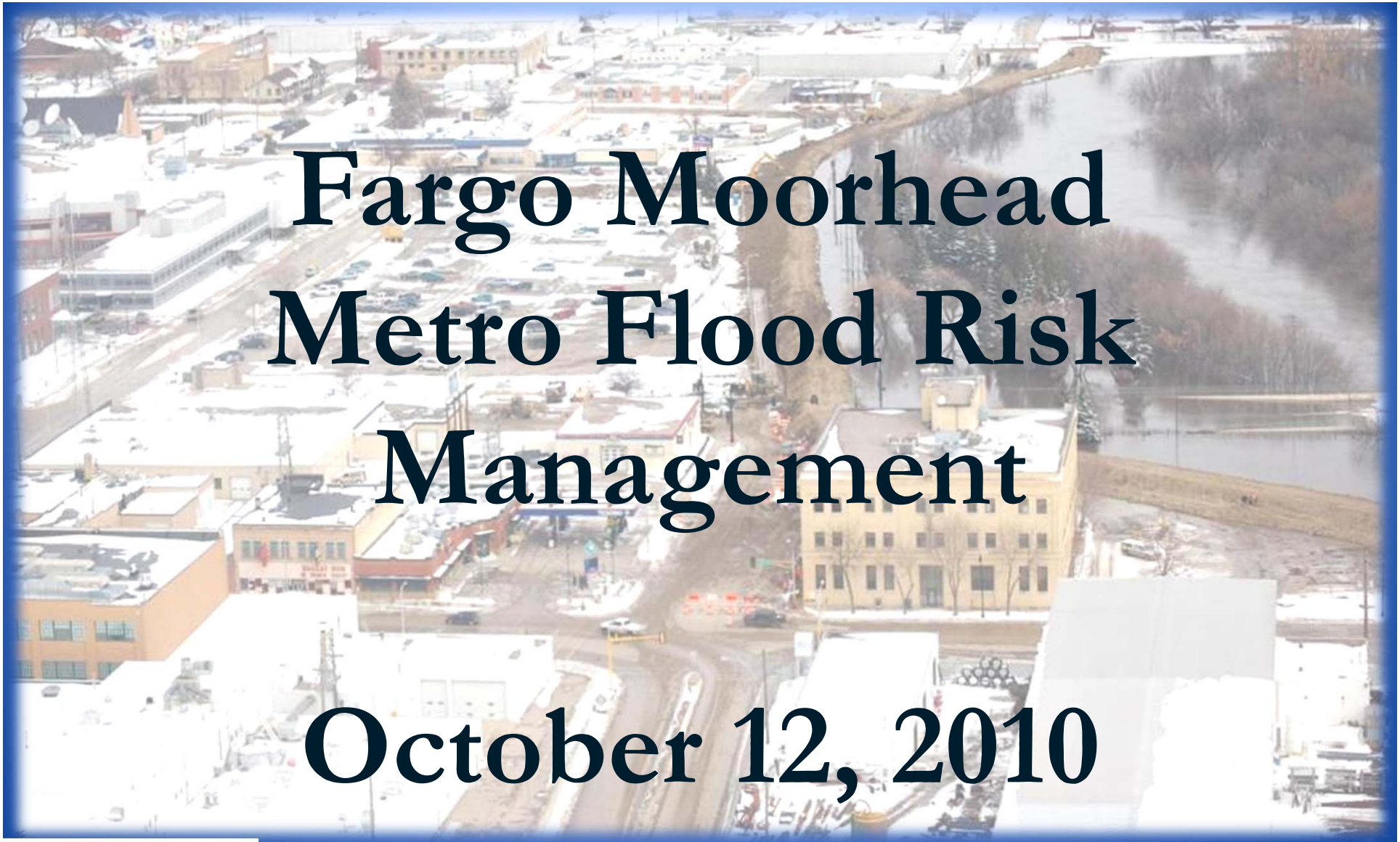


Fargo Moorhead Metro Flood Risk Management

October 12, 2010

MOORHEAD MINNESOTA

CLAY COUNTY

CASS COUNTY GOVERNMENT

CITY OF Fargo

CBS Video

Red River Basin

45,000 SQ Miles

Flows north to Lake Winnipeg

Average slope of 1-2 feet per mile

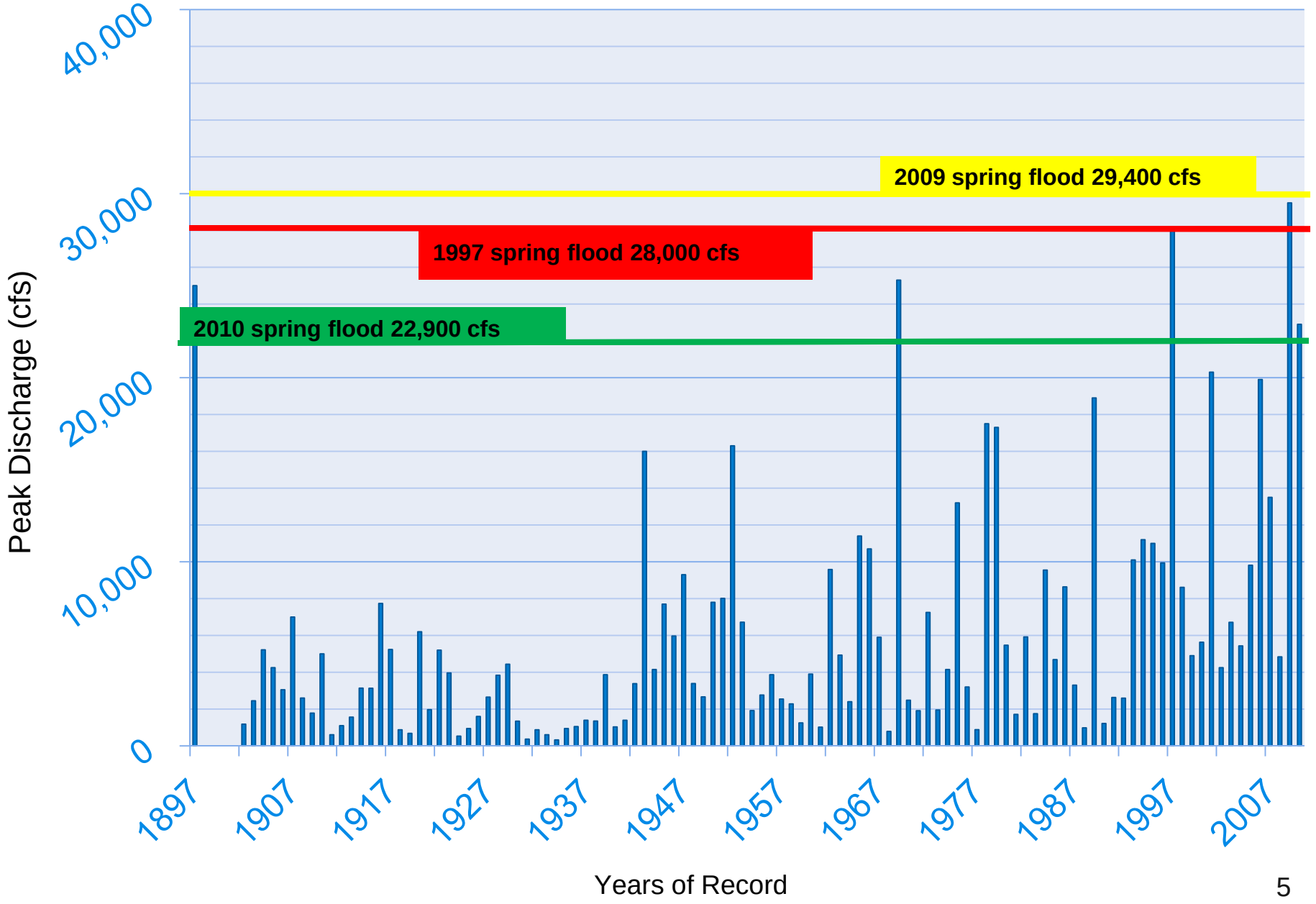
The confluence of the ND Wild Rice River & the Red River is just south of Fargo Moorhead

Metro Area

	Fargo	Moorhead	Metro
Population	102,000	36,000	202,000
Households	45,321	13,465	83,782
Jobs	90,010	14,846	120,467

Regional center for Economy, Education, & Health Care

Red River at Fargo - USGS GAGING STATION
HISTORICAL FLOOD DATA



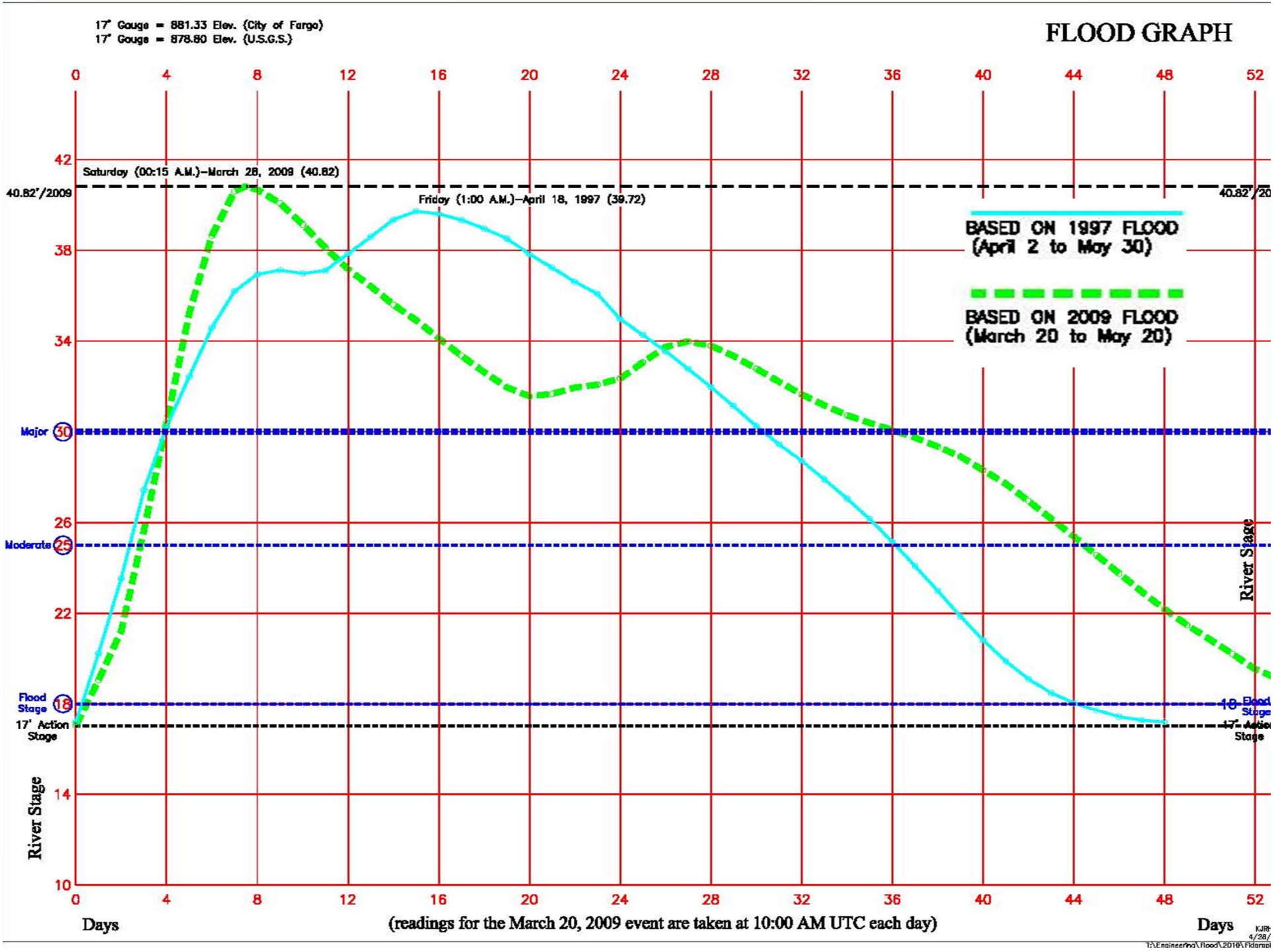
Luck & Preparation

Preplan - (Plan A, Plan B, Plan C)

Commit Resources Early

Be prepared to accommodate changes in:

- -Rate of Rise
- -Expected Crest Height
- -Overland Flooding Expectations
- -Ground Conditions
- -Weather Conditions (Cold Weather)
- -Material Availability (Volunteers)


17' Gauge = 881.33 Elev. (City of Fargo)
17' Gauge = 878.80 Elev. (U.S.G.S.)
FLOOD GRAPH
0
4
8
12
16
20
24
28
32
36
40
44
48
52
42
38
34
26
22
14
10
Saturday (00:15 A.M.)–March 28, 2009 (40.82)
40.82'/2009
Friday (1:00 A.M.)–April 18, 1997 (39.72)
BASED ON 1997 FLOOD
(April 2 to May 30)
BASED ON 2009 FLOOD
(March 20 to May 20)
Major 30
Moderate 25
Flood Stage 18
17' Action Stage
River Stage
Days
(readings for the March 20, 2009 event are taken at 10:00 AM UTC each day)

Preplanning - Resource Estimates

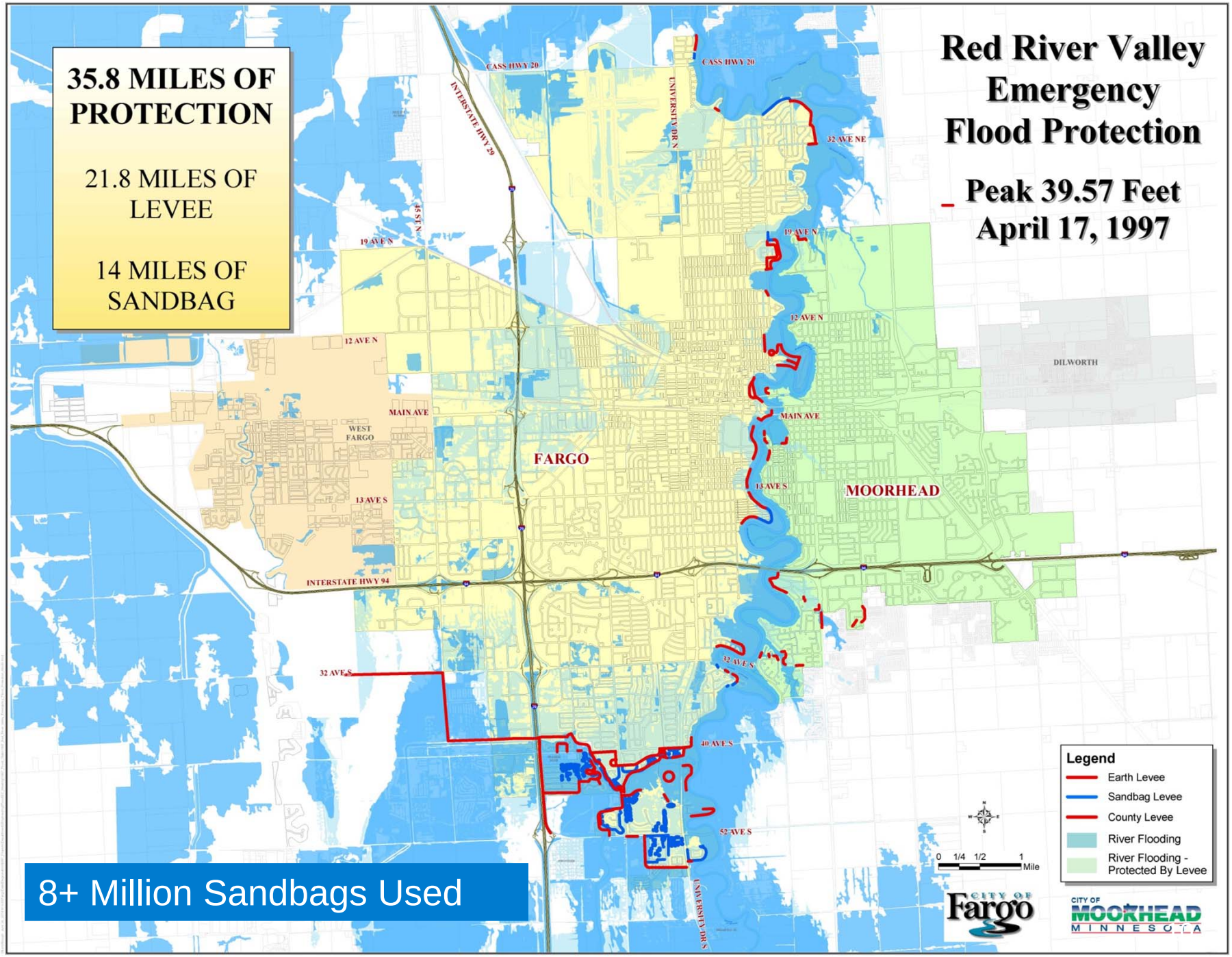
Forecast Crest (NWS)	2009	2010
50% Chance Protection Goal w/freeboard	38 ft 40 ft	38 ft 40 ft
10% Chance	40 ft	42.7 ft
Actual Crest Protection Required	40.8 ft 42.8 ft	36.99 ft 38.99 ft

