HOUSTON engineering, inc.

Fargo, ND | HEI No. 6019-0138
August 11, 2023

MODELING AND ASSESSMENT REPORT – SUPPLEMENTAL ANALYSIS

CITY OF MOORHEAD CLIMATE CHANGE RESILIENCY PLANNING

PREPARED FOR THE CITY OF MOORHEAD AND THE MPCA

TABLE OF CONTENTS

LIST OF APPENDICIES

1 PURPOSE

At the request of the project partners, an additional alternative for the South Improvement Area was developed. This alternative moves the proposed 6th Avenue South trunks storm sewer to 3rd Avenue South. The proposed improvements along Main Ave and 16th Avenue South were not modified from the original report. This alternative provides flexibility in implementing the proposed improvements identified in this study. The methodology outlined in the original Modeling and Assessment Report dated June 29, 2023 was utilized for this supplemental analysis.

2 SOUTH IMPROVEMENT AREA – 3RD AVE SOUTH ALTERNATIVE

In addition to the improvements along Main Avenue and 16th Avenue South presented in the original report, an alternative to construct a new trunk storm sewer and gravity outfall along 3rd Avenue South was analyzed. By providing a trunk storm sewer along 3rd Avenue South potential impacts to the residential area north of Minnesota State University Moorhead and south of Main Avenue are reduced. Additionally, the 3rd Avenue South alternative provides capacity to capture and convey runoff that flows north to the 2nd Avenue South trunk storm sewer. This would reduce flooding along the 2nd Avenue South corridor by free up capacity in the existing storm sewer system. Under high tailwater/blocked gravity conditions (i.e. spring river flood event) the 3rd Avenue trunk storm sewer will be cross connected to the proposed lift at 2nd Avenue South. The proposed lift station will serve both the proposed Main Avenue and 3rd Avenue South storm sewers as well as the existing 2nd Avenue South storm sewer. The anticipated cost for the entire improvement plan for the South Improvement Area is approximately $61 million. Figures outlining the improvements and a comparison of inundation with and without the proposed improvements are included in **Appendix SA-1**. Updated impact and risk assessments reflecting the proposed improvements are included as **Appendices SA-2 and SA-3**, respectively. A summary of the cost estimate is included in **Appendix SA-4.**

3 CONCLUSION

The proposed 3rd Avenue South storm sewer alternative will provide an additional gravity outfall for the south study area. This increased outfall capacity will result in a decreased risk of impacts from flooding and increase the City's resilience to climate change. Although determined to be technically feasible, the alternatives presented in this supplement are conceptual and will require optimization. Additionally, final improvement plans should follow a phased implementation over several years to coincide with City capital improvement projects wherever possible.

APPENDIX SA-1

Proposed Conditions Inundation Comparison

Appendix SA-1

Legend

- Proposed Storm Sewer
- Existing Storm Sewer
- Inundation With Proposed Improvements
- Inundation Without Proposed Improvements
- Rain Garden
- Underground Retention
- Project Study Area

0 325 650 Feet

South Improvement Area
Moorhead Climate Resiliency Study
2-Inch CCH, 24-Hr Inundation Comparison

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
1 inch = 325 feet	JPE	MJF	6019-0138	7/27/2023	1 of 1

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Appendix SA-1

Legend

- Proposed Storm Sewer
- Existing Storm Sewer
- Inundation With Proposed Improvements
- Inundation Without Proposed Improvements
- Rain Garden
- Underground Retention
- Project Study Area

0 325 650 Feet

South Improvement Area
Moorhead Climate Resiliancy Study
3-Inch CCH, 24-Hr Inundation Comparison

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Appendix SA-2

Legend

- Proposed Storm Sewer
- Existing Storm Sewer
- Inundation With Proposed Improvements
- Inundation Without Proposed Improvements
- Rain Garden
- Underground Retention
- Project Study Area

0 325 650 Feet

South Improvement Area
Moorhead Climate Resiliancy Study
4-Inch CCH, 24-Hr Inundation Comparison

