Houston Engineering Inc.

Rehabilitation of:
Tongue River Dam M-3 (Senator Young Dam)
Tongue River Dam T-7-1 (Olson Dam)
Tongue River Dam T3-1 (Bourbanis Dam)

PEMBINA COUNTY WATER RESOURCE DISTRICT

Scoping Meeting
March 5, 2020

Introductions

- Christi Fisher, PE – NRCS
- Craig Odenbach, PE – Houston Engineering, Inc.
- Zach Herrmann, PE – Houston Engineering Inc.
- LuAnn Kemp – Secretary of Pembina County Water Resource District
- Joshua Heuchert – Chairman of Pembina County Water Resource District
- Charles Thacker – Vice-Chairman of Pembina County Water Resource District
- Don Kemp – Manager of Pembina County Water Resource District
- Randall Emanuelson – Manager of Pembina County Water Resource District
- Richard Kendall – Manager of Pembina County Water Resource District

Agenda

- PL-566 Watershed Rehabilitation Overview
- Background
- Purpose
- Dam and Watershed Plan History
- Dam Safety Concerns
- Flood Prevention Concerns
- Anticipated Alternatives
- Factors Considered
- Public Input

PL-566 Watershed Rehabilitation Overview

NRCS

Pembina County
NORTH DAKOTA

HOUSTON ENGINEERING INC.

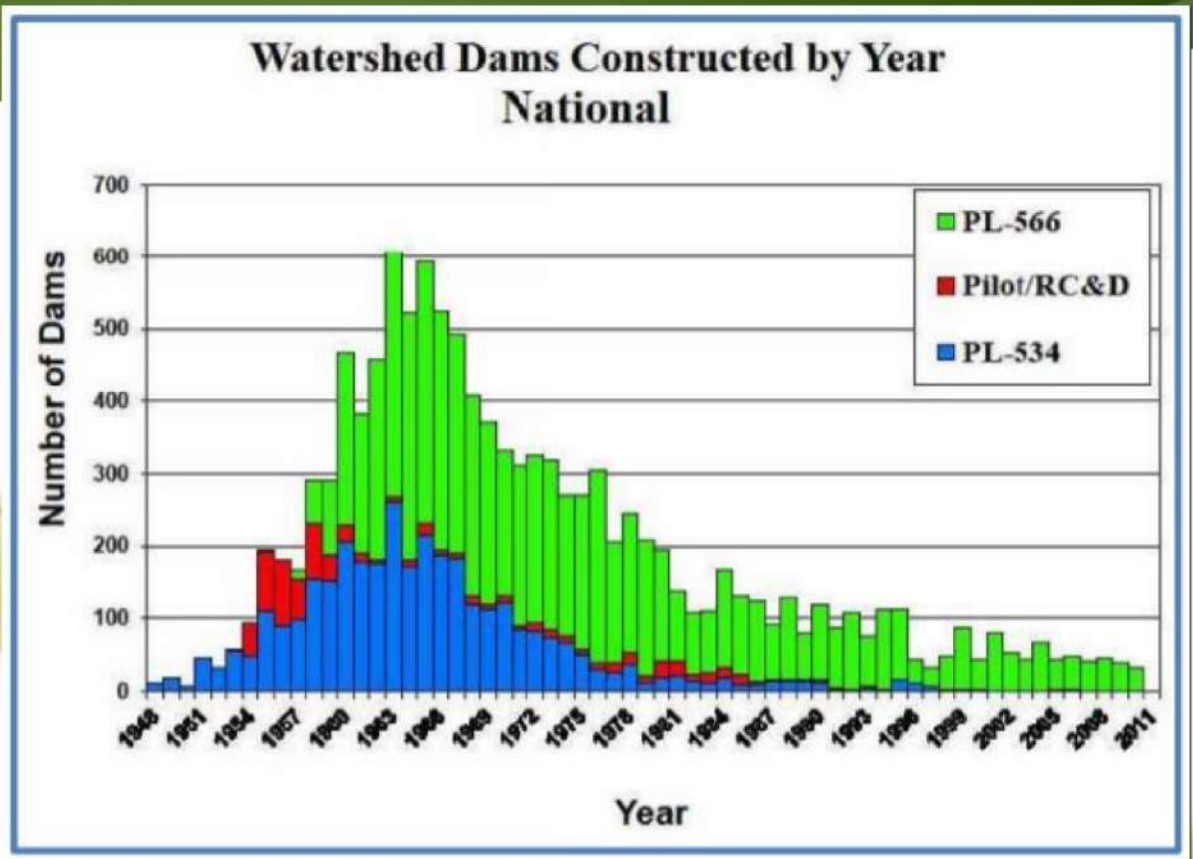
Applicable Agency Authority - Construction

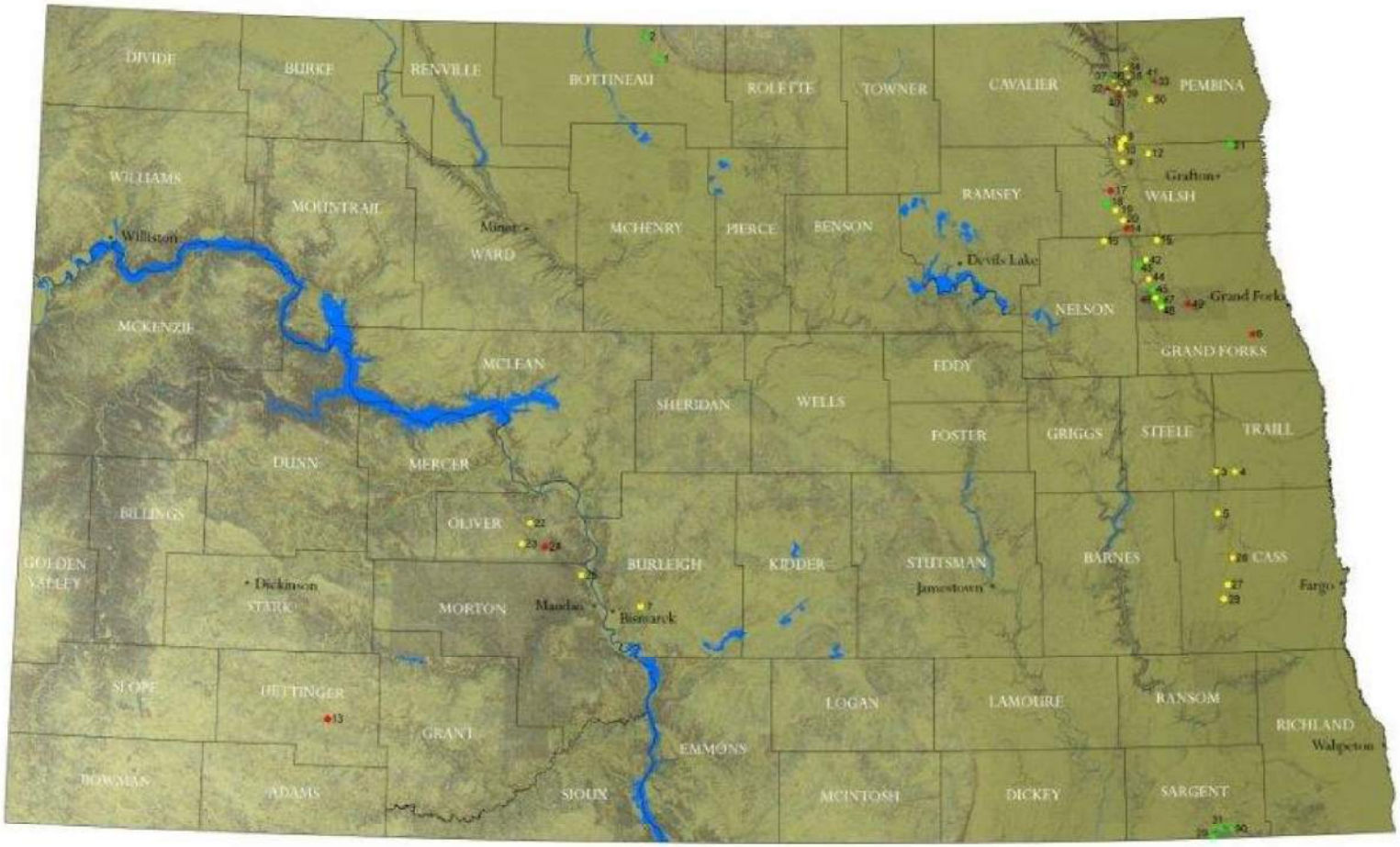
Federal Watershed Protection and Flood Prevention Act

Public Law 78-534
1944

Public Law 83-566
Section 14(a)(1) 1954

11,000+ dams nationally





DAM #	DAM NAME	INSTALLED
1	Boundary Creek Dam #1	1982
2	Boundary Creek Dam #3	1973
3	Elm River Dam #1	1964
4	Elm River Dam #2	1966
5	Elm River Dam #3	1962
6	English Coulee Dam	1990
7	McDowell Dam	1976
8	Middle Br. Park River Dam #10	1971
9	Middle Br. Park River Dam #6	1974
10	Middle Br. Park River Dam #8	1970
11	Middle Br. Park River Dam #9	1970
12	Middle Br. Park River Dam #5	2005
13	Mott Watershed Dam	1969
14	Middle South Br. Forest River Dam #1	1966
15	Middle South Br. Forest River Dam #4	1978
16	Middle South Br. Forest River Dam #6	1965
17	North Br. Forest River Dam #1	1964
18	North Br. Forest River Dam #3	1962
19	North Br. Forest River Dam #5	1962
20	North Br. Forest River Dam #6	1966
21	North Salt Lake	1971
22	Square Butte Creek Dam #2	1973
23	Square Butte Creek Dam #4	1974
24	Square Butte Creek Dam #5	1979
25	Square Butte Creek Dam #6	2007
26	Swan Buffalo Dam #12	1960
27	Swan Buffalo Dam #5	1961
28	Swan Buffalo Dam #8	1968
29	Tewaukon Dam T-1-A	1963
30	Tewaukon Dam T-2	1965
31	Tewaukon Dam T-7	1961
32	Tongue River W.S. Dam M-3	1961
33	Tongue River W.S. Dam M-4	1961
34	Tongue River W.S. Dam T-2-2	1957
35	Tongue River W.S. Dam T-2-4	1958
36	Tongue River W.S. Dam T-3-1	1957
37	Tongue River W.S. Dam T-3-2	1955
38	Tongue River W.S. Dam T-3-5	1955
39	Tongue River W.S. Dam T-3-6	1957
40	Tongue River W.S. Dam T-7-1	1957
41	Tongue River W.S. Dam T-8-1	1956
42	Upper Turtle River Dam #1	1977
43	Upper Turtle River Dam #2	1974
44	Upper Turtle River Dam #4	1980
45	Upper Turtle River Dam #5	1975
46	Upper Turtle River Dam #6	1972
47	Upper Turtle River Dam #7	1973
48	Upper Turtle River Dam #8	1973
49	Upper Turtle River Dam #9	1979
50	Willow Creek-Park River Dam #1	1968

Applicable Agency Authority - Rehabilitation

2000 Amendment to the Federal Watershed Protection and Flood Prevention Act

Public Law 106-472, Section 313

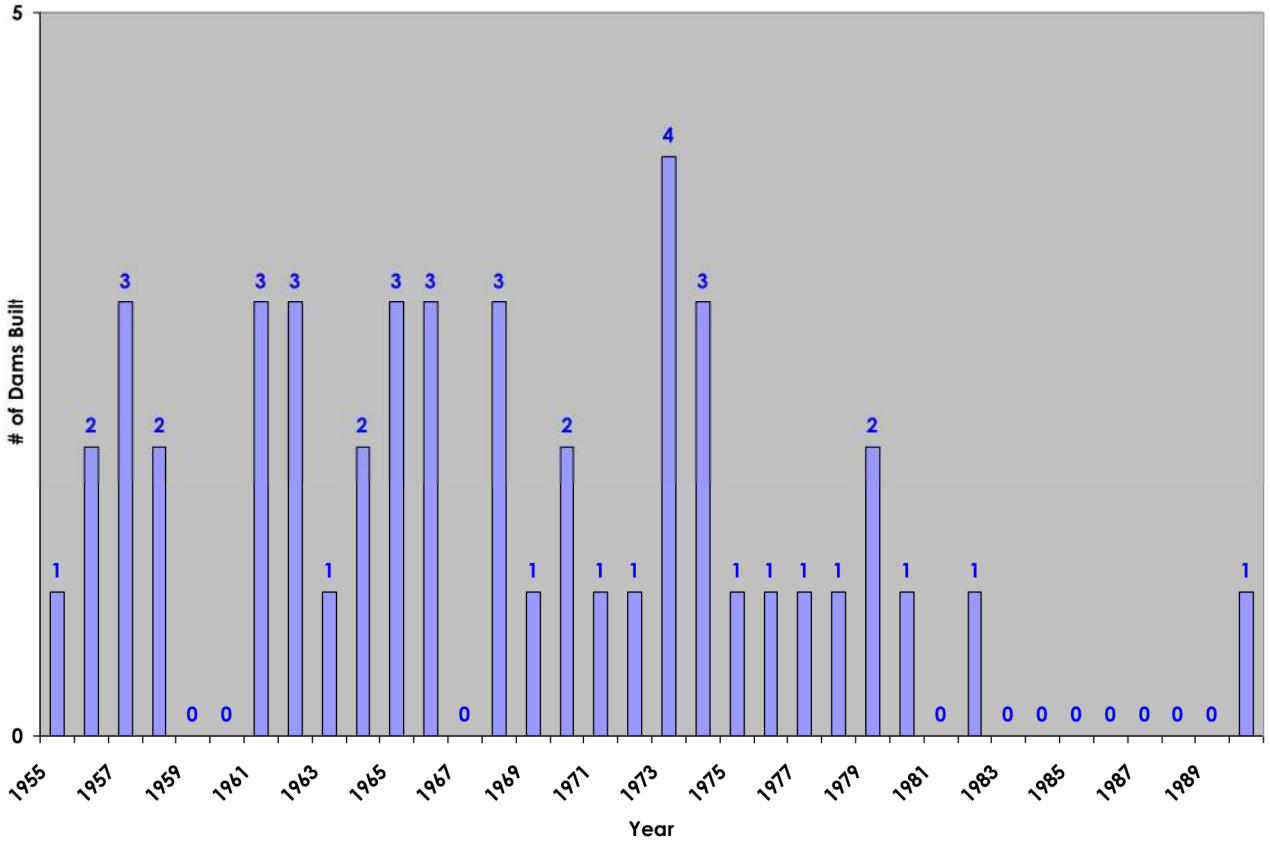
Rehabilitation:

Extend the service life of dams and bring them up to applicable safety and performance standards, or decommission them so they no longer pose a threat to life or property.

