ClimateWest

2025 WESTERN FLOOD MAPPING CONFERENCE

Drumheller Flood Mitigation Program:

Floodplain Mapping in Drumheller
A Case Study on Mapping Uses

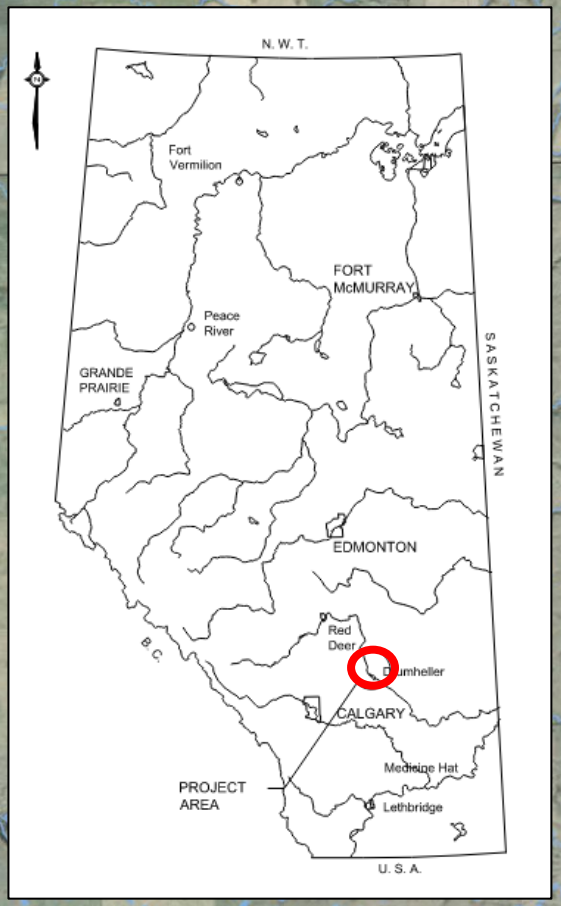
Canada

DRUMHELLER VALLEY

Alberta

Drumheller Geography

Town of Drumheller
Made up of a group of smaller neighbourhoods spread out over 40km along the Red Deer River



Drumheller Valley History of Flooding

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Drumheller River Hazard Study

- Study led by Alberta Environment and Parks – Jane Eaket; consultant team – Northwest Hydraulic Consultants
- Study initiated in 2018 with survey and base data collection
- Encompasses 56.1km of the Red Deer River, 7.9km of Kneehills Creek, 5.3km of Michichi Creek, 10.7km of the Rosebud River and 3.0km of Willow Creek
- Study components – survey, hydrology, channel stability, hydraulic modelling, inundation mapping, flood risk inventory, and flood hazard mapping
- Mapped 13 return period floods, with the 100-year flood as the regulatory event
- Special model run of 1:100 year regulated flow initially completed for Flood Mitigation Program design work
- **Following negotiation between the Town and Province, inundation mapping updated from naturalized flows to regulated flows (Dickson Dam)**
- Study finalized, and flood hazard maps completed September 2024

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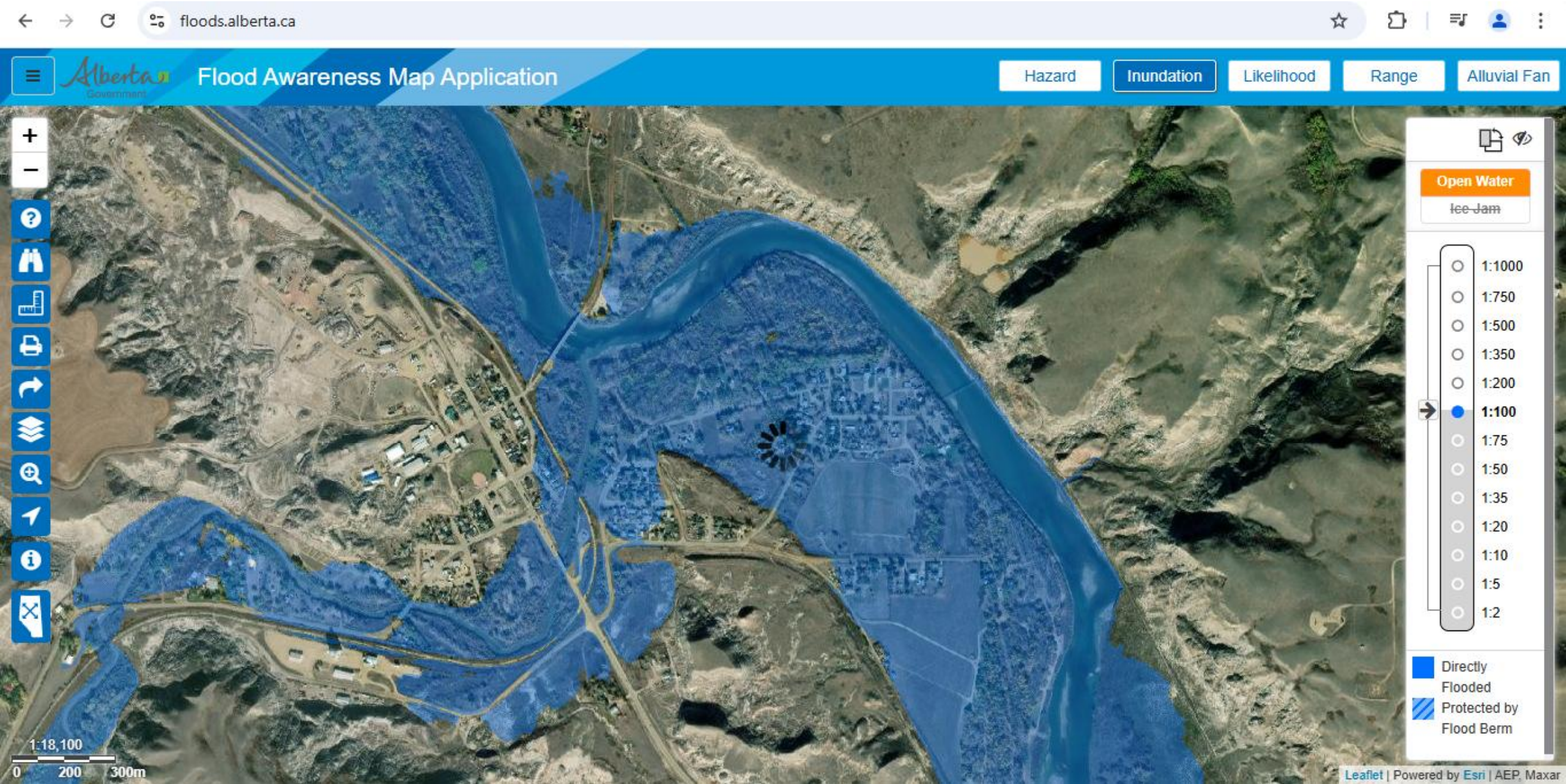
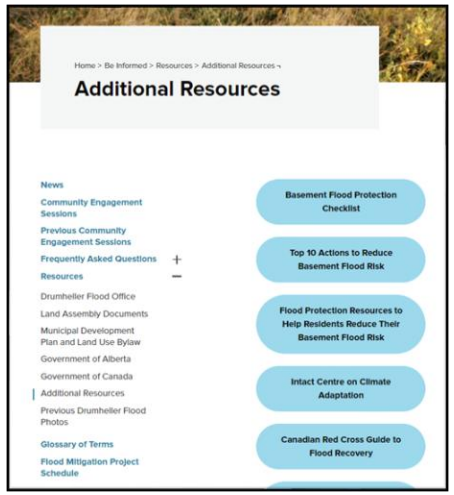
Drumheller River Hazard Study