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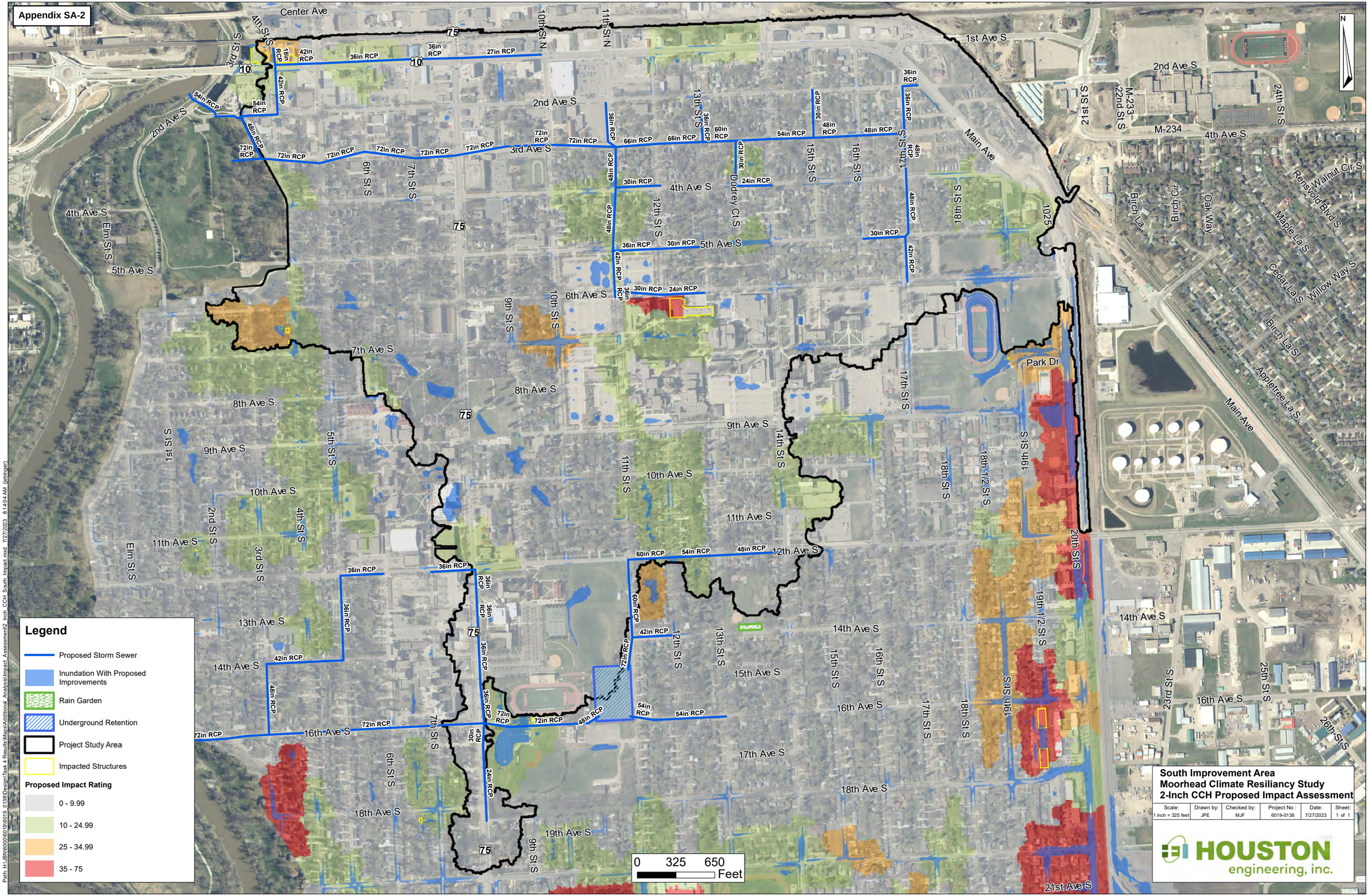
APPENDIX SA-2

Proposed Conditions CCH Impact Assessment

Appendix SA-2



Legend

- Proposed Storm Sewer
- Inundation With Proposed Improvements
- Rain Garden
- Underground Retention
- Project Study Area
- Impacted Structures

Proposed Impact Rating

- 0 - 9.99
- 10 - 24.99
- 25 - 34.99
- 35 - 75

South Improvement Area
Moorhead Climate Resiliancy Study
2-Inch CCH Proposed Impact Assessment

