Stormwater Presentation Outline

• Existing conditions results for 10 study areas
• Proposed alternatives for 10 study areas
• Cost estimates for proposed alternatives
• Results of compensatory storage analysis
• Risk assessment of alternatives
• Flood proofing of homes
• Recommendations for City Ordinance
Computer Modeling of Ten Storm Sewer Study Areas

- Developed hydrologic and hydraulic modeling for storm sewer study areas.

<table>
<thead>
<tr>
<th>Storm Sewer Study Area ID</th>
<th>Area Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pine Street</td>
</tr>
<tr>
<td>2</td>
<td>Geneva Avenue</td>
</tr>
<tr>
<td>3</td>
<td>York St to Salt Creek between McKinley Ave and Butterfield Rd</td>
</tr>
<tr>
<td>4</td>
<td>York St to Salt Creek between McKinley Ave and Ii Prairie Path</td>
</tr>
<tr>
<td>5</td>
<td>Larch Avenue</td>
</tr>
<tr>
<td>6</td>
<td>Seminole Avenue</td>
</tr>
<tr>
<td>7</td>
<td>York Street at I-290</td>
</tr>
<tr>
<td>8</td>
<td>Brynhaven Subdivision</td>
</tr>
<tr>
<td>9</td>
<td>Pick Subdivision</td>
</tr>
<tr>
<td>10</td>
<td>Butterfield Road Area (Yorkfield)</td>
</tr>
</tbody>
</table>
Computer Modeling of Ten Study Areas

- Computer modeling based on following information:
  - 500 flood questionnaires
  - City’s GIS storm sewer database
  - As-built drawings
  - Pump station plans and operation procedure
  - Previous studies
  - Field investigations/survey by CBBEL staff
  - DuPage County aerial topographic mapping
• Hydrologic Model:
  • Delineated drainage boundaries and determined existing drainage patterns.
    • DuPage County aerial topography
    • Storm sewer information
  • Determined hydrologic parameters for drainage areas.
    • Runoff curve number (CN)
    • Time of concentration ($t_c$)
  • Simulated flow rates and runoff volume for rainfall events using the US EPA-based XP-SWMM computer model to determine stormwater runoff response.
    • July 2010 storm event
    • Design storm events
Storm Events Analyzed

- Engineering analyses performed for the peak 1-, 2-, 5- 10-, 25-, 50-, and 100-year storm events.
  - Today storm sewers are typically designed to convey the peak 10-year flow to meet ordinances. A storm sewer installed in 1960’s typically has +/- 5-year capacity.
- The term “10-year storm” is used to define a rainfall event or recurrence interval that statistically has the same 10% chance of occurring in any given year.

<table>
<thead>
<tr>
<th>Recurrence interval in years</th>
<th>Probability of occurrence in any given year</th>
<th>Percent chance of occurrence in any given year</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>1 in 100</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>1 in 10</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>1 in 5</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>1 in 2</td>
<td>50</td>
</tr>
</tbody>
</table>
• Design storms included in analysis have durations equal to 1-, 2-, 3-, 6-, 12-, 18-, 24- and 48-hour storm events.

• Storm duration that results in highest flood elevations is the critical duration for that study area.

• The critical storm duration was simulated for the 2-, 5-, 10-, 25-, 50-, and 100-year return intervals for each study area.
Intensity, Duration and Recent Storms

- Storm intensity and duration are used to determine the recurrence intervals.
  - 2.1 inches in 60 minutes is a 10-year event
  - 2.1 inches in 15 minutes is a 100-year event

- September 12-14, 2008
  - 7.5 inches in 24 hours

- June 23, 2010
  - 4.5 inches in 30 minutes

- July 23 – 24, 2010
  - 6.84 inches in 12 hours
Computer Modeling of Ten Study Areas

- **Hydraulic Model**
  - Input existing drainage features
    - **Storm sewers:**
      - Length
      - Diameter
      - Invert and rim elevations
      - Pipe material
  - Overland flow routes
  - Stormwater pumping station information
  - Flood storage (depressional areas)
  - Simulated stormwater runoff from storm events through drainage system using US EPA-based XP-SWMM computer model.
    - Determined flood levels
    - Quantified level of protection for flood problem areas
    - Determined effectiveness of proposed drainage improvements
Computer Modeling of Ten Study Areas

- XP-SWMM computer modeling included:
  - Over 100 subbasins
  - Over 700 storm sewers and overland flow routes
  - Over 40 flood/depressional storage areas
  - 6 stormwater pumping stations
• Surveyed high water elevations from July 2010 storm event
  • 27 surveyed elevations that cover 7 of 10 study areas
  • Compared to model results for July 2010 simulation

• Preliminary analysis showed XP-SWMM flood elevations generally higher than surveyed elevations
  • Hydrologic parameters were adjusted in each study area to match observed elevations.

• Calibrated XP-SWMM model corresponded well with survey data

• Use calibrated models to simulate design storm events.
Surveyed High Water Marks – South Elmhurst
Surveyed High Water Marks – North Elmhurst
• The low-entry elevation of this house is greater than the 50-year flood elevation but less than the 100-year flood elevation.

