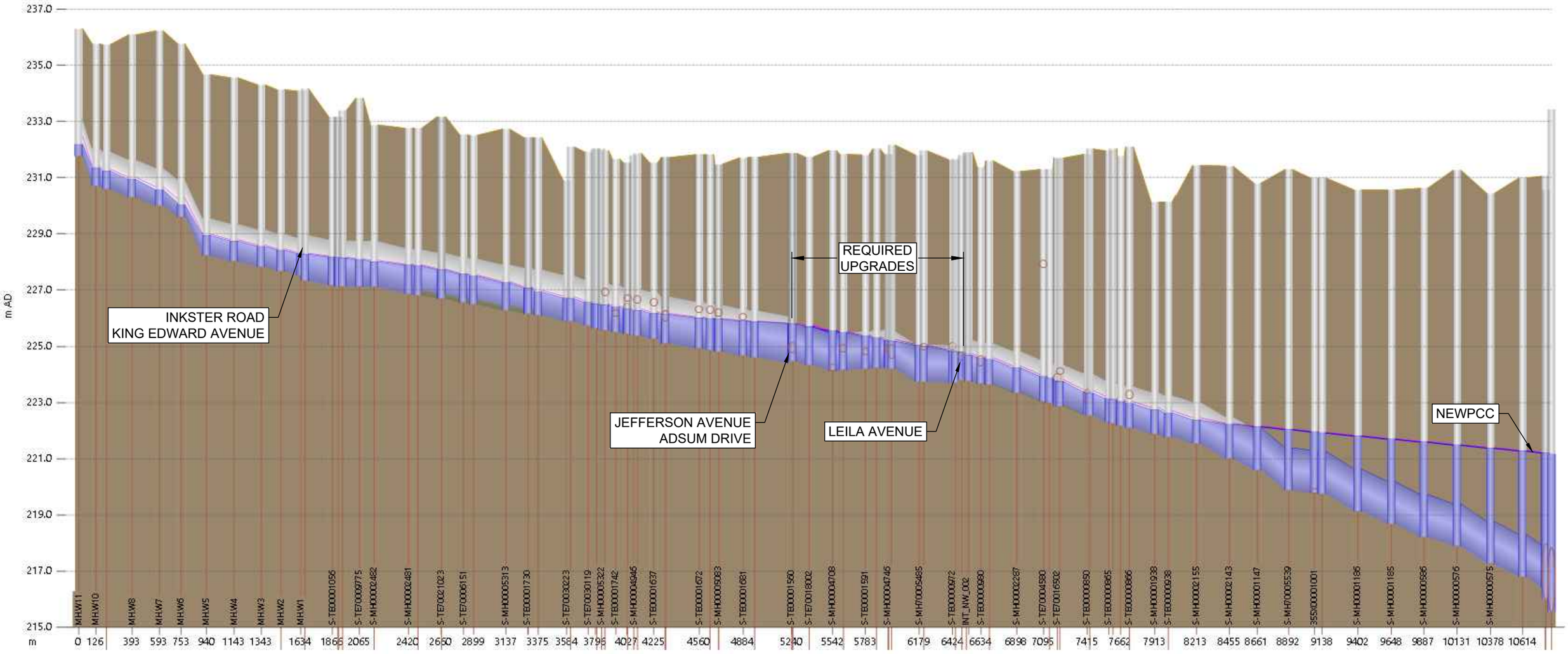
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NORTHWEST INTERCEPTOR
PROFILE STAGE 2

DWG. NO.

MAR 2020 PLATE 5.12

REV: 0



NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
0	20/06/18	ISSUED WITH REPORT	DW	RBO

REVISIONS / ISSUE

KGS GROUP

wsp

CLIENT:

Winnipeg

PROJECT:

AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY ENGINEERING

DWG. DESCRIPTION:

NORTHWEST INTERCEPTOR
PROFILE STAGE 3

DWG. NO.

MAR 2020 PLATE 5.13

REV:

0

LEGEND:

FDM	=	FEEDERMAIN
SSM	=	SECONDARY SUPPLY MAIN
	=	300 & 400 WM
	=	600 ROUGE RD. FDM & 900 SILVER AVE. FDM
	=	750 STURGEON RD. FDM
	=	INKSTER SSM & ROUGE SSM
	=	FDM OFFTAKE STRUCTURE/ VALVE CHAMBER

ROSSER RD.
INKSTER SSM
600 INKSTER BLVD. FDM
CREEK
O.S.4
STURGEON RD.
O.S.3b
STURGEON RD.
O.S.3a
STURGEON CREEK
WINNIPEG AIRPORT
CREEK
O.S.R2
SASKATCHEWAN AVE.
O.S.R1
ROUGE SSM
O.S.2
750 STURGEON RD. FDM
HAMILTON AVE.
600 ROUGE RD. FDM
O.S.1
900 SILVER AVE. FDM
STURGEON RD.
NESS AVE.
MORAY ST.

AREA OF INTEREST

KEYPLAN

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | WSP

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
PROPOSED STURGEON ROAD
FEEDERMAIN AND SECONDARY SUPPLY
ALIGNMENTS

SEAL			
	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.01 REV: B

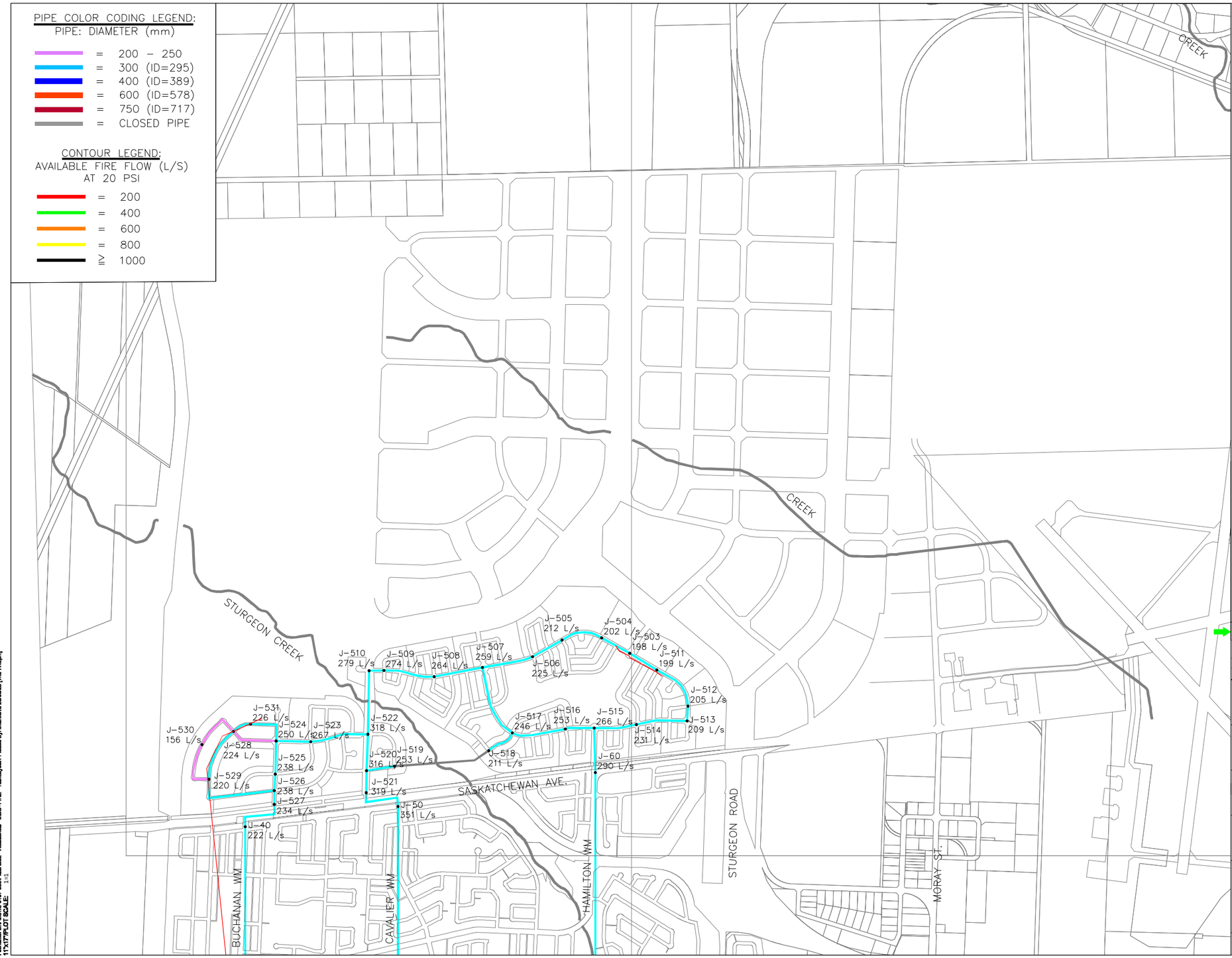
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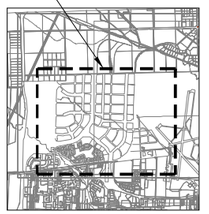
- = 200 – 250
- = 300 (ID=295)
- = 400 (ID=389)
- = 600 (ID=578)
- = 750 (ID=717)
- = CLOSED PIPE

CONTOUR LEGEND:
AVAILABLE FIRE FLOW (L/S)
AT 20 PSI

- = 200
- = 400
- = 600
- = 800
- ≧ 1000



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

MDD = 1.6 x ADD
100% OF MDD

CONNECTIONS TO C.O.W. SYSTEM AT:

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	**ISSUED FOR FINAL REPORT**	SH	RBO
A	20/02/25	**ISSUED FOR 60% REVIEW**	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
PRELIMINARY RESIDENTIAL ANALYSIS
MAXIMUM DAY FIRE FLOW
WITH 20 PSI RESIDUAL PRESSURE

SEAL

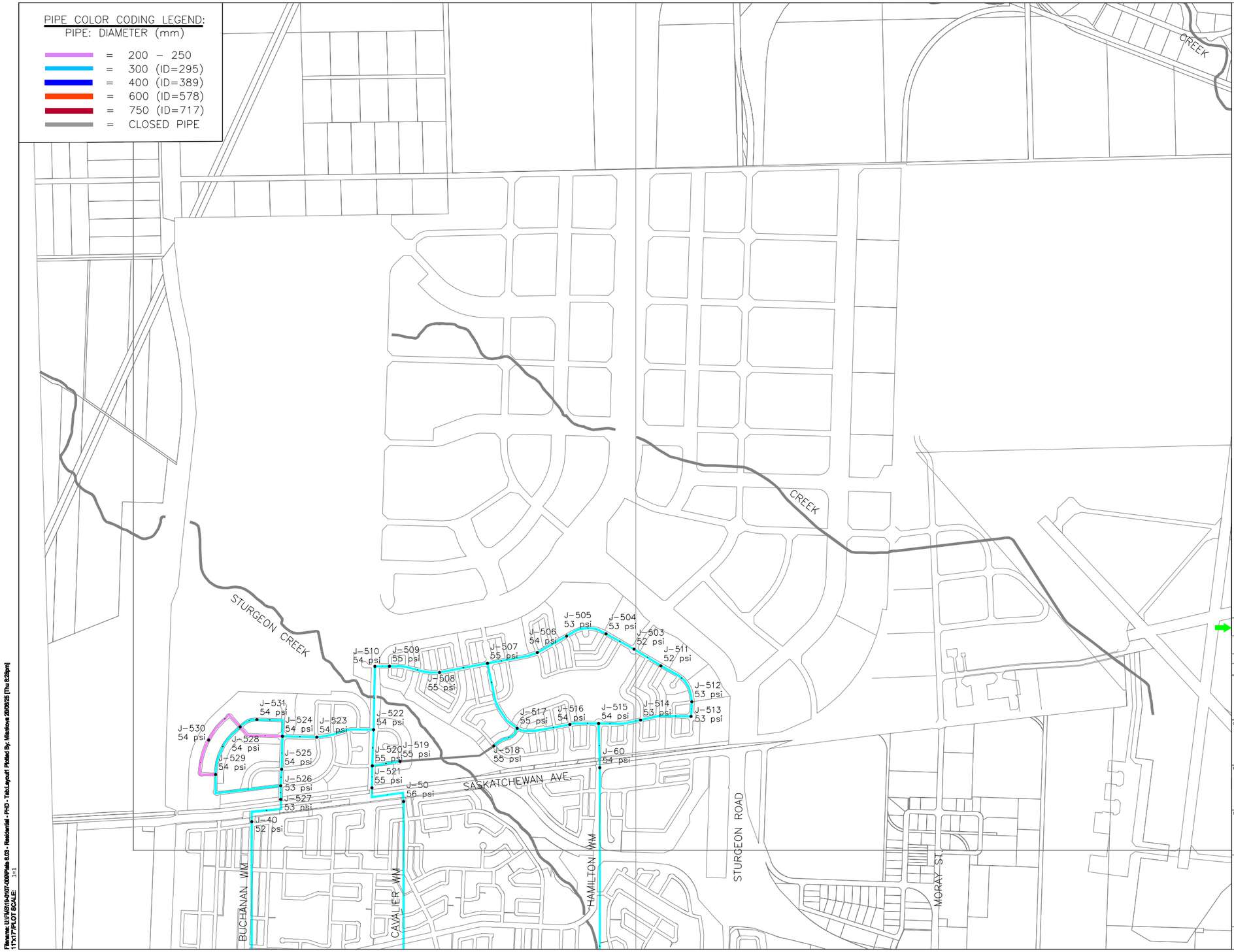
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DESIGN CHECK: RBO	DATE: YY/MM/DD
DRAWN BY: MID	DATE: 20/01/20
DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.02 REV: B

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PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

PHD = 2.5 x ADD
100% OF PHD

CONNECTIONS TO C.O.W. SYSTEM AT:

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | WSP

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
PRELIMINARY RESIDENTIAL ANALYSIS
PEAK HOUR DEMAND
MINIMUM PRESSURES

SEAL		
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	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.03 REV. B

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PIPE COLOR CODING LEGEND
PIPE: DIAMETER (mm)

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= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

CONTOUR LEGEND:
AVAILABLE FIRE FLOW (L/S)
AT 20 PSI

= 200
= 400
= 600
= 800
≧ 1000

AREA OF INTEREST

KEYPLAN

SCENARIO NOTES:

COMMERCIAL/INDUSTRIAL 300mm GRID
MDD = 1.6 x ADD
100% OF MDD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON ROAD FDM

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | WSP

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
COMMERCIAL / INDUSTRIAL 300mm GRID
MAXIMUM DAY FIRE FLOW
WITH 20 PSI RESIDUAL PRESSURE

SEAL		
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	DESIGN CHECK: RBO	DATE: YY/MM/DD
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	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.04 REV. B

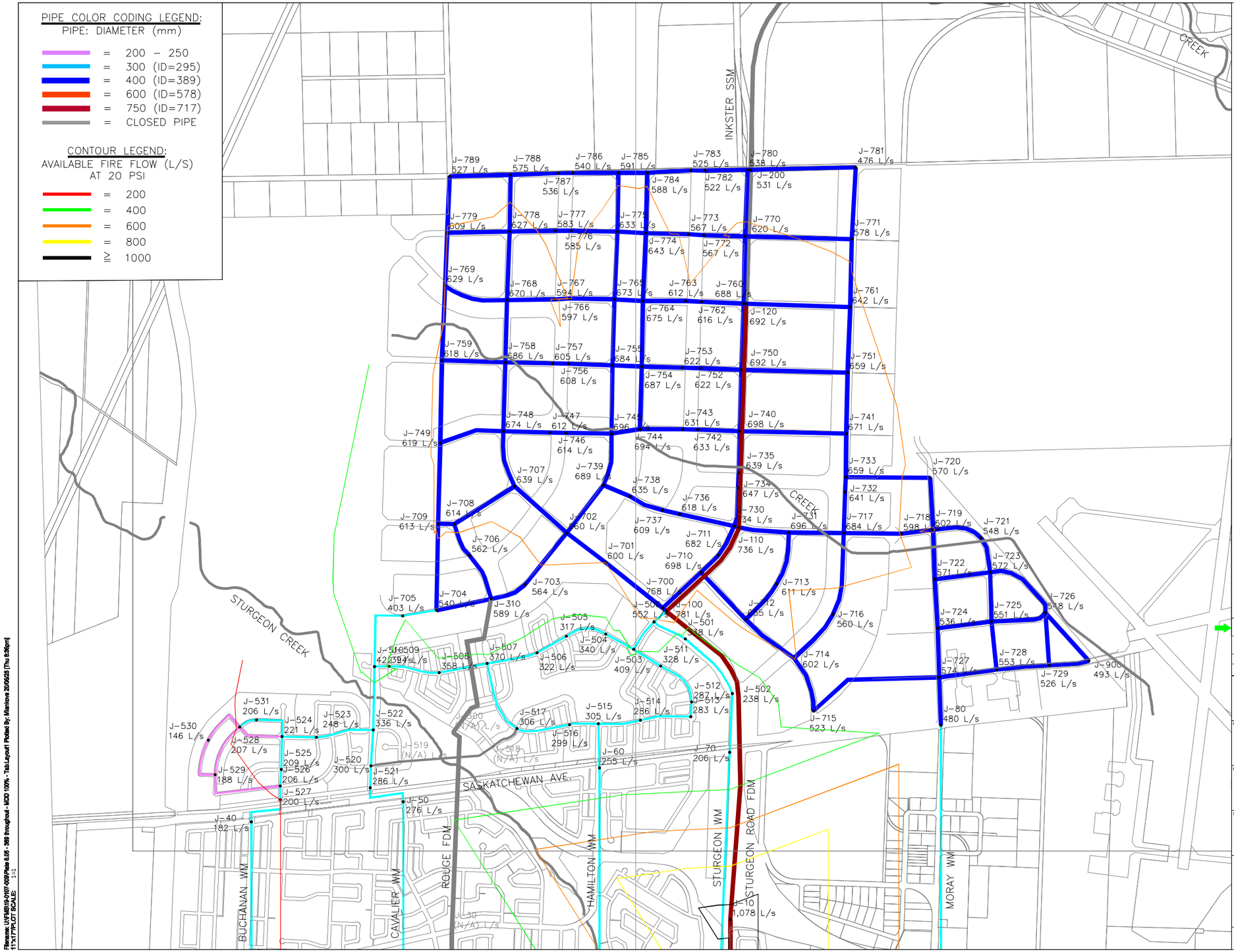
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PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

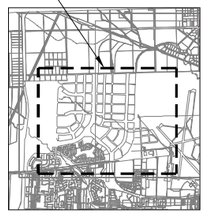
= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

CONTOUR LEGEND:
AVAILABLE FIRE FLOW (L/S)
AT 20 PSI

= 200
= 400
= 600
= 800
≧ 1000



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

COMMERCIAL/INDUSTRIAL 400mm GRID
MDD = 1.6 x ADD
100% OF MDD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON ROAD FDM

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | WSP

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
COMMERCIAL / INDUSTRIAL 400mm GRID
MAXIMUM DAY FIRE FLOW
WITH 20 PSI RESIDUAL PRESSURE

SEAL	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.05 REV B

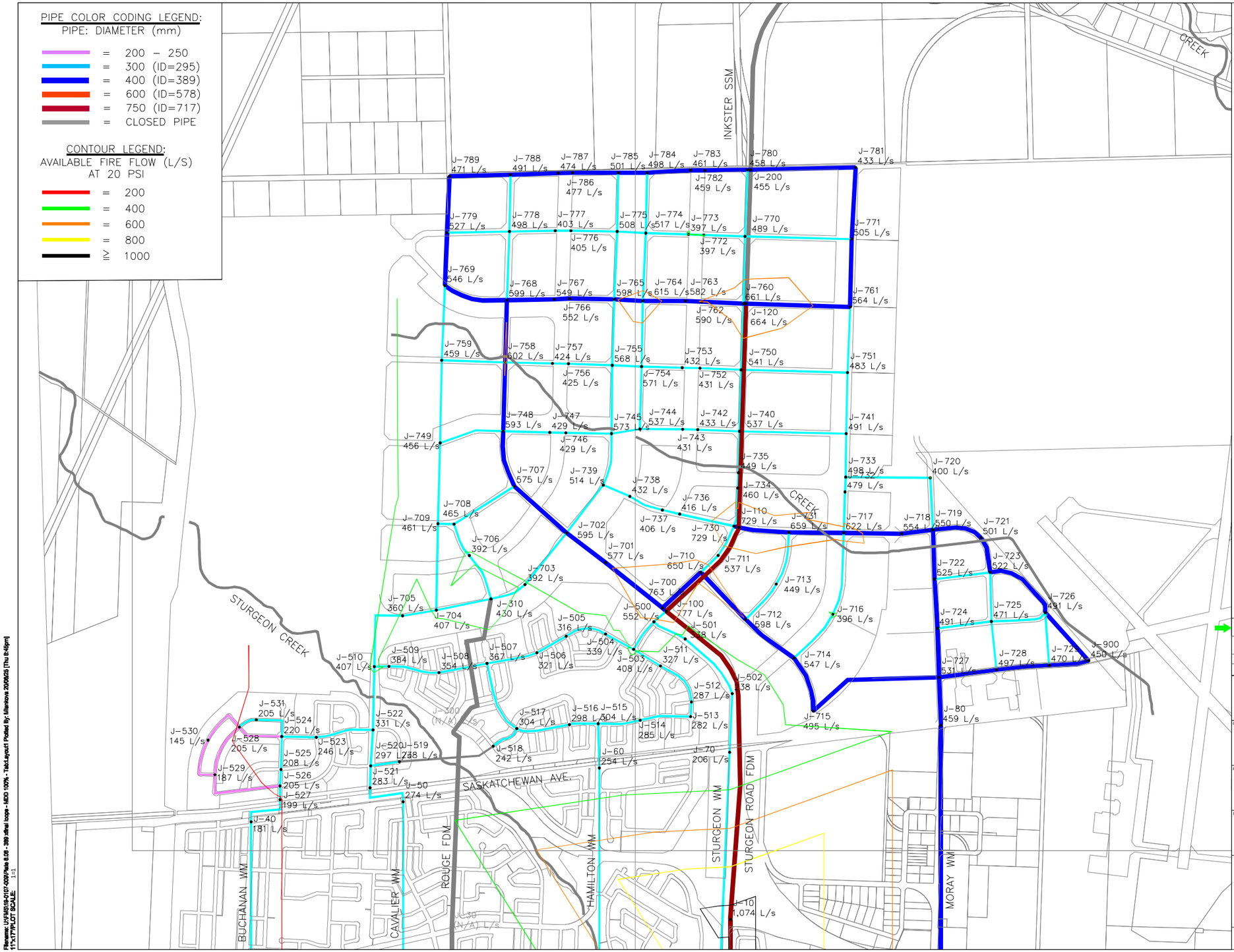
Filename: I:\#PMS\19-0107-009\Plate 6.05 - 360 throughout - MDD 100% - Tab\Layout1 Plotted By: Mlantvoe 20/06/26 [Thu 8:56pm]
11"x17"PLOT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

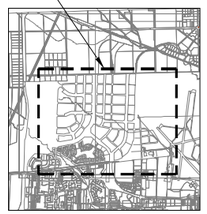
= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

CONTOUR LEGEND:
AVAILABLE FIRE FLOW (L/S)
AT 20 PSI

= 200
= 400
= 600
= 800
≧ 1000



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

COMMERCIAL/ INDUSTRIAL MIXED GRID
MDD = 1.6 x ADD
100% OF MDD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON ROAD FDM

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 80% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SservicING PRELIMINARY DESIGN

DWG. DESCRIPTION:
COMMERCIAL / INDUSTRIAL MIXED GRID
MAXIMUM DAY FIRE FLOW
WITH 20 PSI RESIDUAL PRESSURE

SEAL	DESIGN BY:	DATE (YY/MM/DD)
	SH	20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.06 REV. B

Filename: I:\Projects\19-0107-009\Plate 6.06 - 389 xlnet loops - MDD 100% - Text Layout Plotted By: Milanova 20/06/26 [Thu 8:46pm]
11X17 PLOT SCALE 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

INKSTER SSM

CREEK

STURGEON CREEK

SASKATCHEWAN AVE.

BUCHANAN WM

CAVALIER WM

ROUGE FDM

HAMILTON WM

STURGEON WM

STURGEON ROAD FDM

MORAY WM

AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

COMMERCIAL/ INDUSTRIAL MIXED GRID
PHD = 2.5 x ADD
100% OF PHD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON ROAD FDM

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
COMMERCIAL / INDUSTRIAL MIXED GRID
PEAK HOUR DEMAND
MINIMUM PRESSURES

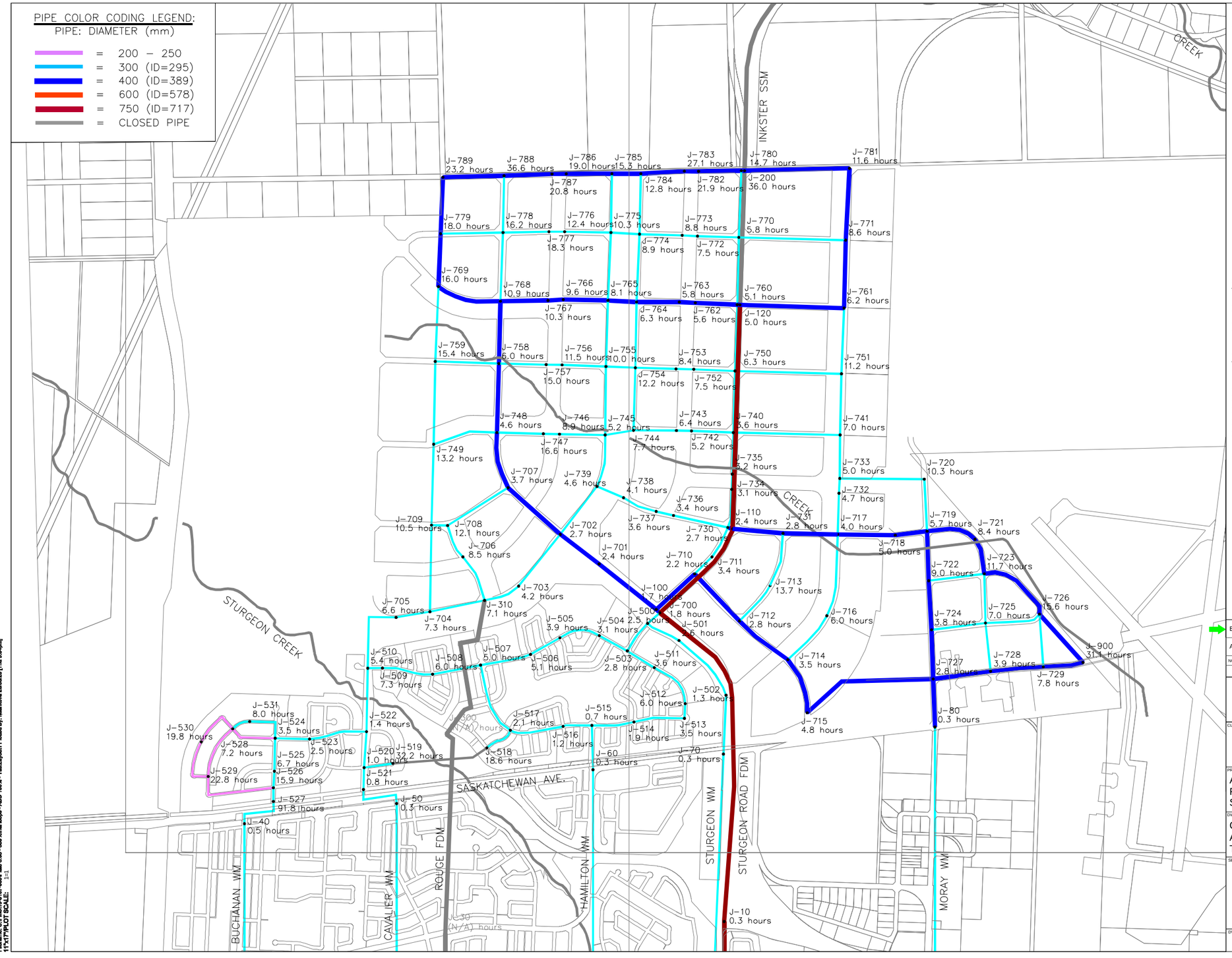
SEAL	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG. CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.07 REV: B

Filename: U:\PW\19\0107.009\Plate 6.07 - 388.xfmat loops - PHD 100% - Tab\Layout1 Plotted By: Mlantowe 20/06/26 (Thu 8:53pm)
11"x17"(PLOT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

COMMERCIAL/ INDUSTRIAL MIXED GRID
AVERAGE DAY DEMAND (ADD)
100% OF ADD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON ROAD FDM

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | WSP

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
COMMERCIAL / INDUSTRIAL MIXED GRID
AVERAGE DAY DEMAND
TRAVEL TIME ANALYSIS

SEAL		
	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.08 REV: B

Filename: U:\WM\19-0107-009\Plate 6.08 - 389 ø/mal loops - ADD 100% - Third Layout\ Plotted By: Milanova 20/06/26 [Thu 9:04pm]
11"x17" PLOT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

INKSTER SECONDARY SUPPLY

CREEK

STURGEON CREEK

SASKATCHEWAN AVE.

ROUGE FDM

BUCHANAN WM

CAVALIER WM

HAMILTON WM

STURGEON WM

STURGEON ROAD FDM

MORAY WM

AREA OF INTEREST

KEYPLAN

SCENARIO NOTES:

SECONDARY ANALYSIS –
STURGEON 750 FDM ONLY

PHD = 2.5 x ADD
100% OF PHD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON ROAD FDM

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY:	DESIGN CHECK:
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
2RY ANALYSIS - STURGEON 750 FDM ONLY
PEAK HOUR DEMAND
MINIMUM PRESSURES

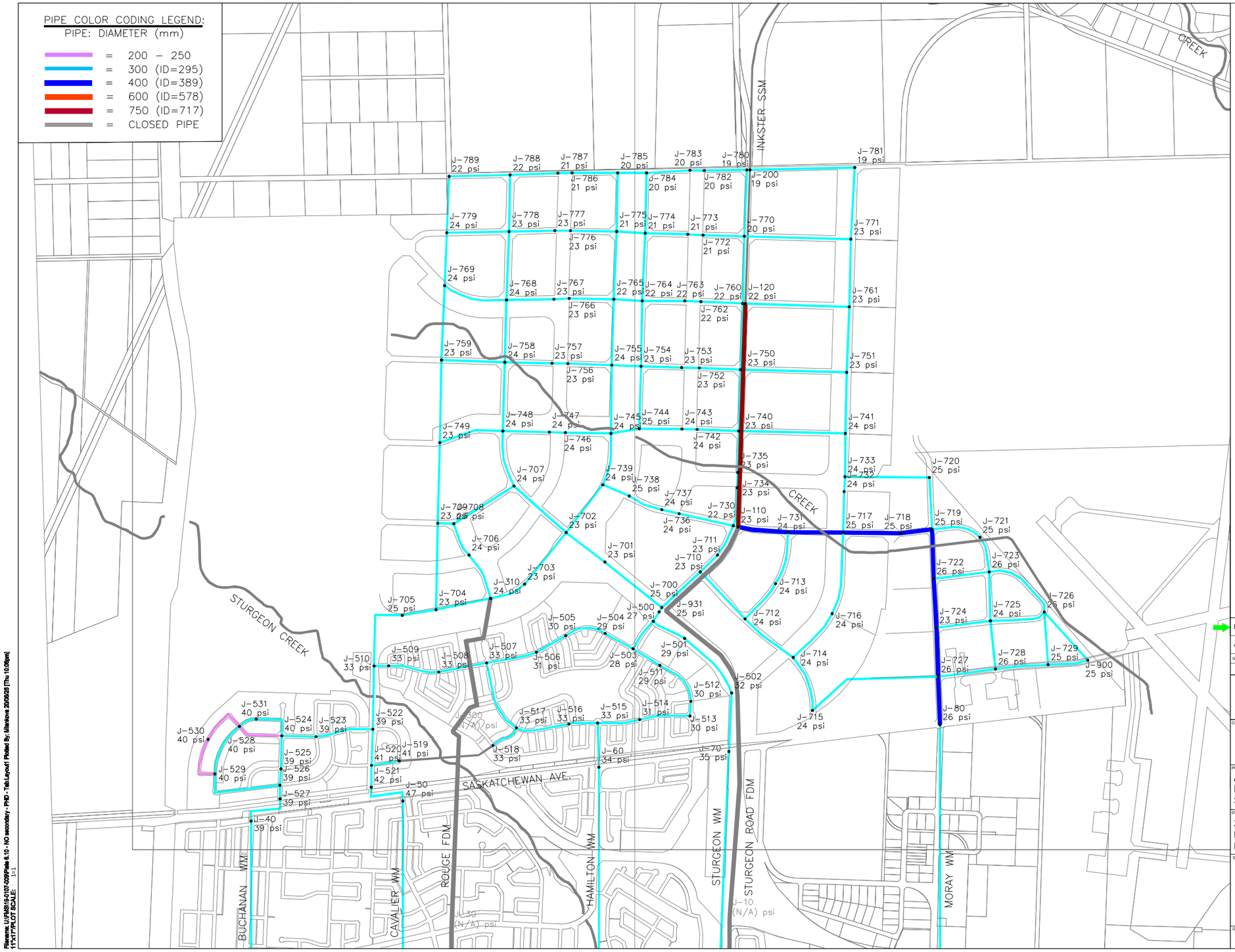
SEAL		
	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.09 REV. B

[Filename: U:\PW\MS\19-0107-009\Plate 6.09 - Sturgeon 750 only - PHD - Tab\Layout1 Plotted By: Marrione 20/06/26 [Thu 6:20pm]
11x17 PRINT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

300/400mm INDUSTRIAL THROUGHOUT
PHD = 2.5 x ADD
100% OF PHD

CONNECTIONS TO C.O.W. SYSTEM AT:

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/01	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | WSP

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
2RY ANALYSIS - NO FDM OR SECONDARY
PEAK HOUR DEMAND
MINIMUM PRESSURES

SEAL		
	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.10 REV. B

Filename: U:\PW\19-0107-009\Plate 6.10 - NO secondary - PHD - Tab\Layout Plotted By: Mlinkova 2020/02/25 [Thu 10:06pm]
11"x17"/PLOT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

AREA OF INTEREST

KEYPLAN

SCENARIO NOTES:

PHD = 2.5 x ADD
100% OF PHD

CONNECTIONS TO C.O.W. SYSTEM AT:
300mm ROUGE ROAD WM

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | WSP

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
2RY ANALYSIS - ROUGE 300 ONLY
PEAK HOUR DEMAND
MINIMUM PRESSURES

SEAL	DESIGN BY:	DATE (YY/MM/DD):
	SH	20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.11 REV: B

Filename: J:\PW\19-0107-009\Plate 6.11 - Rouge 300 secondary - PHD - Tiled.mxd Plotted By: Mlintova 20/06/29 [Fri 12:10pm]
11"x17"PLOT SCALE 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

INKSTER SSM
CREEK
STURGEON CREEK
SASKATCHEWAN AVE.
BUCHANAN WM
CAVALIER WM
ROUGE FDM
HAMILTON WM
STURGEON WM
STURGEON ROAD FDM
MORAY WM

AREA OF INTEREST

KEYPLAN

SCENARIO NOTES:

PHD = 2.5 x ADD
100% OF PHD

CONNECTIONS TO C.O.W. SYSTEM AT:
300mm INKSTER SSM

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
2RY ANALYSIS - INKSTER ONLY
PEAK HOUR DEMAND
MINIMUM PRESSURES

SEAL		
	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.12 REV. B

Filename: U:\PW\80\19-0107-009\Plate 6.12 - Inkster 300 secondary - PHD - Tech Layout1 Plotted By: Miranova 20/06/29 (Fri 12:39pm)
11"x17" PLOT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

INKSTER SSM

CREEK

STURGEON CREEK

SASKATCHEWAN AVE.

ROUGE FDM

STURGEON ROAD FDM

BUCHANAN WM

CAVALIER WM

HAMILTON WM

STURGEON WM

MORAY WM

AREA OF INTEREST

KEYPLAN

SCENARIO NOTES:

PHD = 2.5 x ADD
100% OF PHD

CONNECTIONS TO C.O.W. SYSTEM AT:
600mm ROUGE ROAD FDM

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP

wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
2RY ANALYSIS - ROUGE 600 ONLY
PEAK HOUR DEMAND
MINIMUM PRESSURES

SEAL		
	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.13 REV: B

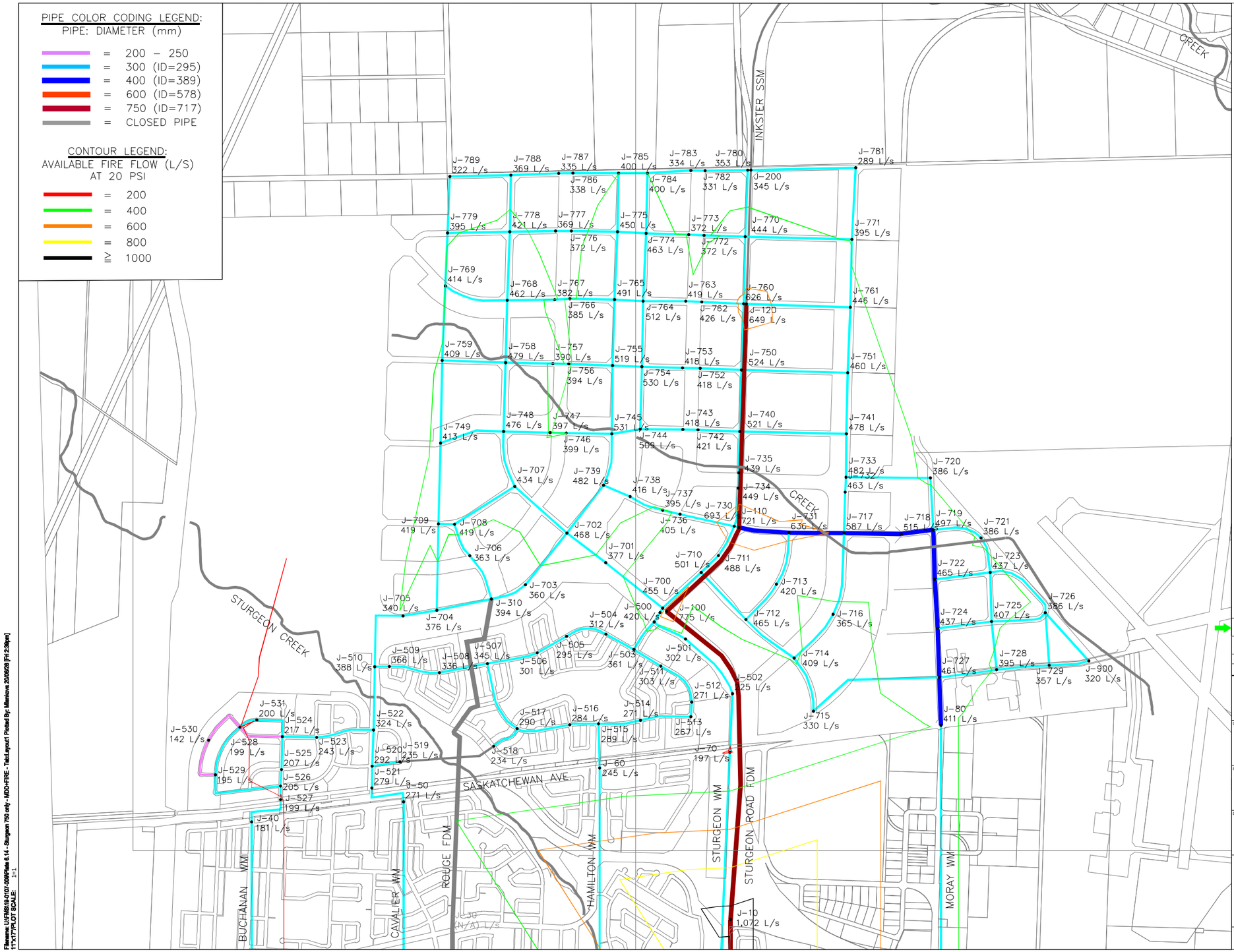
Filename: U:\Projects\19-0107-009\Plots & 6.13 - Rouge 600 secondary - PHD - Tiled.layout Plotted By: Milanova 20/06/26 (Fri 1:45pm)
11"X17"PC.CTT SCALE: 1:1

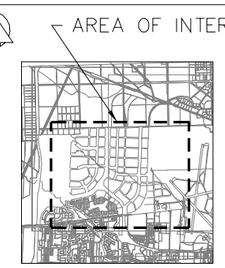
PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

- = 200 – 250
- = 300 (ID=295)
- = 400 (ID=389)
- = 600 (ID=578)
- = 750 (ID=717)
- = CLOSED PIPE

CONTOUR LEGEND:
AVAILABLE FIRE FLOW (L/S)
AT 20 PSI

- = 200
- = 400
- = 600
- = 800
- ≧ 1000





KEYPLAN

SCENARIO NOTES:

MDD = 1.6 x ADD
100% OF MDD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON ROAD FDM

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | WSP

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
2RY ANALYSIS - STURGEON 750 FM ONLY
MAXIMUM DAY FIRE FLOW
WITH 20 PSI RESIDUAL PRESSURE

SEAL	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.14 REV: B

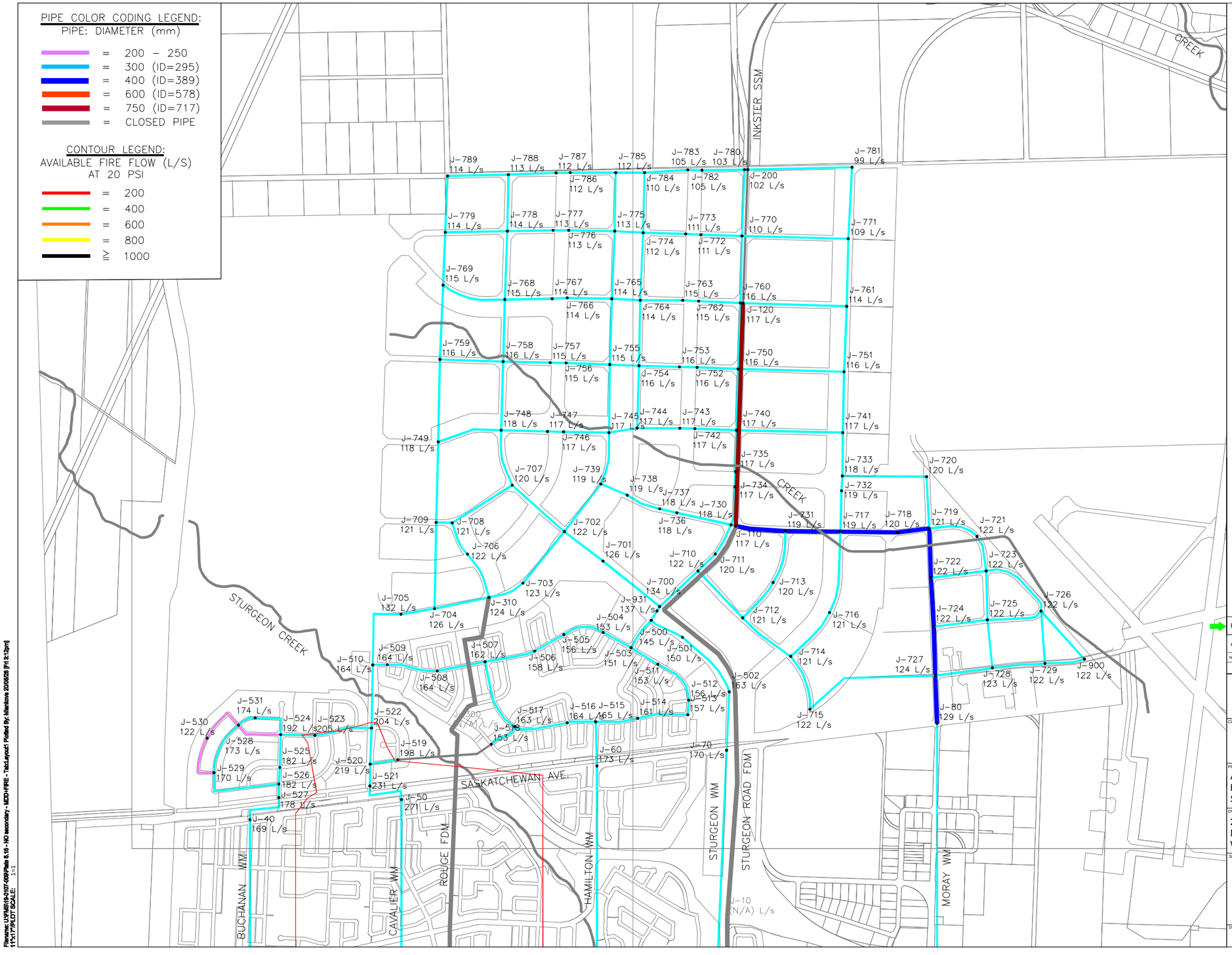
[Filename: U:\PW\19-0107-009\Plate 6.14 - Sturgeon 750 only - MDD+FIRE - TileLayout1 Plotted By: Mlevrove 2006/26 [Fri 2:39pm]
YY/MM/DD SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

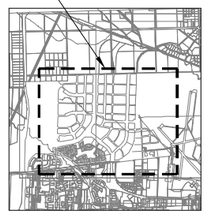
= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

CONTOUR LEGEND:
AVAILABLE FIRE FLOW (L/S)
AT 20 PSI

= 200
= 400
= 600
= 800
≧ 1000



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

MDD = 1.6 x ADD
100% OF MDD

CONNECTIONS TO C.O.W. SYSTEM AT:

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | WSP

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
2RY ANALYSIS - NO FM OR SECONDARY
MAXIMUM DAY FIRE FLOW
WITH 20 PSI RESIDUAL PRESSURE

SEAL		
	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.15 REV. B

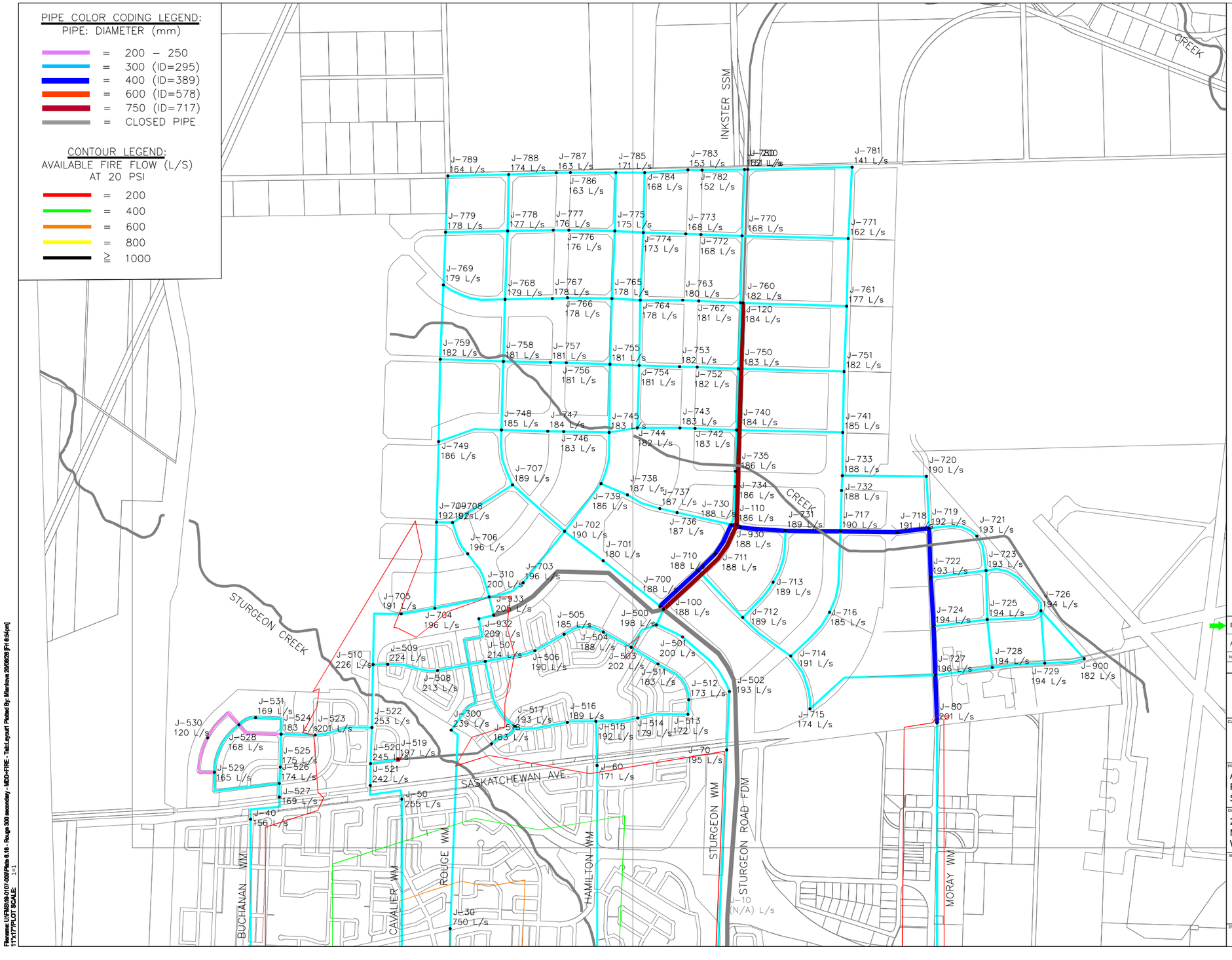
Filename: I:\P\MS\19-0107-000\Plate 6.15 - NO secondary - MDD+FIRE - 1hr\Layout1 Plotted By: Miankova 20/06/26 (Fri 8:12pm)
11"x17"/PLOT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

CONTOUR LEGEND:
AVAILABLE FIRE FLOW (L/S)
AT 20 PSI

= 200
= 400
= 600
= 800
≧ 1000



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

MDD = 1.6 x ADD
100% OF MDD

CONNECTIONS TO C.O.W. SYSTEM AT:
300mm ROUGE ROAD WM

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP

wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
2RY ANALYSIS - ROUGE 300 ONLY
MAXIMUM DAY FIRE FLOW
WITH 20 PSI RESIDUAL PRESSURE

SEAL		
	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.16 REV: B

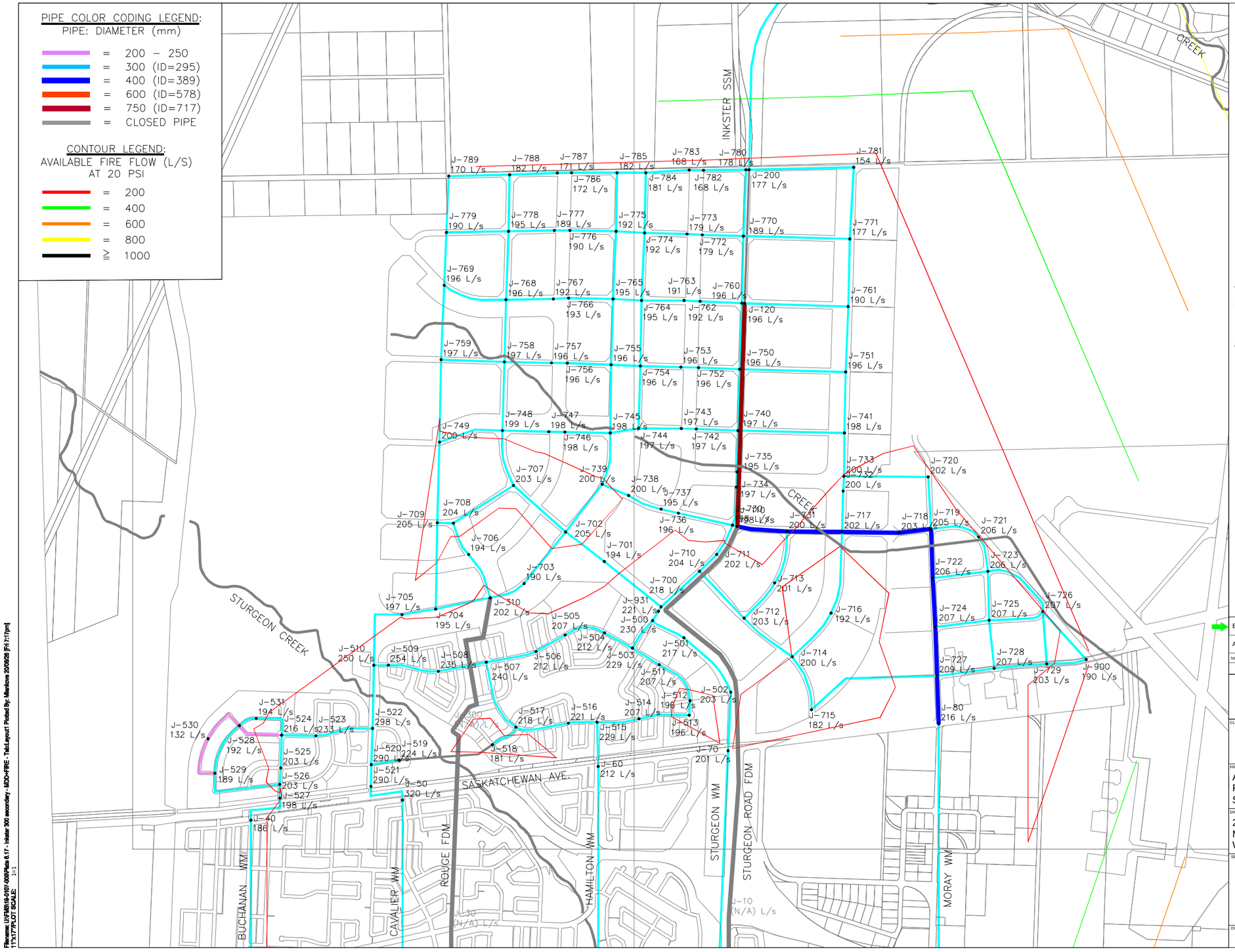
Filename: I:\AP\6\19-0107-009\Plate 6.16 - Rouge 300 secondary - MDD+FIRE - Tile1.mxd Plotted By: Mlamlova 20/06/26 [Fri 6:54pm]
11"x17"/PLOT SCALE: 1:1

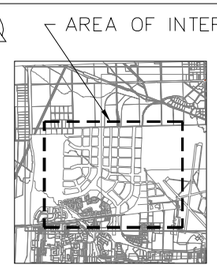
PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

CONTOUR LEGEND:
AVAILABLE FIRE FLOW (L/S)
AT 20 PSI

= 200
= 400
= 600
= 800
≧ 1000





KEYPLAN

SCENARIO NOTES:

MDD = 1.6 x ADD
100% OF MDD

CONNECTIONS TO C.O.W. SYSTEM AT:
300mm INKSTER SSM

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	**ISSUED FOR FINAL REPORT**	SH	RBO
A	20/02/25	**ISSUED FOR 60% REVIEW**	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
2RY ANALYSIS - INKSTER ONLY
MAXIMUM DAY FIRE FLOW
WITH 20 PSI RESIDUAL PRESSURE

SEAL		
	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.17 REV. B

Filename: I:\KGS\19-0107-009\Plate 6.17 - Inkster 300 secondary - MDD+FIRE - Tiled.aprx\01 Plotted By: Mlamkone 20/06/26 [Fri 1:17pm]
11"x17"\PLOT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

CONTOUR LEGEND:
AVAILABLE FIRE FLOW (L/S)
AT 20 PSI

= 200
= 400
= 600
= 800
≧ 1000

AREA OF INTEREST

KEYPLAN

SCENARIO NOTES:

MDD = 1.6 x ADD
100% OF MDD

CONNECTIONS TO C.O.W. SYSTEM AT:
600mm ROUGE ROAD FDM

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP

WSP

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
2RY ANALYSIS - ROUGE 600 ONLY
MAXIMUM DAY FIRE FLOW
WITH 20 PSI RESIDUAL PRESSURE

SEAL		
	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.18 REV. B

Filename: LW\FMS\19-0107-009\Plate 6.18 - Rouge 600 secondary - MDD+FIRE - Tbl2.layout1 Plotted By: Mlenkova 20/06/26 [Fri 7:40pm]
11"x17"PLOT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

J-789 31 psi
J-788 31 psi
J-787 30 psi
J-785 29 psi
J-783 28 psi
J-780 28 psi
J-200 28 psi
J-781 28 psi
J-786 30 psi
J-784 29 psi
J-782 28 psi
J-779 33 psi
J-778 31 psi
J-777 32 psi
J-775 30 psi
J-774 30 psi
J-773 30 psi
J-770 29 psi
J-771 32 psi
J-776 32 psi
J-772 30 psi
J-769 33 psi
J-768 33 psi
J-767 32 psi
J-765 31 psi
J-764 31 psi
J-763 31 psi
J-760 31 psi
J-120 31 psi
J-761 32 psi
J-766 32 psi
J-762 31 psi
J-759 32 psi
J-758 33 psi
J-757 32 psi
J-755 33 psi
J-754 32 psi
J-753 32 psi
J-750 31 psi
J-751 32 psi
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J-752 32 psi
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J-747 33 psi
J-745 33 psi
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J-749 32 psi
J-746 33 psi
J-742 33 psi
J-735 31 psi
J-733 33 psi
J-720 34 psi
J-707 33 psi
J-739 33 psi
J-738 34 psi
J-737 33 psi
J-734 31 psi
J-732 33 psi
J-709 33 psi
J-708 33 psi
J-730 31 psi
J-736 33 psi
J-731 33 psi
J-717 33 psi
J-718 33 psi
J-719 34 psi
J-721 33 psi
J-706 33 psi
J-702 31 psi
J-110 32 psi
J-701 31 psi
J-710 31 psi
J-711 31 psi
J-722 34 psi
J-723 34 psi
J-310 33 psi
J-703 33 psi
J-700 31 psi
J-713 32 psi
J-705 33 psi
J-901 374 psi
J-704 32 psi
J-500 32 psi
J-712 32 psi
J-716 33 psi
J-724 31 psi
J-725 32 psi
J-726 35 psi
J-505 34 psi
J-503 33 psi
J-501 34 psi
J-509 39 psi
J-508 37 psi
J-507 36 psi
J-504 33 psi
J-511 33 psi
J-714 32 psi
J-727 34 psi
J-728 34 psi
J-729 34 psi
J-900 34 psi
J-506 35 psi
J-502 37 psi
J-512 34 psi
J-513 34 psi
J-531 42 psi
J-517 36 psi
J-516 36 psi
J-515 36 psi
J-514 35 psi
J-715 32 psi
J-80 33 psi
J-530 42 psi
J-524 42 psi
J-522 42 psi
J-528 42 psi
J-523 42 psi
J-519 44 psi
J-520 44 psi
J-518 36 psi
J-70 39 psi
J-60 36 psi
J-525 42 psi
J-529 42 psi
J-521 45 psi
J-300 48 psi
J-526 41 psi
J-527 41 psi
J-50 49 psi
J-40 41 psi
J-30 56 psi

STURGEON CREEK
CREEK
CREEK
SASKATCHEWAN AVE.
BUCHANAN WM
CAVALIER WM
ROUGE SSM
HAMILTON WM
STURGEON WM
MORAY WM

AREA OF INTEREST

KEYPLAN

SCENARIO NOTES:

PHD = 2.5 x ADD
100% OF PHD

CONNECTIONS TO C.O.W. SYSTEM AT:
400mm ROUGE SSM

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
2RY ANALYSIS - ROUGE 400 ONLY
PEAK HOUR DEMAND
MINIMUM PRESSURES

SEAL	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.19 REV. B

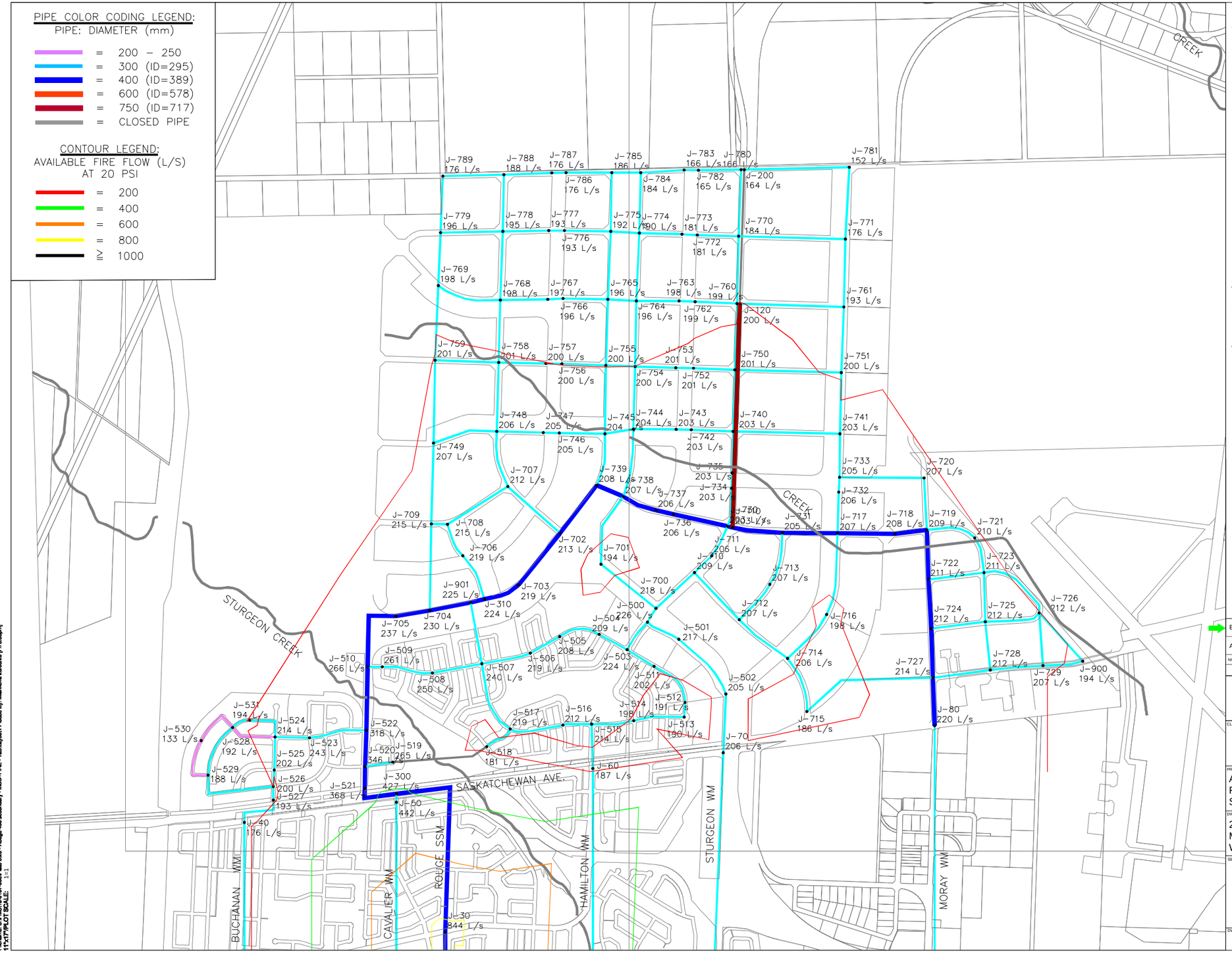
Filename: I:\AFA\19-0107-009\Plots & 1D - Rouge 400 secondary - PHD - Tab\Layout1 Plotted By: Milanova 2026/02/26 [Fri 8:07pm]
11"x17"/PLOT SCALE: 1:1

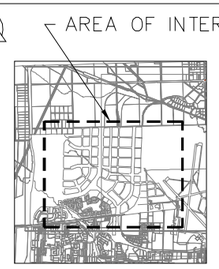
PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