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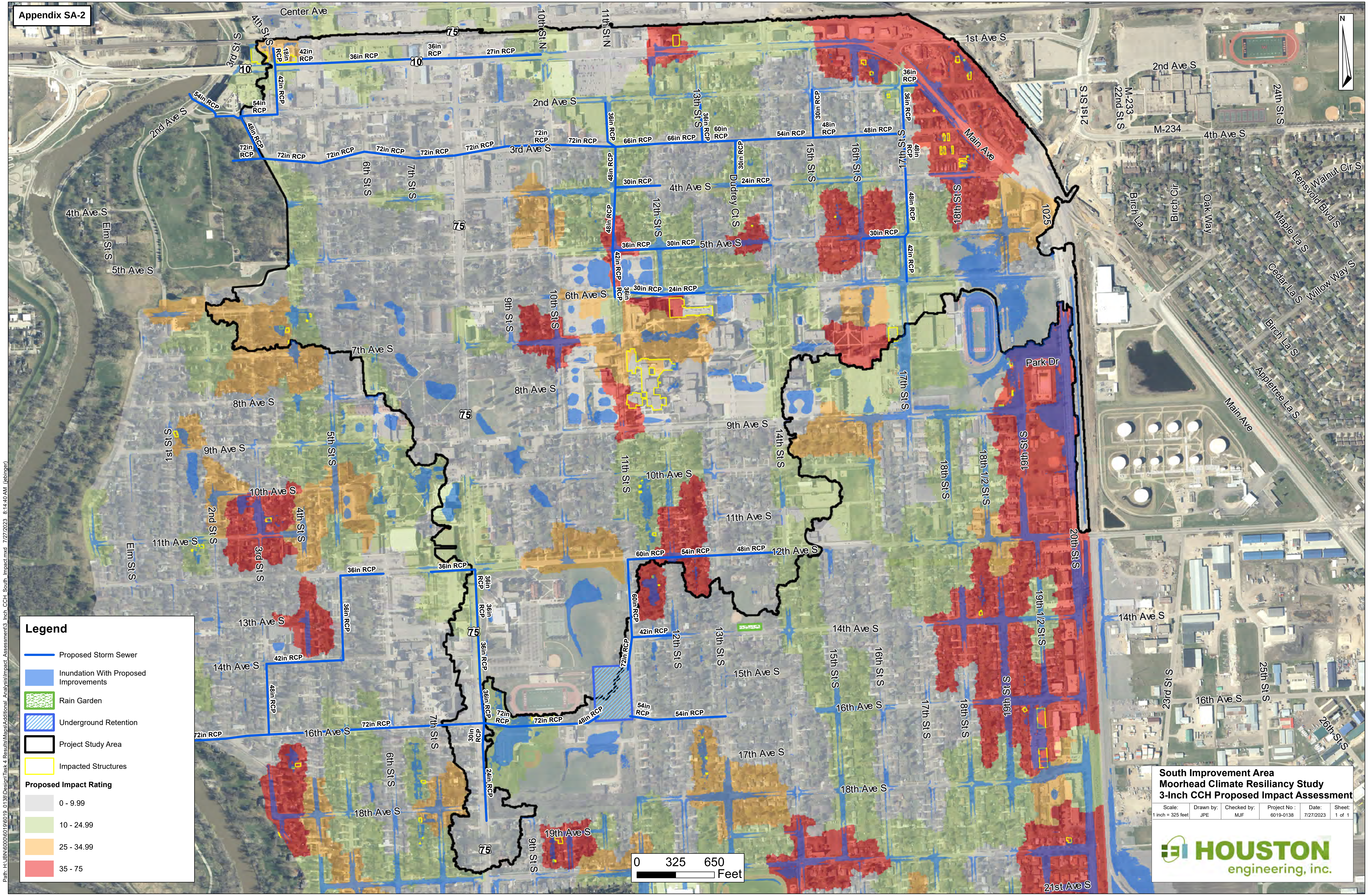
Appendix SA-2
Center Ave
1st Ave S
2nd Ave S
3rd Ave S
4th Ave S
5th Ave S
6th Ave S
7th Ave S
8th Ave S
9th Ave S
10th Ave S
11th Ave S
12th Ave S
13th Ave S
14th Ave S
15th Ave S
16th Ave S
17th Ave S
18th Ave S
19th Ave S
21st Ave S
Main Ave
Park Dr
M-234
Dudley Ct S
Elm St S
1st St S
2nd St S
3rd St S
4th St S
5th St S
6th St S
7th St S
9th St S
10th St S
10th St N
11th St N
11th St S
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14th St S
15th St S
16th St S
17th St S
18th St S
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19th St S
19th 1/2 St S
20th St S
21st St S
22nd St S
23rd St S
