City of Elmhurst Comprehensive Flooding Plan City Council Meeting



Prepared by CBBEL RJN Group

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.

Storm Sewer Study Area ID	Area Description		
1	Pine Street		
2	Geneva Avenue		
3	York St to Salt Creek between McKinley Ave and Butterfield Rd		
4	York St to Salt Creek between McKinley Ave and II Prairie Path		
5	Larch Avenue		
6	Seminole Avenue		
7	York Street at I-290		
8	Brynhaven Subdivision		
9	Pick Subdivision		
10	Butterfield Road Area (Yorkfield)		



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

Computer Modeling of Ten Study Areas

- 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 flowrates 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 10year 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.

Recurrence interval in years	Probability of occurrence in any given year	Percent chance of occurrence in any given year	
100	1 in 100	1	
10	1 in 10	10	
5	1 in 5	20	
2	1 in 2	50	

Critical Duration Analysis

- 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
- Invert and rim elevations
- Diameter
 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



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XP-SWMM Model Calibration

- 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



Level of Protection



• The low-entry elevation of this house is greater than the 50-year flood elevation but less than the 100year 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



Flood Storage Examples



Dry-Bottom Detention Basin



Wet-Bottom Detention Basin



Underground Detention

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 <u>not</u> 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



Pine Street Study Area Existing Conditions Summary

- 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 50yr (16 homes) on Pine St. and Avon Ave.

Project Cost (Dry-bottom basin) = \$1,650,000 Project Cost (Underground storage) = \$3,810,000

Pine Street Study Area - Alternative #2 100-Year Level of Protection



Project Cost (Dry-bottom basin) = \$2,560,000 Project Cost (Underground storage) = \$7,970,000 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).

Overview of Brynhaven Subdivision Study Area 116 Pipe System



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



Brynhaven Subdivision Study Area Existing Conditions Summary

- 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)



Project Cost (Dry-bottom basin) = \$890,000* Project Cost (Underground storage) = \$2,480,000* *In addition to cost of Pine Street Alternative #2 Pine Street Alternative #2 improvements <u>AND</u>:

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 100year inundation area).

Brynhaven Study Area - 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 100year inundation area).

Project Cost (Dry-bottom basin) = \$ 1,670,000 Project Cost (Underground storage) = \$2,620,000

Overview of Geneva Avenue Study Area 116 Pipe System



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



Geneva Avenue Study Area Existing Conditions Summary

- 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 100year 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



Overview of Southwest 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



Southwest Study Area (North Side) XP-SWMM Simulated July 2010 Inundation Area



Southwest Study Areas Existing Conditions Summary

Problem Area ID	Problem Area Location	Number of Homes Within July 2010 Inundation Area*	Depth of Flooding (ft)**	Existing Level of Flood Protection***
А	Spring Rd & Harrison St	17	1.9	5-year
В	Saylor Ave & Jackson Ave	65	2.0	5-year
С	Vallette St & Swain Ave	94	1.6	2-year
D	Washington St	62	2.0	5-year
E	Crescent Ave & Cambridge Ave	13	1.8	10-year
TOTAL		251		

*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

Problem	Problem Area Location	Number of Homes Flooded Per Flood Frequency*							
Area ID		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year		
А	Spring Rd & Harrison St	0	0	13	13	15	17		
В	Saylor Ave & Jackson Ave	0	0	4	11	47	104		
С	Vallette St & Swain Ave	0	5	7	55	80	94		
D	Washington St	0	0	13	30	53	63		
E	Crescent Ave & Cambridge Ave	0	0	0	3	10	38		
	TOTAL	0	5	37	112	205	316		

*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.

Reverse-Slope Driveway Location Map



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.