Why now?

Fiscal Year	Program Funding
2000	$8 M
2001	$8 M
2002	$10 M
2003	$30 M
2004	$30 M
2005	$28 M
2006	$32 M
2007	$31 M
2008	$20 M
2009	$35 M
2010	$83 M
2011	$17 M
2012	$15 M
2013	$14 M
2014	$262 M
2015	$83 M
2016	$12 M
2017	$21 M
2018	$12 M
2019	$10 M
Total	**$761 M**

ND Watershed Dams Built by Year



ND PL-566 Dams

Total = 50

High Hazard (NRCS) = 14

Assessments Complete = 11

Rehabilitation Complete = 1

Planning Underway = 7

2018 Start: Matecjek

2019 Start: Fordville
Larimore
Bylin
Senator Young
Bourbanis
Olson

Planning Team Structure

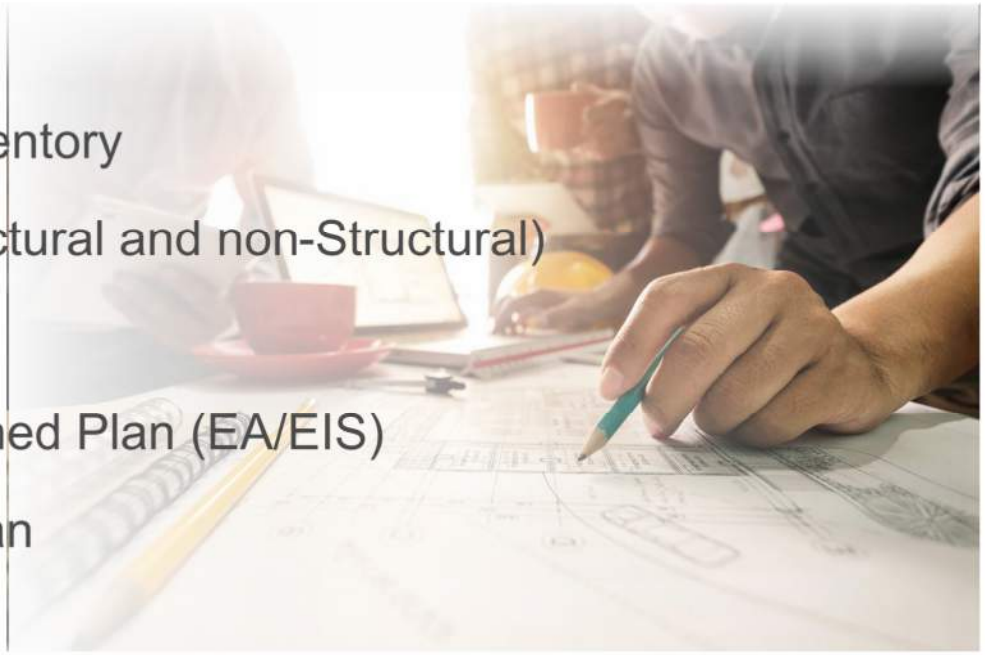
- **Planning Lead:** Natural Resources Conservation Service
  - **State Conservationist:** Mary Podoll
  - **State Conservation Engineer:** Christi Fisher, PE
- **Sponsoring Local Organization:** Pembina County Water Resource District
  - **Secretary:** LuAnn Kemp
  - **Chairman:** Joshua Heuchert
  - **Vice-Chairman:** Charles Thacker
  - **Manager:** Don Kemp
  - **Manager:** Randall Emanuelson
  - **Manager:** Richard Kendall
- **Planning Technical Lead:** Craig Odenbach, PE *(Houston Engineering, Inc.)*

Planning to Construction

- Planning, typically 2 years
- Design, typically 1-2 years
- Construction, typically 1-2 years
- Complex process, informal and formal public input, regulatory agency involvement
- Local endorsement and support of the plan is key
- Planning requires patience and perseverance

Planning Process- Locally Led

- Purpose and Need for Action
- Data Collection and Resource Inventory
- Development of Alternatives (Structural and non-Structural)
- Evaluation of Alternatives
- Preliminary Supplemental Watershed Plan (EA/EIS)
- Final Supplemental Watershed Plan



Purpose and Need

Purpose: Bring Senator Young, Olson, and Bourbanis Dams into compliance for current federal and state dam safety standards for dam performance, design, and safety while maintaining current flood prevention benefits.

Need:

- Dam Performance, Design, and Safety
- Flood Prevention
- Water Supply

Agency Participation – State & Federal

Federal

- USACE
- USFWS
- FEMA

US Army Corps of Engineers

FEMA

State

- ND State Water Commission
- ND Game & Fish Department
- ND Department of Transportation
- ND State Historical Society
- ND Department of Environmental Quality

NORTH Dakota | Water Commission
Be Legendary.

NORTH Dakota | Game and Fish
Be Legendary.

NDDOT
North Dakota Department of Transportation

STATE HISTORICAL SOCIETY OF NORTH DAKOTA

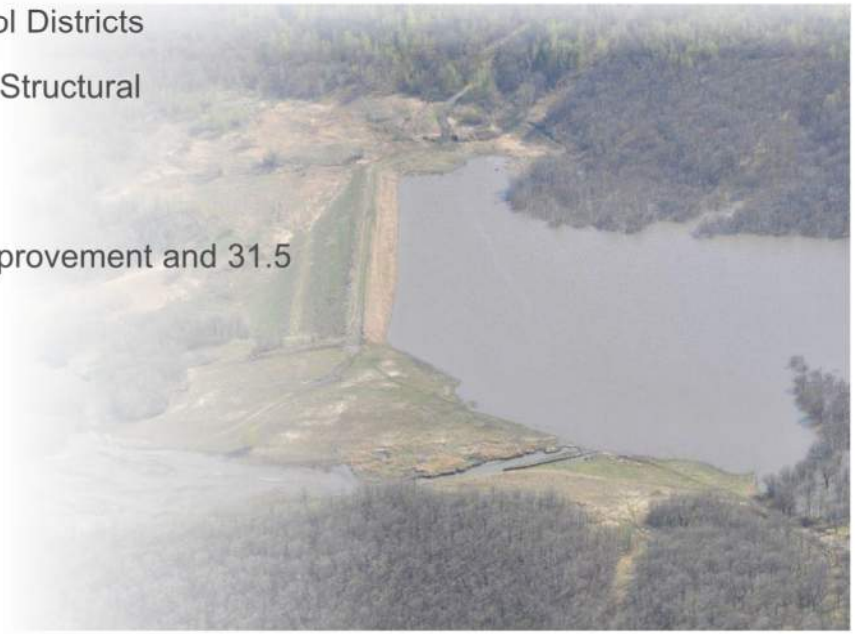
NORTH Dakota | Environmental Quality
Be Legendary.

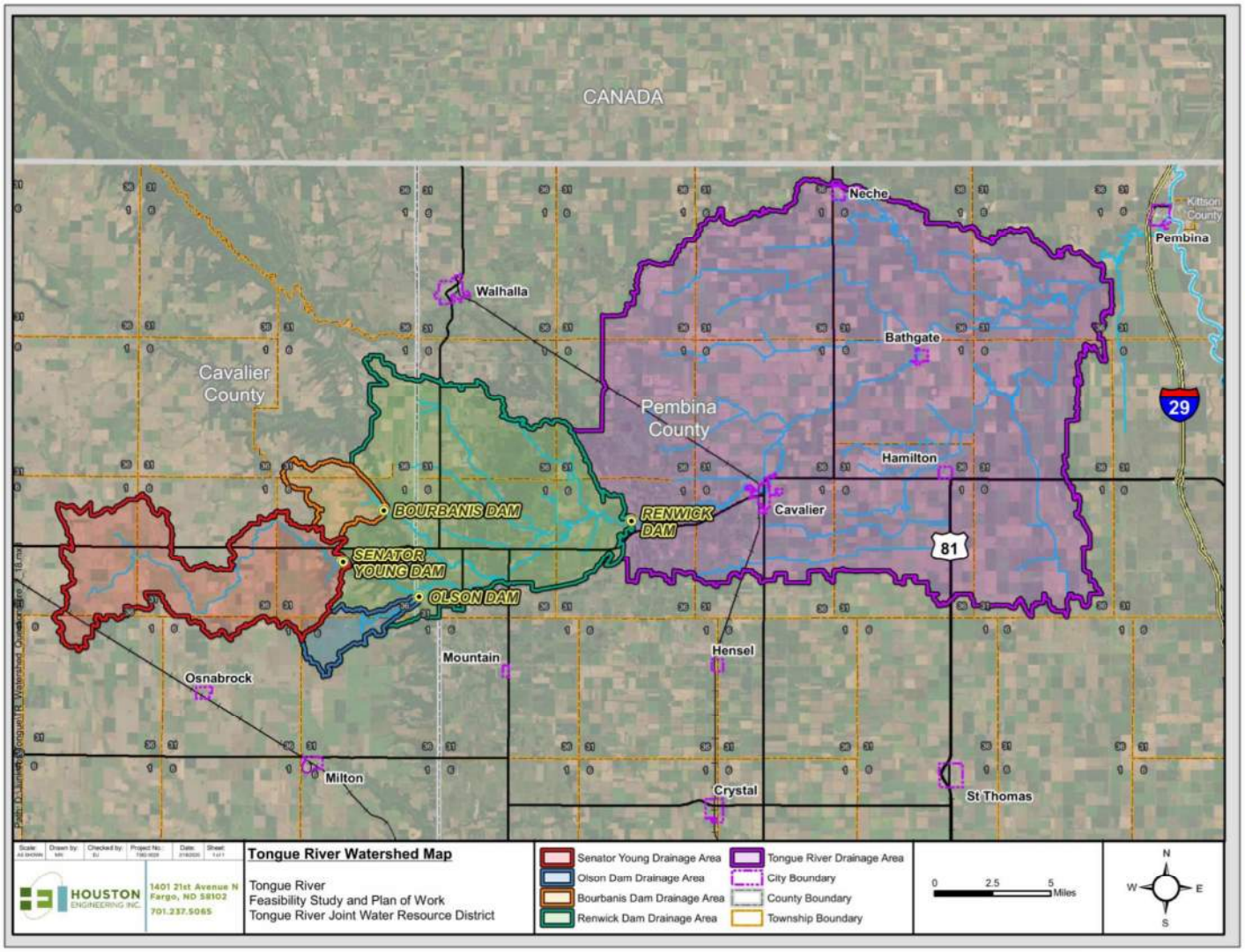
Agency Participation - Local

- Tribal Entities
- Pembina & Cavalier County
  - Commissions
  - Water Resource Districts
  - Departments of Emergency Management
  - Soil Conservation Districts
  - Highway Departments

Watershed Work Plan - History

- Part of a Watershed Work Plan for the Tongue River Watershed (SCS, 1954)
- Sponsored by various local Soil Conservation and Flood Control Districts
- Plan included a combination of Land Treatment Measures and Structural Improvements
- A total of eighteen Flood Retarding Structures were planned.
- Other structural improvements included 30 miles of channel improvement and 31.5 miles of floodway construction.
- Annual flood damage estimated at $734,900 in 1954 Dollars
- Estimated Annual benefits at $1,828,690 in 1954 Dollars
- Resulted in a Benefit-Cost Ratio of 6.62:1 (SCS, 1954)