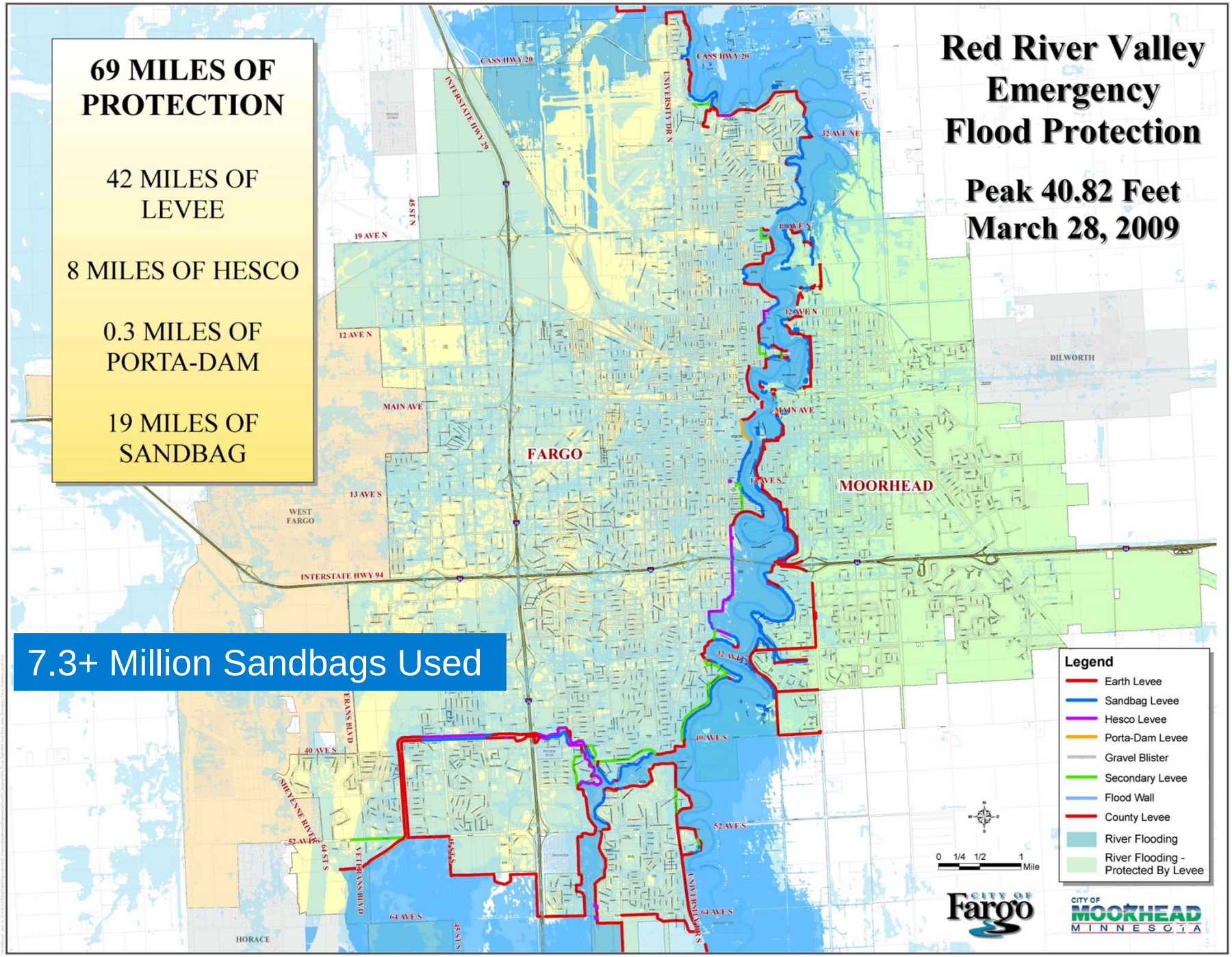
Estimated Sandbags by Stage

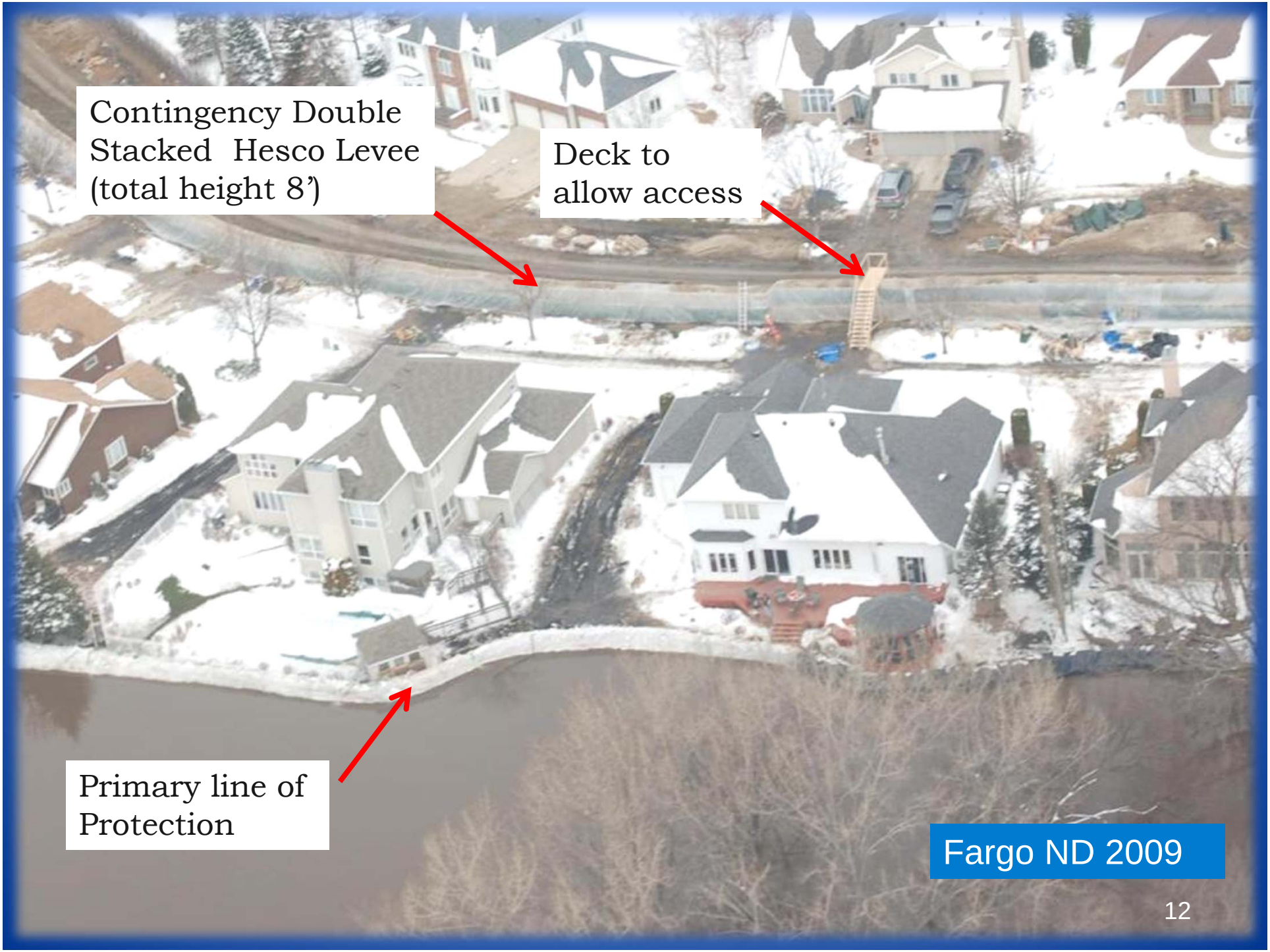
Bags @ 36	Bags @ 37	Bags @ 38	Bags @ 39	**Bags @ 40**	Bags @ 41	Bags @ 42	Bags @ 43	Bags @ 44	Bags @ 45
30,950	83,091	219,218	264,138	561,938	2,366,123	4,074,064	6,485,402	9,508,720	1,3307,705

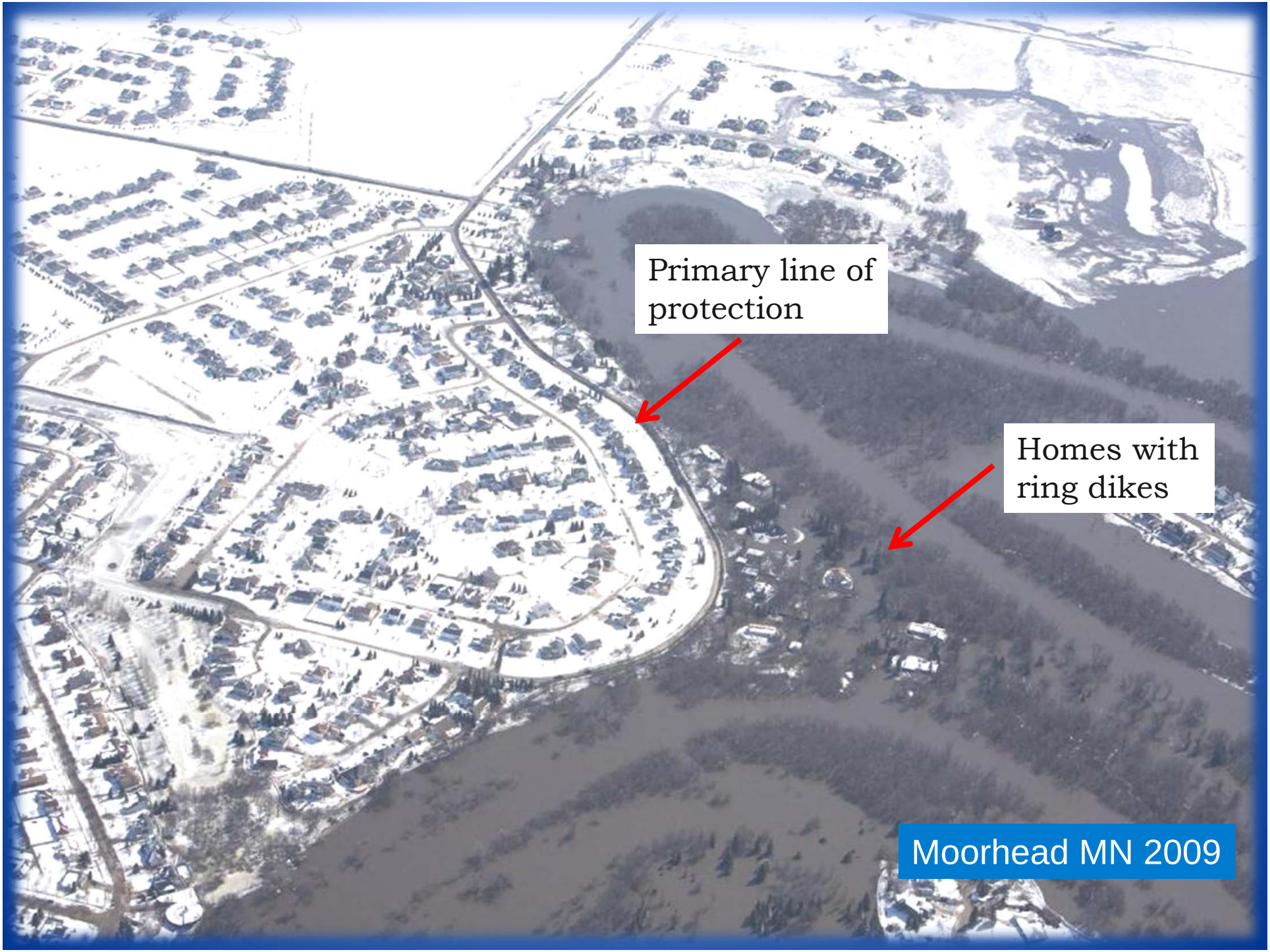
Material Availability

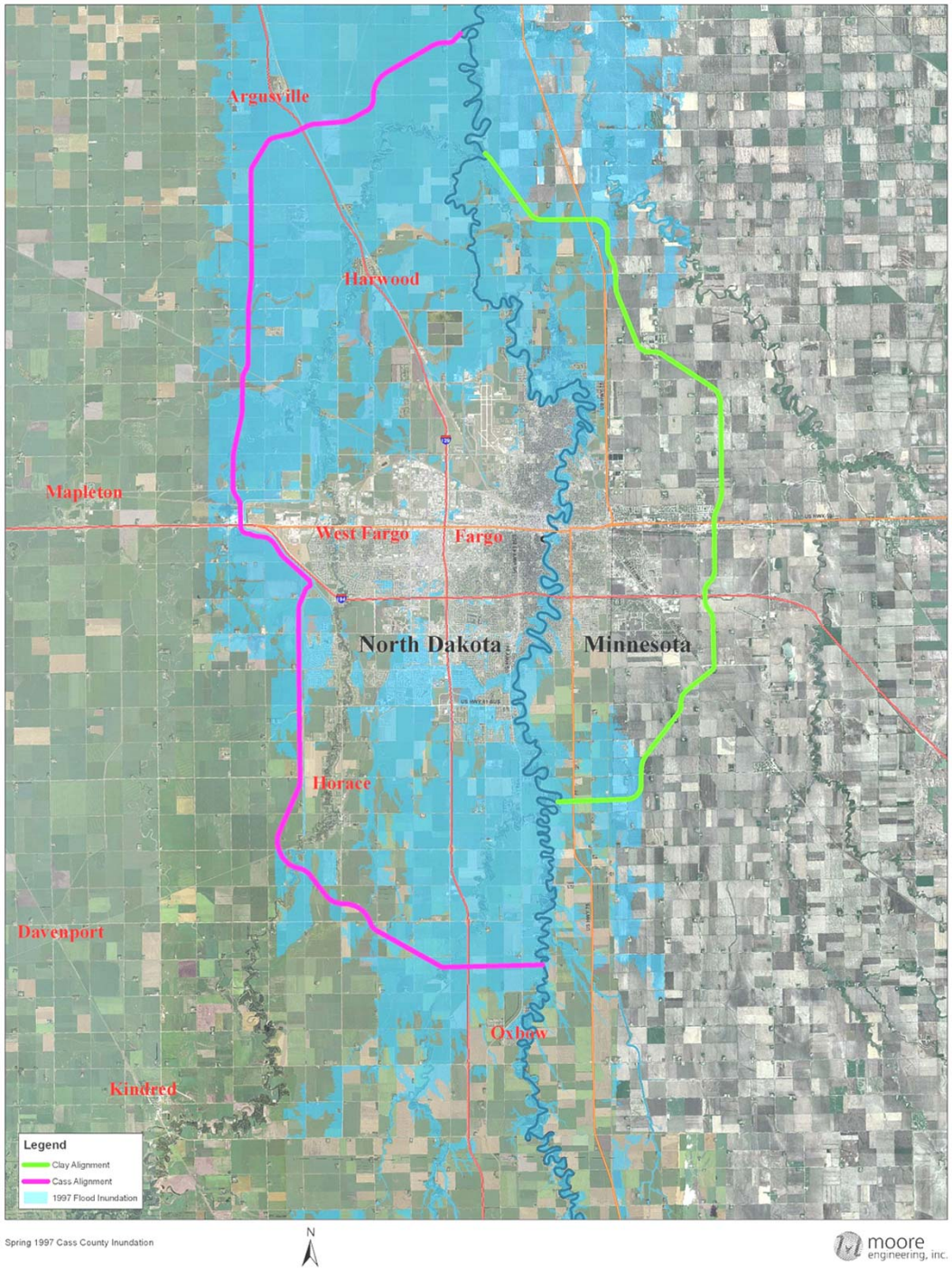
RESOURCES GET STRETCHED


35.8 MILES OF PROTECTION
21.8 MILES OF LEVEE
14 MILES OF SANDBAG
Red River Valley Emergency Flood Protection
Peak 39.57 Feet
April 17, 1997
8+ Million Sandbags Used
FARGO
MOORHEAD
WEST FARGO
DILWORTH
CASS HWY 20
INTERSTATE HWY 29
UNIVERSITY DR N
32 AVE NE
19 AVE N
12 AVE N
MAIN AVE
13 AVE S
INTERSTATE HWY 94
32 AVE S
40 AVE S
52 AVE S
UNIVERSITY DR S
Legend
Earth Levee
Sandbag Levee
County Levee
River Flooding
River Flooding - Protected By Levee
0 1/4 1/2 1 Mile
CITY OF Fargo
CITY OF MOORHEAD MINNESOTA


