



Borea Construction
**Seven Stars Energy Project Hydrology
Assessment**

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Prepared for

Borea Construction (Client), and Enbridge (Owner)

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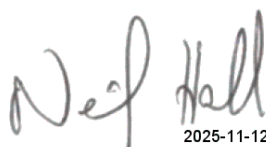
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1. Introduction

Borea Construction (the Client) engaged WSP Canada to complete a desktop hydrology and hydraulics study of the existing drainage conditions that encompass the proposed Seven Stars Energy Project. The project consists of 46 turbines and associated infrastructure located on a plain above the Souris River valley in southern Saskatchewan. The intent of this study is to define the existing drainage conditions and flood risks as well as preliminary culvert locations for the Project based on the preliminary infrastructure design. The study results will support planning, design, and regulatory applications that are being prepared by Enbridge (the Owner).

The study employs the HEC-RAS 2D platform to complete the hydrologic and hydraulic modelling. The model results predict flood flow depths and velocities across the modelled Study Area, which are presented in a set of figures. This report provides a summary of model development and results.

1.1 Project Location and Study Area

The Seven Stars Energy Project (the Project) is in southern Saskatchewan east of the City of Weyburn and west of the municipality of Griffin as shown in **Figure 1**. The Study Area covers approximately 123 km² and is planned to incorporate 46 turbines, two meteorological stations, a laydown area for construction, an operations and maintenance pad, and a substation, as shown in **Figure 2**. The Project also includes several access roads and existing municipal road upgrades.

The Study Area has been defined by the extents of the high resolution (0.5 m) project specific LiDAR that was flown for this project. The Study Area is intended to cover the portion of the Project Land Base where infrastructure is proposed. For the purposes of this assessment, WSP expanded the Study Area beyond the project LiDAR to include terrain surrounding Turbines 1, 31–33, 41–42, and 44–45. Higher-resolution public elevation data were available for most of these expanded areas, while only lower-resolution data was available in the vicinity of Turbine 1. Additional details on the terrain data sources and resolutions are provided in **Section 2.1**.

The following terms are used in this report to denote the extents of the project, the study, and the modelling:

- Project Land Base – The area defined by the Owner where development was considered.
- Study Area – The area defined by WSP and the project specific LiDAR where model results are presented. This area includes all proposed infrastructure.
- 2D Model Area – The full modelled area that includes offsite areas discharging runoff into the Study Area

The Study Area is located on the western edge of a plain that overlooks the Souris River Valley. Area runoff generally drains southwest, discharging into the Souris River and Nickle Lake reservoir. Located in



the Prairie Pothole Region (PPR) and the Moist Mixed Grassland Ecoregion of southern Saskatchewan, this is a glaciated landscape characterized by fine-textured glacial till soils, poorly defined drainage networks, minimal channel development, and numerous depressional wetlands. Wetlands typically collect snowmelt runoff in spring and experience a gradual drawdown through the summer months. As a result, flow paths between wetlands may not be evident as they will only “spill” and discharge during extreme precipitation events. This ecoregion represents the northern extent of open grassland under semi-arid moisture conditions, and while most of the Study Area is cultivated agricultural land, a few patches of native grassland remain.

The geotechnical findings outlined in WSP (2004) are consistent with expectations based on the glacial history, indicating that the Project lies within an area of glaciolacustrine and morainic provenance, with upper soils comprising unsorted gravel, sand, silt, and clay deposits. The soil particle size ratios indicated in the geotechnical report match silty clay loam and clay loam soil textures.

1.2 Existing Flood Mapping

WSP is not aware of any existing flood hazard mapping for the area surrounding the project.

1.3 Supporting Data and References

Data provided by the Client and used in this assessment are listed below:

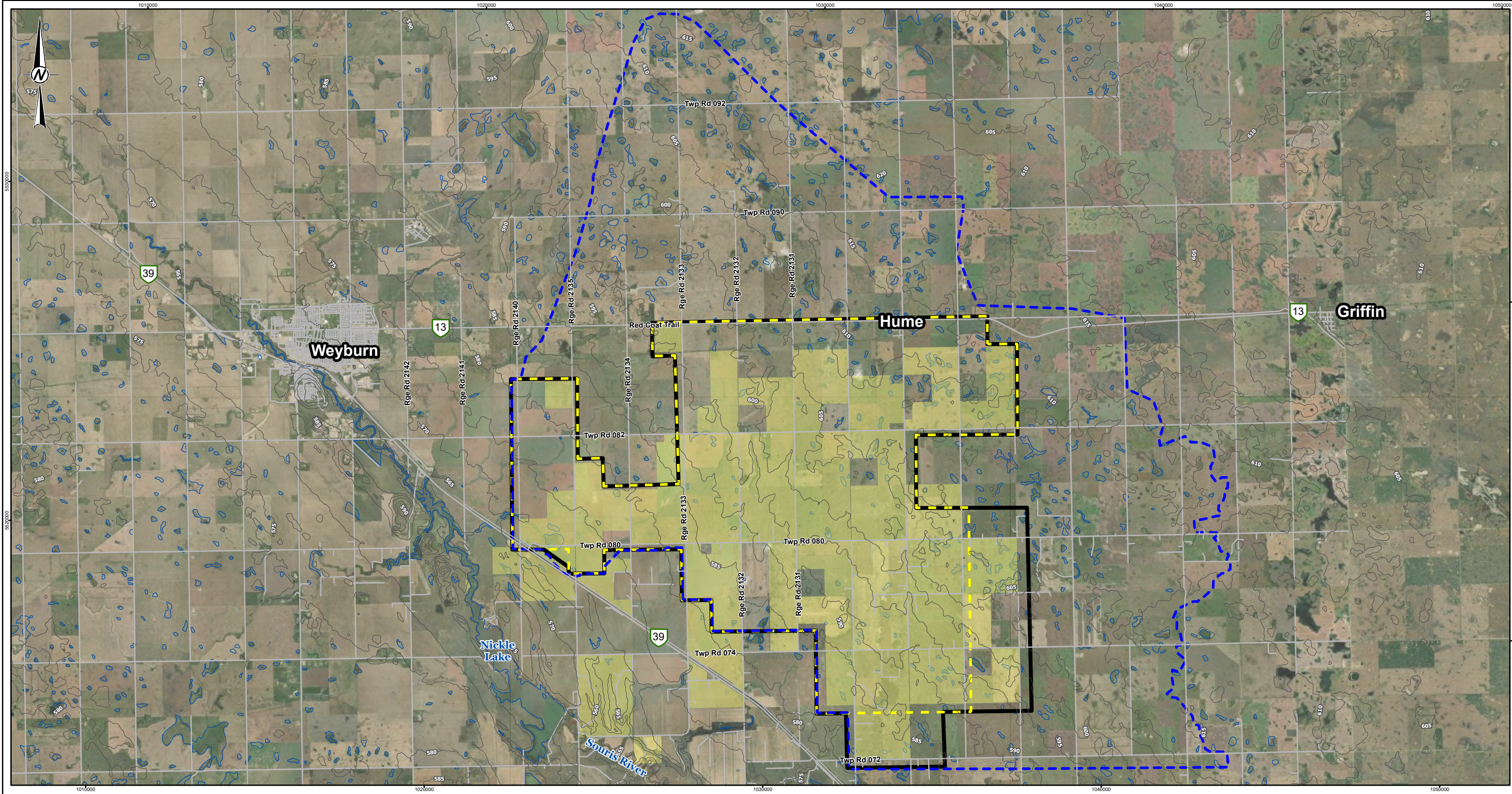
- Airborne Imaging (November 25, 2024). *Seven Stars Bare Earth LiDAR*.
- Enbridge (updated October 15, 2025). *Seven Stars Project Information*. Shape files.

Additionally, WSP used the following publicly available data and resources:

- Google Earth aerial imagery.
- Government of Canada (October 31, 2022). *Short Duration Rainfall Intensity-Duration-Frequency Data*. Text File. Data downloaded for Weyburn Station 401HP5R. <https://climatedata.ca>
- Government of Canada (accessed 2025). *National Hydro Network – NHN*. Shape files downloaded for 05NB000. <https://open.canada.ca/data/en/dataset/a4b190fe-e090-4e6d-881e-b87956c07977>
- Government of Canada (accessed 2025). *Medium Resolution Digital Elevation Model Mosaic (MRDEM)*. <https://open.canada.ca/data/en/dataset/18752265-bda3-498c-a4ba-9dfe68cb98da>.
- Government of Canada (accessed 2025). *High Resolution Digital Elevation Model Mosaic (HRDEM)*. Tiles E_9_148, E_9_149, E_9_150, E_10_148, E_10_149, E_10_150 of the Lake Roy 2024 dataset. <https://open.canada.ca/data/en/dataset/0fe65119-e96e-4a57-8bfe-9d9245fba06b>.

References cited in this report are listed below:

- Chow, Ven Te (1959). *Open-Channel Hydraulics*.
- Natural Resources Conservation Service (1986). *TR-55 Urban Hydrology for Small Watersheds*
- Saskatchewan Conservation Data Centre (accessed October 22, 2025). *Saskatchewan's Ecoregions*. <http://biodiversity.sk.ca/eco.htm>.
- WSP (June 2024). *Weyburn Wind Farm*. Preliminary Geotechnical Report.



