



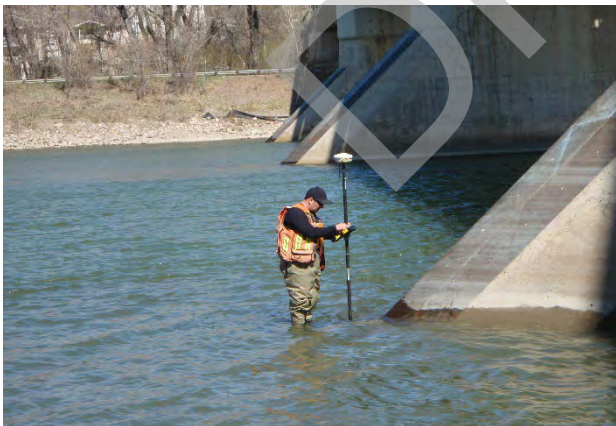
MEDICINE HAT RIVER HAZARD STUDY

GOVERNING DESIGN FLOOD HAZARD MAP PRODUCTION

FINAL REPORT



Prepared for:



20 May 2022

NHC Ref. No. 1003094



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Prepared for:

Alberta Environment and Parks
Edmonton, Alberta

Prepared by:

Northwest Hydraulic Consultants Ltd.
Edmonton, Alberta

20 May 2022

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This report has been prepared by Northwest Hydraulic Consultants Ltd. (NHC) in accordance with generally accepted engineering practices, for the benefit of Alberta Environment and Parks for specific application to the Medicine Hat River Hazard Study in Alberta. The information and data contained herein represent the best professional judgment of NHC, based on the knowledge and information available to NHC at the time of preparation.

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EXECUTIVE SUMMARY

Alberta Environment and Parks retained Northwest Hydraulic Consultants Ltd. in August 2017 to complete a river hazard study for the City of Medicine Hat and surrounding areas of Cypress County, including the Town of Redcliff and the Hamlet of Desert Blume. The river hazard study area includes 26 km of the South Saskatchewan River below Ross Creek, 19 km of the South Saskatchewan River above Ross Creek, 24 km of Ross Creek above the confluence with the South Saskatchewan River, 24 km of Seven Persons Creek above the confluence with Ross Creek, and 9.6 km of Bullshead Creek above the confluence with Ross Creek.

The study is being conducted under the provincial Flood Hazard Identification Program. The overall objectives of the study are to enhance public safety and to reduce potential future flood damages and disaster assistance costs.

The Medicine Hat River Hazard Study is comprised of eight major project components. This report summarizes the work of the sixth component, **Governing Design Flood Hazard Map Production**. The governing design flood hazard map depicts the floodway and flood fringe based on the information resulting from the floodway criteria mapping for the open water design flood. The governing 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; governing design flood water surface TIN; and governing design flood depth grid, and elevation grid.

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. James Choles, P.Eng., CFM managed and directed the Medicine Hat River Hazard Study on behalf of Alberta Environment and Parks.

The following NHC personnel were part of the study team and participated in the governing design flood hazard mapping component of the study:

- Robyn Andrishak (Project Manager) – responsible for the overall direction of the project and provided advice and senior review throughout the governing design flood hazard map production.
- Dan Healy (Governing Design Flood Hazard Map Production Lead) – co-authored this report and was responsible for selecting the governing design flood levels and determination of the floodway and flood fringe limits, in consultation with AEP .
- Makamum Mahmood (Project Engineer) – co-authored this report and assisted with selecting the governing design flood levels and determination of the floodway and flood fringe limits.
- Rebecca Himsl and Jerry Yan (GIS Analyst) – responsible for creation of base maps and map production.

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1 INTRODUCTION

1.1 Study Objectives

The overall objective of the Medicine Hat River Hazard Study is to identify and assess river and flood hazards along the South Saskatchewan River, Ross Creek, Seven Persons Creek, and Bullshead Creek within the City of Medicine Hat and surrounding areas of Cypress County, including the Town of Redcliff and the Hamlet of Desert Blume. 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 the eight major study components listed below. A report and associated deliverables have been prepared for each individual study component.

- 1) Survey and Base Data Collection
- 2) Open Water Hydrology Assessment
- 3) Hydraulic Model Creation and Calibration
- 4) Open Water Flood Inundation Map Production
- 5) Open Water Flood Hazard Identification
- 6) Governing Flood Hazard Map Production
- 7) Flood Risk Assessment and Inventory
- 8) Channel Stability Investigation

This report summarizes the work of the sixth component – **Governing Design Flood Hazard Map Production**. The determination of the governing design flood and development of the governing design flood hazard map, and associated deliverables, support development of the statistics pertaining to the floodway and flood fringe required for the flood risk assessment.

1.2 Study Area and Reach

The City of Medicine Hat is located approximately 290 km southeast of Calgary and approximately 45 km west of the Alberta-Saskatchewan border. **Figure 1** shows the location and boundaries of the river hazard study area and contributing river basins. The river hazard study area includes the following reaches: 26 km of the South Saskatchewan River below Ross Creek; 19 km of the South Saskatchewan River above Ross Creek; 24 km of Ross Creek above the confluence with the South Saskatchewan River;

24 km of Seven Persons Creek above the confluence with Ross Creek; and 9.6 km of Bullshead Creek above the confluence with Ross Creek. Municipalities along these study reaches include the City of Medicine Hat, the Town of Redcliff, the Hamlet of Desert Blume, and Cypress County.

The contributing river basins cover an area of about 61,500 km², extending from the headwaters in the Rocky Mountains to the downstream boundary of the river hazard study area. Major upstream rivers include the Bow and Oldman rivers, which join together approximately 100 km upstream of Medicine Hat to form the South Saskatchewan River. The gross drainage areas of the Bow River and Oldman River basins are 25,600 km² and 28,300 km², respectively. The Bow and Oldman rivers generally flow southeast and east through the Foothills and Grassland natural regions. Most of the runoff from these two sub-basins is typically derived from spring snowmelt augmented by rainfall within the Rocky Mountain and Foothills portions of the basin. The Grassland Region is the largest region within the South Saskatchewan River basin in Alberta, extending from just west of Calgary to the Saskatchewan border. It is the warmest and driest region in Alberta.

The Ross Creek sub-basin has a gross drainage area of 4,790 km² and includes Ross Creek, Seven Persons Creek, and Bullshead Creek. The headwaters of the sub-basin are located in the Cypress Hills, southeast of Medicine Hat. While high flows in this sub-basin more commonly occur in the spring due to snowmelt runoff with or without rainfall, intense summer rainstorm events can often result in high annual peak flows.

A number of dams and flow diversion structures have been developed throughout the South Saskatchewan River basin for various purposes including: irrigation; low-flow augmentation; water supply for industrial, municipal, and domestic users; and hydropower. These developments have altered the natural flow regime in the South Saskatchewan River basin since the beginning of the twentieth century. It is important to note, however, that the existing system was not designed to mitigate floods.

2 GOVERNING DESIGN FLOOD DETERMINATION

2.1 Open Water Design Flood Details

The open water design flood adopted for this study was the flood associated with a natural (non-regulated) peak instantaneous discharge that has a one percent chance of being equaled or exceeded in any given year, which is commonly referred to as the “one in one hundred year flood” (also denoted as the 100-year flood). Information pertaining to the open water design flood is detailed in the *Open Water Flood Hazard Identification* study report (NHC, 2022a).

2.2 Governing Design Flood Limiting Criteria

The governing design flood is determined on a reach by reach basis, with the limiting criteria being the governing flooding mechanism that produces higher design flood levels. The flooding mechanisms normally considered to govern are the 100-year open water flood or the 100-year ice jam flood; in some cases a significant flood of record that has been well documented may also be considered. 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 relative to open water flooding. The 100-year open water flood was used to define the governing design flood for the Medicine Hat River Hazard Study – this is the most commonly adopted design flood for flood hazard studies in Alberta.

2.3 Governing Design Flood Profile

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. Information pertaining to the 100-year open water design flood is detailed in the *Open Water Flood Hazard Identification* study report (NHC, 2022a). **Figure 2** through **Figure 5** provide charts of the governing design flood profiles on the South Saskatchewan River, Seven Persons Creek, Bullshead Creek, and Ross Creek, respectively. A summary of the governing design flood levels is provided in **Appendix A**.

3 GOVERNING DESIGN FLOOD HAZARD MAP PRODUCTION

The governing design flood hazard maps divide the governing design flood extents into floodway and flood fringe zones (which include the high hazard flood fringe and protected flood fringe areas). The information used to create the governing design flood hazard maps was based on the open water flood hazard mapping information detailed in the *Open Water Flood Hazard Identification* study report (NHC, 2022a).

The limits of the floodway were delineated by the floodway boundary developed for the open water floodway criteria map. Areas of high ground or areas of depth less than 1 m inside the floodway boundaries were included as part of the floodway.

The open water design flood extent developed for the open water floodway criteria map was adjusted to create the flood fringe. The limits of the flood fringe followed the extent of direct inundation of the open water design flood. Areas of high ground within the extent of direct inundation (and outside of the floodway) were preserved and were not indicated as flood fringe in the flood hazard map. The flood fringe represented areas with shallower, slower, and less destructive flooding during the 100-year design flood. However, areas with deep or fast moving water which excluded from the floodway defined as high hazard flood fringe within the flood fringe. Areas at risk behind flood berms were mapped as protected flood fringe areas.

The resulting governing flood hazard maps are provided as **Appendix B**.

3.1 Areas in the Floodway

Developed areas or other areas of interest within the floodway included:

- buildings near the water treatment plant upstream of Highway 1;
- Kiwanis River Park;
- portions of Riverside area along 1st St NE behind the flood control structure;
- Police Point Park;
- portions of Desert Blume Golf Course; and
- buildings south of CP rail near Factory St SE.

3.2 Areas in the High Hazard Flood Fringe

Areas of interest within the high hazard flood fringe included:

- portions of Harlow behind the flood control structure;
- portions of Riverside area behind the flood control structure extended to 1 St NW;

- Athletic Park, River Park, Lions Park and adjacent areas behind Lions Park flood control structure;
- Strathcona Island Park;
- portions of Cottonwood Coulee Golf Course;
- portions of Kin Coulee Park;
- buildings around Mill St SE and Smelter Ave SE;
- portions of North Flats adjacent to Ross Creek; and,
- portions of the industrial areas within South Flats.

3.3 Areas in the Protected Flood Fringe

Following areas are within the protected flood fringe area:

- power plant natural area; and
- portions of North Flats.

3.4 Areas in the Flood Fringe

- Eco Dale Regional Park;
- portions of Harlow behind the flood control structure;
- portions of Riverside area behind the flood control structure extended beyond 2 St NE;
- portions of North Flats;
- portions of Desert Blume Golf Course;
- portions of Cottonwood Coulee Golf Course;
- portions of Paradise Valley Coulee Golf Course;
- portions of Kin Coulee Park;
- areas north of Kipling St SE; and,
- portions of South Flats.

Additional information pertaining to areas within the flood hazard area is summarized within the ***Flood Risk Inventory and Assessment*** study report (NHC, 2022b).

4 GOVERNING DESIGN FLOOD GRIDS

Flood depth and water surface elevation grids were prepared for the governing design flood and provided with the GIS deliverables for this study component, along with the WSE TINs and inundation extent polygons. A description of the flood grids is provided below.

4.1 Water Surface Elevation Grids

For the governing flood scenario, the adjusted WSE TINs 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 metres are provided as 32-bit floating point grid cell values. The WSE grids at this stage were used to compute the flood depth grids.

As a final step, the inundation extent polygons generated from the flood depth grids were used to clip the WSE grids 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.

WSE grids are 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.

4.2 Flood Depth Grids

For the governing 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 grids are 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 water surface 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 should not be considered accurate.

5 CONCLUSIONS

The objectives of this study were to assess river and flood-related hazards along the modelled reach of the South Saskatchewan River, Ross Creek, Seven Persons Creek and Bullshead Creek that includes the City of Medicine Hat, the Town of Redcliff, the Hamlet of Desert Blume, and Cypress County. The Medicine Hat River Hazard Study was divided into eight major project components. This report summarizes the work of the **Governing Design Flood Hazard Map Production** component, for which the floodway, high hazard flood fringe, protected flood fringe and flood fringe areas have been identified in accordance with provincial FHIP guidelines (Alberta Environment, 2011) and incorporates technical changes implemented in 2021 regarding how floodways are mapped in Alberta. The reports for previous work components should also be read in conjunction with this report, as they provide additional pertinent supporting information.

The governing design flood hazard map depicts the floodway, high hazard flood fringe, protected flood fringe, and flood fringe, and associated flood hazard boundary. The open water design flood was the governing condition for all the modelled reaches. And thus the flood hazard map information relied on the information developed for the open water floodway criteria map.

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6 REFERENCES

Alberta Environment. 2011. Flood Hazard Identification Program Guidelines – July 2011.

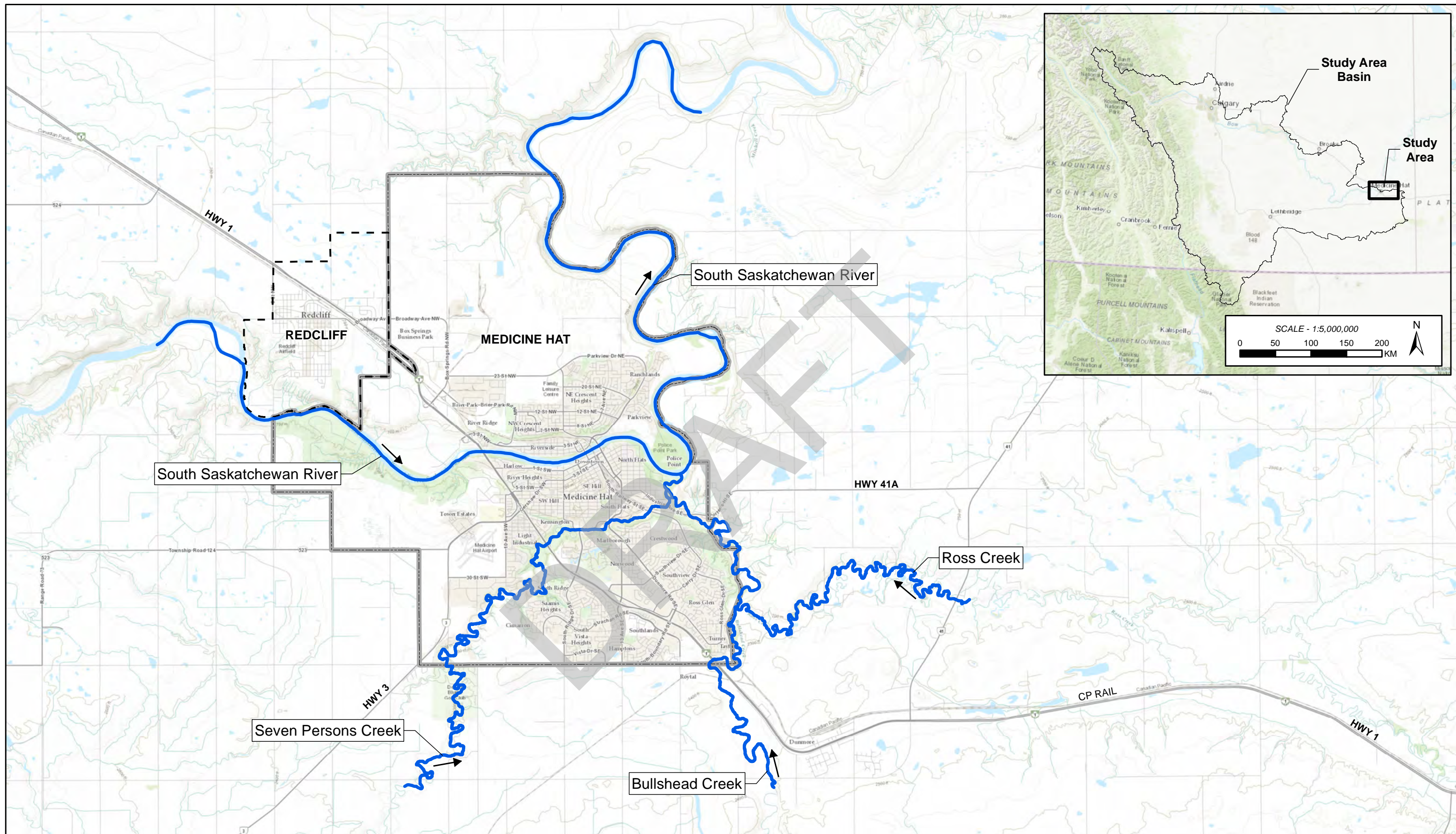
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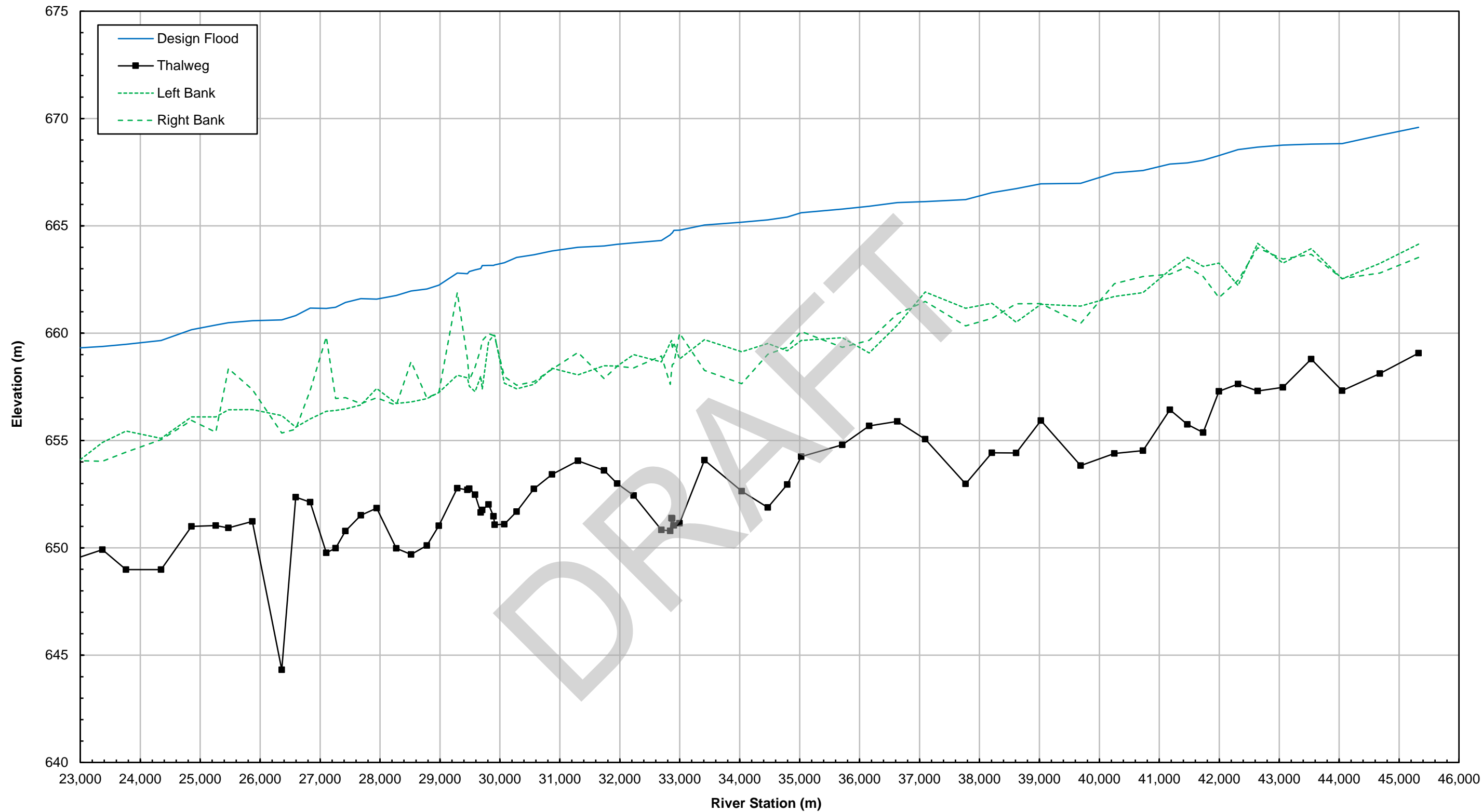
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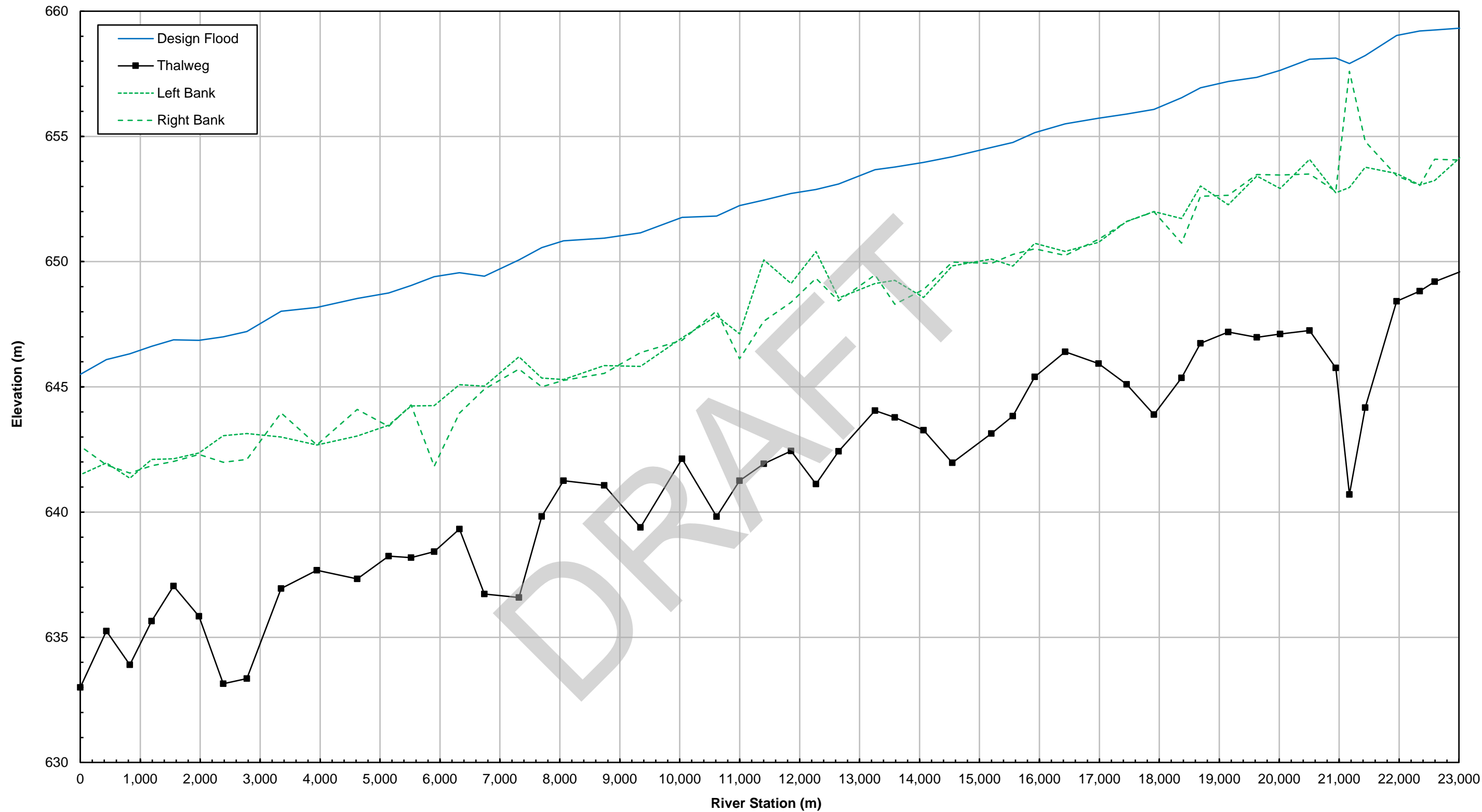
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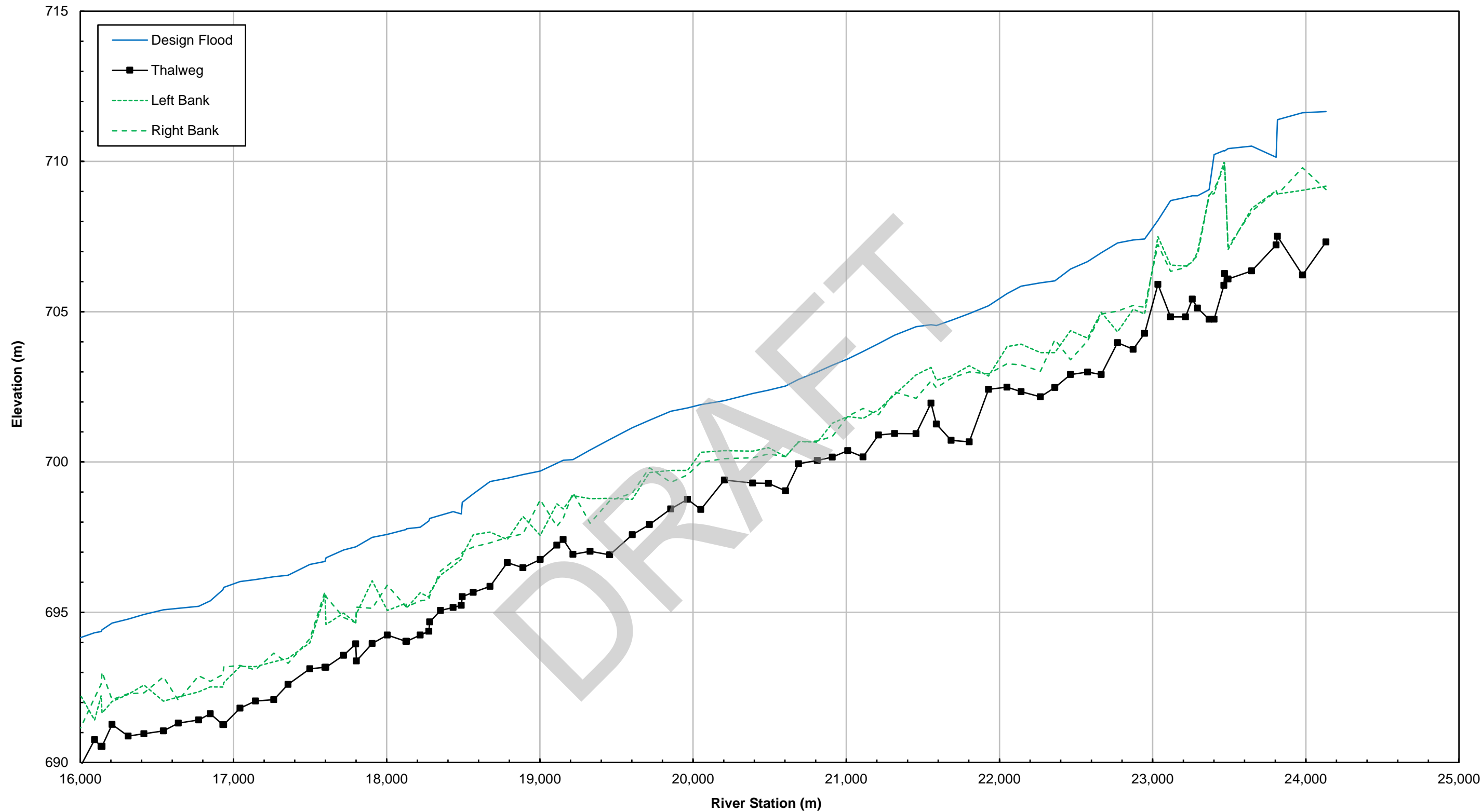
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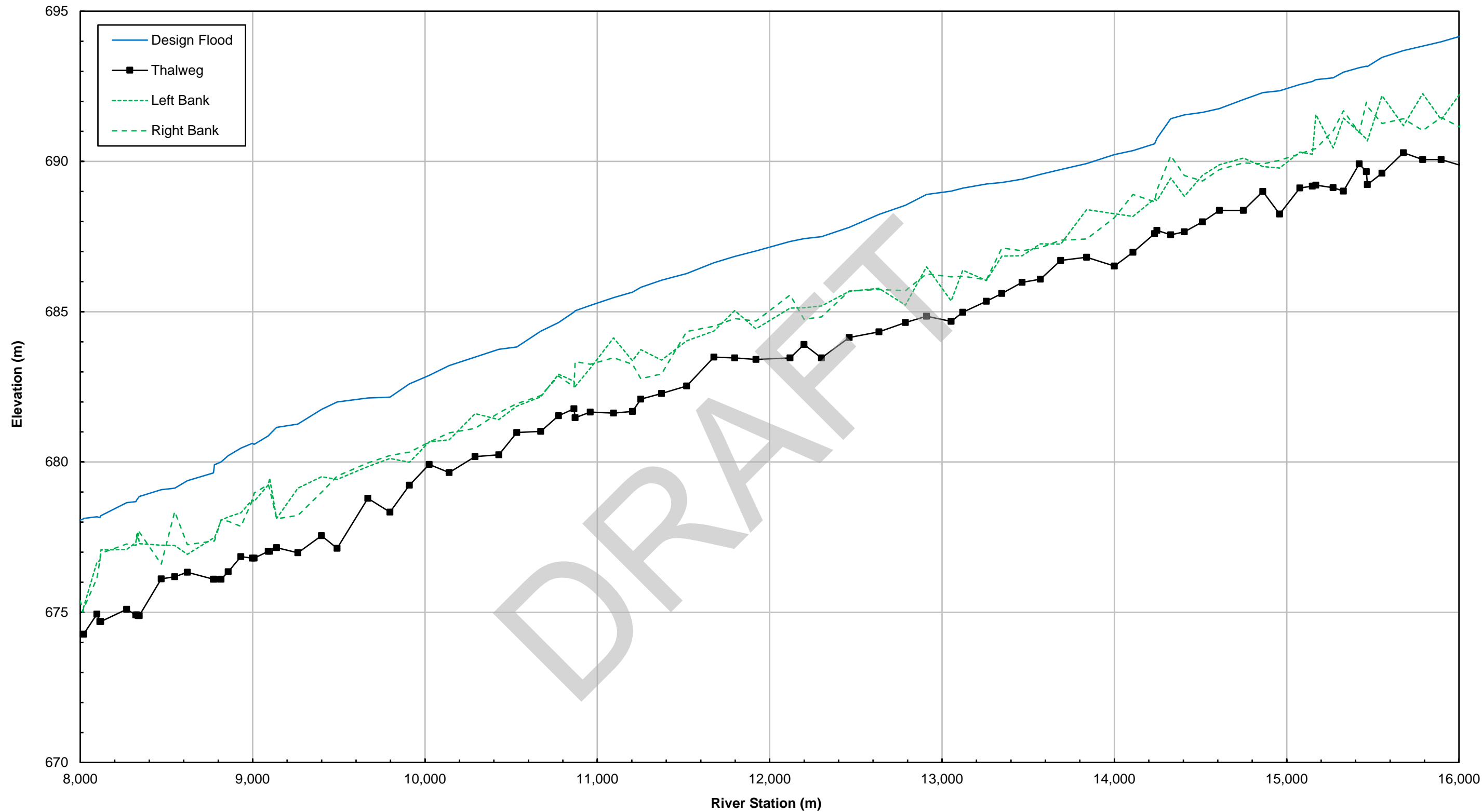
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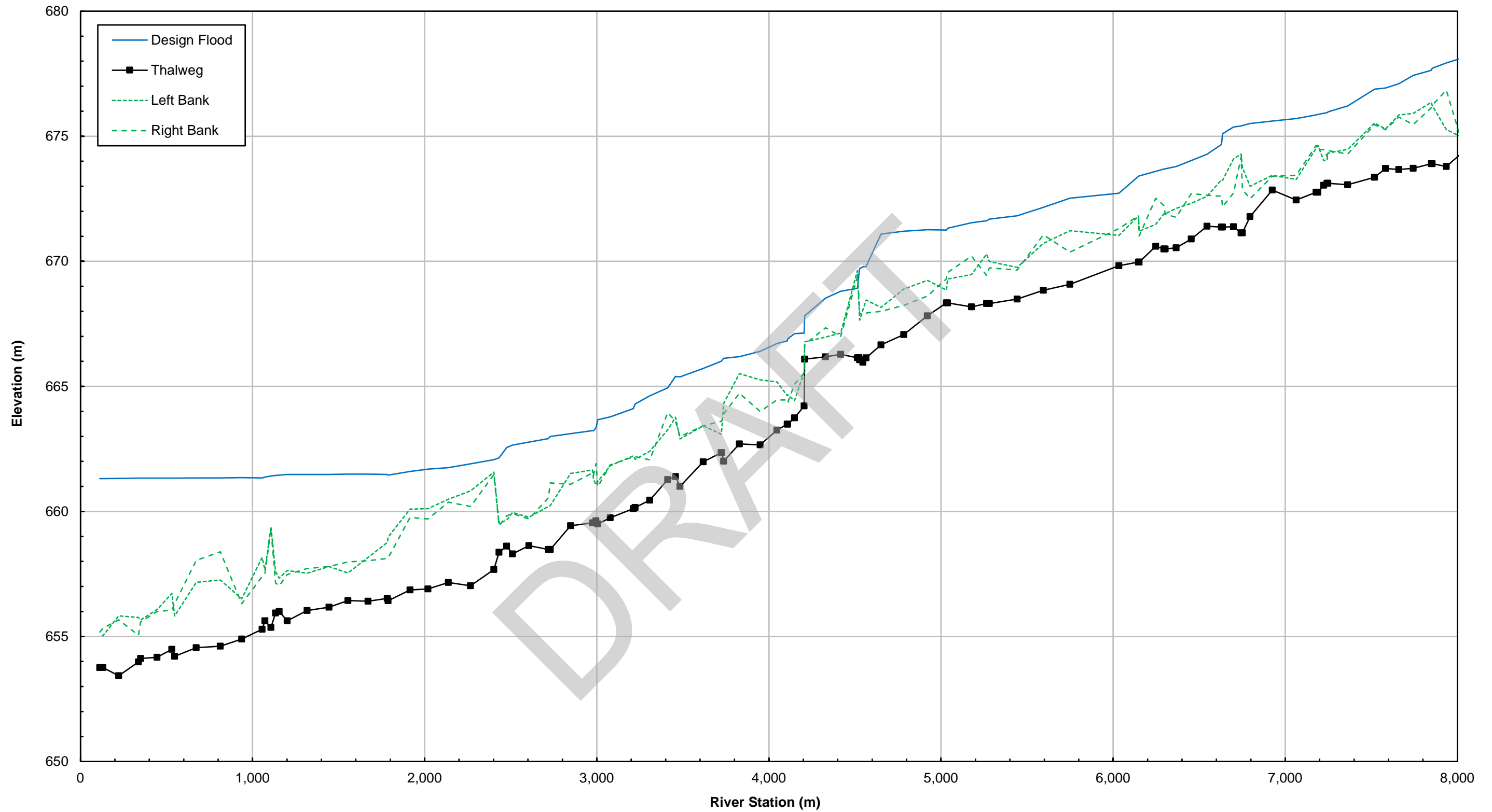