69 MILES OF PROTECTION
42 MILES OF LEVEE
8 MILES OF HESCO
0.3 MILES OF PORTA-DAM
19 MILES OF SANDBAG
Red River Valley Emergency Flood Protection
Peak 40.82 Feet March 28, 2009
7.3+ Million Sandbags Used
FARGO
MOORHEAD
WEST FARGO
HORACE
DILWORTH
CASS HWY 20
INTERSTATE HWY 29
UNIVERSITY DR N
32 AVE NE
19 AVE N
12 AVE N
MAIN AVE
13 AVE S
INTERSTATE HWY 94
40 AVE S
52 AVE S
64 AVE S
Legend
Earth Levee
Sandbag Levee
Hesco Levee
Porta-Dam Levee
Gravel Blister
Secondary Levee
Flood Wall
County Levee
River Flooding
River Flooding - Protected By Levee
0 1/4 1/2 1 Mile
CITY OF Fargo
CITY OF MOORHEAD MINNESOTA


Contingency Double Stacked Hesco Levee (total height 8')
Deck to allow access
Primary line of Protection
Fargo ND 2009

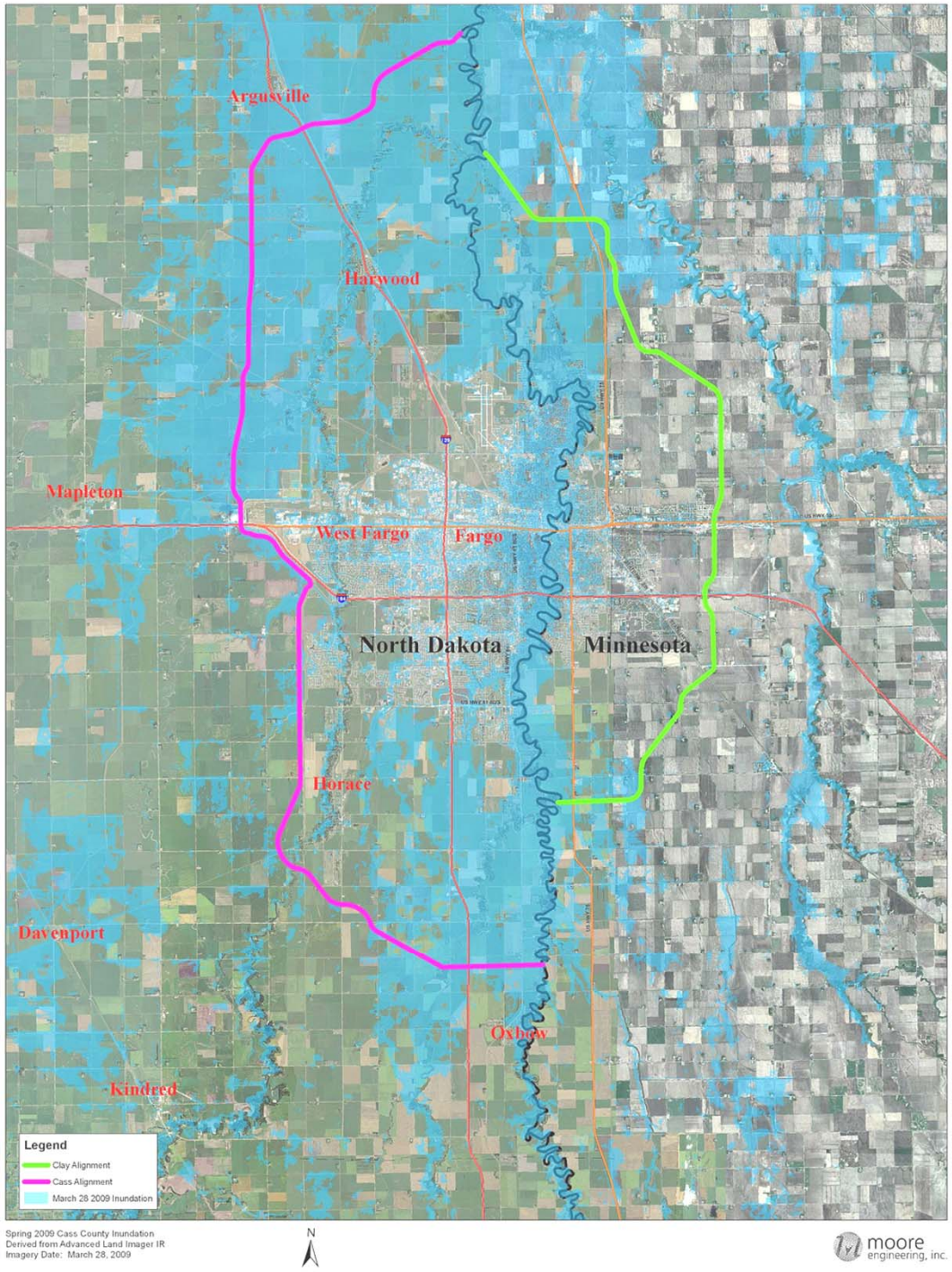

Primary line of protection
Homes with ring dikes
Moorhead MN 2009



Flood Inundation 1997

MN Short Diversion Alignment

ND East Diversion Alignment



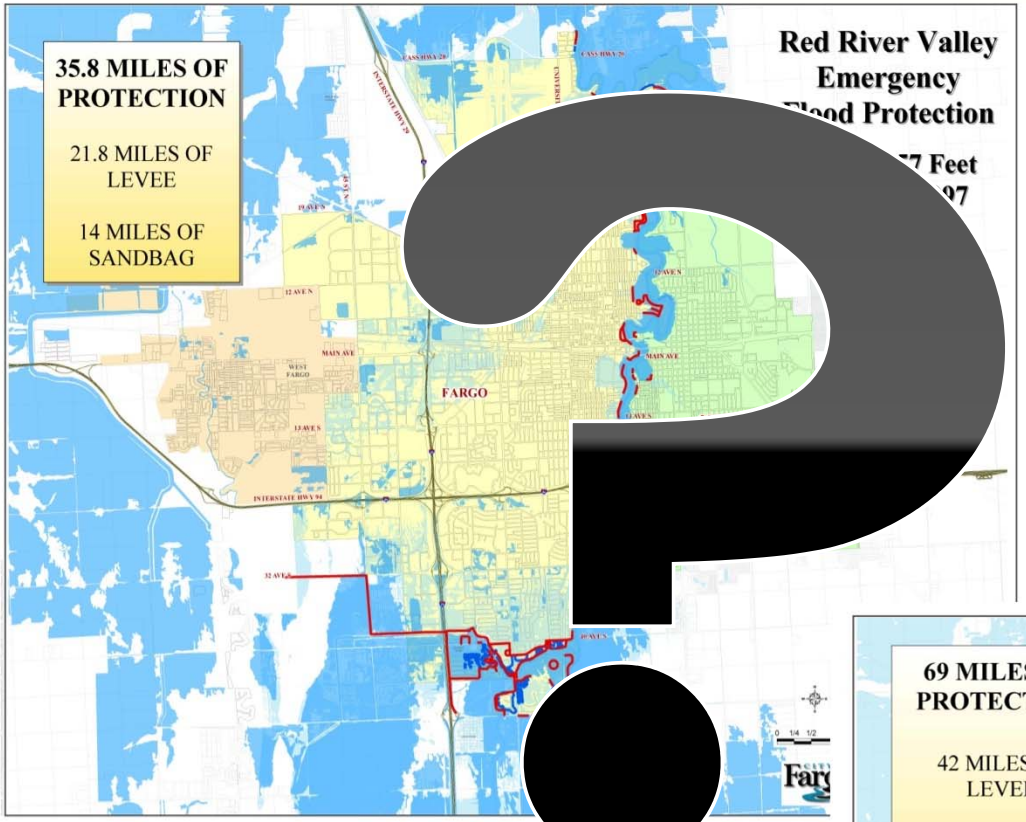
Flood Inundation 3/28/09

MN Short Diversion Alignment

ND East Diversion Alignment

Sheyenne River Flooding 2010

Future Flood Fight Strategy



We will continue to wage emergency flood fights but we will not always win!

Future Flood Fight Strategy

- **Pursue Permanent Flood Protection**

- Continue to Acquire & Remove Flood Prone Houses
- Construct Permanent Infrastructure Improvements
- Continue to Construct Emergency Levees

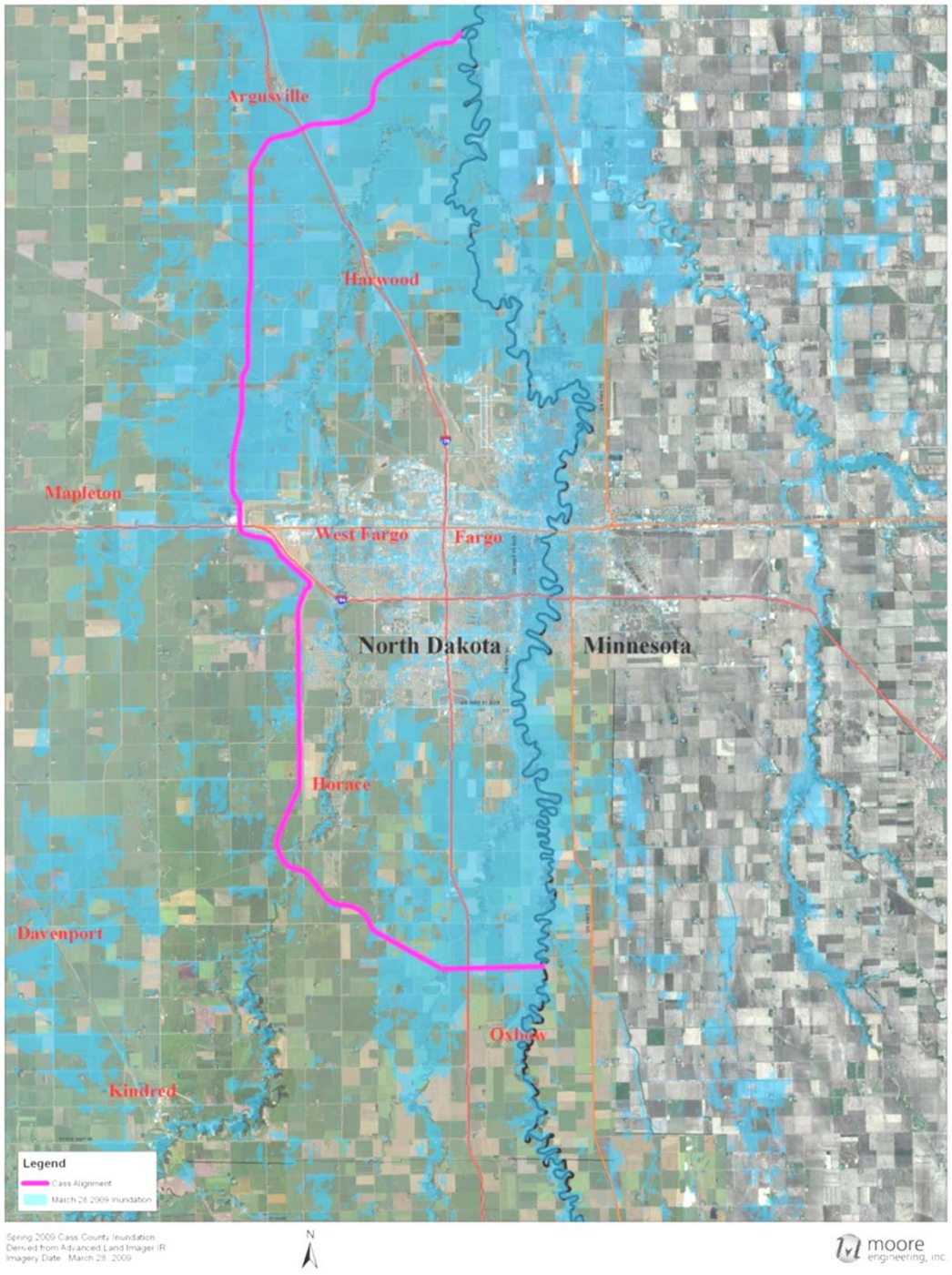
Permanent Flood Protection

Ridgewood
Photo Date: April 17, 1997

KJRheault
4/22/2010
T:\Engineering\Flood\2010\AEW Presentations\04-25-2010_Asst Sec of Army.dwg

Ridgewood
Photo Date: March 21, 2010
T:\Engineering\Flood\2010\Vern Whitten Pictures\Disc B 3-21-10\IMG_9888.jpg

City of Fargo
Engineering Dept.