- LEGEND**
- STUDY AREA
 - PROJECT LAND BASE
 - PROJECT SPECIFIC LIDAR EXTENTS (0.5M)
 - 2D MODEL AREA
 - MUNICIPAL ROAD
 - RAIL
 - WATER BODY
 - CONTOURS WITH LABELS (5m)

REFERENCE(S)
IMAGERY COPYRIGHT © 20230914 ESRI AND ITS LICENSORS. SOURCE: EARTHSTAR GEOGRAPHICS. USED UNDER LICENSE, ALL RIGHTS RESERVED.
PROJECTED COORDINATE SYSTEM: NAD 1983 CSRS UTM ZONE 13N
NOTE: FLOW PATHS AND CATCHMEN LIMITS ARE BASED ON A DESKTOP ASSESSMENT OF TERRAIN DATA. LOCATIONS OF DRAINAGE CULVERTS ARE NOT AVAILABLE AND THEIR IMPACTS HAVE NOT BEEN CONSIDERED.

CLIENT / OWNER
BOREA CONSTRUCTION / ENBRIDGE

PROJECT
SEVEN STARS ENERGY PROJECT HYDROLOGY ASSESSMENT

CONSULTANT



YYYY-MM-DD	2025-11-06
DESIGNED	YR, NH
PREPARED	YR
REVIEWED	KU
APPROVED	JM

TITLE
STUDY AREA

PROJECT NO.
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1



2. Model Development

The hydrologic and hydraulic analysis for the Seven Stars Energy Project was conducted using a 2-dimensional (2D) model developed in HEC-RAS version 6.6, a software program by the US Army Corps of Engineers. HEC-RAS offers robust 1-dimensional and 2-dimensional modelling capabilities for simulating water flow in natural channels, floodplains, and other water bodies.

The 2D model was developed to assess flood risk within the 123 km² Study Area which is indicated in **Figures 1 and 2**. The extent of the Study Area is intended to cover the portion of the Project Land Base where infrastructure is proposed. The exact extent is defined by the client provided LiDAR, except for three areas where publicly available historic data was leveraged to expand the coverage to include all areas with turbines. The 2D Model Area was defined and extended beyond the immediate Study Area, spanning a total of 240 km², to ensure that offsite areas discharging runoff into the Study Area were accounted for in the model. LiDAR data from three different sources was used to create a terrain model, which was then modified to incorporate select hydraulic structures.

A computational mesh was generated to discretize the flow area into smaller cells, with the mesh resolution refined iteratively through trial simulations to determine the most appropriate cell size for the Study Area. Precipitation and outflow boundary conditions were assigned to control the flow in and out of the model. The model was then used to simulate 1 in 100-year and 1 in 25-year design storms to assess flood risk within the project area. Details of the model development are presented in the following subsections and summarized in **Table 1**.

2.1 Terrain

Detailed and accurate terrain data is essential for developing a reliable 2D model. High-resolution (0.5 m) processed LiDAR was provided by the Owner spanning most of the Study Area. Small gaps remained along the southeast perimeter and in a limited section of the west. To ensure complete coverage of the Study Area and to capture upstream catchments draining toward the site, publicly available historical datasets were incorporated. These included the High-Resolution Digital Elevation Model (HRDEM) and Medium-Resolution Digital Elevation Model (MRDEM) from the CanElevation series, with spatial resolutions of 1 m and 30 m, respectively. **Figure 1** illustrates the extents of the project specific LiDAR dataset and where additional publicly available LiDAR was incorporated to generate the terrain model within the Study Area.

The final terrain model was produced as a mosaic of multiple LiDAR sources, providing full coverage across the full model area, which consists of the Study Area as well as offsite areas that discharge runoff into the Study Area. Where datasets overlapped, the mosaic dataset prioritized the highest-resolution data (0.5 m LiDAR), followed by the HRDEM, and then the MRDEM for any remaining gaps. All raster datasets were resampled to a uniform resolution (1 m) and projection (NAD 1983 CSRS UTM Zone 13N) before being merged into a single terrain model.

2.1.1 Terrain Modification

The Study Area is largely agricultural with limited hydraulic infrastructure. Existing structures include culverts across municipal roads, dugouts, and berms created to collect runoff; desktop information is not available for these structures. Unless the DEM is modified, the model excludes culverts and assumes that runoff overtops the road. This approach provides a conservative estimate of flood risk, representing conditions where structures may be blocked, undersized, or overtopped during extreme events. Excluding culverts, particularly those where flow leaves the Study Area, results in greater water storage within the Study Area and higher ponding upstream of road crossings. However, flow may be locally underestimated immediately downstream of culverts with extensive ponding due to this upstream water storage. To address this concern, the turbines located near flow paths where the flow may be underestimated were reviewed on a case-by-case basis to assess flood risk.

An exception was made for the culverts along Highway 13, which convey runoff from the north into the Study Area. These were incorporated into the terrain model by locally lowering the terrain along the roadway where culverts are present. This method preserves continuous flow paths from upstream drainage areas, ensuring all flow entering the Study Area is represented.

Dugouts and berms were included in the model where their size and depth were resolvable within the LiDAR data and mesh. These features were treated as natural depressions that store runoff until they fill up and spill over to downstream areas. A limitation of this approach is that depressions are represented based solely on LiDAR data, making the results dependent on the timing of data collection. If the LiDAR was acquired under wet conditions with water present in surface depressions, it may underestimate storage capacity and overestimate surface water in the model.

2.2 2D Mesh

The 2D model area was defined to encompass all upstream catchments draining into the Study Area. A standard cell resolution of 30 metres was selected for the computational mesh outside the Study Area boundary, while a refinement region with higher resolution cells of 20 metres was applied within the boundary. Further mesh refinement was applied within the boundary, using breaklines along road and stream centrelines to better capture hydraulic dynamics.

The mesh was refined by two rows of 5 metre cells on each side of roadway centerlines to accurately capture elevated topography. Similarly, four rows of 5 metre cells were applied on each side of the major stream centrelines to align the mesh and guide flow along streams. Mesh refinement was applied only where necessary to balance model precision and computational efficiency. Excessive refinement increases the number of computational cells and the Courant number, potentially requiring smaller time steps and extending simulation times. The selected mesh configuration provides adequate resolution while maintaining reasonable model run times and stable performance.

2.3 Surface Roughness and Imperviousness

A Manning's n value of 0.25 was applied to represent shallow overland flow. For streams with concentrated flow, a coefficient of 0.045 was assigned within a 10 m buffer of main stream centrelines and a 4 m buffer along smaller channels. Main streams refer to the continuous channels forming the primary drainage pathways across the Study Area, while smaller channels include tributaries draining into these main streams. A coefficient of 0.045 was also applied for roads. These values are within the limits suggested in NRCS (1986) and Chow (1959).

Because the Study Area is largely agricultural with minimal built infrastructure, an imperviousness of 0% was assumed across most of the Study Area, except for roadways, which were represented as 90% impervious.

2.4 Boundary Conditions

Boundary conditions were established to define inflows and outflows at the edges of the modeled system. Inflow was represented by a global precipitation boundary condition applied uniformly across all mesh cells, as discussed further in **Section 2.5**. Additional inflow boundary conditions were not required as the model encompasses all upstream contributing areas, ensuring relevant offsite inflows are captured.

Outflow from the model is controlled using Normal Depth boundary conditions, which approximate flow conditions at the downstream extent of the modeled system. A Normal Depth boundary requires specifying a friction slope to define the downstream water surface and represent how the channel or terrain would continue beyond the model limits. This approach allows flows to exit the model extents under realistic flow conditions without causing artificial backwater effects. For this study, a friction slope of 1% was specified based on terrain data to represent a uniform continuation of the terrain and channel geometry beyond the model perimeter and allow flow to exit the model.

2.5 Precipitation and Runoff

Rainfall runoff is input into the model through a “rain on mesh” approach that applies rainfall directly onto each cell of the 2D mesh. The amount of runoff generated from each cell is calculated by determining infiltration losses; this project adopted the SCS Curve Number method.

A universal Curve Number (CN) value of 84 was initially adopted for all model sub-catchments based on a Hydrologic Soil Group (HSG) type D, which is applicable for the Study Area's silty clay loam to clay loam soils, for Antecedent Moisture Condition (AMC) Type II, and an initial abstraction (I_a) coefficient of 0.2. However, this was increased to 88 during the model validation process to improve alignment with the regional analysis results. This new value is still within acceptable limits for the soil type and agricultural lands.

Two design storm scenarios were simulated to assess flood risk: the 100-year, 24-hour and 25-year, 24-hour rainfall events. Intensity–Duration–Frequency (IDF) data from Environment and Climate Change

Canada (ECCC) were obtained for the Weyburn climate station, chosen for its proximity to the Study Area. The dataset spans precipitation records from 1962–2021 and indicates 24-hour rainfall depths of 87.9 mm and 111.5 mm for the 25-year and 100-year return periods, respectively.

The SCS Type II rainfall distributions were selected for this project since they widely used and accepted for hydrologic modelling in rural prairie areas across the United States and Canada. Type II represents the most intense rainfall among the SCS distributions, and is considered appropriate for interior areas (NRCS, 1986). This distribution was applied to both the 25-year and 100-year, 24-hour storm events to generate the model hyetographs using 6-minute time intervals; the resulting hyetographs are shown in **Figure 3**.

