DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAPPING REPORT

Prepared for:

Alberta

08 December 2022

NHC Ref. No. 1003877

nhc
northwest hydraulic consultants
water resource specialists

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FINAL REPORT

Prepared for:

Alberta Environment and Parks
Edmonton, Alberta

Prepared by:

Northwest Hydraulic Consultants Ltd.
Edmonton, Alberta

08 December 2022

NHC Ref No. 1003877

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EXECUTIVE SUMMARY

Alberta Environment and Parks retained Northwest Hydraulic Consultants Ltd. in June 2018 to complete a river hazard study for the Town of Drumheller and surrounding areas of Kneehill County, Starland County, Wheatland County, and Special Area No. 2. The river hazard study area includes 56.1 km of the Red Deer River, 7.9 km of Kneehills Creek, 5.3 km of Michichi Creek, 10.7 km of the Rosebud River, and 3.0 km of Willow Creek. The study is being conducted under the provincial Flood Hazard Identification Program; the overall objectives are to enhance public safety and to reduce future flood damages and disaster assistance costs.

The Drumheller River Hazard Study is comprised of six major project components. This report summarizes the work of the fourth component: ***Design Flood Hazard Mapping***. This component includes open water flood hazard identification and determination, flood hazard map production, and consideration of potential climate change impacts.

Design details for planned flood control structures that were provided by the Town of Drumheller were incorporated into the calibrated hydraulic model, which was used to determine the design flood water surface profile and extent of inundation. It is worth noting that if flood control structure plans change, this report may not accurately reflect future conditions.

Open water flood hazard identification involves defining the open water flood hazard area, which is comprised of floodway and flood fringe zones. The methods summarized in this report follow the provincial Flood Hazard Identification Program guidelines, incorporating technical changes implemented in 2021 regarding how floodways are mapped in Alberta. The floodway criteria maps are the key deliverable for this project component and are provided as an appendix to this report. The design flood hazard map depicts the floodway and flood fringe based on the information resulting from the floodway criteria mapping. The design flood hazard map series is included as an appendix to this summary report. All of the supporting GIS data are provided as a separate electronic deliverable including: floodway and flood fringe limits; design flood water surface elevation TIN; and design flood depth and water surface elevation grids. The consideration of potential climate change impacts is also included in this report.

CREDITS AND ACKNOWLEDGEMENTS

Northwest Hydraulic Consultants Ltd. would like to express appreciation to Alberta Environment and Parks for initiating this project, making extensive background information available, and providing the project team with valuable technical input throughout the project. Mr. Peter Bezeau and Ms. Jane Eaket managed and directed the Drumheller River Hazard Study on behalf of Alberta Environment and Parks (AEP). Thanks are also expressed to Dr. Jennifer Nafziger and other members of AEP for providing relevant information and valuable comments throughout the course of the work.

The following NHC personnel were part of the study team and participated in the hydraulic modelling and flood inundation mapping component of the study:

- Robyn Andrishak (Project Manager) – responsible for the overall direction of the project as well as determination of the floodway limits.
- Agata Hall (Hydraulic Modelling Specialist) – authored this report and assisted in the determination of the floodway limits as well as compilation of results.
- Rebecca Himsl (GIS Analyst) – responsible for development of mapping and GIS deliverables.
- Sarah North (GIS Analyst) – responsible for review of mapping and GIS deliverables.
- Gary Van Der Vinne (Senior Technical Reviewer) – provided senior review input and advice.

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1 INTRODUCTION

1.1 Study Background

The Drumheller River Hazard Study was initiated by Alberta Environment and Parks (AEP) to identify and assess river and flood hazards along the Red Deer River, Kneehills Creek, Michichi Creek, Rosebud River, and Willow Creek within the Town of Drumheller and surrounding areas of Kneehill County, Starland County, Wheatland County, and Special Area No. 2. A flood hazard mapping study was previously completed for the Drumheller area by Matrix Solutions (2007); however, the present study covers an expanded study reach and represents a significant update to the prior work.

Results from this study are designed to inform local land use planning decisions, flood mitigation projects, and emergency response planning. This study is being undertaken as part of the Flood Hazard Identification Program (FHIP), with the intent of enhancing public safety and reducing future flood damages within the Province of Alberta.

This river hazard study is comprised of six major study components:

1) Survey and Base Data Collection
2) Open Water Hydrology Assessment
3) Hydraulic Modelling and Flood Inundation Mapping
4) Design Flood Hazard Mapping
5) Flood Risk Assessment and Inventory
6) Channel Stability Investigation

Each component includes a separate report and associated deliverables for that portion of the study.

1.2 Study Objectives

This report summarizes the work of the fourth component: ***Design Flood Hazard Mapping***. The primary tasks, services, and deliverables associated with this report are:

- Design flood selection;
- Floodway determination;
- Design flood levels and profile creation;
- Floodway criteria map production;

- Flood hazard map production;
- Flood water surface elevation (WSE) triangulated irregular network (TIN) development;
- Flood depth and WSE grid creation; and
- Potential climate change impact analysis.

The development of the design flood hazard map, and associated deliverables, support development of the floodway and flood fringe required for the flood risk assessment and inventory.

1.3 Study Area and Reach

The Town of Drumheller is located along the Red Deer River, approximately 100 km northeast of the City of Calgary and 115 km southeast of the City of Red Deer. **Figure 1** shows the location and boundaries of the river hazard study area and provides an overview of the upstream watershed boundaries. The study area includes the following river reaches and Alberta Township System quarter section boundaries:

- 56.1 km of the Red Deer River from the northern boundary of NW/NE-27-29-21-W4M to the southern boundary of SW/SE-3-27-17-W4M
- 7.9 km of Kneehills Creek from the western boundary of SE-15-29-21-W4M to the Red Deer River
- 5.3 km of Michichi Creek from the eastern boundary of SE-13-29-20-W4M to the Red Deer River
- 10.7 km of the Rosebud River from the southern boundary of SW-7-28-19-W4M to the Red Deer River
- 3.0 km of Willow Creek from the eastern boundary of NE-7-28-18-W4M to the Red Deer River

River cross section surveys extended beyond these boundaries to accommodate hydraulic modelling and inundation mapping requirements. Local authorities within the study area include the Town of Drumheller, Kneehill County, Starland County, Wheatland County, and Special Area No. 2.

The contributing watershed covers a total area of about 29,970 km^2, extending from the headwaters of the Red Deer River in the Rocky Mountains to the downstream boundary of the river hazard study area. The Kneehills Creek, Michichi Creek, Rosebud River, and Willow Creek sub-basins account for 2,440, 1,170, 4,360, and 400 km^2 of the total watershed area, respectively. Floods are typically derived from rapid spring snowmelt augmented by heavy rainfall events, although the nature and timing of flooding on the tributary reaches is typically unique and independent of those experienced by the Red Deer River.

Flows in the Red Deer River have been regulated since 1983 by Dickson Dam which impounds Gleniffer Reservoir located about 50 km upstream of Red Deer. The drainage area upstream of the reservoir (5,590 km^2) accounts for about 22% of the area upstream of Drumheller.

2 AVAILABLE DATA

2.1 Flood Hydrology

Basin hydrology, documented in the ***Open Water Hydrology Assessment Report*** (NHC, 2020a) provided under separate cover, determined estimates of flood frequencies for a range of return periods, from the 2-year up to the 1000-year at the following locations:

- Red Deer River above Kneehills Creek
- Red Deer River above Michichi Creek
- Red Deer River at Drumheller (WSC Station No 05CE001)
- Red Deer River below Rosebud River
- Red Deer River below Willow Creek
- Kneehills Creek near Drumheller (WSC Station No. 05CE002)
- Michichi Creek at Drumheller (WSC Station No. 05CE020)
- Rosebud River at the mouth
- Willow Creek at the mouth

The hydrology assessment recommended that the flood frequency estimates for WSC Station 05CE001 be used for all the ungauged sites on the Red Deer River, including Red Deer River above Kneehills Creek, above Michichi Creek, below Rosebud River and below Willow Creek. Flood frequency estimates for the study sites on Kneehills Creek, Michichi Creek and the Rosebud River were based on measured peak discharges on these streams, while regional analysis was performed to develop flood frequency estimates for Willow Creek at the mouth.

Table 1 summarizes the flood frequency discharges for the 2- to 1000-year floods, with associated annual probabilities of exceedance, for the Red Deer River and its tributaries.

Table 1 Flood frequency discharge estimates for the Red Deer River and its tributaries

Return Period (Years)	Probability of Exceedance in Any Given Year (%)	Flood Frequency Discharge (m^3/s)					
		Red Deer River at Drumheller[1] (05CE001)		Kneehills Creek near Drumheller (05CE002)	Michichi Creek at Drumheller (05CE020)	Rosebud River at the mouth	Willow Creek at the mouth
		Naturalized	Regulated				
1,000	0.10	3,820	3,820[2]	286	103	641	66
750	0.13	3,600	3,580[3]	274	99	586	62
500	0.20	3,300	3,170[3]	256	93	515	58
350	0.29	3,050	2,900[3]	241	87	458	54
200	0.50	2,680	2,450[3]	216	79	377	49
100	1.0	2,260	1,850[3]	186	68	292	41
75	1.3	2,090	1,670[3]	173	64	260	40
50	2.0	1,870	1,430[3]	155	58	220	35
35	2.9	1,690	1,240[3]	140	52	188	31
20	5.0	1,410	869[4]	116	44	145	26
10	10	1,100	702[4]	87	33	99	19
5	20	807	542[4]	58	23	63	13
2	50	448	330[4]	22	10	27	5

Notes:

1. The estimates are applicable for Red Deer River at Drumheller (WSC Station 05CE001), above Kneehills Creek, above Michichi Creek, below Rosebud River, and below Willow Creek.
2. The 1000-year naturalized peak discharge has been adopted as the estimate for the regulated flow condition.
3. The adopted value is from the synthetic flood hydrograph routing.
4. The adopted value is from the flood frequency curve for the regulated peak discharges of Red Deer River at Drumheller.

2.2 Survey and Digital Terrain Model Details

The majority of the survey program was conducted between July and September of 2018, with some additional surveying conducted in January of 2019, as is documented in the ***Survey and Base Data Collection Report*** (NHC, 2020b) provided under separate cover.

A total of 444 cross sections were surveyed between July and September of 2018, with some additional surveying conducted in January of 2019, including: 210 cross sections on the Red Deer River, 60 cross sections on Kneehills Creek, 41 cross sections on Michichi Creek, 120 cross sections on Rosebud River, and 13 cross sections on Willow Creek. Cross section spacing varied based on the size of the water body, with the mean spacing being 269 m on the Red Deer River, 132 m on Kneehills Creek, 129 m on Michichi Creek, 89 m on the Rosebud River, and 223 m on Willow Creek.

A digital terrain model (DTM) based on LiDAR data was supplied by AEP for this study. The LiDAR data were collected by Airborne Imaging in May 2018 (Airborne Imaging, 2018). A complete description of the digital terrain model data, including a comparison to ground survey data, is provided in the ***Survey and Base Data Collection Report*** (NHC, 2020b) under separate cover.

2.3 HEC-RAS Model

A calibrated HEC-RAS model was developed for the the following reaches: 56.1 km of the Red Deer River, which is represented by five sub-reaches; 7.9 km of Kneehills Creek above the confluence with the Red Deer River; 5.3 km of Michichi Creek above the confluence with the Red Deer River; 10.7 km of Rosebud River above the confluence with the Red Deer River; and 3.0 km of Willow Creek above the confluence with the Red Deer River. In total, 440 cross sections were specified in the model: 211 on the Red Deer River, 58 on Kneehills Creek, 41 on Michichi Creek, 120 on Rosebud River, and 10 on Willow Creek. Details on the modelling and flood inundation mapping are provided under separate cover in the ***Hydraulic Modelling and Flood Inundation Mapping Report*** (NHC, 2022a).

The calibrated hydraulic model includes planned flood control structure upgrades which are to be constructed beginning in 2022. Although the proposed upgrades were not constructed at the time of this report, it is expected that they will be completed in the near future. Therefore, it was deemed appropriate to include their hydraulic impact to ensure the results are relevant when the upgrades are complete and for future planning. It is worth noting that if flood control structure plans change, this report may not accurately reflect future conditions.

The calibrated hydraulic model was used to determine the design flood levels and flow velocities required for the open water floodway criteria maps.

3 DESIGN FLOOD HAZARD DETERMINATION

Flood hazard identification involves delineation of floodway and flood fringe zones for a specified design flood. A description of key terms from the FHIP Guidelines (Alberta Environment, 2011), incorporating technical changes implemented in 2021 regarding how floodways are mapped in Alberta, is provided in Sections 3.1 and 3.2 below.

3.1 Design Flood Details

The design flood for open water flood hazard identification in Alberta is typically associated with a natural (non-regulated) peak instantaneous discharge that has a one percent chance of being equaled or exceeded in any given year. This is a flood with a statistical 100-year return period, also commonly referred to as the "one in one hundred year flood". For the Red Deer River in Drumheller, the 100-year regulated flood was selected as the open water design flood. The 100-year flood was also selected for design for Kneehills Creek, Michichi Creek, Rosebud River, and Willow Creek. The discharge values used for the open water design flood correspond to the 100-year regulated return period discharges listed in **Table 1.**

The flooding mechanisms normally considered as part of the governing design flood selection are: the 100-year open water flood, the 100-year ice jam flood, or a significant flood of record that has been well documented. As there was no flood of record that could be considered for this study and ice jam flooding was not determined to be of a significant concern, the 100-year open water flood was used to define the governing design flood for the Drumheller River Hazard Study. This is the most commonly adopted design flood for flood hazard studies in Alberta. Since open water flooding was determined as the governing flood mechanism, the 100-year open water design flood profile was adopted as the governing design flood profile. This was the case for all study reaches, with the 100-year regulated flood selected for the Red Deer River.

3.2 Floodway and Flood Fringe Terminology

Flood Hazard Area

The flood hazard area is the area of land that would be flooded during the design flood. It is composed of the floodway and the flood fringe zones, which are defined below.

Flood Hazard Mapping

Flood hazard mapping identifies the area flooded for the design flood and is typically divided into floodway and flood fringe zones. Flood hazard maps can also show additional flood hazard information, including areas of high hazard within the flood fringe and incremental areas at risk for more severe floods, like the 200-year and 500-year floods. Flood hazard mapping is typically used for long-term flood hazard area management and land-use planning.

Floodway

When a floodway is first defined on a flood hazard map, it typically represents the area of highest flood hazard where flows are deepest, fastest, and most destructive during the 100-year design flood. The floodway generally includes the main channel of a stream and a portion of the adjacent overbank area. Previously mapped floodways do not typically become larger when a flood hazard map is updated, even if the flood hazard area gets larger or design flood levels get higher.

Flood Fringe

The flood fringe is the portion of the flood hazard area outside of the floodway. The flood fringe typically represents areas with shallower, slower, and less destructive flooding during the 100-year design flood. However, areas with deep or fast moving water may also be identified as high hazard flood fringe within the flood fringe. Areas at risk behind flood berms may also be mapped as protected flood fringe areas.

Design Flood Levels

Design flood levels are the computed water levels associated with the design flood.

3.3 Floodway Determination Criteria

In areas being mapped for the first time, the floodway typically represents the area of highest hazard where flows are deepest, fastest, and most destructive during the design flood. The following criteria, based on those described in current FHIP guidelines, are used to delineate the floodway in such cases:

- Areas in which the depth of water exceeds 1 m or the flow velocities are greater than 1 m/s shall be part of the floodway.
- Exceptions may be made for small backwater areas, ineffective flow areas, and to support creation of a hydraulically smooth floodway.
- The floodway must include the main river channel area.
- For reaches of supercritical flow, the floodway boundary should correspond to the edge of inundation or the main channel, whichever is larger.

When a flood hazard map is updated, an existing floodway will not change in most circumstances. Exceptions to this would be: (1) a floodway could get larger if a main channel shifts outside of a previously-defined floodway or (2) a floodway could get smaller if an area of previously-defined floodway is no longer flooded by the design flood.

Portions of the current study reach have a previously mapped floodway, specifically 36 km of the Red Deer River, the most downstream 2 km of Michichi Creek, and the most downstream 2 km of the Rosebud River. The previous floodway for the Red Deer River was based on a design flood corresponding

to the 100-year naturalized flood. Since the Red Deer River design flood for the current study was selected to be the 100-year regulated flood, the previously mapped floodway was disregarded for the Red Deer River, and the floodway was mapped using the procedures for previously unmapped reaches. The same approach was taken for Michichi Creek, since the existing mapped reach that is not impacted by Red Deer River backwater is relatively insignificant. For the Rosebud River, the previously mapped floodway upstream of the Highway 10 bridge was considered when mapping the new floodway.

Areas of deeper or faster moving water outside of the floodway are identified as high hazard flood fringe. These high hazard flood fringe zones are identified in all areas, whether they are newly-mapped or have an existing floodway. The depth and velocity criteria used to define high hazard flood fringe zones will be aligned with the 1 m depth and 1 m/s velocity floodway determination criteria for newly-mapped areas.

All areas protected by dedicated flood berms that are not overtopped during the design flood are excluded from the floodway. Areas behind flood berms will still be mapped as flooded if they are overtopped, but areas at risk of flooding behind dedicated flood berms that are not overtopped will be mapped as a protected flood fringe zone.

The floodway limits and governing criteria for each cross section are listed in **Appendix A**. The floodway boundary intersects cross sections at the floodway limits. In some instances, the floodway boundary is coincident with the extent of inundation. This condition typically occurs when a floodway limit (defined by the usual criteria) is very close to the extent of inundation and there is no practical width of flood fringe – along steep valley walls or high slopes, for example.

The floodway boundary extending between cross sections was delineated based on the adjacent governing criteria and drawn such that the resulting lines followed a hydraulically-smooth path. In most instances, the lines followed along the 1 m depth contour. In some instances, the floodway limits extended into depths less than 1 m where velocities were high. When the width of the flood fringe was impractically small, the floodway line was drawn coincident with the edge of inundation. In areas adjacent to dedicated flood berms, the floodway was drawn along the river-side of the dedicated flood berm.

3.4 Design Flood Profile

The open water design flood levels presented in **Appendix B** were extracted from the calibrated HEC-RAS model. **Figure 2** and **Figure 3** depict the open water design flood level profile for the Red Deer River and its tributaries within the study area.

4 DESIGN FLOOD HAZARD MAP PRODUCTION

The design flood hazard maps divide the design flood extents into floodway and flood fringe zones. The information used to create the design flood hazard maps was based on the open water flood hazard mapping information, as described in the sections above.

4.1 Flood Mapping Methodology

The following details the methods used to produce the floodway criteria maps and the flood hazard maps. The mapping exercise began with the computed water surface elevations and flow velocities for the design flood. The extent of inundation was then mapped using the general procedure described in the ***Hydraulic Modelling and Flood Inundation Mapping Report*** (NHC, 2022a). This procedure included generation of the corresponding WSE TIN, WSE grid, and flood depth grid.

Inundated areas where the depth of water is 1 m or greater and the 1 m depth contours were derived from the flood depth grid. The depth contours were then filtered and smoothed using the same parameters and procedures as those applied to the inundation extents, also described in the ***Hydraulic Modelling and Flood Inundation Mapping Report*** (NHC, 2022a).

Since a one-dimensional computational modelling approach was used for this study, flow velocities were only available at the cross section locations. HEC-RAS can apportion channel and overbank discharge into a maximum of 45 sub-sections at any cross section location. Discharge is apportioned based on the computed water level and a weighted flow area approach. This provides a convenient means to estimate the lateral variation in velocity across a section. For this study, the maximum number of velocity subsections were specified in the overbanks. The velocity values for each segment along the cross sections were symbolized on the floodway criteria maps to visualize the transverse variation in velocity along each cross section.

The design flood extent developed for the floodway criteria map was used to identify the flood hazard area, which includes both the floodway and flood fringe. The floodway was delineated by converting the floodway boundary developed for the floodway criteria map into a single continuous polygon. Areas of high ground or areas of depth less than 1 m inside the floodway boundaries were included as part of the floodway. The limits of the flood fringe followed the design flood extent, and areas of high ground within the design flood extent (and outside of the floodway) were preserved and excluded from the flood fringe.

4.2 Floodway Criteria Maps

The floodway criteria maps provide visual documentation of the floodway delineation and depict the limits of the floodway and flood fringe for the design flood. The floodway criteria maps are provided in **Appendix C**. The information documented on the maps include:

- inundation extents for the 100-year design flood;

- areas where the depth of water is 1 m or greater and the corresponding 1 m depth contour;
- the portions of each cross section where the computed velocity is 1 m/s or faster;
- the proposed floodway boundary, as well as the associated floodway limits corresponding to the floodway determination criteria;
- isolated areas of non-flooded, high ground (i.e., “dry areas”) within the design flood extent;
- the location and extent of all cross sections used in the HEC-RAS model; and
- the previously-mapped floodway boundary (where it exists).

As described in **Section 3.3**, local hydraulic conditions are considered in addition to the criteria described. This was the case for the five upstream-most cross sections of the Rosebud River. The depth of water in the area along the right side of the railway is greater than 1 m in depth; however, this portion was excluded from the floodway because it is isolated from the main channel and considered ineffective.

4.3 Flood Hazard Maps

The flood hazard maps depict the floodway and flood fringe, including the high hazard flood fringe and protected flood fringe areas, for the design flood. In addition, the flood hazard maps show incremental areas at risk of flooding for the 200-year and 500-year floods. Areas of direct inundation and inundation due to potential flood control structure failure are not differentiated in the mapped areas at risk of flooding for the 200-year and 500-year open water floods. The resulting flood hazard maps are provided as **Appendix D**.

4.3.1 Areas in the Floodway

Notable areas in the floodway include:

- Residences adjacent to Kneehills Creek near the mouth west of Kirkpatrick;
- Rosedale along Railway Avenue, areas south of the suspension bridge park, 11 Bridges Campground, Rosedale Community Campground, and Pinters Campground;
- A portion of Cambria upstream of the Highway 10 bridge and lower portions of the Hoodoo RV Resort and Campground east of Cambria;
- The majority of Lehigh up to Highway 10; and
- Wayne along Atlas Street.

The floodway boundaries were also carried into the mouths of small tributaries, following the governing criteria established for adjacent cross sections on the Red Deer River and tributaries.

More information regarding existing infrastructure and property within the floodway can be found in the ***Flood Risk Inventory and Assessment Report*** (NHC, 2022b).

4.3.2 Areas in the Flood Fringe

The flood fringe includes all inundated areas outside the limits of the floodway and may include high hazard flood fringe or protected flood fringe areas. Inundated areas of note within the flood fringe include other low-lying portions of:

- Nacmine;
- Midland;
- Newcastle;
- North Drumheller;
- Central Drumheller;
- Riverside;
- Willow Estates;
- Rosedale;
- Cambria;
- Lehigh;
- East Coulee;
- Dunphy;
- Kirkpatrick; and
- Wayne.

Of the areas listed above, the following include portions with protected flood fringe adjacent to dedicated flood berms that are not overtopped or outflanked: Nacmine, Central Drumheller, and Willow Estates.

Additionally, the following areas include portions with high hazard flood fringe adjacent to overtopped or outflanked dedicated flood berms: Midland, Newcastle, North Drumheller, and East Coulee.

More information regarding infrastructure and property within the flood fringe can be found in the ***Flood Risk Inventory and Assessment Report*** (NHC, 2022b).

5 DESIGN FLOOD GRIDS

A WSE grid and a flood depth grid were prepared for the design flood and provided with the GIS deliverables for this study component, along with the WSE TIN, polygons delineating the flood hazard area, floodway and flood fringe (including protected and high hazard areas), 1 m depth contour, 1 m/s velocity contours, and incremental areas at risk of flooding for the 200-year and 500-year floods. All these GIS deliverables were generated for the open water design flood, which is the governing design flood condition. A description of the WSE grid and flood depth grid is provided below.

5.1 Water Surface Elevation Grids

First, a WSE TIN was created, which represents the design flood level profile along the modelled river reaches. The adjusted WSE TINs then were converted to a tiled set of WSE grids matching the alignment, horizontal resolution, and tiling boundaries of the LiDAR-derived DTM supplied by AEP. Water surface elevations in meters are provided as 32-bit floating point grid cell values. The WSE grid at this stage was used to compute the flood depth grid, as described in the following section.

As a final step, the inundation extent polygon generated from the flood depth grid was used to clip the WSE grid such that a value of *NoData* is provided for all dry areas and the water surface elevation values are indicated only where inundation is shown.

The WSE grid is provided for information only. Grid cell values are based on linear interpolation between cross sections in the hydraulic model, and as such, discrete cell values should be considered approximate. Since the adjusted WSE grids have been clipped using the smoothed inundation extent polygons, water's edge boundaries implied by the raster WSE grids correspond to the inundation extent boundaries presented on the inundation maps.

5.2 Flood Depth Grids

For the design flood scenario, each bare earth DTM grid tile was subtracted from the corresponding adjusted WSE grid tile (prior to clipping) to generate a set of flood depth grid tiles representing water depth in metres as 32-bit floating point values. All flood depth grids maintained the same alignment, horizontal resolution, and tiling boundaries as the LiDAR-derived bare earth DTM supplied by AEP. Grid cells with depth values less than 0 m, which represent dry areas, were assigned a value of *NoData*.

The flood depth grid is provided for information only. Grid values are based on linear interpolation of water surface elevations between cross sections in the hydraulic model, and as such, discrete cell values should be considered approximate. Water's edge boundaries implied by the raster depth grids may deviate slightly from the inundation extent boundaries presented on the inundation maps. This is because the depth grids are computed by subtracting the bare earth DTM grids from the adjusted WSE grids, whereas the mapped inundation extent boundaries, which were derived from the depth grids, have been further filtered and smoothed.

Also, since the LiDAR-derived DTM indicates the approximate water surface elevation at the time of the LiDAR survey for submerged portions of river beds and other ground covered by water, depth values in those areas are not accurate. Elsewhere, the depth grids may be used for many purposes, such as to identify areas in the floodplain that exceed a specified depth criteria.

6 POTENTIAL CLIMATE CHANGE IMPACTS

To address the potential impacts of climate change on flood levels, more severe open water flood scenarios were compared to the current design flood estimates in order to obtain a measure of "freeboard" that may be generally appropriate for long-term planning purposes. To obtain information appropriate for other applications, the simplified approach taken herein could be supplemented in the future by a more rigorous regional climate analysis and site-specific impact assessment.

6.1 Comparative Scenarios

For the open water hazard, the current 100-year open water design flood water levels were compared to those associated with discharges that are 10 and 20 percent greater than the current 100-year design flood estimates. This approach is consistent with guidelines prepared by EGBC (2018). EGBC recommends that for basins where no historical trend is detectable in local or regional streamflow magnitude frequency relations, a 10 percent upward adjustment in design discharge be applied to account for likely future changes in water input from precipitation. On the other hand, if a statistically significant trend is detected, a 20 percent adjustment may be appropriate, particularly for smaller basins.

6.2 Results

The results of the analysis for the open water flood hazard are provided in **Table 2**. The magnitude of the increases were found to be fairly uniform along each stream.

Table 2 Increases in water level associated with more severe open water flood scenarios

Stream	Open Water Flood Discharge	
	100-Year Plus 10%	100-Year Plus 20%
Red Deer River	0.4 m	0.7 m
Kneehills Creek	0.1 m	0.3 m
Michichi Creek	0.2 m	0.4 m
Rosebud River	0.2 m	0.4 m
Willow Creek	0.1 m	0.3 m

6.3 Supplementary Information

Climate change has the potential to affect many factors related to flood severity. For open water floods, more frequent and greater intensity summer rain storms are commonly attributed to future climate flood risks. A comprehensive analysis would consider meteorological and hydrological factors at the basin scale to assess changes in flood peak discharges and their associated return periods.

7 CONCLUSIONS

The objectives of this study were to assess river flood-related hazards along the Red Deer River and local tributaries (Kneehills Creek, Michichi Creek, Rosebud River, and Willow Creek) in the Drumheller area. Municipalities within the study area include the Town of Drumheller and surrounding areas of Kneehill County, Starland County, Wheatland County, and Special Area No. 2. The Drumheller River Hazard Study was divided into six major project components. This report summarizes the work of the ***Design Flood Hazard Mapping*** component, for which open water flood hazards were identified in accordance with the provincial FHIP guidelines, incorporating technical changes implemented in 2021 regarding how floodways are mapped in Alberta. The reader is advised to reference the previous work components for additional context on the work summarized in this report.

The floodway criteria maps document the open water flood hazard identification criteria and resulting floodway boundaries. The floodway boundaries were mostly governed by the 1 m depth criterion. Along steep valley walls and high banks the 1 m depth contours followed closely along the full limit of inundation, which would have resulted in a very narrow, impractical, band of flood fringe. In these instances, the floodway limits were set to coincide with the water's edge. In areas adjacent to dedicated flood berms, the floodway was drawn along the river-side of the dedicated flood berm. The design flood hazard map depicts the floodway, and associated flood hazard extents, including flood fringe, high hazard flood fringe, and protected flood fringe areas. The open water design flood was the governing condition for the entire study area; thus, the flood hazard map information relied on the information developed for the floodway criteria map.

Notable areas within the floodway include: residences adjacent to Kneehills Creek near the mouth; Rosedale along Railway Avenue, areas south of the suspension bridge park, 11 Bridges Campground, Rosedale Community Campground, and Pinters Campground; a portion of Cambria upstream of the Highway 10 bridge and lower portions of the Hoodoo RV Resort and Campground, east of Cambria; the majority of Lehigh; and Wayne along Atlas Street.

8 REFERENCES

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NHC (2022a). Drumheller River Hazard Study – Hydraulic Modelling and Flood Inundation Mapping Report. Report prepared for Alberta Environment and Parks. Northwest Hydraulic Consultants Ltd., June 2022.

NHC (2022b). Drumheller River Hazard Study – Flood Risk Inventory and Assessment Report. Report prepared for Alberta Environment and Parks. Northwest Hydraulic Consultants Ltd., December 2022.

Figures

Michichi Creek

Red Deer River

Kneehills Creek

Rosebud River

Willow Creek

STARLAND COUNTY

KNEEHILL COUNTY

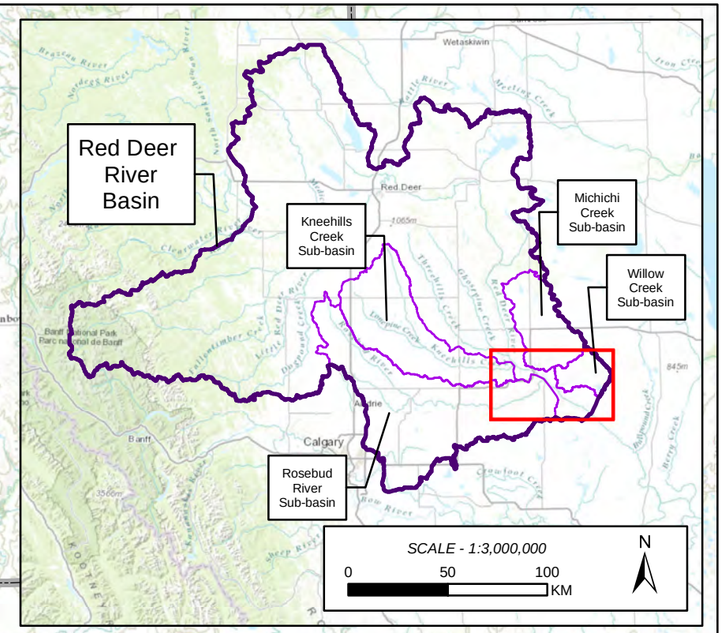
DRUMHELLER

SPECIAL AREA 2

WHEATLAND COUNTY

HWY 56

HWY 9



FLOW DIRECTION

STUDY REACH

MUNICIPAL BOUNDARY

SCALE - 1:150,000

0 2 4 6 KM

N

Coordinate System: NAD 1983 CSRS 3TM 114; Vertical Datum: CGVD28 HTv2.0; Units: Metres

DATA SOURCES: Basemap from Esri & NRCan.

Job: 1003877

Date: 27-MAR-2020

DRUMHELLER RIVER HAZARD STUDY
DESIGN FLOOD HAZARD MAPPING

STUDY AREA

FIGURE 1

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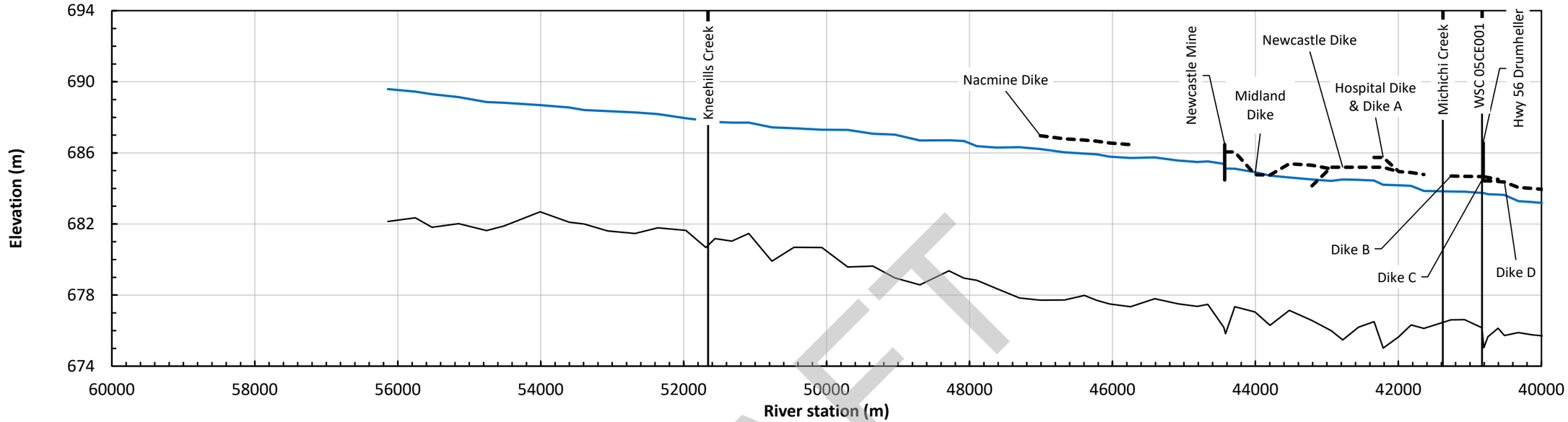
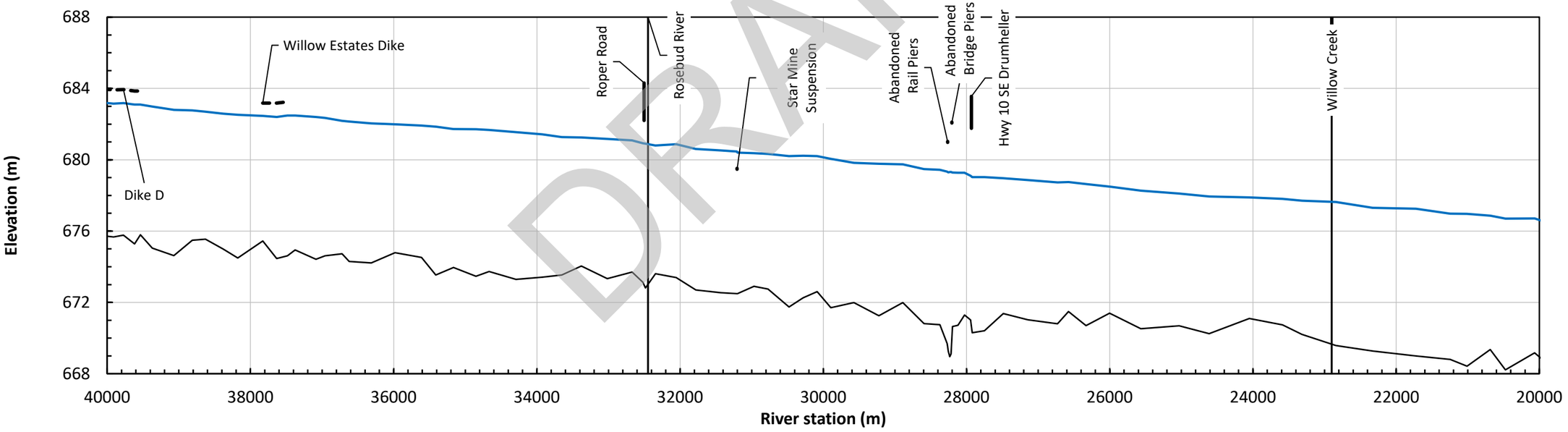
Alberta

RED DEER RIVER





Alberta

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LEGEND

- Design Flood
- Dikes
- Profile Features
- Thalweg

SCALE – AS SHOWN

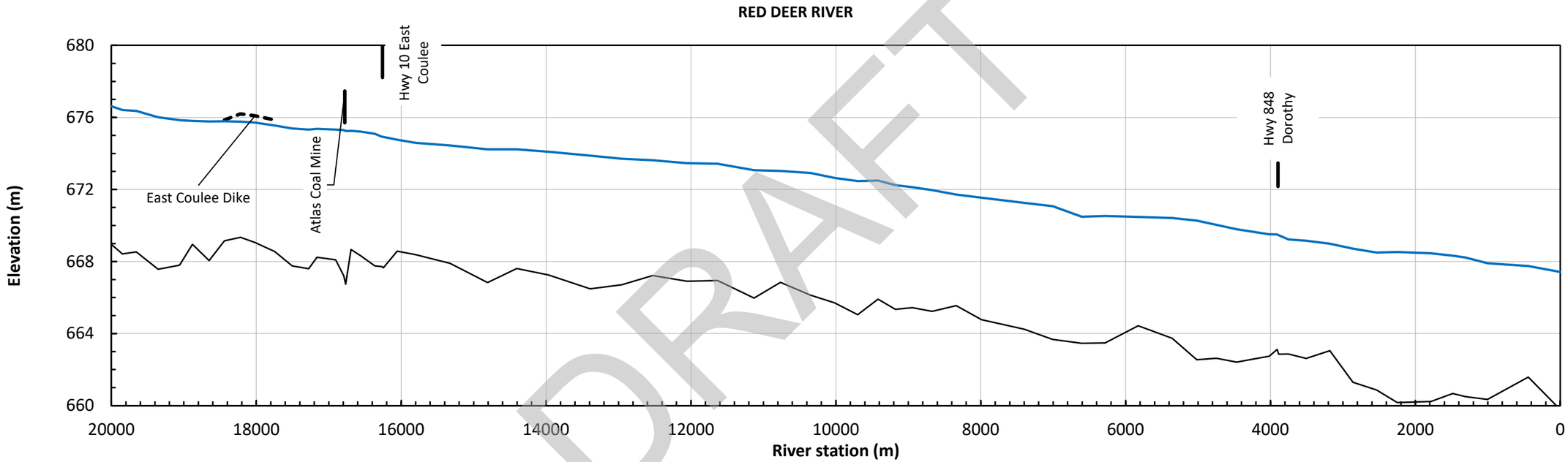
Elevation Datum: CGVD28 (HTv2.0)
Units: As Shown

Job: 1003877 | Date: 04-MAR-2022

DRUMHELLER RIVER HAZARD STUDY
DESIGN FLOOD HAZARD MAPPING

DESIGN FLOOD PROFILES
RED DEER RIVER

FIGURE 2A



Alberta

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LEGEND

- Design Flood
- Dikes
- Profile Features
- Thalweg

SCALE – AS SHOWN

Elevation Datum: CGVD28 (HTv2.0)
Units: As Shown

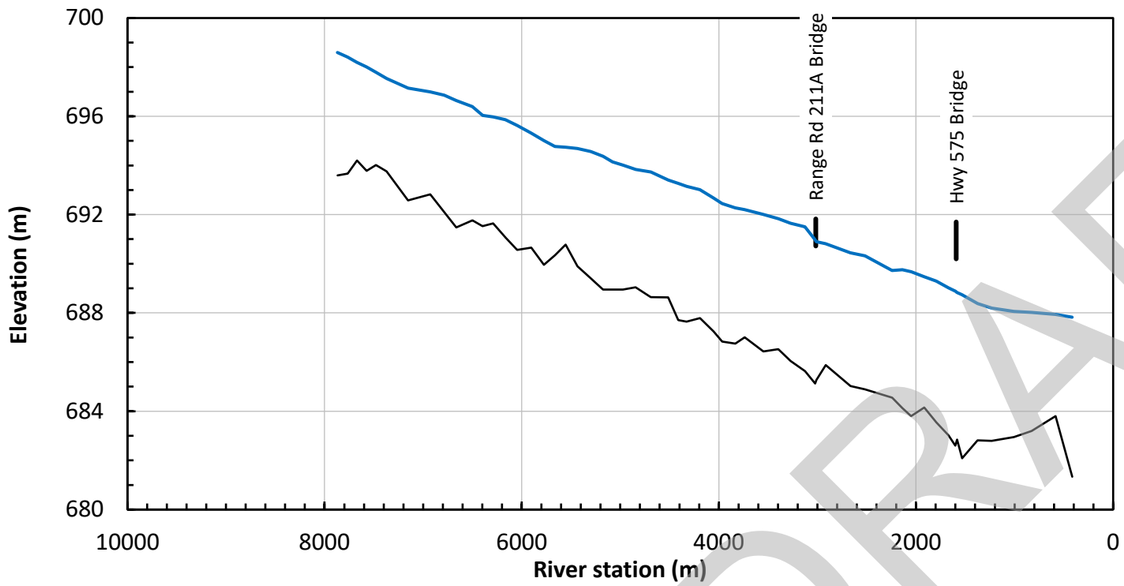
Job: 1003877 | *Date: 04-MAR-2022*

DRUMHELLER RIVER HAZARD STUDY
DESIGN FLOOD HAZARD MAPPING

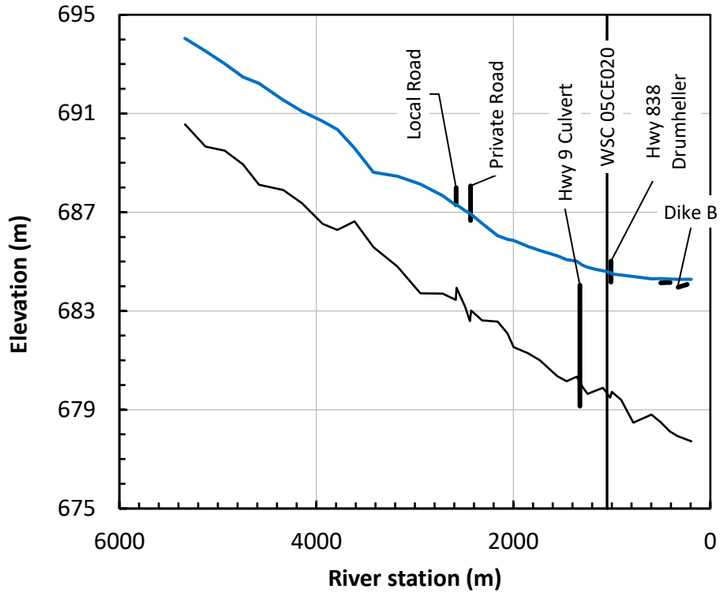
DESIGN FLOOD PROFILES
RED DEER RIVER

FIGURE 2B

KNEEHILLS CREEK



MICHICHI CREEK



Alberta

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LEGEND

- Design Flood
- Dikes
- Profile Features
- Thalweg

SCALE – AS SHOWN

Elevation Datum: CGVD28 (HTv2.0)
Units: As Shown

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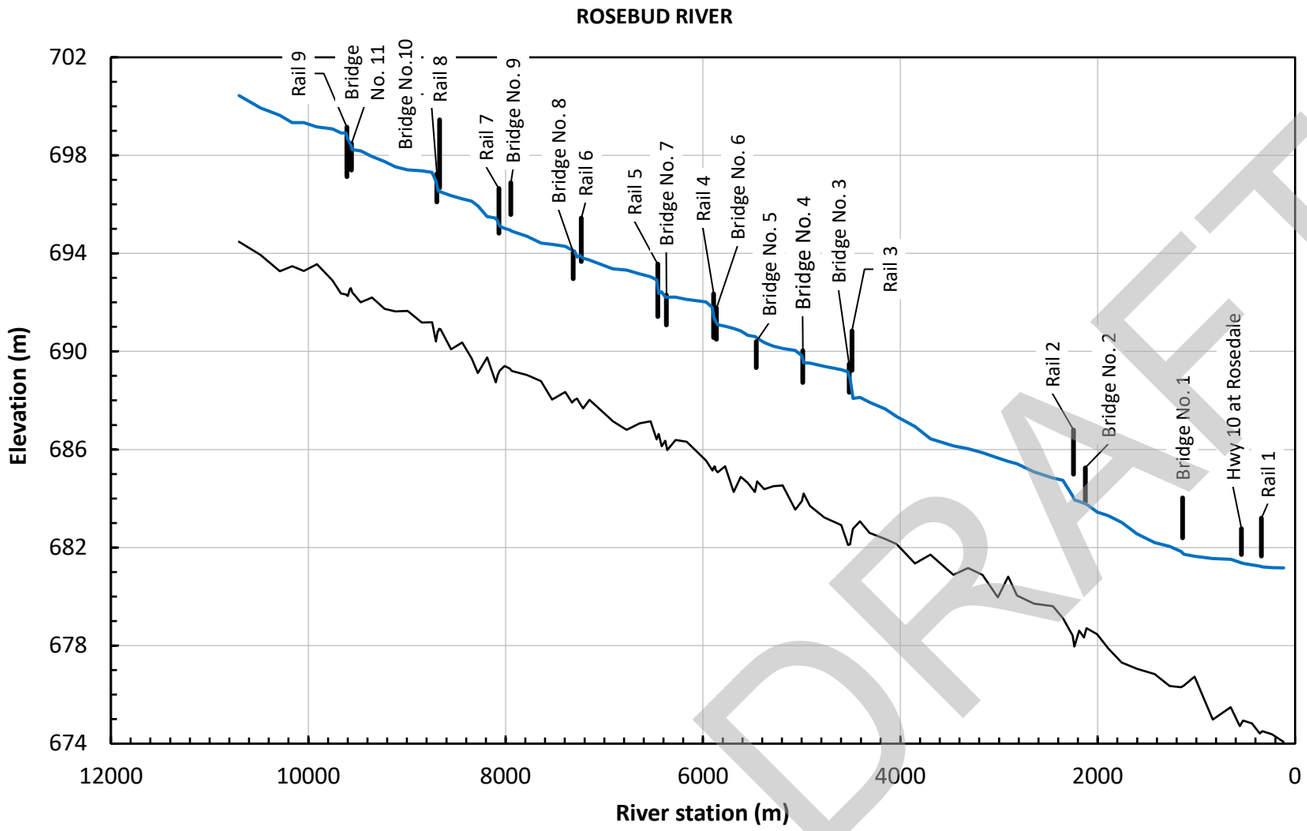
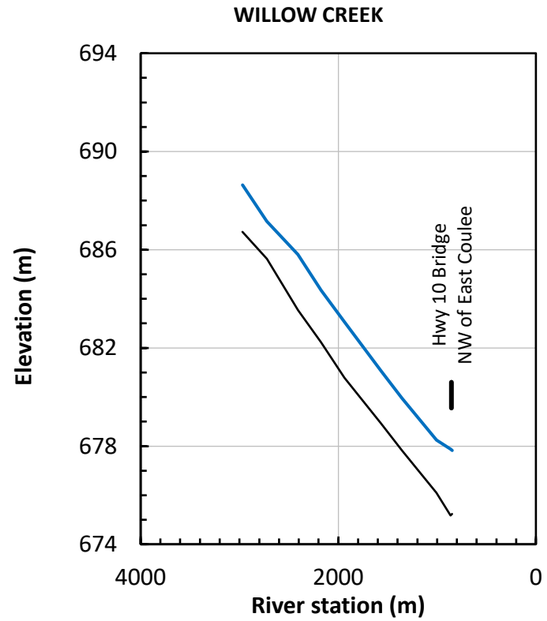
DRUMHELLER RIVER HAZARD STUDY
DESIGN FLOOD HAZARD MAPPING

