

Pembina County Drain 16 Expansion Analysis

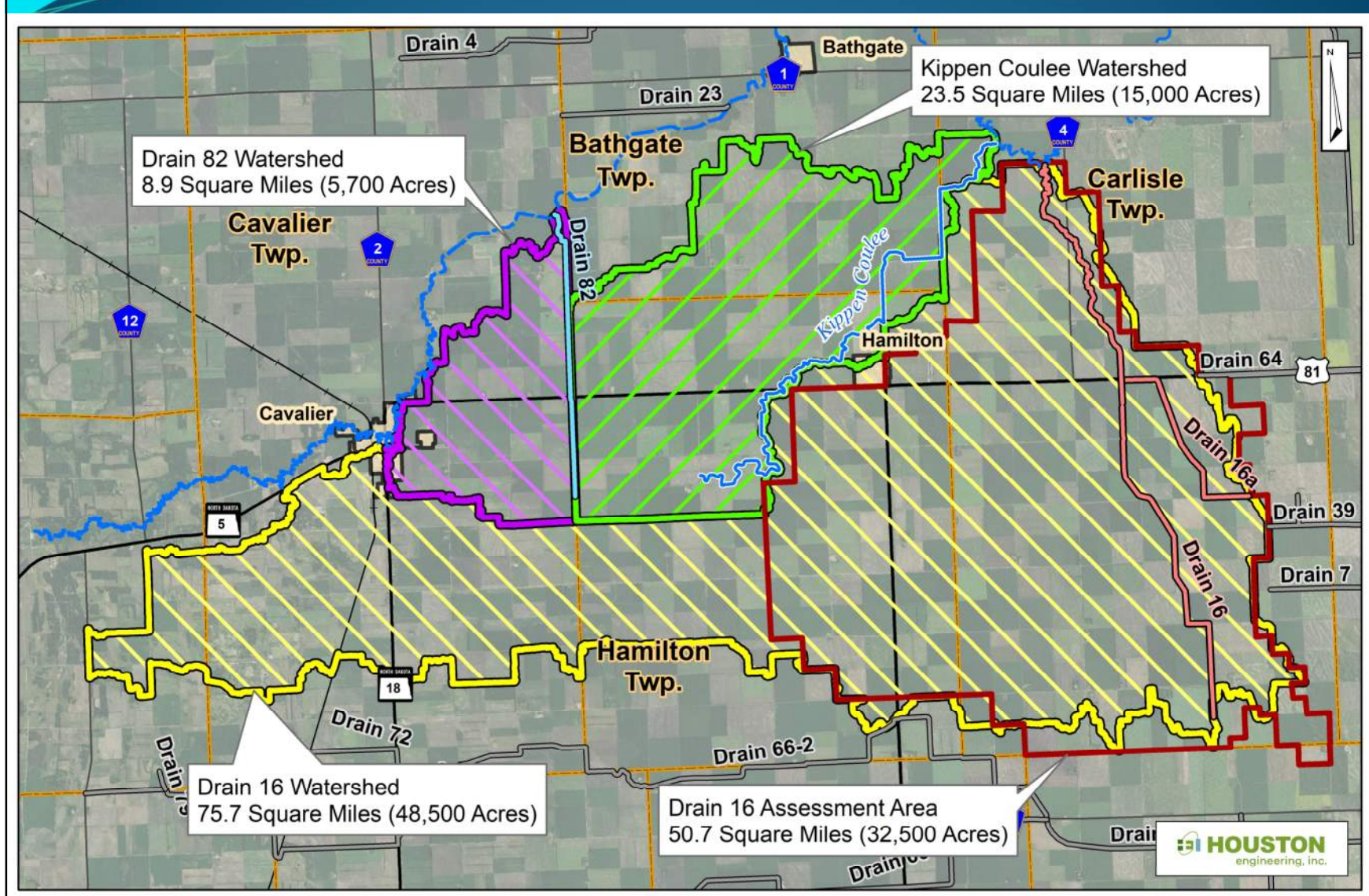
Existing Conditions Drainage and Flooding Review

March 23, 2023
Cavalier, ND

Scope

- **Purpose of Study:** Explore alternatives that will alleviate flood damages within the Drain 16 Assessment Area.
 - Project Phases
 - Field Survey
 - Existing Conditions Hydrology and Hydraulics
 - Alternative Development and Analysis
 - Concept Design of Alternative(s)
 - **Purpose of this Meeting:**
 - Verify drainage and flooding that occurs in Drain 16 and surrounding areas
 - Discuss areas of concern in the watershed (target areas) where drainage improvements may be most beneficial
- Public Participation Occurs Throughout

Background



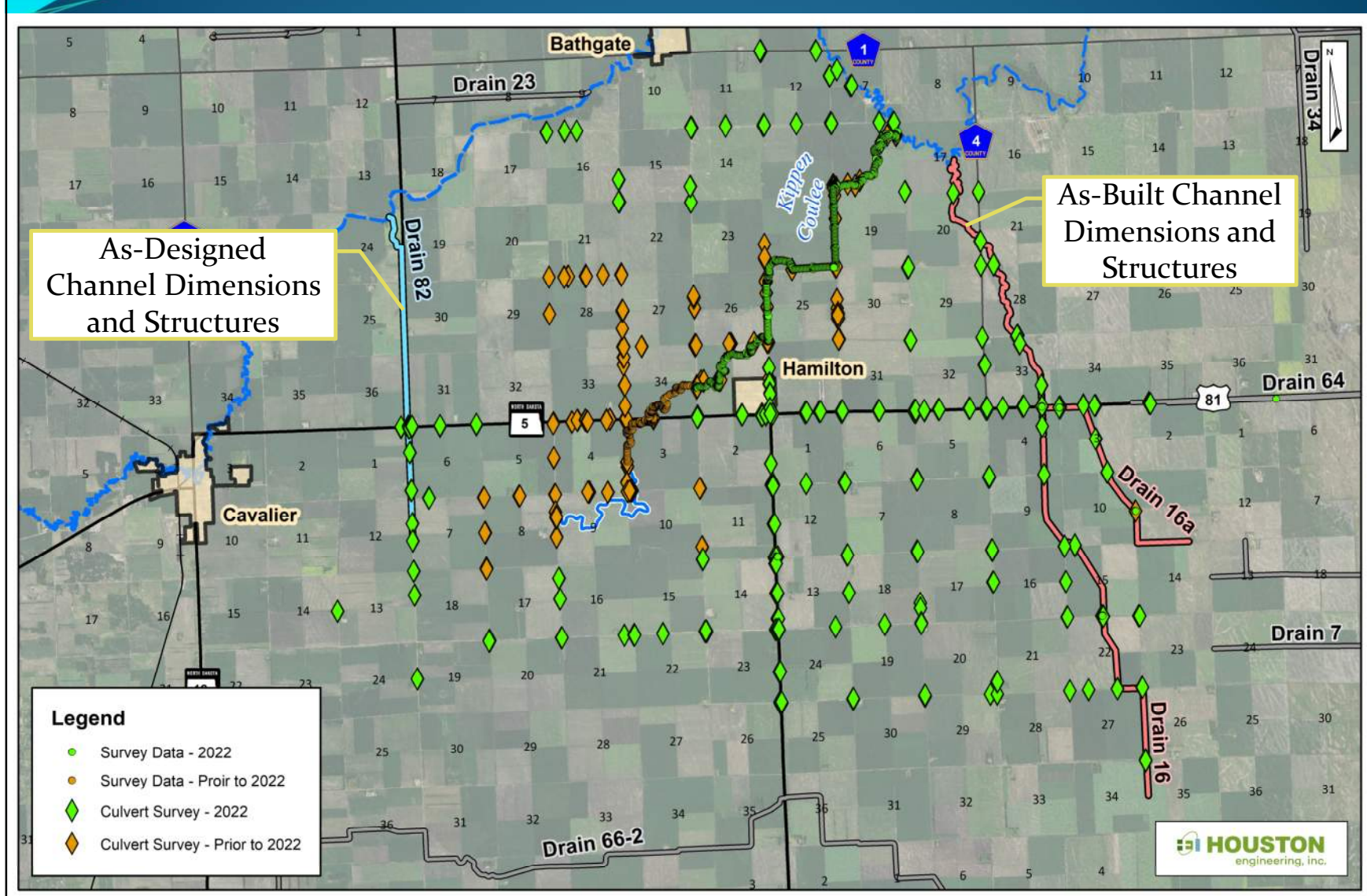
Noted Issues Related to Drainage and Flooding

- Prolonged high water in/along Drain 16.
- Overland flooding near Hamilton, ND
- Overland flooding in the Kippen Coulee area.
- Impacts:
 - Roadway damages
 - Agricultural impacts
 - Scour/erosion on agricultural land.
 - Impacts to Hamilton, ND.

Field Survey

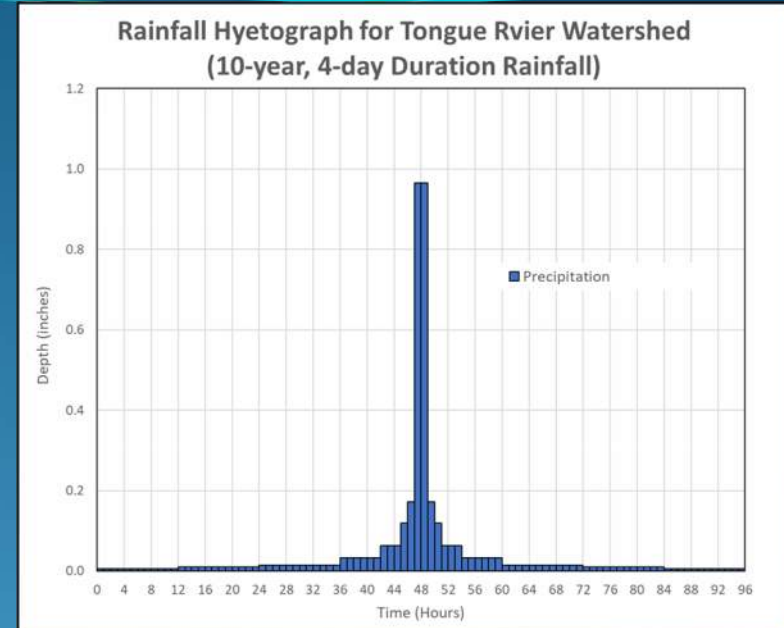
- Project uses survey data collected for other projects beginning in 2018.
- Field survey collected in 2022 includes:
 - Approximately 27 cross sections in Kippen Coulee
 - Inventory and survey of over 250 culverts in the Drain 16 and Kippen Coulee areas.
- As-built plans were used for Pembina County Drain 16.
- LiDAR data used for all other topography for the project was collected in 2017

Field Survey



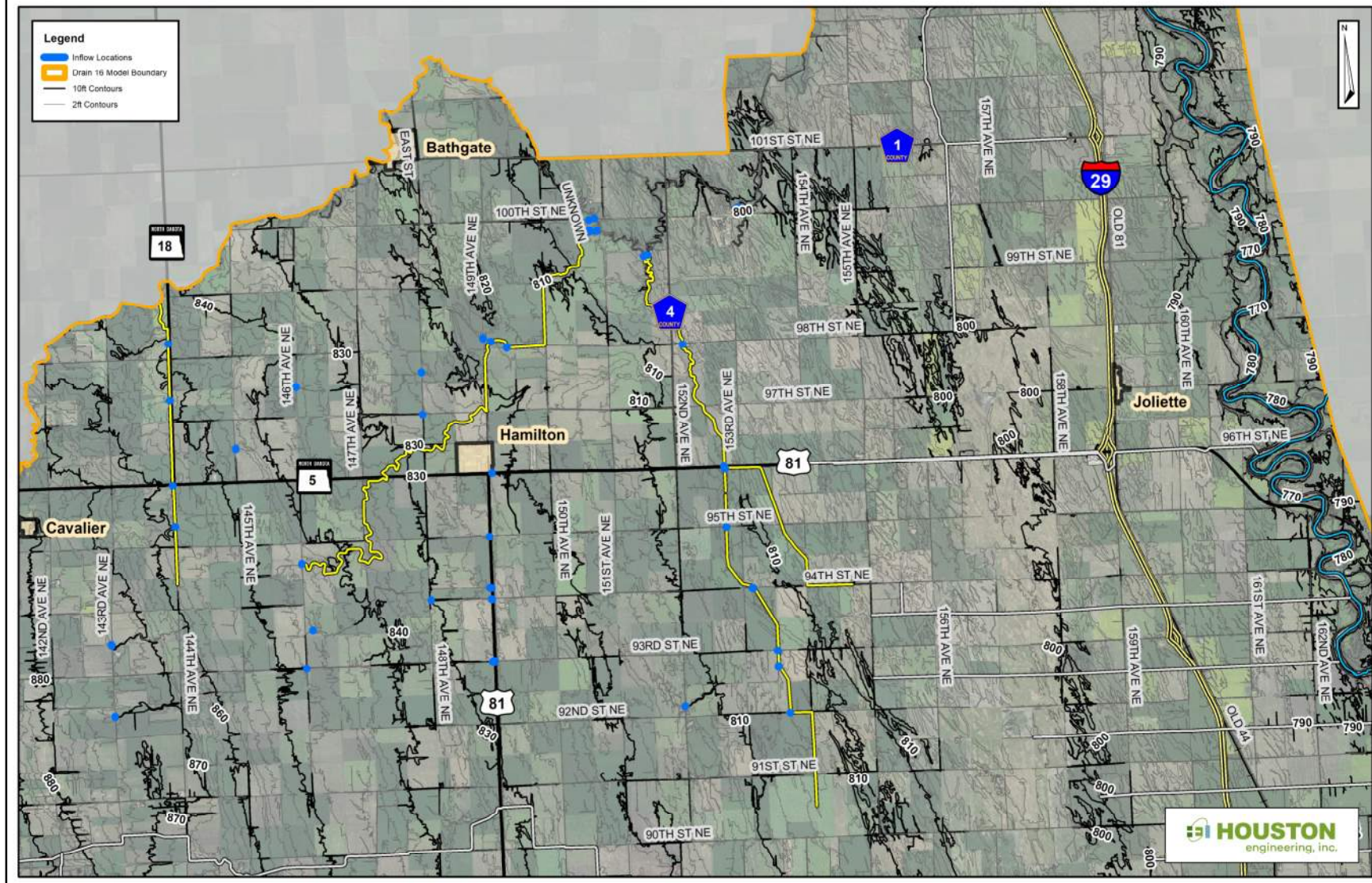
Hydrology & Hydraulics

- Hydrology model developed to estimate runoff hydrographs.
- Survey and LiDAR data used to develop hydraulic model to estimate flood plain characteristics (depth, duration, extents, etc...)
- Models utilize NOAA Atlas 14 rainfall depths (4-day duration) over entire Tongue River Watershed