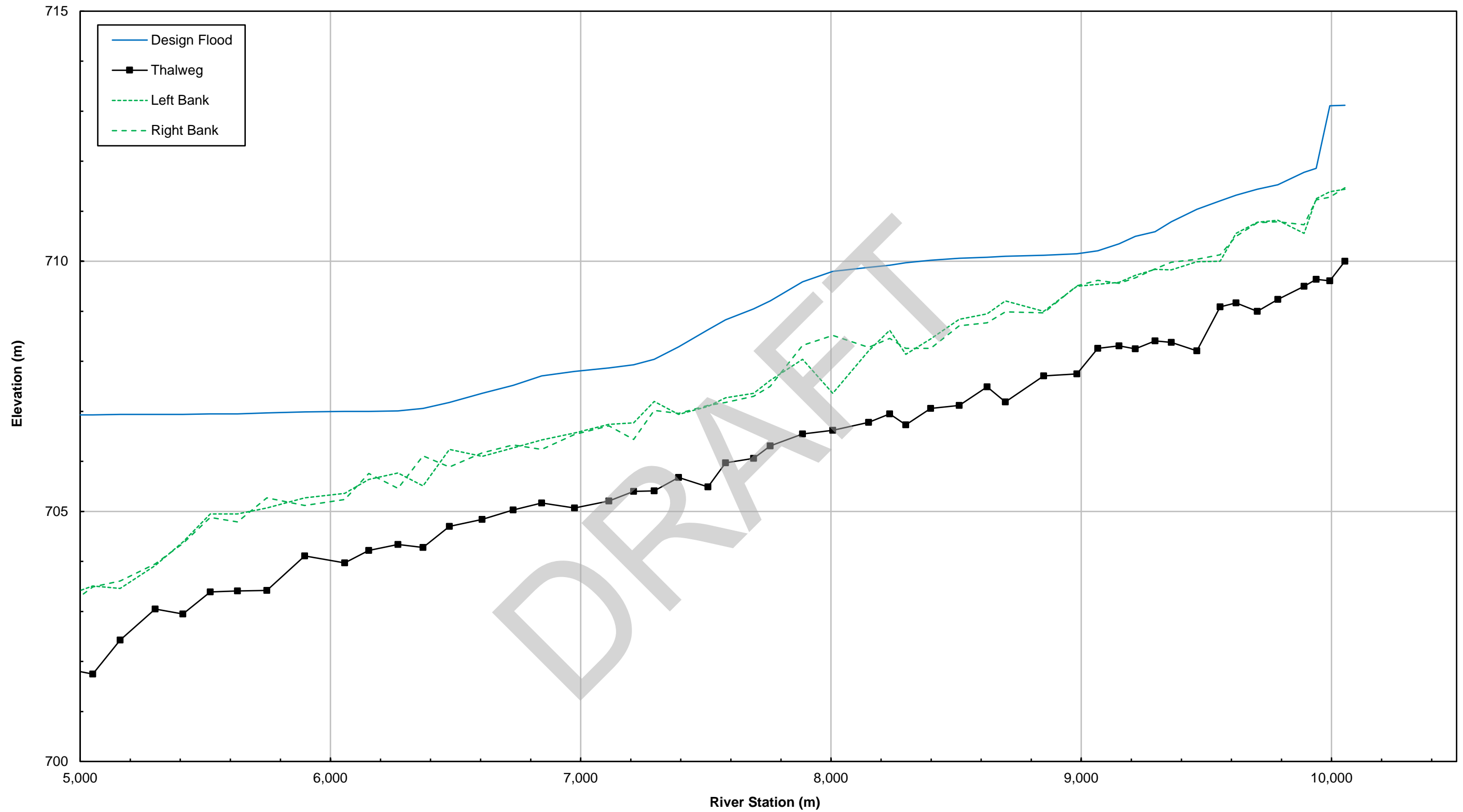


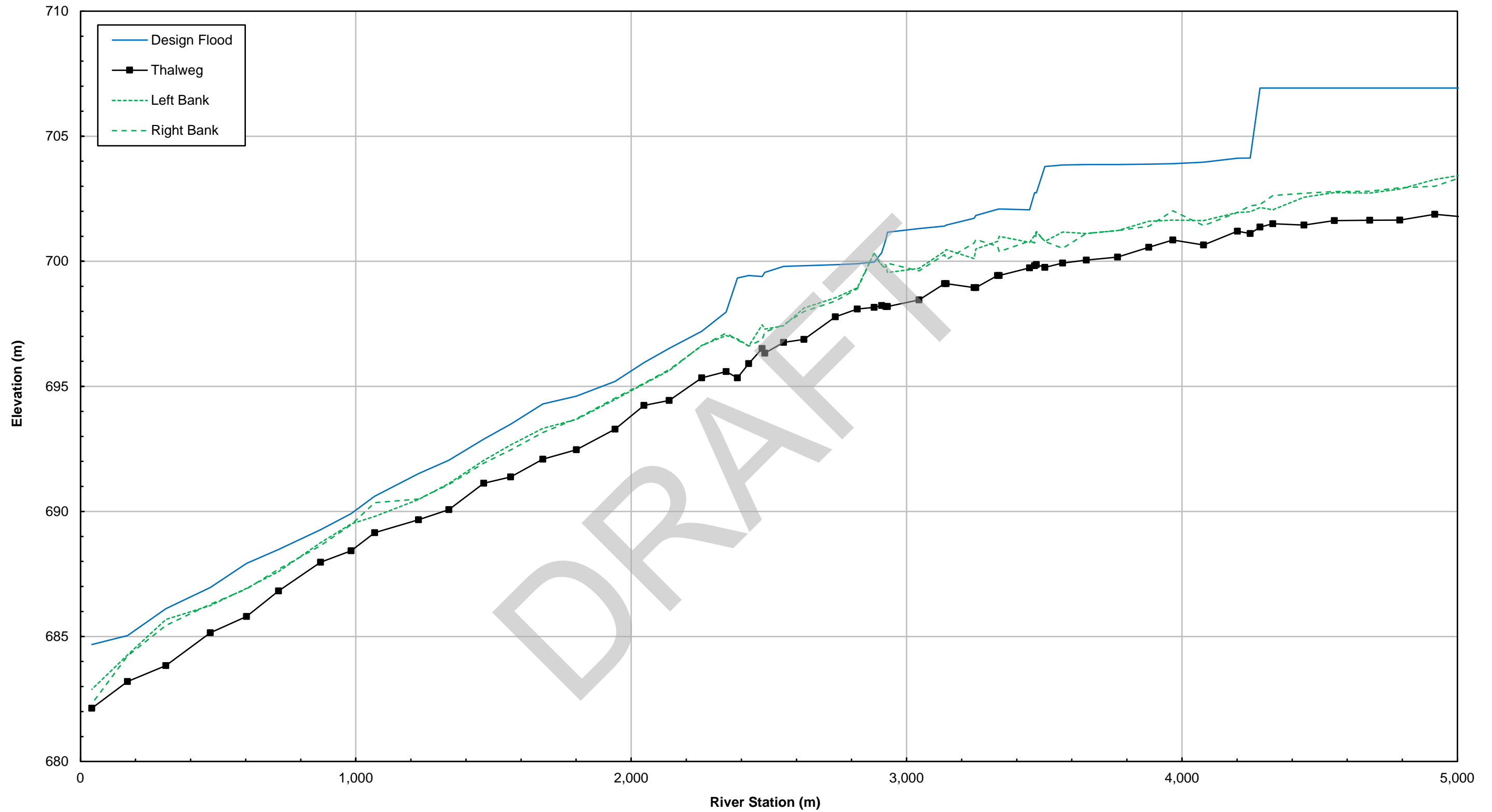




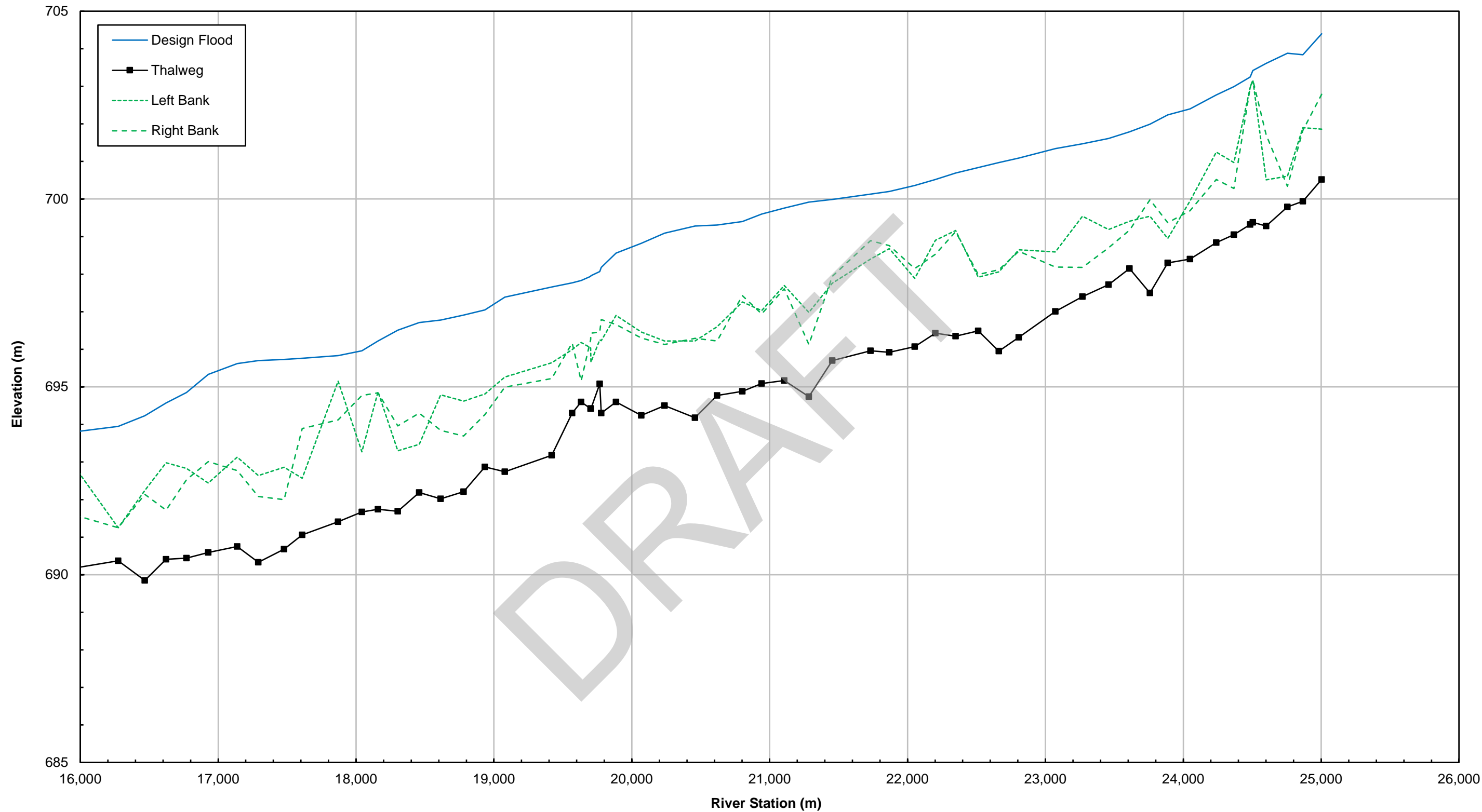
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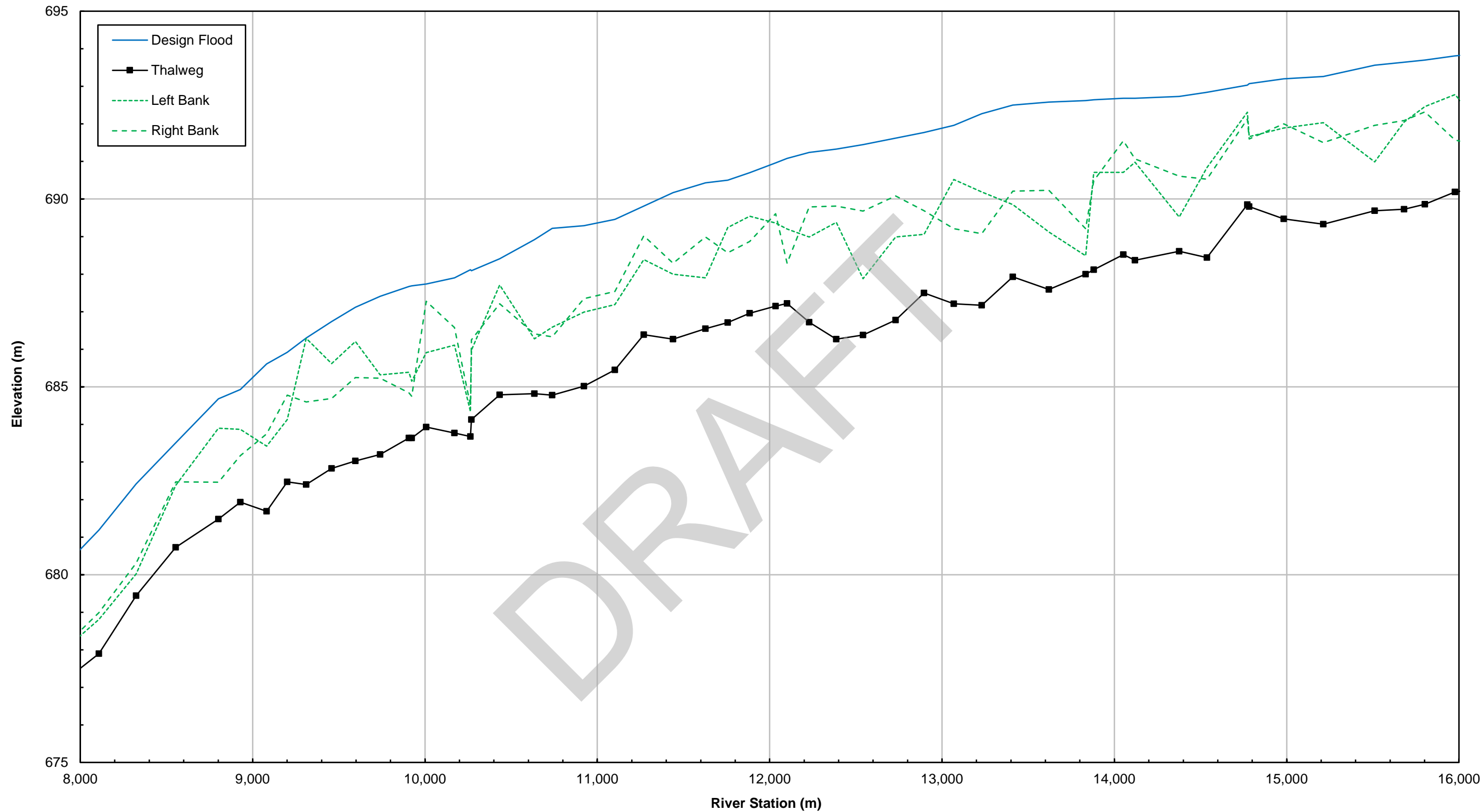




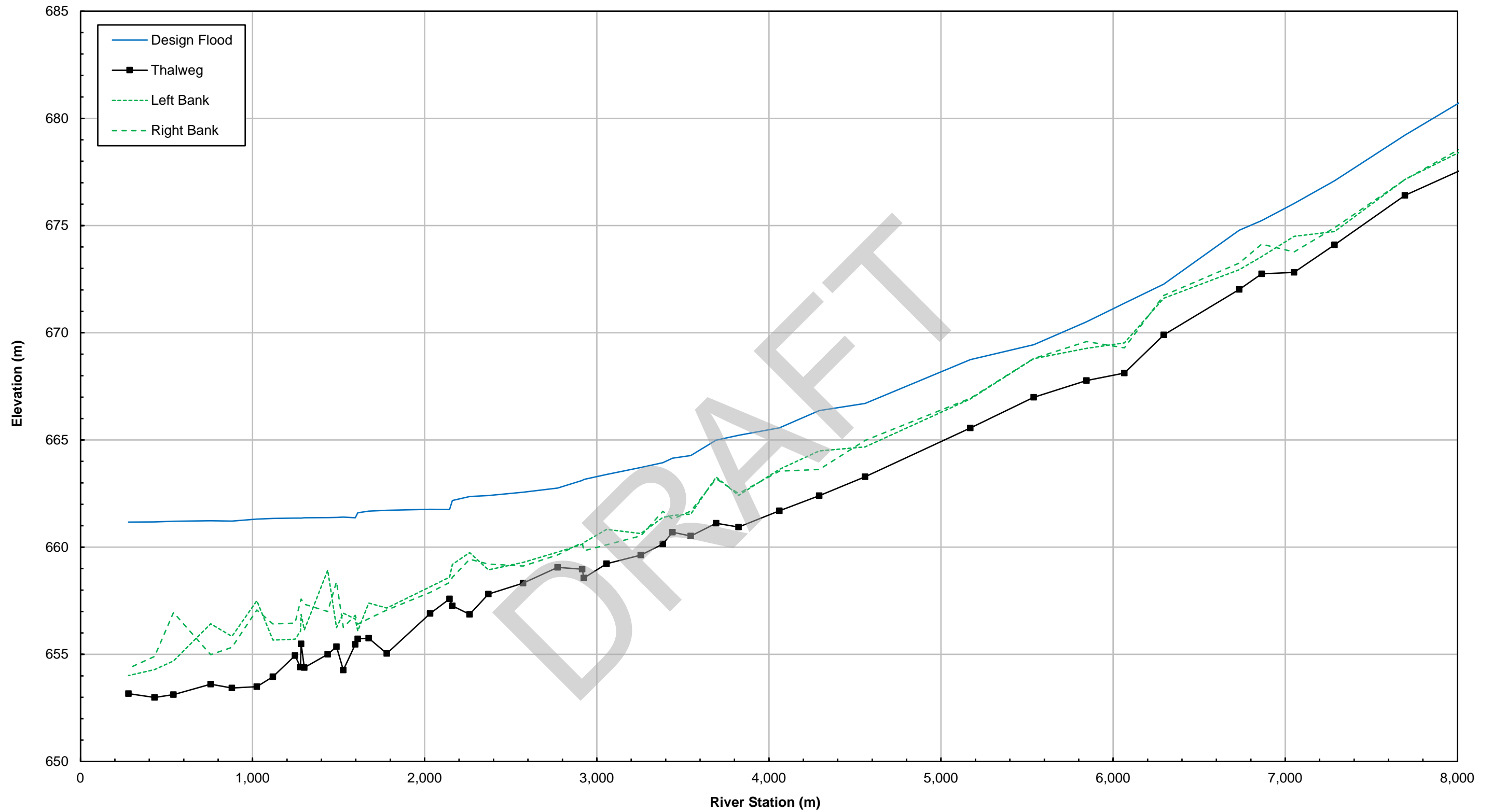


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Appendix A
Governing Design Flood Levels