DESIGN FLOOD PROFILES
KNEEHILLS CREEK, MICHICHI CREEK

FIGURE 3A





Alberta

nhc northwest hydraulic consultants

LEGEND

- Design Flood
- Dikes
- Profile Features
- Thalweg

SCALE – AS SHOWN

Elevation Datum: CGVD28 (HTv2.0)
Units: As Shown

Job: 1003877 | Date: 04-MAR-2022

DRUMHELLER RIVER HAZARD STUDY
DESIGN FLOOD HAZARD MAPPING

DESIGN FLOOD PROFILES
ROSEBUD RIVER, WILLOW CREEK

FIGURE 3B

Appendix A
Floodway Determination Criteria Summary

Table A-1 Floodway limits and governing criteria – Red Deer River

River Station (m)	Left		Right	
	Floodway Limit (m)	Governing Criteria	Floodway Limit (m)	Governing Criteria
56,139	23.11	Inundation Limit[1]	250.45	1 m Depth
55,755	80.98	Inundation Limit[1]	255.13	1 m Depth
55,521	267.34	1 m Depth	448.38	1 m Depth
55,149	421.82	1 m Depth	602.60	1 m Depth
54,759	269.33	1 m Depth	422.46	Inundation Limit[1]
54,516	269.81	1 m Depth	442.93	Inundation Limit[1]
54,007	446.10	1 m Depth	653.83	Inundation Limit[1]
53,602	434.05	1 m Depth	635.61	Inundation Limit[1]
53,393	349.18	1 m Depth	578.33	1 m Depth
53,064	217.47	1 m Depth	448.05	1 m Depth
52,682	119.19	1 m Depth	468.39	1 m Depth
52,364	127.18	1 m Depth	481.05	1 m Depth
51,970	318.26	1 m Depth	700.72	1 m Depth
51,689	389.33	1 m Depth	N/A	None[2]
51,563	301.53	1 m Depth	683.22	1 m Depth
51,326	73.69	1 m Depth	464.78	1 m Depth
51,089	122.77	1 m Depth	536.59	1 m Depth
50,765	72.84	1 m Depth	238.21	1 m Depth
50,457	120.65	1 m Depth	317.87	1 m Depth
50,067	203.66	1 m Depth	388.89	1 m Depth
49,706	242.95	Inundation Limit[1]	567.02	1 m Depth
49,354	374.27	1 m Depth	597.83	1 m Depth
49,045	317.12	1 m Depth	611.54	1 m Depth
48,695	492.53	1 m Depth	689.11	1 m Depth
48,288	579.07	1 m Depth	792.27	1 m Depth
48,079	426.36	1 m Depth	605.50	Inundation Limit[1]
47,899	544.33	1 m Depth	680.87	1 m Depth
47,630	430.68	1 m Depth	648.11	1 m Depth
47,303	185.61	1 m Depth	557.85	1 m Depth
47,010	56.93	1 m Depth	319.17	Interior Boundary[3]
46,672	94.08	1 m Depth	240.30	Interior Boundary[3]
46,395	274.36	1 m Depth	407.35	Interior Boundary[3]
46,221	308.83	1 m Depth	473.02	Interior Boundary[3]
46,039	267.10	1 m Depth	411.67	Interior Boundary[3]

Table A-1 Floodway limits and governing criteria – Red Deer River (continued)

River Station (m)	Left		Right	
	Floodway Limit (m)	Governing Criteria	Floodway Limit (m)	Governing Criteria
45,748	146.79	1 m Depth	303.54	Interior Boundary[3]
45,410	93.62	1 m Depth	515.42	1 m Depth
45,086	84.27	1 m Depth	471.49	Inundation Limit[1]
44,815	229.48	1 m Depth	625.55	Inundation Limit[1]
44,666	234.45	1 m Depth	685.61	Inundation Limit[1]
44,443	217.80	1 m Depth	765.85	1 m Depth
44,420	283.98	Interior Boundary[3]	445.87	1 m Depth
44,290	238.45	Interior Boundary[3]	453.03	1 m Depth
44,005	516.89	Interior Boundary[3]	705.53	1 m Depth
43,798	427.65	Interior Boundary[3]	587.54	1 m Depth
43,527	461.46	Interior Boundary[3]	606.31	1 m Depth
43,209	359.10	Interior Boundary[3]	525.40	Interior Boundary[3]
42,942	202.34	Interior Boundary[3]	398.34	Interior Boundary[3]
42,779	152.39	1 m Depth	430.21	Interior Boundary[3]
42,558	96.04	Inundation Limit[1]	472.02	Interior Boundary[3]
42,341	240.59	Interior Boundary[3]	634.24	Interior Boundary[3]
42,214	373.71	Interior Boundary[3]	694.47	Interior Boundary[3]
41,996	614.78	Interior Boundary[3]	896.54	Interior Boundary[3]
41,823	711.61	Interior Boundary[3]	944.68	1 m Depth
41,644	730.13	Interior Boundary[3]	866.51	Inundation Limit[1]
41,263	388.65	Interior Boundary[3]	514.06	Inundation Limit[1]
41,074	693.90	Interior Boundary[3]	829.41	1 m Depth
40,832	535.34	Interior Boundary[3]	670.73	1 m Depth
40,804	382.08	Interior Boundary[3]	526.60	Interior Boundary[3]
40,748	356.35	Interior Boundary[3]	511.93	Interior Boundary[3]
40,606	101.42	Interior Boundary[3]	254.26	Interior Boundary[3]
40,517	34.04	Inundation Limit[1]	194.70	Interior Boundary[3]
40,322	10.67	Inundation Limit[1]	150.99	Interior Boundary[3]
40,132	42.18	Inundation Limit[1]	159.58	Interior Boundary[3]
39,912	35.60	Inundation Limit[1]	152.53	Interior Boundary[3]
39,774	22.58	1 m Depth	164.80	Interior Boundary[3]
39,619	60.45	1 m Depth	183.00	Interior Boundary[3]
39,538	52.18	1 m Depth	221.22	Interior Boundary[3]
39,370	119.69	1 m Depth	292.87	Inundation Limit[1]

Table A-1 Floodway limits and governing criteria – Red Deer River (continued)

River Station (m)	Left		Right	
	Floodway Limit (m)	Governing Criteria	Floodway Limit (m)	Governing Criteria
39,070	69.55	1 m Depth	216.50	1 m Depth
38,812	55.87	Inundation Limit[1]	271.45	1 m Depth
38,629	131.03	Inundation Limit[1]	317.44	1 m Depth
38,381	91.61	Inundation Limit[1]	274.03	1 m Depth
38,176	60.60	1 m Depth	234.18	Inundation Limit[1]
37,829	178.84	1 m Depth	335.85	Interior Boundary[3]
37,633	94.66	1 m Depth	347.71	Interior Boundary[3]
37,484	218.26	1 m Depth	455.10	Interior Boundary[3]
37,376	223.35	1 m Depth	522.05	1 m Depth
37,086	328.75	Inundation Limit[1]	659.94	1 m Depth
36,958	376.59	1 m Depth	607.12	1 m Depth
36,721	464.86	1 m Depth	626.23	1 m Depth
36,621	522.95	1 m Depth	734.42	1 m Depth
36,313	417.71	1 m Depth	579.05	1 m Depth
35,982	353.94	1 m Depth	542.31	1 m Depth
35,611	368.41	1 m Depth	609.27	1 m Depth
35,412	231.73	1 m Depth	535.64	1 m Depth
35,165	245.93	1 m Depth	440.82	1 m Depth
34,850	198.37	1 m Depth	611.00	1 m Depth
34,667	102.26	1 m Depth	490.97	1 m Depth
34,292	91.79	1 m Depth	423.51	1 m Depth
33,924	99.61	1 m Depth	356.07	Mixed
33,653	21.67	Inundation Limit[1]	456.14	1 m Depth
33,378	27.44	Inundation Limit[1]	488.23	1 m Depth
33,017	151.47	Inundation Limit[1]	573.02	Inundation Limit[1]
32,670	399.80	1 m Depth	630.62	Inundation Limit[1]
32,519	470.14	1 m Depth	625.00	1 m Depth
32,484	473.84	1 m Depth	672.62	1 m Depth
32,344	463.03	1 m Depth	824.11	1 m Depth
32,054	146.98	1 m Depth	840.06	1 m Depth
31,781	20.32	Inundation Limit[1]	712.70	1 m Depth
31,429	25.83	Inundation Limit[1]	195.04	1 m Depth
31,207	75.44	1 m Depth	681.00	1 m Depth
31,198	66.07	1 m Depth	667.97	1 m Depth

Table A-1 Floodway limits and governing criteria – Red Deer River (continued)

River Station (m)	Left		Right	
	Floodway Limit (m)	Governing Criteria	Floodway Limit (m)	Governing Criteria
30,968	26.14	1 m Depth	606.54	1 m Depth
30,771	69.03	Inundation Limit[1]	702.65	1 m Depth
30,480	170.71	Inundation Limit[1]	744.71	1 m Depth
30,282	297.48	1 m Depth	770.00	1 m Depth
30,086	403.02	1 m Depth	789.72	Inundation Limit[1]
29,895	461.92	1 m Depth	736.28	Inundation Limit[1]
29,573	196.09	1 m Depth	581.89	Inundation Limit[1]
29,224	165.50	1 m Depth	456.21	Inundation Limit[1]
28,890	101.18	Inundation Limit[1]	414.31	1 m Depth
28,595	103.48	Inundation Limit[1]	260.89	1 m Depth
28,373	76.91	Inundation Limit[1]	421.61	1 m Depth
28,271	151.44	Inundation Limit[1]	451.46	1 m Depth
28,255	118.30	1 m Depth	441.62	1 m Depth
28,234	134.18	1 m Depth	362.65	1 m Depth
28,215	149.93	1 m Depth	353.09	1 m Depth
28,196	157.10	1 m Depth	342.10	1 m Depth
28,120	135.07	1 m Depth	344.74	1 m Depth
28,028	130.84	1 m Depth	327.77	1 m Depth
27,943	322.21	1 m Depth	461.37	1 m Depth
27,921	242.39	1 m Depth	380.57	1 m Depth
27,749	104.94	1 m Depth	425.30	1 m Depth
27,487	81.84	1 m Depth	502.96	1 m Depth
27,145	107.97	1 m Depth	666.17	Inundation Limit[1]
26,728	307.69	Inundation Limit	690.58	Inundation Limit[1]
26,576	326.57	Inundation Limit	737.35	Inundation Limit[1]
26,330	408.22	1 m Depth	633.40	Inundation Limit[1]
26,001	430.66	1 m Depth	640.76	Inundation Limit[1]
25,566	440.50	1 m Depth	655.63	1 m Depth
25,030	499.64	1 m Depth	673.64	1 m Depth
24,611	512.96	1 m Depth	697.09	1 m Depth
24,051	204.51	1 m Depth	606.54	1 m Depth
23,586	163.02	1 m Depth	606.05	1 m Depth
23,316	208.27	1 m Depth	684.61	1 m Depth
22,842	273.83	1 m Depth	716.47	Inundation Limit[1]

Table A-1 Floodway limits and governing criteria – Red Deer River (continued)

River Station (m)	Left		Right	
	Floodway Limit (m)	Governing Criteria	Floodway Limit (m)	Governing Criteria
22,328	285.51	1 m Depth	685.82	Inundation Limit[1]
21,724	110.35	1 m Depth	683.38	Inundation Limit[1]
21,245	303.15	Inundation Limit[1]	615.84	1 m Depth
21,011	336.40	1 m Depth	667.49	1 m Depth
20,686	428.31	1 m Depth	695.66	1 m Depth
20,474	318.92	1 m Depth	644.48	Inundation Limit[1]
20,065	145.65	1 m Depth	566.97	Inundation Limit[1]
19,848	101.96	1 m Depth	411.26	1 m Depth
19,656	58.47	1 m Depth	257.33	1 m Depth
19,356	46.99	Inundation Limit[1]	172.23	1 m Depth
19,059	41.80	Mixed	214.46	1 m Depth
18,881	66.35	Inundation Limit[1]	250.12	1 m Depth
18,652	43.29	Inundation Limit[1]	317.84	1 m Depth
18,440	154.77	Interior Boundary[3]	386.33	1 m Depth
18,219	298.99	Interior Boundary[3]	492.37	1 m Depth
18,020	376.12	Interior Boundary[3]	551.12	Inundation Limit[1]
17,745	390.36	Interior Boundary[3]	554.20	Inundation Limit[1]
17,505	403.03	1 m Depth	588.86	Inundation Limit[1]
17,278	366.68	1 m Depth	521.10	Inundation Limit[1]
17,161	314.88	1 m Depth	521.49	Inundation Limit[1]
16,904	230.11	1 m Depth	452.20	1 m Depth
16,791	232.83	1 m Depth	450.90	1 m Depth
16,767	188.41	1 m Depth	458.73	1 m Depth
16,692	197.76	1 m Depth	479.68	1 m Depth
16,555	215.29	1 m Depth	490.73	1 m Depth
16,363	164.95	1 m Depth	479.57	1 m Depth
16,272	203.50	1 m Depth	343.70	1 m Depth
16,246	212.33	1 m Depth	352.59	1 m Depth
16,054	110.04	1 m Depth	394.97	1 m Depth
15,799	147.79	1 m Depth	330.11	1 m Depth
15,326	50.14	Inundation Limit[1]	198.25	1 m Depth
14,807	92.49	Inundation Limit[1]	301.85	1 m Depth
14,404	153.00	Inundation Limit[1]	432.93	1 m Depth
13,966	107.54	1 m Depth	441.81	Inundation Limit[1]

Table A-1 Floodway limits and governing criteria – Red Deer River (continued)

River Station (m)	Left		Right	
	Floodway Limit (m)	Governing Criteria	Floodway Limit (m)	Governing Criteria
13,392	196.25	1 m Depth	401.11	1 m Depth
12,955	51.17	1 m Depth	303.93	1 m Depth
12,528	48.46	Inundation Limit[1]	256.15	1 m Depth
12,053	60.09	Inundation Limit[1]	263.60	1 m Depth
11,633	61.80	Inundation Limit[1]	341.05	1 m Depth
11,128	113.38	1 m Depth	296.60	1 m Depth
10,764	232.75	1 m Depth	449.85	1 m Depth
10,351	114.63	1 m Depth	381.99	1 m Depth
10,016	96.84	1 m Depth	312.90	1 m Depth
9,697	186.26	1 m Depth	354.38	1 m Depth
9,417	59.27	1 m Depth	294.59	1 m Depth
9,179	79.49	1 m Depth	293.46	1 m Depth
8,943	122.73	1 m Depth	415.63	1 m Depth
8,669	230.00	1 m Depth	460.74	1 m Depth
8,338	281.17	1 m Depth	470.32	1 m Depth
7,988	249.63	1 m Depth	391.53	1 m Depth
7,398	82.00	1 m Depth	337.08	Inundation Limit[1]
7,006	38.98	Inundation Limit[1]	321.81	Inundation Limit[1]
6,606	33.22	Inundation Limit[1]	163.03	1 m Depth
6,283	41.88	Inundation Limit[1]	265.09	1 m Depth
5,827	224.09	1 m Depth	593.95	1 m Depth
5,356	186.34	Inundation Limit[1]	647.22	Inundation Limit[1]
5,018	362.02	Inundation Limit[1]	698.99	Inundation Limit[1]
4,746	505.44	1 m Depth	660.06	Inundation Limit[1]
4,466	382.23	1 m Depth	566.08	Inundation Limit[1]
4,233	378.28	1 m Depth	568.93	Inundation Limit[1]
4,018	452.79	1 m Depth	606.80	1 m Depth
3,908	396.67	1 m Depth	543.47	1 m Depth
3,888	397.05	1 m Depth	545.00	1 m Depth
3,752	387.22	1 m Depth	556.30	1 m Depth
3,508	420.53	1 m Depth	583.47	1 m Depth
3,182	477.33	1 m Depth	638.49	Inundation Limit[1]
2,861	525.19	1 m Depth	706.78	Inundation Limit[1]
2,536	422.25	1 m Depth	586.37	Inundation Limit[1]

Table A-1 Floodway limits and governing criteria – Red Deer River (continued)

River Station (m)	Left		Right	
	Floodway Limit (m)	Governing Criteria	Floodway Limit (m)	Governing Criteria
2,249	286.62	1 m Depth	649.54	Inundation Limit[1]
1,783	178.12	1 m Depth	818.64	1 m Depth
1,484	30.93	1 m Depth	635.60	1 m Depth
1,306	19.16	1 m Depth	330.63	1 m Depth
1,004	35.50	1 m Depth	182.68	1 m Depth
442	274.17	1 m Depth	566.65	Inundation Limit[1]
0	449.87	1 m Depth	624.71	Inundation Limit[1]

Notes:

1. No viable flood fringe.
2. Stream confluence; floodway limit is specified on the adjacent reach cross section.
3. Floodway limit is specified on inside edge of flood control structure.

Table A-2 Floodway limits and governing criteria – Kneehills Creek

River Station (m)	Left		Right	
	Floodway Limit (m)	Governing Criteria	Floodway Limit (m)	Governing Criteria
7,869	167.05	1 m Depth	237.42	1 m Depth
7,766	160.19	1 m Depth	237.78	1 m Depth
7,671	144.51	1 m Depth	242.58	Inundation Limit[1]
7,574	92.76	1 m Depth	203.57	Inundation Limit[1]
7,479	82.66	1 m Depth	154.35	1 m Depth
7,370	71.64	1 m Depth	166.72	1 m Depth
7,153	220.33	1 m Depth	340.72	1 m Depth
6,927	252.97	1 m Depth	449.24	1 m Depth
6,786	249.38	1 m Depth	347.77	1 m Depth
6,665	231.19	1 m Depth	282.97	Inundation Limit[1]
6,500	139.93	1 m Depth	196.20	1 m Depth
6,397	93.92	1 m Depth	145.27	1 m Depth
6,289	120.85	1 m Depth	171.59	1 m Depth
6,165	179.21	1 m Depth	214.10	1 m Depth
6,045	204.12	1 m Depth	250.33	1 m Depth
5,903	220.50	1 m Depth	269.02	1 m Depth
5,774	233.76	1 m Depth	266.02	Inundation Limit[1]
5,662	189.93	1 m Depth	255.32	1 m Depth
5,554	177.86	1 m Depth	306.41	1 m Depth
5,435	285.49	1 m Depth	422.22	1 m Depth
5,300	177.47	1 m Depth	294.56	Inundation Limit[1]
5,175	109.02	1 m Depth	223.11	1 m Depth
5,078	65.22	1 m Depth	168.88	1 m Depth
4,972	83.65	1 m Depth	198.87	1 m Depth
4,844	67.11	1 m Depth	228.42	1 m Depth
4,690	67.68	1 m Depth	216.92	1 m Depth
4,513	54.17	1 m Depth	83.48	1 m Depth
4,412	45.99	1 m Depth	71.38	1 m Depth
4,326	69.26	1 m Depth	132.90	1 m Depth
4,192	168.53	1 m Depth	226.93	1 m Depth
4,053	170.88	1 m Depth	245.72	1 m Depth
3,966	229.12	1 m Depth	297.79	1 m Depth
3,833	182.73	1 m Depth	262.03	1 m Depth
3,738	92.67	1 m Depth	219.44	1 m Depth

Table A-2 Floodway limits and governing criteria – Kneehills Creek (continued)

River Station (m)	Left		Right	
	Floodway Limit (m)	Governing Criteria	Floodway Limit (m)	Governing Criteria
3,549	180.08	1 m Depth	228.66	1 m Depth
3,397	85.46	1 m Depth	237.94	1 m Depth
3,272	127.84	1 m Depth	233.59	1 m Depth
3,126	213.29	1 m Depth	307.03	1 m Depth
3,023	299.20	1 m Depth	319.73	1 m Depth
3,011	283.59	1 m Depth	307.77	1 m Depth
2,916	183.60	1 m Depth	313.20	1 m Depth
2,665	28.91	1 m Depth	220.48	1 m Depth
2,517	34.98	1 m Depth	264.60	1 m Depth
2,242	164.23	1 m Depth	184.34	1 m Depth
2,139	136.97	1 m Depth	269.92	1 m Depth
2,049	110.86	1 m Depth	252.70	1 m Depth
1,915	170.37	1 m Depth	222.26	1 m Depth
1,794	181.00	1 m Depth	241.66	1 m Depth
1,669	149.00	1 m Depth	215.49	1 m Depth
1,600	99.72	1 m Depth	125.68	1 m Depth
1,584	97.48	1 m Depth	123.97	1 m Depth
1,532	10.17	1 m Depth	49.95	1 m Depth
1,375	4.77	1 m Depth	62.09	1 m Depth
1,231	3.93	1 m Depth	136.52	1 m Depth
1,007	N/A	None[2]	214.08	1 m Depth
827	N/A	None[2]	222.58	1 m Depth
583	N/A	None[2]	137.97	1 m Depth
416	N/A	None[2]	77.96	1 m Depth

Notes:

1. No viable flood fringe.
2. Stream confluence; floodway limit is specified on the adjacent reach cross section.

Table A-3 Floodway limits and governing criteria – Michichi Creek

River Station (m)	Left		Right	
	Floodway Limit (m)	Governing Criteria	Floodway Limit (m)	Governing Criteria
5,335	21.76	1 m Depth	38.47	1 m Depth
5,127	8.80	Inundation Limit[1]	21.88	1 m Depth
4,932	72.82	1 m Depth	86.14	1 m Depth
4,747	75.13	1 m Depth	87.35	1 m Depth
4,584	97.99	1 m Depth	111.54	1 m Depth
4,337	58.45	1 m Depth	68.92	1 m Depth
4,146	59.69	1 m Depth	74.36	1 m Depth
3,938	44.14	1 m Depth	58.98	1 m Depth
3,788	54.41	1 m Depth	65.69	1 m Depth
3,614	52.80	1 m Depth	64.66	Main Channel
3,422	29.01	1 m Depth	41.55	1 m Depth
3,178	113.90	1 m Depth	140.71	1 m Depth
2,945	134.46	1 m Depth	144.61	1 m Depth
2,718	10.39	Inundation Limit[1]	25.01	1 m Depth
2,587	55.67	1 m Depth	68.26	Main Channel
2,577	69.76	1 m Depth	86.08	1 m Depth
2,491	128.94	1 m Depth	143.54	Inundation Limit[1]
2,442	111.81	1 m Depth	126.96	1 m Depth
2,429	107.54	1 m Depth	124.94	1 m Depth
2,318	54.66	1 m Depth	66.51	1 m Depth
2,161	124.96	1 m Depth	139.40	1 m Depth
2,059	200.61	1 m Depth	216.91	Inundation Limit[1]
1,999	250.39	1 m Depth	266.13	Inundation Limit[1]
1,852	206.90	1 m Depth	224.94	1 m Depth
1,731	129.23	1 m Depth	155.72	1 m Depth
1,554	80.57	1 m Depth	106.96	1 m Depth
1,461	90.25	1 m Depth	106.70	1 m Depth
1,358	48.69	1 m Depth	71.70	1 m Depth
1,295	88.52	1 m Depth	101.80	1 m Depth
1,248	126.71	1 m Depth	140.70	1 m Depth
1,171	182.10	1 m Depth	198.52	1 m Depth
1,091	239.16	1 m Depth	258.78	1 m Depth
1,018	285.62	1 m Depth	302.37	1 m Depth
1,001	297.24	1 m Depth	313.49	1 m Depth

Table A-3 Floodway limits and governing criteria – Michichi Creek (continued)

River Station (m)	Left		Right	
	Floodway Limit (m)	Governing Criteria	Floodway Limit (m)	Governing Criteria
905	2.80	1 m Depth	22.35	1 m Depth
782	4.57	1 m Depth	23.55	1 m Depth
598	2.75	1 m Depth	25.61	1 m Depth
506	3.56	1 m Depth	N/A	Interior Boundary[2]
412	N/A	Interior Boundary[2]	N/A	Interior Boundary[2]
334	N/A	Interior Boundary[2]	N/A	Interior Boundary[2]
194	N/A	Interior Boundary[2]	N/A	Interior Boundary[2]

Notes:

1. No viable flood fringe.
2. Floodway limit is specified on inside edge of flood control structure.

Table A-4 Floodway limits and governing criteria – Rosebud River

River Station (m)	Left		Right	
	Floodway Limit (m)	Governing Criteria	Floodway Limit (m)	Governing Criteria
10,702	9.18	Inundation Limit[1]	41.23	1 m Depth
10,485	10.84	Inundation Limit[1]	44.18	Inundation Limit[1]
10,289	55.07	1 m Depth	125.48	Inundation Limit[1]
10,163	99.55	1 m Depth	159.93	Inundation Limit[1]
10,045	27.64	Inundation Limit[1]	167.78	1 m Depth
9,912	2.77	Inundation Limit[1]	99.84	1 m Depth
9,755	46.52	Inundation Limit[1]	162.70	1 m Depth
9,668	101.26	Inundation Limit[1]	192.39	1 m Depth
9,618	120.62	Inundation Limit[1]	272.66	1 m Depth
9,600	154.93	1 m Depth	235.95	1 m Depth
9,580	144.08	1 m Depth	199.83	1 m Depth
9,570	134.56	1 m Depth	192.61	1 m Depth
9,554	127.30	1 m Depth	197.91	1 m Depth
9,468	111.67	1 m Depth	218.89	1 m Depth
9,355	88.78	1 m Depth	203.22	Inundation Limit[1]
9,227	144.67	1 m Depth	206.53	1 m Depth
9,116	164.70	1 m Depth	236.27	Inundation Limit[1]
8,994	170.88	1 m Depth	281.66	Inundation Limit[1]
8,849	78.95	1 m Depth	286.66	Inundation Limit[1]
8,745	79.64	1 m Depth	216.96	Inundation Limit[1]
8,706	47.73	1 m Depth	158.11	Inundation Limit[1]
8,689	51.90	1 m Depth	137.10	1 m Depth
8,682	50.50	1 m Depth	126.45	1 m Depth
8,675	46.48	1 m Depth	121.72	1 m Depth
8,661	43.20	1 m Depth	111.27	1 m Depth
8,553	15.41	Inundation Limit[1]	82.92	1 m Depth
8,439	7.70	Inundation Limit[1]	109.68	1 m Depth
8,343	7.94	Inundation Limit[1]	105.19	1 m Depth
8,281	32.35	1 m Depth	76.70	1 m Depth
8,187	35.33	1 m Depth	64.22	1 m Depth
8,101	83.05	1 m Depth	127.13	1 m Depth
8,080	121.66	1 m Depth	162.37	1 m Depth
8,060	125.29	1 m Depth	171.43	1 m Depth
8,009	134.36	1 m Depth	186.52	1 m Depth

Table A-4 Floodway limits and governing criteria – Rosebud River (continued)

River Station (m)	Left		Right	
	Floodway Limit (m)	Governing Criteria	Floodway Limit (m)	Governing Criteria
7,958	184.54	1 m Depth	226.19	1 m Depth
7,937	211.48	1 m Depth	252.76	1 m Depth
7,783	169.22	1 m Depth	263.19	Inundation Limit[1]
7,641	93.17	1 m Depth	198.99	1 m Depth
7,530	95.52	1 m Depth	237.55	1 m Depth
7,395	113.65	1 m Depth	250.04	1 m Depth
7,326	113.03	1 m Depth	251.70	1 m Depth
7,303	103.04	1 m Depth	204.34	1 m Depth
7,276	114.85	1 m Depth	168.42	1 m Depth
7,246	98.03	1 m Depth	207.24	1 m Depth
7,215	79.66	1 m Depth	215.24	1 m Depth
7,151	79.21	1 m Depth	191.15	1 m Depth
6,913	82.29	1 m Depth	179.63	1 m Depth
6,774	33.26	1 m Depth	156.10	1 m Depth
6,641	37.69	Inundation Limit[1]	190.00	1 m Depth
6,532	27.38	Inundation Limit[1]	194.39	1 m Depth
6,469	106.97	Inundation Limit[1]	276.02	1 m Depth
6,450	129.64	1 m Depth	277.11	1 m Depth
6,419	118.08	1 m Depth	253.44	1 m Depth
6,382	122.29	1 m Depth	301.00	1 m Depth
6,361	120.42	1 m Depth	305.20	1 m Depth
6,278	113.57	1 m Depth	284.31	1 m Depth
6,166	122.48	1 m Depth	279.10	Inundation Limit[1]
5,969	87.67	1 m Depth	236.46	Inundation Limit[1]
5,904	92.35	1 m Depth	199.92	1 m Depth
5,886	101.45	1 m Depth	178.96	1 m Depth
5,879	114.66	1 m Depth	193.85	1 m Depth
5,872	137.84	1 m Depth	214.27	1 m Depth
5,851	129.78	1 m Depth	209.78	1 m Depth
5,776	75.49	1 m Depth	187.72	1 m Depth
5,689	8.31	Inundation Limit[1]	139.43	1 m Depth
5,616	10.03	Inundation Limit[1]	105.70	1 m Depth
5,547	26.96	1 m Depth	119.00	1 m Depth
5,473	100.73	1 m Depth	244.01	1 m Depth

Table A-4 Floodway limits and governing criteria – Rosebud River (continued)

River Station (m)	Left		Right	
	Floodway Limit (m)	Governing Criteria	Floodway Limit (m)	Governing Criteria
5,452	105.56	1 m Depth	234.09	1 m Depth
5,378	84.44	1 m Depth	161.20	1 m Depth
5,288	78.32	1 m Depth	138.09	1 m Depth
5,193	94.10	1 m Depth	166.29	1 m Depth
5,065	102.65	1 m Depth	209.04	1 m Depth
4,997	126.08	1 m Depth	230.85	1 m Depth
4,980	82.88	1 m Depth	174.84	1 m Depth
4,917	9.97	Inundation Limit[1]	178.95	1 m Depth
4,771	11.01	Inundation Limit[1]	153.17	1 m Depth
4,599	10.21	1 m Depth	132.62	1 m Depth
4,530	126.98	1 m Depth	302.17	1 m Depth
4,509	172.24	1 m Depth	287.77	1 m Depth
4,501	195.74	1 m Depth	228.05	1 m/s Velocity
4,480	207.87	1 m Depth	247.00	1 m/s Velocity
4,409	256.42	1 m Depth	294.55	1 m Depth
4,313	315.10	1 m Depth	358.18	Inundation Limit[1]
4,153	302.37	1 m Depth	342.96	1 m Depth
4,037	277.18	1 m Depth	303.01	1 m Depth
3,852	195.51	1 m Depth	261.93	1 m Depth
3,694	159.56	1 m Depth	269.86	1 m Depth
3,461	174.15	1 m Depth	411.96	Inundation Limit[1]
3,314	157.34	1 m Depth	389.91	Inundation Limit[1]
3,167	145.00	1 m Depth	312.89	Inundation Limit[1]
3,011	106.81	Inundation Limit[1]	214.03	1 m Depth
2,907	37.56	Inundation Limit[1]	152.36	1 m Depth
2,817	100.60	Inundation Limit[1]	203.54	1 m Depth
2,645	142.61	1 m Depth	230.37	1 m Depth
2,454	217.93	1 m Depth	322.53	1 m Depth
2,352	244.43	Inundation Limit[1]	359.74	Inundation Limit[1]
2,255	254.57	1 m Depth	309.13	Inundation Limit[1]
2,235	234.94	1 m Depth	290.94	1 m Depth
2,187	184.82	1 m Depth	241.62	1 m Depth
2,138	167.41	1 m Depth	211.68	1 m Depth
2,113	167.71	1 m Depth	210.84	1 m Depth

Table A-4 Floodway limits and governing criteria – Rosebud River (continued)

River Station (m)	Left		Right	
	Floodway Limit (m)	Governing Criteria	Floodway Limit (m)	Governing Criteria
2,005	99.82	1 m Depth	162.45	1 m Depth
1,894	18.06	1 m Depth	124.58	1 m Depth
1,757	---	Previous Floodway	---	Previous Floodway
1,602	---	Previous Floodway	---	Previous Floodway
1,422	---	Previous Floodway	136.39	Main Channel[2]
1,271	---	Previous Floodway	---	Previous Floodway
1,155	66.16	Inundation Limit[3]	124.37	Inundation Limit[3]
1,127	83.68	Inundation Limit[3]	143.99	Inundation Limit[3]
1,017	97.45	Inundation Limit[3]	227.72	Inundation Limit[3]
833	---	Previous Floodway	---	Previous Floodway
652	16.79	Inundation Limit[3]	---	Previous Floodway
559	---	Previous Floodway	---	Previous Floodway
527	310.52	1 m Depth	364.13	1 m Depth
438	232.98	1 m Depth	320.97	1 m Depth
357	296.12	1 m Depth	418.35	1 m Depth
332	318.22	1 m Depth	513.41	1 m Depth
234	301.27	1 m Depth	566.18	1 m Depth
116	286.30	1 m Depth	643.44	1 m Depth

Notes:

1. No viable flood fringe.
2. Previous floodway is inside the main channel.
3. Previous floodway is outside inundation limit.

Table A-5 Floodway limits and governing criteria – Willow Creek

River Station (m)	Left		Right	
	Floodway Limit (m)	Governing Criteria	Floodway Limit (m)	Governing Criteria
2,970	31.41	Main Channel	46.03	1 m/s Velocity
2,723	24.54	Main Channel	33.41	Main Channel
2,408	95.36	Main Channel	103.51	Main Channel
2,174	61.27	1 m/s Velocity	72.69	1 m Depth
1,937	63.15	1 m/s Velocity	91.07	Main Channel
1,566	77.26	Main Channel	88.68	1 m Depth
1,356	124.01	Main Channel	132.24	1 m Depth
1,007	329.66	Main Channel	340.30	Main Channel
863	373.68	1 m Depth	390.92	1 m Depth
848	383.25	1 m Depth	401.22	1 m Depth

Appendix B
Design Flood Levels

Table B-1 Design flood levels – Red Deer River

River Station (m)	Design Flood Level (m)
56,139	689.59
55,755	689.45
55,521	689.30
55,149	689.14
54,759	688.86
54,516	688.82
54,007	688.69
53,602	688.55
53,393	688.41
53,064	688.35
52,682	688.28
52,364	688.19
51,970	687.95
51,689	687.82
51,563	687.74
51,326	687.70
51,089	687.70
50,765	687.44
50,457	687.39
50,067	687.30
49,706	687.29
49,354	687.08
49,045	687.03
48,695	686.70
48,288	686.71
48,079	686.67
47,899	686.38
47,630	686.30
47,303	686.32
47,010	686.22
46,672	686.03
46,395	685.96
46,221	685.92
46,039	685.79

Table B-1 Design flood levels – Red Deer River (continued)

River Station (m)	Design Flood Level (m)
45,748	685.71
45,410	685.75
45,086	685.57
44,815	685.49
44,666	685.52
44,443	685.39
44,420	685.12
44,290	685.11
44,005	684.92
43,798	684.72
43,527	684.62
43,209	684.51
42,942	684.42
42,779	684.51
42,558	684.48
42,341	684.44
42,214	684.21
41,996	684.18
41,823	684.15
41,644	683.86
41,263	683.83
41,074	683.82
40,832	683.75
40,804	683.74
40,748	683.68
40,606	683.65
40,517	683.63
40,322	683.29
40,132	683.23
39,912	683.15
39,774	683.18
39,619	683.10
39,538	683.10
39,370	682.98

Table B-1 Design flood levels – Red Deer River (continued)

River Station (m)	Design Flood Level (m)
39,070	682.80
38,812	682.77
38,629	682.70
38,381	682.59
38,176	682.52
37,829	682.46
37,633	682.40
37,484	682.48
37,376	682.48
37,086	682.40
36,958	682.35
36,721	682.19
36,621	682.14
36,313	682.04
35,982	681.99
35,611	681.92
35,412	681.86
35,165	681.72
34,850	681.71
34,667	681.67
34,292	681.55
33,924	681.43
33,653	681.27
33,378	681.25
33,017	681.17
32,670	681.09
32,519	680.92
32,484	680.90
32,344	680.80
32,054	680.87
31,781	680.61
31,429	680.52
31,207	680.46
31,198	680.40

Table B-1 Design flood levels – Red Deer River (continued)

River Station (m)	Design Flood Level (m)
30,968	680.37
30,771	680.33
30,480	680.21
30,282	680.23
30,086	680.21
29,895	680.05
29,573	679.83
29,224	679.78
28,890	679.75
28,595	679.48
28,373	679.44
28,271	679.34
28,255	679.29
28,234	679.32
28,215	679.32
28,196	679.28
28,120	679.27
28,028	679.27
27,943	679.10
27,921	679.03
27,749	679.03
27,487	678.97
27,145	678.86
26,728	678.73
26,576	678.75
26,330	678.64
26,001	678.49
25,566	678.27
25,030	678.11
24,611	677.94
24,051	677.89
23,586	677.81
23,316	677.71
22,842	677.63

Table B-1 Design flood levels – Red Deer River (continued)

River Station (m)	Design Flood Level (m)
22,328	677.31
21,724	677.25
21,245	676.98
21,011	676.97
20,686	676.87
20,474	676.70
20,065	676.71
19,848	676.41
19,656	676.36
19,356	676.01
19,059	675.85
18,881	675.81
18,652	675.78
18,440	675.79
18,219	675.77
18,020	675.71
17,745	675.55
17,505	675.39
17,278	675.33
17,161	675.37
16,904	675.32
16,791	675.29
16,767	675.24
16,692	675.25
16,555	675.21
16,363	675.09
16,272	674.94
16,246	674.92
16,054	674.76
15,799	674.59
15,326	674.44
14,807	674.23
14,404	674.23
13,966	674.10

Table B-1 Design flood levels – Red Deer River (continued)

River Station (m)	Design Flood Level (m)
13,392	673.88
12,955	673.71
12,528	673.62
12,053	673.46
11,633	673.43
11,128	673.07
10,764	673.03
10,351	672.92
10,016	672.64
9,697	672.47
9,417	672.50
9,179	672.24
8,943	672.13
8,669	671.96
8,338	671.72
7,988	671.54
7,398	671.26
7,006	671.07
6,606	670.49
6,283	670.53
5,827	670.48
5,356	670.41
5,018	670.27
4,746	670.04
4,466	669.79
4,233	669.65
4,018	669.51
3,908	669.50
3,888	669.46
3,752	669.23
3,508	669.15
3,182	668.99
2,861	668.71
2,536	668.50

Table B-1 Design flood levels – Red Deer River (continued)

River Station (m)	Design Flood Level (m)
2,249	668.53
1,783	668.46
1,484	668.32
1,306	668.22
1,004	667.90
442	667.75
0	667.42

Table B-2 Design flood levels – Kneehills Creek

River Station (m)	Design Flood Level (m)
7,869	698.59
7,766	698.41
7,671	698.19
7,574	698.01
7,479	697.79
7,370	697.53
7,153	697.14
6,927	696.99
6,786	696.86
6,665	696.64
6,500	696.39
6,397	696.03
6,289	695.97
6,165	695.86
6,045	695.62
5,903	695.32
5,774	695.01
5,662	694.77
5,554	694.74
5,435	694.69
5,300	694.57
5,175	694.37
5,078	694.14
4,972	694.01
4,844	693.84
4,690	693.73
4,513	693.40
4,412	693.27
4,326	693.15
4,192	693.01
4,053	692.67
3,966	692.45
3,833	692.27
3,738	692.20

Table B-2 Design flood levels – Kneehills Creek (continued)

River Station (m)	Design Flood Level (m)
3,549	692.01
3,397	691.83
3,272	691.65
3,126	691.50
3,023	690.98
3,011	690.90
2,916	690.82
2,665	690.45
2,517	690.32
2,242	689.73
2,139	689.76
2,049	689.67
1,915	689.47
1,794	689.29
1,669	689.02
1,600	688.88
1,584	688.83
1,532	688.74
1,375	688.38
1,231	688.19
1,007	688.06
827	688.02
583	687.94
416	687.82