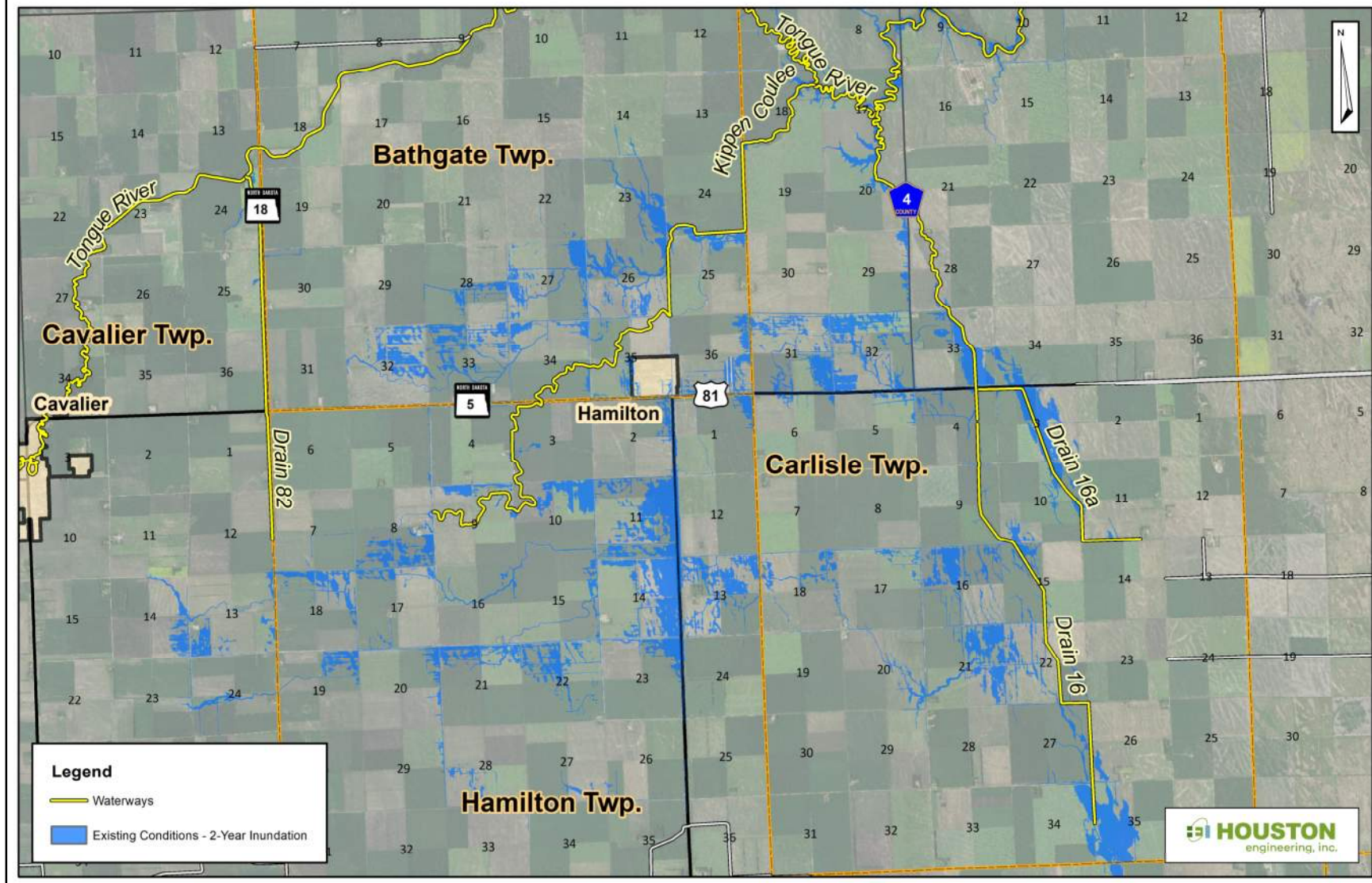


Recurrence Interval	Annual Probability	Rainfall Depth (inches)
2-year	50%	2.8
5-year	20%	3.4
10-year	10%	4.0
25-year	4%	4.9
50-year	2%	5.6
100-year	1%	6.4