• This house has a “50-year level of flood protection.”
Flood Storage Volume

• One acre-foot is the equivalent of an acre of land that is one foot deep.

• It is also equivalent to:
  • 325,851 gallons
  • 5,925 rain barrels (55 gallons each)
  • 616,715 2-liter bottles
  • Elmhurst Quarry has a capacity of 8,300 acre-feet
Conceptual Cost Estimates

• Unit costs taken from recently completed projects.
  • Storm sewers
  • Manholes
  • Earth excavation
  • Pump station upgrades

• Assumptions in costs estimates:
  • 20% Contingency
  • 10% Engineering

• Conceptual cost estimates do **not** include items such as:
  • Land acquisition
  • Temporary/permanent construction easements
  • Relocation of utilities
  • Cost of recreational facilities in open spaces
Overview of Pine Street Study Area

116 Pipe System

Pine Street is a depressional area ("bowl") with a storm sewer outlet, there is no designated overland flow route for this area. The Pine Street storm sewer is connected to the 48-inch storm sewer that flows east along 1st Street. The lowest rim elevations of the storm sewer system are located at Pine Street.
Pine Street Study Area
XP-SWMM Simulated July 2010 Inundation Area

VOLUME = 11 AC-FT
• During July 2010 storm event, significant street and home flooding occurred at Pine Street and Avon Road.
  • Approximately 2.2 ft of ponding depth on Pine Street at low point
  • 20 homes within July 2010 flood inundation area.*

• Existing level of flood protection is the 10-year return interval:
  • Street ponding occurs for storm events greater than the 10-year return interval.
  • Structural flooding occurs for storm events greater than the 25-year return interval*.

*Based on Lowest Adjacent Grade taken from DuPage County topography and SWMM analysis
Pine Street Study Area - Alternative #1
50-Year Level of Protection

Construct 3,000 LF of relief sewers along Pine, Avon, and 1st Street to Golden Meadows Park.

Provide additional 7 ac-ft of gravity-drained flood storage in Golden Meadows Park (average depth of excavation = 7 ft).

Increases level of flood protection from 25-yr to 50-yr (16 homes) on Pine St. and Avon Ave.

Project Cost (Dry-bottom basin) = $1,650,000
Project Cost (Underground storage) = $3,810,000
Construct 3,000 LF of relief sewers along Pine, Avon, and 1st Street to Golden Meadows Park storage.

Provide additional 17 ac-ft of gravity-drained flood storage in Golden Meadows Park (average depth of excavation = 8 ft).

Increases level of flood protection from 25-yr to 100-yr (removes all 20 homes from 100-year inundation area).

Project Cost (Dry-bottom basin) = $2,560,000
Project Cost (Underground storage) = $7,970,000
An area of 447 acres drains via storm sewer and overland flow to the low area located on Park Avenue. A system of pipes drains this area to the Lower Elmhurst Reservoir. Due to the railroad tracks and the tollway, there is no overland flow outlet for the low-lying area along Park Avenue.
Brynhaven Subdivision
XP-SWMM Simulated July 2010 Inundation Area

VOLUME = 2 AC-FT
During the July 2010 storm event, significant street and yard ponding occurred along Park Avenue. There was approximately 1.2 ft of street/yard ponding at this location.

Two homes are within the July 2010 inundation area.

Street ponding occurs for storm events greater than the 50-year return interval.

Structural flooding for two homes occurs during storm events equal to or greater than the 100-year return interval.

*Based on Lowest Adjacent Grade taken from DuPage County topography and SWMM analysis
Brynhaven Study Area - Alternative #1
(Combined with Pine Street Alternative #2)

Pine Street Alternative #2 improvements **AND**:  

Provide 5 ac-ft of additional storage volume in Golden Meadows Park (average depth of excavation = 8 ft).

Construct 400 LF of relief sewer from Park Avenue to Golden Meadows Park storage area.

Provides 100-year level of flood protection for Brynhaven, Pine Street and Avon Avenue (removes 22 homes from 100-year inundation area).

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**Project Cost (Dry-bottom basin)** = $890,000*

**Project Cost (Underground storage)** = $2,480,000*

*In addition to cost of Pine Street Alternative #2
Construct 3 ac-ft of additional flood storage volume on open parcel (average depth of excavation = 22 ft).

Construct 350 LF of relief sewer from Park Avenue to proposed flood storage area.

Increases level of flood protection from 25-year to 100-year return interval (removes 2 homes from 100-year inundation area).

Project Cost (Dry-bottom basin) = $1,670,000

Project Cost (Underground storage) = $2,620,000
Geneva Avenue is a low area in the middle of an overland flow path toward East End Park. Overland flow from the west is blocked by the houses on the east side of the street. As East End Park fills up, houses experience flooding from the east.
Geneva Avenue Study Area
XP-SWMM Simulated July 2010 Inundation Area

VOLUME = 12 AC-FT

EAST END PARK
Based on computer modeling, 9 homes are within July 2010 inundation area along Geneva Avenue*.