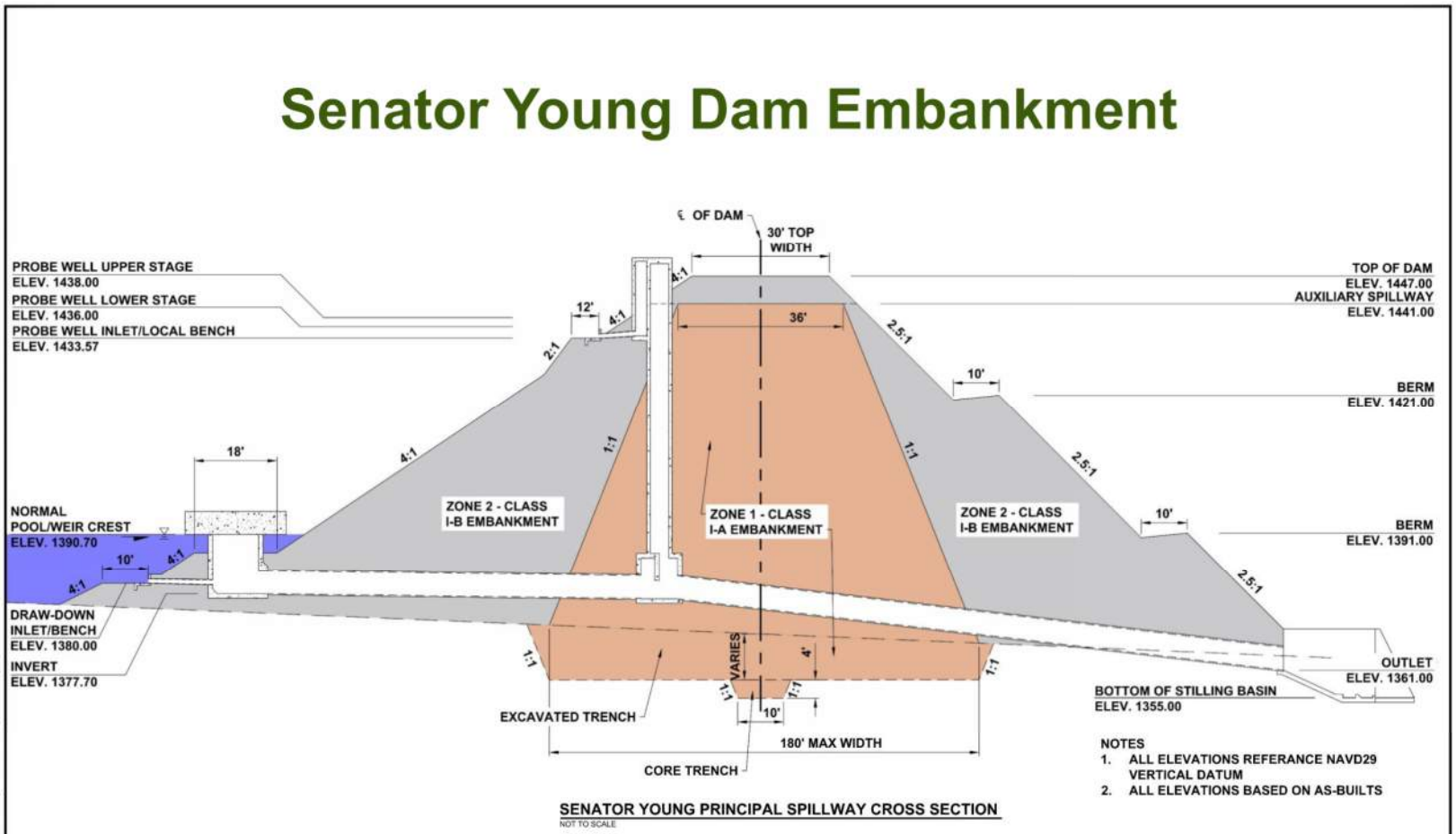




Watershed Map

Senator Young Dam Plan View

Senator Young Dam Embankment

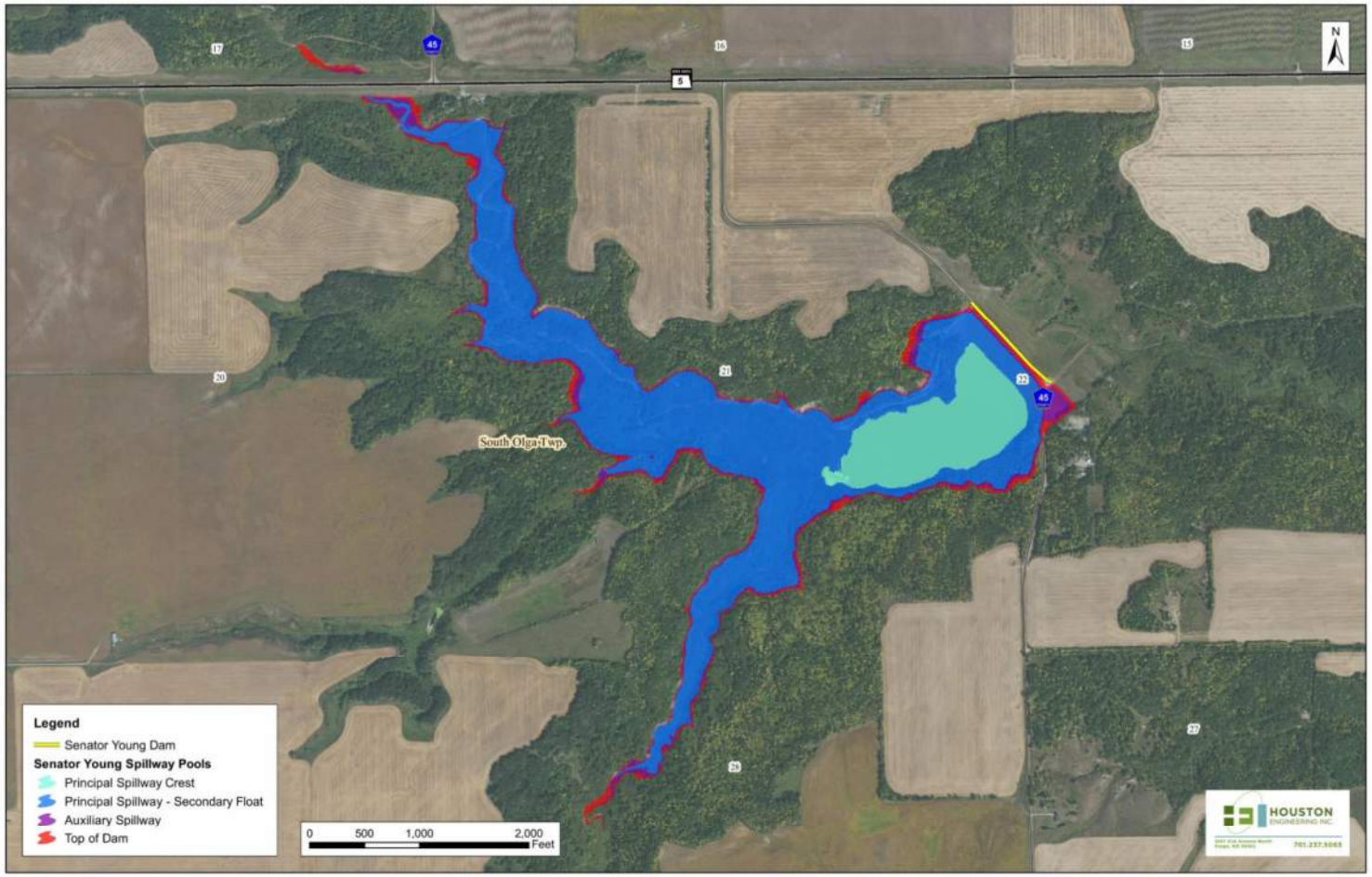


NOTES
1. ALL ELEVATIONS REFERANCE NAVD29 VERTICAL DATUM
2. ALL ELEVATIONS BASED ON AS-BUILTS

SENATOR YOUNG PRINCIPAL SPILLWAY CROSS SECTION
NOT TO SCALE

No.	Revision	Date	By	**PRELIMINARY** Not for Construction	Houston Engineering Inc.	Fargo P: 701.237.5065 F: 701.237.5101	Drawn by CAO / Checked by - / Date 02-12-20 / Scale AS SHOWN	SENATOR YOUNG DETENTION DAM PEMBINA COUNTY WATER RESOURCE DISTRICT CAVALIER, NORTH DAKOTA	SENATOR YOUNG DETENTION DAM SECTION PROJECT NO. 7382-0029	SHEET 1

Senator Young Dam Site Map of the Pool



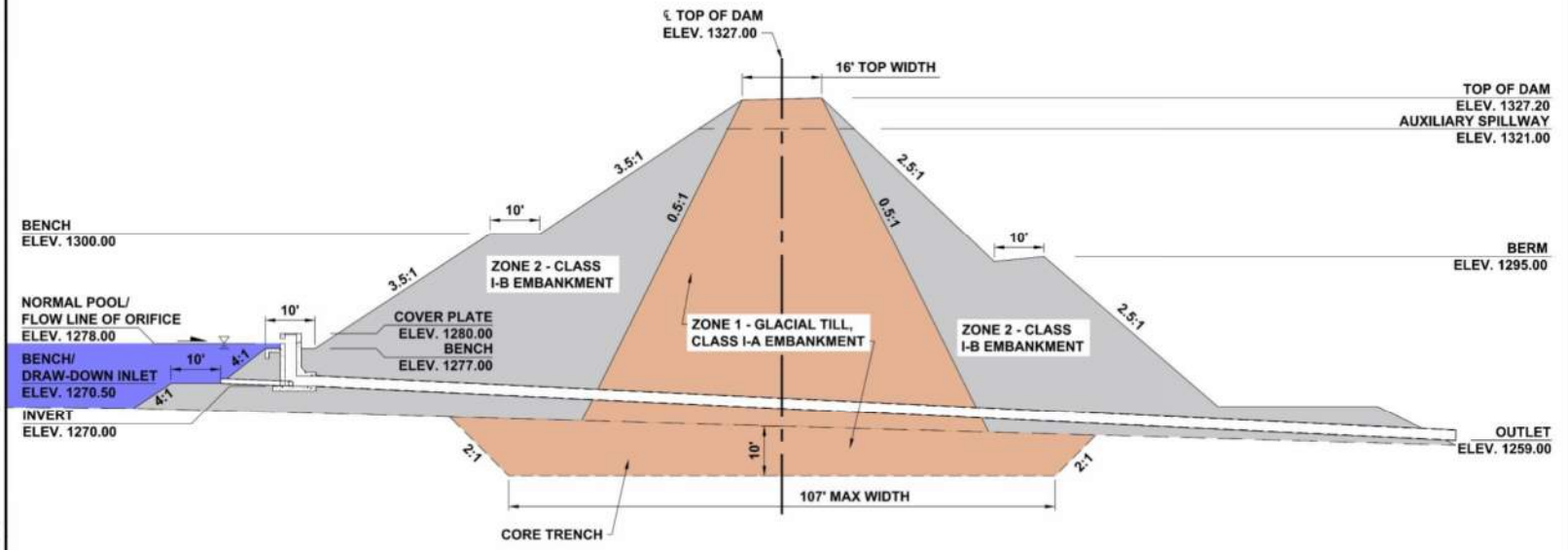
Senator Young Dam Overview

General Data		
Year Design	1955	
Year Constructed	1961	
Purpose(s)	Flood Control, Water Supply	
Original Hazard Classification	Significant	
Current Hazard Classification	High	
Design Life	50 years	
Original Design Drainage Area	53.8 sq. mi.	
Revised Drainage Area (Direct) [1]	43.0 sq. mi.	
Dam Height	81 feet	
Maximum Dam Height	92 feet	
Embankment Length	900 feet	
Embankment Top Width [2]	30 feet	
Embankment Upstream Slope	4.0 H:1 V	
Embankment Downstream Slope	2.5 H:1 V	
Critical Elevations	**Elevation (MSL) [3]**	
Top of Dam	1,447.0	
Auxiliary Spillway Crest	1,441.0	
Principal Spillway Secondary Float	1,436.0	
Principal Spillway Crest	1,390.7	
Principal Spillway Outfall Invert	1,361.0	
Principal Spillway Outlet Channel Invert	1,355.0	
Reference Point	**Storage**	**Surface Area**
Top of Dam	5,958 acre - feet	--
Auxiliary Spillway Crest	5,053 acre - feet	146.7 acres
Principal Spillway Riser Tower Crest	4,345 acre - feet	135.9 acres
Principal Spillway Orifice Inverts	441 acre - feet	38.6 acres

[1] Revised using available LiDAR information.
[2] Includes roadway width of Cavalier County Road 45.
[3] Add 1.21 feet to convert MSL vertical datum to NAVD 1988 vertical datum (approximate).