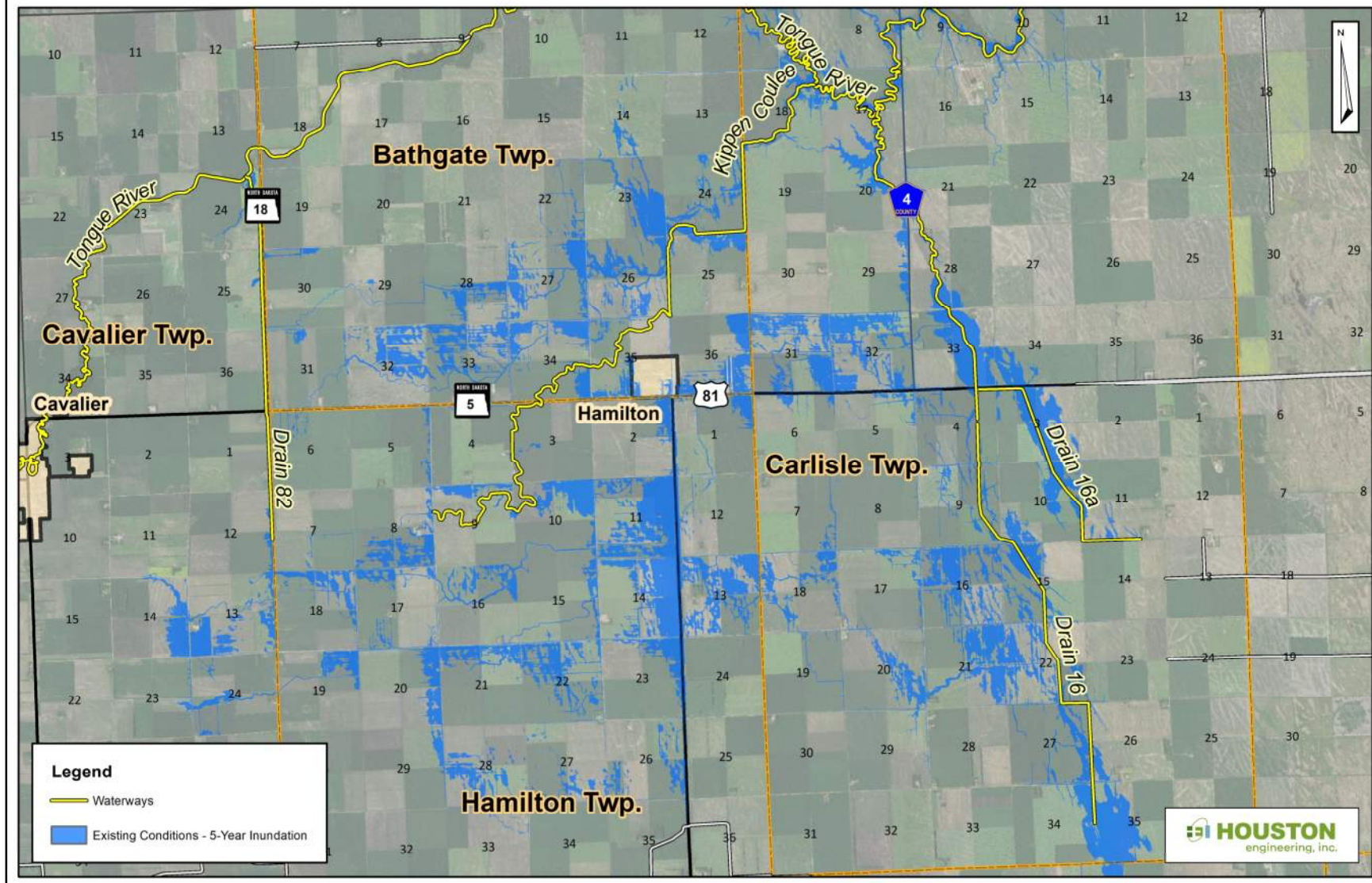
Hydrology & Hydraulics



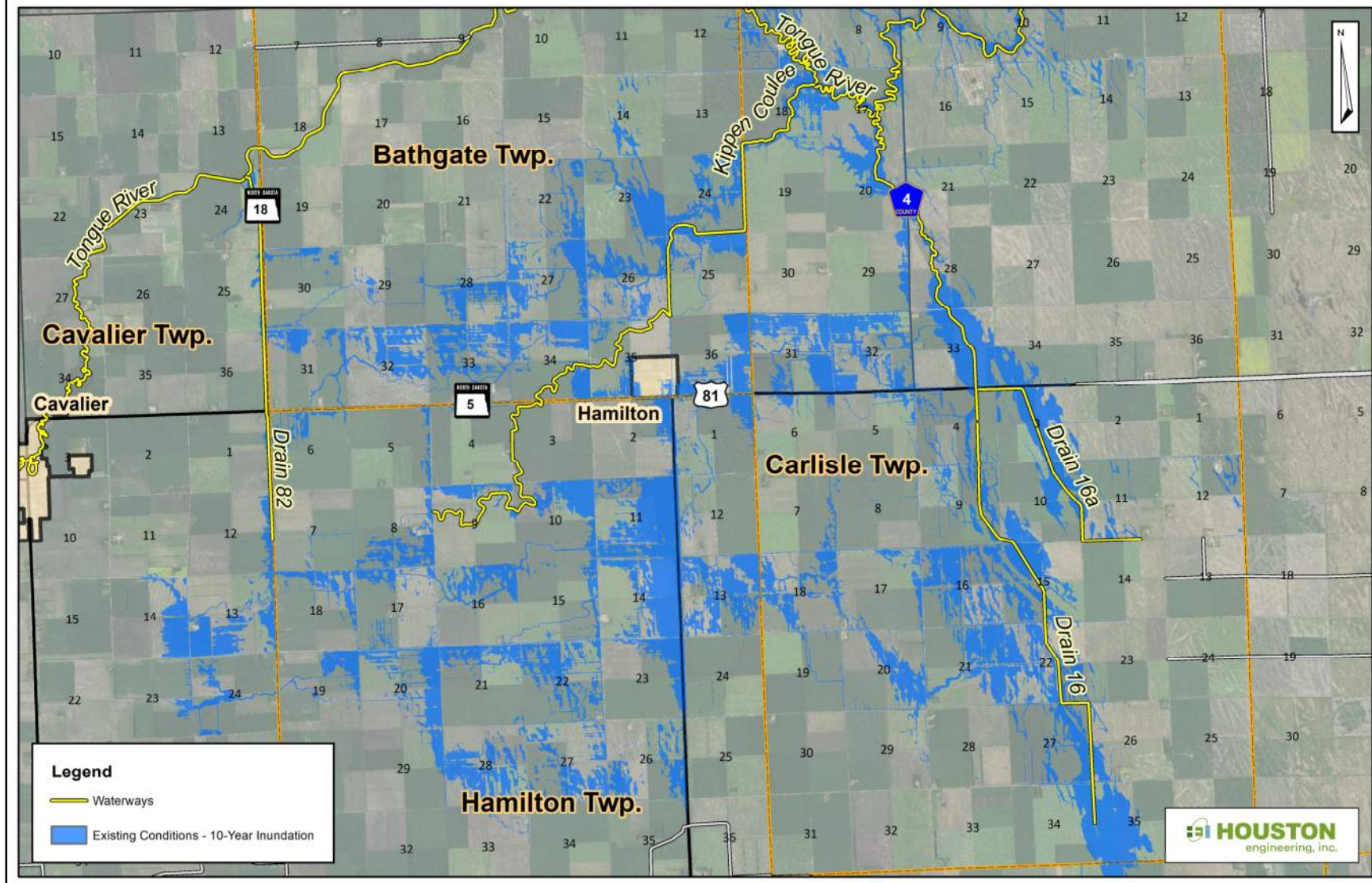
Inundation Review: 2-year Event



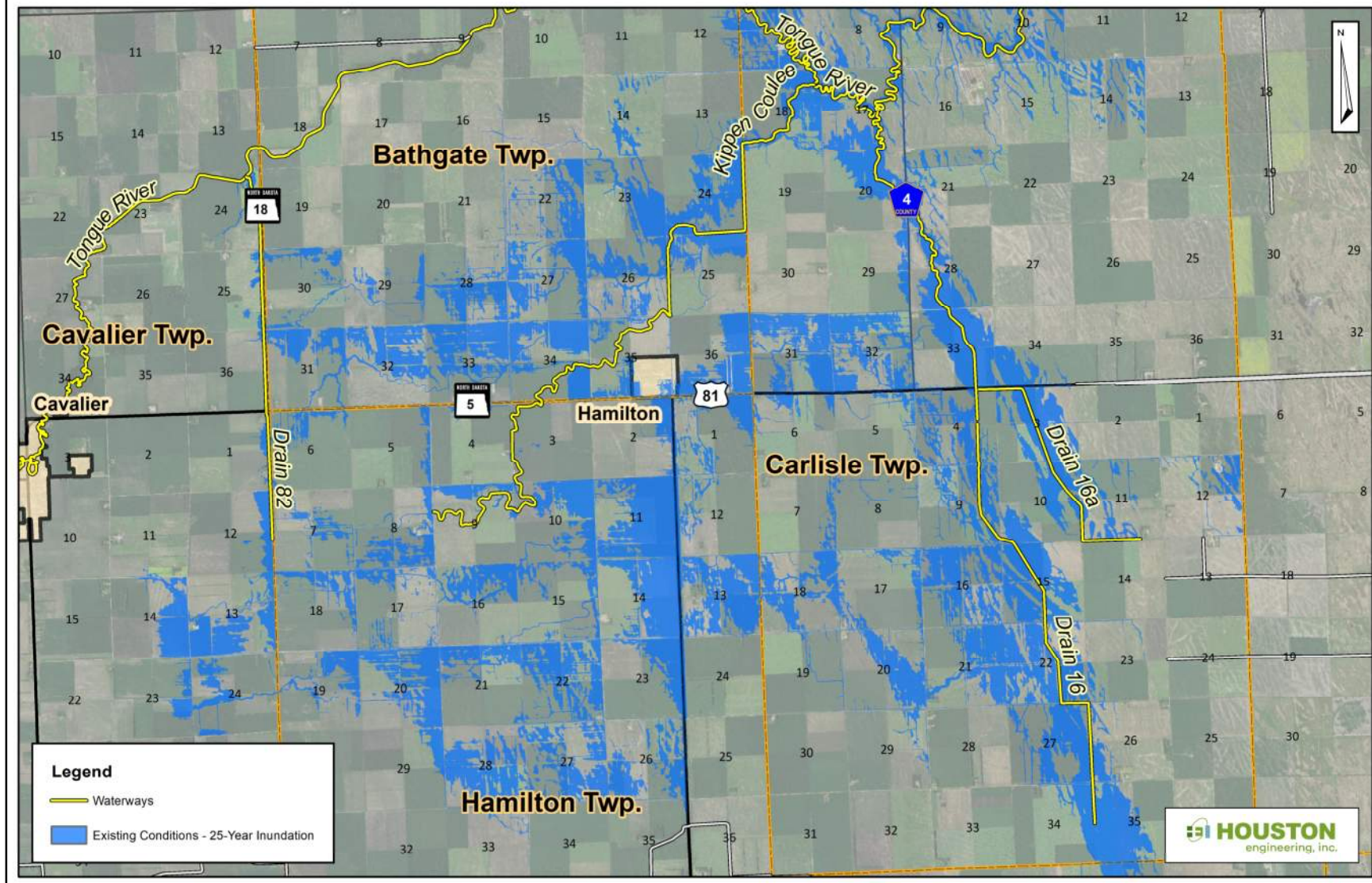
Inundation Review: 5-year Event



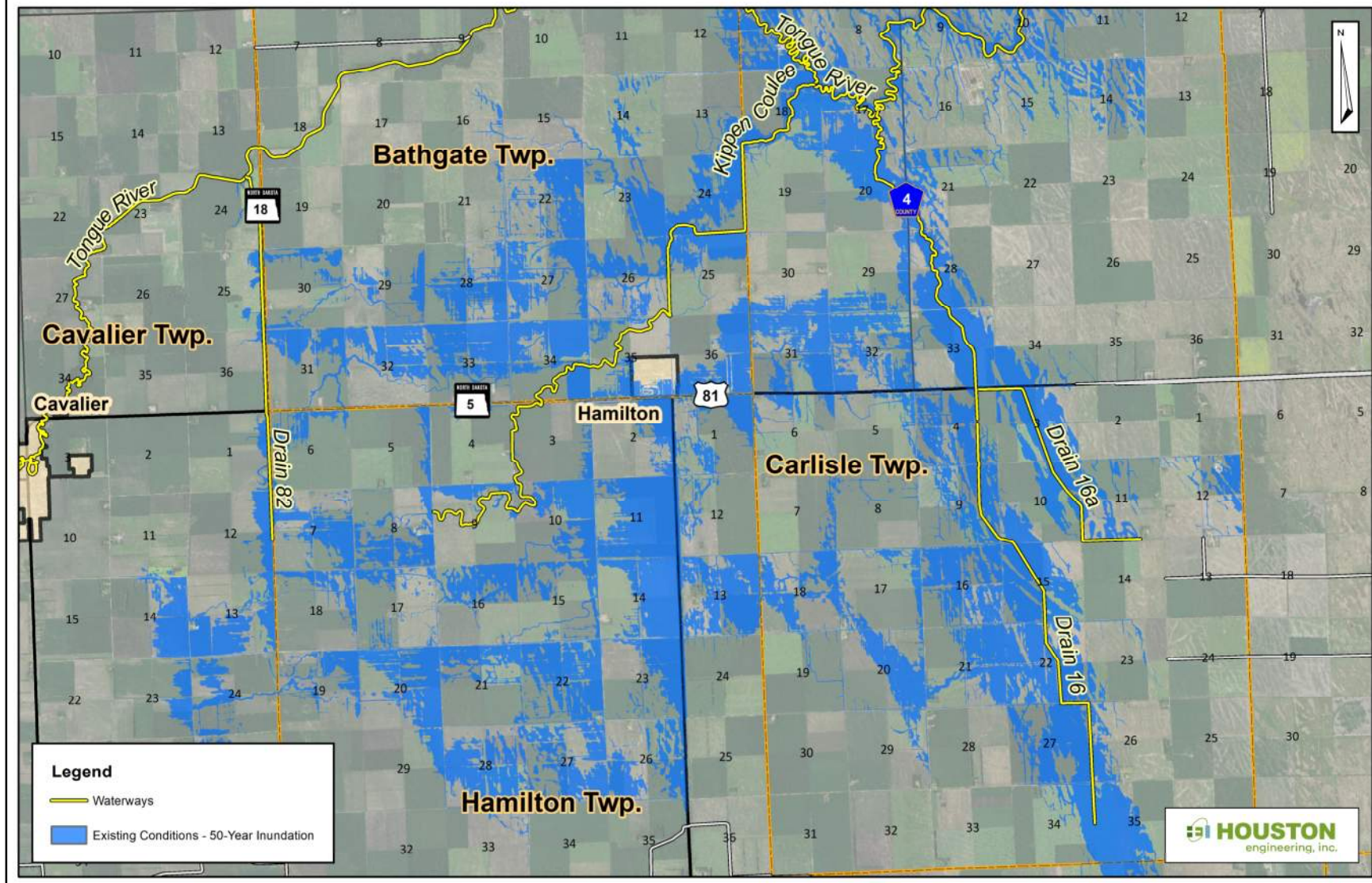
Inundation Review: 10-year Event