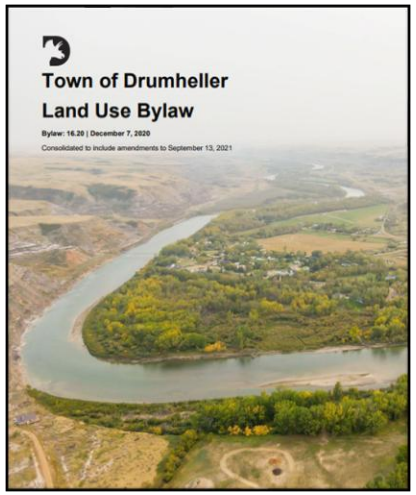


Drumheller Flood Mitigation Program Components

1. Communication/Education



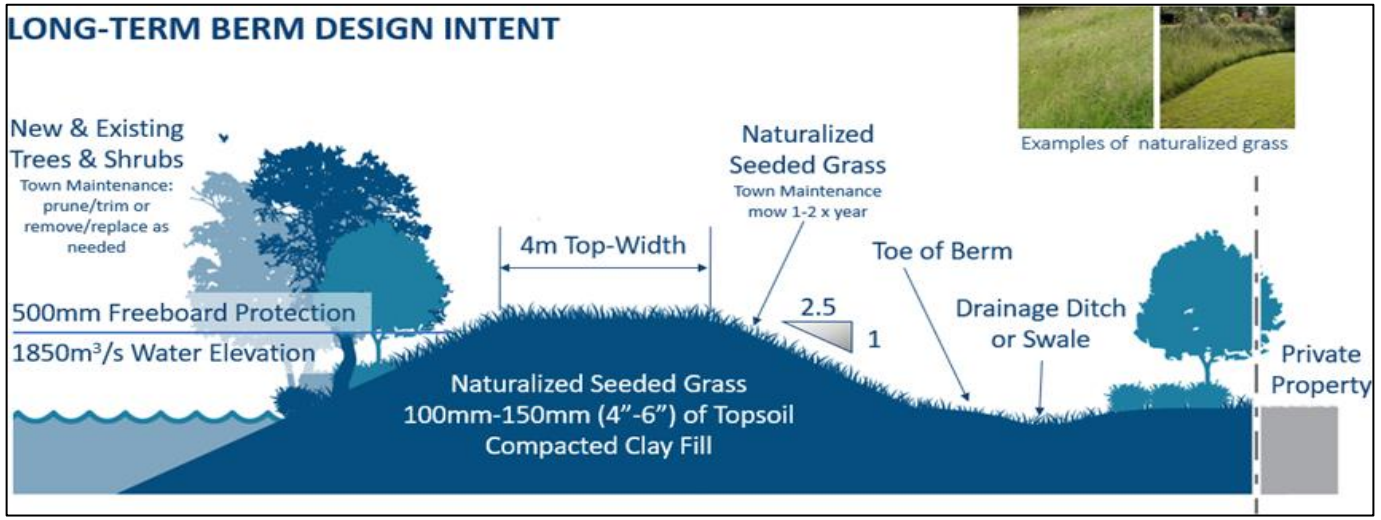
2. Policy



3. Flood & Emergency Preparedness

4. Buyouts in Floodway

5. Structural Mitigation



Public Communication of Flood Risk

- Initially, low level of public trust for the Flood Program, maps not available; or when they were – confusing as they were for natural flow rates but mitigation was for regulated flow; maps still in draft
- Landowners felt they had already “survived” the worst floods they could see – in 2005 and 2013; could not imagine anything worse
- Through the program we persisted in sharing mapping information, including AEP staff at virtual an in-person open houses, right from 2021 when maps were made available

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Public Education

- Booths at Flood Office project events to show floods.alberta.ca tool
- Visual imagery – Inundation mapping showing design flood extents on maps in project areas
- Flood risk info shared online and with stakeholders (realtors, utility providers, service providers)

