Prairie Gateway Area Structure Plan – Determination of Sanitary Sewer Flow and Potable Water Demand

Technical Memorandum

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Prepared for:

The City of Calgary
Rocky View County
Shepard Development Corporation

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PRAIRIE GATEWAY AREA STRUCTURE PLAN – DETERMINATION OF SANITARY SEWER FLOW AND POTABLE WATER DEMAND

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Executive Summary

Stantec Consulting Ltd. (Stantec) has been retained by Shepard Development Corporation (SDC), to support the sanitary and water servicing review of the Prairie Gateway Area Structure Plan (ASP). As outlined in the Terms of Reference for the above noted ASP, this memorandum has been prepared to establish the design criteria used for the calculation of the sanitary flow generation and water demand of the study area.

The information provided in this document will support the assessment of the existing sanitary sewer and water infrastructure in the City of Calgary & Rocky View County and identify capacity constraints and areas of potential expansion to meet the demands of the anticipated growth.

Through the analysis, different methods were compared for generating the employment numbers for the Prairie Gateway ASP to calculate the sanitary flow and water demand requirements. The employment numbers for the site generated based on the National Building Code, Alberta Environment, and The City of Calgary are all very high based on the expected end user employee density and comparable developments in North America.

These methodologies are considered standard practice during an area structure plan for determining employee numbers and the respective flows. Due to the concurrent processes underway and the unique framework for this area structure plan, if an unrealistic employee density is used for generating the sanitary and water demands for the site, the offsite infrastructure would be oversized resulting in greater investment levels than required for servicing the ASP.

The criteria for determining the sanitary flow will be based on measured flow data from the City of Calgary southeast industrial. A reduction to the typical inflow and infiltration flow rates is recommended as this will be a modern development that follows current best practices for materials and construction with a reduced number of connections and sanitary network length due to the anticipated parcel size and layout.

The criteria proposed for the water demand for the Prairie Gateway ASP will be based on a flow rate dependent on the gross development area. Due to the uncertainty around actual employment numbers and to the significant variability in industrial water usage based on industry, this provides a reasonable approach for sizing the offsite water infrastructure that will be based on the maximum daily demand. The criteria used proposes a lower peaking factor than typically used in the City of Calgary, however the average day demand is higher. The peak hour demand (PHD) and fire flow demand (FFD) will be managed through on-site reservoirs and pump stations.

Should end user water requirements be known at the conceptual scheme stage or at the time of detailed design for the offsite water infrastructure. The water demand outlined in this memo should be reevaluated to confirm the optimal sizing of infrastructure.

1.0 STUDY AREA

The Prairie Gateway Area Structure Plan includes approximately 895.9 hectares (2,214 acres) of land in the southeast of Rocky View County, adjacent to the east side of the City of Calgary. It is located immediately east of Range Road 284; north of the Canadian Pacific Kansas City Southern (CPKC) Rail mainline right-of-way; south of the abandoned rail right-of-way, approximately one-half mile north of Township Road 232; west of Range Road 282; and includes a triangular parcel of land bordering the CPKC Rail mainline to the southeast.

The ASP area consists of un-subdivided quarter sections, larger farming parcels, few smaller parcels comprised of predominately light industrial uses, and lands owned by CPKC. The area has been identified as a City of Calgary future growth corridor for industrial development in the Intermunicipal Development Plan (IDP) between Rocky View County and The City of Calgary. The ASP would provide direct access to a future potential CPKC Facility.

The ASP lands are inclusive of the following parcels, as shown on Figure 1.0

- NW¼-3-23-28-W4, NE¼-3-23-28-W4, SE¼-9-23-28-W4 and SW¼-9-23-28-W4
- Portion of SW ¼-2-23-28-W4
- Section 9-23-28-W4 & 10-23-28-W4
- SE¼-16-23-28-W4, SW¼-16-23-28-W4, NE¼-15-23-28-W4 and SW¼-15-23-28-W4
- SE¼-15-23-28-W4

2.0 SANITARY SERVICING PLAN

The subject ASP lands are currently unserved by a connection to a public sanitary sewer. The onsite sanitary servicing of the ASP area will convey flows through a combination of public sanitary sewer gravity mains and pressurized force mains to a central lift station. The sanitary mains will be located generally within the public road alignments and/or public utility right of ways to be determined with the conceptual scheme.

The centralized lift station will convey all flows from the ASP via an offsite force main which will connect to the existing City of Calgary system. It is anticipated the land for any lift stations would be dedicated by the municipality.

It is anticipated that multiple lift stations will be required in the ASP area for the servicing of the land. The onsite servicing strategy, and determination of onsite catchments will be reviewed further as part of the sanitary servicing study and through the conceptual scheme development. It is assumed that the lift stations, and the onsite and offsite sanitary conveyance system will be designed and constructed using City of Calgary specifications.

The following three tie-in options for the offsite force main to the existing City sanitary system will be reviewed as part of the sanitary servicing as shown in Figure 2. It is assumed only a single tie in location will be required.

- Belvedere East Basin sanitary trunk, located at Peigan Trail, East of 84th Street
- Rangeview sanitary trunk, located at 212th Avenue & 88th Street SE
- Shepard sanitary trunk, located at 52nd Street and 114th Avenue SE

3.0 SANITARY SERVICING DESIGN CRITERIA

3.1 DEVELOPMENT AREA

The gross developable area of the ASP is 895.9 hectares (2,213.9 acres). For the purpose of this study, the ASP area has been divided into three cells as shown in Figure 2.0.

The area North of 114th Avenue will consist of primarily non-rail served industrial and approximately 3.50 hectares of commercial land use, for the purpose of this report the flows from the commercial site have been included in the flows calculated in Cell A and not calculated separately due to the negligible difference. The lands South of 114th Avenue and North of the CPKC lands will consist of primarily rail served industrial development land uses. The CPKC lands will consist primarily of rail transportation corridor. The size of each of the cells is defined below.

Table 1: Development Area

CELL	AREA (hectares)	AREA (acres)
Cell A (North of 114th Avenue)	262.8	649.5
Cell B (South of 114th Avenue)	523.1	1292.6
Cell C (CPKC Lands)	110.0	271.8
Total	895.9	2,213.9

As Cell C will consist primarily of the track area and not have a sizable employee count, it will be excluded from the development area for the purpose of calculating sanitary flow generation.

The total area used for the purpose of this study will be the combination of Cell A + Cell B, 785.9 ha.

3.2 FLOW GENERATION

It is expected and assumed that the development end users will not be predominantly classified as high-water users (i.e.. meat packing, breweries, food processing etc.) Therefore, for the purpose of this report, four methodologies were evaluated for the determination of the average dry weather flow **(Q_{ADWF})** and Peak Dry Weather Flow **(Q_{PDWF})**.

1. Alberta Environment Guidelines for System Planning Purposes
2. The City of Calgary- Sanitary Servicing Study Guidelines
3. Forecasted Trip Generation & National Building Code
4. Comparable Existing Development – City of Calgary Southeast Industrial Area

3.2.1 Alberta Environment Guidelines for System Planning Purposes

For system planning purposes, the Alberta Environment guidelines for Industrial development suggests the lower limit for average flow generation should be calculated as follows,

- **Q_{ADWF} = Q_{avg} x Gross Development Area**
  - Where, Average Daily Flow (Q_{avg})= 30 m^3 /day/ha (0.35 L/s/ha)
  - Site Area = Cell A + Cell B = 785.9 ha
  - **Q_{ADWF}** = 30 m^3/day/ha X 785.9 ha
  - **Q_{ADWF}** = 23,577 m^3/day or 275 L/s

A peaking factor **(P_f)** needs to be applied to the average dry weather flow (**Q_{ADWF})** in L/s for the determination of the Peak Dry Weather Flow **(Q_{PDWF}**), The peaking factor **(P_f)** is determined as follows, to a maximum value of 5.0.