24th St S
25th St S
26th St S
Birch La
Birch Cir
Oak Way
Maple La S
Cedar La S
Willow Way S
Birch La S
Appletree La S
Walnut Cir S
Rensvold Blvd S
Legend
Proposed Storm Sewer
Inundation With Proposed Improvements
Rain Garden
Underground Retention
Project Study Area
Impacted Structures
Proposed Impact Rating
0 - 9.99
10 - 24.99
25 - 34.99
35 - 75
0 325 650 Feet
South Improvement Area
Moorhead Climate Resiliancy Study
3-Inch CCH Proposed Impact Assessment
Scale: 1 inch = 325 feet
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Project No.: 6019-0138
Date: 7/27/2023
Sheet: 1 of 1
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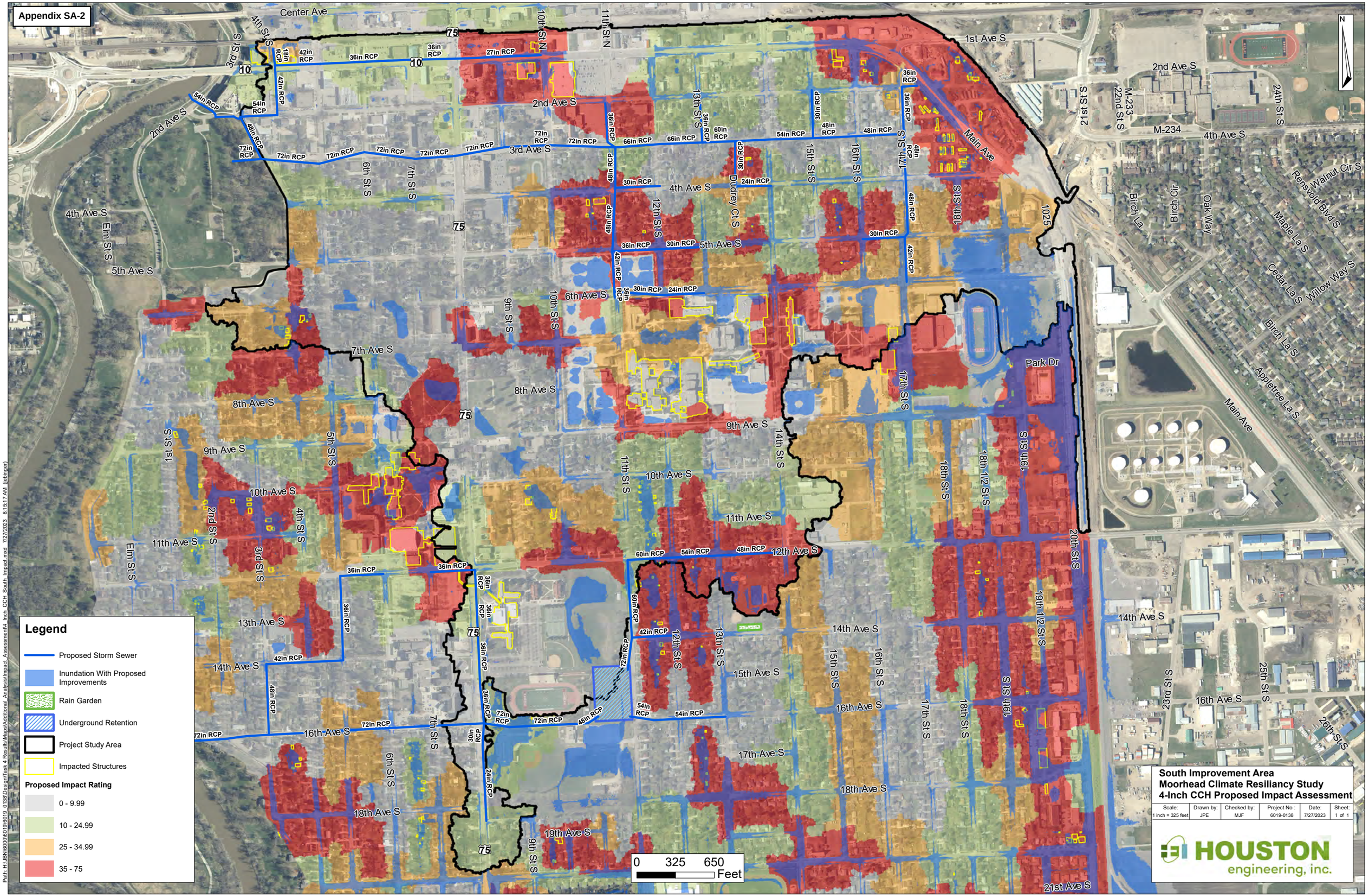
Appendix SA-2