CONTOUR LEGEND:
AVAILABLE FIRE FLOW (L/S)
AT 20 PSI

= 200
= 400
= 600
= 800
≧ 1000





KEYPLAN

SCENARIO NOTES:

MDD = 1.6 x ADD
100% OF MDD

CONNECTIONS TO C.O.W. SYSTEM AT:
300mm ROUGE ROAD SSM

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
2RY ANALYSIS - ROUGE 400 ONLY
MAXIMUM DAY FIRE FLOW
WITH 20 PSI RESIDUAL PRESSURE

SEAL	DESIGN BY:	DATE (YY/MM/DD)
	SH	20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.20 REV. B

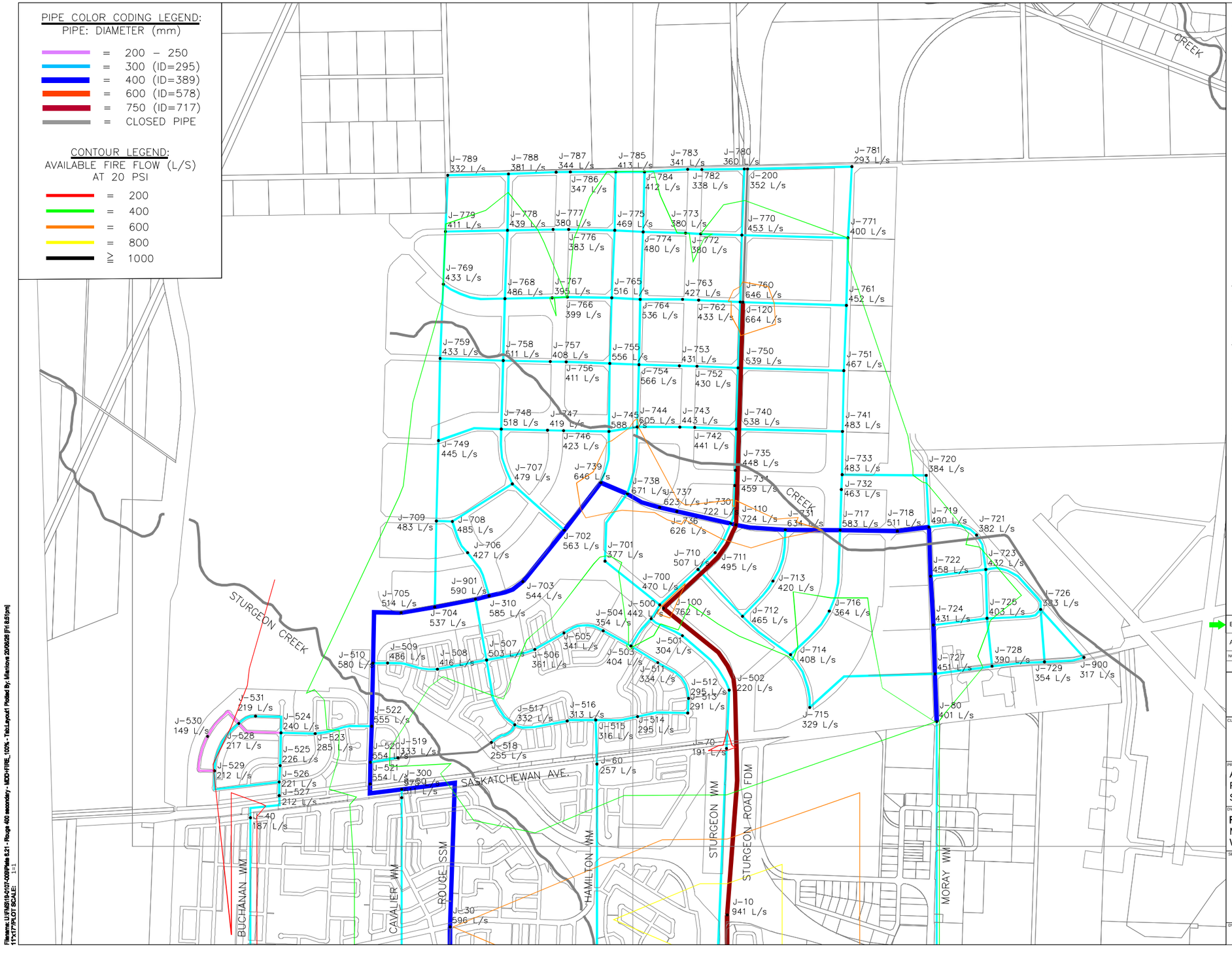
Filename: U:\PAR\19-0107-009\Plate 6.20 - Rouge 400 secondary - MDD+FIRE - Tab\Layout1 Plotted By: Mlenkova 2026/2/6 (Fri 8:35pm)
11"x17"PLOT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

CONTOUR LEGEND:
AVAILABLE FIRE FLOW (L/S)
AT 20 PSI

= 200
= 400
= 600
= 800
≧ 1000



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

MDD = 1.6 x ADD
100% OF MDD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON FDM
400mm ROUGE SECONDARY SUPPLY

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | WSP

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
FINAL MODEL - 750 STURGEON + 400 ROUGE 2RY
MAXIMUM DAY FIRE FLOW
WITH 20 PSI RESIDUAL PRESSURE

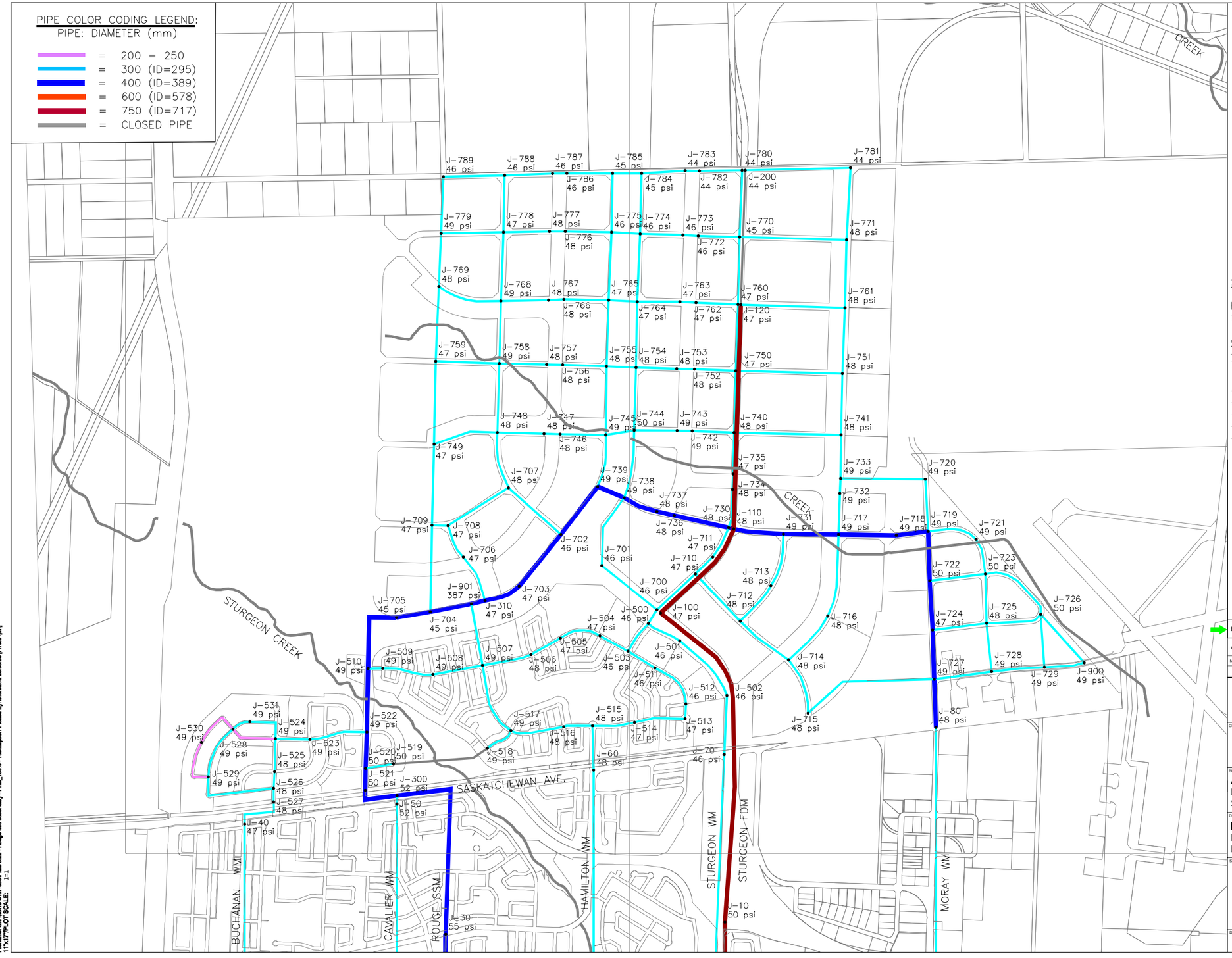
SEAL	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.21 REV. B

Filename: U:\ENS\19-0107-009\Plate 6.21 - Rouge 400 secondary - MDD+FIRE_100% - Tiled Layout1 Plotted By: Milankovic 20/06/26 [Fri 8:51pm]
11"x17" PLOT SCALE: 1=1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

PHD = 2.5 x ADD
100% OF PHD

CONNECTIONS TO C.O.W. SYSTEM AT:
400mm ROUGE SECONDARY SUPPLY
750mm STURGEON FEEDERMAIN

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP

wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
FINAL MODEL- STURGEON 750 + 400 ROUGE 2RY
PEAK HOUR DEMAND
MINIMUM PRESSURES

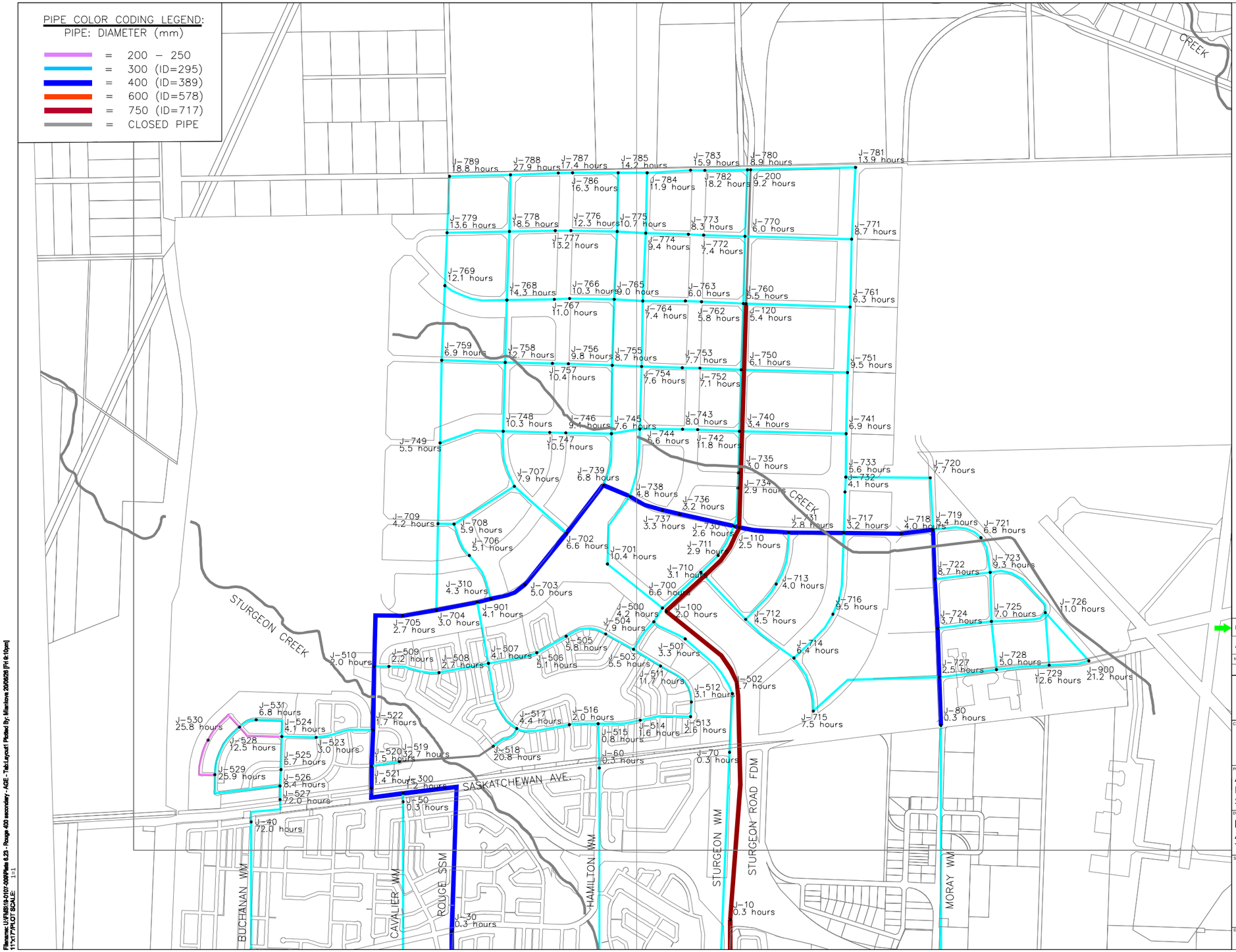
SEAL		
	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.22 REV: B

Filename: L:\#PMS\19-0107-009\Plate 6.22 - Rouge 400 secondary - PHD_100% - Tekd.aycuff Plotted By: Ullankova 20/02/26 (Fri 8:01pm)
11"x17"(PLOT SCALE: 1=1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

AVERAGE DAY DEMAND (ADD)
100% OF ADD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON ROAD FDM
400mm ROUGE SECONDARY SUPPLY

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP

wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
FINAL MODEL - STURGEON 750 + 400 ROUGE 2DY
AVERAGE DAY DEMAND
TRAVEL TIME ANALYSIS

SEAL	DESIGN BY:	DATE (YY/MM/DD):
	SH	20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO: 19-0107-009 PLATE 6.23 REV: B

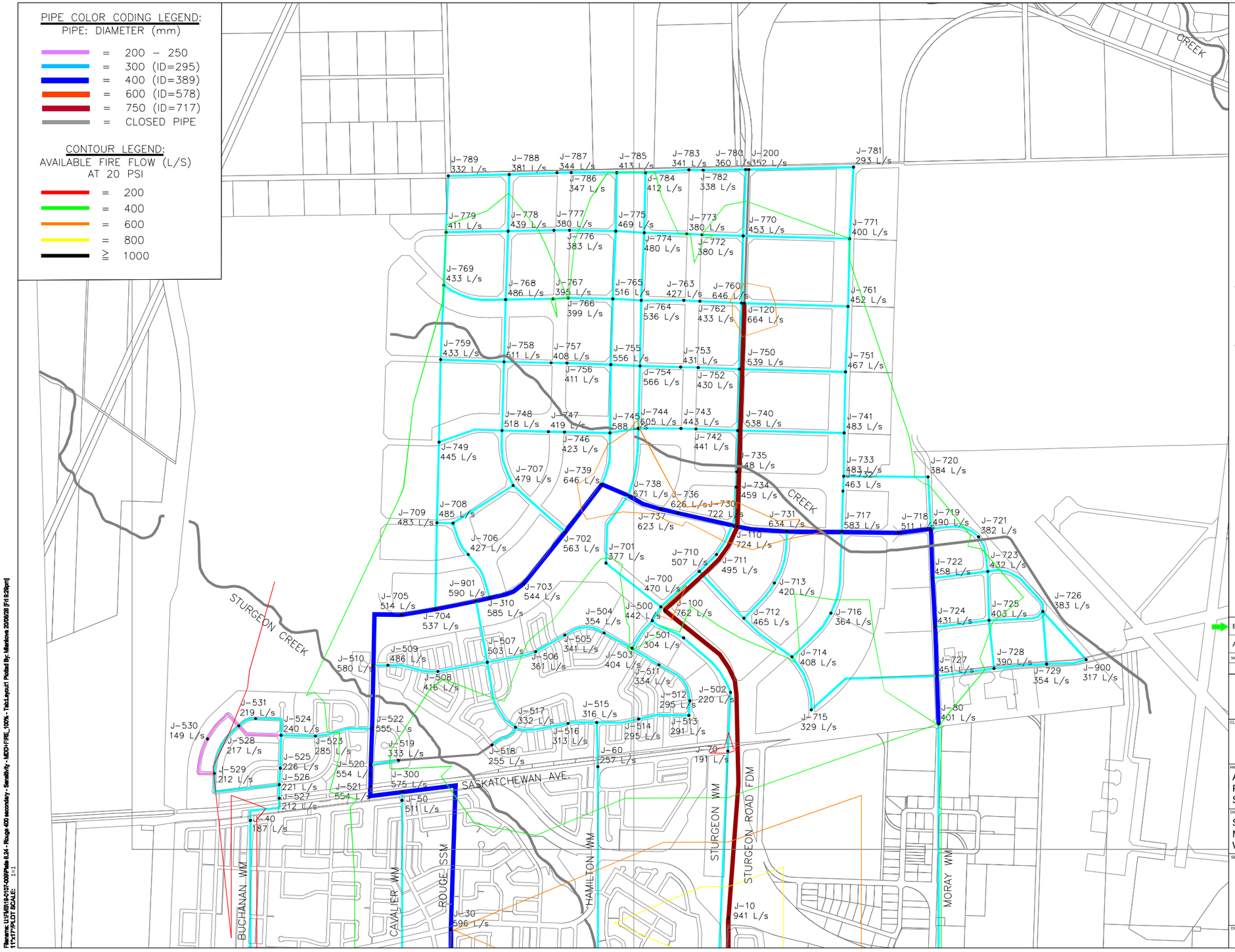
Filename: U:\PM\19-0107-009\Plate 6.23 - Rouge 400 secondary - AGE - Tek\Layout1 Plotted By: Mlarkova 20/06/29 [Fri 8:10pm]
11"x17"/PLOT SCALE: 1:1

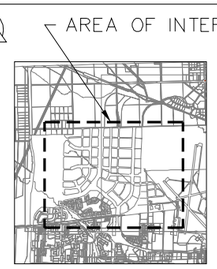
PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

CONTOUR LEGEND:
AVAILABLE FIRE FLOW (L/S)
AT 20 PSI

= 200
= 400
= 600
= 800
≧ 1000





KEYPLAN

SCENARIO NOTES:

MDD = 1.6 x ADD
100% OF MDD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON FDM
400mm ROUGE SECONDARY SUPPLY

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | WSP

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
SENSITIVITY ANALYSIS - 100% MDD
MAXIMUM DAY FIRE FLOW
WITH 20 PSI RESIDUAL PRESSURE

SEAL	DESIGN BY:	DATE (YY/MM/DD):
	SH	20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG. CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.24 REV. B

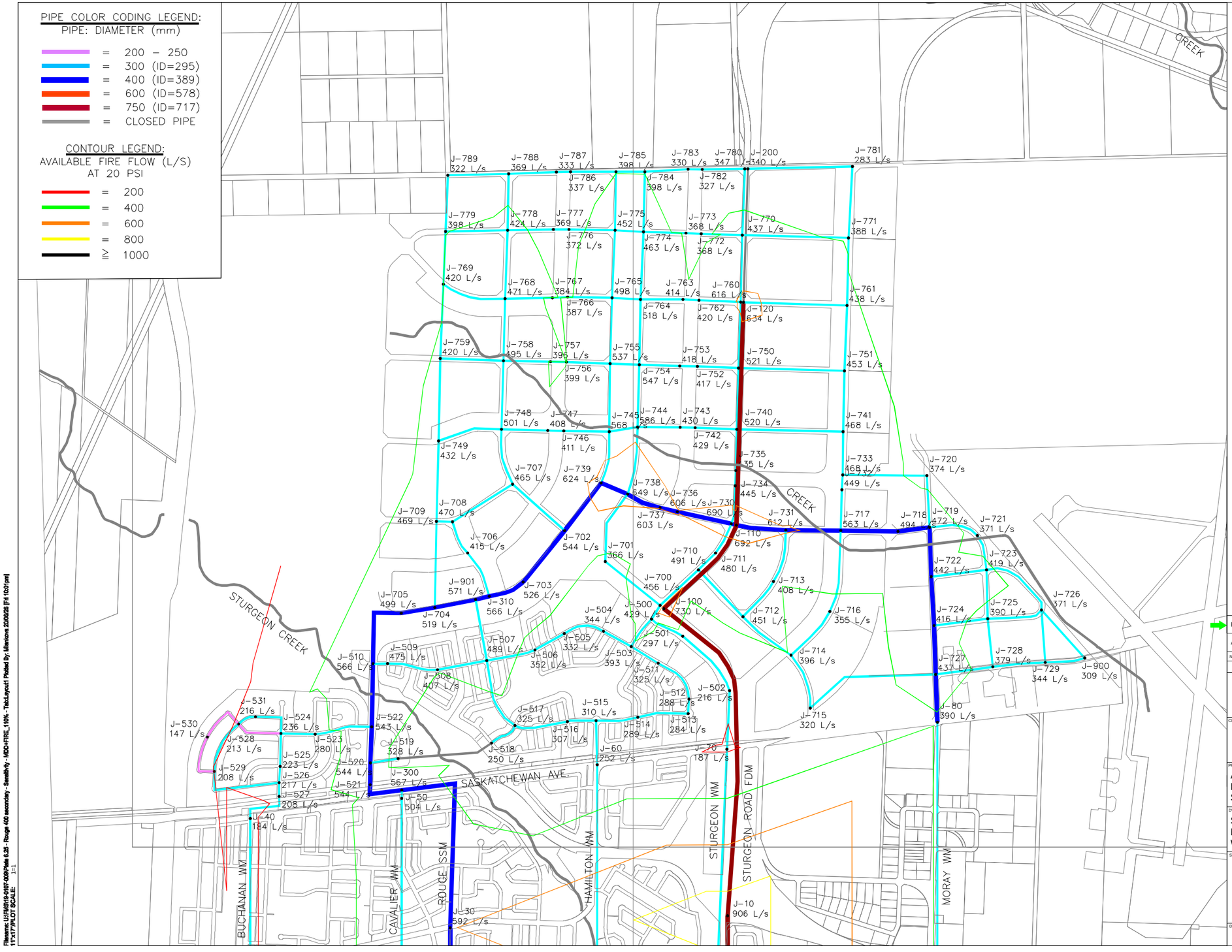
Filename: U:\FMS\19-0107-009\Plate 6.24 - Rouge 400 secondary - Sensitivity - MDD+FIRE_100% - Tbl.Layout1 Plotted By: Mlamova 20/06/26 [Fri 02pm]
11"x17"/PLOT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

- = 200 – 250
- = 300 (ID=295)
- = 400 (ID=389)
- = 600 (ID=578)
- = 750 (ID=717)
- = CLOSED PIPE

CONTOUR LEGEND:
AVAILABLE FIRE FLOW (L/S)
AT 20 PSI

- = 200
- = 400
- = 600
- = 800
- ≧ 1000



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

MDD = 1.6 x ADD
110% OF MDD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON FDM
400mm ROUGE SECONDARY SUPPLY

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	**ISSUED FOR FINAL REPORT**	SH	RBO
A	20/02/25	**ISSUED FOR 60% REVIEW**	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
SENSITIVITY ANALYSIS - 110% MDD
MAXIMUM DAY FIRE FLOW
WITH 20 PSI RESIDUAL PRESSURE

SEAL		
	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.25 REV: B

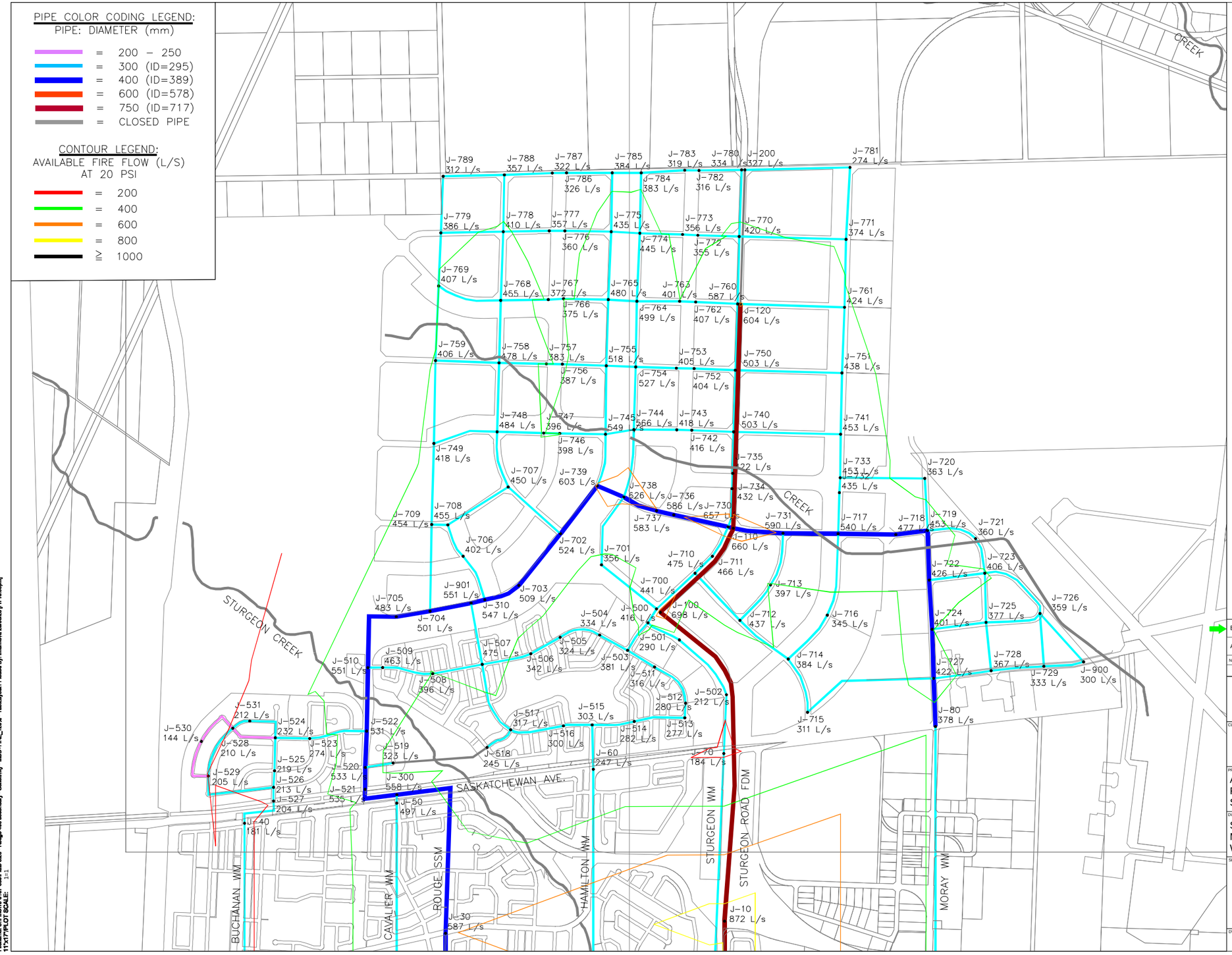
Filename: U:\Fil\19-0107-009\Fdls 6.25 - Rouge 400 secondary - Sensitivity - MDD+FIRE_110% - Tab1.layout1 Plotted By: Milanova 2020/02/26 [Fri 10:01 pm]
11"x17" PLOT SCALE: 1=1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

CONTOUR LEGEND:
AVAILABLE FIRE FLOW (L/S)
AT 20 PSI

= 200
= 400
= 600
= 800
≧ 1000



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

MDD = 1.6 x ADD
120% OF MDD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON FDM
400mm ROUGE SECONDARY SUPPLY

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | WSP

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
SENSITIVITY ANALYSIS - 120% MDD
MAXIMUM DAY FIRE FLOW
WITH 20 PSI RESIDUAL PRESSURE

SEAL

DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
DESIGN CHECK: RBO	DATE: YY/MM/DD
DRAWN BY: MID	DATE: 20/01/20
DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.26 REV. B

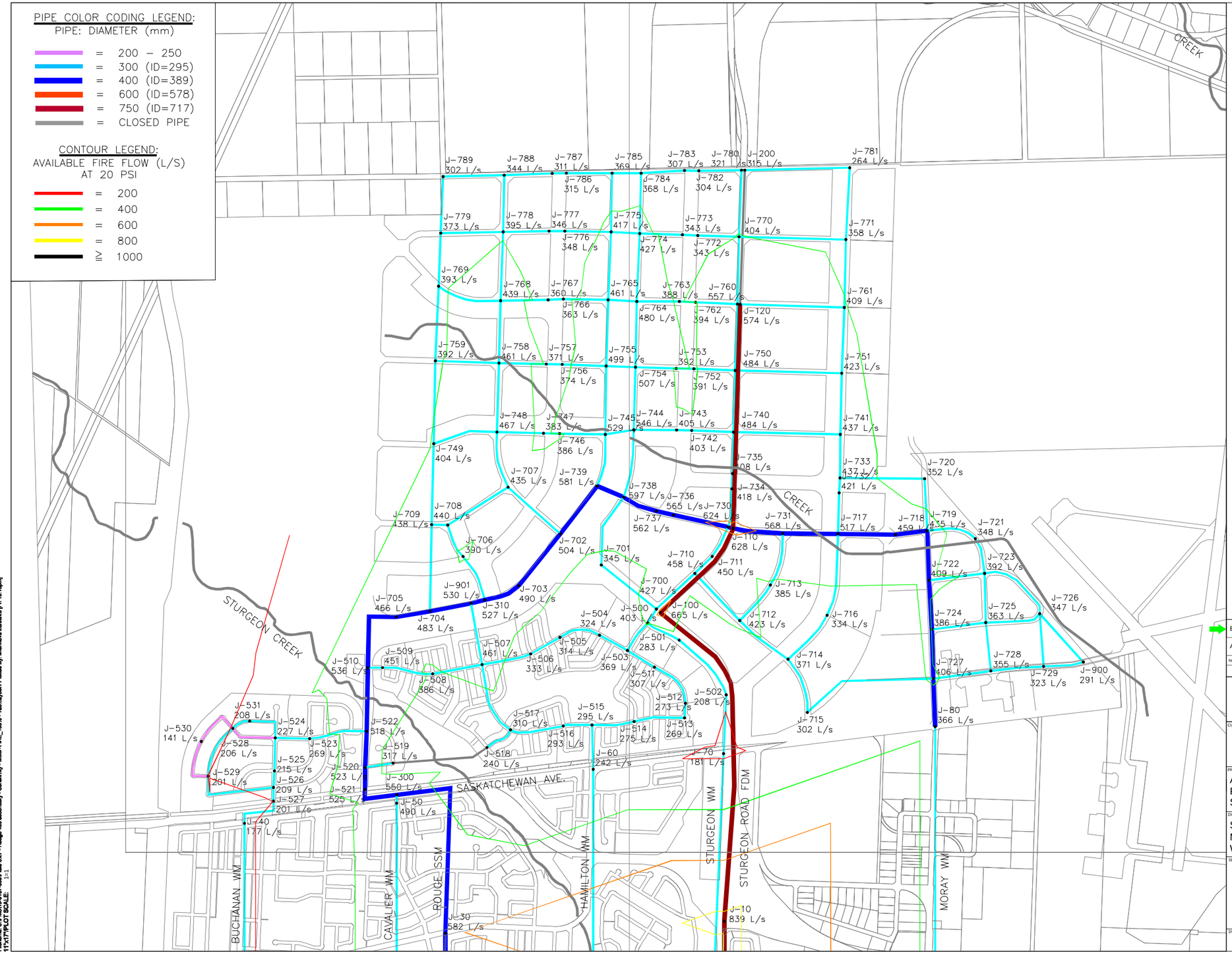
Filename: L:\FM\5\19-0107-009\Plate 6.26 - Rouge 400 secondary - Sensitivity - MDD+FIRE_120% - Tab2.layout1 Plotted By: Marinova 20/06/26 [Fri 10:05pm]
11"x17"/PLOT SCALE: 1=1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

- = 200 – 250
- = 300 (ID=295)
- = 400 (ID=389)
- = 600 (ID=578)
- = 750 (ID=717)
- = CLOSED PIPE

CONTOUR LEGEND:
AVAILABLE FIRE FLOW (L/S)
AT 20 PSI

- = 200
- = 400
- = 600
- = 800
- ≧ 1000



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

MDD = 1.6 x ADD
130% OF MDD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON FDM
400mm ROUGE SECONDARY SUPPLY

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | WSP

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
SENSITIVITY ANALYSIS - 130% MDD
MAXIMUM DAY FIRE FLOW
WITH 20 PSI RESIDUAL PRESSURE

SEAL

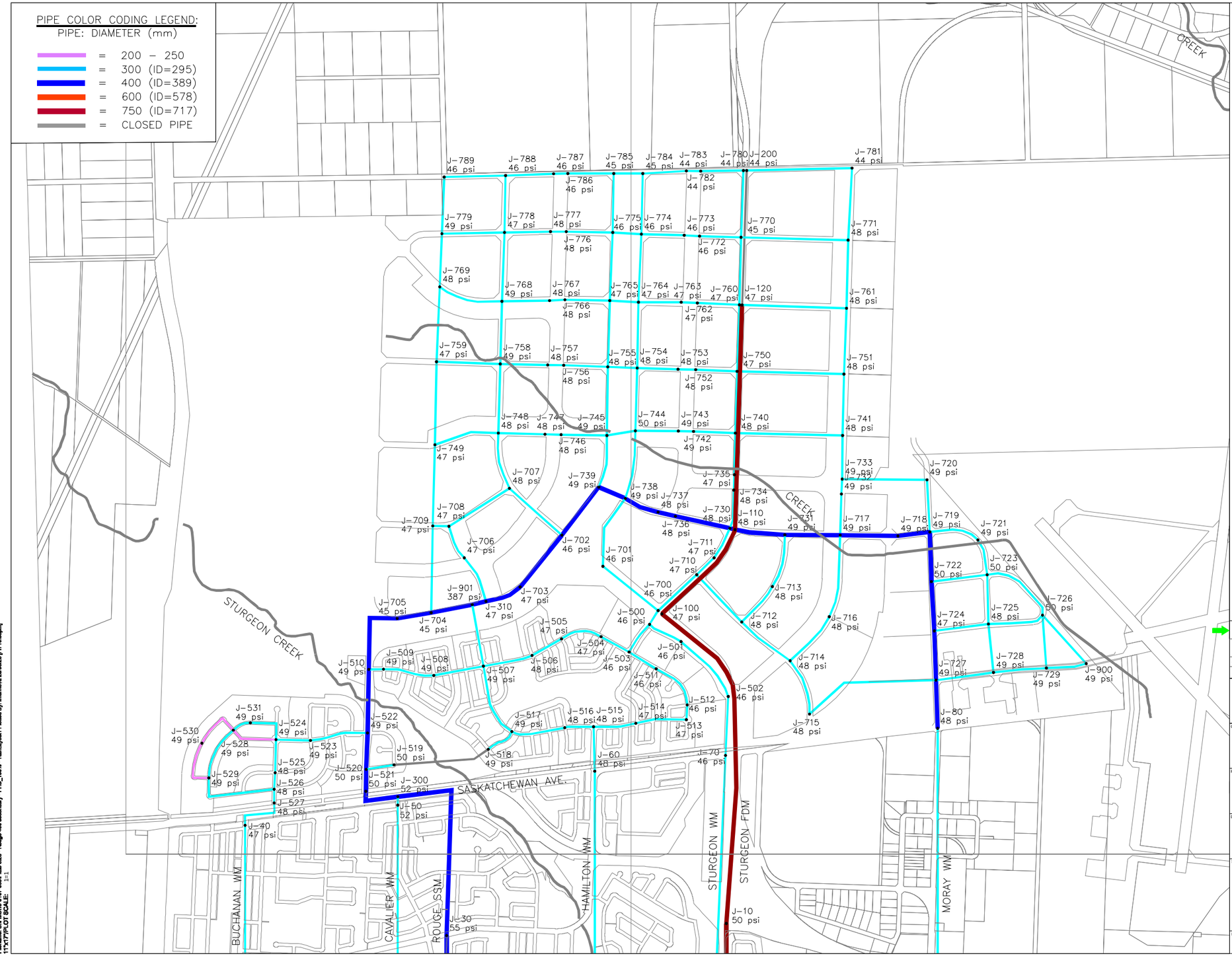
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DESIGN CHECK: RBO	DATE: YY/MM/DD
DRAWN BY: MID	DATE: 20/01/20
DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.27 REV: B

Filename: U:\PW\MS\19\0107-009\Plate 6.27 - Rouge 400 secondary - Sensitivity - MDD+PFFE_130% - Tabx\Layout1 Plotted By: Milanova 20/06/26 [Fri 10:16pm]
11x17 PLOT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

PHD = 2.5 x ADD
100% OF PHD

CONNECTIONS TO C.O.W. SYSTEM AT:
400mm ROUGE SECONDARY SUPPLY
750mm STURGEON FEEDERMAIN

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/25	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
SENSITIVITY ANALYSIS - 100% PHD
PEAK HOUR DEMAND
MINIMUM PRESSURES

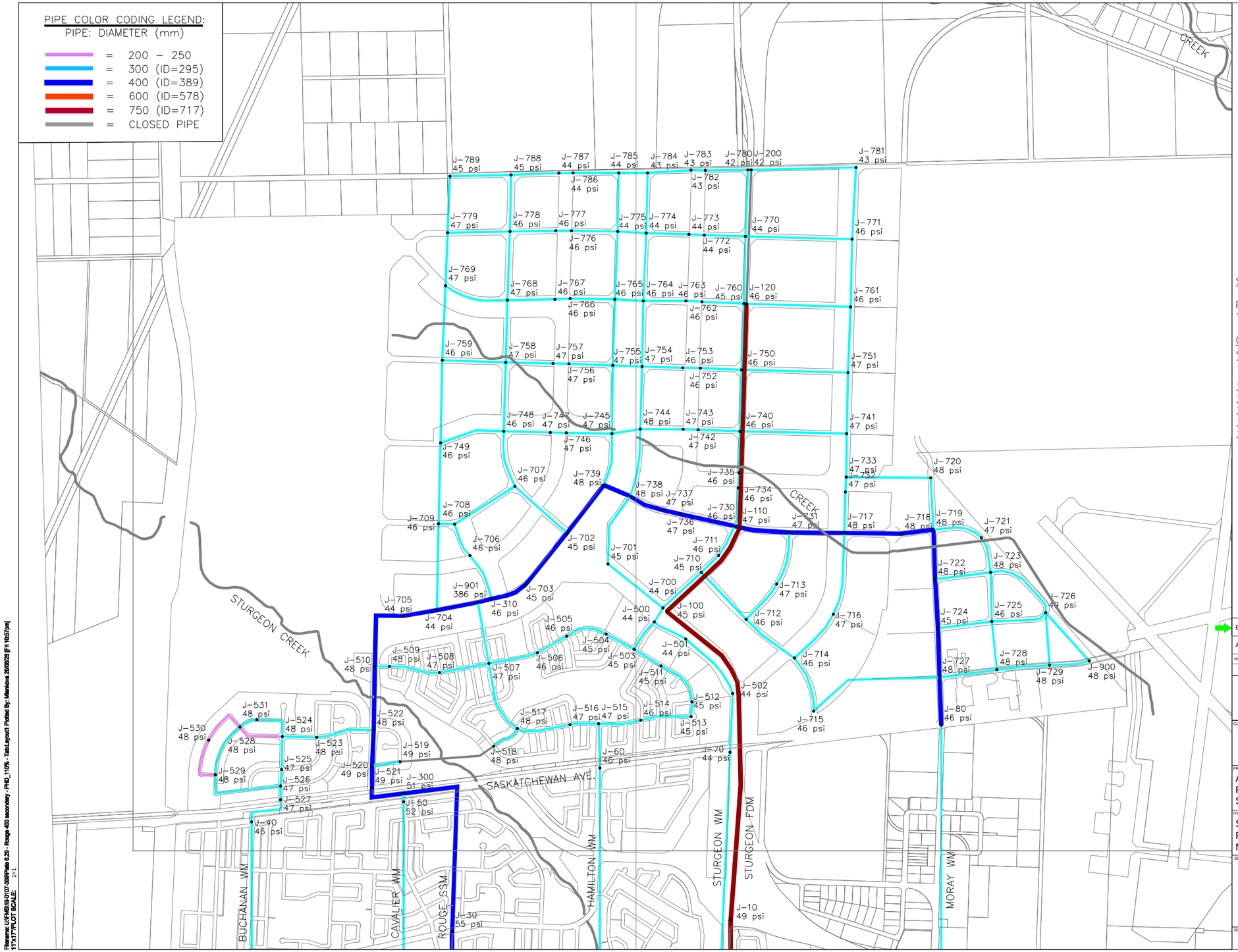
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	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.28 REV. B

Filename: I:\HFAS\19-0107-009\Plate 6.28 - Rouge 400 secondary - PHD_100% - Tab1.aysdf | Plotted By: Mfarnione 20/06/25 [Fri 10:23pm]
11"x17"/PLOT SCALE: 1=1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

PHD = 2.5 x ADD
110% OF PHD

CONNECTIONS TO C.O.W. SYSTEM AT:
400mm ROUGE SECONDARY SUPPLY
750mm STURGEON FEEDERMAIN

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/25	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | WSP

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
SENSITIVITY ANALYSIS - 110% PHD
PEAK HOUR DEMAND
MINIMUM PRESSURES

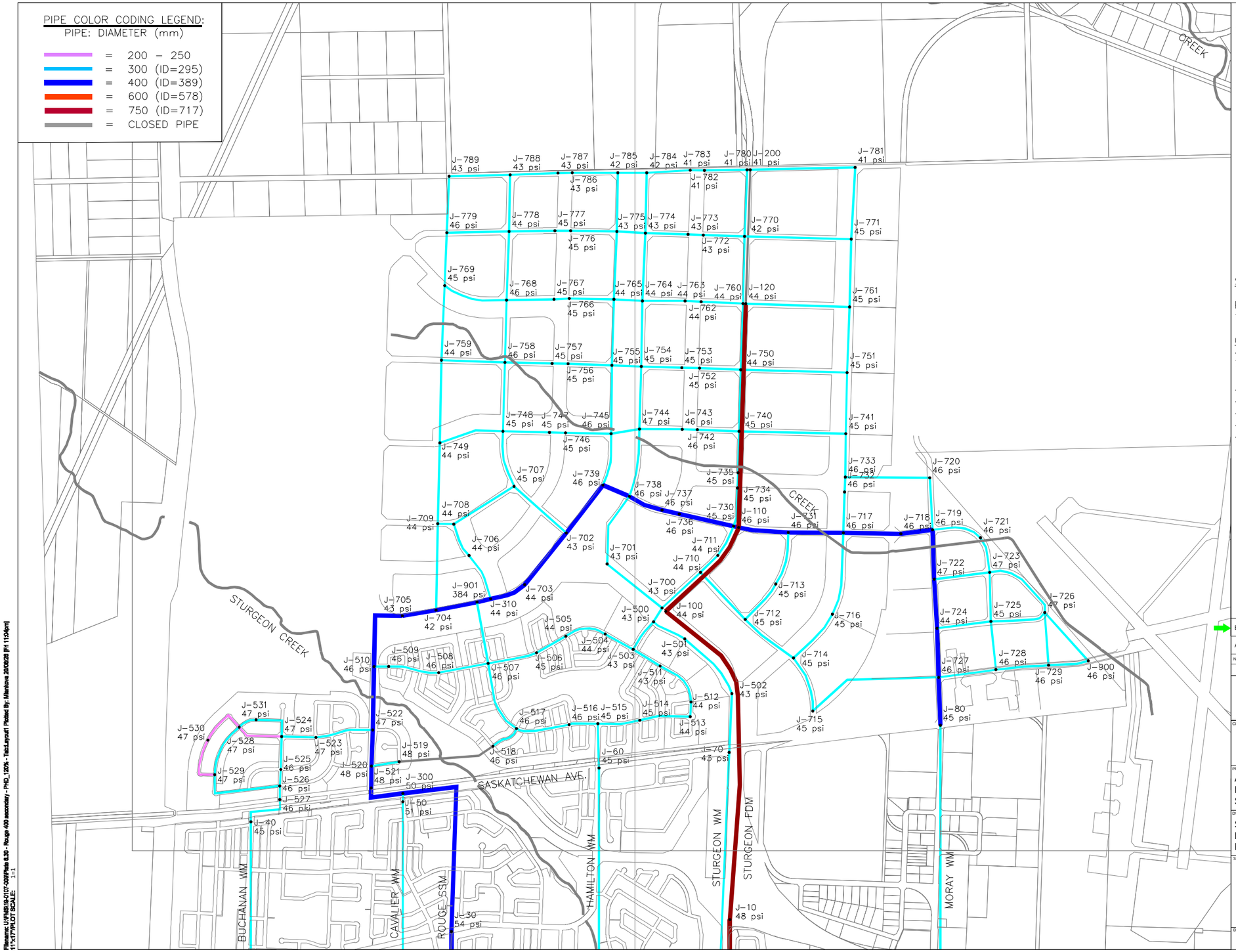
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	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.29 REV. B

Filename: I:\P\1901\10-0107-0009\Plate 6.29 - Rouge 400 secondary - PHD_110% - Tbd.aprx\t1 Plotted By: Mlennox 20/06/26 [Fri 10:57pm]
11"x17"PLOT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

PHD = 2.5 x ADD
120% OF PHD

CONNECTIONS TO C.O.W. SYSTEM AT:
400mm ROUGE SECONDARY SUPPLY
750mm STURGEON FEEDERMAIN

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
SENSITIVITY ANALYSIS - 120% PHD
PEAK HOUR DEMAND
MINIMUM PRESSURES

SEAL	DESIGN BY:	DATE (YY/MM/DD):
	SH	20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.30 REV. B

Filename: U:\FMG\19-0107-009\Plate 6.30 - Rouge 400 secondary - PHD_120% - Tiled.aprx#1 | Plotted By: Mikenkova 20/06/26 [Fri 11:04pm]
11"x17"/PLOT SCALE: 1=1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

PHD = 2.5 x ADD
130% OF PHD

CONNECTIONS TO C.O.W. SYSTEM AT:
400mm ROUGE SECONDARY SUPPLY
750mm STURGEON FEEDERMAIN

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP

wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
SENSITIVITY ANALYSIS - 130% PHD
PEAK HOUR DEMAND
MINIMUM PRESSURES

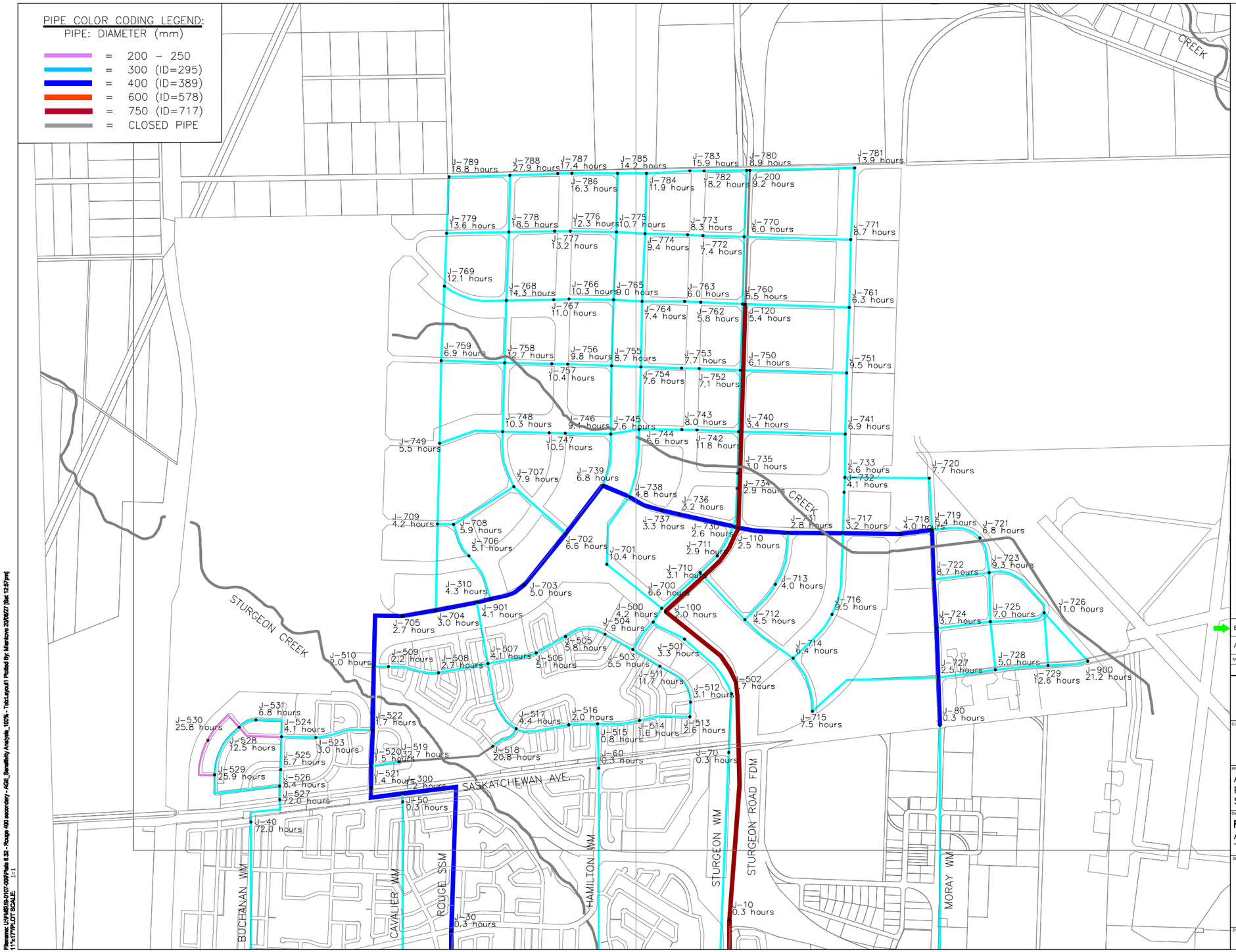
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	SH	20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.31 REV. B

Filename: U:\FMS\19-0107-009\Plate 6.31 - Rouge 400 secondary - PHD_130% - Tiled.aprx#1 Plotted By: Milenkova 20/06/26 [Fri 11:13pm]
11"x17"/PLOT SCALE: 1=1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

AVERAGE DAY DEMAND (ADD)
100% OF ADD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON ROAD FDM
400mm ROUGE SECONDARY SUPPLY

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	**ISSUED FOR FINAL REPORT**	SH	RBO
A	20/02/25	**ISSUED FOR 60% REVIEW**	SH	RBO

REVISIONS / ISSUE

KGS GROUP | WSP

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
FINAL MODEL - SENSITIVITY ANALYSIS 100% ADD
AVERAGE DAY DEMAND
TRAVEL TIME ANALYSIS

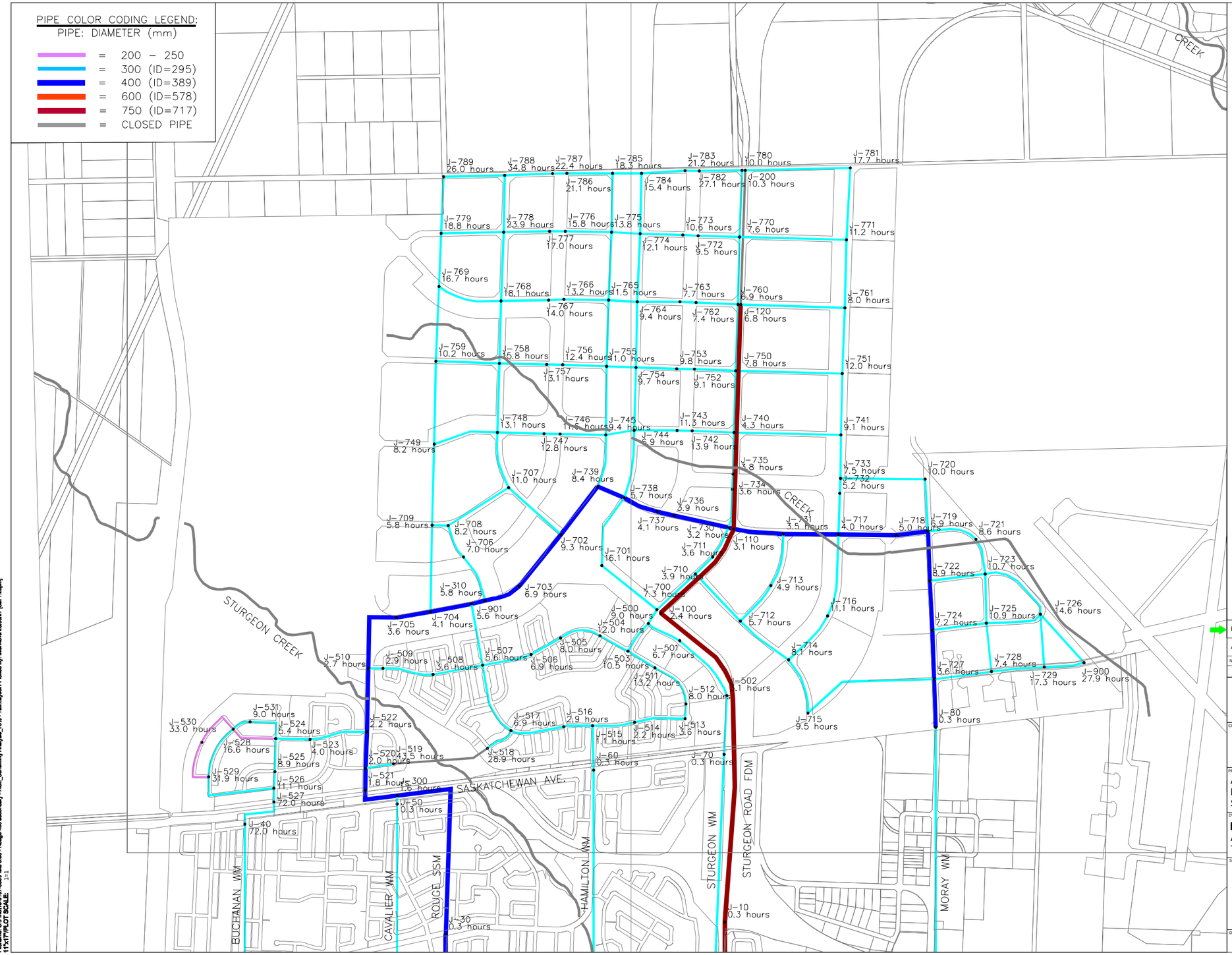
SEAL		
	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.32 REV: B

Filename: U:\PGIS\19-0107-009\Plate 6.32 - Rouge 400 secondary - AGE_Sensitivity Analysis_100% - Tim1.mxd1 Plotted By: Milankova 20/06/27 [Sat 12:57pm]
11"x17"/PLOT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

AVERAGE DAY DEMAND (ADD)
75% OF ADD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON ROAD FDM
400mm ROUGE SECONDARY SUPPLY

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | WSP

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
FINAL MODEL - SENSITIVITY ANALYSIS 75% ADD
AVERAGE DAY DEMAND
TRAVEL TIME ANALYSIS

SEAL	DESIGN BY:	DATE (YY/MM/DD):
	SH	20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.33 REV. B

Filename: U:\PA\19-0107-009\Plots 6.33 - Rouge 400 secondary - AGE_Sensitivity Analysis_75% - Tobi\.aprx#1 Plotted By: Mlennox 20/06/27 [Sat 1:28pm]
11"x17"/PLOT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

J-789 43.2 hours
J-788 45.0 hours
J-787 31.0 hours
J-785 25.5 hours
J-783 33.3 hours
J-780 13.9 hours
J-781 25.6 hours
J-786 29.3 hours
J-784 21.7 hours
J-782 44.2 hours
J-200 14.4 hours
J-779 31.0 hours
J-778 35.0 hours
J-776 21.7 hours
J-775 18.8 hours
J-773 14.5 hours
J-770 10.5 hours
J-771 15.9 hours
J-777 23.3 hours
J-774 16.8 hours
J-772 13.1 hours
J-769 27.7 hours
J-768 26.1 hours
J-766 17.5 hours
J-765 15.1 hours
J-763 10.6 hours
J-760 9.6 hours
J-761 11.2 hours
J-767 18.7 hours
J-764 12.9 hours
J-762 10.3 hours
J-120 9.5 hours
J-759 18.4 hours
J-758 23.3 hours
J-756 14.9 hours
J-755 12.9 hours
J-753 13.9 hours
J-750 11.1 hours
J-751 16.4 hours
J-757 15.9 hours
J-754 12.9 hours
J-752 12.8 hours
J-748 20.9 hours
J-746 11.2 hours
J-745 9.0 hours
J-743 34.4 hours
J-740 5.8 hours
J-741 13.2 hours
J-749 14.6 hours
J-747 13.3 hours
J-744 7.9 hours
J-742 10.9 hours
J-735 5.1 hours
J-733 11.3 hours
J-720 14.5 hours
J-707 19.5 hours
J-739 7.2 hours
J-732 7.3 hours
J-738 6.1 hours
J-736 5.2 hours
J-734 4.9 hours
J-709 9.1 hours
J-708 12.7 hours
J-737 5.5 hours
J-730 4.3 hours
J-731 4.7 hours
J-717 5.5 hours
J-718 6.8 hours
J-719 9.7 hours
J-721 12.0 hours
J-706 10.8 hours
J-702 17.7 hours
J-701 22.3 hours
J-711 4.8 hours
J-110 4.2 hours
J-722 11.9 hours
J-723 14.6 hours
J-710 5.2 hours
J-713 6.6 hours
J-310 8.8 hours
J-703 11.1 hours
J-700 13.4 hours
J-716 13.8 hours
J-726 21.7 hours
J-901 8.5 hours
J-500 14.2 hours
J-100 4.3 hours
J-712 7.8 hours
J-725 17.8 hours
J-704 6.3 hours
J-504 17.9 hours
J-724 13.2 hours
J-705 5.6 hours
J-505 10.7 hours
J-714 11.1 hours
J-510 4.1 hours
J-509 4.4 hours
J-508 5.5 hours
J-507 6.7 hours
J-506 8.9 hours
J-503 15.8 hours
J-501 72.0 hours
J-727 6.8 hours
J-728 13.2 hours
J-511 18.5 hours
J-502 72.0 hours
J-729 27.4 hours
J-900 40.1 hours
J-512 16.4 hours
J-715 12.9 hours
J-80 0.3 hours
J-531 13.5 hours
J-530 47.6 hours
J-524 8.0 hours
J-522 3.3 hours
J-517 30.6 hours
J-516 11.1 hours
J-514 4.0 hours
J-513 6.5 hours
J-528 24.9 hours
J-523 5.9 hours
J-515 2.0 hours
J-525 13.3 hours
J-519 5.3 hours
J-518 60.6 hours
J-60 6.3 hours
J-70 72.0 hours
J-520 2.9 hours
J-529 44.0 hours
J-526 16.6 hours
J-521 2.7 hours
J-300 2.3 hours
J-527 72.0 hours
J-50 72.0 hours
J-40 72.0 hours
J-10 0.3 hours
J-30 0.3 hours

CREEK
CREEK
STURGEON CREEK
SASKATCHEWAN AVE.
BUCHANAN WM
CAVALIER WM
ROUGE SSM
HAMILTON WM
STURGEON WM
STURGEON ROAD FDM
MORAY WM

AREA OF INTEREST

KEYPLAN

SCENARIO NOTES:

AVERAGE DAY DEMAND (ADD)
50% OF ADD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON ROAD FDM
400mm ROUGE SECONDARY SUPPLY

300mm BUCHANAN WM
300mm CAVALIER WM
300mm HAMILTON WM
300mm STURGEON WM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP
wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
FINAL MODEL - SENSITIVITY ANALYSIS 50% ADD
AVERAGE DAY DEMAND
TRAVEL TIME ANALYSIS

SEAL	DESIGN BY:	DATE (YY/MM/DD):
	SH	20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.34 REV: B

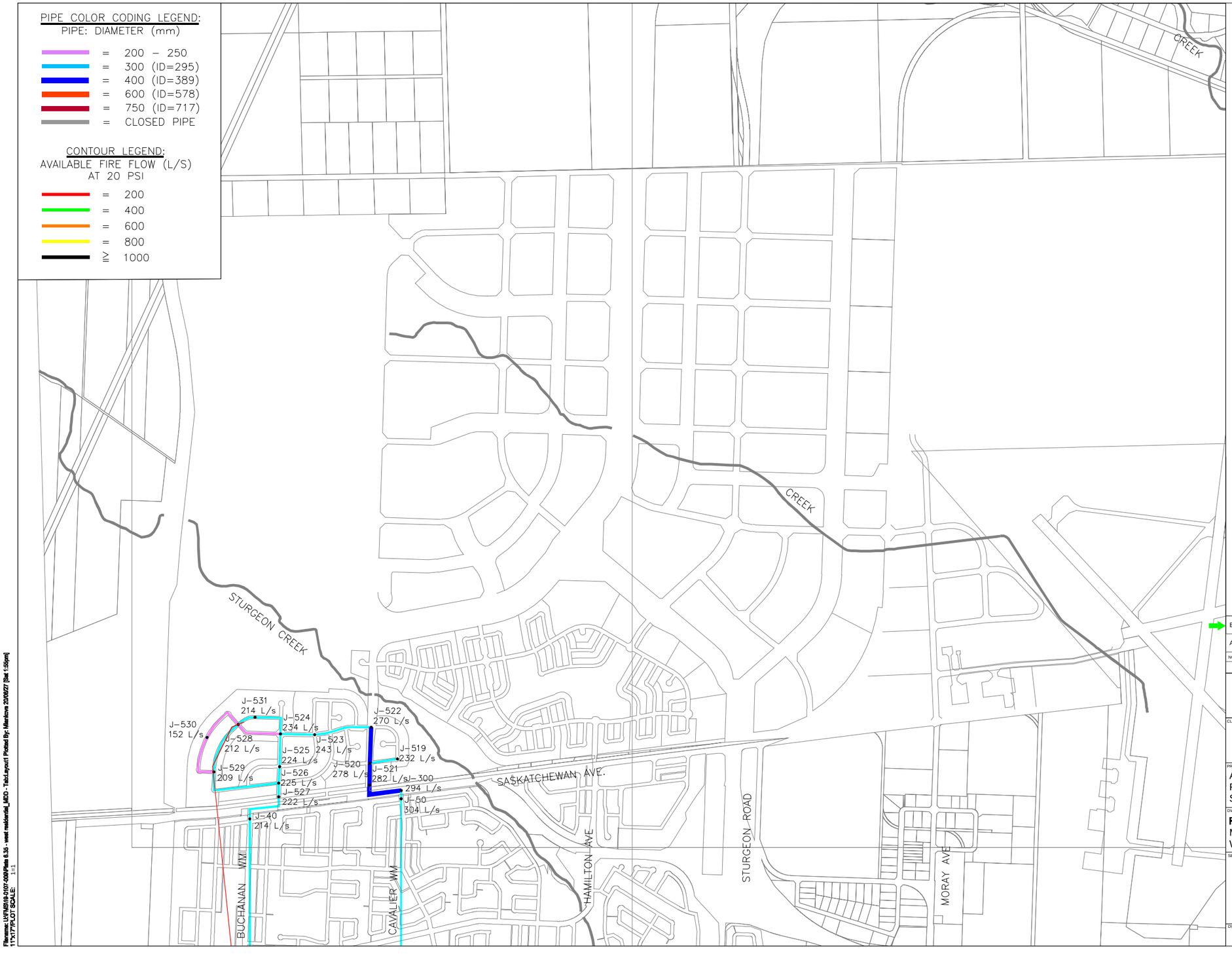
Filename: U:\FMS\19-0107-009\Plate 6.34 - Rouge 400 secondary - AGE_Sensitivity Analysis_50% - Tabs\Layout1 Plotted By: Milenova 20/06/27 [Sat 1:36pm]
11"x17"/PLOT SCALE: 1=1

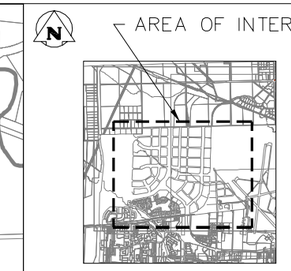
PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

CONTOUR LEGEND:
AVAILABLE FIRE FLOW (L/S)
AT 20 PSI

= 200
= 400
= 600
= 800
≧ 1000





KEYPLAN

SCENARIO NOTES:

MDD = 1.6 x ADD
100% OF MDD

CONNECTIONS TO C.O.W. SYSTEM AT:

300mm BUCHANAN WM
300mm CAVALIER WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP

wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
RESIDENTIAL SUB. - WESTERNMOST STAGE
MAXIMUM DAY FIRE FLOW
WITH 20 PSI RESIDUAL PRESSURE

SEAL

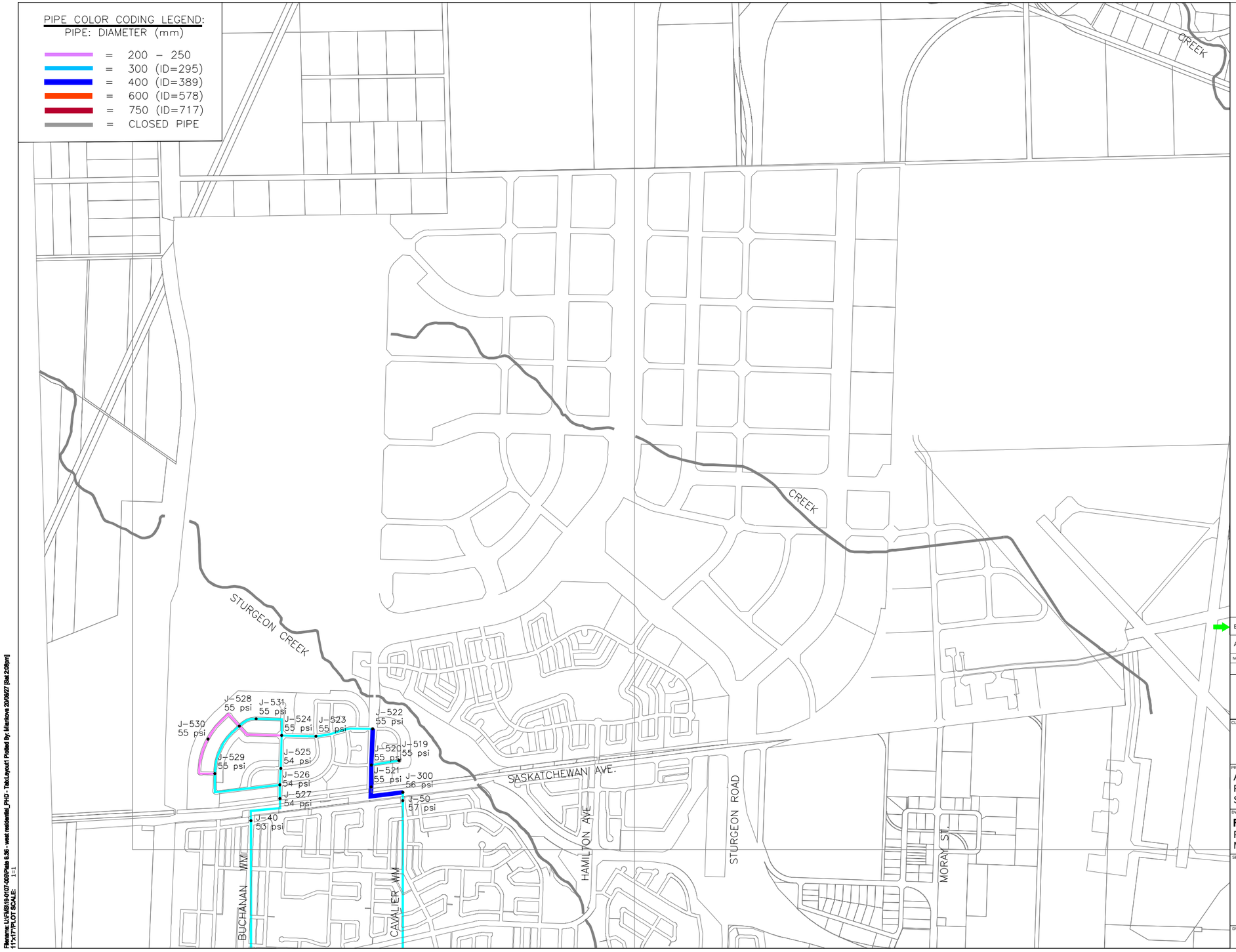
DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
DESIGN CHECK: RBO	DATE: YY/MM/DD
DRAWN BY: MID	DATE: 20/01/20
DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO: 19-0107-009 PLATE 6.35
REV: B

Filename: I:\HFM\19-0107-009\Plate 6.35 - west residential_MDD - Tabl.ayout1 Plotted By: Mlankove 20/06/27 [Sat 1:55pm]
11"x17"/PLOT SCALE: 1=1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

- = 200 – 250
- = 300 (ID=295)
- = 400 (ID=389)
- = 600 (ID=578)
- = 750 (ID=717)
- = CLOSED PIPE



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

PHD = 2.5 x ADD
100% OF PHD

CONNECTIONS TO C.O.W. SYSTEM AT:

300mm BUCHANAN WM
300mm CAVALIER WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	**ISSUED FOR FINAL REPORT**	SH	RBO
A	20/02/25	**ISSUED FOR 60% REVIEW**	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
RESIDENTIAL SUB. - WESTERNMOST STAGE
PEAK HOUR DEMAND
MINIMUM PRESSURES

SEAL		
	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.36 REV. B

Filename: U:\FMS\19-0107-009\Plate 6.36 - west residential_PHD - Tabs4.dwg:ct1 Plotted By: Milankova 20/06/27 [Sat 2:08pm]
11"x17"/PLOT SCALE: 1=1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

CREEK

CREEK

STURGEON CREEK

J-531
8.5 hours
J-524
5.8 hours
J-530
27.4 hours
J-528
14.2 hours
J-523
4.7 hours
J-522
3.4 hours
J-525
8.4 hours
J-520
2.2 hours
J-519
33.4 hours
J-529
27.4 hours
J-526
10.1 hours
J-521
1.5 hours
J-527
72.0 hours
J-300
0.4 hours
J-50
0.3 hours
J-40
72.0 hours

SASKATCHEWAN AVE.