- **(P_f)** = 6.659 ($Q_{avg}^{-0.168}$)

From this, **(Q_{PDWF})** = **(P_f)** **Q_{avg}** = 6.659 *($Q_{avg}^{0.832}$)*

Using this methodology, the **(Q_{PDWF})** is calculated for the development is as follows, **(Q_{PDWF})= 712.74 L/s**

3.2.2 The City of Calgary

The following design criteria have been used for establishing the flow generation based on the City of Calgary guidelines,

  - Employee density for Industrial and Commercial users of 55 people per hectare
  - Average Daily Per Capita Dry Weather Flow Generation of 190 L/employee/day

Using these parameters, an Average Dry Weather Flow **(Q_{ADWF}**) for the development can be calculated as follows,

- **Q_{ADWF} = Gross Development Area x Employee Density x ADCWF**
  - **Q_{ADWF} =** 785.9-hectare x 55 pp/ha x 190 L/e/d
  - **Q_{ADWF} =** 8216.64 m^3/day or 95.1 L/s

The peak dry weather sanitary flows **(Q_{PDWF})** are calculated using the following methodology, where the peak flows shall be calculated using Harmon peaking factor formula, as following:

$$(Q_{PDWF}) = (G \times P \times (P_f))/\ 86.4$$

Where: **(Q_{PDWF})** = the peak dry weather flow (L/s)

G = the per capita average daily design flow (L/day/person)

P = the design contributing population in thousands,

(P_f) = Harmon's Peaking Factor = 1 + 14/ (4 +P0.5) but not less than 2.5

The design population for the purpose of the peaking factor will be equivalent to the employee density for the gross development area, excluding Cell C.

Using this methodology, the **(Q_{PDWF})** is calculated for the development is as follows, **(Q_{PDWF})= 237.76 L/s**

3.2.3 Forecasted Trip Generation & National Building Code

It is expected that for Cell A, there will be two land uses. Based on the occupant loading as per the National Building Code and with an assumed floor area ratio (FAR) based on similar developments, the estimated employment count is as follows,

Table 2: National Building Code Employee Estimates

	AREA (Hectares)	***Developable Parcel Ratio to Gross Land***	***Anticipated Floor Area Ratio***	***Occupant Load, Area per person, m^2***	**Estimated Employment Count**
Non-Rail Served Industrial Storage Space (Warehouse)	259.30	75%	0.40	28	27,782
Commercial Business and personal services use (personal service shops)	3.50	70%	0.23	4.6	1225
Total					29,007

Based on the National Building Code, the employee density for Cell A is as follows,

- **Employee Density = Forecasted Employee Count / Area**
- **Employee Density** = 29,007/ 262.8 ha
- **Employee Density** = 110 employees per hectare

Utilizing this rationale, the employee per hectare ratio of Cell A is substantially higher than densities suggested by the City of Calgary and what is expected based on similar developments, therefore we have examined an alternative methodology for evaluating the population on the development.

The following design criteria have been used align the utility servicing demands with the forecasted employment data that has been prepared for the transportation impact assessment underway by others.

The employee breakdown by cell is shown in Figure 4.

Table 3: Trip Generation Data Cell A

	Peak Trips Generated (PM)	Daily Trips Generated
Cell A	1000	10,000

Based on this trip count, the maximum employee density for Cell A is as follows,

- **Employee Density = Forecasted Employee Count / Area**
- **Employee Density** = 10,000/ 262.8 ha
- **Employee Density** = 38 employees per hectare
    - Employee density for Cell A of 38 people per hectare
    - Average Daily Per Capita Dry Weather Flow Generation of 190 L/employee/day

Using these parameters, an Average Dry Weather Flow **(Q_{ADWF}**) for Cell A can be calculated as follows,

- **Q_{ADWF} = Gross Development Area x Employee Density x ADCWF**
    - **Q_{ADWF} =** 262.80-hectare x 38 pp/ha x 190 L/e/d
    - **Q_{ADWF} =** 1,900 m^3/day or 22.00 L/s

The peak dry weather sanitary flows **(Q_{PDWF})** are calculated using the following methodology, where the peak flows shall be calculated using Harmon peaking factor formula, as following:

$$(Q_{PDWF}) = (G \times P \times (P_f))/ 86.4$$

Where: **(Q_{PDWF})** = the peak dry weather flow (L/s)

G = the per capita average daily design flow (L/day/person)

P = the design contributing population in thousands,

(P_f) = Harmon's Peaking Factor = 1 + 14/ (4 +P0.5) but not less than 2.5

The design population for the purpose of the peaking factor will be equivalent to the employee density used for Cell A.

Using this methodology, the **(Q_{PDWF})** is calculated for Cell A is as follows, **($Q_{PDWF\ CELL\ A}$)= 65.0 L/s**

The employee number estimated for the lands in Cell B is approximately 2700 employees based on information provided by the rail operator. This is based on the forecast data of 150 employees per building and an estimated 18 buildings to be in this Cell.

The revised employee density for Cell B is as follows,

- **Employee Density = Forecasted Employee Count / Area**
- **Employee Density** = 2,700/ 523.1 ha
- **Employee Density** = 5.16 employees per hectare

Utilizing this rationale, the employee per hectare ratio of Cell B is substantially lower than densities suggested by the City of Calgary.

- Employee density for Cell B of 5.16 people per hectare
- Average Daily Per Capita Dry Weather Flow Generation of 190 L/employee/day

Using these parameters, an Average Dry Weather Flow **(Q_{ADWF}**) for Cell B can be calculated as follows,

- **Q_{ADWF} = Gross Development Area x Employee Density x ADCWF**
  - **Q_{ADWF} =** 523.10-hectare x 5.16 pp/ha x 190 L/e/d
  - **Q_{ADWF} =** 1788.48 m^3/day or 20.67 L/s

The peak dry weather sanitary flows **(Q_{PDWF})** are calculated using the following methodology, where the peak flows shall be calculated using Harmon peaking factor formula, as following:

(Q_{PDWF}) = (G x P x (P_f))/ 86.4

Where: **(Q_{PDWF})** = the peak dry weather flow (L/s)

G = the per capita average daily design flow (L/day/person)

P = the design contributing population in thousands,

(P_f) = Harmon's Peaking Factor = 1 + 14/ (4 +P0.5) but not less than 2.5

The design population for the purpose of the peaking factor will be based on the employee density used for Cell B.

Using this methodology, the **(Q_{PDWF})** is calculated for Cell B is as follows, **($Q_{PDWF\ CELL\ B}$)= 146.47 L/s**

The combined peak dry weather flow for Cell A and Cell B is as follows,

- **(Q_{PDWF}) = ($Q_{PDWF\ Cell\ A}$) + ($Q_{PDWF\ Cell\ B}$)**

  (Q_{PDWF})= 212.47 L/s

3.2.4 Comparable Existing Development – City of Calgary Southeast Industrial Area

As per the meeting held with the City of Calgary, the city calibrated model flow rates from the Southeast Industrial catchment area within the City of Calgary. The Southeast industrial development mimics what is expected in the Prairie Gateway ASP as it is primarily industrial in terms of zoning and development.

The following information was received from the City of Calgary, and has been included in the attachments,

Table 4: City of Calgary Southeast Industrial Flow Data

	Peak Dry Weather Flow Rate (L/s/ha)	**Peak 1:50 Year Wet Weather Flor Rate (L/s/ha)**
Southeast Industrial Area 1	0.09	0.32
Southeast Industrial Area 2	0.13	0.37

For initial comparison of the dry weather flow, using the peak dry weather flow rate for the higher of the two numbers provided, the following was calculated,

- **Q_{PDWF} = Q_{avg} x Gross Development Area**
    - Where, Average Daily Flow (**Q_{avg}**)= 11.23 m^3 /day/ha (0.13 L/s/ha)
    - Site Area = Cell A + Cell B = 785.9 ha
    - **Q_{PDWF}** = 11.23 m^3/day/ha X 785.9 ha
    - **Q_{PDWF}** = 8,827 m^3/day or 102 L/s

3.3 INFLOW AND INFILTRATION

Inflow and infiltration occur when water from the environment enters the sanitary sewer system. The inflow of stormwater to the system can occur from illegal connections to the sanitary system, leaking manhole covers, and structural defects. Infiltration occurs when groundwater enters the system through defective pipes, pipe joints, or poorly sealed connections.

In the City of Calgary & within the Alberta Environment Guidelines, the design criteria for both residential and employment catchments, require that design flows shall include an allowance of I&I peak rate of 0.28 L/s/ha to account for system inflow and infiltration.

Determination of the Inflow and Infiltration Peak Flow under this methodology would be calculated as follows,

- **(Q_{I+I}) = I&I x Gross Development Area**
- **(Q_{I+I}) = 0.28 L/s/ha x 785.9 ha**
- **(Q_{I+I}) =220.1 L/s**

Actual reported values were provided by The City of Calgary as shown in Appendix A, based on a 1:50 storm event for the southeast industrial catchment areas which resulted in an **I&I** peak rate of 0.24 L/s/ha to account for system inflow and infiltration. This value represents a reduction from the Alberta Environment and City of Calgary guidelines.

