EXECUTIVE SUMMARY

INTRODUCTION

The 2009 Crystal Lake Flooding Study recommended analysis of the following alternatives to address flooding for Area 4 south of the Lake and also areas along Crystal Creek.

- Control leakage from the Lake into the 24-inch Lakewood storm sewer under Crystal Creek
- Improve the minor (10-year) drainage system for Area 4 with storage downstream to mitigate higher flows.
- Increase Lake outlet capacity to lower the Crystal Lake floodplain elevations and improve drainage around the Lake.
- Improve culvert capacity under Country Club Road to remove properties from the floodplain and the floodway.
- Analyze flooding along Crystal Creek above St. Andrews Lane to develop specific alternatives to reduce flooding by removing existing flow restrictions.

The Crystal Creek Flooding Analysis was commissioned by the City in March 2009 to analyze the feasibility and approximate cost to implement the above recommendations.

POSSIBLE PROJECTS

Ten possible projects to improve flooding along Crystal Creek and around Crystal Lake were identified. Most of these projects were identified as possibilities in the Crystal Lake Flooding Study.

A. Submit a LOMR for Crystal Creek using the project model
B. Prepare a new hydrologic model for Crystal Lake watershed above Lake Avenue and submit LOMR
C. Investigate leakage into the Lakewood storm sewer
D. Larger culvert under Lake Avenue
E. Notch Lake outlet weir to 890.0 from current 890.9
F. Larger culvert under Country Club Road
G. Lower Crystal Creek five feet from Broadway Avenue to Edgebrook Drive
H. Add 10-year storm sewer system to Area 4 (Lakewood could connect in the future if they so choose)
I. Lower overland flow channel from Edgebrook Drive to St. Andrews Lane by 1.5 feet
J. Restore Crystal Creek to its original open channel from Edgebrook Drive to St. Andrews Lane
K. Storage on School District property

ALTERNATIVES

The eleven possible projects were developed into seven alternatives to address the above recommendations (Table E-1).

Alternative 1	Increase culvert capacity under Lake Avenue (Project D with A, B, F, I, K)
Alternative 2	Notch Crystal Lake weir along with Alternative 1 (D and E with A, B, C, F, I, K)
Alternative 3A	Increase culvert capacity under Country Club Road (F with A)
Alternative 3B	Submit for a Letter of Map Revision for a lower floodplain using new documentation (A)
Alternative 4	Add overland flow conveyance downstream of the 30-inch culvert at Edgebrook Drive (I with A, K)
Alternative 5	Add 10-year storm sewer for Area 4, lower Crystal Creek between Broadway Avenue and Edgebrook Drive and lower overflow at Edgebrook Drive (H, I, G with A, K)
Alternative 6	Add 10-year storm sewer for Area 4, lower Crystal Creek between Broadway Avenue and Edgebrook Drive and open the Creek to St. Andrews Lane (H, G, J with A, K)
Alternative 7	Combine Alternatives 1, 2, 3 and 4 with storage downstream (D, E, F, I, K with A, B, C)

Alternatives 1 through 6 were analyzed without the storage needed to mitigate for increased discharges so that the project impact could be seen. Storage needed to mitigate increased discharges was included in Alternative 7.

RESULTS

The analytical results are grouped by original Flooding Study options below. Conceptual cost estimates are provided in Table E-1.

Improve the minor drainage system for Area 4

The first benefit for Area 4 would come from fixing the Lake "leak" which should free up capacity in the Lakewood storm sewer. However, the existing Lakewood storm sewer capacity is small and can only handle storms less than the 1-year event.

Both Alternatives 5 and 6 would provide better drainage for 300 properties in Area 4 and Lakewood. Both alternatives would address Area 4 and Lakewood drainage complaints. Both alternatives would remove 40 properties from the Crystal Creek floodplain and 25 from the floodway. Alternative 5 is estimated to cost $4,702,000. Alternative 6 is estimated to cost $5,002,000.