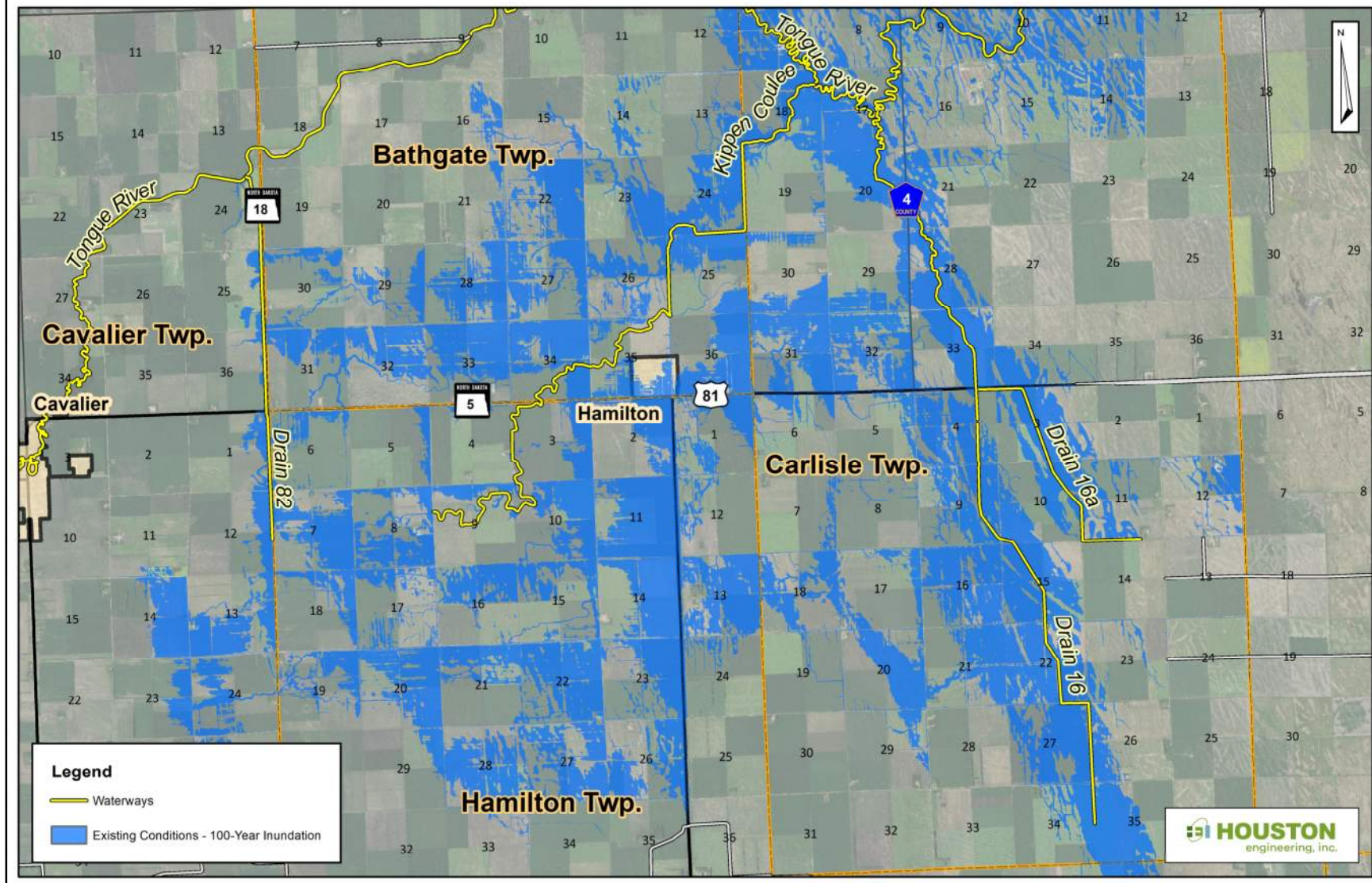
Inundation Review: 25-year Event



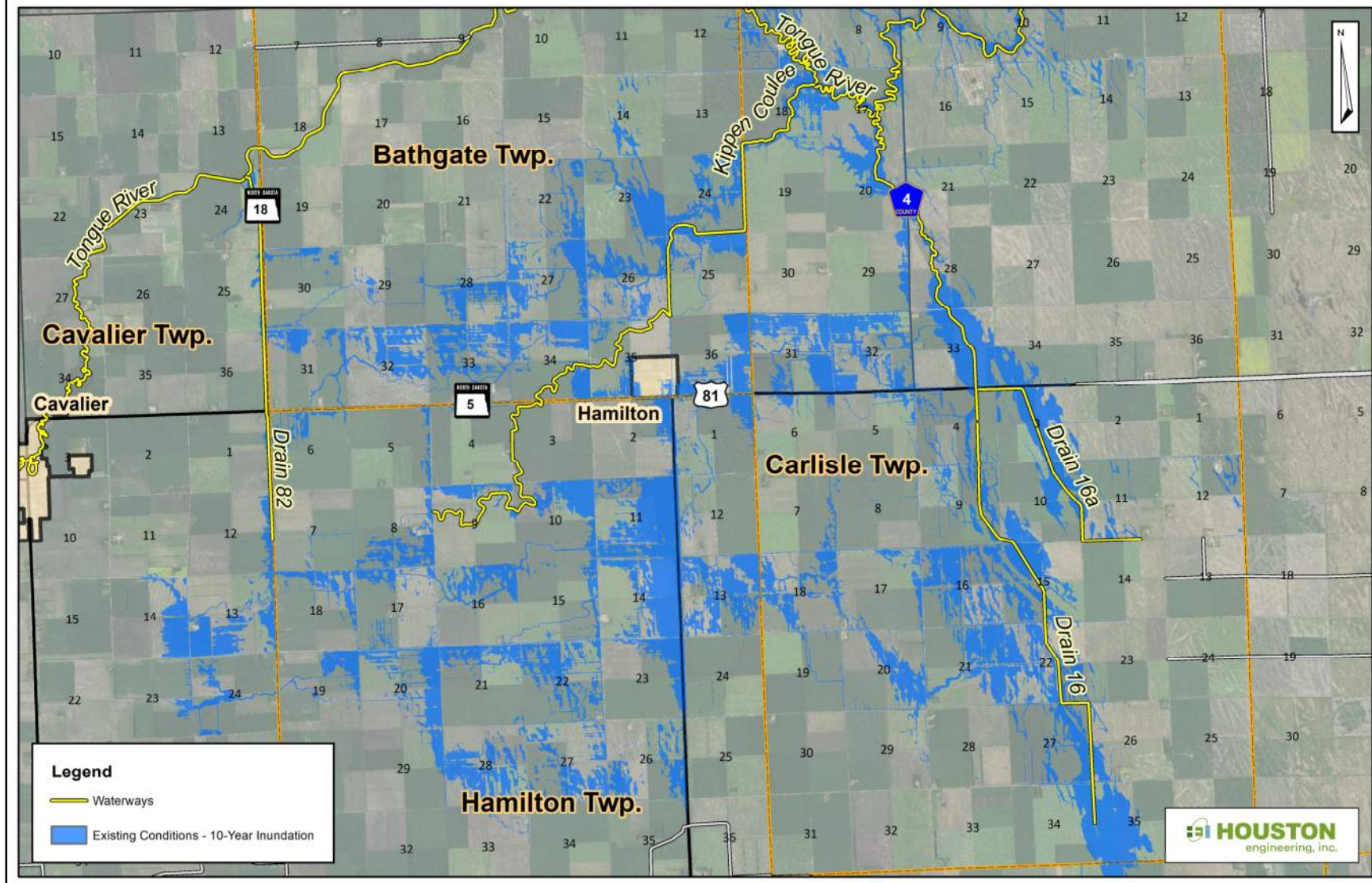
Inundation Review: 50-year Event



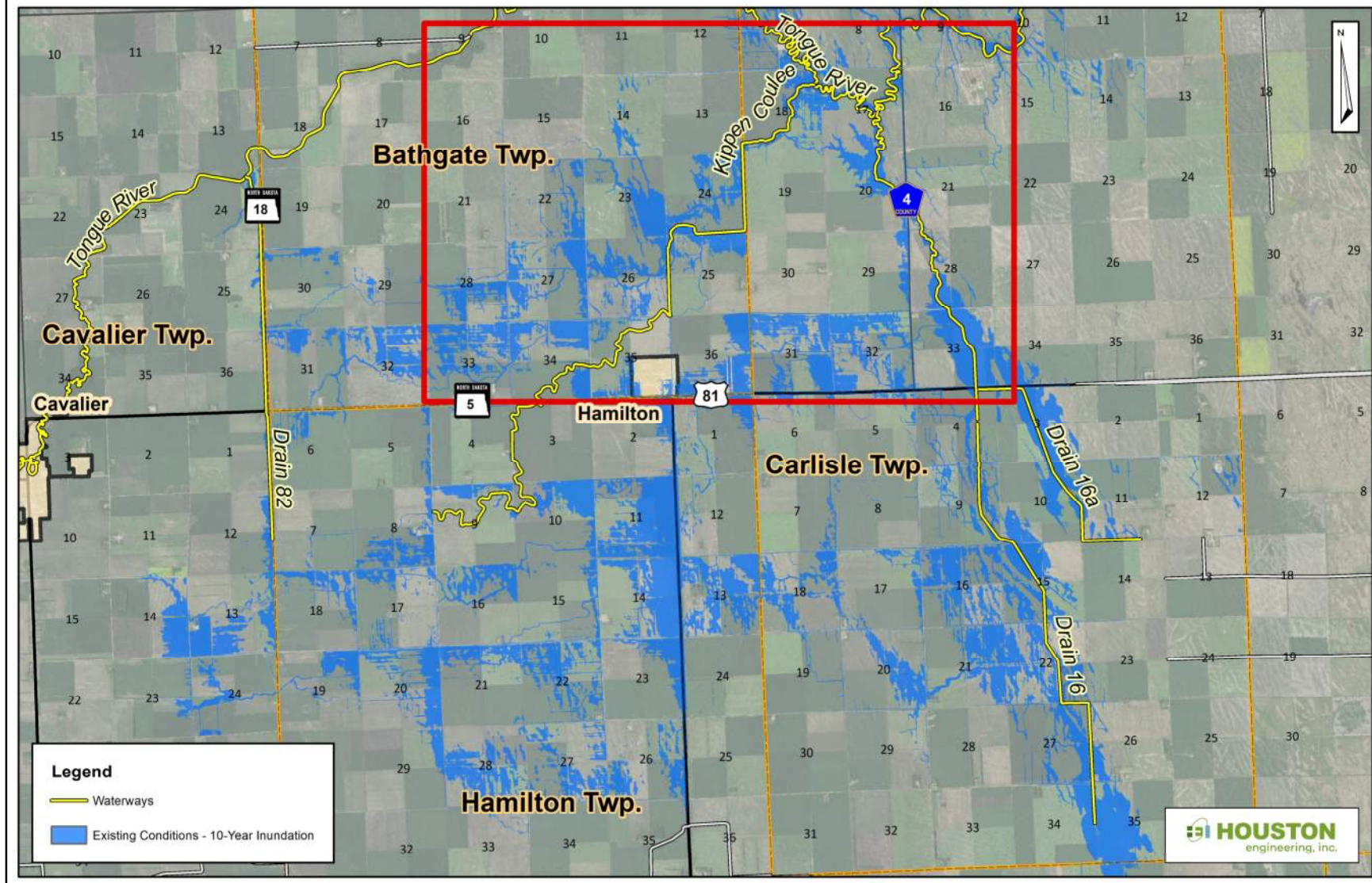
Inundation Review: 100-year Event



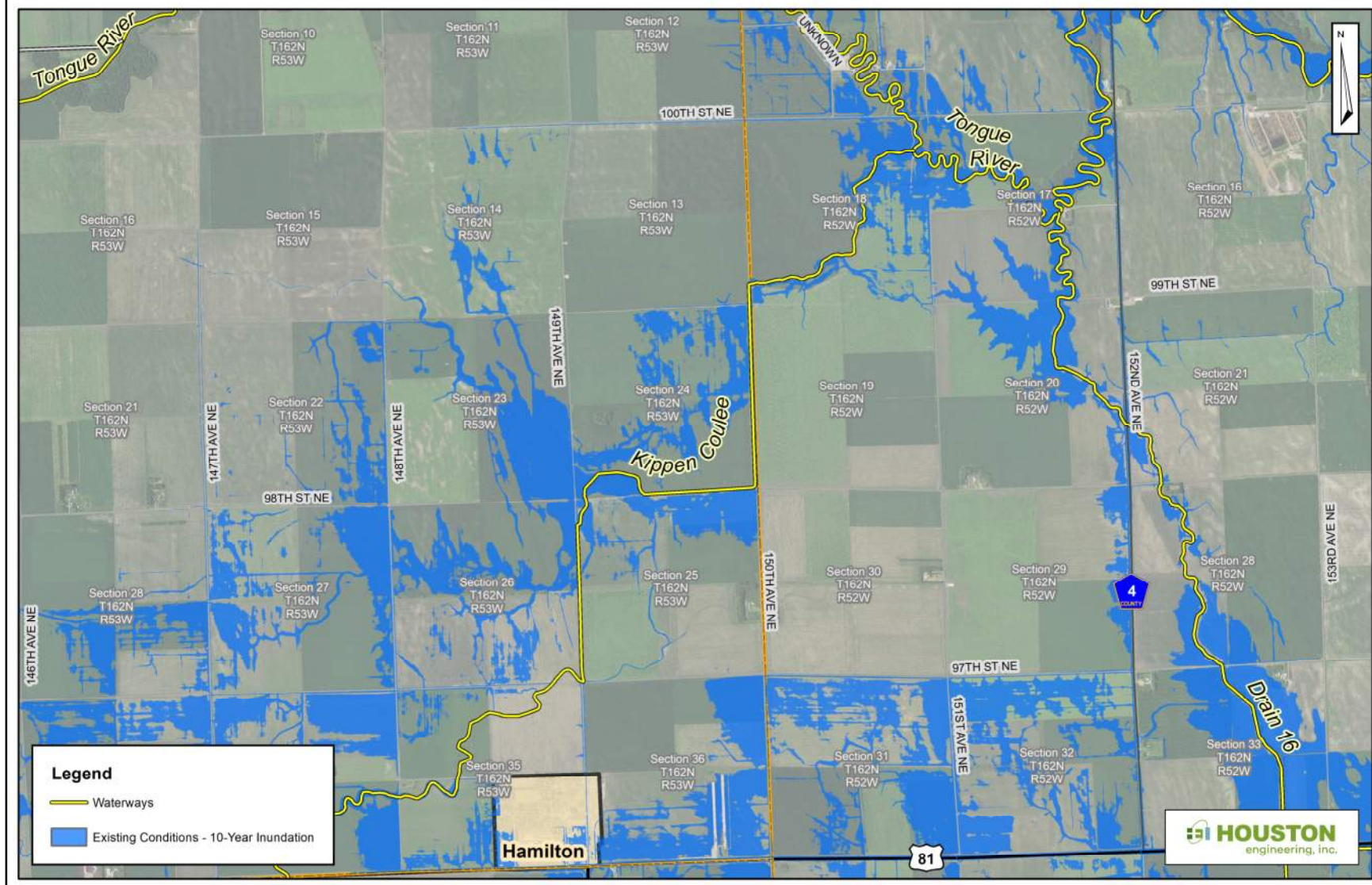
Inundation Review: 10-year Event (Detailed)