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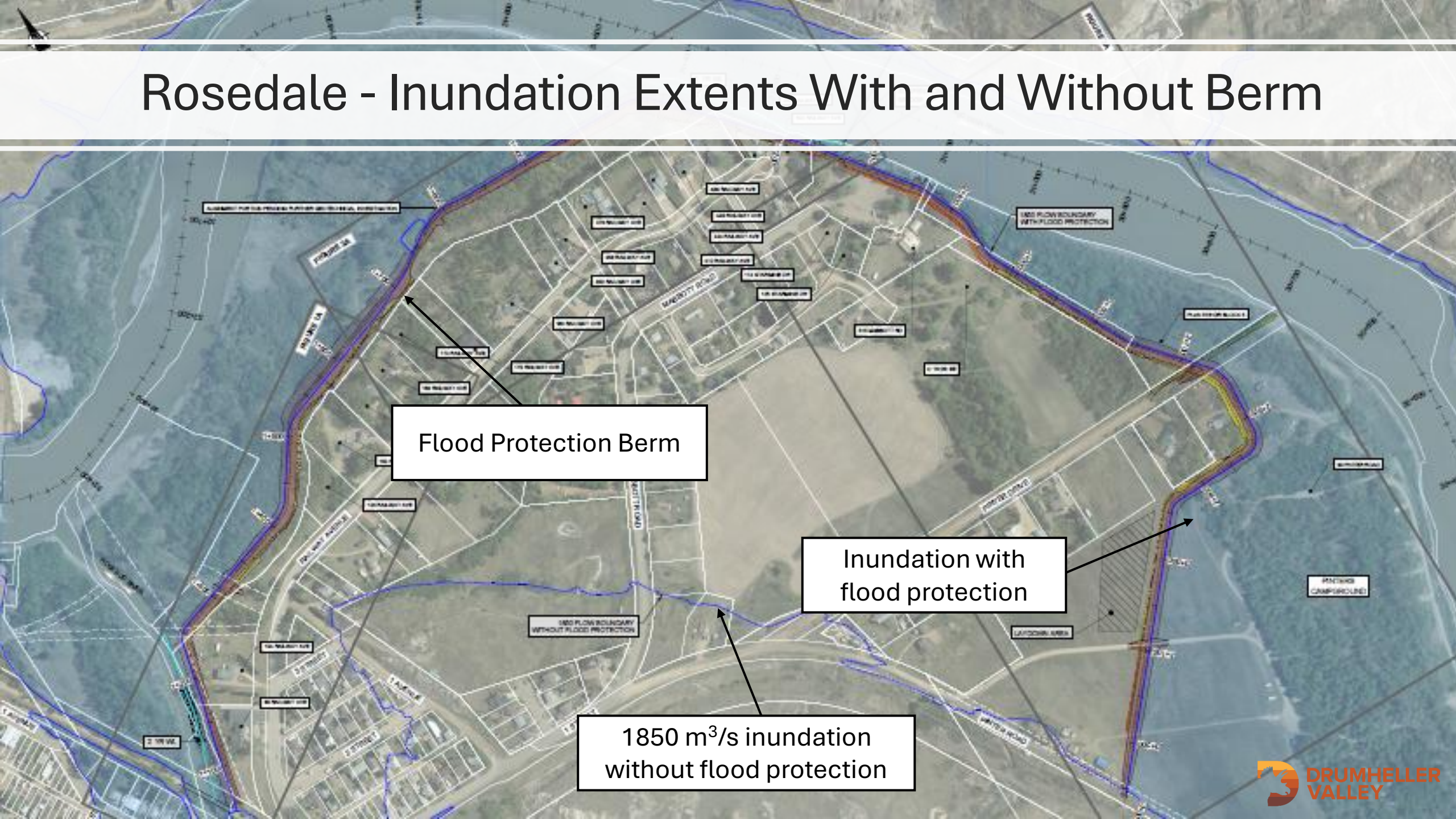
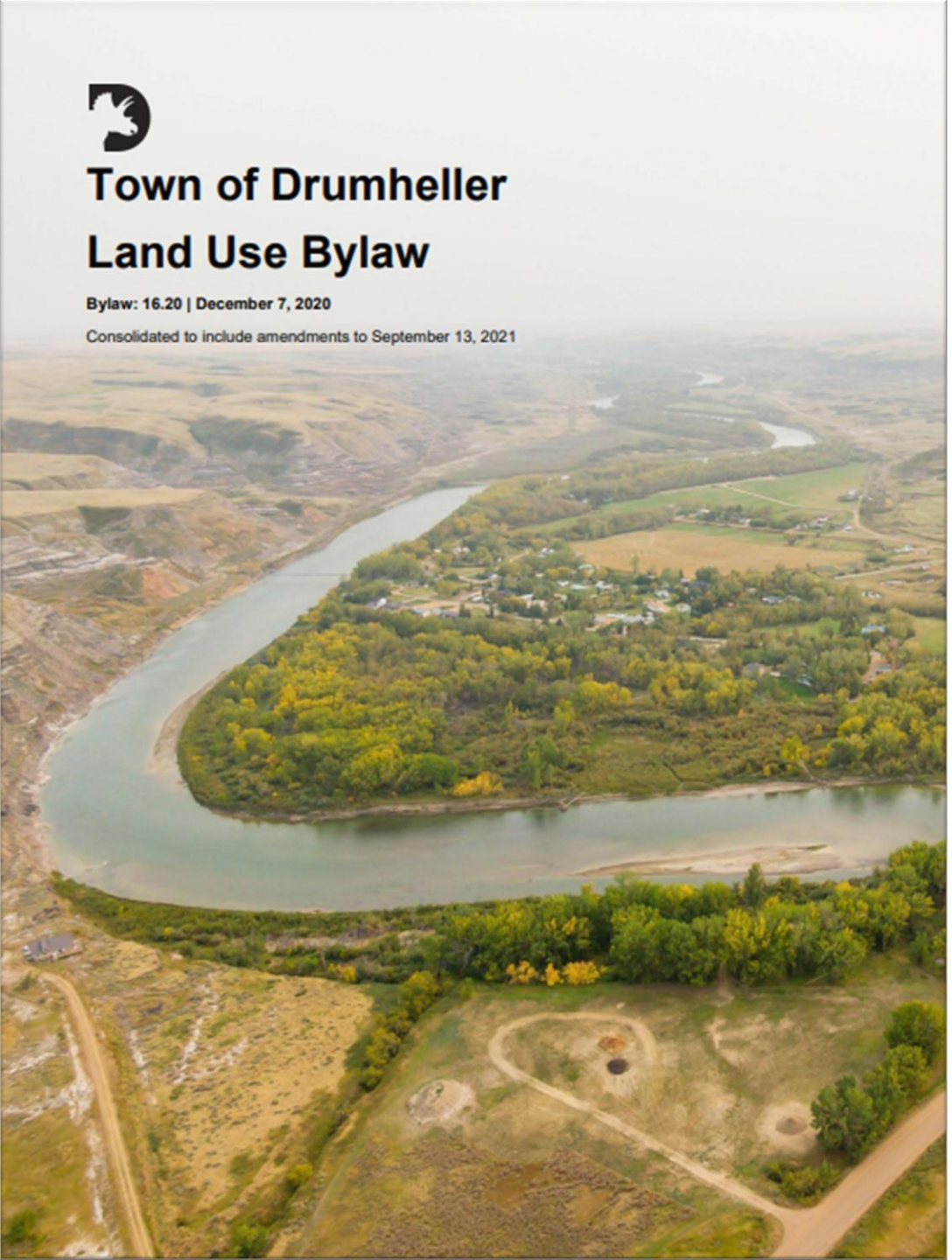
Rosedale - Inundation Extents With and Without Berm