BUCHANAN WM

CAVALIER WM

HAMILTON AVE.

STURGEON ROAD

MORAY ST.

N

AREA OF INTEREST

KEYPLAN

SCENARIO NOTES:

AVERAGE DAY DEMAND (ADD)
100% OF ADD

CONNECTIONS TO C.O.W. SYSTEM AT:

300mm BUCHANAN WM
300mm CAVALIER WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP

wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
RESIDENTIAL SUB. - WESTERNMOST STAGE
AVERAGE DAY DEMAND
TRAVEL TIME ANALYSIS

SEAL		
	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.37 REV: B

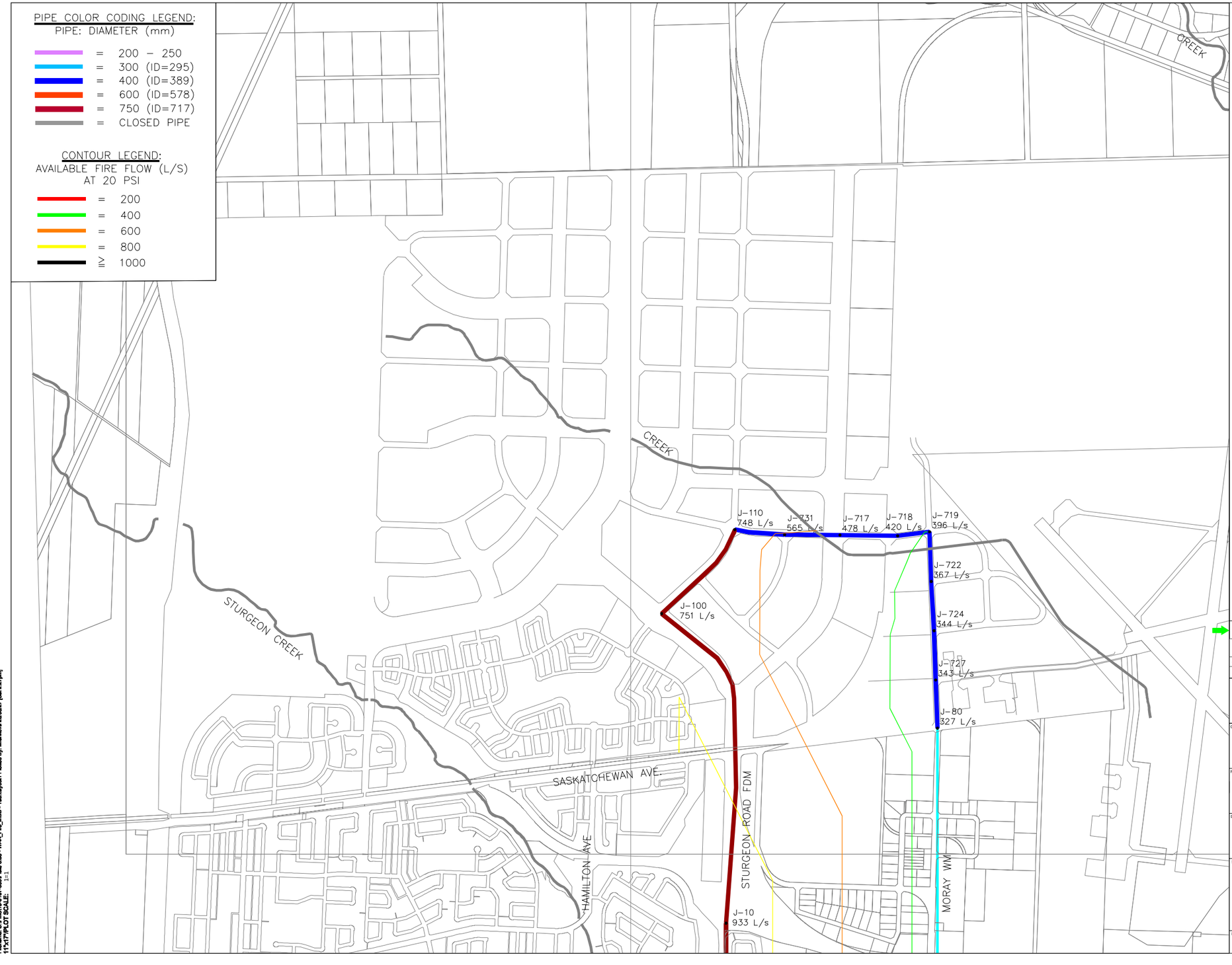
Filename: I:\1F\5618\01\07-009\Plate 6.37 - west residential_ADE_ADD - Tabs\Layout Plotted By: Milanova 20/06/27 [Sat 2:17pm]
11"X17"/PLOT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

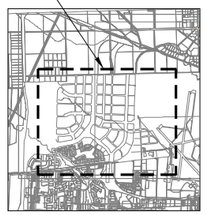
CONTOUR LEGEND:
AVAILABLE FIRE FLOW (L/S)
AT 20 PSI

= 200
= 400
= 600
= 800
≧ 1000



N

AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

MAXIMUM DAY DEMAND (MDD)
MDD = 1.6 x ADD
100% OF MDD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON ROAD FDM
300mm MORAY WM

PHASING:
DEVELOPMENT BEGINS IN WINNIPEG AIRPORT AUTHORITY LANDS

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	**ISSUED FOR FINAL REPORT**	SH	RBO
A	20/02/25	**ISSUED FOR 60% REVIEW**	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
WAA AREA 8 - POTENTIAL FIRST STAGE
MAXIMUM DAY FIRE FLOW
WITH 20 PSI RESIDUAL PRESSURE

SEAL

DESIGN BY:	SH	DATE (YY/MM/DD):	20/01/20
DESIGN CHECK:	RBO	DATE:	YY/MM/DD
DRAWN BY:	MID	DATE:	20/01/20
DWG CHECK:	SH	DATE:	YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.38 REV: B

Filename: L:\Y\SR\19-0107-009\Plate 6.38 - WAA_Fire_MDD - Tab1.layout1 Plotted By: Marinova 20/06/27 [Sat 2:27pm]
11"x17"/PLOT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

CREEK

CREEK

J-110
56 psi

J-731
57 psi

J-717
57 psi

J-718
57 psi

J-719
57 psi

J-722
58 psi

J-100
54 psi

J-724
55 psi

J-727
57 psi

J-80
55 psi

STURGEON CREEK

SASKATCHEWAN AVE.

HAMILTON AVE.

STURGEON FDM

MORAY WM

J-10
55 psi

AREA OF INTEREST

KEYPLAN

SCENARIO NOTES:

PEAK HOUR DEMAND (PHD)
PHD = 2.5 x ADD
100% OF PHD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON ROAD FDM
300mm MORAY WM

PHASING:
DEVELOPMENT BEGINS IN WINNIPEG AIRPORT AUTHORITY LANDS

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP

wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
WAA AREA 8 - POTENTIAL FIRST STAGE PEAK HOUR DEMAND MINIMUM PRESSURES

SEAL

DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
DESIGN CHECK: RBO	DATE: YY/MM/DD
DRAWN BY: MID	DATE: 20/01/20
DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.39 REV: B

Filename: L:\FMS\19-0107-009\Plate 6.39 - WAA_Pre_PHD - Tab1.layout1 Plotted By: Milankova 20/06/27 [Set 2:35pm]
11"x17"/PLOT SCALE: 1=1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

- = 200 – 250
- = 300 (ID=295)
- = 400 (ID=389)
- = 600 (ID=578)
- = 750 (ID=717)
- = CLOSED PIPE

CREEK

CREEK

STURGEON CREEK

SASKATCHEWAN AVE.

HAMILTON AVE

STURGEON ROAD FDM

MORAY WM

J-110
11.5 hours

J-721
11.9 hours

J-717
12.3 hours

J-718
12.9 hours

J-719
13.3 hours

J-722
14.0 hours

J-724
14.8 hours

J-727
16.1 hours

J-80
19.4 hours

J-100
8.7 hours

J-10
0.3 hours

AREA OF INTEREST

KEYPLAN

SCENARIO NOTES:

AVERAGE DAY DEMAND (ADD)
100% OF ADD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON ROAD FDM
300mm MORAY WM

PHASING:
DEVELOPMENT BEGINS IN WINNIPEG AIRPORT AUTHORITY LANDS

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	**ISSUED FOR FINAL REPORT**	SH	RBO
A	20/02/25	**ISSUED FOR 80% REVIEW**	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
WAA AREA 8 - POTENTIAL FIRST STAGE
AVERAGE DAY DEMAND
TRAVEL TIME ANALYSIS

SEAL	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.40 REV: B

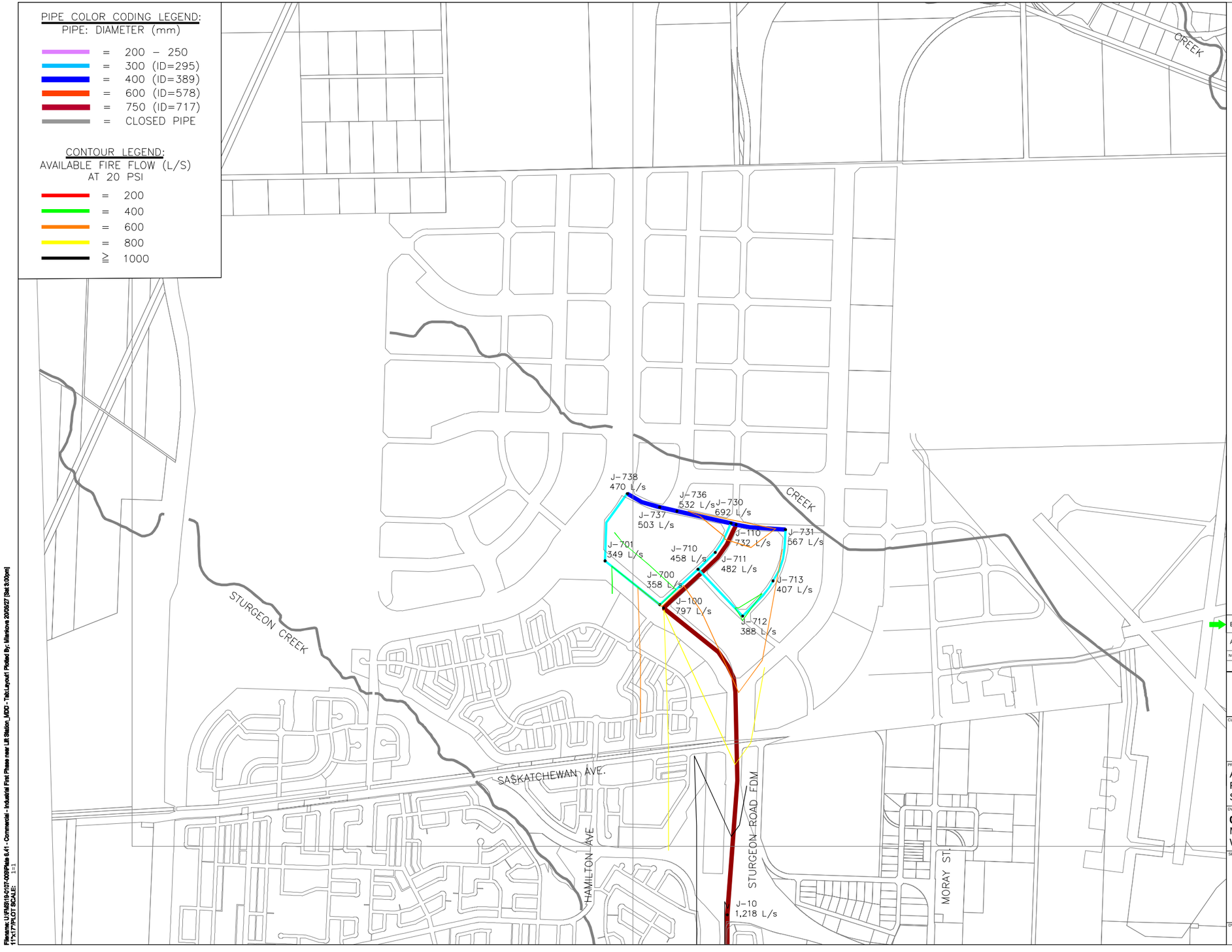
Filename: U:\FMS\19-0107-009\Plate 6.40 - WAA_Pre_ADE_ADD - Tab1.layout1 Plotted By: Milenkova 20/06/27 [Sat 2:44pm]
11"x17"/PLOT SCALE: 1=1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

- = 200 – 250
- = 300 (ID=295)
- = 400 (ID=389)
- = 600 (ID=578)
- = 750 (ID=717)
- = CLOSED PIPE

CONTOUR LEGEND:
AVAILABLE FIRE FLOW (L/S)
AT 20 PSI

- = 200
- = 400
- = 600
- = 800
- ≧ 1000



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:
MAXIMUM DAY DEMAND (MDD)
MDD = 1.6 x ADD
100% OF ADD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON ROAD FDM

PHASING:
COMMERCIAL/ INDUSTRIAL FIRST
PHASE NEAR LIFT STATION

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
COMM/ INDUSTRIAL FIRST STAGE NEAR L/STA
MAXIMUM DAY FIRE FLOW
WITH 20 PSI RESIDUAL PRESSURE

SEAL		
	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.41 REV: B

Filename: U:\PM\19-0107-009\Plate 6.41 - Commercial - Industrial First Phase near Lift Station_MDD - Tab:Layout1 Plotted By: Milenkova 20/06/27 [Sat 8:00pm]
11"x17"PLOT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

CREEK
CREEK
STURGEON CREEK
SASKATCHEWAN AVE.
HAMILTON AVE.
STURGEON FDM
MORAY ST.

J-738 58 psi
J-737 57 psi
J-736 57 psi
J-730 56 psi
J-110 56 psi
J-731 57 psi
J-711 55 psi
J-701 54 psi
J-710 55 psi
J-713 57 psi
J-700 54 psi
J-100 54 psi
J-712 56 psi
J-10 56 psi

N

AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:
PEAK HOUR DEMAND (PHD)
PHD = 2.5 x ADD
100% OF PHD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON ROAD FDM

PHASING:
COMMERCIAL/ INDUSTRIAL FIRST PHASE NEAR LIFT STATION

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	**ISSUED FOR FINAL REPORT**	SH	RBO
A	20/02/25	**ISSUED FOR 60% REVIEW**	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
COMM/ INDUSTRIAL FIRST STAGE NEAR L/STA
PEAK HOUR DEMAND
MINIMUM PRESSURES

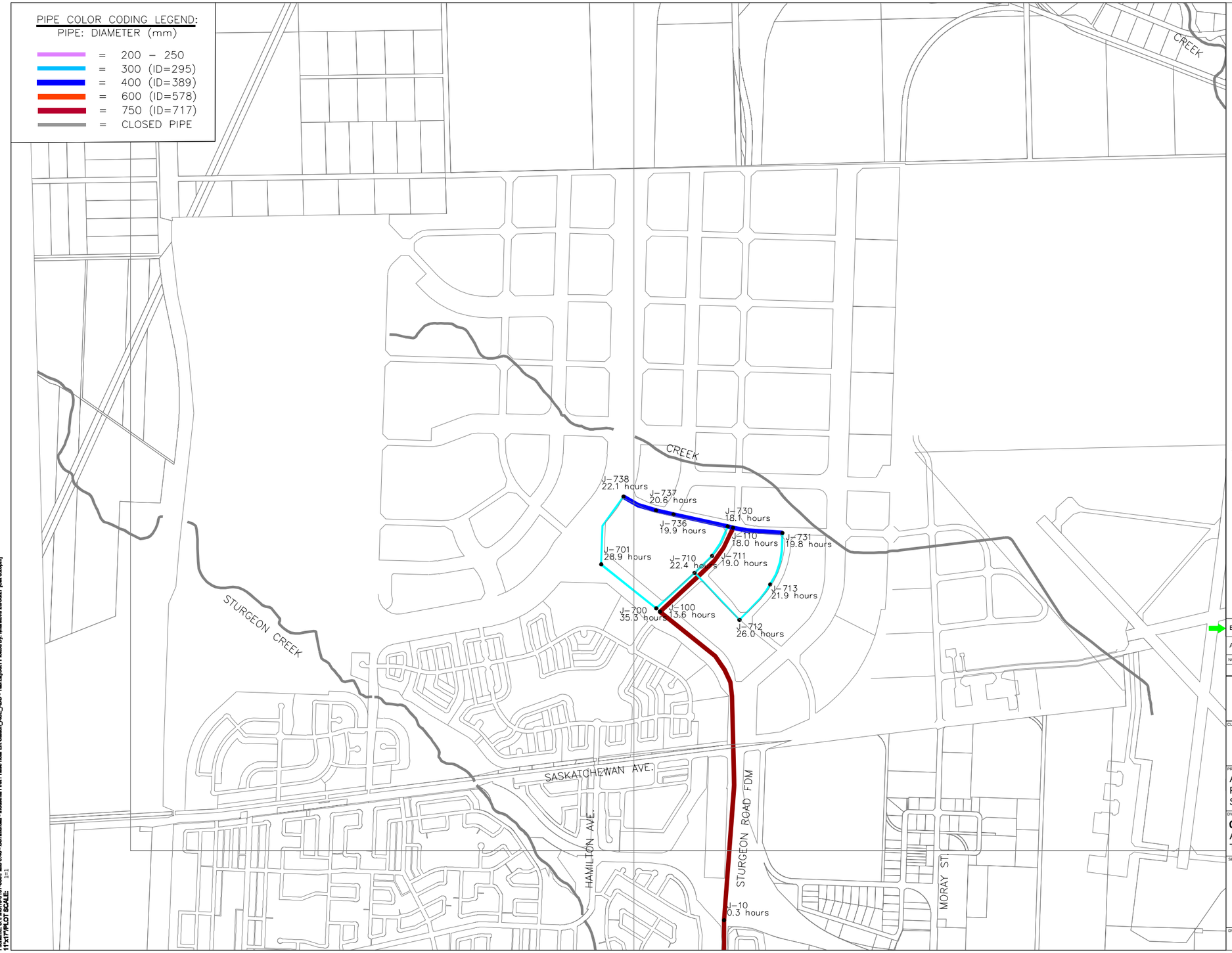
SEAL:	DESIGN BY:	DATE (YY/MM/DD):
	SH	20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.42 REV. B

Filename: U:\KMS\19-0107-009\Plate 6.42 - Commercial - Industrial First Phase near Lift Station_PHD - Tidel.layout Plotted By: Milentowa 20/06/27 (Sat 3:14pm)
11"x17"PLOT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

AVERAGE DAY DEMAND (ADD)
100% OF ADD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON ROAD FDM

PHASING:
COMMERCIAL/ INDUSTRIAL FIRST PHASE NEAR LIFT STATION

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 80% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | WSP

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
COMM/ INDUSTRIAL FIRST STAGE NEAR L/STA
AVERAGE DAY DEMAND
TRAVEL TIME ANALYSIS

SEAL		DESIGN BY:	DATE (YY/MM/DD):
		SH	20/01/20
		DESIGN CHECK:	DATE:
		RBO	YY/MM/DD
		DRAWN BY:	DATE:
		MID	20/01/20
		DWG CHECK:	DATE:
		SH	YY/MM/DD

DWG. NO.: 19-0107-009 PLATE 6.43 REV.: B

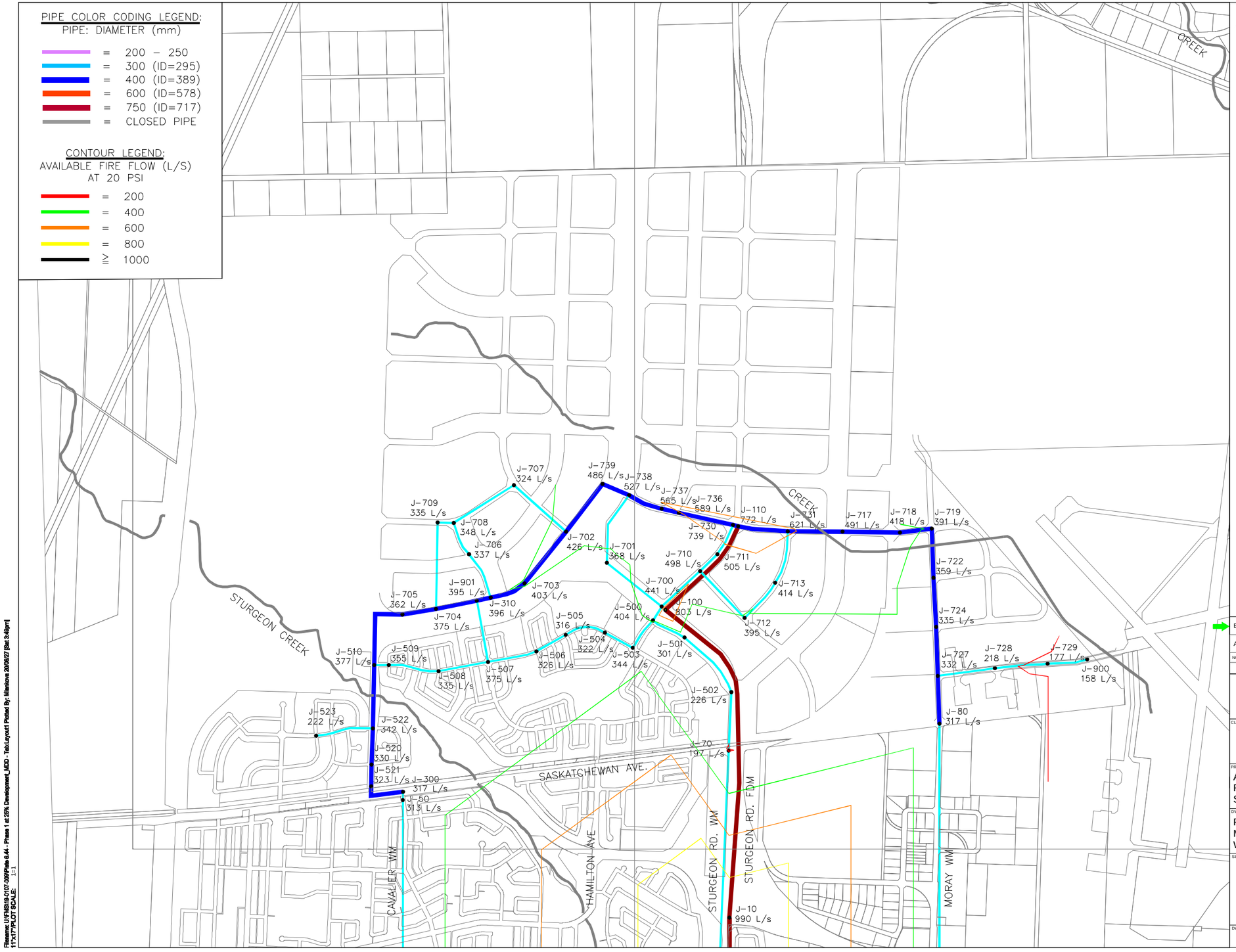
Filename: U:\Jobs\19-0107-009\Plate 6.43 - Commercial - Industrial First Phase near Lift Station_AGE_ADD - Tab:Layout1 Plotted By: Mlankova 20/06/27 [Sat 3:25pm]
11"x17"/PLOT SCALE: 1=1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

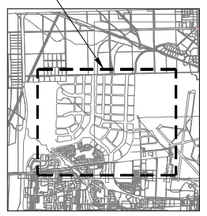
= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

CONTOUR LEGEND:
AVAILABLE FIRE FLOW (L/S)
AT 20 PSI

= 200
= 400
= 600
= 800
≧ 1000



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

MAXIMUM DAY DEMAND (MDD)
MDD = 1.6 x ADD
100% OF MDD

CONNECTIONS TO C.O.W. SYSTEM AT:

750mm STURGEON ROAD FDM
300mm STURGEON WM
300mm CAVALIER WM
300mm MORAY WM

PHASING:
PHASE 1 AT 25% DEVELOPMENT

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
PHASE 1 AT 25% DEVELOPMENT
MAXIMUM DAY FIRE FLOW
WITH 20 PSI RESIDUAL PRESSURE

SEAL

DESIGN BY:	SH	DATE (YY/MM/DD): 20/01/20
DESIGN CHECK:	RBO	DATE: YY/MM/DD
DRAWN BY:	MID	DATE: 20/01/20
DWG CHECK:	SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.44 REV: B

Filename: L:\FAS\19-0107-009\Plate 6.44 - Phase 1 at 25% Development_MDD - Tab\Layout1 Plotted By: Milankova 20/06/27 [Sat 3:40pm]
11"x17"PLOT SCALE: 1=1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

CREEK
CREEK
STURGEON CREEK
SASKATCHEWAN AVE.
HAMILTON AVE
CAVALIER WM
STURGEON WM
STURGEON FDM
MORAY WM

J-707 53 psi
J-739 55 psi
J-738 55 psi
J-737 54 psi
J-736 54 psi
J-730 54 psi
J-110 54 psi
J-731 55 psi
J-717 55 psi
J-718 55 psi
J-719 55 psi
J-709 53 psi
J-708 53 psi
J-706 53 psi
J-702 52 psi
J-701 52 psi
J-711 53 psi
J-710 53 psi
J-722 56 psi
J-310 53 psi
J-703 52 psi
J-700 51 psi
J-713 54 psi
J-705 51 psi
J-704 51 psi
J-901 393 psi
J-505 53 psi
J-504 52 psi
J-100 52 psi
J-712 54 psi
J-724 53 psi
J-500 51 psi
J-501 51 psi
J-509 54 psi
J-508 54 psi
J-506 53 psi
J-503 52 psi
J-728 55 psi
J-729 55 psi
J-510 54 psi
J-507 54 psi
J-727 55 psi
J-900 55 psi
J-502 51 psi
J-523 53 psi
J-522 53 psi
J-80 53 psi
J-520 54 psi
J-70 51 psi
J-521 54 psi
J-300 54 psi
J-50 55 psi
J-10 54 psi

AREA OF INTEREST

KEYPLAN

SCENARIO NOTES:

PEAK HOUR DEMAND (PHD)
PHD = 2.5 x ADD
100% OF PHD

CONNECTIONS TO C.O.W. SYSTEM AT:

750mm STURGEON ROAD FDM
300mm STURGEON WM
300mm CAVALIER WM
300mm MORAY WM

PHASING:

PHASE 1 AT 25% DEVELOPMENT

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | WSP

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
PHASE 1 AT 25% DEVELOPMENT
PEAK HOUR DEMAND
MINIMUM PRESSURES

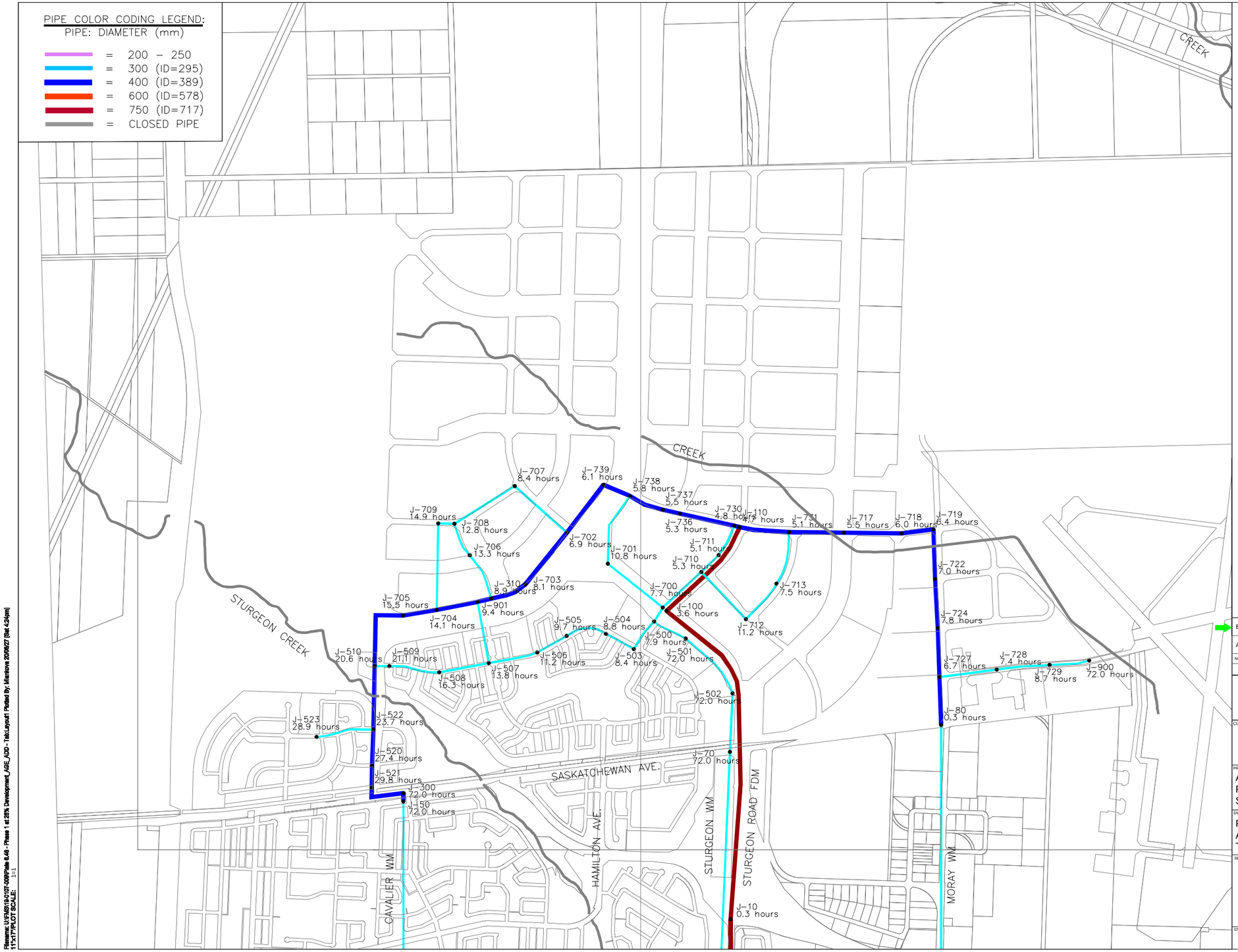
SEAL	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.45 REV: B

Filename: I:\PW\S\19\0107.009\Plate 6.45 - Phase 1 at 25% Development_PHD - Tab\Layout1 Plotted By: Mantova 20/06/27 [Sat 4:09pm]
11 X 17 PLOT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

AVERAGE DAY DEMAND (ADD)
100% OF ADD

CONNECTIONS TO C.O.W. SYSTEM AT:

750mm STURGEON ROAD FDM
300mm STURGEON ROAD WM
300mm CAVALIER WM
300mm MORAY WM

PHASING:

PHASE 1 AT 25% DEVELOPMENT

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
PHASE 1 AT 25% DEVELOPMENT
AVERAGE DAY DEMAND
TRAVEL TIME ANALYSIS

SEAL	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.46 REV: B

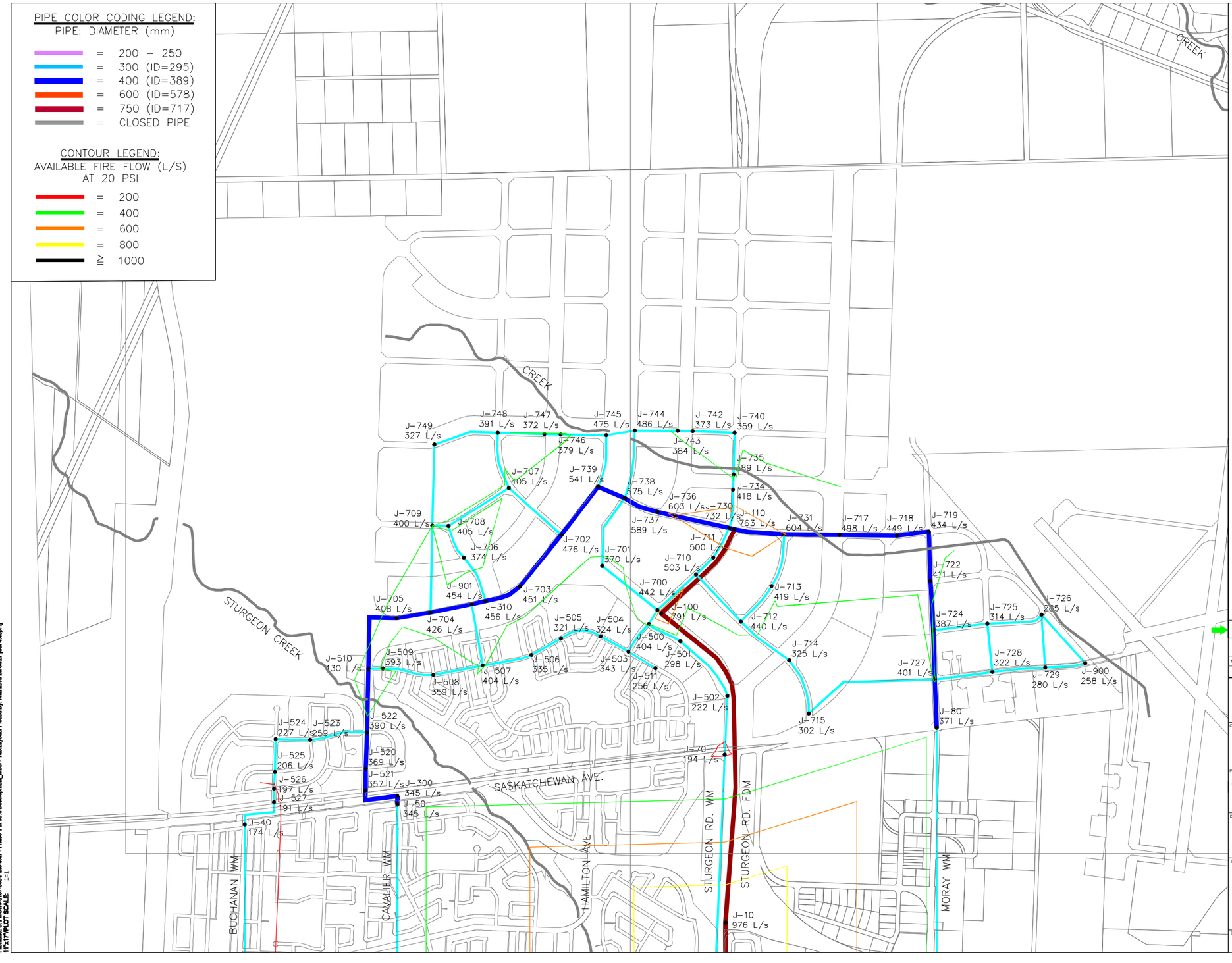
Filename: I:\V\PMS\19-0107-009\Plate 6.46 - Phase 1 at 25% Development_ADE_AJD - Tabl.layout Plotted By: Milenkova 20/06/27 (Sat 4:24pm)
11"x17"PLOT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

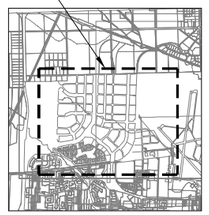
= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

CONTOUR LEGEND:
AVAILABLE FIRE FLOW (L/S)
AT 20 PSI

= 200
= 400
= 600
= 800
≧ 1000



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

MAXIMUM DAY DEMAND (MDD)
MDD = 1.6 x ADD
100% OF MDD

CONNECTIONS TO C.O.W. SYSTEM AT:

750mm STURGEON ROAD FDM
300mm CAVALIER WM
300mm MORAY WM
300mm STURGEON ROAD WM
300mm BUCHANAN WM

PHASING:

PHASE 1 AT 50% DEVELOPMENT

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
PHASE 1 AT 50% DEVELOPMENT
MAXIMUM DAY FIRE FLOW
WITH 20 PSI RESIDUAL PRESSURE

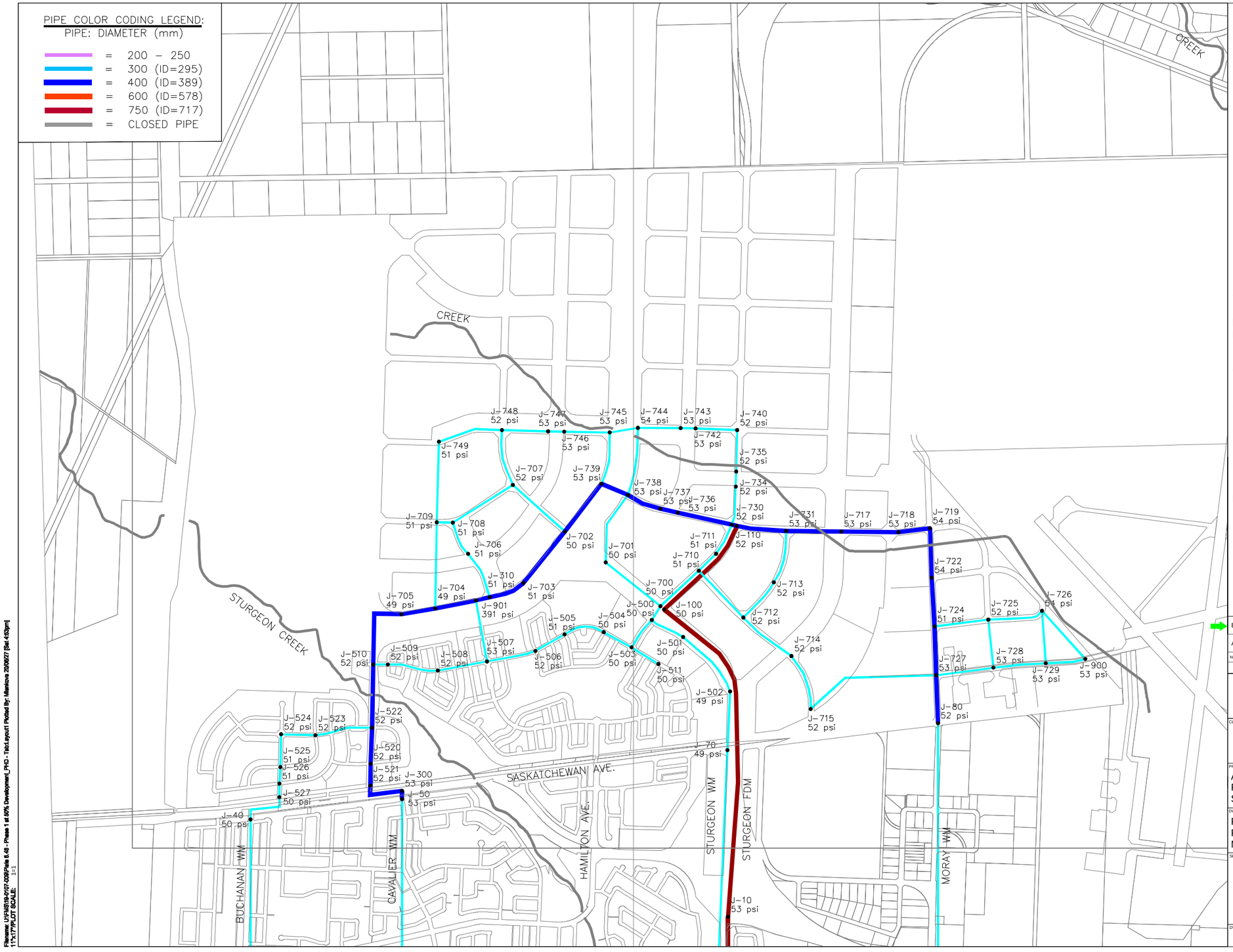
SEAL		
	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.47 REV. B

Filename: I:\VFM\19-0107-009\File 6.47 - Phase 1 at 50% Development_MDD - Tile\Layout1 Plotted By: Milankova 20/06/27 [Set 4x4Opm]
11"x17"/PLOT SCALE: 1=1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

- = 200 – 250
- = 300 (ID=295)
- = 400 (ID=389)
- = 600 (ID=578)
- = 750 (ID=717)
- = CLOSED PIPE



N

AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

PEAK HOUR DEMAND (PHD)
PHD = 2.5 x ADD
100% OF PHD

CONNECTIONS TO C.O.W. SYSTEM AT:

750mm STURGEON ROAD FDM
300mm CAVALIER WM
300mm MORAY WM
300mm STURGEON ROAD WM
300mm BUCHANAN WM

PHASING:

PHASE 1 AT 50% DEVELOPMENT

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	**ISSUED FOR FINAL REPORT**	SH	RBO
A	20/02/25	**ISSUED FOR 60% REVIEW**	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
PHASE 1 AT 50% DEVELOPMENT
PEAK HOUR DEMAND
MINIMUM PRESSURES

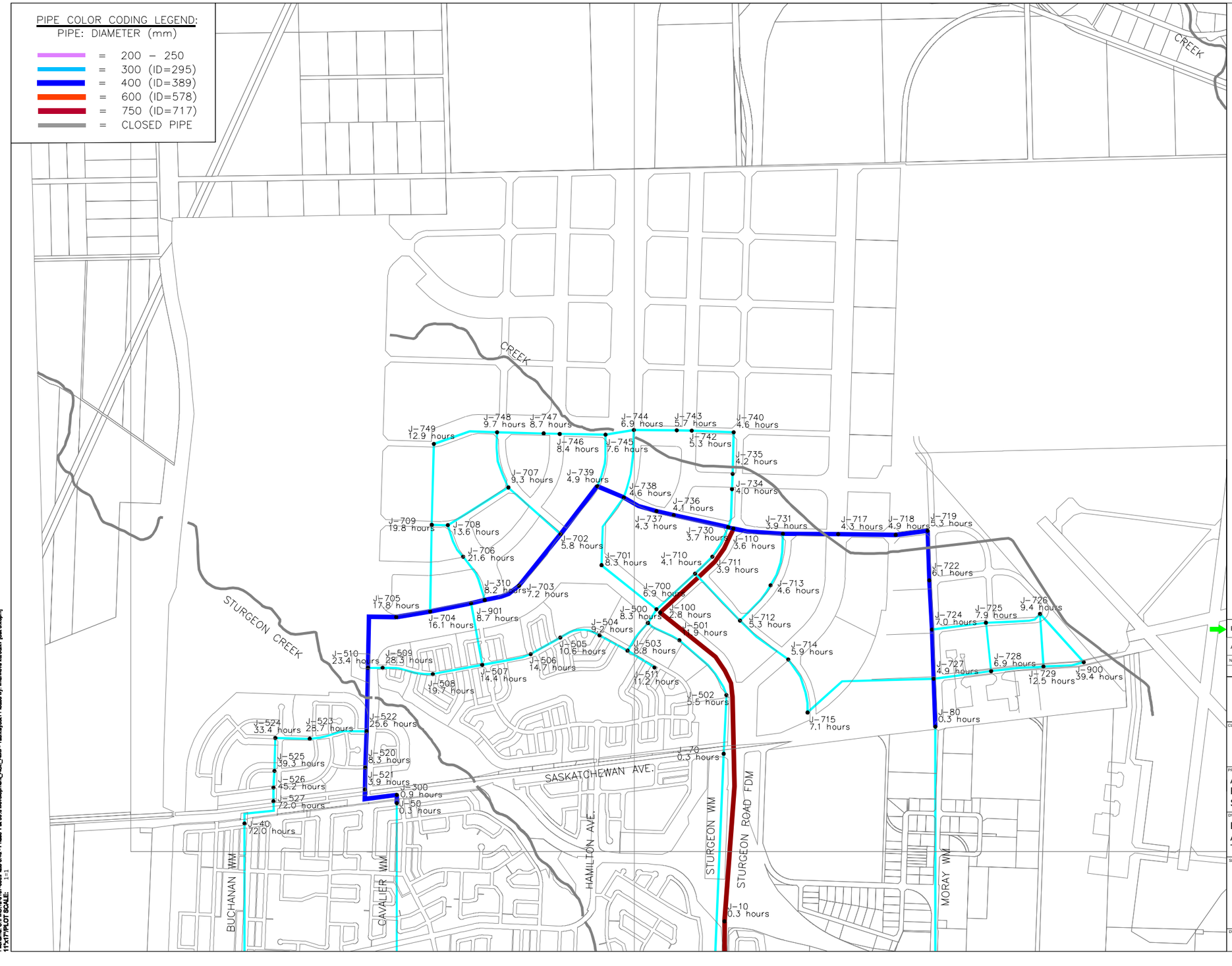
SEAL	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

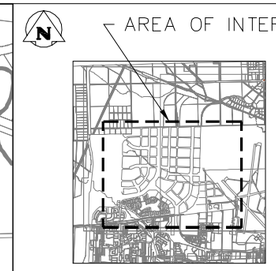
DWG. NO. 19-0107-009 PLATE 6.48 REV: B

Filename: I:\PWS\19-0107-009\Plate 6.48 - Phase 1 at 50% Development_PHD - Tech.sysout Plotted By: Mlemkow 20/06/27 [Sat 4:53pm]
11"x17"PLOT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

- = 200 – 250
- = 300 (ID=295)
- = 400 (ID=389)
- = 600 (ID=578)
- = 750 (ID=717)
- = CLOSED PIPE





KEYPLAN

SCENARIO NOTES:

AVERAGE DAY DEMAND (ADD)
100% OF ADD

CONNECTIONS TO C.O.W. SYSTEM AT:

750mm STURGEON ROAD FDM
300mm CAVALIER WM
300mm MORAY WM
300mm STURGEON ROAD WM
300mm BUCHANAN WM

PHASING:

PHASE 1 AT 50% DEVELOPMENT

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
PHASE 1 AT 50% DEVELOPMENT
AVERAGE DAY DEMAND
TRAVEL TIME ANALYSIS

SEAL	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.49 REV: B

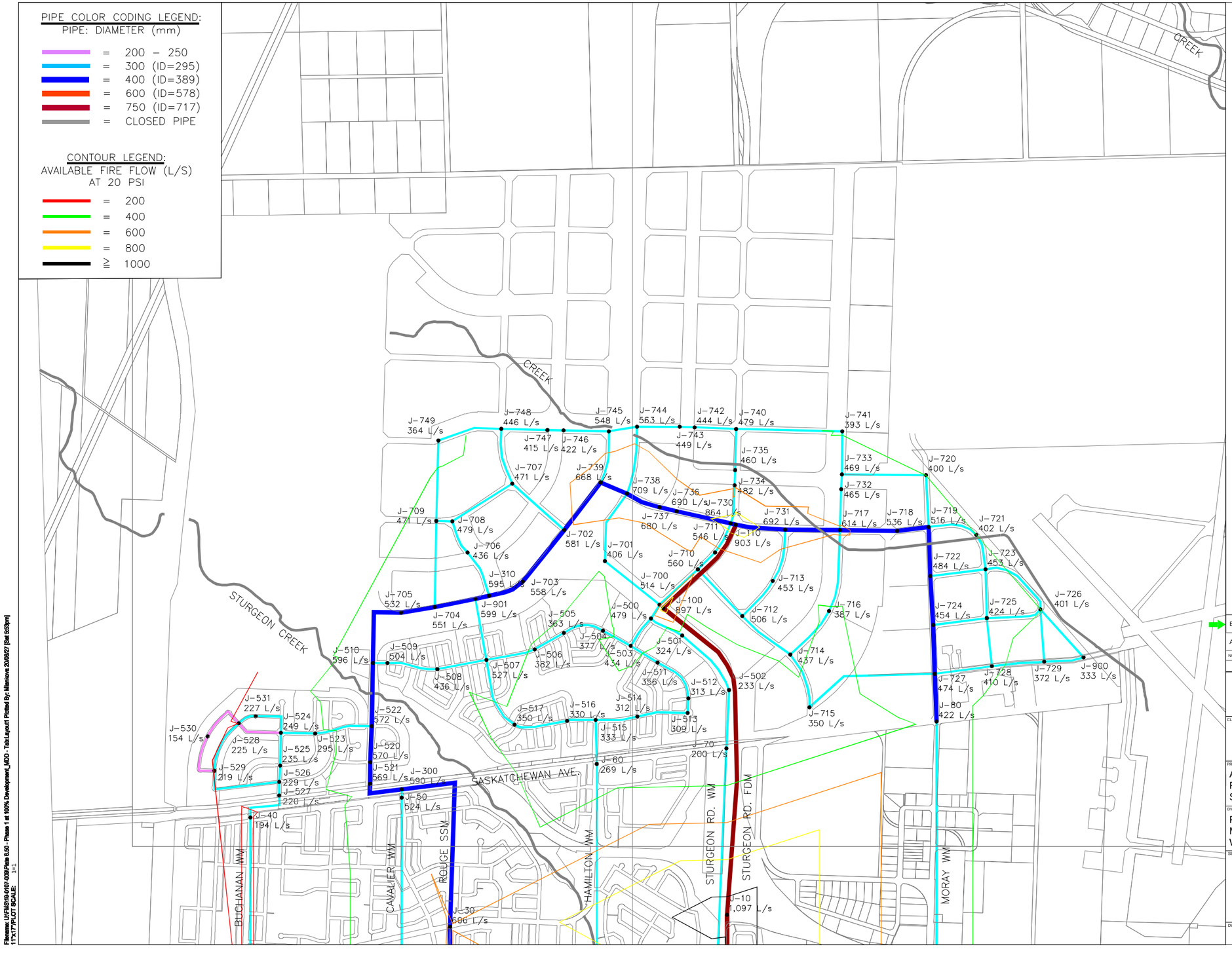
Filename: I:\HAS\19-0107-009\Plate 6.49 - Phase 1 at 50% Development_AGE_ADD - Tab1.mxd41 Plotted By: Mlavkova 20/06/27 [Sat 6:28pm]
11"x17"/PLOT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

CONTOUR LEGEND:
AVAILABLE FIRE FLOW (L/S)
AT 20 PSI

= 200
= 400
= 600
= 800
≧ 1000



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

MAXIMUM DAY DEMAND (MDD)
MDD = 1.6 x ADD
100% OF MDD

CONNECTIONS TO C.O.W. SYSTEM AT:

750mm STURGEON ROAD FDM
400mm ROUGE SSM

300mm MORAY WM
300mm STURGEON ROAD WM
300mm BUCHANAN WM
300mm HAMILTON WM
300mm CAVALIER WM

PHASING:

PHASE 1 AT 100% DEVELOPMENT

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | WSP

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
PHASE 1 AT 100% DEVELOPMENT
MAXIMUM DAY FIRE FLOW
WITH 20 PSI RESIDUAL PRESSURE

SEAL

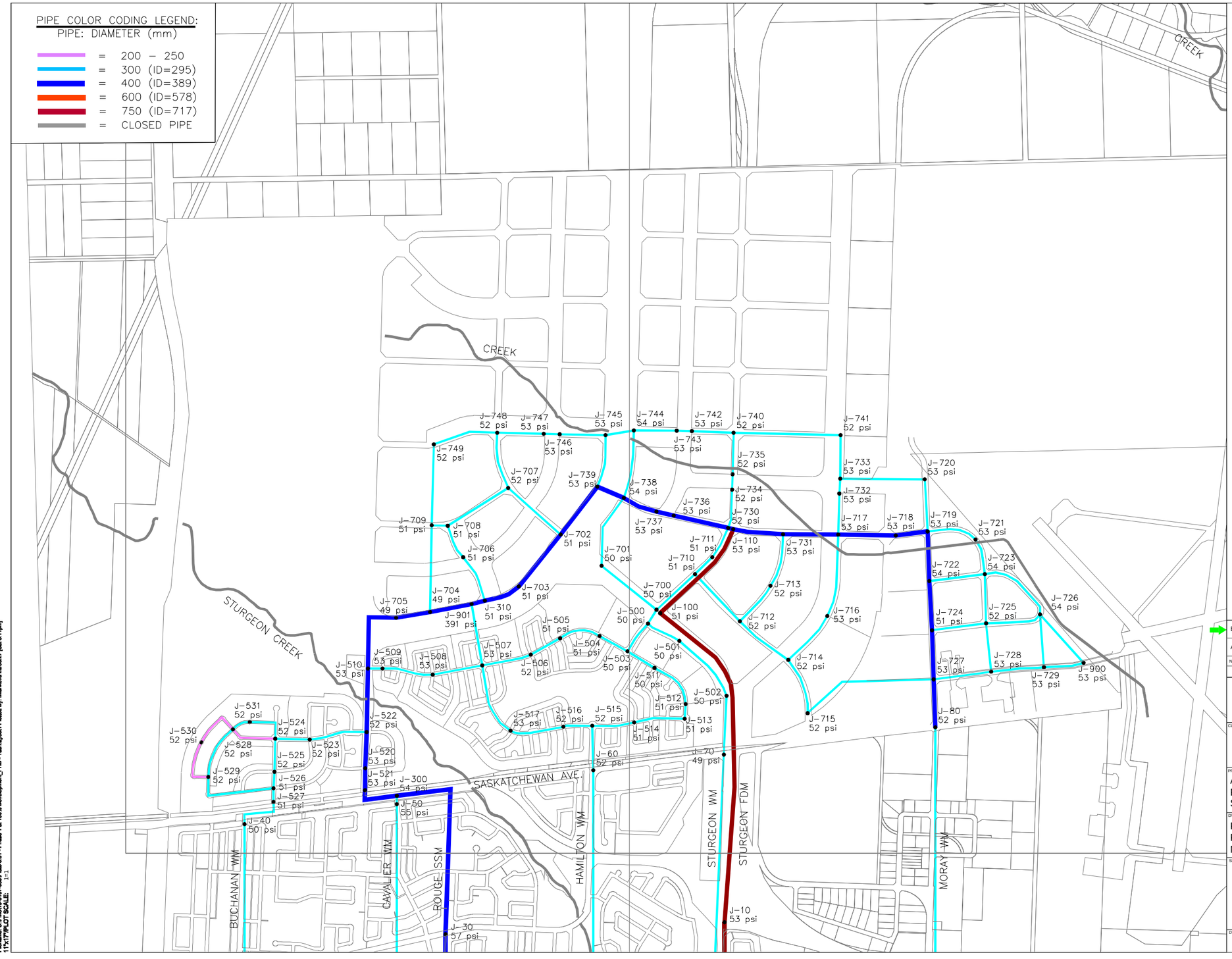
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DESIGN CHECK: RBO	DATE: YY/MM/DD
DRAWN BY: MID	DATE: 20/01/20
DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.50 REV: B

Filename: I:\PW\519\01\07-009\Plate 6.50 - Phase 1 at 100% Development_MDD - Text.layout Plotted By: Mlennox 20/06/27 [Sat 5:53pm]
11"x17" PLOT SCALE: 1:1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

PEAK HOUR DEMAND (PHD)
PHD = 2.5 x ADD
100% OF PHD

CONNECTIONS TO C.O.W. SYSTEM AT:

750mm STURGEON ROAD FDM
400mm ROUGE SSM

300mm MORAY WM
300mm STURGEON ROAD WM
300mm BUCHANAN WM
300mm HAMILTON WM
300mm CAVALIER WM

PHASING:

PHASE 1 AT 100% DEVELOPMENT

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 80% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
PHASE 1 AT 100% DEVELOPMENT
PEAK HOUR DEMAND
MINIMUM PRESSURES

SEAL		
	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.51 REV. B

Filename: L:\FAS\19-0107-009\Plate 6.51 - Phase 1 at 100% Development_PHD - Tab\ Layout1 Plotted By: Mlankova 20/06/27 (Set 6:11pm)
11"x17"PLOT SCALE: 1=1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE

CREEK
CREEK
STURGEON CREEK
SASKATCHEWAN AVE.
BUCHANAN WM
CAVALIER WM
ROUGE SSM
HAMILTON WM
STURGEON WM
STURGEON ROAD FDM
MORAY WM

J-749 14.3 hours
J-748 21.1 hours
J-747 21.7 hours
J-745 6.9 hours
J-744 7.1 hours
J-742 8.7 hours
J-740 5.7 hours
J-741 7.0 hours
J-746 9.8 hours
J-743 8.2 hours
J-735 4.2 hours
J-733 7.1 hours
J-720 8.5 hours
J-707 12.9 hours
J-739 5.4 hours
J-738 4.8 hours
J-734 4.1 hours
J-732 5.3 hours
J-736 4.3 hours
J-730 3.8 hours
J-737 4.5 hours
J-731 3.9 hours
J-717 4.3 hours
J-718 4.9 hours
J-719 6.3 hours
J-721 7.4 hours
J-709 8.4 hours
J-708 10.9 hours
J-702 7.9 hours
J-701 7.6 hours
J-711 4.0 hours
J-110 3.7 hours
J-706 9.7 hours
J-710 4.2 hours
J-722 7.2 hours
J-723 8.6 hours
J-310 7.6 hours
J-703 18.0 hours
J-700 8.7 hours
J-713 4.9 hours
J-705 4.2 hours
J-901 6.5 hours
J-100 2.8 hours
J-500 11.2 hours
J-712 5.4 hours
J-716 8.5 hours
J-724 8.5 hours
J-725 10.5 hours
J-726 12.2 hours
J-704 5.3 hours
J-504 13.1 hours
J-505 8.9 hours
J-510 3.3 hours
J-509 3.6 hours
J-506 8.0 hours
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J-714 7.0 hours
J-727 4.8 hours
J-728 8.3 hours
J-729 15.4 hours
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J-511 13.1 hours
J-512 11.2 hours
J-502 8.1 hours
J-531 7.7 hours
J-524 5.0 hours
J-530 26.6 hours
J-522 2.6 hours
J-528 13.4 hours
J-523 3.9 hours
J-517 13.1 hours
J-515 1.3 hours
J-514 2.4 hours
J-513 3.8 hours
J-715 7.8 hours
J-80 0.3 hours
J-520 2.3 hours
J-516 31.3 hours
J-60 0.3 hours
J-70 0.3 hours
J-529 26.7 hours
J-525 7.6 hours
J-521 2.2 hours
J-526 9.3 hours
J-527 72.0 hours
J-50 0.3 hours
J-40 72.0 hours
J-10 0.3 hours
J-30 0.3 hours