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Table A-1 Governing design flood levels – South Saskatchewan River

Cross Section	River Station (m)	Design Flood Level (m)
XS-120	45,325	669.59
XS-119	44,679	669.22
XS-118	44,049	668.83
XS-117	43,533	668.81
XS-116	43,063	668.76
XS-115	42,640	668.67
XS-114	42,313	668.55
XS-113	41,994	668.27
XS-112	41,730	668.06
XS-111	41,467	667.93
XS-110	41,176	667.88
XS-109	40,727	667.58
XS-108	40,250	667.47
XS-107	39,686	666.98
XS-106	39,026	666.96
XS-105	38,613	666.73
XS-104	38,206	666.55
XS-103	37,769	666.22
XS-102	37,096	666.13
XS-101	36,628	666.08
XS-100	36,160	665.91
XS-99	35,711	665.78
XS-98	35,027	665.61
XS-97	34,794	665.41
XS-96	34,469	665.28
XS-95	34,035	665.17
XS-94	33,412	665.04
XS-93	32,996	664.80
XS-92	32,901	664.79
XS-91	32,874	664.67
XS-90	32,864	664.65
XS-89	32,841	664.58
XS-88	32,695	664.32
XS-87	32,232	664.21
XS-86	31,958	664.14
XS-85	31,737	664.06
XS-84	31,302	664.00

Table A-1 Governing design flood levels – South Saskatchewan River (Continued)

Cross Section	River Station (m)	Design Flood Level (m)
XS-83	30,870	663.83
XS-82	30,568	663.65
XS-81	30,278	663.53
XS-80	30,073	663.28
XS-79	29,912	663.18
XS-78	29,893	663.16
XS-77	29,810	663.16
XS-76	29,705	663.15
XS-75	29,679	663.01
XS-74	29,586	662.95
XS-73	29,490	662.87
XS-72	29,458	662.77
XS-71	29,288	662.80
XS-70	28,982	662.24
XS-69	28,782	662.06
XS-68	28,518	661.97
XS-67	28,272	661.76
XS-66	27,944	661.59
XS-65	27,680	661.61
XS-64	27,421	661.43
XS-63	27,259	661.21
XS-62	27,103	661.15
XS-61	26,834	661.17
XS-60	26,592	660.82
XS-59	26,362	660.62
XS-58	25,869	660.58
XS-57	25,470	660.49
XS-56	25,260	660.38
XS-55	24,856	660.16
XS-54	24,346	659.66
XS-53	23,762	659.48
XS-52	23,368	659.38
XS-51	22,594	659.25
XS-50	22,345	659.21
XS-49	21,960	659.03
XS-48	21,436	658.23
XS-47	21,170	657.91

Table A-1 Governing design flood levels – South Saskatchewan River (Continued)

Cross Section	River Station (m)	Design Flood Level (m)
XS-46	20,944	658.13
XS-45	20,505	658.08
XS-44	20,015	657.64
XS-43	19,627	657.36
XS-42	19,151	657.19
XS-41	18,687	656.94
XS-40	18,369	656.54
XS-39	17,911	656.08
XS-38	17,457	655.89
XS-37	16,987	655.73
XS-36	16,430	655.50
XS-35	15,922	655.15
XS-34	15,557	654.76
XS-33	15,200	654.56
XS-32	14,548	654.19
XS-31	14,068	653.96
XS-30	13,587	653.78
XS-29	13,257	653.67
XS-28	12,651	653.10
XS-27	12,272	652.88
XS-26	11,856	652.72
XS-25	11,401	652.46
XS-24	10,997	652.24
XS-23	10,616	651.82
XS-22	10,038	651.77
XS-21	9,344	651.15
XS-20	8,739	650.94
XS-19	8,061	650.83
XS-18	7,699	650.56
XS-17	7,319	650.07
XS-16	6,742	649.42
XS-15	6,324	649.56
XS-14	5,902	649.40
XS-13	5,517	649.05
XS-12	5,143	648.75
XS-11	4,620	648.53
XS-10	3,946	648.17
XS-9	3,351	648.02

Table A-1 Governing design flood levels – South Saskatchewan River (Continued)

Cross Section	River Station (m)	Design Flood Level (m)
XS-8	2,779	647.21
XS-7	2,385	647.00
XS-6	1,981	646.86
XS-5	1,554	646.88
XS-4	1,188	646.62
XS-3	826	646.32
XS-2	434	646.09
XS-1	0	645.50

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Table A-2 Governing design flood levels – Seven Persons Creek

Cross Section	River Station (m)	Design Flood Level (m)
XS-559	24,132	711.66
XS-558	23,979	711.62
XS-557	23,814	711.39
XS-556	23,806	710.14
XS-555	23,647	710.51
XS-554	23,493	710.43
XS-553	23,470	710.35
XS-552	23,465	710.36
XS-551	23,401	710.23
XS-550	23,369	709.06
XS-549	23,292	708.86
XS-548	23,260	708.86
XS-547	23,215	708.80
XS-546	23,117	708.70
XS-545	23,034	708.04
XS-544	22,948	707.42
XS-543	22,873	707.39
XS-542	22,771	707.29
XS-541	22,664	706.96
XS-540	22,575	706.67
XS-539	22,464	706.42
XS-538	22,361	706.03
XS-537	22,267	705.96
XS-536	22,142	705.85
XS-535	22,050	705.60
XS-534	21,928	705.20
XS-533	21,803	704.94
XS-532	21,685	704.71
XS-531	21,588	704.54
XS-530	21,553	704.57
XS-529	21,455	704.50
XS-528	21,316	704.22
XS-527	21,210	703.94
XS-526	21,109	703.68
XS-525	21,010	703.43
XS-524	20,908	703.22
XS-523	20,811	703.00

Table A-2 Governing design flood levels – Seven Persons Creek (Continued)

Cross Section	River Station (m)	Design Flood Level (m)
XS-522	20,688	702.75
XS-521	20,604	702.53
XS-520	20,492	702.39
XS-519	20,389	702.28
XS-518	20,205	702.04
XS-517	20,050	701.91
XS-516	19,964	701.80
XS-515	19,854	701.69
XS-514	19,715	701.39
XS-513	19,604	701.14
XS-512	19,456	700.75
XS-511	19,328	700.40
XS-510	19,216	700.08
XS-509	19,152	700.06
XS-508	19,111	699.96
XS-507	19,002	699.70
XS-506	18,890	699.58
XS-505	18,787	699.46
XS-504	18,675	699.35
XS-503	18,565	698.94
XS-502	18,494	698.66
XS-501	18,486	698.27
XS-500	18,434	698.35
XS-499	18,351	698.23
XS-498	18,280	698.12
XS-497	18,275	698.04
XS-496	18,219	697.83
XS-495	18,130	697.78
XS-494	18,126	697.75
XS-493	18,004	697.59
XS-492	17,905	697.49
XS-491	17,802	697.19
XS-490	17,798	697.18
XS-489	17,719	697.07
XS-488	17,604	696.81
XS-487	17,598	696.69
XS-486	17,499	696.59
XS-485	17,357	696.23

Table A-2 Governing design flood levels – Seven Persons Creek (Continued)

Cross Section	River Station (m)	Design Flood Level (m)
XS-484	17,263	696.18
XS-483	17,143	696.09
XS-482	17,043	696.02
XS-481	16,936	695.83
XS-480	16,931	695.75
XS-479	16,848	695.38
XS-478	16,772	695.20
XS-477	16,640	695.13
XS-476	16,542	695.08
XS-475	16,415	694.93
XS-474	16,312	694.77
XS-473	16,208	694.64
XS-472	16,142	694.42
XS-471	16,136	694.36
XS-470	16,093	694.32
XS-469	16,003	694.16
XS-468	15,897	693.98
XS-467	15,790	693.84
XS-466	15,677	693.69
XS-465	15,553	693.46
XS-464	15,468	693.16
XS-463	15,462	693.17
XS-462	15,421	693.12
XS-461	15,330	692.97
XS-460	15,270	692.78
XS-459	15,169	692.72
XS-458	15,148	692.66
XS-457	15,076	692.56
XS-456	14,959	692.35
XS-455	14,861	692.29
XS-454	14,749	692.06
XS-453	14,610	691.76
XS-452	14,511	691.63
XS-451	14,406	691.55
XS-450	14,327	691.42
XS-449	14,247	690.77
XS-448	14,233	690.59
XS-447	14,108	690.36

Table A-2 Governing design flood levels – Seven Persons Creek (Continued)

Cross Section	River Station (m)	Design Flood Level (m)
XS-446	14,000	690.23
XS-445	13,839	689.93
XS-444	13,689	689.73
XS-443	13,570	689.57
XS-442	13,465	689.41
XS-441	13,347	689.30
XS-440	13,258	689.25
XS-439	13,121	689.11
XS-438	13,053	689.01
XS-437	12,911	688.90
XS-436	12,787	688.54
XS-435	12,635	688.24
XS-434	12,461	687.81
XS-433	12,300	687.50
XS-432	12,200	687.43
XS-431	12,119	687.34
XS-430	11,921	687.02
XS-429	11,798	686.84
XS-428	11,676	686.63
XS-427	11,519	686.27
XS-426	11,372	686.05
XS-425	11,253	685.81
XS-424	11,204	685.65
XS-423	11,095	685.47
XS-422	10,959	685.21
XS-421	10,871	685.03
XS-420	10,865	684.99
XS-419	10,775	684.64
XS-418	10,671	684.35
XS-417	10,533	683.83
XS-416	10,429	683.75
XS-415	10,290	683.49
XS-414	10,140	683.21
XS-413	10,024	682.88
XS-412	9,910	682.60
XS-411	9,797	682.16
XS-410	9,668	682.13
XS-409	9,490	682.00

Table A-2 Governing design flood levels – Seven Persons Creek (Continued)

Cross Section	River Station (m)	Design Flood Level (m)
XS-408	9,399	681.75
XS-407	9,262	681.26
XS-406	9,139	681.15
XS-405	9,099	680.92
XS-404	9,091	680.87
XS-403	9,009	680.59
XS-402	8,998	680.62
XS-401	8,932	680.46
XS-400	8,858	680.21
XS-399	8,817	680.00
XS-398	8,778	679.91
XS-397	8,773	679.64
XS-396	8,621	679.38
XS-395	8,548	679.13
XS-394	8,469	679.08
XS-393	8,342	678.85
XS-392	8,336	678.80
XS-391	8,330	678.76
XS-390	8,322	678.68
XS-389	8,269	678.65
XS-388	8,118	678.21
XS-387	8,114	678.15
XS-386	8,097	678.18
XS-385	8,019	678.12
XS-384	8,016	678.10
XS-383	7,936	677.93
XS-382	7,853	677.72
XS-381	7,849	677.64
XS-380	7,744	677.43
XS-379	7,660	677.10
XS-378	7,583	676.93
XS-377	7,519	676.88
XS-376	7,363	676.21
XS-375	7,248	675.97
XS-374	7,243	675.94
XS-373	7,224	675.92
XS-372	7,190	675.87
XS-371	7,180	675.85

Table A-2 Governing design flood levels – Seven Persons Creek (Continued)

Cross Section	River Station (m)	Design Flood Level (m)
XS-370	7,064	675.71
XS-369	6,925	675.61
XS-368	6,795	675.51
XS-367	6,751	675.43
XS-366	6,744	675.41
XS-365	6,699	675.37
XS-364	6,635	675.10
XS-363	6,630	674.67
XS-362	6,546	674.28
XS-361	6,454	674.03
XS-360	6,366	673.79
XS-359	6,303	673.70
XS-358	6,295	673.69
XS-357	6,248	673.60
XS-356	6,151	673.41
XS-355	6,147	673.40
XS-354	6,034	672.72
XS-353	5,749	672.52
XS-352	5,594	672.16
XS-351	5,443	671.82
XS-350	5,281	671.69
XS-349	5,265	671.62
XS-348	5,177	671.54
XS-347	5,038	671.32
XS-346	5,032	671.25
XS-345	4,920	671.26
XS-344	4,783	671.20
XS-343	4,651	671.09
XS-342	4,565	669.79
XS-341	4,546	669.78
XS-340	4,527	669.71
XS-339	4,522	669.44
XS-338	4,514	668.92
XS-337	4,417	668.80
XS-336	4,329	668.53
XS-335	4,207	667.82
XS-334	4,205	667.13
XS-333	4,149	667.11

Table A-2 Governing design flood levels – Seven Persons Creek (Continued)

Cross Section	River Station (m)	Design Flood Level (m)
XS-332	4,109	666.90
XS-331	4,106	666.82
XS-330	4,046	666.71
XS-329	3,949	666.40
XS-328	3,829	666.19
XS-327	3,737	666.12
XS-326	3,726	666.03
XS-325	3,723	666.00
XS-324	3,618	665.72
XS-323	3,483	665.38
XS-322	3,457	665.40
XS-321	3,412	664.94
XS-320	3,308	664.62
XS-319	3,223	664.30
XS-318	3,212	664.11
XS-317	3,079	663.78
XS-316	3,006	663.67
XS-315	2,995	663.34
XS-314	2,981	663.22
XS-313	2,975	663.23
XS-312	2,847	663.11
XS-311	2,730	663.00
XS-310	2,719	662.91
XS-309	2,606	662.77
XS-308	2,510	662.65
XS-307	2,476	662.55
XS-306	2,432	662.14
XS-305	2,402	662.07
XS-304	2,266	661.90
XS-303	2,138	661.75
XS-302	2,019	661.69
XS-301	1,915	661.60
XS-300	1,788	661.45
XS-299	1,783	661.48
XS-298	1,671	661.49
XS-297	1,554	661.49
XS-296	1,444	661.48
XS-295	1,317	661.48

Table A-2 Governing design flood levels – Seven Persons Creek (Continued)

Cross Section	River Station (m)	Design Flood Level (m)
XS-294	1,201	661.48
XS-293	1,155	661.45
XS-292	1,134	661.44
XS-291	1,106	661.42
XS-290	1,072	661.37
XS-289	1,056	661.34
XS-288	937	661.35
XS-287	812	661.34
XS-286	673	661.34
XS-285	547	661.33
XS-284	531	661.33
XS-283	445	661.33
XS-282	350	661.33
XS-281	337	661.33
XS-280	222	661.32
XS-279	130	661.31
XS-278	112	661.31

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Table A-3 Governing design flood levels – Bullshead Creek

Cross Section	River Station (m)	Design Flood Level (m)
XS-667	10,054	713.12
XS-666	9,993	713.11
XS-665	9,939	711.86
XS-664	9,890	711.78
XS-663	9,785	711.53
XS-662	9,704	711.44
XS-661	9,619	711.32
XS-660	9,555	711.21
XS-659	9,462	711.04
XS-658	9,360	710.79
XS-657	9,295	710.59
XS-656	9,216	710.50
XS-655	9,151	710.35
XS-654	9,066	710.21
XS-653	8,983	710.15
XS-652	8,850	710.12
XS-651	8,697	710.10
XS-650	8,624	710.08
XS-649	8,512	710.06
XS-648	8,398	710.02
XS-647	8,299	709.97
XS-646	8,234	709.92
XS-645	8,150	709.88
XS-644	8,007	709.80
XS-643	7,886	709.59
XS-642	7,757	709.21
XS-641	7,691	709.05
XS-640	7,579	708.83
XS-639	7,509	708.63
XS-638	7,391	708.29
XS-637	7,294	708.04
XS-636	7,211	707.93
XS-635	7,113	707.87
XS-634	6,976	707.80
XS-633	6,844	707.71
XS-632	6,730	707.52
XS-631	6,606	707.36

Table A-3 Governing design flood levels – Bullshead Creek (Continued)

Cross Section	River Station (m)	Design Flood Level (m)
XS-630	6,475	707.18
XS-629	6,370	707.06
XS-628	6,270	707.01
XS-627	6,153	707.00
XS-626	6,057	707.00
XS-625	5,897	706.99
XS-624	5,746	706.97
XS-623	5,629	706.95
XS-622	5,520	706.95
XS-621	5,410	706.94
XS-620	5,300	706.94
XS-619	5,160	706.94
XS-618	5,050	706.93
XS-617	4,918	706.93
XS-616	4,791	706.93
XS-615	4,682	706.93
XS-614	4,554	706.93
XS-613	4,443	706.93
XS-612	4,330	706.93
XS-611	4,283	706.93
XS-610	4,248	704.13
XS-609	4,201	704.12
XS-608	4,078	703.96
XS-607	3,967	703.90
XS-606	3,879	703.88
XS-605	3,766	703.87
XS-604	3,653	703.87
XS-603	3,567	703.85
XS-602	3,502	703.79
XS-601	3,472	702.74
XS-600	3,465	702.74
XS-599	3,447	702.06
XS-598	3,336	702.09
XS-597	3,330	702.08
XS-596	3,252	701.83
XS-595	3,245	701.72
XS-594	3,144	701.45
XS-593	3,138	701.41

Table A-3 Governing design flood levels – Bullshead Creek (Continued)

Cross Section	River Station (m)	Design Flood Level (m)
XS-592	3,045	701.31
XS-591	2,931	701.16
XS-590	2,925	700.87
XS-589	2,910	700.34
XS-588	2,882	699.97
XS-587	2,821	699.90
XS-586	2,741	699.86
XS-585	2,627	699.82
XS-584	2,553	699.80
XS-583	2,485	699.56
XS-582	2,476	699.39
XS-581	2,427	699.43
XS-580	2,386	699.33
XS-579	2,345	697.97
XS-578	2,256	697.20
XS-577	2,138	696.52
XS-576	2,046	695.95
XS-575	1,941	695.20
XS-574	1,801	694.61
XS-573	1,679	694.30
XS-572	1,562	693.49
XS-571	1,465	692.89
XS-570	1,338	692.05
XS-569	1,227	691.51
XS-568	1,069	690.61
XS-567	983	689.91
XS-566	872	689.27
XS-565	719	688.48
XS-564	603	687.92
XS-563	472	686.96
XS-562	310	686.11
XS-561	171	685.04
XS-560	42	684.68

Table A-4 Governing design flood levels – Ross Creek

Cross Section	River Station (m)	Design Flood Level (m)
XS-277	25,004	704.40
XS-276	24,867	703.84
XS-275	24,755	703.88
XS-274	24,601	703.61
XS-273	24,504	703.42
XS-272	24,485	703.25
XS-271	24,367	702.99
XS-270	24,239	702.77
XS-269	24,049	702.40
XS-268	23,888	702.24
XS-267	23,758	701.99
XS-266	23,609	701.79
XS-265	23,458	701.61
XS-264	23,269	701.47
XS-263	23,072	701.34
XS-262	22,807	701.09
XS-261	22,662	700.97
XS-260	22,513	700.84
XS-259	22,349	700.69
XS-258	22,202	700.52
XS-257	22,052	700.36
XS-256	21,868	700.20
XS-255	21,732	700.13
XS-254	21,455	699.99
XS-253	21,284	699.92
XS-252	21,105	699.76
XS-251	20,942	699.60
XS-250	20,802	699.40
XS-249	20,619	699.31
XS-248	20,459	699.28
XS-247	20,238	699.09
XS-246	20,069	698.82
XS-245	19,885	698.56
XS-244	19,778	698.18
XS-243	19,768	698.07
XS-242	19,704	697.96

Table A-4 Governing design flood levels – Ross Creek (Continued)

Cross Section	River Station (m)	Design Flood Level (m)
XS-241	19,701	697.94
XS-240	19,632	697.83
XS-239	19,567	697.77
XS-238	19,419	697.66
XS-237	19,079	697.39
XS-236	18,934	697.05
XS-235	18,780	696.91
XS-234	18,614	696.78
XS-233	18,458	696.71
XS-232	18,303	696.51
XS-231	18,159	696.22
XS-230	18,042	695.96
XS-229	17,870	695.83
XS-228	17,609	695.76
XS-227	17,478	695.73
XS-226	17,291	695.70
XS-225	17,138	695.62
XS-224	16,928	695.33
XS-223	16,771	694.85
XS-222	16,622	694.57
XS-221	16,467	694.23
XS-220	16,275	693.95
XS-219	15,977	693.81
XS-218	15,802	693.70
XS-217	15,681	693.64
XS-216	15,510	693.56
XS-215	15,213	693.26
XS-214	14,983	693.20
XS-213	14,783	693.07
XS-212	14,771	693.03
XS-211	14,537	692.84
XS-210	14,376	692.73
XS-209	14,120	692.68
XS-208	14,052	692.68
XS-207	13,881	692.64
XS-206	13,834	692.62
XS-205	13,620	692.58
XS-204	13,411	692.50

Table A-4 Governing design flood levels – Ross Creek (Continued)

Cross Section	River Station (m)	Design Flood Level (m)
XS-203	13,230	692.27
XS-202	13,068	691.96
XS-201	12,896	691.77
XS-200	12,731	691.62
XS-199	12,542	691.45
XS-198	12,386	691.33
XS-197	12,229	691.24
XS-196	12,101	691.08
XS-195	12,034	690.96
XS-194	11,884	690.70
XS-193	11,757	690.50
XS-192	11,627	690.43
XS-191	11,439	690.17
XS-190	11,270	689.81
XS-189	11,101	689.46
XS-188	10,922	689.29
XS-187	10,738	689.22
XS-186	10,635	688.92
XS-185	10,434	688.41
XS-184	10,269	688.09
XS-183	10,264	688.12
XS-182	10,171	687.90
XS-181	10,007	687.74
XS-180	9,923	687.69
XS-179	9,907	687.67
XS-178	9,740	687.41
XS-177	9,597	687.12
XS-176	9,458	686.74
XS-175	9,311	686.30
XS-174	9,201	685.92
XS-173	9,081	685.61
XS-172	8,929	684.93
XS-171	8,801	684.68
XS-170	8,553	683.51
XS-169	8,324	682.42
XS-168	8,108	681.19
XS-167	7,695	679.22
XS-166	7,286	677.09

Table A-4 Governing design flood levels – Ross Creek (Continued)

Cross Section	River Station (m)	Design Flood Level (m)
XS-165	7,051	676.03
XS-164	6,863	675.23
XS-163	6,733	674.78
XS-162	6,294	672.27
XS-161	6,066	671.38
XS-160	5,846	670.51
XS-159	5,538	669.44
XS-158	5,170	668.75
XS-157	4,558	666.70
XS-156	4,293	666.37
XS-155	4,061	665.57
XS-154	3,824	665.22
XS-153	3,693	664.99
XS-152	3,546	664.27
XS-151	3,440	664.15
XS-150	3,384	663.94
XS-149	3,256	663.72
XS-148	3,057	663.39
XS-147	2,925	663.16
XS-146	2,915	663.11
XS-145	2,772	662.76
XS-144	2,572	662.56
XS-143	2,370	662.41
XS-142	2,261	662.36
XS-141	2,161	662.18
XS-140	2,145	661.76
XS-139	2,032	661.77
XS-138	1,780	661.72
XS-137	1,675	661.68
XS-136	1,611	661.60
XS-135	1,596	661.37
XS-134	1,527	661.40
XS-133	1,488	661.39
XS-132	1,437	661.38
XS-131	1,300	661.37
XS-130	1,282	661.36
XS-129	1,278	661.36
XS-128	1,247	661.36

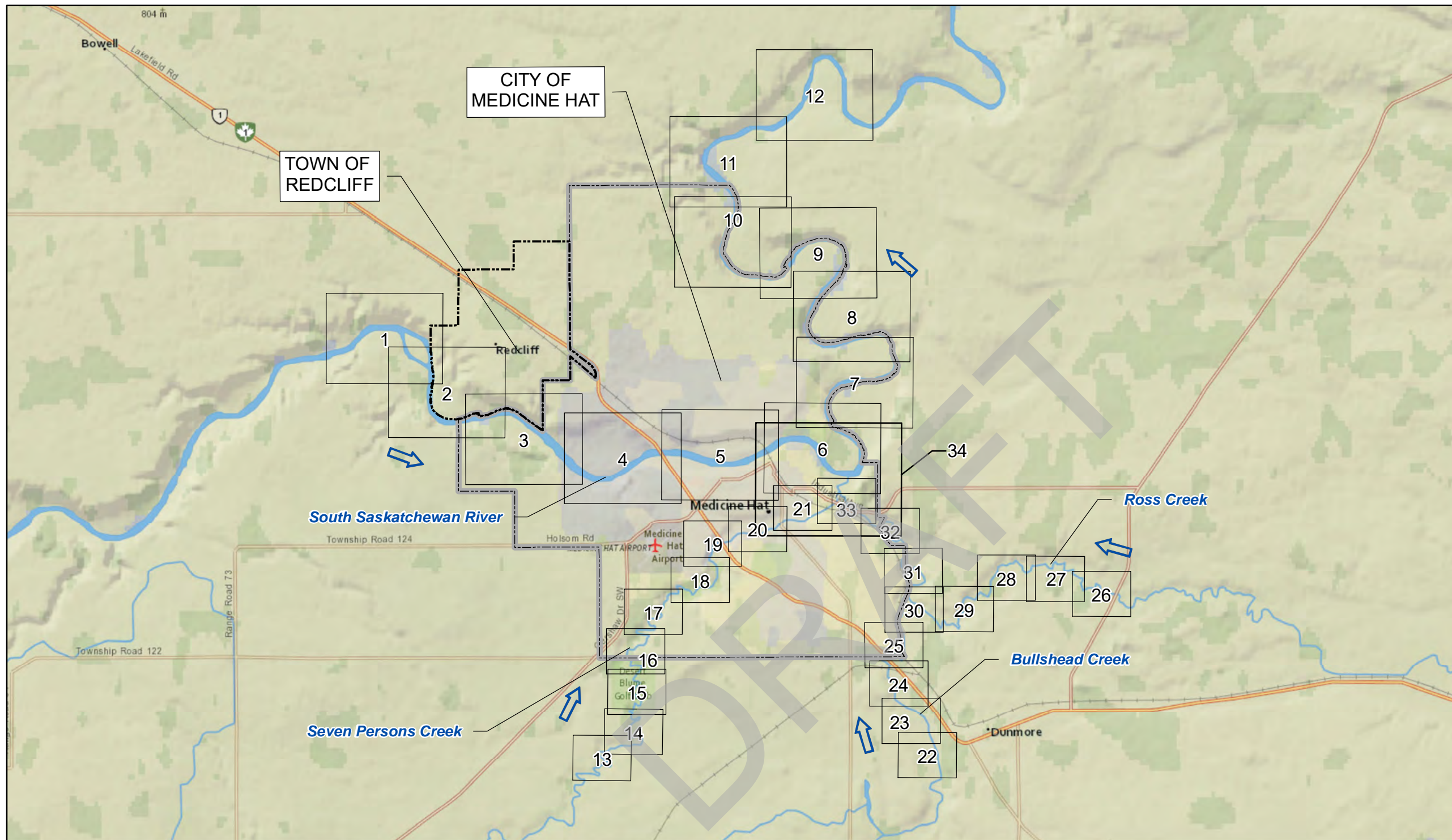
Table A-4 Governing design flood levels – Ross Creek (Continued)

Cross Section	River Station (m)	Design Flood Level (m)
XS-127	1,118	661.34
XS-126	1,025	661.31
XS-125	880	661.22
XS-124	757	661.23
XS-123	540	661.21
XS-122	431	661.18
XS-121	279	661.17

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Appendix B
Governing Design Flood Hazard Map

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Notes to Users:

1. Please refer to the accompanying **Medicine Hat River Hazard Study - Governing Design Flood Hazard Map Production Report** for important information concerning these maps.
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 as 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):

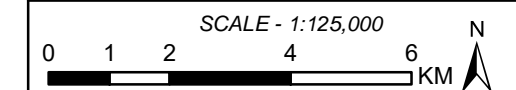
shallower, slower, and less destructive flooding, but it may also include “high hazard flood fringe” areas. Areas at risk of flooding behind flood berms may also be mapped as “protected flood fringe” areas.

