City of Moorhead Comprehensive Flood Mitigation Improvements

Annual Meeting of the City Engineers Association of Minnesota

January 27, 2016
Historic Flooding: Top 10 Crests

- 100-Year Major
- Flood Stage


Crest (ft): 45, 40, 35, 30, 25, 20, 15, 10, 5, 0
Project Drivers

2009 emergency protection

- 9 miles - sandbag levee
  - 2,500,000 bags
  - Deployed in ≈ 1 week (1st crest)

- 9 miles - clay levee
  - (75,000 cu yd)
  - Most deployed for predicted 2nd crest
  - Sandbag levee conflicts

- 61 emergency auxiliary pumps

- Numerous sanitary & storm sewer plugs

- Mitigation planning initiated the day after the 2009 crest
Project Drivers

➢ First event where properties off of the riverfront were threatened
  □ Direct surface flooding & storm sewer backup
  ➢ 3,800 properties at risk
  ➢ 2,000 households evacuated
  ➢ 300 properties damaged

Several requests for voluntary acquisition
Goals

➢ Reduce emergency flood protection measures & flood risk to RS 42.5 feet
➢ Reduce emergency response time
  ❑ Acquisition of at-risk properties
  ➢ Construction of permanent infrastructure
➢ Keep the community in business during a major flood event
➢ Send a positive message to new & expanding businesses & homeowners
➢ Avoid continued burden and risk to City and State finances and later...FEMA accreditation
Keys to Success

➢ Flood-fatigued riverfront property owners
➢ State & national media attention
➢ Strong State & local support
  ❑ State Legislature in session during each event ($$$)
➢ Incremental & adaptive approach
Keys to Success

➢ Initial project concepts developed after 2009 crest
  ▪ Known high-risk areas & voluntary acquisition requests
  ▪ Prioritized acquisition offers based on risk (lowest elevation)
  ▪ Scattered & not conducive to construction of levees

➢ Greatly expanded following 2010 & 2011 floods
  ▪ Prioritized project areas based on past experience & elevation
  ▪ Greatest risk to public infrastructure & private property
  ▪ Prioritized acquisitions within project areas
Total Sources: $105.2M

State FDR Grant: $72.70M (69.1%)

3M: $18.3 Mn (17.4%)

Local Match: $13.92M (13.2%)

Federal: $0.25M (0.2%)

Overmatch: $0.08M (0.1%)
Total Uses: $105.2M

- Infrastructure: $47.0M (44.7%)
- Acquisition: $58.2M (55.3%)
Local Sources: $32.25

- Property Sales: $2.32M (7.2%)
- CI Funds: $0.39M (1.2%)
- Misc: $0.21M (0.7%)
- G.O. Improvement Bond: $29.33M (90%)

MOORHEAD MINNESOTA
<table>
<thead>
<tr>
<th></th>
<th>%</th>
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</thead>
<tbody>
<tr>
<td>Special Assessments</td>
<td>20%</td>
<td>Property Owner Benefit</td>
</tr>
<tr>
<td>Water Utility Transfer</td>
<td>9%</td>
<td></td>
</tr>
<tr>
<td>Wastewater Utility Transfer</td>
<td>12%</td>
<td></td>
</tr>
<tr>
<td>Stormwater Utility Transfer</td>
<td>14%</td>
<td></td>
</tr>
<tr>
<td>CI Fund Transfer</td>
<td>28%</td>
<td></td>
</tr>
<tr>
<td>General Property Tax Levy</td>
<td>17%</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100%</td>
<td></td>
</tr>
</tbody>
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**Special Assessments:**
- **Single-Family Residential**
  - 2010: $162 payable over 5 years
  - 2012: $399 payable over 20 years
- **Commercial/Industrial**
  - scaled on size with maximum
## Project Summary