Permanent Flood Protection FM Metro

Acquisitions

1994-2009

403 completed

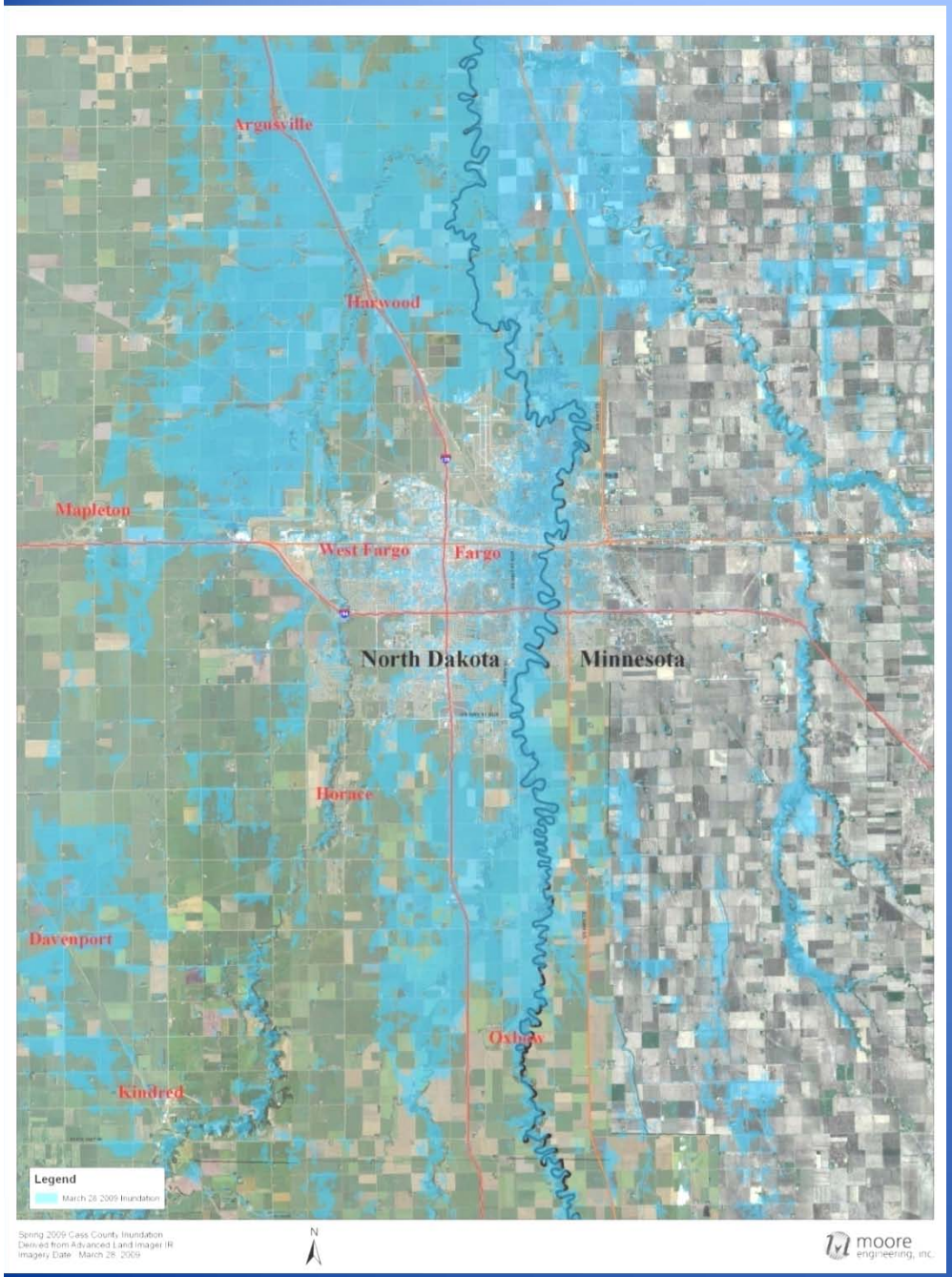
2010-2011

232 planned

1990-2010

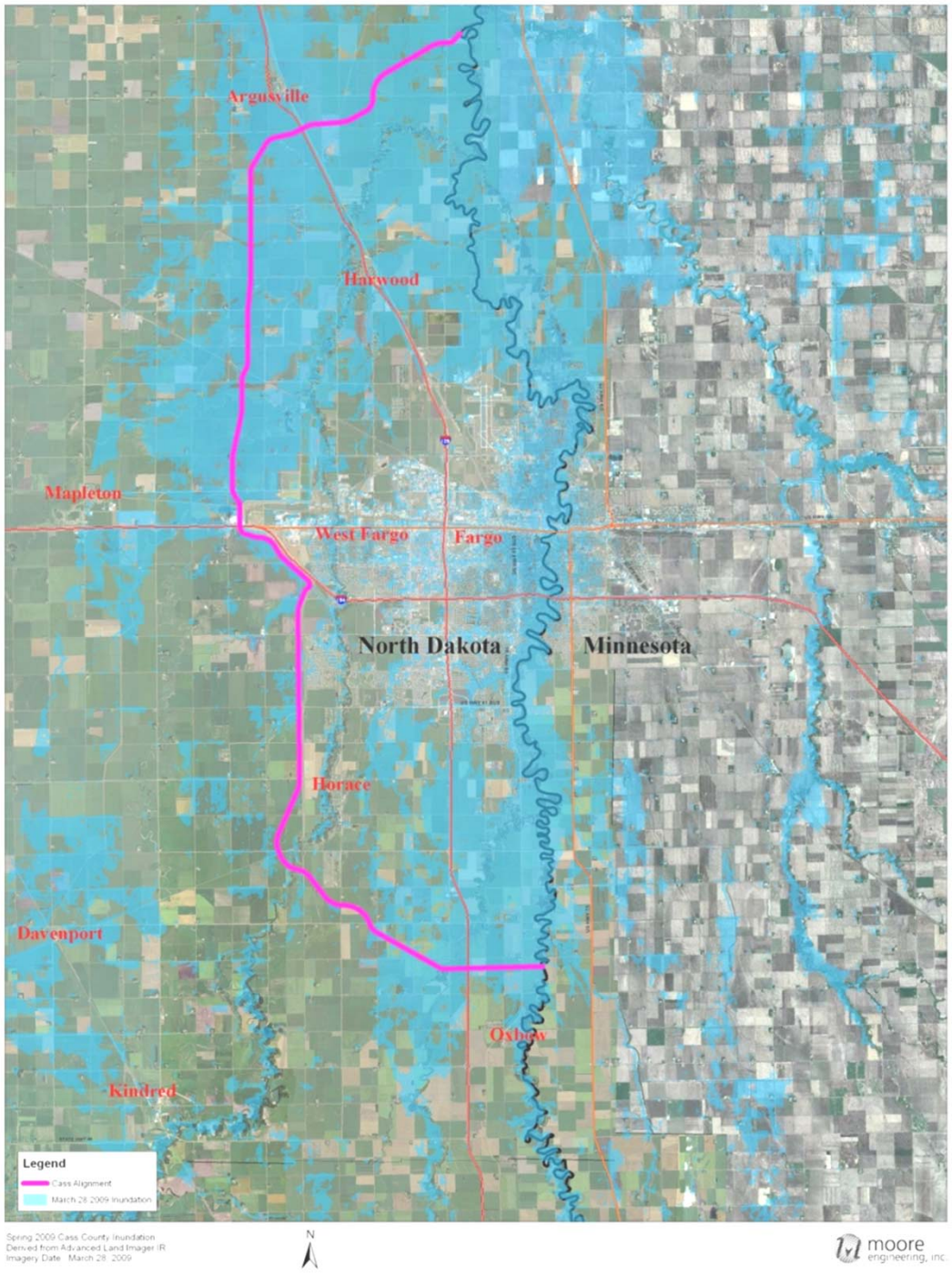
	$ Millions
Moorhead	42.5
Cass County	71.0
Clay County	35.2
Fargo	44.5
***Total**	**193.2**

*Includes Acquisitions, and Infrastructure Improvements related to Flood protection



Improvements totaling in excess of $193.2 Million

Protection level still less than the 50 Year flood level



FM Flood Risk Management

Locally Preferred Plan

Approved with out a single dissenting vote

ND 35,000 CFS Option

- Metro Study Work group
  - Fargo
  - Moorhead
  - Cass County
  - Clay County
  - Cass County Joint Water Resource District
  - Buffalo Red Water Board

The ND Plan

- Solves MORE flooding problems in multiple river systems.
- Provides MORE access by reducing prolonged high water on the Sheyenne.
- Reduces residual risk to MORE people.
- Has MORE benefits from a local and regional perspective.
- Has MORE support from local people on both sides of the river.

This is not a permanent solution!

WDAY Video

This is what it looks like when we win!?

This is what it looks like when we win!?

This is what it looks like when we win!?

This is what it looks like when we win!?

This is what it looks like when we win!?

This is what it looks like when we win!?

This is what it looks like when we win!?

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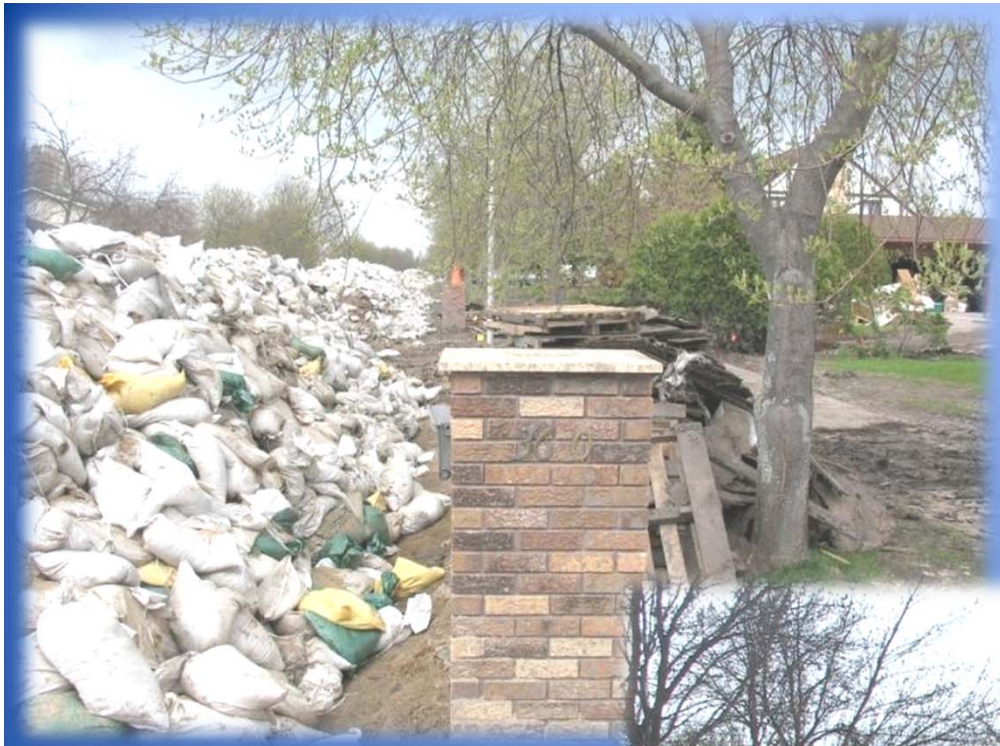


This is what it looks like when we win!?

This is what it looks like when we win!?

This is what it looks like when we win!?

This is what it looks like when we win!?

This is what it looks like when we win!?

This is what it looks like when we win!?

Additional slides

This is not a permanent solution!

Cass County Video

Acquisitions Fargo

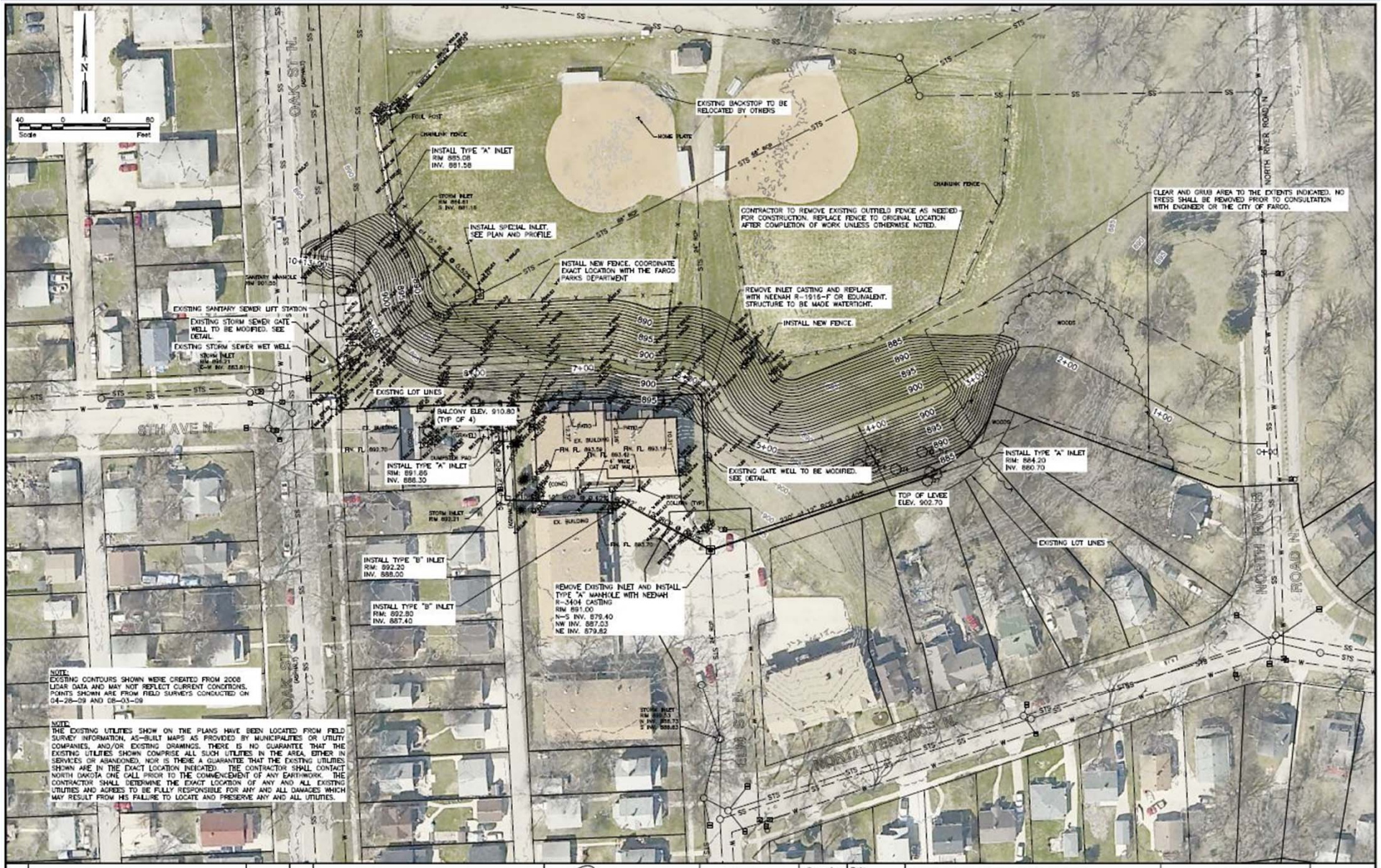
2010 River Level 36.99 ft
Saved 90,000 sandbags

1997-2009
150 completed
2010-2011
86 planned

Mickelson Field Permanent Dike 5902– Oak Grove Neighborhood Meeting City of Fargo

August 31, 2009

City Commission Chambers



No.	Revision	Date	By

Houston Engineering Inc.