Bourbanis Dam Plan View

Bourbanis Dam Embankment

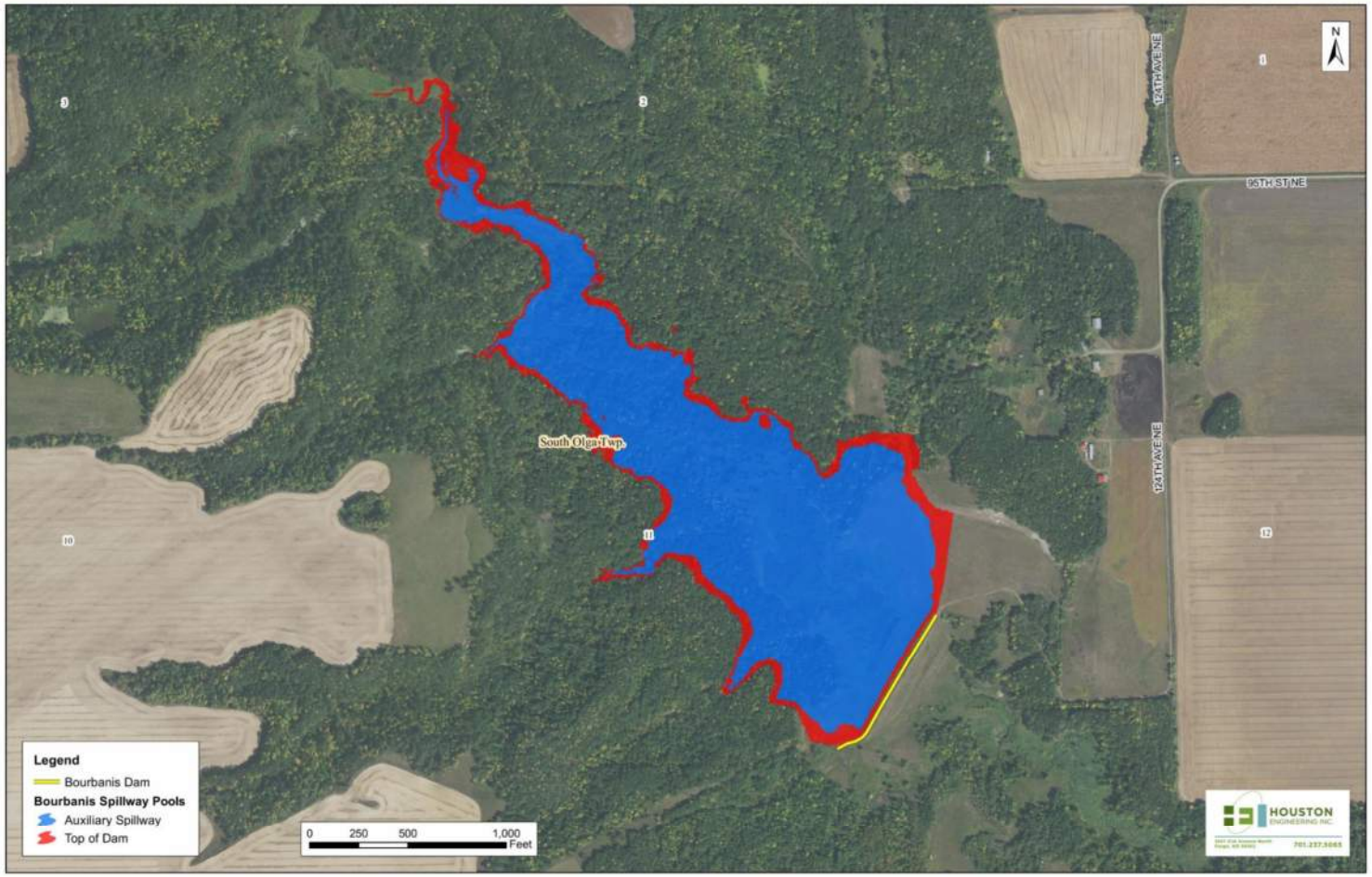


BOURBANIS PRINCIPAL SPILLWAY CROSS SECTION
NOT TO SCALE

NOTES
1. ALL ELEVATIONS REFERANCE NAVD29 VERTICAL DATUM
2. ALL ELEVATIONS BASED ON AS-BUILTS

No.	Revision	Date	By	**PRELIMINARY** Not for Construction	Houston Engineering Inc.	Fargo P: 701.237.5065 F: 701.237.5101	Drawn by CAO / Checked by - / Date 02-12-20 / Scale AS SHOWN	BOURBANIS DETENTION DAM PEMBINA COUNTY WATER RESOURCE DISTRICT CAVALIER, NORTH DAKOTA	BOURBANIS DETENTION DAM SECTION PROJECT NO. 7382-0033	SHEET 2

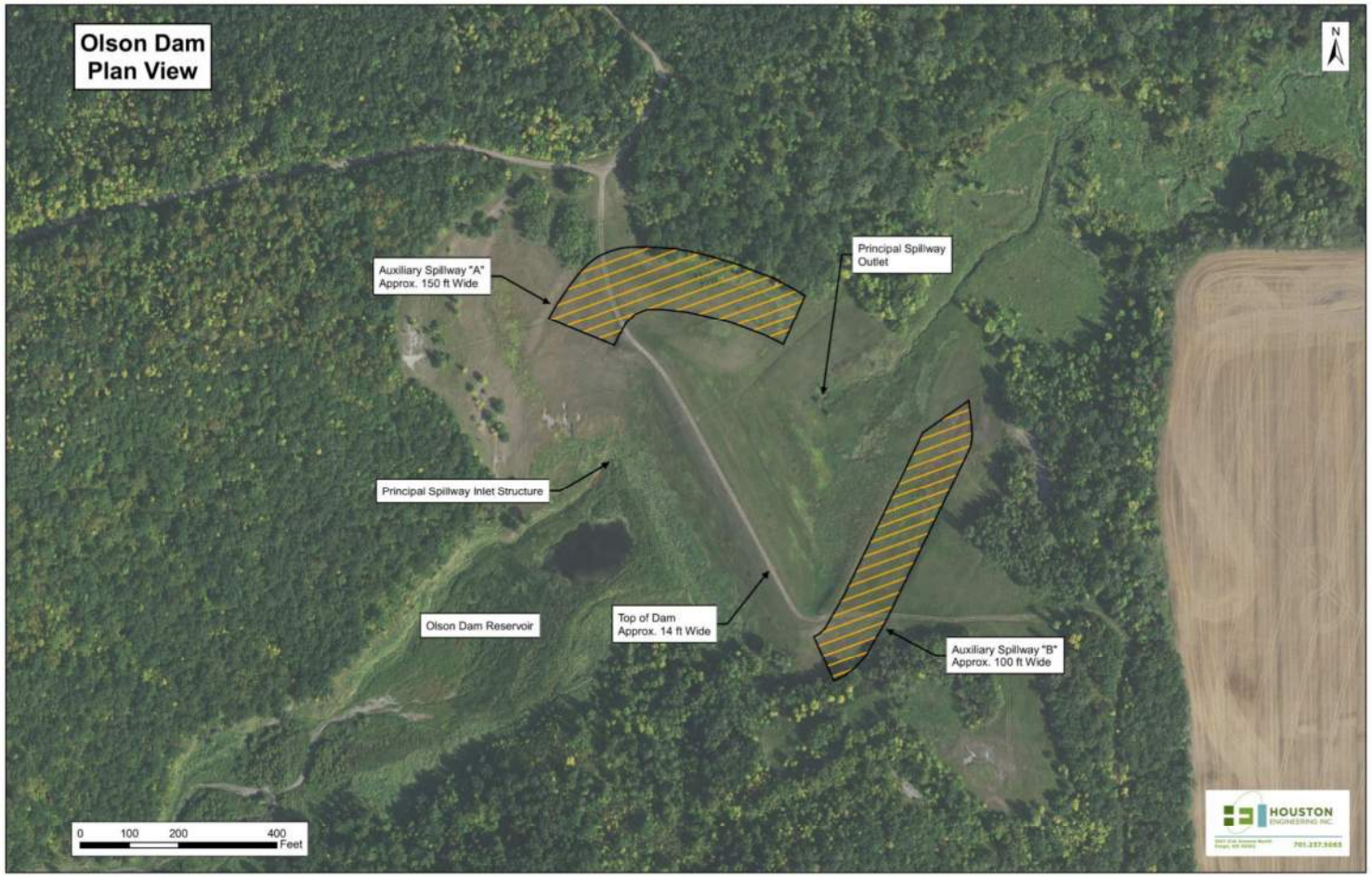
Bourbanis Dam Site Map of the Pool



Bourbanis Dam Overview

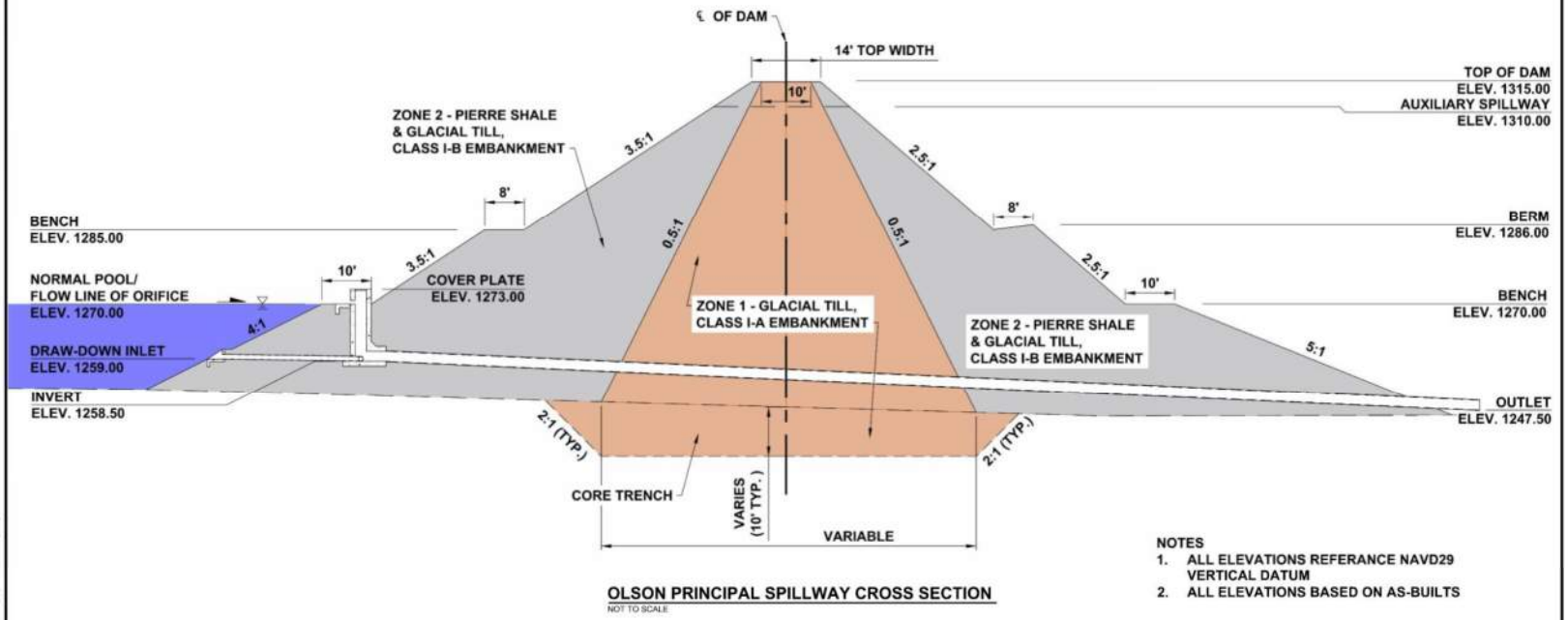
General Data		
Year Design	1955	
Year Constructed	1957	
Purpose(s)	Flood Control	
Original Hazard Classification	Significant	
Current Hazard Classification	High	
Design Life	50 years	
Original Design Drainage Area	8.15 sq. mi.	
Revised Drainage Area (Direct) [1]	6.5 sq. mi. (8.6 sq. mi.)	
Dam Height	61 feet	
Maximum Dam Height	68 feet	
Embankment Length	745 feet	
Embankment Top Width	16 feet	
Embankment Upstream Slope	3.5 H:1 V	
Embankment Downstream Slope	2.5 H:1 V	
Critical Elevations	**Elevation (MSL) [3]**	
Top of Dam	1,327.0	
Auxiliary Spillway Crest	1,321.0	
Principal Spillway Orifice Invert	1,278.0	
Principal Spillway Top of Riser	1,280.0	
Principal Spillway Outfall Invert	1,259.0	
Principal Spillway Outlet Channel Invert	1,258.0	
Reference Point	**Storage**	**Surface Area**
Top of Dam	1,502 acre - feet	49.5 acres
Auxiliary Spillway Crest	1,208 acre - feet	49.5 acres
Principal Spillway	74 acre - feet	9.5 acres

[1] Revised using available LiDAR information.
[3] Add 1.23 feet to convert MSL vertical datum to NAVD 1988 vertical datum (approximate).