Street ponding occurs for storm events greater than the 25-year return interval.

Structural flooding occurs for storm events greater than the 25-year return interval*.

- At the low area along Geneva Avenue, 5 to 8 homes are flooded from storm events between the 50 and 100-year return interval.

*Based on Lowest Adjacent Grade taken from DuPage County topography and SWMM analysis
Geneva Avenue Study Area - Alternative #1

Provide 4 ac-ft of additional storage volume in East End Park (average depth of excavation = 3 ft)

Construct 950 LF of relief sewer from Geneva Avenue to East End Park storage basin.

Increases level of flood protection from 25-year to 100-year return interval (removes 8 homes from 100-year inundation area).

Project Cost (Dry-bottom basin) = $1,300,000
Project Cost (Underground storage) = $3,890,000
Overview of Southwest Study Areas
North and South Study Areas
During intense storm events when the capacities of the inlets/storm sewers are exceeded, the flow of stormwater does not follow the storm sewer drainage boundaries (yellow lines) but rather the overland flow routes (red arrows) toward the low-lying areas.

The storm sewer inlets in the low areas may see stormwater runoff from areas that are 10-20 times the size of the tributary area that they were designed to handle.

Following slides illustrate inundation locations for the July 2010 storm event. The flood prone areas have been labeled A, B, C, D, and E for future reference.
Southwest Study Area (South Side)
XP-SWMM Simulated July 2010 Inundation Area

Volume = 36 AC-FT

Volume = 11 AC-FT
Southwest Study Area (North Side)

XP-SWMM Simulated July 2010 Inundation Area

VOLUME = 10 AC-FT

VOLUME = 12 AC-FT

VOLUME = 8 AC-FT
Southwest Study Areas
Existing Conditions Summary

<table>
<thead>
<tr>
<th>Problem Area ID</th>
<th>Problem Area Location</th>
<th>Number of Homes Within July 2010 Inundation Area*</th>
<th>Depth of Flooding (ft)**</th>
<th>Existing Level of Flood Protection***</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Spring Rd &amp; Harrison St</td>
<td>17</td>
<td>1.9</td>
<td>5-year</td>
</tr>
<tr>
<td>B</td>
<td>Saylor Ave &amp; Jackson Ave</td>
<td>65</td>
<td>2.0</td>
<td>5-year</td>
</tr>
<tr>
<td>C</td>
<td>Vallette St &amp; Swain Ave</td>
<td>94</td>
<td>1.6</td>
<td>2-year</td>
</tr>
<tr>
<td>D</td>
<td>Washington St</td>
<td>62</td>
<td>2.0</td>
<td>5-year</td>
</tr>
<tr>
<td>E</td>
<td>Crescent Ave &amp; Cambridge Ave</td>
<td>13</td>
<td>1.8</td>
<td>10-year</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>251</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Based on Lowest Adjacent Grade from DuPage County topography and surveyed elevations
**Measured from low point in street
***Flood frequency at which no structures are damaged
### Southwest Study Areas

#### Existing Level of Protection

<table>
<thead>
<tr>
<th>Problem Area ID</th>
<th>Problem Area Location</th>
<th>Number of Homes Flooded Per Flood Frequency*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2-Year</td>
</tr>
<tr>
<td>A</td>
<td>Spring Rd &amp; Harrison St</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>Saylor Ave &amp; Jackson Ave</td>
<td>0</td>
</tr>
<tr>
<td>C</td>
<td>Vallette St &amp; Swain Ave</td>
<td>0</td>
</tr>
<tr>
<td>D</td>
<td>Washington St</td>
<td>0</td>
</tr>
<tr>
<td>E</td>
<td>Crescent Ave &amp; Cambridge Ave</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL</strong></td>
<td>0</td>
</tr>
</tbody>
</table>

*Based on Lowest Adjacent Grade from DuPage County topography, surveyed elevations, and SWMM analysis. Note that for some basins the 100-year critical duration storm produced higher elevations than the surveyed July 2010 storm event elevation. Thus there are more homes flooded in the modeled 100-year event."
In the identified flood problem areas in Southwest Elmhurst, there are 57 homes with reverse-slope driveways.
Reverse-Slope Driveways

• Of the 65 homes shown to be flooded in July 2010 (Saylor & Jackson Flood Problem Area B), 21 of them have reverse-slope driveways.

• The majority of the impacted homes are concentrated along Parkside and Prospect Avenue, between Jackson Street and Butterfield Road.

• As shown in the table below, these homes begin to flood from the curb overtopping during storm events equal to a 10-year flood frequency.