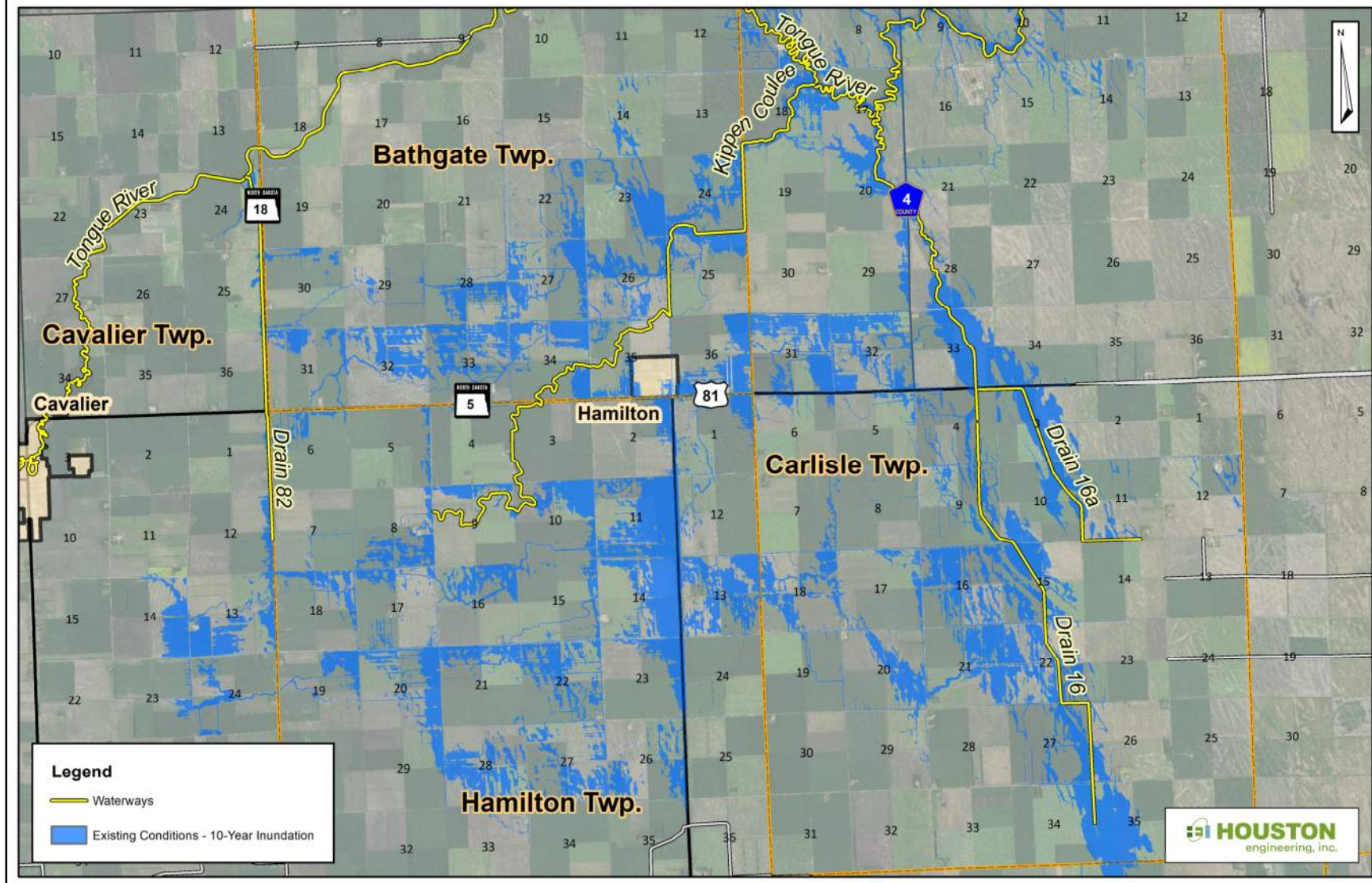
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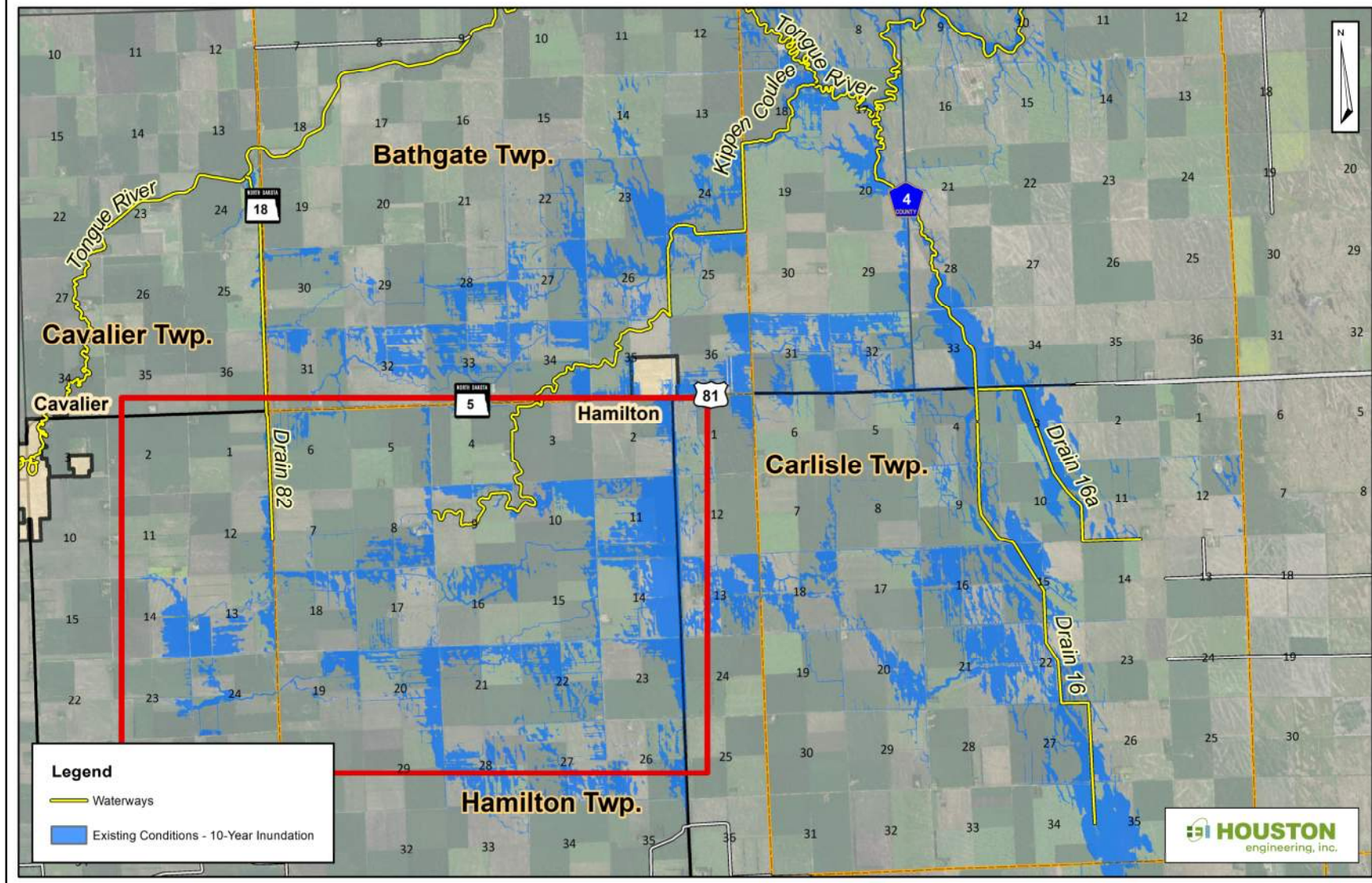
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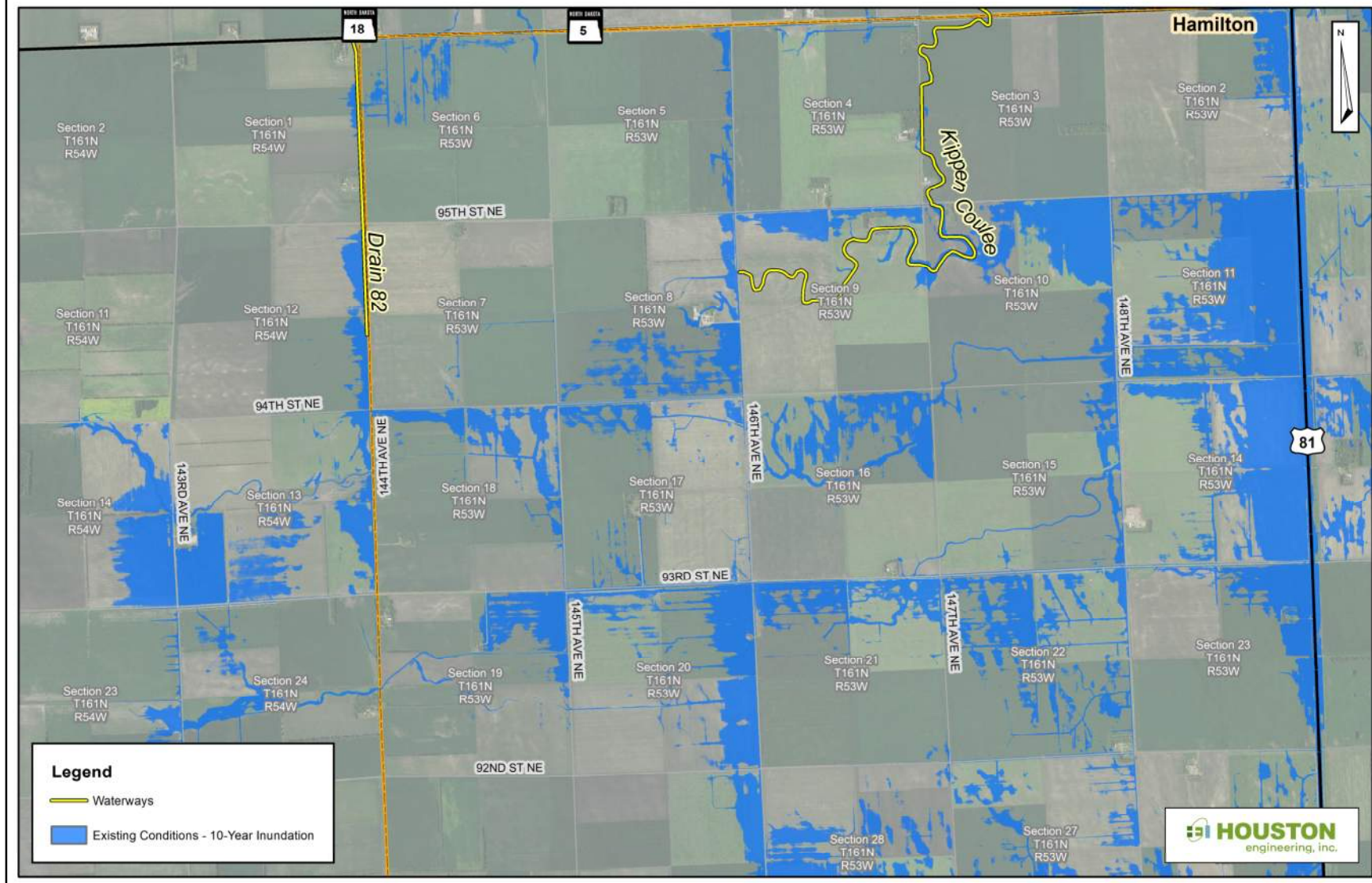
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Inundation Review: 10-year Event (Detailed)



Legend

- Waterways
- Existing Conditions - 10-Year Inundation

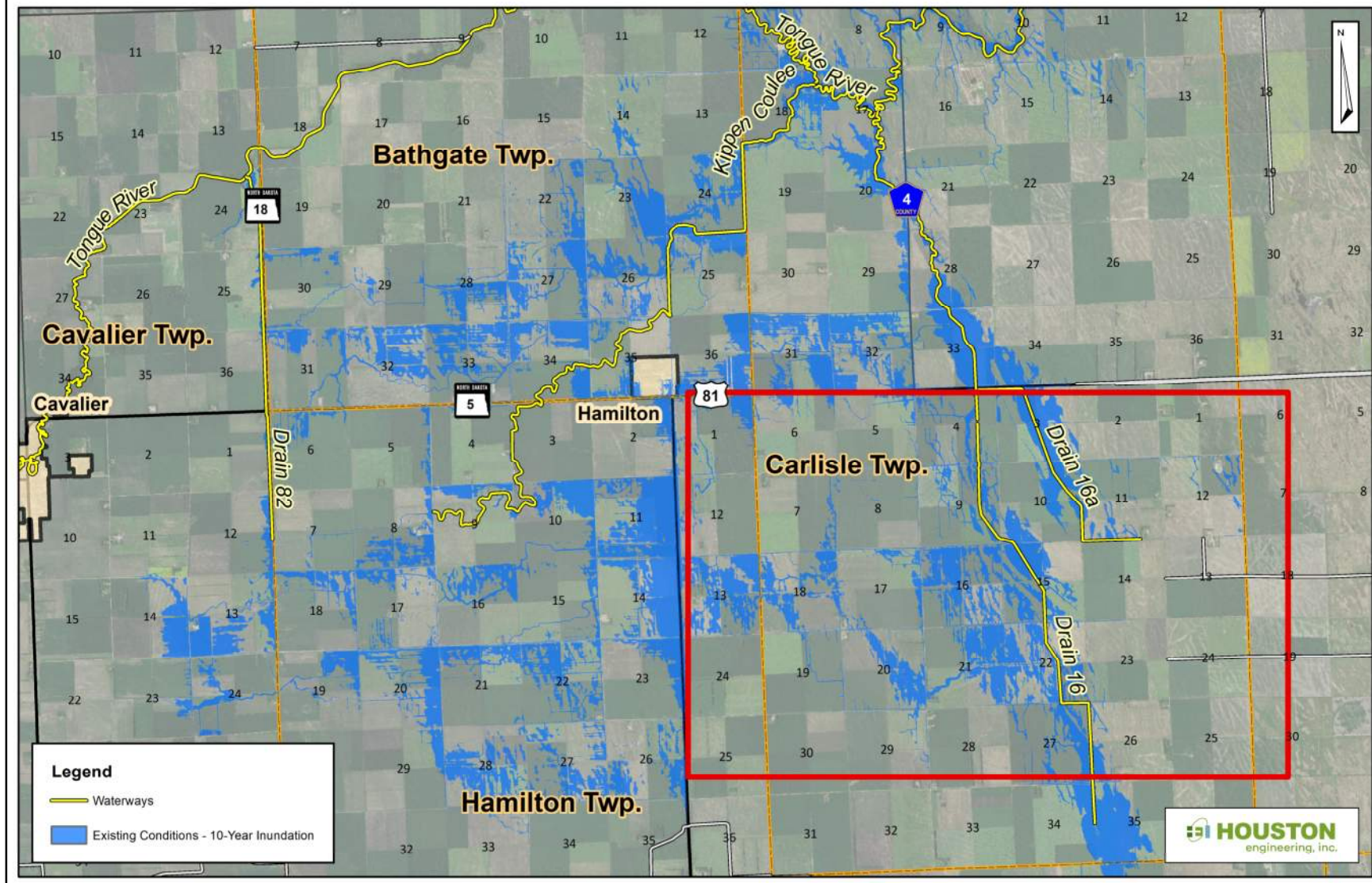
Map Labels: Bathgate Twp., Cavalier Twp., Cavalier, Hamilton, Carlisle Twp., Hamilton Twp., Tongue River, Kippen Coulee, Drain 82, Drain 16a, Drain 16.

Infrastructure: Highway 18, Highway 5, Highway 81, County 4.