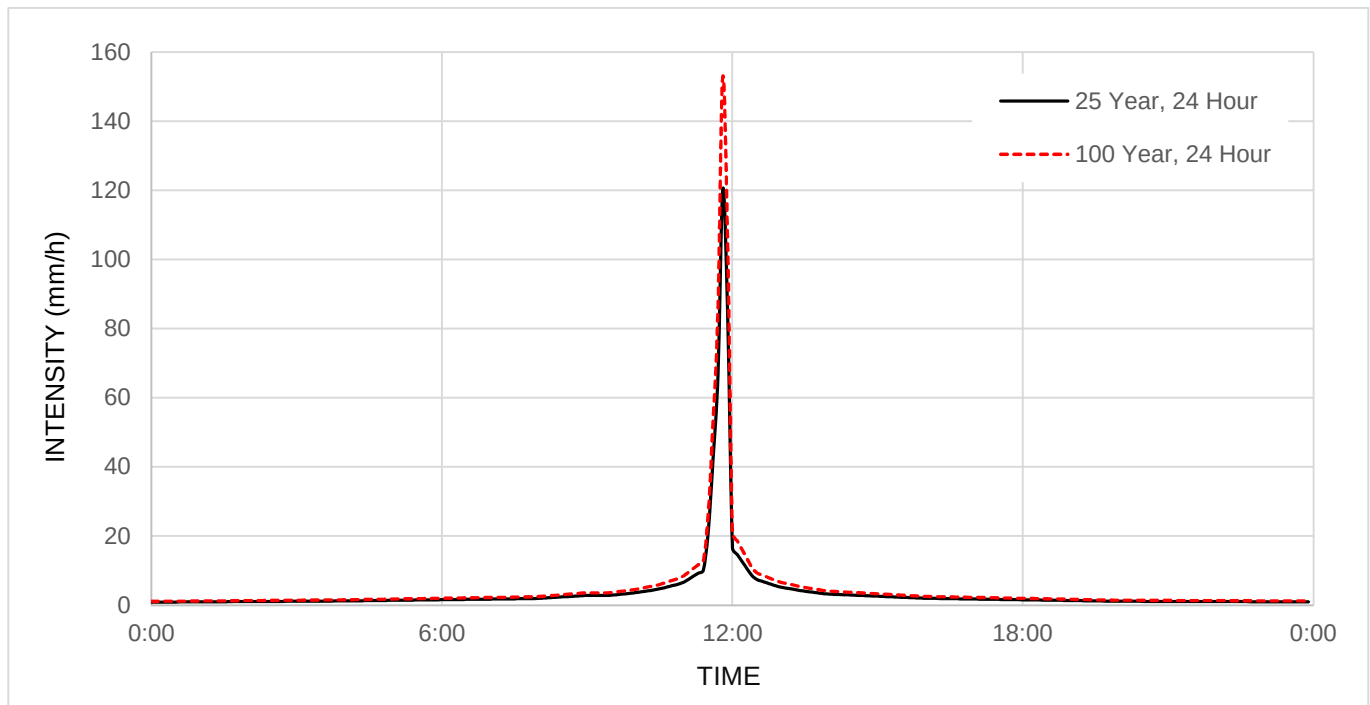


Figure 3 – Selected SCS Type II Hyetographs

2.6 Simulation Settings

HEC-RAS provides the option of solving either the Shallow Water Equations (SWE) or the Diffusion Wave Equations (DWE) for 2D analysis. The system default is DWE as this method runs faster and is inherently more stable, while still being applicable for most modelling applications. The SWE produce more accurate results; however, this approach requires greater computational power and longer model run times. The selection of the DWE or SWE depends upon the accuracy of initial simulation results. Generally, the default DWE are initially applied, and the simulation results are reviewed to confirm whether this selection is acceptable. For this project, initial simulation results using the DWE were found to be acceptable, thus, DWE were used for all subsequent modeling.



Further, the 2D model was executed using a variable time step (Model Computation Interval) to keep the Courant number small while not significantly adding to the runtimes. Care was taken when choosing the starting timestep as high values increase the Courant number resulting in a wave travel distance in excess of the mesh resolution, which could cause instability in the model. Key parameters are summarized in **Table 1**.

Table 1. HEC-RAS Model Parameters

PARAMETER	DESCRIPTION	VALUE
Surface Roughness Manning N	Overland Sheet Flow	0.25
	Concentrated Overland Flow	0.045 ¹
Precipitation	Design Hyetograph	SCS Type II
	25-Year 24-Hour Rainfall Depth	87.9
	100-Year 24-Hour Rainfall Depth	111.5
Imperviousness	Default	0%
	Roads	90%
Simulation Settings	Model Computation Interval	Initial Time-Step: 10 seconds Variable Range: 2.5 – 40 seconds
	Model Result Interval	6 minutes
	Simulation Duration	30 hours

¹Applied for all flow paths and minor flow paths denoted on figures.

3. Model Results

Model results for the 25-year and 100-year 24-hour SCS Type II design events are presented in **Figure 4** to **Figure 11**. The predicted flood flow depths and velocities are displayed with colour gradients; the shallowest depths and lowest velocities are omitted for clarity. The model can resolve flow properties in much greater detail than mesh resolution. This is because each mesh cell is not a single elevation, but a detailed elevation volume/area relationship that represents the details of the underlying terrain. The HEC-RAS cell faces are detailed cross sections, which get processed into detailed elevation versus area, wetted perimeter, and roughness relationships. This approach allows the model to use larger cell sizes with HEC-RAS and still accurately represent the underlying terrain. This HEC-RAS characteristic is apparent in the result figures, which provide flow depth and velocity resolution greater than the 5 – 30 metre cell resolution.

The model result figures include the concept design locations for turbines, access roads, and existing municipal road upgrades. In general, the model results provide a clear indication of locations with concentrated flow and potential flood risk due to deeper ponding. High flow depths are typically a result of ponding within a natural depression or upstream of a road crossing, or channelized flow. Note that the mapped flood depths may be conservatively high where flow crosses existing roads through small diameter drainage culverts; these culverts were excluded from the model and as a result the flow is shown to overtop the road. Several proposed turbine pads appear to be located within these locations and will need to be raised to protect them from flooding; existing and proposed roads cross numerous channels that convey flow during wet periods. Key flood risks identified for proposed building pads, turbines, and access roads are outlined in **Section 3.3**.

3.1 Regional Analysis

A regional analysis was completed to validate the model results. The validation was completed by comparing the modeled peak discharge results of five major catchments that drain from the Study Area with the regional analysis results. This section presents the results of the regional analysis; refer to **Section 3.1.1** for comparison with the model results.

The Study Area was discretized into 5 subcatchments based on the existing topography as shown in **Figure 1** (A through E), from north to south, with a sixth catchment that is partially within the study area (F). Given the hummocky topography and numerous depressional basins throughout the area, catchment boundaries are approximate and may vary depending on the severity of a runoff event.

The regional analysis incorporated peak runoff data from the Water Survey Canada Stations listed in **Table 2**. The selected stations are located near the project area and represent catchments of comparable or larger size and similar terrain characteristics to those within the Study Area. A frequency analysis of instantaneous peak discharge records was performed for each of the five stations to derive event-based discharge values (**Table 3**) and establish a relationship between catchment area and unit

discharge. This relationship was then applied to estimate frequency event discharges for five Study Area catchments, to provide a comparison with modelled results. The estimated discharges are summarized in **Table 4**.

All the catchments have many local depressions which accumulate runoff, many of these depressions likely do not contribute much to runoff during a severe event. These depressions are a regular feature in the five Study Area catchments, as well as the regional analysis stream catchments. However, a portion of Catchment E is part of a much larger depressed area which the modelling suggests does not contribute to catchment runoff. This 20 km² area has been subtracted from the analysis results in **Table 4** to provide a consistent comparison across all catchments.

Table 2. Selected Water Survey Canada Stations

Station ID	Name	Drainage Area (km ²)	Record Length (Years)
05NB014	Jewel Creek Near Goodwater	211	50
05NB033	Moseley Creek Near Halbrite	59	32
05NB035	Cooke Creek Near Goodwater	129	29
05NB040	Souris River Near Ralph	3980	23
05NB041	Roughbank Creek Above Rafferty Reservoir	269	23

Table 3. Calculated Frequency Discharges for Selected Stations

Station ID	Name	Frequency Discharge (m ³ /s)				
		5-Year	10-Year	20-Year	50-Year	100-Year
05NB014	Jewel Creek Near Goodwater	15.1	26.1	39.1	59.0	75.8
05NB033	Moseley Creek Near Halbrite	3.5	5.8	8.4	12.5	16.0
05NB035	Cooke Creek Near Goodwater	1.2	3.8	9.6	27.5	55.4
05NB040	Souris River Near Ralph	24.7	49.5	88.2	170.0	264.0
05NB041	Roughbank Creek Above Rafferty Reservoir	5.0	8.9	13.6	20.4	25.9

Table 4. Estimated Frequency Discharges for Project Catchments

Catchment	Drainage Area (km ²)	Frequency Discharge (m ³ /s)				
		5-Year	10-Year	20-Year	50-Year	100-Year
A	44	2.17	4.34	7.38	12.78	18.06
B	53	2.40	4.81	8.19	14.23	20.17
C	20	1.41	2.81	4.75	8.11	11.32
D	33	1.85	3.71	6.28	10.83	15.23
E	24* (44 total)	1.56	3.11	5.26	9.01	12.61

*The northern headwater of Catchment E consists of a large-scale depression that does not appear to contribute to catchment runoff. This 20 km² area has been subtracted from the total catchment area in Table 3.

3.1.1 Model Validation

Model validation was completed by comparing the modelled 100-year peak runoff rates against the regional analysis results for the five major catchments draining the Study Area. Modelled peak flows were between 1% and 16% lower than the regional estimates, with a weighted average difference of approximately 12%. This result was achieved by modifying the model infiltration parameter (SCS Curve Number) from 84 to 88, which is considered to be the upper bounds for silty clay loam to clay loam soils developed for agricultural purposes. This level of agreement between the model and the regional analysis is considered to be strong, given the desktop nature of the study. Slightly lower modelled flows are expected, as minor drainage culverts were not represented in the model, resulting in greater upstream storage and attenuation within the catchments.