Remove property and structures from the floodplain of Crystal Lake and improve drainage in Areas 1, 2 and 3

Alternative 1 (with Projects A, B, F, I and K) would lower the floodplain elevation of Crystal Lake from 892.6 to approximately 892.0. An estimated 200 properties would be removed from the floodplain. This alternative was estimated to cost $1,387,000 including storage and necessary downstream improvements. The enhanced XP-SWMM model needed for permitting with FEMA was included in this cost.

Alternative 2 would lower the weir at the outlet of the Lake to 890.0 from 890.9 and would be combined with Alternative 1. The lower weir would result in a floodplain elevation of approximately 891.55 for the Lake. An estimated 70 additional properties would be removed from the floodplain around the Lake. Drainage would be improved in Areas 1, 2 and 3 around the Lake as a result of stable lower water levels. This alternative would cost $76,000 in addition to Alternative 1 for a total of $1,463,000. The analysis of Lake levels indicated that if the "leak" were fixed, lowering the weir would not significantly affect Lake levels. Because the FIS hydrology model for Crystal Lake is missing, it was not possible to use it to assess the new floodplain elevation for the Lake that would result from this alternative. A new more detailed model is needed to replace the missing FIS model for any future permit submittals to implement these alternatives.

Remove property and structures from the floodway and floodplain of Crystal Creek above Country Club Road

The cost of new Country Club culverts (Alternative 3A) is estimated at $169,000. However, it may not be necessary. Alternative 3B, the XP-SWMM model used in this analysis, results in lower discharges and floodplain elevations two feet lower than the existing FIS floodplain mapping. The model would need to be enhanced for a submittal to FEMA for a LOMR. This alternative does not require any construction just better and more detailed model documentation. Implementation of either Alternative 3A or 3B results in the removal of 40 properties from the floodplain and 25 properties from the floodway. The cost of the FEMA LOMR submittal is estimated to be $35,000. A new model for Crystal Lake would add $25,000.

Decrease flooding between Country Club Road and Edgebrook Drive

Alternative 4 would decrease flooding on the Crystal Lake Country Club, address flooding complaints and remove properties from the floodplain in the reach of the Creek between Broadway Avenue and Edgebrook Drive. This alternative lowers the floodplain by 1.6 feet. It would remove approximately 30 properties from the floodplain between Country Club Road and St. Andrews Lane. Additional storage would still be needed on School District property to prevent increases in flow below St. Andrews Lane. This alternative is estimated to cost $1,089,000.

Combination of Flooding Study Options

Finally, Alternative 7 was evaluated to address all of the recommendations except the new storm sewer system. It included alternatives 1, 2, 3 and 4 and storage on School District property.

This alternative would provide the following benefits.

- Removal of over 260 properties from the floodplain
- Removal of over 40 properties from the floodway
- Stabilization of Lake levels
- Restoration of Lakewood storm sewer capacity
- Improved routine drainage around the Lake and along Crystal Creek
- Less frequent flooding of Country Club property