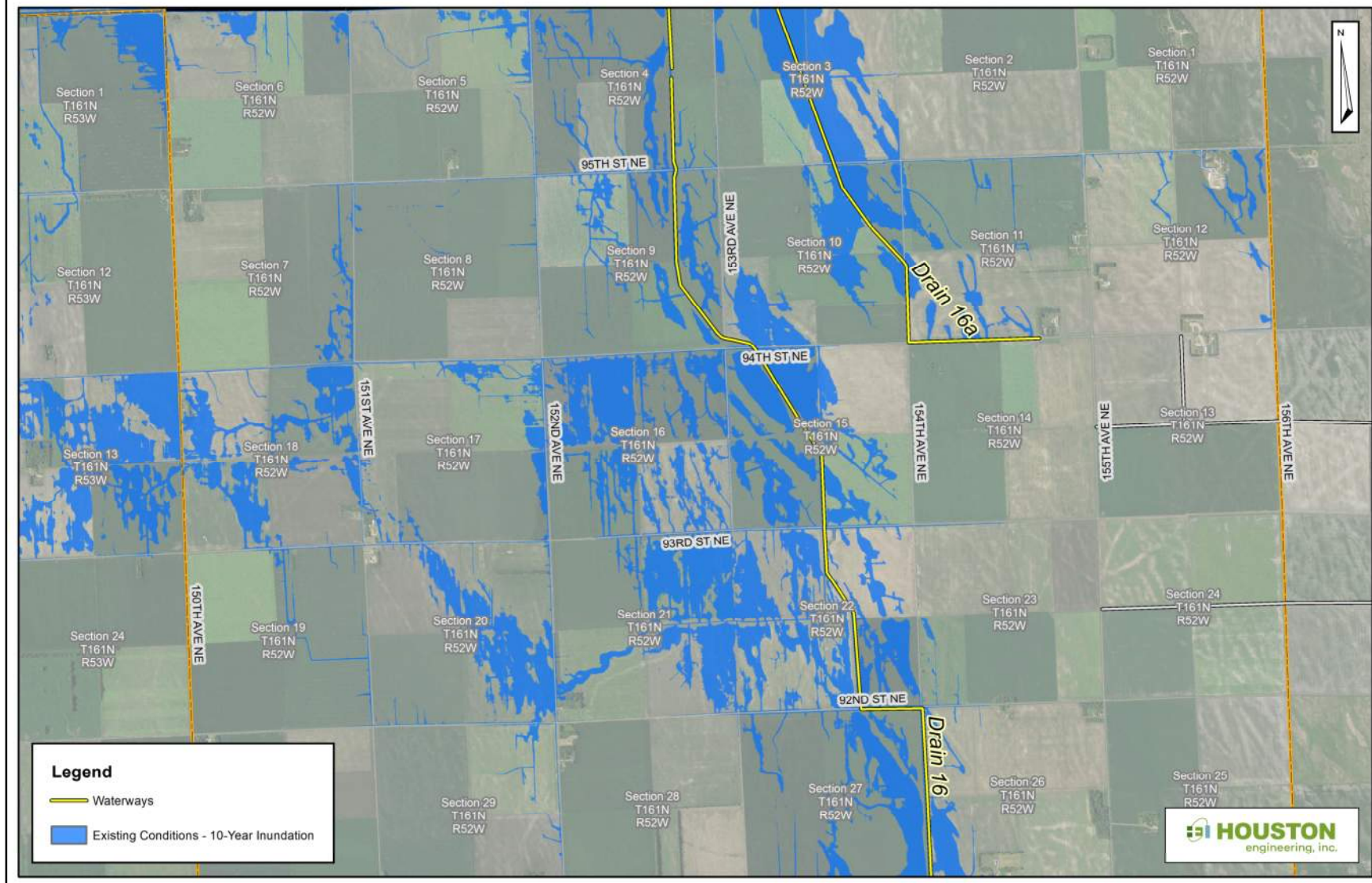
Scale: 0 to 10 miles.

Source: HOUSTON engineering, inc.

Inundation Review: 10-year Event (Detailed)



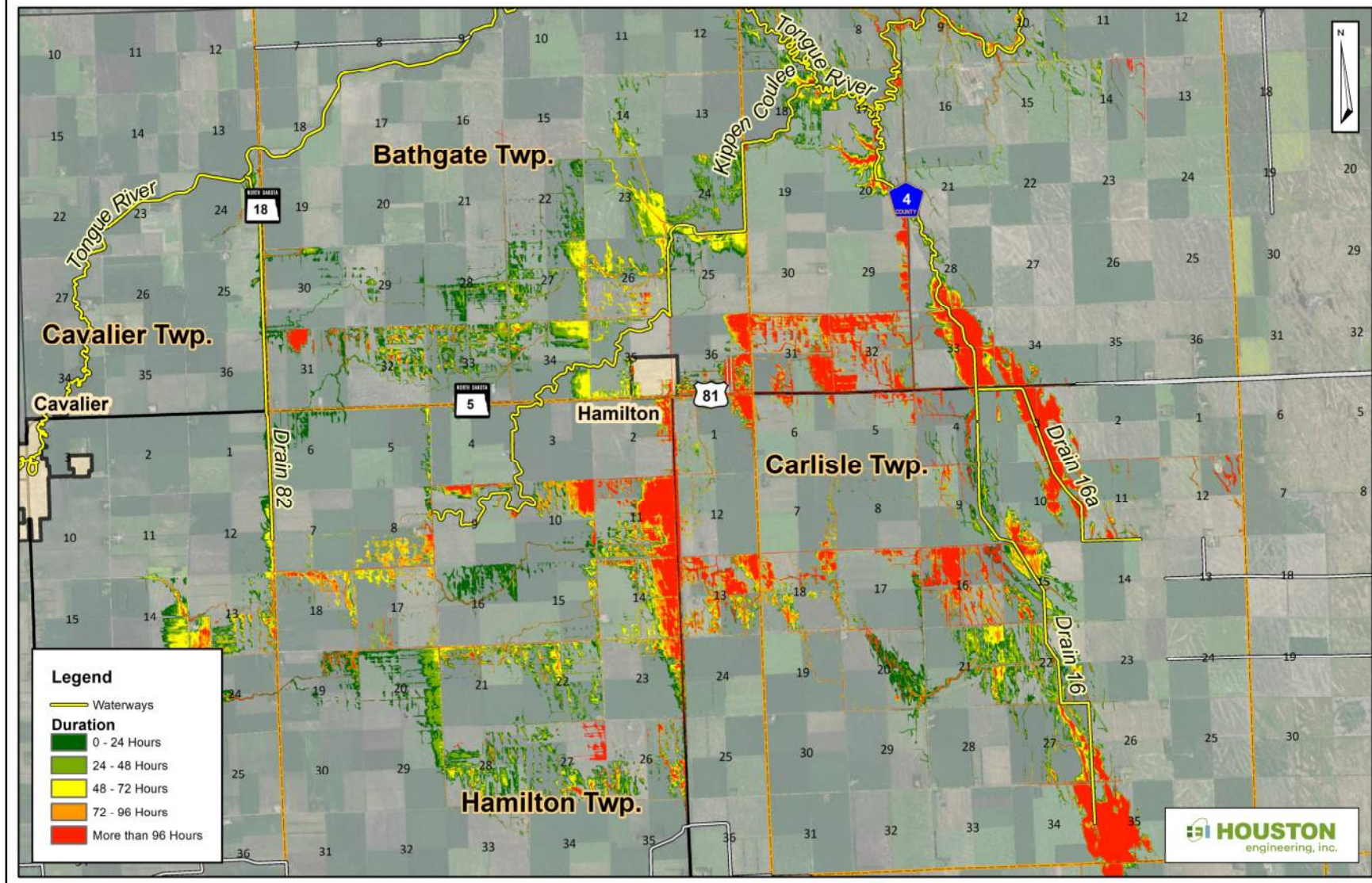
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Scope

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- Project Phases
 - Field Survey
 - Existing Conditions Hydrology and Hydraulics
 - Alternative Development and Analysis
 - Concept Design of Alternative(s)
- **Timeline**
 - Existing conditions drainage and flooding review.....Today
 - Develop alternatives to alleviate noted issues.....March – May
 - Public meeting to review results.....June

} Public Participation

COMMENT SHEET

Pembina County Drain 16 Expansion Analysis Existing Conditions Drainage and Flooding Review

Public Meeting – March 23, 2023

Please list any comments or concerns regarding this project: _____

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

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

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

Name: _____

Address: _____

Email: _____

Phone Number: _____

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

EMAIL: pleclaire@houstoneng.com

MAIL: Pembina County Drain 16 Expansion Analysis
c/o Pembina County Water Resource District
308 Courthouse Drive #5
Cavalier, ND 58220

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

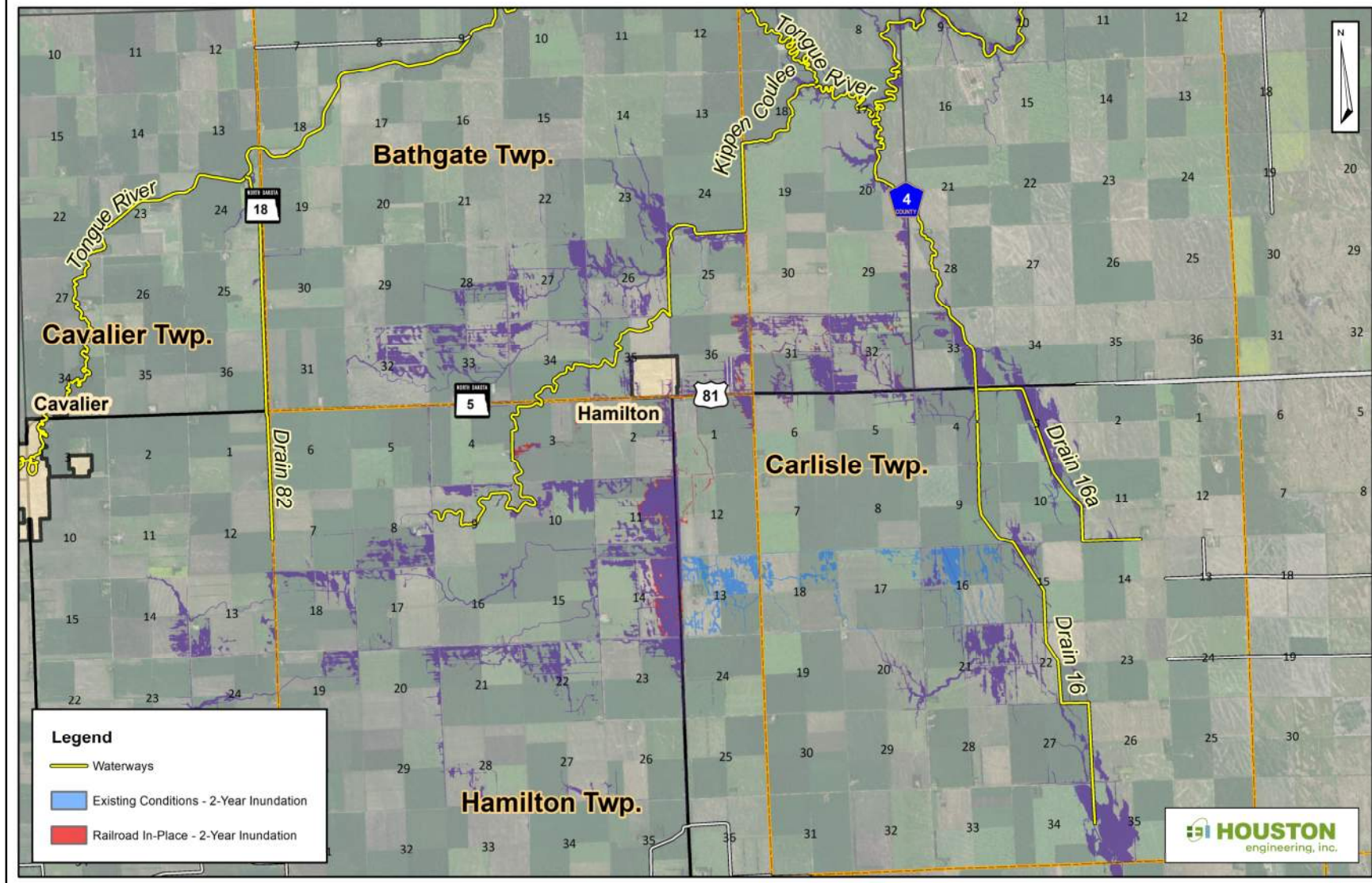
If you would like more time to complete this form, please return no later than **MONDAY, APRIL 24, 2023**, using the email/mail instructions above. Completed forms may also be dropped off at the Pembina County Water Resource District office.

Thank You!!