<table>
<thead>
<tr>
<th>Problem Area ID</th>
<th>Problem Area Location</th>
<th>Number of Homes Flooded Per Flood Frequency*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2-Year</td>
</tr>
<tr>
<td>B</td>
<td>Saylor Ave &amp; Jackson Ave</td>
<td>0</td>
</tr>
</tbody>
</table>

*Based on surveyed elevations
Southwest Study Area (South) - Alternative #1

Areas B, D, and E

Provide 65 acre-feet (AF) of gravity-drained flood storage at:
- York Commons Park (36 AF, 6 ft of excavation)
- Early Childhood Elementary School (6 AF, 8 ft of excavation)
- Bryan Middle School (18 AF, 8 ft of excavation)
- Christ United Methodist Church (2 AF, 3 ft of excavation)
- Jackson Elementary School (3 AF, 3 ft of excavation)

Construct 6,100 linear feet of relief sewers to convey floodwaters to flood storage.

Removes 150 homes out of 205 from 100-year inundation area (Areas B, D, and E).

Project Cost (Dry-bottom basins) = $6,910,000
Project Cost (Underground storage) = $27,260,000
## Southwest Study Areas
### Alternative #1 – Simulated Level of Flood Protection

<table>
<thead>
<tr>
<th>Problem Area ID</th>
<th>Problem Area Location</th>
<th>Number of Homes Flooded Per Flood Frequency*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2-Year</td>
</tr>
<tr>
<td>B</td>
<td>Saylor Ave &amp; Jackson Ave</td>
<td>0</td>
</tr>
<tr>
<td>D</td>
<td>Washington St</td>
<td>0</td>
</tr>
<tr>
<td>E</td>
<td>Crescent Ave &amp; Cambridge Ave</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

*Based on Lowest Adjacent Grade from DuPage County topography, surveyed elevations, and SWMM analysis.
Gravity flood storage areas and relief sewers from Alternative #1 **AND:**

Upsize trunk sewers along Jackson Street, Madison Street, and Hillside Avenue (7,900 LF).

Upsize pump capacities at Jackson Street and Berkeley & Adams pump stations*.

Removes 193 homes out of 205 from 100-year inundation area (Areas B, D, and E).

**Project Cost (Dry-bottom basins) = $26,100,000**

**Project Cost (Underground storage) = $46,450,000**

*Mitigating storage must be provided and is not included in cost.
## Southwest Study Areas
### Alternative #2 – Level of Flood Protection

<table>
<thead>
<tr>
<th>Problem Area ID</th>
<th>Problem Area Location</th>
<th>2-Year</th>
<th>5-Year</th>
<th>10-Year</th>
<th>25-Year</th>
<th>50-Year</th>
<th>100-Year</th>
</tr>
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<tbody>
<tr>
<td>B</td>
<td>Saylor Ave &amp; Jackson Ave</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1**</td>
<td>1**</td>
<td>1**</td>
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<tr>
<td>D</td>
<td>Washington St</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1**</td>
<td>11**</td>
</tr>
<tr>
<td>E</td>
<td>Crescent Ave &amp; Cambridge Ave</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>12</td>
</tr>
</tbody>
</table>

* Based on Lowest Adjacent Grade from DuPage County topography, surveyed elevations, and SWMM analysis.

** Individual house flood proofing is option due to shallow flood depths
Southwest Study Area (South) - Alternative #3
Provides 100-Year Level of Protection for Problem Area A

Upsize 1,250 LF of existing storm sewer along Harrison Street.

Increase pumping capacity at Harrison Street station.

100-year level of flood protection at Spring Road and Harrison Street.

Removes all 17 homes from 100-year inundation area.

Requires off-site compensatory storage to mitigate increased flows to Salt Creek, which is not included in cost.

Project Cost = $3,730,000
### Southwest Study Areas
### Alternative #3 Summary

<table>
<thead>
<tr>
<th>Problem Area ID</th>
<th>Problem Area Location</th>
<th>Number of Homes Flooded Per Flood Frequency*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2-Year</td>
</tr>
<tr>
<td>A</td>
<td>Spring Rd &amp; Harrison St</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

*Based on Lowest Adjacent Grade taken from DuPage County topography and SWMM analysis.
Southwest Study Area - Alternative #4

Provides 100-Year Level of Protection for Problem Area C

Construct 3,000 linear feet of relief sewer along Swain and McKinley Avenue to the pump station.

Upsize 1,200 LF of storm sewer along Swain Ave.

Increase capacity of McKinley Avenue pumping station*.

100-year level of flood protection for Swain Ave/Vallette St for all but 7 homes in area (removes 87 of 94 homes from 100-year inundation area).

Project Cost = $11,530,000

*Requires off-site compensatory storage to mitigate increased flows to Salt Creek, which is not included in cost.
## Southwest Study Areas Alternative #4 Summary

<table>
<thead>
<tr>
<th>Problem Area ID</th>
<th>Problem Area Location</th>
<th>Number of Homes Flooded Per Flood Frequency*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2-Year</td>
</tr>
<tr>
<td>C</td>
<td>Vallette St &amp; Swain Ave</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

*Based on Lowest Adjacent Grade taken from DuPage County topography and SWMM analysis