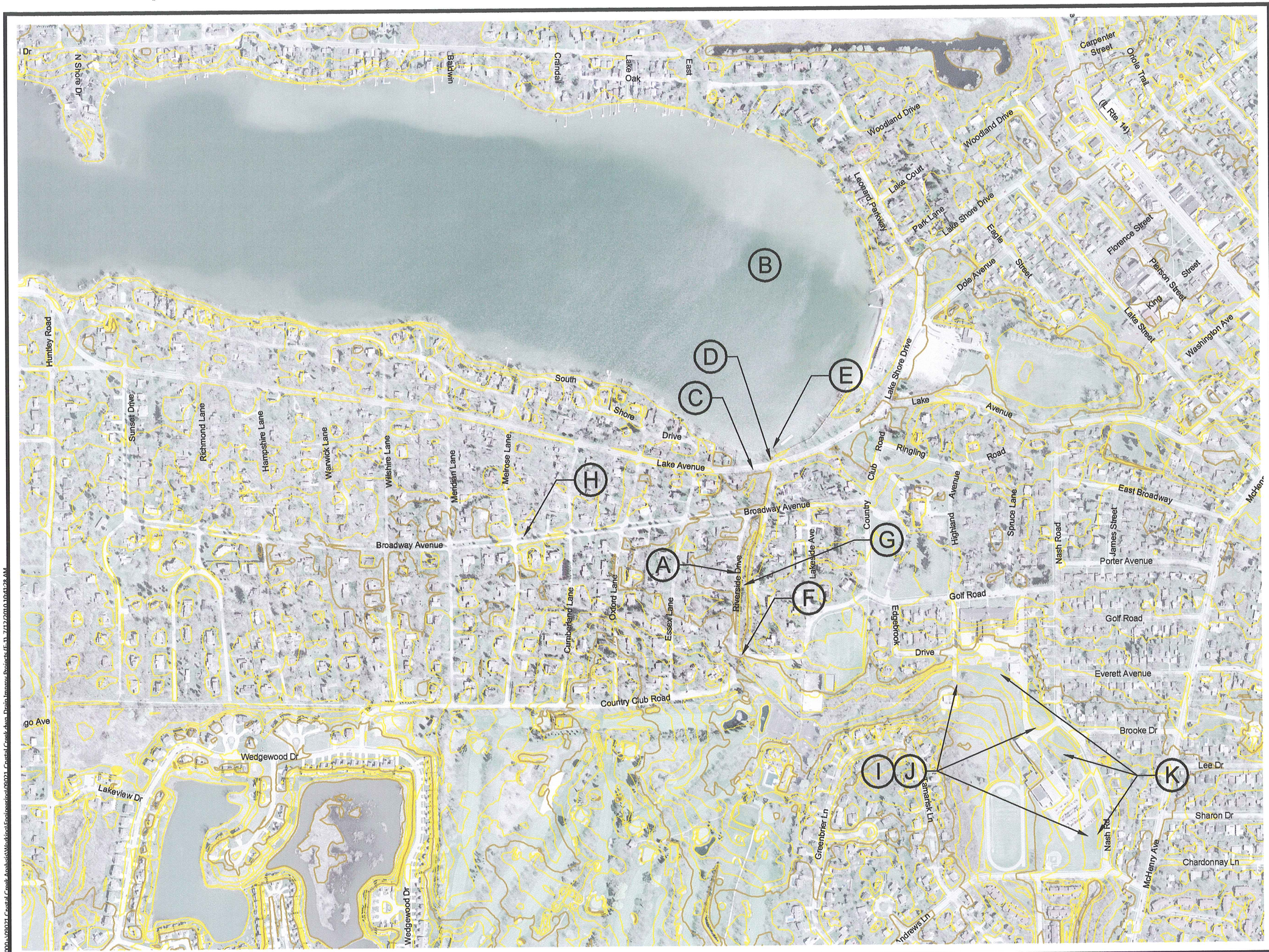
The estimated cost for Alternative 7 is $1,463,000.

RECOMMENDATION

It appears that the most cost-effective approach for the City to address flooding along Crystal Creek and around the Lake is as follows.

1. Submit a LOMR for Crystal Creek.
2. Implement Alternative 7. The steps to implement Alternative 7 would be as follows.
    a. Complete a hydrology model for Crystal Lake and additional documentation for the model prepared in this project and submit to FEMA for a LOMR.
    b. Meet again with the School District, the CLPD, residents and the Country Club to obtain input and support for the components of Alternative 7.
    c. Form a cooperative effort among the CLPD, Lakewood and the City to investigate the "leak" from Crystal Lake and fix it.
    d. Confirm easement requirements and utility conflicts.
    e. Complete preliminary engineering and submit a CLOMR for construction of a lower overflow channel through School District property from Country Club Road to St. Andrews Lane along with the storage needed for future alternatives.
    f. Complete final engineering, bid and construct the lower overflow channel and storage.
    g. Complete preliminary engineering and submit a CLOMR for larger culverts under Lake Avenue and Country Club Road and a lower weir elevation at the Lake outlet.
    h. Complete final engineering, bid and construction for the larger culverts and the lower weir.