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 (2018). Medicine Hat aerial imagery acquisition memorandum, project number 2018-502, submitted to Alberta Environment and Parks, 4 pp.*
2. Base data from City of Medicine Hat, Alberta Environment and Parks, Altalis, and Natural Resources Canada.
3. Additional base mapping from Esri.



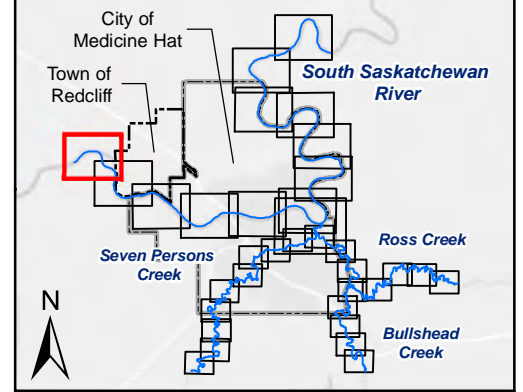
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Vertical Datum: CGVD28 HTv2.0; Units: Metres

Engineer DJH/MMM	GIS REH/JY	Reviewer RBA
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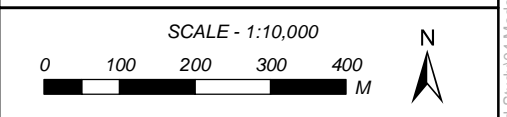
Job: 1003094 Date: 28- APR-2022

**MEDICINE HAT
RIVER HAZARD STUDY
DESIGN FLOOD HAZARD
INDEX MAP**

INDEX MAP



- FLOW DIRECTION
- BRIDGE
- CROSS SECTION
- CULVERT
- WEIR
- STUDY LIMIT
- FLOOD CONTROL STRUCTURE
- FLOODWALL
- FLOODWAY
- FLOOD FRINGE
- PROTECTED FLOOD FRINGE
- HIGH HAZARD FLOOD FRINGE
- 200-YEAR FLOOD EXTENT
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- LOCAL ROAD
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- MEDICINE HAT CITY BOUNDARY
- REDCLIFF TOWN BOUNDARY



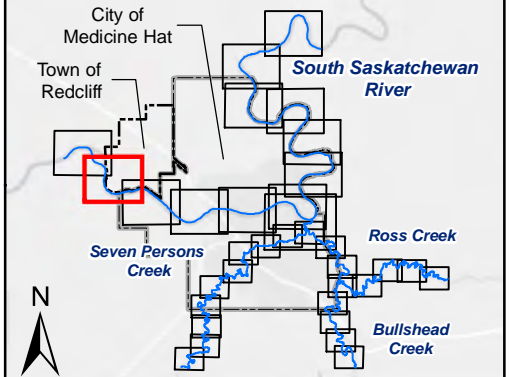
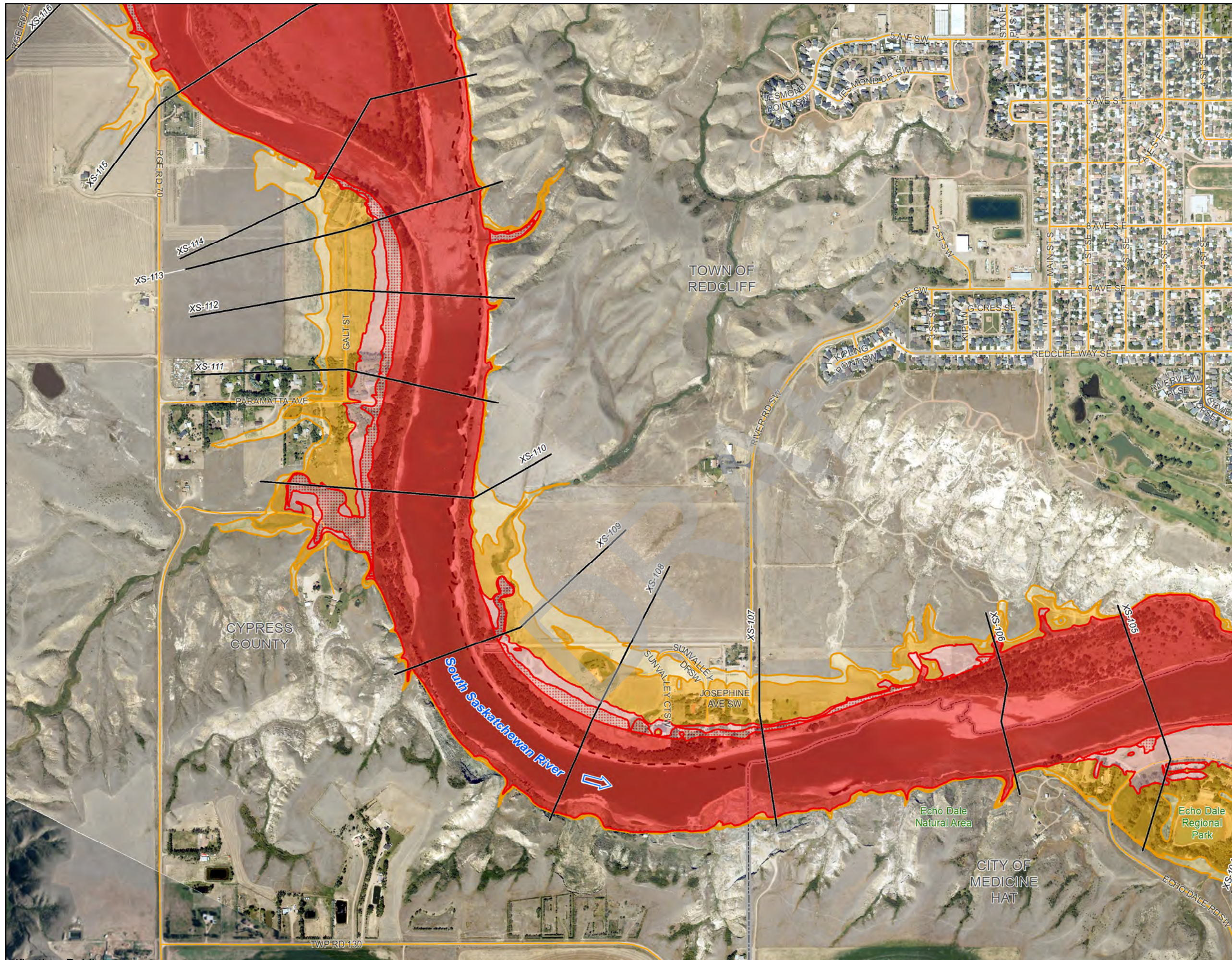
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Engineer DJH/MMM	GIS REH/JY	Reviewer RBA
Job: 1003094		Date: 29-APR-2022

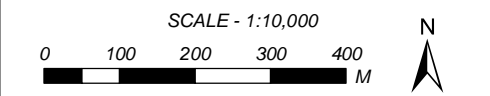
**MEDICINE HAT
RIVER HAZARD STUDY
DESIGN FLOOD HAZARD
MAP**



J:_P\Projects (Active)\1003094 Medicine Hat River Hazard Study\04_Medicine Hat River Hazard Study\1006302_T600_JY_FloodHazard_2021Update.mxd



- FLOW DIRECTION
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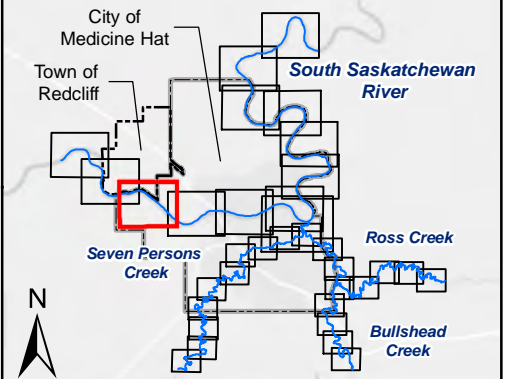
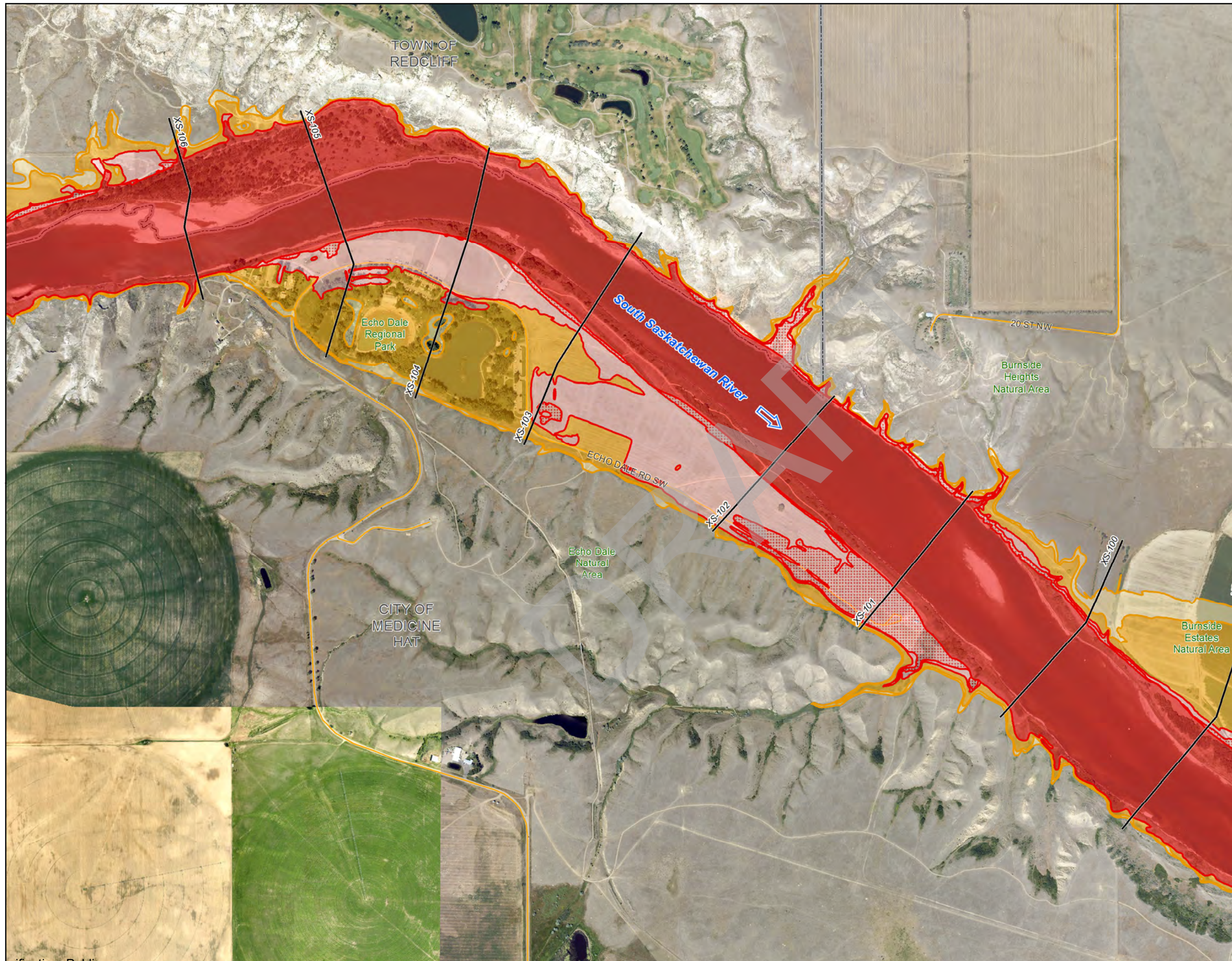


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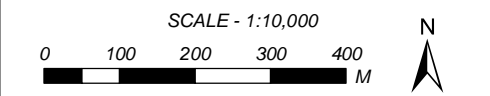
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Job: 1003094		Date: 29-APR-2022

**MEDICINE HAT
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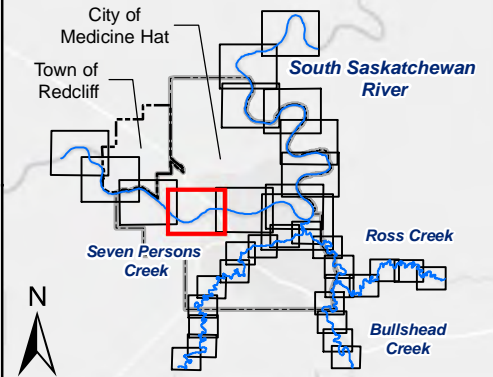


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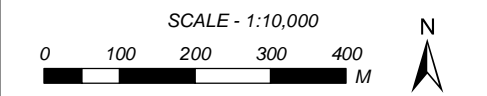
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**MEDICINE HAT
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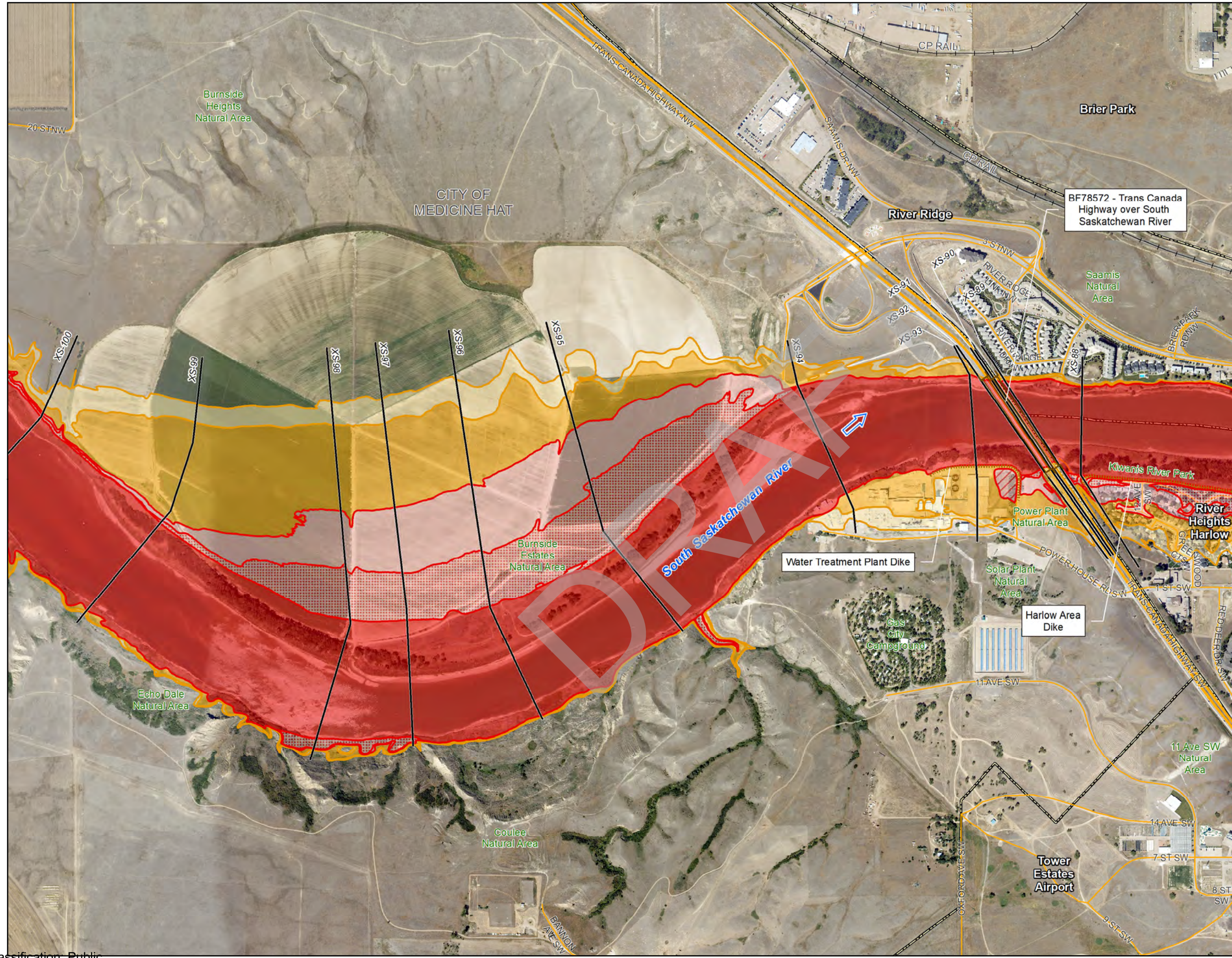
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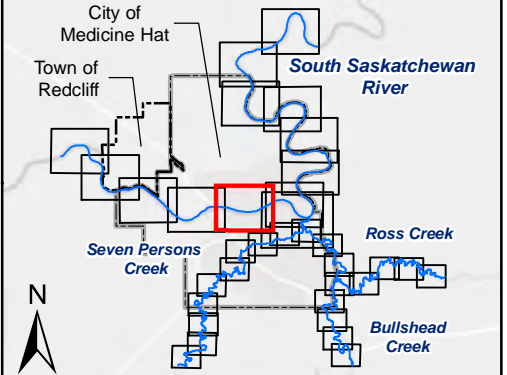
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Job: 1003094		Date: 29-APR-2022

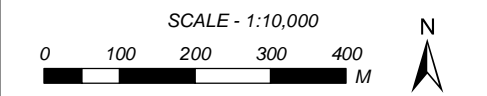
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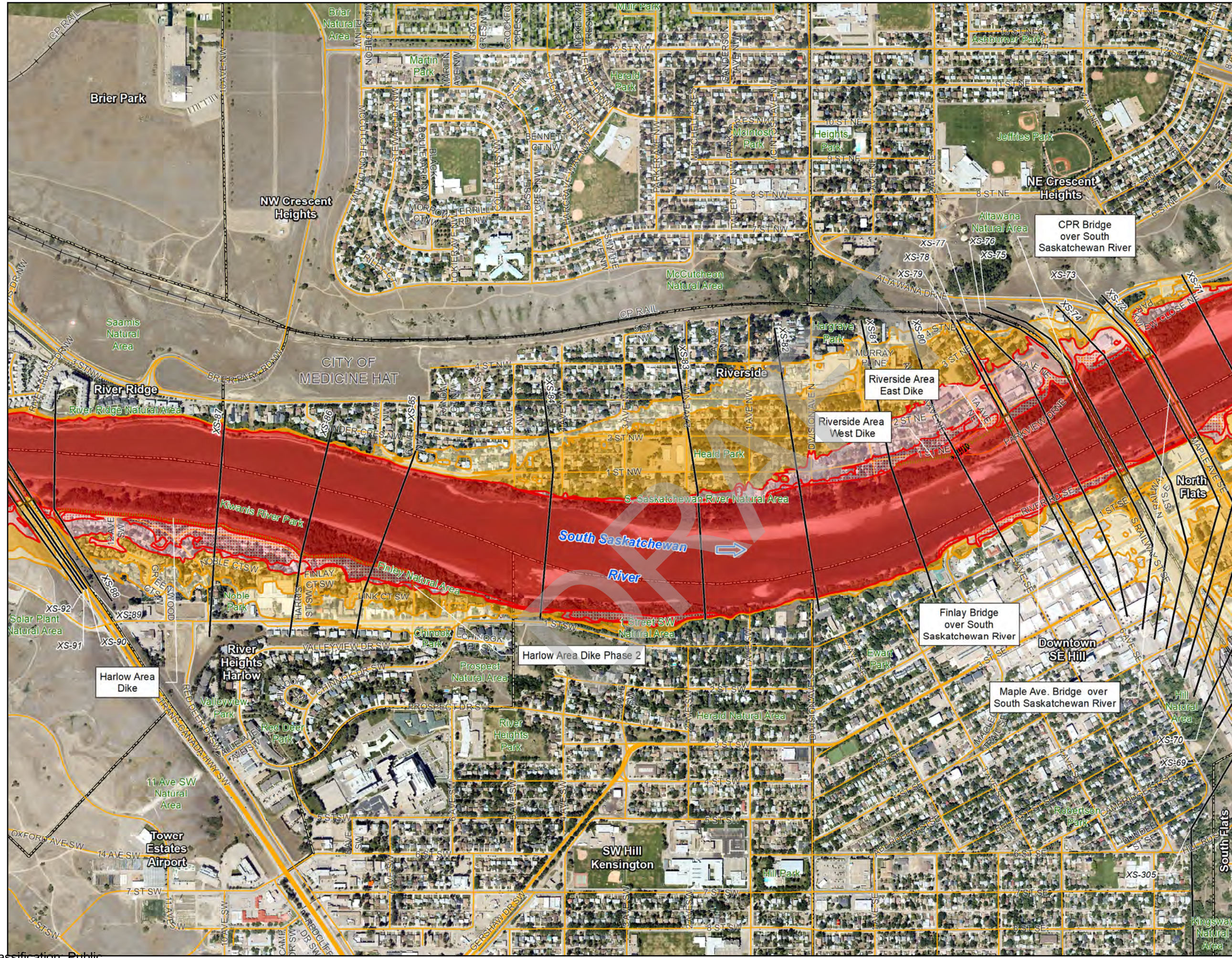
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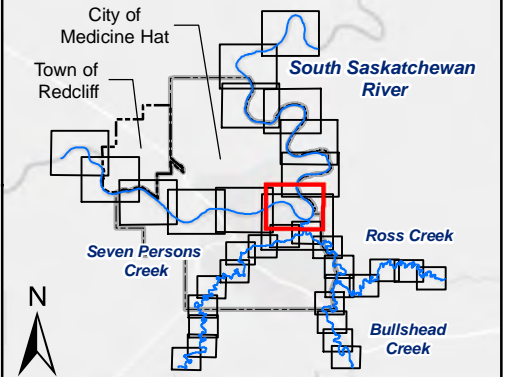
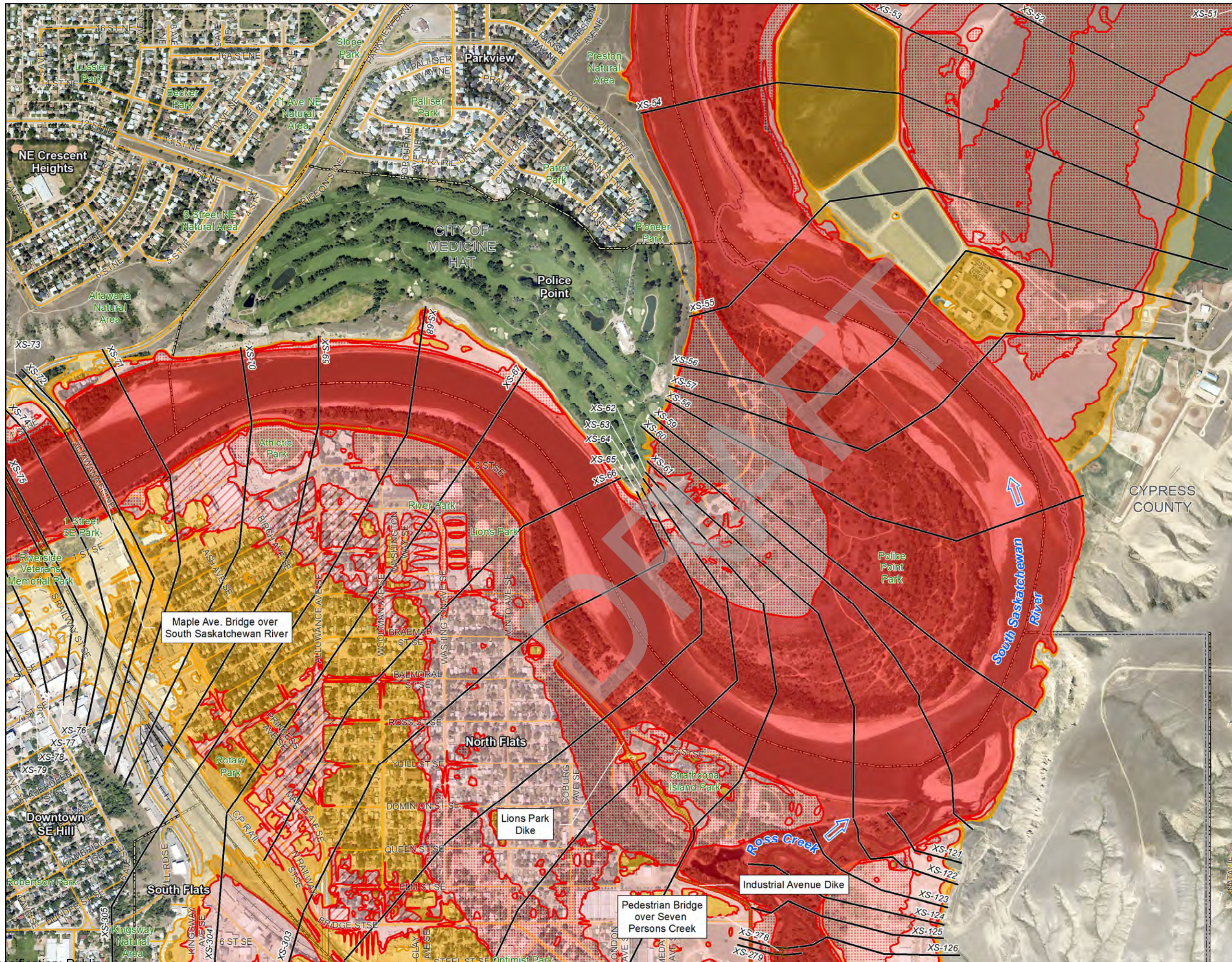
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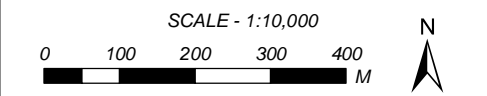
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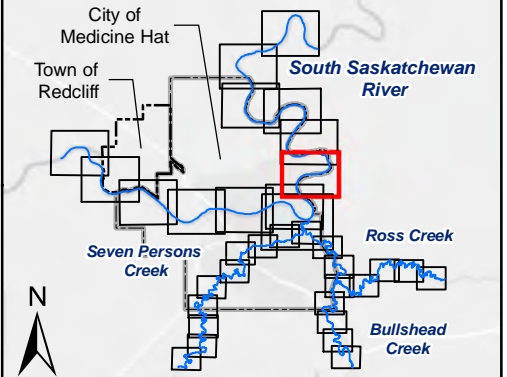
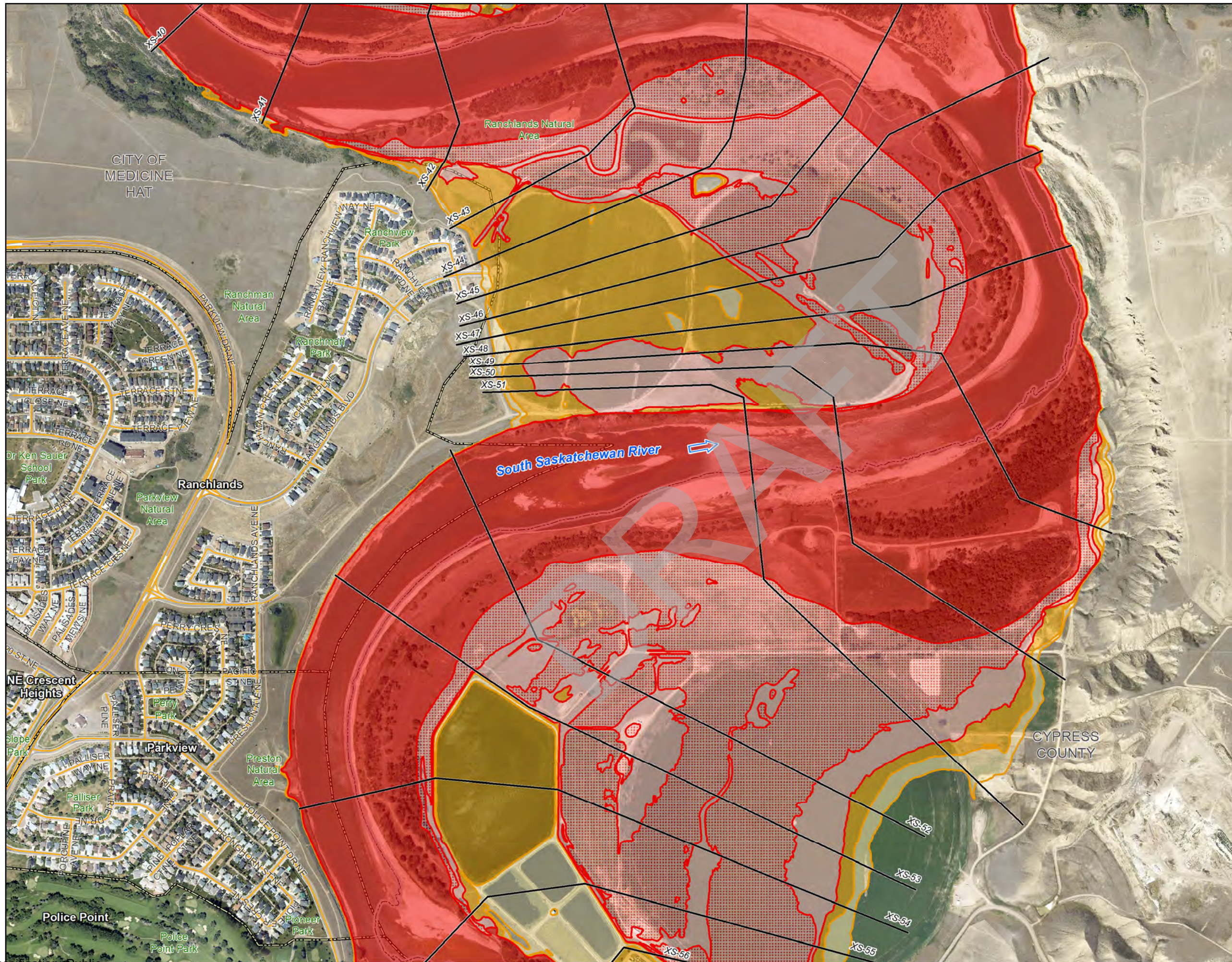