Fargo
P: 701.237.5065
F: 701.237.5101

Drawn by: KNM, BTP
Checked by: MPL
Date: 8-20-09
Scale: AS SHOWN

MICKELSON FIELD PERMANENT DIKE
OAK GROAVE NEIGHTBORHOOF
FARGO, ND

SITE PLAN

PROJECT NO. 6059-011 PH4

SHEET 3 of 13

City of Fargo
4th Street
Levee Raise
5909

2010 Schedule

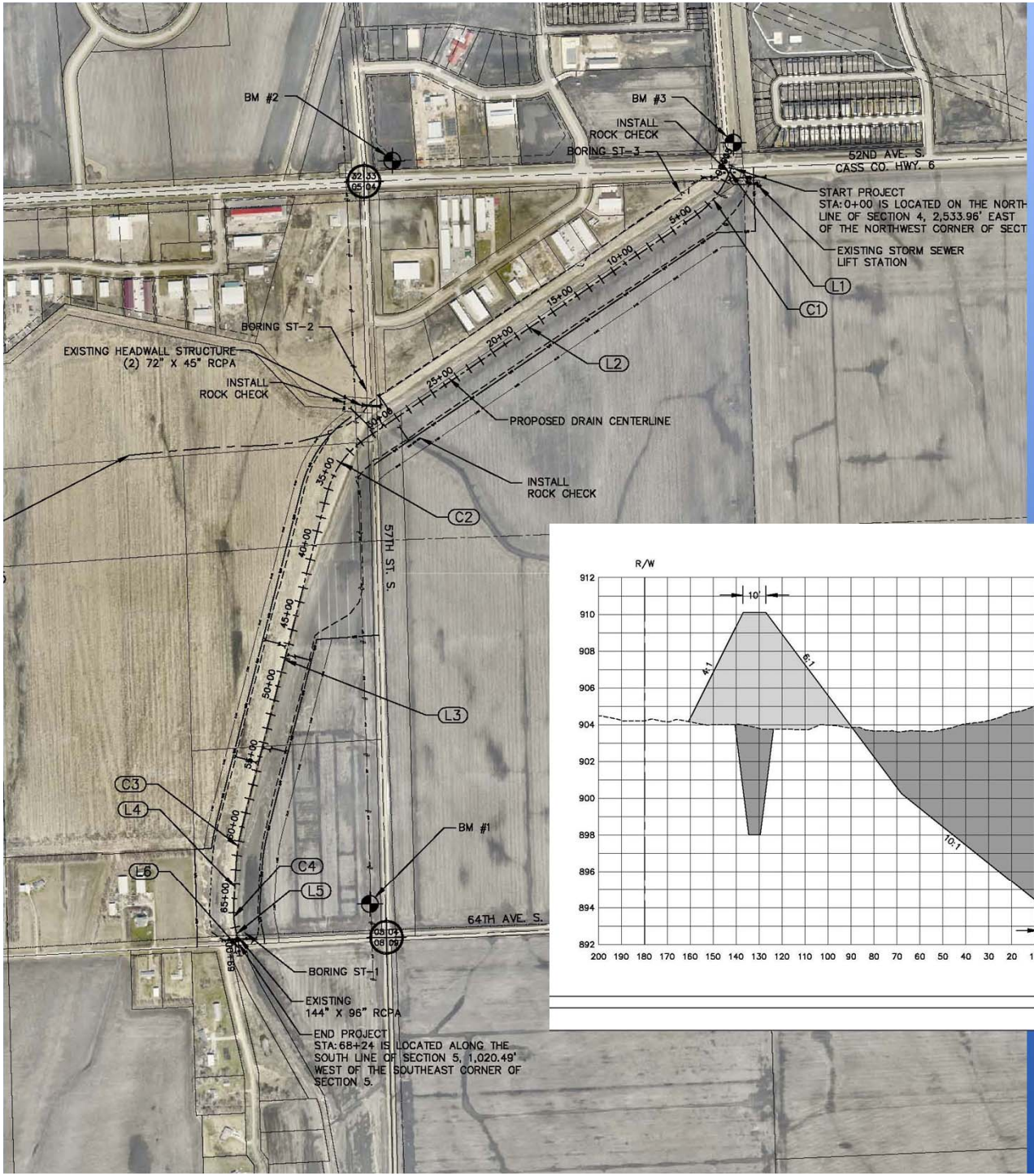
Project Completed

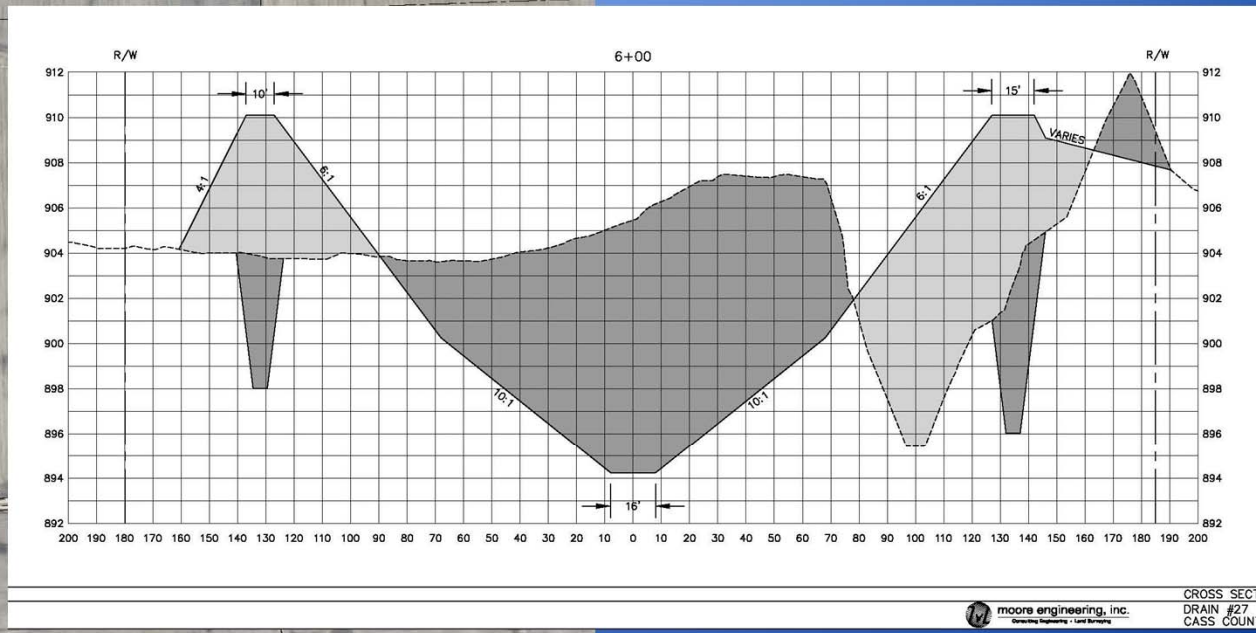
T:\Engineering\Flood\2010\MHB Presentations\2-24-2010 using Vern Whitten photos 3-27-2009\IMG_9766.jpg

Map Reference #3

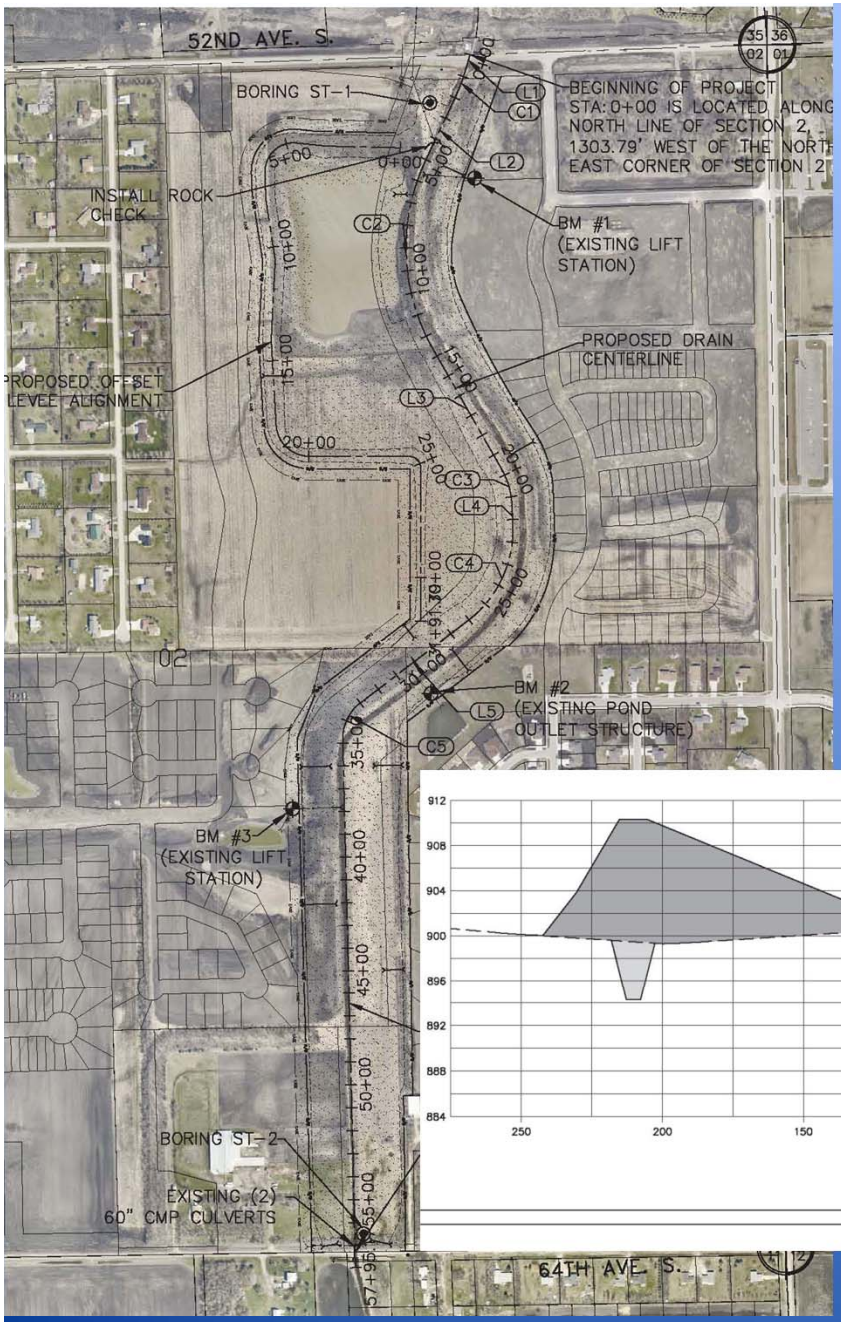
CITY OF Fargo
Engineering Dept.

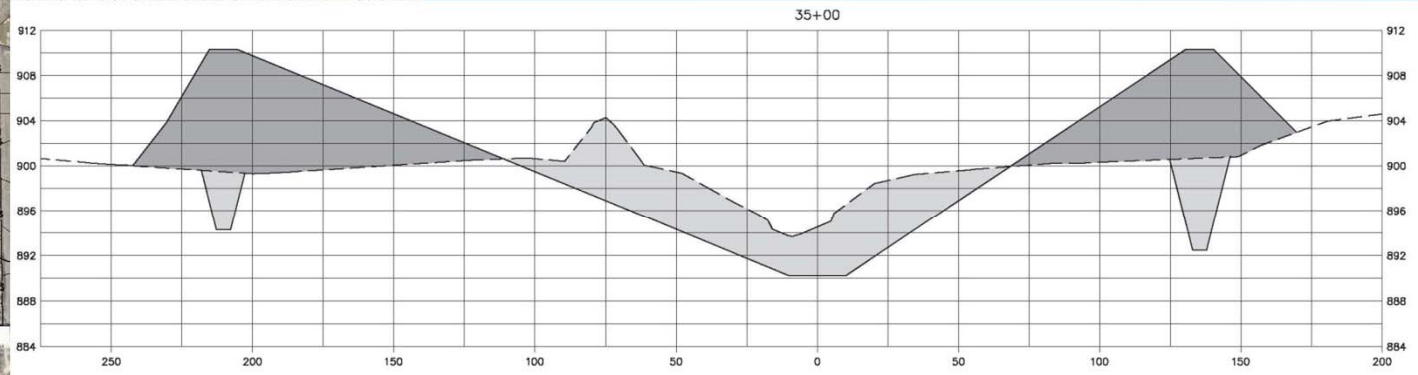
City of Fargo
SE Cass WRD
Drain 27
5903





City of Fargo
SE Cass WRD
Drain 27
5904





moore engineering, inc.

CROSS SECTIONS

DRAIN #53 DRAINAGE AND FLOOD CONTROL IMPROVEMENT
CASS COUNTY, NORTH DAKOTA

T:\Engineering\Flood\2010\Vern Whitten Pictures\Disc B 3-21-10\IMG_9685.jpg

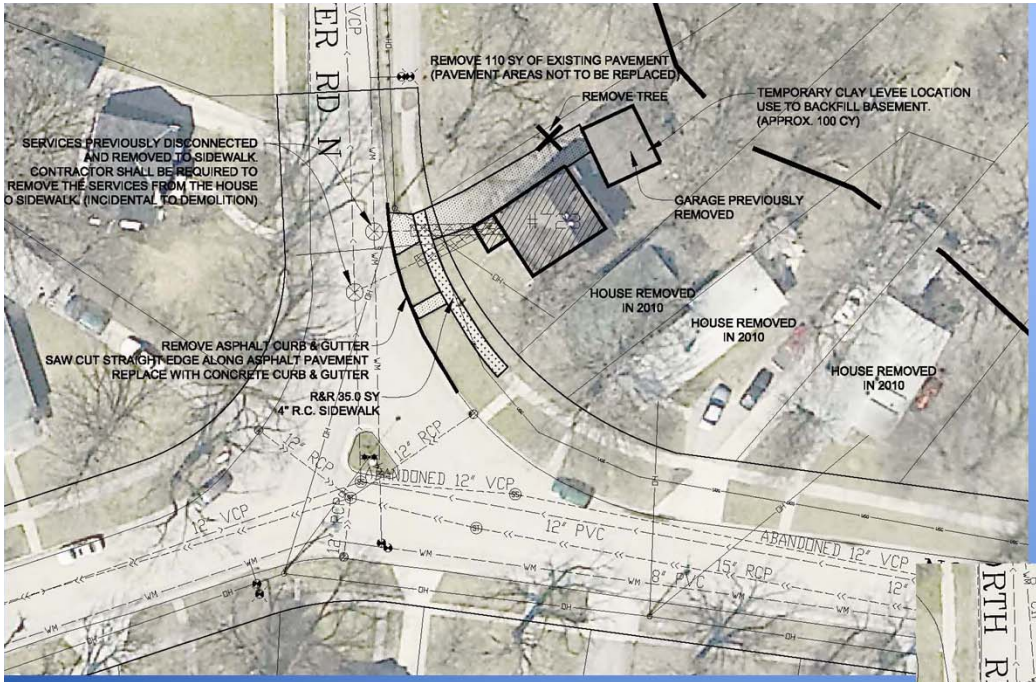
Map Reference #6

CITY OF Fargo
Engineering Dept.

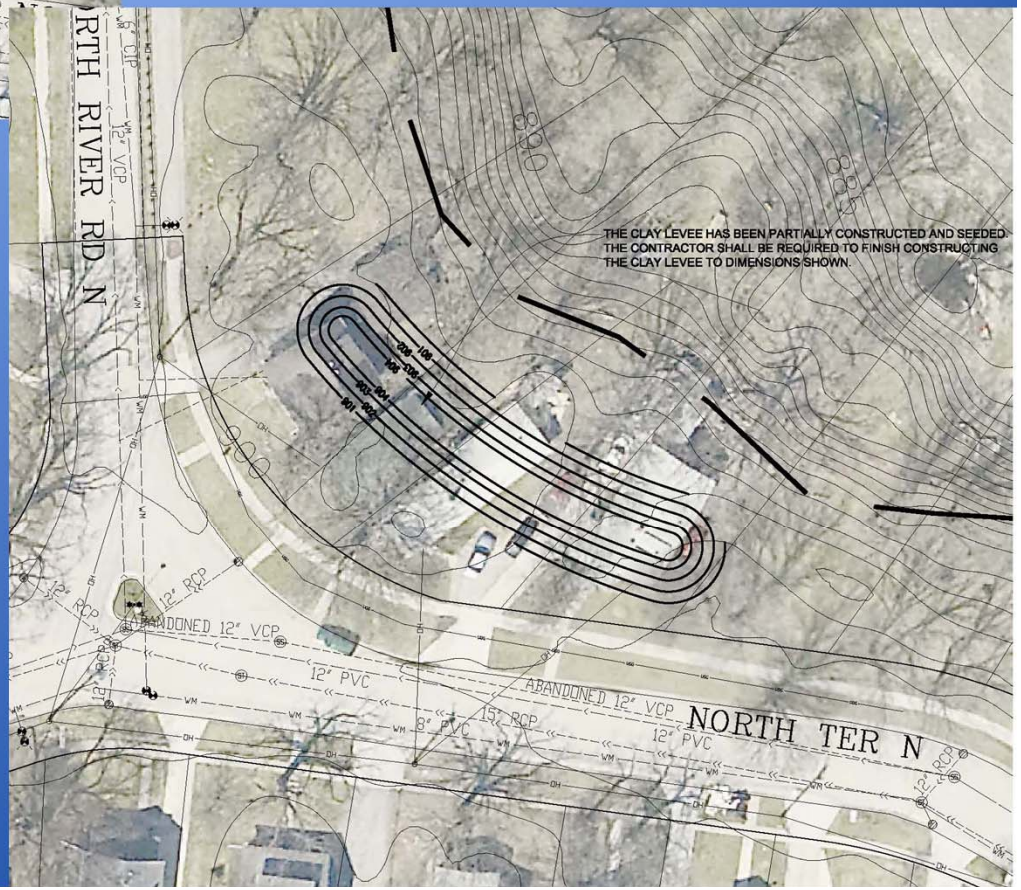
T:\Engineering\Flood\2010\Vern Whitten Pictures\Disc B 3-21-10\IMG_9848.jpg

Map Reference #3A

CITY OF Fargo
Engineering Dept.