Steps e through h could be combined into a single project if affordable and desired by the City.



0 300 600

Scale in Feet

N

LEGEND

Existing Contours

- (A) Submit a LOMR for Crystal Creek using the project model
- (B) Prepare a new hydrologic model for Crystal Lake watershed above Lake Avenue and submit LOMR
- (C) Investigate leakage into the Lakewood storm sewer
- (D) Larger culvert under Lake Avenue
- (E) Notch Lake outlet weir to 890.0 form current 890.9
- (F) Larger culvert under Country Club Road
- (G) Lower Crystal Creek five feet from Broadway Avenue to Edgebrook Drive
- (H) Add 10-year storm sewer system to Area 4 (Lakewood could connect in the future if they so choose
- (I) Lower overland flow channel from Edgebrook Drive to St. Andrews Lane by 1.5 feet
- (J) Restore Crystal Creek to its original open channel from Edgebrook Drive to St. Andrews Lane
- (K) Storage on School District Property

No.	Revision/Issue	Date
3	Per City Comments	07/12/10
2	Per City Comments	05/12/10
1	Per City Comments	04/13/10

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Crystal Creek Flooding Analysis

Crystal Lake and Crystal Creek Drainage Improvement Projects

PROJECT NO.	09021	SHEET NO.
DESIGNED BY	GCS/DAK	E-1
DRAWN BY	CFR	
CHECKED BY	GCS	
APPROVED BY	GCS	
ISSUE DATE	08/28/2009	

Table E-1: Crystal Creek Project Matrix

Project	ALTERNATIVES								BENEFITS					ESTIMATED COSTS		
	1	2	3A	3B	4	5	6	7	Floodplain Properties Removed	Floodway Properties Removed	Flooding Complaints Benefited	Total Properties Helped	Construction	Design	Permits	Total
														12%		
A. Submit LOMR for Crystal Creek using new model									40	25	0	40			$35,000	$35,000
	35000	35000	35000	35000	35000	35000	35000	35000								
B. Prepare new hydrologic model for Crystal Lake watershed above Lake Avenue and submit LOMR															$25,000	$25,000
	25000	25000						25000								
C. Investigate leakage into the Lakewood storm sewer									0	0	>10	300		$50,000		$50,000
		50000						50000								
D. Larger culvert under Lake Avenue									200	0	>30	Areas 1-3	$120,000	$14,000	$5,000	$139,000
	139000	139000						139000								
E. Notch Lake outlet weir to 890.0 from current 890.9									250	0	>30	Areas 1-3	$14,000	$2,000	$10,000	$26,000
		26000						26000								
F. Larger culvert under Country Club Road									40	25	0	40	$115,000	$14,000	$5,000	$134,000
	134000	134000	134000					134000								
G. Lower Crystal Creek five feet from Broadway Avenue to Edgebrook Drive									40	25	>10	300	$556,000	$67,000	$25,000	$648,000
						648000	648000									
H. Add 10-year storm sewer system to Area 4 and Lakewood									0	0	>10	300	$2,634,000	$316,000	$15,000	$2,965,000
						2965000	2965000									
I. Lower overland flow channel from Edgebrook Drive to St. Andrews Lane by 1.5 feet									25	20	>5	25	$361,000	$43,000	$25,000	$429,000
	429000	429000			429000	429000		429000								
J. Restore Crystal Creek to its original open channel from Edgebrook Drive to St. Andrews Lane									65	40	>10	300	$629,000	$75,000	$25,000	$729,000
							729000									
K. Storage on School District Property													$560,000	$65,000	$0	$625,000
	625000	625000			625000	625000	625000	625000								
Alternative Cost (Additional project costs included)	$1,387,000	$1,463,000	$169,000	$35,000	$1,089,000	$4,702,000	$5,002,000	$1,463,000								

Additional project required based on analysis
Project included in analysis