AREA OF INTEREST

KEYPLAN

SCENARIO NOTES:

AVERAGE DAY DEMAND (ADD)
100% OF ADD

CONNECTIONS TO C.O.W. SYSTEM AT:

750mm STURGEON ROAD FDM
400mm ROUGE SSM

300mm MORAY WM
300mm STURGEON ROAD WM
300mm BUCHANAN WM
300mm HAMILTON WM
300mm CAVALIER WM

PHASING:

PHASE 1 AT 100% DEVELOPMENT

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
PHASE 1 AT 100% DEVELOPMENT
AVERAGE DAY DEMAND
TRAVEL TIME ANALYSIS

SEAL

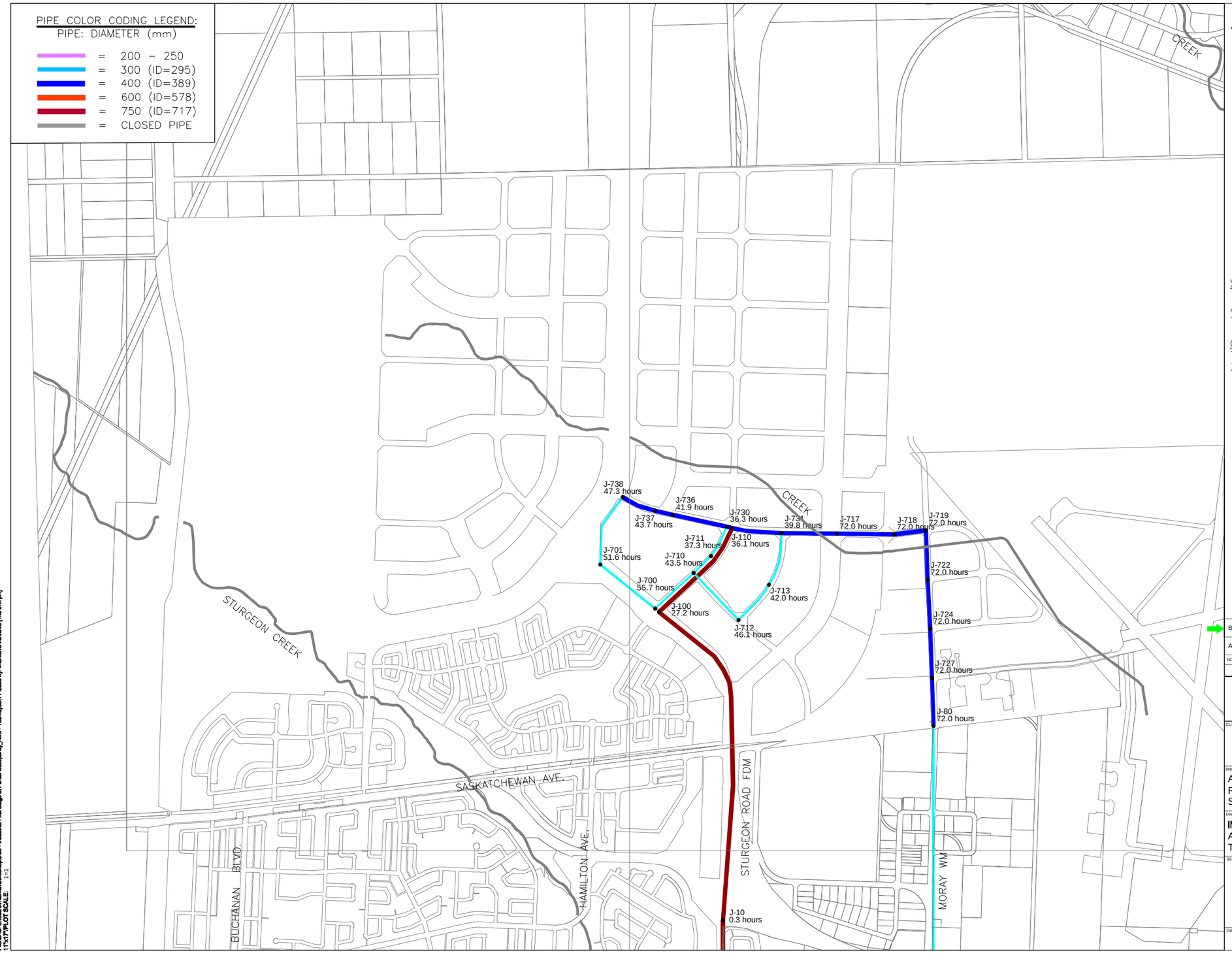
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DESIGN CHECK: RBO	DATE: YY/MM/DD
DRAWN BY: MID	DATE: 20/01/20
DWG CHECK: SH	DATE: YY/MM/DD

DWG. NO. 19-0107-009 PLATE 6.52 | REV: B

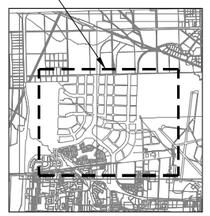
Filename: L:\FM\19-0107-009\Plate 6.52 - Phase 1 at 100% Development_AGE_ADD - Tab Layout1 Plotted By: MarkAnne 20/06/27 [Sat 8:25pm]
11"x17"/PLOT SCALE: 1=1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

= 200 – 250
= 300 (ID=295)
= 400 (ID=389)
= 600 (ID=578)
= 750 (ID=717)
= CLOSED PIPE



AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

AVERAGE DAY DEMAND (ADD)
100% OF ADD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON ROAD FDM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	**ISSUED FOR FINAL REPORT**	SH	RBO
A	20/02/25	**ISSUED FOR 60% REVIEW**	SH	RBO

REVISIONS / ISSUE

KGS GROUP | WSP

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
INDUSTRIAL FIRST STAGE AT PARTIAL OCCUPANCY
AVERAGE DAY DEMAND
TRAVEL TIME ANALYSIS

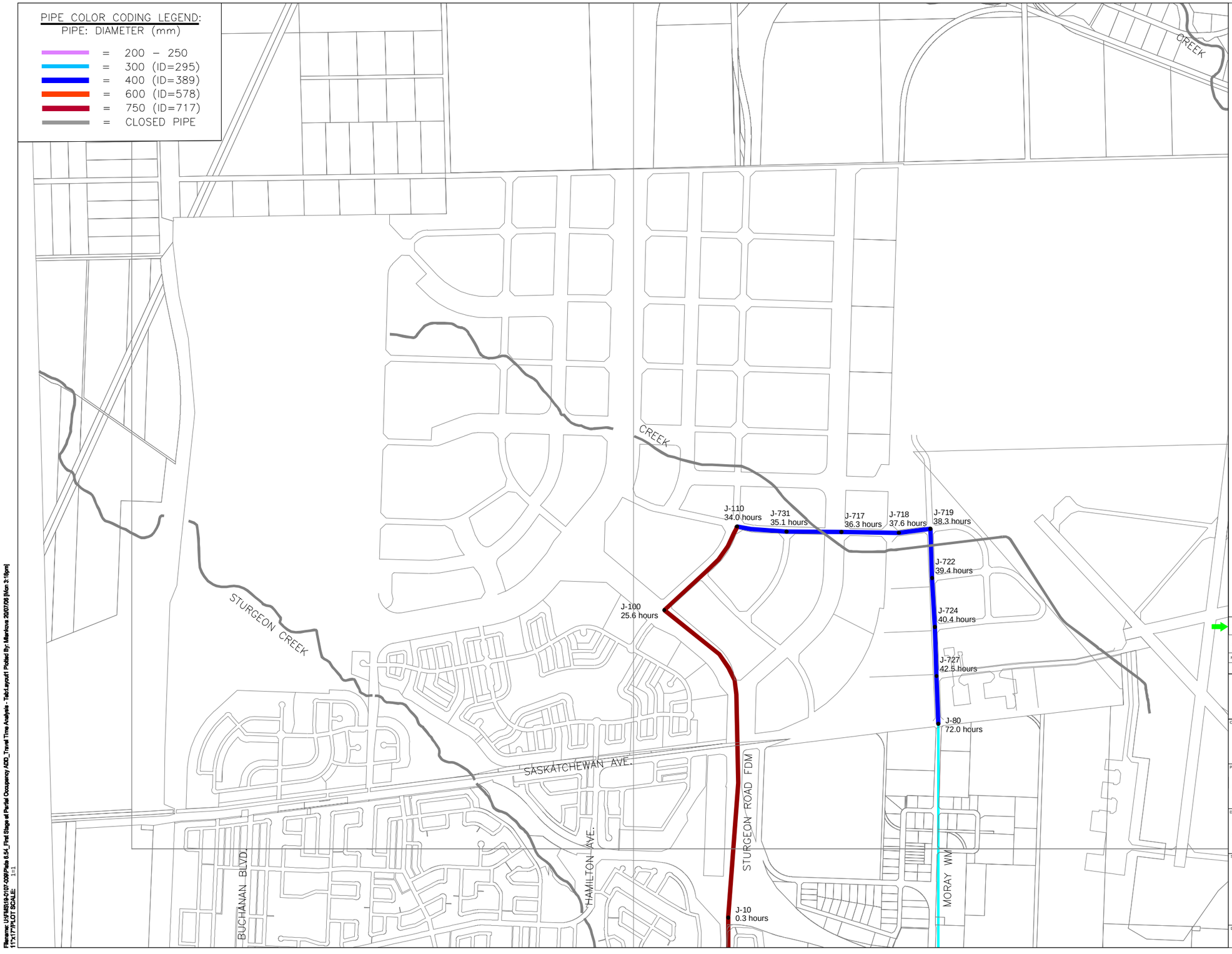
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	DESIGN CHECK: RBO	DATE: YY/MM/DD	
	DRAWN BY: MID	DATE: 20/01/20	
	DWG CHECK: SH	DATE: YY/MM/DD	

DWG. NO. 19-0107-009 PLATE 6.53 REV. B

Filename: C:\Users\mlinkova\Desktop\6.53 - Industrial First Stage at Partial Occupancy_ADD - Tab1.layout1 Plotted By: MLinkova 20/06/25 [Thu 9:47pm]
11"x17" PLOT SCALE: 1=1

PIPE COLOR CODING LEGEND:
PIPE: DIAMETER (mm)

- = 200 – 250
- = 300 (ID=295)
- = 400 (ID=389)
- = 600 (ID=578)
- = 750 (ID=717)
- = CLOSED PIPE



N

AREA OF INTEREST



KEYPLAN

SCENARIO NOTES:

AVERAGE DAY DEMAND (ADD)
100% OF ADD

CONNECTIONS TO C.O.W. SYSTEM AT:
750mm STURGEON ROAD FDM
300mm MORAY WM

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/26	ISSUED FOR FINAL REPORT	SH	RBO
A	20/02/25	ISSUED FOR 60% REVIEW	SH	RBO

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
AIRPORT AREA WEST
REGIONAL WATER AND WASTEWATER
SERVICING PRELIMINARY DESIGN

DWG. DESCRIPTION:
FIRST STAGE AT PARTIAL OCCUPANCY
AVERAGE DAY DEMAND
TRAVEL TIME ANALYSIS

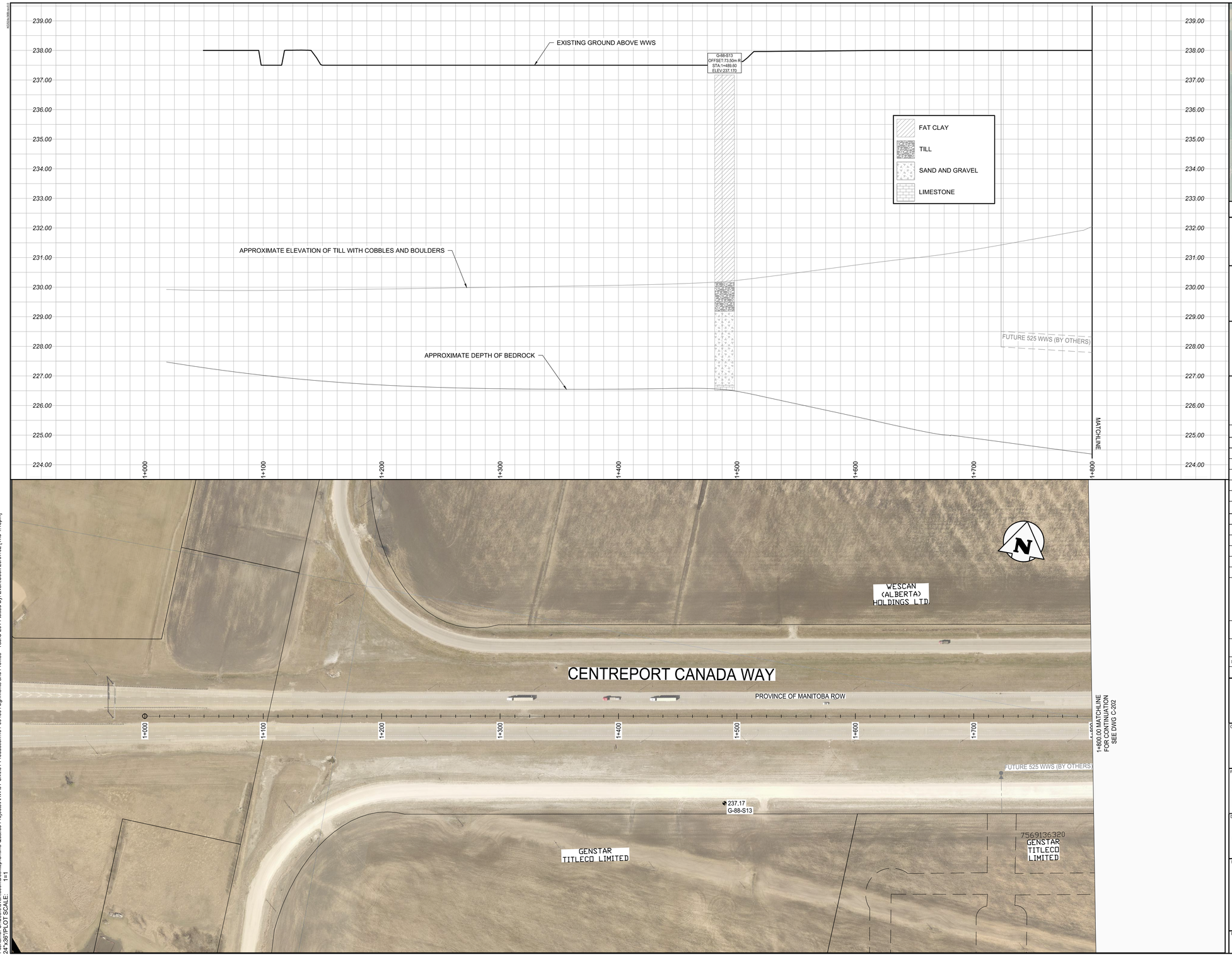
SEAL		
	DESIGN BY: SH	DATE (YY/MM/DD): 20/01/20
	DESIGN CHECK: RBO	DATE: YY/MM/DD
	DRAWN BY: MID	DATE: 20/01/20
	DWG CHECK: SH	DATE: YY/MM/DD

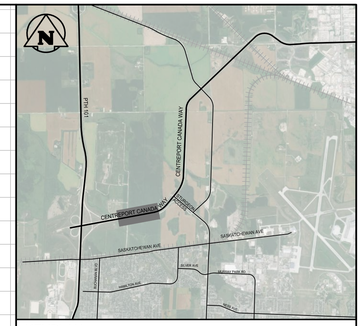
DWG. NO. 19-0107-009 PLATE 6.54 REV: B

Filename: I:\1\PIB\01\19-0107-009\Plate 6.54_First Stage at Partial Occupancy ADD_Travel Time Analysis - Tab1.layout1 Plotted By: Mlamkova 20/07/06 [Mon 3:16pm]
11"x17" PLOT SCALE: 1:1

DRAWINGS

Preliminary Design Drawings





KEYPLAN:

PROPERTY LIMITS DELINEATION

DELINEATION OF PROPERTY LIMITS AS SHOWN ON THIS DWG DOES NOT REPRESENT A "LEGAL SURVEY". KGS GROUP MAKES NO REPRESENTATION OR WARRANTY AS TO THE ACCURACY OF PROPERTY LIMITS DELINEATED ON THIS DWG, NOR ON THE DIMENSIONAL ACCURACY OF DWG FEATURES RELATIVE TO THOSE PROPERTY LIMITS.

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

WARNING

1. NOTIFY THE GAS COMPANY OF THE PROPOSED LOCATION OF EXCAVATION.
2. TAKE PRECAUTION TO AVOID DAMAGE TO GAS COMPANY INSTALLATIONS.
3. SEE PROVINCIAL REGULATION 210/72 FOR DETAILS.

NOTES: (MOVE UP IF NO KEYPLAN)
1. NOTE

LEGEND:

EXISTING	LEGEND-PLAN	PROPOSED
300 FDM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
○	MANHOLE	●
◇	HYDRANT	✦
⊗	VALVE	⊗
EXISTING	LEGEND-PROFILE	PROPOSED
300 WM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
	BEDROCK	
	TILL	
	COBBLES	

PRELIMINARY

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/29	PRELIMINARY DESIGN	R.S.	B.H.
A	20/03/16	60% PRELIMINARY DESIGN	R.S.	B.H.

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

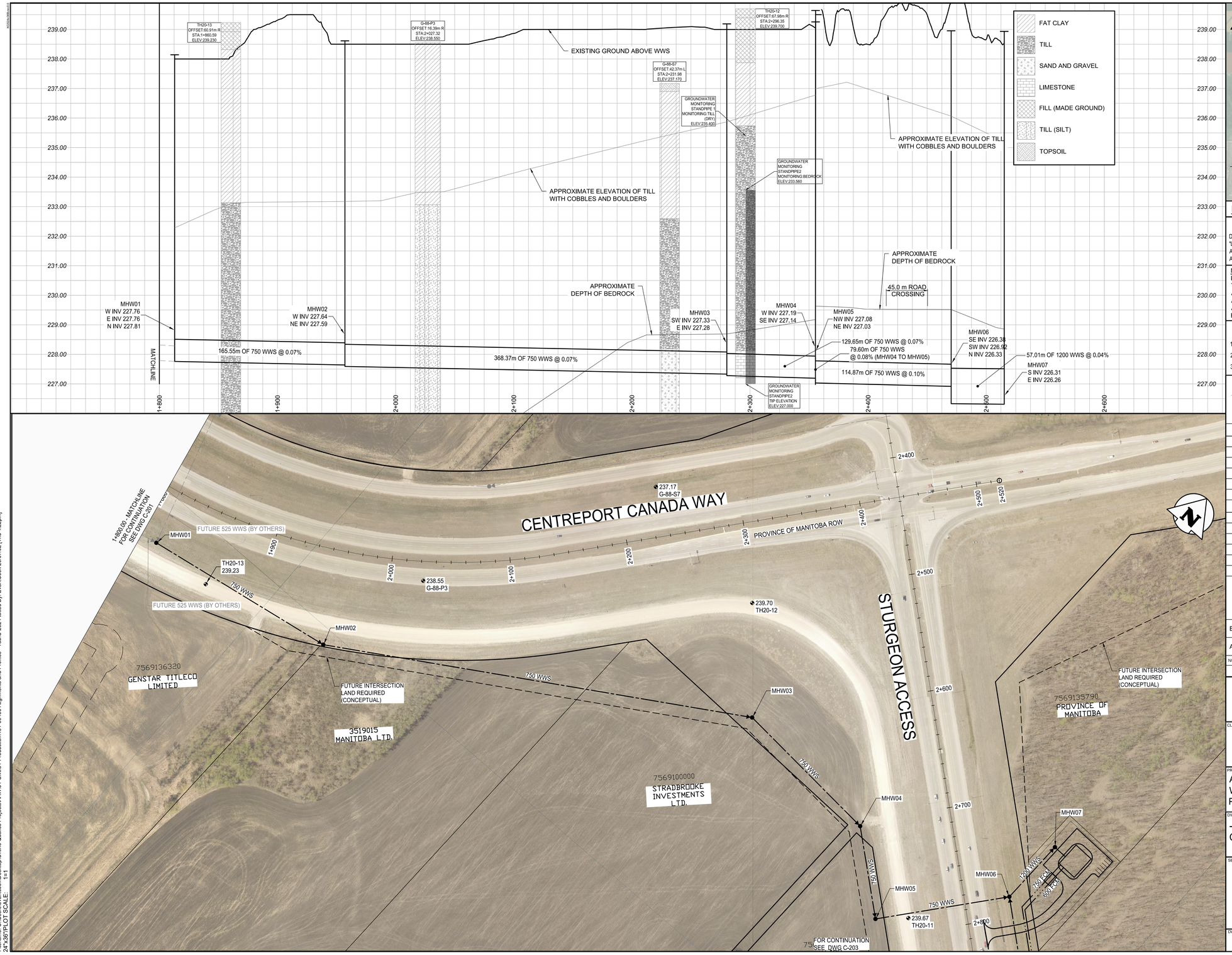
PROJECT:
Airport Area West Regional Water and Wastewater Servicing
Preliminary Engineering

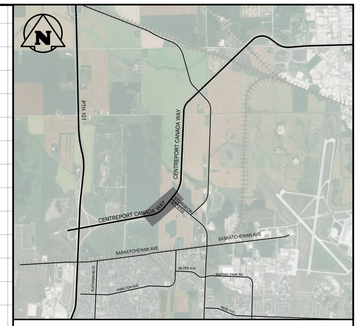
DWG. DESCRIPTION:
CENTREPORT CANADA WAY 1+000 - 1+800

SEAL		
	DESIGN BY: R.S. / B.R.	DATE (YY/MM/DD): 20/02/25
	DESIGN CHECK: B.H.	DATE: 20/02/25
	DRAWN BY: R.S. / B.R.	DATE: 20/02/26
	DWG CHECK: B.H.	DATE: 20/02/26

DWG. NO. 191-09486-00 C-201 REV: B

Filename: C:\Users\evan.cook\Desktop\Offline Qualico Projects\AAW\01-Civil\01-Production\191-09486 Alignments and Profiles - Tab:C-201 Plotted By: Evan.Cook 2007/02 [Thu 4:18pm]
24"X36" PLOT SCALE: 1=1





KEYPLAN:

PROPERTY LIMITS DELINEATION

DELINEATION OF PROPERTY LIMITS AS SHOWN ON THIS DWG DOES NOT REPRESENT A "LEGAL SURVEY". KGS GROUP MAKES NO REPRESENTATION OR WARRANTY AS TO THE ACCURACY OF PROPERTY LIMITS DELINEATED ON THIS DWG, NOR ON THE DIMENSIONAL ACCURACY OF DWG FEATURES RELATIVE TO THOSE PROPERTY LIMITS.

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

WARNING

1. NOTIFY THE GAS COMPANY OF THE PROPOSED LOCATION OF EXCAVATION.
2. TAKE PRECAUTION TO AVOID DAMAGE TO GAS COMPANY INSTALLATIONS.
3. SEE PROVINCIAL REGULATION 210/72 FOR DETAILS.

NOTES: (MOVE UP IF NO KEYPLAN)
1. NOTE

LEGEND:

EXISTING	LEGEND-PLAN	PROPOSED
300 FDM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
○	MANHOLE	●
◇	HYDRANT	◆
⊗	VALVE	⊗
EXISTING	LEGEND-PROFILE	PROPOSED
300 WM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
	BEDROCK	
	TILL	
	COBBLES	

PRELIMINARY

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/29	PRELIMINARY DESIGN	R.S.	B.H.
A	20/03/16	60% PRELIMINARY DESIGN	R.S.	B.H.

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing
Preliminary Engineering

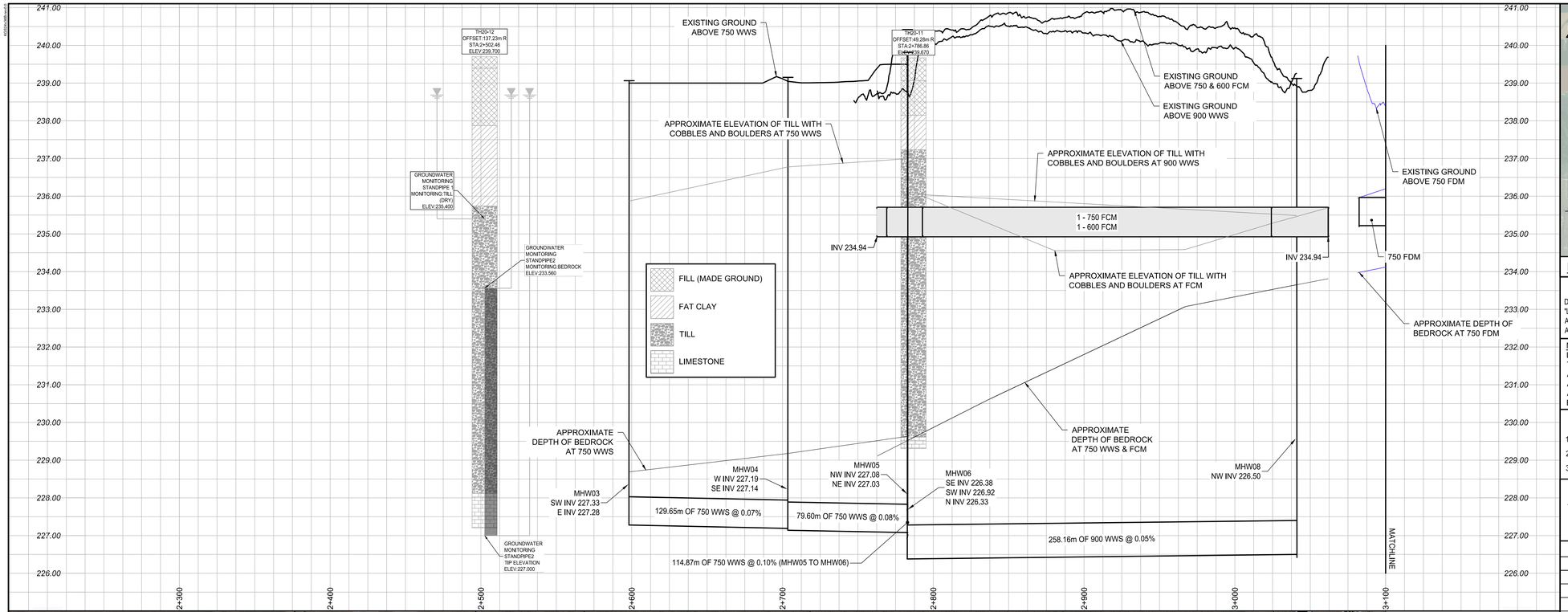
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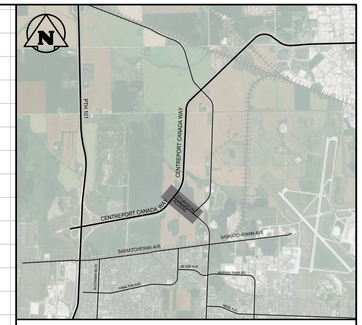
CENTREPORT CANADA WAY 1+800 - 2+520

SEAL		
	DESIGN BY: R.S. / B.R.	DATE (YY/MM/DD): 20/02/03
	DESIGN CHECK: B.H.	DATE: 20/02/03
	DRAWN BY: R.S. / B.R.	DATE: 20/02/03
	DWG CHECK: B.H.	DATE: 20/02/03

DWG. NO. 191-09486-00 C-202 REV: B

Filename: C:\Users\evan.cook\Desktop\Offline Qualico Projects\AAW\01-Civil\01-Production\191-09486 Alignments and Profiles - Tab.C-202 Plotted By: Evan.Cook 20/07/02 [Thu 4:22pm]
24"x36"(PLOT SCALE: 1=1





KEYPLAN:

PROPERTY LIMITS DELINEATION

DELINEATION OF PROPERTY LIMITS AS SHOWN ON THIS DWG DOES NOT REPRESENT A "LEGAL SURVEY". KGS GROUP MAKES NO REPRESENTATION OR WARRANTY AS TO THE ACCURACY OF PROPERTY LIMITS DELINEATED ON THIS DWG, NOR ON THE DIMENSIONAL ACCURACY OF DWG FEATURES RELATIVE TO THOSE PROPERTY LIMITS.

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

WARNING

1. NOTIFY THE GAS COMPANY OF THE PROPOSED LOCATION OF EXCAVATION.
2. TAKE PRECAUTION TO AVOID DAMAGE TO GAS COMPANY INSTALLATIONS.
3. SEE PROVINCIAL REGULATION 210/72 FOR DETAILS.

NOTES: (MOVE UP IF NO KEYPLAN)
1. NOTE

LEGEND:

EXISTING	LEGEND-PLAN	PROPOSED
300 FDM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
○	MANHOLE	●
◇	HYDRANT	◆
⊗	VALVE	⊗

EXISTING	LEGEND-PROFILE	PROPOSED
300 WM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
	BEDROCK	
	TILL	
	COBBLES	

PRELIMINARY

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/29	PRELIMINARY DESIGN	R.S.	B.H.
A	20/03/16	60% PRELIMINARY DESIGN	R.S.	B.H.

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing
Preliminary Engineering

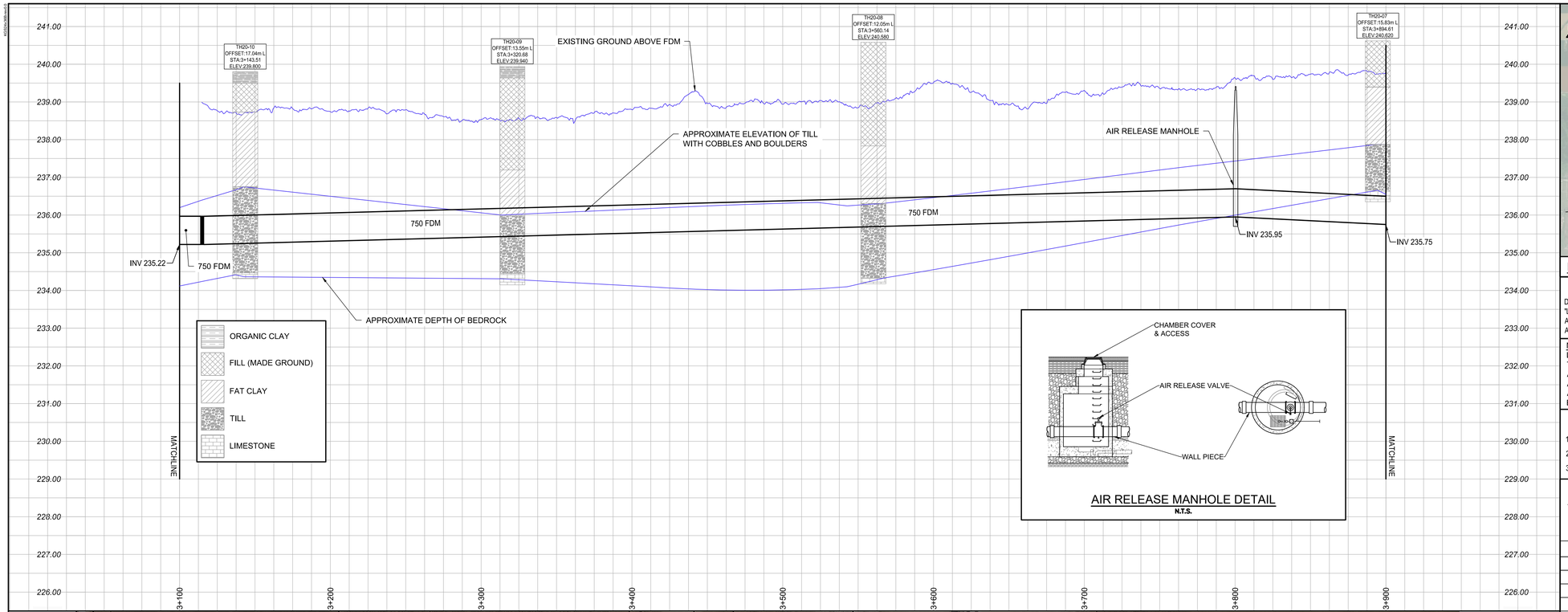
DWG. DESCRIPTION:

STURGEON ACCESS 2+344 - 3+100

SEAL		
	DESIGN BY: R.S. / B.R.	DATE (YY/MM/DD): 20/02/03
	DESIGN CHECK: B.H.	DATE: 20/02/03
	DRAWN BY: R.S. / B.R.	DATE: 20/02/03
	DWG CHECK: B.H.	DATE: 20/02/03

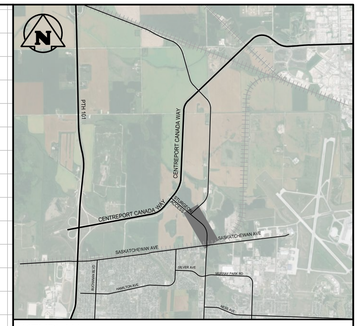
DWG. NO. 191-09486-00 C-203 REV: B

Filename: C:\Users\evan.cook\Desktop\Offline Qualico Projects\AAW\01-Civil\01-Production\191-09486 Alignments and Profiles - Tab:C-203 Plotted By: Evan.Cook 2007/02 [Thu 4:25pm]
24"x36"PLOT SCALE: 1=1



AIR RELEASE MANHOLE DETAIL
N.T.S.





KEYPLAN:

PROPERTY LIMITS DELINEATION

DELINEATION OF PROPERTY LIMITS AS SHOWN ON THIS DWG DOES NOT REPRESENT A "LEGAL SURVEY". KGS GROUP MAKES NO REPRESENTATION OR WARRANTY AS TO THE ACCURACY OF PROPERTY LIMITS DELINEATED ON THIS DWG, NOR ON THE DIMENSIONAL ACCURACY OF DWG FEATURES RELATIVE TO THOSE PROPERTY LIMITS.

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WARNING

1. NOTIFY THE GAS COMPANY OF THE PROPOSED LOCATION OF EXCAVATION.
2. TAKE PRECAUTION TO AVOID DAMAGE TO GAS COMPANY INSTALLATIONS.
3. SEE PROVINCIAL REGULATION 210/72 FOR DETAILS.

NOTES: (MOVE UP IF NO KEYPLAN)
1. NOTE

LEGEND:

EXISTING	LEGEND-PLAN	PROPOSED
300 FDM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
○	MANHOLE	●
◇	HYDRANT	◆
⊗	VALVE	⊗
EXISTING	LEGEND-PROFILE	PROPOSED
300 WM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
	BEDROCK	
	TILL	
	COBBLES	

PRELIMINARY

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/29	PRELIMINARY DESIGN	R.S.	B.H.
A	20/03/16	60% PRELIMINARY DESIGN	R.S.	B.H.

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing
Preliminary Engineering

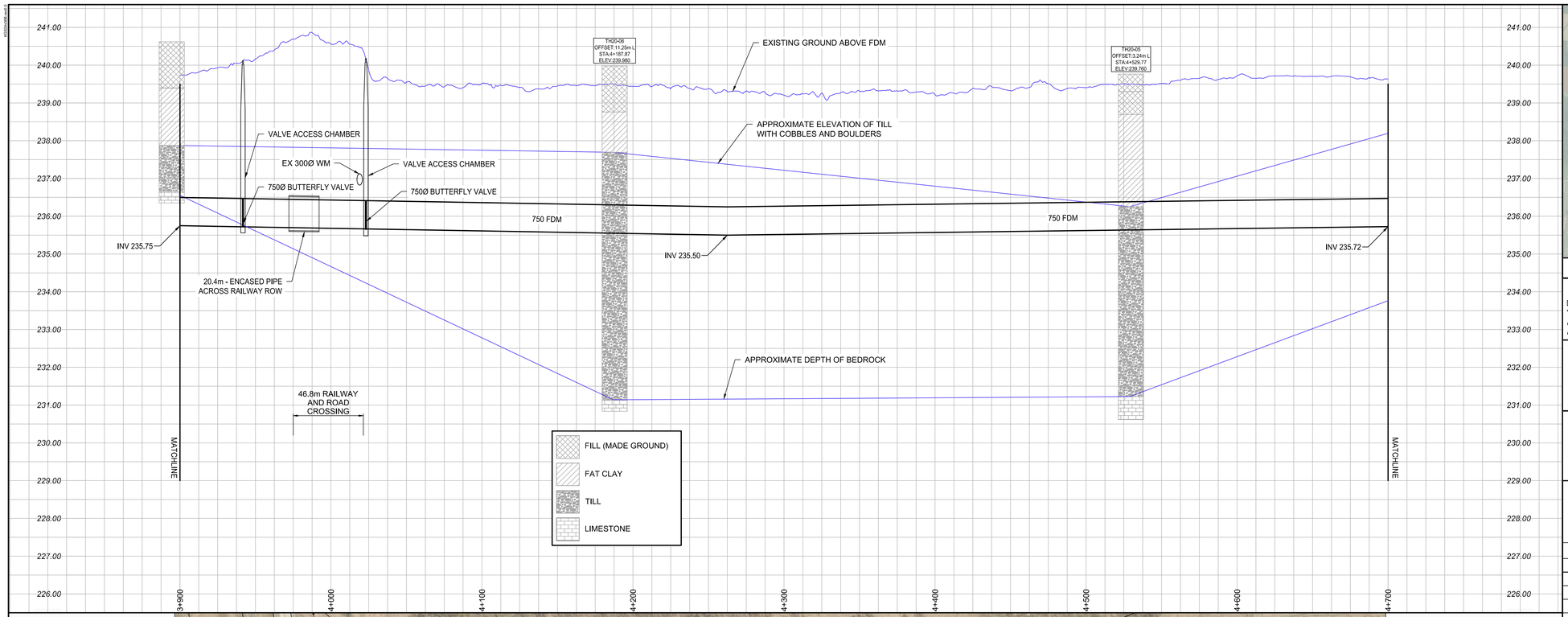
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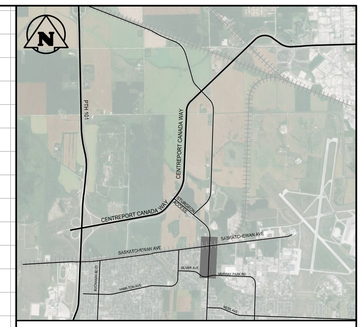
STURGEON ROAD 3+100 - 3+900

SEAL		
	DESIGN BY: R.S. / B.R.	DATE (YY/MM/DD): 20/02/03
	DESIGN CHECK: B.H.	DATE: 20/02/03
	DRAWN BY: R.S. / B.R.	DATE: 20/02/03
	DWG CHECK: B.H.	DATE: 20/02/03

DWG. NO. 191-09486-00 C-204 REV: B

Filename: C:\Users\evan.cook\Desktop\Offline Qualico Projects\AAW\01-Civil\01-Production\191-09486 Alignments and Profiles - Tab:C-204 Plotted By: Evan.Cook 2007/02 [Thu 4:28pm]
24"x36"PLOT SCALE: 1=1





KEYPLAN:

PROPERTY LIMITS DELINEATION

DELINEATION OF PROPERTY LIMITS AS SHOWN ON THIS DWG DOES NOT REPRESENT A "LEGAL SURVEY". KGS GROUP MAKES NO REPRESENTATION OR WARRANTY AS TO THE ACCURACY OF PROPERTY LIMITS DELINEATED ON THIS DWG, NOR ON THE DIMENSIONAL ACCURACY OF DWG FEATURES RELATIVE TO THOSE PROPERTY LIMITS.

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WARNING

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2. TAKE PRECAUTION TO AVOID DAMAGE TO GAS COMPANY INSTALLATIONS.
3. SEE PROVINCIAL REGULATION 210/72 FOR DETAILS.

NOTES: (MOVE UP IF NO KEYPLAN)
1. NOTE

LEGEND:

EXISTING	LEGEND-PLAN	PROPOSED
300 FDM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
○	MANHOLE	●
⊹	HYDRANT	✦
⊗	VALVE	⊗
EXISTING	LEGEND-PROFILE	PROPOSED
300 WM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
	BEDROCK	
	TILL	
	COBBLES	

PRELIMINARY

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/29	PRELIMINARY DESIGN	R.S.	B.H.
A	20/03/16	60% PRELIMINARY DESIGN	R.S.	B.H.

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing
Preliminary Engineering

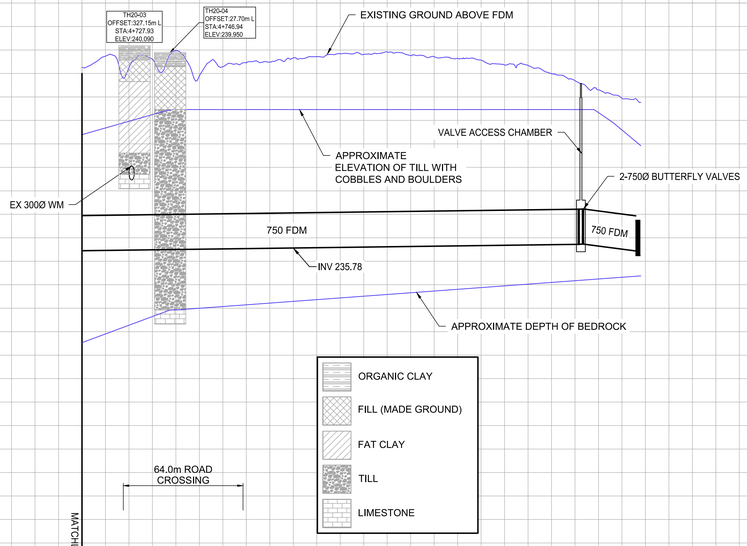
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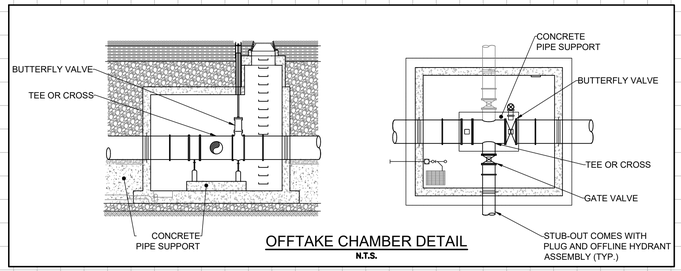
STURGEON ROAD 3+900 - 4+700

SEAL		
	DESIGN BY: R.S. / B.R.	DATE (YY/MM/DD): 20/02/03
	DESIGN CHECK: B.H.	DATE: 20/02/03
	DRAWN BY: R.S. / B.R.	DATE: 20/02/03
	DWG CHECK: B.H.	DATE: 20/02/03

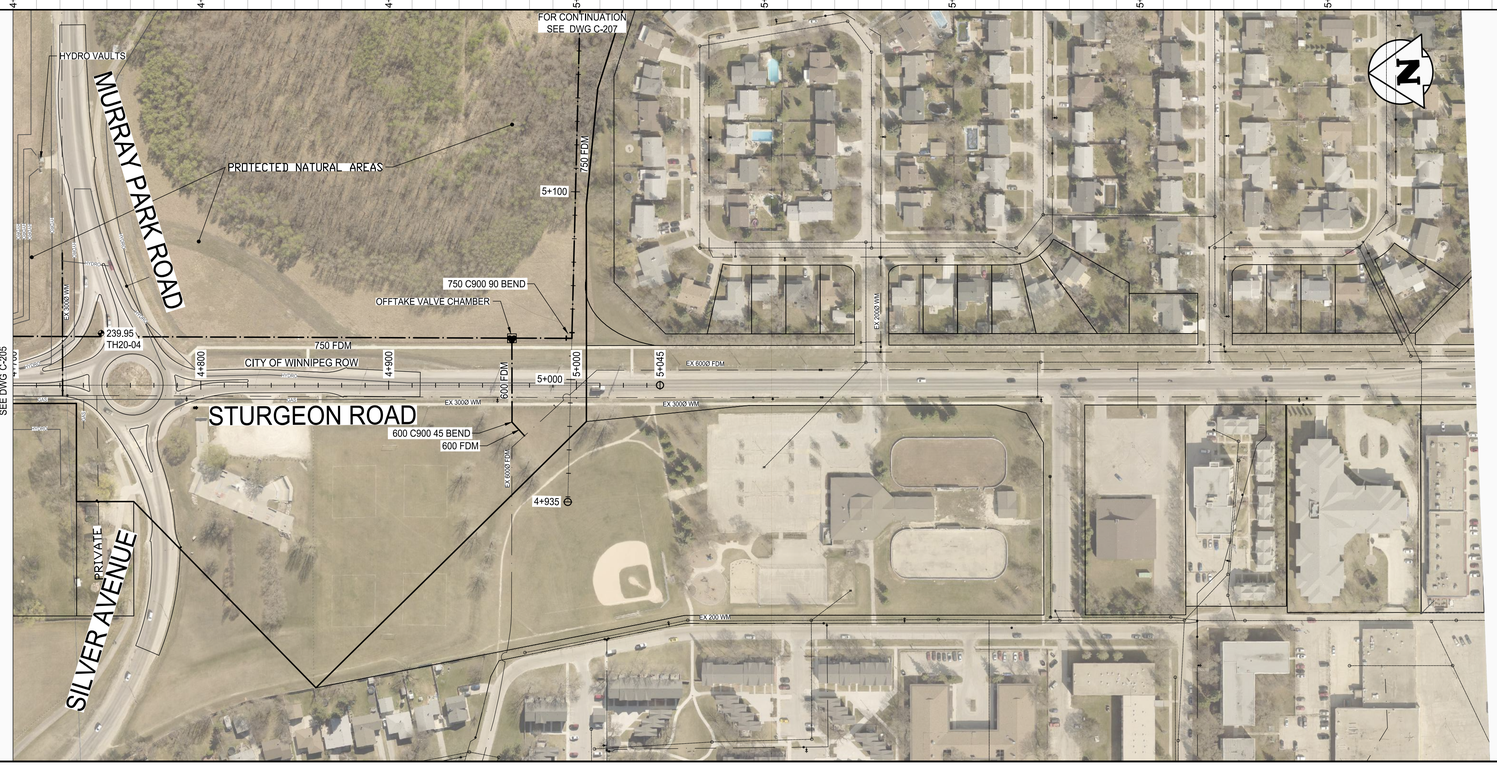
DWG. NO. 191-09486-00 C-205 REV: B

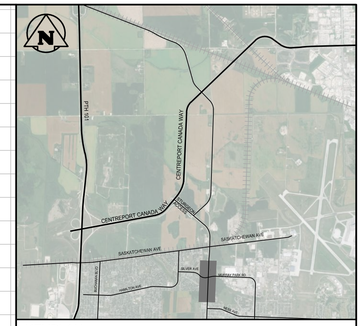
FileName: C:\Users\evan.cook\Desktop\Offline Qualico Projects\AAW01-Civil\01-Production\191-09486 Alignments and Profiles - Tab.C-205 Plotted By: Evan.Cook 20/07/02 [Thu 6:43pm]
24"x36" PLOT SCALE: 1=1





OFFTAKE CHAMBER DETAIL
N.T.S.





KEYPLAN:

PROPERTY LIMITS DELINEATION

DELINEATION OF PROPERTY LIMITS AS SHOWN ON THIS DWG DOES NOT REPRESENT A "LEGAL SURVEY". KGS GROUP MAKES NO REPRESENTATION OR WARRANTY AS TO THE ACCURACY OF PROPERTY LIMITS DELINEATED ON THIS DWG, NOR ON THE DIMENSIONAL ACCURACY OF DWG FEATURES RELATIVE TO THOSE PROPERTY LIMITS.

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

WARNING

1. NOTIFY THE GAS COMPANY OF THE PROPOSED LOCATION OF EXCAVATION.
2. TAKE PRECAUTION TO AVOID DAMAGE TO GAS COMPANY INSTALLATIONS.
3. SEE PROVINCIAL REGULATION 210/72 FOR DETAILS.

NOTES: (MOVE UP IF NO KEYPLAN)
1. NOTE

LEGEND:

EXISTING	LEGEND-PLAN	PROPOSED
300 FDM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
○	MANHOLE	●
⊹	HYDRANT	✦
⊗	VALVE	⊗

EXISTING	LEGEND-PROFILE	PROPOSED
300 WM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
	BEDROCK	
	TILL	
	COBBLES	

PRELIMINARY

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/29	PRELIMINARY DESIGN	R.S.	B.H.
A	20/03/16	60% PRELIMINARY DESIGN	R.S.	B.H.

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing
Preliminary Engineering

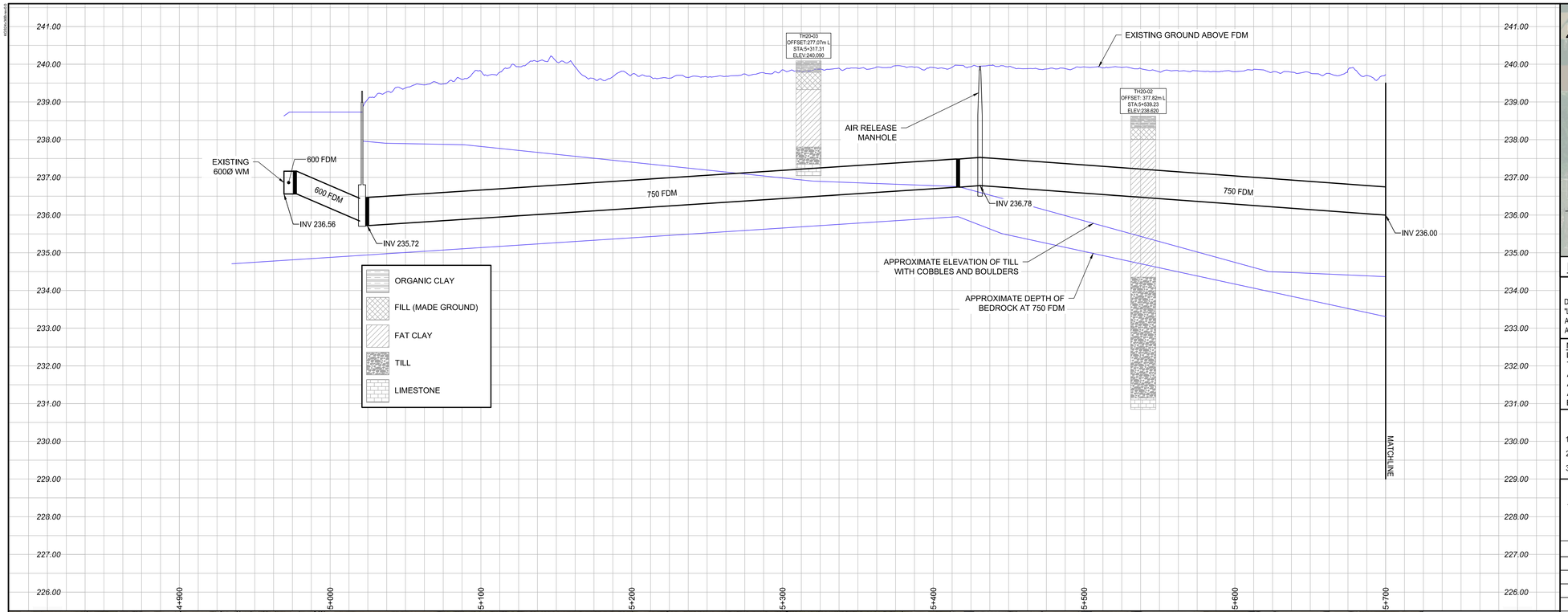
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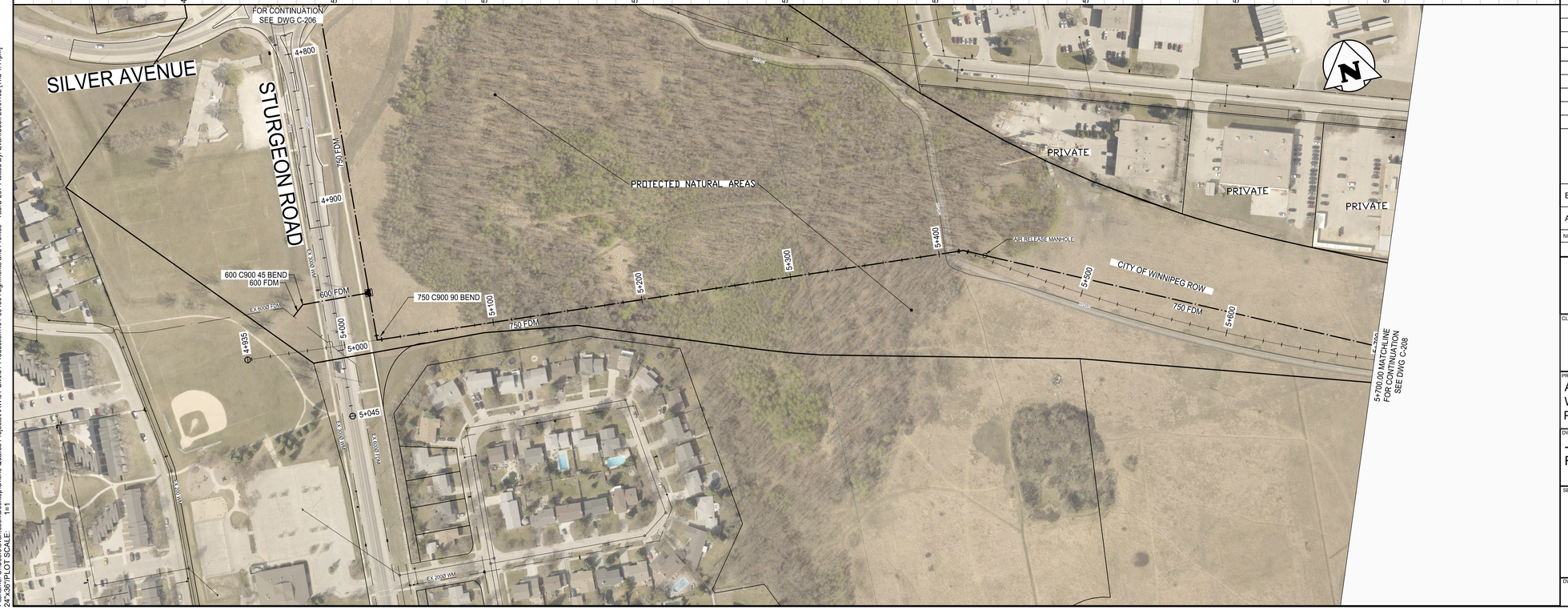
STURGEON ROAD 4+700 - 5+045

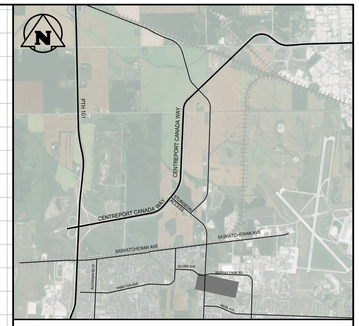
SEAL		
	DESIGN BY: R.S. / B.R.	DATE (YY/MM/DD): 20/02/03
	DESIGN CHECK: B.H.	DATE: 20/02/03
	DRAWN BY: R.S. / B.R.	DATE: 20/02/03
	DWG CHECK: B.H.	DATE: 20/02/03

DWG. NO. 191-09486-00 C-206 REV: B

Filename: C:\Users\evan.cook\Desktop\Offline Qualico Projects\AAW\01-Civil\01-Production\191-09486 Alignments and Profiles - Tab C-206 Plotted By: Evan.Cook 20/07/02 [Thu 4:37pm]
24"x36" PLOT SCALE: 1=1







KEYPLAN:

PROPERTY LIMITS DELINEATION

DELINEATION OF PROPERTY LIMITS AS SHOWN ON THIS DWG DOES NOT REPRESENT A "LEGAL SURVEY". KGS GROUP MAKES NO REPRESENTATION OR WARRANTY AS TO THE ACCURACY OF PROPERTY LIMITS DELINEATED ON THIS DWG, NOR ON THE DIMENSIONAL ACCURACY OF DWG FEATURES RELATIVE TO THOSE PROPERTY LIMITS.

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WARNING

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3. SEE PROVINCIAL REGULATION 210/72 FOR DETAILS.

NOTES: (MOVE UP IF NO KEYPLAN)
1. NOTE

LEGEND:

EXISTING	LEGEND-PLAN	PROPOSED
300 FDM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
○	MANHOLE	●
◇	HYDRANT	◆
⊗	VALVE	⊗
EXISTING	LEGEND-PROFILE	PROPOSED
300 WM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
	BEDROCK	
	TILL	
	COBBLES	

PRELIMINARY

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/29	PRELIMINARY DESIGN	R.S.	B.H.
A	20/03/16	60% PRELIMINARY DESIGN	R.S.	B.H.

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing
Preliminary Engineering

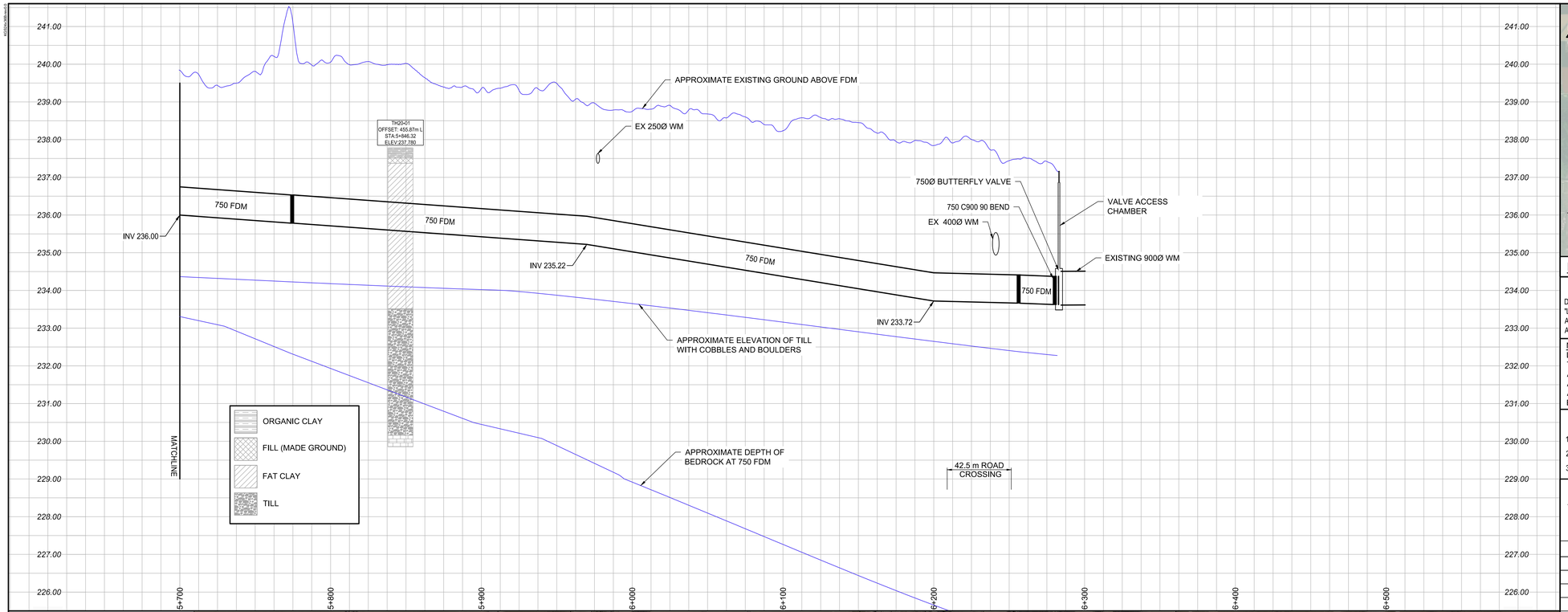
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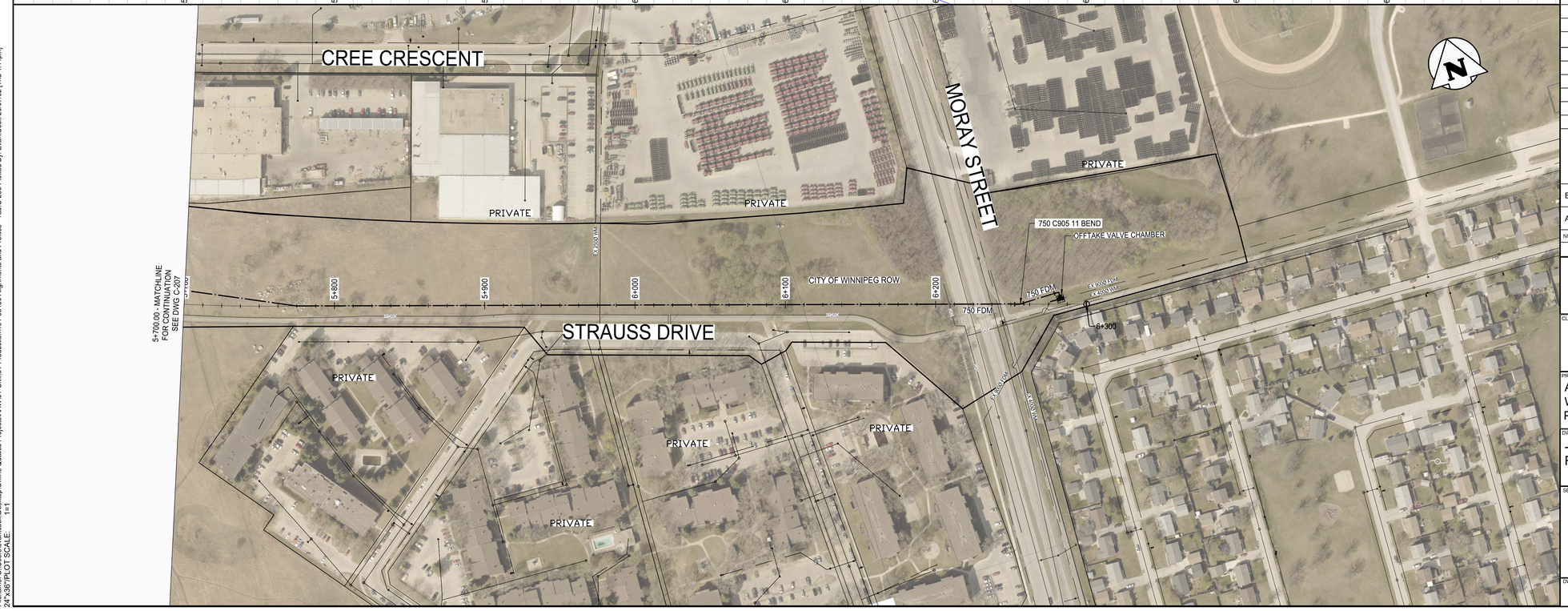
FEEDER MAIN 4+935 - 5+700

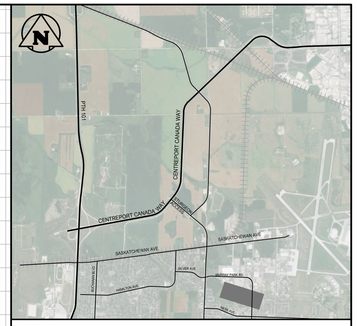
SEAL		
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	DESIGN CHECK: B.H.	DATE: 20/02/03
	DRAWN BY: R.S. / B.R.	DATE: 20/02/03
	DWG CHECK: B.H.	DATE: 20/02/03

DWG. NO. 191-09486-00 C-207 REV: B

Filename: C:\Users\evan.cook\Desktop\Offline Qualico Projects\AAW\01-Civil\01-Production\191-09486 Alignments and Profiles - Tab:C-207 Plotted By: Evan.Cook 2007/02 [Thu 4:41pm]
24"x36"PLOT SCALE: 1=1







KEYPLAN:

PROPERTY LIMITS DELINEATION

DELINEATION OF PROPERTY LIMITS AS SHOWN ON THIS DWG DOES NOT REPRESENT A "LEGAL SURVEY". KGS GROUP MAKES NO REPRESENTATION OR WARRANTY AS TO THE ACCURACY OF PROPERTY LIMITS DELINEATED ON THIS DWG, NOR ON THE DIMENSIONAL ACCURACY OF DWG FEATURES RELATIVE TO THOSE PROPERTY LIMITS.