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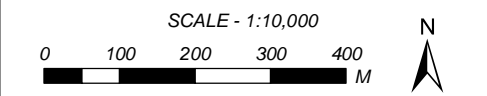
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Job: 1003094		Date: 29-APR-2022

**MEDICINE HAT
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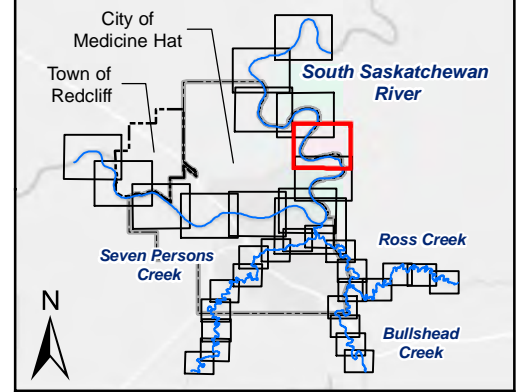
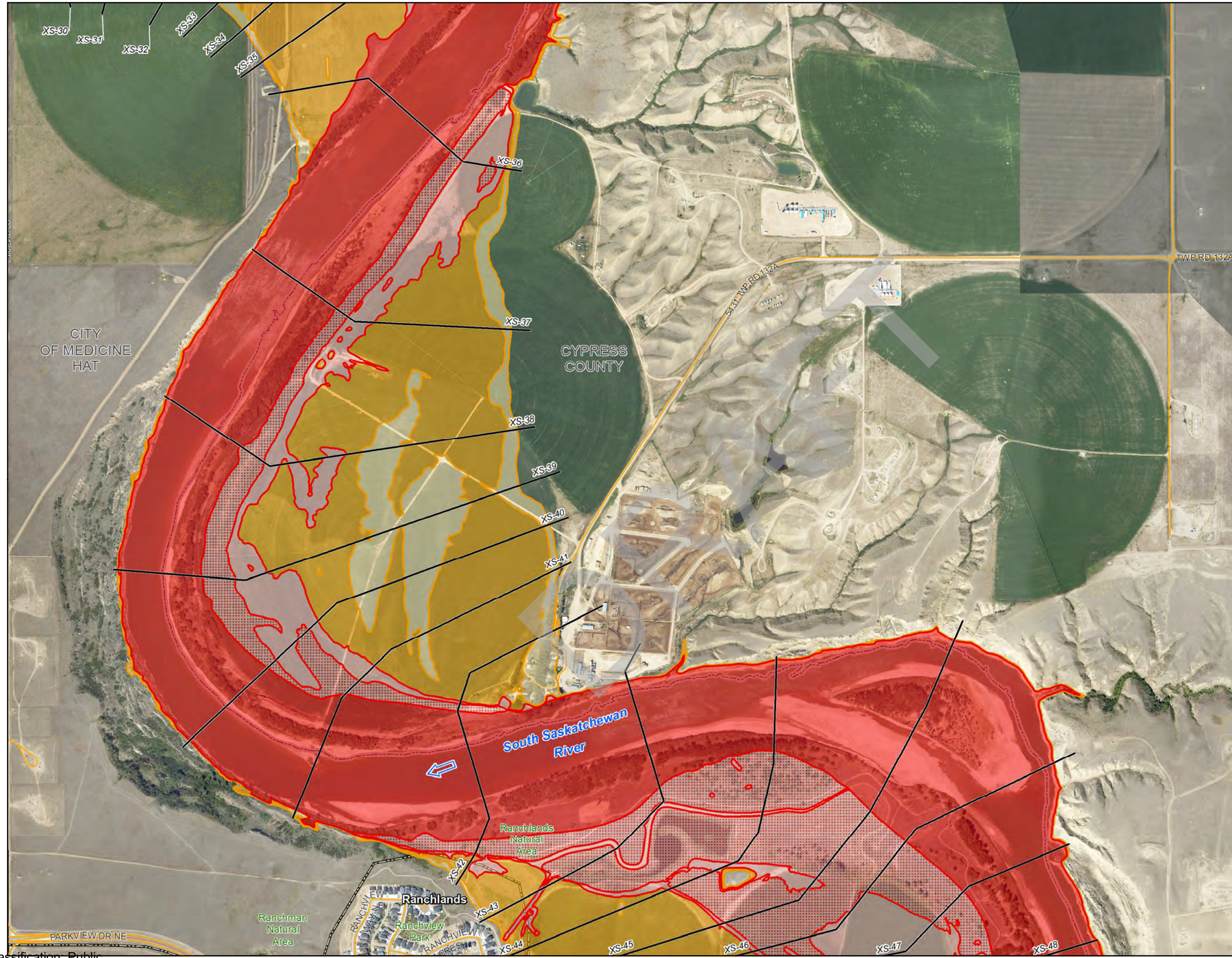


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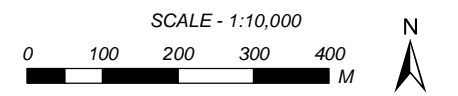
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**MEDICINE HAT
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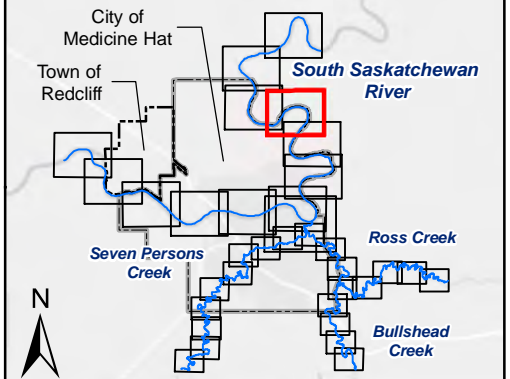
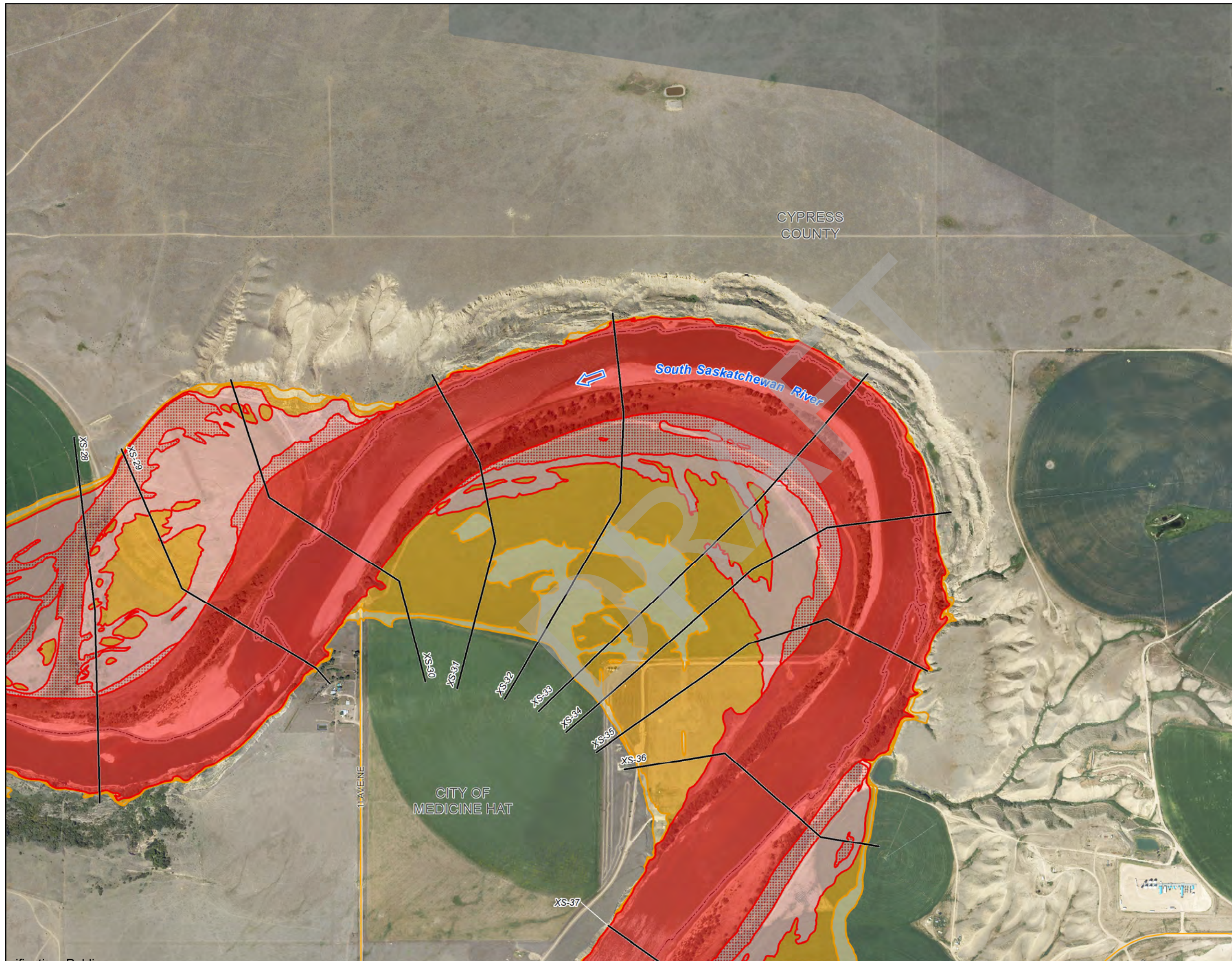


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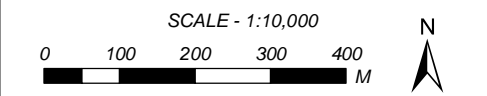
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**MEDICINE HAT
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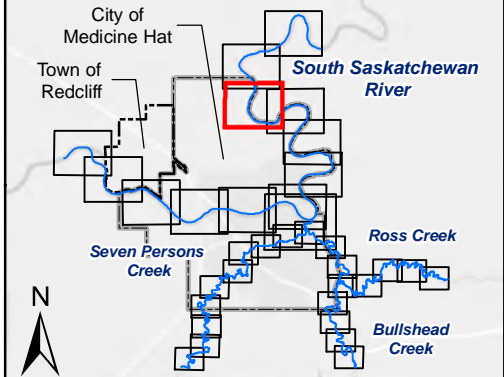


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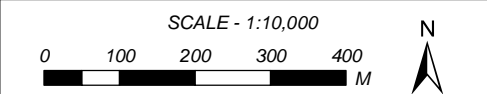
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**MEDICINE HAT
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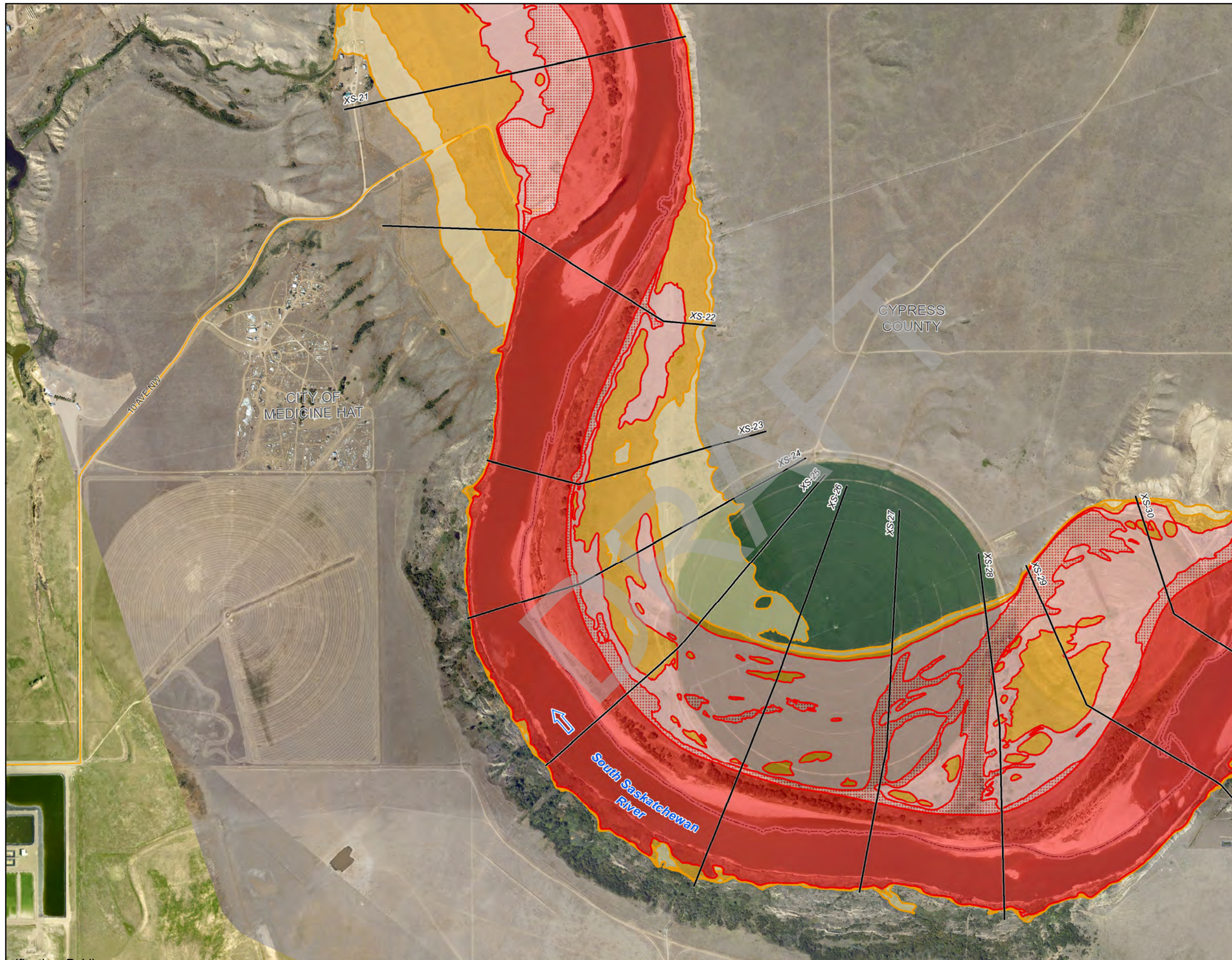
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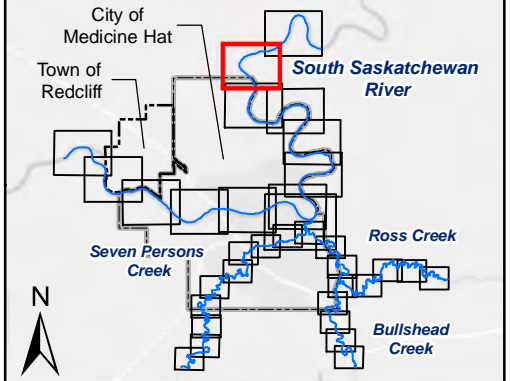
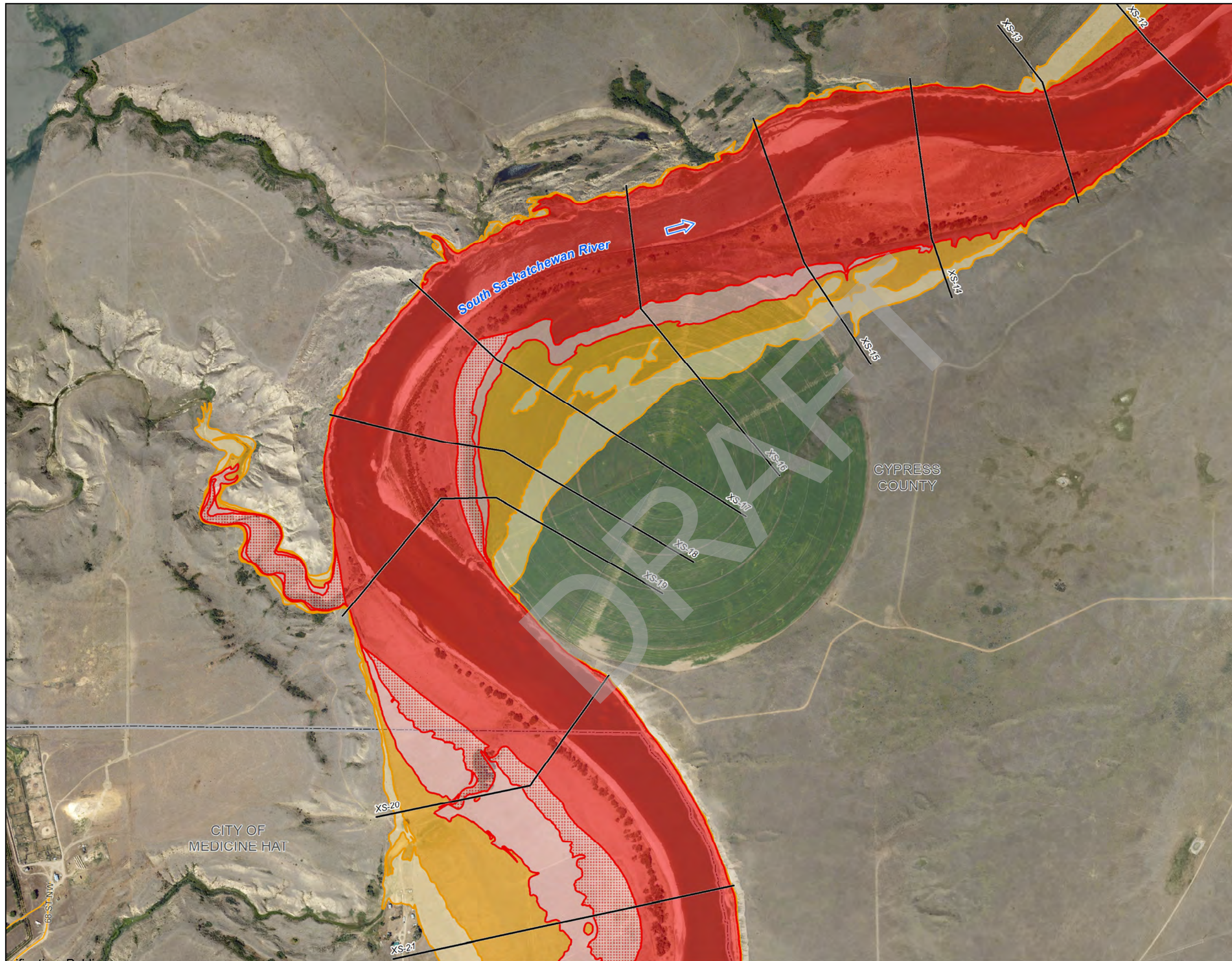
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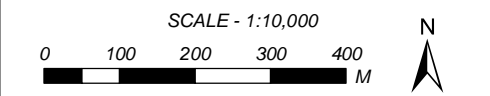
**MEDICINE HAT
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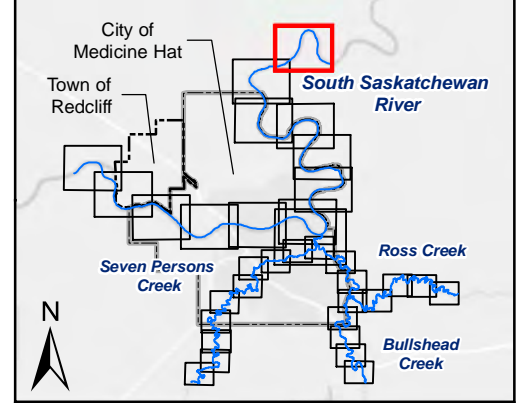