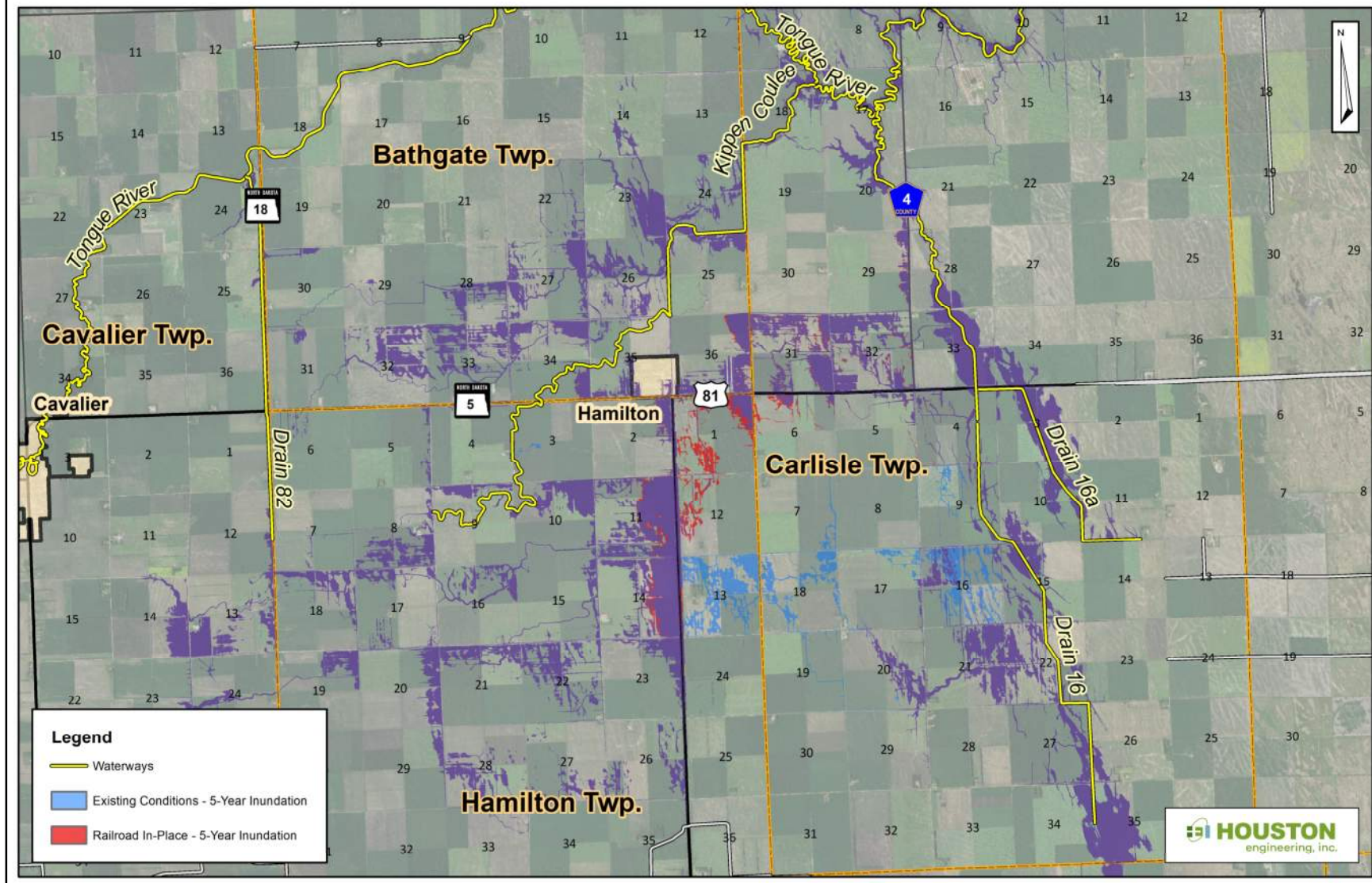


- Comment sheets available at the public meeting on March 23rd and on PCWRD website.
- Map of watershed is provided on the reverse side.
- Submit comments by April 24, 2023.