Olson Dam Plan View

Olson Dam Embankment



OLSON PRINCIPAL SPILLWAY CROSS SECTION
NOT TO SCALE

NOTES
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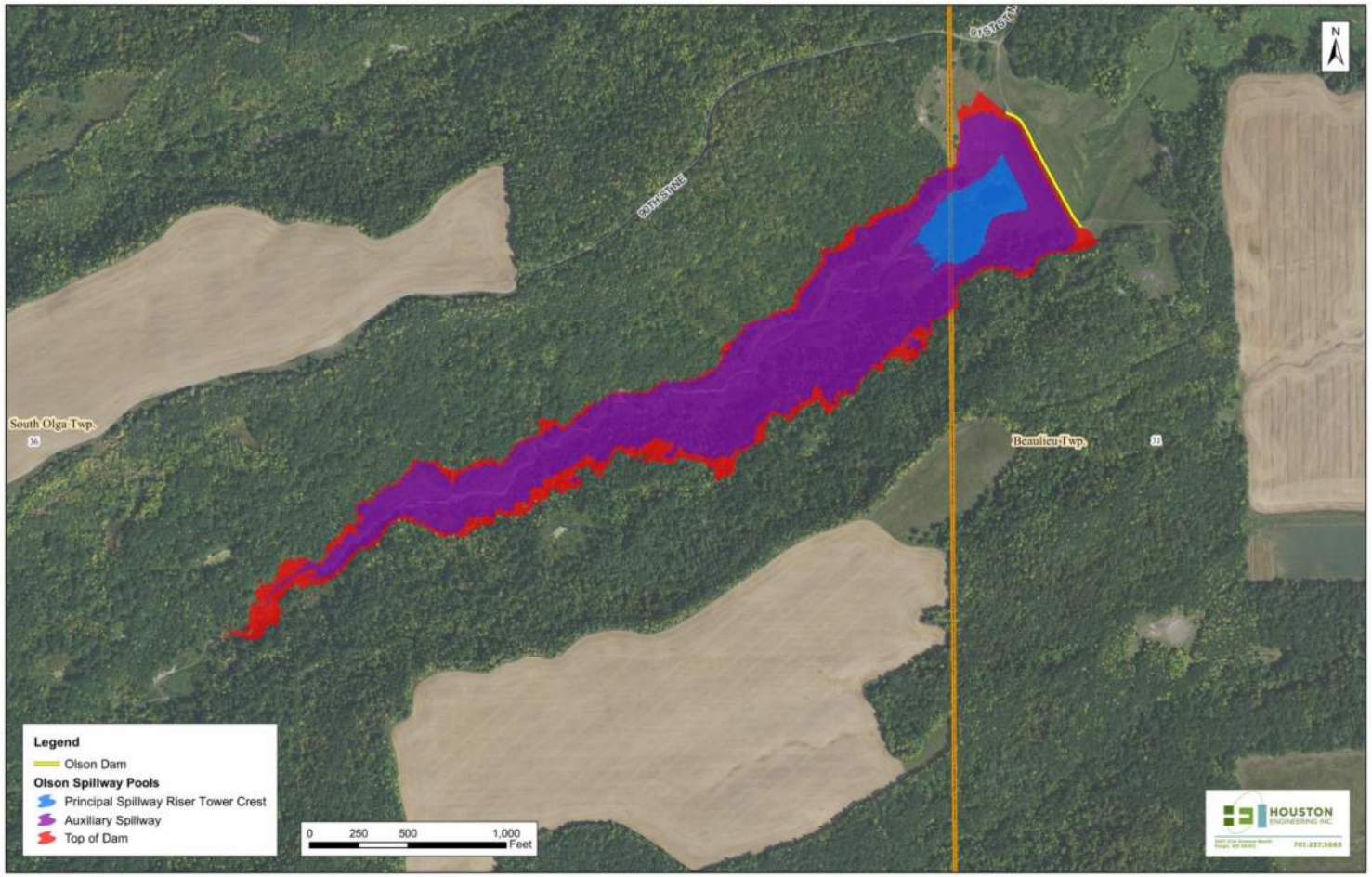
2. ALL ELEVATIONS BASED ON AS-BUILTS

No.	Revision	Date	By	**PRELIMINARY** Not for Construction	Houston Engineering Inc.	Fargo P: 701.237.5065 F: 701.237.5101	Drawn by CAO Checked by - Date 02-12-20 Scale AS SHOWN	OLSON DETENTION DAM PEMBINA COUNTY WATER RESOURCE DISTRICT CAVALIER, NORTH DAKOTA	OLSON DETENTION DAM SECTION PROJECT NO. 7382-0034	SHEET 3



Olson Dam Site Map of the Pool

Olson Dam Overview

General Data		
Year Design		1955
Year Constructed		1957
Purpose(s)		Flood Control
Original Hazard Classification		Significant
Current Hazard Classification		High
Design Life		50 years
Original Design Drainage Area		5.9 sq. mi.
Revised Drainage Area (Direct) [1]		6.4 sq. mi.
Dam Height		65 feet
Maximum Dam Height		67.7 feet
Embankment Length		719 feet
Embankment Top Width		14 feet
Embankment Upstream Slope		3.5 H:1 V
Embankment Downstream Slope		2.5 H:1 V
Critical Elevations		**Elevation (MSL) [3]**
Top of Dam		1,315.0
Auxiliary Spillway Crest		1,310.0
Principal Spillway Orifice Invert		1,270.0
Principal Spillway Top of Riser		1,273.0
Principal Spillway Outfall Invert		1,248.5
Principal Spillway Outlet Channel Invert		1,247.5
Reference Point	**Storage**	**Surface Area**
Top of Dam	1,077 acre - feet	--
Auxiliary Spillway Crest	861 acre - feet	38.9 acres
Principal Spillway Orifice Invert	61 acre - feet	7.1 acres
Low Level Drawdown	8 acre - feet	-

[1] Revised using available LiDAR information.
[3] Add 1.28 feet to convert MSL vertical datum to NAVD 1988 vertical datum (approximate).

Downstream Risk

- **Senator Young Dam***
  - Up to 22 potentially inhabitable structures flooded
  - One residence located within 2700 feet of the dam
- **Olson Dam***
  - Up to 24 potentially inhabitable structures flooded
  - One residence located 4.5 miles downstream of dam
- **Bourbanis Dam**
  - No breach model completed

**Downstream risk results in a High Hazard Designation*

**Breach Analysis From Dam Assessment Report (subject to revision)*

Hazard Classification/Dam Safety Standards
TR-60 Federal Requirements

Precipitation Depth (Inches)		
Standard	**Significant Hazard**	**High Hazard**
Principal Spillway	P_{50}	P_{100}
Auxiliary Spillway	$P_{100} + 0.12 (PMP - P_{100})$	$P_{100} + 0.26 (PMP - P_{100})$
Freeboard	$P_{100} + 0.40 (PMP - P_{100})$	PMP

*Probable Maximum Precipitation is being updated and subject to revisions.
** ND Dam Safety Guidelines are being updated.

Hazard Classification/Dam Safety Standards
TR-60 Federal Requirements

Dam Assessment Report – Senator Young and Olson Dams

Precipitation Depth (Inches)	
Standard	**High Hazard**
Principal Spillway (24-hour / 10-day)	4.8 / 8.8
Auxiliary Spillway (24-hour)	10.8
Freeboard (24-hour)	27.1

Dam Safety - Classification

- **Dam Assessment Report – Senator Young and Olson Dams do not meet High Hazard Design Standards**
  - The Principal Spillways (PS) do not pass the 100-year event without activating the Auxiliary Spillways (AS)
  - The PS's do not evacuate the 100-year storage in 10-days
  - The AS's do not pass the Freeboard Hydrograph without overtopping the dam
- **Bourbanis Dam to be evaluated against standards as part of this study**

Dam Safety – Other Concerns
Senator Young and Olson Dams*

- Soil Stability Analyses show the AS's breaching during a design 24-hour storm
- Existing riser structure is non-standard
- Irregular downstream slope
- No filter diaphragm used along the PS conduit
- Observed seepage areas

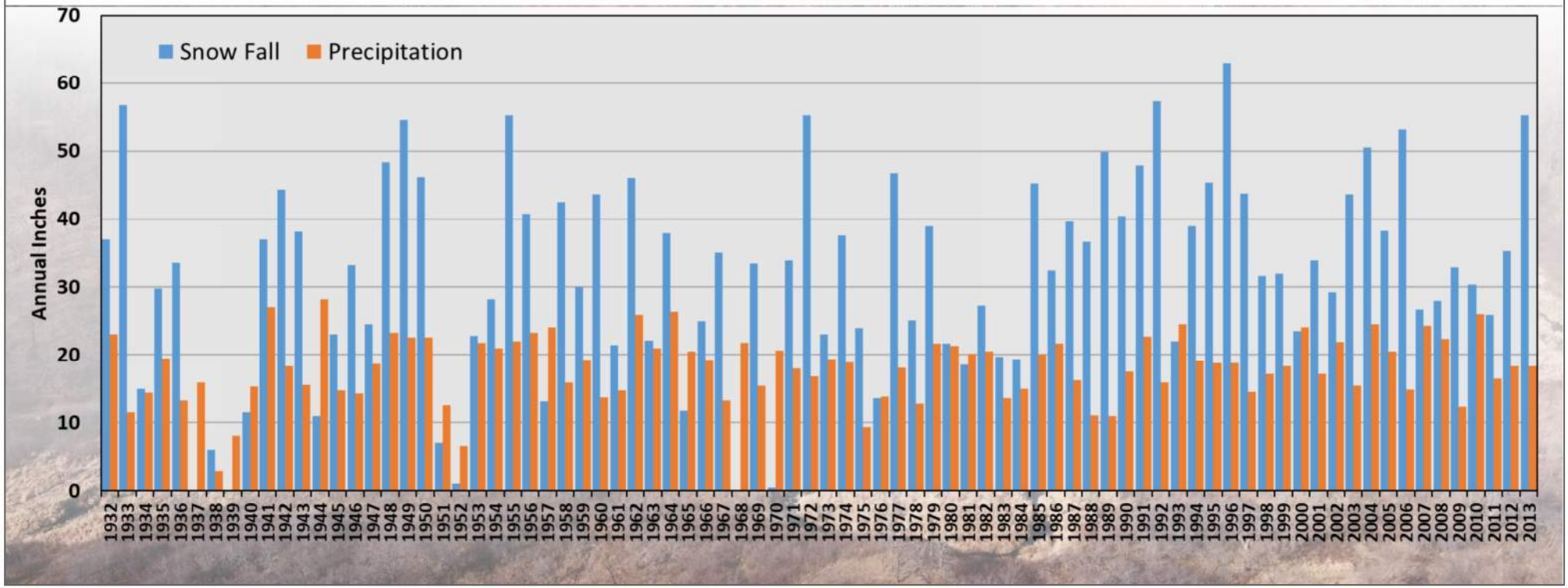
**Bourbanis Dam to be evaluated as part of this study effort*

Flood Prevention

- **Agriculture** – delayed planting, prevented planting, crop damage, reduced yields, overland erosion, etc.
- **Infrastructure** – road overtopping, culvert washouts, road embankment scour, critical utilities, etc.
- **Structural** – Inhabited & uninhabited buildings
- **Public Safety** – Impacted transportation systems (possible critical access routes)

Flood Trends

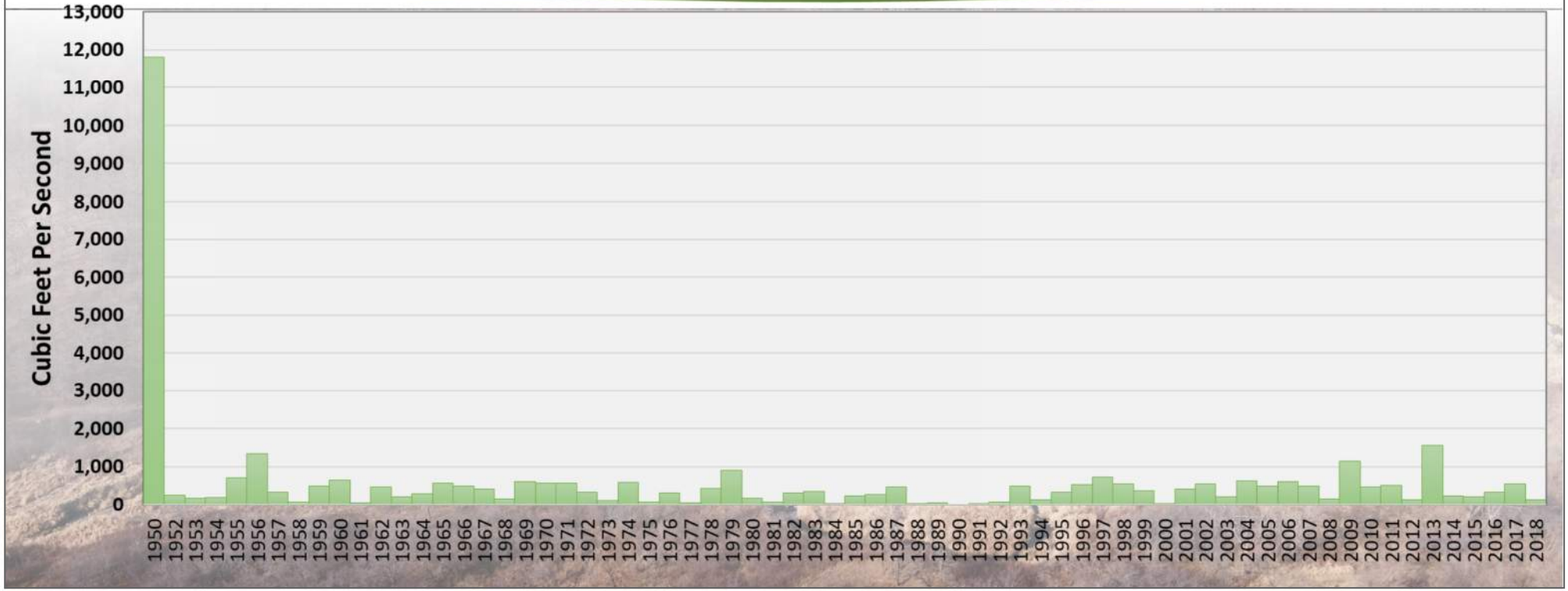
Historic Observed Rainfall and Snowmelt - 6 miles NW of Cavalier, ND