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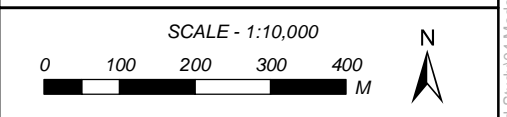
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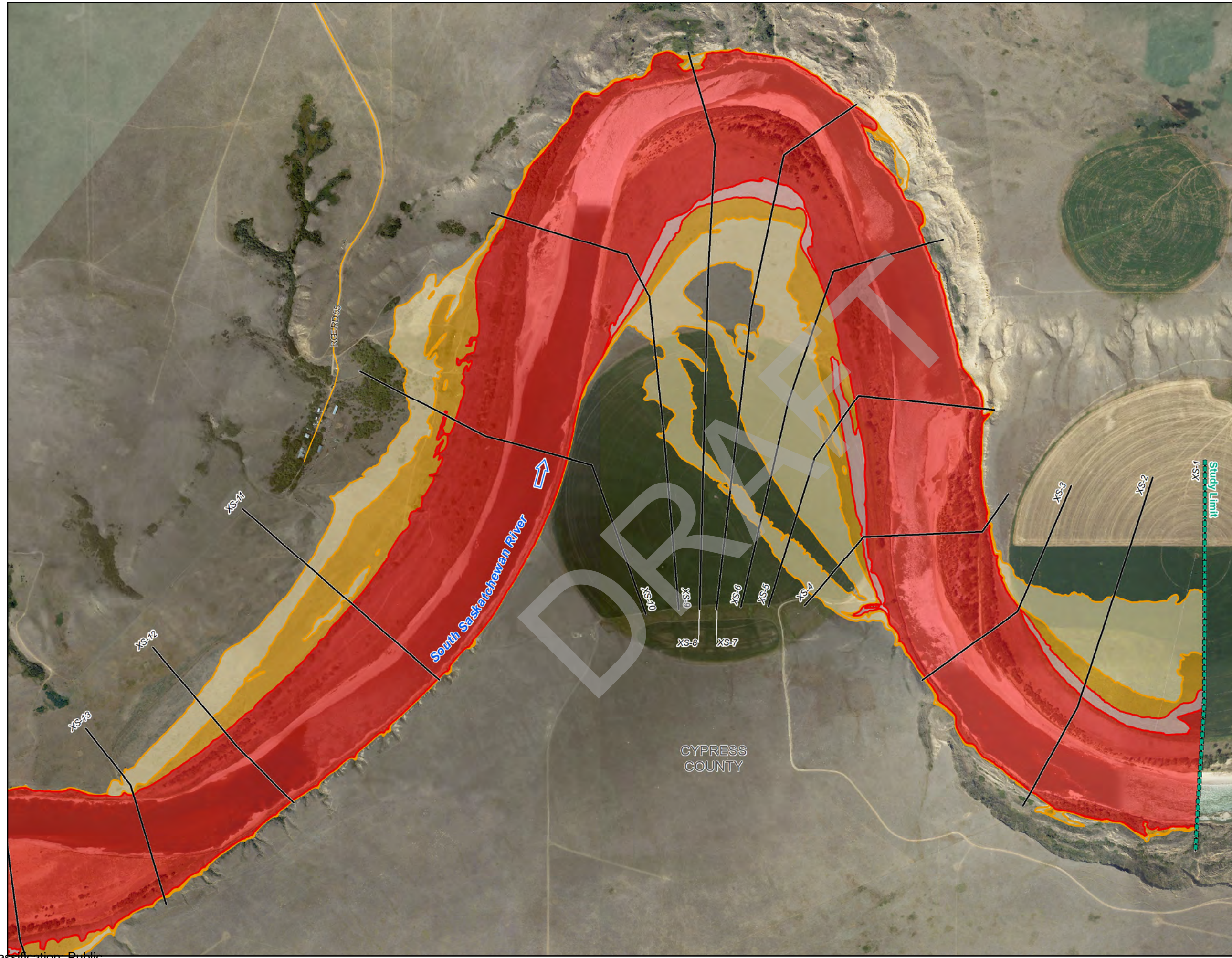
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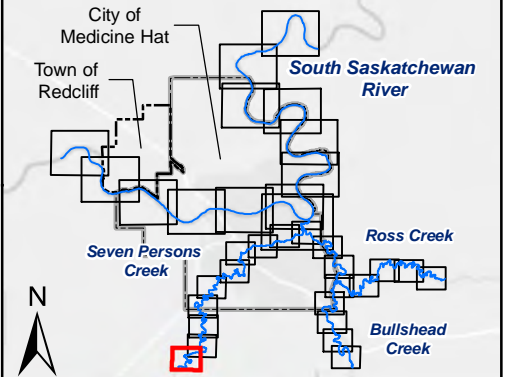
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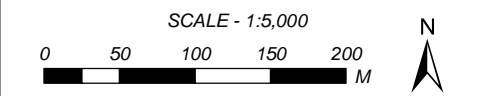
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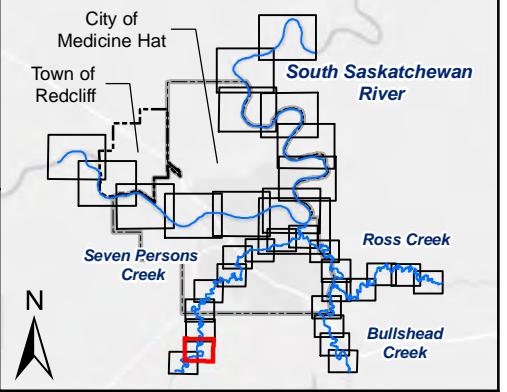
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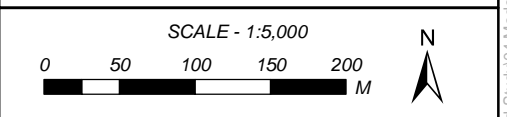
**MEDICINE HAT
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Desert Blume Golf Course Bridge 1
over Seven Persons Creek



- FLOW DIRECTION
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Desert Blume Golf Course Bridge 7
over Seven Persons Creek

Desert Blume Golf Course Bridge 6
over Seven Persons Creek

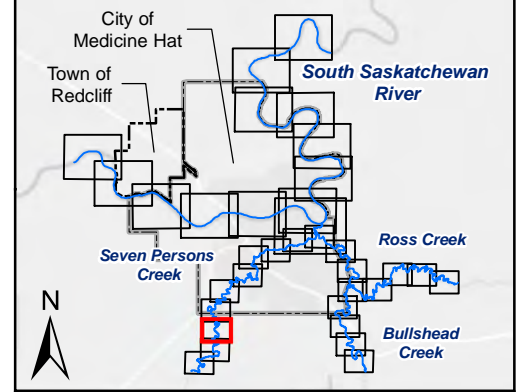
Desert Blume Golf Course Bridge 5
over Seven Persons Creek

Desert Blume Golf Course Bridge 4
over Seven Persons Creek

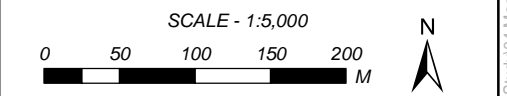
Desert Blume Golf Course Bridge 3
over Seven Persons Creek

Desert Blume Golf Course Bridge 2
over Seven Persons Creek

Desert Blume Golf Course Bridge 1
over Seven Persons Creek



- FLOW DIRECTION
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- FLOODWALL
- FLOODWAY
- FLOOD FRINGE
- PROTECTED FLOOD FRINGE
- HIGH HAZARD FLOOD FRINGE
- 200-YEAR FLOOD EXTENT
- 500-YEAR FLOOD EXTENT
- MAJOR ROAD
- LOCAL ROAD
- RAILWAY
- NEIGHBOURHOOD
- MEDICINE HAT CITY BOUNDARY
- REDCLIFF TOWN BOUNDARY

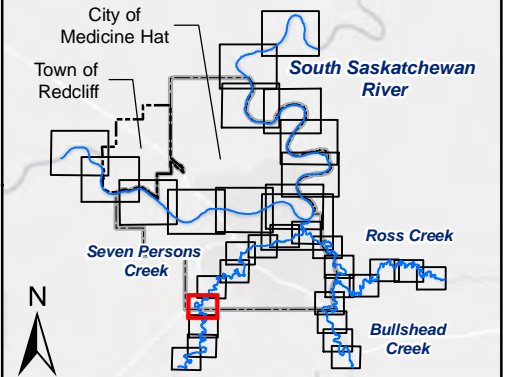


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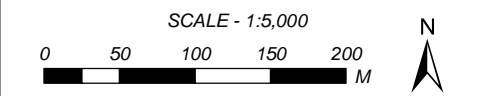
Engineer	GIS	Reviewer
DJH/MMM	REH/JY	RBA
Job: 1003094		Date: 29-APR-2022

**MEDICINE HAT
RIVER HAZARD STUDY
DESIGN FLOOD HAZARD
MAP**

J:_P\Projects (Active)\1003094_Medicine Hat River Hazard Study\04_Medicine Hat River Hazard Study\GIS\1006302_T600_JY_FloodHazard_2021Update.mxd



- FLOW DIRECTION
- BRIDGE
- CROSS SECTION
- CULVERT
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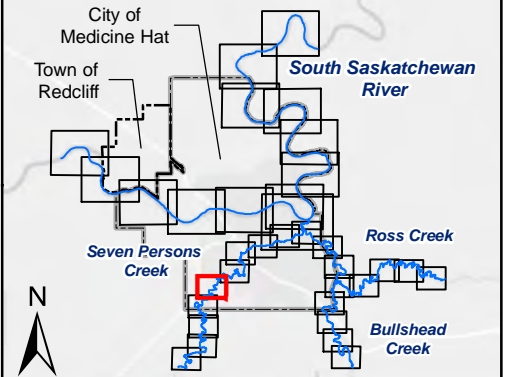


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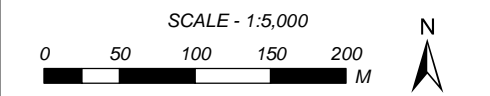
Engineer DJH/MMM	GIS REH/JY	Reviewer RBA
Job: 1003094		Date: 29-APR-2022

**MEDICINE HAT
RIVER HAZARD STUDY
DESIGN FLOOD HAZARD
MAP**

J:_P\Projects (Active)\1003094 - Medicine Hat River Hazard Study\04 - Medicine Hat River Hazard Study\1006302_T600_JY_FloodHazard_2021Update.mxd



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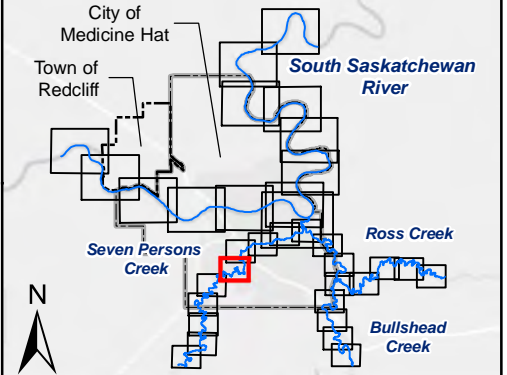


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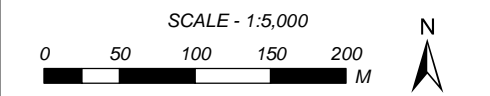
Engineer	GIS	Reviewer
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Job: 1003094		Date: 29-APR-2022

**MEDICINE HAT
RIVER HAZARD STUDY
DESIGN FLOOD HAZARD
MAP**

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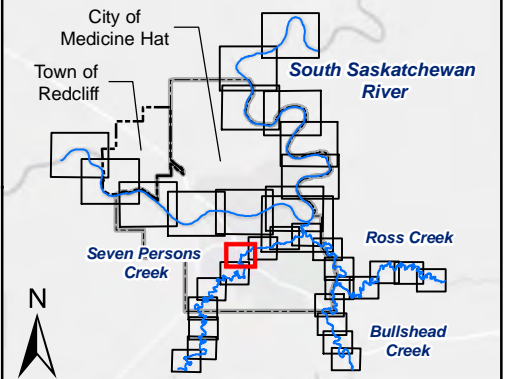
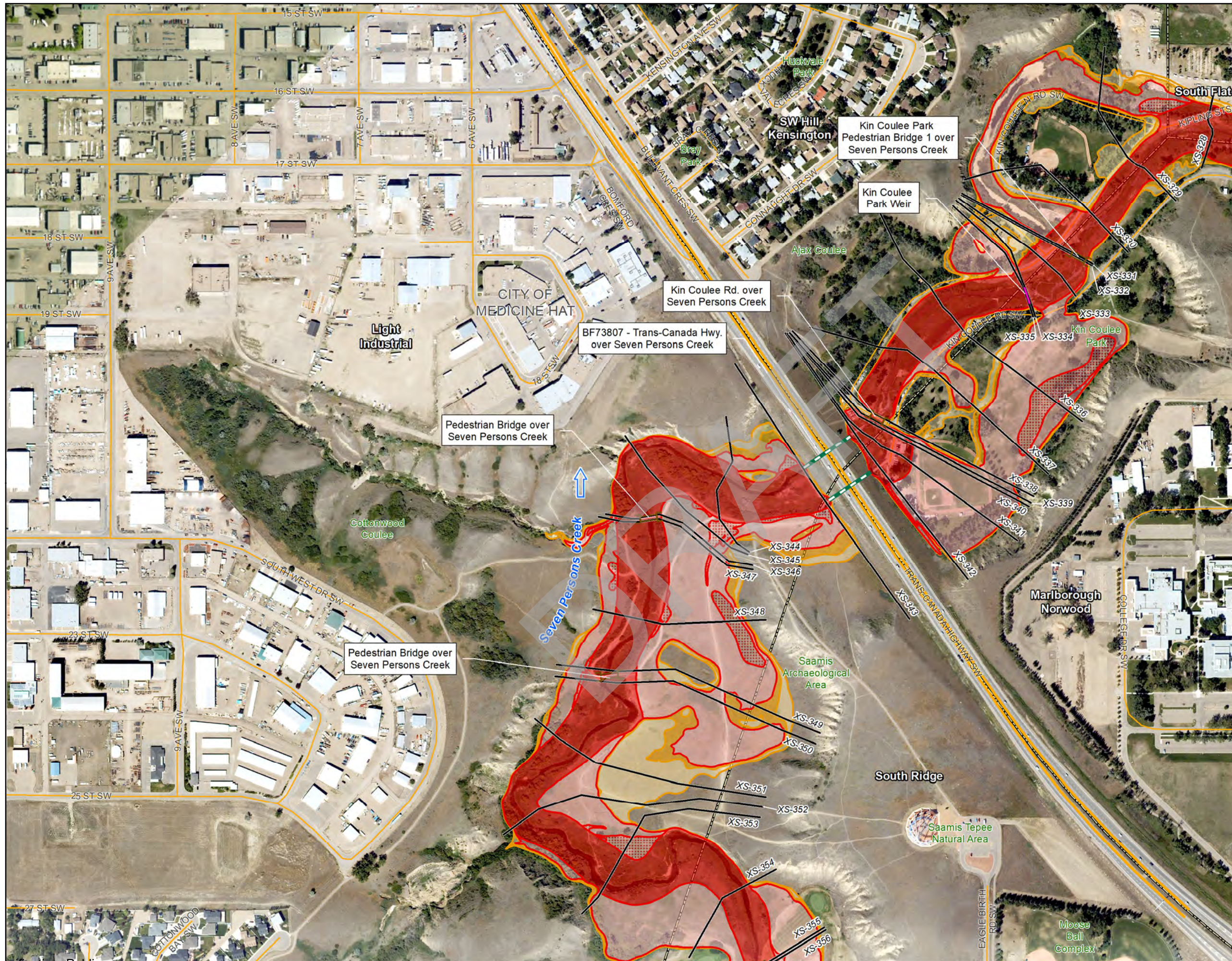


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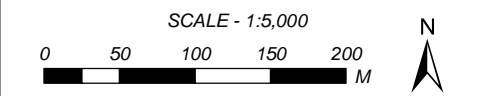
Engineer DJH/MMM	GIS REH/JY	Reviewer RBA
Job: 1003094		Date: 29-APR-2022

**MEDICINE HAT
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MAP**

J:_P\A\Projects (Active)\1003094_Medicine Hat River Hazard Study\04_Medicine Hat River Hazard Study\1006302_T600_JY_FloodHazard_2021Update.mxd



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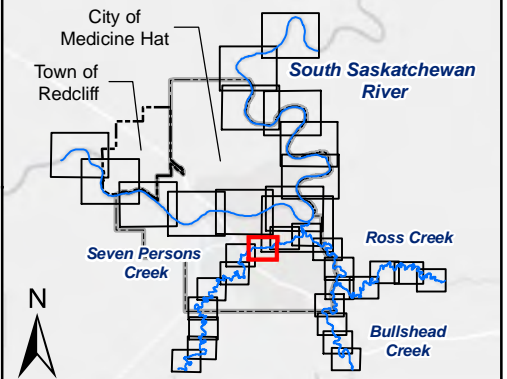
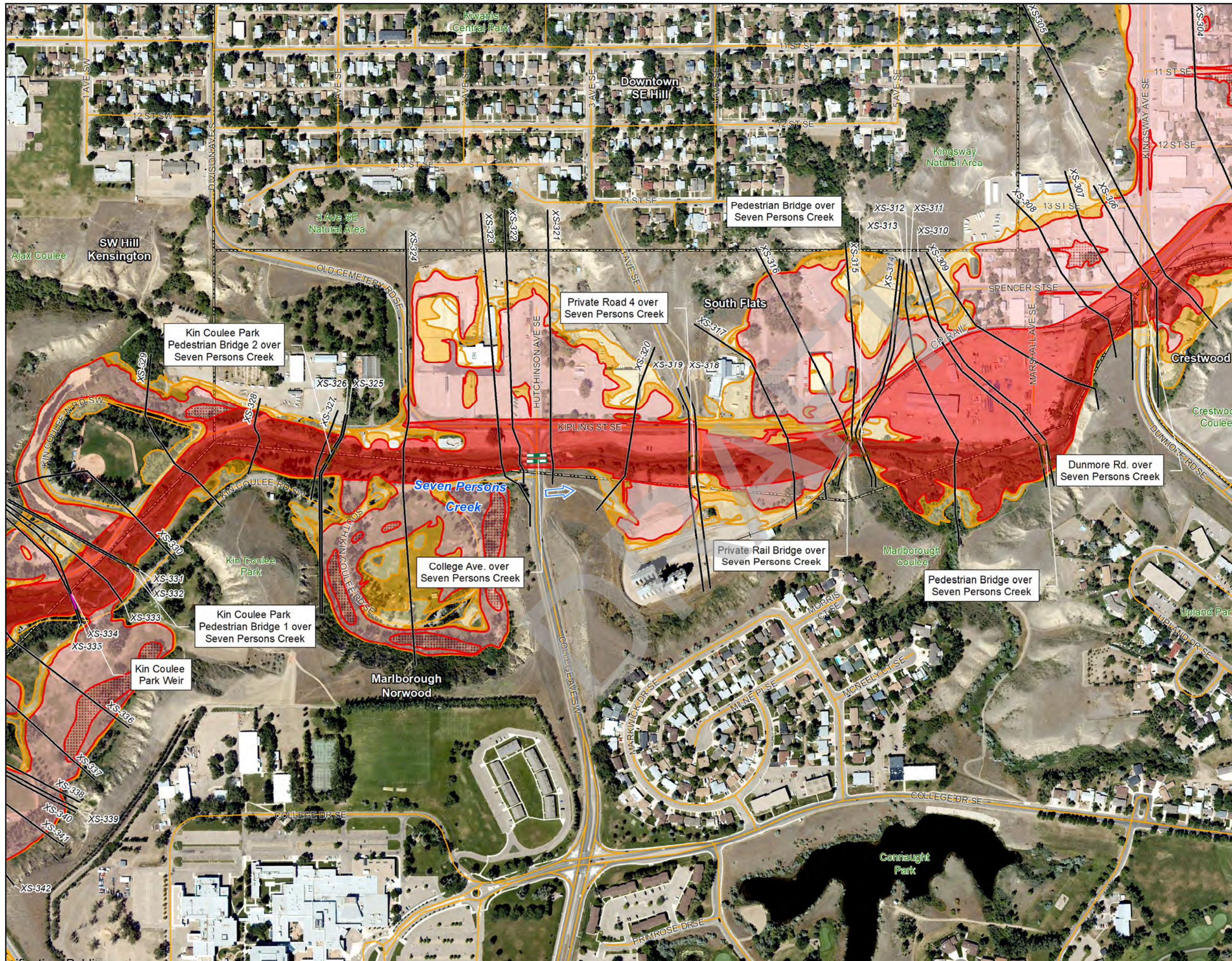


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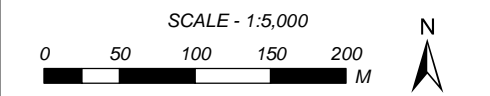
Engineer DJH/MMM	GIS REH/JY	Reviewer RBA
Job: 1003094		Date: 29-APR-2022

**MEDICINE HAT
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MAP**

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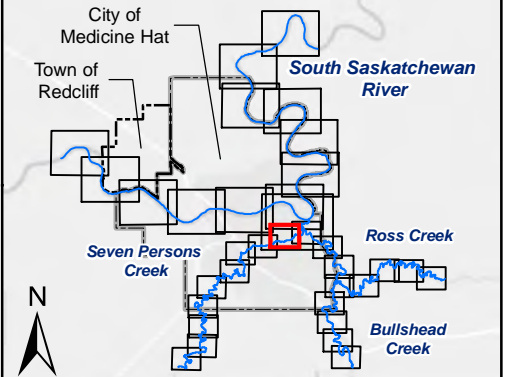
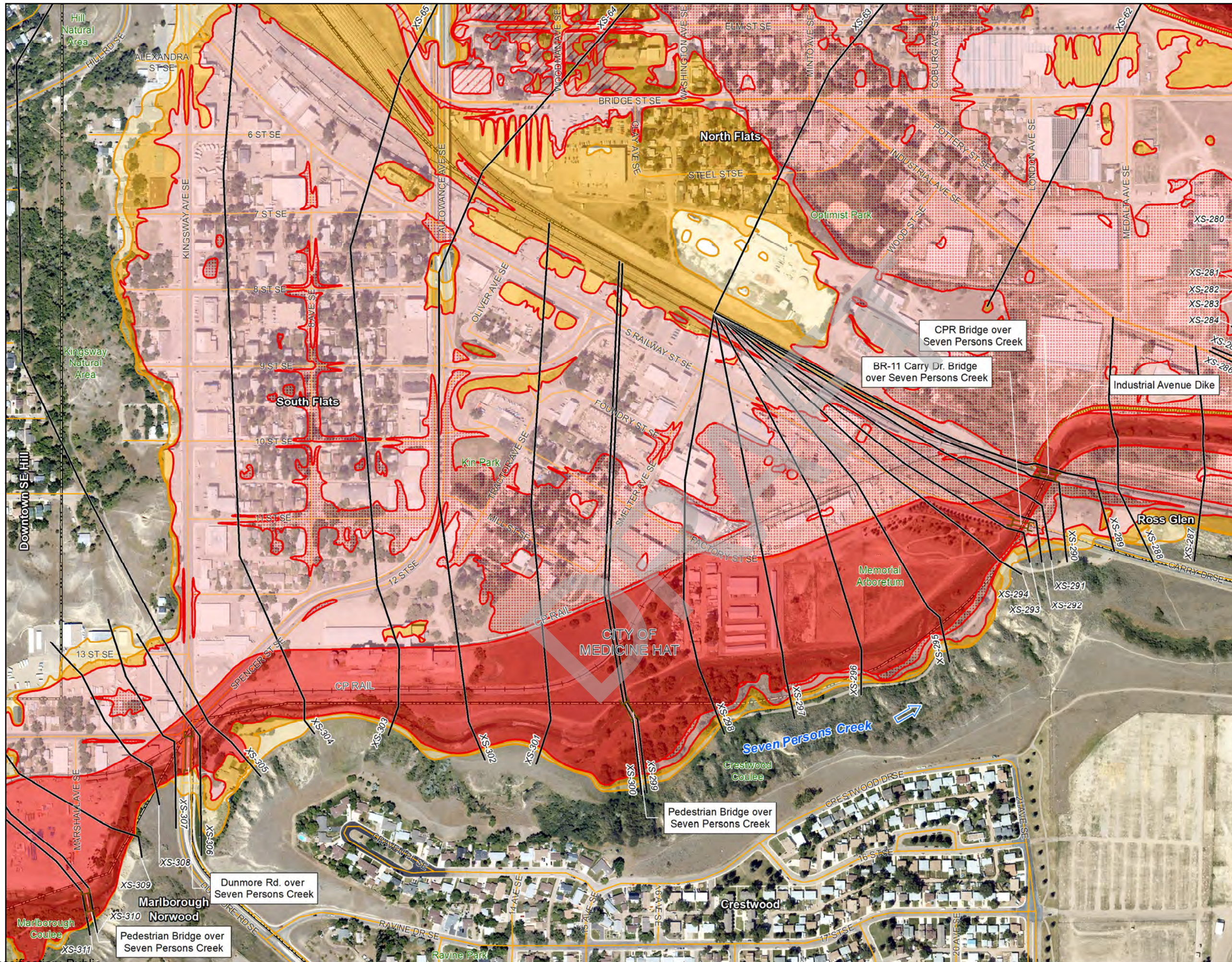


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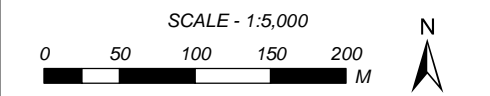
Engineer	GIS	Reviewer
DJH/MMM	REH/JY	RBA
Job: 1003094	Date: 29-APR-2022	

**MEDICINE HAT
RIVER HAZARD STUDY
DESIGN FLOOD HAZARD
MAP**

J:_P\Projects (Active)\1003094_Medicine Hat River Hazard Study\04_Models\GIS\GIS_L1006302_T600_JY_FloodHazard_2021Update.mxd



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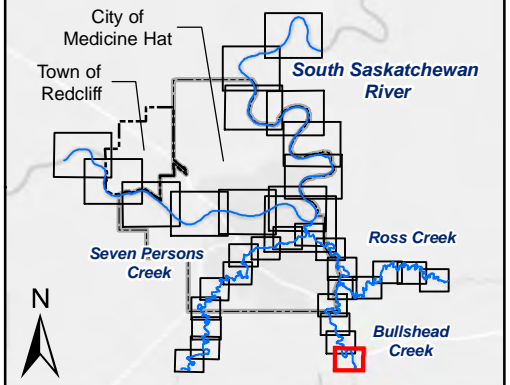


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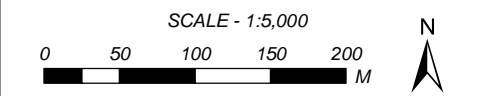
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Job: 1003094		Date: 29-APR-2022

**MEDICINE HAT
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DESIGN FLOOD HAZARD
MAP**

J:\Projects (Active)\1003094 - Medicine Hat River Hazard Study\04 - Medicine Hat River Hazard Study\1006302_T600_JY_FloodHazard_2021Update.mxd



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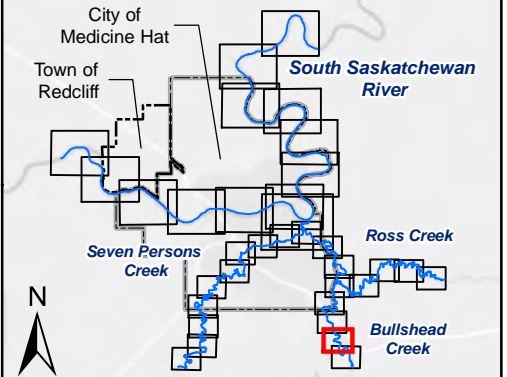


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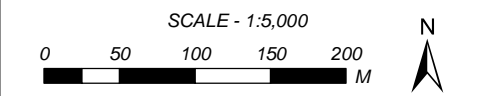
Engineer DJH/MMM	GIS REH/JY	Reviewer RBA
Job: 1003094		Date: 29-APR-2022