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3. SEE PROVINCIAL REGULATION 210/72 FOR DETAILS.

NOTES: (MOVE UP IF NO KEYPLAN)
1. NOTE

LEGEND:

EXISTING	LEGEND-PLAN	PROPOSED
300 FDM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
○	MANHOLE	●
◇	HYDRANT	✦
⊗	VALVE	⊗
EXISTING	LEGEND-PROFILE	PROPOSED
300 WM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
	BEDROCK	
	TILL	
	COBBLES	

PRELIMINARY

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/29	PRELIMINARY DESIGN	R.S.	B.H.
A	20/03/16	60% PRELIMINARY DESIGN	R.S.	B.H.

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing
Preliminary Engineering

DWG. DESCRIPTION:

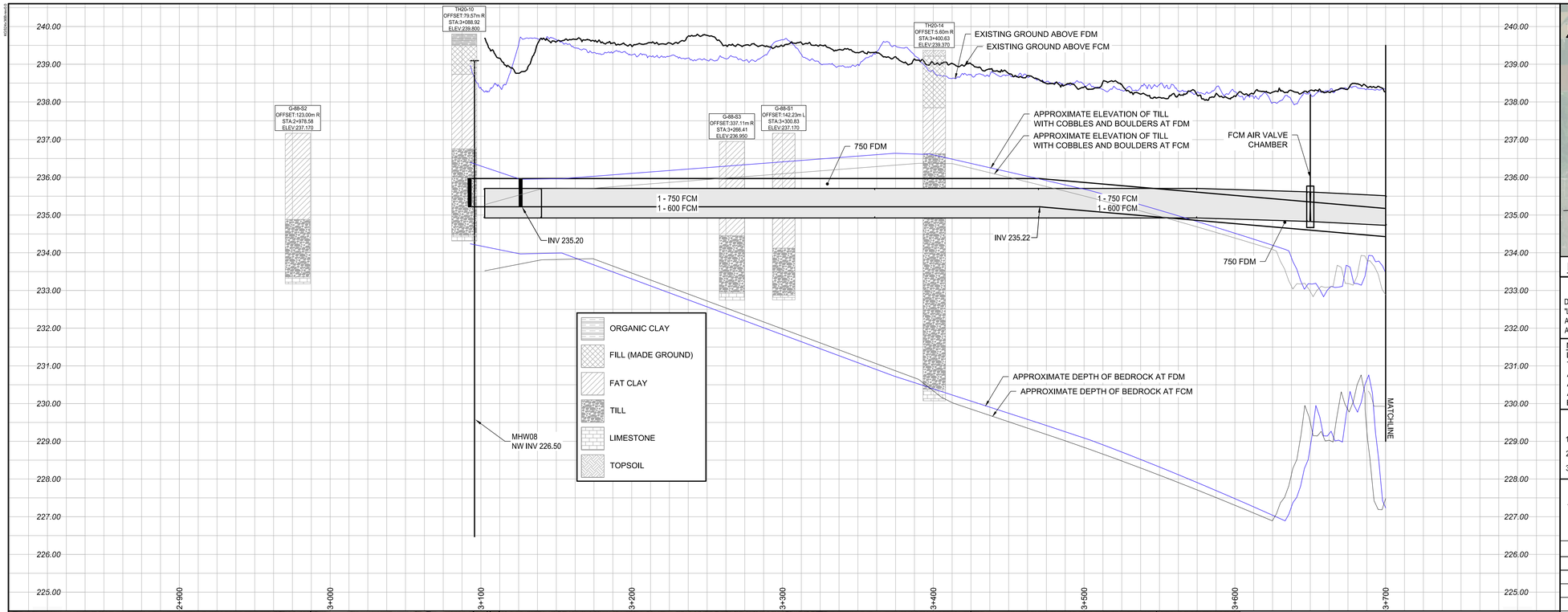
FEEDER MAIN 5+700 - 6+241

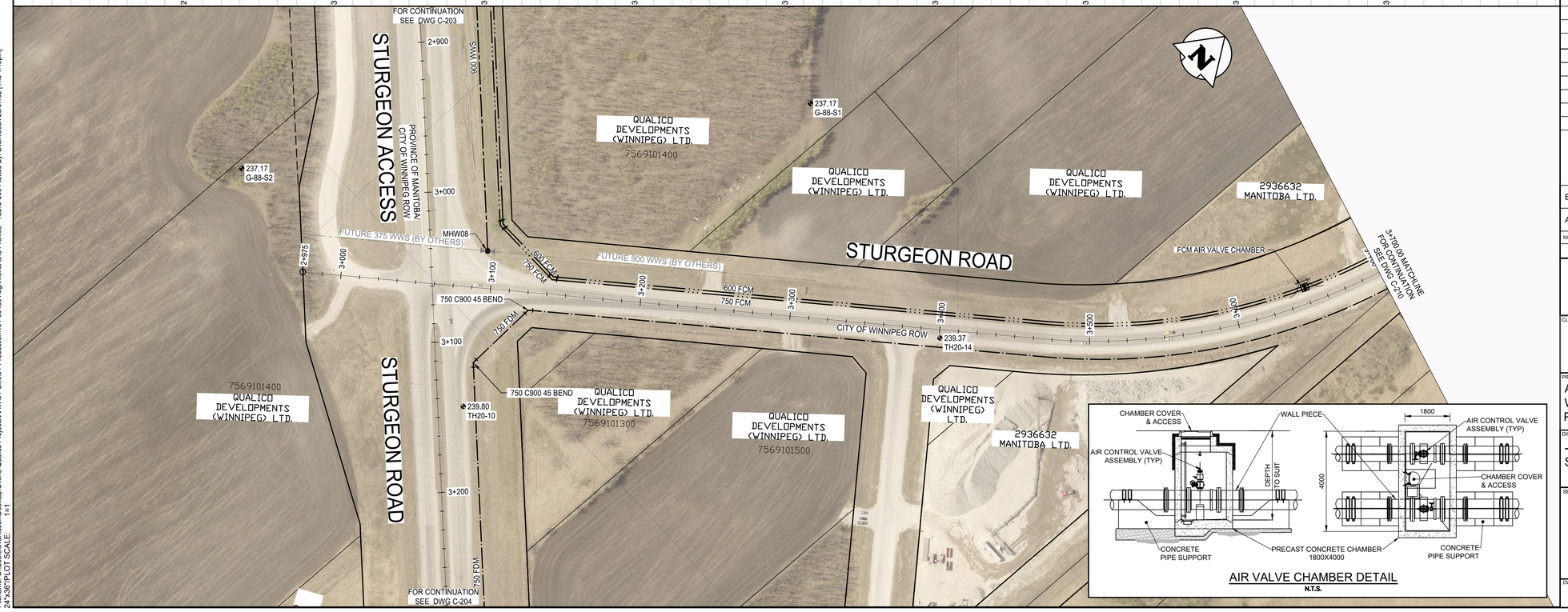
SEAL

DESIGN BY: R.S. / B.R.	DATE (YY/MM/DD): 20/02/03
DESIGN CHECK: B.H.	DATE: 20/02/03
DRAWN BY: R.S. / B.R.	DATE: 20/02/03
DWG CHECK: B.H.	DATE: 20/02/03

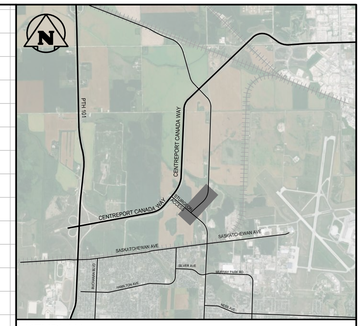
DWG. NO. 191-09486-00 C-208 REV: B

Filename: C:\Users\evan.cook\Desktop\Offline Quattco Projects\AAW\01-Civil\01-Production\191-09486 Alignments and Profiles - Tab:C-208 Plotted By: Evan.Cook 2020/7/02 [Thu 4:44pm]
24"x36"PLOT SCALE: 1=1





AIR VALVE CHAMBER DETAIL
N.T.S.



KEYPLAN:

PROPERTY LIMITS DELINEATION

DELINEATION OF PROPERTY LIMITS AS SHOWN ON THIS DWG DOES NOT REPRESENT A "LEGAL SURVEY". KGS GROUP MAKES NO REPRESENTATION OR WARRANTY AS TO THE ACCURACY OF PROPERTY LIMITS DELINEATED ON THIS DWG, NOR ON THE DIMENSIONAL ACCURACY OF DWG FEATURES RELATIVE TO THOSE PROPERTY LIMITS.

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3. SEE PROVINCIAL REGULATION 210/72 FOR DETAILS.

NOTES: (MOVE UP IF NO KEYPLAN)
1. NOTE

LEGEND:

EXISTING	LEGEND-PLAN	PROPOSED
300 FDM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
○	MANHOLE	●
◇	HYDRANT	◆
⊗	VALVE	⊗
EXISTING	LEGEND-PROFILE	PROPOSED
300 WM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
	BEDROCK	
	TILL	
	COBBLES	

PRELIMINARY

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/29	PRELIMINARY DESIGN	R.S.	B.H.
A	20/03/16	60% PRELIMINARY DESIGN	R.S.	B.H.

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing
Preliminary Engineering

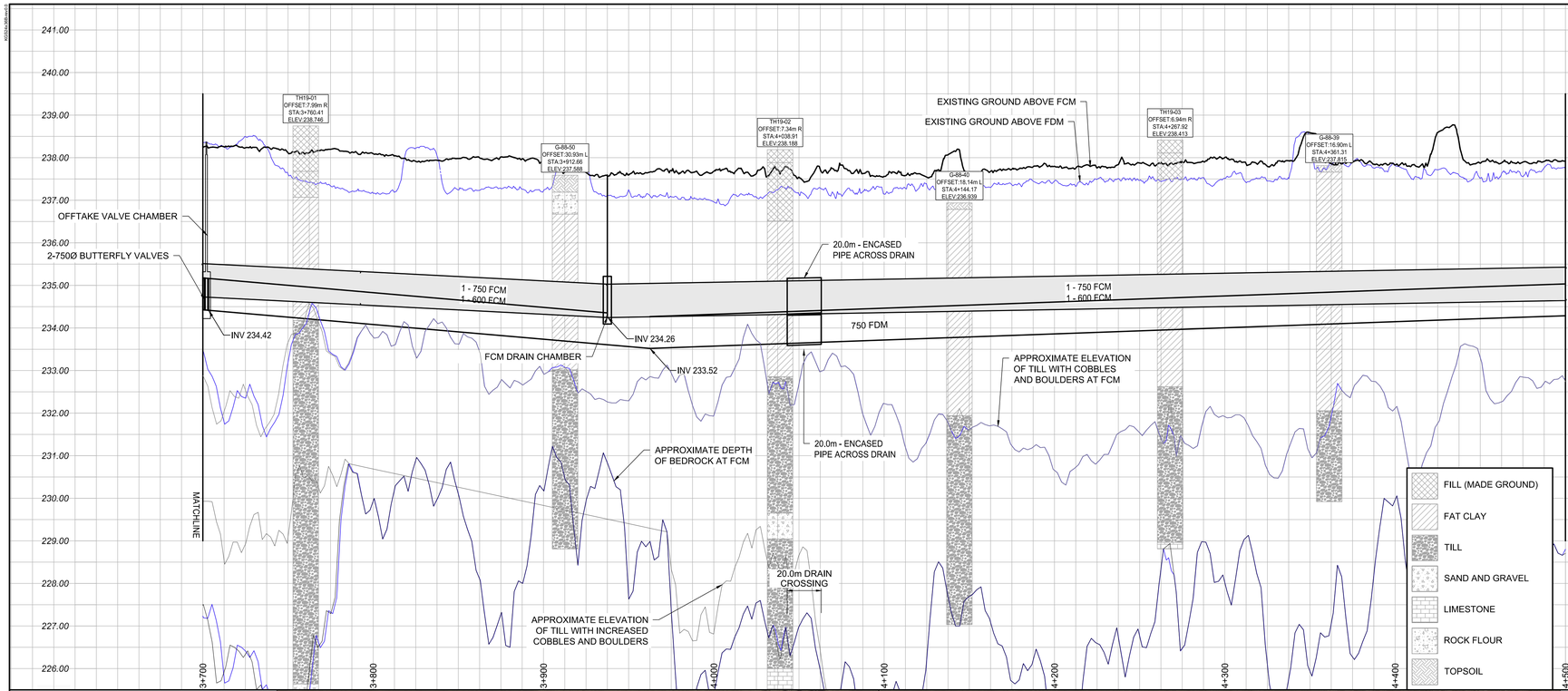
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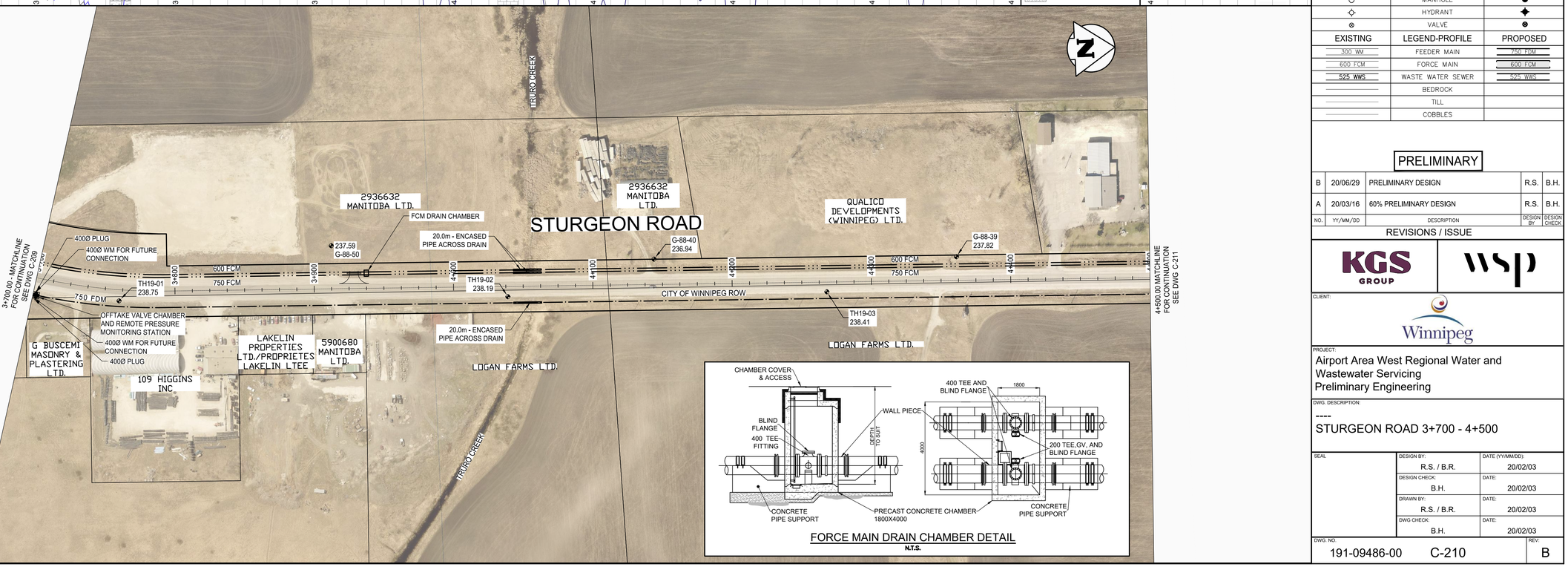
STURGEON ROAD 2+975 - 3+700

SEAL		
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	DRAWN BY: R.S. / B.R.	DATE: 20/02/03
	DWG CHECK: B.H.	DATE: 20/02/03

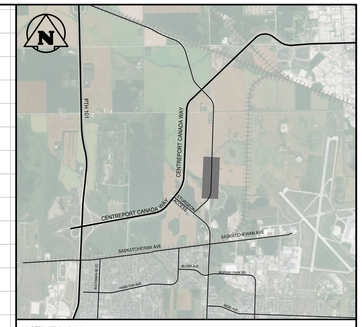
DWG. NO. 191-09486-00 C-209 REV: B

Filename: C:\Users\evan.cook\Desktop\Offline Qualico Projects\AAW\01-Civil\01-Production\191-09486 Alignments and Profiles - Tab:C-209 Plotted By: Evan.Cook 2007/02 [Thu 4:49pm]
24"x36"PLOT SCALE: 1=1





FORCE MAIN DRAIN CHAMBER DETAIL
N.T.S.



KEYPLAN:

PROPERTY LIMITS DELINEATION

DELINEATION OF PROPERTY LIMITS AS SHOWN ON THIS DWG DOES NOT REPRESENT A "LEGAL SURVEY". KGS GROUP MAKES NO REPRESENTATION OR WARRANTY AS TO THE ACCURACY OF PROPERTY LIMITS DELINEATED ON THIS DWG, NOR ON THE DIMENSIONAL ACCURACY OF DWG FEATURES RELATIVE TO THOSE PROPERTY LIMITS.

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WARNING

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2. TAKE PRECAUTION TO AVOID DAMAGE TO GAS COMPANY INSTALLATIONS.
3. SEE PROVINCIAL REGULATION 210/72 FOR DETAILS.

NOTES: (MOVE UP IF NO KEYPLAN)
1. NOTE

LEGEND:

EXISTING	LEGEND-PLAN	PROPOSED
300 FDM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
○	MANHOLE	●
◇	HYDRANT	◆
⊗	VALVE	⊗

EXISTING	LEGEND-PROFILE	PROPOSED
300 WM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
	BEDROCK	
	TILL	
	COBBLES	

PRELIMINARY

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/29	PRELIMINARY DESIGN	R.S.	B.H.
A	20/03/16	60% PRELIMINARY DESIGN	R.S.	B.H.

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing
Preliminary Engineering

DWG. DESCRIPTION:

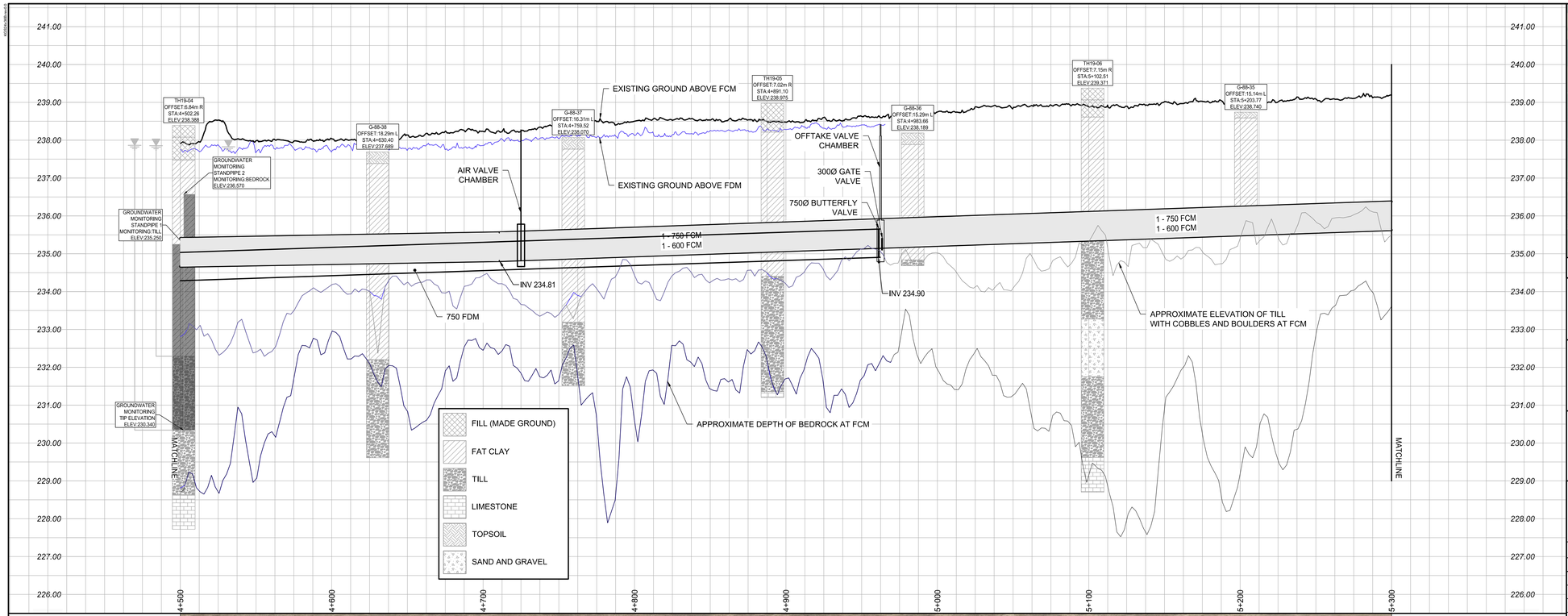
STURGEON ROAD 3+700 - 4+500

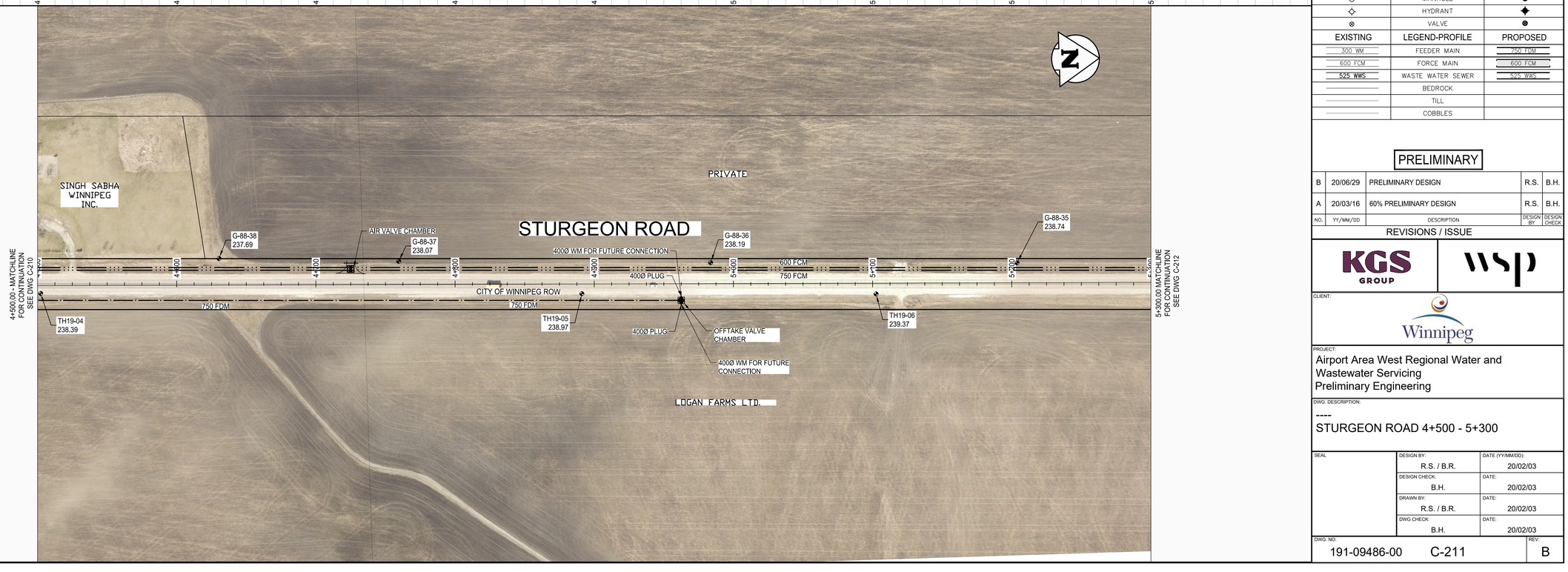
SEAL

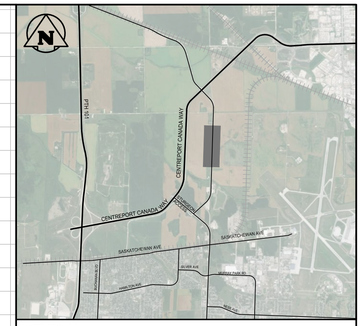
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DESIGN CHECK:	B.H.	DATE:	20/02/03
DRAWN BY:	R.S. / B.R.	DATE:	20/02/03
DWG CHECK:	B.H.	DATE:	20/02/03

DWG. NO. 191-09486-00 C-210 REV: B

Filename: C:\Users\evan.cook\Desktop\Offline Qualico Projects\AAW\01-Civil\01-Production\191-09486 Alignments and Profiles - Tab:C-210 Plotted By: Evan.Cook 2020/7/02 [Thu 4:52pm]
24"x36"PLOT SCALE: 1=1







KEYPLAN:

PROPERTY LIMITS DELINEATION

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NOTES: (MOVE UP IF NO KEYPLAN)
1. NOTE

LEGEND:

EXISTING	LEGEND-PLAN	PROPOSED
300 FDM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
○	MANHOLE	●
◇	HYDRANT	✦
⊗	VALVE	⊗
EXISTING	LEGEND-PROFILE	PROPOSED
300 WM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
	BEDROCK	
	TILL	
	COBBLES	

PRELIMINARY

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/29	PRELIMINARY DESIGN	R.S.	B.H.
A	20/03/16	60% PRELIMINARY DESIGN	R.S.	B.H.

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing
Preliminary Engineering

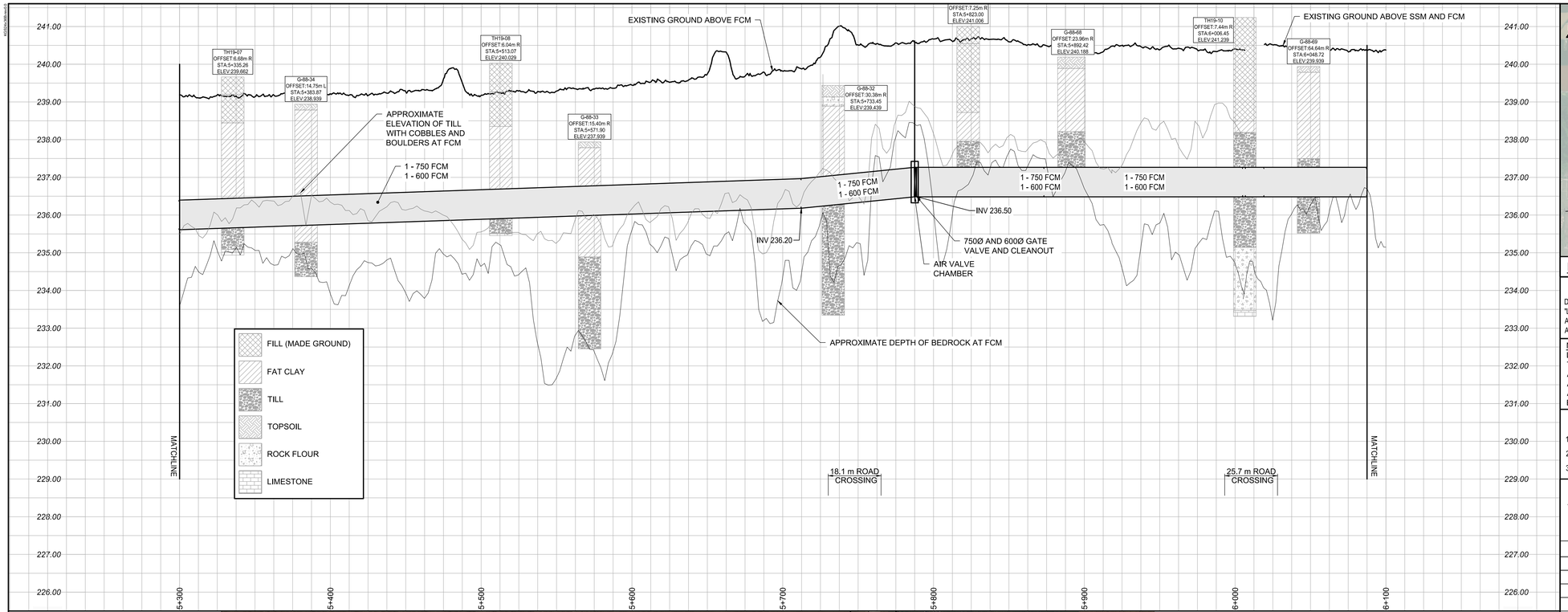
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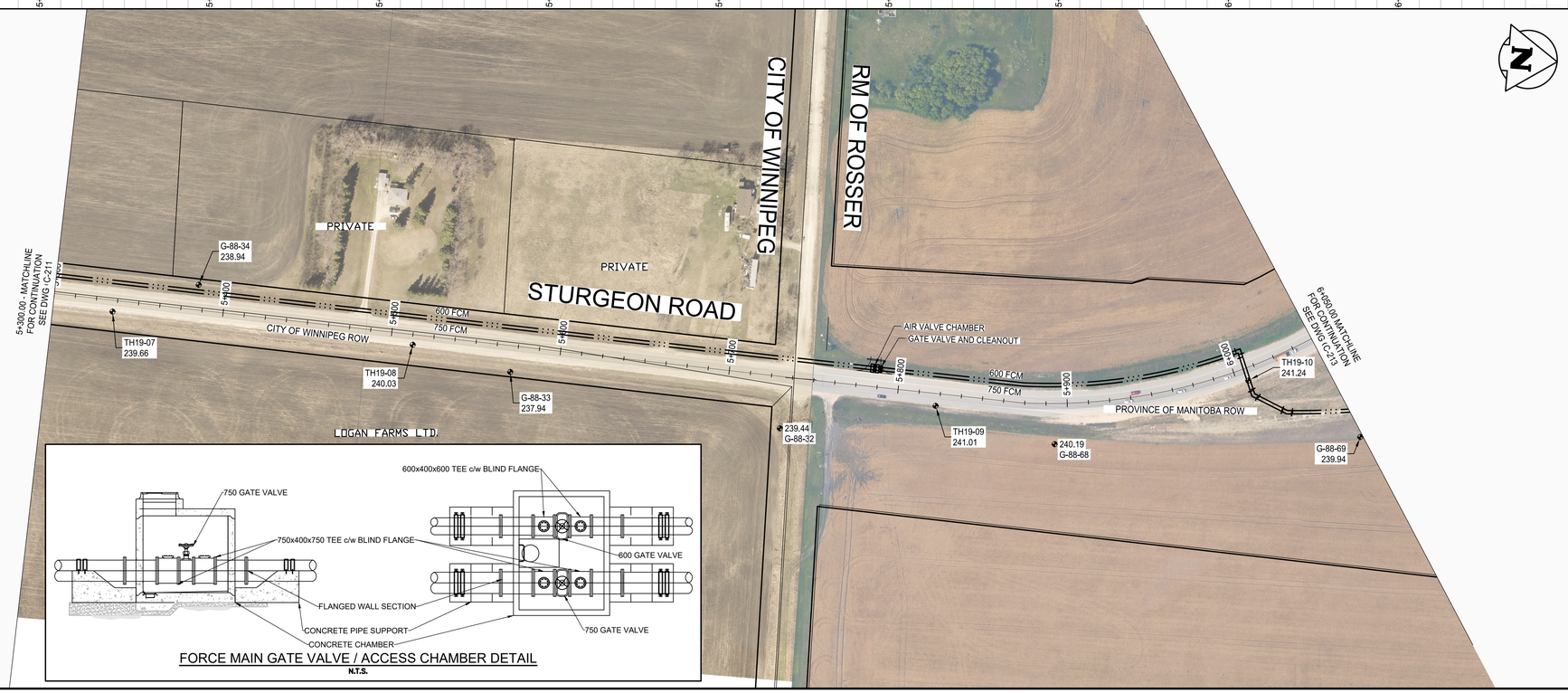
STURGEON ROAD 4+500 - 5+300

SEAL		
	DESIGN BY: R.S. / B.R.	DATE (YY/MM/DD): 20/02/03
	DESIGN CHECK: B.H.	DATE: 20/02/03
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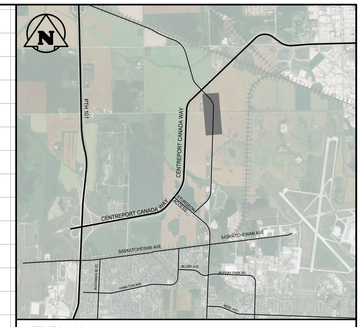
DWG. NO. 191-09486-00 C-211 REV: B

Filename: C:\Users\evan.cook\Desktop\Offline Qualico Projects\AAW\01-Civil\01-Production\191-09486 Alignments and Profiles - Tab:C-211 Plotted By: Evan.Cook 20/07/02 [Thu 4:55pm]
24"x36" PLOT SCALE: 1=1





FORCE MAIN GATE VALVE / ACCESS CHAMBER DETAIL
N.T.S.



KEYPLAN:

PROPERTY LIMITS DELINEATION

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NOTES: (MOVE UP IF NO KEYPLAN)
1. NOTE

LEGEND:

EXISTING	LEGEND-PLAN	PROPOSED
300 FDM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
○	MANHOLE	●
◇	HYDRANT	◆
⊗	VALVE	⊗
EXISTING	LEGEND-PROFILE	PROPOSED
300 WM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
	BEDROCK	
	TILL	
	COBBLES	

PRELIMINARY

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
C	20/09/11	PRELIMINARY DESIGN - REVISED	R.S.	B.H.
B	20/06/29	PRELIMINARY DESIGN	R.S.	B.H.
A	20/03/16	60% PRELIMINARY DESIGN	R.S.	B.H.

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing
Preliminary Engineering

DWG. DESCRIPTION:

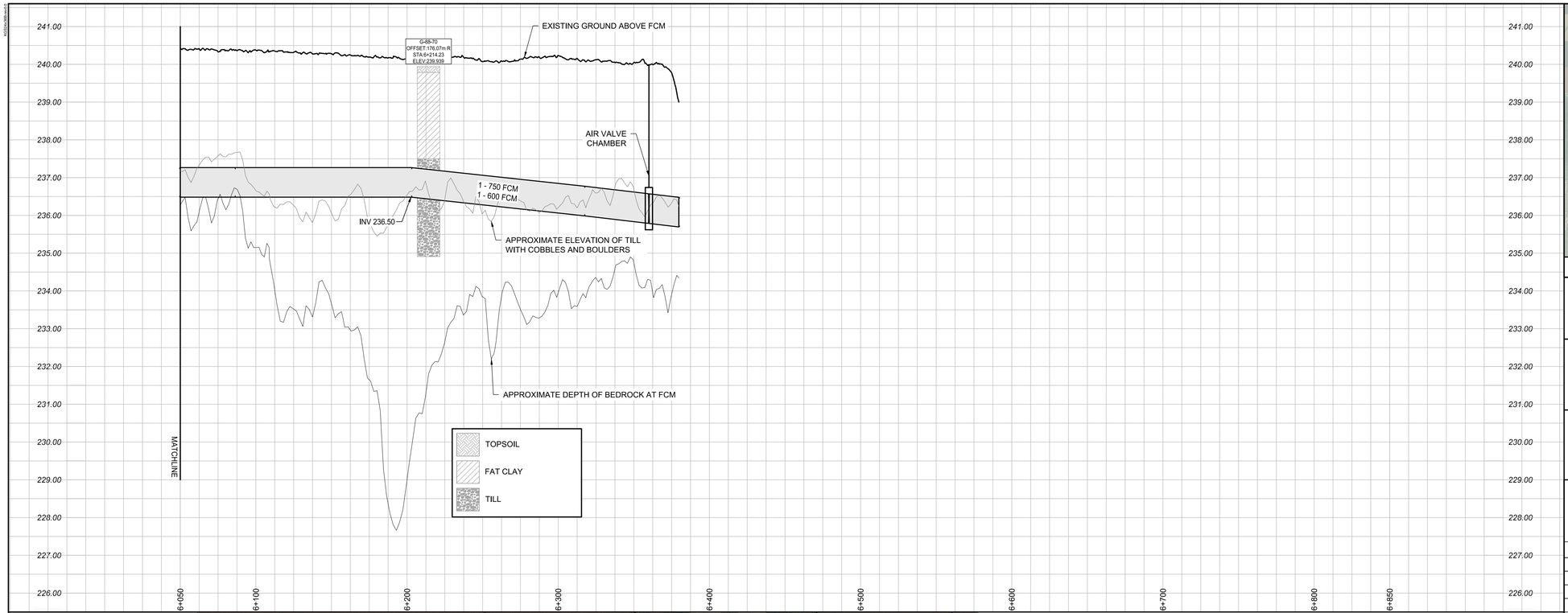
STURGEON ROAD 5+300 - 6+050

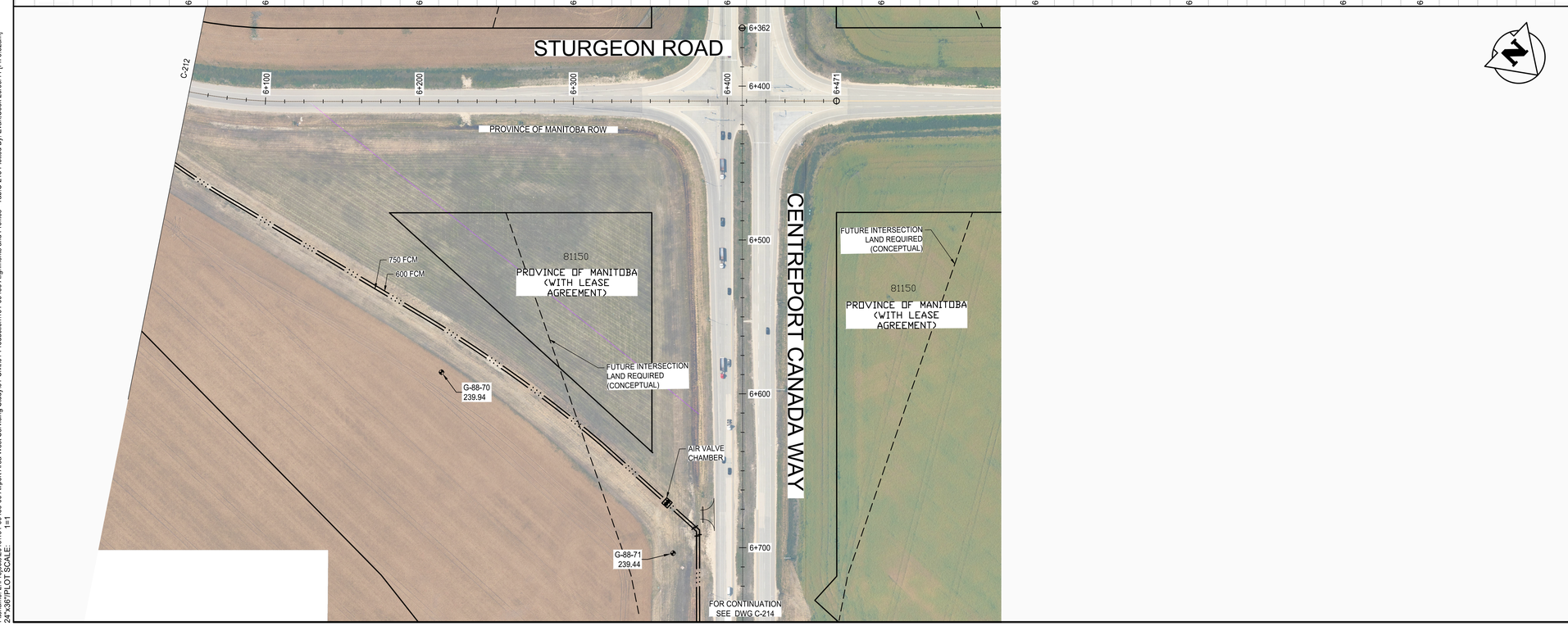
SEAL

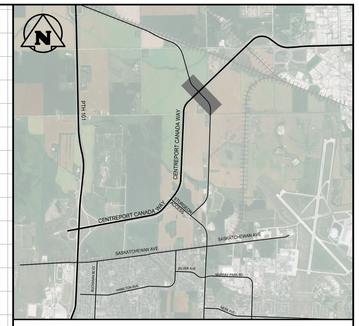
DESIGN BY:	R.S. / B.R.	DATE (YY/MM/DD): 20/02/03
DESIGN CHECK:	B.H.	DATE: 20/02/03
DRAWN BY:	R.S. / B.R.	DATE: 20/02/03
DWG CHECK:	B.H.	DATE: 20/02/03

DWG. NO. 191-09486-00 C-212 REV: C

Filename: L:\Projects\2019\191-09486-00 Airport Area West Servicing Study\01-Civil\01-Production\191-09486 Alignments and Profiles - Tab:C-212 Plotted By: Evan.Cook 20/09/11 [Fri 9:21am]
24"x36"PLOT SCALE: 1=1







KEYPLAN:

PROPERTY LIMITS DELINEATION

DELINEATION OF PROPERTY LIMITS AS SHOWN ON THIS DWG DOES NOT REPRESENT A "LEGAL SURVEY". KGS GROUP MAKES NO REPRESENTATION OR WARRANTY AS TO THE ACCURACY OF PROPERTY LIMITS DELINEATED ON THIS DWG, NOR ON THE DIMENSIONAL ACCURACY OF DWG FEATURES RELATIVE TO THOSE PROPERTY LIMITS.

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NOTES: (MOVE UP IF NO KEYPLAN)
1. NOTE

LEGEND:

EXISTING	LEGEND-PLAN	PROPOSED
300 FDM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
○	MANHOLE	●
◇	HYDRANT	◆
⊗	VALVE	⊗
EXISTING	LEGEND-PROFILE	PROPOSED
300 WM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
	BEDROCK	
	TILL	
	COBBLES	

PRELIMINARY

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
C	20/09/11	PRELIMINARY DESIGN - REVISED	R.S.	B.H.
B	20/06/29	PRELIMINARY DESIGN	R.S.	B.H.
A	20/03/16	60% PRELIMINARY DESIGN	R.S.	B.H.

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing
Preliminary Engineering

DWG. DESCRIPTION:

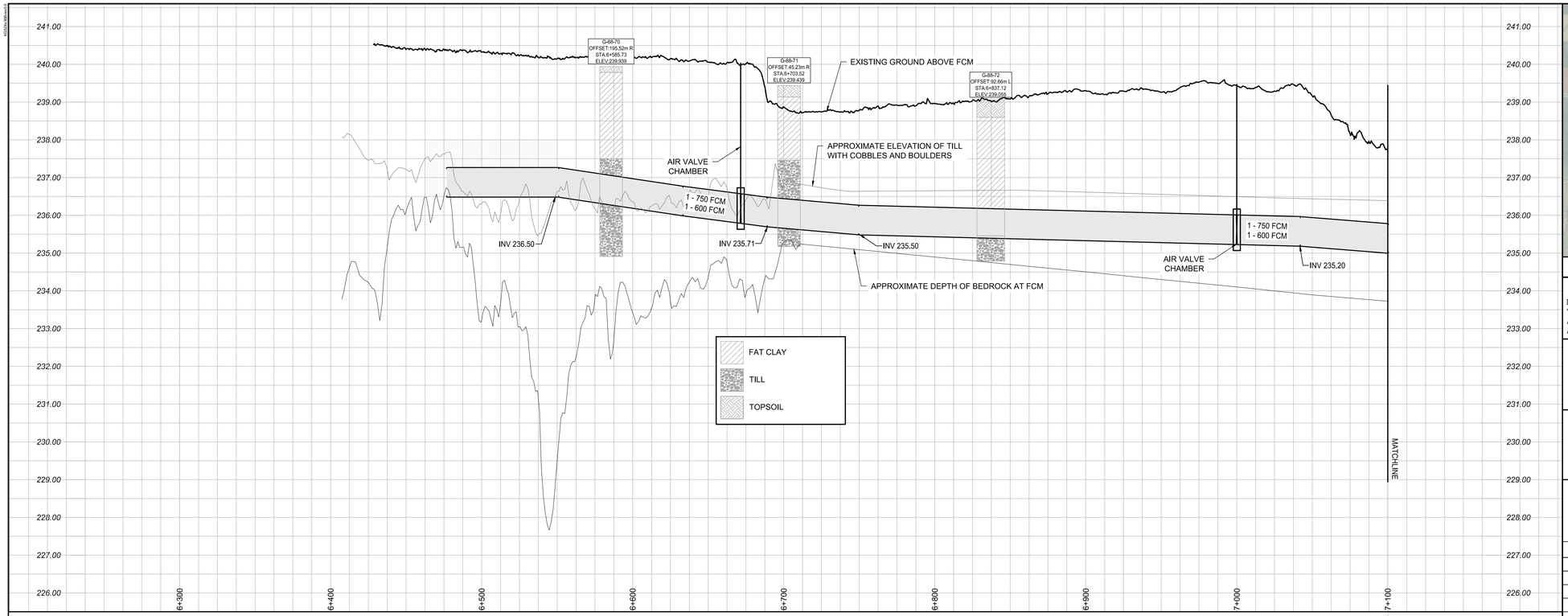
STURGEON ROAD 6+050 - 6+471

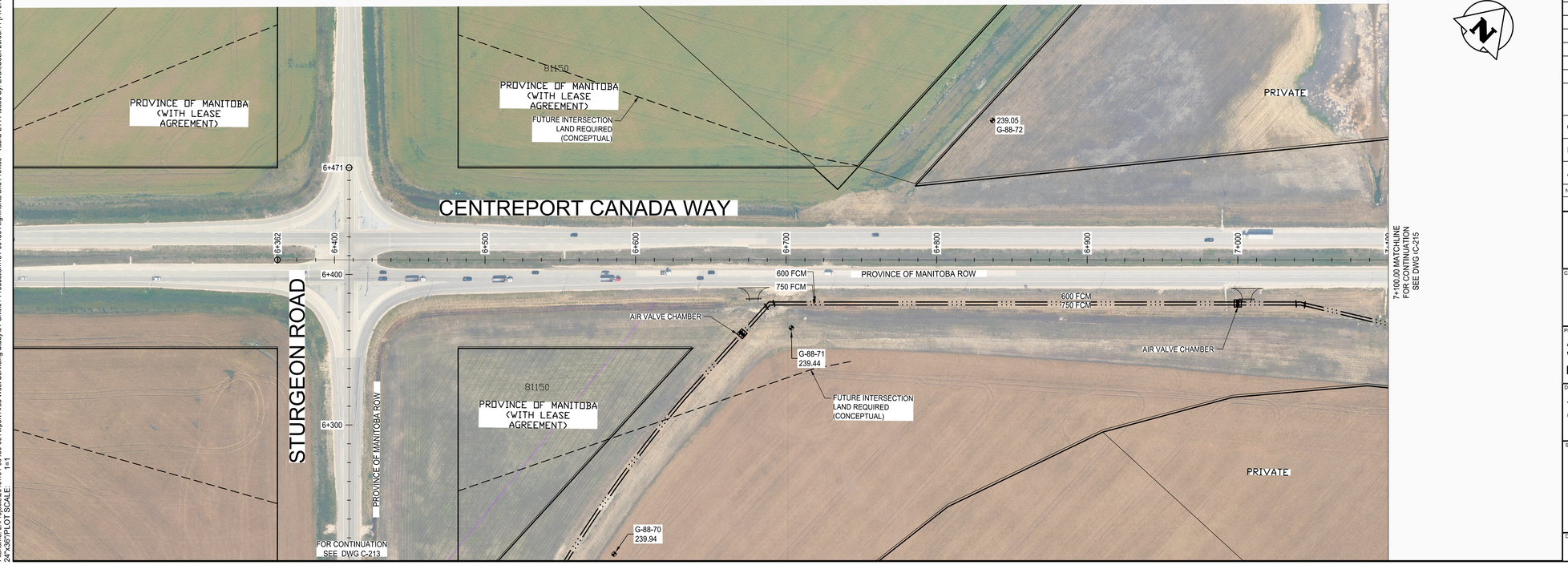
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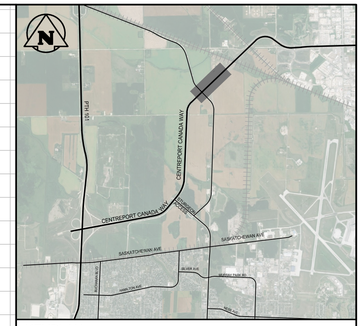
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DWG CHECK:	B.H.	DATE:	20/02/03

DWG. NO. 191-09486-00 C-213 REV: C

Filename: L:\Projects\2019\191-09486-00 Airport Area West Servicing Study\01-Civil\01-Production\191-09486 Alignments and Profiles - Tab:C-213 Plotted By: Evan.Cook 20/09/11 [Fri 9:32am]
24"x36"PLOT SCALE: 1=1







KEYPLAN:

PROPERTY LIMITS DELINEATION

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NOTES: (MOVE UP IF NO KEYPLAN)
1. NOTE

LEGEND:

EXISTING	LEGEND-PLAN	PROPOSED
300 FDM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
○	MANHOLE	●
◇	HYDRANT	◆
⊗	VALVE	⊗
EXISTING	LEGEND-PROFILE	PROPOSED
300 WM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
	BEDROCK	
	TILL	
	COBBLES	

PRELIMINARY

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
C	20/09/11	PRELIMINARY DESIGN - REVISED	R.S.	B.H.
B	20/06/29	PRELIMINARY DESIGN	R.S.	B.H.
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REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing
Preliminary Engineering

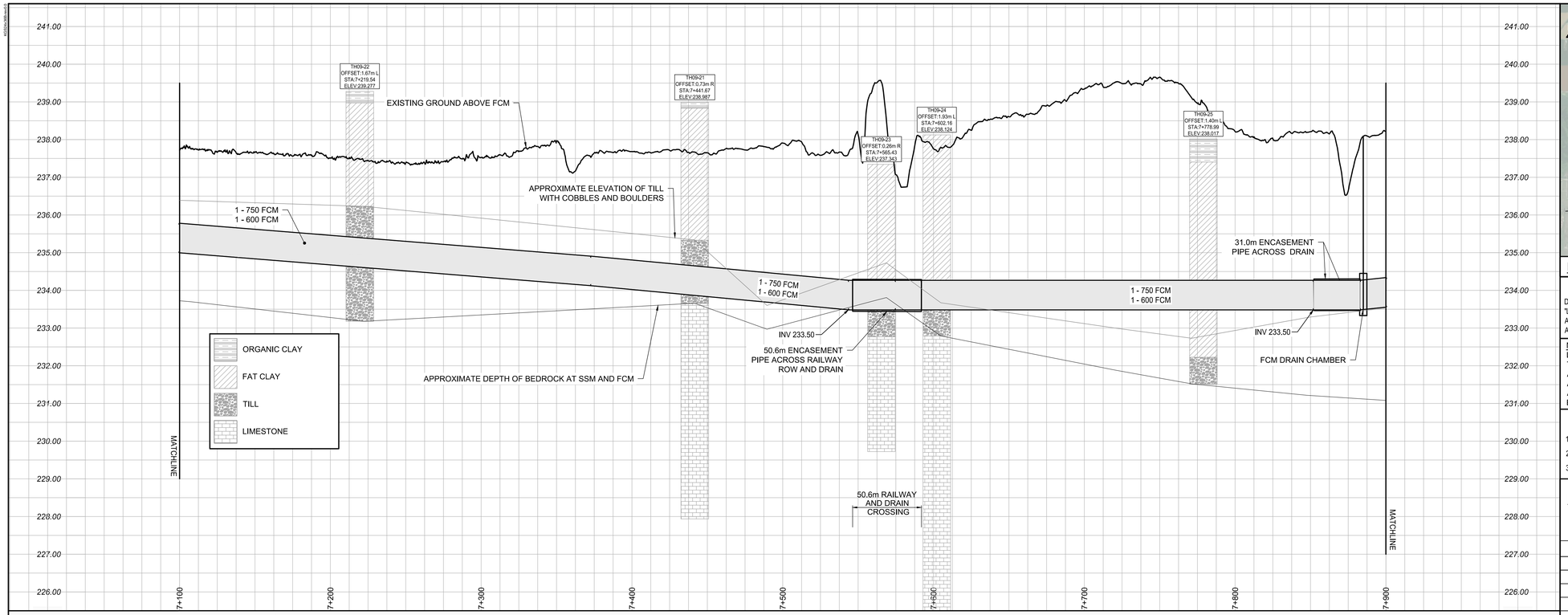
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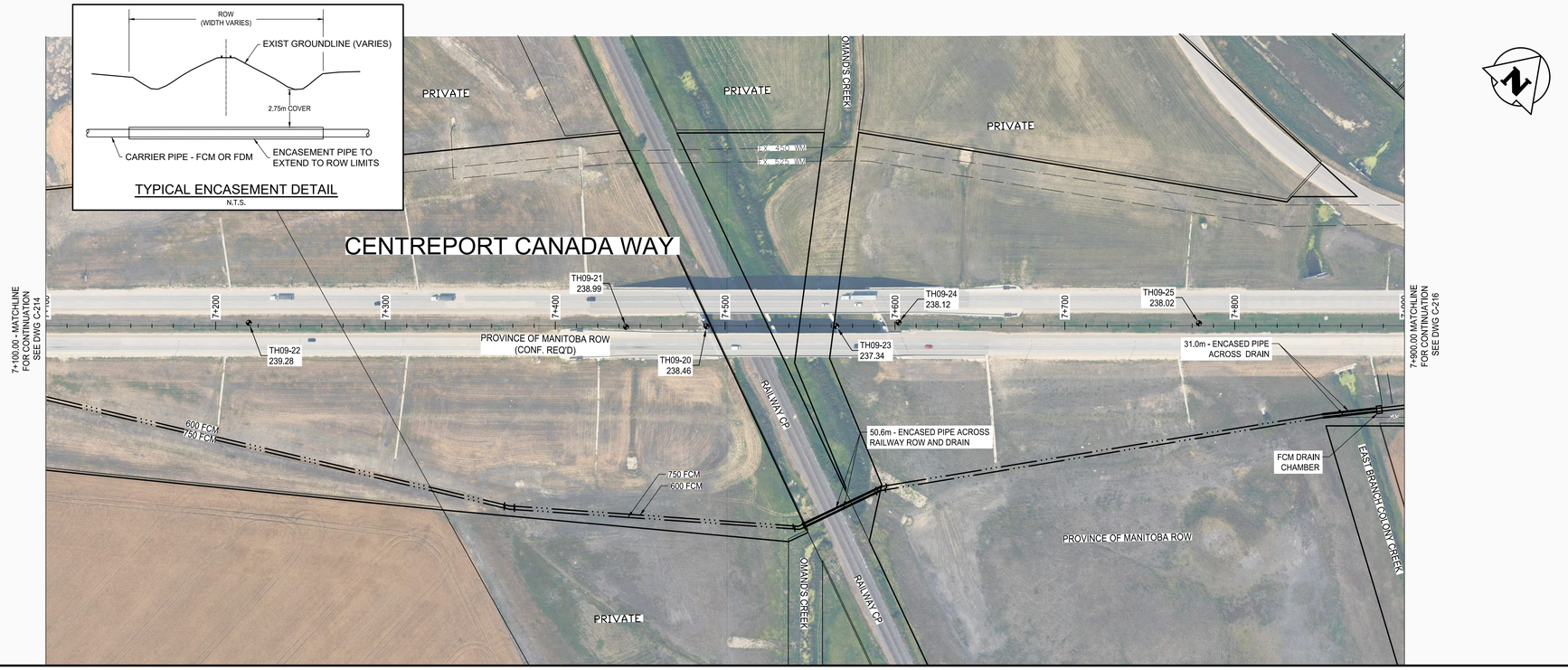
CENTREPORT CANADA WAY 6+362 - 7+100

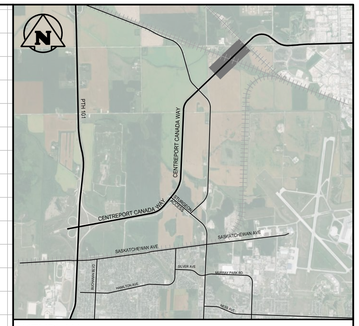
SEAL		
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	DESIGN CHECK: B.H.	DATE: 20/02/03
	DRAWN BY: R.S. / B.R.	DATE: 20/02/03
	DWG CHECK: B.H.	DATE: 20/02/03

DWG. NO. 191-09486-00 C-214 REV: C

Filename: L:\Projects\2019\191-09486-00 Airport Area West Servicing Study\01-Civil\01-Production\191-09486 Alignments and Profiles - Tab:C-214 Plotted By: Evan.Cook 20/09/11 [Fri 9:40am]
24"x36"PLOT SCALE: 1=1







KEYPLAN:

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NOTES: (MOVE UP IF NO KEYPLAN)
1. NOTE

LEGEND:

EXISTING	LEGEND-PLAN	PROPOSED
300 FDM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
○	MANHOLE	●
◇	HYDRANT	◆
⊗	VALVE	⊗
EXISTING	LEGEND-PROFILE	PROPOSED
300 WM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
	BEDROCK	
	TILL	
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PRELIMINARY

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REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

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Airport Area West Regional Water and Wastewater Servicing
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DWG. DESCRIPTION:

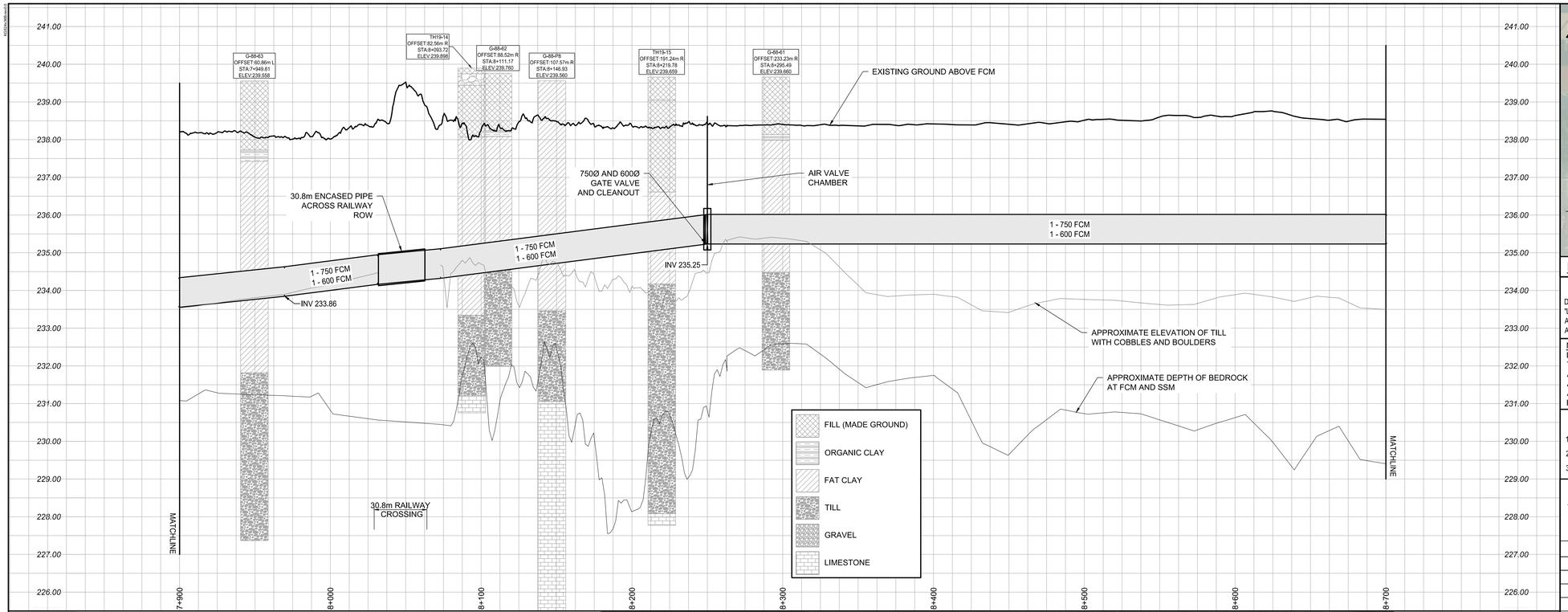
CENTREPORT CANADA WAY 7+100 - 7+900

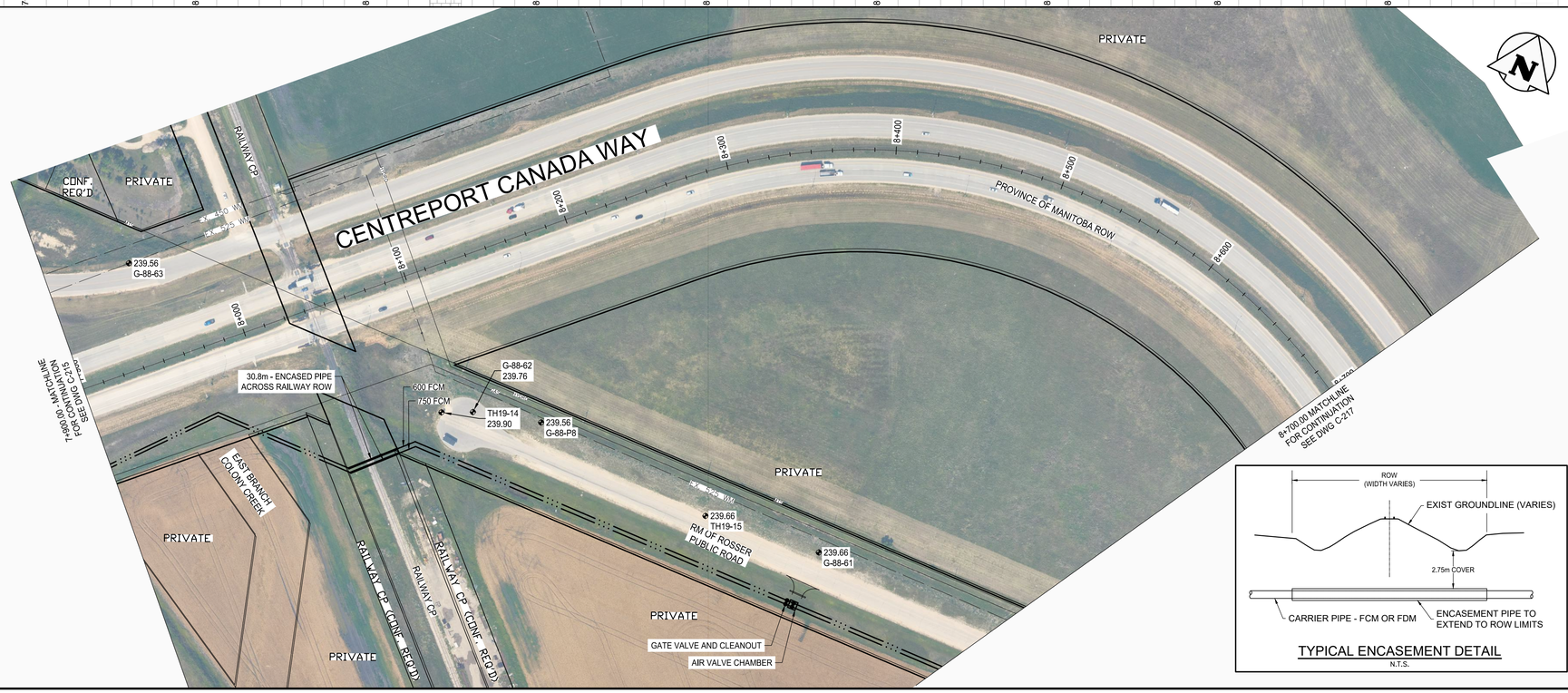
SEAL

DESIGN BY: R.S. / B.R.	DATE (YY/MM/DD): 20/02/03
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DRAWN BY: R.S. / B.R.	DATE: 20/02/03
DWG CHECK: B.H.	DATE: 20/02/03

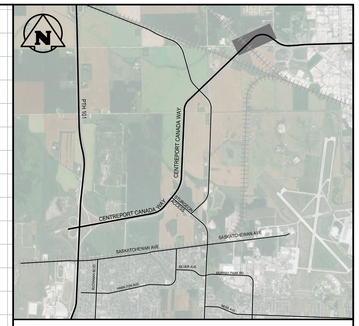
DWG. NO. 191-09486-00 C-215 REV: B

Filename: C:\Users\evan.cook\Desktop\Offline Qualtco Projects\AAW\01-Civil\01-Production\191-09486 Alignments and Profiles - Tab:C-215 Plotted By: Evan.Cook 2007/02 [Thu 5:19pm]
24"x36"PLOT SCALE: 1=1





TYPICAL ENCASEMENT DETAIL
N.T.S.