From review of the infrastructure in the southeast industrial catchment areas, it was found there is a high percentage of concrete and asbestos cement pipe as commonly used for sanitary sewers in the 1970s.

We would anticipate lower values for inflow and infiltration in this development through use of PVC piping which reduces the number of joints in the pipe segments.

As the ASP area will be comprised of an industrial development with a large parcel size and FAR ratio of 0.40. The total length of the sanitary sewer network will be considerably lower per hectare than what is typically experienced in a residential, commercial, or traditional industrial development.

This will be a modern development that follows current best practices for materials and construction techniques, and it is expected that connections will be made directly to manholes and no connections roof leaders or weeping drains will occur. Through the use of lift stations on this site, it will also allow for active monitoring data on inflow and infiltration rates and allow for preventative maintenance to occur. Under the report completed by the Idea Group '*Shepard Industrial Area Structure Plan: Servicing Study, February 2021*", a recommended I&I rate of 0.10 L/s/ha was proposed based on previous considerations by RVC. As this report is being used in support of the area structure plan, a more conservative approach is recommended. For this memo, we propose to reduce the **I&I** rate by 30% from The City of Calgary to **0.20 L/s/ha**.

Determination of the Inflow and Infiltration Peak Flow is calculated as follows,

- **(Q_{I+I}) = I&I x Gross Development Area**
- **(Q_{I+I}) = 0.20 L/s/ha x 785.9 ha**
- **(Q_{I+I}) =157.2 L/s**

3.4 ULTIMATE PEAK WET WEATHER FLOW GENERATION

The total peak wet weather design flows **(Q_{PWWF})** are calculated based on the sum of the **(Q_{I+I})** and (**Q_{PDWF})**

- **(Q_{PWWF})= (Q_{I+I})** +(**Q_{PDWF})**

For Method 4, The Peak Wet Weather Design Flow Rate for a 1:50 year storm was provided for two catchments, Catchment 1 was 0.32 L/s/ha and Catchment 2 was 0.37 L/s/ha. Using the higher of the flow rates,

- **(Q_{PWWF})= Peak Wet Weather Flow Rater x Gross Development Area**
- **(Q_{PWWF})= 0.37 L/s/ha x Gross Development Area**
- **(Q_{PWWF})= 290.8 L/s**

A comparison between the four different methodologies is shown below,

Table 5: Summary of Sanitary Flow Calculations by Method

Method	Peak Dry Weather Flow L/s, (Q_{PDWF})	Peak Inflow and Infiltration Flow L/s, (Q_{I+I})	Peak Wet Weather Design Flow L/s, (Q_{PWWF})
Alberta Environment Guidelines for System Planning Purposes	712.8	157.2	870
The City of Calgary- Sanitary Servicing Study Guidelines	237.8	157.2	395
Forecasted Trip Generation & National Building Code	212.5	157.2	369.7
Comparable Existing Development – City of Calgary Southeast Industrial Area	102.0	189.0*	290.8
**I&I calculated as the difference between the Peak 1:50 Year Storm Wet Weather Flow and the Peak Dry Weather Flow Rate*			

4.0 SANITARY FLOW CONCLUSION

From the table above and in consideration of the proposed land use we propose the following:

- Method 1- Alberta Environment Guidelines provides an overly conservative estimate of the future sanitary flow. The estimated design flow resulting from this method is, compared to the other methods, more than 200% larger and it would be equivalent to a projected total population that is not reasonably foreseeable given the known land destination.
- Methods 2 through 4 give results which are comparable, however, we would suggest that the use of rates comparable to the City of Calgary southeast industrial area of **(Q_{PDWF})=0.13 L/s/ha and an I&I rate of 0.20 L/s/ha** be used for the purpose of this report as shown below,

Table 6: Sanitary Designs for Prairie Gateway ASP

Area (ha)	Peak Dry Weather Flow L/s, (Q_{PDWF})	Peak Inflow and Infiltration Flow L/s, (Q_{I+I})	Peak Wet Weather Design Flow L/s, (Q_{PWWF})
785.9 ha	102.0	157.2	259.2

Any proposed land use or transportation network changes to this ASP may require re-evaluation and modification of sanitary infrastructure.

It is suggested that if additional sanitary catchment areas are added in the future, that actual flow data from the catchment areas defined in this memo are evaluated in conjunction with the additional proposed catchments.

Based on modeling completed by the City of Calgary, it is understood that provision of a public sanitary service to the ASP will require an agreement for wastewater servicing between The City and The County.

The City of Calgary, undertook the phased approach to the analysis of existing sanitary infrastructure adding the flows from the first two phases of Gateway development, for servicing Options A and B.

Based on the flows and timing estimated by Stantec, The City's preliminary analysis identified that the first phase can develop without upgrades to the downstream infrastructure, in case of servicing Option A.

Phase 2 would require upgrades to the existing Shepard sanitary trunk, as well as advance the timeline for upgrades required to the Fish Creek wastewater treatment plant.

If servicing Option B is chosen, no upgrades to existing Rangeview infrastructure were identified for the first two phases of development based on The City's preliminary analysis.

5.0 WATER SERVICING PLAN

The subject ASP lands are currently unserved by a connection to a public potable water supply network. The plan area is at a geodetic elevation between 1017.00m and 1031.00m, and final development will not fall outside of this elevation range. The entire subject lands fall within the City of Calgary Ogden water pressure zone which services lands at a geodetic elevation between 1012.00m to 1052.00m.

The following definitions will be used for the water demand, as defined by Alberta Environment.

- Average daily demand (ADD) is the greatest annual average per capita daily demand flow.
- Maximum Daily Demand (MDD) is the maximum three consecutive day average of past recorded flows, times the design population of the facility. If past records are not available, then a peaking factor will be applied.
- Fire flow demand (FFD) is defined as the rate of water flow, at a residual pressure of 20 psi (138 kPa) and for a specified duration, that is necessary to control a major fire in a specific structure.
- Peak demand design (PDD) flow is the maximum daily design flow plus the fire flow demand,
- Peak hourly demand (PHD) flow is the (PDD), divided by 24,

The onsite potable water supply network will consist of a looped public potable water network to maintain flows and provide security of supply and will generally be located within the public road alignments and/or public utility right of ways with the layout to be determined at the conceptual scheme development. The network will be sized based on layout, topography, population projections and land uses.

A looped offsite water feeder main will be required to connect the ASP onsite public potable water network to the existing City of Calgary system. The offsite water feeder main will be sized based on the MDD and the PDD and FFD will be managed through on-site reservoirs and pump stations. Pressure reducing valves may be required at the ASP onsite potable water network system tie ins to the offsite feeder main.

The proposed offsite feeder main routing is shown in Figure 5.0. It is anticipated that the feeder main will connect to the existing 1200mm Glenmore feeder main located on the northeast side of Glenmore Trail and 52nd Street SE, and a second tie in location proposed to one of the following,

- 900mm East Mackenzie feeder main at 146th Avenue SE and Stoney Trail
- 400mm watermain at 114th Avenue SE and 68th Street SE

It is under the assumption that the onsite and offsite water network will be designed and constructed using City of Calgary specifications.

6.0 PRELIMINARY WATER SERVICING DESIGN CRITERIA

6.1 WATER DEMAND DESIGN CRITERIA

Water demand for industrial land uses can vary significantly by industry and that fluctuation is more significant than fluctuations observed with residential water usage. Industrial water demand also continues to trend downward due to technological advancements, process improvements and policies encouraging water conservation. Furthermore, there has been a significant shift in industries trends toward water reuse for processes when feasible (AWWA (American Water Works Association), 2014).

As noted in the sanitary demand previously, it is assumed that the development end users will not be classified as high-water users (i.e.. meat packing, breweries, food processing etc.).

As the development will be predominantly industrial land uses, it is also not expected that there will be a seasonal variance for water demand as is typically seen in residential land use areas due to residential landscape requirements. Any landscape irrigation requirements will be managed through non-potable water sources.

For this report's purpose, five methodologies were evaluated for the determination of the ADD, MDD and PDD.