**MEDICINE HAT
RIVER HAZARD STUDY
DESIGN FLOOD HAZARD
MAP**

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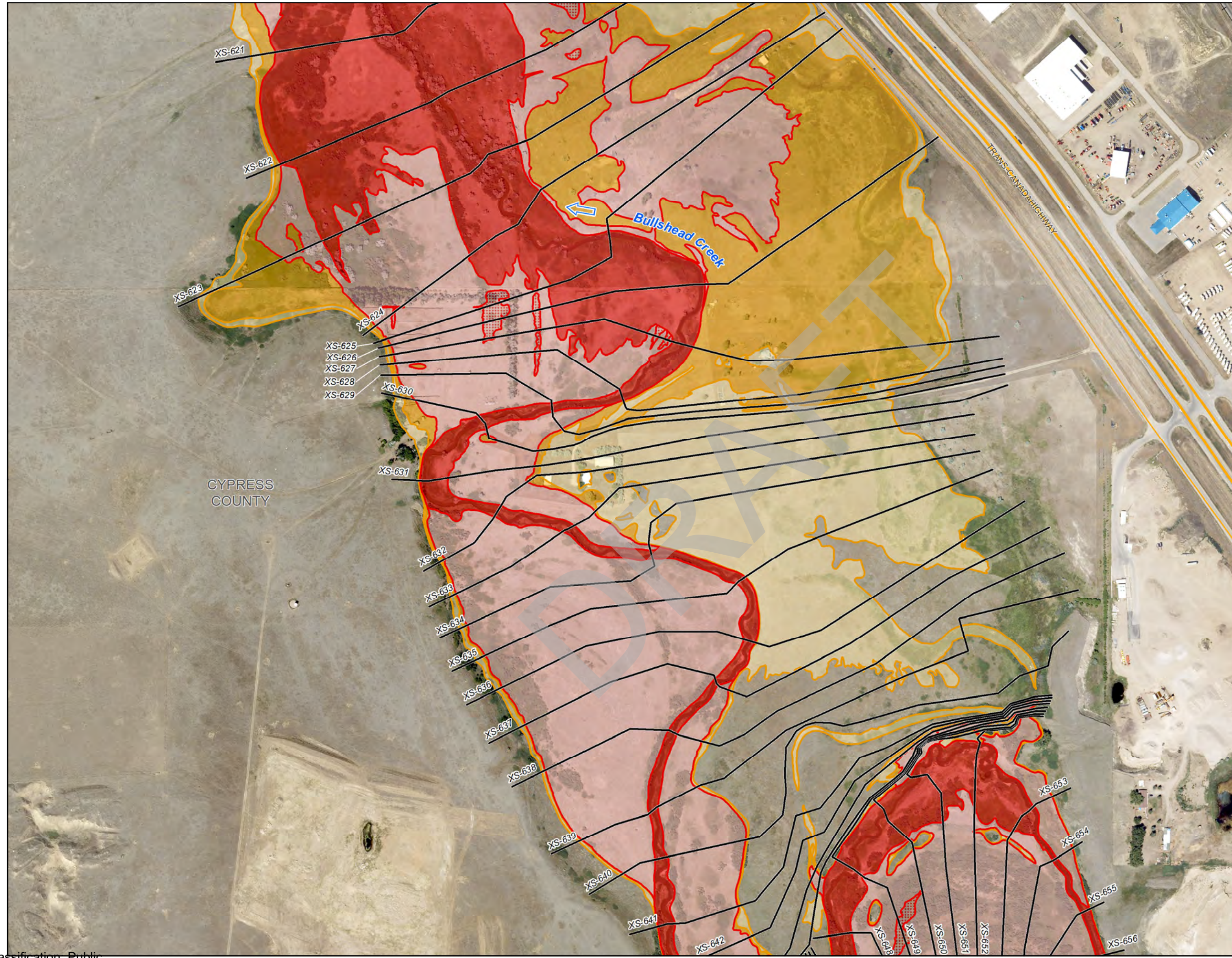
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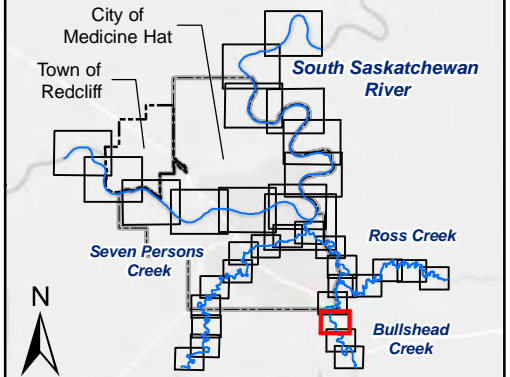
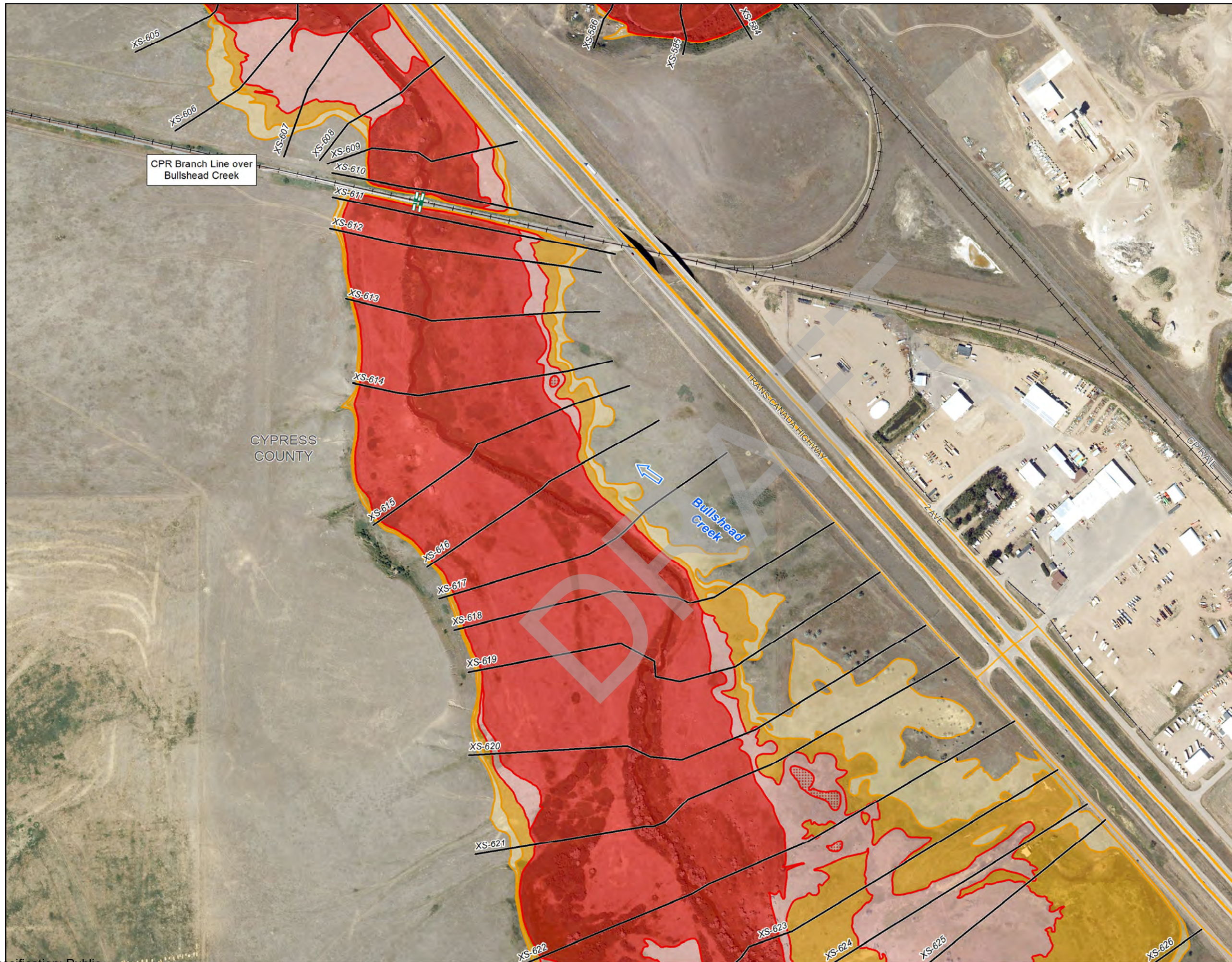
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Engineer DJH/MMM	GIS REH/JY	Reviewer RBA
Job: 1003094		Date: 29-APR-2022

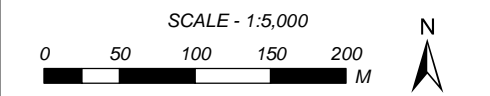
**MEDICINE HAT
RIVER HAZARD STUDY
DESIGN FLOOD HAZARD
MAP**



J:_P\Projects (Active)\1003094_Medicine Hat River Hazard Study\04_Medicine Hat River Hazard Study\GIS\1006302_T600_JY_FloodHazard_2021Update.mxd



- FLOW DIRECTION
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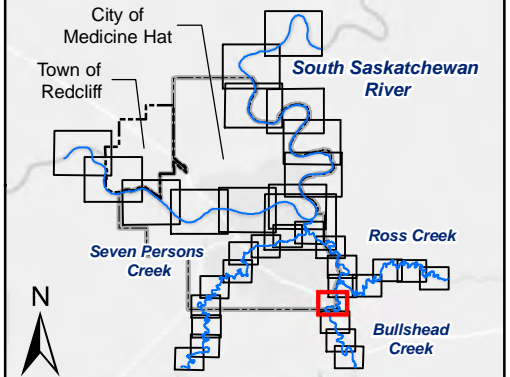
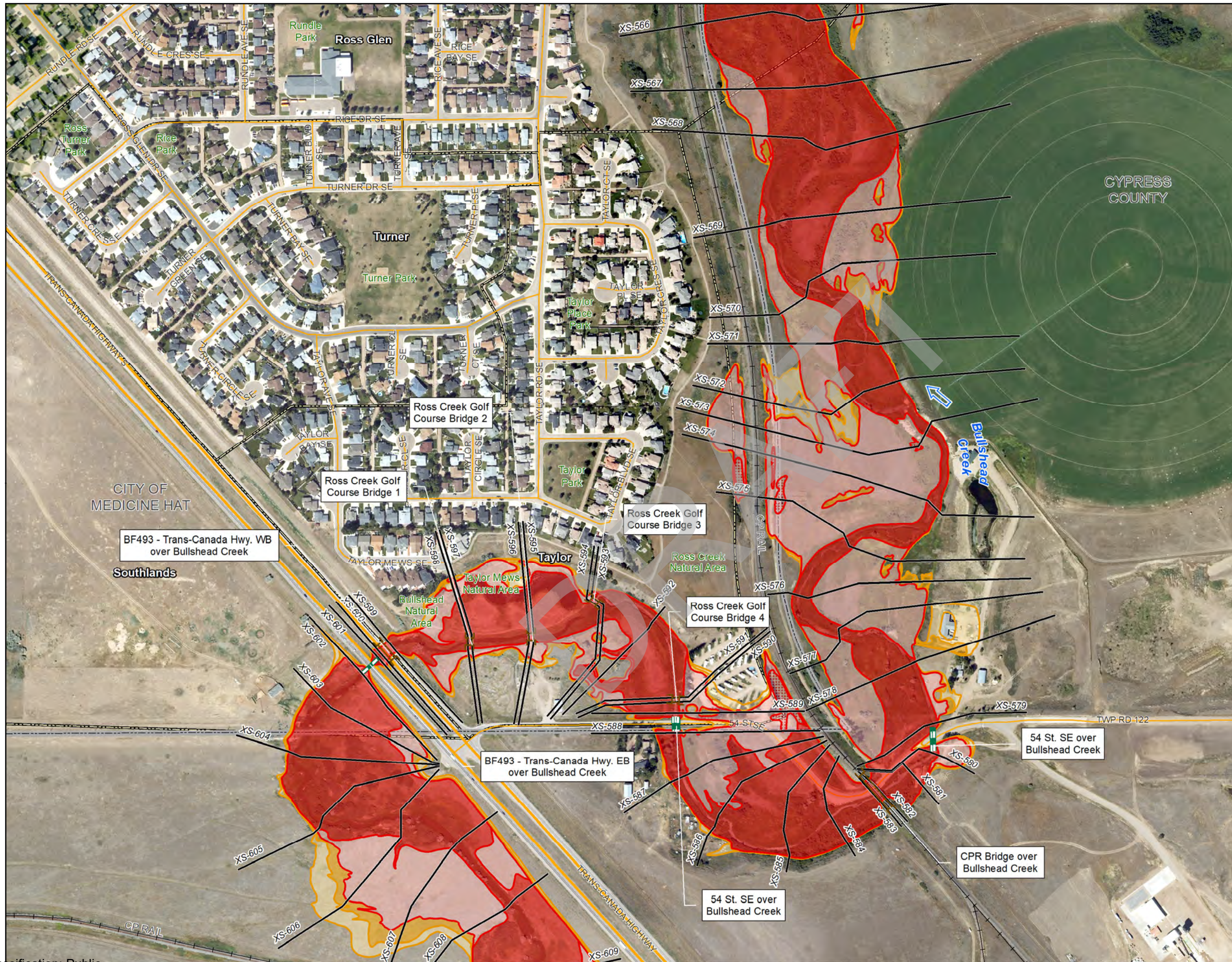


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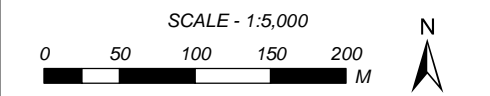
Engineer DJH/MMM	GIS REH/JY	Reviewer RBA
Job: 1003094		Date: 29-APR-2022

**MEDICINE HAT
RIVER HAZARD STUDY
DESIGN FLOOD HAZARD
MAP**

J:_P\Projects (Active)\1003094_Medicine Hat River Hazard Study\04_Medicine Hat River Hazard Study\1006302_T600_JY_FloodHazard_2021Update.mxd



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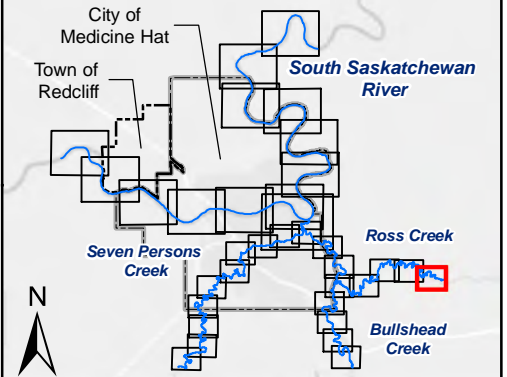


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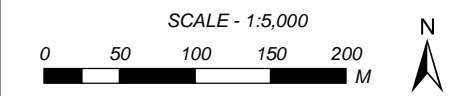
Engineer DJH/MMM	GIS REH/JY	Reviewer RBA
Job: 1003094		Date: 29-APR-2022

**MEDICINE HAT
RIVER HAZARD STUDY
DESIGN FLOOD HAZARD
MAP**

J:_P\Projects (Active)\1003094 - Medicine Hat River Hazard Study\04 - Medicine Hat River Hazard Study\1006302_T600_JY_FloodHazard_2021Update.mxd



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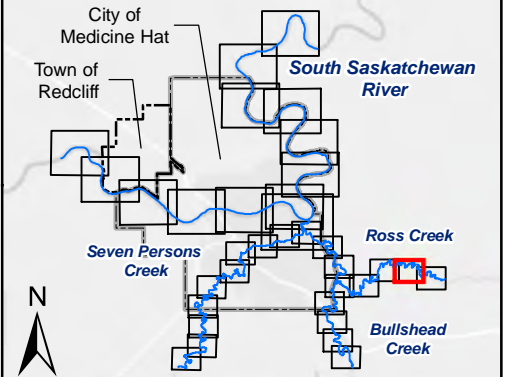


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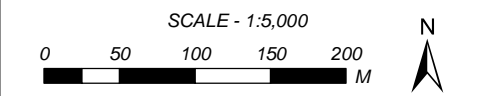
Engineer DJH/MMM	GIS REH/JY	Reviewer RBA
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**MEDICINE HAT
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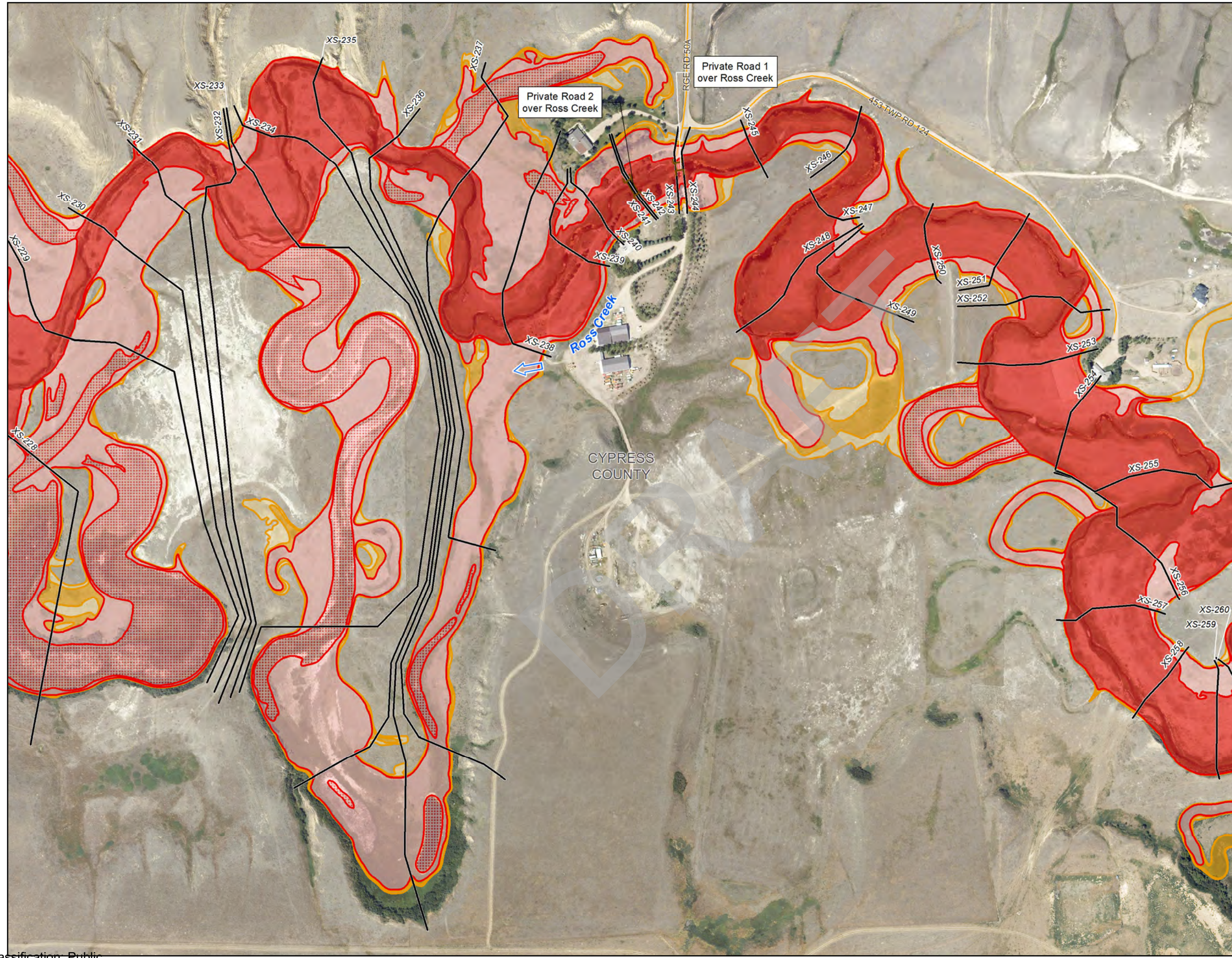
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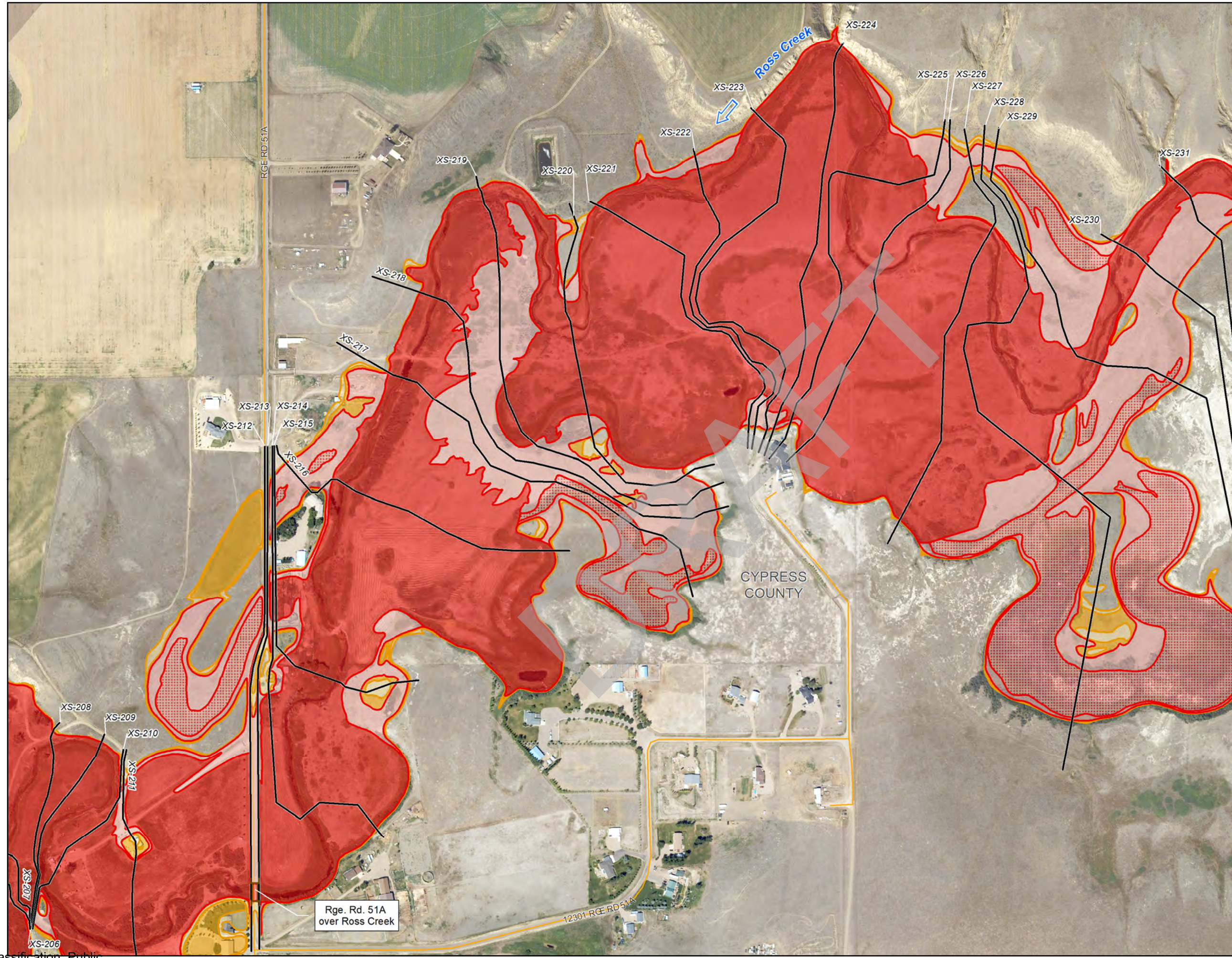
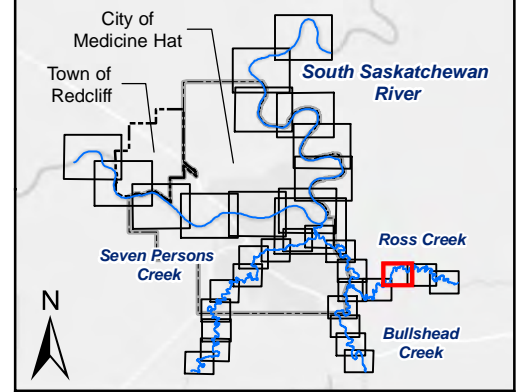
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Job: 1003094		Date: 29-APR-2022

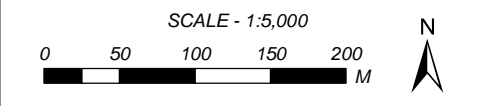
**MEDICINE HAT
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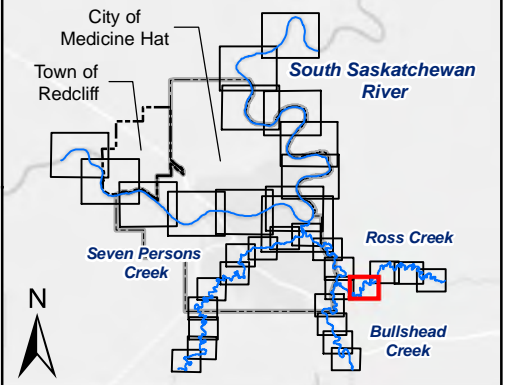
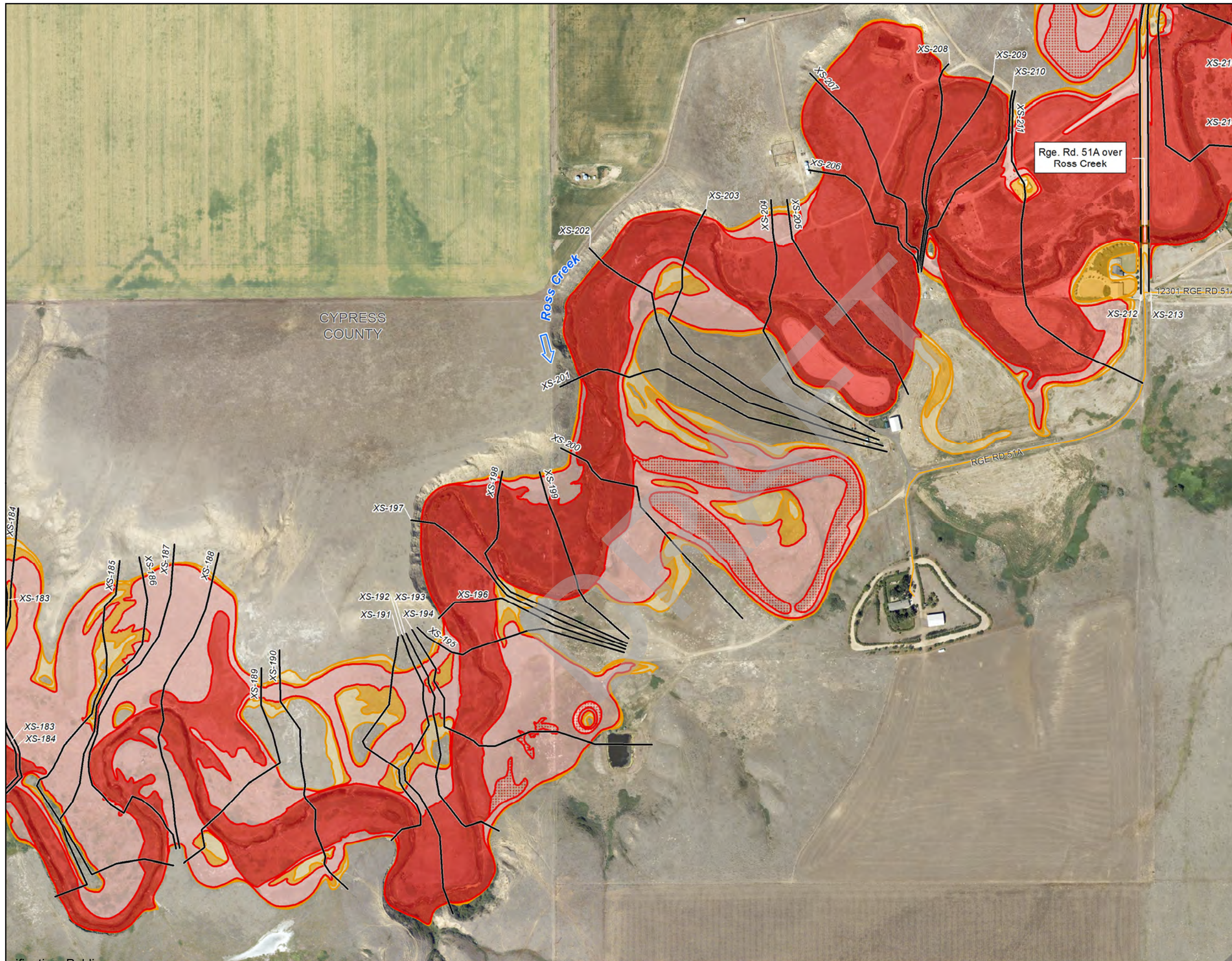