3.2 Culvert Locations

Preliminary culvert locations were identified along each access road and upgraded municipal road based on the existing terrain and the proposed road alignments and are illustrated on the figures. The locations assume that access roads will be constructed to conform with the existing terrain where possible. A culvert is proposed at each sag in the road alignment where the drainage catchment is greater than 0.5 ha. Culvert location and sizing will be confirmed in future design.

3.3 Flood Risks

The model results were reviewed to identify potential flood risks to project infrastructure. The review considered model results in parallel with terrain data and aerial imagery to provide a more comprehensive desktop assessment. The terrain data was used to identify depressions and potential flow paths, while aerial imagery was used to identify vegetation changes that may coincide with flood prone areas. These depressions and associated flow pathways are apparent in the model results (see **Figure 4 to Figure 11**). To mitigate flood risk, it is recommended that turbine pads and access roads be



designed to consider projected flood levels. While model results inform structure design, refinement may be warranted.

Building Pads

Four building pads are proposed, with all four being accessed from Twp Road 80. The pads are required for construction laydown, operations and maintenance, a substation, and a radar tower. The northernmost pad, intended for construction laydown, is located within a small, shallow depression. The pad should be raised up above the surrounding terrain with the perimeter soils graded to allow positive drainage away from the pad.

The three pads located south of Twp Road 80 are located near minor flow paths. The pads should be raised up above the surrounding terrain, with the perimeter soils graded to allow positive drainage away from and around the pads.

Turbines and Access Roads

The turbine and access road locations were reviewed to identify those which may require additional design effort to mitigate flood risk. In general, relocating turbines or associated infrastructure to higher ground outside of flood-prone areas may be the most practical and cost-effective approach. Although a wetland delineation was not completed as part of the current scope, some the surface depressions within the Study Area may represent wetlands and should be avoided where possible. Where this is not feasible, turbine pads located within flood-prone areas should be raised above the expected ponding depth.

Table 5 and **Table 6** summarize locations where additional flood mitigation effort may be required. It is noted that this summary is based on a preliminary review and assumes that typical pad design is raised above grade and incorporates perimeter ditching.

Table 5: Turbine Locations with Flood Concerns

Turbine Met Station ID	Description
1	This turbine is in a low area near a relatively large flow path that is expected to flood a wide area during high flows due to the flat terrain at the existing culvert crossing Twp Rd 80. The turbine is located within 20 m of drainage channel that helps to drain the area toward the culvert. Flooding is expected when flow backs up from the Twp Rd 80 crossing. The turbine pad should be raised above the elevation of Twp Rd 080 since this road may be overtopped during a large runoff event. Consider relocating this turbine slightly south to sit on higher ground; the current location's proximity to the drainage channel suggests it may flood regularly and the

Turbine Met Station ID	Description
	turbine construction including the crane pad is likely to impact the drainage channel alignment.
6	Located on the edge of a small depression that is roughly 0.7 m lower than the surrounding area. The turbine pad should be raised above the surrounding area with positive drainage around the perimeter. Shifting this location east could also alleviate flood risk.
13	Located along a flow path where flow is expected to encompass the turbine pad. The pad should be raised above the maximum anticipated flow depth, or shifted slightly east.
14	Located along a flow path where flow is expected to encompass the turbine pad. The pad should be raised above the maximum anticipated flow depth, or shifted slightly north.
25	Located in a low area surrounding a wetland that is at risk of flooding during a large runoff event. The turbine pad should be raised above the surrounding area with positive drainage around the perimeter. The pad should be higher than the sag in the access road at the proposed culvert to be protected from flooding since runoff from the depression will drain through the culvert at that sag. Shifting this location south could also alleviate flood risk.
28	Located within a shallow depression that appears to regularly collect runoff. The turbine pad should be raised above the expected ponding depth with positive drainage around the perimeter or shifted slightly north or east.
29	Located uphill from Twp Rd 80, within an area that may flood if the capacity of the nearby municipal culvert is compromised. The flood depth at the turbine location may exceed 1.0 m if culvert backs up and flow overtops the road. The turbine pad should be raised to an elevation that is higher than the Twp Rd at the culvert crossing, or relocated slightly east, outside of the flood-prone area.
30	Located in a low area within a small catchment, however, the vegetation suggests that it regularly collects runoff. The turbine pad should be raised above the expected ponding depth with positive drainage around the perimeter or relocated slightly east to sit on higher ground.

Turbine Met Station ID	Description
35	Located along a flow path where flow is expected to encompass the turbine pad. The pad should be raised above the maximum anticipated flow depth, or relocated east, outside of the flood-prone area.
39	Located in a low area near a flow path where flow may encompass the turbine pad. The pad should be raised above the maximum anticipated flow depth, or shifted north to sit on higher ground.
45	Located in a low area near a flow path that is expected to flood the turbine pad area with ponding. The pad should be raised above the maximum anticipated flow depth, or shifted south or east, outside of the flood-prone area.
46	Located within a low area that is expected to be flooded by an unnamed stream during large runoff events. The pad will need to be raised to protect the turbine from flooding, or shifted slightly south or east, outside of the flood-prone area.
Met Station 1 (North)	Located near a relatively large flow path in a low area that is expected to experience ponding during a runoff event. The pad should be raised above the anticipated ponding depth.
Met Station 2 (South)	Located within an area with poor drainage. A channel appears to have been created to drain the area, however, ponding is still likely during large runoff events. The pad will need to be raised to protect the station from flooding, or shifted south to sit on higher ground.

Table 6: Access Roads with Flood Potential

Road ID	Description
1	This access road crosses over a low area which conveys runoff from Catchment B. The original flow path appears to be realigned into the Twp Rd 80 ditch. The access road will cross this ditch as well as two drainage channels that help drain the area. The flow crosses Twp Rd 80 just west of the access road. Details of the culvert crossing are not available, however, flooding is expected if or when flow backs up from this existing culvert.

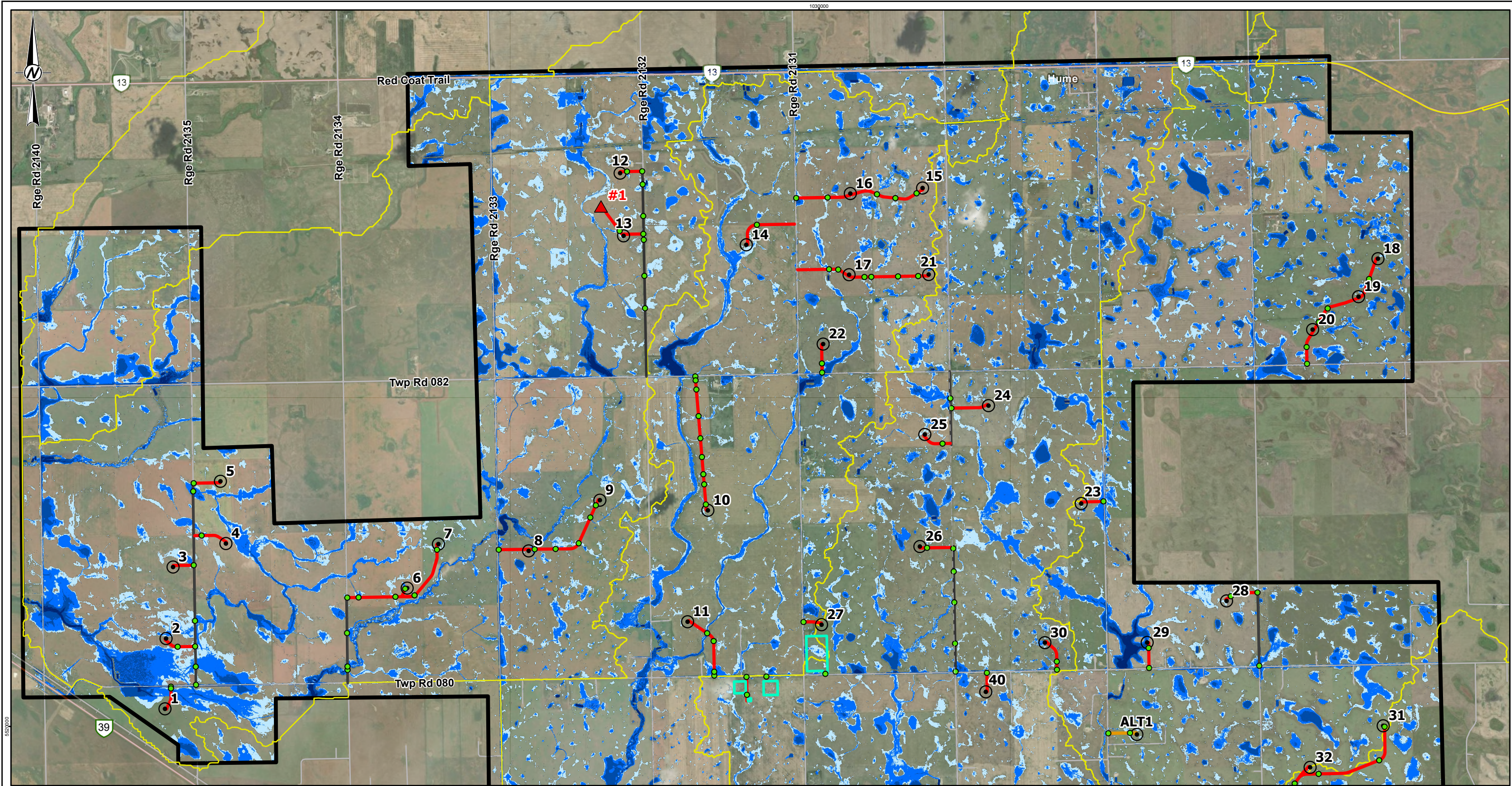
4. Conclusions

WSP Canada Inc. was retained by Borea Construction to complete a desktop hydrology study of the Seven Stars Energy Project. The 100-year, 24-hour and 25-year, 24-hour rainfall events were simulated to assess flood risk across the Study Area. The model results, presented in **Figure 4** to **Figure 11**, identified locations of flood risk due to deep ponding within depressions and high flows along drainage channels.