5747-26



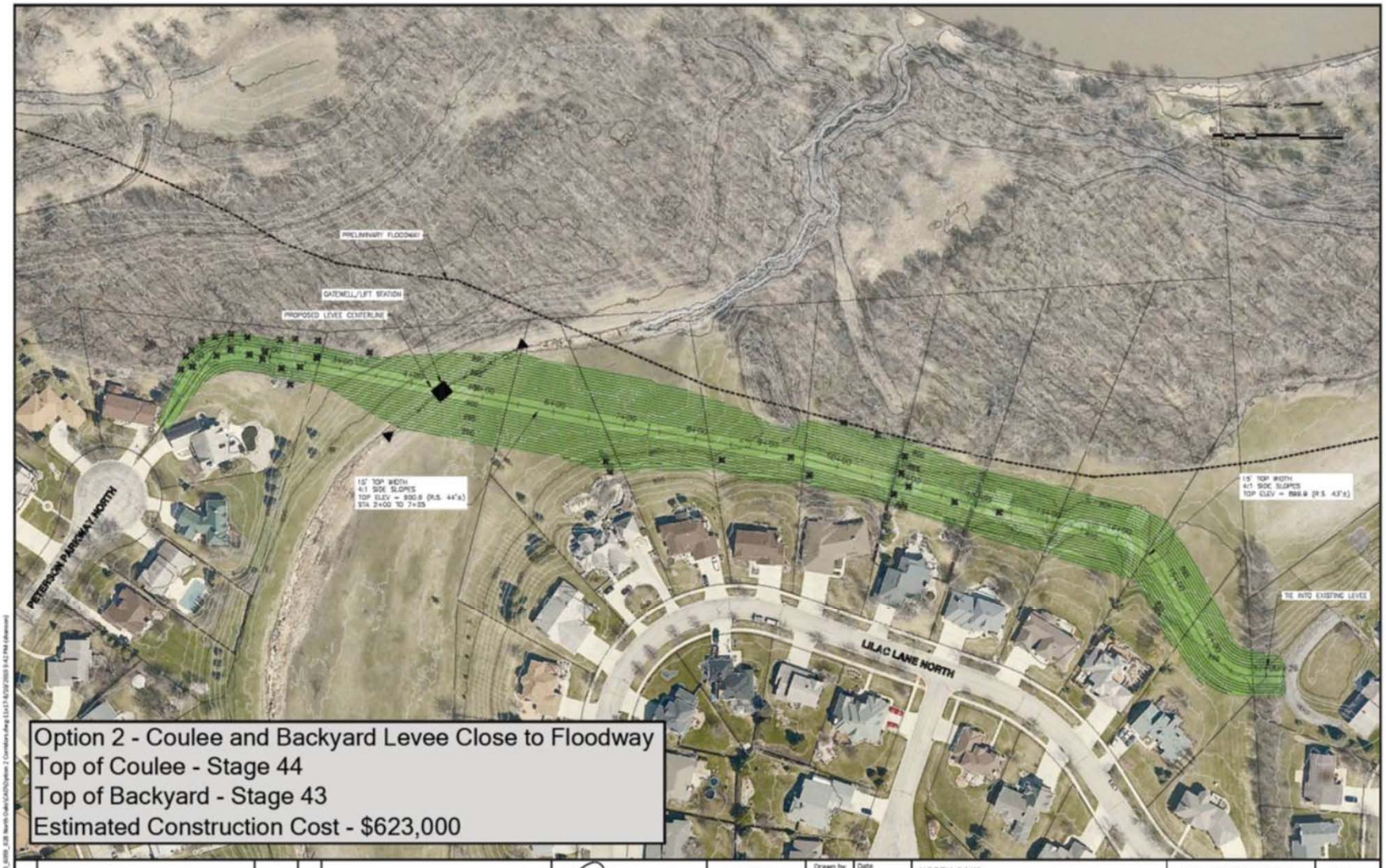
2010 Schedule

Project Currently Under Contract for Construction

City of Fargo
North Oaks Area Flood Risk Management Project 5946

Public Information Meeting

August 10, 2010



No.	Revision	Date	By

Houston Engineering Inc.

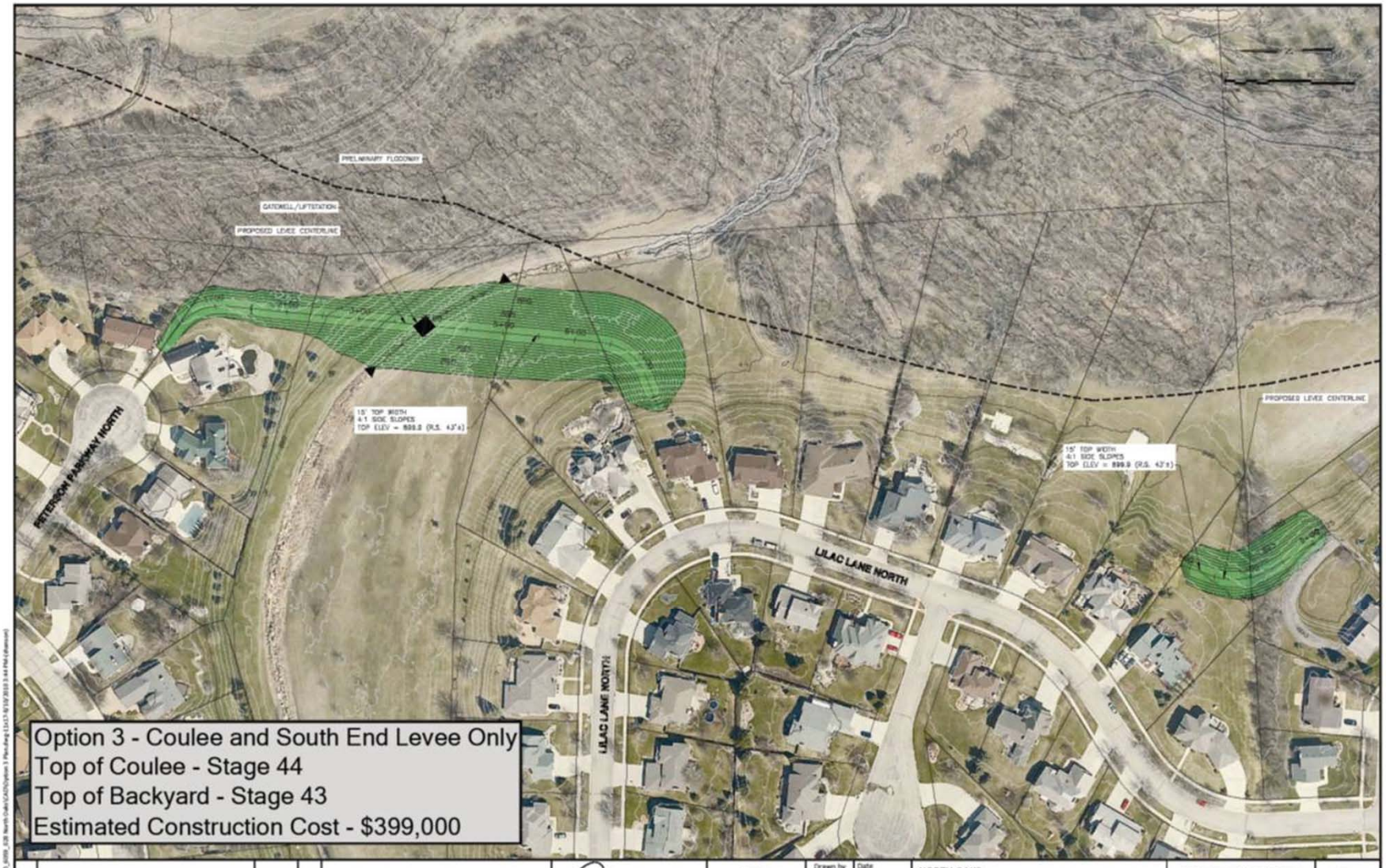
Fargo
P: 701.237.5065
F: 701.237.5101

Drawn by: BTP
Checked by: RSG
Date: 08-02-10
Scale: AS SHOWN

NORTH OAKS
CITY OF FARGO
FARGO, ND

PRELIMINARY OPTION 2
PROJECT NO. 6059-028

SHEET 2 of 5



No.	Revision	Date	By

Houston Engineering Inc.

Fargo
P: 701.237.5065
F: 701.237.5101

Drawn by: BTP
Checked by: RSG
Date: 07-12-10
Scale: AS SHOWN

NORTH OAKS
CITY OF FARGO
FARGO, ND

PRELIMINARY OPTION 3
PROJECT NO. 6059-028

SHEET 5 of 5

T:\Engineering\Flood\2010\Vern Whitten Pictures\Disc B 3-21-10\IMG_9820.jpg

Map Reference #4A

CITY OF Fargo
Engineering Dept.

2010 Schedule

Project is partially under contract homes (2 homes removed)

T:\Engineering\Flood\2010\Vern Whitten Pictures\Disc B 3-21-10\IMG_9818.jpg

Map Reference #4

CITY OF Fargo
Engineering Dept.

2010 Schedule

Project is currently in the process of being bid

T:\Engineering\Flood\2010\Vern Whitten Pictures\Disc B 3-21-10\IMG_9723.jpg

Map Reference #7

CITY OF Fargo
Engineering Dept.

T:\Engineering\Flood\2010\Vern Whitten Pictures\Disc B 3-21-10\IMG_9721.jpg

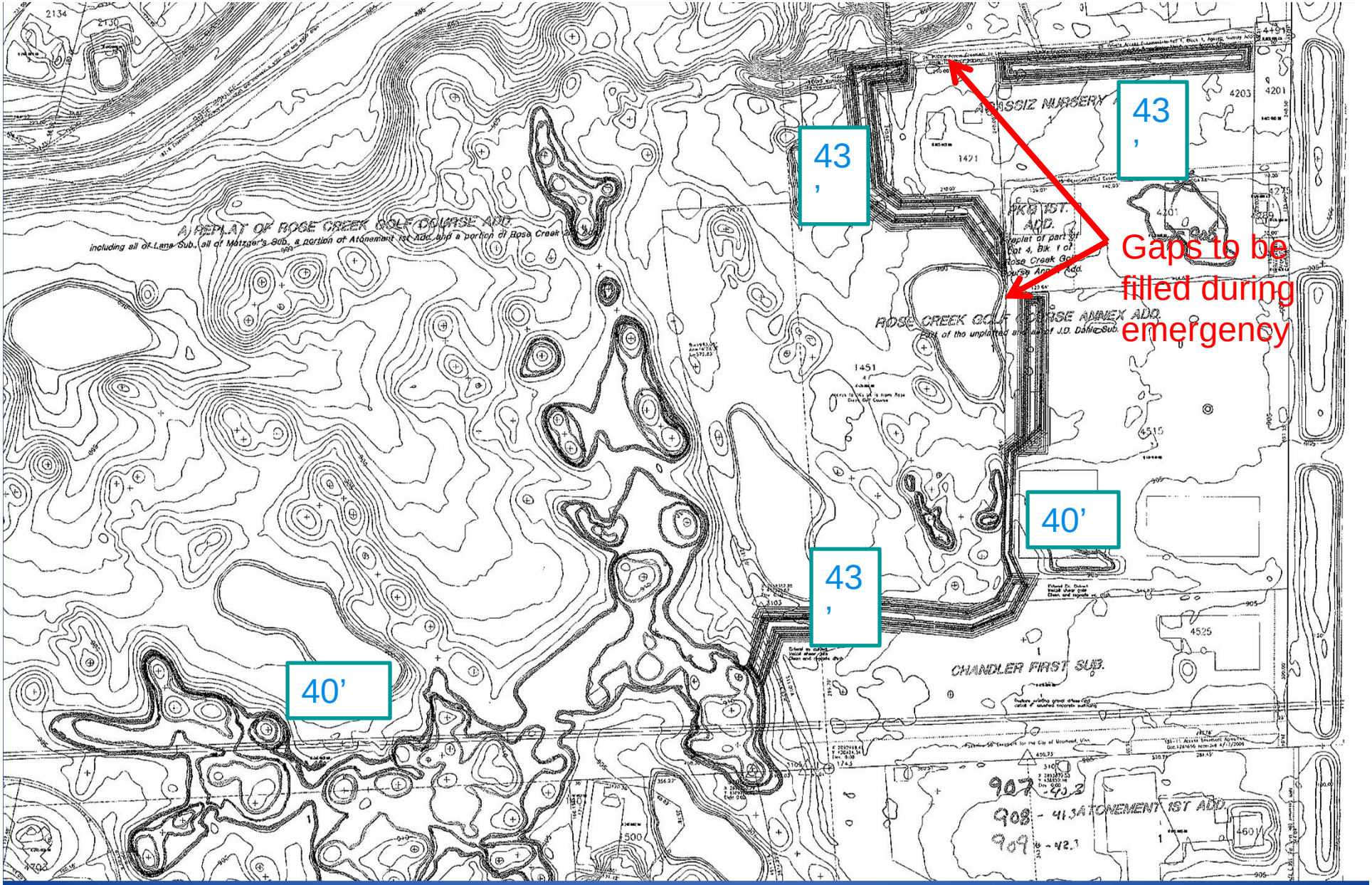
Map Reference #8

CITY OF Fargo
Engineering Dept.

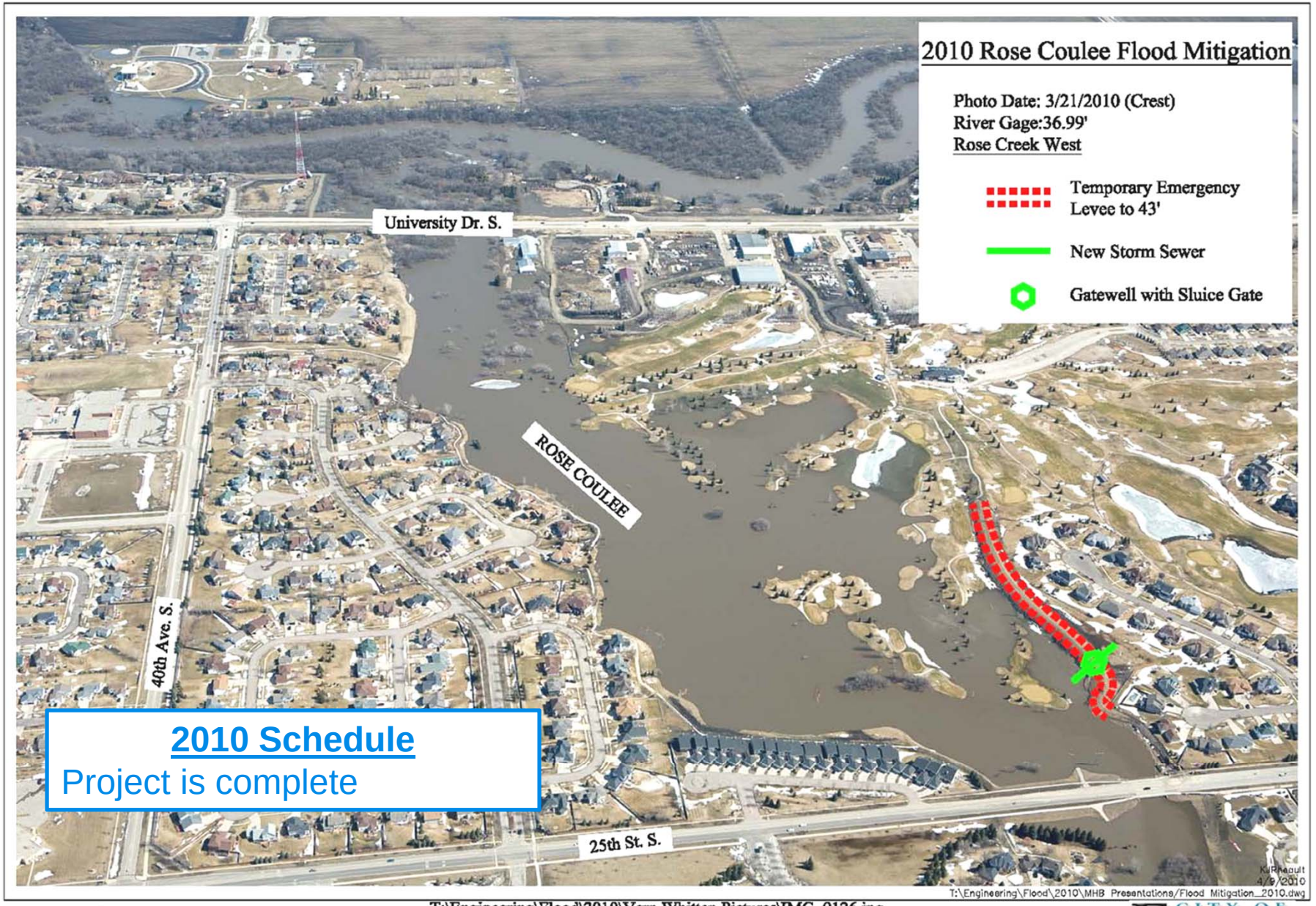
T:\Engineering\Flood\2010\Vern Whitten Pictures\Disc B 3-21-10\IMG_9727.jpg

Map Reference #9

CITY OF Fargo
Engineering Dept.



Map Reference 9 A



2010 Schedule

Project is complete

T:\Engineering\Flood\2010\Vern Whitten Pictures\IMG_9126.jpg

Map Reference #10

CITY OF Fargo
Engineering Dept.