KEYPLAN:

PROPERTY LIMITS DELINEATION

DELINEATION OF PROPERTY LIMITS AS SHOWN ON THIS DWG DOES NOT REPRESENT A "LEGAL SURVEY". KGS GROUP MAKES NO REPRESENTATION OR WARRANTY AS TO THE ACCURACY OF PROPERTY LIMITS DELINEATED ON THIS DWG, NOR ON THE DIMENSIONAL ACCURACY OF DWG FEATURES RELATIVE TO THOSE PROPERTY LIMITS.

NOTE:
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WARNING

1. NOTIFY THE GAS COMPANY OF THE PROPOSED LOCATION OF EXCAVATION.
2. TAKE PRECAUTION TO AVOID DAMAGE TO GAS COMPANY INSTALLATIONS.
3. SEE PROVINCIAL REGULATION 210/72 FOR DETAILS.

NOTES: (MOVE UP IF NO KEYPLAN)
1. NOTE

LEGEND:

EXISTING	LEGEND-PLAN	PROPOSED
300 FDM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
○	MANHOLE	●
◇	HYDRANT	◆
⊗	VALVE	⊗
EXISTING	LEGEND-PROFILE	PROPOSED
300 WM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
	BEDROCK	
	TILL	
	COBBLES	

PRELIMINARY

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/29	PRELIMINARY DESIGN	R.S.	B.H.
A	20/03/16	60% PRELIMINARY DESIGN	R.S.	B.H.

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing
Preliminary Engineering

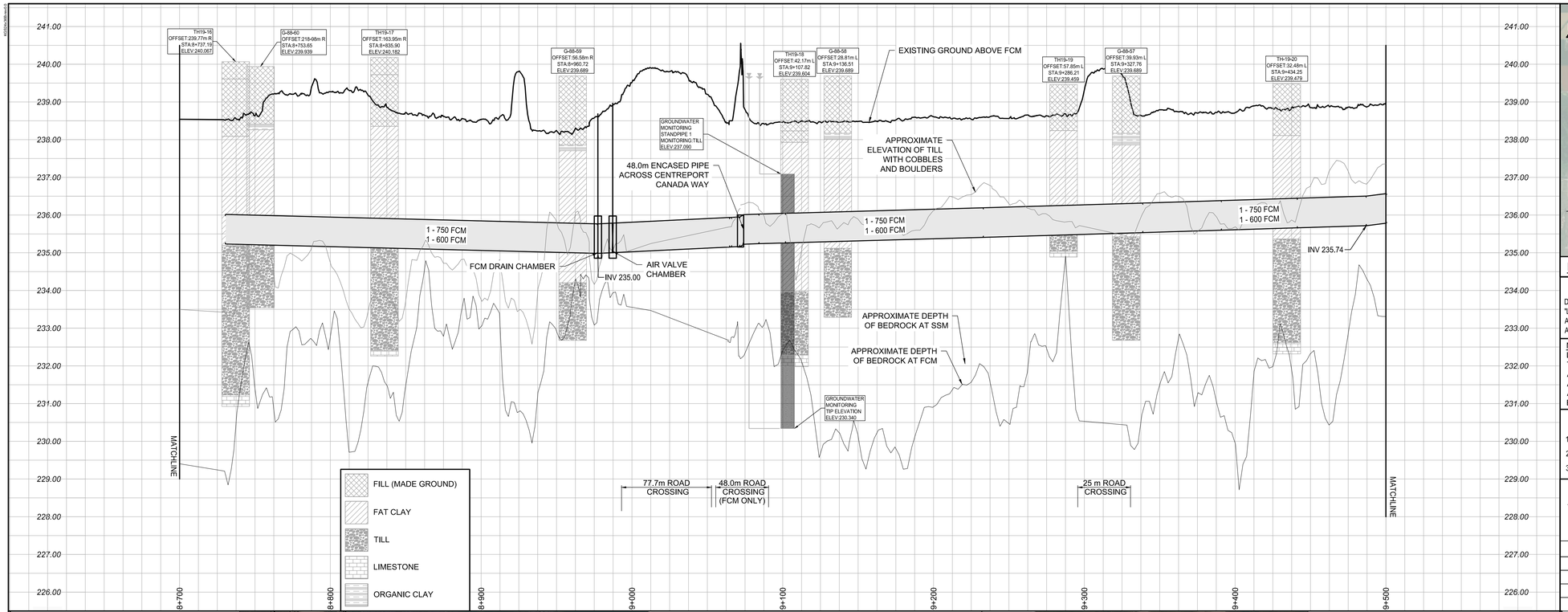
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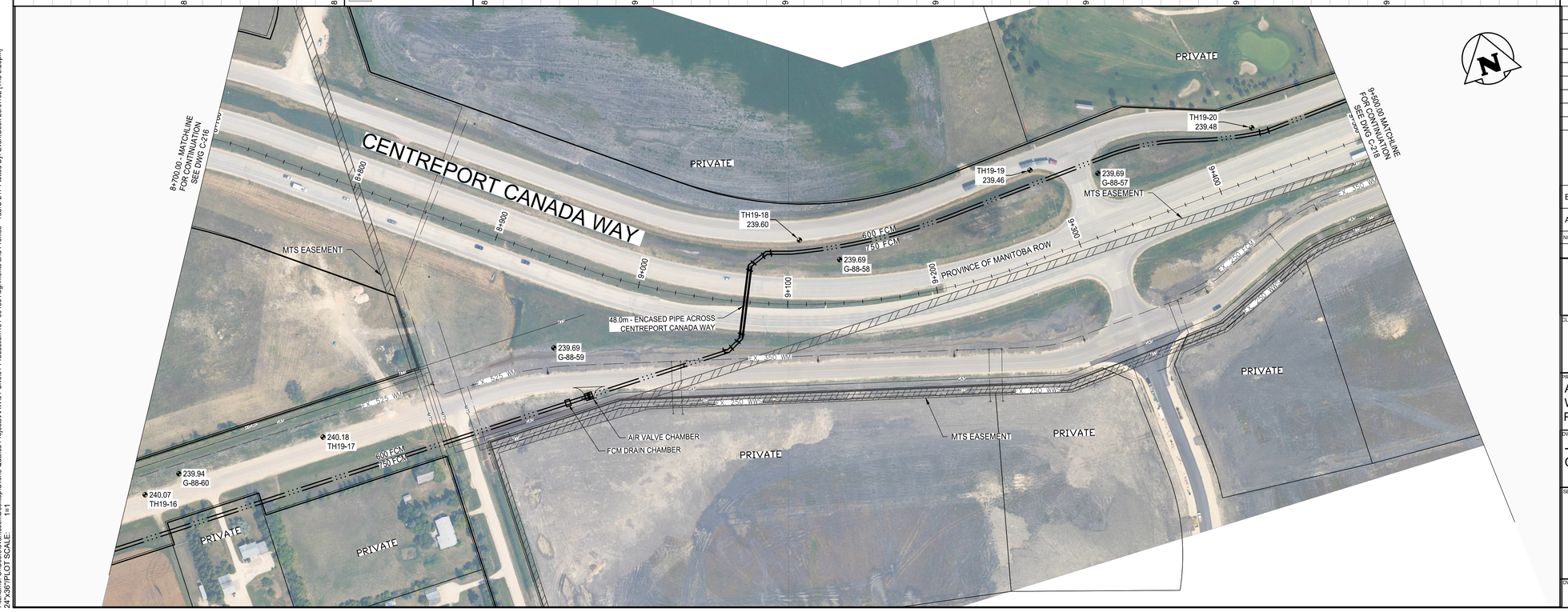
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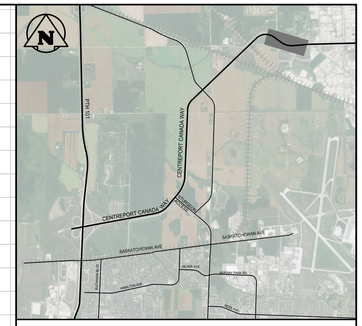
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	DESIGN BY: R.S. / B.R.	DATE (YY/MM/DD): 20/02/03
	DESIGN CHECK: B.H.	DATE: 20/02/03
	DRAWN BY: R.S. / B.R.	DATE: 20/02/03
	DWG CHECK: B.H.	DATE: 20/02/03

DWG. NO. 191-09486-00 C-216 REV: B

Filename: C:\Users\evan.cook\Desktop\Offline Qualtco Projects\AAW\01-Civil\01-Production\191-09486 Alignments and Profiles - Tab:C-216 Plotted By: Evan.Cook 2020/7/02 [Thu 5:23pm]
24"x36"PLOT SCALE: 1=1







KEYPLAN:

PROPERTY LIMITS DELINEATION

DELINEATION OF PROPERTY LIMITS AS SHOWN ON THIS DWG DOES NOT REPRESENT A "LEGAL SURVEY". KGS GROUP MAKES NO REPRESENTATION OR WARRANTY AS TO THE ACCURACY OF PROPERTY LIMITS DELINEATED ON THIS DWG, NOR ON THE DIMENSIONAL ACCURACY OF DWG FEATURES RELATIVE TO THOSE PROPERTY LIMITS.

NOTE:
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WARNING

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3. SEE PROVINCIAL REGULATION 210/72 FOR DETAILS.

NOTES: (MOVE UP IF NO KEYPLAN)
1. NOTE

LEGEND:

EXISTING	LEGEND-PLAN	PROPOSED
300 FDM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
○	MANHOLE	●
◇	HYDRANT	◆
⊗	VALVE	⊗
EXISTING	LEGEND-PROFILE	PROPOSED
300 WM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
	BEDROCK	
	TILL	
	COBBLES	

PRELIMINARY

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/29	PRELIMINARY DESIGN	R.S.	B.H.
A	20/03/16	60% PRELIMINARY DESIGN	R.S.	B.H.

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing
Preliminary Engineering

DWG. DESCRIPTION:

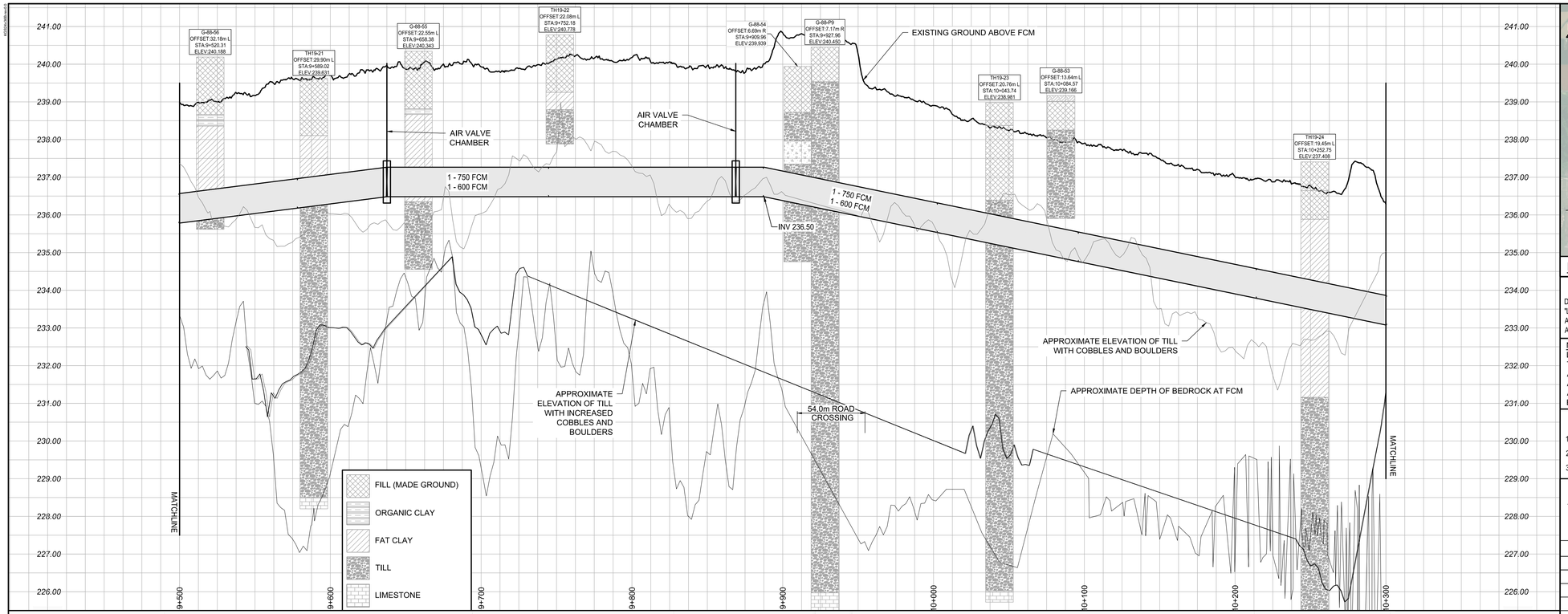
CENTREPORT CANADA WAY 8+700 - 9+500

SEAL

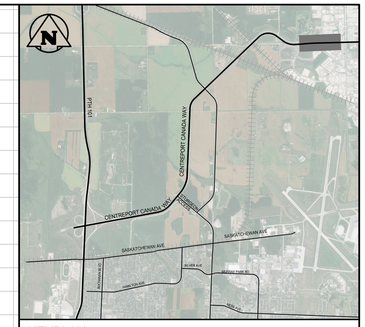
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DESIGN CHECK: B.H.	DATE: 20/02/03
DRAWN BY: R.S. / B.R.	DATE: 20/02/03
DWG CHECK: B.H.	DATE: 20/02/03

DWG. NO. 191-09486-00 C-217 REV: B

Filename: C:\Users\evan.cook\Desktop\Offline Qualtco Projects\AAW\01-Civil\01-Production\191-09486 Alignments and Profiles - Tab:C-217 Plotted By: Evan.Cook 2020/7/02 [Thu 5:28pm]
24"x36"PLOT SCALE: 1=1







KEYPLAN:

PROPERTY LIMITS DELINEATION

DELINEATION OF PROPERTY LIMITS AS SHOWN ON THIS DWG DOES NOT REPRESENT A "LEGAL SURVEY". KGS GROUP MAKES NO REPRESENTATION OR WARRANTY AS TO THE ACCURACY OF PROPERTY LIMITS DELINEATED ON THIS DWG, NOR ON THE DIMENSIONAL ACCURACY OF DWG FEATURES RELATIVE TO THOSE PROPERTY LIMITS.

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3. SEE PROVINCIAL REGULATION 210/72 FOR DETAILS.

NOTES: (MOVE UP IF NO KEYPLAN)
1. NOTE

LEGEND:

EXISTING	LEGEND-PLAN	PROPOSED
300 FDM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
○	MANHOLE	●
◇	HYDRANT	◆
⊗	VALVE	⊗
EXISTING	LEGEND-PROFILE	PROPOSED
300 WM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
	BEDROCK	
	TILL	
	COBBLES	

PRELIMINARY

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
C	20/09/11	PRELIMINARY DESIGN - REVISED	R.S.	B.H.
B	20/06/29	PRELIMINARY DESIGN	R.S.	B.H.
A	20/03/16	60% PRELIMINARY DESIGN	R.S.	B.H.

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing
Preliminary Engineering

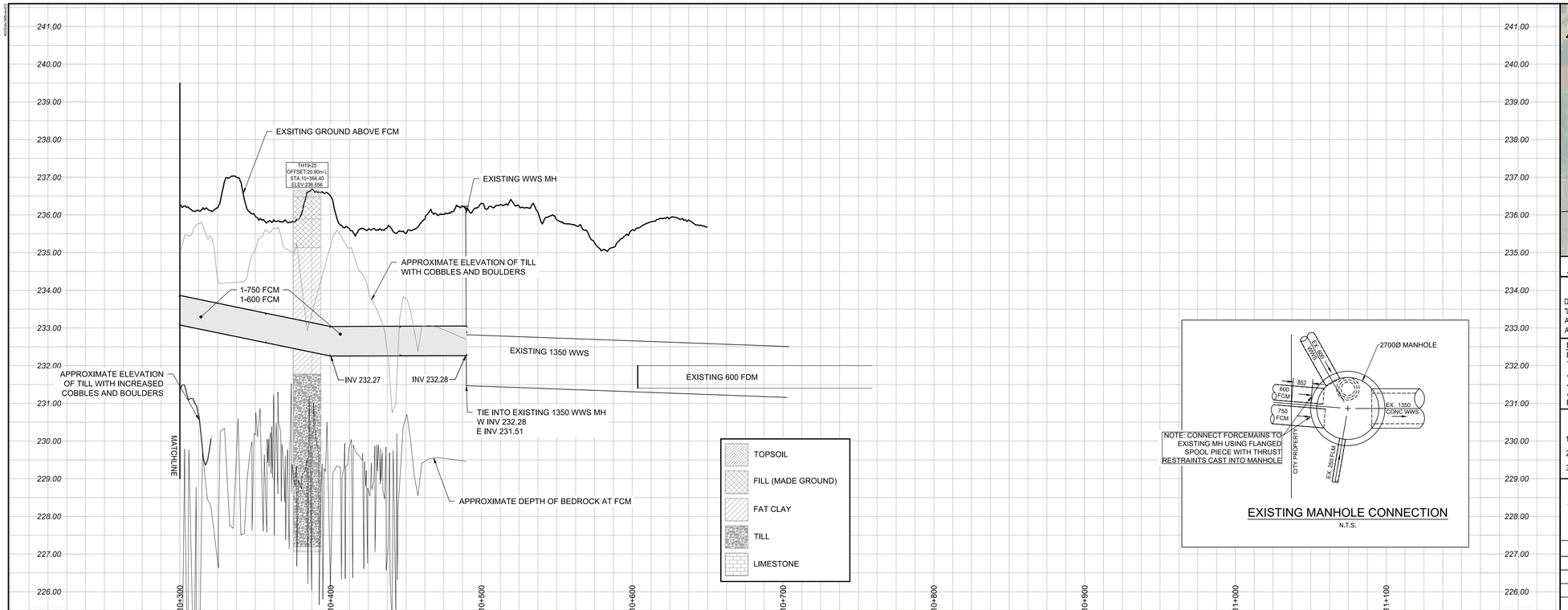
DWG. DESCRIPTION:

INKSTER BOULEVARD 9+500 - 10+300

SEAL		
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	DESIGN CHECK: B.H.	DATE: 20/02/03
	DRAWN BY: R.S. / B.R.	DATE: 20/02/03
	DWG CHECK: B.H.	DATE: 20/02/03

DWG. NO. 191-09486-00 C-218 REV: C

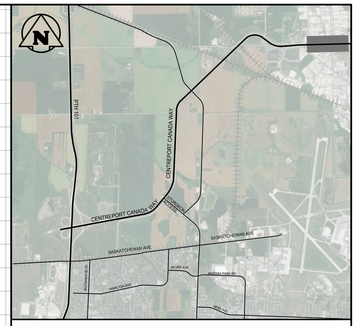
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24"x36"PLOT SCALE: 1=1



EXISTING MANHOLE CONNECTION

N.T.S.





KEYPLAN:

PROPERTY LIMITS DELINEATION

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3. SEE PROVINCIAL REGULATION 210/72 FOR DETAILS.

NOTES: (MOVE UP IF NO KEYPLAN)

1. NOTE

LEGEND:

EXISTING	LEGEND-PLAN	PROPOSED
300 FDM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
○	MANHOLE	●
◇	HYDRANT	◆
⊗	VALVE	⊗
EXISTING	LEGEND-PROFILE	PROPOSED
300 WM	FEEDER MAIN	750 FDM
600 FCM	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
	BEDROCK	
	TILL	
	COBBLES	

PRELIMINARY

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/29	PRELIMINARY DESIGN	R.S.	B.H.
A	20/03/16	60% PRELIMINARY DESIGN	R.S.	B.H.

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing
Preliminary Engineering

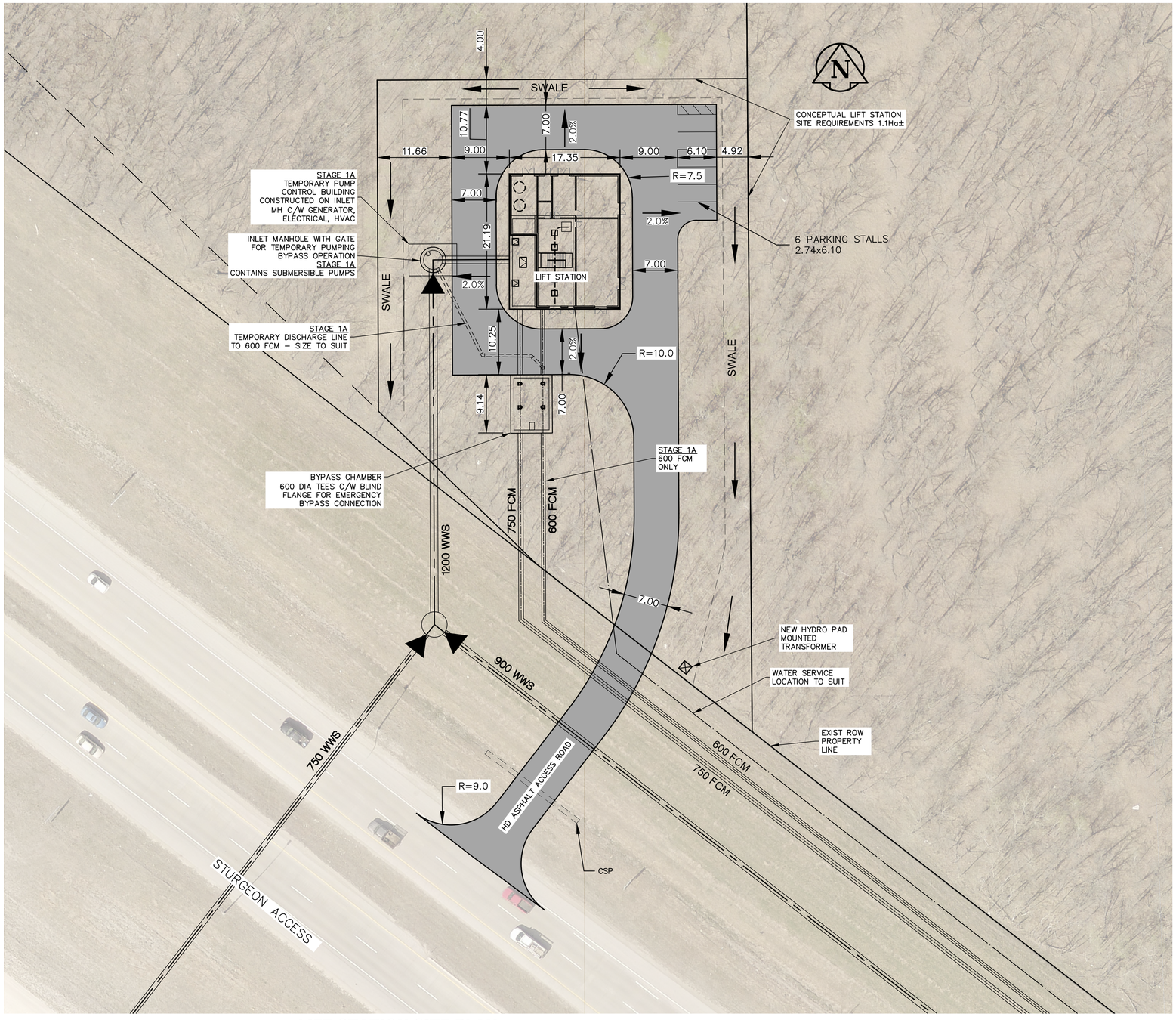
DWG. DESCRIPTION:

INKSTER BOULEVARD 10+300 - 10+548

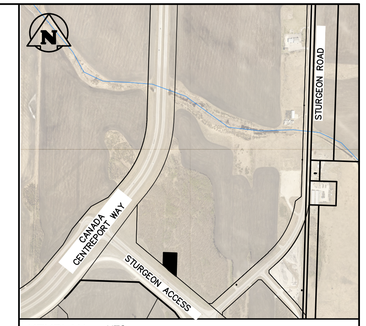
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	DRAWN BY: R.S. / B.R.	DATE: 20/02/03
	DWG CHECK: B.H.	DATE: 20/02/03

DWG. NO. 191-09486-00 C-219 REV: B

Filename: C:\Users\evan.cook\Desktop\Offline Qualico Projects\AAW\01-Civil\01-Production\191-09486 Alignments and Profiles - Tab:C-219 Plotted By: Evan.Cook 20/07/02 [Thu 5:36pm]
24"x36" PLOT SCALE: 1=1



LIFT STATION SITE PLAN



KEYPLAN: NTS

PROPERTY LIMITS DELINEATION

DELINEATION OF PROPERTY LIMITS AS SHOWN ON THIS DWG DOES NOT REPRESENT A "LEGAL SURVEY". KGS GROUP MAKES NO REPRESENTATION OR WARRANTY AS TO THE ACCURACY OF PROPERTY LIMITS DELINEATED ON THIS DWG, NOR ON THE DIMENSIONAL ACCURACY OF DWG FEATURES RELATIVE TO THOSE PROPERTY LIMITS.

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WARNING

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3. SEE PROVINCIAL REGULATION 210/72 FOR DETAILS.

NOTES: (MOVE UP IF NO KEYPLAN)
1. NOTE

LEGEND:

EXISTING	LEGEND-PLAN	PROPOSED
300 WM	WATER MAIN	300 WM
	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
○	MANHOLE	●

EXISTING	LEGEND-PROFILE	PROPOSED
300 WM	WATER MAIN	300 WM
	FORCE MAIN	600 FCM
525 WWS	WASTE WATER SEWER	525 WWS
	BEDROCK	
	TILL	
	NORTH/EAST DITCH	
	SOUTH/WEST DITCH	

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
C	20/09/11	PRELIMINARY DESIGN - REVISED	I.G.	S.K.
B	20/06/29	PRELIMINARY DESIGN	I.G.	S.K.
A	20/05/29	60% CONCEPTUAL	I.G.	S.K.

REVISIONS / ISSUE

KGS GROUP | wsp

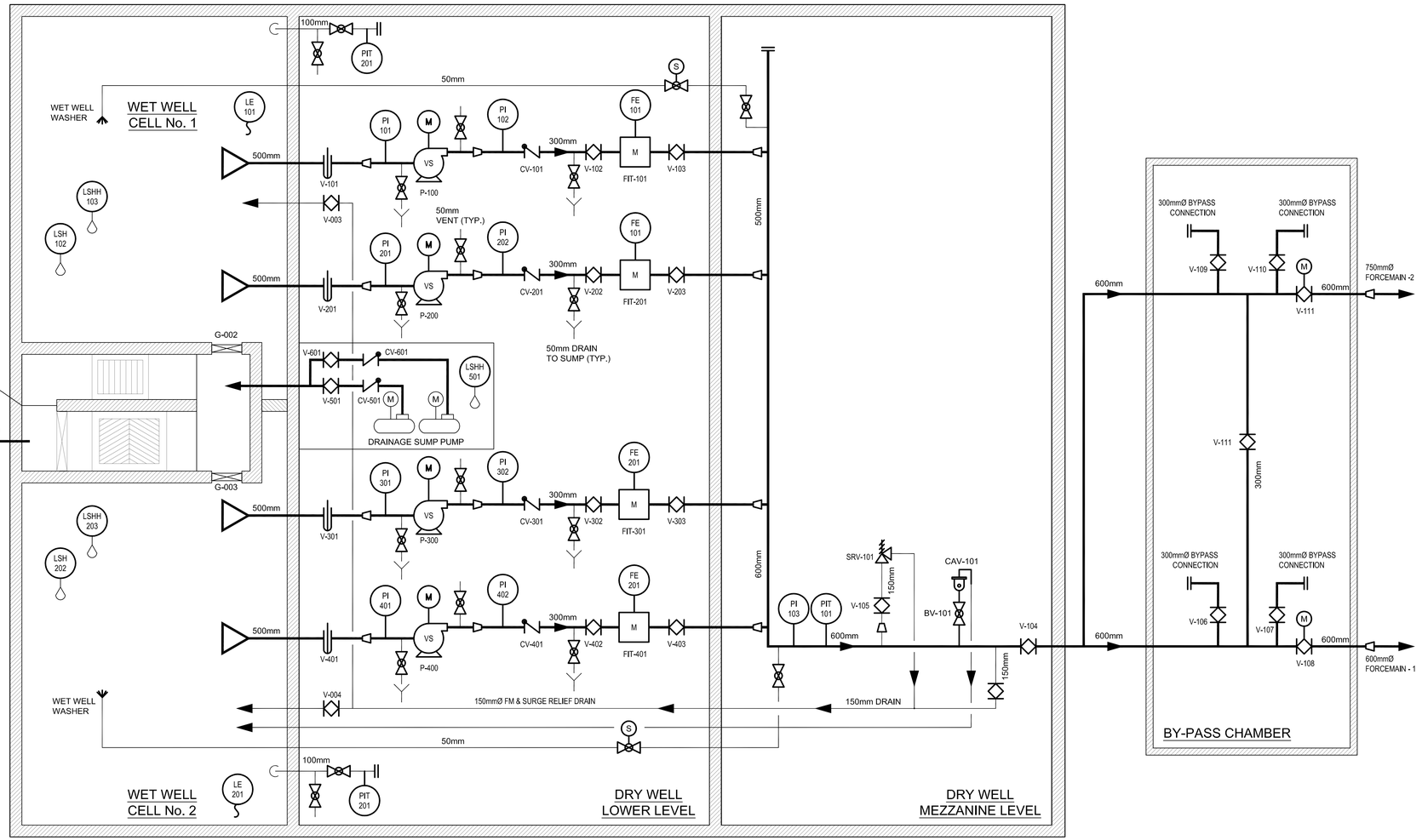
CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing
Preliminary Engineering

DWG. DESCRIPTION:
LIFT STATION - SITE PLAN

SEAL	DESIGN BY:	DATE (YY/MM/DD):
	I.G.	20/05/29
	DESIGN CHECK: S.K.	DATE: 20/05/29
	DRAWN BY: C.S.	DATE: 20/05/29
	DWG CHECK: I.G.	DATE: 20/05/29

DWG. NO. 191-09486-00 LS-100 REV: B





NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/30	PRELIMINARY DESIGN	I.G.	S.K.
A	20/05/29	ISSUED FOR REVIEW	I.G.	S.K.

REVISIONS / ISSUE

KGS GROUP

wsp

CLIENT:

Winnipeg

PROJECT:

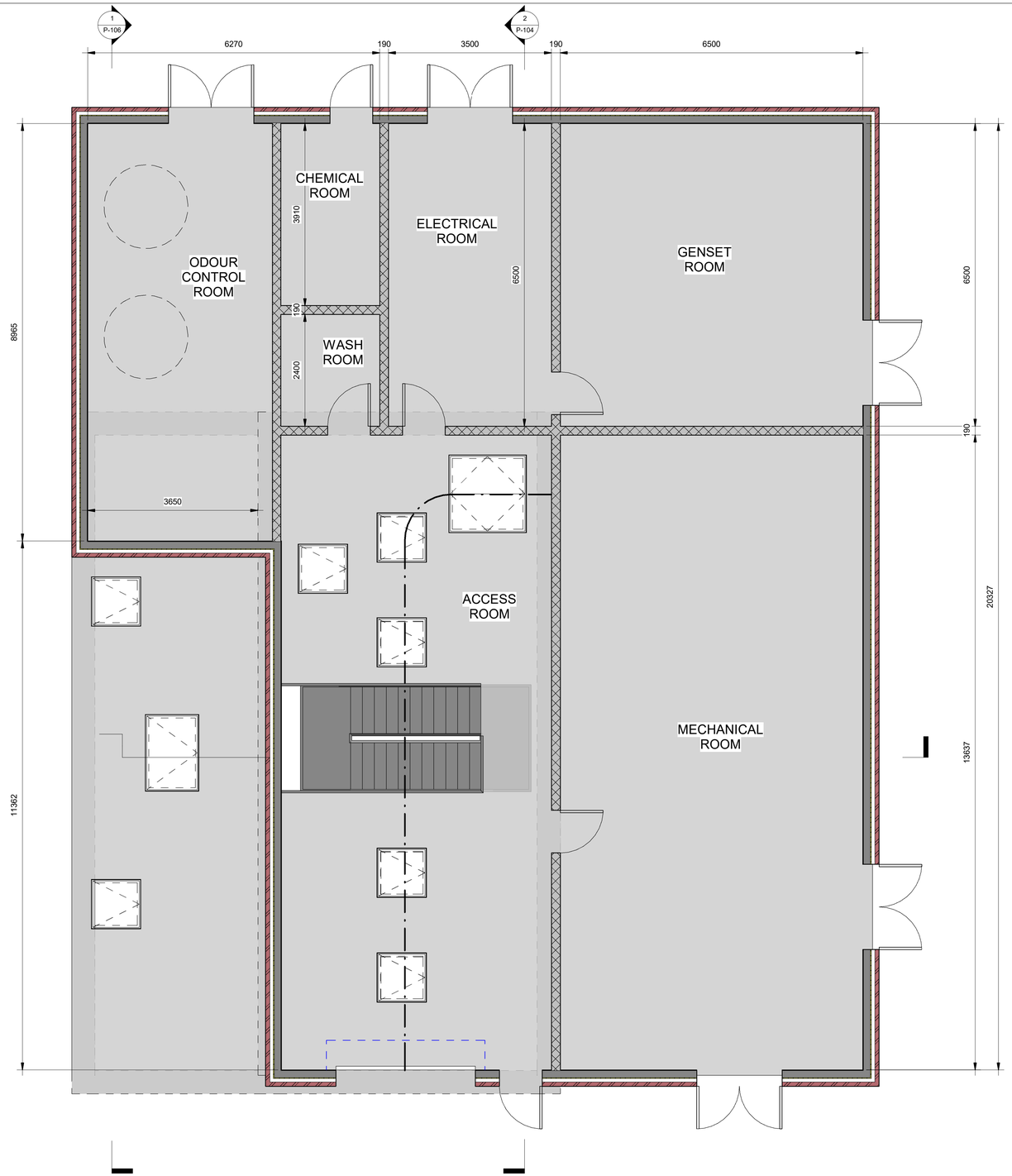
Airport Area West Regional Water and Wastewater Servicing
Preliminary Engineering

DWG. DESCRIPTION:

LIFT STATION
PROCESS FLOW SCHEMATIC

SEAL		
	DESIGN BY: I.G.	DATE (YY/MM/DD): 20/05/05
	DESIGN CHECK: S.K.	DATE: 20/05/05
	DRAWN BY: C.S.	DATE: 20/05/05
	DWG CHECK: I.G.	DATE: 20/05/05

DWG. NO. 191-09486-00 P-100 REV: B



MAIN FLOOR PLAN

1 : 50



NO.	YY/MM/DD	REVISION	DESIGN BY:	DESIGN CHECK:
B	20/06/30	PRELIMINARY DESIGN	I.G.	S.K.
A	20/05/29	ISSUED FOR REVIEW	I.G.	S.K.

REVISIONS / ISSUE

KGS GROUP

wsp

CLIENT:

Winnipeg

PROJECT:

Airport Area West Regional Water and Wastewater Servicing Preliminary Engineering

DWG. DESCRIPTION:

MAIN FLOOR PLAN

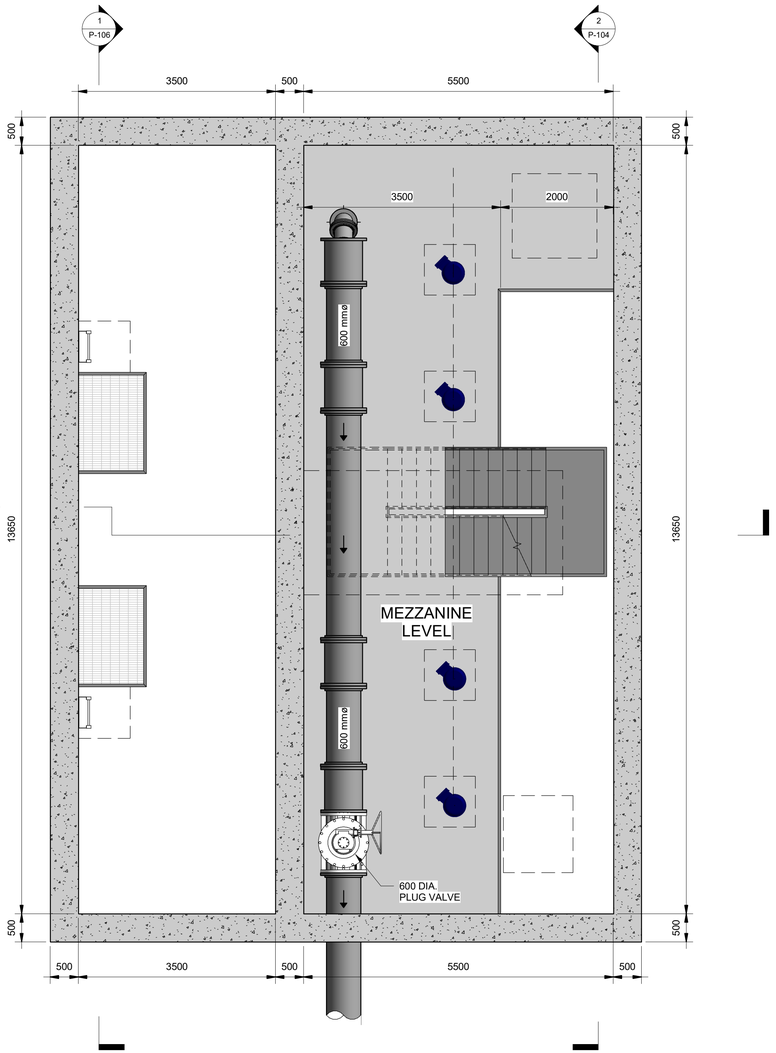
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	DESIGN CHECK: S.K.	DATE: 20/05/29
	DRAWN BY: C.S	DATE: 20/05/29
	DWG CHECK: I.G.	DATE: 20/05/29

DWG. NO. 191-09486-00 P-101

REV: B

Project Status

Filename:
24"x36"PLOT SCALE:



MEZZANINE FLOOR PLAN

1 : 50



NO.	YY/MM/DD	DESCRIPTION	ORIGINATED BY	REVIEWED CHECK
B	20/06/30	PRELIMINARY DESIGN	I.G.	S.K.
A	20/05/29	ISSUED FOR REVIEW	I.G.	S.K.

REVISIONS / ISSUE

KGS GROUP

wsp

CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing
Preliminary Engineering

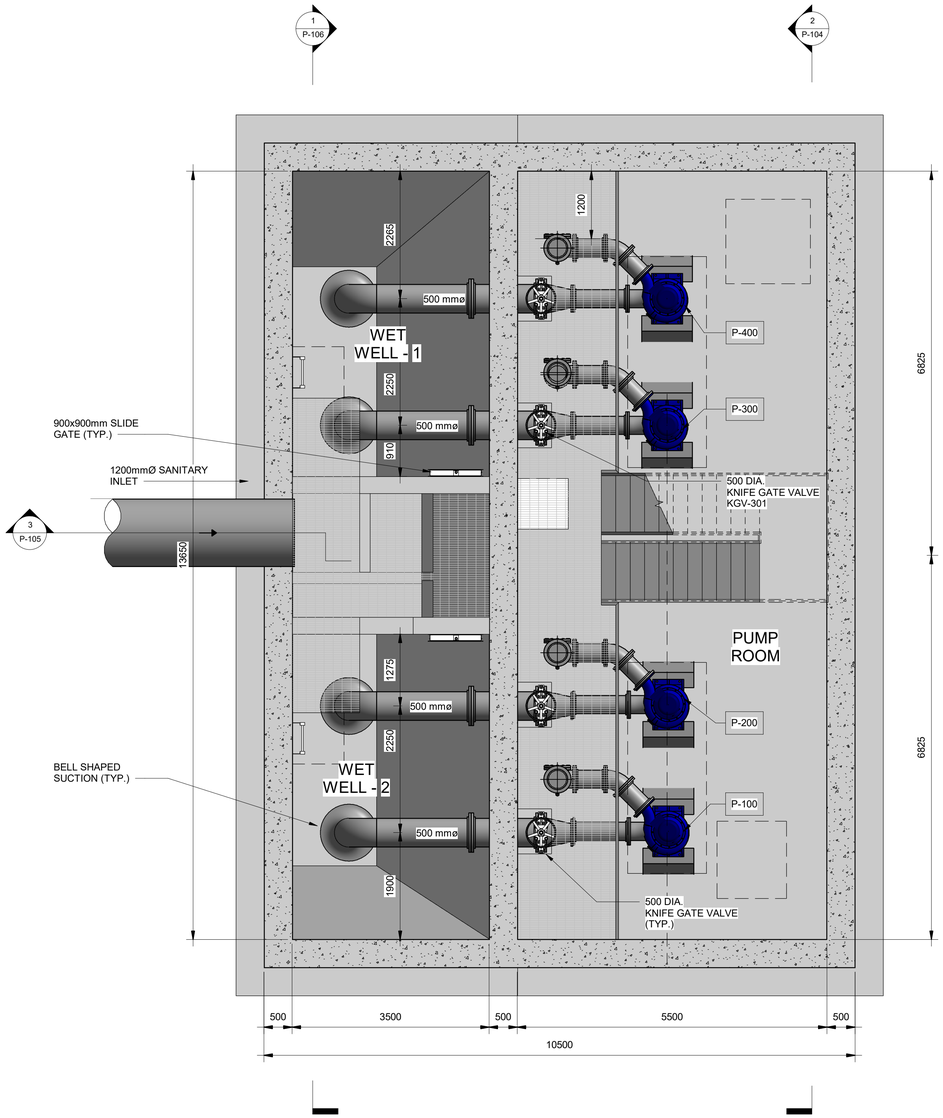
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MEZZANINE FLOOR PLAN

SEAL		
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	DESIGN CHECK: S.K.	DATE: 20/05/29
	DRAWN BY: C.S	DATE: 20/05/29
	DWG CHECK: I.G.	DATE: 20/05/29

DWG. NO. 191-09486-00 P-102 REV: B

Project Status

Filename:
24"X36"PLOT SCALE:



LOWER FLOOR PLAN

1 : 50



NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/30	PRELIMINARY DESIGN	I.G.	S.K.
A	20/05/29	ISSUED FOR REVIEW	I.G.	S.K.

REVISIONS / ISSUE

KGS GROUP

wsp

CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing Preliminary Engineering

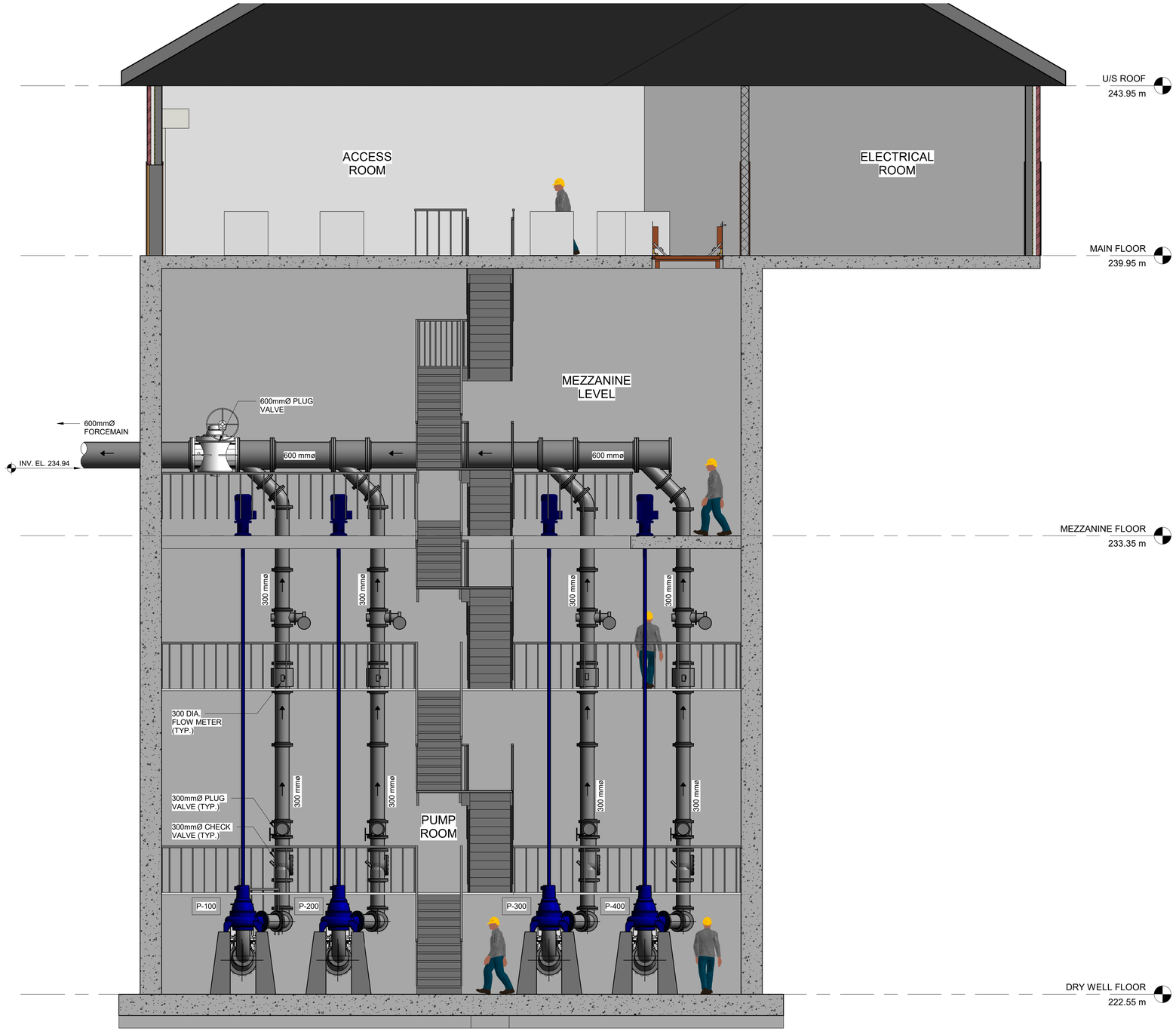
DWG. DESCRIPTION:
LOWER FLOOR PLAN

SEAL		
	DESIGN BY: I.G.	DATE (YY/MM/DD):
	DESIGN CHECK: S.K.	DATE: 20/05/29
	DRAWN BY: C.S	DATE: 20/05/29
	DWG CHECK: I.G.	DATE: 20/05/29

DWG. NO. 191-09486-00 P-103 REV: B

Project Status

Filename:
24"x36"PLOT SCALE:



2 P-101 SECTION

1 : 50



NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/30	PRELIMINARY DESIGN	I.G.	S.K.
A	20/05/29	ISSUED FOR REVIEW	I.G.	S.K.

REVISIONS / ISSUE

KGS GROUP

wsp

CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing Preliminary Engineering

DWG. DESCRIPTION:

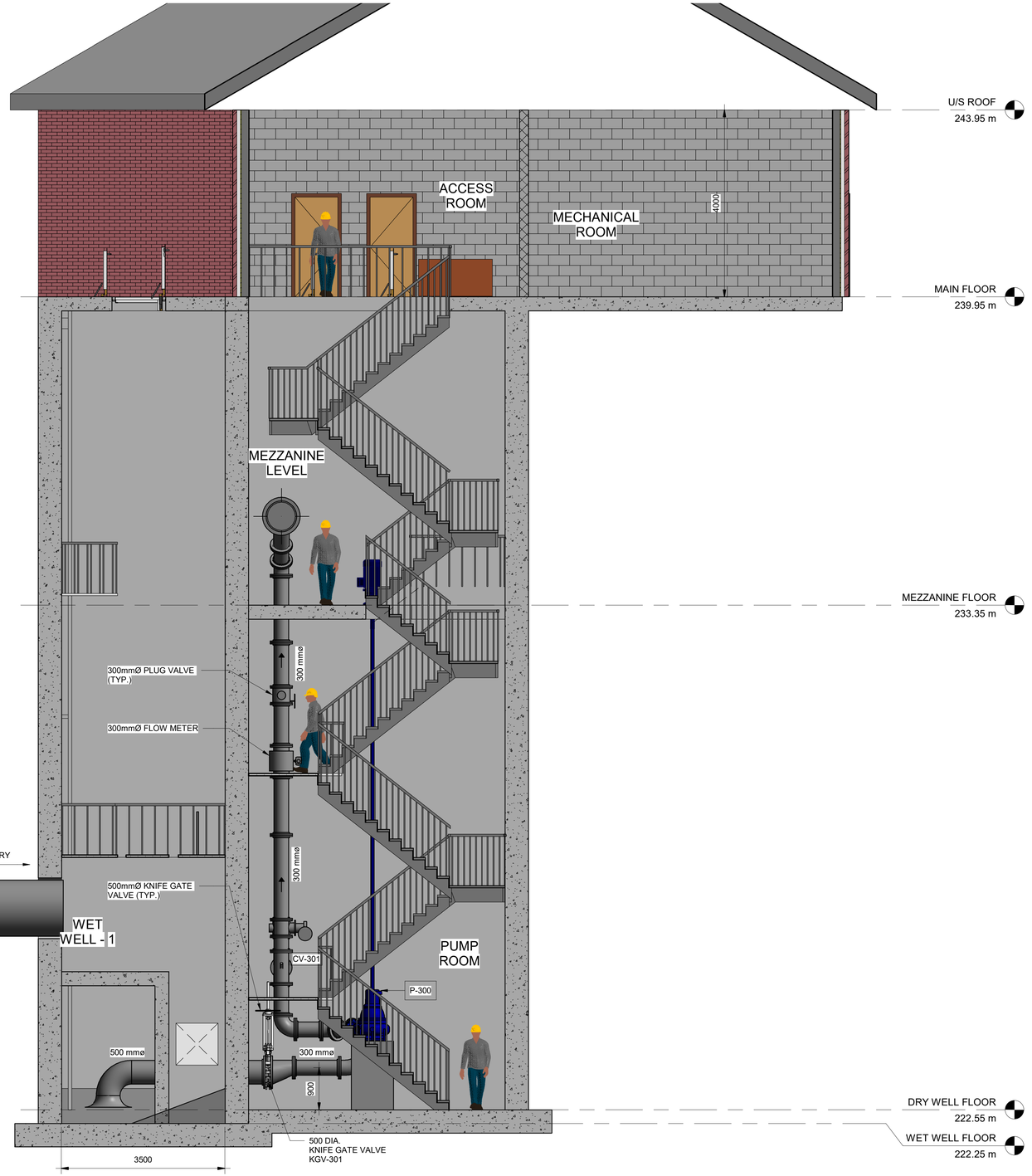
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	DESIGN CHECK: S.K.	DATE: 20/05/29
	DRAWN BY: C.S	DATE: 20/05/29
	DWG CHECK: I.G.	DATE: 20/05/29

DWG. NO. 191-09486-00 P-104 REV: B

Project Status

Filename:
24"x36"PLOT SCALE:



3 SECTION
1 : 50



NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
B	20/06/30	PRELIMINARY DESIGN	I.G.	S.K.
A	20/05/29	ISSUED FOR REVIEW	I.G.	S.K.

REVISIONS / ISSUE

KGS GROUP

wsp

CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing Preliminary Engineering

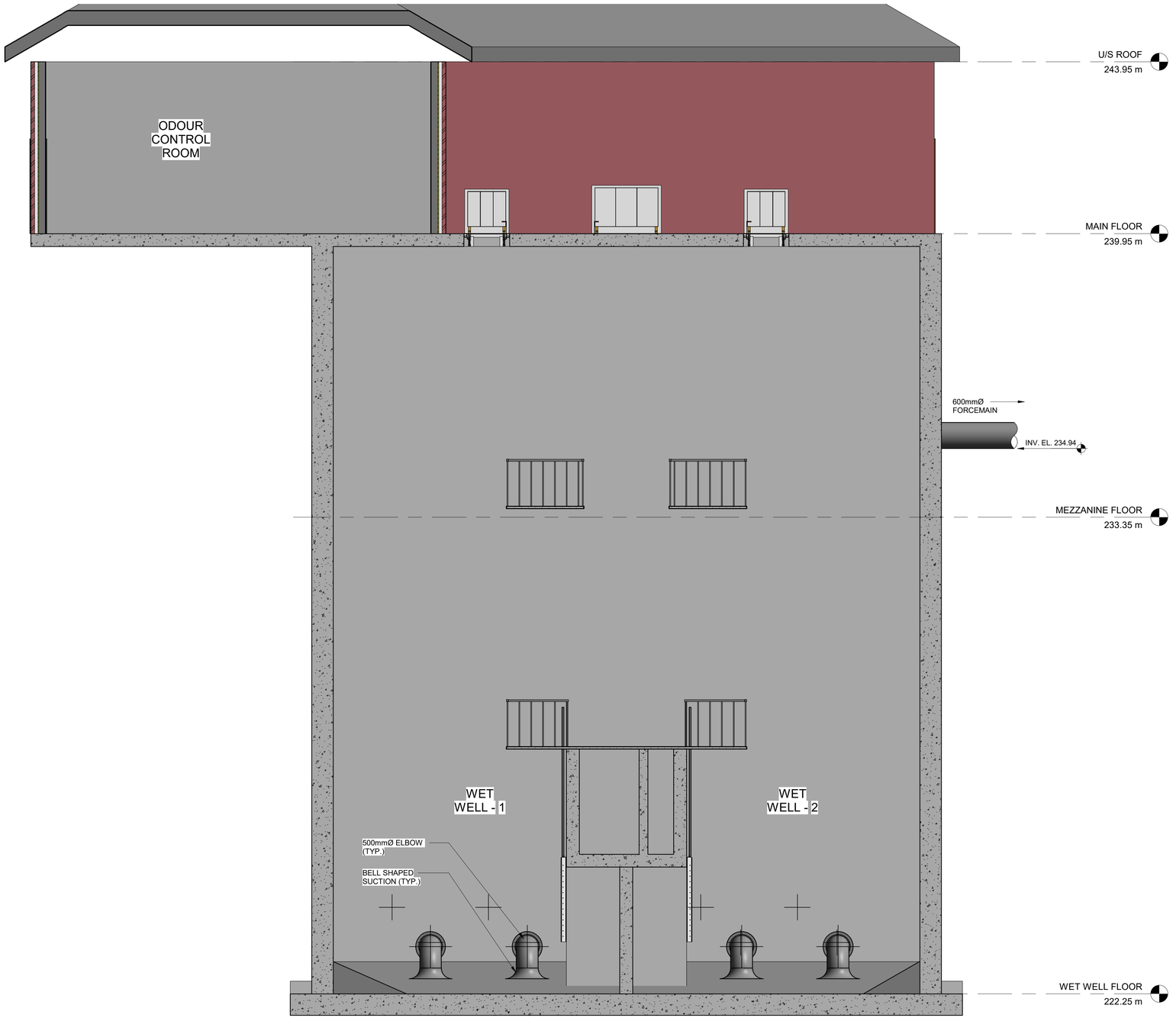
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SECTION (2)

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	DRAWN BY: C.S	DATE: 20/05/29
	DWG CHECK: I.G.	DATE: 20/05/29

DWG. NO. 191-09486-00 P-105 REV: B

Project Status

Filename:
24"x36"PLOT SCALE:



1 SECTION
1 : 50



NO.	YY/MM/DD	REVISION/ISSUE	DESIGN BY:	DESIGN CHECK:
B	20/06/30	PRELIMINARY DESIGN	I.G.	S.K.
A	20/05/29	ISSUED FOR REVIEW	I.G.	S.K.

REVISIONS / ISSUE

KGS GROUP | wsp

CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing Preliminary Engineering

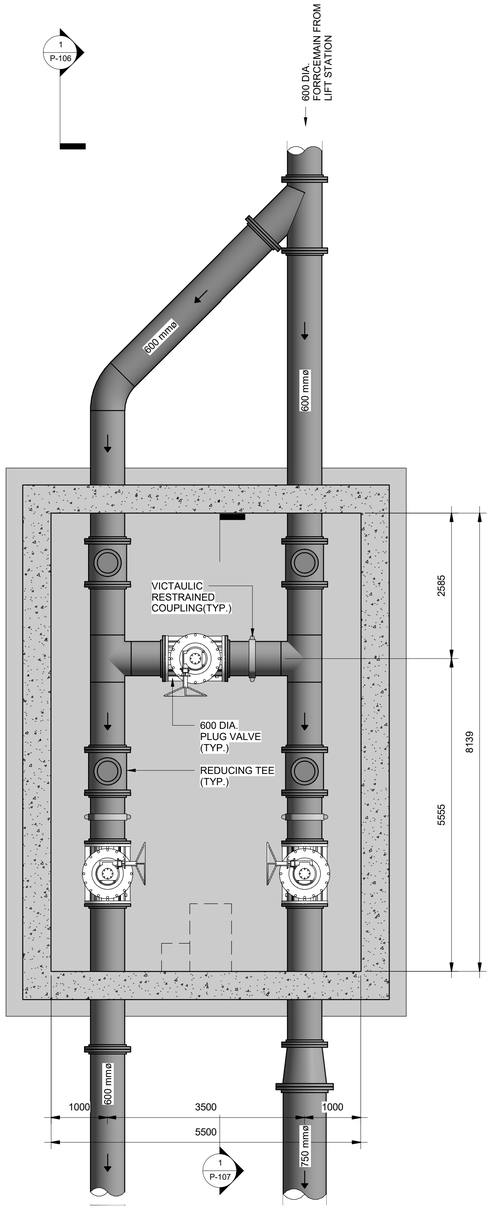
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SECTIONS (3)

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	I.G.	
	DESIGN CHECK: S.K.	DATE: 20/05/29
	DRAWN BY: C.S	DATE: 20/05/29
	DWG CHECK: I.G.	DATE: 20/05/29

DWG. NO. 191-09486-00 P-106 REV: B

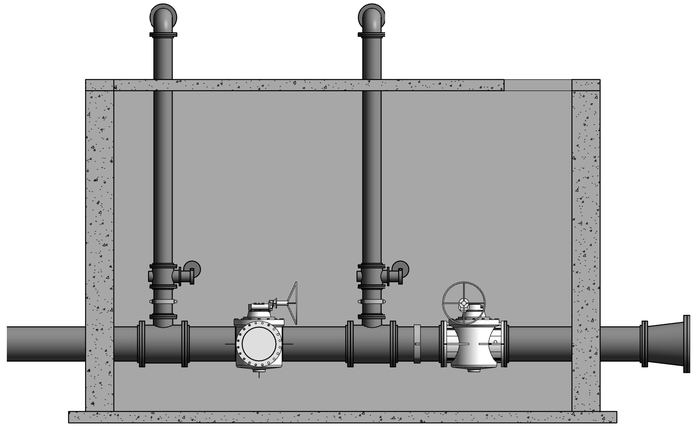
Project Status

Filename:
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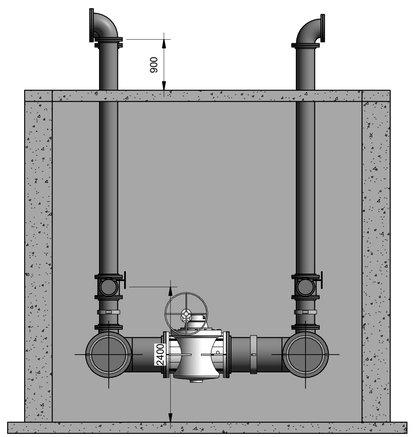
BY-PASS CHAMBER PLAN

1 : 50



1 P-107 SECTION

1 : 50



2 P-107 SECTION

1 : 50



NO.	YY/MM/DD	REVISION	ORIGINATOR BY:	DESIGN CHECK
B	20/06/30	PRELIMINARY DESIGN	I.G.	S.K.
A	20/05/29	ISSUED FOR REVIEW	I.G.	S.K.

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CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water
and Wastewater Servicing
Preliminary Engineering

DWG. DESCRIPTION:

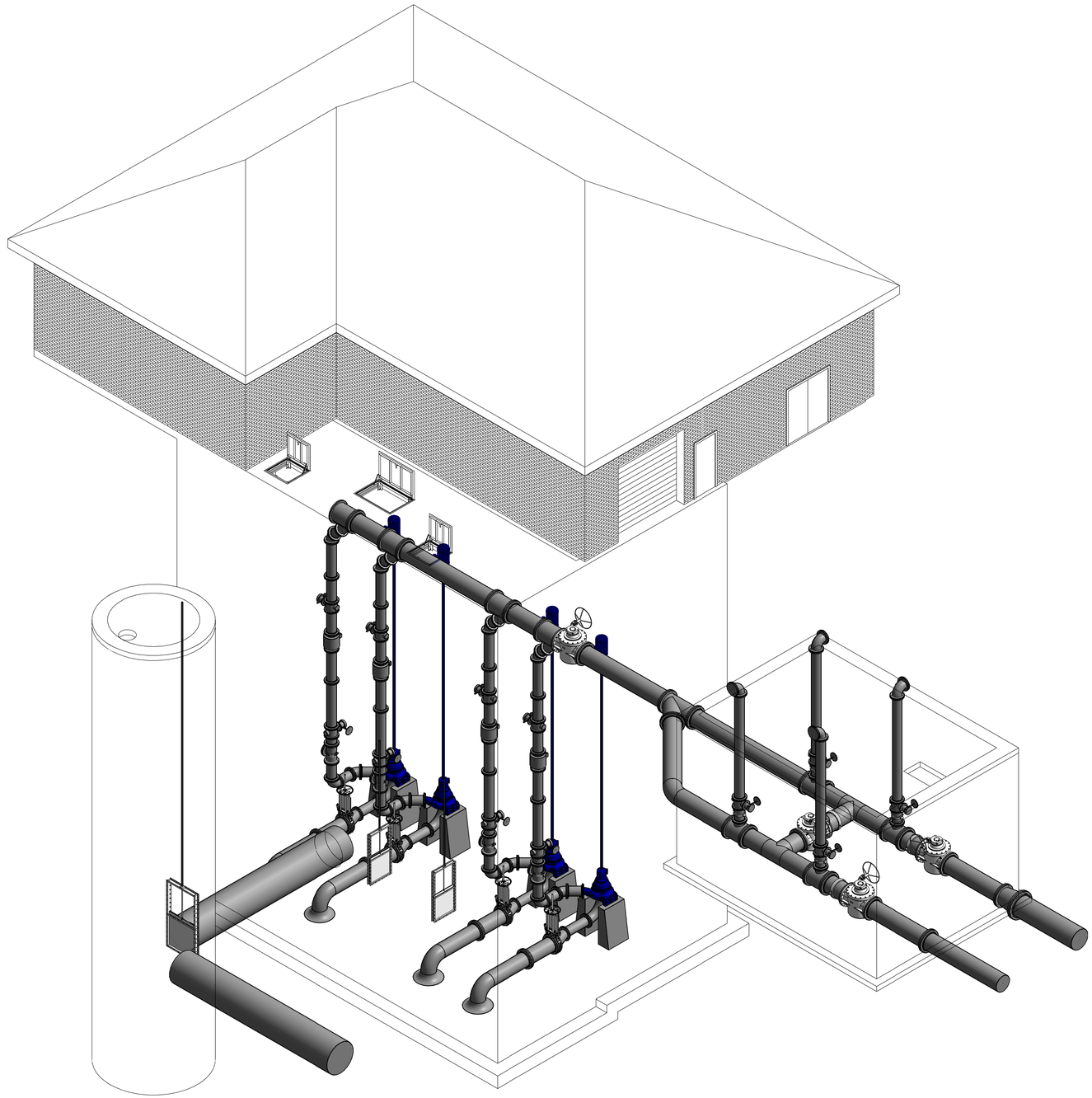
BY-PASS CHAMBER PLAN & SECTIONS

SEAL	DESIGN BY:	DATE (YY/MM/DD):
	I.G.	
	DESIGN CHECK: S.K.	DATE: 20/05/29
	DRAWN BY: C.S	DATE: 20/05/29
	DWG CHECK: I.G.	DATE: 20/05/29

DWG. NO. 191-09486-00 P-107 REV: B

Project Status

Filename:
24"x36"PLOT SCALE:



1 PROCESS 3D VIEW



NO.	YY/MM/DD	REVISION	DRAWN BY	DESIGN CHECK
B	20/06/30	PRELIMINARY DESIGN	I.G.	S.K.
A	20/05/29	ISSUED FOR REVIEW	I.G.	S.K.