**Individual house flood proofing is option due to shallow flood depths
## Compensatory Storage Analysis

<table>
<thead>
<tr>
<th>Alternative ID</th>
<th>Pump Station Location</th>
<th>Capacity (cfs)</th>
<th>Storage volume required to mitigate downstream impacts* (ac-ft)</th>
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<tbody>
<tr>
<td></td>
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<td>Existing</td>
<td>Proposed</td>
</tr>
<tr>
<td>SW Alternative #2</td>
<td>Berkeley &amp; Adams</td>
<td>147</td>
<td>213</td>
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<tr>
<td></td>
<td>Jackson Street</td>
<td>134</td>
<td>236</td>
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<tr>
<td>SW Alternative #3</td>
<td>Harrison Street</td>
<td>45</td>
<td>125</td>
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<tr>
<td>SW Alternative #4</td>
<td>McKinley Avenue</td>
<td>134</td>
<td>290</td>
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<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>460</strong></td>
<td><strong>864</strong></td>
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</tbody>
</table>

*Based on Salt Creek FEQ hydraulic analysis  
** Eldridge Park Reservoir has 50 ac-ft available
Mitigation for Increased Pumping

- All increases must be mitigated (no Salt Creek water surface elevation increase) and must be permitted by State and County.

- It may be possible to use some excess storage in the Eldridge Park Reservoir but that still has to be evaluated.

- An open parcel located downstream could be purchased and storage created.

- The quarry operation could be modified to compensate for the increased flow.
Larch Avenue between Fremont Avenue and Armitage Avenue is a low-lying area with a single 15-inch pipe outlet and no overland flow path.
Larch Avenue Study Area
XP-SWMM Simulated July 2010 Inundation Area

VOLUME = 2 AC-FT
Larch Avenue Study Area
Existing Conditions Summary

- July 2010 storm event
  - Street ponding (approximately 0.3 feet) occurred at Larch Avenue.
  - Jaycee Tot Lot (approximately 1.8 feet) experienced flooding.
  - 3 homes along Addison Avenue*

- Jaycee Tot Lot ponding occurs for storm events greater than the 2-year return interval.

- Street ponding occurs for storm events greater than the 25-year return interval.

*Based on Lowest Adjacent Grade taken from DuPage County topography and SWMM analysis.
Reconfigure existing storage basins to provide additional 7 acre-feet of flood storage.

Construct 1,400 LF of relief sewers with backflow preventer to convey flow from Larch Avenue to south basin.

Upsize 300 LF of storm sewer along Addison Avenue and outlet to south storage basin.

Increases level of flood protection from 50-year to 100-year (removes 3 homes from 100-year inundation area).

Project Cost (Dry-bottom basin) = $1,800,000
Project Cost (Underground storage) = $3,970,000
An area of 157 acres drains to the storage basins of I-290 via storm sewer and overland flow. A single 24-inch pipe outlets the north storage basin. When the storage capacity is exceeded, flow overtops York Street to the east.
York/I-290 Study Area
XP-SWMM Simulated July 2010 Inundation Area

VOLUME = 29 AC-FT
York/I-290 Study Area  
Existing Conditions Summary

- During the July 2010 storm event, there was approximately 1 foot of street ponding at York Road south of Crestview Avenue and the York Road exit ramp off of I-290 west.

- Street flooding occurs for storm events greater than the 50-year return interval.
York/I-290 Study Area - Alternative #1

Reconfigure existing storage areas to provide additional 6 ac-ft of storage volume.

Increases level of flood protection from 50-year to 100-year return interval (eliminates roadway flooding).

Project Cost (Dry-bottom basin) = $670,000
Project Cost (Underground storage) = $2,640,000
An area of 179 acres drains to the low spot located at Seminole and Cottage Hill via storm sewer and overland flow. A single 48-inch pipe outlets the low spot with no existing overland flow route.
During July 2010 storm event, significant street ponding (approximately 1 ft) occurred at Seminole and Cottage Hill Avenue.

- Three homes within July 2010 flood inundation area*.

Existing level of flood protection is the 25-year return interval.

- Street ponding occurs for storm events greater than the 25-year return interval.

- Structural flooding for 1 home occurs at 50-year return interval, 4 homes in 100-year inundation area*.

*Based on Lowest Adjacent Grade taken from DuPage County topography and SWMM analysis.
Seminole Study Area - Alternative #1

Construct gravity-drained flood storage facility (4 ac-ft) at Pioneer Park (average depth of excavation = 5 ft)

Construct 1,300 linear feet of relief sewer from intersection at Cottage Hill Ave & Seminole Ave to Pioneer Park.

Increases level of flood protection from 25-year to 100-year return interval (removes 4 homes from 100-year inundation area).

Project Cost (Dry-bottom basin) = $ 810,000

Project Cost (Underground storage) = $2,080,000
An area of 66 acres drains to the low spot located at Thomas St and Monterey Ave via storm sewer and overland flow. A single 15-inch pipe outlets the low spot with no existing overland flow route. The elevation of Salt Creek prevents positive drainage from this low-lying area.
Pick Subdivision – Flood Insurance Rate Map (FIRM)
Pick Subdivision Study Area
XP-SWMM Simulated July 2010 Inundation Area

VOLUME = 1 AC-FT
During the July 2010 storm event, significant yard and street flooding occurred at the low spot near Thomas Avenue and Monterey Avenue.