Land Use Development Regulation

- Land Use Bylaw updated in 2020 - design flow rate used was 1640m^3/s + 0.75m of freeboard
- Community information sessions and open houses were held to present mapping and upcoming changes to flood overlays
- LUB updated again in July 2021 to update to new design flow rate of 1,850 m^3/s (regulated flow) and to remove out of date mapping, once draft Provincial mapping became posted on-line, to avoid confusion over any inconsistency
- Further updates completed in 2023 and 2024 to improve alignment with new Provincial Flood Hazard mapping terminology (i.e. high hazard flood fringe, protected flood fringe) and add a new designation unique to Drumheller

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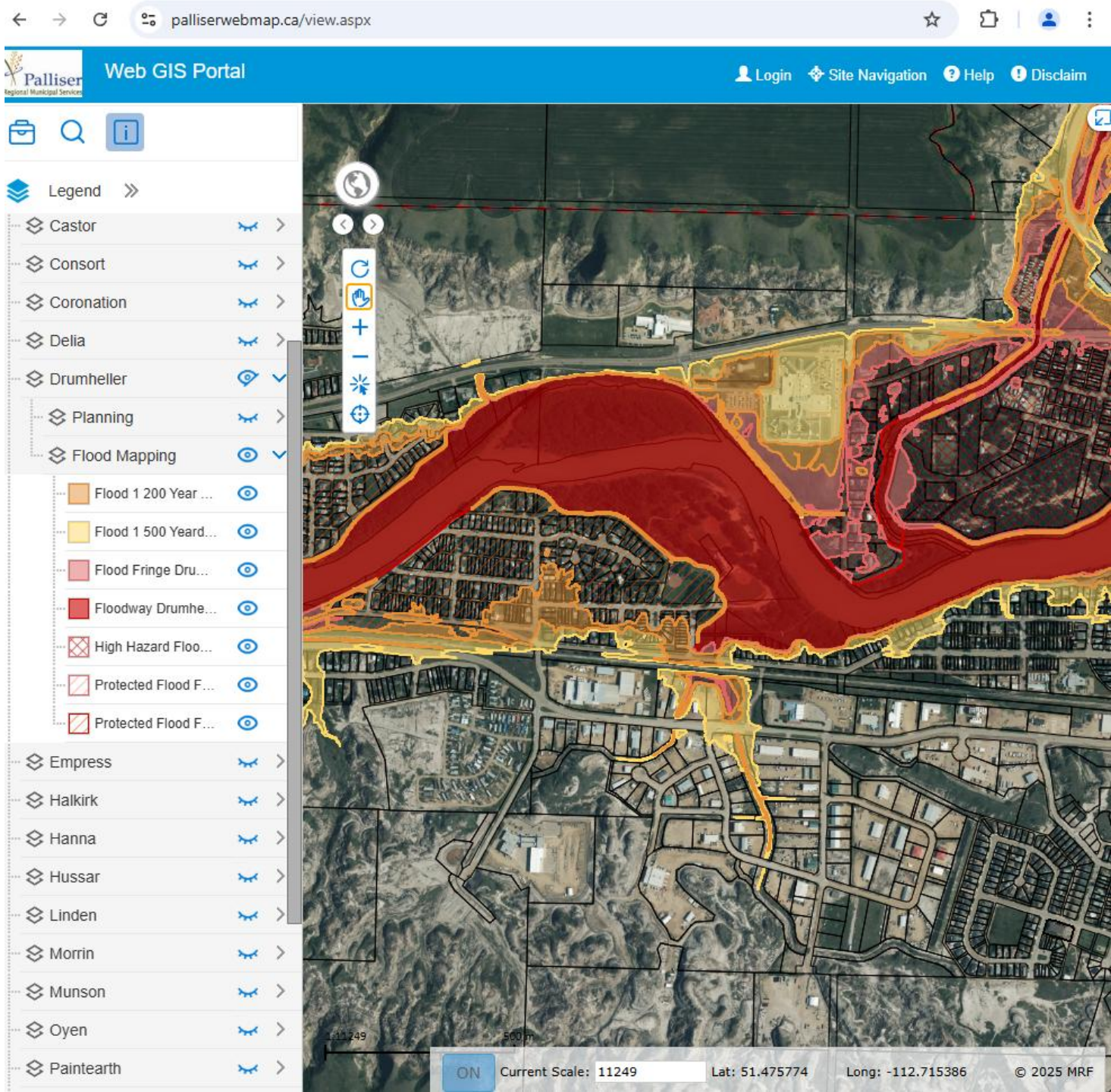
Land Use Development Regulation

- Flood hazard maps are posted on the Palliser Web GIS Portal for use in development applications
- Drumheller has a unique layer, not seen in other municipalities – ***protected flood fringe (temporary)***
- This acknowledges the Towns' 2-3 day lead-time ahead of floods and the ability to install temporary, adaptive fill to close gaps in permanent protection

Image from: palliserwebmap.ca



Temporary Adaptive Fill – Past Flood Examples

- Ahead of the 2005 flood, the Town, working 24 hrs/day for 3 days was able to place 86,000 cubic meters of fill, building over 7km of temporary berms, 2.5 to 3.0m tall
- Presently, the Town has plans to install temporary adaptive fill to block gaps in Newcastle and Midland Berms where there was not space to build permanent infrastructure, as well as to add a section of freeboard to the Downtown Berm