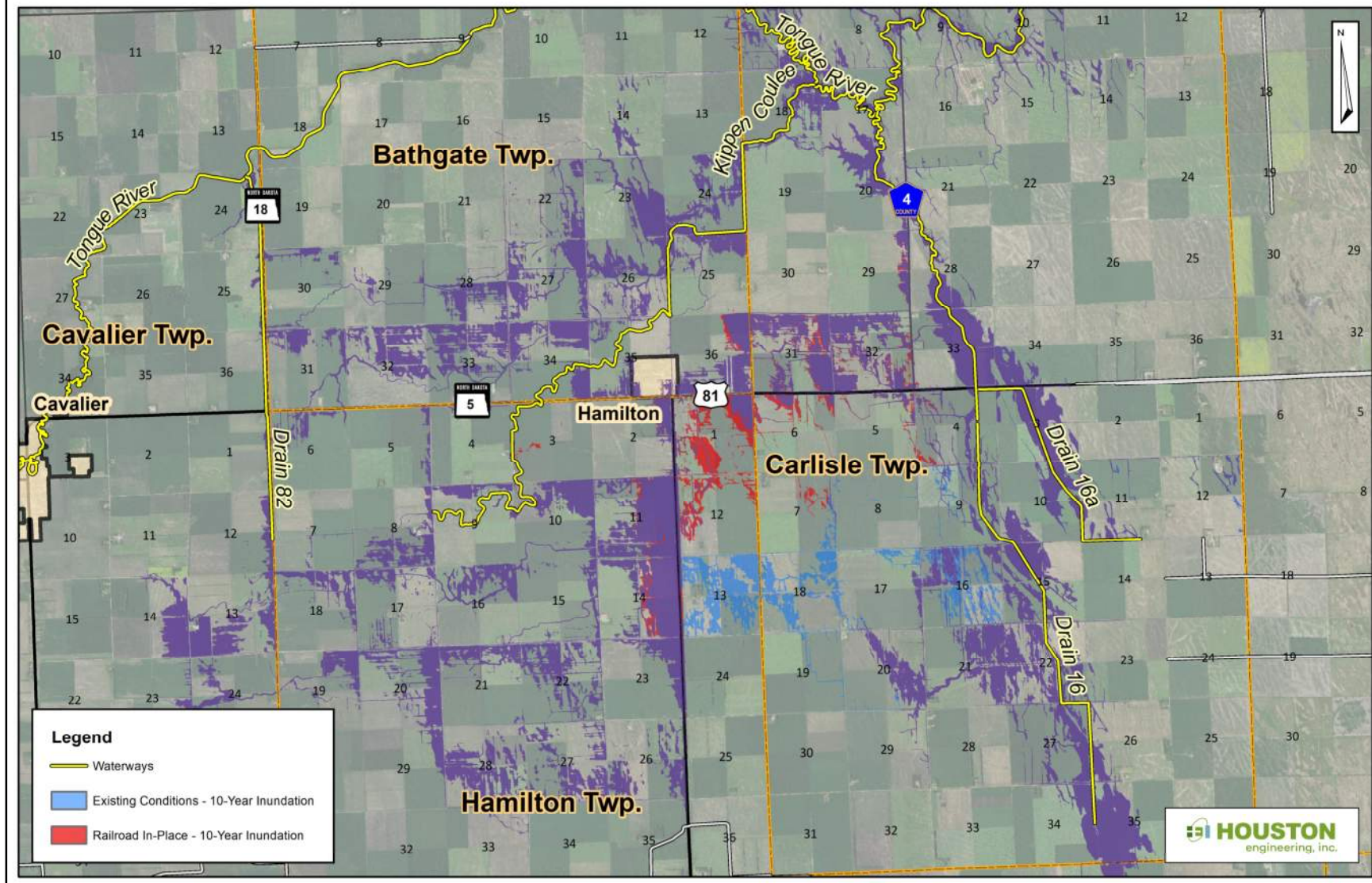
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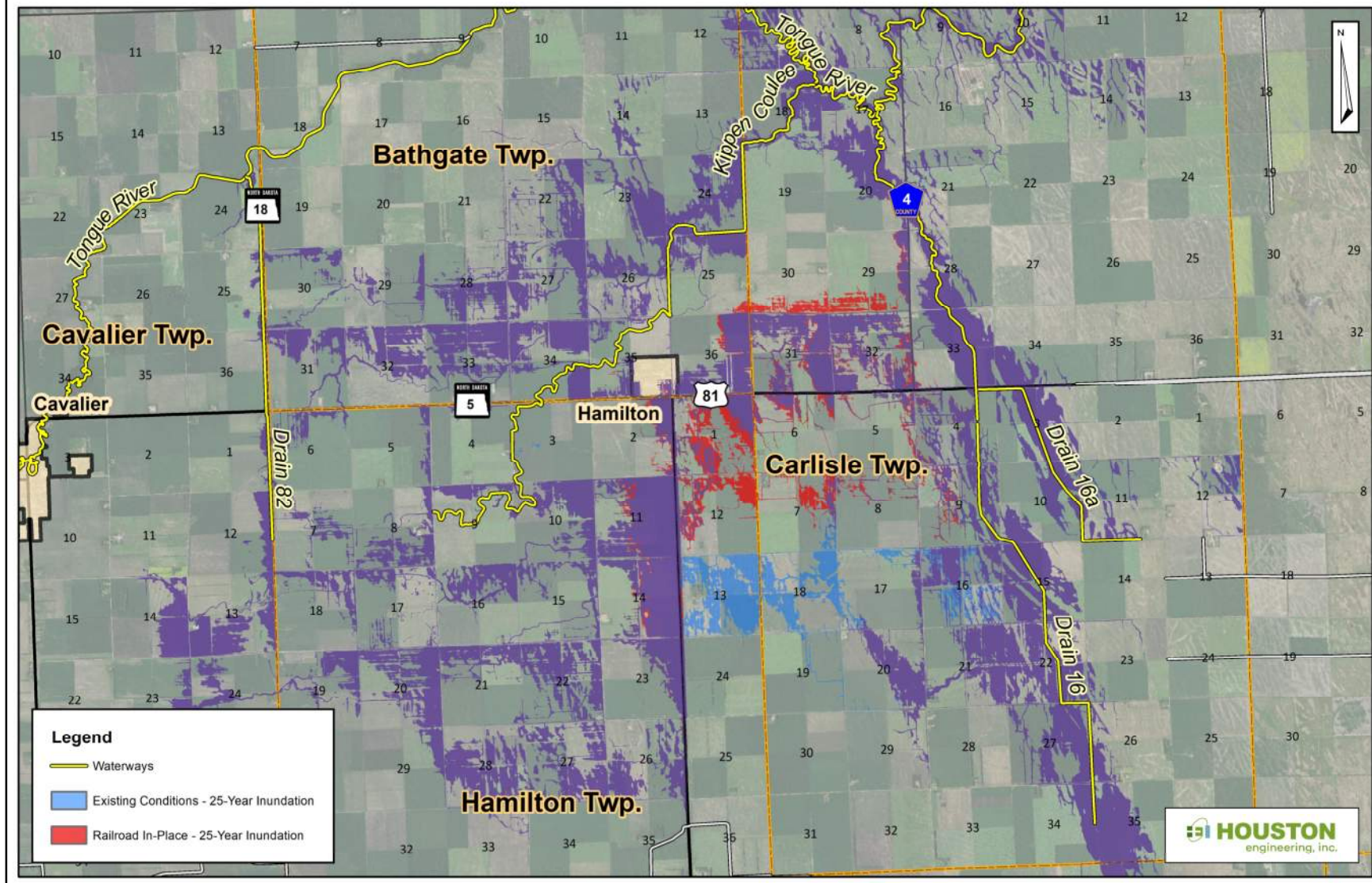
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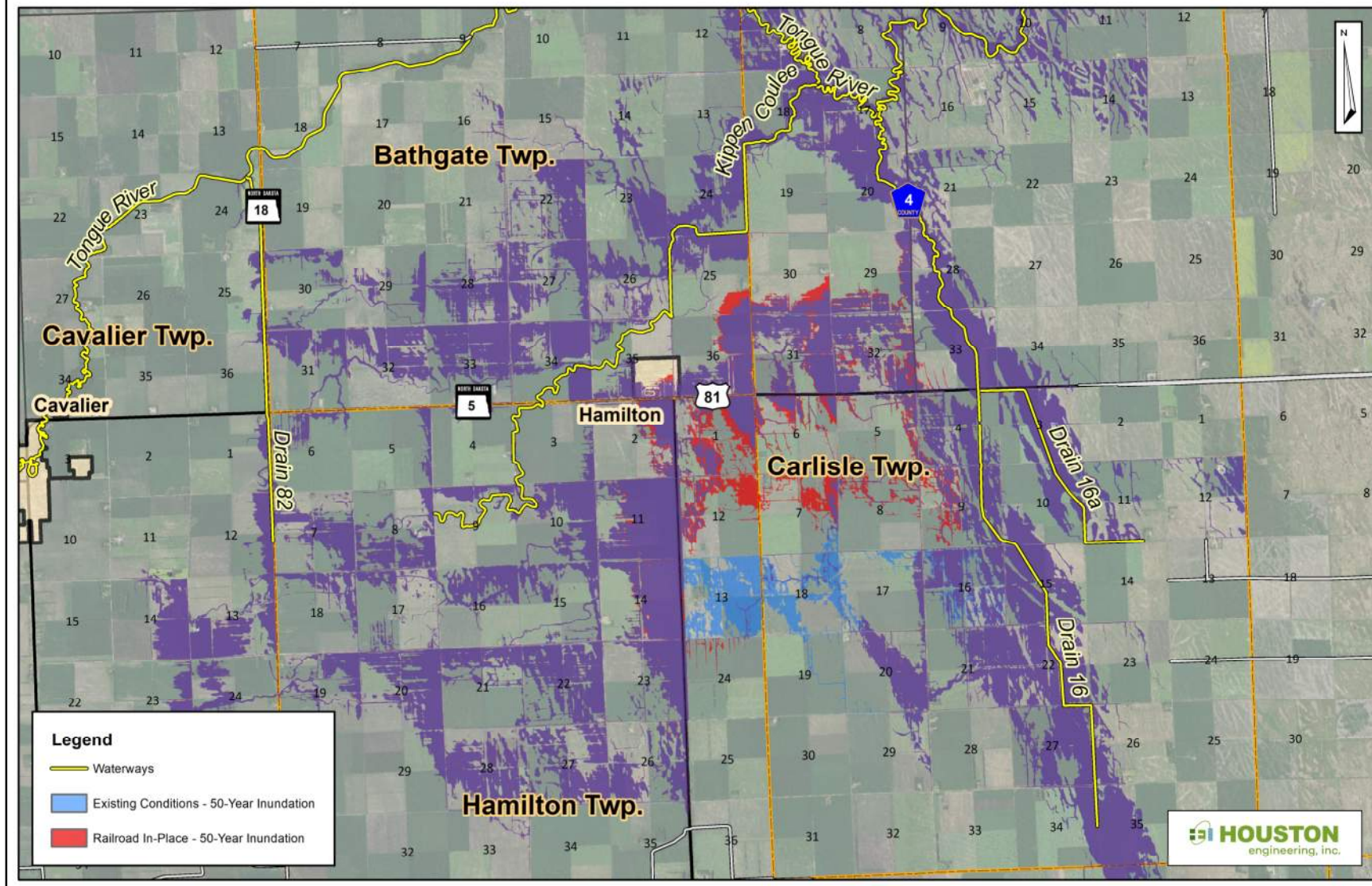
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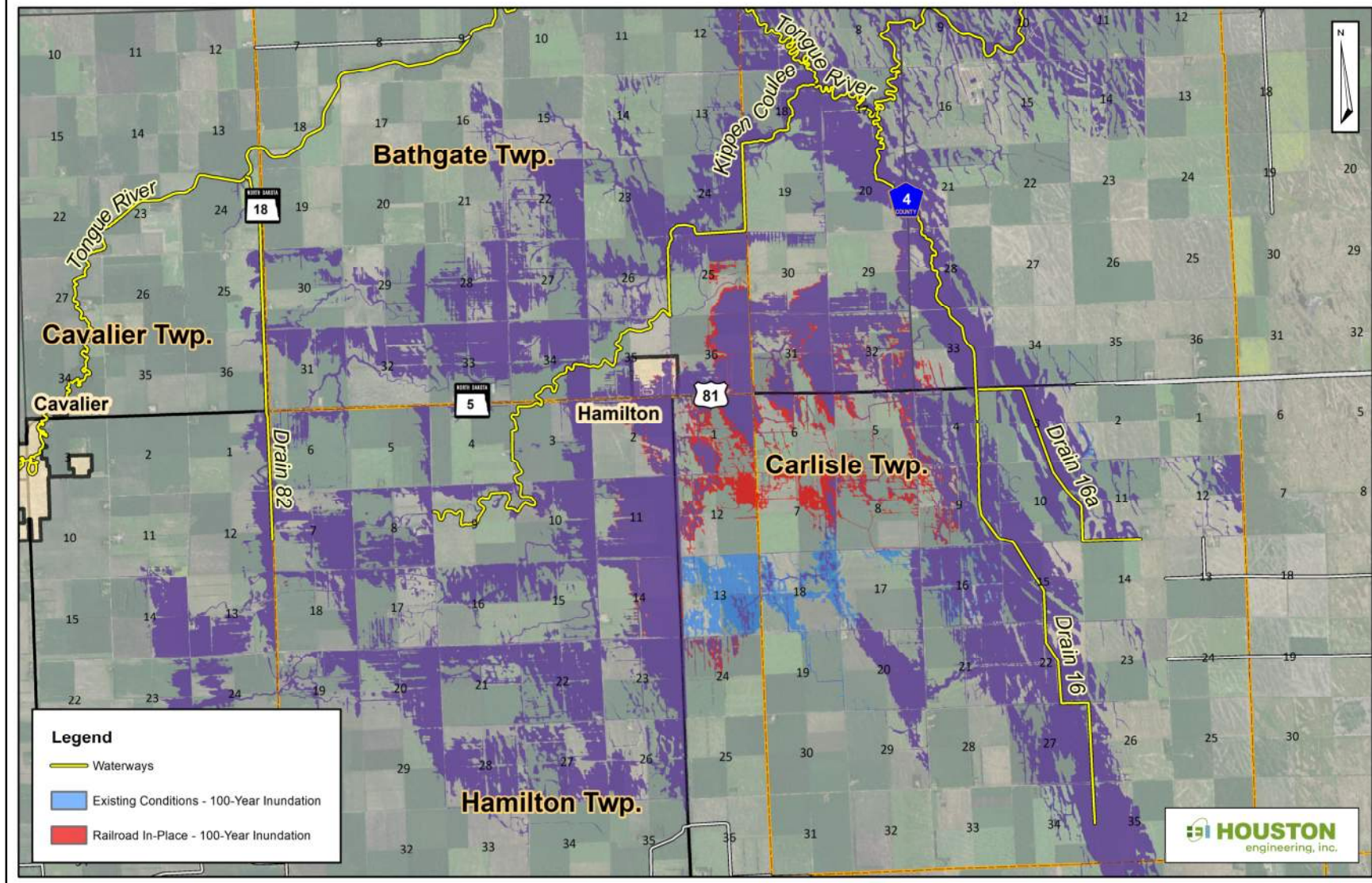
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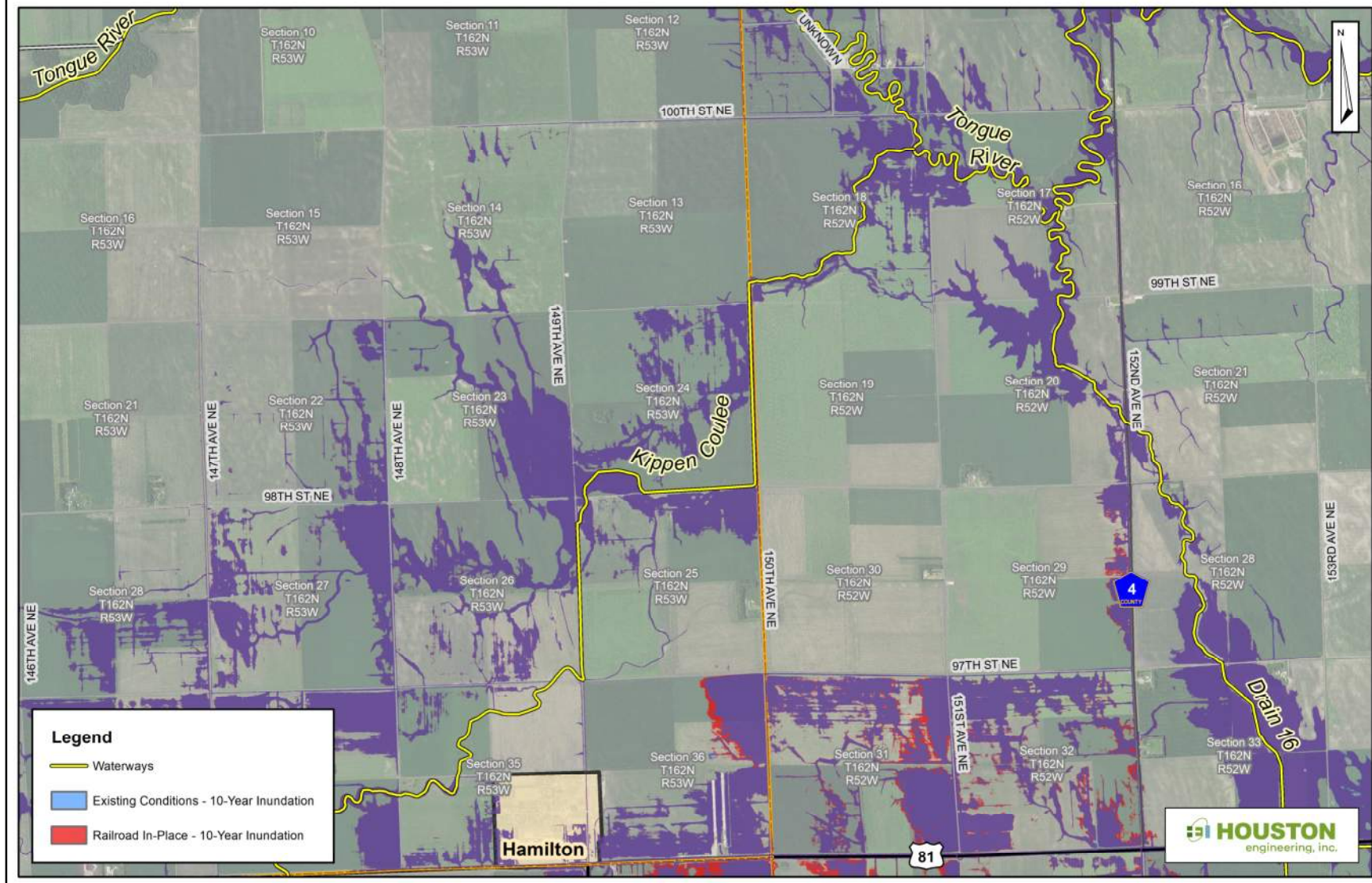
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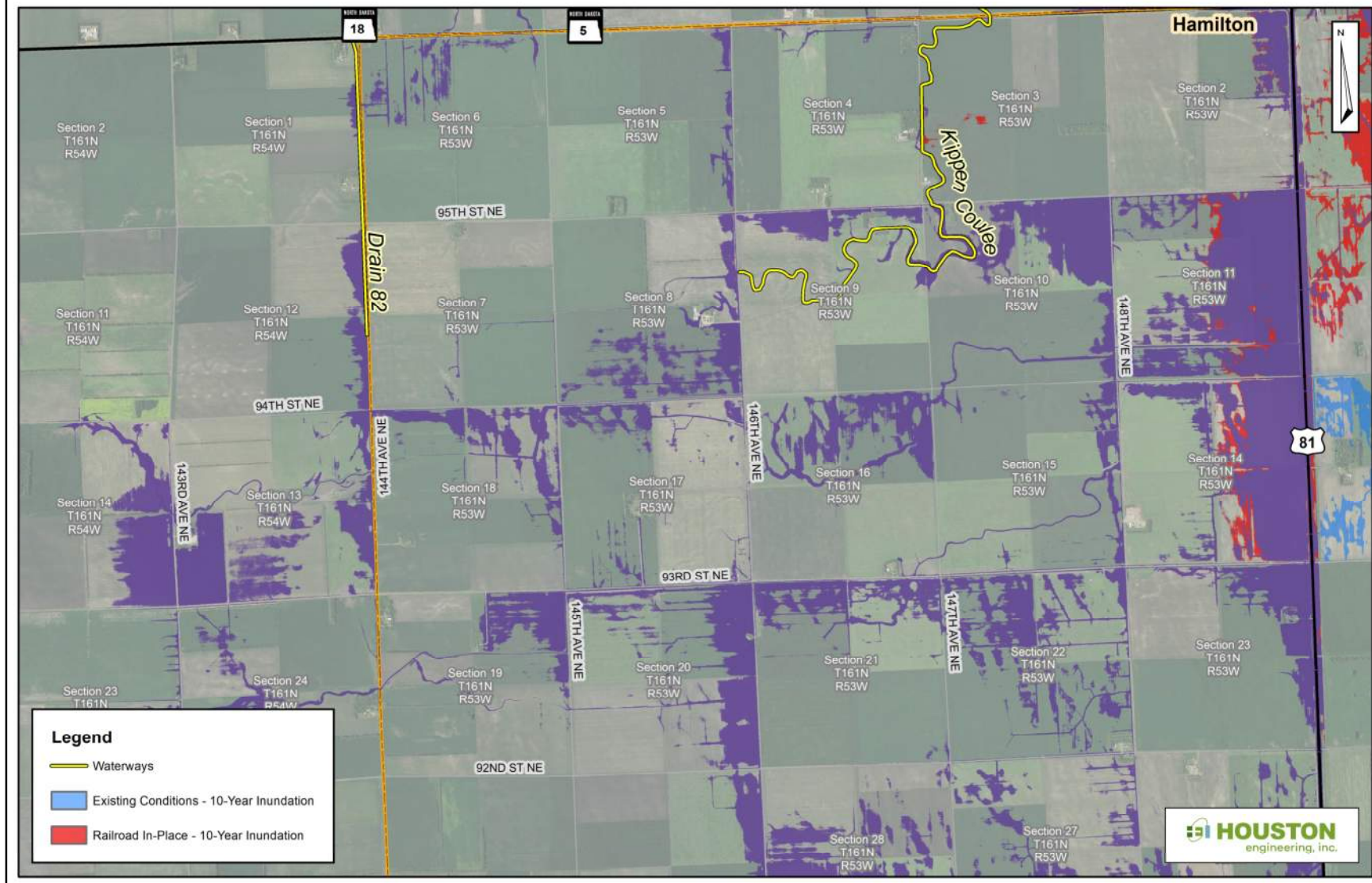
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Inundation Review: 10-year Event (Detailed)



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