- Approximately 1.5 ft of flooding (measured from low point in rear yards).

- No structure flooding reported through flood questionnaires.

- Computer modeling shows one structure flooded during the 100-year flood frequency.

- Street flooding occurs at Thomas Ave & Monterey Avenue for storm events greater than the 5–year return interval.
Pick Study Area - Alternative #1

Upsize existing storm sewers and outlet to depressional area (560 LF)

Construct 60-cfs pump station to Salt Creek*.

Provides 100-year level of protection for all tailwater conditions.

Increases level of flood protection from 10-year to 100-year return interval (removes 1 home from 100-year inundation area).

**Project Cost = $3,010,000**

*Requires off-site compensatory storage to mitigate increased flows to Salt Creek and land costs were not included in project cost.
Pick Study Area - Alternative #2

Upsize existing outlet from depressional area (160 LF).

Provide 1 ac-ft of underground storage in oversized pipes (1,200 LF).

Eliminates street flooding for storm events under 10-year frequency.

Increases level of flood protection from 5-year to 10-year return interval.

Project Cost = $1,570,000
Provide 4 ac-ft of flood storage (underground) in rear yards of homes*.

Construct small pump station to outlet underground storage area.

Increases level of flood protection from 10-year to 100-year return interval (removes 1 home from 100-year inundation area).

Project Cost = $2,340,000

*Land costs were not included in project cost.
There is a low spot at Butterfield Road and Chatham Avenue, near the entrance to the subdivision. When the 48-inch Butterfield Road storm sewer surcharges, stormwater flows overland down Chatham Avenue into the subdivision. Stormwater runoff from the neighborhood drains to the detention basin located south of Harrison Street, which has a pump/gravity combination outlet.
Yorkfield Study Area
XP-SWMM Simulated July 2010 Inundation Area

VOLUME = 9 AC-FT
During July 2010 storm event, street ponding (approximately 0.4 ft) at Yorkfield & Chatham Avenue.

- Approximately 9 homes within July 2010 flood inundation area*.
- 5 homes with reverse-slope driveways.

Existing level of flood protection is a 25-year return interval.

- Street flooding at Yorkfield Avenue for storm events greater than 25-year return interval.
- Structural flooding occurs for storm events greater than the 25-year return interval*.

*Based on Lowest Adjacent Grade taken from DuPage County topography, surveyed elevations, and SWMM analysis.
Yorkfield Study Area - Alternative #1

Expand Harrison Street detention basin onto adjacent vacant lot (additional 5 acre-feet of flood storage, average depth of excavation = 8 ft).

Construct 400 linear feet of relief sewer from Yorkfield Avenue to detention basins.

Construct equalizer pipe between storage basins.

Increases level of flood protection from 25-year to 100-year return interval (11 homes removed from 100-year inundation area).

**Project Cost (Dry-bottom basin) = $ 710,000**

**Project Cost (Underground storage) = $2,290,000**

*Cost does not include land acquisition.*
Yorkfield Study Area - Alternative #2

Expand Harrison Street detention basin using retaining walls and excavation (additional 5 ac-ft).

Construct 400 linear feet of relief sewer from Yorkfield Avenue to detention basin.

Increases level of flood protection from 25-year to 100-year return interval (11 homes removed from 100-year inundation area).

Project Cost = $1,880,000
# Summary of Proposed Alternatives

<table>
<thead>
<tr>
<th>Alternative ID</th>
<th># of Homes Removed</th>
<th>Cost*</th>
<th>Proposed Level of Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pine Street #1</td>
<td>16</td>
<td>$1,650,000</td>
<td>50-Year</td>
</tr>
<tr>
<td>Pine Street #2</td>
<td>20</td>
<td>$2,560,000</td>
<td>100-Year</td>
</tr>
<tr>
<td>Southwest #1</td>
<td>162</td>
<td>$6,910,000</td>
<td>5- through 100-Year</td>
</tr>
<tr>
<td>Southwest #2</td>
<td>215</td>
<td>$26,100,000</td>
<td>100-Year</td>
</tr>
<tr>
<td>Southwest #3</td>
<td>17</td>
<td>$3,730,000</td>
<td>100-Year</td>
</tr>
<tr>
<td>Southwest #4</td>
<td>87</td>
<td>$11,530,000</td>
<td>100-Year</td>
</tr>
<tr>
<td>Geneva Ave #1</td>
<td>8</td>
<td>$1,300,000</td>
<td>100-Year</td>
</tr>
<tr>
<td>Brynhaven #1</td>
<td>22</td>
<td>$3,450,000</td>
<td>100-Year</td>
</tr>
<tr>
<td>Brynhaven #2</td>
<td>2</td>
<td>$1,670,000</td>
<td>100-Year</td>
</tr>
<tr>
<td>Larch #1</td>
<td>3</td>
<td>$1,800,000</td>
<td>100-Year</td>
</tr>
</tbody>
</table>

*Assuming above-ground storage
## Summary of Proposed Alternatives, cont.