1. Rocky View County Water Demand Design Criteria
2. The City of Calgary Design Criteria
3. Water Demand Based on Gross Developable Area [City of Ottawa]
4. Water Demand Based on Gross Developable Area [City of Winnipeg]
5. Water Demand Estimation Based on Sanitary Design Flow

6.1.1 Rocky View County Water Demand Design Criteria

Within Rocky View County, the following design parameters are utilized for calculating the water demand usage for non-residential development,

- Average Daily Demand (minimum) is 0.15 L/s/ha or 12.96 m^3/d/ha
- Maximum Daily Demand, based on MDD = ADD x P_f =10 $Q^{-0.45}$, where Q=ADD in L/s to a maximum of 25 and a minimum of 2.5

Based on the ADD of 117.89 L/s, the P_f = 2.5

As defined above, the Peak Daily Demand is the sum of the MDD and FFD. For industrial uses in Rocky View County, the Fire Flow varies based on usage and is suggested as 10,000 L/minute to 15,000 L/minute + MDD.

Utilizing the higher fire flow range, of 15,000 L/minutes, the Peak Hour Demand is MDD/24 + 900 m^3/hour

Table 7: Method 1 -Water Demand Summary

Gross Development Area (Cell A + Cell B) (hectares)	Non-Residential Average Day Demand (m^3/hectare)	Average Day Demand (m^3/day)	Maximum Day Demand (m^3/day)	Peak Hour Demand (m^3/hour)
785.9	12.96	10,185	25,463	1,961

6.1.2 The City of Calgary Water Demand Design Criteria

The City of Calgary uses the following design parameters for water network planning purposes.

- Average Daily Demand 350 L/c/d for combined demand.
- Maximum Daily Demand 585 L/c/d for combined demand.
- MDD Peaking Factor 1.67

The identified combined demands include residential as well as Industrial, Commercial and Institutional customers. These design parameters also account for authorized water uses such as flushing and fire flows as well as system leakage losses.

Utilizing the same City of Calgary ICI employment density of 55 pp/hectare identified under the sanitary design flow criteria, the water demand for the Prairie Gateway ASP is calculated as follows:

Table 8: Method 2 - Water Demand Summary

Gross Development Area (Cell A + Cell B) (hectares)	Employment Density (pp/hectare)	Average Day Demand (m^3/day)	Maximum Day Demand (m^3/day)	Peak Hour Demand (m^3/hour)
785.9	55	15,128	25,263	2,105

6.1.3 Water Demand based on Gross Development Area [City of Ottawa]

It has been recognized that for industrial water usage there is not a direct correlation between estimated employment numbers and water demand. Often industrial water demands are expressed in terms of water requirement per gross hectare of development area.

The Ontario Ministry of Environment *Design Guidelines for Drinking-Water Systems* utilizes the following design criteria for calculating water demand in industrial park where the end user is unknown,

- Light Industrial Average Day Demand – 35/m^3/hectare
- Heavy Industrial Average Day Demand - 55/m^3/hectare
- Peak Usage Demand, Peaking Factor 2.0 to 4.0 (varies by industry & municipality)

The City of Ottawa, utilizes the following peaking factors for calculation of the MDD & Peak Hour Demand (PHD)

- MDD = 1.5 x ADD
- PHD = 1.8 x MDD / 24

Assuming heavy industrial use for the gross development area, the water demand is calculated as follows,

Table 9: Method 3 - Water Demand Summary

Gross Development Area (Cell A + Cell B) (hectares)	Heavy Industrial Average Day Demand (m^3/hectare)	Average Day Demand (m^3/day)	Maximum Day Demand (m^3/day)	Peak Hour Demand (m^3/hour)
785.9	55	43,224	64,836	4,862

6.1.4 Water Demand based on Gross Development Area [City of Winnipeg]

The City of Winnipeg utilizes a calculation similar to the City of Ottawa, based on gross development area for calculating non-residential water demands; the design criteria for non-residential water usage are as follows:

- Commercial-ADD: 16,800 L/ha/day or 16.8 m^3/ ha/day
- Light Industrial ADD: 22,500 L/ha/day or 22.5 m^3/ ha/day
- Wet Industrial ADD: 33,600 L/ha/day or 33.6 m^3/ha/day

The wet industrial usage is aligned with what has been identified as heavy industrial usages in

The City of Winnipeg utilizes the following peaking factors for calculation of the MDD & Peak Hour Demand (PHD)

- MDD = 1.4 x ADD
- PHD = 2.3 x ADD / 24

Assuming wet industrial use for the gross development area, the water demand is calculated as follows,

Table 10: Method 4 – Water Demand Summary

Gross Development Area (Cell A + Cell B) (hectares)	Heavy Industrial Average Day Demand (m^3/hectare)	Average Day Demand (m^3/day)	Maximum Day Demand (m^3/day)	Peak Hour Demand (m^3/hour)
785.9	33.6	26,406	36,968	2,531

6.1.5 Water Demand Estimation Based on Sanitary Design Flow

An alternative method for calculating the water demand is applying a multiplier to the projected average sanitary dry weather flow, **(Q_{PDWF}).** In this usage case, a multiplier of 110% is utilized to calculate the average daily demand.

The following peaking factors have been applied to the average daily demand,

- MDD = 2.0 x ADD
- PHD = 2.0 x MDD / 24

Table 11: Method 5 – Water Demand Summary

Sanitary Peak Dry Weather Flow m^3/day, (Q_{PDWF})	Water to Sanitary Peak Demand Ratio	Average Daily Water Demand, (m^3/day)	Maximum Daily Water Demand, (m^3/day)	Peak Hour Demand (m^3/hour)
8812.8	110%	9694.0	19,388	1,616

7.0 WATER DEMAND SUMMARY

In review of the various methods, it is noted that there is significant variability in water flow demand design criteria for industrial developments across jurisdictions in Canada. The MDD and PHD calculated under Method 1 – Rocky View County and Method 2 – City of Calgary are closely aligned although are dependent on different variables, developable area and employment numbers.

The City of Calgary methodology is based on a combined usage which includes a residential component. The residential component potentially skews the average daily demand value lower than what could occur with the Prairie Gateway development where no residential land uses are proposed.

The design criteria generated using Method 3- Ottawa generates MDD value that is approximately 250% higher than the values calculated in Method 1 and Method 2. This approach could be attributed to water usage behavior and regional variability.

Under Method 4 Winnipeg the average daily demand is significantly higher than utilizing design criteria of Method 1 and Method 2. It is also observed that the peaking factors utilized to calculate MDD and PHD are lower than in other jurisdictions.

Basing the water demand off the sanitary flows as explored in Method 5, under the previous servicing study completed for the Shepard ASP provides the lowest ADD, MDD and PHD.

Table 12: Water Demand Comparison

Methodology	Average Daily Water Demand, (m^3/day)	Maximum Daily Water Demand, (m^3/day)	Peak Hour Demand (m^3/hour)
Method 1 – RVC	10,185	25,463	1,961
Method 2- City of Calgary	15,128	25,263	2,105
Method 3 – Gross Development Area [Ottawa]	43,224	64,836	4,862
Method 4– Gross Development Area [Winnipeg]	26,406	36,968	2,531
Method 5- Sanitary Flow Modifier	9694.0	19,388	1,616

8.0 WATER DEMAND DESIGN CONCLUSION

As the employment numbers have a higher degree of uncertainty during the development of the Area Structure Plan, it is recommended that evaluation of water demand usage should be dependent on gross development area as it constitutes a more moderate approach. Basing the evaluation of water demand on sanitary flow provides a high degree of uncertainty as there is not necessarily a direct correlation between the two and it is recommended that this method be disregarded due to the number of variables.

The calculation of ADD presented under Method 4 (City of Winnipeg) provides a higher flow volume compared to one calculated with the design criteria utilized by Calgary and Rocky View County, although the peaking factors used are lower for calculating the MDD and PHD. As the offsite infrastructure that will service the Prairie Gateway ASP will be sized based on the MDD, it is understood that this methodology provides a reasonable approach and as such it will be recommended.

The design criteria proposed is as follows,

- Wet (Heavy) Industrial ADD: 33,600 L/ha/day or 33.6 m^3/ha/day
- MDD = 1.4 x ADD
- PHD = 2.3 x ADD / 24

It is therefore this study conclusion that the water demand recommended to be used for modeling the Prairie Gateway ASP be as follows,

Table 13 – Water Demand Design

Heavy Industrial Average Day Demand (m^3/hectare)	Average Day Demand (m^3/day)	Maximum Day Demand (m^3/day)	Peak Hour Demand (m^3/hour)
33.6	26,406	36,968	2,531

Any proposed land use or transportation network changes to this ASP may require re-evaluation and modification of water infrastructure.