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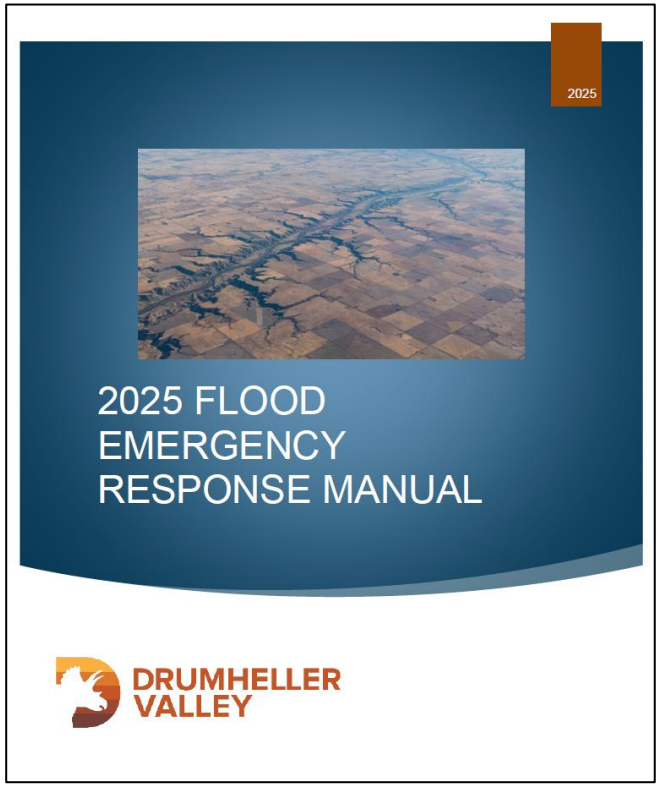
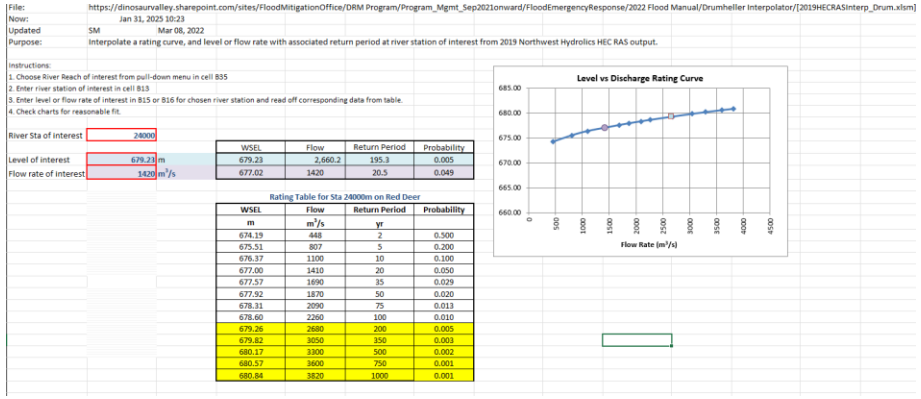
Flood Emergency Response Planning with Floodplain Maps



- Mapping study data used to improve the level of detail in the Town's Flood Emergency Response Manual
- Overall Flood Emergency Response Manual format based on City of Calgary document
- Manual includes 14 sections with various response activities
- Inundation mapping and model results used for flood response
- 1D model output used to help determine when critical impacts occur and allow for emergency response plans to be developed



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Emergency Plans

- Example emergency plans include:
  - Parks and pathways closures
  - Outfall closures and associated pumping needs
  - Temporary barrier construction plans
  - Evacuation mapping, and assessment of number of impacted citizens for reception center planning

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Emergency Response Planning

The Town has taken things one step further and issuing the Provincial mapping layers to develop a GIS web-map based flood emergency response plan to facilitate faster response times

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2 Year Flood (330 m^3/s) | 50 Year Flood (1410 m^3/s) | **100 Year Flood (1850 m^3/s)**

100-Year Flood Scenario Map (1850 m^3/s)

Neighbourhood: Newcastle

Drumheller Outfalls: All Outfalls

1 of 4

Temporary Berm Design Details

Temporary Dike: N3_A

Design Sheet:

TEMPORARY_BARRIER_FOR_FLOOD_PROTECTION_N3-100_2024Sept.pdf

Total Temporary Berm Length for 100 Yr Flood: 1107 m

Flood Response Action Sheets:

Evacuation Map: Print Sheet

Outfall Closure Map: Print Sheet

Outfall Table: Print Sheet

Impacted Outfalls*

6 / 65

* Number of impacted outfalls in selected neighbourhood shown as fraction of total impacted outfalls