Flood Trends

Annual Peak Stream Flow

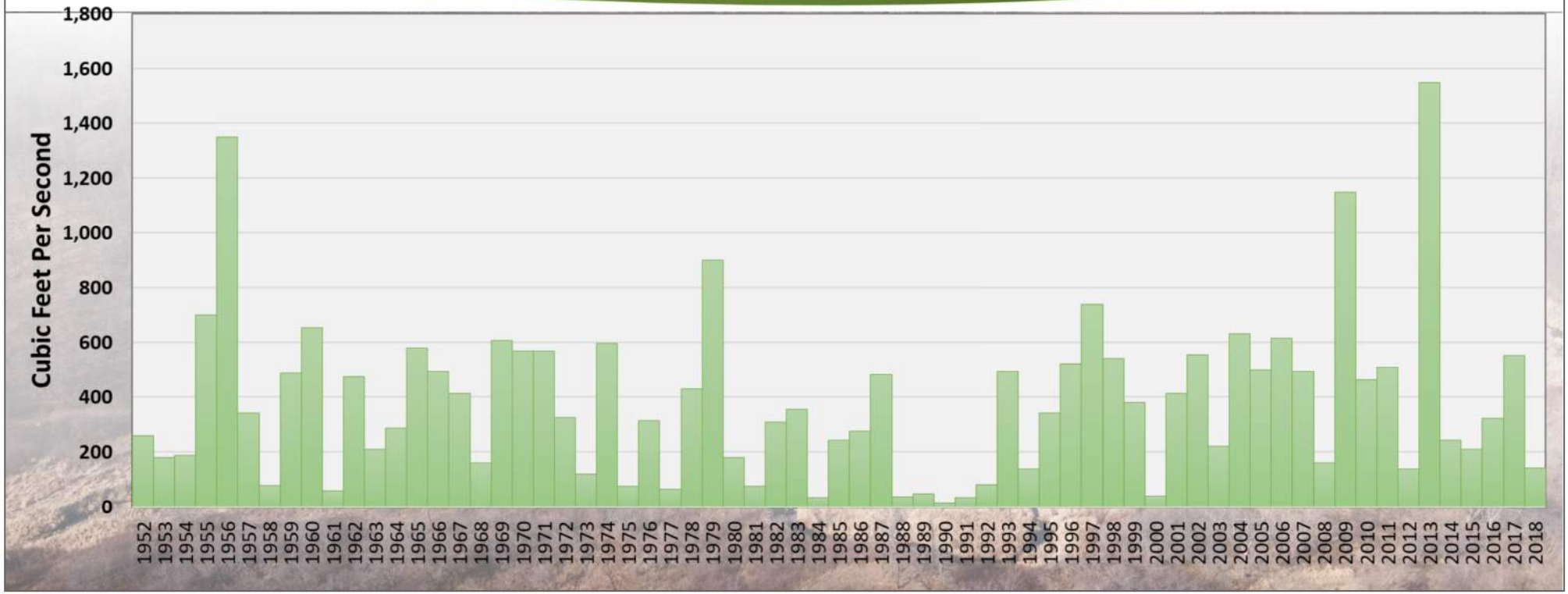
Tongue River at Akra, ND (USGS Gage 05101000)



Flood Trends

Annual Peak Stream Flow

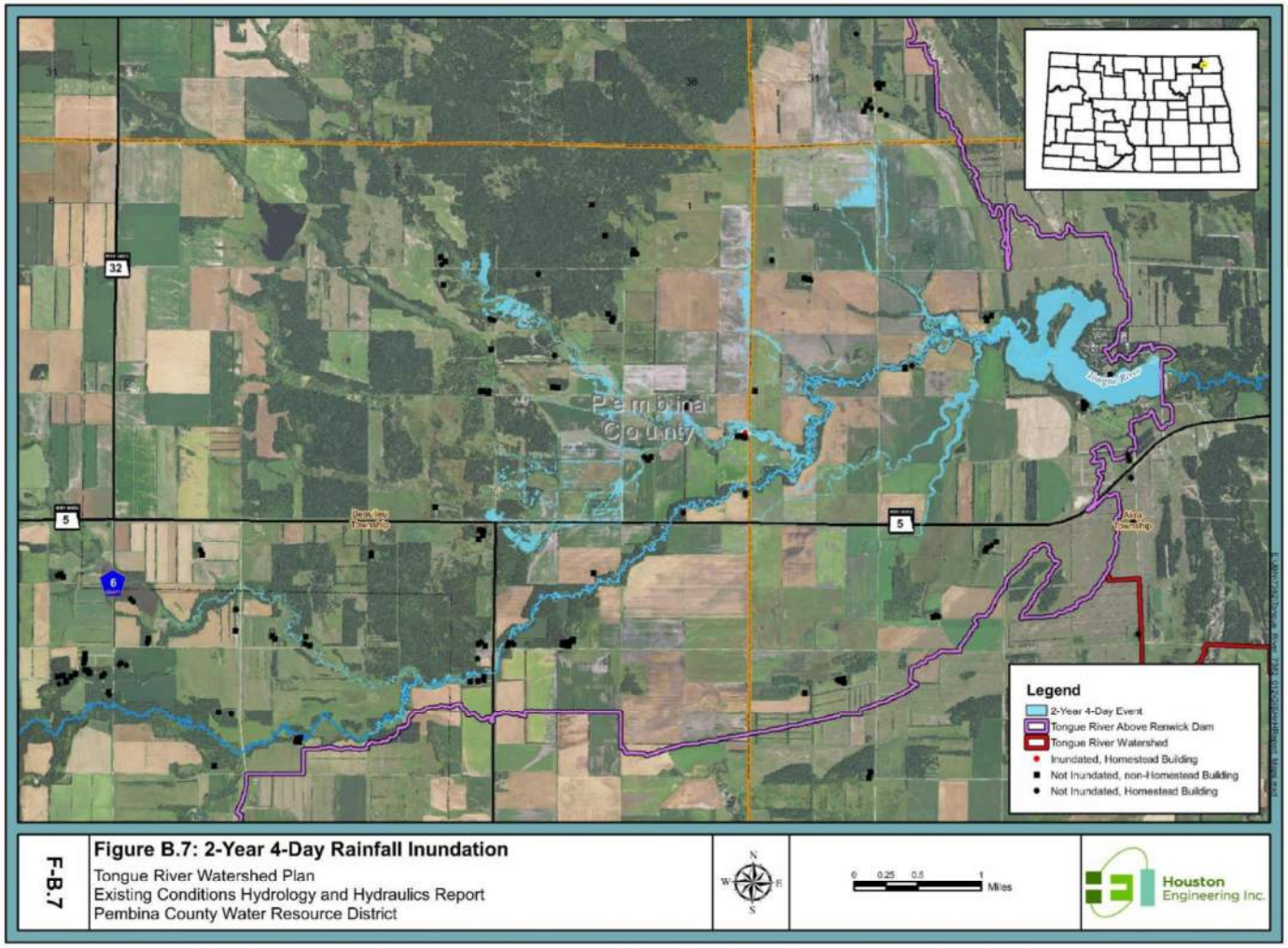
Tongue River at Akra, ND (USGS Gage 05101000)



Hydrology and Hydraulics

- HEC-HMS hydrologic model developed to estimate flood flow and timing characteristics for the Tongue River Watershed
- HEC-RAS unsteady state hydraulic model was developed estimate flood elevations using HEC-HMS results
- Hydrology and hydraulic models were calibrated to historic rainfall events
  - June 2002
  - May 2013
- Synthetic rainfall events were modeled (Source – Atlas 14)
- Model used to determine inundated acreages, duration of flooding, and potential damages to structures.
- Review of results determine the 4-day duration rainfall is the most damaging rainfall event.

Return Period	24-Hour Rainfall (in.)	4-Day Rainfall (in.)	10-Day Rainfall (in.)
2-year	2.2	2.8	3.7
5-year	2.9	3.5	4.4
10-year	3.4	4.1	5.1
25-year	4.2	5.0	6.0
50-year	4.9	5.8	6.7
100-year	5.6	6.5	7.5



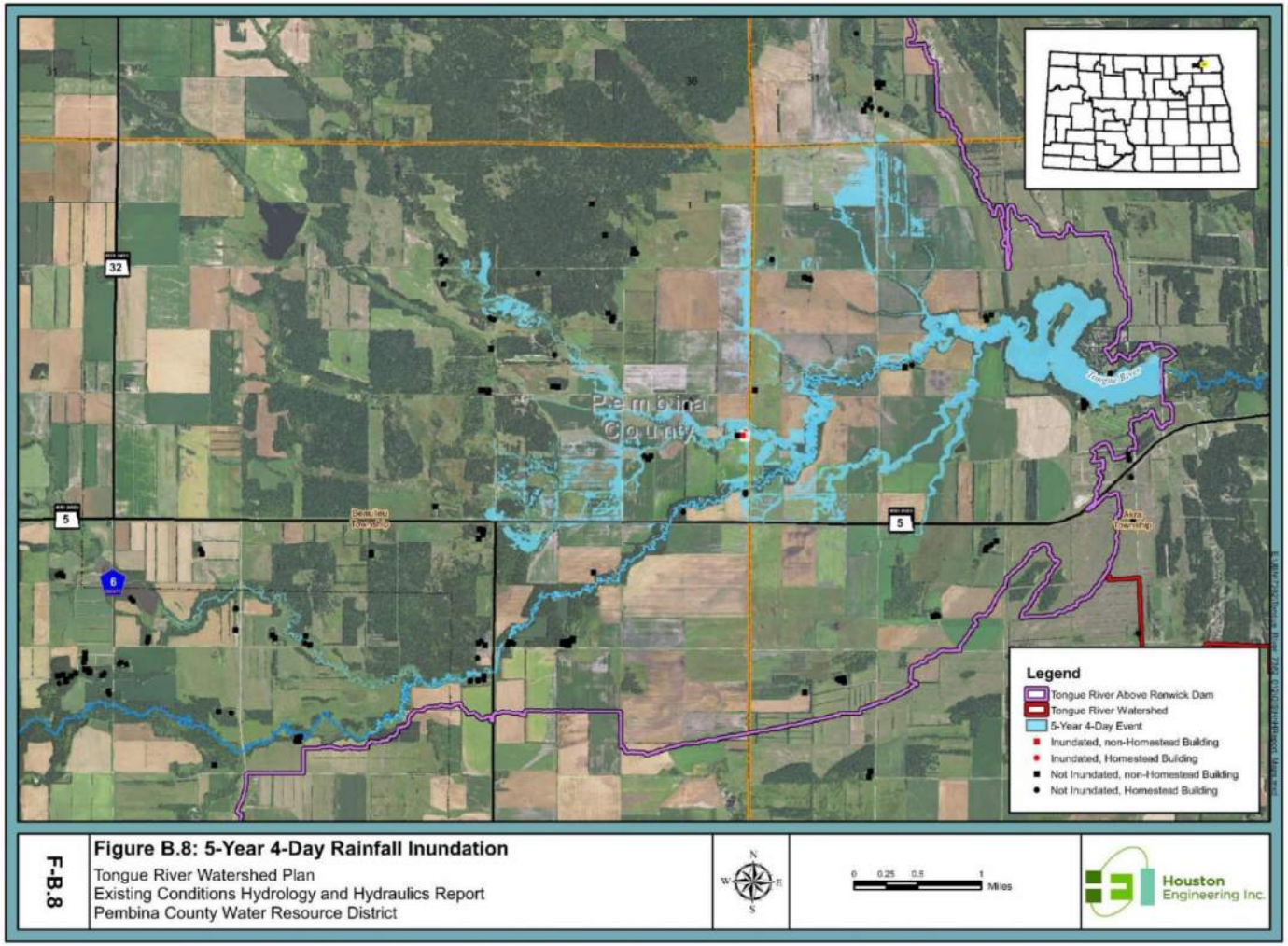
F-B.7

Figure B.7: 2-Year 4-Day Rainfall Inundation

Tongue River Watershed Plan
Existing Conditions Hydrology and Hydraulics Report
Pembina County Water Resource District

2-Year Event

4-Day Rainfall Depth:	**2.84 inches**
Total Inundation:	**712 Acres**
Inundated Structures:	**1**