Legend

- Proposed Storm Sewer
- Inundation With Proposed Improvements
- Rain Garden
- Underground Retention
- Project Study Area
- Impacted Structures

Proposed Impact Rating

- 0 - 9.99
- 10 - 24.99
- 25 - 34.99
- 35 - 75

South Improvement Area
Moorhead Climate Resiliancy Study
4-Inch CCH Proposed Impact Assessment

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APPENDIX SA-3

Proposed Conditions CCH Risk Assessment

Appendix SA-3

Legend

- Proposed Storm Sewer
- Rain Garden
- Underground Retention
- Project Study Area

Proposed Risk Rating

- Low
- Slight
- Moderate
- High

0 325 650 Feet

South Improvement Area
Moorhead Climate Resiliancy Study
Proposed Risk Assessment

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APPENDIX SA-4

Improvements Opinion of Probable Cost

Appendix SA-4

Opinion of Probable Cost
City of Moorhead Climate Resilience Study
South Improvement Area (3rd Ave S Alt.)

No.	Item	Units	Unit Price	Quantity	Total
1	Remove Storm Sewer	LF	$30	28,765	$862,950
2	Remove Catch Basin	EA	$750	440	$330,000
3	Remove Manhole	EA	$1,000	110	$110,000
4	18in RCP Storm Sewer	LF	$80	140	$11,200
5	24in RCP Storm Sewer	LF	$100	1,285	$128,500
6	27in RCP Storm Sewer	LF	$120	665	$79,800
7	30in RCP Storm Sewer	LF	$140	2,455	$343,700
8	36in RCP Storm Sewer	LF	$180	5,700	$1,026,000
9	42in RCP Storm Sewer	LF	$250	2,530	$632,500
10	48in RCP Storm Sewer	LF	$300	4,155	$1,246,500
11	54in RCP Storm Sewer	LF	$380	2,685	$1,020,300
12	60in RCP Storm Sewer	LF	$420	1,310	$550,200
13	66in RCP Storm Sewer	LF	$480	735	$352,800
14	72in RCP Storm Sewer	LF	$500	7,105	$3,552,500
15	60in Dia Storm Manhole	EA	$8,000	8	$64,000
16	72in Dia Storm Manhole	EA	$12,000	16	$192,000
17	84in Dia Storm Manhole	EA	$15,000	28	$420,000
18	96in Dia Storm Manhole	EA	$18,000	35	$630,000
19	108in Dia Storm Manhole	EA	$20,000	11	$220,000
20	120in Dia Storm Manhole	EA	$25,000	12	$300,000
21	Catch Basin	EA	$3,000	440	$1,320,000
22	Underground Retention System	LS	$3,000,000	1	$3,000,000
23	Lift Station Modifications	LS	$5,000,000	1	$5,000,000
24	Rain Garden	LS	$50,000	1	$50,000
				Storm Sewer Subtotal	**$21,442,950**
				Storm Sewer Contingencies (30%)	**$6,432,885**
				Storm Sewer Construction Total	**$27,875,835**
				Street Reconstruction Total (1,197,500 SF & $21/SF)	**$25,147,500**
				Total Construction Cost	**$53,023,335**
				Design, Staking, Insepction, and Testing (15%)	**$7,953,500**
				Total Project Cost	**$60,976,835**