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CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing
Preliminary Engineering

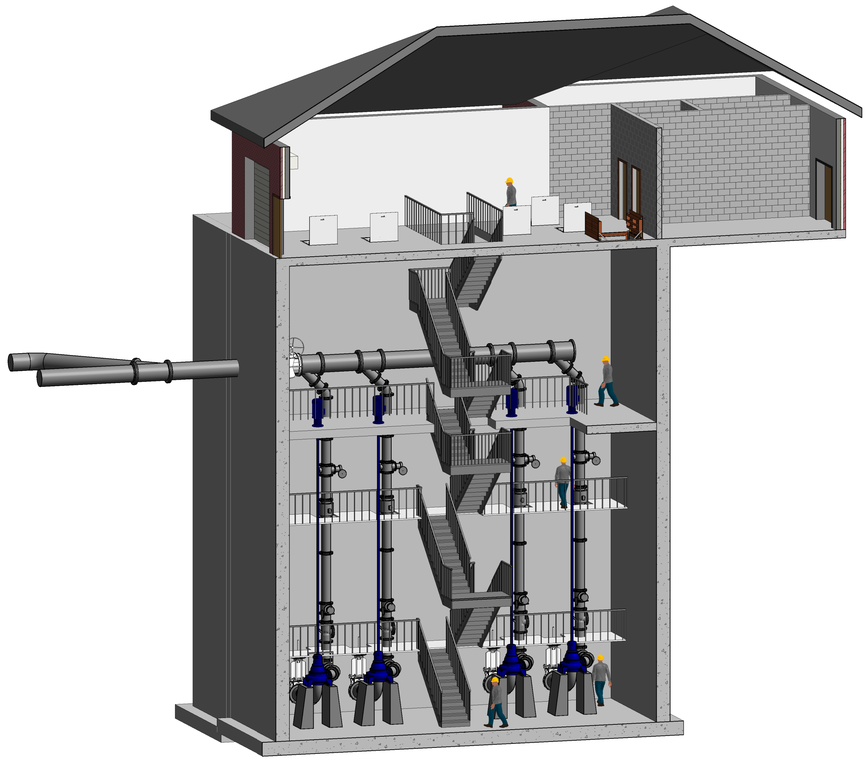
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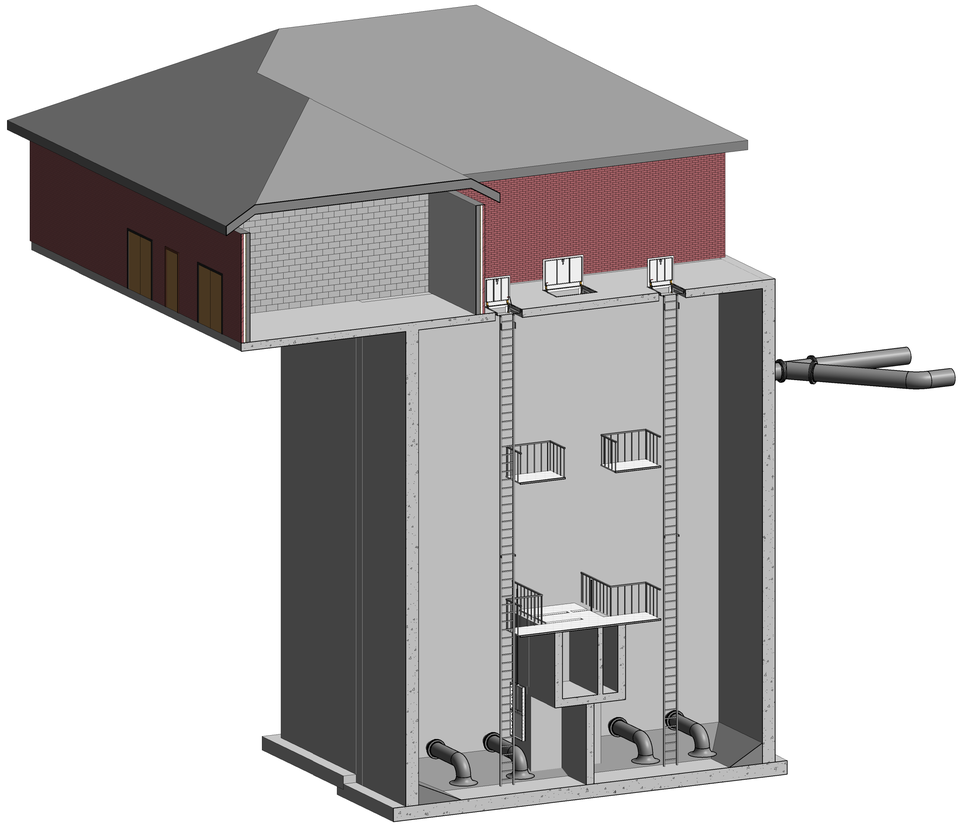
DWG. NO. 191-09486-00 P-108 REV: B

Project Status

Filename:
24"x36" PLOT SCALE:



1 3D VIEW - 1



2 3D VIEW - 2



NO.	YY/MM/DD	DESCRIPTION	ORIGINATOR BY	DESIGN CHECK
B	20/06/30	PRELIMINARY DESIGN	I.G.	S.K.
A	20/05/29	ISSUED FOR REVIEW	I.G.	S.K.

REVISIONS / ISSUE

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CLIENT: Winnipeg

PROJECT:
Airport Area West Regional Water and Wastewater Servicing Preliminary Engineering

DWG. DESCRIPTION:
3D VIEWS

SEAL		
	DESIGN BY: I.G.	DATE (YY/MM/DD):
	DESIGN CHECK: S.K.	DATE: 20/05/29
	DRAWN BY: C.S	DATE: 20/05/29
	DWG CHECK: I.G.	DATE: 20/05/29

DWG. NO. 191-09486-00 P-109 | REV: B

Project Status

Filename:
24"X36"PLOT SCALE:

APPENDIX A

Peak Day Wet Weather Flow Calculation Spreadsheet

Airport Area West **Wastewater Sewer Design - Flow Calculation Table**

	Single Family	3.05	/unit	Per Capita Flow	270	lpcd average
Common Factors		6.0	units/acre	Schools	70	l/day/student average
		14.8	units/ha			
	Multi-family	2.3	/unit			
		30.0	units/acre	Manhole inflow	12.0	l/mh/min
		74.1	units/ha			
		Average	Peak Day			
	Commercial flow	16,800	28,100	l/ha/day	Groundwater	2200	l/ha/day
	Light Industrial/Business Park flow	22,500	37,600	l/ha/day	Manholes	1.6	/ha residential
	Wet Industrial flow	33,600	44,900	l/ha/day		1.0	/ha commercial / industrial

			Phase 1				Phase 2			Uptake Rates (Ha/Yr)	
		Totals	0-5 Yrs	6-10 Yrs	11-15 Yrs	16-20 Yrs	21-30 Yrs	31-40 Yrs	41-50 Yrs	Phase 1 20 yr	Phase 2 30 yr
	Gross Area (Ha) Residential	**176.0 Ha**	**38.19**	**48.01**	**43.52**	**46.28**	**0.00**	**0.00**	**0.00**		
	Net Area Residential (Ha)	**163.1 Ha**	**35.40**	**44.50**	**40.34**	**42.90**	**0.00**	**0.00**	**0.00**		
	Single family (ha)	**136.0 Ha**	**30.40**	**38.10**	**32.64**	**34.90**	**0.00**	**0.00**	**0.00**	**6.8**	**0.0**
	Multi family (ha)	**27.1 Ha**	**5.00**	**6.40**	**7.70**	**8.00**	**0.00**	**0.00**	**0.00**	**1.4**	**0.0**
	Total Single Family Lots	2013 Lots	450 Lots	564 Lots	483 Lots	517 Lots	Lots	Lots	Lots		
	Area Total Single Family Population	6141	1372	1720	1474	1576	0	0	0		
	Accumulated Total Single Family Population	6141	1372	3092	4566	6142	6142	6142	6142		
	Average flow (l/d) based on 270 lpcd	1,658,070	370,440	834,840	1,232,820	1,658,340	1,658,340	1,658,340	1,658,340		
	Total Multi Family Units	2008 Units	371 Units	474 Units	571 Units	593 Units	Units	Units	Units		
	Area Total Multi Family Population	4619	852	1091	1312	1363	0	0	0		
	Accumulated Total Multi Family Population	4619	852	1943	3255	4618	4618	4618	4618		
	Average flow (l/d) based on 270 lpcd	1,247,130	230,040	524,610	878,850	1,246,860	1,246,860	1,246,860	1,246,860		
	Total Average Flow Residential	2,905,200	600,480	1,359,450	2,111,670	2,905,200	2,905,200	2,905,200	2,905,200		
	Harmon Peaking Factor	2.92	3.55	3.24	3.06	2.92	2.92	2.92	2.92		
1.	**Peak Day flow Residential (l/sec)**	**98.29**	**24.67**	**51.01**	**74.78**	**98.29**	**98.29**	**98.29**	**98.29**		
	Commerical / Industrial Peak Day										
	Commerical - area (Ha)	**28.6 Ha**	5.05	5.05	5.05	5.05	2.80	2.80	2.80	**1.0**	**0.3**
	Commerical Flow l/sec	9.30 l/s	1.64 l/s	1.64 l/s	1.64 l/s	1.64 l/s	0.91 l/s	0.91 l/s	0.91 l/s		
	Business park - area (Ha)	**45.1 Ha**	11.27	11.27	11.27	11.27	0.00	0.00	0.00	**2.3**	**0.0**
	Business park mix Flow	19.62 l/s	4.90 l/s	4.90 l/s	4.90 l/s	4.90 l/s	0.00 l/s	0.00 l/s	0.00 l/s		
	Light industrial - area (Ha) incl schools	**437.8 Ha**	62.8	62.8	62.8	62.8	62.2	62.2	62.2	**12.6**	**6.2**
	Light industrial Flow incl schools l/sec	190.52 l/s	27.33 l/s	27.33 l/s	27.33 l/s	27.33 l/s	27.07 l/s	27.07 l/s	27.07 l/s		
	Wet industrial - area (Ha)	**77.9 Ha**	3.45	3.45	3.45	3.45	21.37	21.37	21.37	**0.7**	**2.1**
	Wet industrial Flow l/sec	40.49 l/s	1.79 l/s	1.79 l/s	1.79 l/s	1.79 l/s	11.11 l/s	11.11 l/s	11.11 l/s		
	Total Net Area Commercial / Industrial (Ha)	**589.39**	**82.57**	**82.57**	**82.57**	**82.57**	**86.37**	**86.37**	**86.37**	**16.5**	**8.6**
2.	**Total Peak Dry Weather Flows Commercial / Industrial**	**259.93**	**35.67**	**35.67**	**35.67**	**35.67**	**39.08**	**39.08**	**39.08**		
3.	**Total Accumulated Peak Dry Weather Flows Com and Ind**	**259.93**	**35.67**	**71.34**	**107.01**	**142.68**	**181.76**	**220.85**	**259.93**		
4.	**Total Peak Day Dry Weather Flows Sub-total 1+3**	**358.22**	**60.34**	**122.35**	**181.79**	**240.96**	**280.05**	**319.13**	**358.22**		
	Additional area for infiltration in commercial/industrial (ROW's)	106.08	14.86	14.86	14.86	14.86	15.55	15.55	15.55		
	No. of manholes	977	159	174	167	171	102	102	102		
	Manhole infiltration (l/sec)	195.42	31.71	34.85	33.41	34.30	20.38	20.38	20.38		
	Groundwater infiltration (l/sec)	22.19	3.45	3.70	3.59	3.66	2.60	2.60	2.60		
	Total infiltration (l/sec)	217.61	35.16	38.55	37.00	37.96	22.98	22.98	22.98		
5.	**Accumulated Total infiltration (l/sec)**	**217.61**	**35.16**	**73.71**	**110.72**	**148.67**	**171.65**	**194.63**	**217.61**		
	Total peak day wet weather flow (l/sec) Sub-total 4+5	**575.83**	**95.50**	**196.07**	**292.51**	**389.64**	**451.70**	**513.76**	**575.83**		
	Total net Area	**752.53**	Ha								

APPENDIX B

Peak Instantaneous Calculation Spreadsheet

Peak Instantaneous Flow Calcs	Totals	Phase 1				Phase 2		
1.67 x Peak Residential plus 2.75 x Average Industrial and Commerical		0-5 Yrs	6-10 Yrs	11-15 Yrs	16-20 Yrs	21-30 Yrs	31-40 Yrs	41-50 Yrs
Peak Residential Day Flow from Appendix A (accumulated)	98.29 l/s	24.67	51.01	74.78	98.29	98.29	98.29	98.29
Peak Instantaneous for Residential **1.67 X**	164.14 l/s	41.20	85.19	124.89	164.14	164.14	164.14	164.14
Average Day for Industrial and Commercial								
Commerical - area (Ha)	28.6 Ha	5.05	5.05	5.05	5.05	2.80	2.80	2.80
Commerical Flow l/sec	5.56 l/s	0.98 l/s	0.98 l/s	0.98 l/s	0.98 l/s	0.54 l/s	0.54 l/s	0.54 l/s
Business park/commercial mix - area (Ha)	45.1 Ha	11.27	11.27	11.27	11.27	0.00	0.00	0.00
Business park/commerical mix Flow	11.74 l/s	2.93 l/s	2.93 l/s	2.93 l/s	2.93 l/s	0.00 l/s	0.00 l/s	0.00 l/s
Light industrial - area (Ha) incl schools	437.8 Ha	62.80	62.80	62.80	62.80	62.20	62.20	62.20
Light industrial Flow incl schools l/sec	114.01 l/s	16.35 l/s	16.35 l/s	16.35 l/s	16.35 l/s	16.20 l/s	16.20 l/s	16.20 l/s
Wet industrial - area (Ha)	77.9 Ha	3.45	3.45	3.45	3.45	21.37	21.37	21.37
Wet industrial Flow l/sec	30.298 l/s	1.34 l/s	1.34 l/s	1.34 l/s	1.34 l/s	8.31 l/s	8.31 l/s	8.31 l/s
Total Net Area Commercial / Industrial (Ha)	589.39Ha	82.57	82.57	82.57	82.57	86.37	86.37	86.37
Total Average Dry Weather Flows Commercial / Industrial	161.61 l/s	21.61 l/s	21.61 l/s	21.61 l/s	21.61 l/s	25.05 l/s	25.05 l/s	25.05 l/s
Peak Instantaneous for Comm/Indust **2.75 X**	444.43 l/s	59.43 l/s	59.43 l/s	59.43 l/s	59.43 l/s	68.90 l/s	68.90 l/s	68.90 l/s
Accumulated		59.43 l/s	118.87 l/s	178.30 l/s	237.74 l/s	306.63 l/s	375.53 l/s	444.43 l/s

Infiltration from Appendix A Accumulated	217.61 l/s	35.16 l/s	73.71 l/s	110.72 l/s	148.67 l/s	171.65 l/s	194.63 l/s	217.61 l/s

	Total	0-5 Yrs	6-10 Yrs	11-15 Yrs	16-20 Yrs	21-30 Yrs	31-40 Yrs	41-50 Yrs
Total Peak Instantaneous	826.17 l/s	135.79 l/s	277.78 l/s	413.91 l/s	550.55 l/s	642.42 l/s	734.30 l/s	826.17 l/s
Pump Operation Stage		Stage 1.1 1.2		Stage 2		Stage 3		
Forcemain Configuration		1x600		1x750		1x600 1x750		

APPENDIX C

Wastewater Subcatchment Data

Subcatchment ID	Drains to (Node ID)	Land Use ID	Total Area (ha)	Population Density (per/ha)	Population	Per Capita Flow (l/day)	Multiplier	Foul Flow (m^3/s)	Base Flow (m3/s)	Total Outflow (m^3/s)
S1_RMH - (10)	RMH - (10)	Single Family	6.60	45.14	297.92	270	2.95	0.00275	0.00230	0.00505
S1_RMH - (11)	RMH - (11)	Single Family	6.60	45.14	297.92	270	2.95	0.00275	0.00230	0.00505
S1_RMH - (12)	RMH - (12)	Single Family	2.48	45.14	111.95	270	2.95	0.00103	0.00090	0.00193
S1_RMH - (13)	RMH - (13)	Single Family	2.50	45.14	112.85	270	2.95	0.00104	0.00090	0.00194
S1_RMH - (14)	RMH - (14)	Single Family	4.64	45.14	209.45	270	2.95	0.00193	0.00160	0.00353
S1_RMH - (16)	RMH - (16)	Single Family	2.38	45.14	107.43	270	2.95	0.00099	0.00080	0.00179
S1_RMH - (17)	RMH - (17)	Single Family	2.30	45.14	103.82	270	2.95	0.00096	0.00080	0.00176
S1_RMH - (19)	RMH - (19)	Single Family	6.20	45.14	279.87	270	2.95	0.00258	0.00210	0.00468
S1_RMH - (2)	RMH - (2)	Single Family	2.38	45.14	107.43	270	2.95	0.00099	0.00080	0.00179
S1_RMH - (22)	RMH - (22)	Single Family	1.62	45.14	73.13	270	2.95	0.00067	0.00060	0.00127
S1_RMH - (23)	RMH - (23)	Single Family	3.28	45.14	148.06	270	2.95	0.00136	0.00110	0.00246
S1_RMH - (24)	RMH - (24)	Single Family	2.98	45.14	134.52	270	2.95	0.00124	0.00100	0.00224
S1_RMH - (25)	RMH - (25)	Single Family	4.08	45.14	184.17	270	2.95	0.00170	0.00140	0.00310
S1_RMH - (26)	RMH - (26)	Single Family	5.95	45.14	268.58	270	2.95	0.00248	0.00210	0.00458
S1_RMH - (27)	RMH - (27)	Single Family	2.52	45.14	113.75	270	2.95	0.00105	0.00090	0.00195
S1_RMH - (28)	RMH - (28)	Single Family	1.76	45.14	79.45	270	2.95	0.00073	0.00060	0.00133
S1_RMH - (29)	RMH - (29)	Single Family	2.72	45.14	122.78	270	2.95	0.00113	0.00090	0.00203
S1_RMH - (3)	RMH - (3)	Single Family	7.68	45.14	346.68	270	2.95	0.00320	0.00270	0.00590
S1_RMH - (30)	RMH - (30)	Single Family	5.17	45.14	233.37	270	2.95	0.00215	0.00180	0.00395
S1_RMH - (31)	RMH - (31)	Single Family	3.12	45.14	140.84	270	2.95	0.00130	0.00110	0.00240
S1_RMH - (32)	RMH - (32)	Single Family	1.67	45.14	75.38	270	2.95	0.00069	0.00230	0.00299
S1_RMH - (34)	RMH - (34)	Single Family	1.35	45.14	60.94	270	2.95	0.00056	0.00050	0.00106
S1_RMH - (35)	RMH - (35)	Single Family	3.79	45.14	171.08	270	2.95	0.00158	0.00130	0.00288
S1_RMH - (36)	RMH - (36)	Single Family	1.92	45.14	86.67	270	2.95	0.00080	0.00070	0.00150
S1_RMH - (37)	RMH - (37)	Single Family	2.28	45.14	102.92	270	2.95	0.00095	0.00080	0.00175
S1_RMH - (38)	RMH - (38)	Single Family	8.76	45.14	395.43	270	2.95	0.00365	0.00300	0.00665
S1_RMH - (39)	RMH - (39)	Single Family	3.60	45.14	162.50	270	2.95	0.00150	0.00120	0.00270
S1_RMH - (40)	RMH - (40)	Single Family	1.22	45.14	55.07	270	2.95	0.00051	0.00040	0.00091
S1_RMH - (41)	RMH - (41)	Single Family	2.48	45.14	111.95	270	2.95	0.00103	0.00090	0.00193
S1_RMH - (42)	RMH - (42)	Single Family	2.20	45.14	99.31	270	2.95	0.00092	0.00080	0.00172
S1_RMH - (43)	RMH - (43)	Single Family	1.10	45.14	49.65	270	2.95	0.00046	0.00040	0.00086
S1_RMH - (44)	RMH - (44)	Single Family	1.06	45.14	47.85	270	2.95	0.00044	0.00040	0.00084
S1_RMH - (45)	RMH - (45)	Single Family	2.14	45.14	96.60	270	2.95	0.00089	0.00240	0.00329
S1_RMH - (46)	RMH - (46)	Single Family	1.02	45.14	46.04	270	2.95	0.00042	0.00140	0.00182
S1_RMH - (47)	RMH - (47)	Single Family	1.02	45.14	46.04	270	2.95	0.00042	0.00120	0.00162
S1_RMH - (48)	RMH - (48)	Single Family	4.08	45.14	184.17	270	2.95	0.00170	0.00180	0.00350
S1_RMH - (49)	RMH - (49)	Single Family	4.08	45.14	184.17	270	2.95	0.00170	0.00180	0.00350
S1_RMH - (5)	RMH - (5)	Single Family	1.84	45.14	83.06	270	2.95	0.00077	0.00060	0.00137
S1_RMH - (52)	RMH - (52)	Single Family	5.55	45.14	250.53	270	2.95	0.00231	0.00240	0.00471
S1_RMH - (7)	RMH - (7)	Single Family	2.80	45.14	126.39	270	2.95	0.00117	0.00100	0.00217
S1_RMH - (8)	RMH - (8)	Single Family	2.60	45.14	117.36	270	2.95	0.00108	0.00090	0.00198
S1_RMH - (9)	RMH - (9)	Single Family	2.60	45.14	117.36	270	2.95	0.00108	0.00090	0.00198
S2_RMH - (15)	RMH - (15)	MultiFamily	3.90	170.5	664.95	270	2.95	0.00613	0.00130	0.00743
S2_RMH - (32)	RMH - (32)	MultiFamily	4.95	170.5	843.97	270	2.95	0.00778	0.00000	0.00778
S2_RMH - (33)	RMH - (33)	MultiFamily	4.95	170.5	843.97	270	2.95	0.00778	0.00170	0.00948
S2_RMH - (45)	RMH - (45)	MultiFamily	4.70	170.5	801.35	270	2.95	0.00739	0.00000	0.00739
S2_RMH - (46)	RMH - (46)	MultiFamily	3.00	170.5	511.50	270	2.95	0.00472	0.00000	0.00472
S2_RMH - (47)	RMH - (47)	MultiFamily	2.50	170.5	426.25	270	2.95	0.00393	0.00000	0.00393
S2_RMH - (6)	RMH - (6)	MultiFamily	3.20	170.5	545.60	270	2.95	0.00503	0.00110	0.00613
S3_MH - 17	MH - 17	Commercial	2.60	1	2.60	28100	1	0.00085	0.00100	0.00185
S3_MH - 2	MH - 2	Commercial	3.40	1	3.40	28100	1	0.00111	0.00100	0.00211
S3_MH - 49	MH - 49	Commercial	3.40	1	3.40	28100	1	0.00111	0.00100	0.00211
S3_MH - 55	MH - 55	Commercial	5.40	1	5.40	28100	1	0.00176	0.00180	0.00356
S3_MH - 65	MH - 65	Commercial	5.80	1	5.80	28100	1	0.00189	0.00180	0.00369
S3_RMH - (48)	RMH - (48)	Commercial	1.90	1	1.90	28100	1	0.00062	0.00000	0.00062
S3_RMH - (49)	RMH - (49)	Commercial	1.90	1	1.90	28100	1	0.00062	0.00000	0.00062
S3_RMH - (51)	RMH - (51)	Commercial	2.10	1	2.10	28100	1	0.00068	0.00050	0.00118
S3_RMH - (52)	RMH - (52)	Commercial	2.10	1	2.10	28100	1	0.00068	0.00000	0.00068
S4_MH - 26	MH - 26	Com/LI Mix	4.75	1	4.75	32850	1	0.00181	0.00130	0.00311

Subcatchment ID	Drains to (Node ID)	Land Use ID	Total Area (ha)	Population Density (per/ha)	Population	Per Capita Flow (l/day)	Multiplier	Foul Flow (m^3/s)	Base Flow (m3/s)	Total Outflow (m^3/s)
S4_MH - 27	MH - 27	Com/LI Mix	4.75	1	4.75	32850	1	0.00181	0.00130	0.00311
S4_MH - 37	MH - 37	Com/LI Mix	10.10	1	10.10	32850	1	0.00384	0.00320	0.00704
S4_MH - 4	MH - 4	Com/LI Mix	7.90	1	7.90	32850	1	0.00300	0.00190	0.00490
S4_MH - 5	MH - 5	Com/LI Mix	2.50	1	2.50	32850	1	0.00095	0.00060	0.00155
S4_MH - 50	MH - 50	Com/LI Mix	10.10	1	10.10	32850	1	0.00384	0.00420	0.00804
S4_MH - 6	MH - 6	Com/LI Mix	5.00	1	5.00	32850	1	0.00190	0.00130	0.00320
S5_MH - 10	MH - 10	Light Industrial	5.67	1	5.67	37600	1	0.00247	0.00160	0.00407
S5_MH - 100	MH - 100	Light Industrial	13.98	1	13.98	37600	1	0.00608	0.00350	0.00958
S5_MH - 101	MH - 101	Light Industrial	5.70	1	5.70	37600	1	0.00248	0.00140	0.00388
S5_MH - 102	MH - 102	Light Industrial	9.45	1	9.45	37600	1	0.00411	0.00230	0.00641
S5_MH - 12	MH - 12	Light Industrial	3.50	1	3.50	37600	1	0.00152	0.00090	0.00242
S5_MH - 13	MH - 13	Light Industrial	2.17	1	2.17	37600	1	0.00094	0.00060	0.00154
S5_MH - 14	MH - 14	Light Industrial	15.15	1	15.15	37600	1	0.00659	0.00390	0.01049
S5_MH - 15	MH - 15	Light Industrial	8.75	1	8.75	37600	1	0.00381	0.00220	0.00601
S5_MH - 16	MH - 16	Light Industrial	6.40	1	6.40	37600	1	0.00279	0.00170	0.00449
S5_MH - 18	MH - 18	Light Industrial	3.17	1	3.17	37600	1	0.00138	0.00090	0.00228
S5_MH - 19	MH - 19	Light Industrial	2.43	1	2.43	37600	1	0.00106	0.00060	0.00166
S5_MH - 20	MH - 20	Light Industrial	5.60	1	5.60	37600	1	0.00244	0.00260	0.00504
S5_MH - 21	MH - 21	Light Industrial	3.17	1	3.17	37600	1	0.00138	0.00150	0.00288
S5_MH - 22	MH - 22	Light Industrial	2.43	1	2.43	37600	1	0.00106	0.00110	0.00216
S5_MH - 28	MH - 28	Light Industrial	5.33	1	5.33	37600	1	0.00232	0.00140	0.00372
S5_MH - 29	MH - 29	Light Industrial	5.33	1	5.33	37600	1	0.00232	0.00140	0.00372
S5_MH - 30	MH - 30	Light Industrial	4.13	1	4.13	37600	1	0.00180	0.00110	0.00290
S5_MH - 31	MH - 31	Light Industrial	4.13	1	4.13	37600	1	0.00180	0.00110	0.00290
S5_MH - 32	MH - 32	Light Industrial	2.10	1	2.10	37600	1	0.00091	0.00110	0.00201
S5_MH - 33	MH - 33	Light Industrial	2.10	1	2.10	37600	1	0.00091	0.00110	0.00201
S5_MH - 37	MH - 37	Light Industrial	2.43	1	2.43	37600	1	0.00106	0.00000	0.00106
S5_MH - 38	MH - 38	Light Industrial	2.43	1	2.43	37600	1	0.00106	0.00060	0.00166
S5_MH - 39	MH - 39	Light Industrial	4.23	1	4.23	37600	1	0.00184	0.00110	0.00294
S5_MH - 40	MH - 40	Light Industrial	1.80	1	1.80	37600	1	0.00078	0.00050	0.00128
S5_MH - 41	MH - 41	Light Industrial	3.70	1	3.70	37600	1	0.00161	0.00100	0.00261
S5_MH - 42	MH - 42	Light Industrial	3.70	1	3.70	37600	1	0.00161	0.00100	0.00261
S5_MH - 43	MH - 43	Light Industrial	3.85	1	3.85	37600	1	0.00168	0.00100	0.00268
S5_MH - 44	MH - 44	Light Industrial	3.85	1	3.85	37600	1	0.00168	0.00100	0.00268
S5_MH - 45	MH - 45	Light Industrial	3.80	1	3.80	37600	1	0.00165	0.00100	0.00265
S5_MH - 46	MH - 46	Light Industrial	3.80	1	3.80	37600	1	0.00165	0.00100	0.00265
S5_MH - 47	MH - 47	Light Industrial	1.85	1	1.85	37600	1	0.00081	0.00050	0.00131
S5_MH - 48	MH - 48	Light Industrial	1.85	1	1.85	37600	1	0.00081	0.00050	0.00131
S5_MH - 50	MH - 50	Light Industrial	6.41	1	6.41	37600	1	0.00279	0.00000	0.00279
S5_MH - 51	MH - 51	Light Industrial	10.01	1	10.01	37600	1	0.00436	0.00260	0.00696
S5_MH - 52	MH - 52	Light Industrial	18.08	1	18.08	37600	1	0.00787	0.00450	0.01237
S5_MH - 53	MH - 53	Light Industrial	10.75	1	10.75	37600	1	0.00468	0.00270	0.00738
S5_MH - 56	MH - 56	Light Industrial	1.70	1	1.70	37600	1	0.00074	0.00040	0.00114
S5_MH - 57	MH - 57	Light Industrial	6.25	1	6.25	37600	1	0.00272	0.00160	0.00432
S5_MH - 58	MH - 58	Light Industrial	3.88	1	3.88	37600	1	0.00169	0.00100	0.00269
S5_MH - 59	MH - 59	Light Industrial	3.88	1	3.88	37600	1	0.00169	0.00250	0.00419
S5_MH - 60	MH - 60	Light Industrial	2.50	1	2.50	37600	1	0.00109	0.00120	0.00229
S5_MH - 61	MH - 61	Light Industrial	5.25	1	5.25	37600	1	0.00228	0.00230	0.00458
S5_MH - 62	MH - 62	Light Industrial	5.80	1	5.80	37600	1	0.00252	0.00300	0.00552
S5_MH - 63	MH - 63	Light Industrial	2.10	1	2.10	37600	1	0.00091	0.00100	0.00191
S5_MH - 64	MH - 64	Light Industrial	3.70	1	3.70	37600	1	0.00161	0.00190	0.00351
S5_MH - 66	MH - 66	Light Industrial	4.23	1	4.23	37600	1	0.00184	0.00110	0.00294
S5_MH - 67	MH - 67	Light Industrial	14.95	1	14.95	37600	1	0.00651	0.00380	0.01031
S5_MH - 68	MH - 68	Light Industrial	7.86	1	7.86	37600	1	0.00342	0.00320	0.00662
S5_MH - 69	MH - 69	Light Industrial	4.08	1	4.08	37600	1	0.00178	0.00110	0.00288
S5_MH - 7	MH - 7	Light Industrial	8.52	1	8.52	37600	1	0.00371	0.00230	0.00601
S5_MH - 70	MH - 70	Light Industrial	3.78	1	3.78	37600	1	0.00165	0.00210	0.00375
S5_MH - 71	MH - 71	Light Industrial	1.95	1	1.95	37600	1	0.00085	0.00160	0.00245
S5_MH - 72	MH - 72	Light Industrial	1.95	1	1.95	37600	1	0.00085	0.00050	0.00135

Subcatchment ID	Drains to (Node ID)	Land Use ID	Total Area (ha)	Population Density (per/ha)	Population	Per Capita Flow (l/day)	Multiplier	Foul Flow (m^3/s)	Base Flow (m3/s)	Total Outflow (m^3/s)
S5_MH - 74	MH - 74	Light Industrial	8.95	1	8.95	37600	1	0.00389	0.00240	0.00629
S5_MH - 76	MH - 76	Light Industrial	8.15	1	8.15	37600	1	0.00355	0.00200	0.00555
S5_MH - 77	MH - 77	Light Industrial	7.38	1	7.38	37600	1	0.00321	0.00200	0.00521
S5_MH - 79	MH - 79	Light Industrial	2.55	1	2.55	37600	1	0.00111	0.00070	0.00181
S5_MH - 8	MH - 8	Light Industrial	7.25	1	7.25	37600	1	0.00316	0.00190	0.00506
S5_MH - 80	MH - 80	Light Industrial	2.65	1	2.65	37600	1	0.00115	0.00070	0.00185
S5_MH - 81	MH - 81	Light Industrial	6.85	1	6.85	37600	1	0.00298	0.00180	0.00478
S5_MH - 82	MH - 82	Light Industrial	8.65	1	8.65	37600	1	0.00376	0.00220	0.00596
S5_MH - 83	MH - 83	Light Industrial	9.00	1	9.00	37600	1	0.00392	0.00230	0.00622
S5_MH - 84	MH - 84	Light Industrial	7.78	1	7.78	37600	1	0.00339	0.00200	0.00539
S5_MH - 85	MH - 85	Light Industrial	3.23	1	3.23	37600	1	0.00141	0.00090	0.00231
S5_MH - 86	MH - 86	Light Industrial	3.23	1	3.23	37600	1	0.00141	0.00090	0.00231
S5_MH - 87	MH - 87	Light Industrial	7.38	1	7.38	37600	1	0.00321	0.00200	0.00521
S5_MH - 88	MH - 88	Light Industrial	1.58	1	1.58	37600	1	0.00069	0.00080	0.00149
S5_MH - 89	MH - 89	Light Industrial	3.08	1	3.08	37600	1	0.00134	0.00170	0.00304
S5_MH - 9	MH - 9	Light Industrial	0.90	1	0.90	37600	1	0.00039	0.00030	0.00069
S5_MH - 91	MH - 91	Light Industrial	1.50	1	1.50	37600	1	0.00065	0.00090	0.00155
S5_MH - 92	MH - 92	Light Industrial	6.33	1	6.33	37600	1	0.00275	0.00170	0.00445
S5_MH - 93	MH - 93	Light Industrial	12.04	1	12.04	37600	1	0.00524	0.00330	0.00854
S5_MH - 94	MH - 94	Light Industrial	13.75	1	13.75	37600	1	0.00598	0.00340	0.00938
S5_MH - 95	MH - 95	Light Industrial	3.44	1	3.44	37600	1	0.00150	0.00100	0.00250
S5_MH - 96	MH - 96	Light Industrial	6.13	1	6.13	37600	1	0.00267	0.00160	0.00427
S5_MH - 97	MH - 97	Light Industrial	5.52	1	5.52	37600	1	0.00240	0.00150	0.00390
S5_MH - 98	MH - 98	Light Industrial	15.55	1	15.55	37600	1	0.00677	0.00380	0.01057
S5_MH - 99	MH - 99	Light Industrial	9.38	1	9.38	37600	1	0.00408	0.00220	0.00628
S6_MH - 20	MH - 20	Wet Industrial	4.18	1	4.18	44900	1	0.00217	0.00000	0.00217
S6_MH - 21	MH - 21	Wet Industrial	2.40	1	2.40	44900	1	0.00125	0.00000	0.00125
S6_MH - 22	MH - 22	Wet Industrial	1.78	1	1.78	44900	1	0.00093	0.00000	0.00093
S6_MH - 23	MH - 23	Wet Industrial	4.18	1	4.18	44900	1	0.00217	0.00110	0.00327
S6_MH - 24	MH - 24	Wet Industrial	2.40	1	2.40	44900	1	0.00125	0.00070	0.00195
S6_MH - 25	MH - 25	Wet Industrial	1.78	1	1.78	44900	1	0.00093	0.00050	0.00143
S6_MH - 32	MH - 32	Wet Industrial	1.85	1	1.85	44900	1	0.00096	0.00000	0.00096
S6_MH - 33	MH - 33	Wet Industrial	1.85	1	1.85	44900	1	0.00096	0.00000	0.00096
S6_MH - 34	MH - 34	Wet Industrial	1.85	1	1.85	44900	1	0.00096	0.00050	0.00146
S6_MH - 35	MH - 35	Wet Industrial	1.85	1	1.85	44900	1	0.00096	0.00050	0.00146
S6_MH - 59	MH - 59	Wet Industrial	5.60	1	5.60	44900	1	0.00291	0.00000	0.00291
S6_MH - 60	MH - 60	Wet Industrial	1.80	1	1.80	44900	1	0.00094	0.00000	0.00094
S6_MH - 61	MH - 61	Wet Industrial	3.80	1	3.80	44900	1	0.00197	0.00000	0.00197
S6_MH - 62	MH - 62	Wet Industrial	5.60	1	5.60	44900	1	0.00291	0.00000	0.00291
S6_MH - 63	MH - 63	Wet Industrial	1.80	1	1.80	44900	1	0.00094	0.00000	0.00094
S6_MH - 64	MH - 64	Wet Industrial	3.80	1	3.80	44900	1	0.00197	0.00000	0.00197
S6_MH - 68	MH - 68	Wet Industrial	4.38	1	4.38	44900	1	0.00228	0.00000	0.00228
S6_MH - 70	MH - 70	Wet Industrial	4.38	1	4.38	44900	1	0.00228	0.00000	0.00228
S6_MH - 71	MH - 71	Wet Industrial	4.38	1	4.38	44900	1	0.00228	0.00000	0.00228
S6_MH - 73	MH - 73	Wet Industrial	4.38	1	4.38	44900	1	0.00228	0.00110	0.00338
S6_MH - 88	MH - 88	Wet Industrial	1.53	1	1.53	44900	1	0.00080	0.00000	0.00080
S6_MH - 89	MH - 89	Wet Industrial	3.45	1	3.45	44900	1	0.00179	0.00000	0.00179
S6_MH - 90	MH - 90	Wet Industrial	6.90	1	6.90	44900	1	0.00359	0.00180	0.00539
S6_MH - 91	MH - 91	Wet Industrial	1.93	1	1.93	44900	1	0.00100	0.00000	0.00100

APPENDIX D

Wastewater Lift Station – Preliminary Pump Selection and System Curves

› **Our technology. Your success.**
Pumps - Valves - Service

Sewatec – Waste Water Pump



Applications:

- Deep Tunnel
- WWTP Inlet Pumping Station
- Waste water transport
- Storm water transport

More information:
www.ksb.com/products

Sewatec/Sewabloc – Waste Water Pump

1 High operating reliability
Double-acting mechanical seal in tandem arrangement with oil reservoir seals off the pumped fluids

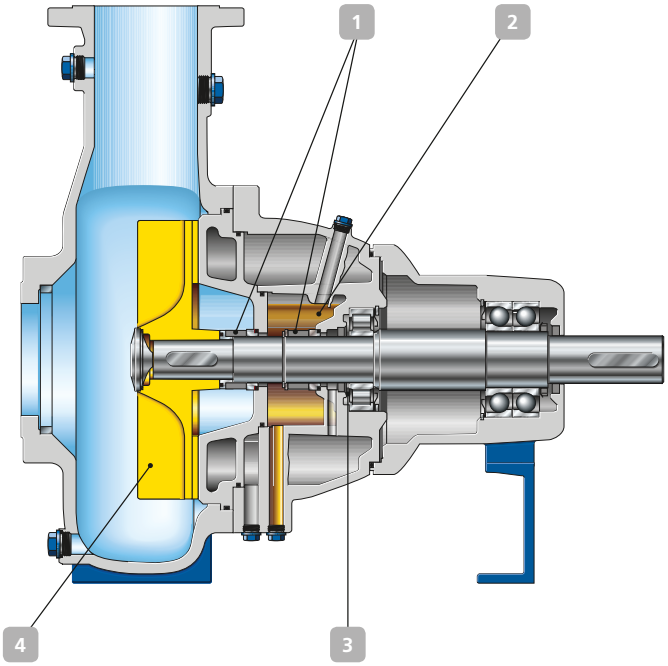
2 Cost reduction
Standardised components are interchangeable within the entire Amarex KRT submersible motor pump series, so spare parts inventories can be optimised

3 Low-maintenance design
Grease-packed rolling element bearings sealed for life

4 Variable hydraulic system
Impellers and casing optimised for handling waste water

Energy savings
When combined with the high-efficiency KSB SuPremE® motor, the pump sets make for significantly reduced operating costs

Variable installation type
see below



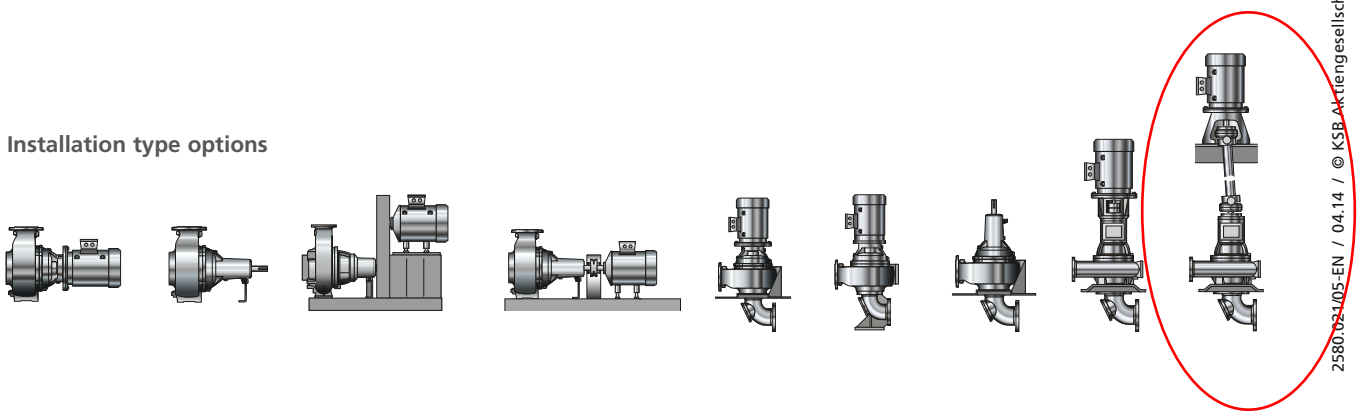
Impellers


Type F Type E Type K Type D

Technical data

Sizes	up to DN 700
Capacity	up to 2,775 l/s
Head	up to 95 m
Discharge pressure	up to 10 bar
Temperature	up to +70 °C

Installation type options



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KSB Aktiengesellschaft
Johann-Klein-Straße 9
67227 Frankenthal (Germany)
www.ksb.com

Data sheet

Customer item no.:Line shaft
Communication dated: 16/04/2020
Doc. no.: Airport Area West Lift station
Quantity: 1

Number: ES 8000363373
Item no.: 100
Date: 29/04/2020

Sewatec K 300-505G V

Version no.: 2

Operating data

Requested flow rate	274.000 l/s	Actual flow rate	274.000 l/s
Requested developed head	24.70 m	Actual developed head	24.70 m
Pumped medium	Wastewater, municipal untreated Not containing chemical and mechanical substances which affect the materials	Efficiency Power absorbed Pump speed of rotation NPSH required	83.8 % 81.60 kW 1189 rpm 3.47 m
Ambient air temperature	20.0 °C	Permissible operating pressure	10.00 bar.g
Fluid temperature	20.0 °C	Discharge press.	2.50 bar.g
Fluid density	1030 kg/m³		
Fluid viscosity	1.00 mm²/s	Min. allow. mass flow	163.97 kg/s
Suction pressure max.	0.00 bar.g	Shutoff head	41.72 m
Static head	9.30 m	Max. allow. mass flow	444.56 kg/s
Mass flow rate	282.29 kg/s	Design	Single system 1 x 100 %
Max. power on curve	84.88 kW	Performance test	Yes
Min. allowable flow rate	159.191 l/s		

Design

Pump standard	KSB-Aggregate North American execution	Manufacturer Type	KSB MG
Design	Vertical bare shaft	Material code	SIC/SIC/NBR
Orientation	Vertical	Impeller type	Multivane radial flow impeller (K-max)
Suction nominal dia.	DN 300		
Suction nominal pressure	CL 125	Wear ring	Casing/impeller wear ring
Suction position	axial	Impeller diameter	414.0 mm
Suction flange drilled according to standard	ASME B 16.1	Free passage size	102.0 mm
		Direction of rotation from drive	Clockwise
Discharge nominal dia.	DN 300	Bearing bracket size	S06
Discharge norminal pressure	CL 125	Bearing seal	Lip seal
Discharge position	top (0°/360°)	Bearing type	Anti-friction bearings
Discharge flange drilled according to standard	ASME B 16.1	Lubrication type	Grease
		Color	Ultramarine blue (RAL 5002) KSB-blue

Standard-EN-flange drilled acc. to ASME FF

Shaft seal	2 mech. seals in tandem arrangement with oil reservoir

Driver, accessories

Baseplate type	Sewatec foundation rails	Drive supplied by	without motor
Baseplate size	U300X800b	Motor const. type	IM3011
Motorside drill	No	Motor size	504/5T
		Frequency	60 Hz
Scope of mounting parts: soleplate and foundation rails		Rated power P2	110.00 kW
Driver type	Electric motor	Available reserve	34.80 %
Drive standard mech.	NEMA	Number of poles	6
Drive standard elec.	NEMA	Suction accessory	Suction elbow

Data sheet

Customer item no.:Line shaft
Communication dated: 16/04/2020
Doc. no.: Airport Area West Lift station
Quantity: 1

Number: ES 8000363373
Item no.: 100
Date: 29/04/2020

Sewatec K 300-505G V

Version no.: 2

Materials G

Pump casing (101)	Cast iron A 48 Class 35 B	Casing wear ring (502.1)	Wear resistant duplex stainless steel
Discharge cover (163)	Cast iron A 48 Class 35 B		
Shaft (210)	Chrome steel A 276 Type 420	Impeller wear ring (503)	Wear resistant duplex stainless steel
Impeller (230)	Cast iron A 48 Class 35 B		
O-Ring (412)	Nitrile rubber NBR	Screwed plug (903)	Steel ST
		Hexagon socket head cap screw (914)	Carbon steel

Packaging

Packaging category	B1 Wooden or plywood case, cover provided with polyproylene cellular sheet, outdoor storage up to 3 months	Packaging for storage	Indoor Outdoor storage at -40°C to +50°C for up to 3 months. Packet must be covered. No corrosion protection, only transport protection.
Packaging for transport	Ship		
IPPC Standard ISPM 15	Yes		

Certifications

		Test participation	Non-witnessed
Hydraulic performance test		Quantity, non-witnessed	1
Acceptance standard	ISO 9906 & ANSI HI Class 2B	Quantity, witnessed	0
Quantity meas. points Q-H	5		
Certificate	Inspection cert. 3.1 to EN 10204		

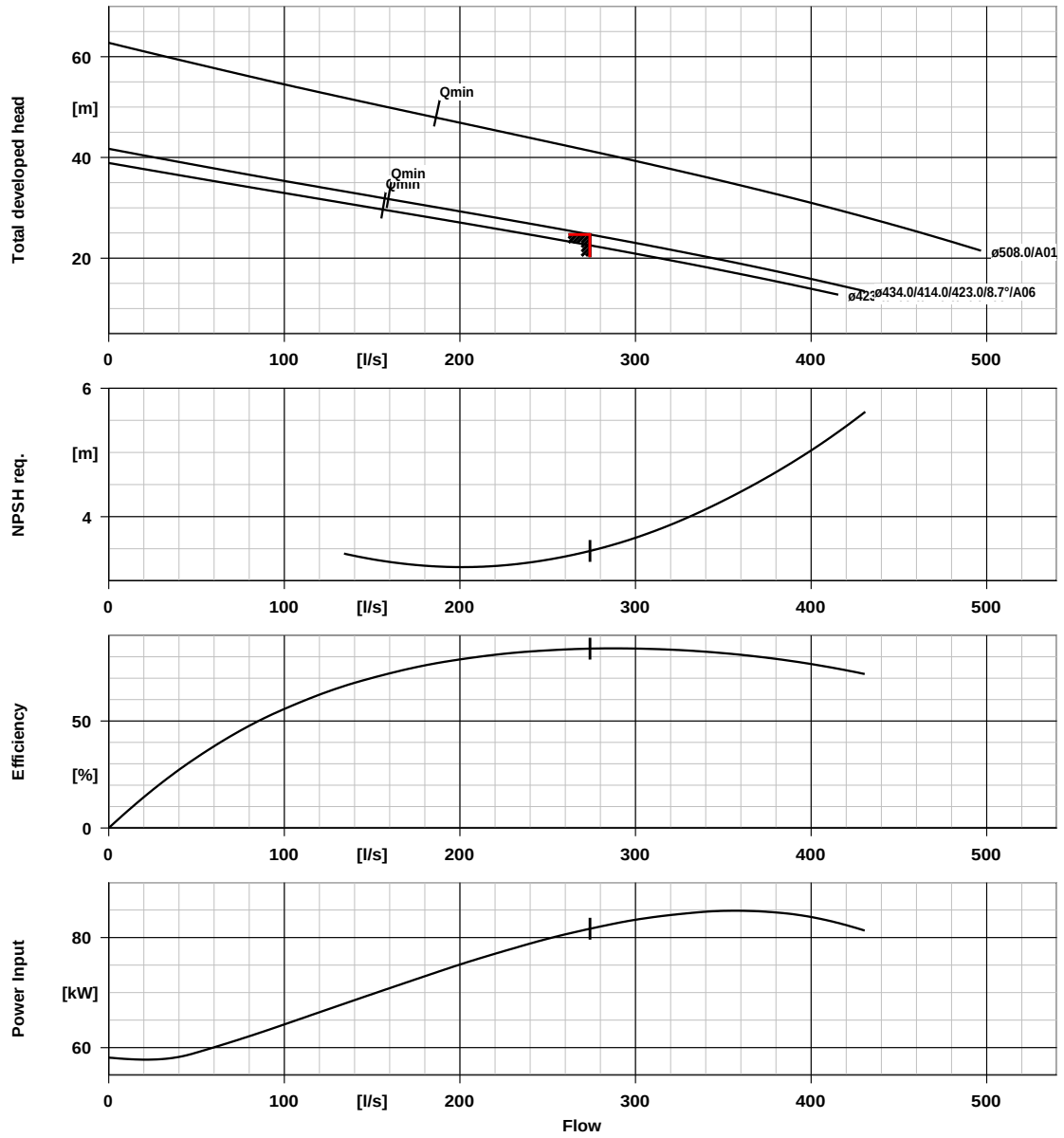
Performance curve

Customer item no.:Line shaft
Communication dated: 16/04/2020
Doc. no.: Airport Area West Lift station
Quantity: 1

Number: ES 8000363373
Item no.:100
Date: 29/04/2020

Version no.: 2

Sewatec K 300-505G V



Curve data

Speed of rotation	1189 rpm	Efficiency	83.8 %
Fluid density	1030 kg/m³	Power absorbed	81.60 kW
Viscosity	1.00 mm²/s	NPSH req. 3%	3.47 m
Flow rate	274.000 l/s	Curve number	K43671
Requested flow rate	274.000 l/s	Effective impeller diameter	414.0 mm
Total developed head	24.70 m	Acceptance standard	ISO 9906 & ANSI HI Class 2B
Requested developed head	24.70 m		

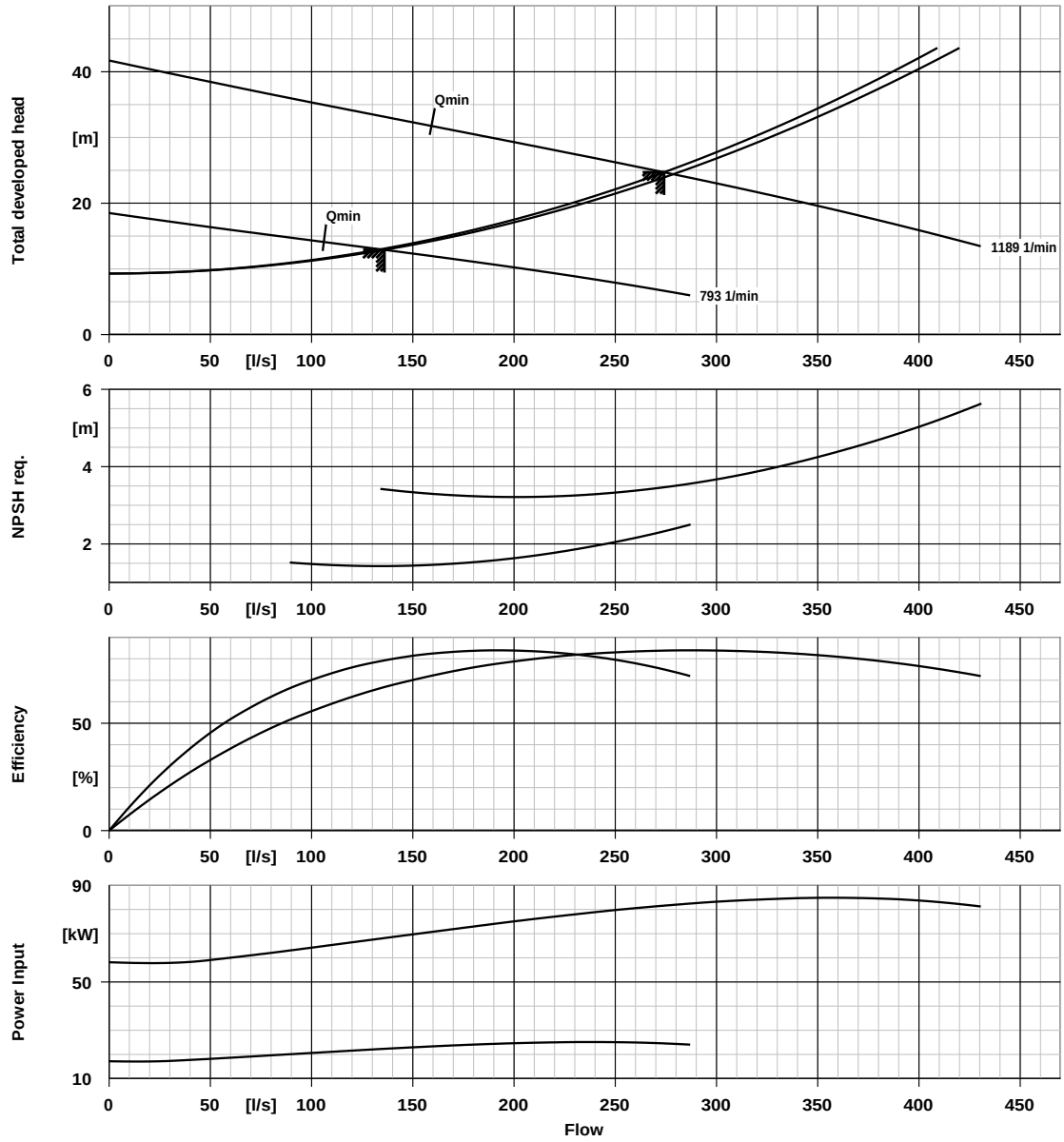
Speed curve

Customer item no.:Line shaft
Communication dated: 16/04/2020
Doc. no.: Airport Area West Lift station
Quantity: 1

Number: ES 8000363373
Item no.:100
Date: 29/04/2020

Sewatec K 300-505G V

Version no.: 2



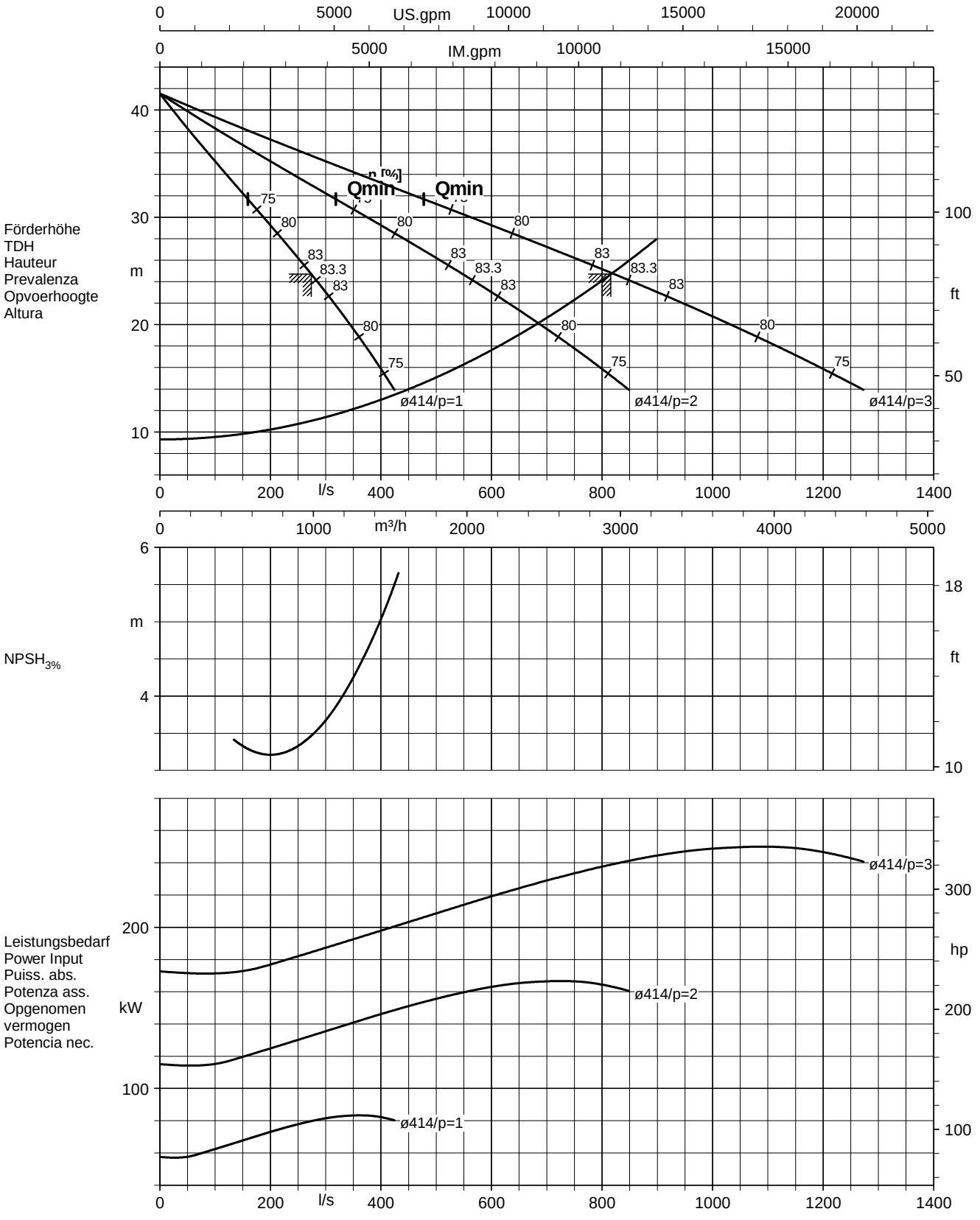
Curve data

Fluid density	1030 kg/m³	Total developed head	24.70 m
Viscosity	1.00 mm²/s	Requested developed head	24.70 m
Flow rate	274.000 l/s	Effective impeller diameter	414.0 mm
Requested flow rate	274.000 l/s		

Baureihe-Größe / Type-Size / Modèle	Tipo / Serie / Tipo	Nenndrehzahl / Nom. speed / Vitesse nom.	Velocità di rotazione nom. / Nominaal toerental / Revolutiones nom.	Laufrad-Ø / Impeller Dia. / Diamètre de roue	Ø Girante / Ø Waaier / Ø Rodete
Amarex KRT 300-505K		1189 1/min		413.5 mm	

Projekt / Project / Projet	Progetto / Projekt / Proyecto	Angebots-Nr. / Project No. / No. de l'offre	Offerta-No. / Offertenr. / Offerta-No.	Pos.-Nr. / Item No. / No. de pos.	Pos.Nr. / Positienr. / Pos.-Nr.

KSB PUMPS INC.
5885 Kennedy Rd.
Mississauga, Ontario, L4Z 2G3
Tel.: 1 905 568-9200
Fax: 1 905 568-3740



Barazandeh, Pasha
CA-Ontario

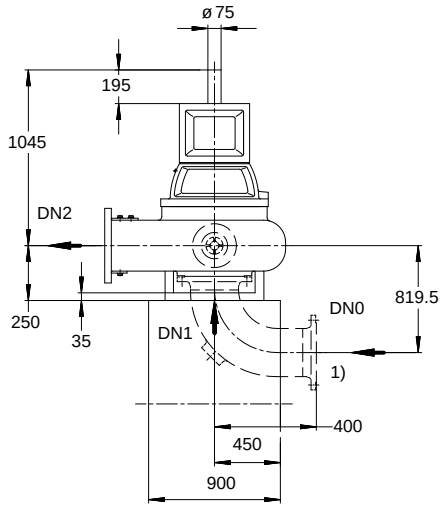
Installation plan

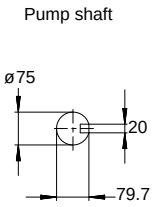
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Communication dated: 16/04/2020
Doc. no.: Airport Area West Lift station
Quantity: 1

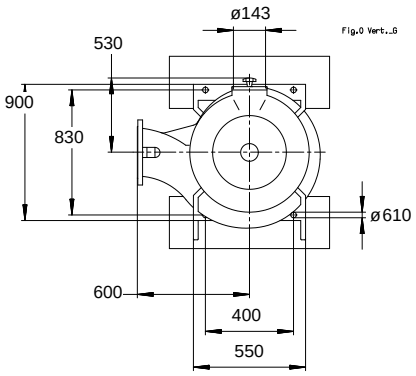
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Item no.:100
Date: 29/04/2020

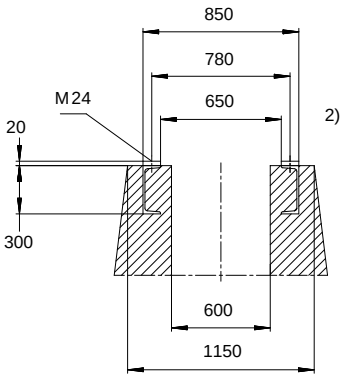
Version no.: 2

Sewatec K 300-505G V









1) Suction elbow available as accessory

2) The soleplate cannot be turned in relation to the foundation

Drawing is not to scale *Dimensions in mm*

Motor

Motor size	504/5T
Motor power	110.00 kW
Number of poles	6
Speed of rotation	1189 rpm

Baseplate

Design	Sewatec foundation rails
Size	U300X800b
Material	Steel ST
Leakage drain baseplate (8B)	Rp1, Without

Connections

Acceleration elbow diameter DN0	DN 400
Suction nominal size DN1	DN 300 / ASME B 16.1
Discharge nominal size DN2	DN 300 / ASME B 16.1
Nominal pressure suct.	CL 125
Rated pressure disch.	CL 125

Standard-EN-flange drilled acc. to ASME FF

Weight net

Pump	820 kg
Baseplate	82 kg
Suction side accessory	93 kg
Total	995 kg

Connect pipes without stress or strain!