Problem	Problem Area	Number of Homes Flooded Per Flood Frequency*						
Area ID	Location	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	
В	Saylor Ave & Jackson Ave	0	0	3	5	22	32	

*Based on surveyed elevations

Southwest Study Area (South) - Alternative #1 Areas B, D, and E



Project Cost (Dry-bottom basins) = \$6,910,000 Project Cost (Underground storage) = \$27,260,000

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). 40

Southwest Study Areas Alternative #1 – Simulated Level of Flood Protection

Problem	Problem Area Location	Number of Homes Flooded Per Flood Frequency*							
Area ID		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year		
В	Saylor Ave & Jackson Ave	0	0	0	7	8	14		
D	Washington St	0	0	0	15	31	41		
E	Crescent Ave & Cambridge Ave	0	0	0	0	0	0		
TOTAL		0	0	0	22	39	55		

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

Southwest Study Area (South) - Alternative #2 Provides 100-Year Level of Protection for Problem Areas B, D & E



Gravity flood storage areas and relief sewers from Alternative #1 <u>AND</u>:

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 <u>not</u> included in cost

Southwest Study Areas Alternative #2 – Level of Flood Protection

Problem	Problem Area Location	Number of Homes Flooded Per Flood Frequency*							
Area ID		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year		
В	Saylor Ave & Jackson Ave	0	0	0	1**	1**	1**		
D	Washington St	0	0	0	0	1**	11**		
Е	Crescent Ave & Cambridge Ave	0	0	0	0	0	0		
TOTAL		0	0	0	1	2	12		

* 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 <u>not</u> included in cost.

Project Cost = \$3,730,000

Southwest Study Areas Alternative #3 Summary

Problem	Problem Area	Number of Homes Flooded Per Flood Frequency*							
Area ID Location	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year			
A	Spring Rd & Harrison St	0	0	0	0	0	0		
	TOTAL	0	0	0	0	0	0		

*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 <u>not</u> included in cost.

Southwest Study Areas Alternative #4 Summary

Problem Area ID	Problem Area Location	Number of Homes Flooded Per Flood Frequency*						
		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	
С	Vallette St & Swain Ave	0	0	0	0	1**	7**	
TOTAL		0	0	0	0	1	7	

*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

Alternative	Pump Station	Сарас	tity (cfs)	Storage volume required to mitigate downstream	
ID	Location	Existing	Proposed	impacts* (ac-ft)	
SW Alternative #2	Berkeley & Adams	147	213	20	
	Jackson Street	134	236	30	
SW Alternative #3	Harrison Street	45	125	30	
SW Alternative #4	McKinley Avenue	134	290	34	
	TOTAL	460	864	114**	

*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.

Overview of Larch Avenue Study Area 39 Pipe System



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



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 25year return interval.

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

Larch Avenue Study Area Alternative #1



Reconfigure existing storage basins to provide additional 7 acrefeet 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

Overview of York Street/I-290 Study Area 39 Pipe System



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



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



Project Cost (Dry-bottom basin) = \$670,000 Project Cost (Underground storage) = \$2,640,000

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

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

Overview of Seminole Avenue Study Area 17 Pipe System



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.

Seminole Avenue Study Area XP-SWMM Simulated July 2010 Inundation Area



Seminole Avenue Study Area Existing Conditions Summary

- 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



Project Cost (Dry-bottom basin) = \$ 810,000 Project Cost (Underground storage) = \$2,080,000 Construct gravity-drained flood storage facility (4 acft) 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).

Overview of Pick Subdivision Study Area 14 Pipe System



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



Pick Subdivision Study Area Existing Conditions Summary

- 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 100year inundation area).

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Project Cost = \$3,010,000

*Requires off-site compensatory storage to mitigate increased flows to Salt Creek and land costs were <u>not</u> 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 10year return interval.

Project Cost = \$1,570,000

Pick Study Area - Alternative #3



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 100year inundation area).

Project Cost = \$2,340,000

*Land costs were <u>not</u> included in project cost.

Overview of Yorkfield Study Area 20 Pipe System



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



Yorkfield Study Area Summary – Existing Conditions

- 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 25year 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 100year 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



Project Cost = \$ 1,880,000

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 100year inundation area).

Summary of Proposed Alternatives

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

*Assuming above-ground storage

Summary of Proposed Alternatives, cont.