Table B-3 Design flood levels – Michichi Creek

River Station (m)	Design Flood Level (m)
5,335	694.04
5,127	693.53
4,932	693.02
4,747	692.48
4,584	692.22
4,337	691.55
4,146	691.08
3,938	690.69
3,788	690.35
3,614	689.60
3,422	688.62
3,178	688.46
2,945	688.14
2,718	687.67
2,587	687.29
2,577	687.30
2,491	687.06
2,442	686.95
2,429	686.91
2,318	686.54
2,161	686.05
2,059	685.90
1,999	685.86
1,852	685.61
1,731	685.45
1,554	685.23
1,461	685.08
1,358	685.02
1,295	684.84
1,248	684.77
1,171	684.69
1,091	684.63
1,018	684.56
1,001	684.50

Table B-3 Design flood levels – Michichi Creek (continued)

River Station (m)	Design Flood Level (m)
905	684.46
782	684.39
598	684.30
506	684.31
412	684.29
334	684.28
194	684.28

Table B-4 Design flood levels – Rosebud River

River Station (m)	Design Flood Level (m)
10,702	700.44
10,485	699.93
10,289	699.63
10,163	699.33
10,045	699.33
9,912	699.16
9,755	699.08
9,668	698.91
9,618	698.91
9,600	698.68
9,580	698.53
9,570	698.44
9,554	698.23
9,468	698.18
9,355	697.95
9,227	697.75
9,116	697.53
8,994	697.41
8,849	697.37
8,745	697.30
8,706	696.94
8,689	696.66
8,682	696.53
8,675	696.56
8,661	696.51
8,553	696.36
8,439	696.22
8,343	696.13
8,281	695.93
8,187	695.50
8,101	695.44
8,080	695.32
8,060	695.11
8,009	695.02

Table B-4 Design flood levels – Rosebud River (continued)

River Station (m)	Design Flood Level (m)
7,958	694.96
7,937	694.90
7,783	694.70
7,641	694.42
7,530	694.37
7,395	694.29
7,326	694.13
7,303	694.10
7,276	693.85
7,246	693.91
7,215	693.80
7,151	693.73
6,913	693.37
6,774	693.32
6,641	693.16
6,532	693.05
6,469	692.92
6,450	692.37
6,419	692.43
6,382	692.21
6,361	692.21
6,278	692.21
6,166	692.12
5,969	692.02
5,904	691.79
5,886	691.33
5,879	691.32
5,872	691.22
5,851	691.09
5,776	691.03
5,689	690.94
5,616	690.83
5,547	690.66
5,473	690.61

Table B-4 Design flood levels – Rosebud River (continued)

River Station (m)	Design Flood Level (m)
5,452	690.55
5,378	690.36
5,288	690.21
5,193	690.12
5,065	690.04
4,997	689.82
4,980	689.54
4,917	689.52
4,771	689.39
4,599	689.26
4,530	689.16
4,509	688.89
4,501	688.65
4,480	688.08
4,409	688.12
4,313	687.93
4,153	687.65
4,037	687.34
3,852	686.94
3,694	686.43
3,461	686.14
3,314	686.03
3,167	685.87
3,011	685.65
2,907	685.52
2,817	685.41
2,645	685.08
2,454	684.84
2,352	684.74
2,255	684.12
2,235	683.94
2,187	683.88
2,138	683.81
2,113	683.76

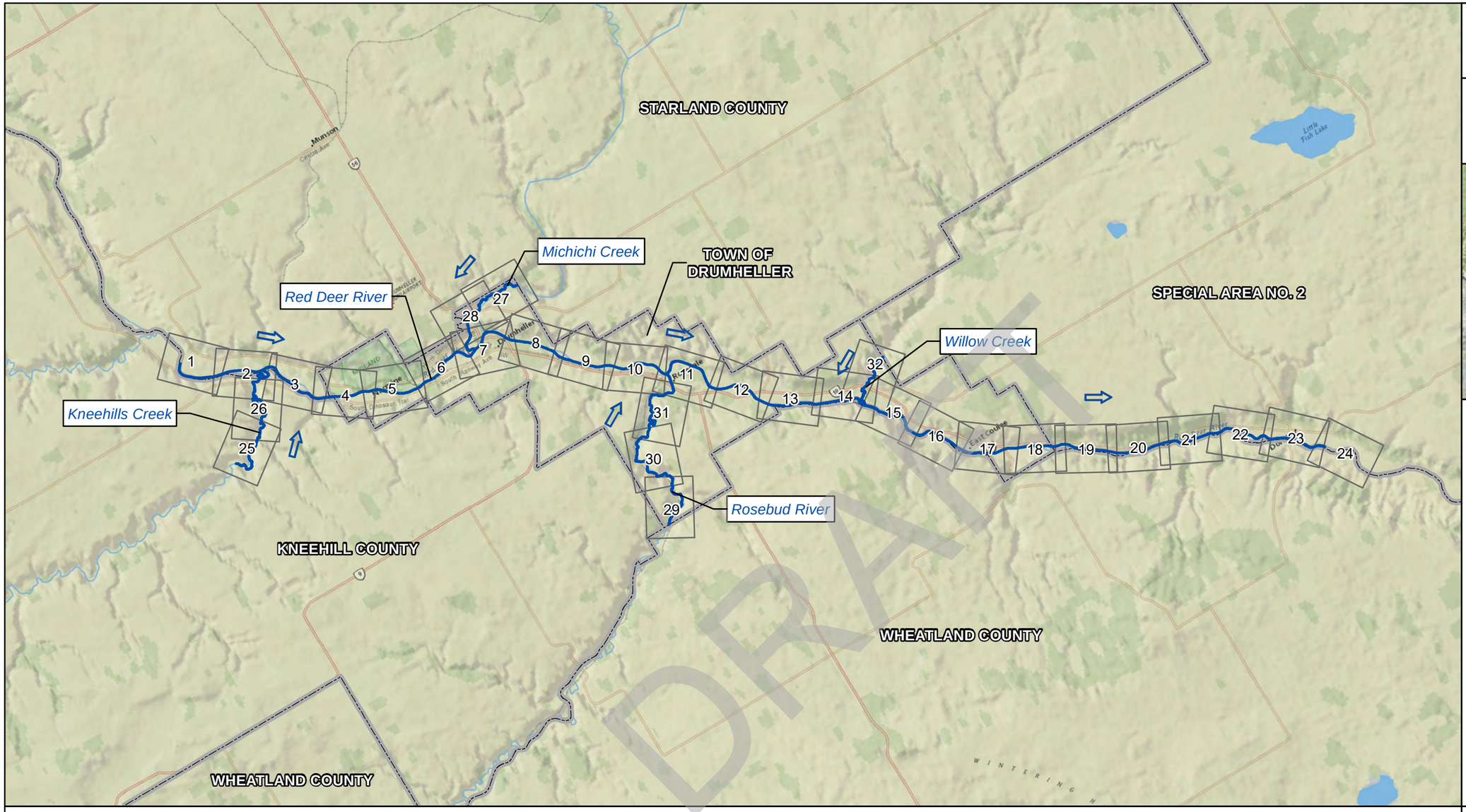
Table B-4 Design flood levels – Rosebud River (continued)

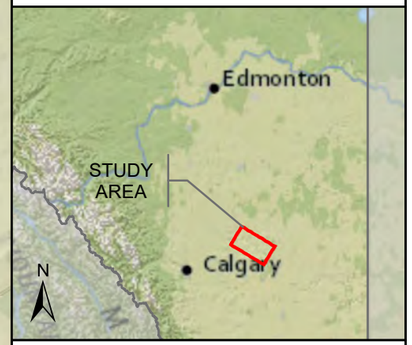
River Station (m)	Design Flood Level (m)
2,005	683.44
1,894	683.30
1,757	683.02
1,602	682.56
1,422	682.20
1,271	682.04
1,155	681.84
1,127	681.72
1,017	681.64
833	681.55
652	681.52
559	681.39
527	681.35
438	681.29
357	681.24
332	681.21
234	681.18
116	681.17

Table B-5 Design flood levels – Willow Creek

River Station (m)	Design Flood Level (m)
2,970	688.64
2,723	687.16
2,408	685.81
2,174	684.35
1,937	683.05
1,566	681.06
1,356	679.95
1,007	678.25
863	677.88
848	677.83

Appendix C
Floodway Criteria Maps





FLOW DIRECTION
STUDY REACH
MAP SHEET
MUNICIPAL BOUNDARY

Note to Users:

1. Please refer to the accompanying **Drumheller River Hazard Study - Design Flood Hazard Mapping Report** for important information concerning the floodway criteria map.
2. Within the flood inundation areas shown on this map, there may be isolated pockets of high ground. To determine whether or not a particular site is subject to flooding, reference should be made to the computed flood levels in conjunction with site-specific surveys where detailed definition is required.
3. Non-riverine and local sources of water have not been considered, and structures such roads and railways can restrict water flow and affect local flood levels. Channel obstruction, local stormwater inflow, groundwater seepage or other land drainage can cause flood levels to exceed those indicated on the map. Lands adjacent to a flooded area may be subject to flooding from tributary streams not indicated on the maps.
4. The flood inundation area is shown above the linework for bridges and flood control structures that are below flood levels.

Definitions:

Flood Hazard Map - A flood hazard map is a specific type of flood map that identifies the area flooded for the 1:100 design flood, and divides that flood hazard area into floodway and flood fringe zones. Flood hazard maps can also show additional flood hazard information, including the incremental areas at risk for more severe floods like the 1:200 and 1:500 floods. Flood hazard maps are typically used for long-term flood hazard area management and land-use planning.

Design Flood - The design flood standard in Alberta is the 1:100 flood, which is a flood that has a 1% chance of being equaled or exceeded in any given year. The design flood is typically based on the 1:100 open water flood, but it can also reflect 1:100 ice jam flood levels or be based on a historical flood event. Different sized floods have different chances of occurring – for example, a 1:200 flood has a 0.5% chance of occurring in any given year and a 1:500 flood has a 0.2% chance of occurring in any given year – but only the 1:100 design flood is used to define the floodway and flood fringe zones on flood hazard maps.

Floodway - When a floodway is first defined on a flood hazard map, it typically represents the area of highest flood hazard where flows are deepest, fastest, and most destructive during the 1:100 design flood. When a flood hazard map is updated, the floodway will not get larger in most circumstances to maintain long-term regulatory certainty, even if the flood hazard area gets larger or design flood levels get higher.

Flood Fringe - The flood fringe is the area outside of the floodway that is flooded or could be flooded during the 1:100 design flood. The flood fringe typically represents areas with

Definitions (continued):

shallower, slower, and less destructive flooding, but it may also include "high hazard flood fringe" areas. Areas at risk of flooding behind flood berms may also be mapped as "protected flood fringe" areas.

High Hazard Flood Fringe - The high hazard flood fringe identifies areas within the flood fringe with deeper or faster moving water than the rest of the flood fringe. High hazard flood fringe areas are likely to be most significant for flood maps that are being updated, but they may also be included in new flood maps.

Protected Flood Fringe - The protected flood fringe identifies areas that could be flooded if dedicated flood berms fail or do not work as designed during the 1:100 design flood, even if they are not overtopped. Protected flood fringe areas are part of the flood fringe and do not differentiate between areas with deeper or faster moving water and shallower or slower moving water.

Data Sources and References:

1. Orthophoto imagery acquired by OGL Engineering for Alberta Environment and Parks: *OGL Engineering (2019). Drumheller aerial imagery acquisition memorandum, project number 2019-501, submitted to Alberta Environment and Parks, 5 pp.*
2. Base data from NRCan, Alberta Environment and Parks, Altalis, and Natural Resources Canada.
3. Additional base mapping from Esri.

SCALE - 1:175,000
0 2 4 6 8 KM

Coordinate System: NAD 1983 CSRS 3TM 114;
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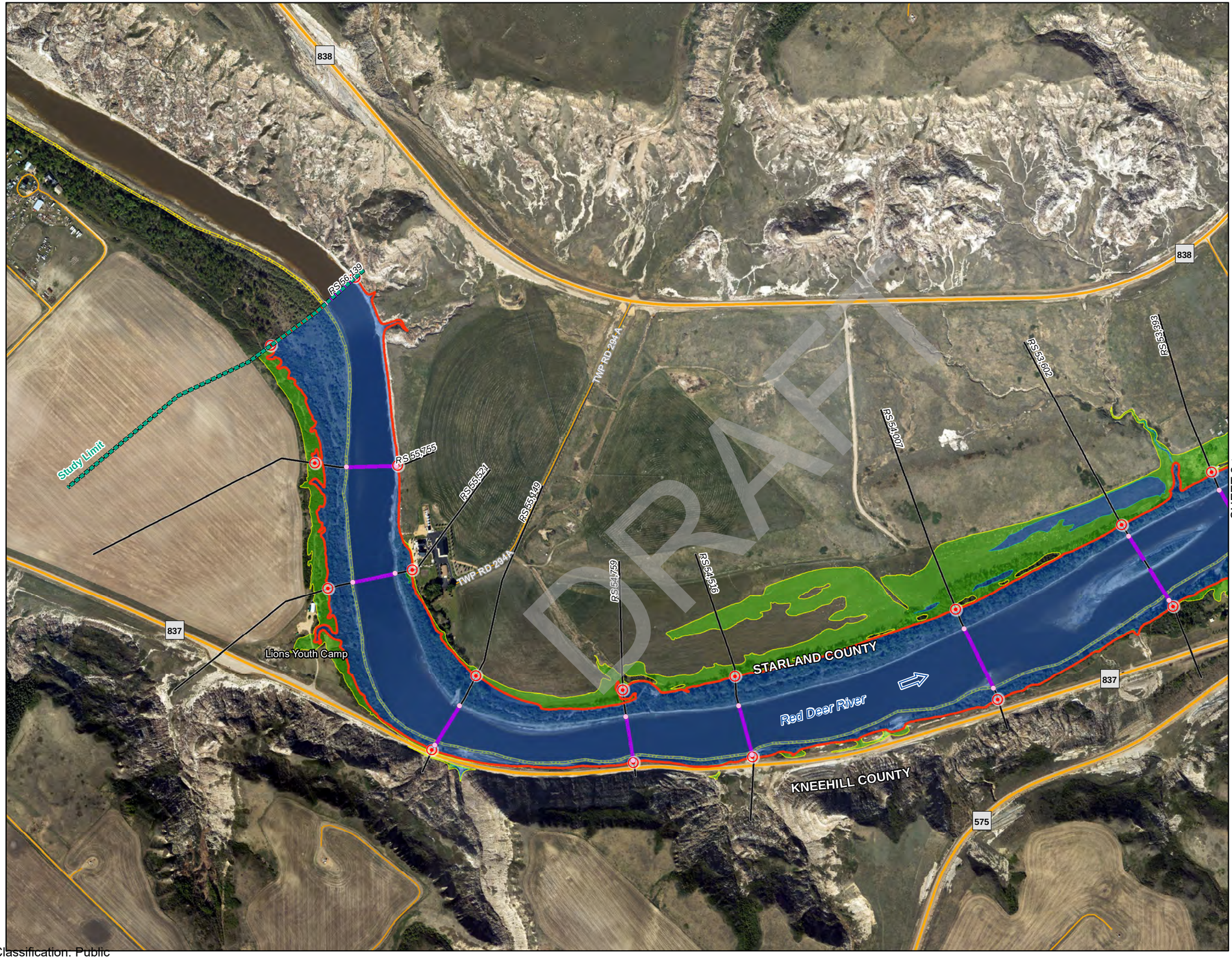
DRUMHELLER RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

INDEX MAP



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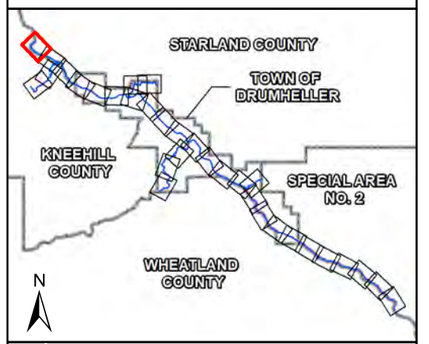

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SCALE - 1:7,500

0 50 100 200 300 M

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FLOODWAY CRITERIA MAP

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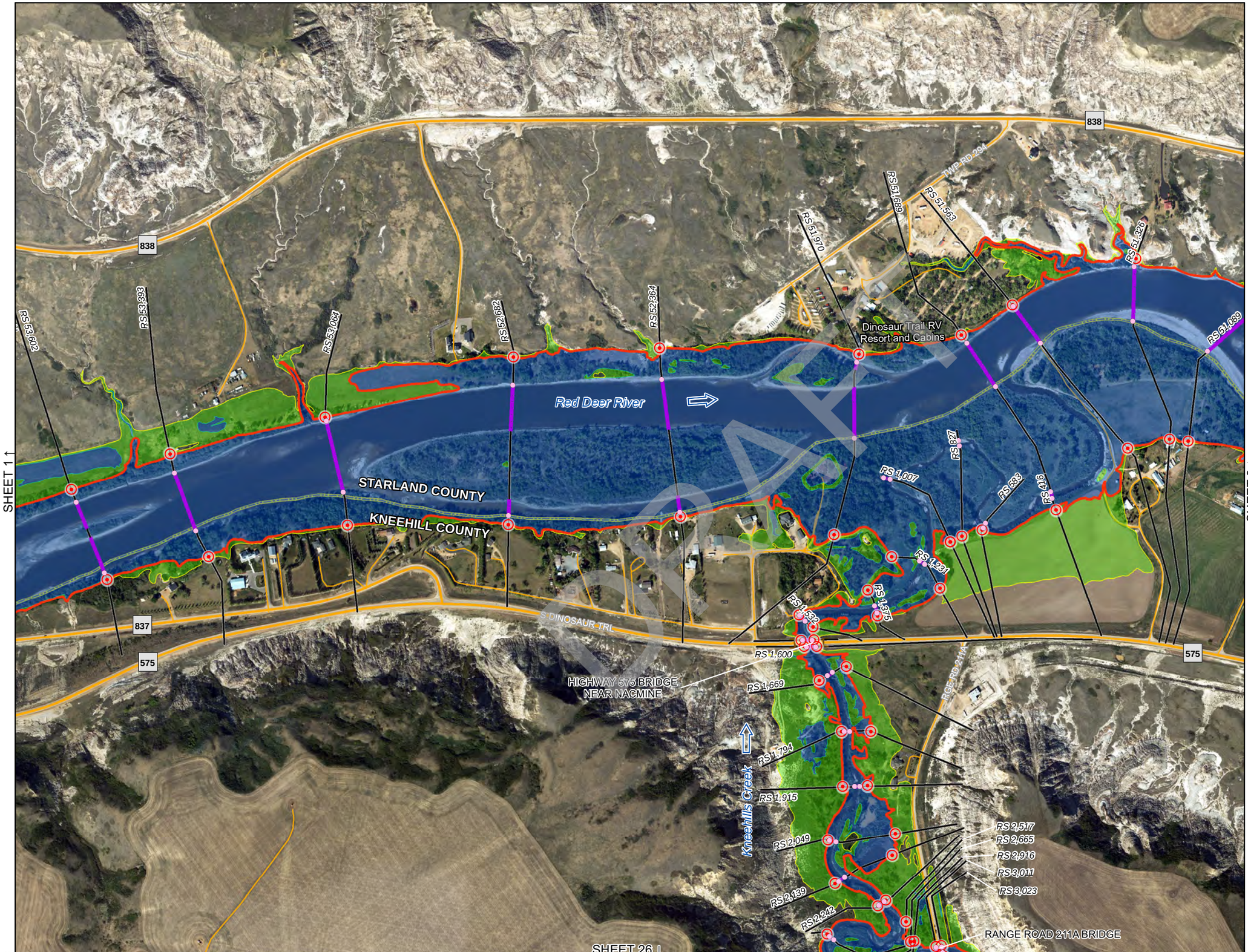

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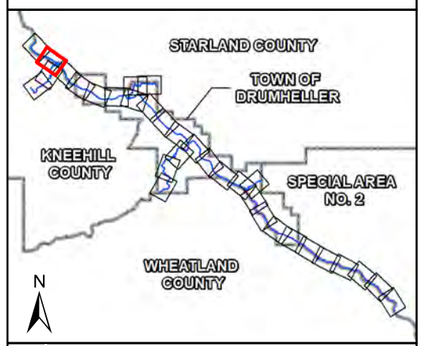

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FLOODWAY CRITERIA MAP

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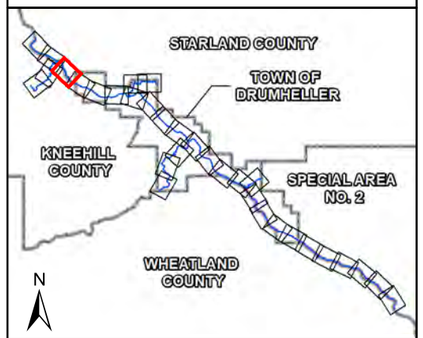

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DRUMHELLER
RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

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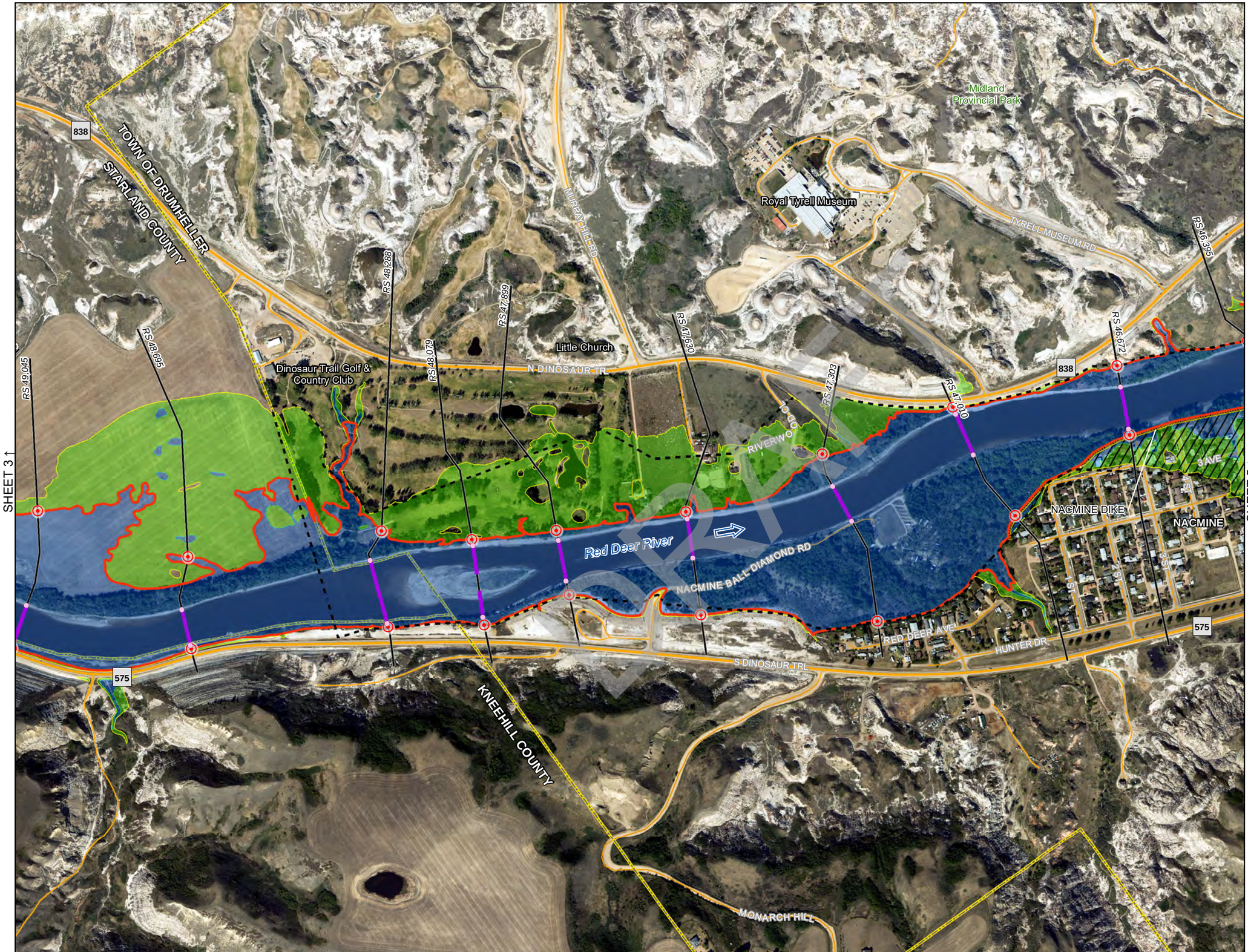

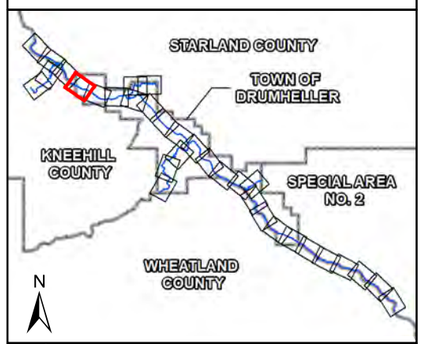

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FLOODWAY CRITERIA MAP

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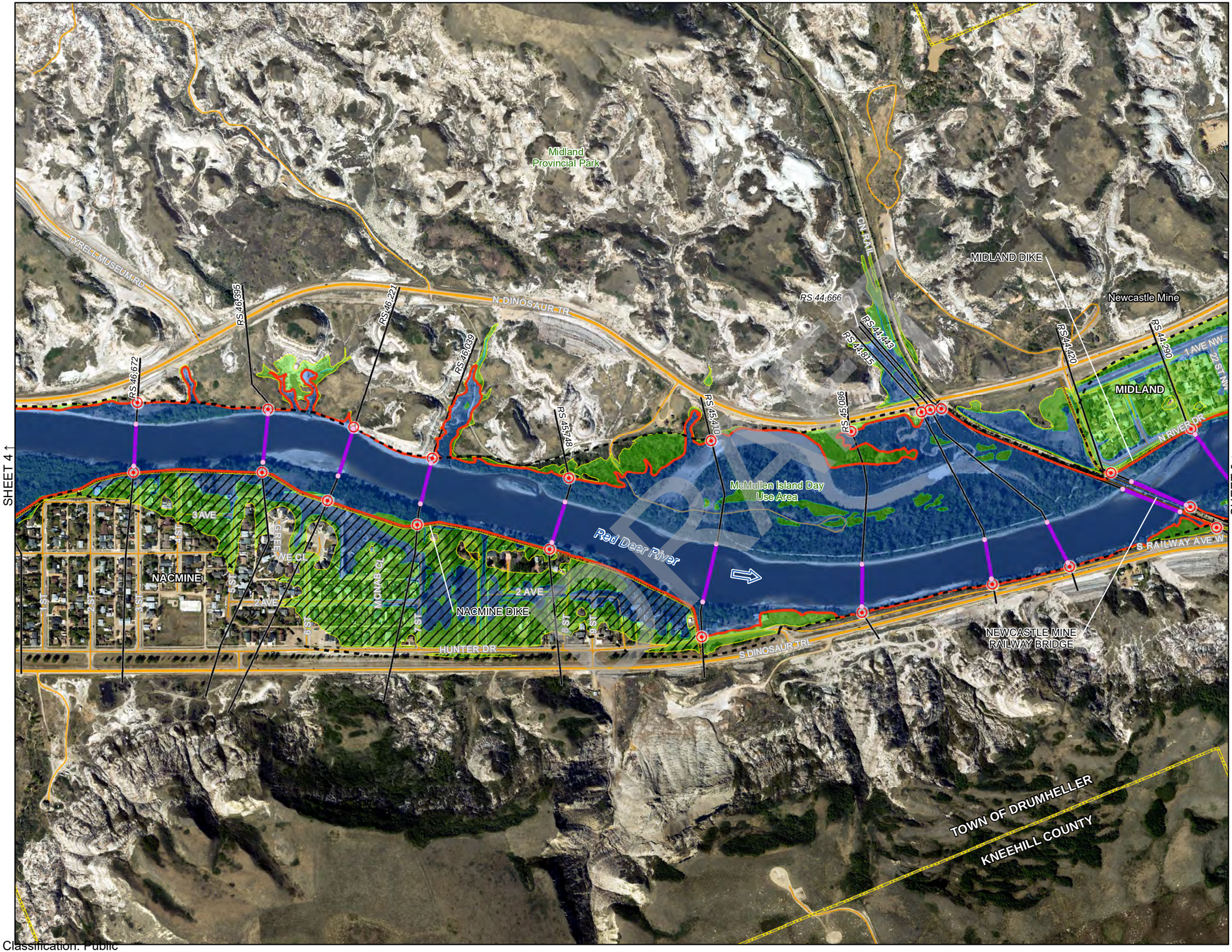

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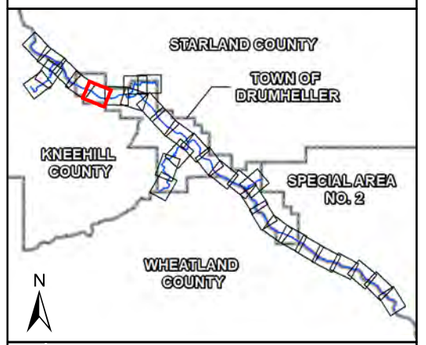

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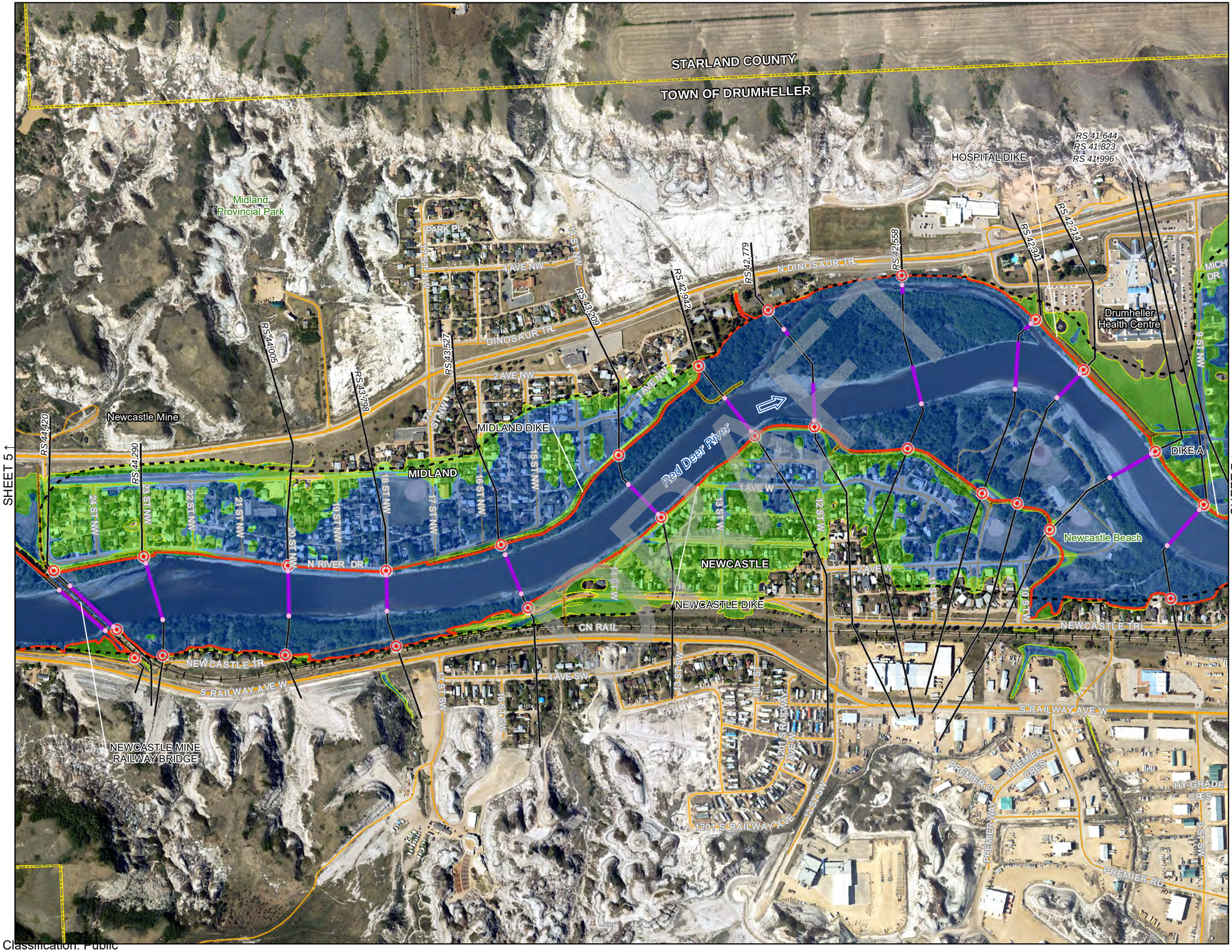

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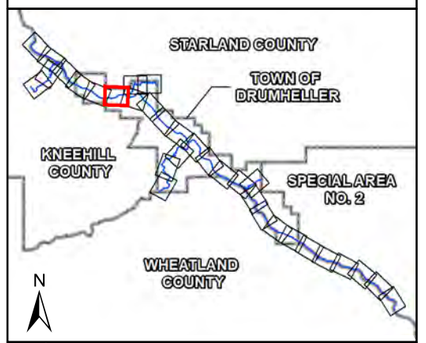

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SCALE - 1:7,500

0 50 100 200 300 M

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DRUMHELLER RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

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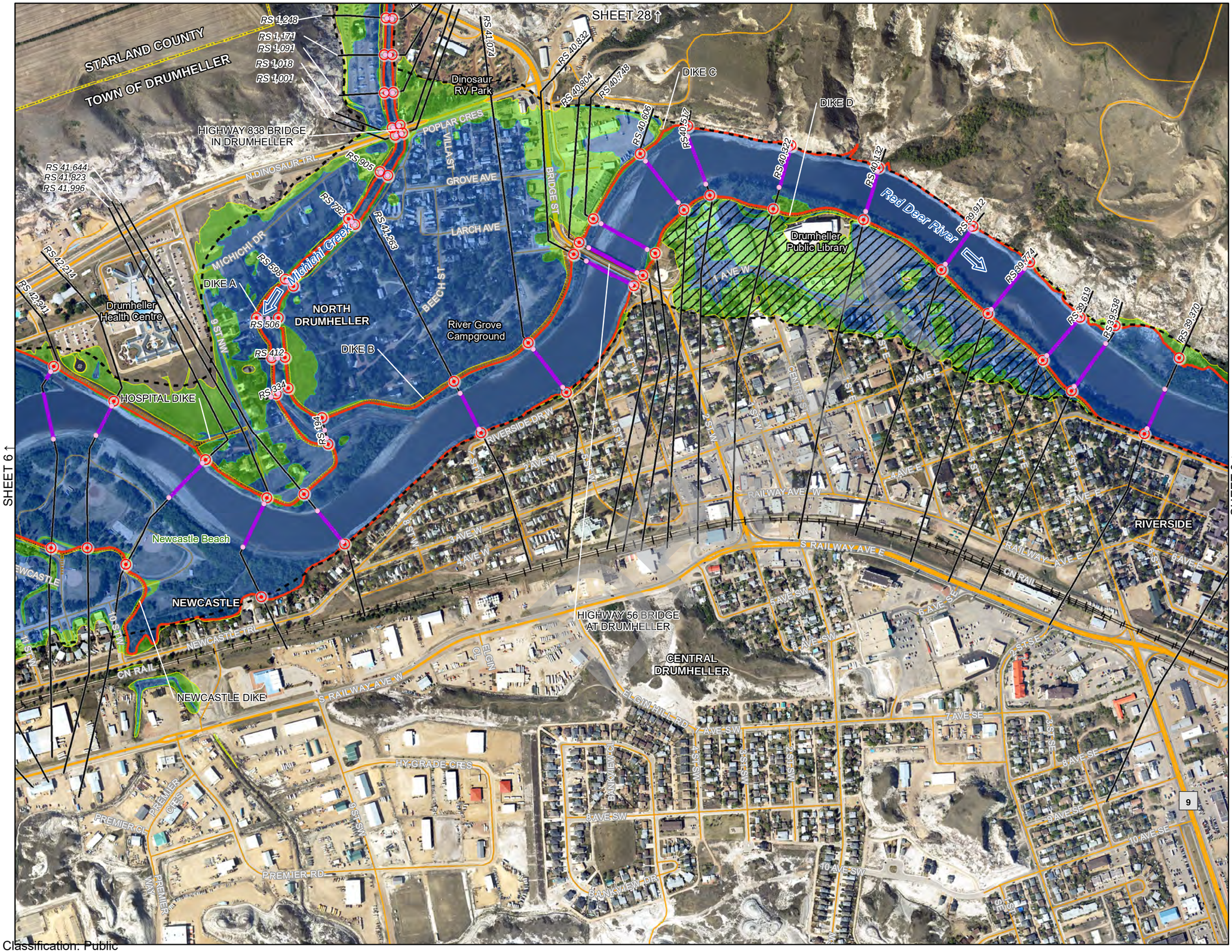

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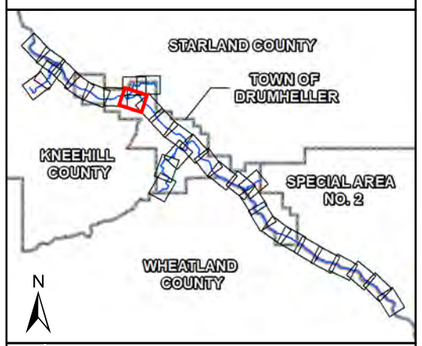

- FLOW DIRECTION
- STUDY LIMIT
- BANK STATION
- PROPOSED FLOODWAY LIMIT
- PREVIOUS FLOODWAY
- PROPOSED FLOODWAY BOUNDARY
- BRIDGE
- CULVERT
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- LOCAL ROAD
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SCALE - 1:7,500

0 50 100 200 300 M

Coordinate System: NAD 1983 CSRS 3TM 114; Vertical Datum: CGVD28 HTv2.0; Units: Metres

Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

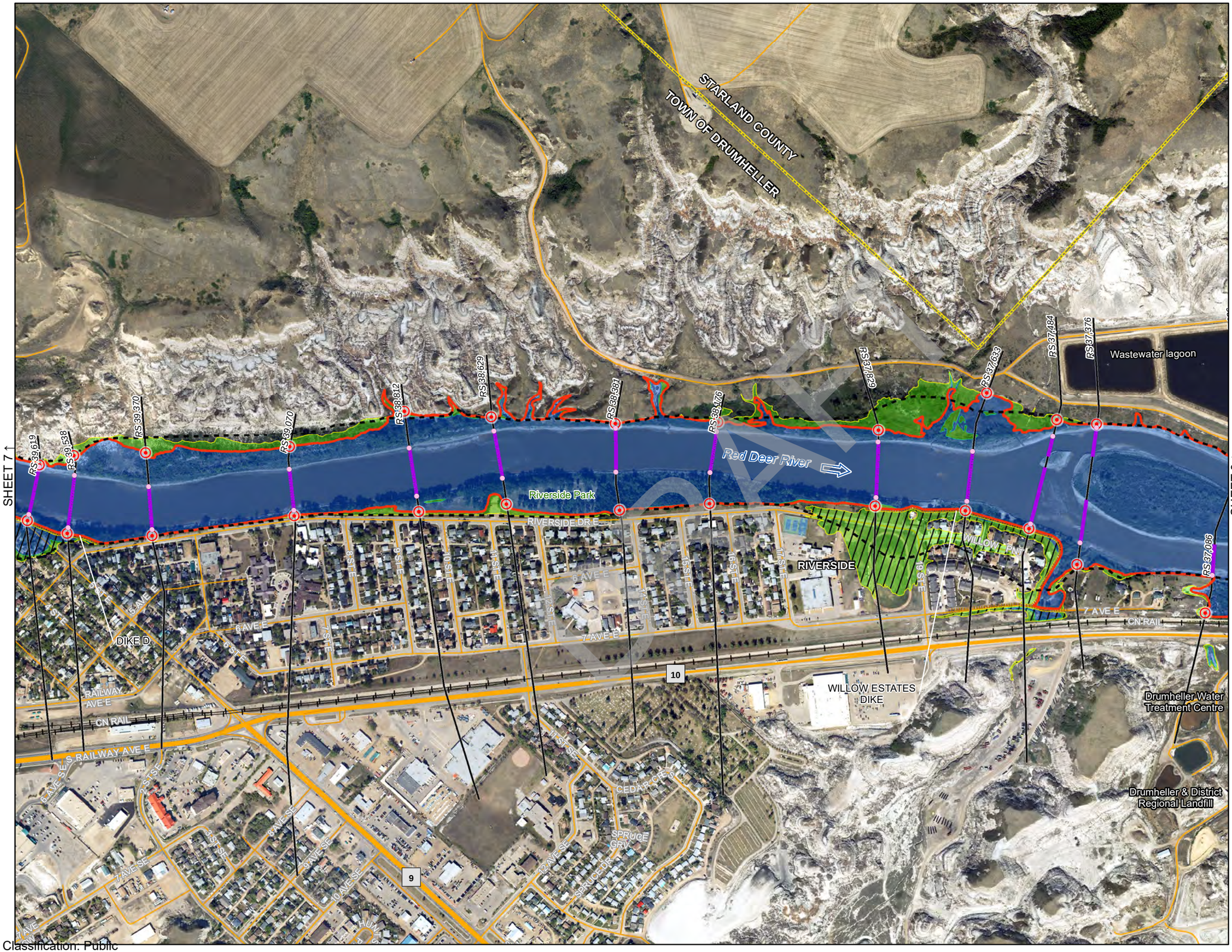
Job: 1003877 | *Date: 05-OCT-2022*

DRUMHELLER RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 7 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T500_FloodwayCriteria.mxd



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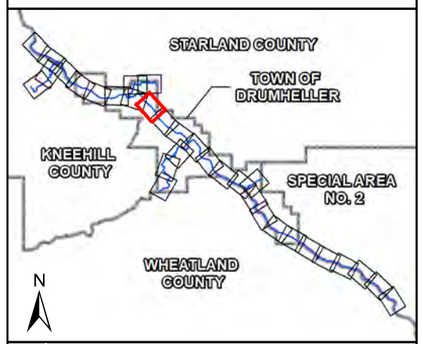