For auxiliary connections see

Installation plan

Customer item no.:Line shaft
Communication dated: 16/04/2020
Doc. no.: Airport Area West Lift station
Quantity: 1

Number: ES 8000363373
Item no.:100
Date: 29/04/2020

Version no.: 2

Sewatec K 300-505G V

Dimensional tolerances for shaft axis height:	DIN 747	**separate drawing.**
Dimensions without tolerances, middle tolerances to:	ISO 2768-m	
Connection dimensions for pumps:	EN735	
Dimensions without tolerances - welded parts:	ISO 13920-B	
Dimensions without tolerances - gray cast iron parts:	ISO 8062-CT9	

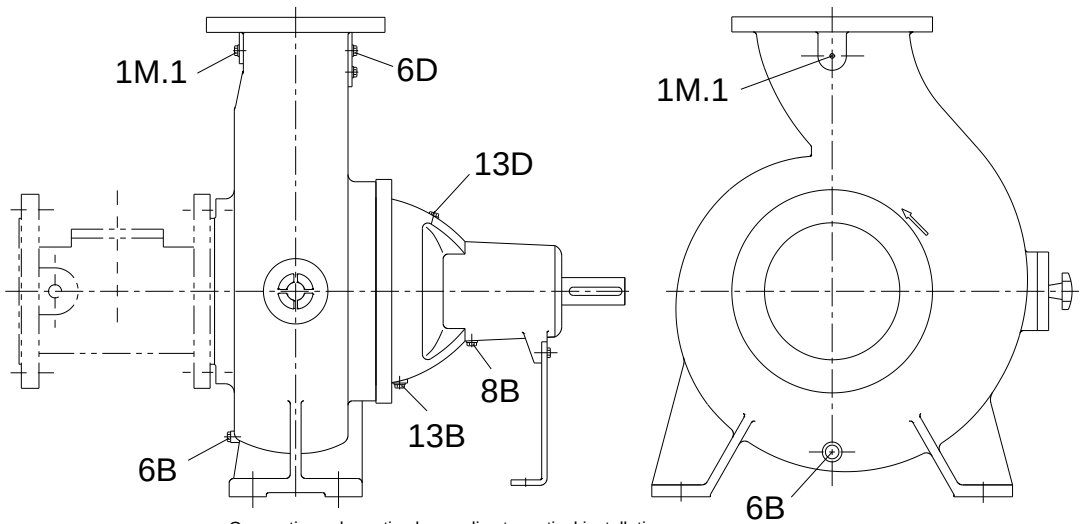
Connection plan

Customer item no.:Line shaft
Communication dated: 16/04/2020
Doc. no.: Airport Area West Lift station
Quantity: 1

Number: ES 8000363373
Item no.:100
Date: 29/04/2020

Version no.: 2

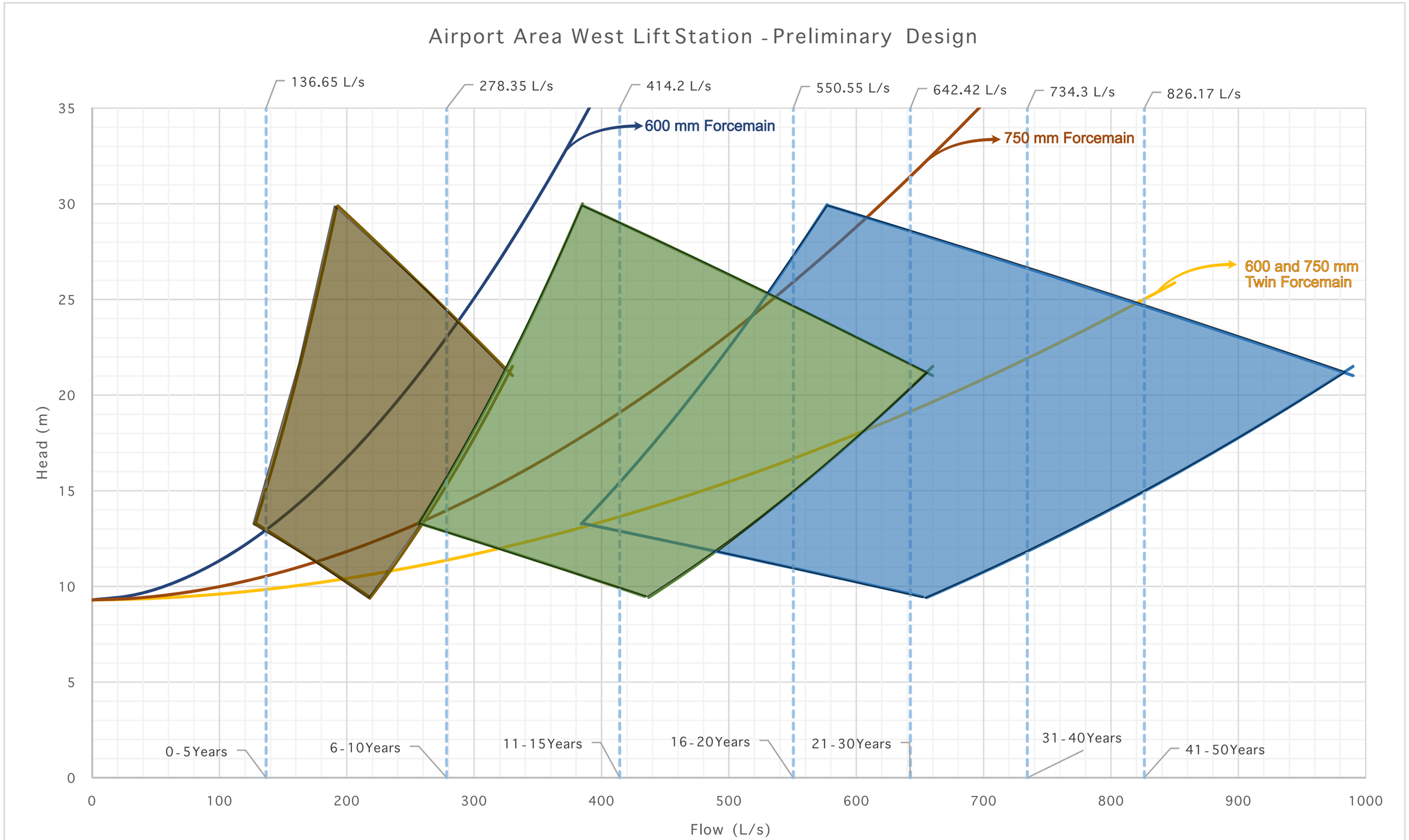
Sewatec K 300-505G V



Connection schematic also applies to vertical installation.

Connections

1M.1 Pressure gauge connection	G 1/2	Drilled and plugged.
6B Pumped liquid drain	G 1	Drilled and plugged.
6D Pumped medium - filling / venting		Drilled and plugged.
8B Leakage drain	G 1/2	Drilled and plugged.
13B Oil drain	G 1/2	Drilled and plugged.
13D Refill / venting	G 1/2	Drilled and plugged.


Airport Area West Lift Station - Preliminary Design
136.65 L/s
278.35 L/s
414.2 L/s
550.55 L/s
642.42 L/s
734.3 L/s
826.17 L/s
600 mm Forcemain
750 mm Forcemain
600 and 750 mm
Twin Forcemain
0-5 Years
6-10 Years
11-15 Years
16-20 Years
21-30 Years
31-40 Years
41-50 Years
Head (m)
Flow (L/s)
0
5
10
15
20
25
30
35
0
100
200
300
400
500
600
700
800
900
1000

APPENDIX E

Easement and Land Acquisition Table

Land Agreements Table

Infrastructure Type	Alignment Reference	From Station	To Station	Drawing Sheet Reference[2]	Land Owner	Anticipated Land Agreement Type	Proposed Width (m)[3]	Proposed Length (m)	Proposed Area (m^2)
Wastewater Lift Station	n/a	n/a	n/a	C-203	Province of Manitoba	Purchase	-	-	11000
750 Interceptor	CentrePort Canada Way	1+960	2+270	C-202	2-Private Owners	Purchase	15	352	5280
750 FCM, 600 FCM	CentrePort Canada Way	7+990	8+020	C-216	Private Owner	Purchase	12	44	528
750 FCM, 600 FCM	CentrePort Canada Way	8+760	8+810	C-217	Private Owner	Purchase	12	64	768
750 FCM, 600 FCM	Sturgeon Road	5+740	6+000	C-212	Province of Manitoba	Easement	12	330	3960
750 FCM, 600 FCM	Sturgeon Road	6+000	6+380	C-212 to C-213	Province of Manitoba	Easement	12	455	5460
750 FCM, 600 FCM	CentrePort Canada Way	6+690	7+550	C-214 to C-215	Province of Manitoba	Easement	12	868	10416
750 FCM, 600 FCM	CentrePort Canada Way	7+570	7+590	C-215	Province of Manitoba	Easement	12	19	228
750 FCM, 600 FCM	CentrePort Canada Way	7+590	7+990	C-215 to C-216	Province of Manitoba	Easement	12	405	4860
750 FCM, 600 FCM	CentrePort Canada Way	8+070	8+760	C-216 to C-217	RM of Rosser/Province of Manitoba	Easement	12	372	4464
750 FCM, 600 FCM	CentrePort Canada Way	8+810	9+050	C-217	RM of Rosser/Province of Manitoba	Easement	12	328	3936
750 FCM, 600 FCM	CentrePort Canada Way	9+050	10+500	C-217 to C-219	Province of Manitoba	Easement	12	1467	17604
750 FDM	Sturgeon Road	3+970	3+990	C-205	Railway	Crossing	1 x 0.75	20	-
750 FCM, 600 FCM	CentrePort Canada Way	7+550	7+570	C-215	CP Railway	Crossing	1 x 0.75, 1 x 0.60	51	-
750 FCM, 600 FCM	CentrePort Canada Way	8+020	8+070	C-216	CP Railway	Crossing	1 x 0.75, 1 x 0.60	31	-

Notes:

1. Stationing in the table above relates to the specific referenced alignment on our drawings which is not always parallel to the pressure pipes. Therefore, the difference between the From and To stations in this table does not necessarily represent an accurate length measurement along the pipes and should not be taken as such.

2. Actual land acquisition/easement areas are not shown on the preliminary design drawings.

3. The Proposed Width as outlined in this table is based on the following cross section assumptions:

- an excavation depth of 3.5 m with 1:1 sideslopes,

- installation of both force mains (1 x 0.75 m diameter and 1 x 0.60 m diameter) in a common trench,

- 1.0 m spacing between the two proposed force main pipes, and

- 0.5 m spacing between the edge of pipe and the edge of excavation.

APPENDIX F

Basis of Estimate (BoE) Tables

Basis of Estimate Capital Cost Detail

Investment Title	Airport Area West Water and Sewer Servicing (Unfunded Capital Only)
BC ID	BC_WWD_DC_2018_0256 (Unfunded)
Estimate Date	September 1, 2020
Is this a Major Capital project?	Yes
In Service Year	2023
Class of Estimate	Class 3

ESTIMATE DETAIL

	Cost Escalation / Capital Inflation		3%	3%	3%	3%	3%	3%	
		Estimate Year	Year Project Work Undertaken						
		2020	2023	2028	2033	2038	2043	2053	Total
Construction/Equipment Costs	% of Const.	($000's)							
Phase 1A	0%		$0	$0	$0	$0	$0	$0	$0
By-pass Lift Station	4%	$3,042	$3,325	$0	$0	$0	$0	$0	$3,325
600 mm Force Main	18%	$14,873	$16,253	$0	$0	$0	$0	$0	$16,253
Interceptor and Intake Sewers	12%	$10,064	$10,998	$0	$0	$0	$0	$0	$10,998
750 mm Feeder Main (Silver to OS3)	20%	$16,355	$17,872	$0	$0	$0	$0	$0	$17,872
	0%		$0	$0	$0	$0	$0	$0	$0
Phase 1B	0%		$0	$0	$0	$0	$0	$0	$0
Lift Station sub/superstructure and associated mechanical and electrical to support development for years 6-10	11%	$9,072	$0	$11,493	$0	$0	$0	$0	$11,493
400 mm Secondary Supply Main	4%	$3,202	$0	$4,057	$0	$0	$0	$0	$4,057
	0%		$0	$0	$0	$0	$0	$0	$0
Phase 1C	0%		$0	$0	$0	$0	$0	$0	$0
Lift Station Mechanical upgrades to support development for years 11 – 50	2%	$1,504	$0	$0	$2,209	$0	$0	$0	$2,209
750 mm Force Main	18%	$14,634	$0	$0	$21,491	$0	$0	$0	$21,491
	0%		$0	$0	$0	$0	$0	$0	$0
Phase 2	0%		$0	$0	$0	$0	$0	$0	$0
750 mm Feeder Main (from OS3 to OS4)	4%	$3,564	$0	$0	$0	$0	$7,034	$0	$7,034
	0%		$0	$0	$0	$0	$0	$0	$0
Phase 3	0%		$0	$0	$0	$0	$0	$0	$0
Wastewater upgrades to the Interceptor Sewer.	8%	$6,687	$0	$0	$0	$0	$0	$17,737	$17,737
	0%		$0	$0	$0	$0	$0	$0	$0
Construction Costs Sub-total	100%	**$82,997**	**$48,448**	**$15,550**	**$23,700**	**$0**	**$7,034**	**$17,737**	**$112,469**
Consultant Costs (Internal & External)	% of Const	($000's)							
Total Consulting Costs (broken out by phase below)	0%		$0	$0	$0	$0	$0	$0	$0
Detailed Design & Studies - $5,022	0%		$0	$0	$0	$0	$0	$0	$0
Contract Administration - $6,696	0%		$0	$0	$0	$0	$0	$0	$0
Post-Construction Services - $837	0%		$0	$0	$0	$0	$0	$0	$0
	0%		$0	$0	$0	$0	$0	$0	$0
Phase 1A	8%	$6,650	$7,267	$0	$0	$0	$0	$0	$7,267
Phase 1B	2%	$1,841	$0	$2,333	$0	$0	$0	$0	$2,333
Phase 1C	3%	$2,421	$0	$0	$3,555	$0	$0	$0	$3,555
Phase 2	1%	$535	$0	$0	$0	$0	$1,056	$0	$1,056
Phase 3	1%	$1,003	$0	$0	$0	$0	$0	$2,661	$2,661
	0%		$0	$0	$0	$0	$0	$0	$0
Consultant Costs Sub-total	15%	**$12,450**	**$7,267**	**$2,333**	**$3,555**	**$0**	**$1,056**	**$2,661**	**$16,872**
Construction & Consultant Sub-total		**$95,447**	**$55,715**	**$17,883**	**$27,255**	**$0**	**$8,090**	**$20,398**	**$129,341**
Utility Costs	% C&C	($000's)							
Total Utility Costs (broken out by phase below)	0%		$0	$0	$0	$0	$0	$0	$0
Wastewater Lift Station - $210	0%		$0	$0	$0	$0	$0	$0	$0
Force Main - $50	0%		$0	$0	$0	$0	$0	$0	$0
Feeder Main and Secondary Supply Main - $50	0%		$0	$0	$0	$0	$0	$0	$0
	0%		$0	$0	$0	$0	$0	$0	$0
Phase 1A	0%	$310	$339	$0	$0	$0	$0	$0	$339
Phase 1B	0%	$0	$0	$0	$0	$0	$0	$0	$0
Phase 1C	0%	$0	$0	$0	$0	$0	$0	$0	$0
Phase 2	0%	$0	$0	$0	$0	$0	$0	$0	$0
Phase 3	0%	$0	$0	$0	$0	$0	$0	$0	$0
	0%		$0	$0	$0	$0	$0	$0	$0
Utility Costs Sub-total	0%	**$310**	**$339**	**$0**	**$0**	**$0**	**$0**	**$0**	**$339**
Other Costs	% C&C	($000's)							
Land Acquisition	0%		$0	$0	$0	$0	$0	$0	$0
Permits - $55	0%		$0	$0	$0	$0	$0	$0	$0
City Project Manager ($110 + 20%/year) - see tab Rationale 3 - $1716 (Divided by Phase)	0%		$0	$0	$0	$0	$0	$0	$0
Land Acquisition - $334 (inc in Phase 1A)	0%		$0	$0	$0	$0	$0	$0	$0
Phase 1A	1%	$785	$858	$0	$0	$0	$0	$0	$858
Phase 1B	1%	$660	$0	$837	$0	$0	$0	$0	$837
Phase 1C	1%	$660	$0	$0	$970	$0	$0	$0	$970
Phase 2	0%	$0	$0	$0	$0	$0	$0	$0	$0
Phase 3	0%	$0	$0	$0	$0	$0	$0	$0	$0
	0%		$0	$0	$0	$0	$0	$0	$0
Other Costs Sub-total	2%	**$2,105**	**$858**	**$837**	**$970**	**$0**	**$0**	**$0**	**$2,665**
Project Costs before Contingencies Sub-total		**$97,862**	**$56,912**	**$18,720**	**$28,225**	**$0**	**$8,090**	**$20,398**	**$132,345**
Contingencies Costs	% Proj Cost	($000's)							
Total Contingency Costs (broken out by phase below)	0%		$0	$0	$0	$0	$0	$0	$0
Construction Cost Contingency (10% on Construction Cost) - $8,300	0%		$0	$0	$0	$0	$0	$0	$0
Engineering Fee Contingency (10% on Engineering) - $1,245	0%		$0	$0	$0	$0	$0	$0	$0
Schedule Delay Contingency (3% on Construction and Engineering) - $2,863	0%		$0	$0	$0	$0	$0	$0	$0
	0%		$0	$0	$0	$0	$0	$0	$0
Phase 1A	7%	$6,628	$7,243	$0	$0	$0	$0	$0	$7,243
Phase 1B	2%	$1,835	$0	$2,325	$0	$0	$0	$0	$2,325
Phase 1C	2%	$2,413	$0	$0	$3,544	$0	$0	$0	$3,544
Phase 2	1%	$533	$0	$0	$0	$0	$1,052	$0	$1,052
Phase 3	1%	$1,000	$0	$0	$0	$0	$0	$2,653	$2,653
	0%		$0	$0	$0	$0	$0	$0	$0
Contingencies Costs Sub-total	13%	**$12,409**	**$7,243**	**$2,325**	**$3,544**	**$0**	**$1,052**	**$2,653**	**$16,817**
Project Sub-total before Administrative Charges Subtotal		**$110,271**	**$64,155**	**$21,045**	**$31,769**	**$0**	**$9,142**	**$23,051**	**$149,162**
							% increase from base		135%
Administrative Charges Detail									
Administrative Charges (** consult department Finance*)									
Departmental Staff	0.00%	$0	$0	$0	$0	$0	$0	$0	$0
Corporate Admin (max $100,000)	1.25%	$100	$100	$0	$0	$0	$0	$0	$100
Municipal Accommodations charges (if delivering the project)	0.00%	$0	$0	$0	$0	$0	$0	$0	$0
Research (SMIR) (Construction Only, only applies to Public Works)	0.00%	$0	$0	$0	$0	$0	$0	$0	$0
Corporate Interest	2.00%	$2,206	$1,283	$421	$635	$0	$183	$461	$2,983
Administrative Charges Sub-total	-	**$2,306**	**$1,383**	**$421**	**$635**	**$0**	**$183**	**$461**	**$3,083**
Project Sub-total before Interest Charges Sub-total		**$112,576**	**$65,538**	**$21,466**	**$32,404**	**$0**	**$9,325**	**$23,512**	**$152,245**
Eligible Costs Detail									
INELIGIBLE COSTS:									
Land Acquisition		$0	$0	$0	$0	$0	$0	$0	$0
Administrative Charges		$2,306	$1,383	$421	$635	$0	$183	$461	$3,083
Sub total Ineligible Costs		$2,306	$1,383	$421	$635	$0	$183	$461	$3,083
TOTAL ELIGIBLE COSTS		**$110,271**	**$64,155**	**$21,045**	**$31,769**	**$0**	**$9,142**	**$23,051**	**$149,162**
Assumed City Contribution (%)			0%	0%	0%	0%	0%	0%	
City's Share of Eligible Project Costs		$0	$0	$0	$0	$0	$0	$0	$0
Interest Charges Detail									
If the project is a major capital project zero out corporate interest percentage in the administrative charges section and enter the rates for interim and long-term:									
Internal Interest Charges			$0	$0	$0	$0	$0	$0	$0
Internal Rate									
Long-Term Rate									
External Debt Interest Charges				$0	$0	$0	$0	$0	$0
Interest Charges Sub-total			**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Total Ineligible Costs (Land Acquisition + Administration + Interest)			**$1,383**	**$421**	**$635**	**$0**	**$183**	**$461**	**$3,083**
Total City Costs (Portion of Eligible + Total Ineligible			**$1,383**	**$421**	**$635**	**$0**	**$183**	**$461**	**$3,083**
Total 3rd Party Costs (Total Project Costs - Total City Costs)			**$64,155**	**$21,045**	**$31,769**	**$0**	**$9,142**	**$23,051**	**$149,162**
TOTAL CAPITAL PROJECT COST		**$112,576**	**$65,538**	**$21,466**	**$32,404**	**$0**	**$9,325**	**$23,512**	**$152,245**

Basis of Estimate Operating Cost Detail

Investment	**Airport Area West Water and Sewer Servicing (Unfunded Capital Only)**
BC ID	**BC_WWD_DC_2018_0256 (Unfunded)**

Operating Budget Impact Detail Table

IN SERVICE YEAR - Please note that interest is charged to the project until the asset is in service at which time interest is then charged to the operating budget.

	Estimate Year	Year of Operating Impact					
NET OPERATING IMPACT ($000's)	2020	2023	2028	2033	2038	2043	2053
Operating Costs		$2,590	$2,861	$3,158	$3,487	$3,849	$4,692
Debt & Finance Charges		$0	$0	$0	$0	$0	$0
Total Direct Costs		$2,590	$2,861	$3,158	$3,487	$3,849	$4,692
Less: Incremental Revenue/Recovery							
Net Cost/(Benefit)		**$2,590**	**$2,861**	**$3,158**	**$3,487**	**$3,849**	**$4,692**
Incremental Full Time Equivalent Positions							
Cost Escalation / Operating Budget Inflation		2%	2%	2%	2%	2%	2%

Budget Impact Detail

OPERATING COSTS

Salaries and Benefits (consult finance/HR) ($000's) — Enter in current dollars in yellow highlighted cells. Inflation will be automatically calculated.

							EXPLANATION/ASSUMPTIONS
Wastewater Lift Station	$117	$117	$117	$117	$117	$117	General Inspections on Bi-Weekly basis (assuming 2 man team and 8h/inspection), Equipment removal and overhaul (assume a pump/motor per year and 2 man team and 80 hours for installation and removal), Minor repairs to electrical/process mechanical/mechanical/structural (assume 2 man team and 6 instance/year and 16 hours/instance)
Force Main							
Feeder Main and Secondary Supply Main							
Interceptor and Intake Sewers							
Sub-total	$117	$117	$117	$117	$117	$117	
Sub-total with Inflation	$124	$138	$152	$168	$185	$225	

Operation & Maintenance Costs (consult operations) ($000's)

							EXPLANATION/ASSUMPTIONS
Wastewater Lift Station	$1,798	$1,798	$1,798	$1,798	$1,798	$1,798	Cell: BQ3
Force Main	$316	$316	$316	$316	$316	$316	Cell: M84
Feeder Main and Secondary Supply Main	$184	$184	$184	$184	$184	$184	Cell: M110
Interceptor and Intake Sewers	$25	$25	$25	$25	$25	$25	Cell: M138
Sub-total	$2,324	$2,324	$2,324	$2,324	$2,324	$2,324	
Sub-total with Inflation	$2,466	$2,723	$3,006	$3,319	$3,664	$4,467	

DEBT & FINANCING CHARGES

Debt & Finance Charges (consult finance) ($000's)

							EXPLANATION/ASSUMPTIONS
Interest							
Principle	2.10%						
Sub-total	$0	$0	$0	$0	$0	$0	
Sub-total with Inflation	$0	$0	$0	$0	$0	$0	

Item	Description	Unit	Quantity	Unit Cost	Cost
A	**Wastewater Lift Station**				
A.1	Site saftey, overhead, office, profit, bonding, insurance, transportation, temporary facilities, groundwater pump operation	ls	1	$ 1,614,770	$ 1,614,770
A.2	Sub Structure (including Structural Excavation, Shoring and Backfill)	ls	1	$ 3,341,944	$ 3,341,944
A.3	Super Structure	ls	1	$ 451,164	$ 451,164
A.4	By-Pass Pumping Manhole/Chamber	ls	1	$ 1,083,389	$ 1,083,389
A.5	Process Mechanical Systems (Supply and Install)	ls	1	$ 2,500,340	$ 2,500,340
A.6	Odour Control	ls	1	$ 265,164	$ 265,164
A.7	Plumbing and HVAC Mechanical Systems	ls	1	$ 750,000	$ 750,000
A.8	Electrical, Instrumentation, and Control Systems	ls	1	$ 1,374,051	$ 1,374,051
A.9	Groundwater Pump Installation and Testing	ls	1	$ 250,000	$ 250,000
A.10	Commissioning, Testing and Startup	ls	1	$ 59,729	$ 59,729
A.11	Mobilisation and Demobilisation	ls	1	$ 300,482	$ 300,482
A.12	Site Development, Drainage, Approach and Parking	ls	1	$ 388,870	$ 388,870
A.13	Miscellaneaous (Provisionals)	ls	1	$ 1,237,990	$ 1,237,990
	Wastewater Lift Station Sub-Total (Class 3)				**$ 13,617,893**
	Stage 1.1 (Year 0)				$ 3,042,100
	Stage 1.2 (Year 5)				$ 9,071,955
	Stage 2 & 3 (Year 10)				$ 1,503,837
	Permits				$ 30,000
	Utility Servicing Costs				$ 210,000
	Land Acquisition	ha	1.1	$ 185,330	$ 203,863
	Wastewatere Lift Station Total (Class 3)				**$ 14,061,756**
	Average Annual O&M				$ 364,350

Item	Description	Unit	Quantity	Unit Cost	Cost
B	**Force Main**				
B.1	600mm PVC DR25				
a	Open Cut/Trenchless	m	6995	$ 1,500	$ 10,492,500
b	Trenchless	m	150	$ 1,500	$ 225,000
B.2	600mm PVC DR25 in Steel Casing Pipe				
a	Trenchless	m	195	$ 2,325	$ 453,375
B.3	750mm PVC DR25				
a	Open Cut/Trenchless	m	6995	$ 1,700	$ 11,891,500
b	Trenchless	m	150	$ 1,700	$ 255,000
B.4	750mm PVC DR25 in Steel Casing Pipe				
a	Trenchless	m	195	$ 2,635	$ 513,825
B.5	Air control chambers	ea	9	$ 100,000	$ 900,000
B.6	Gate valve and cleanout chambers	ea	2	$ 75,000	$ 150,000
B.7	Drain chambers	ea	3	$ 65,000	$ 195,000
B.8	Connection to Existing Infrastructure	ls	2	$ 50,000	$ 100,000
B.9	Construction of Granular Mainenance Access Pullouts	ea	11	$ 15,000	$ 165,000
B.10	Site Development and Restoration	ls	1	$ 1,266,459	$ 1,266,459
B.11	Miscellaneaous (Provisionals)	ls	1	$ 2,660,766	$ 2,660,766
B.12	Changing ground conditions	ls	1	$ 238,312.00	$ 238,312.00
				Force Main Sub-Total (Class 3)	**$ 29,506,736**
				Stage 1.0 (Year 0)	$ 14,872,812
				Stage 2.0 (Year 10)	$ 14,633,924
				Permits	$ 10,000
				Utility Relocations	$ 50,000
	Land Acquisition	ha	0.7	$ 185,330	$ 129,731
				Force Main Total (Class 3)	**$ 29,696,467**
				Average Annual O&M	$ 63,220

Item	Description	Unit	Quantity	Unit Cost	Cost
C	**Feeder Main and Secondary Supply Main**				
C.1	400 mm DR18 PVC Pipe				
a)	Open Cut/Trenchless	m	1121	$ 1,300	$ 1,457,300
C.3	750 mm DR18 PVC Pipe				
a)	Open Cut/Trenchless	m	5020	$ 1,700	$ 8,534,000
C.4	750mm PVC DR25 in Steel Casing Pipe				$ -
a)	Trenchless	m	41	$ 2,635	$ 108,035
C.5	400 mm DR18 PVC Pipe - Fittings	ls	1	$ 72,865	$ 72,865
C.6	750 mm DR18 PVC Pipe - Fittings	ls	1	$ 432,102	$ 432,102
C.7	Hydrant Assemblies	ea	12	$ 9,800	$ 117,600
C.8	Offtake Chambers	ea	6	$ 500,000	$ 3,000,000
C.9	Valve Chambers	ea	2	$ 200,000	$ 400,000
C.10	Air Release Chambers	ea	2	$ 75,000	$ 150,000
C.11	Pressure Monitoring Station	ea	1	$ 100,000	$ 100,000
C.12	Pressure Test and Disinfection (or Commisioning)	ea	1	$ 50,000	$ 50,000
C.13	Site Development and Restoration	ls	1	$ 736,534	$ 736,534
C.14	Miscellaneaous (Provisionals)	ls	1	$1,515,844	$ 1,515,844
C.15	Changing ground conditions	ls	1	$ 100,993	$ 100,993
	Feeder Main and Secondary Supply Main Sub-Total (Class 3)				**$ 16,775,273**
	Stage 1.0 (Year 0)				$10,008,800
	Stage 2.0 (Year 5)				$3,202,414
	Stage 3.0 (Year 20)				$3,564,058
	Permits				$ 10,000
	Utility Relocations				$ 50,000
	Feeder Main and Secondary Supply Main Total (Class 3)				**$ 16,835,273**
	Average Annual O&M				$ 36,749

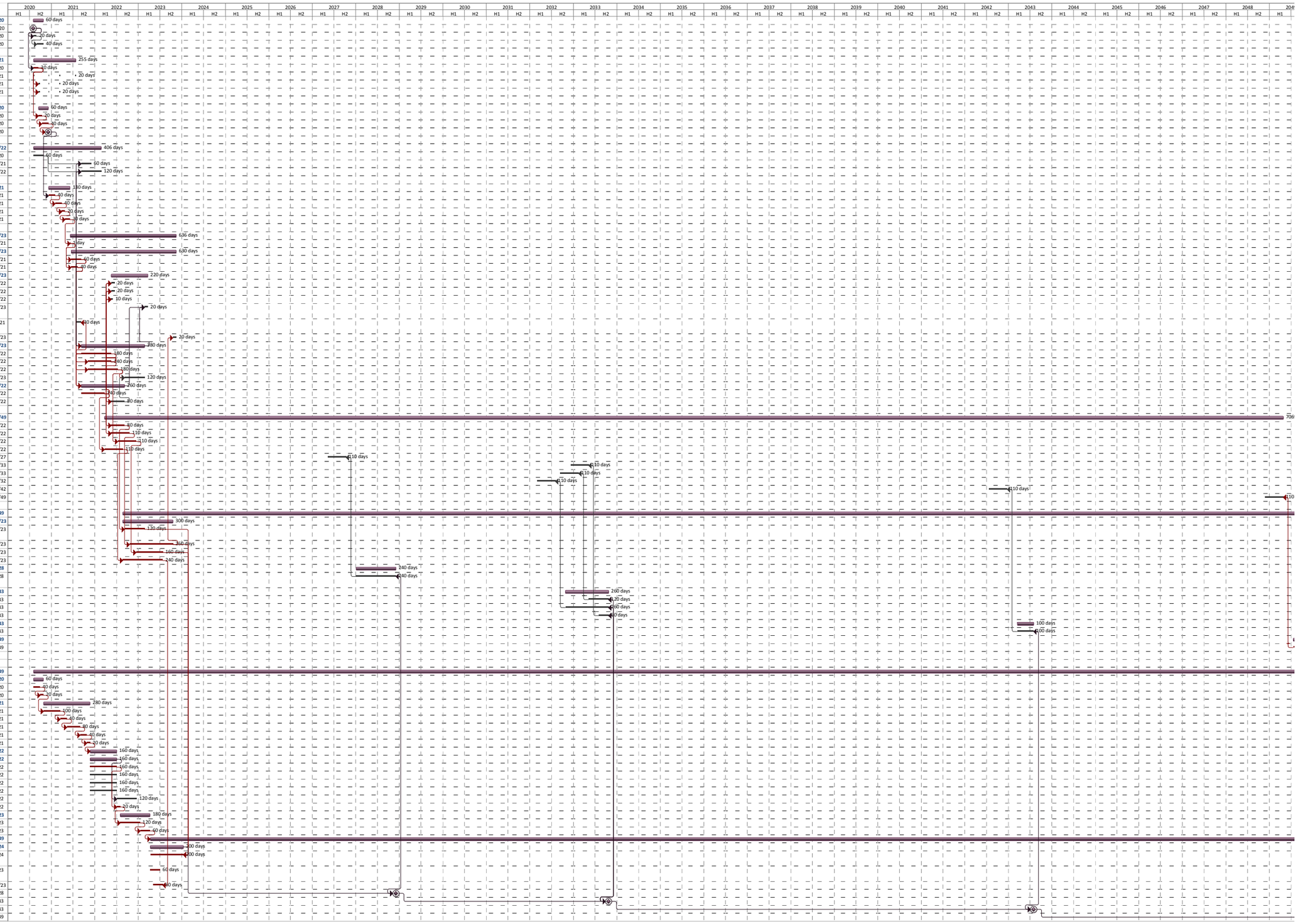
Item	Description	Unit	Quantity	Unit Cost	Cost
D	**Interceptor and Intake Sewers**				
D.1	900 mm C76 - Class V - In Bedrock	m	780	$ 10,492	$ 8,183,995
D.2	900 mm C76 - Class V -In Overburden Soils	m	415	$ 3,420	$ 1,419,300
D.3	1200 mm C76 - Class V - In Bedrock	m	70	$ 10,492	$ 734,461
D.4	Construction of Microtunneling Shafts				
a)	Construction in Overburden Soils	v.m	22.4	$ 59,410	$ 1,330,793
b)	Construction within Bedrock (To a Depth of 1.2m Below Carrier Pipe Invert)	v.m	15.6	$ 125,186	$ 1,952,905
D.5	Disc Change	ea	1	$ 250,000	$ 250,000
D.6	Jet Grouting	ls	1	$ 250,000	$ 250,000
D.7	Upgrades to Existing Sewer System				
a)	1050 mm C76- Class IV or V	m	1312	$ 4,180	$ 5,484,160
b)	Manhole 2400mm Diameter Base	vert. m	24	$ 10,000	$ 240,000
c)	Connection to Existing Manhole 1050mm to MH	ea	2	$ 5,000	$ 10,000
D.8	Site Development and Restoration	ls	1	$ 997,008	$ 997,008
D.9	Miscellaneaous (Provisionals)	ls	1	$2,085,262	$ 2,085,262
D.10	Changing ground conditions	ls	1	$158,219	$ 158,219
	Interceptor and Intake Sewer Sub-Total (Class 3)				**$ 23,096,102**
	Stage 1.0 (Year 0)				$16,409,530
	Stage 2.0 (Year 30)				$6,686,572
	Permits				$ 5,000
	Interceptor and Intake Sewer Total (Class 3)				**$ 23,101,102**
	Average Annual O&M				$ 5,060

APPENDIX G

Schedule

Airport Area West Retional Water and Wastewater Preliminary Design - Project Schedule

ID	Task Name	Duration	Start	Finish
1	**Preliminary Design Study**	**60 days**	**Sat 01/08/20**	**Fri 23/10/20**
2	Submit Study to City	0 days	Sat 01/08/20	Sat 01/08/20
3	Water and Waste Administrative Report	20 days	Mon 03/08/20	Fri 28/08/20
4	Review of Study (WW Committee, EPC, Council)	40 days	Mon 31/08/20	Fri 23/10/20
5				
6	**City Public Engagement process**	**255 days**	**Mon 03/08/20**	**Fri 23/07/21**
7	General Public - Online Process	30 days	Mon 03/08/20	Fri 11/09/20
8	Key Stakeholders (Owners, Developers, Centerport)	20 days	Mon 03/08/20	Fri 23/07/21
9	Manitoba Infrastructure	20 days	Mon 14/09/20	Fri 12/03/21
10	RM of Rosser	20 days	Mon 14/09/20	Fri 12/03/21
11				
12	**Regional Infrastructure Funding**	**60 days**	**Mon 14/09/20**	**Fri 04/12/20**
13	Preparation of Administrative Report/Business Case	20 days	Mon 14/09/20	Fri 09/10/20
14	Council Reviews Report	40 days	Mon 12/10/20	Fri 04/12/20
15	**Council Approves Funding of Regional Infrastructure (Day 0**	0 days	Fri 04/12/20	Fri 04/12/20
16				
17	**Land Use Planning**	**406 days**	**Mon 03/08/20**	**Mon 21/02/22**
18	Initiate Discssions with Land Owners	60 days	Mon 03/08/20	Fri 23/10/20
19	Aquire Easements	60 days	Tue 07/09/21	Mon 29/11/21
20	Purchase Land	120 days	Tue 07/09/21	Mon 21/02/22
21				
22	**Procure Consultant**	**130 days**	**Mon 07/12/20**	**Fri 04/06/21**
23	Draft Consultant RFP	40 days	Mon 07/12/20	Fri 29/01/21
24	Tender Period	40 days	Mon 01/02/21	Fri 26/03/21
25	Review Period	20 days	Mon 29/03/21	Fri 23/04/21
26	Award Period	30 days	Mon 26/04/21	Fri 04/06/21
27				
28	**Detailed Design of Regional Infrastructure**	**636 days**	**Mon 07/06/21**	**Mon 13/11/23**
29	Project Initiation	1 day	Mon 07/06/21	Mon 07/06/21
30	**Studies**	**630 days**	**Tue 15/06/21**	**Mon 13/11/23**
31	Geotechnical Investigation	60 days	Tue 15/06/21	Mon 06/09/21
32	Topographic Survey	40 days	Tue 15/06/21	Mon 09/08/21
33	**Environmental Studies**	**220 days**	**Tue 17/05/22**	**Mon 20/03/23**
34	Waterways Permit	20 days	Tue 17/05/22	Mon 13/06/22
35	DFO (creek Crossings)	20 days	Tue 17/05/22	Mon 13/06/22
36	Navigable Waters (Creek Crossings)	10 days	Tue 17/05/22	Mon 30/05/22
37	Permits (Alterations to Existing Sewer and Water Systems	20 days	Tue 21/02/23	Mon 20/03/23
38	External Servicing Studies (Hydro Distribution/Gas and Communication)	30 days	Tue 27/07/21	Tue 07/09/21
39	Odour Control Study	20 days	Tue 17/10/23	Mon 13/11/23
40	**Regional Wastewater Design & Tender Prep**	**380 days**	**Tue 07/09/21**	**Mon 20/02/23**
41	Lift Station	180 days	Tue 07/09/21	Mon 16/05/22
42	Force Mains	140 days	Tue 02/11/21	Mon 16/05/22
43	Interceptor Sewer	180 days	Tue 02/11/21	Mon 11/07/22
44	Upgraders to City Sewer System	120 days	Tue 06/09/22	Mon 20/02/23
45	**Regional Water Design and Tender Prep**	**260 days**	**Tue 07/09/21**	**Mon 05/09/22**
46	Feeder Main	140 days	Tue 07/09/21	Mon 21/03/22
47	Secondary Suppy Main	80 days	Tue 17/05/22	Mon 05/09/22
48				
49	**Procurement and Award**	**7069 days**	**Tue 22/03/22**	**Mon 26/04/49**
50	Contract 1A - Lift Station By-Pass System	80 days	Tue 17/05/22	Mon 05/09/22
51	Contract 2A -600 mm Force main	110 days	Tue 17/05/22	Mon 17/10/22
52	Contract 3 - Interceptor Sewer	110 days	Tue 12/07/22	Mon 12/12/22
53	Contract 4A - Feeder Main (to OS3)	110 days	Tue 22/03/22	Mon 22/08/22
54	Contract 1B - Main Lift station to Stage 1.2 Capacity	110 days	Mon 10/05/27	Mon 11/10/27
55	Contarct 5 - Secondary Supply Main	110 days	Mon 06/12/32	Mon 09/05/33
56	Contract 1C - Main Lift station to Stage 1.3 Capacity	110 days	Mon 13/09/32	Mon 14/02/33
57	Contract 2B - 750 mm Force Main	110 days	Mon 01/03/32	Mon 02/08/32
58	Contract 4B - Feeder Main (to OS4)	110 days	Mon 21/07/42	Mon 22/12/42
59	Contract 6 - Upgrades to City Sewer System	110 days	Mon 23/11/48	Mon 26/04/49
60				
61	**Construction**	**7139 days**	**Tue 23/08/22**	**Fri 31/12/49**
62	**Stage 1.1/Phase 1A - Development Year 0**	**300 days**	**Tue 23/08/22**	**Mon 16/10/23**
63	Contract 1A: Electrical Distribution and By-Pass Lift Station	120 days	Tue 06/09/22	Mon 20/02/23
64	Contract 2A: 600 mm Force Main	260 days	Tue 18/10/22	Mon 16/10/23
65	Contract 3: Interceptor and Intake Sewers	160 days	Tue 13/12/22	Mon 24/07/23
66	Contract 4A: 750 mm Feedermain (Silver to OS3)	240 days	Tue 23/08/22	Mon 24/07/23
67	**Stage 1.2/Phase 1B- Development Year 5**	**240 days**	**Mon 03/01/28**	**Fri 01/12/28**
68	Contract 1B: Lift Station sub/superstructure & Process Mech for Yr 6-10	240 days	Mon 03/01/28	Fri 01/12/28
69	**Stage 2/Phase 1B - Development Year 10**	**260 days**	**Mon 25/10/32**	**Fri 21/10/33**
70	Contract 1C: Lift Station Process Mech for Yr 20-50	120 days	Mon 09/05/33	Fri 21/10/33
71	Contract 2B: 750 mm Force Main	260 days	Mon 25/10/32	Fri 21/10/33
72	Contract 5: 400 mm Secondary Supply Main	60 days	Mon 01/08/33	Fri 21/10/33
73	**Phase 2 - For Development Year 20**	**100 days**	**Mon 16/03/43**	**Fri 31/07/43**
74	Contract 4B: 750 mm Feedermain (OS3 to OS4)	100 days	Mon 16/03/43	Fri 31/07/43
75	**Stage 3 - Development Year 30**	**120 days**	**Mon 19/07/49**	**Fri 31/12/49**
76	Contract 6: Wastewater upgrades to Interceptor Sewer	119 days	Mon 19/07/49	Fri 31/12/49
77				
78				
79	**Landowner/ Developer Planning**	**7675 days**	**Mon 03/08/20**	**Fri 31/12/49**
80	**Secondary Plan Stage**	**60 days**	**Mon 03/08/20**	**Fri 23/10/20**
81	Review by City and Council (ongoing)	40 days	Mon 03/08/20	Fri 25/09/20
82	Approval of Secondary Plans (ongoing)	20 days	Mon 28/09/20	Fri 23/10/20
83	**Rezoning Plan/ Conceptual stage**	**280 days**	**Mon 26/10/20**	**Fri 19/11/21**
84	Conceptual Development Plans	100 days	Mon 26/10/20	Fri 12/03/21
85	Subdivision Application	40 days	Mon 15/03/21	Fri 07/05/21
86	Community Committee (3 readings)	80 days	Mon 10/05/21	Fri 27/08/21
87	Council Approval	40 days	Mon 30/08/21	Fri 22/10/21
88	Land Rezoning	20 days	Mon 25/10/21	Fri 19/11/21
89	**Development Agreement Stage**	**160 days**	**Mon 22/11/21**	**Fri 01/07/22**
90	**Detailed Design**	**160 days**	**Mon 22/11/21**	**Fri 01/07/22**
91	Lot Design and Phasing	160 days	Mon 22/11/21	Fri 01/07/22
92	Servicing Report	160 days	Mon 22/11/21	Fri 01/07/22
93	Transportation study	160 days	Mon 22/11/21	Fri 01/07/22
94	Land Drainage Study	160 days	Mon 22/11/21	Fri 01/07/22
95	Development Applications (to City- PPD Dept.)	120 days	Mon 04/07/22	Fri 16/12/22
96	Development Agreement (Between City and Developer)	20 days	Mon 04/07/22	Fri 29/07/22
97	**Procurement Stage**	**180 days**	**Mon 01/08/22**	**Fri 07/04/23**
98	Construction Drawings	120 days	Mon 01/08/22	Fri 13/01/23
99	Tender Work	60 days	Mon 16/01/23	Fri 07/04/23
100	**Development Construction Stage**	**6975 days**	**Mon 10/04/23**	**Fri 31/12/49**
101	**Development Year 1**	**200 days**	**Mon 10/04/23**	**Fri 12/01/24**
102	Construct Local Sewer to Interceptor Sewers (Industrial and Residential	200 days	Mon 10/04/23	Fri 12/01/24
103	Residential Neighbourhood Connects Locally to Ctiy Water	60 days	Mon 10/04/23	Fri 30/06/23
104	Industrial Zone Water Connects to OS3	60 days	Tue 02/05/23	Mon 24/07/23
105	Development Year 5	0 days	Fri 01/12/28	Fri 01/12/28
106	Development Year 10	0 days	Fri 21/10/33	Fri 21/10/33
107	Development Year 20	0 days	Fri 31/07/43	Fri 31/07/43
108	Development Year 30	0 days	Fri 31/12/49	Fri 31/12/49



APPENDIX H

Risk Management Plan

Risk Management Plan (RMP)

Project	AAW Regional Water and Wastewater Servicing - Preliminary Design	**Date**	11/15/2019
Description	The scope of this project includes Project Management, Topographic Survey, Geotechnical Investigation, Land Use Planning and Phasing, Risk Analysis, Preliminary Design of Water and Wastewater Infrastructure and Stakeholder Engagement.	**Business Case ID**	
		Bid Opp. No.	289-2019

Risk Event Identification					Risk Severity	Risk Response	Action (s) to be undertaken	Proposed Action Taken as part of Prelim Design Yes/No/ Transfer	Contingency Plan	Risk Severity	Cost to Manage Risks (Identified in BOE with the "cost breakdown" detail shown on separate worksheet)	Risk Owner
Risk Event Outcome	**Threat or Opportunity?**	**As a result of (Risk Cause)**	**This event may occur (Uncertain Event)**	**Which leads to (Effect on objectives)**								
Systemic Risks												
Project Definition												
Increased construction cost due to shallow till and bedrock	Threat	Shallow till and bedrock	Pipe installation methods may be limited	Increase in construction cost	Critical	Reduce	Conduct seismic analysis at Preliminary Design phase to accurately determine bedrock elevations and suitable installation method.	Yes	Provide data in future contruction Tenders	Serious	Yes	Contractor
Increased construction cost due to shallow till and bedrock	Threat	Shallow till and bedrock	Obstructions during pipe installation	Delays to construction schedule, contractor claims for unexpected construction conditions	Critical	Reduce	Obtain bedrock profiles at Preliminary Design phase using seismic refraction survey along pipe alignments and adapt design accordingly.	Yes	Provide data in future contruction Tenders; DD may require some additional geotech for feedermain	Serious	Yes	Contractor
Increased construction cost due to shallow till and bedrock	Threat	Shallow till and bedrock	Potential requirement for blasting	Increase in construction cost	Critical	Reduce	Use seismic refraction survey information in the preliminary design of infrastructure alignments to avoid these areas.	Yes	Provide data in future contruction Tenders	Serious	Yes	Contractor
Increased construction cost due to groundwater conditions	Threat	High groundwater table	Depressurization of lift station excavation may be necessary	Increase in construction cost	Critical	Reduce	Examine groundwater conditions as part of the geotechnical investigation.	Yes	Use data in BOE and provide data in future construction tenders	Serious	Yes	Contractor
Increased construction cost due to groundwater conditions	Threat	High groundwater table	Increased complexity of the Force Main installation	Increase in construction cost	Critical	Reduce	Examine groundwater conditions as part of the geotechnical investigation.	Yes	Use data in BOE and provide data in future construction tenders	Serious	Yes	Contractor
Increased in construction cost due to unidentified changing soil conditions	Threat	Unidentified changing soil conditions	Delays in construction schedule	Increase in construction cost	Critical	Reduce	Use seismic information to produce a geotechnical baseline report to inform contractors of soil conditions.	yes	Provide data in future contruction Tenders; however infill may be requried during Detailed design.	Serious	Yes	City/Contractor
Increase in construction cost due to pre-existing contamination	Threat	Pre-existing contamination	Delays in construction schedule	Increased construction cost	Important	Accept	Review of contaminates sites website as part of Detailed Design phase.	No	Address as part of future phases?	Important	No	City
Preliminary Design with undersized regional infrastructure due to inaccurate water demand assumptions	Threat	Unknown scale of food processing and Agricultural industries coming to AAW	Precedent water demand data used to predict future demand may not be representative	Preliminary Design with undersized regional infrastructure	Serious	Reduce	Conduct sensitivity analysis for water and wastewater models to establish water demand/wastewater generation range for the preliminary design. Meet with landowners to get a sense of potential development	Yes	As part of Detilaed Design, coordination will be required and review of the servicing reports and rezoning applications	Important	No	City
Additional geotechnical investigation requirement prior to detailed design	Threat	Potential time delay between Preliminary and Detailed Design as well as ongoing development in RM of Rosser	The Preliminary Design geotechnical investigation is not on top of the future Detailed Design pipe alignment	Increase in Detail Design costs	Important	Accept	Include additional geotechnical investigation allowance to Detailed Design phase	No	allowance for geotech will be in future stages of the AAW project	Important	No	City
Redesign and evaluation of feasible tie-in location for AAW Force Mains to 1350 Inkster Interceptor during Detailed Design	Threat	Ongoing development in the RM of Rosser that connects several Force Mains to the 1350 Inkster Interceptor at the AAW tie-in location	Available space at tie in location to 1350 Inkster Interceptor will be used up by RM of Rosser Infrastructure	Unrepresentative Preliminary Design of tie-in to 1350 Inkster Interceptor at Brookside Blvd.	Serious	Reduce	Review existing permits for tie-in to 1350 Inkster Interceptor from the RM of Rosser. Response to RFI No. 1 directs Consultant team to assume full capacity is available in the 1350 Inkster Interceptor. City has priority of RM of Rosser flows.	Yes	Connection to be evaluated at detailed design stage.	Important		City
Increase in construction cost due to increased Feeder Main size	Threat	Limitation on the number of Water Main crossing CentrePort Canada Way	Increase Feeder Main size to provide required pressure to extremities of AAW lands	Increase in construction cost	Important	Transfer	Consultation with MI to occur in Post prelim design by City	no	Consultation with MI will occur in later phases of AAW project (post prelim design). Rouge option may limit pressure pipe under MI roadways but not eliminate it as the Force main is still under CCW	Important	Yes	City
Need for a 300 water main feed from Inkster Blvd. through RM of Rosser possible but not to provide water to the RM.	Threat	Agreement between City of Winnipeg and Shoal Lake	Water from Shoal Lake may not be transferred to jurisdiction outside of the City of Winnipeg	Political and First Nations concerns	Important	Reduce	Review Shoal Lake water agreement and include appropriate considerations in Preliminary Design.	Yes	If inkster secondary is selected option, we have below grade or tamper proof flush ports and valves with no hydrants to provide water to the RM of Rosser	Acceptable	Yes	City
Untimely construction of regional infrastructure due to developer phasing	Threat	Limited understanding of planned development phasing during the Preliminary Design phase	Development phasing assumed during Preliminary Design does not match actual development phasing used by the developers	Inappropriate phasing for construction of regional infrastructure	Serious	Reduce	Meet with landowners and stakeholder to develop better development phasing understanding. Develop preliminary infrastructure design, schedule, and Class 3 cost estimate that account for development phasing.	Yes	Future consultaiton and review of actual planned development will be essential at DD stage to ensure that risks from short term flows are effectively addressed	Important	Yes?	City
Reduced accuracy of Class 3 cost estimate and Preliminary Design	Threat	Unrepresentative shadow design and assumed water demand/wastewater generation	Inaccurate water and wastewater models	Insufficient infrastructure sizing	Important	Reduce	Obtain input from potential developers to determine land use/zoning plans to ensure sufficient infrastructure capacity to all areas.	Yes	As part of Detilaed Design, coordination will be required and review of the servicing reports and rezoning applications	Acceptable		City
Reduced accuracy of Class 3 cost estimate and Preliminary Design	Threat	Unvalidated wastewater and drainage model (does not yet exist)	Model results do not accurately predict hydraulic and hydrologic conditions	Insufficient infrastructure sizing	Important	Reduce	Perform a sensitivity analysis to identify variability of model parameters.	Yes	Limit actual development to the flow capacity and wastewater collection capactiy that will be constructued by the City.	Acceptable	no	Developer
Reduced accuracy of Class 3 cost estimate and Preliminary Design	Threat	Water modelling assumptions	Model results do not accurately predict hydraulic and hydrologic conditions	Insufficient infrastructure sizing	Important	Reduce	Perform a sensitivity analysis to identify variability of model parameters. Met with developers, used accepted flow values based on anticipated land uses	Yes	Limit actual development to the flow capacitythat will be constructued by the City.	Acceptable	no	Developer
Reduced accuracy of Class 3 cost estimate and Preliminary Design	Threat	Inadequate land owner review	Expropriation or easement requirements are overlooked	Unaccounted costs and schedule delays	Serious	Reduce	Conduct a thorough review of landowners and existing infrastructure in the project area to determine easement requirements early in the design process.	Yes	Inquired about land ownership as part of the Land Use Study during early stages of the project. Displayed ownership information on design drawings and created table summarizing different type of land agreements that will be required for the proposed preliminary design alignments.	Important		City
Reduced accuracy of Class 3 cost estimate and Preliminary Design	Threat	Inadequate utility review	Existing utility corridors along selected Force Main alignment have not room for AAW pressure pipes	Inappropriate Preliminary Design alignment	Critical	Reduce	Conduct a thorough review of existing utilities in the project area to determine available corridors, crossing or relocation requirements early in the design process.	Yes	Purchased title searches to learn about existing utility easements. Displayed information on design drawings to identify potential conflicts along the proposed perliminary desing alignments.	Important		City
Reduced accuracy of Class 3 cost estimate and Preliminary Design	Threat	Incomplete geotechnical investigation	Geotechnical investigation does not cover Feeder Main and additional Interceptor alignments	Unknown detailed subsurface conditions along the Feeder Main and added Interceptor alignments	Critical	Reduce	Discuss possibility of using available funds from the Additional Work Allowance to increase geotechnical investigation scope.	Yes	Captured additional geotech info as part of Prelim Design and updated geotech report to capture gravity interceptor piping and portinos of feedermain. Allowance for geotech will be in detailed design stages of the AAW project for infill	Critical		City
Reduced accuracy of Class 3 cost estimate and Preliminary Design	Threat	Unknown capacity of 1350 Inkster Interceptor currently taken up by wastewater flow from the RM of Rosser	Assumptions concerning available capacity within 1350 Inkster Interceptor for Preliminary Design which may not represent reality	Flawed understanding of potential upgrades to the existing system required to accommodate AAW wastewater flows.	Critical	Accept	Obtain actual capacity available within 1350 Inkster Interceptor. Response to RFI No. 1 directs Consultant team to assume full capacity is available in the 1350 Inkster Interceptor. City has priority of RM of Rosser flows.	na	City is monitoring development applciations from the Rm of Rosser. Future discussions with the City and RM will be required to address their wastewater needs. Ie. Additional upgrades to regional infrastructure may be requried in the future to suppor thier needs.	Critical	no	City/RM of Rosser
Increase in project cost	Threat	Insufficient field data, topographic survey collection	Additional collection of data or misrepresentation of existing conditions	Delays to project schedule to obtain additional data	Serious	Reduce	Use LIDAR survey methods with ground truthing to collect complete topographic data from the large project area.	yes	Data is considered accurate for preliminary design. Additional survey will be required at the detailed design stage.	Important		City

Risk Management Plan (RMP)

Project	AAW Regional Water and Wastewater Servicing - Preliminary Design	**Date**	11/15/2019
Description	The scope of this project includes Project Management, Topographic Survey, Geotechnical Investigation, Land Use Planning and Phasing, Risk Analysis, Preliminary Design of Water and Wastewater Infrastructure and Stakeholder Engagement.	**Business Case ID**	
		Bid Opp. No.	289-2019

Risk Event Identification					Risk Severity	Risk Response	Action (s) to be undertaken	Proposed Action Taken as part of Prelim Design Yes/No/ Transfer	Contingency Plan	Risk Severity	Cost to Manage Risks (Identified in BOE with the "cost breakdown" detail shown on separate worksheet)	Risk Owner
Risk Event Outcome	**Threat or Opportunity?**	**As a result of (Risk Cause)**	**This event may occur (Uncertain Event)**	**Which leads to (Effect on objectives)**								
Design Complexity												
Reduced accuracy of Class 3 cost estimate and Preliminary Design	Threat	Requirements for water and wastewater infrastructure running along, across, or through Jurisdictions other than the City of Winnipeg not fully understood	Omission of critical requirements imposed by other Jurisdictions	Incomplete preliminary design and Class 3 cost estimate	Important	Reduce	Review of applicable jurisdictional requirements based on selected preliminary design requirement.		We captured locations where encasement or other requirements would likely be imposed on the project and added them to our cost estimates.; Future consultation should be undertaken, especially with MI to look at limiting encasement requriements along CCW for Forcemain (and seconary feedermain if selected)	Important	Yes	City
Reduced accuracy of Class 3 cost estimate and Preliminary Design	Threat	Environmental requirements not fully understood	Omission of critical requirements imposed by environmental agencies (i.e. associated with Waterways and Department of Fisheries and Oceans)	Incomplete preliminary design and Class 3 cost estimate	Important	Accept	Detailed review of all environmental regulations to be undertake as part of the Detailed Design.		As part of prelim we have reviewd anticipated environmental implications to long the project to address in planning, design and construction schedule. We also looke at impacts that could lead to costs to include in our cost esitmate. Detailed review will be part of future phases of project.	Important		City
Increase in project cost	Threat	Wastewater flows that exceed capacity of 1350 Inkster Interceptor	Wastewater flows from the AAW exceed capacity of the 1350 Inkster Interceptor	Requirement to evaluate sewer system outside of project scope.	Important	Reduce	Conduct wastewater modelling. Review infrastructure upgrade options and parameters outlined in AECOM report with approval from the City if 1350 Inkster Interceptor capacity is found to be insufficient.	Yes	For prelim design the assumptions are well established to limit the risk. however, for future detailed design should consider actively planned development in other locations wthin the City of Winnipeg that will increase sanitary flows to the inkster interceptor or other downstream locations.	Important		City
Project Management and Estimating Process												
Reduced accuracy of Class 3 cost estimate and Preliminary Design	Threat	Definition of Regional Infrastructure	Some pressure pipes or gravity sewer pipes may be included/excluded to/from the preliminary design and Class 3 cost estimate	Incomplete preliminary design and Class 3 cost estimate	Serious	Reduce	Engage with the City to clarify definition of Regional Infrastructure and infrastructure components to be included in project scope.	Yes	Steering committee and design team have developed definitions to address this risk.	Important		City
Reduced accuracy of Class 3 cost estimate and Preliminary Design	Threat	Lack of applicable cost information for similar sized lift stations, Force and Feeder Mains and the Operation and Maintenance costs for this type of infrastructure	Cost assumptions will need to be made	Assumed costs may not be representative of actual construction and Operation and Maintenance costs	Important	Reduce	Requested cost information from the City for the construction and the Operation and Maintenance of existing Force Mains, Feeder Mains, and Lift Stations here in Winnipeg.	Yes	Assume O+M cost. Break annual O+M into separate items (power, staff, buliding maintenance, etc.) and capture in BoE table with assumptions to be defensible.	Important		City
Requirement to revise Preliminary Designs prior to Detailed Design phase	Threat	Assumed development rates during the Preliminary Design phase	Actual market capacity during the AAW build-out may not align with the assumed development rate	Challenges with cost recovery for the City and potentially oversized regional infrastructure	Serious	Reduce	Evaluate assumed development rates through discussions with AAW area landowners and stakeholders. Project team met with landowners twice. First meeting was to gather information and the second meeting was to present land use assumptions and receive feedback.	Yes	Include expanded maintenance program for early phases of the development to allow for additional flushing and pigging.	Serious	O&M costs to be added	City
Project -Specific Risks												
Risks												
Delay in Detailed Design phase timing	Threat	AAW Preliminary Design project	Inaccurate information may be heard by he public	Negative public perception	Serious	Reduce	Develop public engagement process with the City	Yes	Met with Landowners and key stakeholders at early stages of the proejct with corporate communications in office of Public Engagement to control messaging. Continue to work with OPE for infromation sharing at end of prelimnary design phase.	Important		City
Reduced accuracy of Class 3 cost estimate and Preliminary Design	Threat	Exclusion of Environmental reviews from the Preliminary Design	Omissions of critical environmental requirements	Incomplete preliminary design and Class 3 cost estimate	Serious	Accept	Environmental reviews to be included in the Detailed Design phase.	Transfer	See above	Serious		City
New Risks added to the Risk Management Plan from Risk Workshop 2												
Avoid use of the report by developer												
Lift station Servicing	Threat	Construction of lift station in advance of development	No existing services to connect to (Electrifcal, gas, water, phone/communication)	Potential scheduling or cost impacts	Serious	Reduce	Assume that the services are in place, and that some future desings may be requied if they are not. Electrical and Communication - included in costs.	Yes				
sufficient development to warrant investment	Threat	Proceeding without development agreement in place, (insufficient devleopment)	Major capital investment without need	Cost with no recovery	Serious		Development agreemtns must be in place with commitment to suppor infrastruture investment.					
Land negotiation and acquisition impacting schedule	Threat	Needing lands	long timelines for negotiations and purchases	impact to planning, design and construction schedule	Serious		initiated land needs for project as part of Prelim design and will capture timlines on planning, design and construciton schedule					
Communication with RM or Rosser	Threat	Requireing private and public land in another jurisdiction	not understanding the RMs expectations for the land	imacts to desing and schedule	Serious		Consultation with RM to be carried out post prelimnary design					
Planning, Design and Construciton Schedule	Threat	Many interconnected and separate studies and planning tasks reqreuid to get to approval of construction	longer timelines for some tasks	impact to planning, design and construction schedule	Serious		Identify these studies and timeline in PD report					
Driver for future phases	Threat	No established PM in WWD to expand project to fiuture phases	No internal City fundig to proceed	no assigned resource for futrue phase of project	Serious		none at this time					
future servicing provides improved opportunity for future development	opportunity	should the regional infrastructure be constructed	development could occur	economic development for the City of Winnipeg	Important							
Expensive repair and maintenenace costs	Threat	a preliminary design concept with a single Wastewater Lift Station to service all of AAW	Local wastewater sewers upstream of the Wastewater Lift Station will be installed at great depths and well within the bedrock layers	Challenging and very deep excavations required to access sewers if required for maintenance or repairs.	Serious							
Increased City captial investment cost	Threat	Uncertain future development rates and patters of the of the AAW lands	A 300 mm secondary feed into AAW (starting at the connection to the Secondary Supply Main at the Saskatchewan Ave.-Cavalier intersection and terminating at OS3) may be found to provide insufficient pressures for regional reduncancy (in the case that the Sturgeon Feeder Main is out of service) in which case the secondary feed will rquire upsizing from a 300 mm Water Main to a 400 mm Large Diameter Main.		Serious	Transfer	Transer Risk to Detail Design phase once the purpose of the secondary feed can be determined.	Yes	Include Class 5 level estimate for cost difference between the construction of a 300 mm Water Main and a 400 mm Large Diameter Water Main of the same length (approximately 3.63 km).	Serious		City

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