A high-level regional analysis was completed to validate hydrologic model results. The Study Area drains through five major catchments, for which representative Water Survey Canada Stations were selected based on similarity in catchment characteristics and terrain. A frequency analysis of instantaneous peak discharge data was completed to establish discharge–area relationships, which were then used to calculate expected peak discharges for the five catchments within the Study Area. A comparison of these estimated values and model results showed that modelled 100-year peak flows were, on average, only 12% lower than regional estimates, demonstrating strong alignment. The slightly lower modelled flows are expected due to the exclusion of minor drainage features (e.g. culverts), which corresponds to increased attenuation within the catchment.

A thorough review of model results, terrain data, and aerial imagery identified several localized flood risks within the Study Area. In total, 12 turbine locations, 2 MET stations, and 1 access road segment were found to be susceptible to ponding or overland flow during large runoff events. Flood risks are primarily associated with low-lying areas, natural depressions, and flow paths where runoff is expected to accumulate or back up due to limited drainage capacity. Some of the natural depressions in the Study Area may represent wetlands and should be avoided where possible. In most cases, minor shifts in the prospective locations may alleviate flood risk. Where this is not feasible, raising turbine and pad elevations above the surrounding terrain and developing designs to facilitate positive perimeter drainage is recommended. Access roads intersecting flow paths will require appropriately sized culverts or flow diversions to maintain drainage connectivity.

Further refinement of the hydraulic model and field verification during detailed design will be required to confirm high water levels and finalize site specific flood protection measures. The refinement will need to include adding some existing culverts into the model based on field measurements.



STUDY AREA

MUNICIPAL ROAD

RAIL

CATCHMENT LIMIT

PROPOSED CULVERT

MET STATION

TURBINE

ACCESS ROAD

ACCESS ROAD ALTERNATIVE

MUNICIPAL ROAD UPGRADE

BUILDING PAD

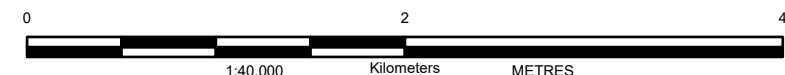
100-YEAR FLOOD DEPTH

0.15m - 0.30m

0.30m - 0.60m

0.60m - 1.10m

1.10m - 3.60m



CLIENT / OWNER
BOREA CONSTRUCTION / ENBRIDGE

CONSULTANT



YYYY-MM-DD	2025-11-07
DESIGNED	YR, NH
PREPARED	YR
REVIEWED	KU
APPROVED	JM

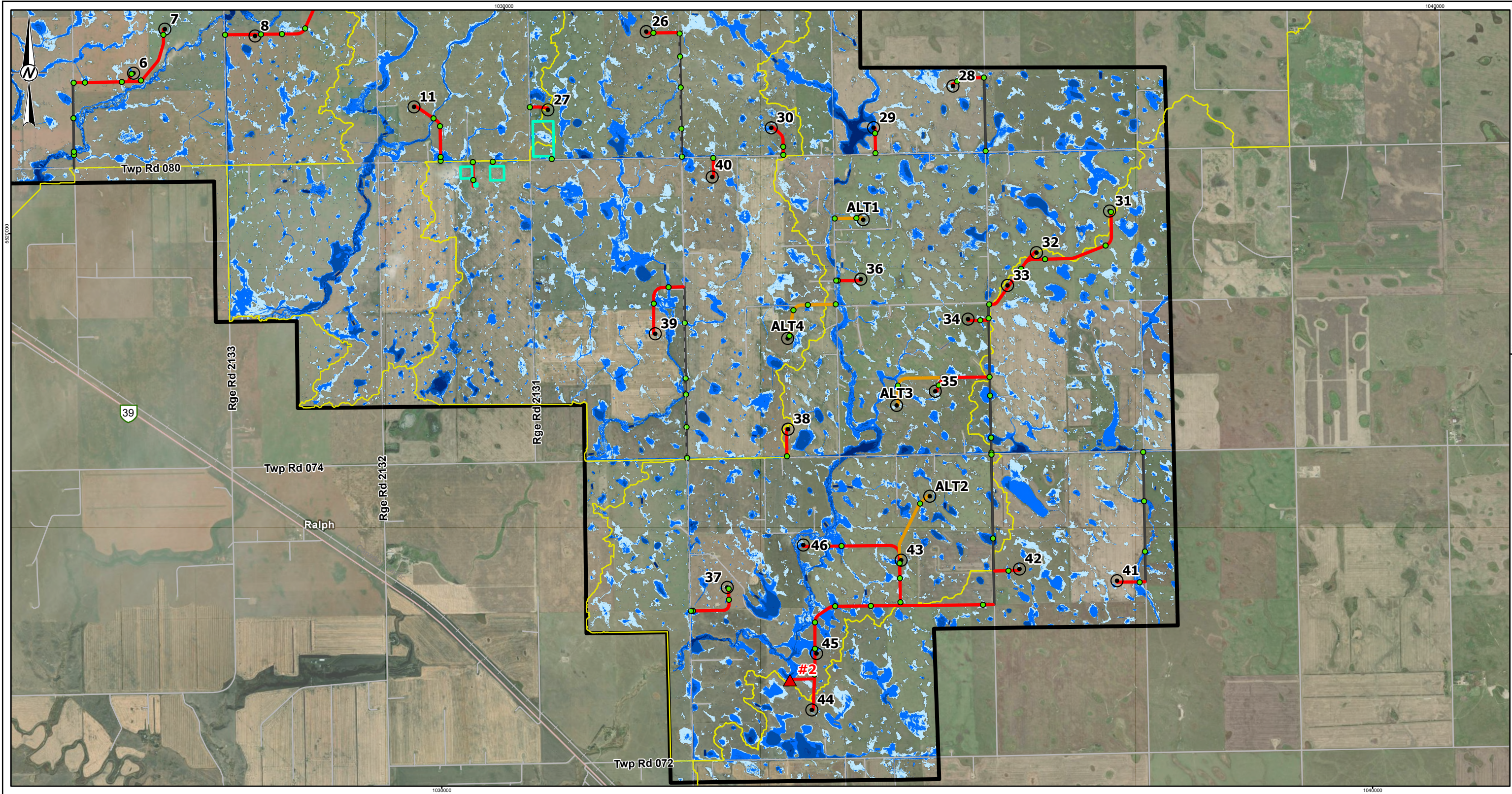
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PROJECTED COORDINATE SYSTEM: NAD 1983 CSRS UTM ZONE 13N
NOTE: FLOW PATHS AND CATCHMEN LIMITS ARE BASED ON A DESKTOP ASSESSMENT OF TERRAIN DATA. LOCATIONS OF DRAINAGE CULVERTS ARE NOT AVAILABLE AND THEIR IMPACTS HAVE NOT BEEN CONSIDERED.