2010 Schedule

Project has been shelved

T:\Engineering\Flood\2010\Vern Whitten Pictures\Disc A 3-21-10\IMG_9335.jpg

Map Reference #17

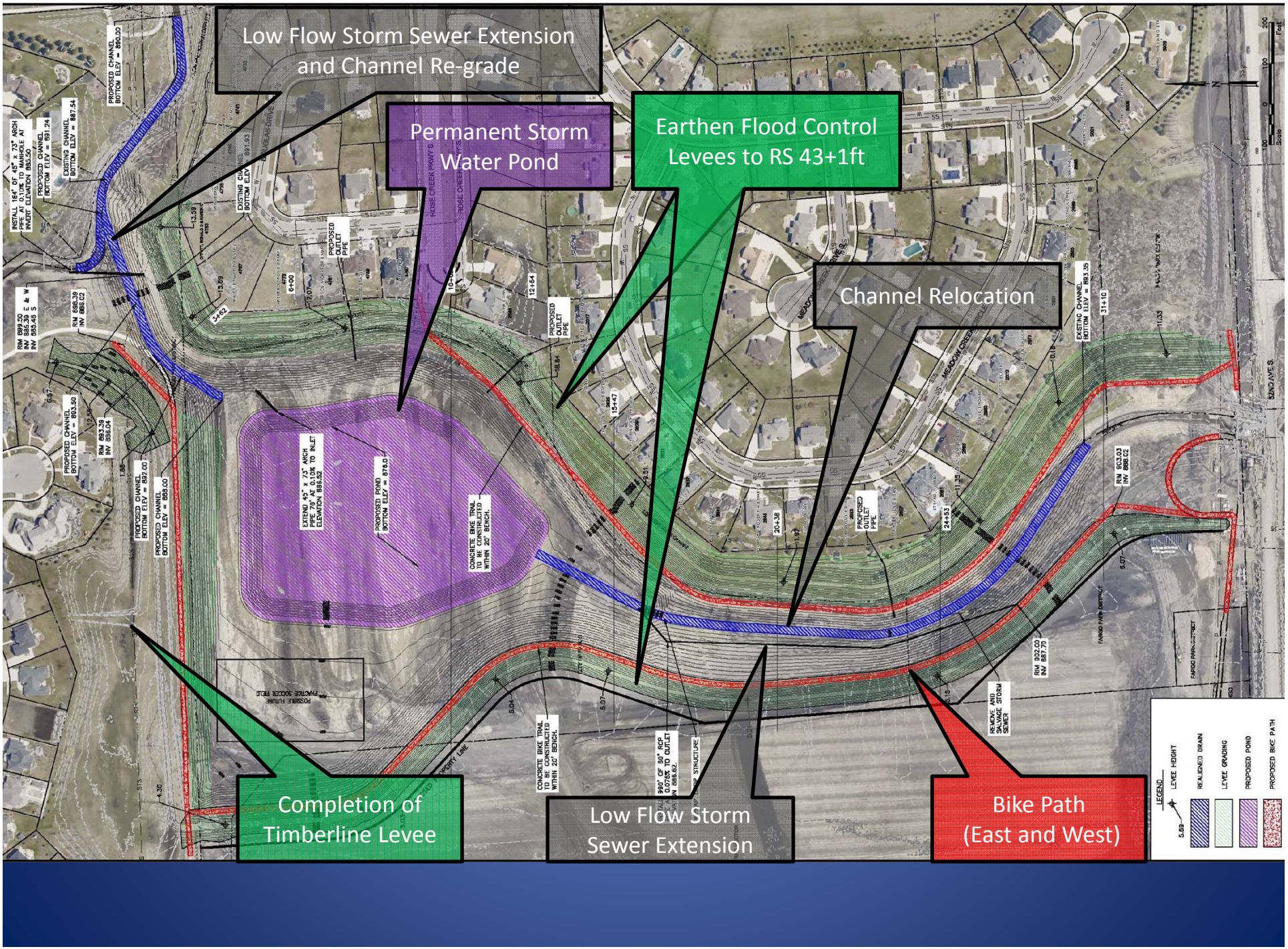
CITY OF Fargo
Engineering Dept.

City of Fargo

Meadow Creek Area Flood Risk Management – Project 5944

Public Information Meeting #2

August 3, 2010


Low Flow Storm Sewer Extension and Channel Re-grade
Permanent Storm Water Pond
Earthen Flood Control Levees to RS 43+1ft
Channel Relocation
Completion of Timberline Levee
Low Flow Storm Sewer Extension
Bike Path (East and West)

2010 Schedule

Construction Fall 2010

Completion Spring 2011

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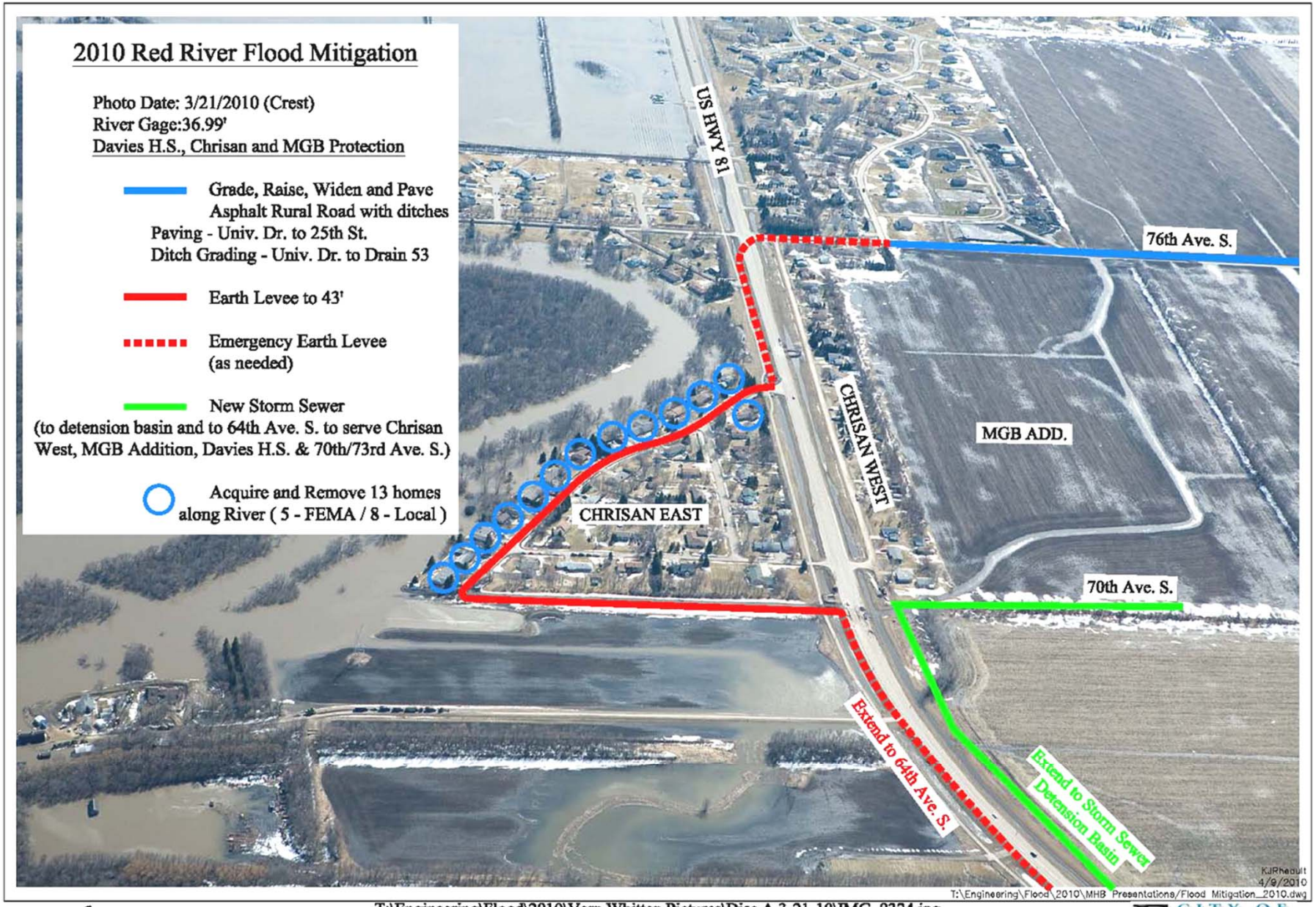
Map Reference #18 & 18A

CITY OF Fargo Engineering Dept.



T:\Engineering\Flood\2010\Vern Whitten Pictures\Disc A 3-21-10\IMG_9324.jpg

Map Reference #18A

CITY OF Fargo
Engineering Dept.

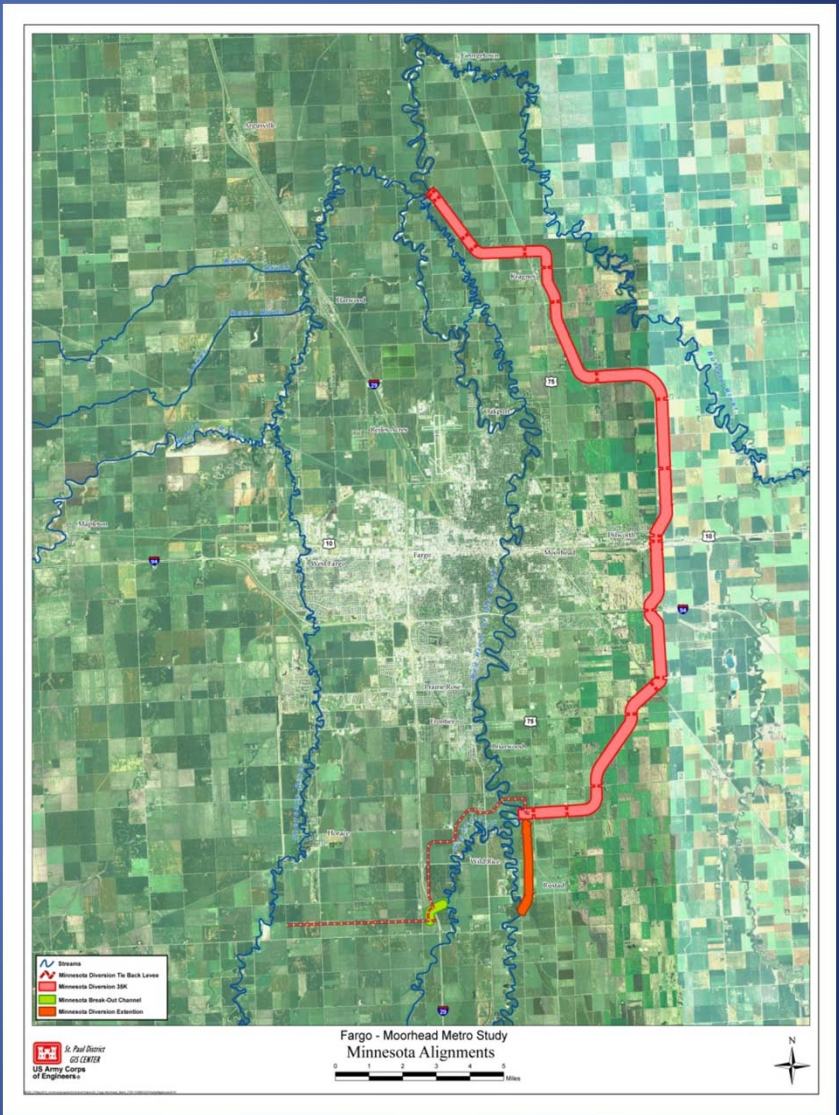
Potential Loss of Life:

Event	Anticipated Event (98% Evacuation)	Unanticipated Event (0% Evacuation)
1% Chance (100 yr)	4	200
0.2% Chance (500 yr)	12	594

*Assume Total Metro Population 200,000

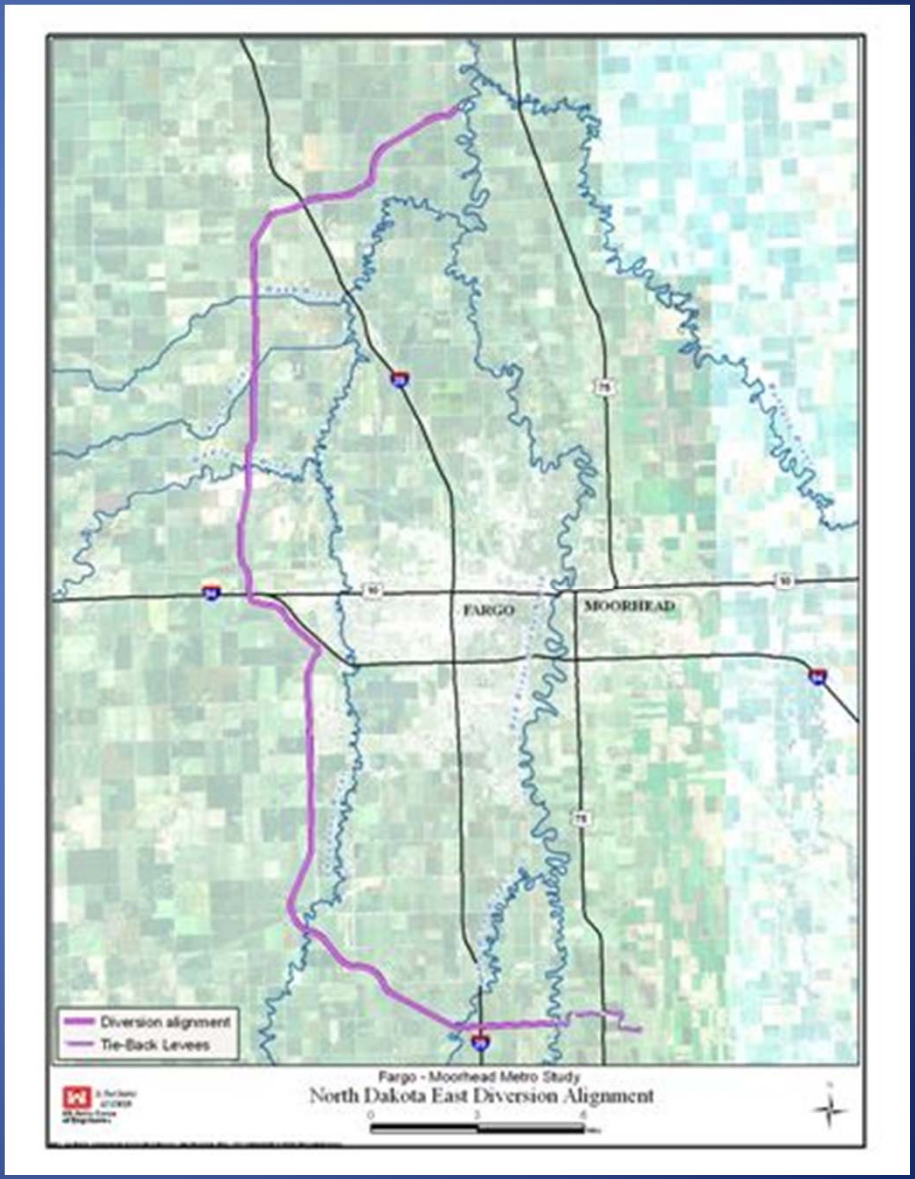
Minnesota alignment:

- 20, 25, 30, 35, 40, and 45K cfs
- 25 mile-long channel
- 9.9 miles of tie back levee
- 7.5 years construction
- Structures needed
  - 1 Control structure
  - 1 Drop structure
  - 0 River crossings
  - 20 Highway bridges
  - 4 Railroad bridges



North Dakota Alignment LPP:

- 30K and 35K cfs
- 36 mile-long channel
- 3.3 miles of tie back levee
- 8.5 years construction
- Structures needed
  - 2 Control structures
  - 2 River aqueducts
  - 2 Tributary drop structures
  - 3 Drop structures
  - 18 Highway bridges
  - 4 Railroad bridges



Screening Results:

Screened Alternatives Ranked by Net Benefits					
Alternative	Cost [1]	Avg Annual Net Benefits [1]	Avg Annual Benefits [1]	Residual Damages [1]	B/C Ratio
MN Short Diversion 20K	$1,032	$87.0	$140.0	$55.9	2.64
MN Short Diversion 25K	$1,121	$98.8	$156.4	$39.5	2.71
MN Short Diversion 30K	$1,194	$101.7	$163.1	$32.8	2.66
MN Short Diversion 35K	$1,286	$104.9	$171.0	$24.9	2.59
MN Short Diversion 40K [2]	$1,367	$105.6	$175.9	$20.0	2.50
MN Short Diversion 45K [2]	$1,450	$104.9	$179.5	$16.4	2.41
ND East Diversion 35K	$1,462	$95.4	$171.1	$24.8	2.26
1. In millions of dollars with interest during construction and discounting included					
2. Estimate based on linear extrapolation					
Expected average annual damages without a project are $195.9 million.					