It is suggested that if additional water demands are provided by end users, or additional service areas added that the actual demands are reviewed in the future for sizing offsite and onsite infrastructure.

Based on modeling completed by the City of Calgary, it is understood that provision of a connection to public water service to the ASP area will also require an agreement for water servicing between The City and The County as well as metering valves installed as identified on Figure 5.0. Through water modeling conducted by the City, preliminary analysis identified that the first phase of development could be serviced without advancing water treatment plant upgrade investment, however, subsequent phases, would be dependent on the timing of the upgrade completio

9.0 DEVELOPMENT PHASING

The development of Prairie Gateway will be phased based on market demand. This allows for the staging of offsite infrastructure and any downstream upgrades to be associated with the development progression of the Prairie Gateway lands.

It is anticipated that the initial requirements will need to be in place for 2026, and the full buildout to occur in 2048. For this report, an initial phasing plan as shown on Figure 7 has been prepared. This is subject to change based on market demand and end user site requirements.

Table 14 -Development Phasing Area & Timeline

Phase	Year of Development	Development Area (hectares)	Development Area (acres)
1	2026	202.0	499.1
2	2031	62.3	153.8
3	2036	262.4	648.3
4	2048	259.2	640.8
Total		785.9	1942.0

Utilizing the sanitary and water design criteria outlined in *4.0 Sanitary Flow Conclusion* and *8.0 Water Demand Design Conclusion* respectively, the following interim sanitary flow and water demand requirements are outlined below,

Table 15 – Interim Sanitary Flows

Phase	Year of Development	Phase Area (hectares)	Cumulative Developed Area (hectares)	Peak Dry Weather Flow, m^3/day (Q_{PDWF})	Peak Inflow and Infiltration Flow, m^3/day (Q_{I+I})	Peak Wet Weather Design Flow, m^3/day (Q_{PWWF})
1	2026	202.0	202.0	2,269	3,491	5,760
2	2031	62.3	262.3	2,946	4,533	7,479
3	2036	262.4	526.7	5,916	9,101	15,017
4	2048	259.2	785.9	8,827	13,580	22,508

Table 16 – Interim Water Demand

Phase	Year of Development	Phase Area (hectares)	Cumulative Developed Area (hectares)	Average Day Demand, m^3/day	Maximum Day Demand, m^3/day	Peak Hour Demand, m^3/hour
1	2026	202.0	202.0	6,787	9,502	650
2	2031	62.3	262.3	8,813	12,339	845
3	2036	262.4	526.7	17,697	24,776	1,696
4	2048	259.2	785.9	26,406	36,969	2,531

10.0 CONCLUSION

The Prairie Gateway ASP's water and sanitary design criteria were chosen as a balance between efficiently sizing infrastructure and not precluding development opportunities based on end user requirements.

As this is an industrial development it is recognized there is a variance between the proposed peak sanitary design flow and maximum water demand, unlike the close correlation observed in residential development. This variance is due to end users that will utilize water demand within their industrial processes that will not return to the sanitary system.

Should end user water and sanitary requirements be known at the conceptual scheme stage or at the time of detailed design for the offsite infrastructure. The sanitary flow and water demands outlined in this memo should be reevaluated to verify the optimal sizing of infrastructure.

Stantec Consulting Ltd.

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Email:Joshua.Matheusik@stantec.com

Attachment: Figure 1 Location Plan
Figure 2 Sanitary Servicing Options
Figure 3 Sanitary Catchments
Figure 4 Estimated Employee Count
Figure 5 Water Servicing ASP
Figure 6 Existing Surface
City of Calgary – Sanitary Flow Email

c. R. Riddell, Shepard Development Corporation
C. McNab, MPE Engineering
A. Ho, ISL Engineering
J. Huber, Stantec Consulting Ltd.
J. Armitage, Stantec Consulting Ltd.
R. Jans, Stantec Consulting Ltd.

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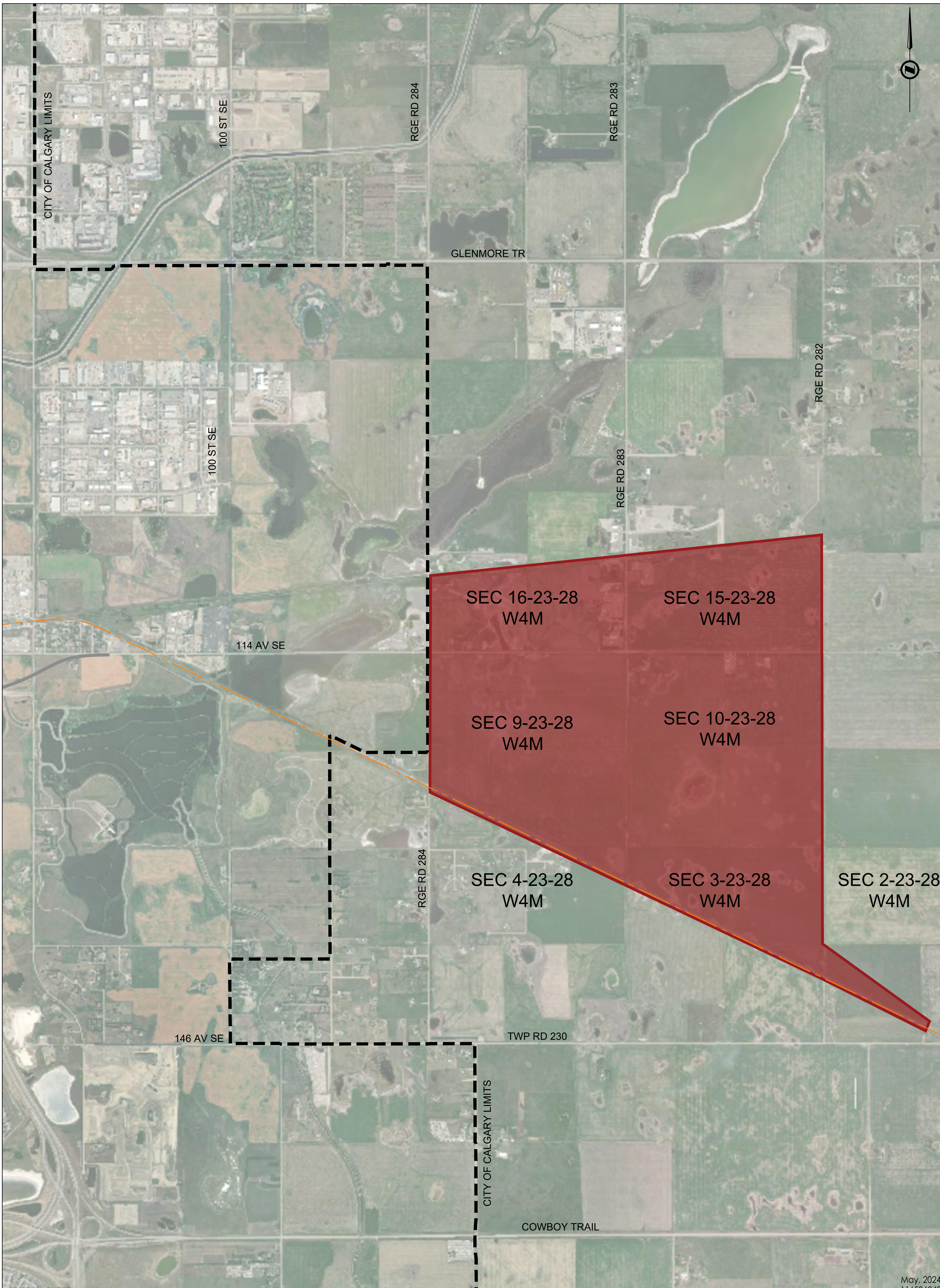