PROJECT
SEVEN STARS ENERGY PROJECT HYDROLOGY ASSESSMENT

TITLE	MODEL RESULTS - 100-YEAR FLOW DEPTH (MAP 1 OF 2)
PROJECT NO.	CA0060582.5330
CONTROL	
REV.	A
FIGURE	4

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STUDY AREA

MUNICIPAL ROAD

RAIL

CATCHMENT LIMIT

PROPOSED CULVERT

MET STATION

TURBINE

ACCESS ROAD

ACCESS ROAD ALTERNATIVE

MUNICIPAL ROAD UPGRADE

BUILDING PAD

100-YEAR FLOOD DEPTH

0.15m - 0.30m

0.30m - 0.60m

0.60m - 1.10m

1.10m - 3.60m



CLIENT / OWNER
BOREA CONSTRUCTION / ENBRIDGE

CONSULTANT

YYYY-MM-DD	2025-11-12
DESIGNED	YR, NH
PREPARED	YR
REVIEWED	KU
APPROVED	JM

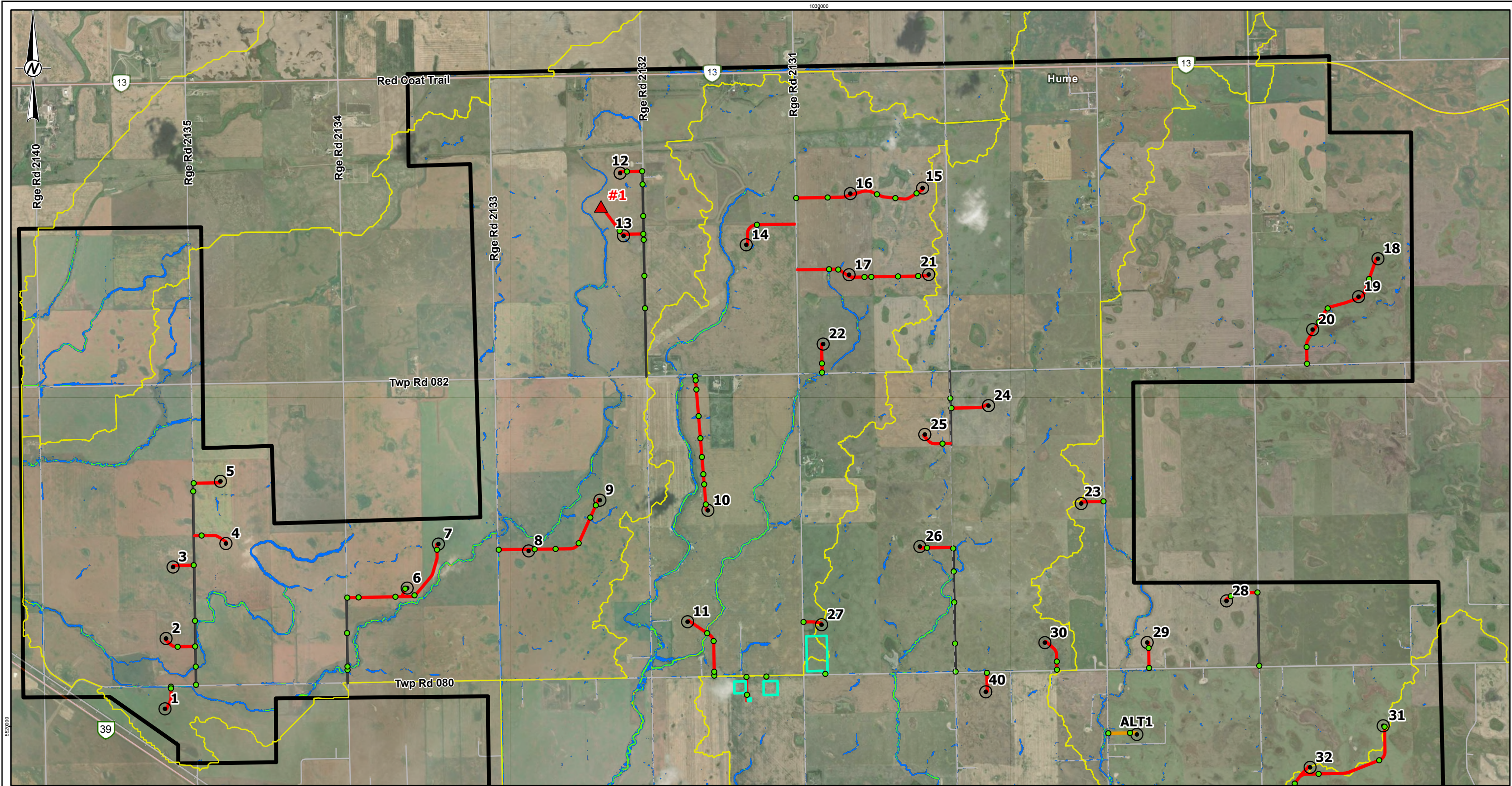
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PROJECT
SEVEN STARS ENERGY PROJECT HYDROLOGY ASSESSMENT