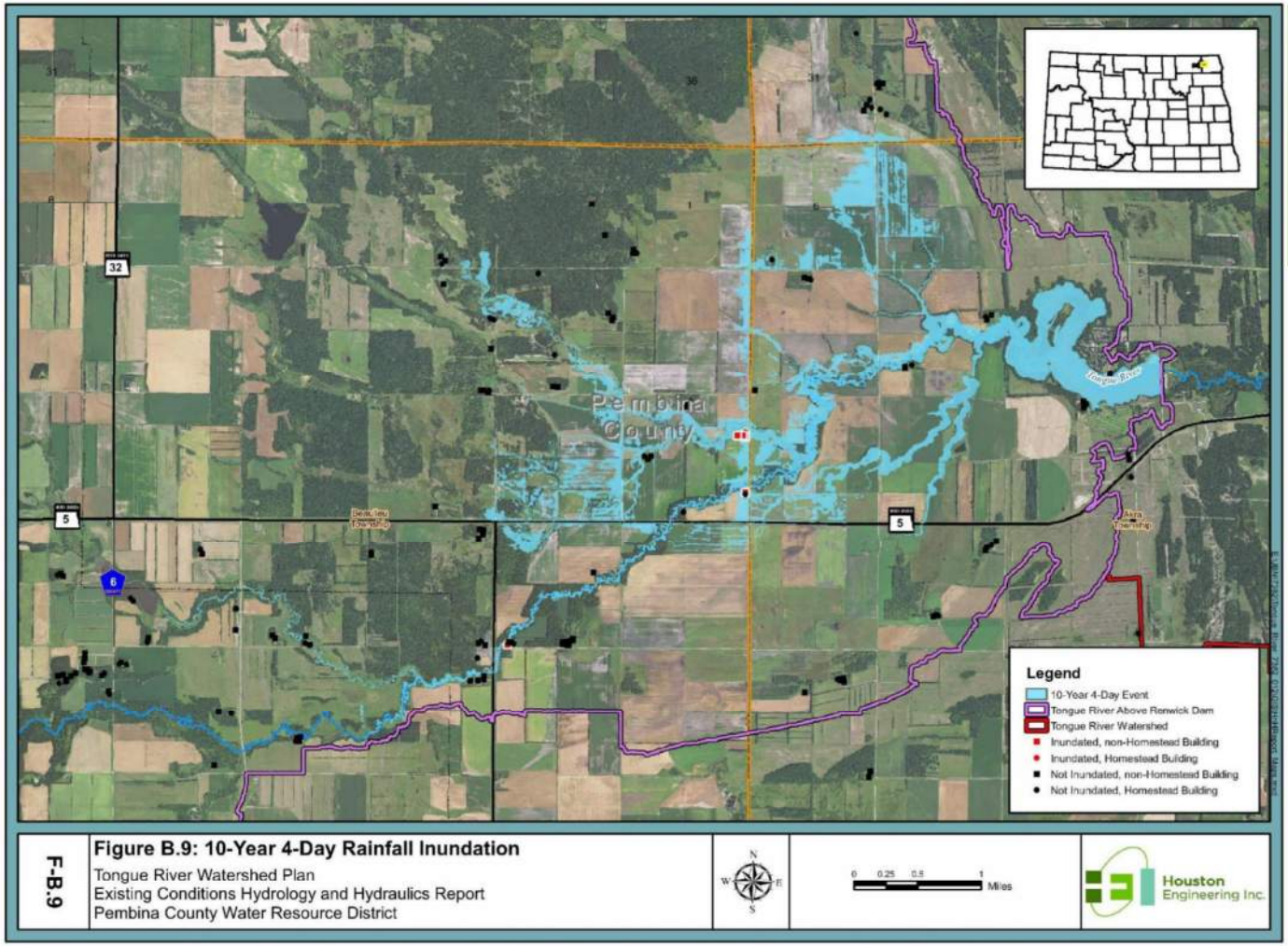
F-B.8

Figure B.8: 5-Year 4-Day Rainfall Inundation

Tongue River Watershed Plan
Existing Conditions Hydrology and Hydraulics Report
Pembina County Water Resource District

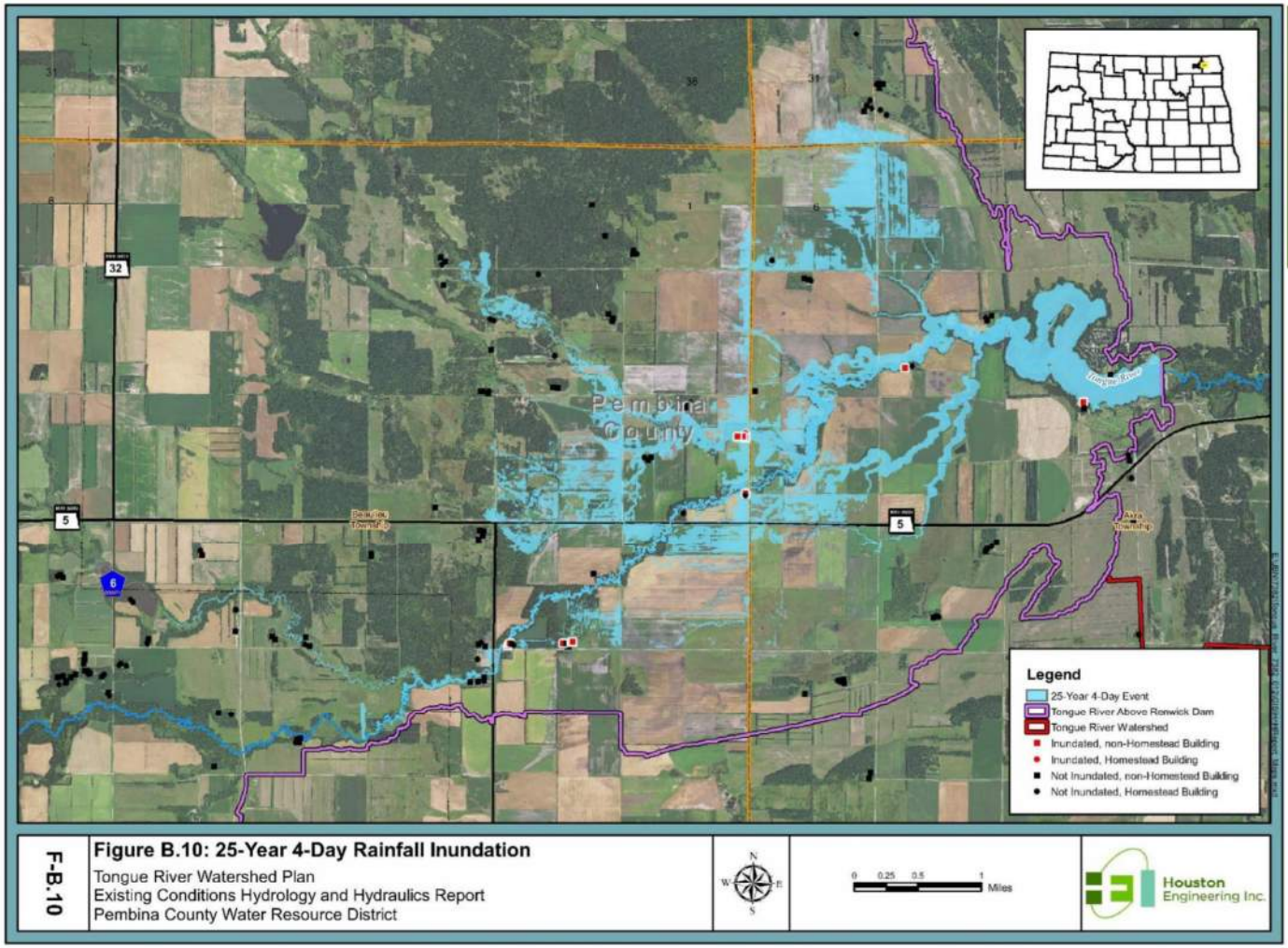
5-Year Event

4-Day Rainfall Depth:	**3.53 inches**
Total Inundation:	**1,095 Acres**
Inundated Structures:	**3**



10-Year Event

4-Day Rainfall Depth:	**4.13 inches**
Total Inundation:	**1,415 Acres**
Inundated Structures:	**6**



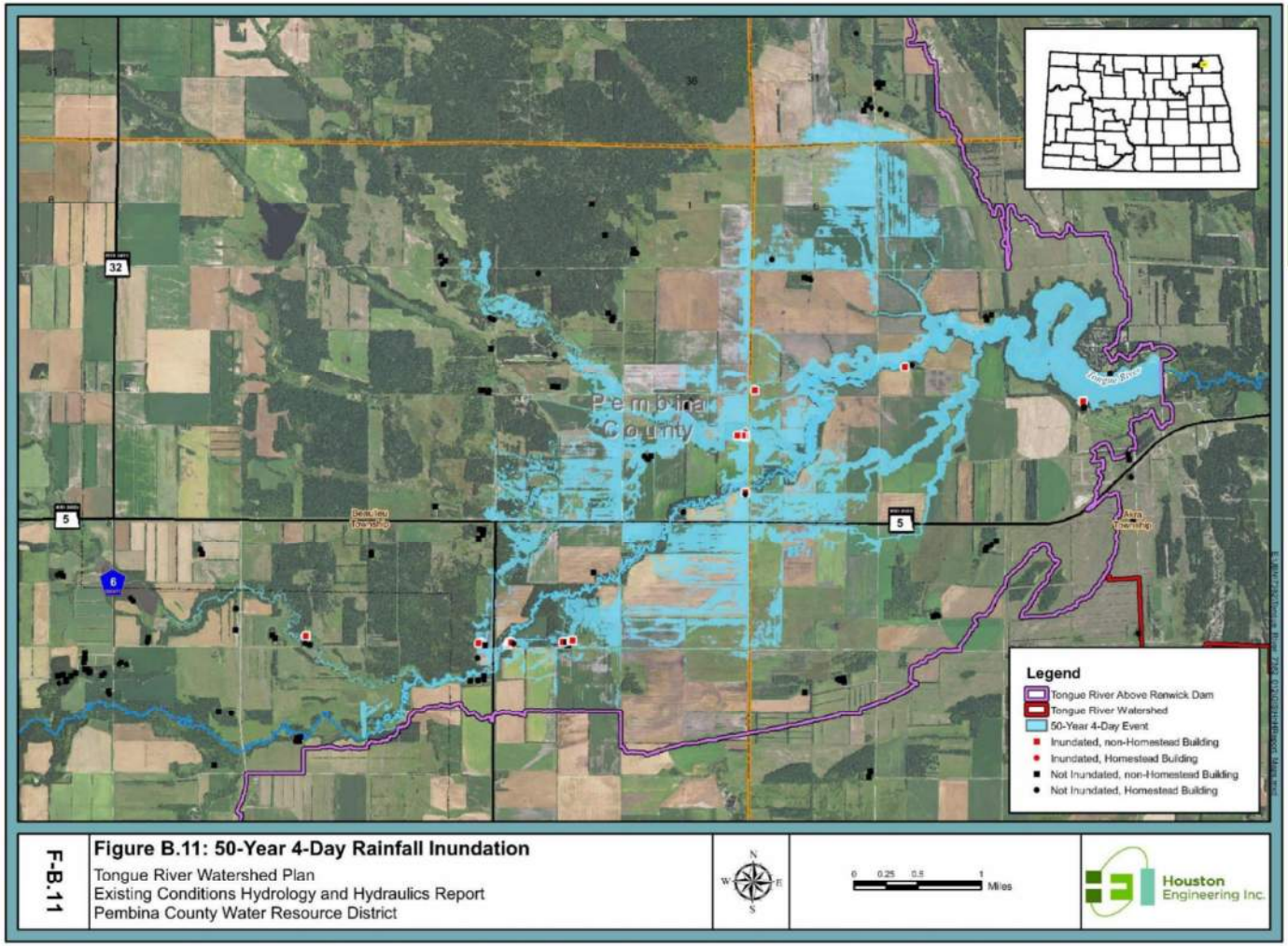
F-B.10

Figure B.10: 25-Year 4-Day Rainfall Inundation

Tongue River Watershed Plan
Existing Conditions Hydrology and Hydraulics Report
Pembina County Water Resource District

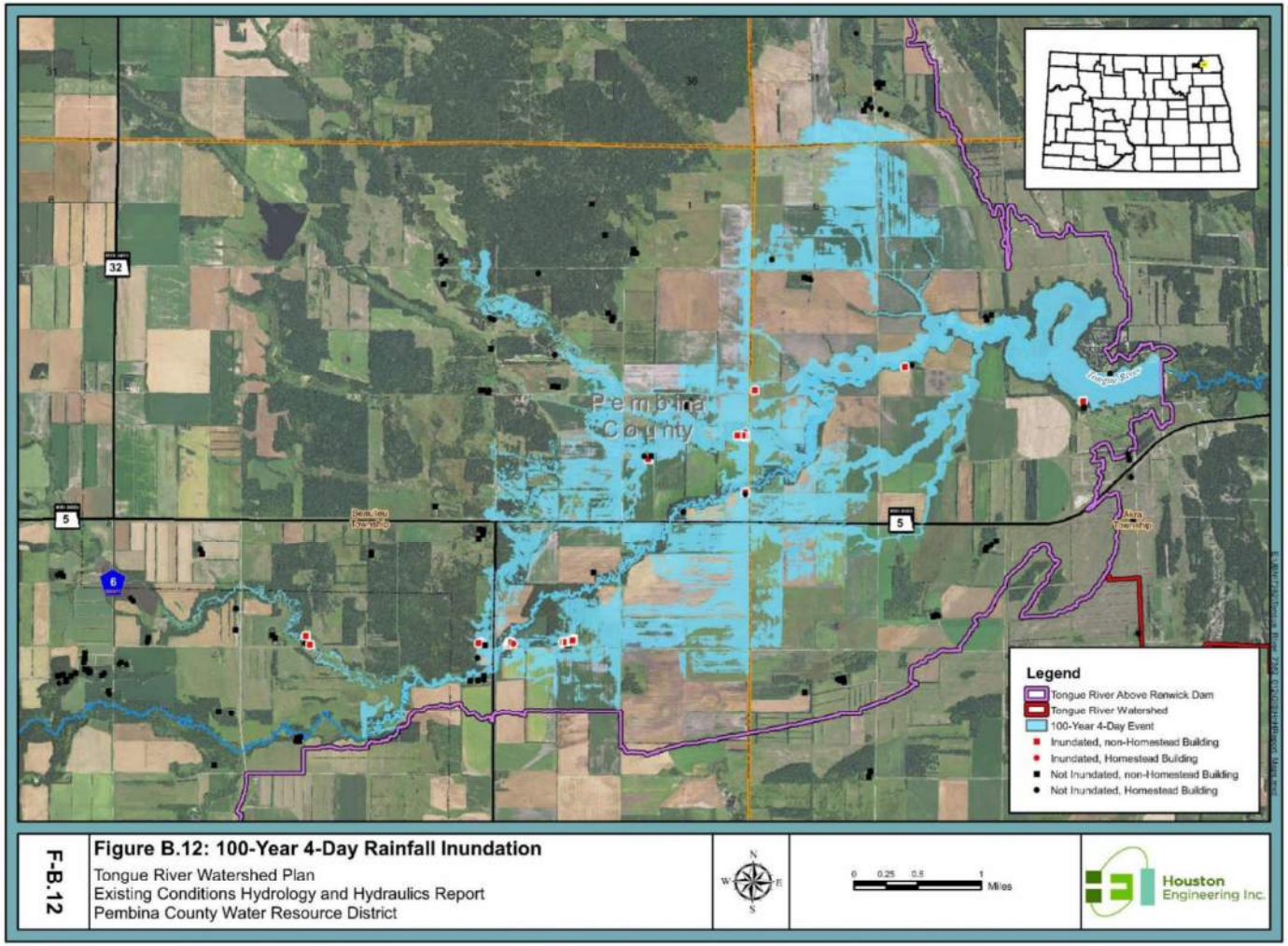
25-Year Event

4-Day Rainfall Depth:	**5.02 inches**
Total Inundation:	**1,911 Acres**
Inundated Structures:	**12**