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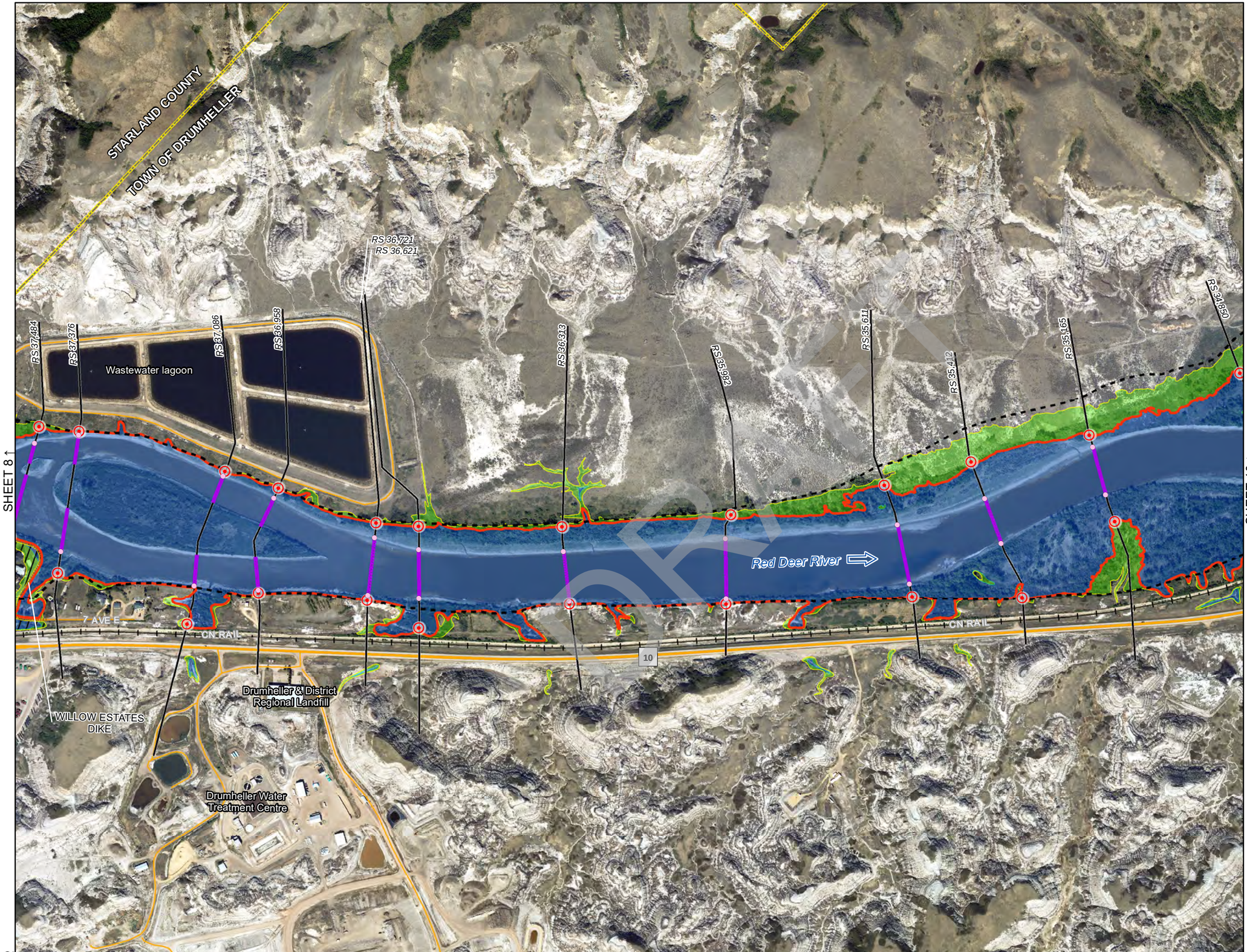
DRUMHELLER RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 8 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T500_FloodwayCriteria.mxd



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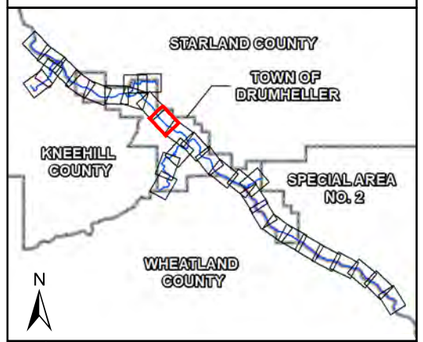

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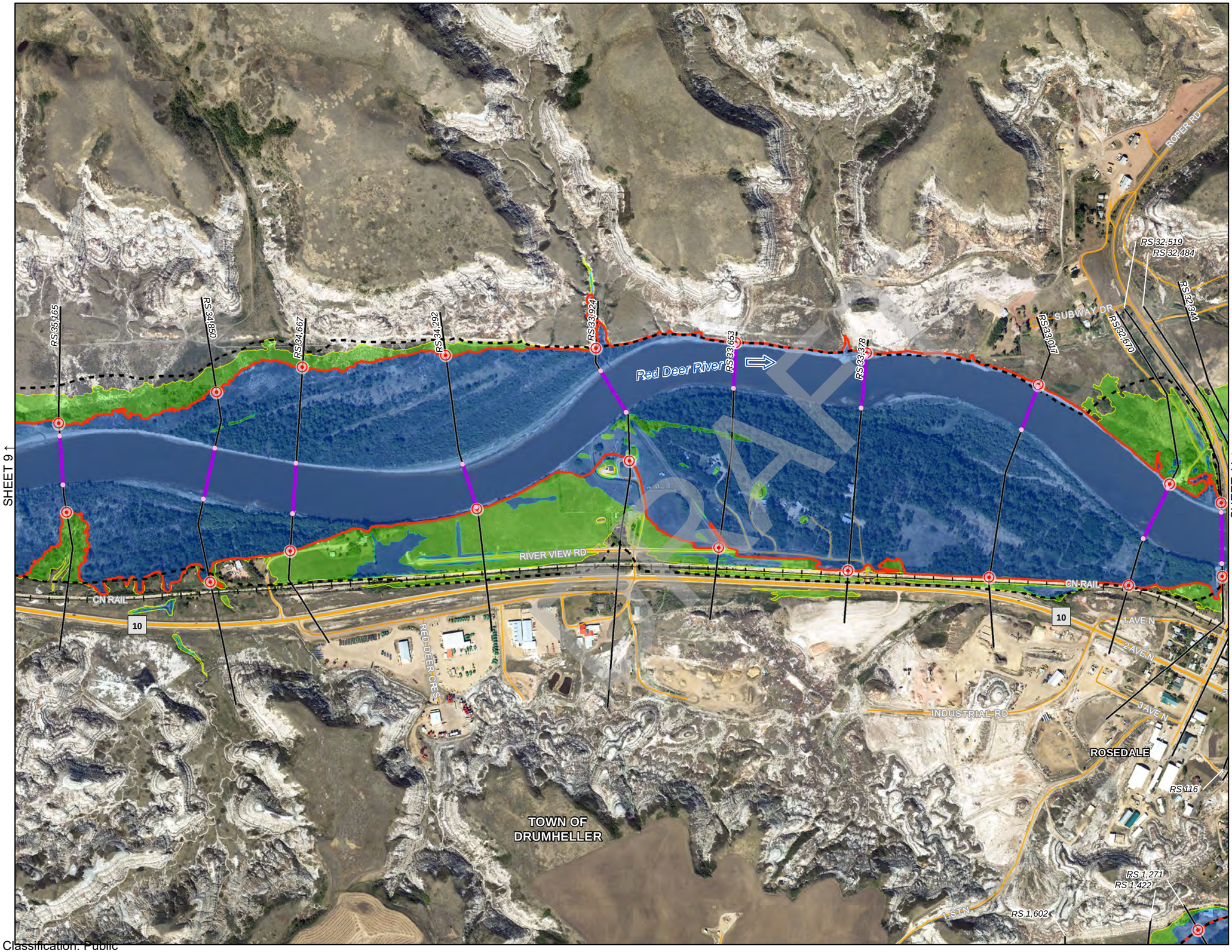
DRUMHELLER RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 9 OF 32



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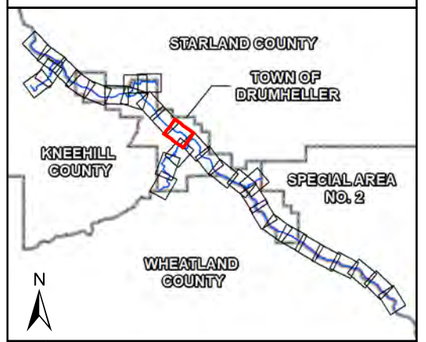

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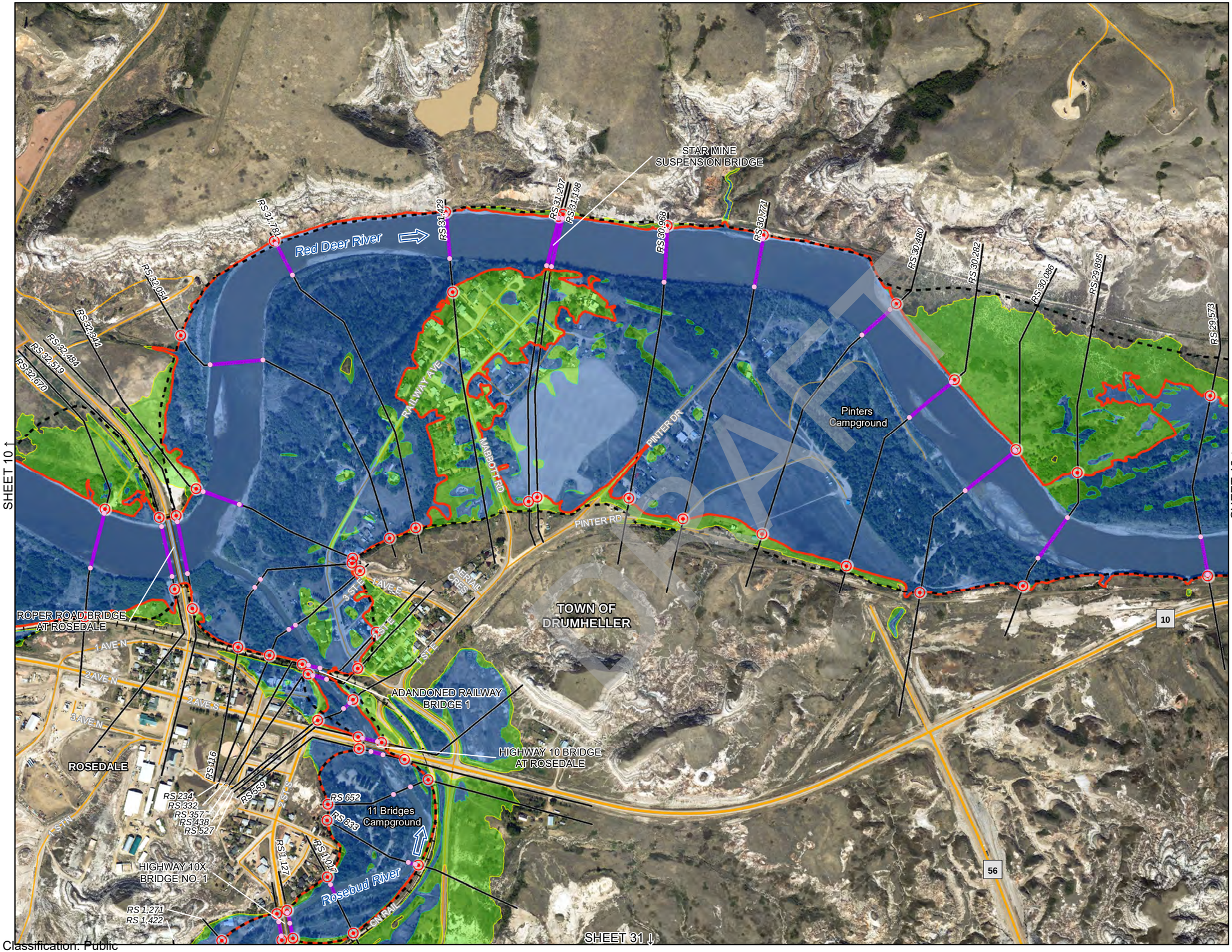
DRUMHELLER RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 10 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T500_FloodwayCriteria.mxd



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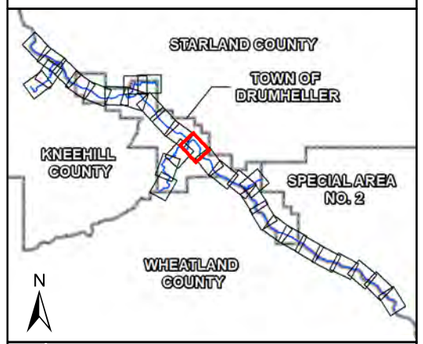

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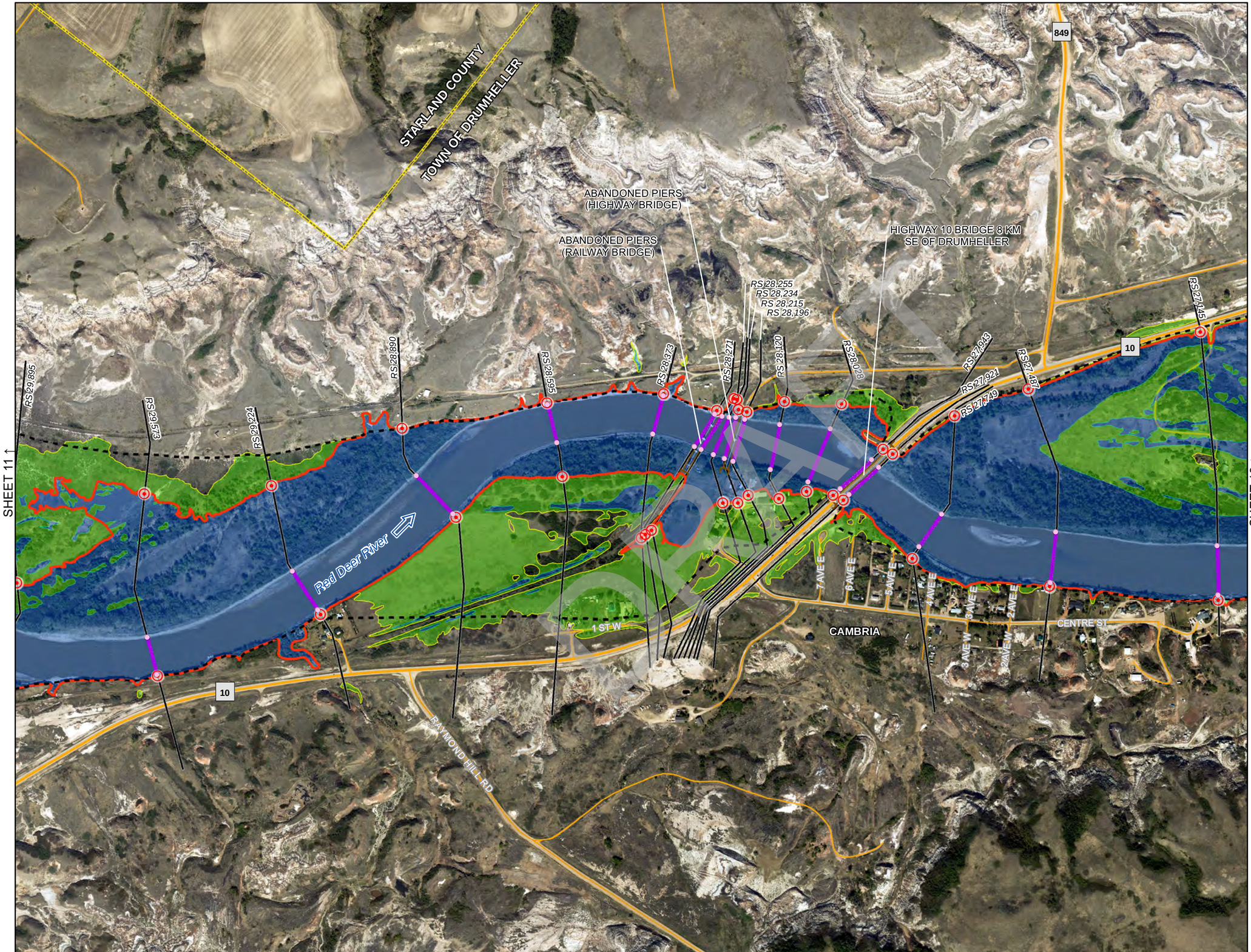
DRUMHELLER RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 11 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T500_FloodwayCriteria.mxd



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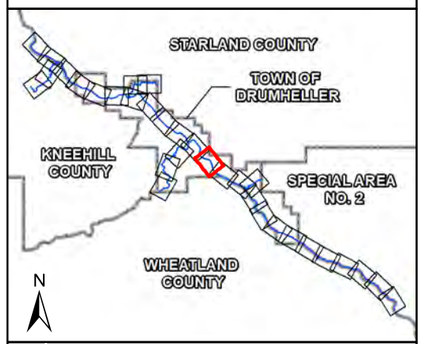

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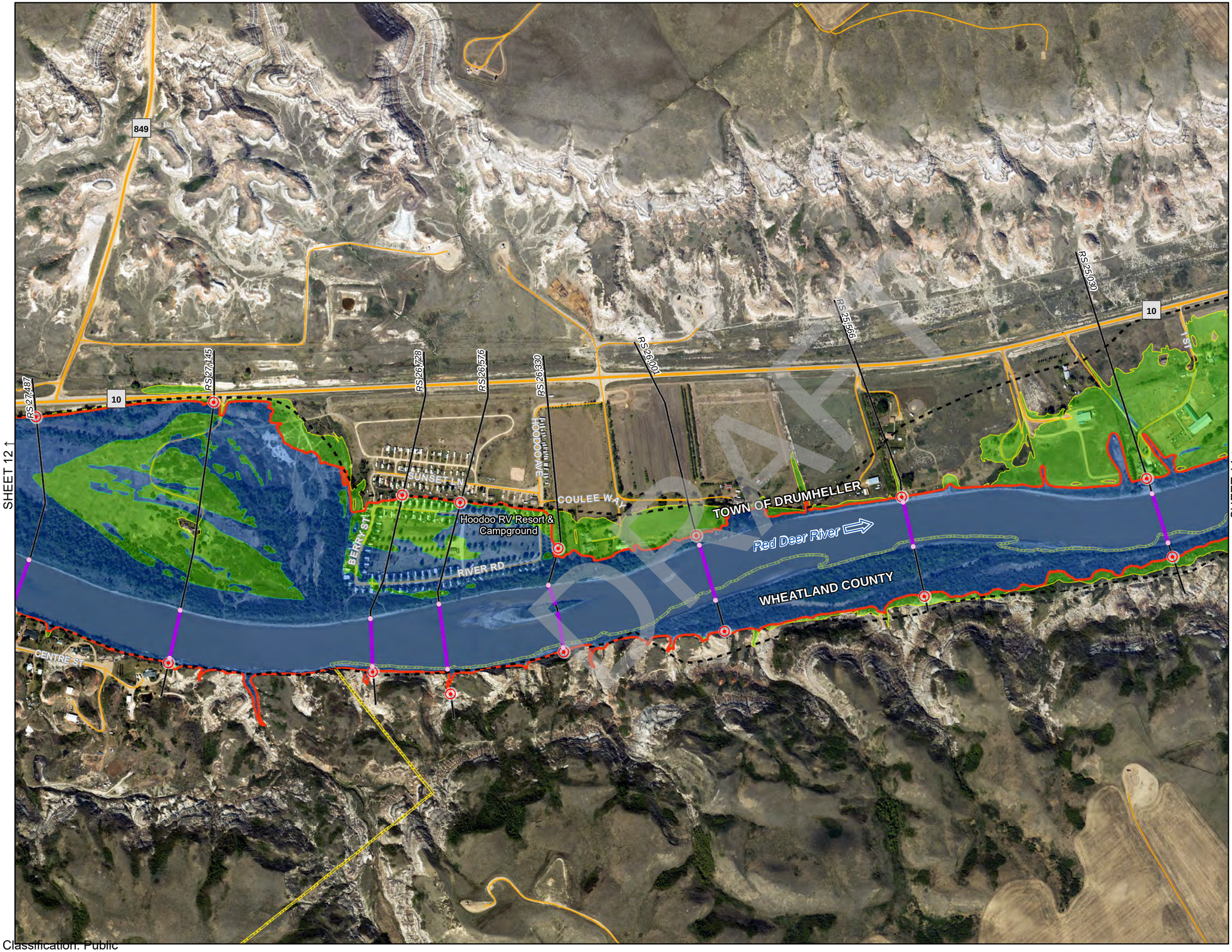
Job: 1003877 | Date: 05-OCT-2022

DRUMHELLER RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 12 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T500_FloodwayCriteria.mxd



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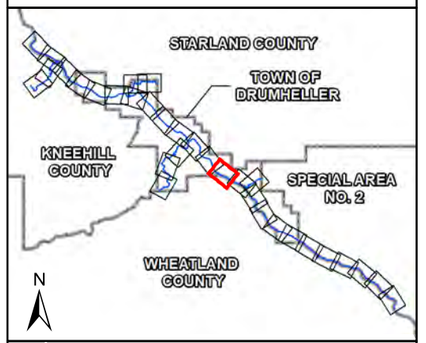

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DRUMHELLER
RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 13 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T500_FloodwayCriteria.mxd

SHEET 32 ↑

SHEET 13 ↑

SHEET 15 ↓

HIGHWAY 10 BRIDGE
10.5 KM NW OF EAST COULEE

Willow Creek

Hoodoos Trail

Red Deer River

TOWN OF DRUMHELLER

WHEATLAND COUNTY

RS 1,596
RS 1,356
RS 1,007
RS 23,316
RS 23,586
RS 24,051
RS 24,611
RS 25,030
RS 863
RS 848
RS 22,842

573
10
10
1 St

DRAFT

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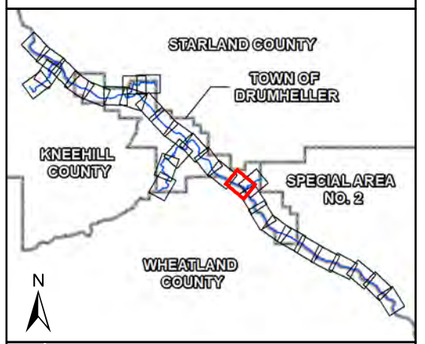

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Vertical Datum: CGVD28 HTv2.0; Units: Metres

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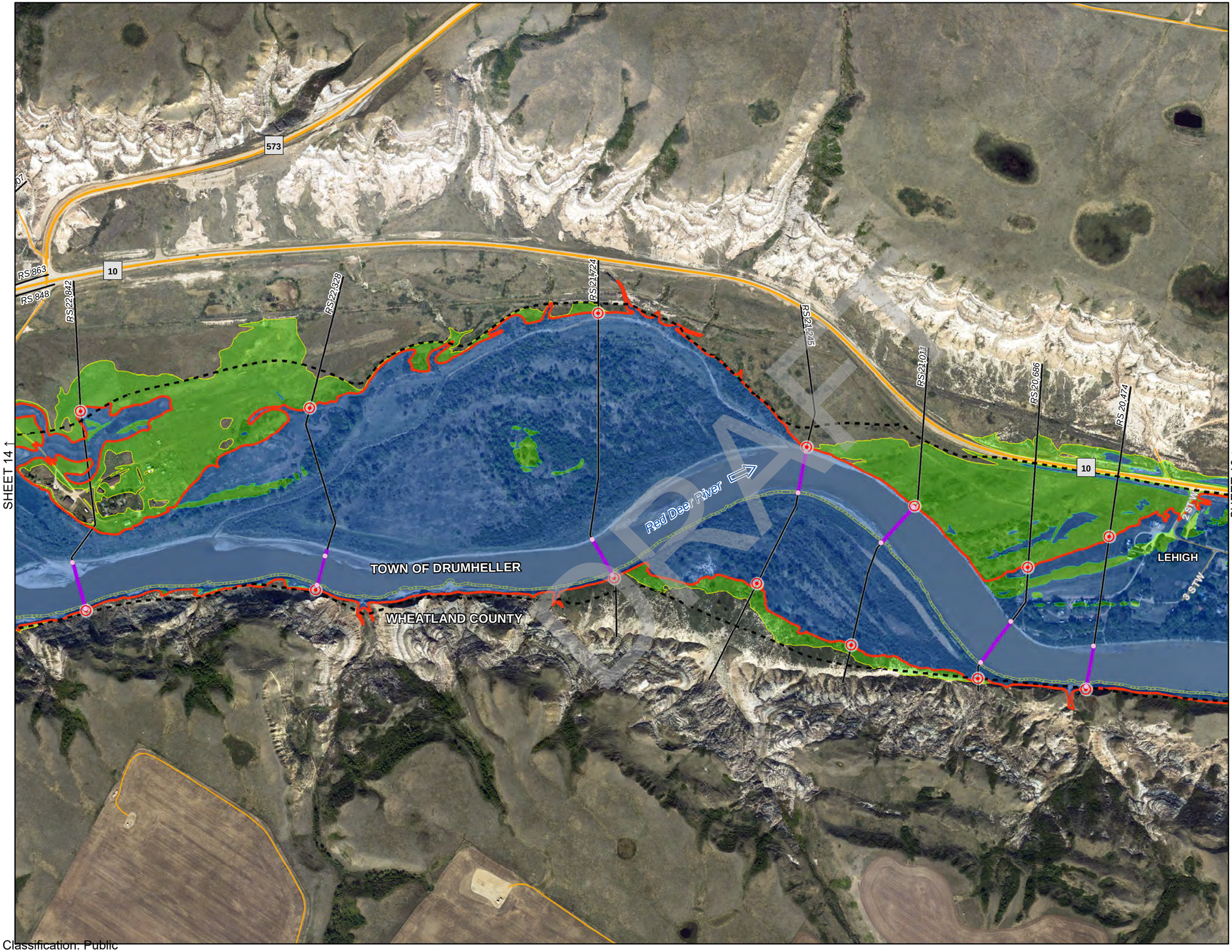
Job: 1003877 | Date: 05-OCT-2022

DRUMHELLER RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 14 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T500_FloodwayCriteria.mxd



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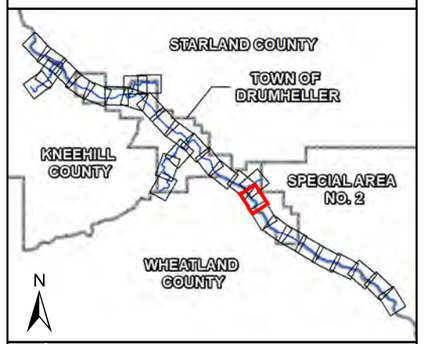

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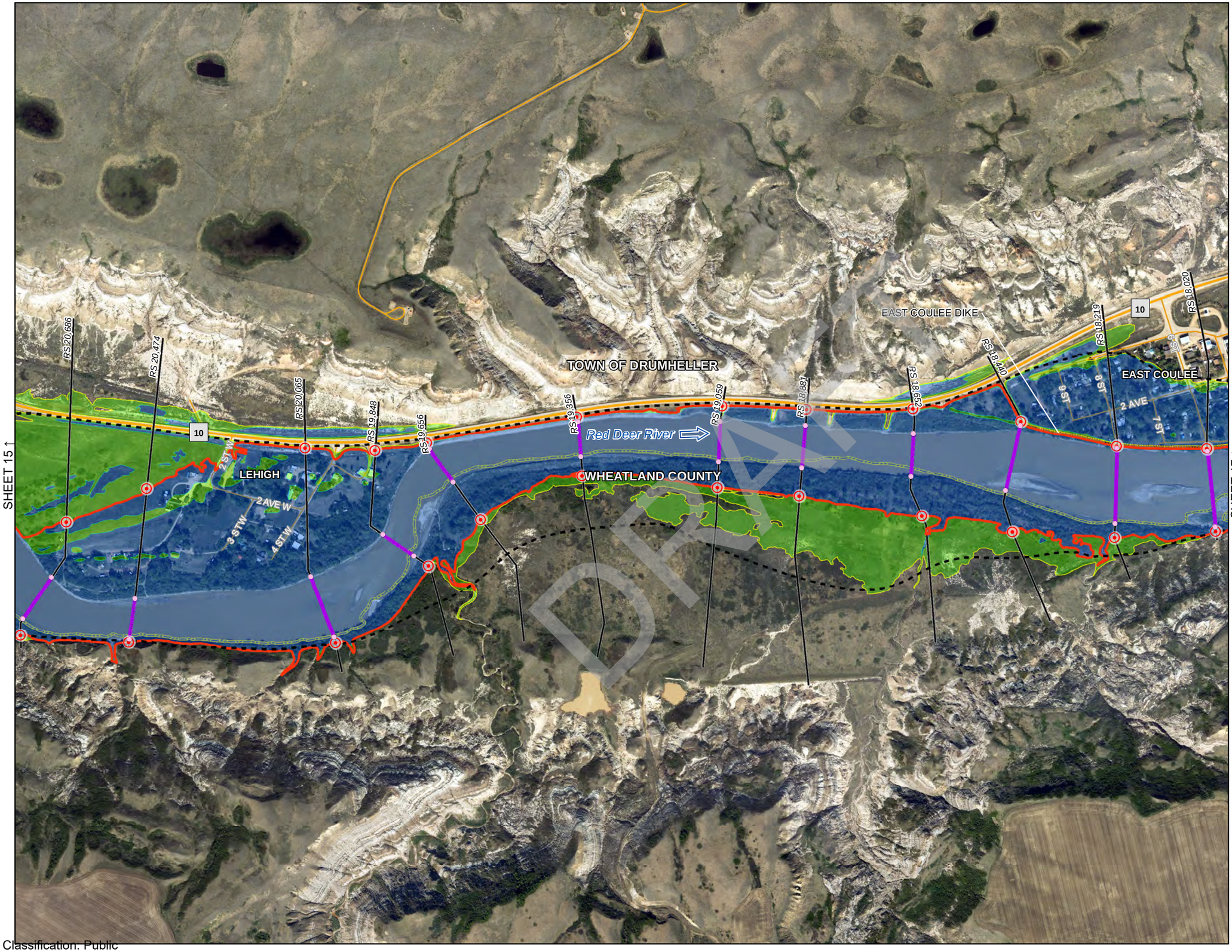
DRUMHELLER RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 15 OF 32

J:\MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T500_FloodwayCriteria.mxd



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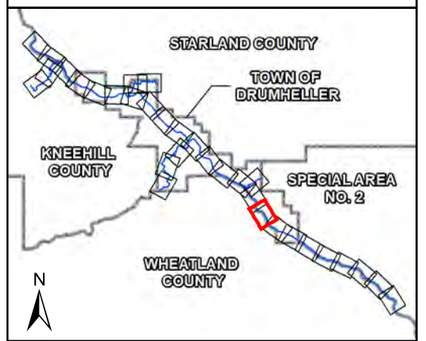

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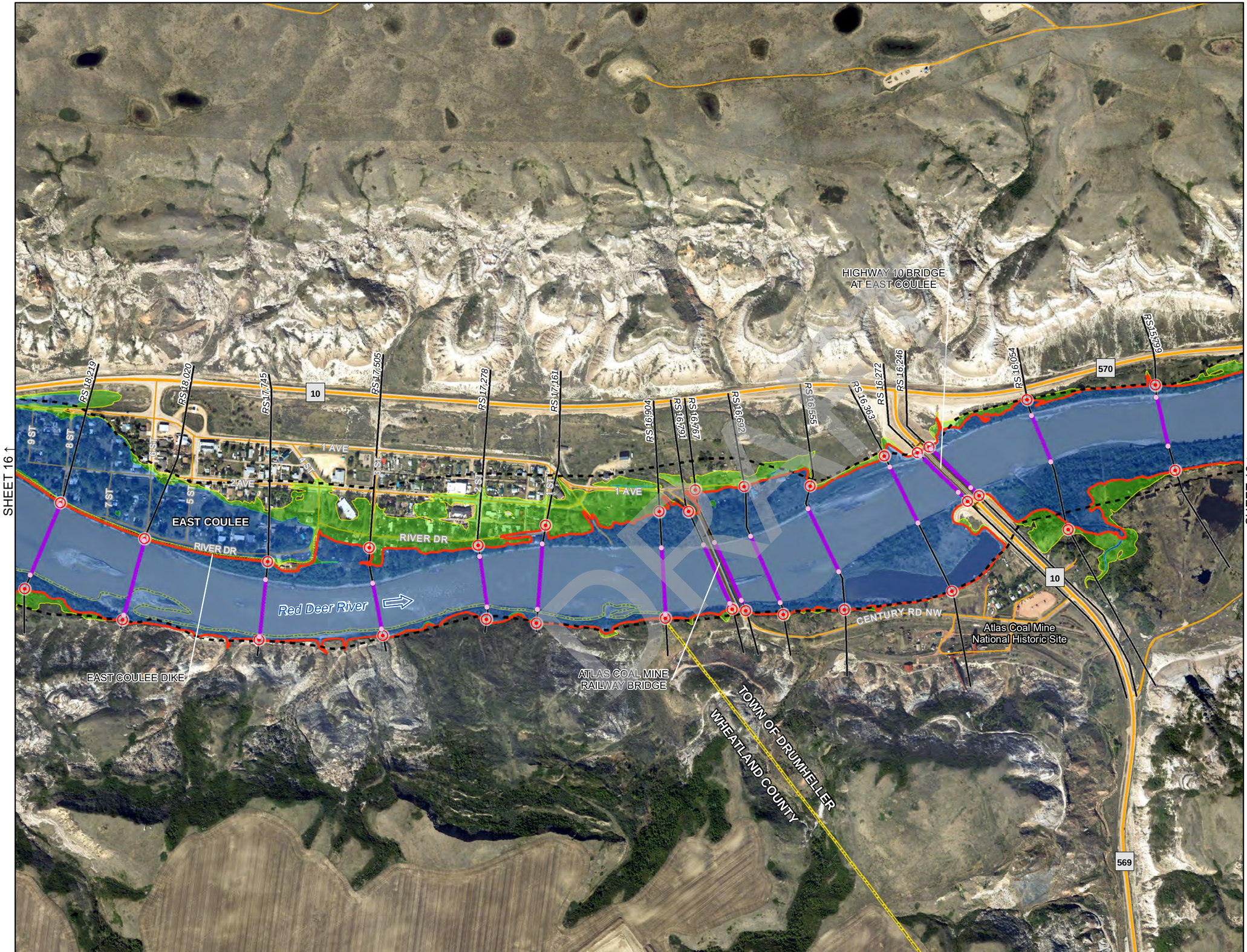
DRUMHELLER RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 16 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T500_FloodwayCriteria.mxd



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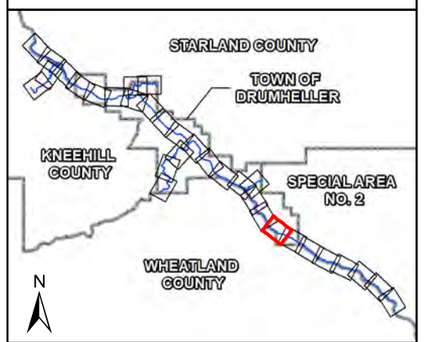

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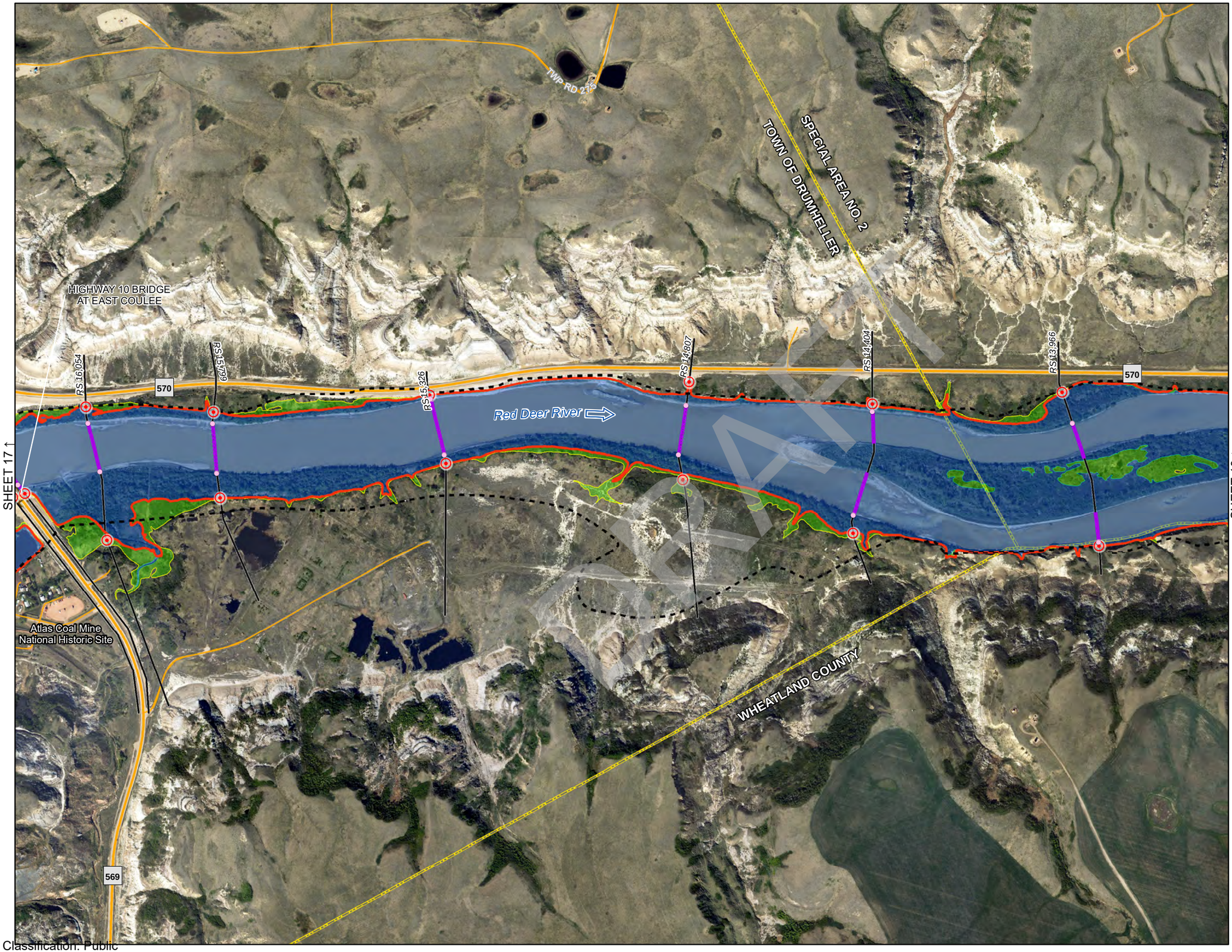
DRUMHELLER RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 17 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T500_FloodwayCriteria.mxd



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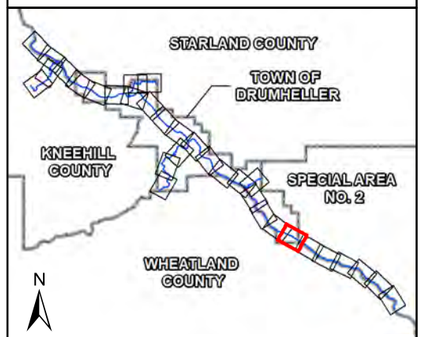

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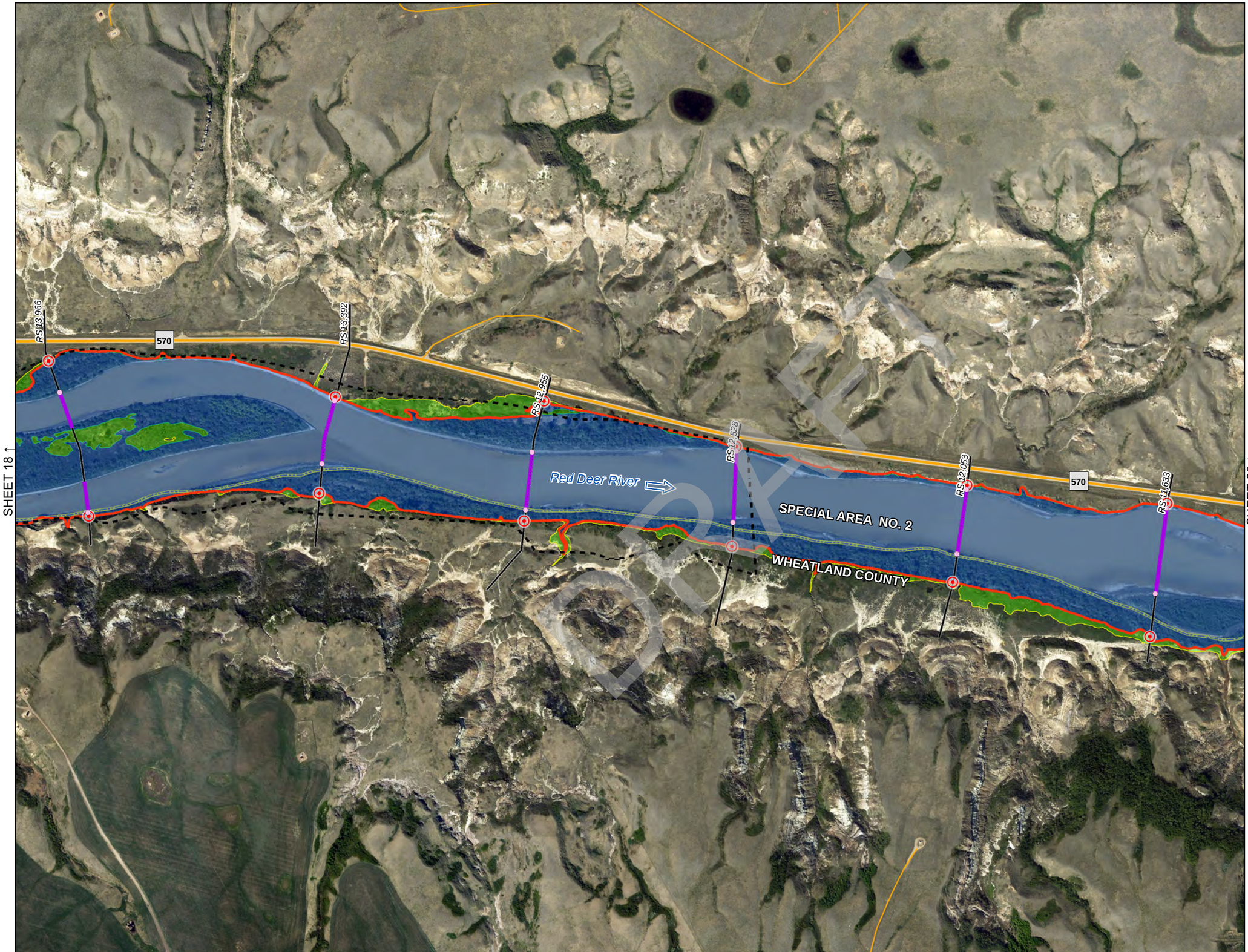
DRUMHELLER RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 18 OF 32



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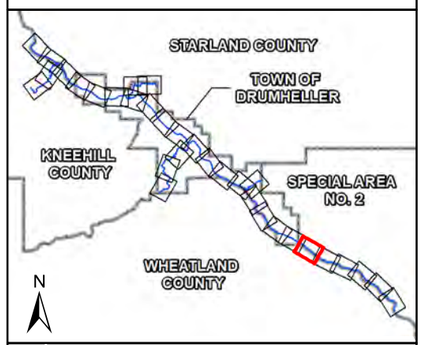