When in operation, average annual benefits: MN35k $168.5 million

ND35k $172.8 million

Effectiveness of Diversions:

	Stage at Fargo Gage (ft)	
Stage / Impacts	1% Chance (100-year)	0.2% Chance (500-year)
27 Fargo Elm Street closed		
Existing Condition (Stage)	42.4	46.7
Existing Condition (CFS)	34,700	61,700
31 Moorhead 1st Ave		
Work Group Goal	30	36
34 First homes in Moorhead threatened		
20K MN Diversion Channel	36.9	43.7
25K MN Diversion Channel	34.8	42.4
35 First homes in Fargo threatened		
30K MN Diversion Channel	33.6	41.9
41.8 2nd to Flood Record Stage		
35K ND Diversion Channel	30.6	40
35K MN Diversion Channel	31.9	39.6
40K MN Diversion Channel	31.9	37.6
45K MN Diversion Channel	31.9	35.3

Fargo, N.D., March 26, 2009

Downstream Effects:

Based on 35K diversions and 100-year event

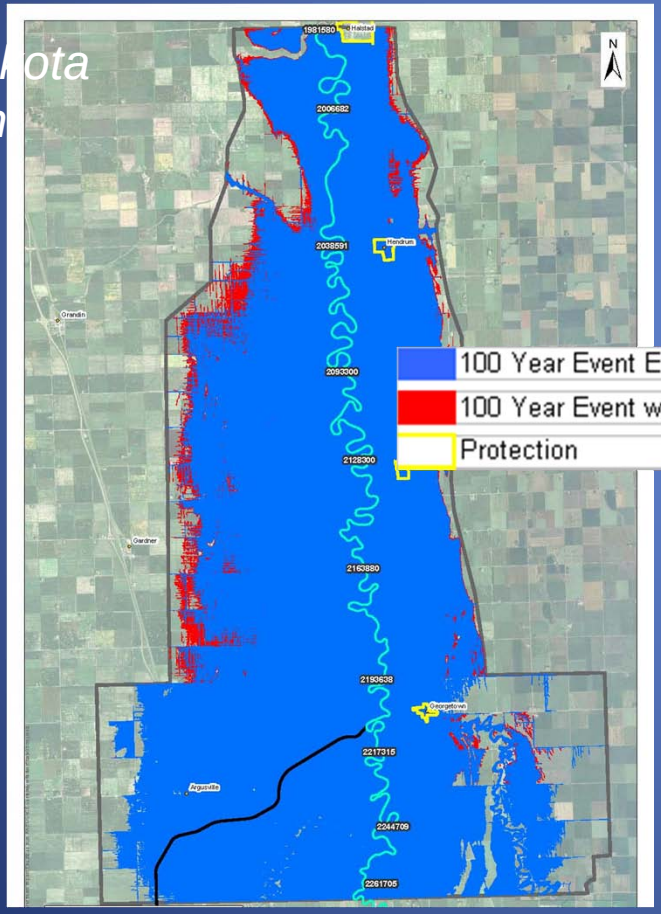
Location	Stage increase (inches)
Minnesota Short 35K - 100 Year	
Halstad Gage	6.7
Peak	7.2
Hendrum	6.8
Perley	4.8
Georgetown	4.7
North Dakota 35K - 100 Year	
Halstad Gage	10.7
Peak	11.6
Hendrum	10.7
Perley	6.6
Georgetown	7.1

* Impacts downstream of Halstad still being assessed.

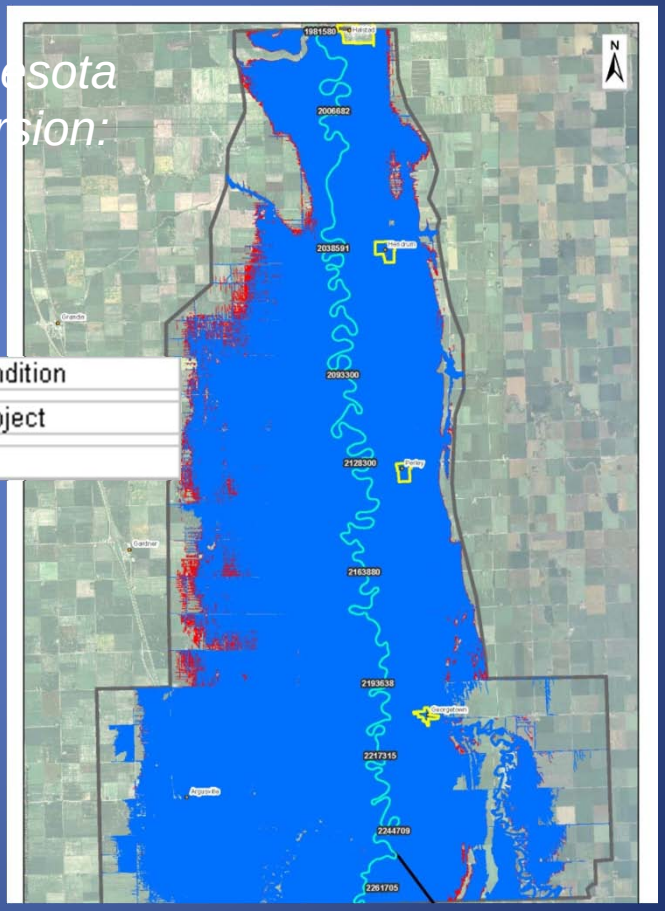
Downstream effects:

Based on 35K diversions and 1% chance event

North Dakota Diversion



Minnesota Diversion:



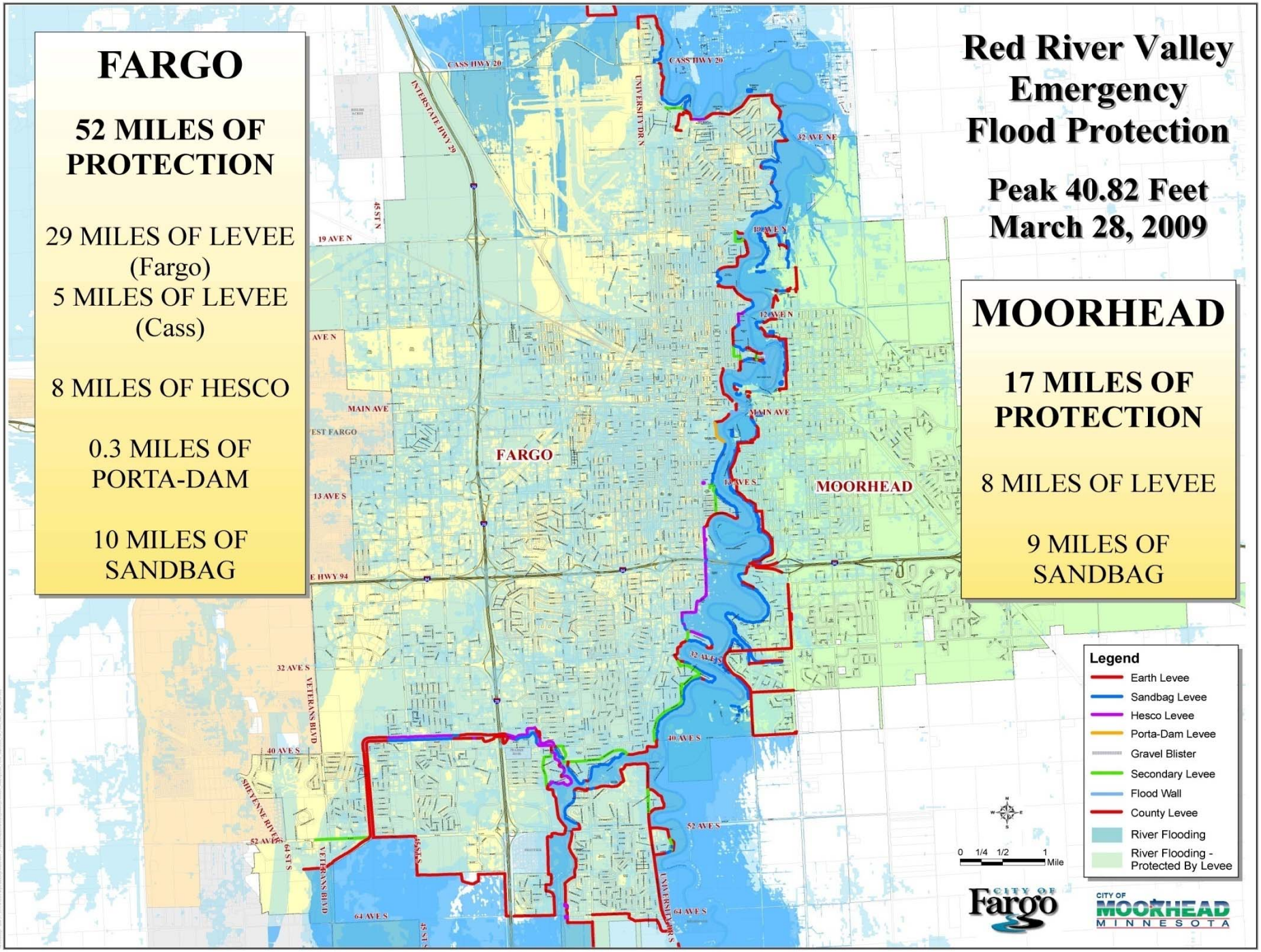
Project Impacts (ND 35k):

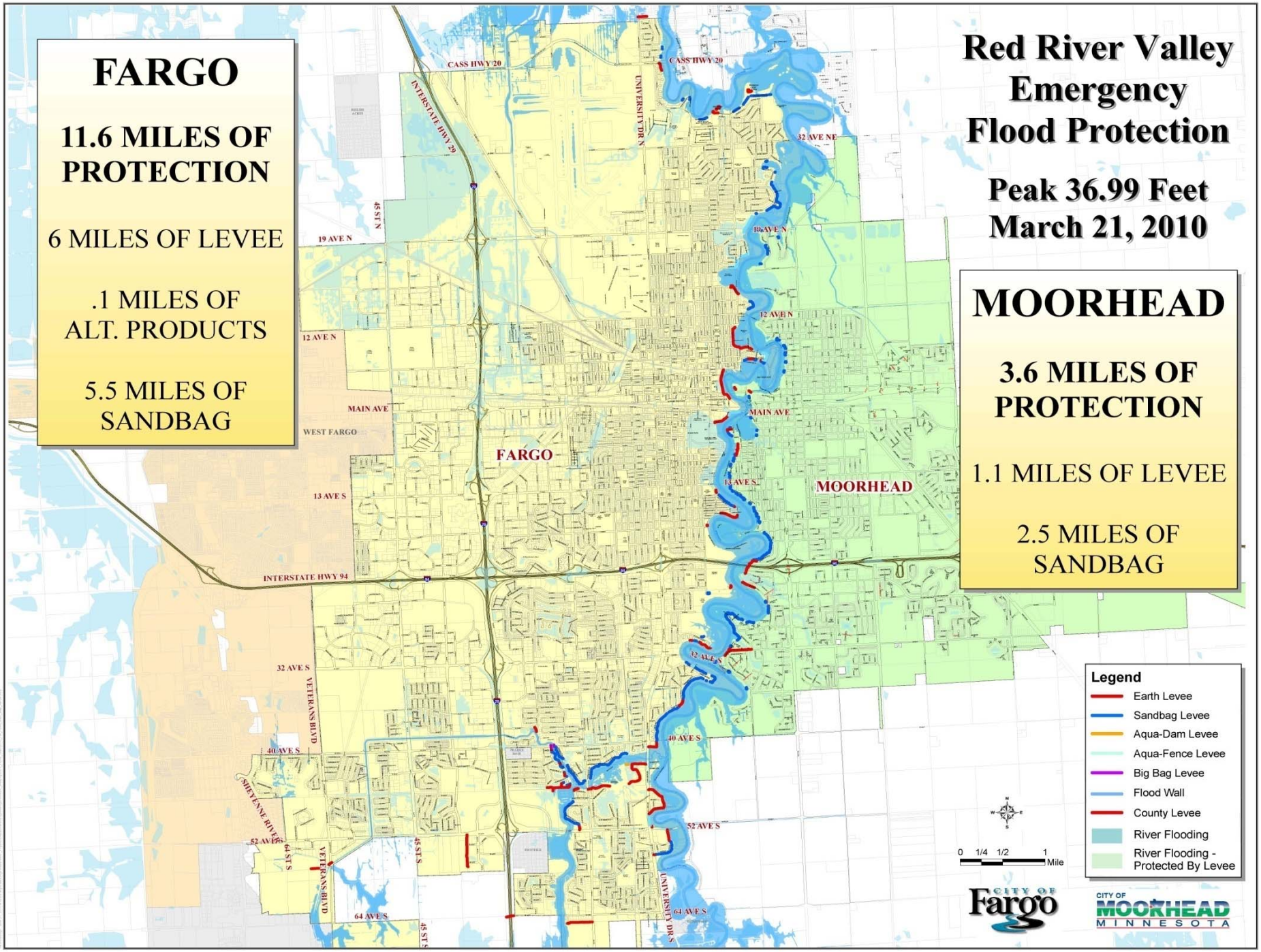
- ✓ Wetlands - 33 acres direct impacts and193 acres of indirect impacts
- ✓ Groundwater - No adverse impacts
- ✓ Sedimentation – Minor impacts on Red River and tributaries
- ✓ Connectivity – Impacts minimized up to the 2-percent chance event
- ✓ Riparian and Aquatic Habitat – 43 acres of river channel and 140 acres of riparian forest
- ✓ Residences – Relocation of six residences
- ✓ Farmland – 5,400 acres of prime and unique farmland

The project includes appropriate mitigation for unavoidable environmental impacts.

F-M Metro Study Timeline:

- Jul 2010: Independent External Peer Review Complete
- Jul 15, 2010: Sponsors letter of support
- Aug 9, 2010: Public Review Period Complete
- Oct 2010: Civil Works Review Board Briefing in Washington DC
- Oct 2010: Finalize feasibility report/EIS
- Oct 2010: Public Meetings
- Nov 2010: Execute Design Agreement
- Dec 2010: Sign Report of Chief of Engineers
- Jan 2011: Begin plans and specifications
- Apr 2012: Begin construction (if authorized and funded)


FARGO
52 MILES OF PROTECTION
29 MILES OF LEVEE (Fargo)
5 MILES OF LEVEE (Cass)
8 MILES OF HESCO
0.3 MILES OF PORTA-DAM
10 MILES OF SANDBAG
Red River Valley Emergency Flood Protection
Peak 40.82 Feet
March 28, 2009
MOORHEAD
17 MILES OF PROTECTION
8 MILES OF LEVEE
9 MILES OF SANDBAG
FARGO
MOORHEAD
CASS HWY 20
INTERSTATE HWY 29
UNIVERSITY DR N
32 AVE NE
19 AVE N
12 AVE N
MAIN AVE
13 AVE S
32 AVE S
40 AVE S
52 AVE S
64 AVE S
VETERANS BLVD
SHEYENNE RIVER
Legend
Earth Levee
Sandbag Levee
Hesco Levee
Porta-Dam Levee
Gravel Blister
Secondary Levee
Flood Wall
County Levee
River Flooding
River Flooding - Protected By Levee
0 1/4 1/2 1 Mile
CITY OF Fargo
CITY OF MOORHEAD MINNESOTA


FARGO
11.6 MILES OF PROTECTION
6 MILES OF LEVEE
.1 MILES OF ALT. PRODUCTS
5.5 MILES OF SANDBAG
Red River Valley Emergency Flood Protection
Peak 36.99 Feet
March 21, 2010
MOORHEAD
3.6 MILES OF PROTECTION
1.1 MILES OF LEVEE
2.5 MILES OF SANDBAG
CASS HWY 20
INTERSTATE HWY 29
UNIVERSITY DR N
32 AVE NE
19 AVE N
45 ST N
12 AVE N
MAIN AVE
WEST FARGO
FARGO
MOORHEAD
13 AVE S
INTERSTATE HWY 94
32 AVE S
VETERANS BLVD
40 AVE S
SHEYENNE RIVER
52 AVE S
64 ST S
45 ST S
64 AVE S
UNIVERSITY DR S
Legend
Earth Levee
Sandbag Levee
Aqua-Dam Levee
Aqua-Fence Levee
Big Bag Levee
Flood Wall
County Levee
River Flooding
River Flooding - Protected By Levee
0 1/4 1/2 1 Mile
CITY OF Fargo
CITY OF MOORHEAD MINNESOTA