TITLE MODEL RESULTS - 100-YEAR FLOW DEPTH (MAP 2 OF 2)			
PROJECT NO.	CONTROL	REV.	FIGURE
CA0060582.5330		A	5

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STUDY AREA

MUNICIPAL ROAD

RAIL

CATCHMENT LIMIT

PROPOSED CULVERT

TURBINE

MET STATION

ACCESS ROAD

ACCESS ROAD ALTERNATIVE

MUNICIPAL ROAD UPGRADE

BUILDING PAD

100-YEAR FLOW VELOCITY

0.15 m/s - 0.5 m/s

0.5 m/s - 1.0 m/s

1.0 m/s - 1.5 m/s

> 1.5 m/s

CLIENT / OWNER
BOREA CONSTRUCTION / ENBRIDGE

CONSULTANT

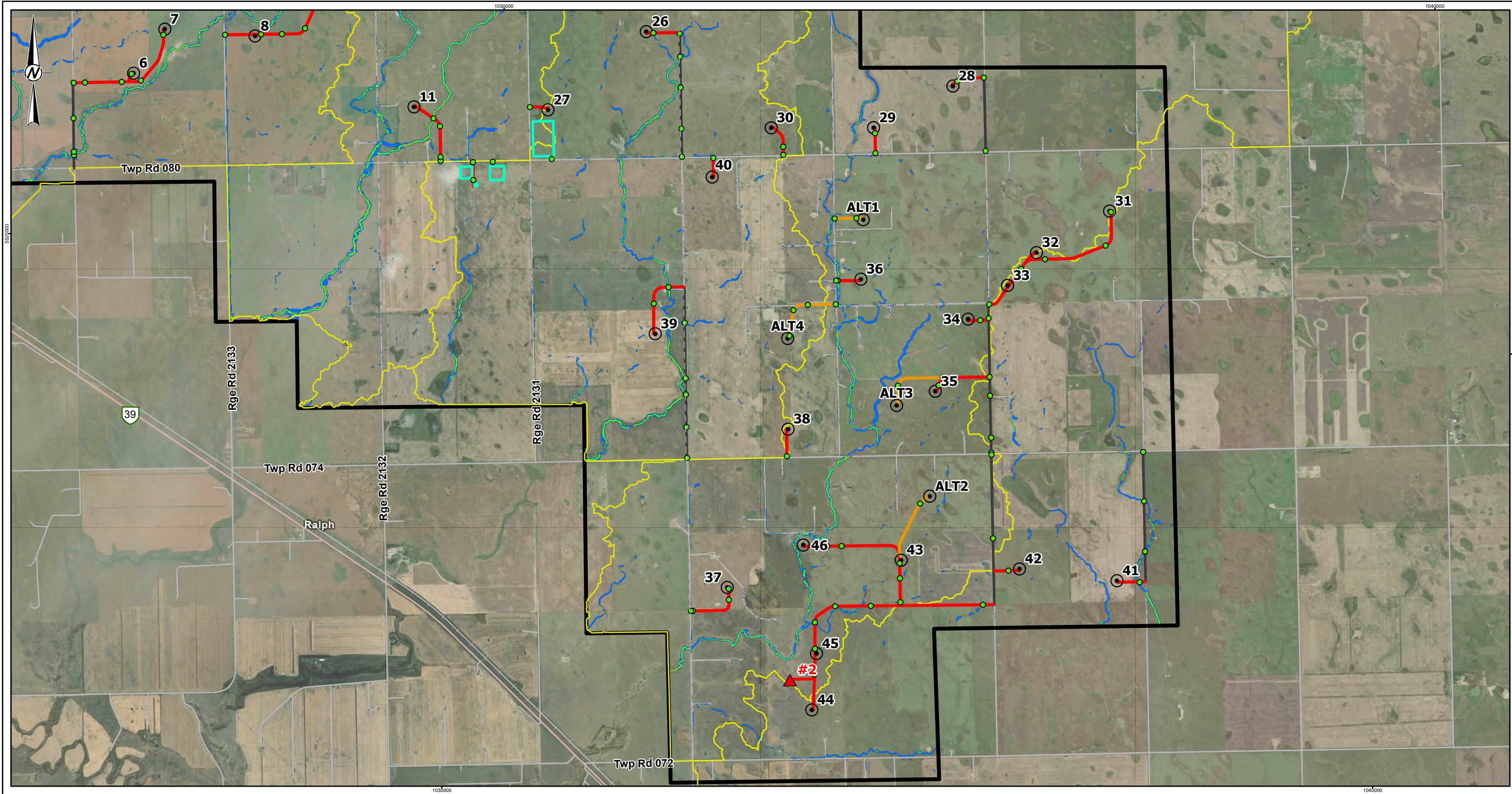
YYYY-MM-DD	2025-11-06
DESIGNED	YR, NH
PREPARED	YR
REVIEWED	KU
APPROVED	JM

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PROJECT
SEVEN STARS ENERGY PROJECT HYDROLOGY ASSESSMENT

TITLE
**MODEL RESULTS - 100-YEAR FLOW VELOCITY
(MAP 1 OF 2)**

PROJECT NO.	CONTROL	REV.	FIGURE
CA0060582.5330		A	6



STUDY AREA

MUNICIPAL ROAD

RAIL

CATCHMENT LIMIT

PROPOSED CULVERT

MET STATION

TURBINE

ACCESS ROAD

ACCESS ROAD ALTERNATIVE

MUNICIPAL ROAD UPGRADE

BUILDING PAD

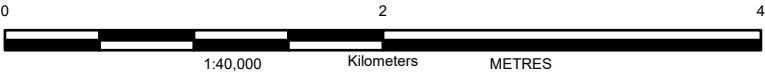
100-YEAR FLOW VELOCITY

0.15 m/s - 0.5 m/s

0.5 m/s - 1.0 m/s

1.0 m/s - 1.5 m/s

> 1.5 m/s



CLIENT / OWNER
BOREA CONSTRUCTION / ENBRIDGE

CONSULTANT

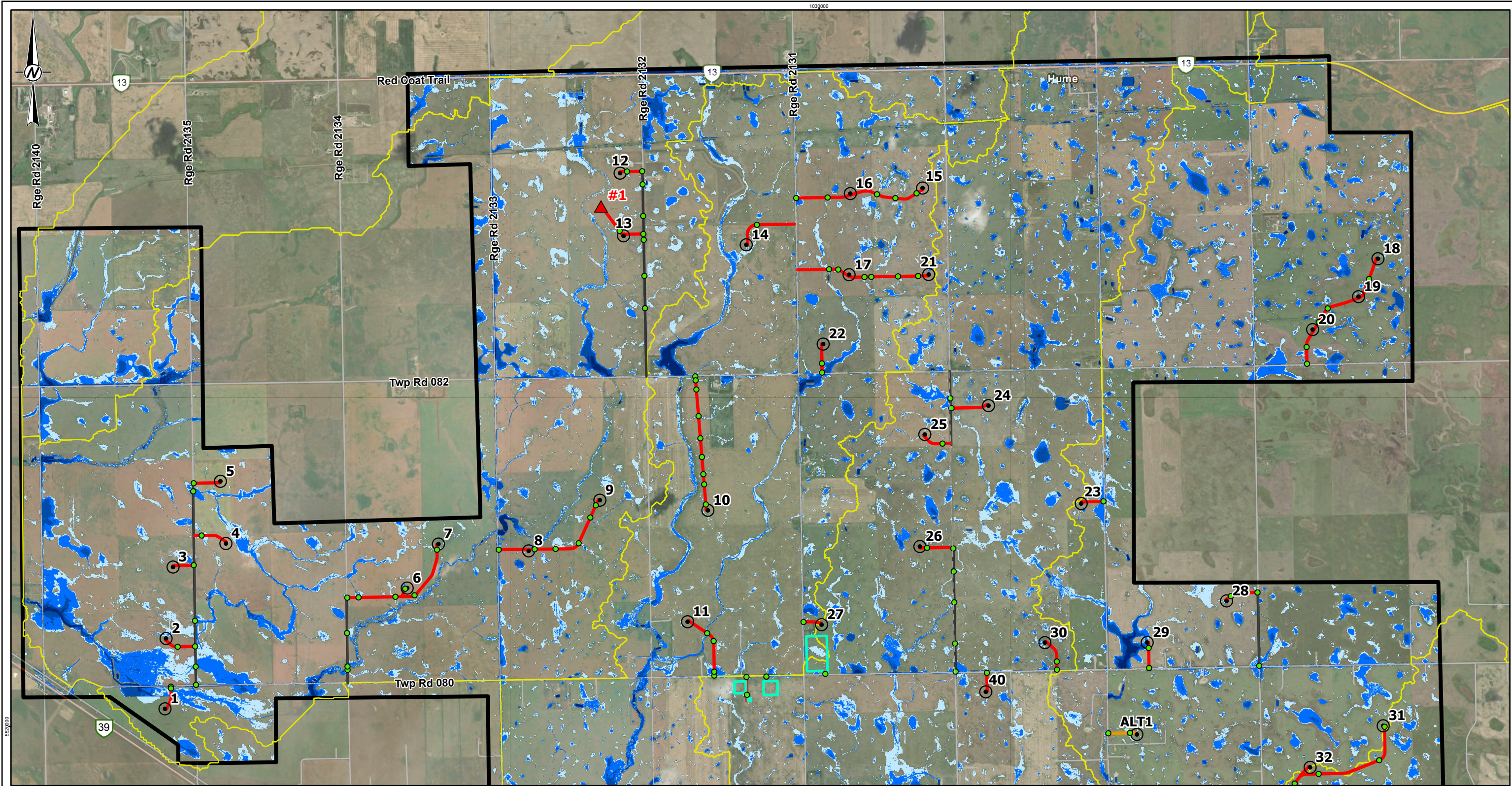
YYYY-MM-DD	2025-11-12
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PREPARED	YR
REVIEWED	KU
APPROVED	JM

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PROJECT
SEVEN STARS ENERGY PROJECT HYDROLOGY ASSESSMENT

TITLE
MODEL RESULTS - 100-YEAR FLOW VELOCITY
(MAP 2 OF 2)

PROJECT NO.	CONTROL	REV.	FIGURE
CA0060582.5330		A	7



STUDY AREA

MUNICIPAL ROAD

RAIL

CATCHMENT LIMIT

PROPOSED CULVERT

TURBINE

MET STATION

ACCESS ROAD

ACCESS ROAD ALTERNATIVE

MUNICIPAL ROAD UPGRADE

BUILDING PAD

25-YEAR FLOOD DEPTH

0.15m - 0.30m

0.30m - 0.60m

0.60m - 1.10m

1.10m - 3.60m

CLIENT / OWNER
BOREA CONSTRUCTION / ENBRIDGE

CONSULTANT

YYYY-MM-DD	2025-11-07
DESIGNED	YR, NH
PREPARED	YR
REVIEWED	KU
APPROVED	JM

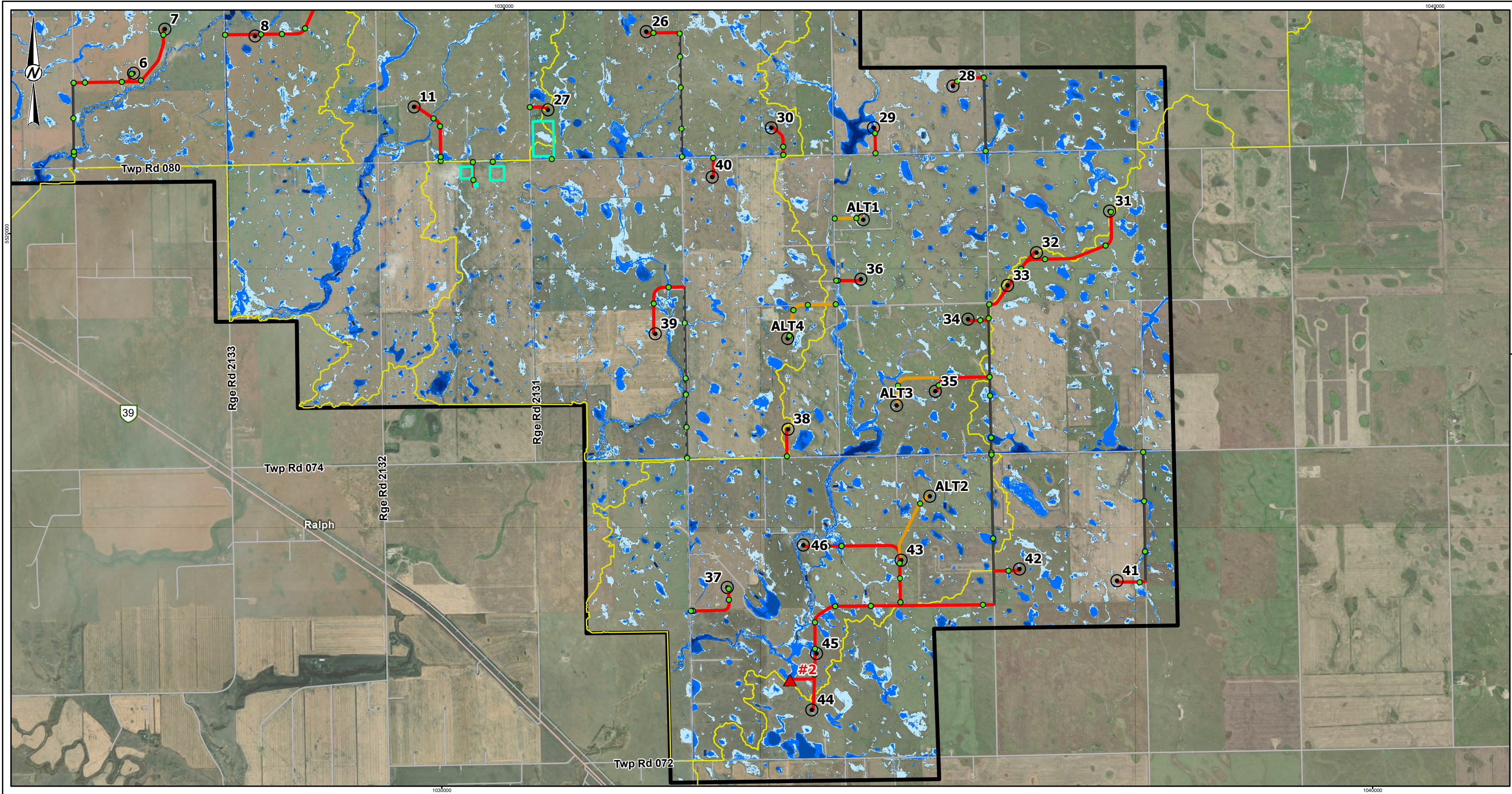
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PROJECT
SEVEN STARS ENERGY PROJECT HYDROLOGY ASSESSMENT