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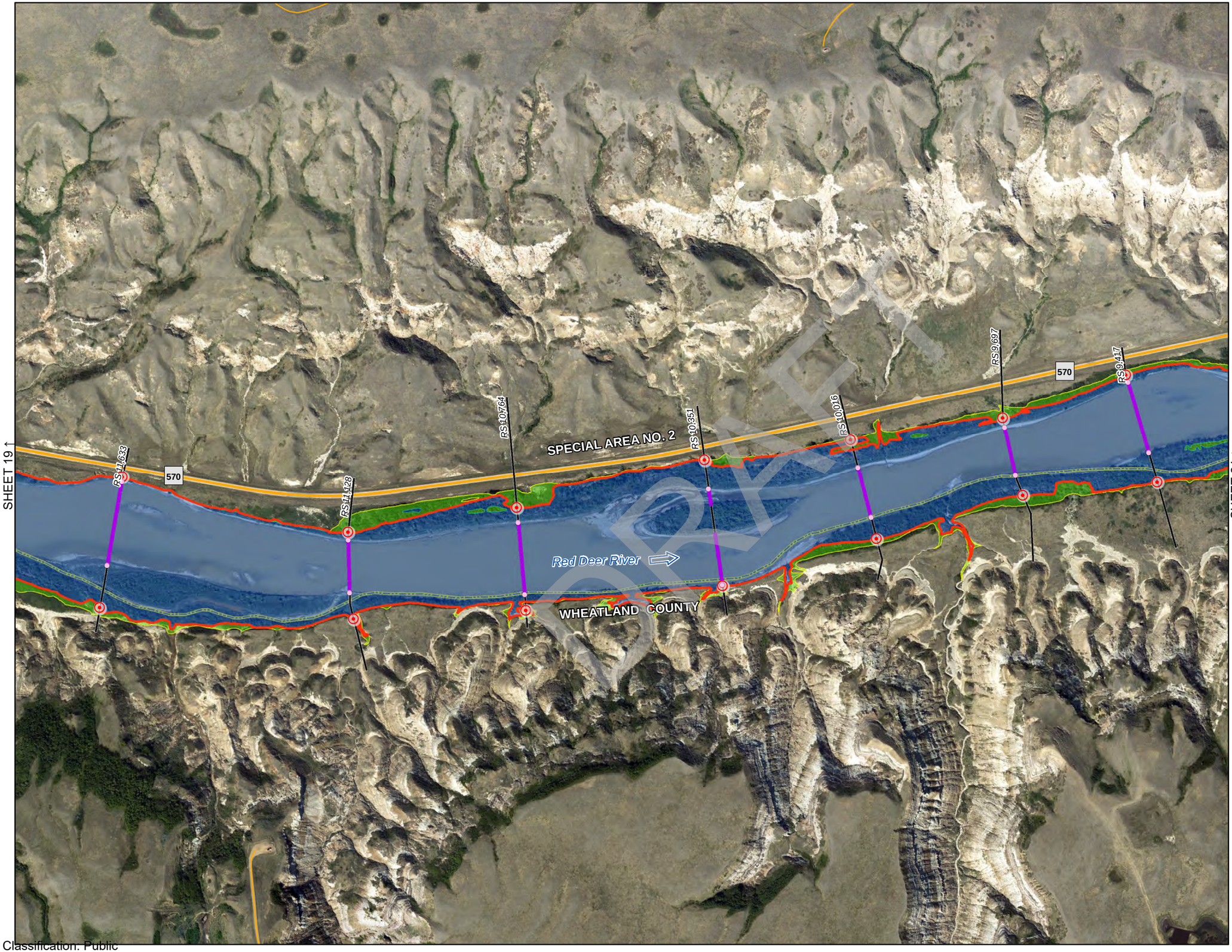
DRUMHELLER RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 19 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T500_FloodwayCriteria.mxd



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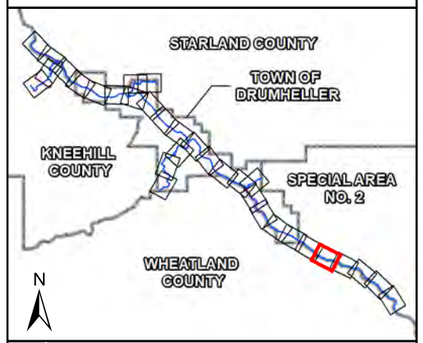


- FLOW DIRECTION
- STUDY LIMIT
- BANK STATION
- PROPOSED FLOODWAY LIMIT
- PREVIOUS FLOODWAY
- PROPOSED FLOODWAY BOUNDARY
- BRIDGE
- CULVERT
- VELOCITY ≥ 1 m/s
- MODEL CROSS SECTION
- FLOOD CONTROL STRUCTURE
- 1m DEPTH CONTOUR
- DEPTH ≥ 1 m
- 100-YEAR OPEN WATER DESIGN FLOOD EXTENT
- PROTECTED FLOOD
- MAJOR ROAD
- LOCAL ROAD
- RAILWAY (ABANDONED)
- MUNICIPAL BOUNDARY

SCALE - 1:7,500

0 50 100 200 300 M

Coordinate System: NAD 1983 CSRS 3TM 114; Vertical Datum: CGVD28 HTv2.0; Units: Metres

Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

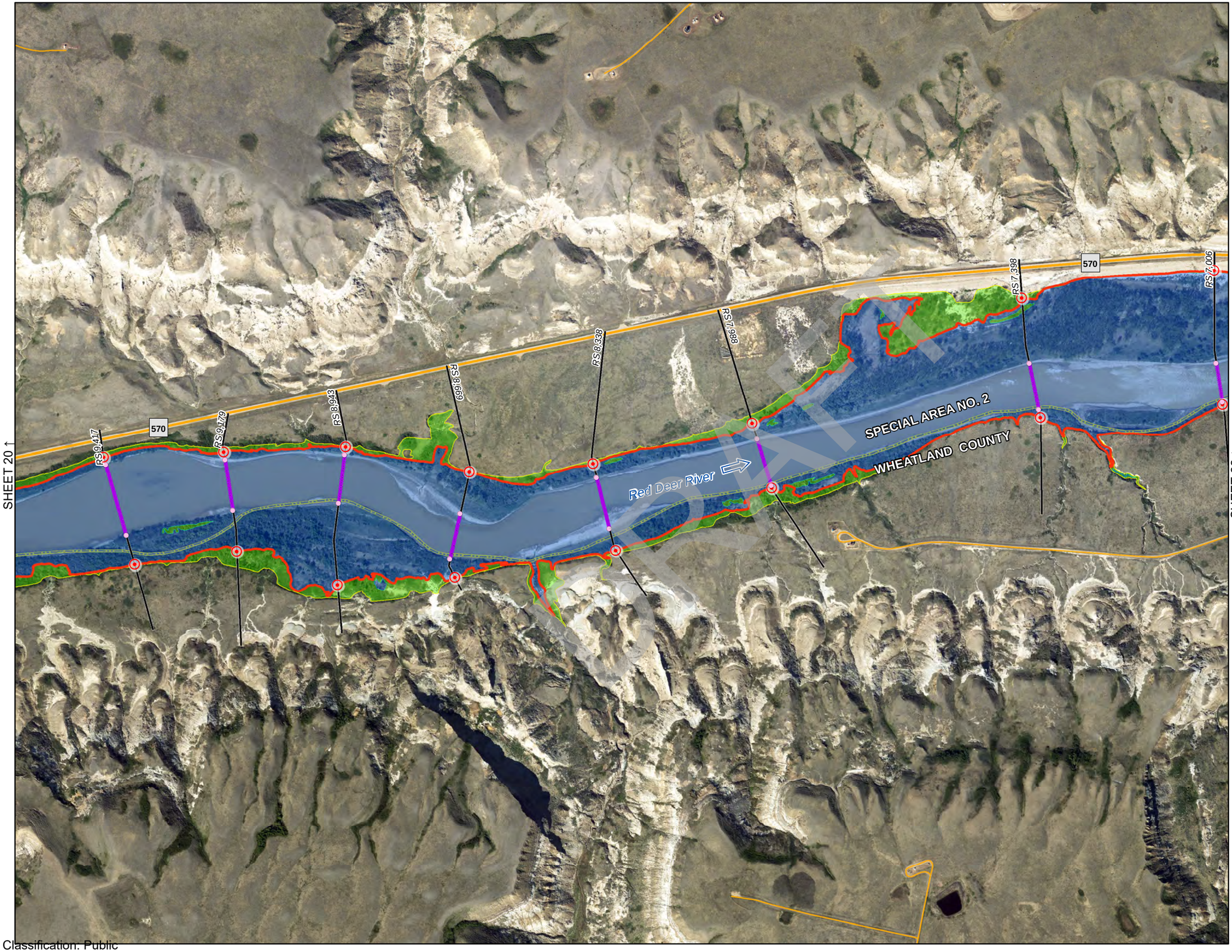
Job: 1003877 | *Date: 05-OCT-2022*

DRUMHELLER RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 20 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T500_FloodwayCriteria.mxd



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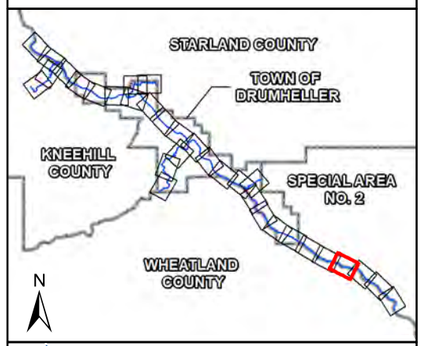

- FLOW DIRECTION
- STUDY LIMIT
- BANK STATION
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- PREVIOUS FLOODWAY
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- MUNICIPAL BOUNDARY

SCALE - 1:7,500

0 50 100 200 300 M

Coordinate System: NAD 1983 CSRS 3TM 114;
Vertical Datum: CGVD28 HTv2.0; Units: Metres

Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

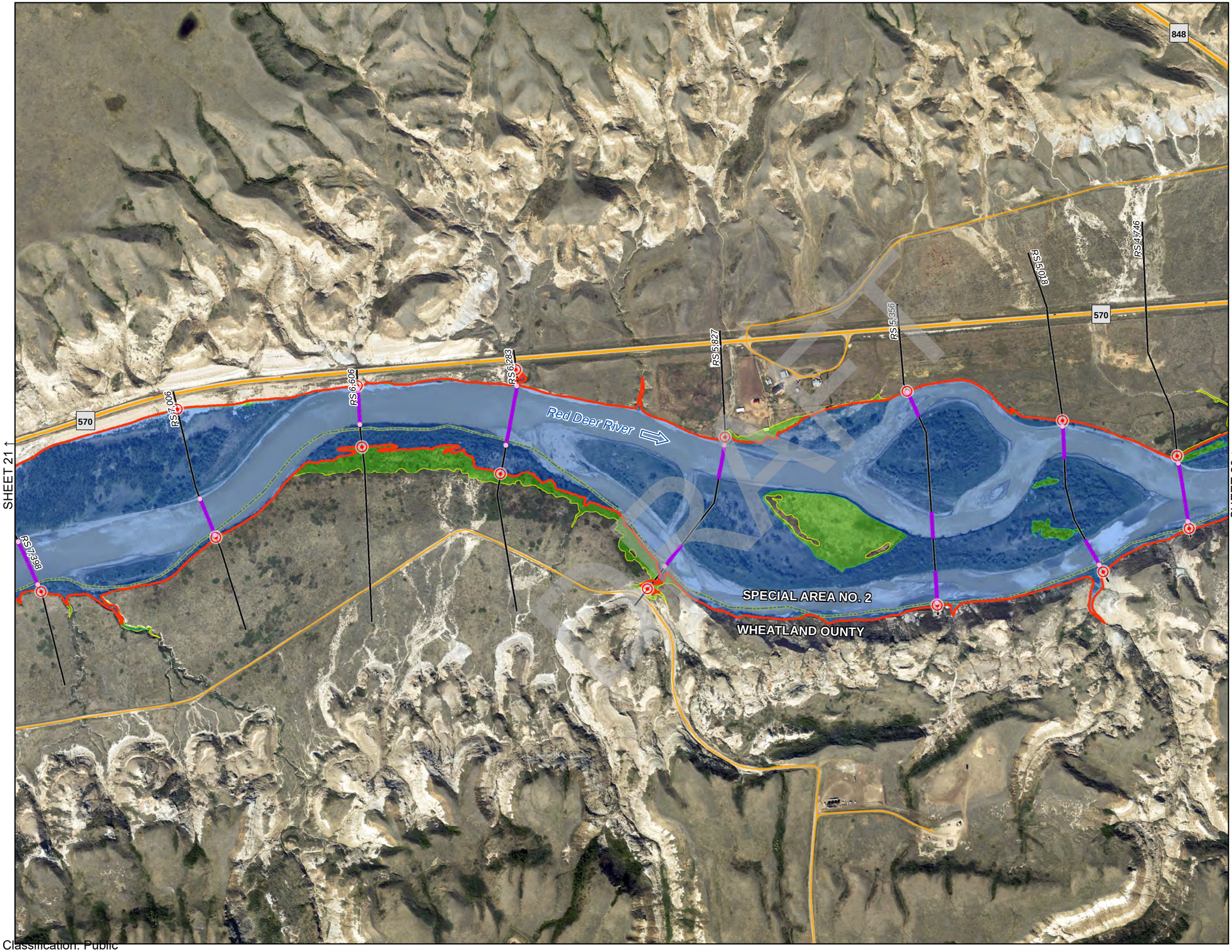
Job: 1003877 | *Date: 05-OCT-2022*

DRUMHELLER
RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 21 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T500_FloodwayCriteria.mxd



- FLOW DIRECTION
- STUDY LIMIT
- BANK STATION
- PROPOSED FLOODWAY LIMIT
- PREVIOUS FLOODWAY
- PROPOSED FLOODWAY BOUNDARY
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- CULVERT
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SCALE - 1:7,500

0 50 100 200 300 M

Coordinate System: NAD 1983 CSRS 3TM 114;
Vertical Datum: CGVD28 HTv2.0; Units: Metres

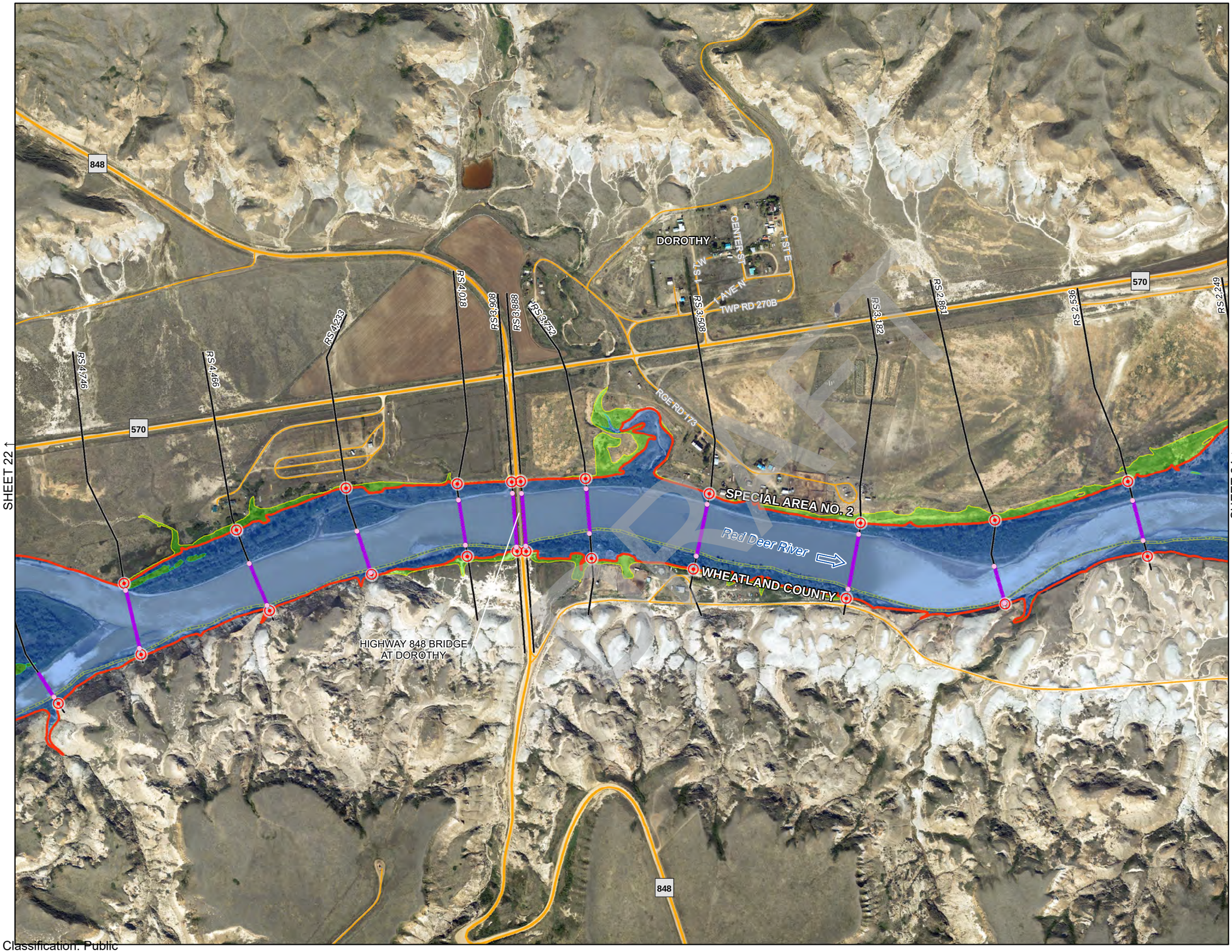
Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

Job: 1003877 | *Date: 05-OCT-2022*

DRUMHELLER
RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 22 OF 32



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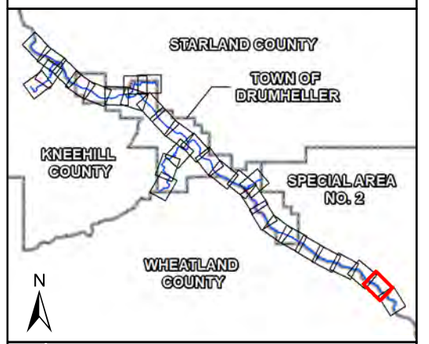

- FLOW DIRECTION
- STUDY LIMIT
- BANK STATION
- PROPOSED FLOODWAY LIMIT
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SCALE - 1:7,500

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Coordinate System: NAD 1983 CSRS 3TM 114;
Vertical Datum: CGVD28 HTv2.0; Units: Metres

Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

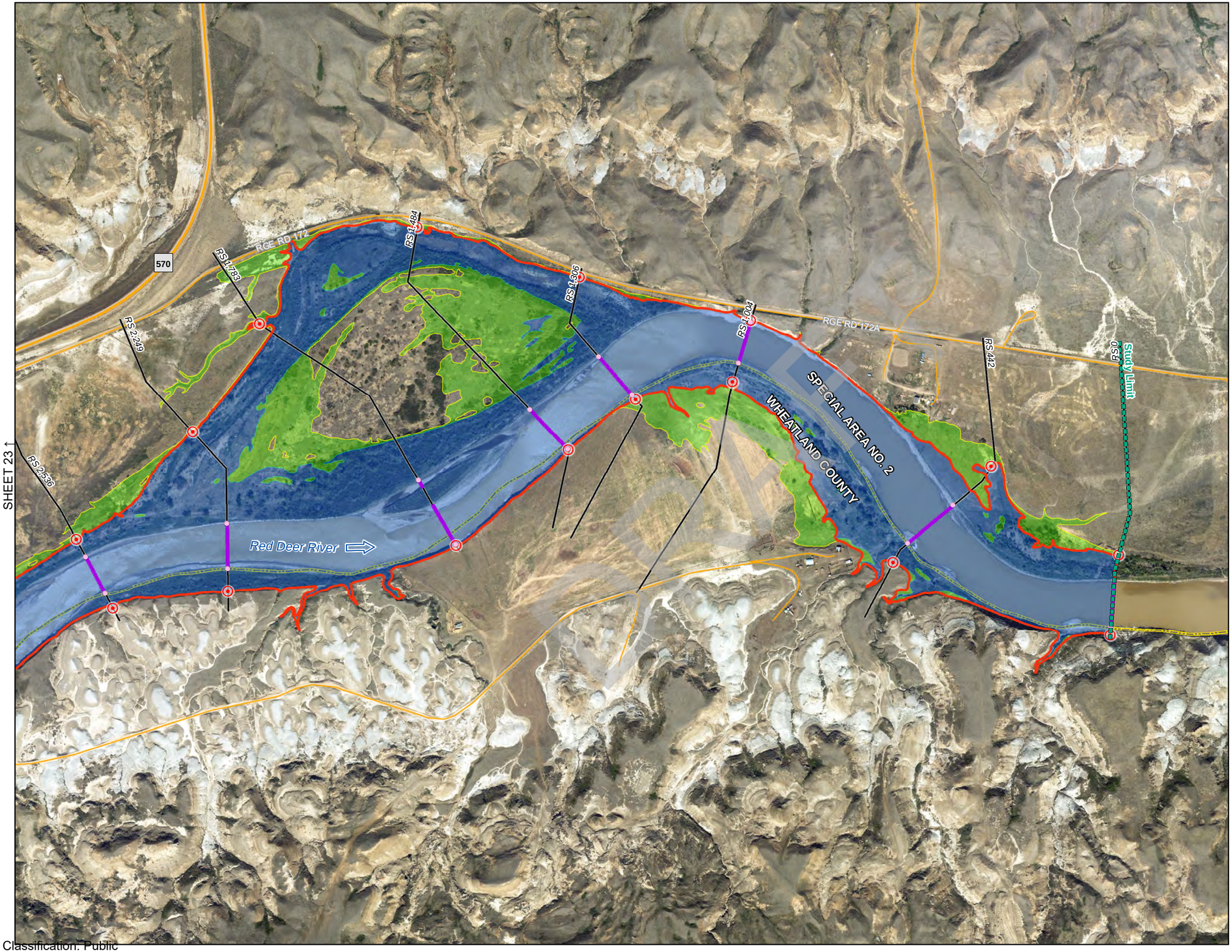
Job: 1003877 | *Date: 05-OCT-2022*

DRUMHELLER
RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 23 OF 32

J:\Y\MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T500_FloodwayCriteria.mxd



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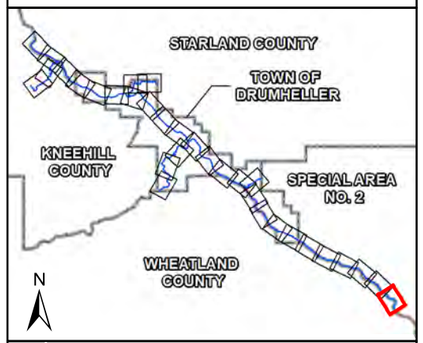

- FLOW DIRECTION
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Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

Job: 1003877 | *Date: 05-OCT-2022*

DRUMHELLER RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 24 OF 32

J:\Y\MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T500_FloodwayCriteria.mxd

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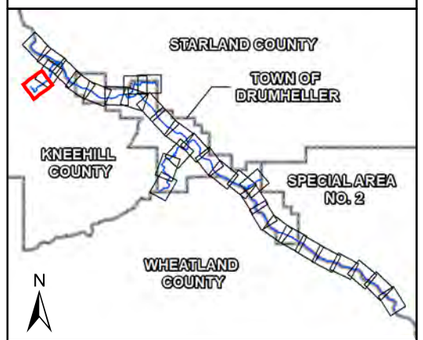

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SCALE - 1:7,500

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Coordinate System: NAD 1983 CSRS 3TM 114; Vertical Datum: CGVD28 HTv2.0; Units: Metres

Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

Job: 1003877 | *Date: 05-OCT-2022*

DRUMHELLER RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 25 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T500_FloodwayCriteria.mxd

SHEET 25 ←

SHEET 2 →

DUNPHY

KNEEHILL COUNTY

HIGHWAY 575 BRIDGE NEAR NACMINE

RANGE ROAD 211A BRIDGE

Kneehills Creek

RGE RD 211A

S DINOSAUR TRL

575

RS 52,682
RS 52,364
RS 51,970
RS 51,563
RS 51,326
RS 51,089
RS 50,765
RS 50,457
RS 5,554
RS 5,435
RS 5,300
RS 5,175
RS 5,073
RS 4,972
RS 4,844
RS 4,690
RS 4,513
RS 4,413
RS 4,326
RS 4,192
RS 4,053
RS 3,966
RS 3,833
RS 3,738
RS 3,549
RS 3,397
RS 3,272
RS 3,126
RS 3,023
RS 3,011
RS 2,915
RS 2,865
RS 2,517
RS 2,242
RS 2,139
RS 2,049
RS 1,915
RS 1,794
RS 1,669
RS 1,600
RS 1,554
RS 1,532
RS 1,375
RS 1,237
RS 1,007
RS 827
RS 583
RS 416

KIRKPATRICK

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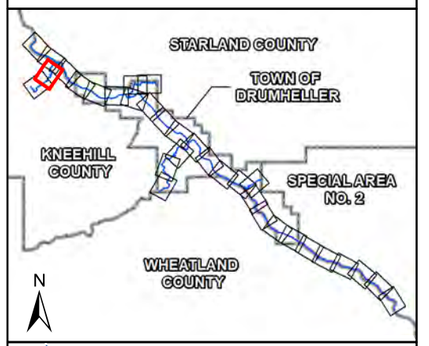

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SCALE - 1:7,500

0 50 100 200 300 M

Coordinate System: NAD 1983 CSRS 3TM 114;
Vertical Datum: CGVD28 HTv2.0; Units: Metres

Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

Job: 1003877 | *Date: 05-OCT-2022*

DRUMHELLER RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 26 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T500_FloodwayCriteria.mxd

Classification: Public

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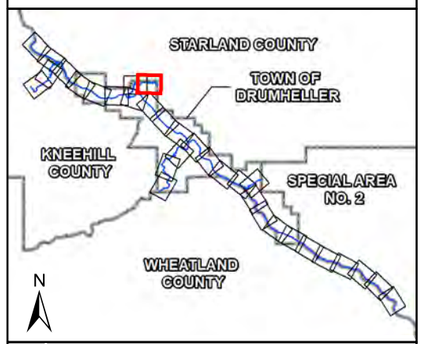

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SCALE - 1:7,500

0 50 100 200 300 M

N

Coordinate System: NAD 1983 CSRS 3TM 114;
Vertical Datum: CGVD28 HTv2.0; Units: Metres

Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

Job: 1003877 | Date: 05-OCT-2022

DRUMHELLER RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 27 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_1500_FloodwayCriteria.mxd

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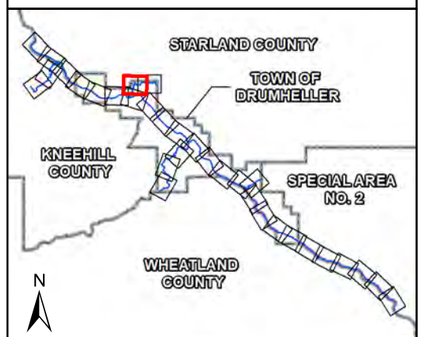

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SCALE - 1:7,500

0 50 100 200 300 M

N

Coordinate System: NAD 1983 CSRS 3TM 114;
Vertical Datum: CGVD28 HTv2.0; Units: Metres

Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

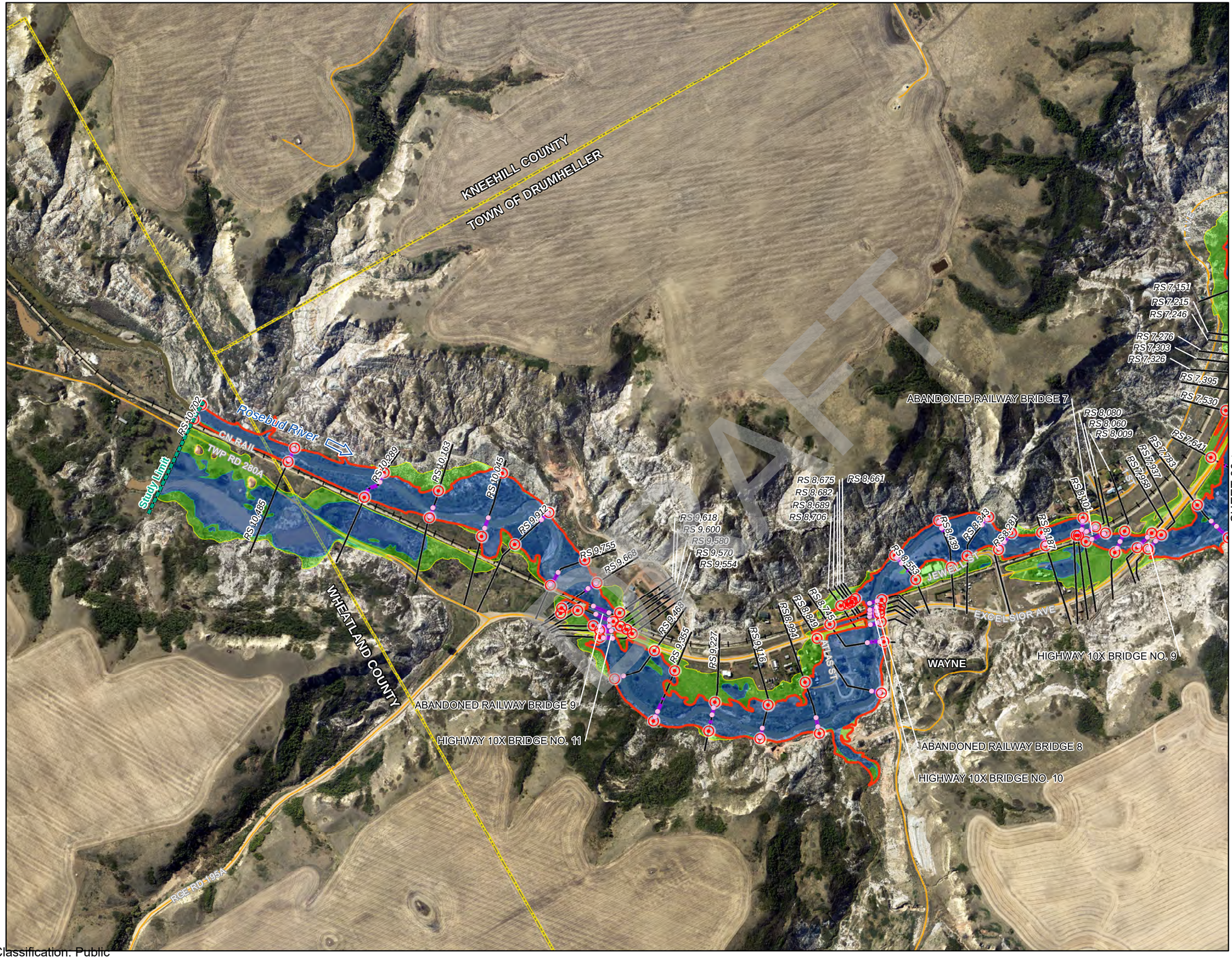
Job: 1003877	Date: 05-OCT-2022

DRUMHELLER RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 28 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T500_FloodwayCriteria.mxd



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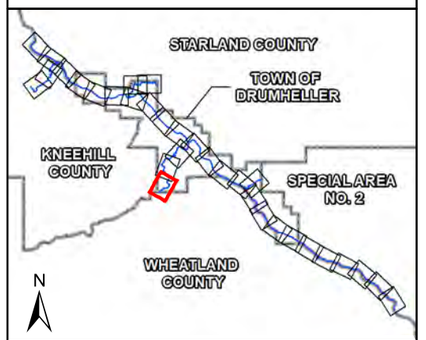

- FLOW DIRECTION
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- PROPOSED FLOODWAY BOUNDARY
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Coordinate System: NAD 1983 CSRS 3TM 114;
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Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

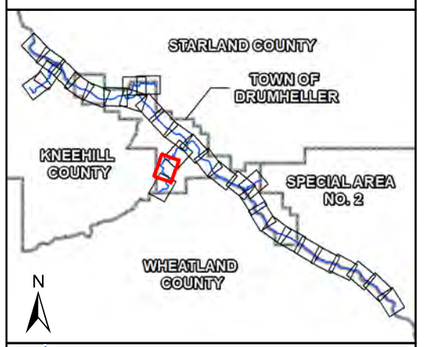
Job: 1003877 | Date: 05-OCT-2022

DRUMHELLER RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 29 OF 32

KNEEHILL COUNTY
TOWN OF DRUMHELLER
HIGHWAY 10X BRIDGE NO. 6
HIGHWAY 10X BRIDGE NO.5
HIGHWAY 10X BRIDGE NO. 4
HIGHWAY 10X BRIDGE NO. 3
HIGHWAY 10X BRIDGE NO. 7
ABANDONED RAILWAY BRIDGE 5
ABANDONED RAILWAY BRIDGE 4
ABANDONED RAILWAY BRIDGE 6
ABANDONED RAILWAY BRIDGE 3
HIGHWAY 10X BRIDGE NO. 8
HIGHWAY 10X BRIDGE NO. 9
ABANDONED RAILWAY BRIDGE 7
WAYNE
Rosebud River
CN RAIL
EXCELSIOR AVE
10X
RS 5,872
RS 5,879
RS 5,886
RS 5,904
RS 5,776
RS 5,951
RS 5,669
RS 5,616
RS 5,517
RS 5,473
RS 5,378
RS 5,288
RS 5,199
RS 5,065
RS 4,997
RS 4,980
RS 4,907
RS 4,771
RS 4,599
RS 4,530
RS 4,509
RS 4,501
RS 4,480
RS 4,409
RS 4,313
RS 4,153
RS 4,037
RS 6,419
RS 6,450
RS 6,469
RS 6,382
RS 6,361
RS 6,278
RS 6,166
RS 5,969
RS 6,532
RS 6,641
RS 6,774
RS 6,913
RS 7,151
RS 7,246
RS 7,276
RS 7,303
RS 7,326
RS 7,395
RS 7,530
RS 7,641
RS 7,789
RS 7,937
RS 7,958
RS 8,009
RS 8,060
RS 8,080
RS 8,101
RS 8,187
SHEET 29 →
← SHEET 31
DRAFT



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SCALE - 1:7,500

0 50 100 200 300 M

Coordinate System: NAD 1983 CSRS 3TM 114;
Vertical Datum: CGVD28 HTv2.0; Units: Metres

Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

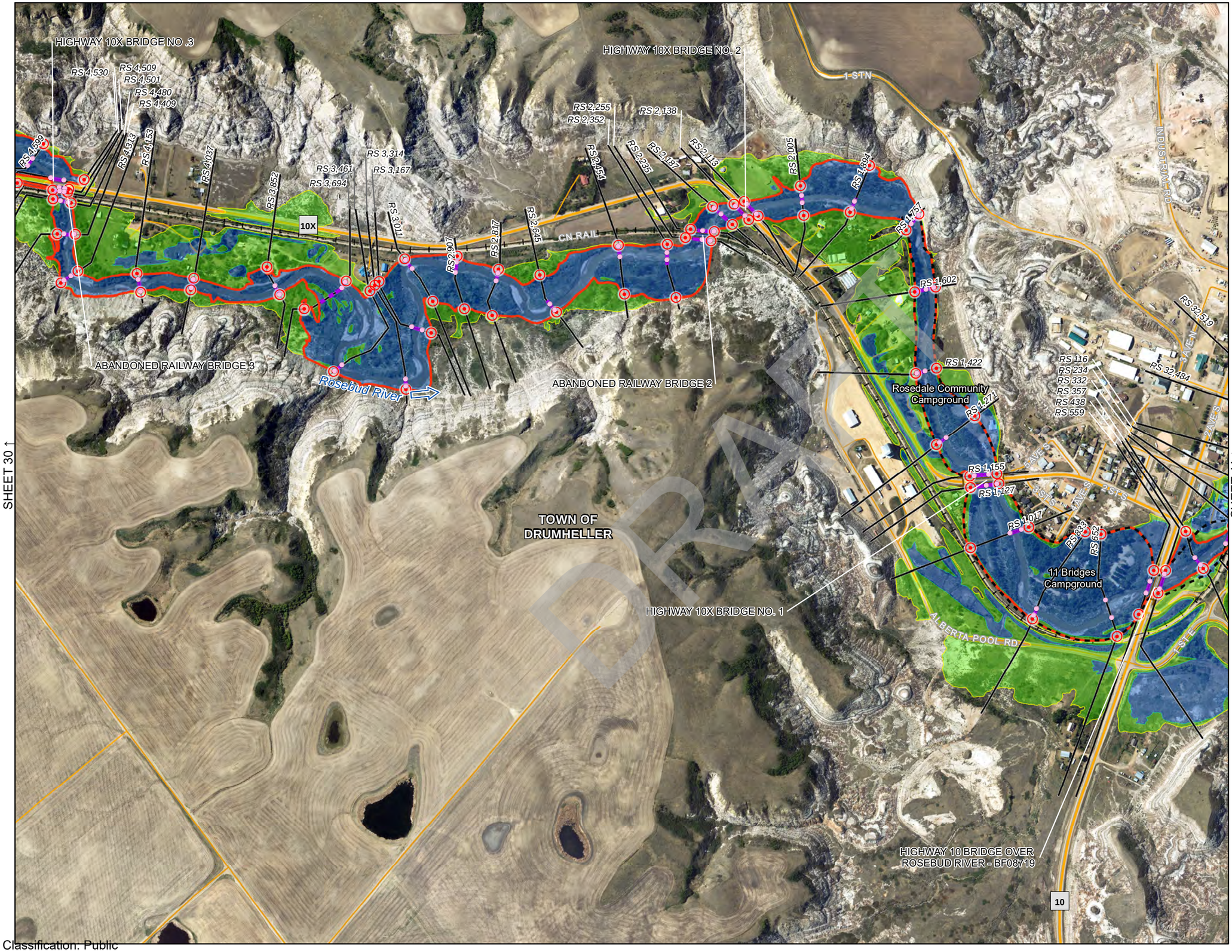
Job: 1003877 | Date: 05-OCT-2022

DRUMHELLER RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 30 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T500_FloodwayCriteria.mxd



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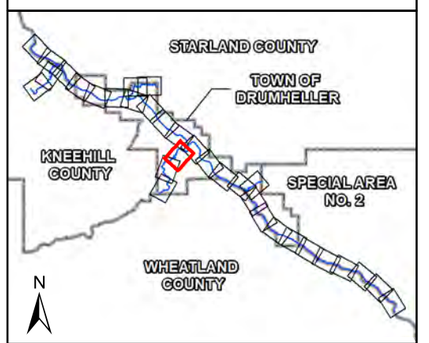

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Job: 1003877 | Date: 05-OCT-2022

DRUMHELLER RIVER HAZARD STUDY

FLOODWAY CRITERIA MAP

SHEET 31 OF 32

J:\Y\MSN_P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T500_FloodwayCriteria.mxd

SPECIAL AREA NO. 2

TOWN OF DRUMHELLER

Study Limit

RS 2,970

RS 2,723

RS 2,408

RS 2,174

RS 1,937

Willow Creek

RS 1,566

RS 1,356

RS 1,077

RS 848

RS 863

RS 22,842

RS 22,328

573

10

Red Deer River

SHEET 14 ↓

HIGHWAY 10 BRIDGE
10.5 KM NW OF EAST COULEE

RS 23,316

Hoodoos Trail

RS 23,586

10

DRAFT

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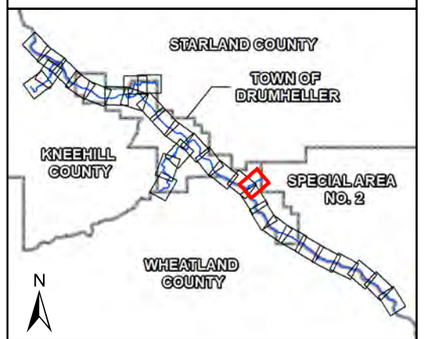

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- CULVERT
- VELOCITY ≥ 1 m/s
- MODEL CROSS SECTION
- FLOOD CONTROL STRUCTURE
- 1m DEPTH CONTOUR
- DEPTH ≥ 1 m
- 100-YEAR OPEN WATER DESIGN FLOOD EXTENT
- PROTECTED FLOOD
- MAJOR ROAD
- LOCAL ROAD
- RAILWAY (ABANDONED)
- MUNICIPAL BOUNDARY

SCALE - 1:7,500

0 50 100 200 300 M

Coordinate System: NAD 1983 CSRS 3TM 114;
Vertical Datum: CGVD28 HTv2.0; Units: Metres

Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

Job: 1003877 | *Date: 05-OCT-2022*

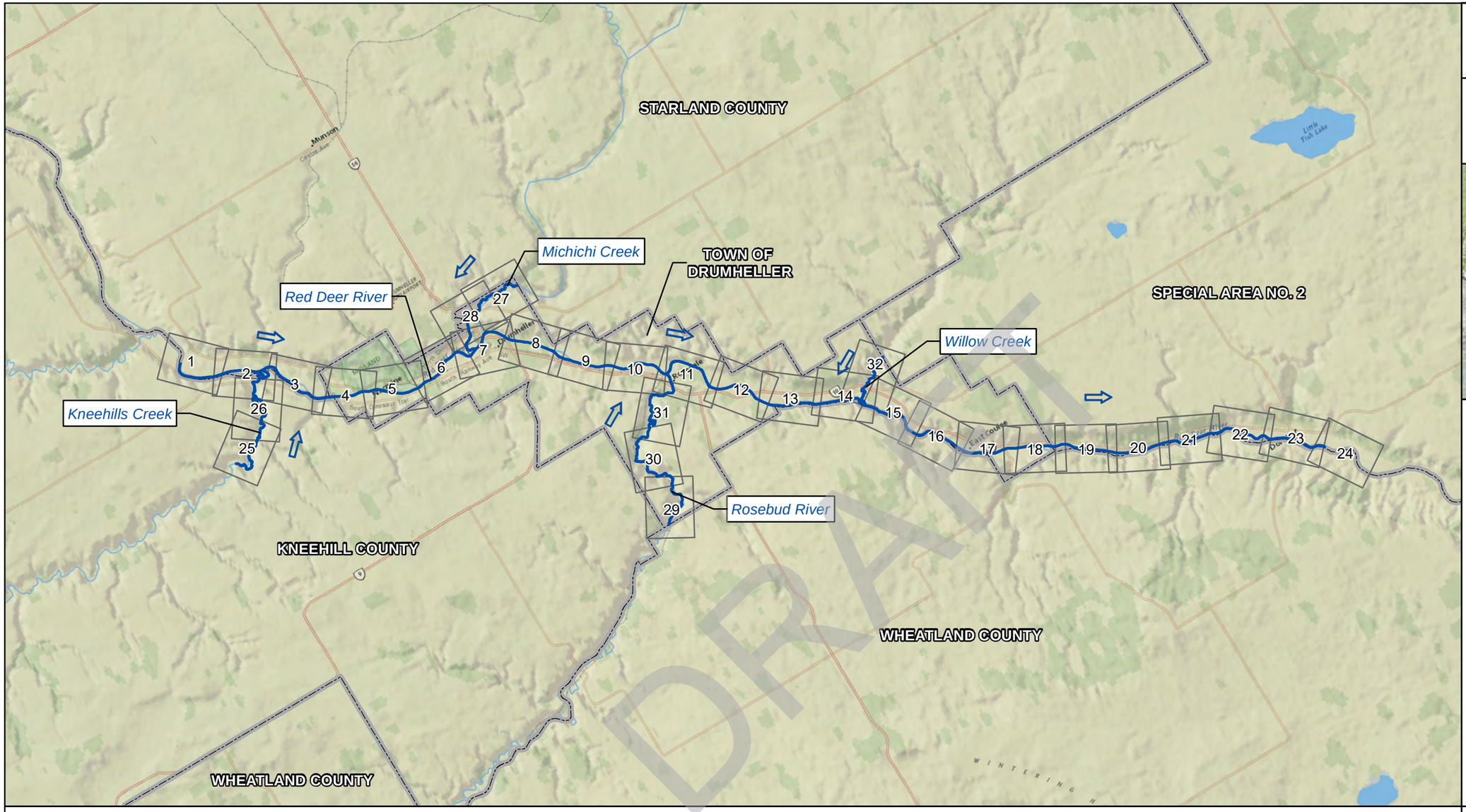
DRUMHELLER
RIVER HAZARD STUDY

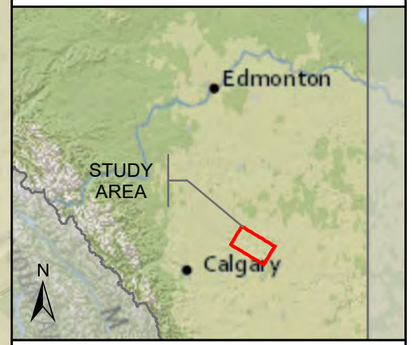
FLOODWAY CRITERIA MAP

SHEET 32 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T500_FloodwayCriteria.mxd

Appendix D
Flood Hazard Maps





FLOW DIRECTION
STUDY REACH
MAP SHEET
MUNICIPAL BOUNDARY

Note to Users:

1. Please refer to the accompanying **Drumheller River Hazard Study - Design Flood Hazard Mapping Report** for important information concerning the floodway criteria map.
2. Within the flood inundation areas shown on this map, there may be isolated pockets of high ground. To determine whether or not a particular site is subject to flooding, reference should be made to the computed flood levels in conjunction with site-specific surveys where detailed definition is required.
3. Non-riverine and local sources of water have not been considered, and structures such roads and railways can restrict water flow and affect local flood levels. Channel obstruction, local stormwater inflow, groundwater seepage or other land drainage can cause flood levels to exceed those indicated on the map. Lands adjacent to a flooded area may be subject to flooding from tributary streams not indicated on the maps.
4. The flood inundation area is shown above the linework for bridges and flood control structures that are below flood levels.