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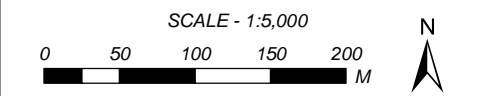
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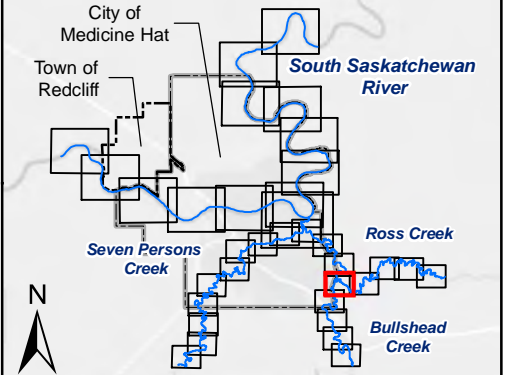
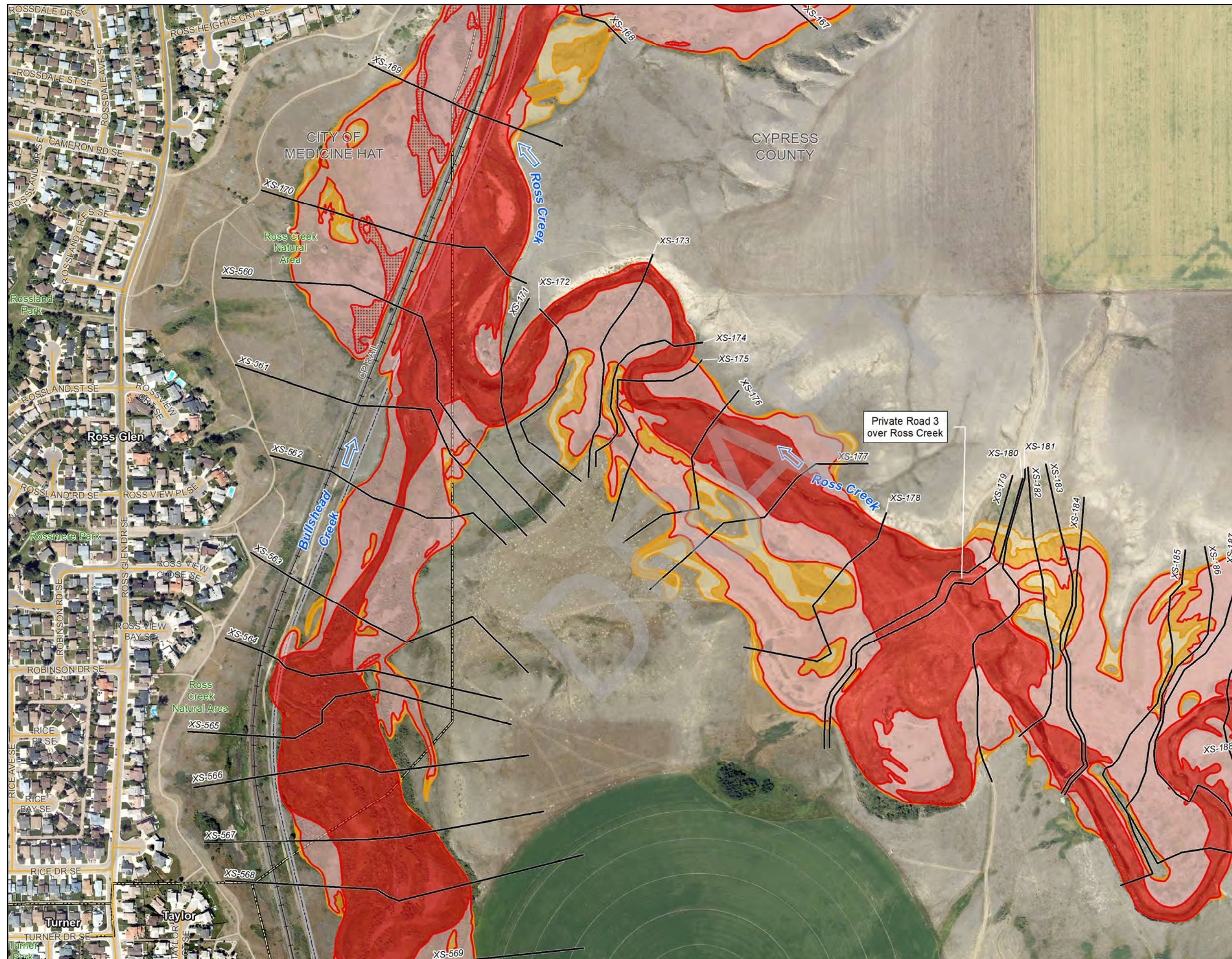


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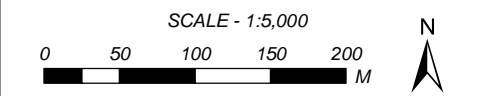
Engineer DJH/MMM	GIS REH/JY	Reviewer RBA
Job: 1003094		Date: 29-APR-2022

**MEDICINE HAT
RIVER HAZARD STUDY
DESIGN FLOOD HAZARD
MAP**

J:_P\Projects (Active)\1003094_Medicine Hat River Hazard Study\04_Medicine Hat River Hazard Study\1006302_T600_JY_FloodHazard_2021Update.mxd



- FLOW DIRECTION
- BRIDGE
- CROSS SECTION
- CULVERT
- WEIR
- STUDY LIMIT
- FLOOD CONTROL STRUCTURE
- FLOODWALL
- FLOODWAY
- FLOOD FRINGE
- PROTECTED FLOOD FRINGE
- HIGH HAZARD FLOOD FRINGE
- 200-YEAR FLOOD EXTENT
- 500-YEAR FLOOD EXTENT
- MAJOR ROAD
- LOCAL ROAD
- RAILWAY
- NEIGHBOURHOOD
- MEDICINE HAT CITY BOUNDARY
- REDCLIFF TOWN BOUNDARY

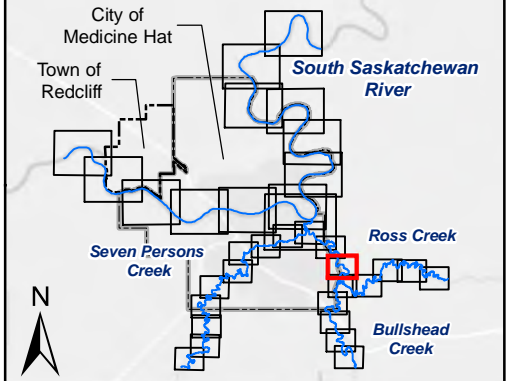
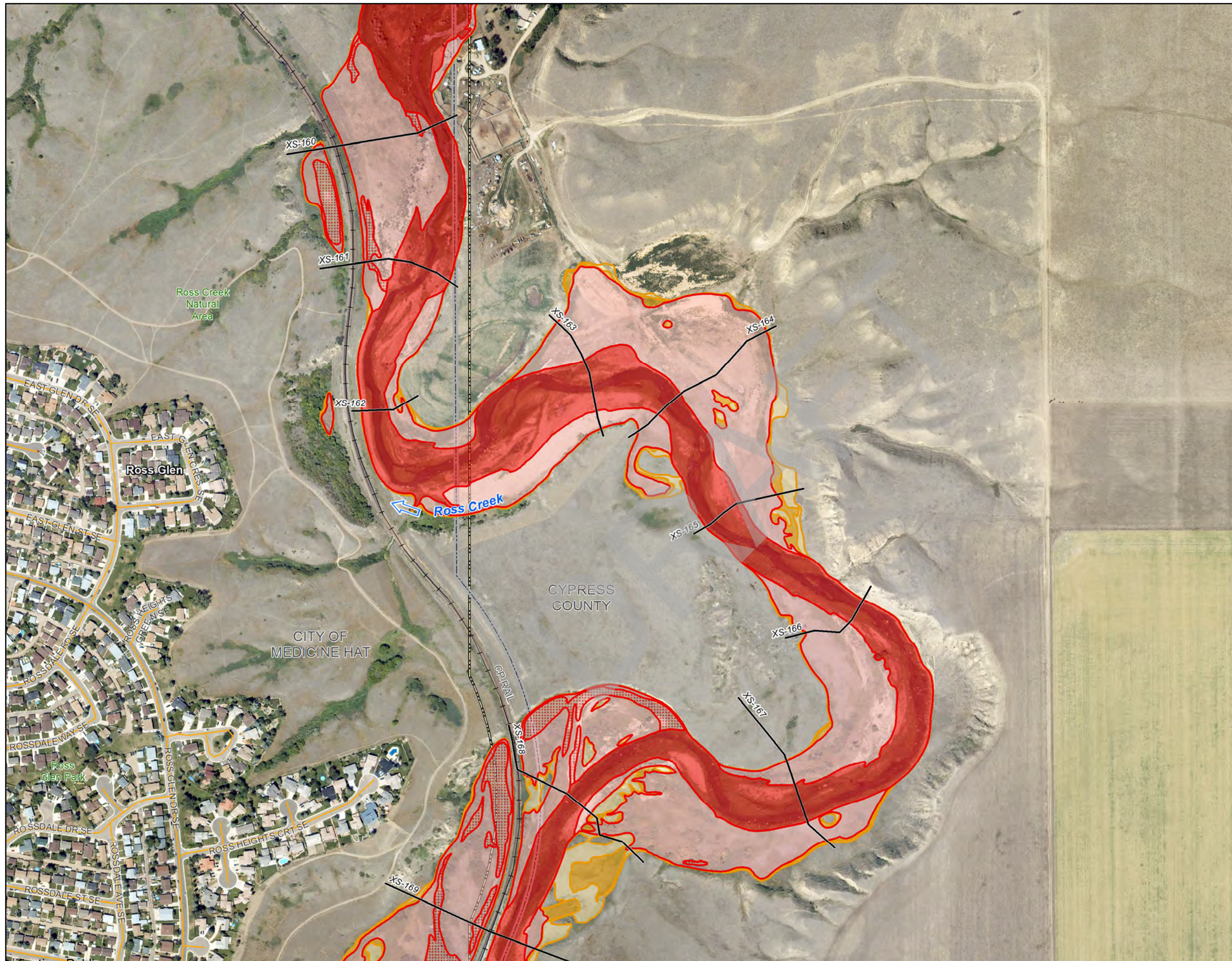


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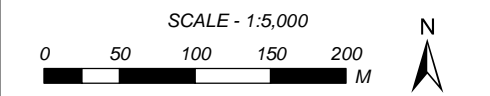
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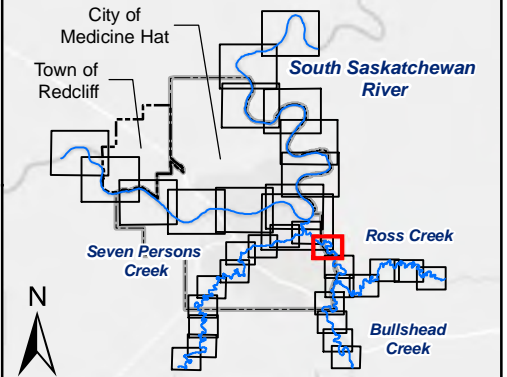
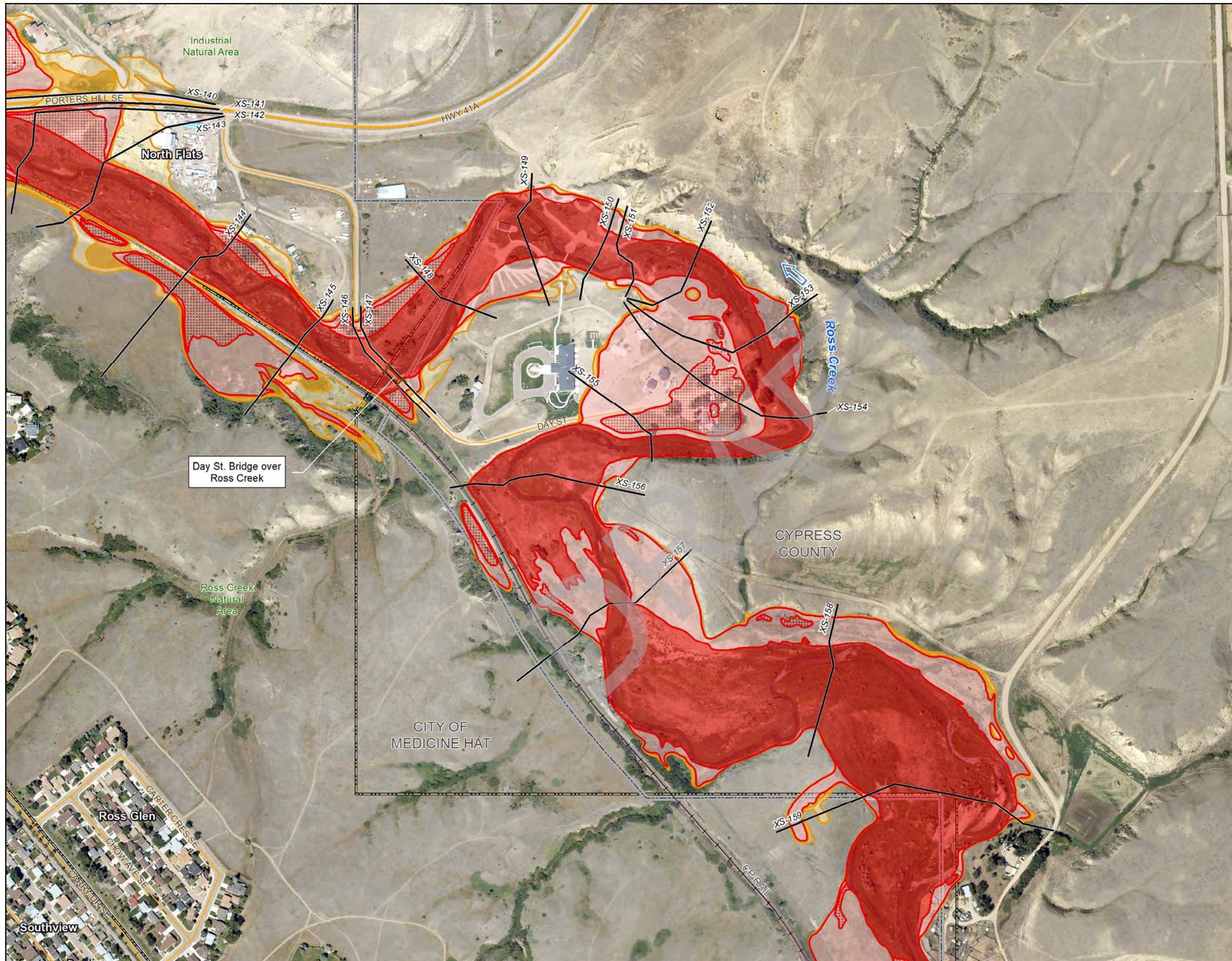


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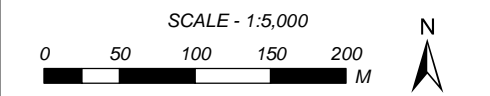
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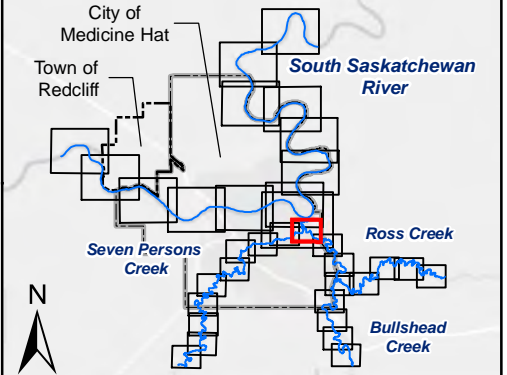


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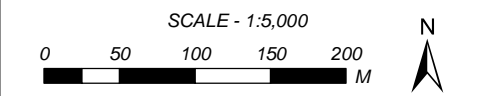
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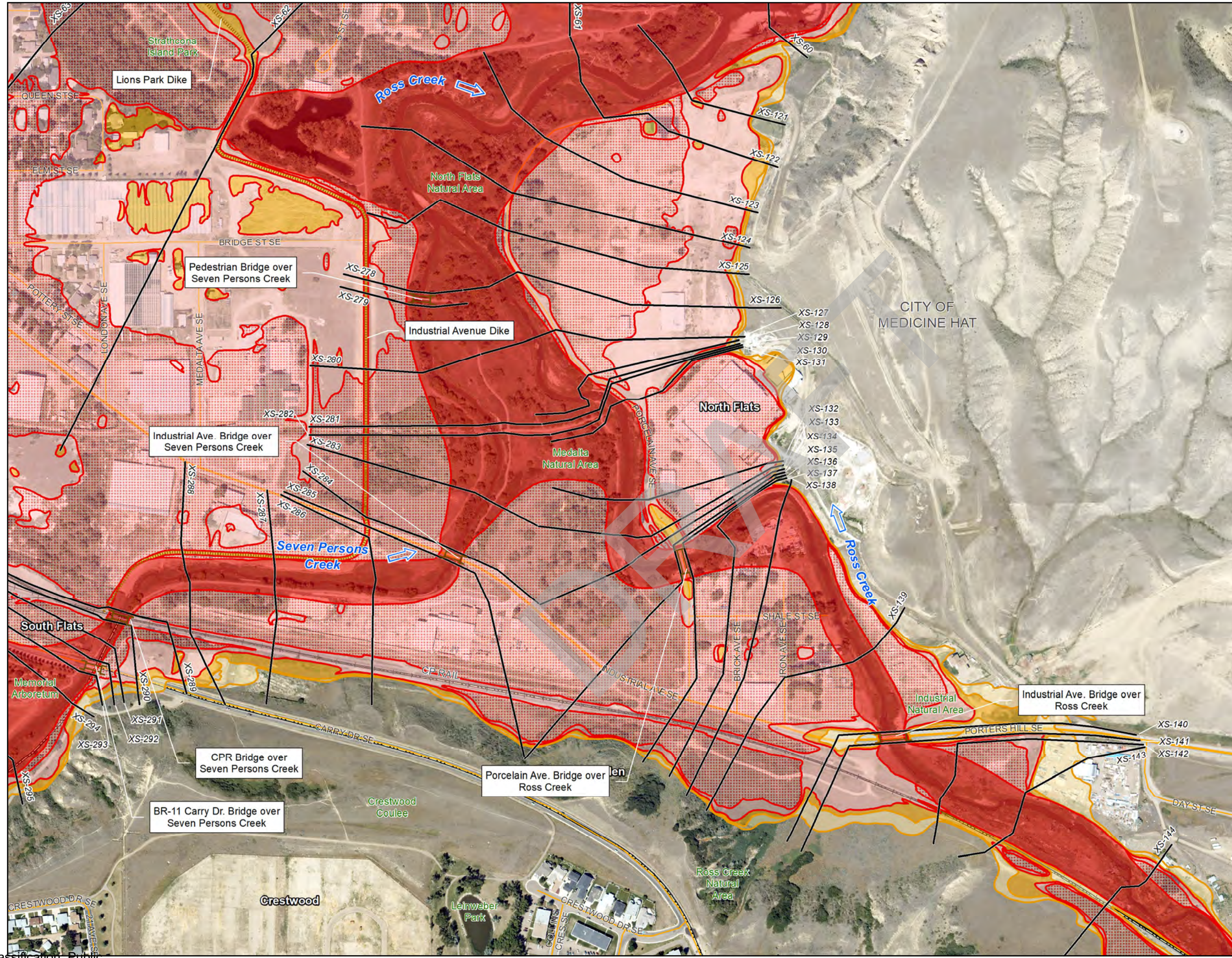
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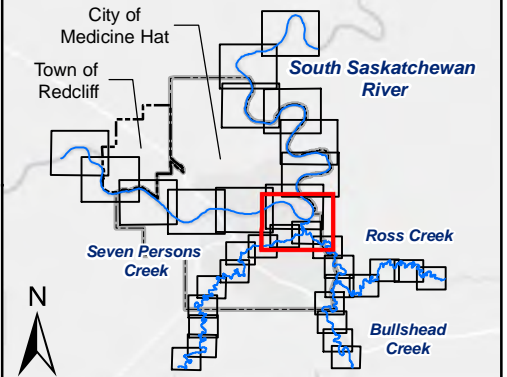
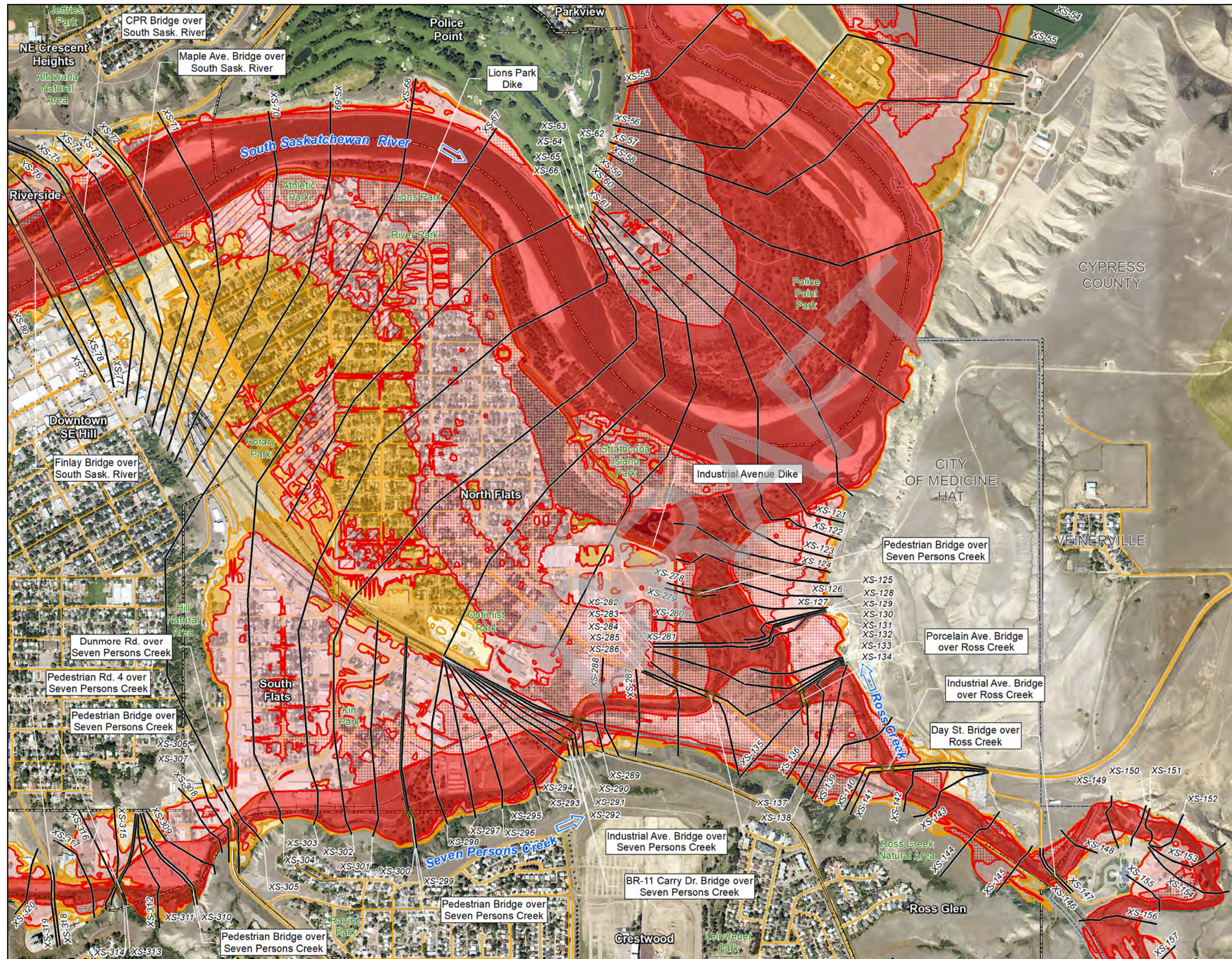
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Engineer	GIS	Reviewer
DJH/MMM	REH/JY	RBA
Job: 1003094	Date: 29-APR-2022	

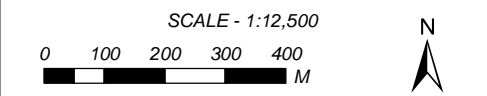
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