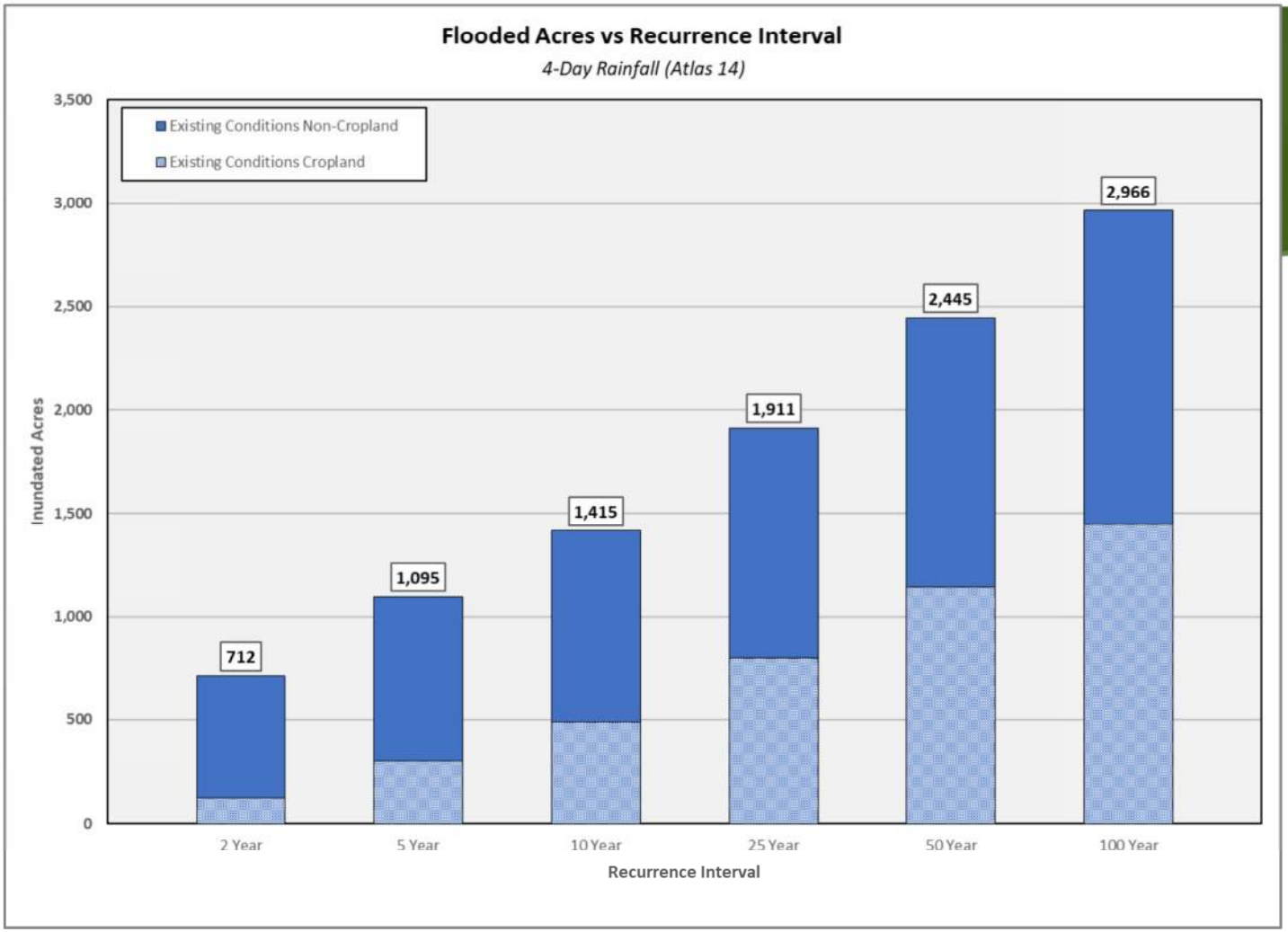
50–Year Event

4-Day Rainfall Depth:	**5.75 inches**
Total Inundation:	**2,445 Acres**
Inundated Structures:	**15**

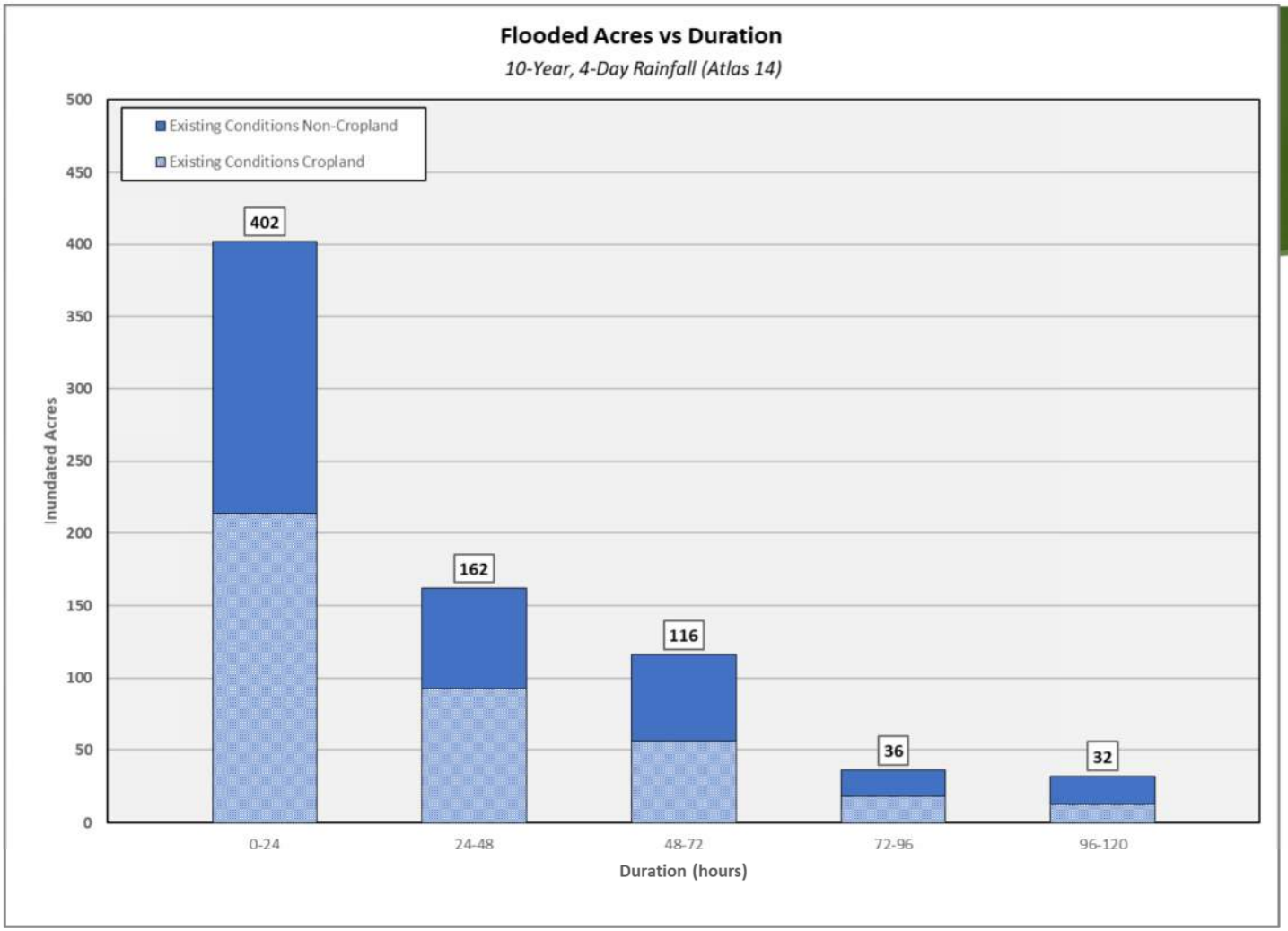


100-Year Event

4-Day Rainfall Depth:	**6.52 inches**
Total Inundation:	**2,966 Acres**
Inundated Structures:	**21**



Existing Flood Characteristics



Existing Flood Characteristics

Alternatives

- No Action
- Decommissioning
- Rehabilitation to High Hazard Criteria
- Remove Downstream Flood Risk and Rehabilitate to Reduced Hazard Classification

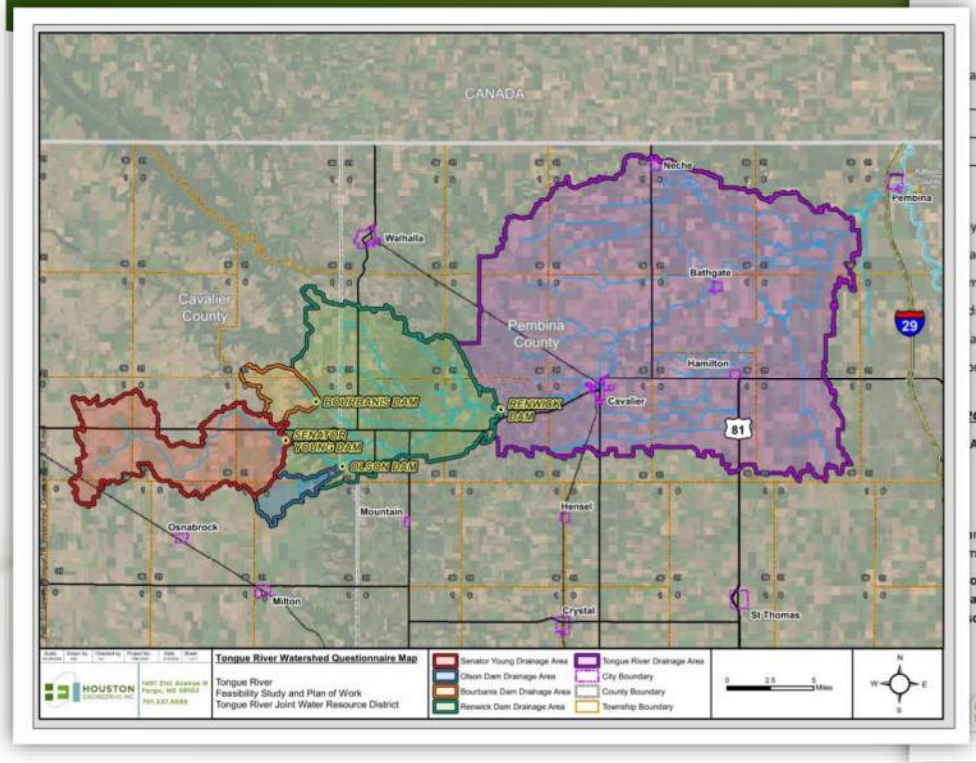
Factors Considered

- Technical Feasibility
- Economic Efficiency
- Public Health and Safety
- Environmental
- Social Considerations
- Cultural and Historic Resources
- Other Unique Factors

Planning Process Timeline

- Purpose and Need for Action; Public Participation ..... *July, 2020*
- Data Collection and Resource Inventory ..... *March, 2021*
- Development of Alternatives (Structural and non-Structural) ..... *July, 2021*
- Evaluation of Alternatives ..... *February, 2022*
- Preliminary Supplemental Watershed Plan (EA/EIS) ..... *April, 2022*
- Final Supplemental Watershed Plan ..... *July, 2022*

Public Input



COMMENT SHEET

Tongue River Watershed Dams
M-3 (Senator Young Dam), T3-1 (Bourbanis Dam) and T7-1 (Olson Dam)

Public Scoping Meeting – March 5, 2020

ase list any comments or concerns regarding this project:_____

_____

_____

_____

(You may also indicate areas of concern on the reverse side of the attached map.)

y we follow up with you for more information? YES NO

ase provide your name, address, email address, and phone number:

me:_____

dress:_____

ail:_____

one Number:_____

ase drop this form off at the conclusion of the meeting, email, or mail back to:

AIL: TongueRiverDams@houstoneng.com

MAIL: Tongue River Dams
c/o Pembina County Water Resource District
308 Courthouse Drive #5
Cavalier, ND 58220

nk you for taking the time to complete this comment form. Please return any completed questionnaire to the nbina County Water Resource District before leaving.

ou would like more time to complete, please return no later than FRIDAY, APRIL 10, 2020 using the ail/mail instructions above. Completed forms may also be dropped off at the Pembina County Water ource District office.

Thank You!!

HOUSTON ENGINEERING INC. Pembina County NORTH DAKOTA NRCS

Comment sheets are due by April 10, 2020


Thank You