Definitions:

Flood Hazard Map - A flood hazard map is a specific type of flood map that identifies the area flooded for the 1:100 design flood, and divides that flood hazard area into floodway and flood fringe zones. Flood hazard maps can also show additional flood hazard information, including the incremental areas at risk for more severe floods like the 1:200 and 1:500 floods. Flood hazard maps are typically used for long-term flood hazard area management and land-use planning.

Design Flood - The design flood standard in Alberta is the 1:100 flood, which is a flood that has a 1% chance of being equaled or exceeded in any given year. The design flood is typically based on the 1:100 open water flood, but it can also reflect 1:100 ice jam flood levels or be based on a historical flood event. Different sized floods have different chances of occurring – for example, a 1:200 flood has a 0.5% chance of occurring in any given year and a 1:500 flood has a 0.2% chance of occurring in any given year – but only the 1:100 design flood is used to define the floodway and flood fringe zones on flood hazard maps.

Floodway - When a floodway is first defined on a flood hazard map, it typically represents the area of highest flood hazard where flows are deepest, fastest, and most destructive during the 1:100 design flood. When a flood hazard map is updated, the floodway will not get larger in most circumstances to maintain long-term regulatory certainty, even if the flood hazard area gets larger or design flood levels get higher.

Flood Fringe - The flood fringe is the area outside of the floodway that is flooded or could be flooded during the 1:100 design flood. The flood fringe typically represents areas with shallower, slower, and less destructive flooding, but it may also include "high hazard flood fringe" areas. Areas at risk of flooding behind flood berms may also be mapped as "protected flood fringe" areas.

High Hazard Flood Fringe - The high hazard flood fringe identifies areas within the flood fringe with deeper or faster moving water than the rest of the flood fringe. High hazard flood fringe areas are likely to be most significant for flood maps that are being updated, but they may also be included in new flood maps.

Protected Flood Fringe - The protected flood fringe identifies areas that could be flooded if dedicated flood berms fail or do not work as designed during the 1:100 design flood, even if they are not overtopped. Protected flood fringe areas are part of the flood fringe and do not differentiate between areas with deeper or faster moving water and shallower or slower moving water.

Data Sources and References:

1. Orthophoto imagery acquired by OGL Engineering for Alberta Environment and Parks: *OGL Engineering (2019). Drumheller aerial imagery acquisition memorandum, project number 2019-501, submitted to Alberta Environment and Parks, 5 pp.*
2. Base data from NRCan, Alberta Environment and Parks, Altalis, and Natural Resources Canada.
3. Additional base mapping from Esri.

SCALE - 1:175,000
0 2 4 6 8 KM

Coordinate System: NAD 1983 CSRS 3TM 114;
Vertical Datum: CGVD28 HTv2.0; Units: Metres

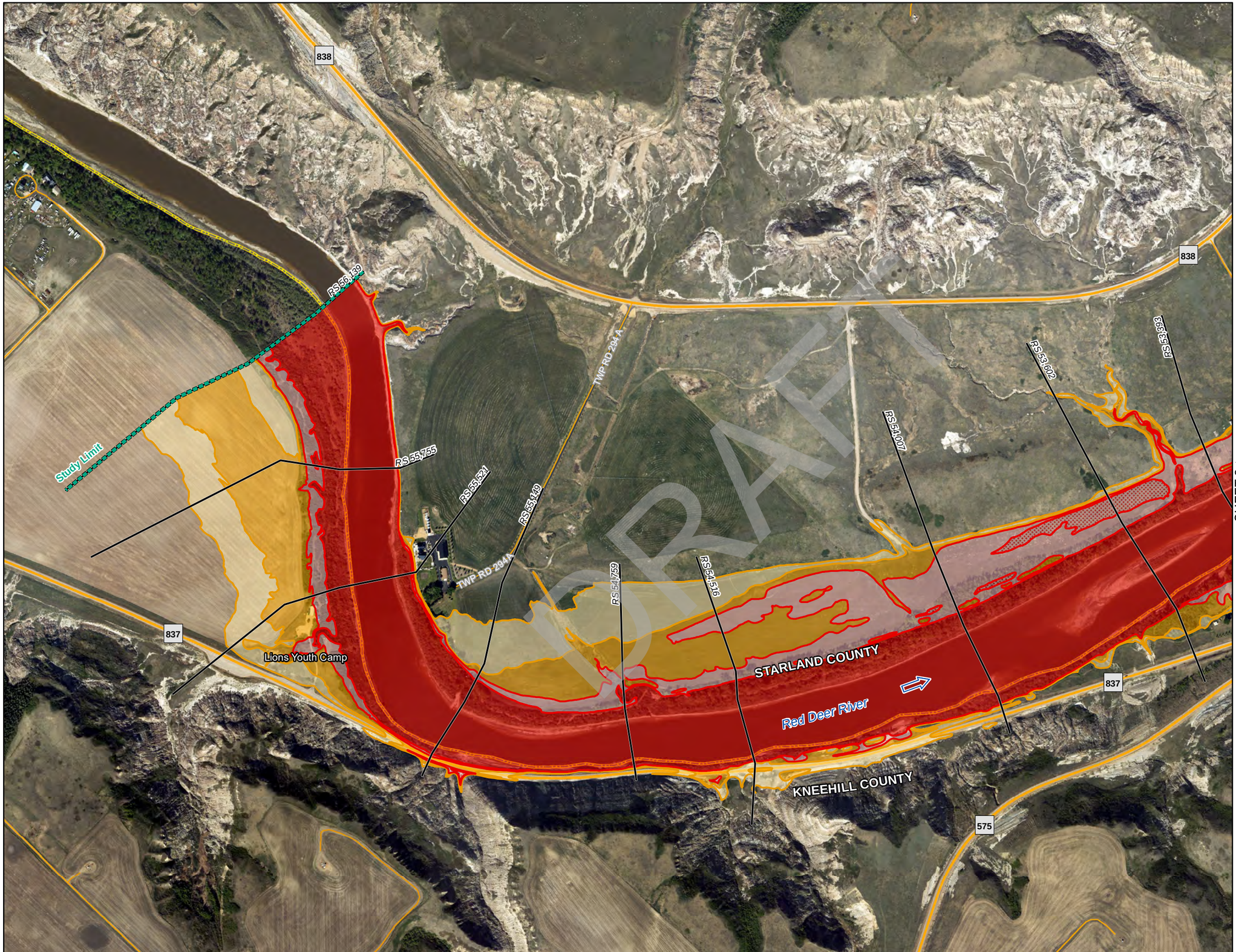
Engineer	GIS	Reviewer
AMH	JY	RBA

Job: 1003877 | Date: 10-JUNE-2022

DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

INDEX MAP



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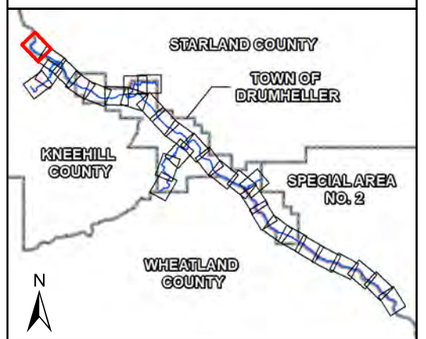


- FLOW DIRECTION
- BRIDGE
- MODEL CROSS SECTION
- CULVERT
- STUDY LIMIT
- FLOOD CONTROL STRUCTURE
- FLOODWAY
- FLOOD FRINGE
- PROTECTED FLOOD FRINGE
- HIGH HAZARD FLOOD FRINGE
- 200-YEAR FLOOD EXTENT
- 500-YEAR FLOOD EXTENT
- MAJOR ROAD
- LOCAL ROAD
- RAILWAY (ABANDONED)
- MUNICIPAL BOUNDARY

SCALE - 1:7,500

0 50 100 200 300 M

Coordinate System: NAD 1983 CSRS 3TM 114;
Vertical Datum: CGVD28 HTv2.0; Units: Metres

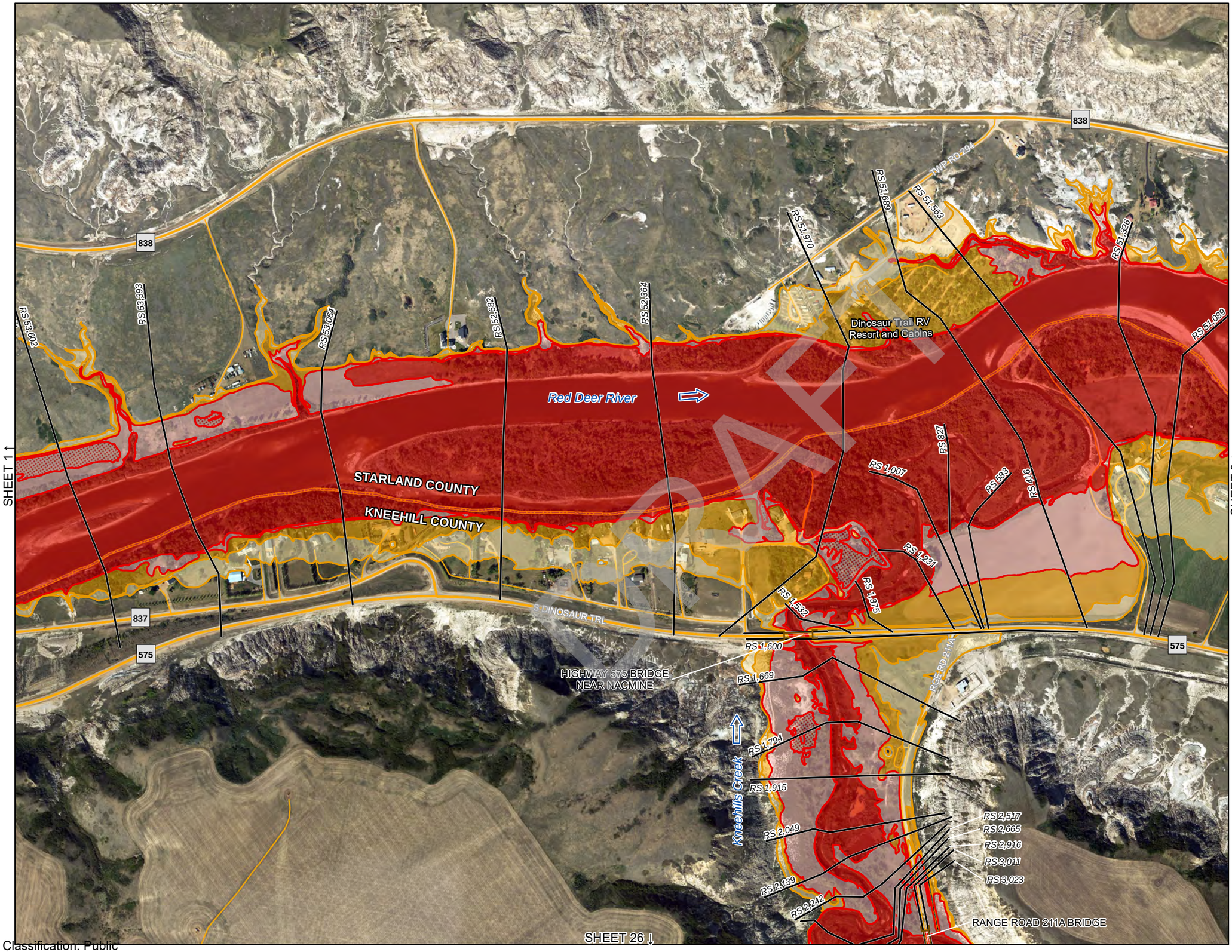
Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

Job: 1003877 | Date: 08-DEC-2022

DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 1 OF 32



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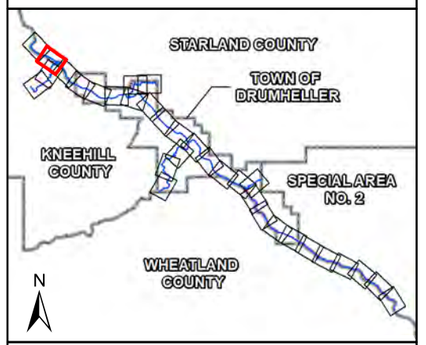

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SCALE - 1:7,500

0 50 100 200 300 M

N

Coordinate System: NAD 1983 CSRS 3TM 114;
Vertical Datum: CGVD28 HTv2.0; Units: Metres

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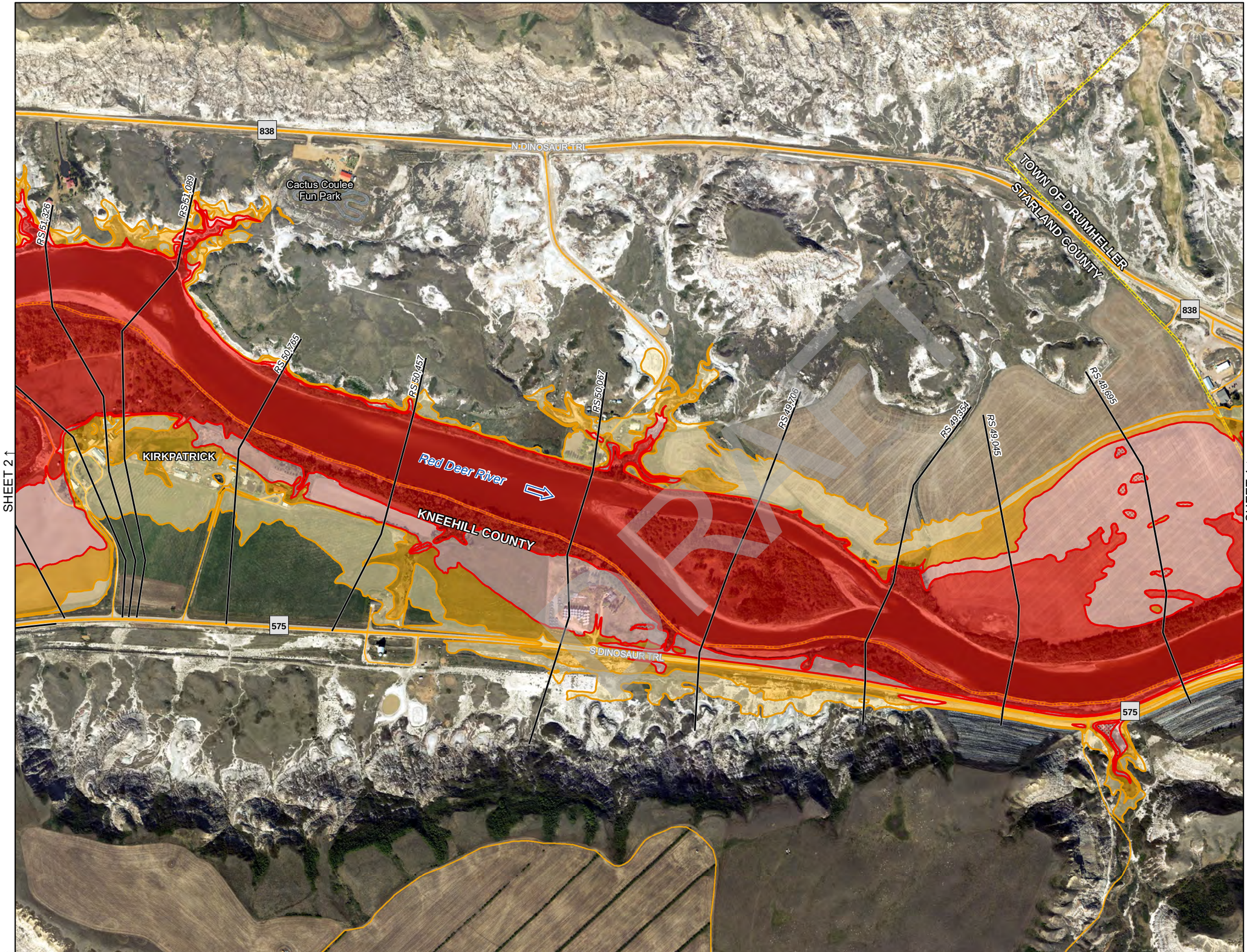
Job: 1003877 | Date: 08-DEC-2022

DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 2 OF 32

J:\MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd



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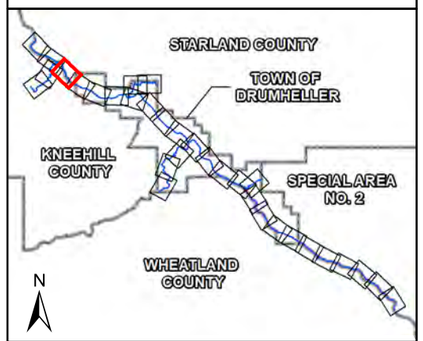

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SCALE - 1:7,500

0 50 100 200 300 M

Coordinate System: NAD 1983 CSRS 3TM 114; Vertical Datum: CGVD28 HTv2.0; Units: Metres

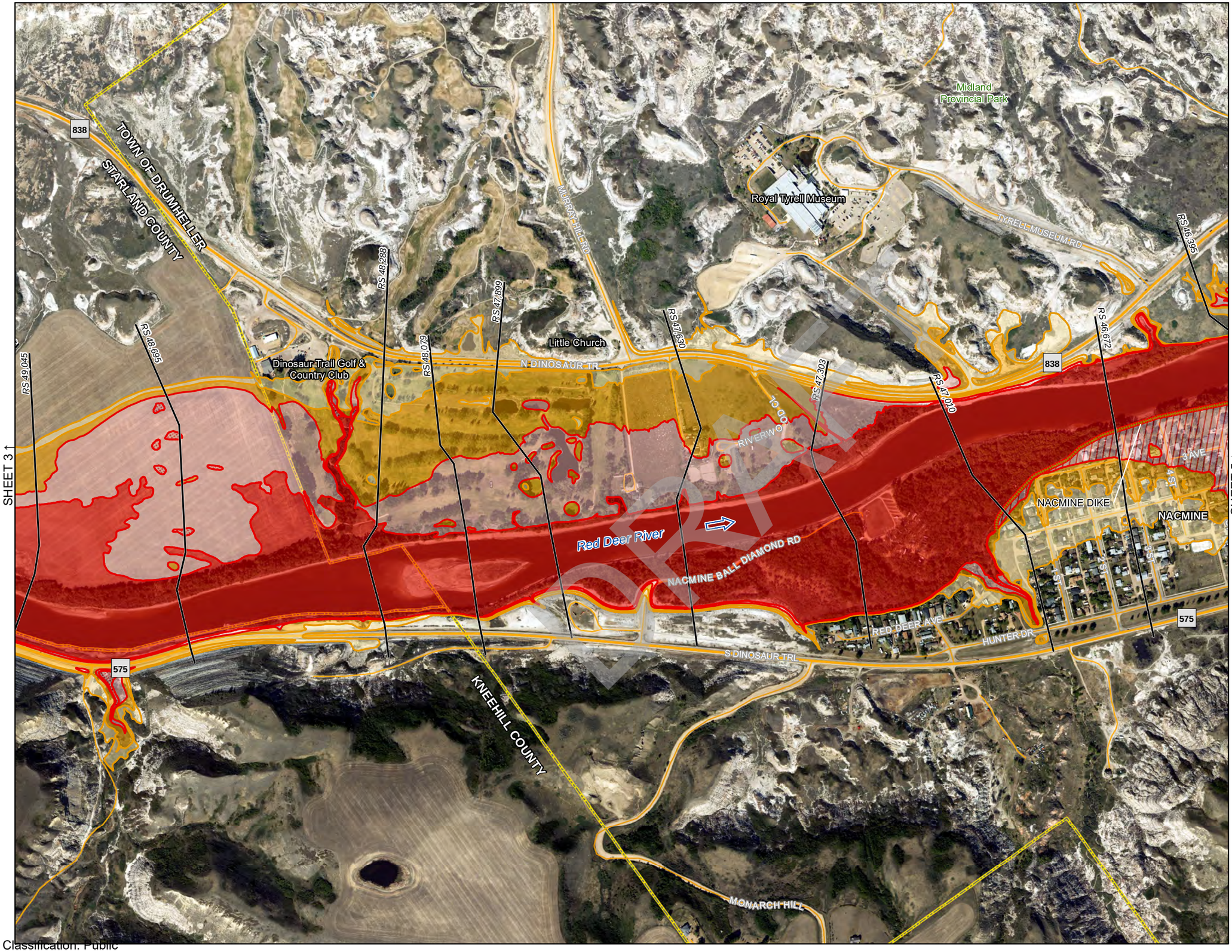
Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

Job: 1003877 | *Date: 08-DEC-2022*

DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 3 OF 32



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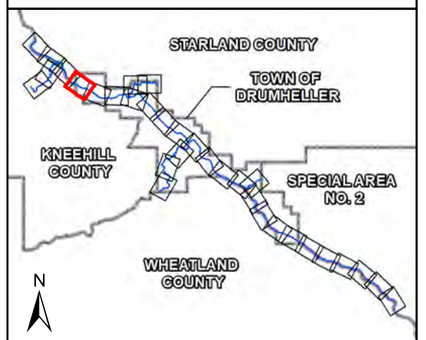

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SCALE - 1:7,500

0 50 100 200 300 M

N

Coordinate System: NAD 1983 CSRS 3TM 114;
Vertical Datum: CGVD28 HTv2.0; Units: Metres

Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

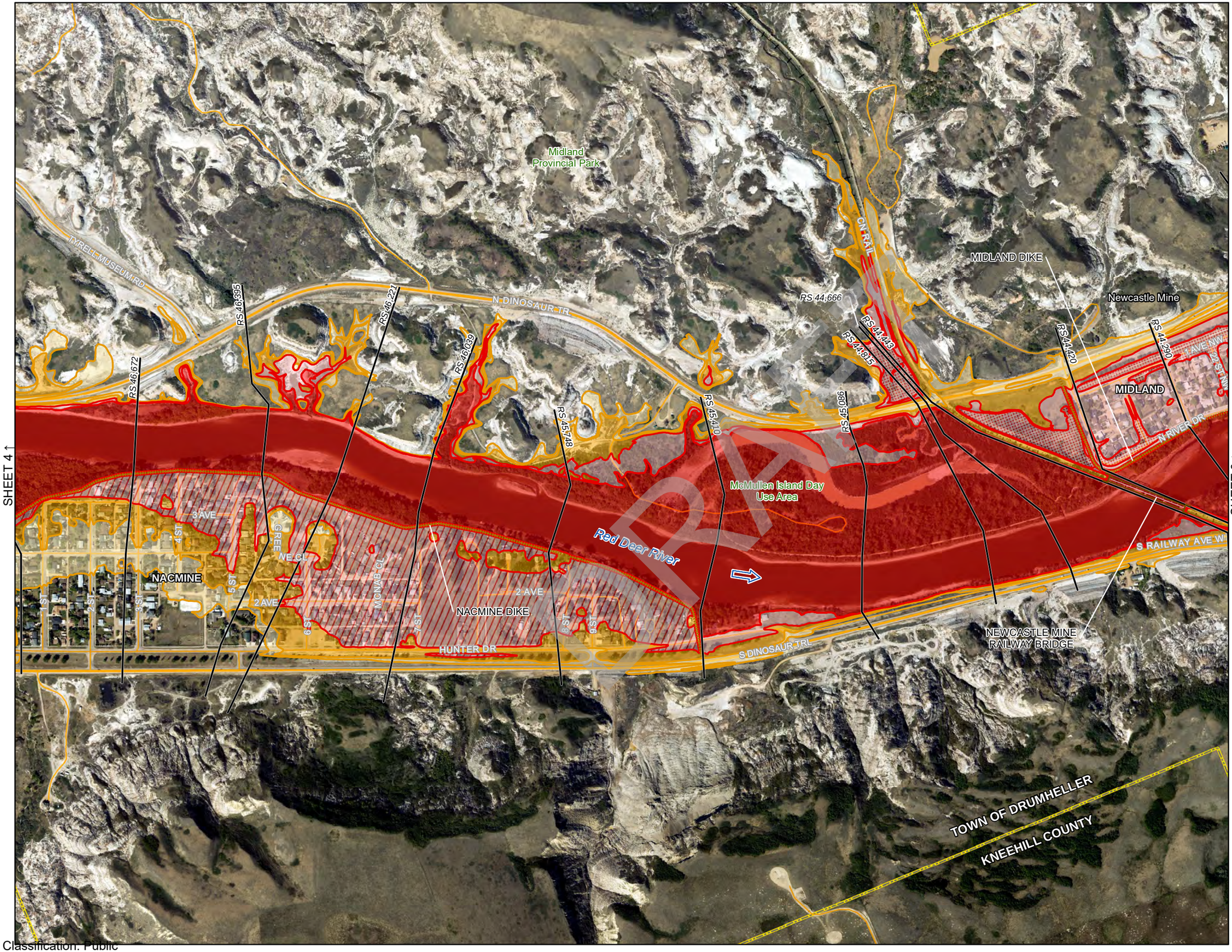
Job: 1003877 | Date: 08-DEC-2022

DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 4 OF 32

J:\Y\MSN_P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd



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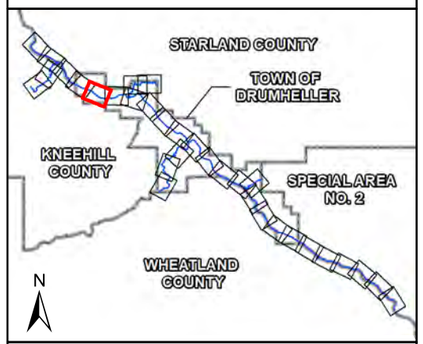

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SCALE - 1:7,500

0 50 100 200 300 M

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Coordinate System: NAD 1983 CSRS 3TM 114;
Vertical Datum: CGVD28 HTv2.0; Units: Metres

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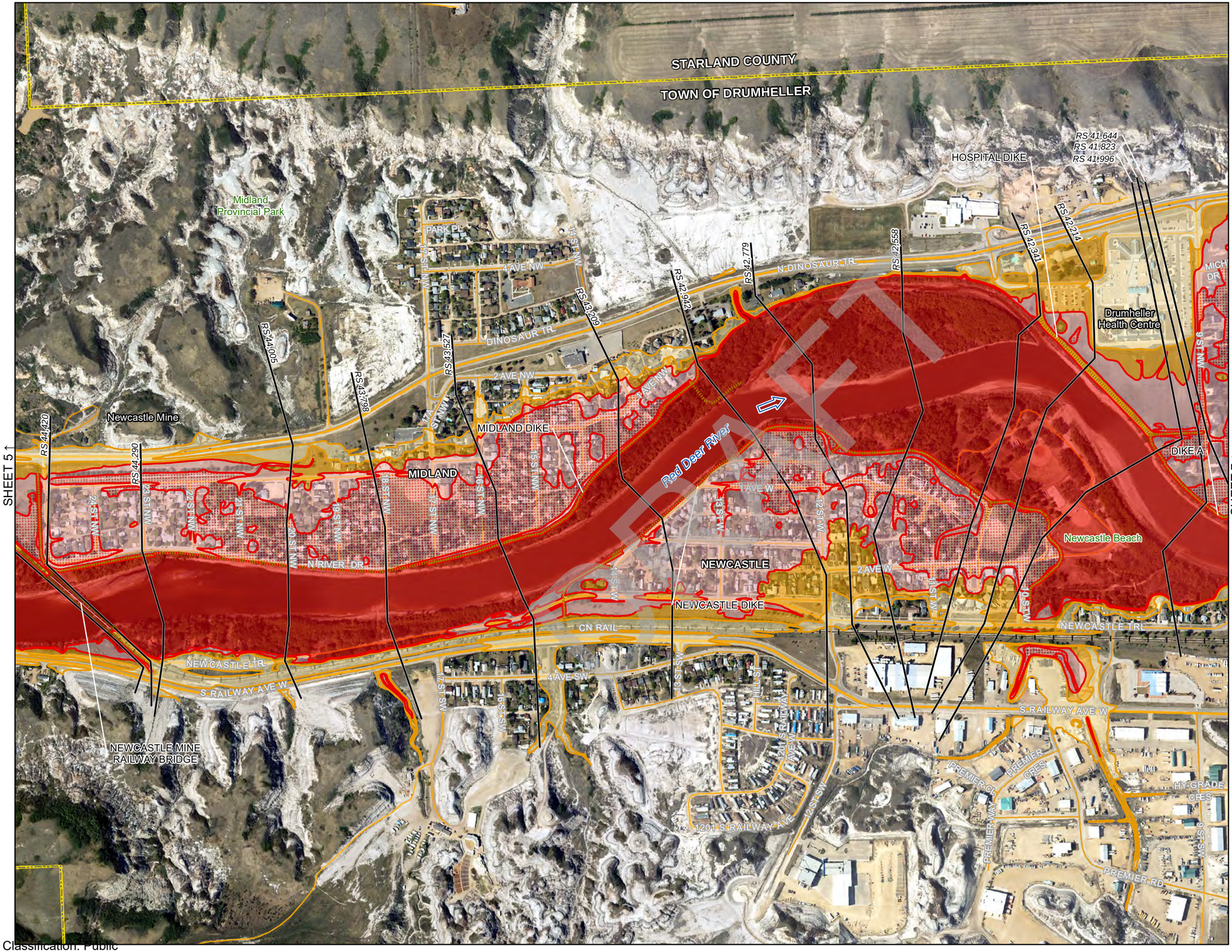
Job: 1003877 | Date: 08-DEC-2022

DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 5 OF 32



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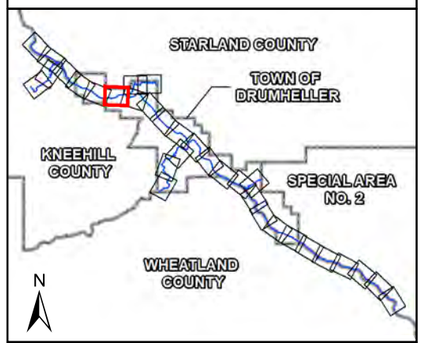

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Coordinate System: NAD 1983 CSRS 3TM 114;
Vertical Datum: CGVD28 HTv2.0; Units: Metres

Engineer	GIS	Reviewer
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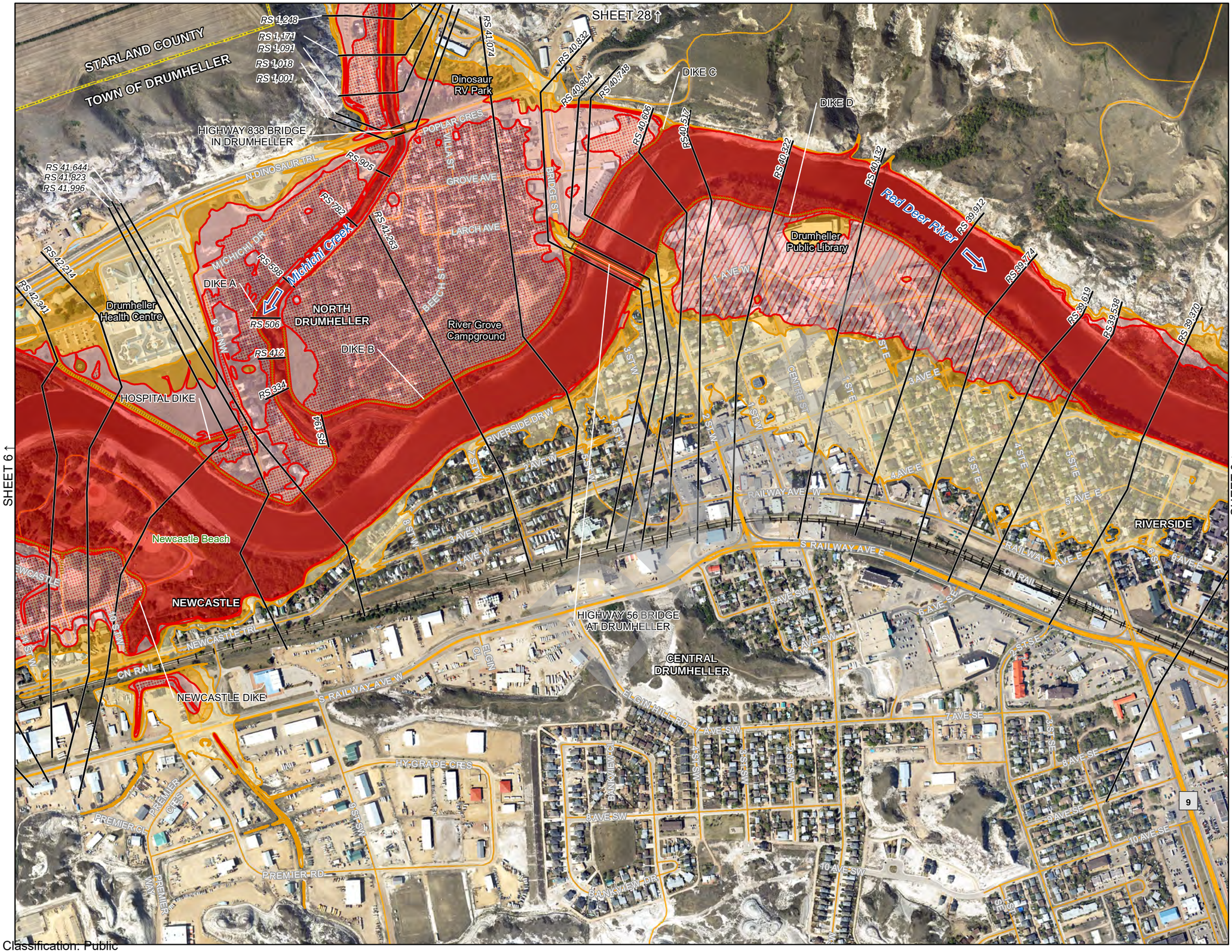
Job: 1003877 | Date: 08-DEC-2022

DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 6 OF 32



Classification: Public

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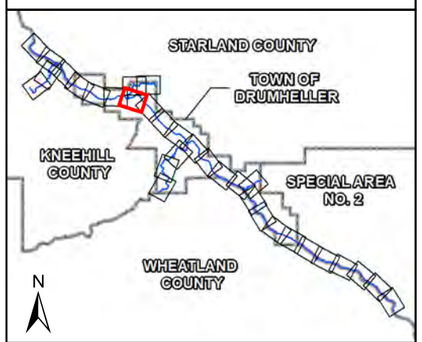

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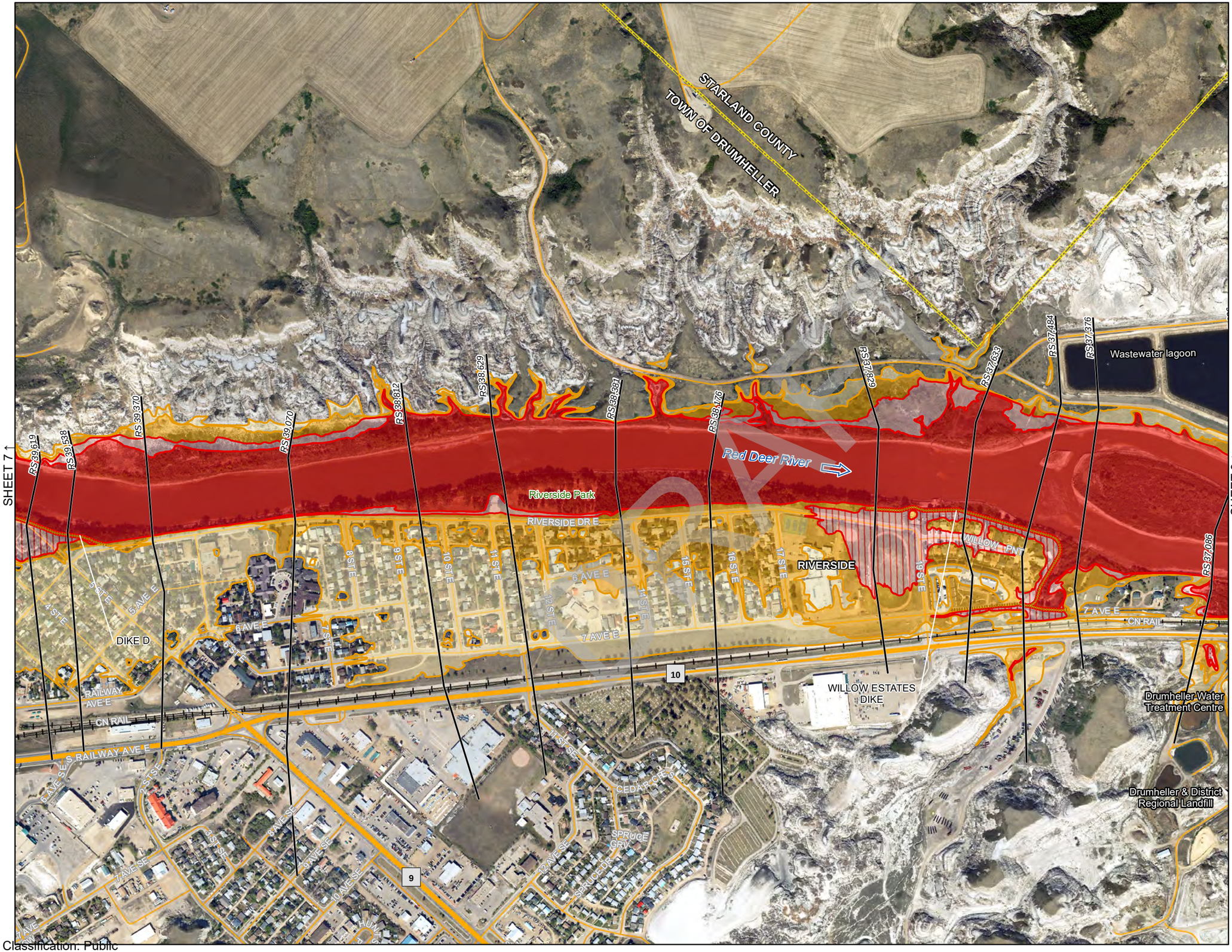
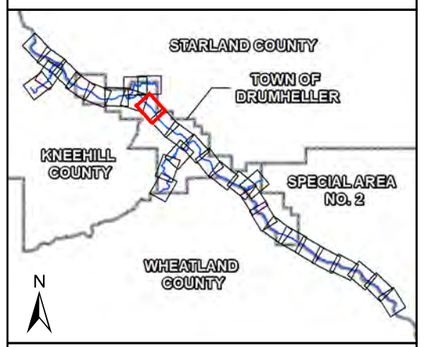
DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 7 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd





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SCALE - 1:7,500

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Coordinate System: NAD 1983 CSRS 3TM 114; Vertical Datum: CGVD28 HTv2.0; Units: Metres

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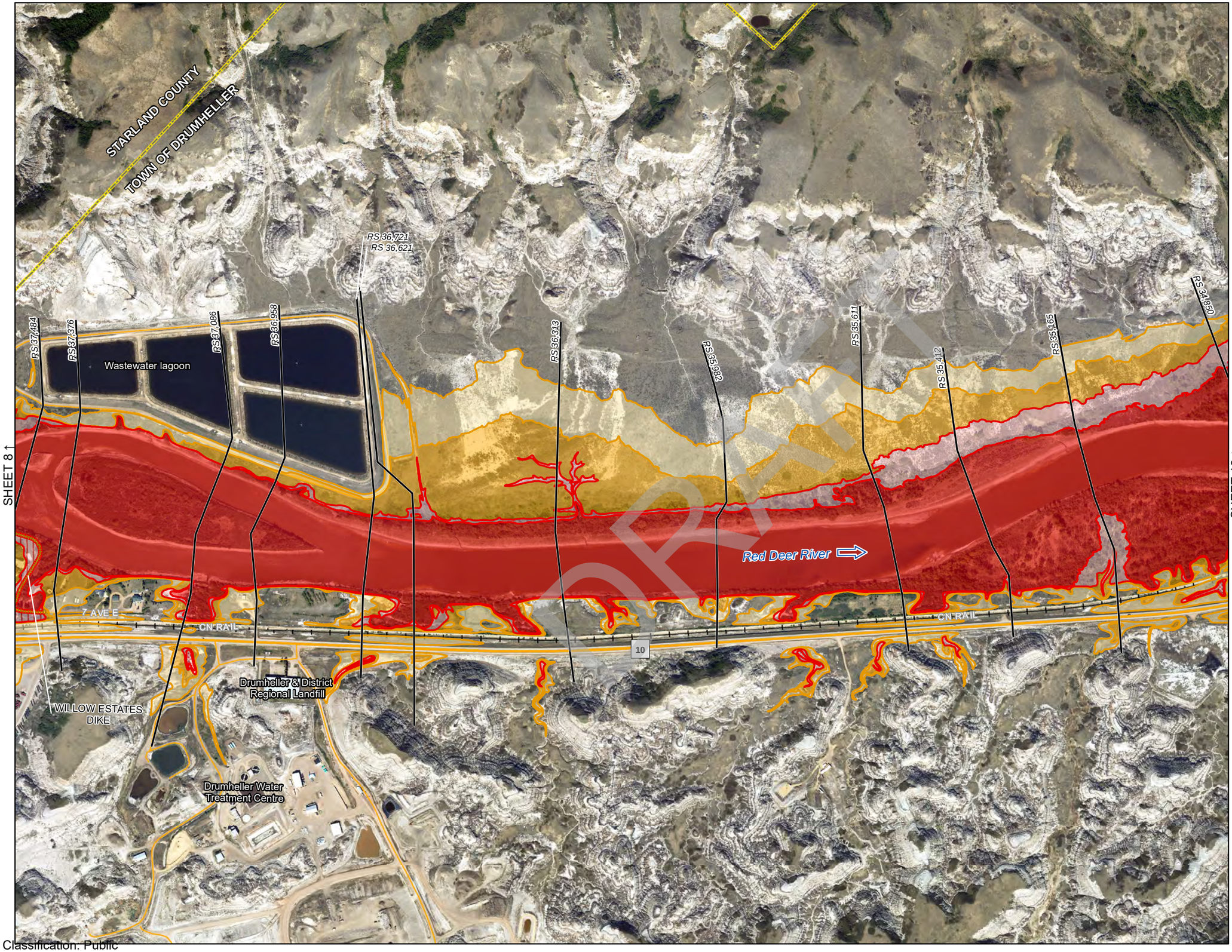
Job: 1003877 | *Date: 08-DEC-2022*

DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 8 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd



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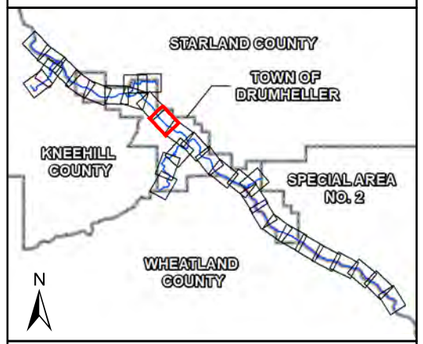

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SCALE - 1:7,500

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Coordinate System: NAD 1983 CSRS 3TM 114;
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Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