Alternative ID	# of Homes Removed	Cost*	Proposed Level of Protection
Seminole #1	4	\$810,000	100-Year
Pick #1	1	\$3,010,000	100-Year
Pick #2	0	\$1,570,000	10-Year
Pick #3	1	\$2,340,000	100-Year
York St/I-290 #1	0	\$670,000	100-Year
Yorkfield #1	11	\$710,000	100-Year
Yorkfield #2	11	\$1,880,000	100-Year

*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

Study Area	# of Flood Proofing Candidates*	Average Flood Proofing Estimate (\$/home)	Total Study Area Flood Proofing Estimate (\$)
Pine Street	5	10,000	50,000
Geneva Avenue	9	10,000	90,000
Spring/Harrison Area	4	10,000	40,000
Washington Street	31	10,000	310,000
Saylor/Jackson Street	67	10,000	670,000
Crescent Avenue	36	10,000	360,000
Swain/Vallette Avenue	79	10,000	790,000
Larch Avenue	3	10,000	30,000
Seminole Avenue	4	10,000	40,000
York Street at I-290	0	10,000	0
Brynhaven Subdivision	2	10,000	20,000
Pick Subdivision	0	10,000	0
Butterfield Road Area (Yorkfield)	6	10,000	60,000
Totals	246		2,460,000

*Homes with less than one foot of flooding depth

Comparison of Costs Drainage Improvements vs Flood Proofing

Alternetive ID	Proposed Improvements		Flood Proofing			
Alternative ID	# of Homes Removed	Cost (\$/home)	Total Cost*	# of Homes Removed	Cost (\$/home)	Total Cost
Southwest #1	162	\$42,700	\$6,910,000		\$10,000	\$2,170,000
Southwest #2	215	\$121,400	\$26,100,000	217		
Southwest #3	17	\$219,500	\$3,730,000	217		
Southwest #4	87	\$132,600	\$11,530,000			
Pine Street #1	16	\$103,200	\$1,650,000	5	\$10,000	\$50,000
Pine Street #2	20	\$128,000	\$2,560,000			
Geneva Ave #1	8	\$162,500	\$1,300,000	8	\$10,000	\$80,000
Larch Ave #1	3	\$600,000	\$1,800,000	3	\$10,000	\$30,000
Brynhaven #1	22**	\$156,900	\$3,450,000	7**	\$10,000	\$70,000
Brynhaven #2	2	\$835,000	\$1,670,000	2	\$10,000	\$20,000
Pick #1	1	\$3,010,000	\$3,010,000		N/A	N/A
Pick #3	1	\$2,340,000	\$2,340,000	0		
Seminole #1	4	\$202,500	\$810,000	4	\$10,000	\$40,000
Yorkfield #1	11	\$64,600	\$710,000	0	\$10,000	\$60,000
Yorkfield #2	11	\$171,000	\$1,880,000	6		

*Assuming above-ground flood storage and does <u>not</u> 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.

Pump Station Location	Existing Capacity (cfs)	Estimated Cost Standby Generator
Harrison Street	45	\$350,000
Jackson Street	134	\$475,000
McKinley Avenue	134	\$550,000
Randolph & West	182	\$600,000

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:

- 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

Redeveloped Properties Analysis

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.

Redeveloped Properties Analysis Summary of Results

Average Increase in Flowrate, Q (%) Pre- to Post-Construction						
Return	1-Hour Storm	6-Hour Storm 24-Hour Sto				
Interval	Duration	Duration	Duration			
1	202	110	10			
2	131	61	6			
10	58	18	1			
100	28	6	0			
July 2010	12					
Average Increase in	Average Increase in Runoff Volume, V (%) Pre- to Post-Construction					
Return	1-Hour Storm	6-Hour Storm	24-Hour Storm			
Interval	Duration	Duration	Duration			
1	100	46	29			
2	73	33	21			
10	39	18	11			
100	16	8	5			
July 2010	6					

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

- 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 Schematic



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).