<table>
<thead>
<tr>
<th>Alternative ID</th>
<th># of Homes Removed</th>
<th>Cost*</th>
<th>Proposed Level of Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seminole #1</td>
<td>4</td>
<td>$810,000</td>
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<tr>
<td>Pick #1</td>
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<td>$3,010,000</td>
<td>100-Year</td>
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<tr>
<td>Pick #2</td>
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<td>10-Year</td>
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<tr>
<td>Pick #3</td>
<td>1</td>
<td>$2,340,000</td>
<td>100-Year</td>
</tr>
<tr>
<td>York St/I-290 #1</td>
<td>0</td>
<td>$670,000</td>
<td>100-Year</td>
</tr>
<tr>
<td>Yorkfield #1</td>
<td>11</td>
<td>$710,000</td>
<td>100-Year</td>
</tr>
<tr>
<td>Yorkfield #2</td>
<td>11</td>
<td>$1,880,000</td>
<td>100-Year</td>
</tr>
</tbody>
</table>

*Assuming above-ground storage
Individual House Flood Proofing

• Alternative to large public drainage improvements.
• Homes with shallow flooding candidates for flood proofing.
• Determined flood proofing measures for a sample of homes.
• Determined average cost of $10,000 per home.
• Flood proofing measures can include:
  • Installation of glass block windows
  • Raising window wells
  • Installation of waterproof window well covers
  • Regrading of sidewalks/driveways
  • Retaining walls
### Flood Proofing Per Study Area

<table>
<thead>
<tr>
<th>Study Area</th>
<th># of Flood Proofing Candidates*</th>
<th>Average Flood Proofing Estimate ($/home)</th>
<th>Total Study Area Flood Proofing Estimate ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pine Street</td>
<td>5</td>
<td>10,000</td>
<td>50,000</td>
</tr>
<tr>
<td>Geneva Avenue</td>
<td>9</td>
<td>10,000</td>
<td>90,000</td>
</tr>
<tr>
<td>Spring/Harrison Area</td>
<td>4</td>
<td>10,000</td>
<td>40,000</td>
</tr>
<tr>
<td>Washington Street</td>
<td>31</td>
<td>10,000</td>
<td>310,000</td>
</tr>
<tr>
<td>Saylor/Jackson Street</td>
<td>67</td>
<td>10,000</td>
<td>670,000</td>
</tr>
<tr>
<td>Crescent Avenue</td>
<td>36</td>
<td>10,000</td>
<td>360,000</td>
</tr>
<tr>
<td>Swain.Vallette Avenue</td>
<td>79</td>
<td>10,000</td>
<td>790,000</td>
</tr>
<tr>
<td>Larch Avenue</td>
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<td>30,000</td>
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<tr>
<td>Seminole Avenue</td>
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<td>10,000</td>
<td>40,000</td>
</tr>
<tr>
<td>York Street at I-290</td>
<td>0</td>
<td>10,000</td>
<td>0</td>
</tr>
<tr>
<td>Brynhaven Subdivision</td>
<td>2</td>
<td>10,000</td>
<td>20,000</td>
</tr>
<tr>
<td>Pick Subdivision</td>
<td>0</td>
<td>10,000</td>
<td>0</td>
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<tr>
<td>Butterfield Road Area (Yorkfield)</td>
<td>6</td>
<td>10,000</td>
<td>60,000</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>246</strong></td>
<td><strong>---</strong></td>
<td><strong>2,460,000</strong></td>
</tr>
</tbody>
</table>

*Homes with less than one foot of flooding depth*
# Comparison of Costs

## Drainage Improvements vs Flood Proofing

<table>
<thead>
<tr>
<th>Alternative ID</th>
<th>Proposed Improvements</th>
<th>Flood Proofing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td># of Homes Removed</td>
<td>Cost ($/home)</td>
</tr>
<tr>
<td>Southwest #1</td>
<td>162</td>
<td>$42,700</td>
</tr>
<tr>
<td>Southwest #2</td>
<td>215</td>
<td>$121,400</td>
</tr>
<tr>
<td>Southwest #3</td>
<td>17</td>
<td>$219,500</td>
</tr>
<tr>
<td>Southwest #4</td>
<td>87</td>
<td>$132,600</td>
</tr>
<tr>
<td>Pine Street #1</td>
<td>16</td>
<td>$103,200</td>
</tr>
<tr>
<td>Pine Street #2</td>
<td>20</td>
<td>$128,000</td>
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<tr>
<td>Geneva Ave #1</td>
<td>8</td>
<td>$162,500</td>
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<td>Larch Ave #1</td>
<td>3</td>
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<tr>
<td>Brynhaven #1</td>
<td>22**</td>
<td>$156,900</td>
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<td>Brynhaven #2</td>
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<td>$3,010,000</td>
</tr>
<tr>
<td>Pick #3</td>
<td>1</td>
<td>$2,340,000</td>
</tr>
<tr>
<td>Seminole #1</td>
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<td>Yorkfield #1</td>
<td>11</td>
<td>$64,600</td>
</tr>
<tr>
<td>Yorkfield #2</td>
<td>11</td>
<td>$171,000</td>
</tr>
</tbody>
</table>

*Assuming above-ground flood storage and does not include land costs or mitigating storage.