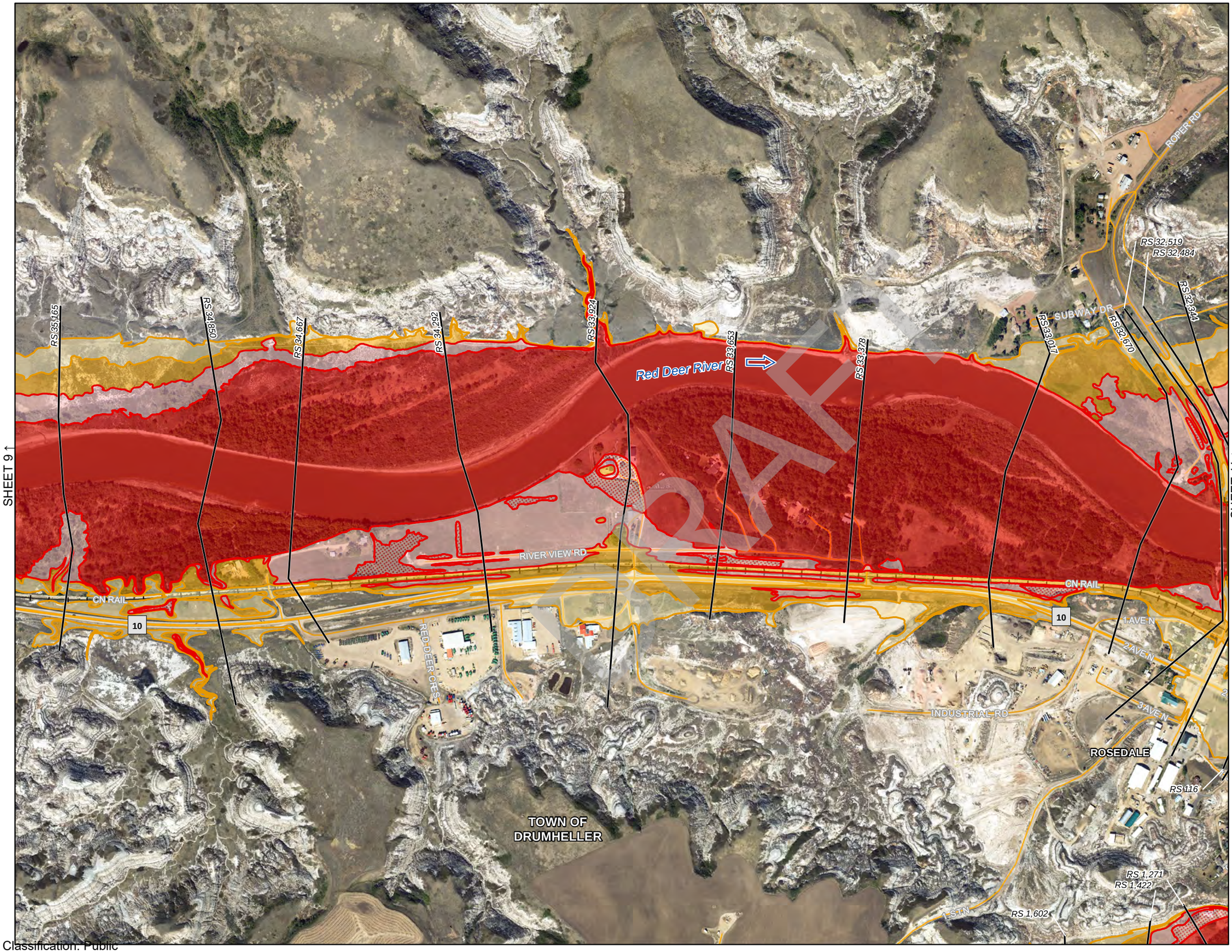
Job: 1003877 | Date: 08-DEC-2022

DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 9 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd



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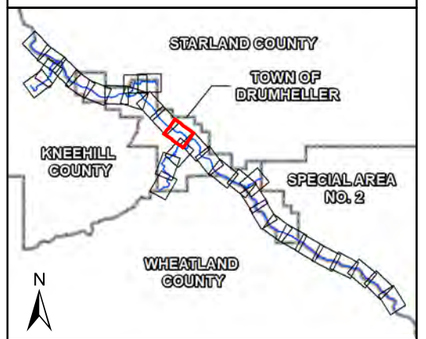

- FLOW DIRECTION
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Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

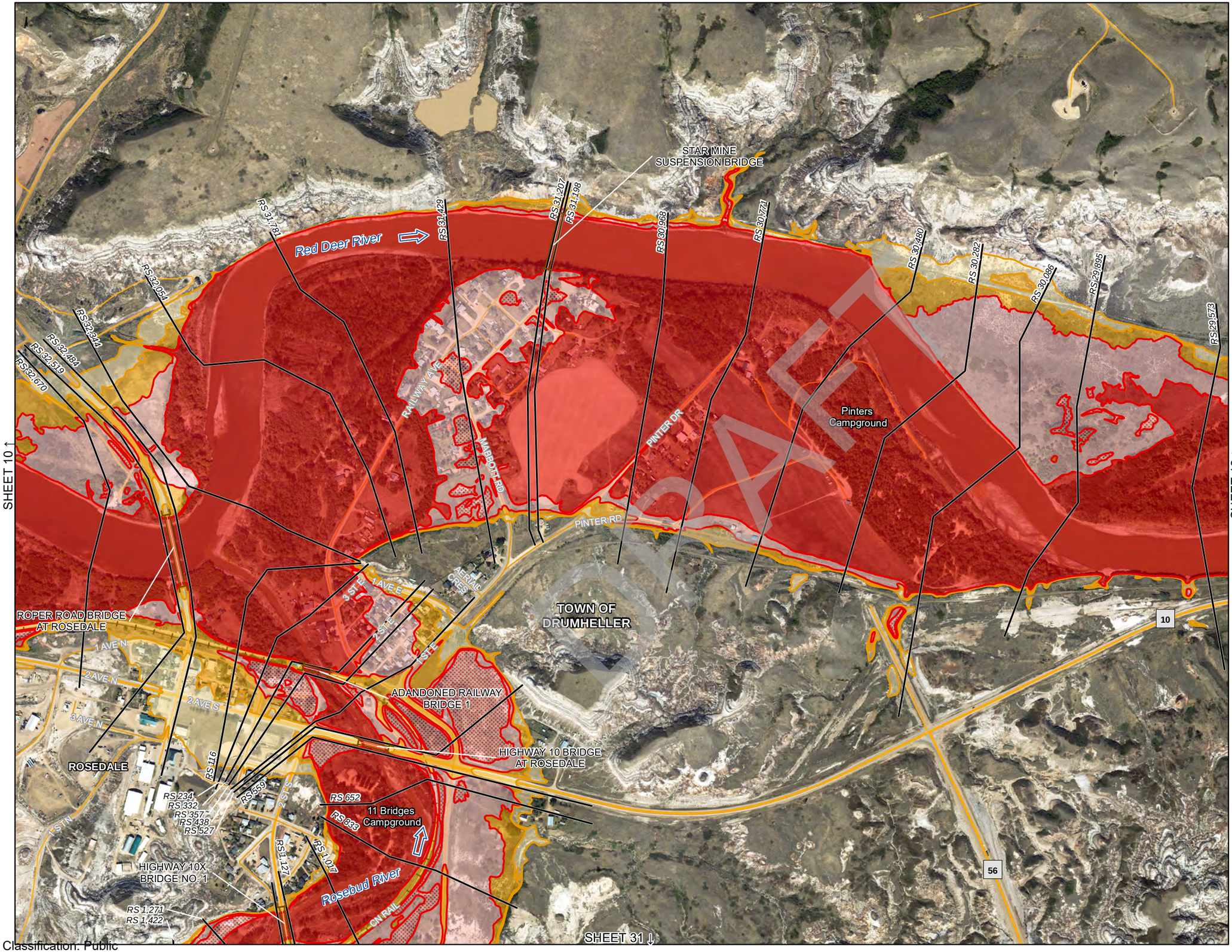
Job: 1003877 | *Date: 08-DEC-2022*

DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 10 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd



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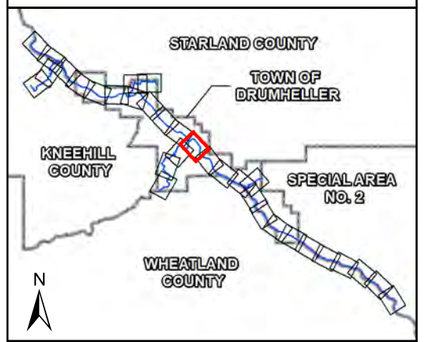

- FLOW DIRECTION
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Coordinate System: NAD 1983 CSRS 3TM 114; Vertical Datum: CGVD28 HTv2.0; Units: Metres

Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

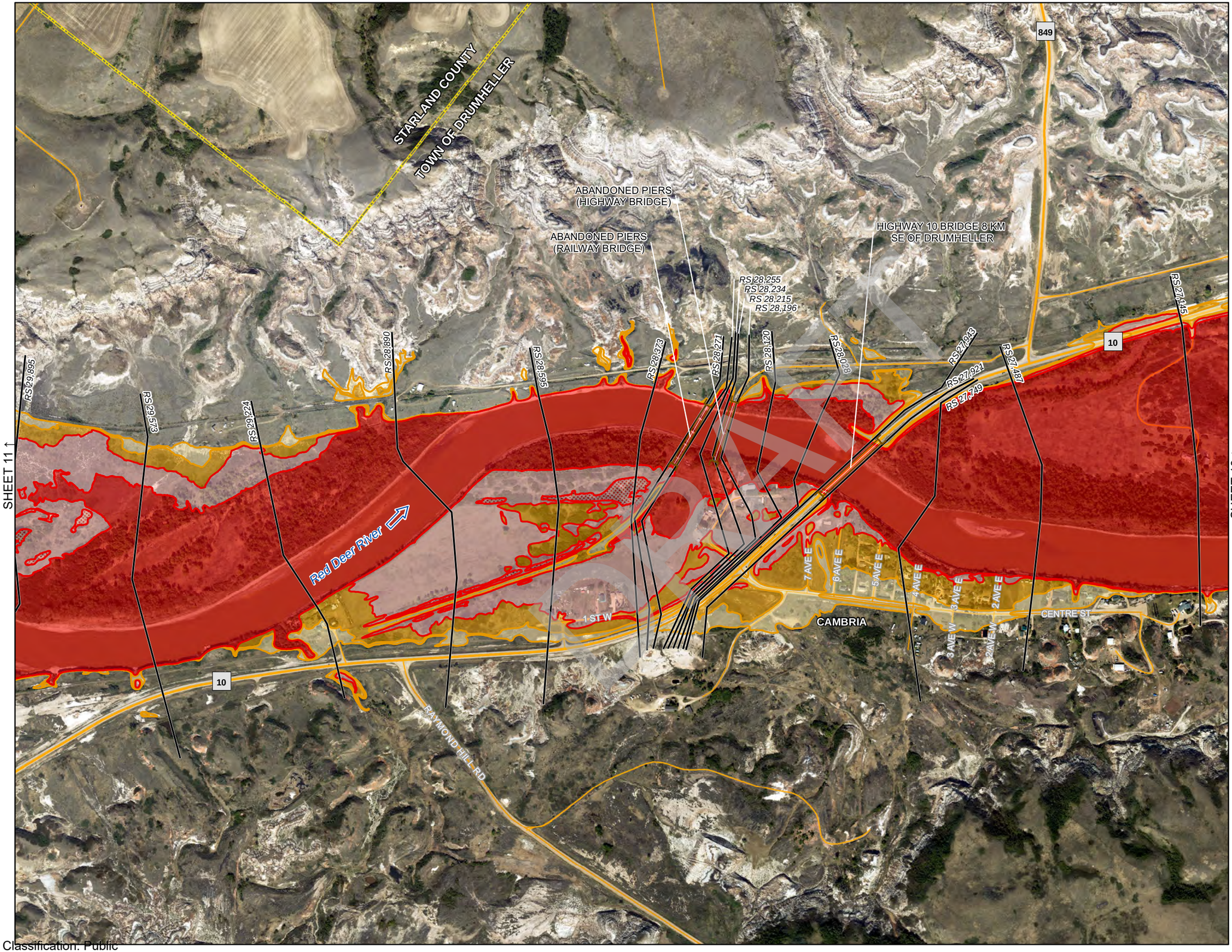
Job: 1003877 | *Date: 08-DEC-2022*

DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 11 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd



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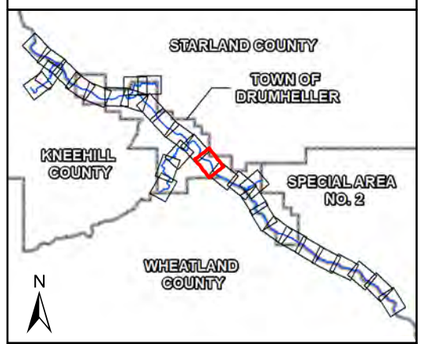


- FLOW DIRECTION
- BRIDGE
- MODEL CROSS SECTION
- CULVERT
- STUDY LIMIT
- FLOOD CONTROL STRUCTURE
- FLOODWAY
- FLOOD FRINGE
- PROTECTED FLOOD FRINGE
- HIGH HAZARD FLOOD FRINGE
- 200-YEAR FLOOD EXTENT
- 500-YEAR FLOOD EXTENT
- MAJOR ROAD
- LOCAL ROAD
- RAILWAY (ABANDONED)
- MUNICIPAL BOUNDARY

SCALE - 1:7,500

0 50 100 200 300 M

Coordinate System: NAD 1983 CSRS 3TM 114;
Vertical Datum: CGVD28 HTv2.0; Units: Metres

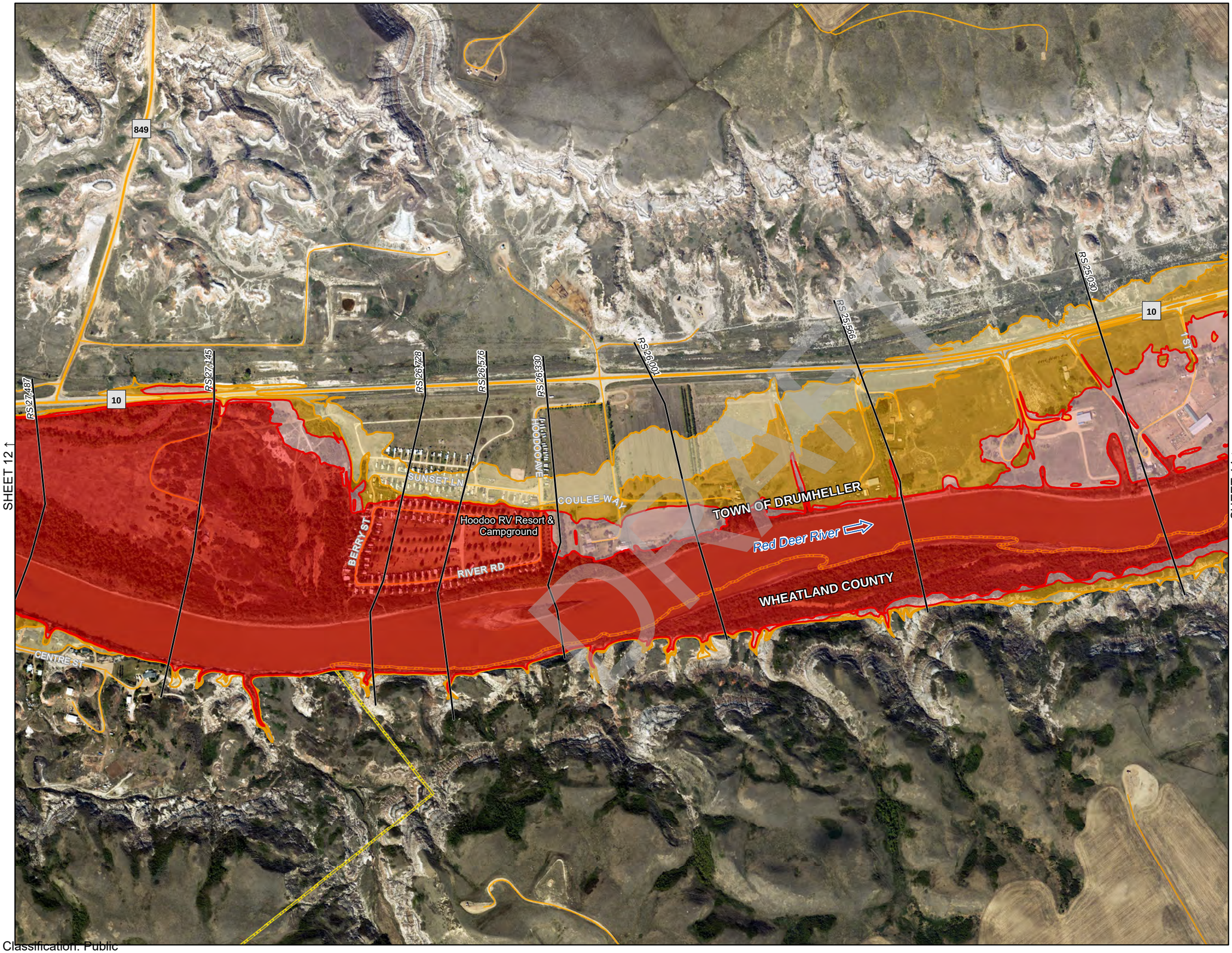
Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

Job: 1003877 | Date: 08-DEC-2022

DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 12 OF 32



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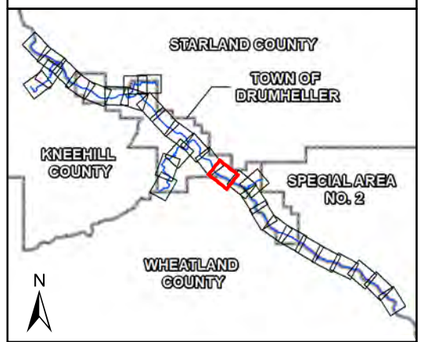

- FLOW DIRECTION
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Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

Job: 1003877 | Date: 08-DEC-2022

DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 13 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd

SHEET 32 ↑

SHEET 13 ↑

SHEET 15 ↓

HIGHWAY 10 BRIDGE
10.5 KM NW OF EAST COULEE

Willow Creek

Hoodoos Trail

Red Deer River

TOWN OF DRUMHELLER

WHEATLAND COUNTY

RS 1,596

RS 1,356

RS 1,007

RS 23,316

RS 23,586

RS 24,051

RS 24,611

RS 25,030

RS 863

RS 848

RS 22,842

573

10

10

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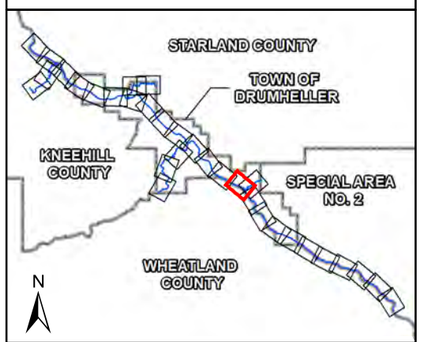

- FLOW DIRECTION
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Engineer	GIS	Reviewer
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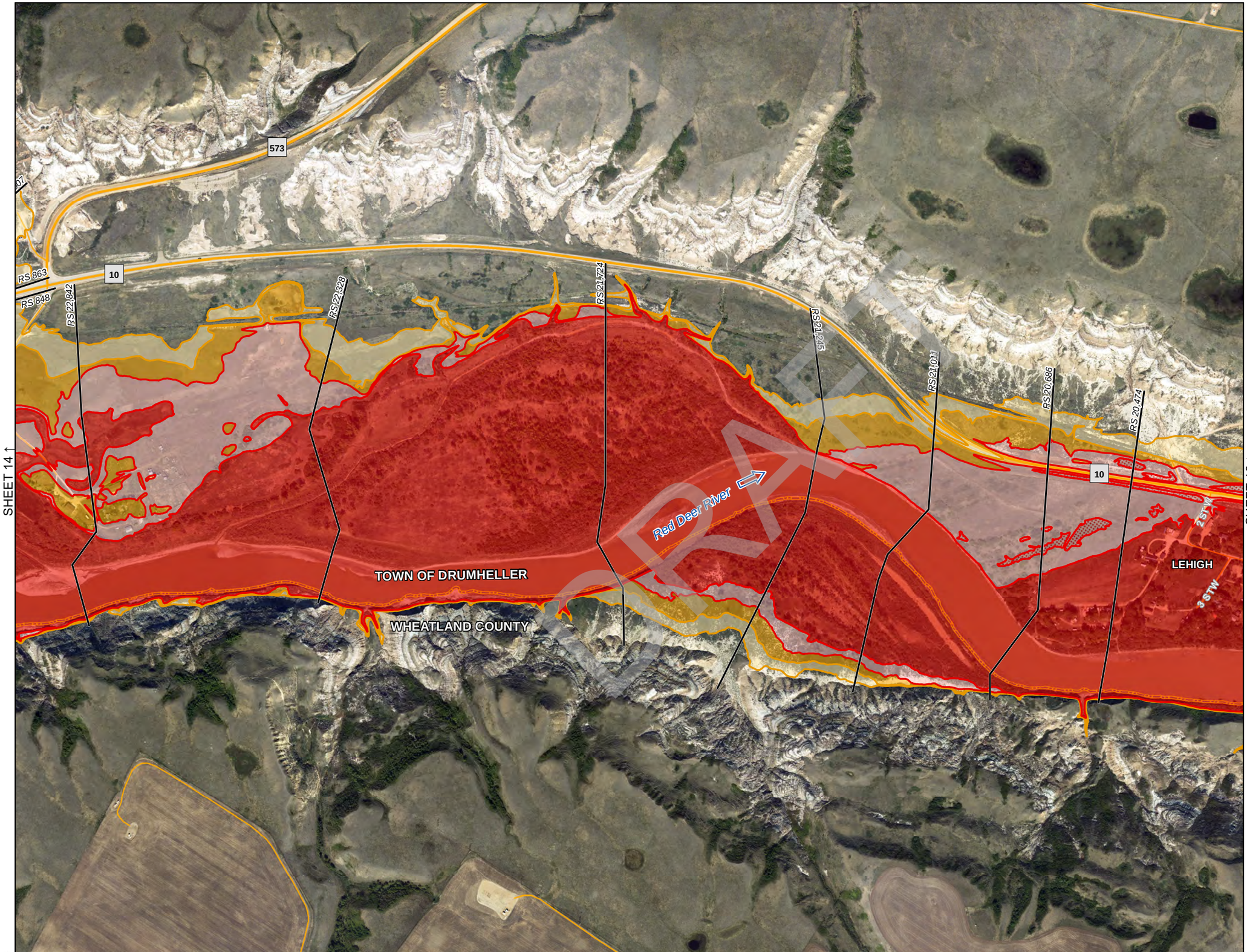
Job: 1003877 | *Date: 08-DEC-2022*

DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 14 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd



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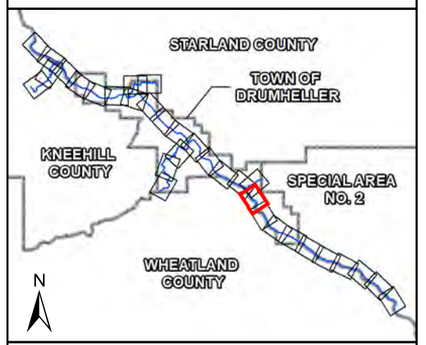

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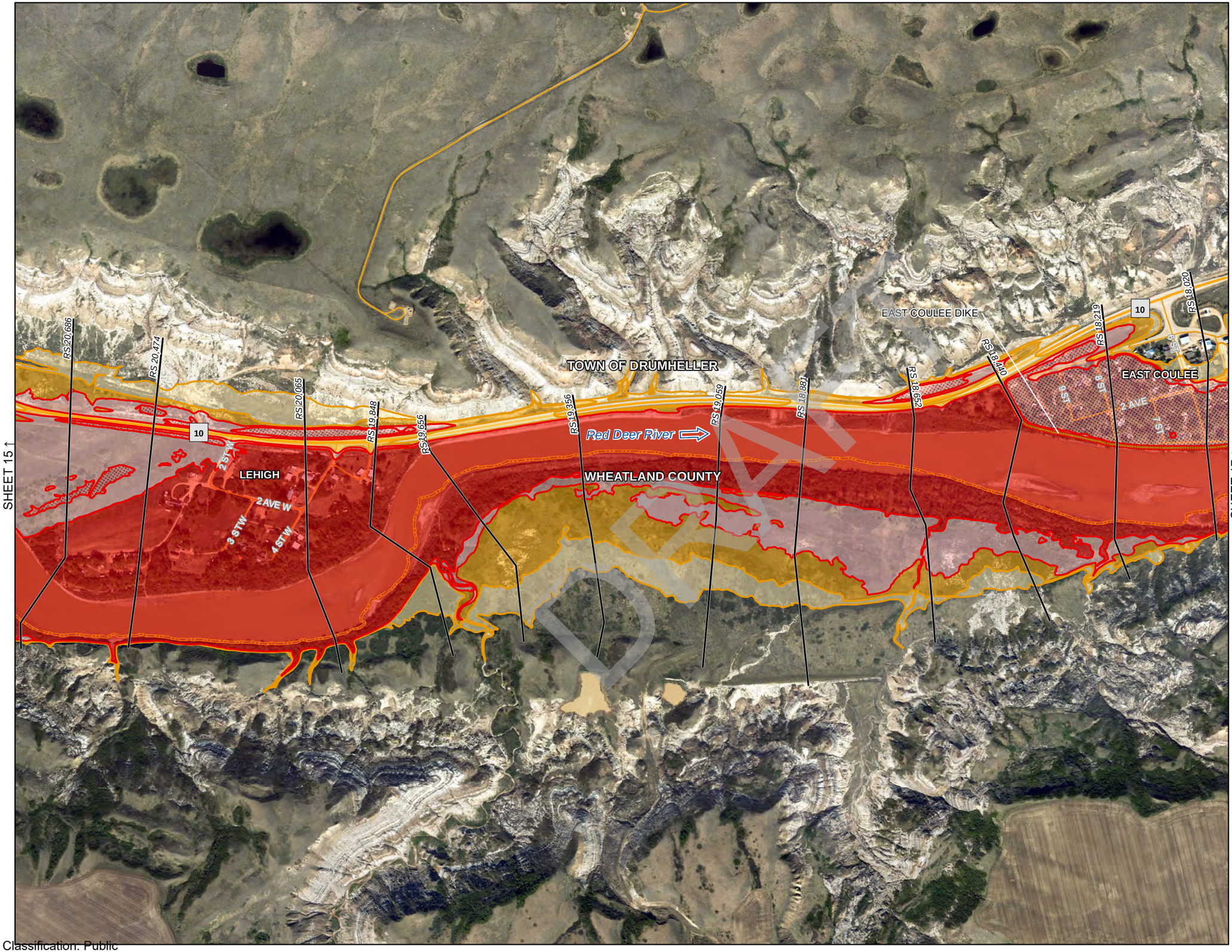
DRUMHELLER
RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 15 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd



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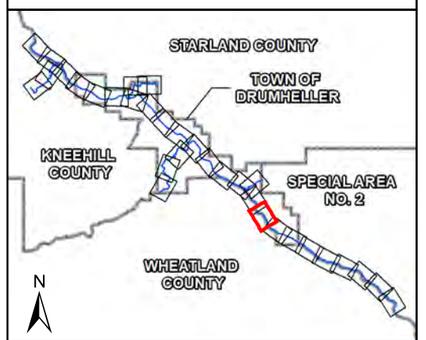

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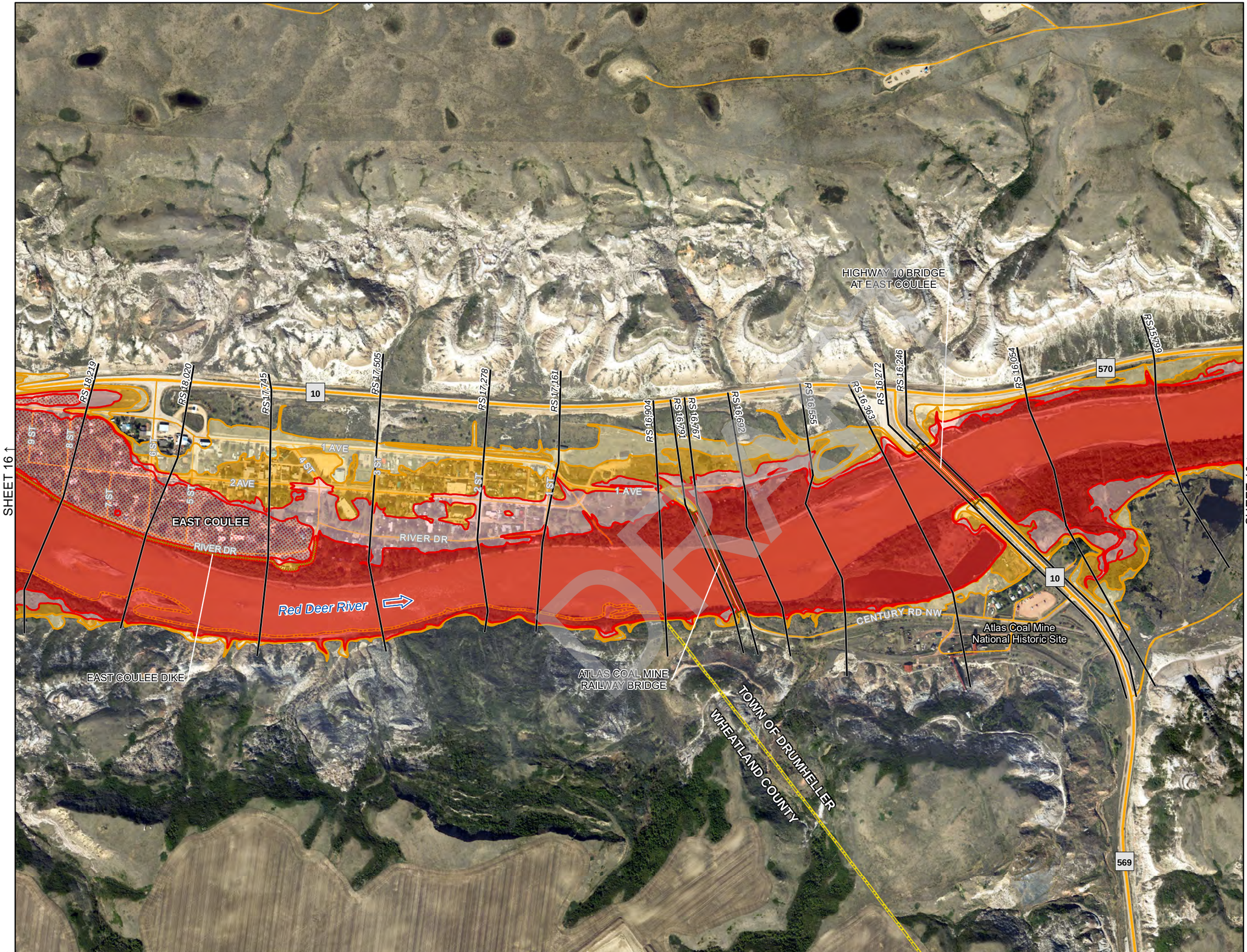
DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 16 OF 32



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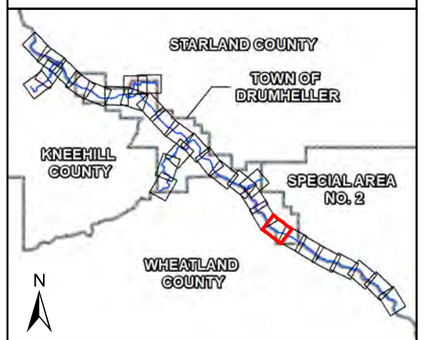

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Coordinate System: NAD 1983 CSRS 3TM 114;
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AMH	JY/MSN	RBA

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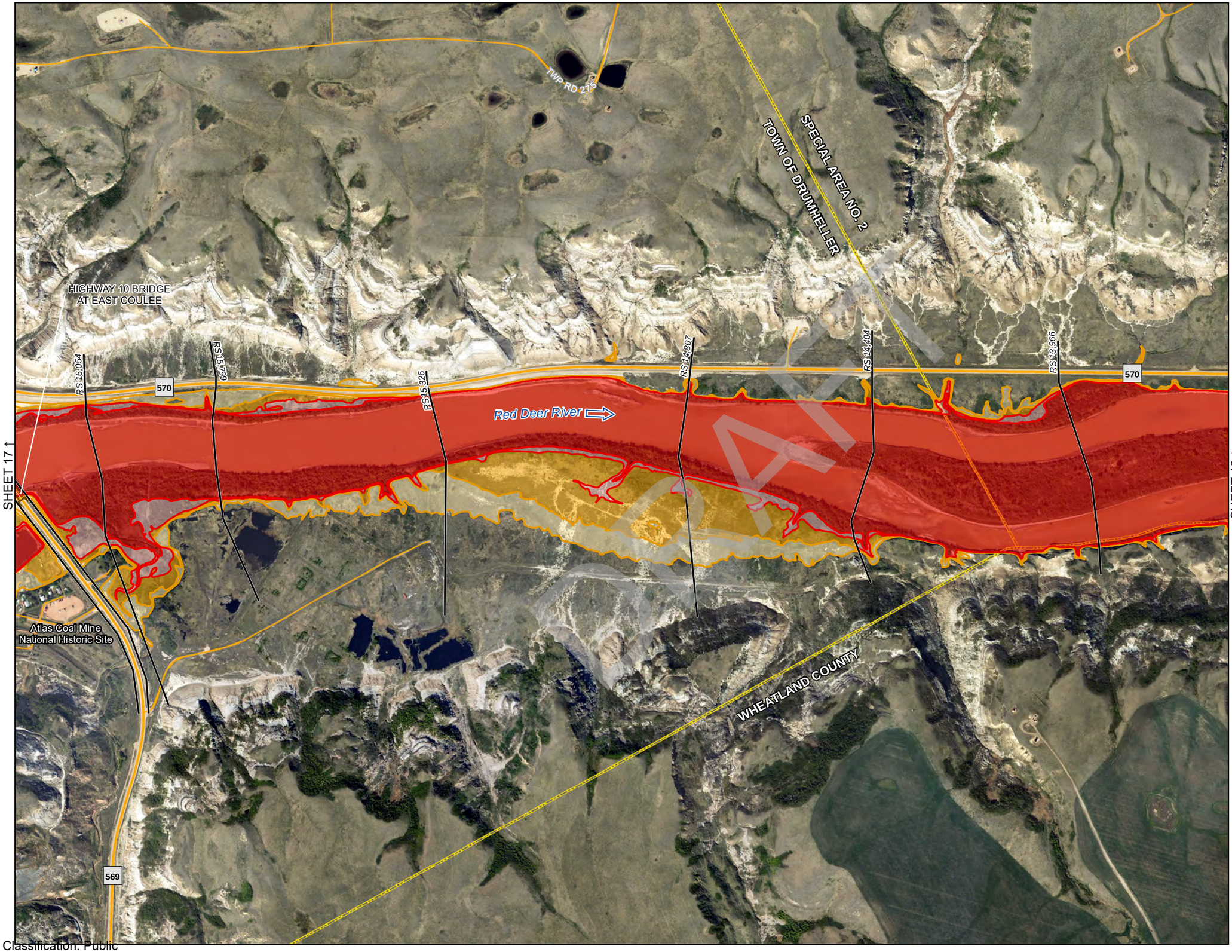
DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 17 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd



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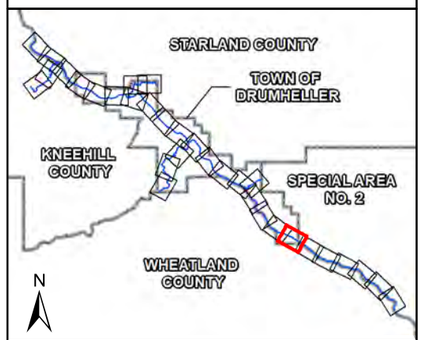

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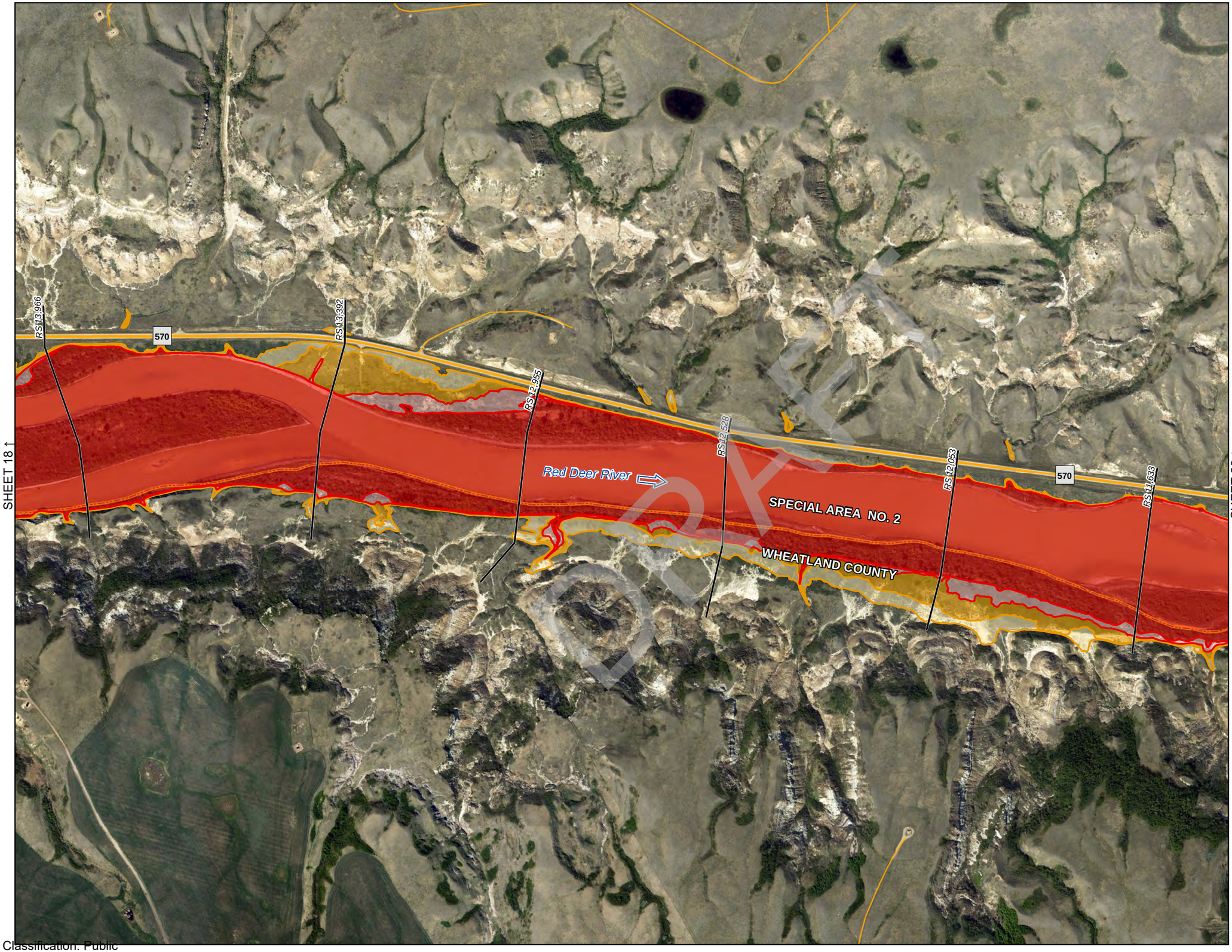
DRUMHELLER
RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 18 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd



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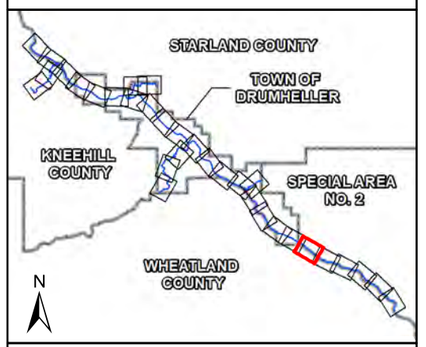

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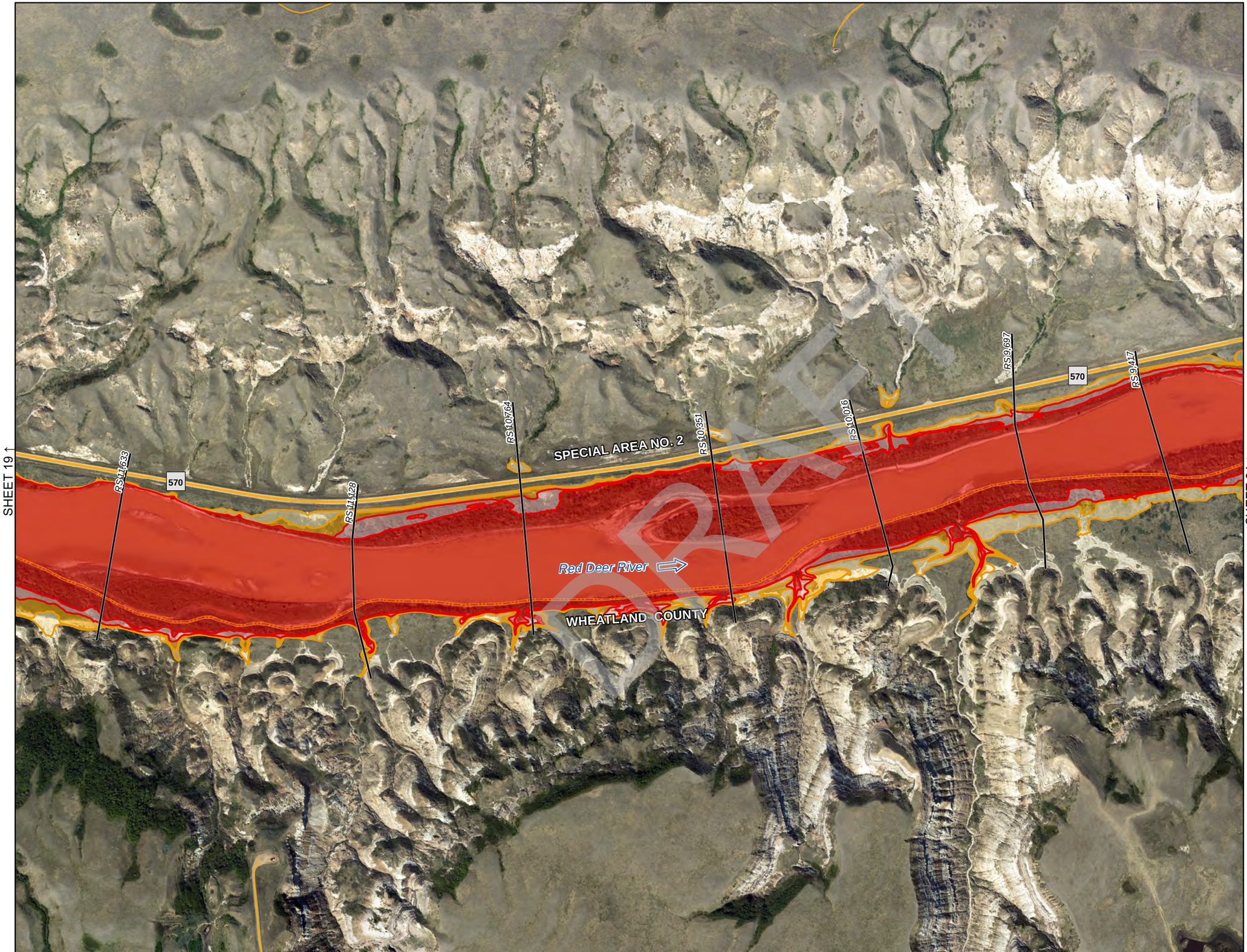
DRUMHELLER
RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 19 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd



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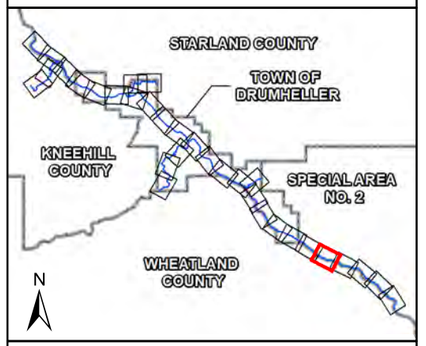

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Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