TITLE	MODEL RESULTS - 25-YEAR FLOW DEPTH (MAP 1 OF 2)
PROJECT NO.	CA0060582.5330
CONTROL	
REV.	A
FIGURE	8

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STUDY AREA

MUNICIPAL ROAD

RAIL

CATCHMENT LIMIT

PROPOSED CULVERT

MET STATION

TURBINE

ACCESS ROAD

ACCESS ROAD ALTERNATIVE

MUNICIPAL ROAD UPGRADE

BUILDING PAD

25-YEAR FLOOD DEPTH

0.15m - 0.30m

0.30m - 0.60m

0.60m - 1.10m

1.10m - 3.60m

CLIENT / OWNER
BOREA CONSTRUCTION / ENBRIDGE

CONSULTANT

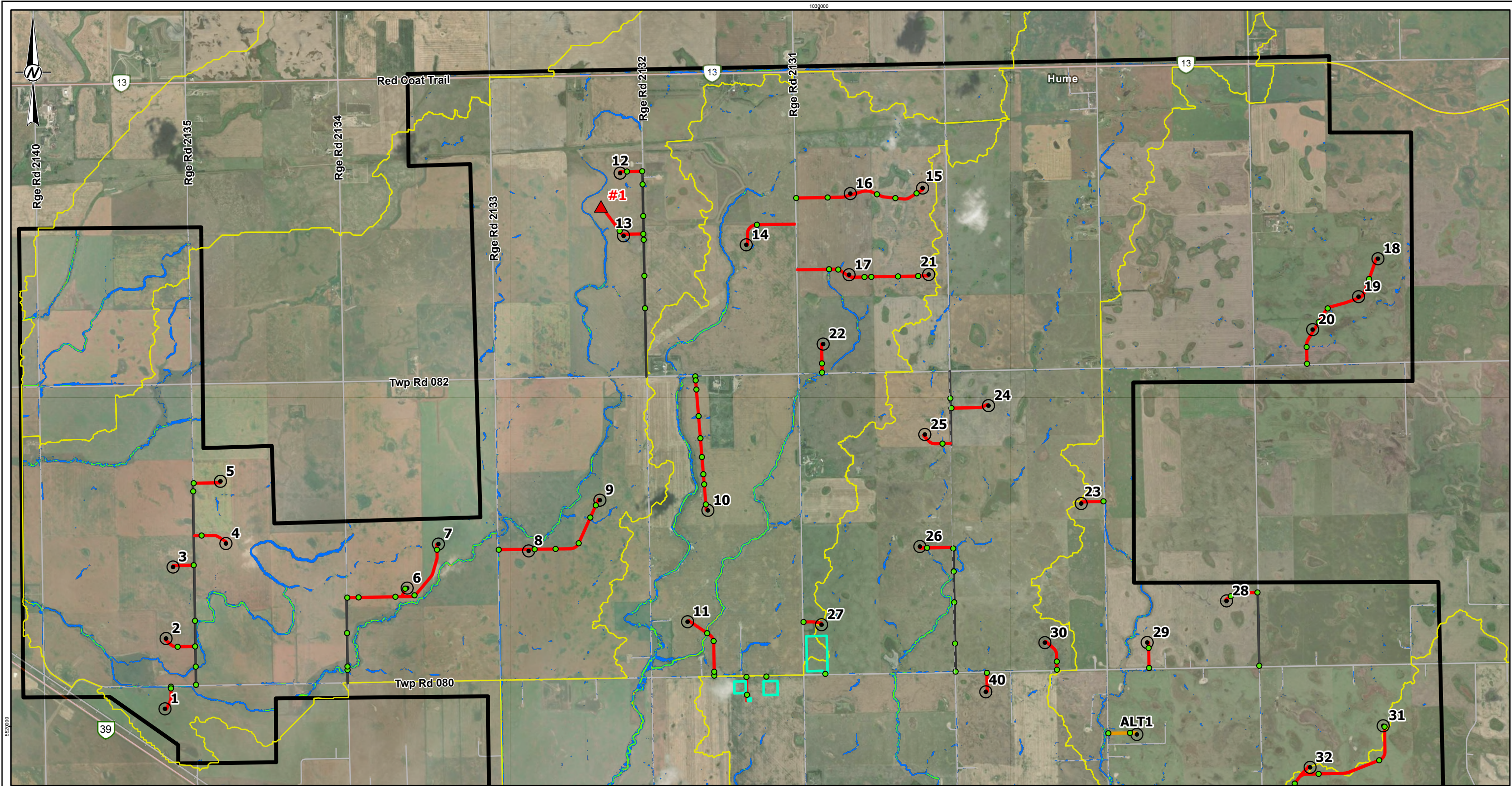
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PREPARED	YR
REVIEWED	KU
APPROVED	JM

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PROJECT
SEVEN STARS ENERGY PROJECT HYDROLOGY ASSESSMENT

TITLE
MODEL RESULTS - 25-YEAR FLOW DEPTH (MAP 2 OF 2)

PROJECT NO.	CONTROL	REV.	FIGURE
CA0060582.5330		A	9



STUDY AREA

MUNICIPAL ROAD

RAIL

CATCHMENT LIMIT

PROPOSED CULVERT

MET STATION

TURBINE

ACCESS ROAD

ACCESS ROAD ALTERNATIVE

MUNICIPAL ROAD UPGRADE

BUILDING PAD

25-YEAR FLOW VELOCITY

0.15 m/s - 0.5 m/s

0.5 m/s - 1.0 m/s

1.0 m/s - 1.5 m/s

> 1.5 m/s

CLIENT / OWNER
BOREA CONSTRUCTION / ENBRIDGE

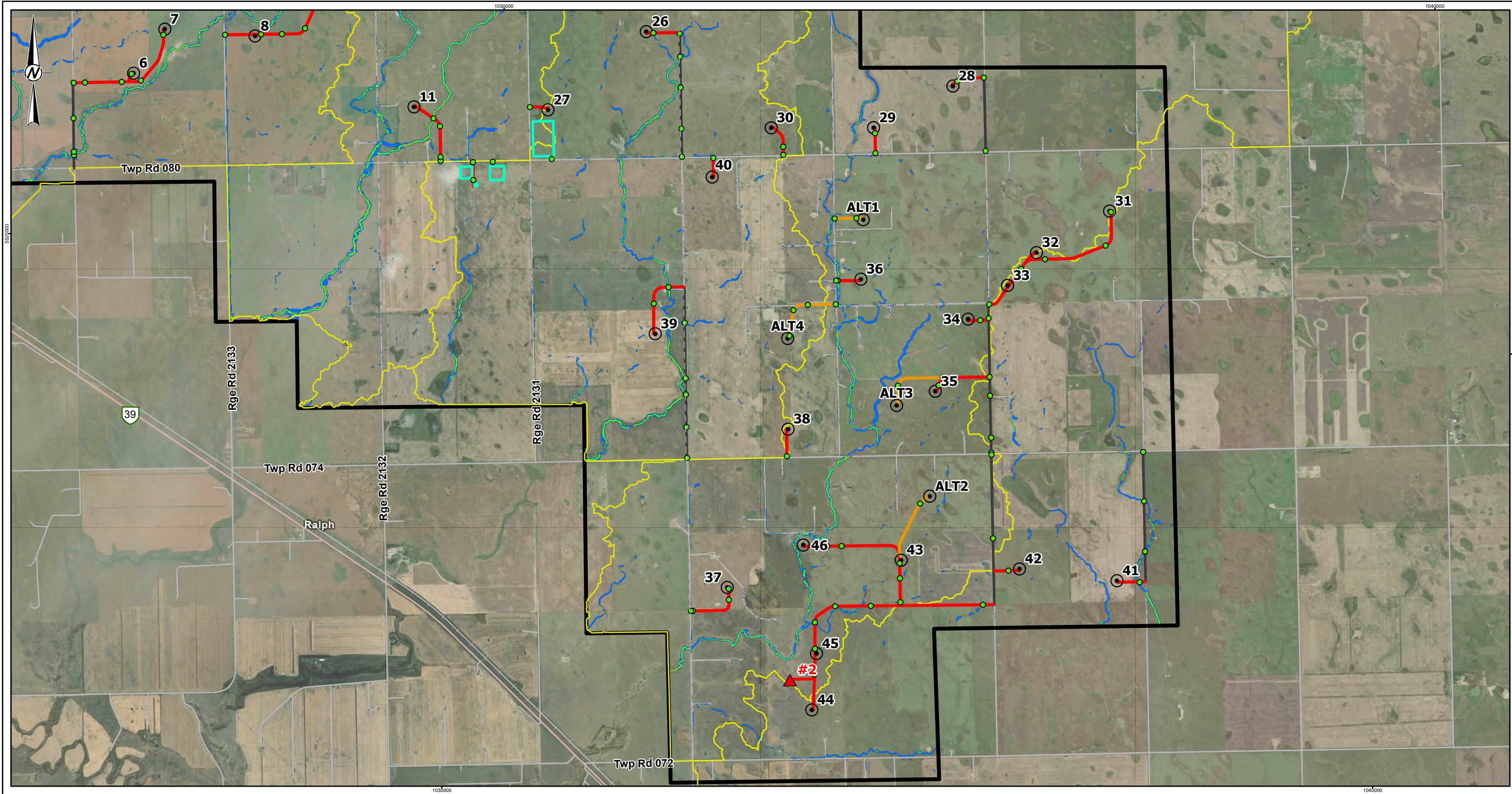
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PROJECT
SEVEN STARS ENERGY PROJECT HYDROLOGY ASSESSMENT

TITLE	MODEL RESULTS - 25-YEAR FLOW VELOCITY (MAP 1 OF 2)
PROJECT NO.	CA0060582.5330
CONTROL	
REV.	A
FIGURE	10



STUDY AREA

MUNICIPAL ROAD

RAIL

CATCHMENT LIMIT

PROPOSED CULVERT

MET STATION

TURBINE

ACCESS ROAD

ACCESS ROAD ALTERNATIVE

MUNICIPAL ROAD UPGRADE

BUILDING PAD

25-YEAR FLOW VELOCITY

0.15 m/s - 0.5 m/s

0.5 m/s - 1.0 m/s

1.0 m/s - 1.5 m/s

> 1.5 m/s

CLIENT / OWNER
BOREA CONSTRUCTION / ENBRIDGE

CONSULTANT

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REVIEWED	KU
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PROJECT
SEVEN STARS ENERGY PROJECT HYDROLOGY ASSESSMENT

TITLE
MODEL RESULTS - 25-YEAR FLOW VELOCITY
(MAP 2 OF 2)

PROJECT NO.	CONTROL	REV.	FIGURE
CA0060582.5330		A	11