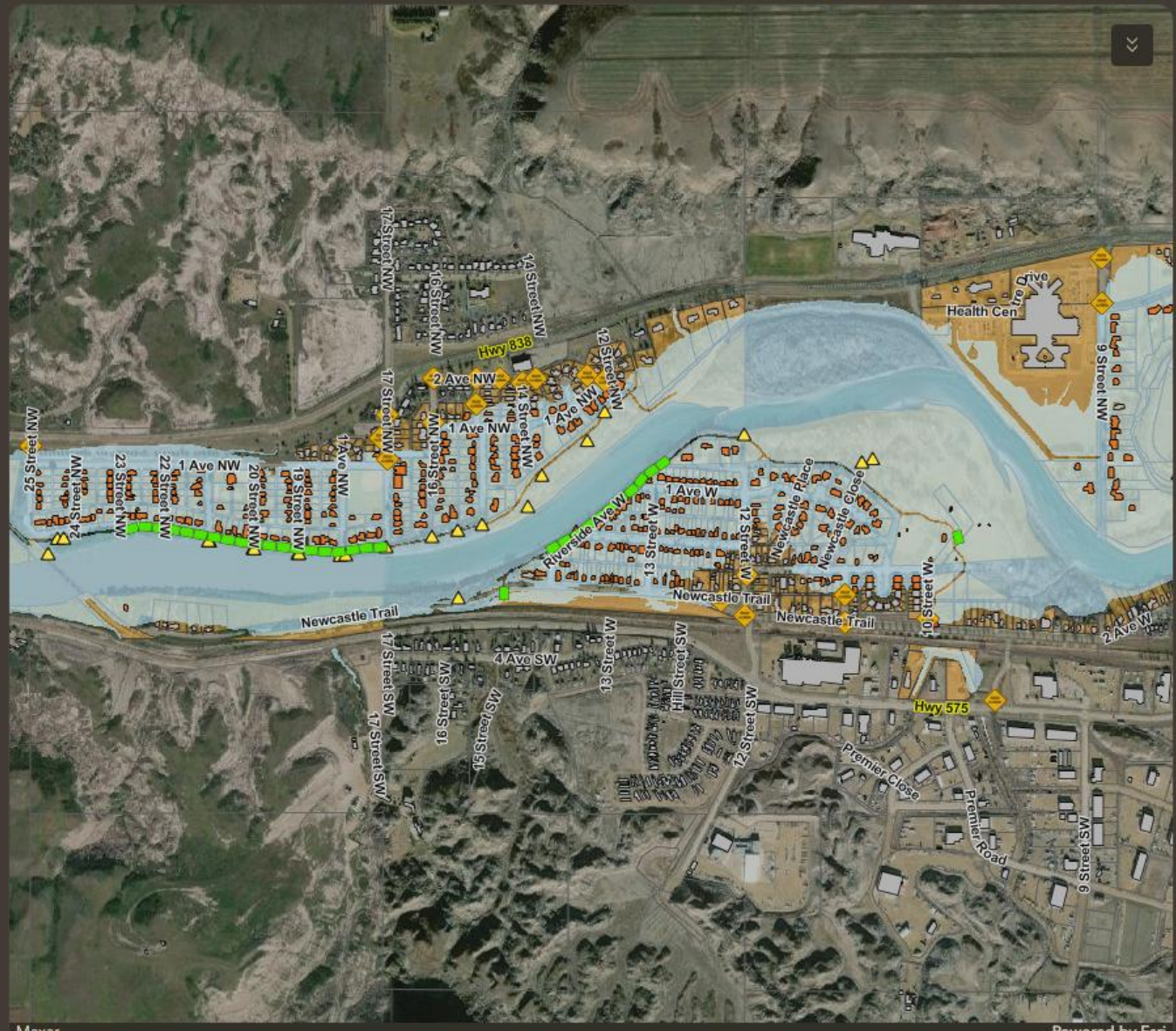
Impacted Roads

7

Evacuated Population*

517

* Estimated population based on residential buildings within affected parcels



Legend

Temporary Berms

Flood Rate: 1850 m^3/s

Proposed Road Barrier Location

Impacted Outfalls

- Impacted - No Valve
- Impacted - Valve
- Impacted - Unknown
- Not Impacted

All Affected Dwelling / Structure

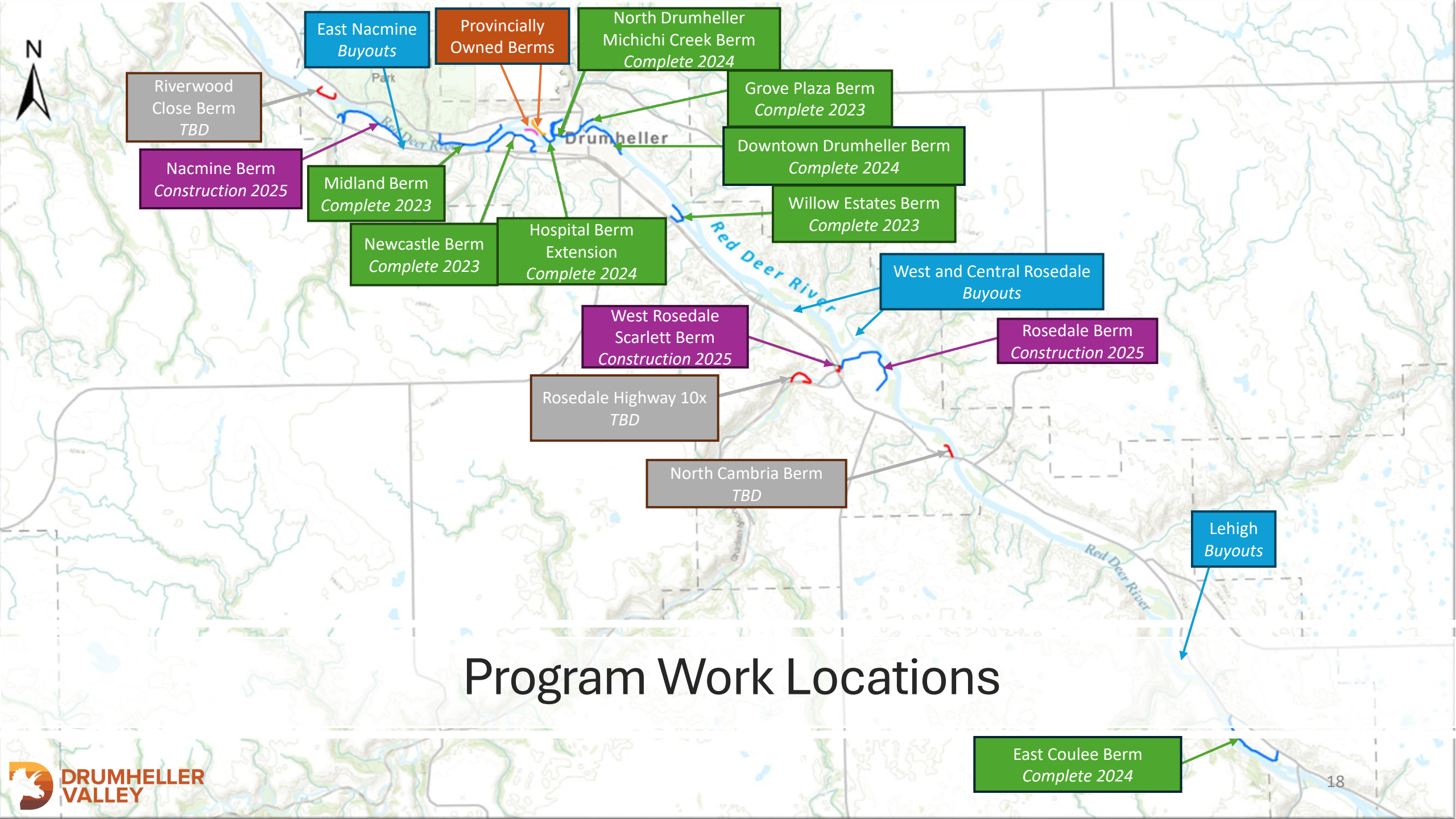
Dwelling / Structure

Flood Inundation Area

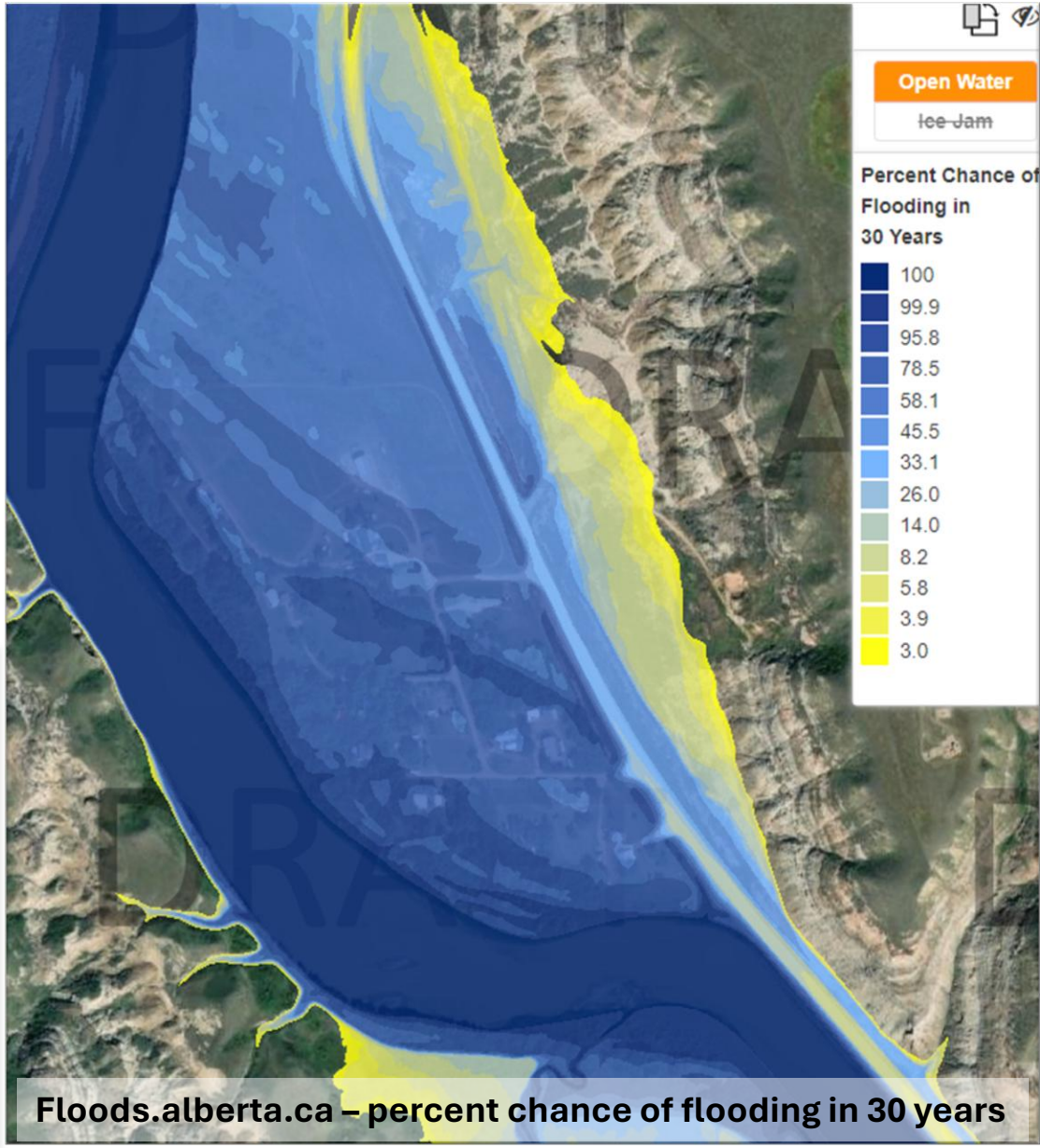
Affected Land Parcels

Design of Flood Mitigation Measures – Structural Mitigation and Floodway Buyouts

- Draft mapping was used to identify areas of highest risk and evaluate properties for floodway buyout program potential