Legend

PRAIRIE ASP

EXISTING CP RAIL MAIN LINE

Notes

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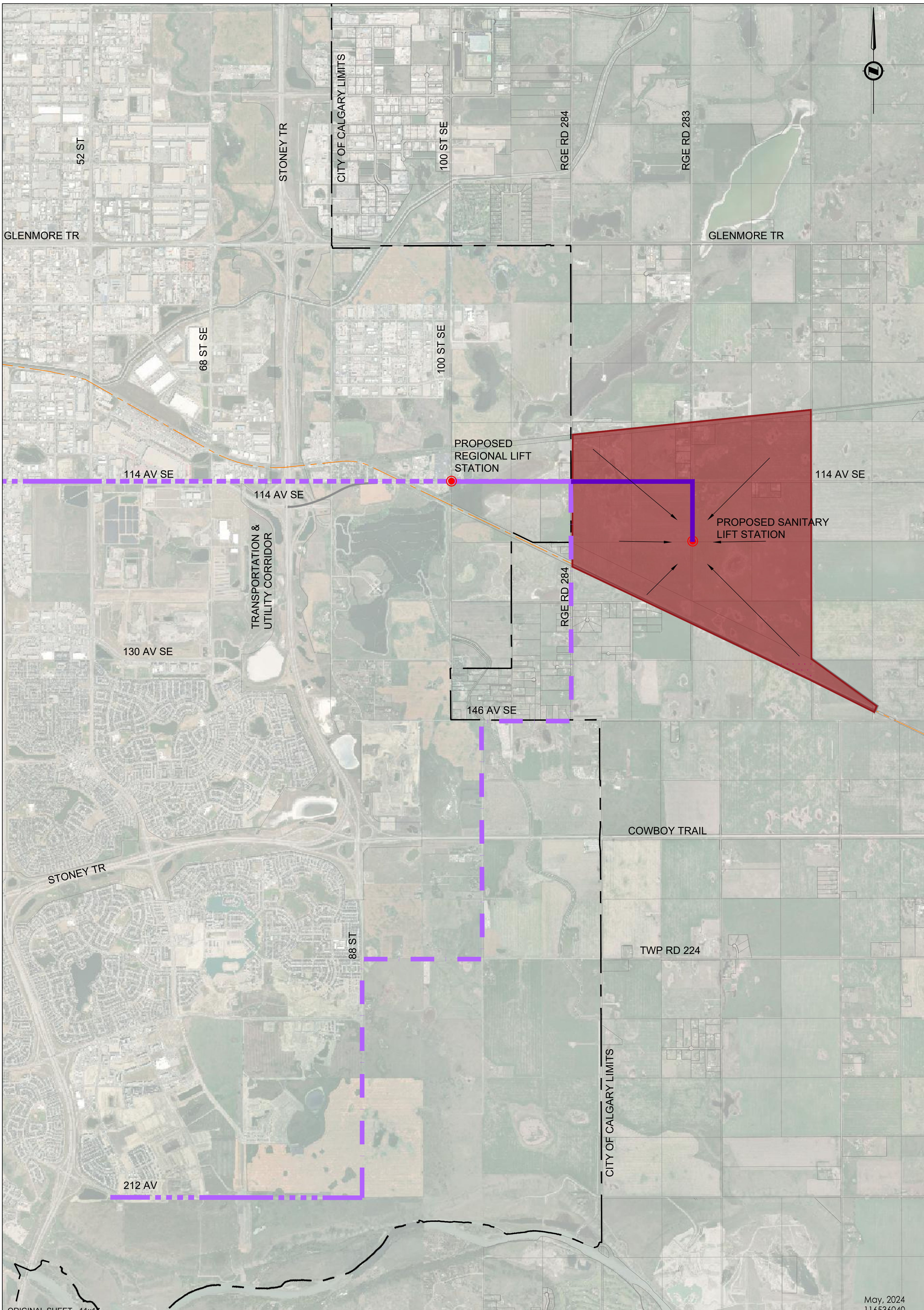
PRAIRIE GATEWAY
DETERMINATION OF SANITARY SEWER
FLOW AND POTABLE WATER

Figure No.

1.0

Title

LOCATION PLAN



Legend

- ASP Boundary
- Existing CPKC Rail
- Proposed Sanitary Lift Station

Forcemian

- Proposed Option A
- Proposed Option B
- Proposed Onsite

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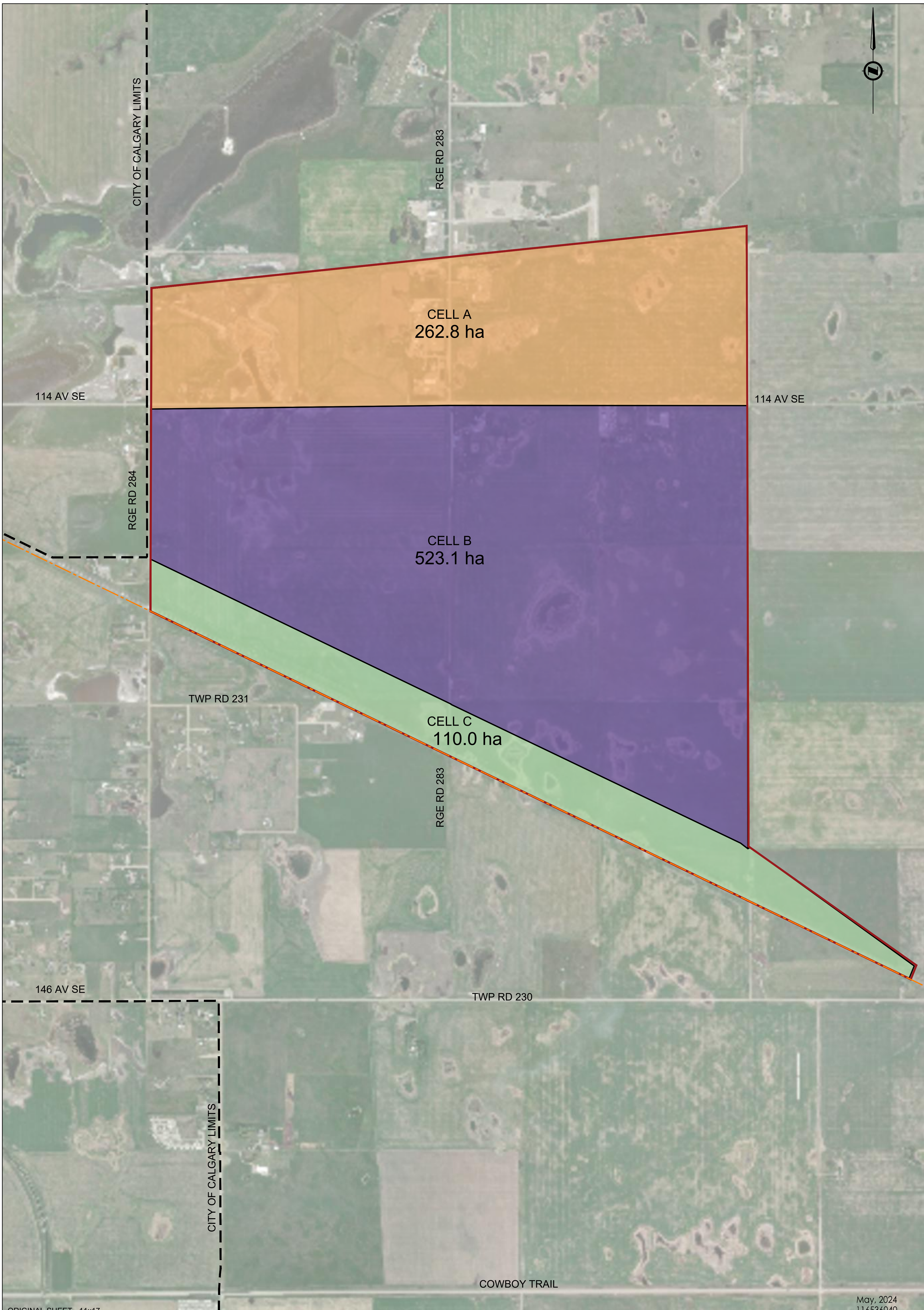
PRAIRIE GATEWAY
DETERMINATION OF SANITARY
FLOW AND POTABLE WATER DEMAND

Figure No.