**Includes homes in Pine Street and Brynhaven study areas
Backup Power – Stormwater Pumping Stations

- Of the stormwater pumping stations on Salt Creek, only the Berkeley & Adams pump station has a standby generator. The other pump stations have dual ComEd feeds.

- To reduce the risk of pump failure during a power outage, it is recommended that standby generators be installed at these pump stations as well.

<table>
<thead>
<tr>
<th>Pump Station Location</th>
<th>Existing Capacity (cfs)</th>
<th>Estimated Cost Standby Generator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harrison Street</td>
<td>45</td>
<td>$350,000</td>
</tr>
<tr>
<td>Jackson Street</td>
<td>134</td>
<td>$475,000</td>
</tr>
<tr>
<td>McKinley Avenue</td>
<td>134</td>
<td>$550,000</td>
</tr>
<tr>
<td>Randolph &amp; West</td>
<td>182</td>
<td>$600,000</td>
</tr>
</tbody>
</table>
Redeveloped Properties Analysis

- Hydrologic analysis of 16 recently redeveloped properties throughout City (shown right)
- Modeled using US Army Corps of Engineers HEC-HMS Hydrologic Model (Version 3.5)
- Objective to quantify effect of direct connections on peak flowrates and runoff volumes for various storm durations and frequency (including July 2010)
Example – Redeveloped Property

**Pre-Construction**
- Impervious: 43%
- Pervious: 57%

**Post-Construction**
- Impervious: 42%
- Pervious: 58%

**Pre-Construction:**
- Long driveway
- Garage in rear
- Smaller house
- Downspouts drain overland to yard

**Post-Construction:**
- Shorter driveway
- Attached garage
- Larger house
- Storm drains and overland flow swales in yard
- Downspouts directly connected to storm sewer
Study Findings:

- Total impervious area of lot remained relatively unchanged from pre- and post-redevelopment (average change of 3% per lot).

- Average increase in directly connected impervious area (DCIA) of 32%
  - DCIA = direct runoff to stormwater collection system (no infiltration).

- Due to storm sewer inlets and drainage swales, time of concentration is reduced, resulting in increased flows to stormwater collection system.

- Significant increases in flowrates and runoff volume for more frequent, high intensity storm events.

- Less significant increases in flowrates and runoff volume for larger magnitude, low intensity storm events.
## Average Increase in Flowrate, Q (%) Pre- to Post-Construction

<table>
<thead>
<tr>
<th>Return Interval</th>
<th>1-Hour Storm Duration</th>
<th>6-Hour Storm Duration</th>
<th>24-Hour Storm Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>202</td>
<td>110</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>131</td>
<td>61</td>
<td>6</td>
</tr>
<tr>
<td>10</td>
<td>58</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>100</td>
<td>28</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>July 2010</td>
<td>12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Average Increase in Runoff Volume, V (%) Pre- to Post-Construction

<table>
<thead>
<tr>
<th>Return Interval</th>
<th>1-Hour Storm Duration</th>
<th>6-Hour Storm Duration</th>
<th>24-Hour Storm Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>46</td>
<td>29</td>
</tr>
<tr>
<td>2</td>
<td>73</td>
<td>33</td>
<td>21</td>
</tr>
<tr>
<td>10</td>
<td>39</td>
<td>18</td>
<td>11</td>
</tr>
<tr>
<td>100</td>
<td>16</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>July 2010</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Analysis of Basement Depth

• From 16 properties used in redevelopment analysis, average building footprint increased by about 1,200 ft².

• Assuming redeveloped basement is 2 feet deeper than existing conditions, the average home displaces a minimum of 1,052 ft³ of groundwater.

• In addition to the displaced groundwater volume, there are increased discharges resulting from sump pumps running more frequently.
City Ordinance Recommendations

1) Modify Building and Plumbing Code (Sections 24.23 and 27.30) regarding direct connections:
   • Require downspouts and sump pumps to discharge overland to rain garden on subject property.
   • Require installation of storm drain to convey flows in excess of rain garden capacity.
   • Rain garden shall be at least fifteen (15) feet away from building.

2) Add new section to Building Code that addresses the groundwater volume displaced by larger/deeper basements. Storage may be provided in rain garden, underground pipe, void space of gravel, or a combination of these.

3) Modify Chapter 7 of Zoning Ordinance to specify maximum impervious percentage per lot.
Rain garden should be located at least 15 feet away from building foundation and outside the zone of influence of the sanitary sewer.
Rain Garden Example
Flood Protection for New Structures

• Require new construction in flood-prone areas to be elevated to two (2) feet above XP-SWMM 100-year flood elevation.

• Parcel-Flood Elevation Database
  • Correlates parcel address to 100-year flood elevation.
  • GIS database of parcels for incorporation into City database.

• Incorporate Flood Protection System into City Ordinance (Section 14.05).