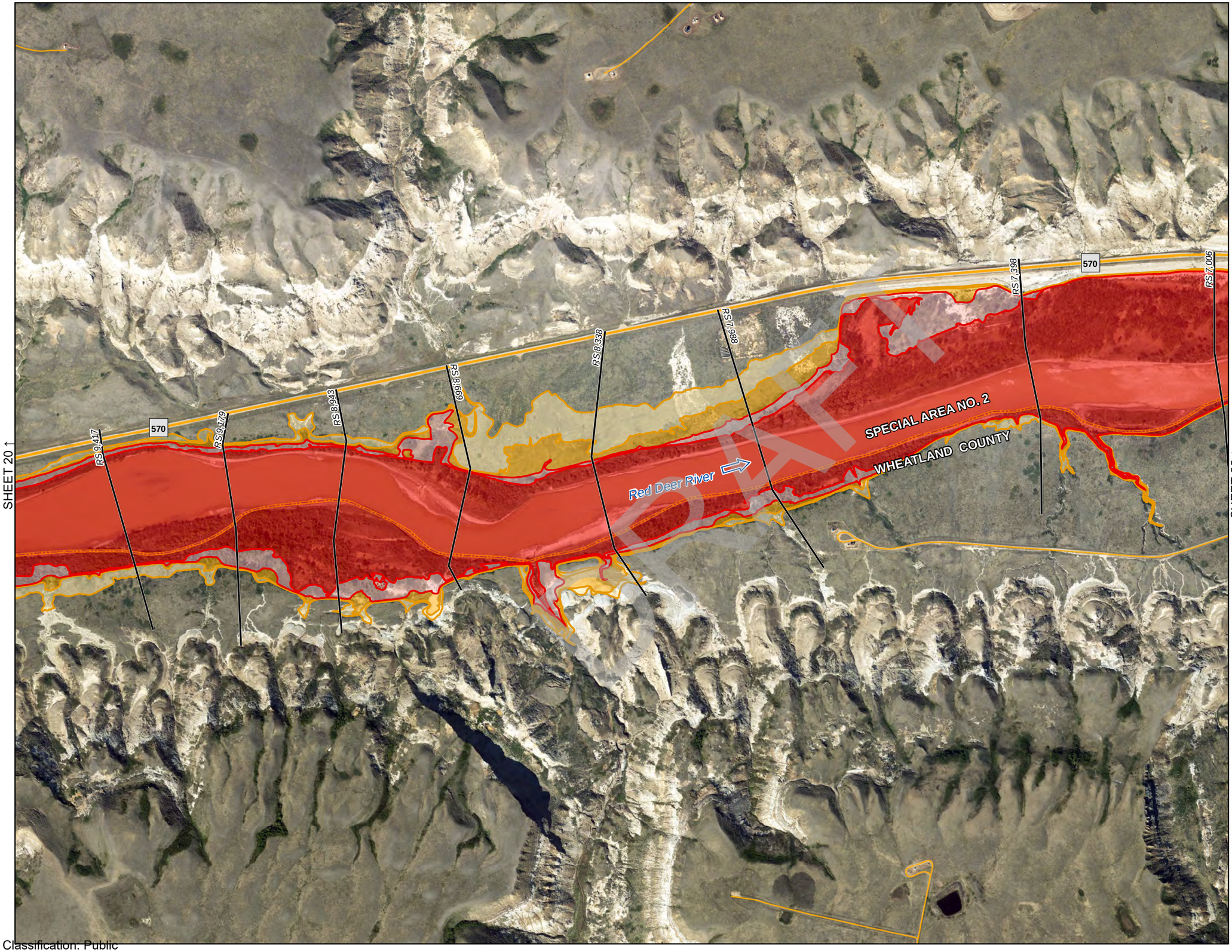
Job: 1003877 | Date: 08-DEC-2022

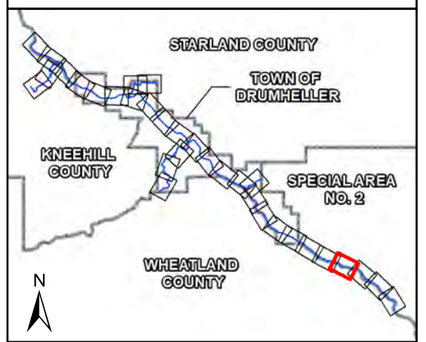
DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 20 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd





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Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

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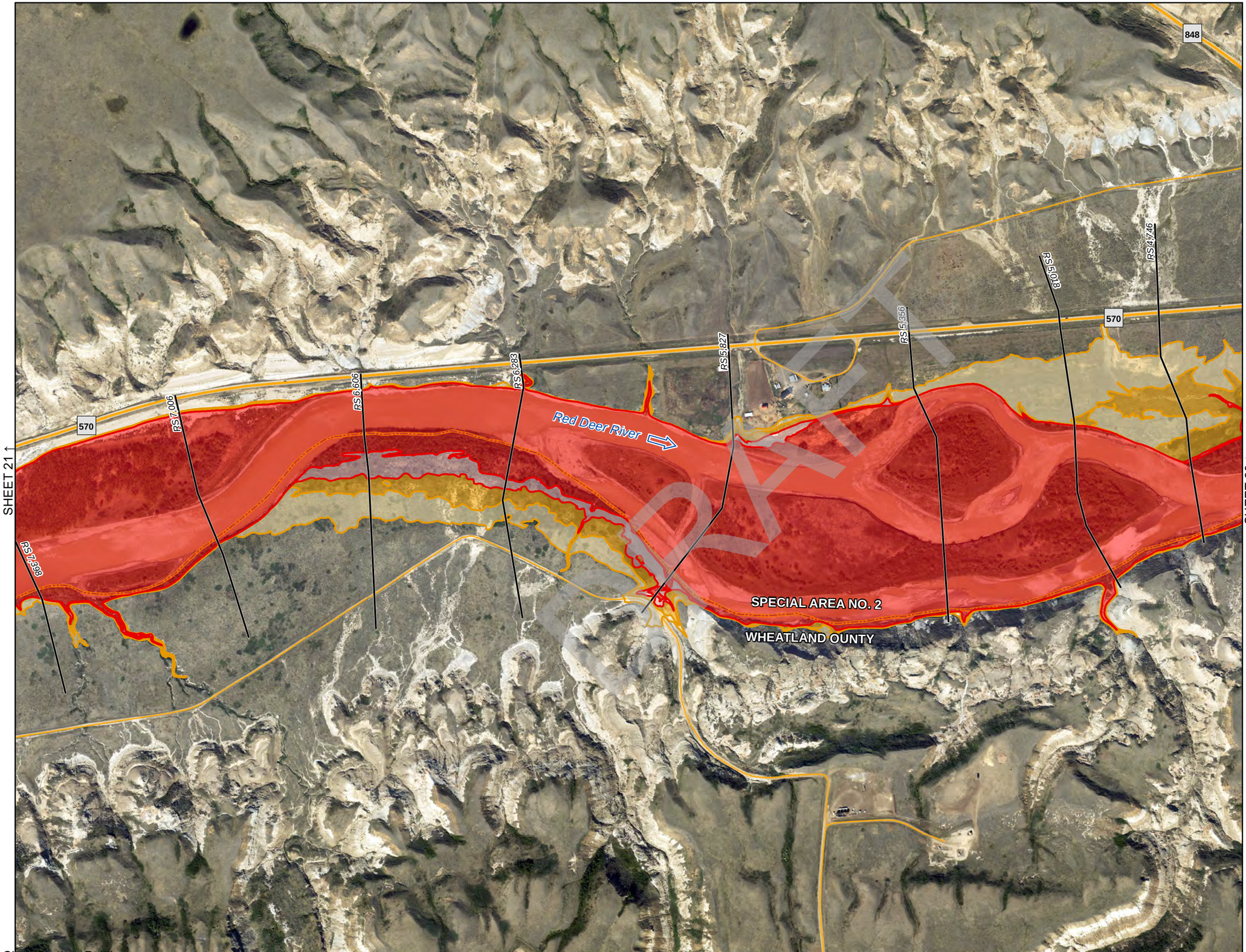
DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 21 OF 32

J:\Y\MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd



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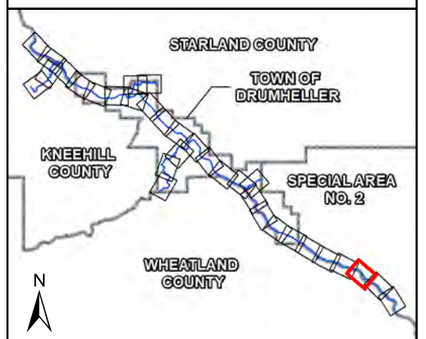

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Engineer	GIS	Reviewer
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Job: 1003877 | *Date: 08-DEC-2022*

DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 22 OF 32

SHEET 22 →

SHEET 24 →

848

570

DOROTHY

CENTER ST

1 ST E

1 ST W

1 AVE N

TWP RD 270B

RGE RD 173

RS 4,746

RS 4,466

RS 4,233

RS 4,018

RS 3,838

RS 3,808

RS 3,752

RS 3,508

RS 3,182

RS 2,961

RS 2,536

RS 2,249

SPECIAL AREA NO. 2

Red Deer River

WHEATLAND COUNTY

HIGHWAY 848 BRIDGE
AT DOROTHY

848

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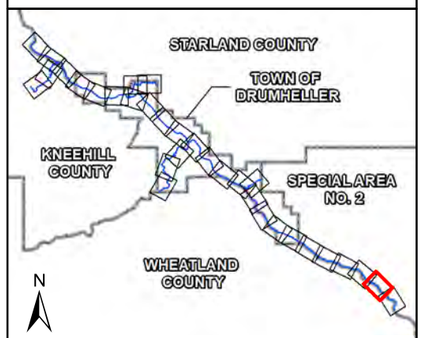

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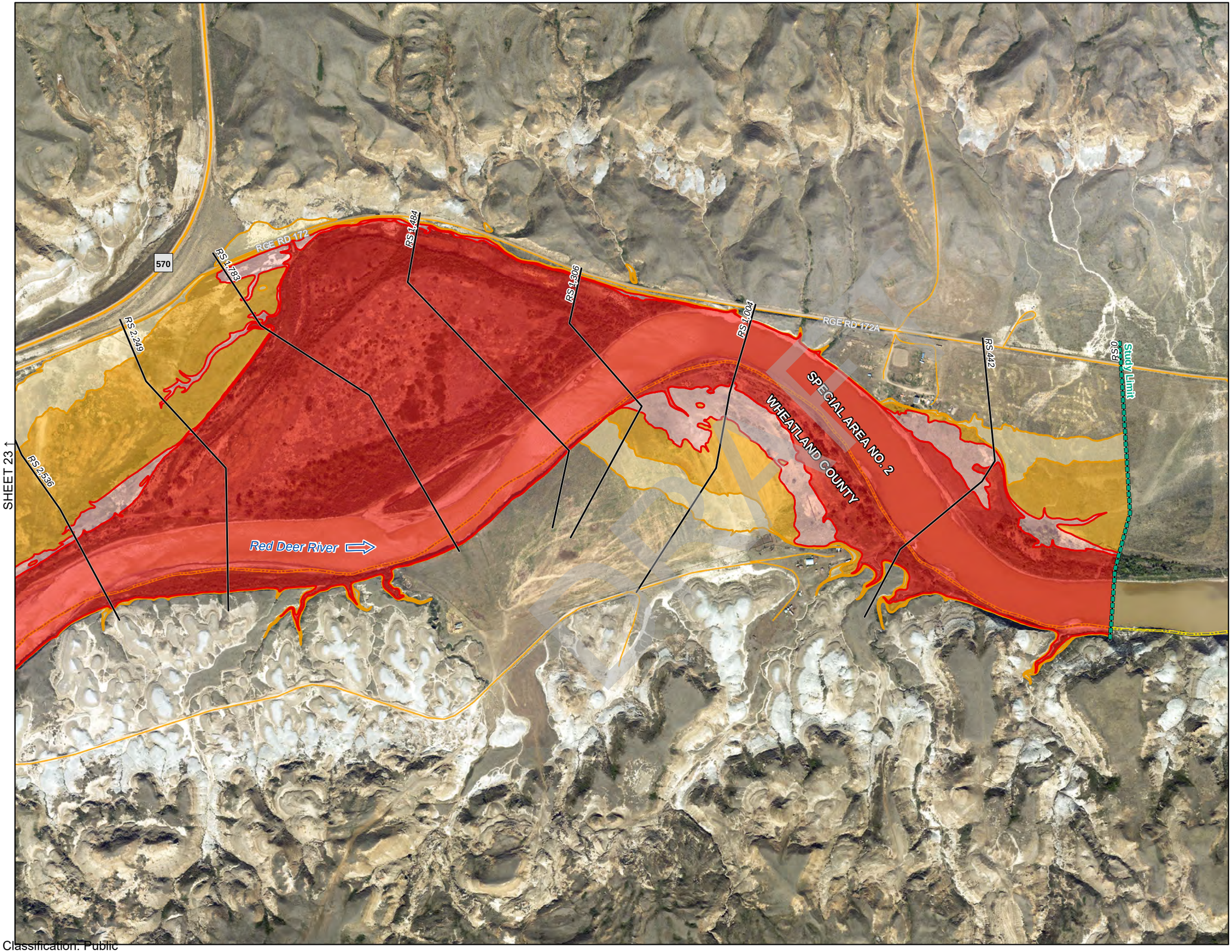
DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 23 OF 32

J:\MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd



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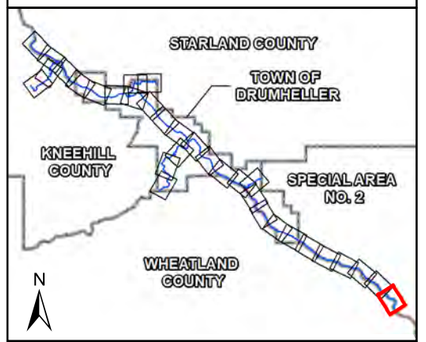

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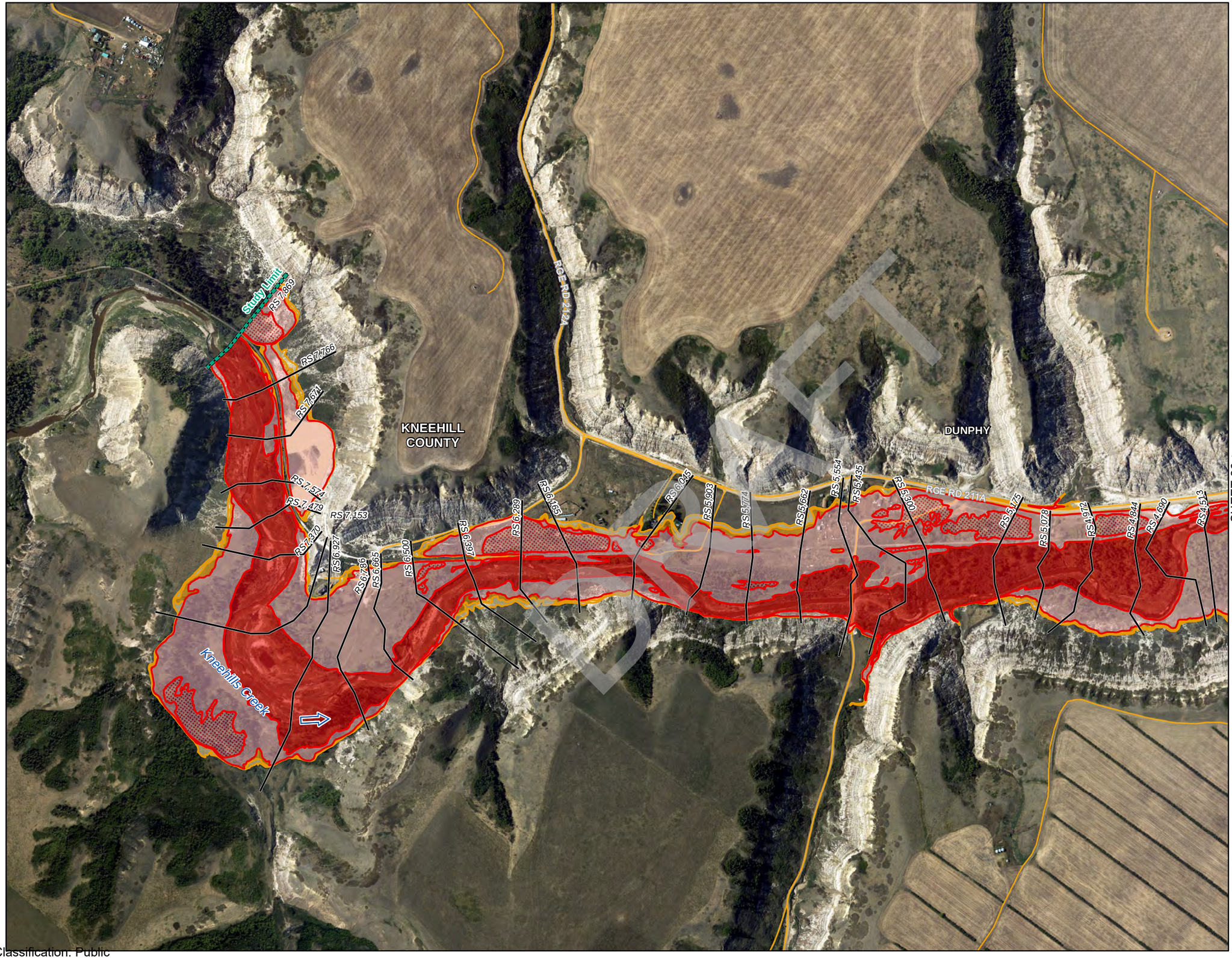
DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 24 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd



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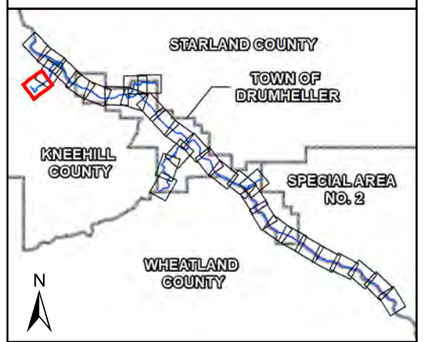

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AMH	JY/MSN	RBA

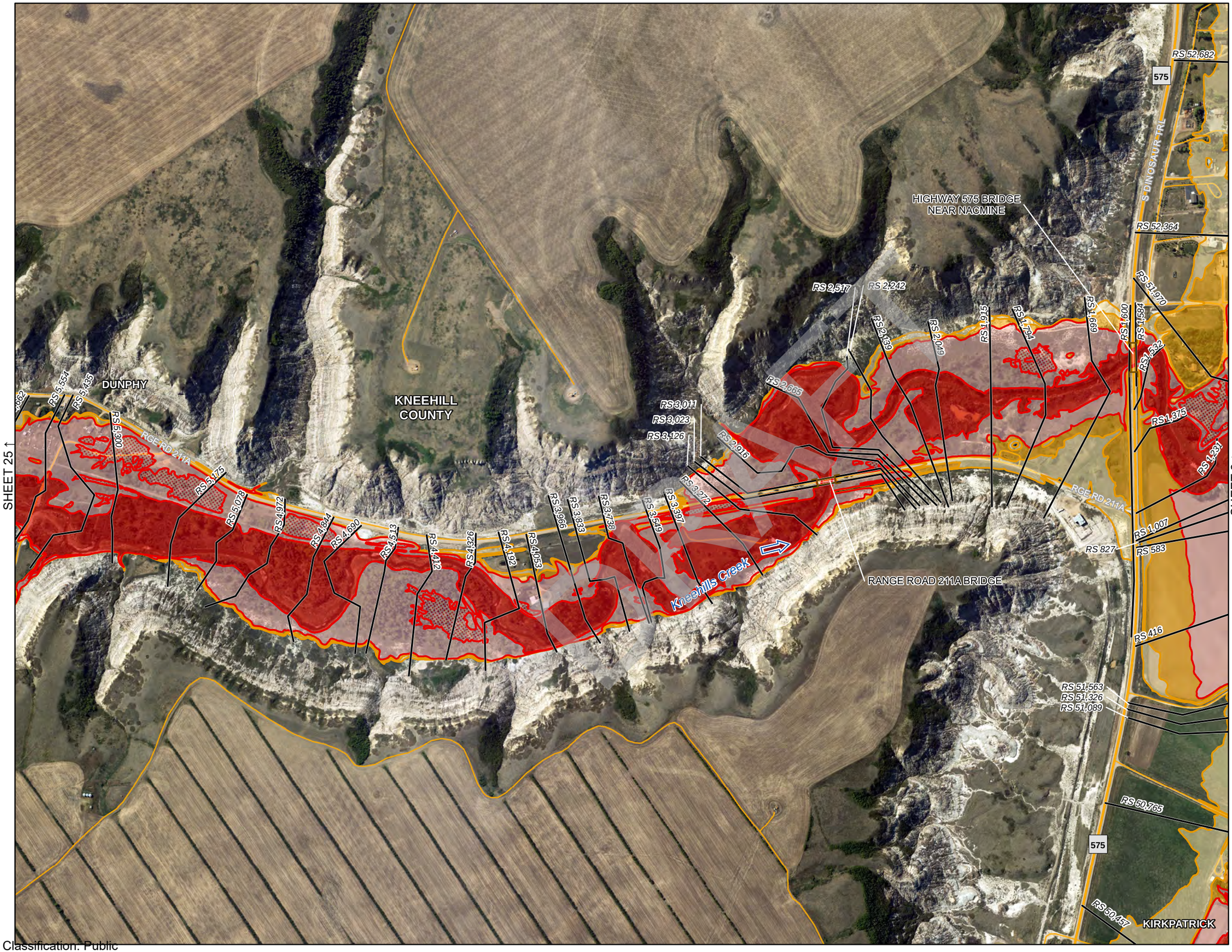
Job: 1003877 | Date: 08-DEC-2022

DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 25 OF 32

J:\JY\MSN_P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd



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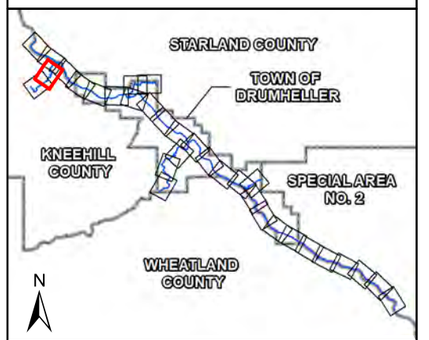


- FLOW DIRECTION
- BRIDGE
- MODEL CROSS SECTION
- CULVERT
- STUDY LIMIT
- FLOOD CONTROL STRUCTURE
- FLOODWAY
- FLOOD FRINGE
- PROTECTED FLOOD FRINGE
- HIGH HAZARD FLOOD FRINGE
- 200-YEAR FLOOD EXTENT
- 500-YEAR FLOOD EXTENT
- MAJOR ROAD
- LOCAL ROAD
- RAILWAY (ABANDONED)
- MUNICIPAL BOUNDARY

SCALE - 1:7,500

0 50 100 200 300 M

Coordinate System: NAD 1983 CSRS 3TM 114;
Vertical Datum: CGVD28 HTv2.0; Units: Metres

Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

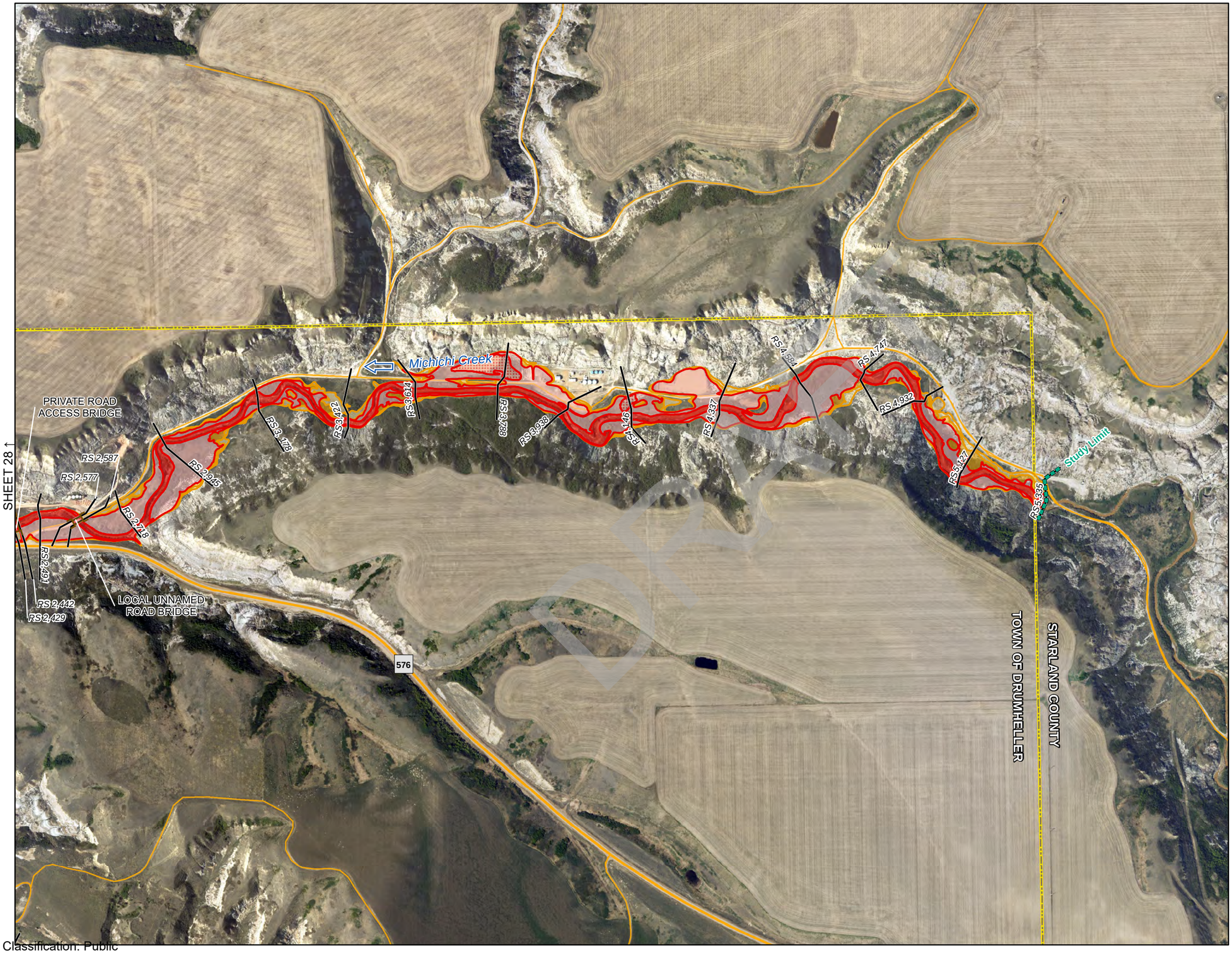
Job: 1003877 | Date: 08-DEC-2022

DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 26 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd



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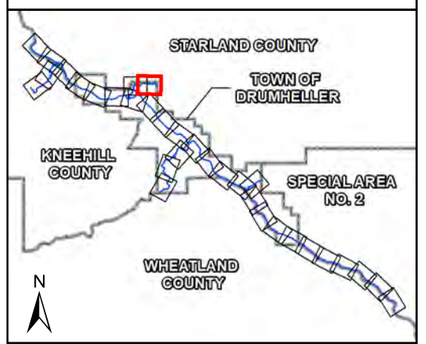

- FLOW DIRECTION
- BRIDGE
- MODEL CROSS SECTION
- CULVERT
- STUDY LIMIT
- FLOOD CONTROL STRUCTURE
- FLOODWAY
- FLOOD FRINGE
- PROTECTED FLOOD FRINGE
- HIGH HAZARD FLOOD FRINGE
- 200-YEAR FLOOD EXTENT
- 500-YEAR FLOOD EXTENT
- MAJOR ROAD
- LOCAL ROAD
- RAILWAY (ABANDONED)
- MUNICIPAL BOUNDARY

SCALE - 1:7,500

0 50 100 200 300 M

N

Coordinate System: NAD 1983 CSRS 3TM 114; Vertical Datum: CGVD28 HTv2.0; Units: Metres

Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

Job: 1003877 | *Date: 08-DEC-2022*

DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 27 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd

STARLAND COUNTY

TOWN OF DRUMHELLER

PRIVATE ROAD ACCESS BRIDGE

RS 2,318

Michichi Creek

RS 3,178

RS 3,422

RS 3,614

RS 2,945

RS 2,719

RS 2,587

RS 2,577

LOCAL UNNAMED ROAD BRIDGE

RS 2,161

RS 2,059

RS 1,999

RS 1,852

RS 2,423

RS 2,441

RS 2,490

RS 1,731

RS 1,554

RS 1,461

HIGHWAY 9 OVER MICHICHI CREEK AT DRUMHELLER

RS 1,358

RS 1,295

RS 1,248

RS 1,170

RS 1,091

RS 1,018

RS 1,001

HIGHWAY 838 BRIDGE IN DRUMHELLER

RS 41,996

RS 41,823

RS 41,644

RS 41,074

Dinosaur RV Park

RS 40,832

RS 40,804

RS 40,748

HOSPITAL DIKE

N DINOSAUR TRL

RS 42,241

RS 42,124

RS 905

RS 782

DIKE A

RS 598

RS 506

RS 41,263

VILLA ST

GROVE AVE

POPLAR ST

BRIDGE ST

GROVE PL

LARCH AVE

DIKE C

RS 40,606

RS 40,517

RS 40,422

Drumheller Health Centre

SHEET 7 ↓

SHEET 27 →

TWP RD 292A

9 N

576

STARLAND COUNTY

TOWN OF DRUMHELLER

KNEEHILL COUNTY

SPECIAL AREA NO. 2

WHEATLAND COUNTY

N

FLOW DIRECTION
BRIDGE
MODEL CROSS SECTION
CULVERT
STUDY LIMIT
FLOOD CONTROL STRUCTURE
FLOODWAY
FLOOD FRINGE
PROTECTED FLOOD FRINGE
HIGH HAZARD FLOOD FRINGE
200-YEAR FLOOD EXTENT
500-YEAR FLOOD EXTENT
MAJOR ROAD
LOCAL ROAD
RAILWAY (ABANDONED)
MUNICIPAL BOUNDARY

SCALE - 1:7,500

0 50 100 200 300 M

N

Coordinate System: NAD 1983 CSRS 3TM 114;
Vertical Datum: CGVD28 HTv2.0; Units: Metres

Engineer	GIS	Reviewer
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Job: 1003877 | Date: 08-DEC-2022

DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 28 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd

KNEEHILL COUNTY
TOWN OF DRUMHELLER
Rosebud River
CN RAIL
TWP RD 280A
Study Limit
RS 10,702
RS 10,485
RS 10,239
RS 10,163
RS 10,045
RS 9,912
RS 9,755
RS 9,668
RS 9,618
RS 9,600
RS 9,580
RS 9,570
RS 9,554
RS 9,408
RS 9,355
RS 9,227
RS 9,116
RS 8,994
RS 8,849
RS 8,745
RS 8,675
RS 8,682
RS 8,689
RS 8,706
RS 8,661
RS 8,553
RS 8,439
RS 8,343
RS 8,281
RS 8,187
RS 8,101
RS 8,080
RS 8,060
RS 8,009
RS 7,937
RS 7,953
RS 7,783
RS 7,641
RS 7,530
RS 7,395
RS 7,326
RS 7,303
RS 7,276
RS 7,246
RS 7,215
RS 7,151
WHEATLAND COUNTY
RGE RD 195A
ABANDONED RAILWAY BRIDGE 9
HIGHWAY 10X BRIDGE NO. 11
ABANDONED RAILWAY BRIDGE 7
WAYNE
JEWELL ST
ATLAS ST
EXCELSIOR AVE
HIGHWAY 10X BRIDGE NO. 9
ABANDONED RAILWAY BRIDGE 8
HIGHWAY 10X BRIDGE NO. 10
SHEET 30 →
DRAFT

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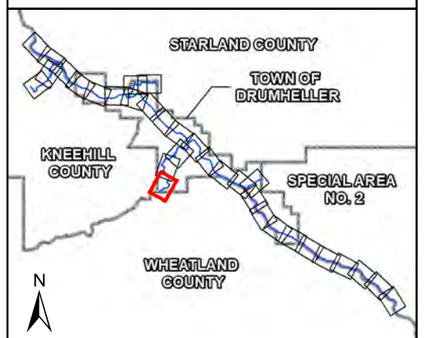

- FLOW DIRECTION
- BRIDGE
- MODEL CROSS SECTION
- CULVERT
- STUDY LIMIT
- FLOOD CONTROL STRUCTURE
- FLOODWAY
- FLOOD FRINGE
- PROTECTED FLOOD FRINGE
- HIGH HAZARD FLOOD FRINGE
- 200-YEAR FLOOD EXTENT
- 500-YEAR FLOOD EXTENT
- MAJOR ROAD
- LOCAL ROAD
- RAILWAY (ABANDONED)
- MUNICIPAL BOUNDARY

SCALE - 1:7,500

0 50 100 200 300 M

Coordinate System: NAD 1983 CSRS 3TM 114;
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Engineer	GIS	Reviewer
AMH	JY/MSN	RBA

Job: 1003877 | Date: 08-DEC-2022

DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 29 OF 32

J:\MSN_P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd

KNEEHILL COUNTY
TOWN OF DRUMHELLER
HIGHWAY 10X BRIDGE NO. 6
HIGHWAY 10X BRIDGE NO.5
HIGHWAY 10X BRIDGE NO. 4
HIGHWAY 10X BRIDGE NO. 3
HIGHWAY 10X BRIDGE NO. 7
ABANDONED RAILWAY BRIDGE 5
ABANDONED RAILWAY BRIDGE 4
ABANDONED RAILWAY BRIDGE 6
ABANDONED RAILWAY BRIDGE 3
HIGHWAY 10X BRIDGE NO. 8
HIGHWAY 10X BRIDGE NO. 9
ABANDONED RAILWAY BRIDGE 7
WAYNE
Rosebud River
CN RAIL
CANADIAN PACIFIC RAILWAY
10X
RS 5,872
RS 5,879
RS 5,886
RS 5,904
RS 5,776
RS 5,851
RS 5,669
RS 5,616
RS 5,517
RS 5,473
RS 5,378
RS 5,288
RS 5,199
RS 5,065
RS 4,997
RS 4,980
RS 4,907
RS 4,771
RS 4,599
RS 4,530
RS 4,509
RS 4,501
RS 4,480
RS 4,409
RS 4,313
RS 4,153
RS 4,037
RS 6,419
RS 6,450
RS 6,469
RS 6,382
RS 6,361
RS 6,278
RS 6,166
RS 5,969
RS 6,532
RS 6,641
RS 6,774
RS 6,913
RS 7,151
RS 7,246
RS 7,276
RS 7,303
RS 7,326
RS 7,395
RS 7,530
RS 7,641
RS 7,789
RS 7,937
RS 7,958
RS 8,009
RS 8,060
RS 8,080
RS 8,101
RS 8,187
SHEET 29 →
SHEET 31 →
DRAFT

STARLAND COUNTY
TOWN OF DRUMHELLER
KNEEHILL COUNTY
SPECIAL AREA NO. 2
WHEATLAND COUNTY
N

FLOW DIRECTION
BRIDGE
MODEL CROSS SECTION
CULVERT
STUDY LIMIT
FLOOD CONTROL STRUCTURE
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FLOOD FRINGE
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Engineer	GIS	Reviewer
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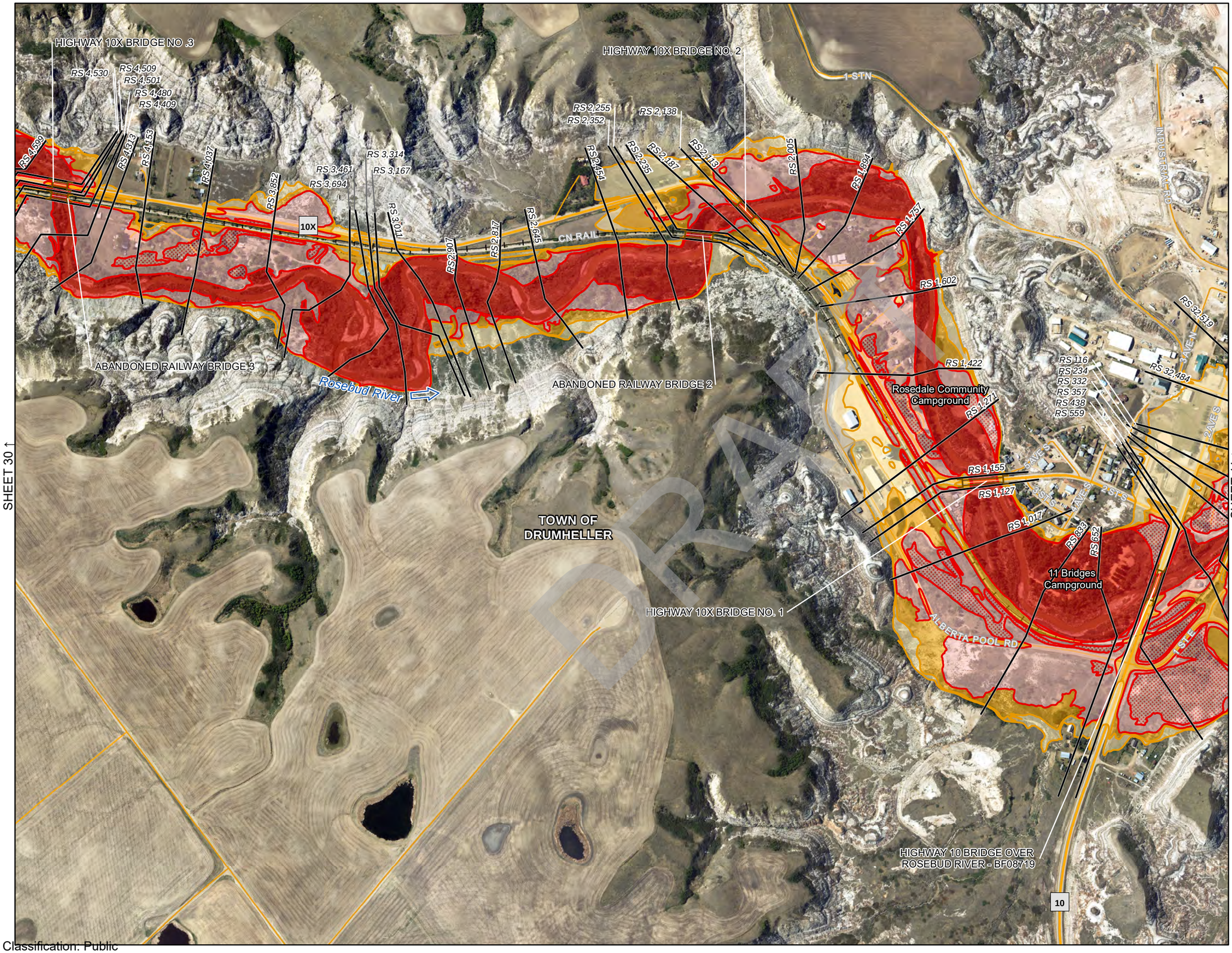
Job: 1003877 | Date: 08-DEC-2022

DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 30 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd



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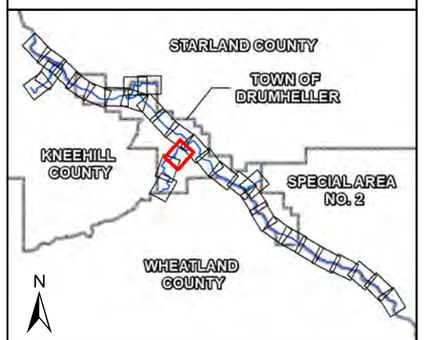

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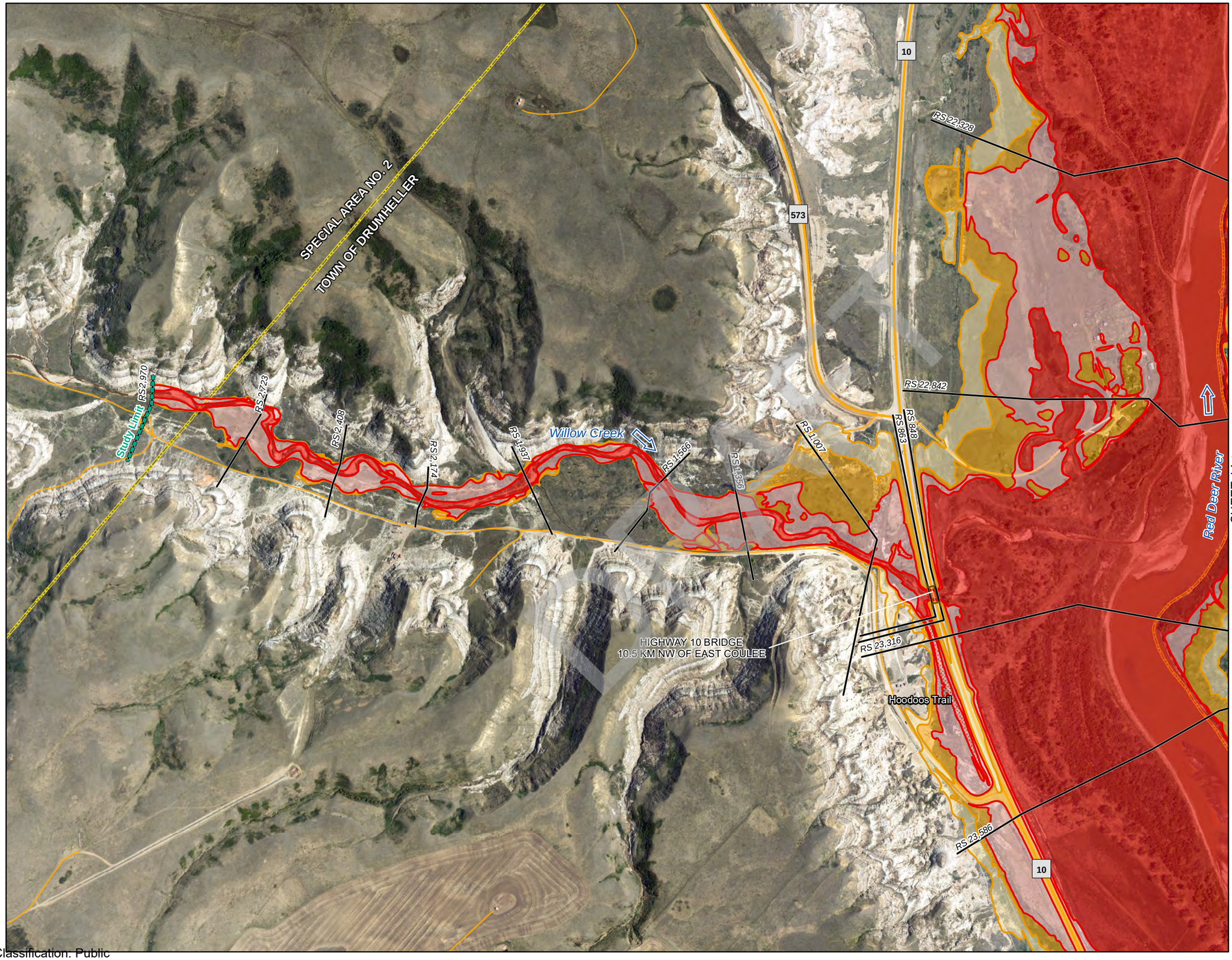
DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 31 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd



SHEET 14 ↓

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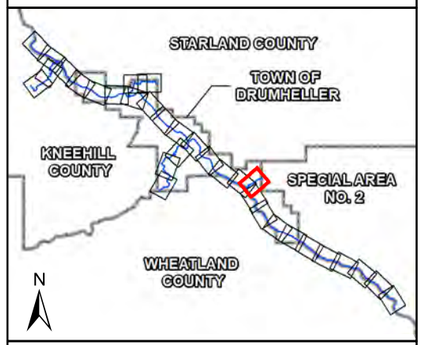

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DRUMHELLER RIVER HAZARD STUDY

DESIGN FLOOD HAZARD MAP

SHEET 32 OF 32

JY/MSN, P:_Projects (Active)\1003877 Drumheller River Hazard Study\90 GIS\1003877_2022_JY_Map_T600_FloodHazard.mxd