2.0

Title

SANITARY
SERVICING OPTIONS



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Legend

PRAIRIE GATEWAY ASP

EXISTING CP RAIL MAIN LINE

Notes

ID	COLOUR	AREA(ha)	AREA(ac)
A		262.8	649.4
B		523.1	1292.6
C		110.0	271.8

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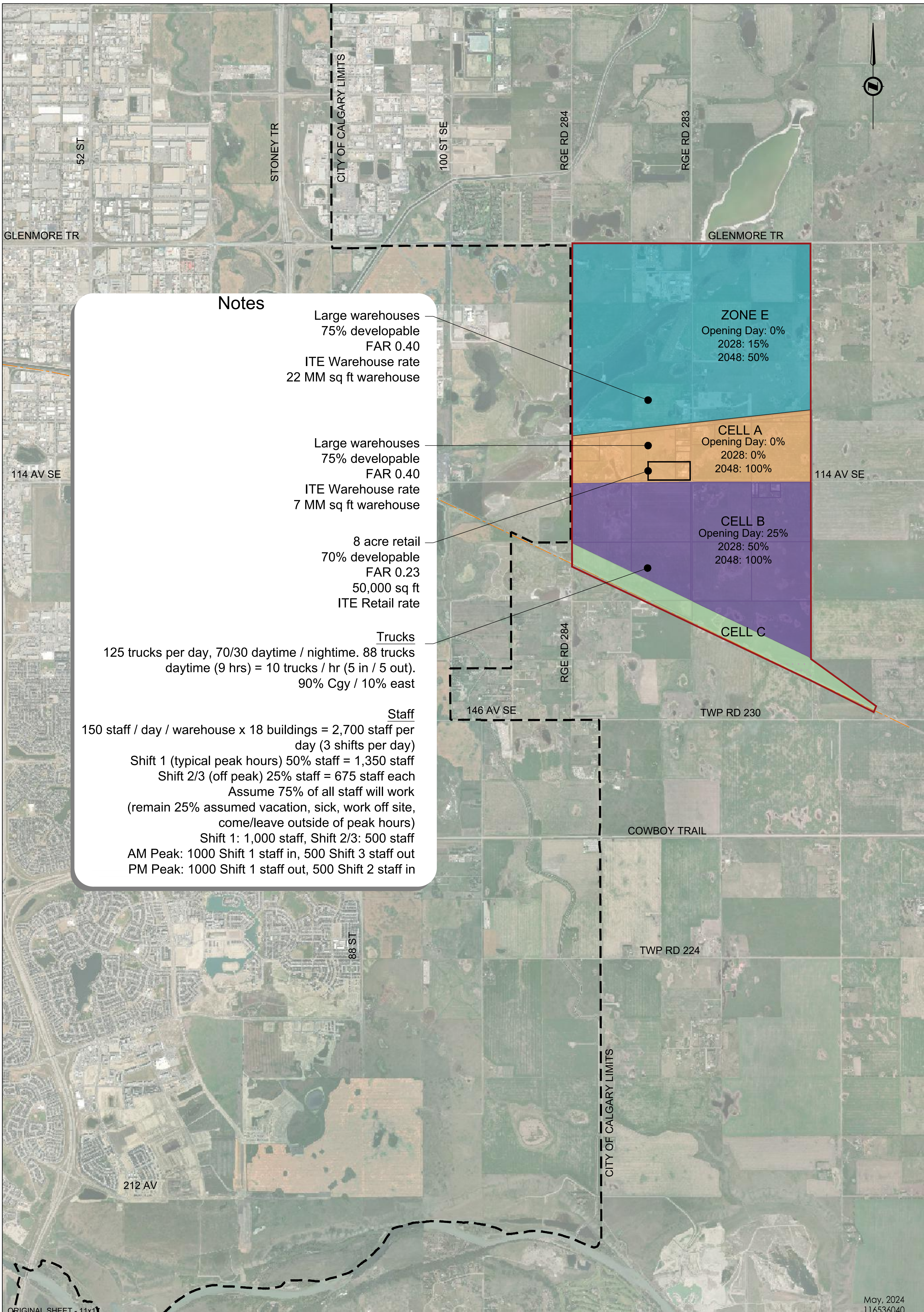
PRAIRIE GATEWAY
DETERMINATION OF SANITARY SEWER
FLOW AND POTABLE WATER DEMAND

Figure No.

3.0

Title

SANITARY CATCHMENTS



Legend

PROPOSED PRAIRE GATEWAY ASP

EXISTING CP RAIL MAIN LINE

Notes

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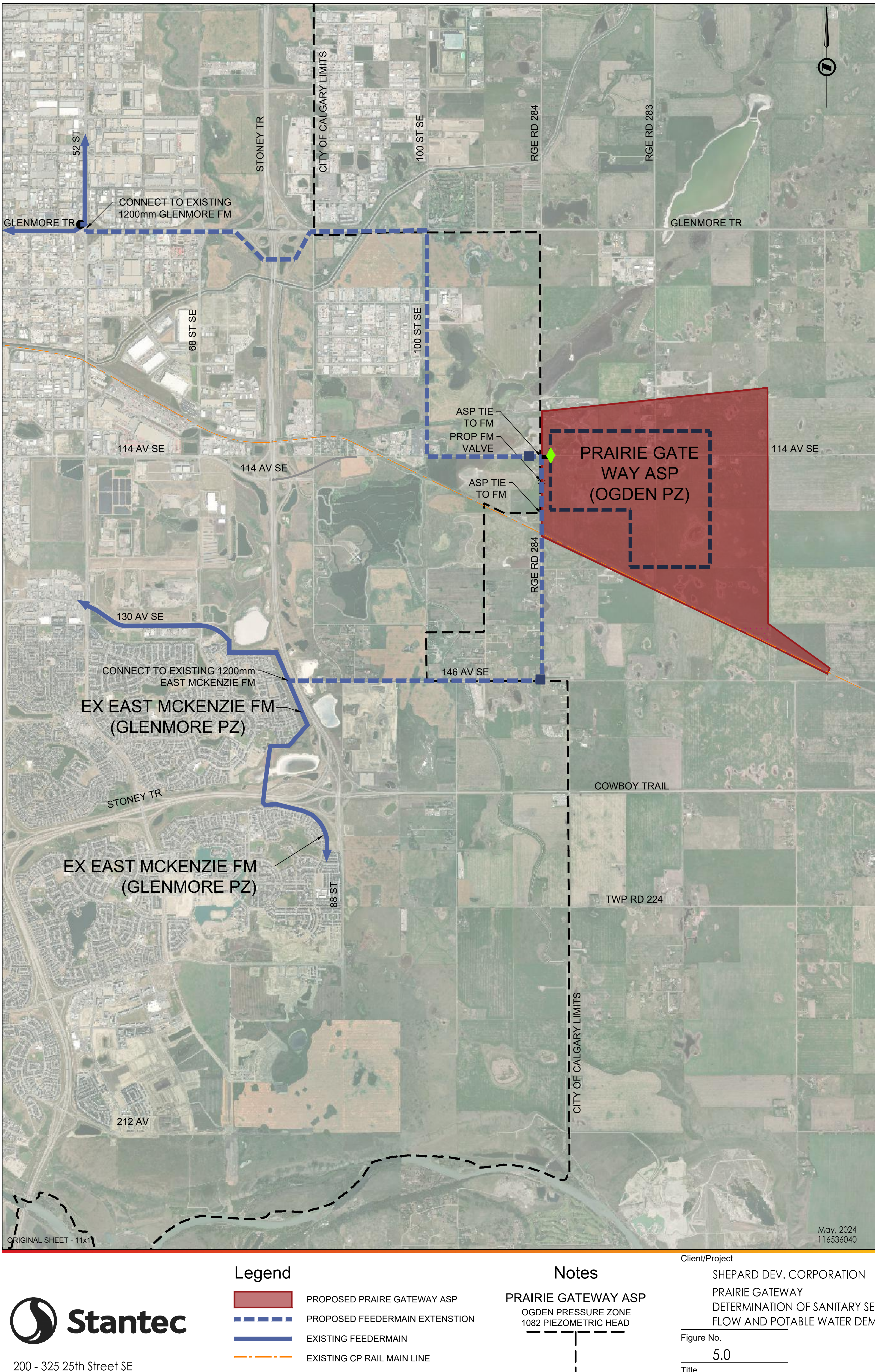
PRAIRIE GATEWAY
DETERMINATION OF SANITARY SEWER FLOW AND POTABLE WATER DEMAND

Figure No.