- Mapping was further used in the community of Lehigh to evaluate a range of flood mitigation options, ahead of commencing buyouts for the whole community
- Mapping and the HEC RAS model from the study were used in the design of the berms and bank erosion protection
- The 2-year flood was also used for several regulatory applications to assess impacts to the aquatic environment and design compensation



Program Work Locations



Floods.alberta.ca – percent chance of flooding in 30 years

Mandatory Floodway Buyouts

Floodway buyouts are taking place for properties in significant flood risk locations with no protection

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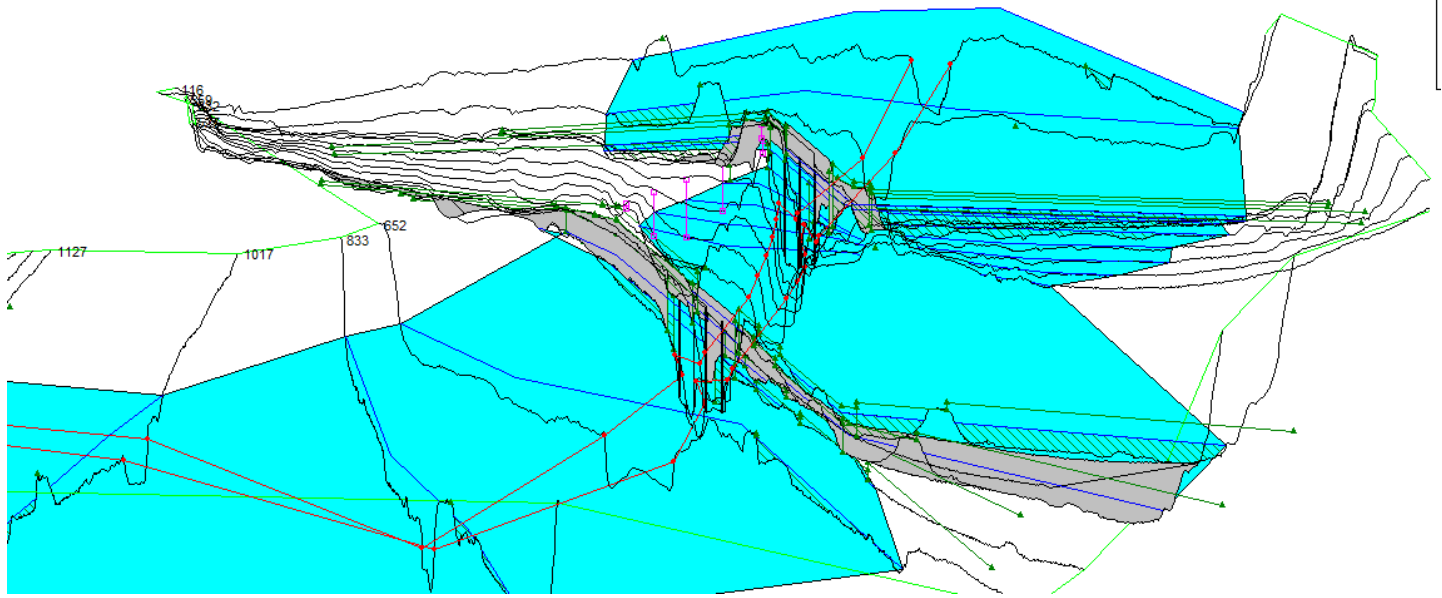
Structural Mitigation