<table>
<thead>
<tr>
<th>Project</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voluntary acquisitions</td>
<td>247</td>
</tr>
<tr>
<td>Easements</td>
<td>67</td>
</tr>
<tr>
<td>Levees/floodwalls (miles)</td>
<td>12.1</td>
</tr>
<tr>
<td>Removable floodwall closures</td>
<td>3</td>
</tr>
<tr>
<td>Stormwater pump stations</td>
<td>19</td>
</tr>
<tr>
<td>Stormwater gates</td>
<td>78</td>
</tr>
<tr>
<td>Sanitary pump station upgrades</td>
<td>5</td>
</tr>
</tbody>
</table>
Innovative Project Features

- Expedited Voluntary Acquisitions
  - First 83 based on appraisals
  - Grant funds offered pre-flood 2011
  - Insufficient time for appraisals
  - Expedited offers at 108% of estimated market value
    - Average of appraisals
  - No negotiations
  - No relocation benefits
- ≈300 eligible properties
- 247 acquisitions (>80%)
- ≈53 remaining
  - Some outside of established line of protection
    - Little to no risk to other properties
  - Continue to receive requests as “life situations” change
  - Requests based on appraisal after Fall 2012
Riverfront Property At Risk

Demolish

Protect & Resale

Relocate
Innovative Project Features

- Removable floodwalls
  - 3 locations
  - Higher ADT streets
  - Deployed as needed
Innovative Project Features

- Sheet pile floodwalls
  - 3 locations
  - Avoid FEMA HMGP buyouts
    - Deed restrictions prohibiting structures (including levees)
  - Aesthetic concerns
- Limited space
  - Constructed in boulevard (public right-of-way)
  - Sheet pile floodwalls
  - Brick fascia
  - Precast concrete cap
Innovative Project Features

• Storm gate installation
  o Hand-formed brick structure
  o Complete replacement not feasible
    o Deep storm sewer
    o Higher ADT street
  o Laser scan to create precise 3D model
  o Prefabricated manhole insert

• AquaFence closures
  o 2 locations
    o Acquisition not feasible
    o Riverbank stability prevented levees
    o Deployed as needed
FEMA Accreditation

- Accreditation not an initial goal post-2009
- Biggert-Waters Flood Insurance Reform Act (2012)
  - Cost of flood insurance increasing dramatically
  - Property values & neighborhood character decline
- Revised focus for accreditation
  - Projects constrained by:
    - Declined voluntary acquisitions
    - FEMA deed restricted properties
    - Riverbank (geotechnical) stability
FEMA Accreditation

- Project modifications needed to tie-in to high ground
- Interior drainage analysis
  - Address risk of internal flooding
  - Detailed stormwater modeling of entire City
  - Outfall capacity increased in several locations
    - New inlet structures
    - Pump stations
    - Outfall pipe upgrades
Emergency Measure Reductions

![Bar graph showing flood crest (ft) with categories 38, 41, and 42.5. The graph compares 2009 conditions and current conditions.](image)
Emergency Measure Reductions

![Graph showing the reduction in sandbags used at different flood crests. The graph compares 2009 conditions with current conditions.](image)
Emergency Measure Reductions

![Bar graph showing deploy time (days) vs. flood crest (ft) with data for 2009 conditions and current conditions. The graph shows significantly shorter deploy times for higher flood crests in 2009 compared to current conditions.]

- **Flood Crest (ft):** 38, 41, 42.5
- **Deploy Time (days):**
  - 2009 Conditions: 2, 6, 10
  - Current: 2, 4, 6
Horn Park
2009 Flood
RS 40.84 ft

Sandbags around homes & Sanitary Pumping Station
Temporary clay levees

Sandbags placed behind homes & on top of existing levee

Contingency clay levee on street
Moorhead Horn Park Area
Emergency Flood Protection Measures
2009 Flood Event (River Stage 41 ft)
Moorhead Horn Park Area
Emergency Flood Protection Measures
Future Flood Event (River Stage 41 ft)