4.0

Title

ESTIMATED EMPLOYEE COUNT



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Legend

- PROPOSED PRAIRE GATEWAY ASP
- PROPOSED FEEDERMAIN EXTENSTION
- EXISTING FEEDERMAIN
- EXISTING CP RAIL MAIN LINE
- PROPOSED INTERNAL ROUTING
- PROPOSED PUMP STATION & RESERVOIR
- PROPOSED METER STATION

Notes

PRAIRIE GATEWAY ASP
OGDEN PRESSURE ZONE
1082 PIEZOMETRIC HEAD

1052
1012
L= 16,825

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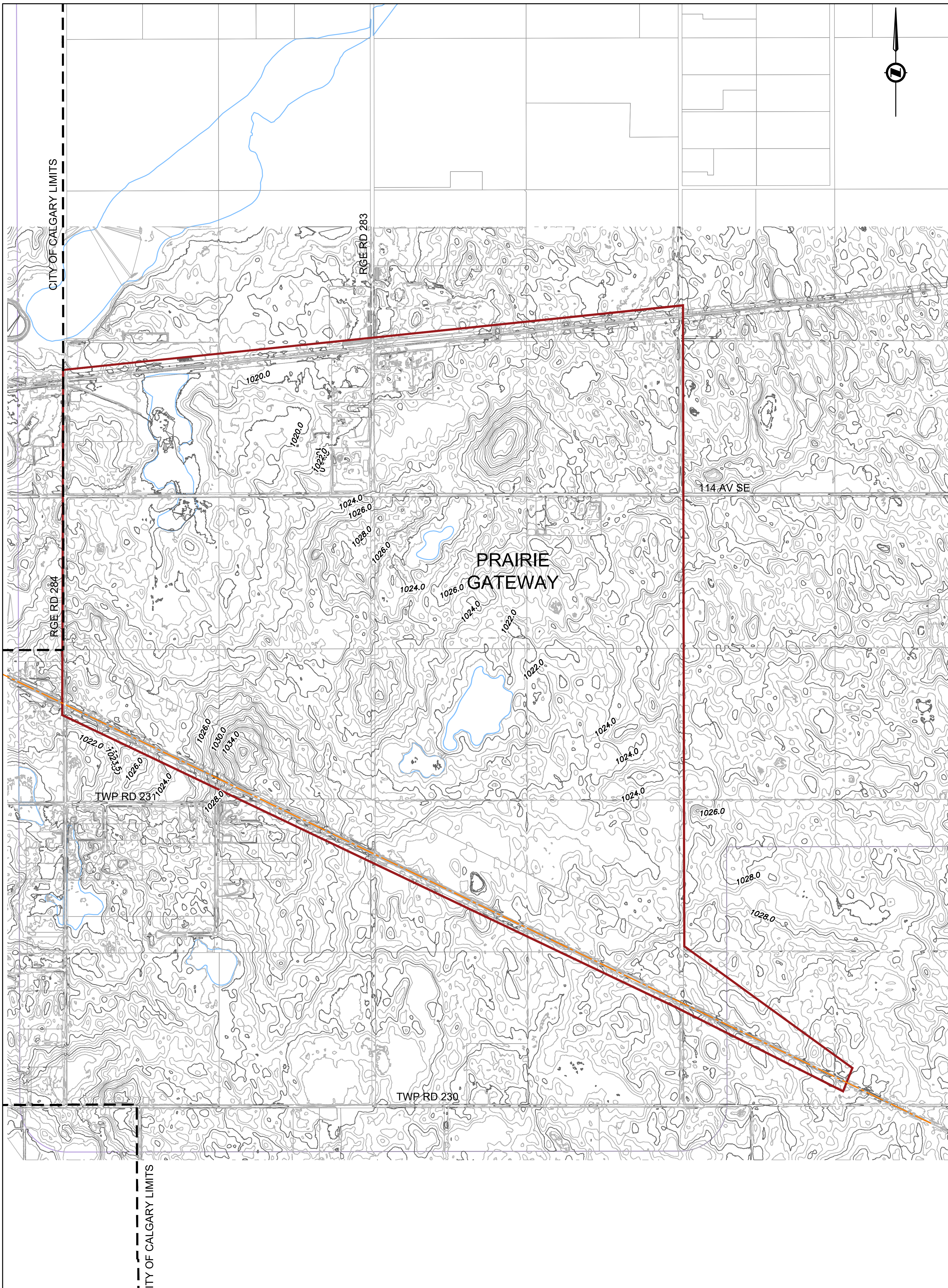
PRAIRIE GATEWAY
DETERMINATION OF SANITARY SEWER
FLOW AND POTABLE WATER DEMAND

Figure No.

5.0

Title

WATER SERVICING
OPTIONS



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1:20000
ORIGINAL SHEET - 11x17

May, 2024
116536040

Legend

- PRAIRIE GATEWAY ASP
- EXISTING CP RAIL MAIN LINE
- 1024.0 / 1026.0 EXISTING GROUND CONTOURS

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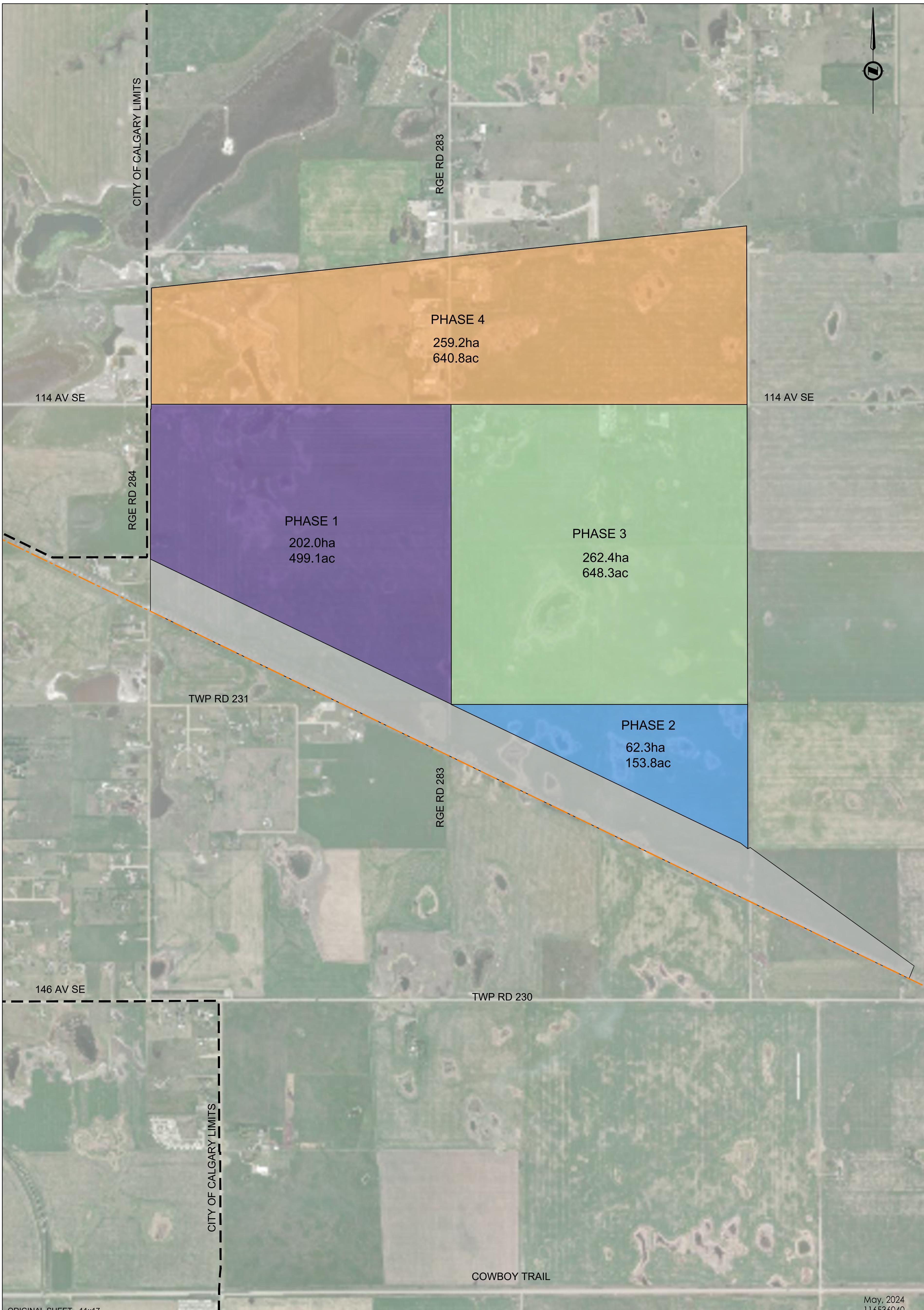
DETERMINATION OF SANITARY SEWER FLOW AND POTABLE WATER DEMAND

Figure No.
6.0

Title
EXISTING SURFACE CONTOURS



Legend

EXISTING CPKC RAIL LINE

Notes

PHASE	COLOUR	AREA(ha)	AREA(ac)
1		202	499.1
2		62.3	153.8
3		262.4	648.3
4		259.2	640.8
TOTAL		785.9	1942

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Figure No.
7.0

Title
PHASING PLAN