- 12 berms are planned as part of the program; with 9 delivered to date
- In some locations, riprap bank erosion protection is also required to protect against erosion of the berms
- Project information used from the flood study included, LiDAR data collected for design of the berms, inundation extents and depths and the project HEC-RAS model:
    - Locating the berm – typically on the flood fringe/floodway boundary
    - Used for optimization – locate berm where flows are shallower
    - HEC RAS used to check velocities and shear stress and assess need for erosion protection, and size rock
    - Areas re-modelled with berms in place to assess hydraulic impacts, and In some cases adjust design elevations to meet new water levels
    - Model also used to run scenarios to answer citizen inquires (i.e. – Midland Rail bridge is the cause of flooding in Nacmine; or Newcastle Berm is the cause of flooding across the river in North Drumheller)



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Summary

- Accurate, up to date maps are key for many municipal functions
- Small municipalities don’t have the resources to develop their own mapping for these purposes, so rely on the Provincial mapping studies data
- Timeliness of issuing the mapping can help to build public trust and avoid confusion
- Consultation with the municipality is also key throughout the mapping study, to ensure the mapping meets the needs of the community (i.e. avoid rework or delays due to natural vs regulated flows)
- It is not just the maps themselves that are useful – also the LiDAR, aerial photos, hydraulic models and associated reports that are used for future work in the municipality

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North Drumheller Flood Improvements – Complete 2024

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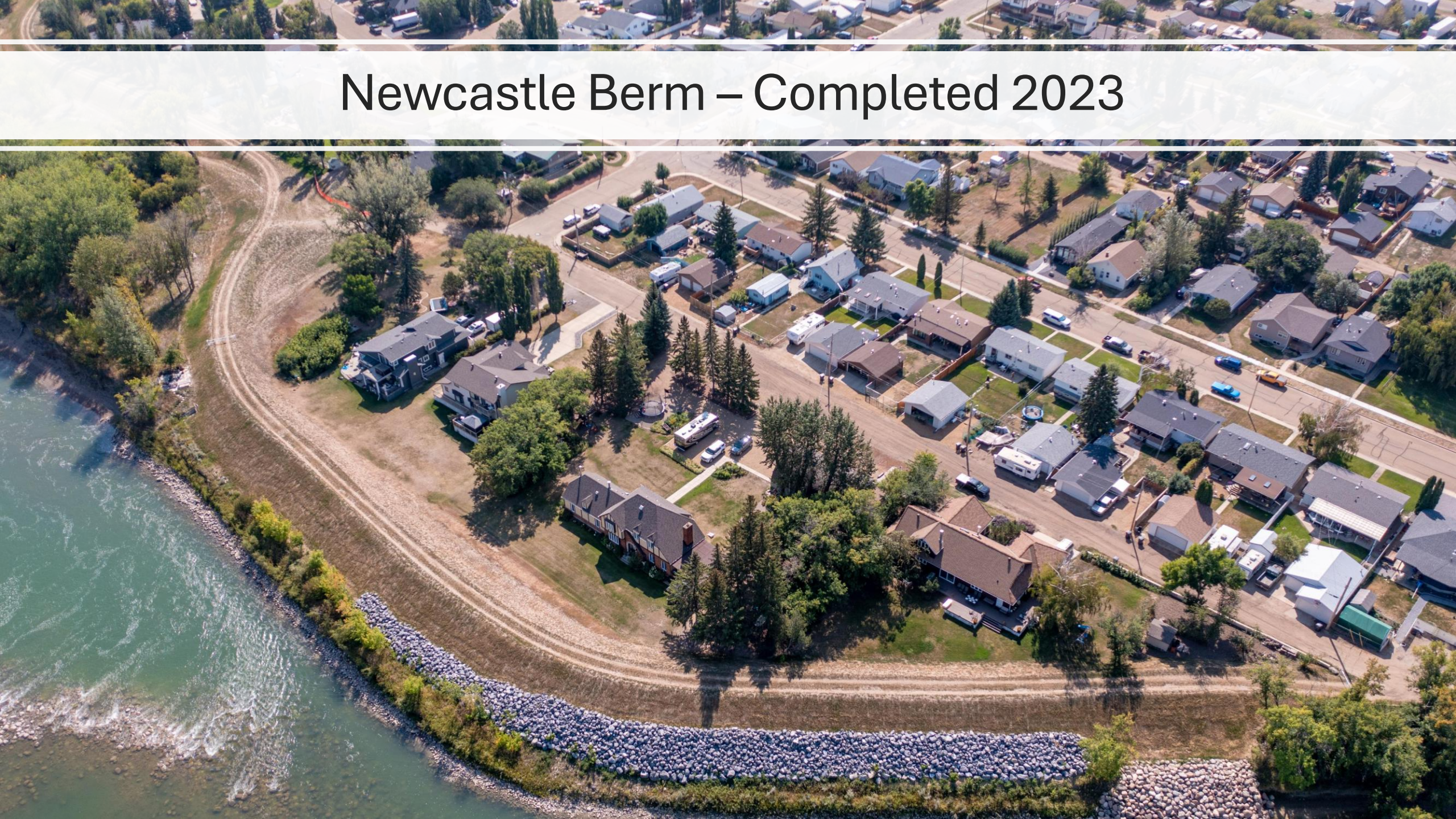
Downtown Berm – Complete 2024

Newcastle Berm – Completed 2023



Lehigh Buyout Location

Midland Berm – Completed 2023

Willow Estates Berm – Completed 2023

Grove Plaza Berm – Completed 2023

East Coulee Phase 1 Berm – Completed 2024

Rosedale Buyout Location