3.5 North Creek

The North Creek subwatershed encompasses approximately 23 square miles (19.46 in Cook County, 1.33 in Will County and 2.16 in Lake County) within the Little Calumet River watershed. There are seven tributaries within the subwatershed, including North Creek, totaling over 23 stream miles. **Table 3.5.1** lists the communities that lie within the subwatershed and the associated drainage area for each community contained within the subwatershed.

Table 3.5.1: Communities Draining to North Creek Subwatershed Within Cook County

Community	Tributary Area (mi^2)
Crete	<0.01
Ford Heights	<0.01
Glenwood	0.65
Lansing	1.95
Lynwood	4.29
Sauk Village	2.47
Unincorporated Cook County	10.09

Table 3.5.2 lists the land use breakdown by area within the North Creek subwatershed. **Figure 3.5.1** provides an overview of the tributary area of the subwatershed. Reported stormwater problem areas and proposed alternative projects are also shown on the figure, and are discussed in the following subsections.

Table 3.5.2: Land Use Distribution for North Creek Subwatershed Within Cook County

Land Use	Acres	%
Commercial/Industrial	635	5
Forest/Open Land	3,477	28
Institutional	197	2
Residential	3,504	28
Transportation/Utility	588	5
Water/Wetland	252	2
Agricultural	3,783	30

Within the North Creek subwatershed, a total of 23.4 stream miles were studied among the seven tributaries: North Creek, Lansing Ditch, Lansing Ditch Tributary A, Lansing Ditch East Tributary, Lansing Ditch Torrence Tributary, Lansing Ditch West Tributary, and Lansing Ditch Lynwood Tributary.

- Lansing Ditch (NCLD) – The tributary extends from upstream of 225th Street in Sauk Village to the confluence with North Creek north of 189th Street and Burnham Avenue in Lansing.

- Lansing Ditch East Tributary (LDET) – The tributary extends from 231st Street/Steger Road to the confluence with Lansing Ditch just upstream of Sauk Trail Road in Sauk Village.

- Lansing Ditch Tributary A (LDTA) – The tributary extends from 223rd Street west of Burnham Avenue to the confluence with Lansing Ditch downstream of Sauk Trail Road.

- Lansing Ditch West Tributary (LDWT) – The tributary extends from approximately 1,000 feet west of Torrence Avenue to the confluence with Lansing Ditch downstream of Sauk Trail Road.

- Lansing Ditch Torrence Tributary (LDTT) – The tributary extends from the southeast quadrant of Lincoln Highway/US 30 and Torrence Avenue to the confluence with Lansing Ditch just downstream of the EJ&E Railroad tracks.

A 6.5'x4' diversion culvert is located on Lansing Ditch just downstream of the confluence of Lansing Ditch and Lansing Ditch Torrence Tributary. The purpose of the culvert is to allow low flows to pass through, but to divert higher flows to the Woodland Reservoir. Backflow generated by the culvert will flow in the reverse direction along Torrence Tributary to a weir located approximately 1,000 feet upstream of the confluence with Lansing Ditch, with a spillway entering into Woodland Reservoir.

- Lansing Ditch Lynwood Tributary (LDLT) – The tributary begins at a flow split from Lansing Ditch located just downstream of 202nd Street near the Lansing Municipal Airport in Lynwood. A weir was originally constructed at this flow split to divert low flows down Lynwood Tributary, but this weir is damaged and is no longer functional. Lynwood Tributary ends at the confluence with North Creek near Torrence Avenue in Unincorporated Cook County.

- North Creek (NOCR) – North Creek extends from just east of Wentworth Avenue in Lansing to its confluence with Thorn Creek in Thornton.

The North Creek subwatershed contains one major detention facility, the Dr. Mary Woodland Reservoir, as well as other smaller detention areas, both natural and manmade.

- Dr. Mary Woodland Reservoir – The largest storage reservoir in the North Creek subwatershed is the Dr. Mary Woodland Reservoir, located south of Lincoln Highway and east of Torrence Avenue in Lynwood. This reservoir, also known as the Lynwood Reservoir, was built in 1988 and provides approximately 1,089 acre-feet of storage. The facility serves to detain flow generated upstream of the confluence of Lansing Ditch and Lansing Ditch–Torrence Tributary. The basis of design was to provide enough detention during the 100-year frequency storm to keep flows within the banks of Lansing Ditch downstream of the reservoir.

- Sandpit 2 – Sandpit 2 is located adjacent to Lansing Ditch, north of Sauk Trail Road and south of the EJ&E railroad tracks. The Sandpit 2 area was once used for mining, but is now Cook County Forest Preserve property and functions as a pond. There is no controlled inlet to the pond, but it receives overbank flows at the 25-year storm frequency and greater from Lansing Ditch and Lansing Ditch–Tributary A.

- Lansing Country Club Reservoir – A reservoir is located in the Lansing Country Club, at the upstream end of North Creek east of Wentworth Avenue and south of 186th Street. It was assumed that all flows originating upstream of

Wentworth Avenue are routed through the reservoir. The reservoir outlets just downstream of an access road running along the pond near the Illinois-Indiana border.

3.5.1 Sources of Data

3.5.1.1 Previous Studies

Previous documents were made available pertaining to the Dr. Mary Woodland Reservoir, as listed below:

- Design Folder, Little Calumet Watershed, Lynwood Reservoir, Project 77-236-AF, Cook County, Illinois, Volume I, undated, by PRC Consoer Townsend.

- *Supplemental Hydrologic and Hydraulic Analysis (Three Pond Reservoir), Lynwood Retention Reservoir,* February 1984, for the Metropolitan Sanitary District of Greater Chicago, by PRC Consoer Townsend.

The above studies were used to supplement the HEC-RAS hydraulic model with respect to the modeling of the Mary Woodland Reservoir. During Phase A of the project, additional survey, topography, precipitation, stream flow, land use and soils data needed for the development of the North Creek subwatershed model were identified and collected.

3.5.1.2 Water Quality Data

Water quality data for the North Creek subwatershed is collected by the Illinois Environmental Protection Agency (IEPA). IEPA has assessed water quality at one monitoring station in the North Creek subwatershed as part of the Ambient Water Quality Monitoring Network (AWQMN). This water quality monitoring station (HBDA-01) is within the Sweet Woods Forest Preserve, part of the Forest Preserve District of Cook County.

IEPA's 2008 Integrated Water Quality Report, which includes the Clean Water Act (CWA) 303(d) and the 305(d) lists, identifies reach IL_HBDA-01 (North Creek) as impaired for Aquatic Life designated uses, with potential causes being sedimentation/siltation and the chemicals aldrin and hexachlorobenzene. Additionally, Stage 1 Total Maximum Daily Load (TMDL) analysis has been developed for North Creek reach IL_HBDA-01 for dissolved oxygen.

NPDES point source discharges within the North Creek subwatershed are listed in **Table 3.5.3**. In addition to the point source discharges listed, municipalities discharging to North Creek or its tributaries are regulated by IEPA's NPDES Phase II Stormwater Permit Program, which was created to improve the water quality of stormwater runoff from urban areas, and requires that municipalities obtain permits for discharging stormwater and implement six minimum control measures for limiting runoff pollution to receiving systems. Also as part of the Phase II Stormwater Permit Program, construction sites disturbing greater than 1 acre of land are required to get a construction permit.

Table 3.5.3: Point Source Dischargers in North Creek Area

Name	NPDES	Community	Receiving Waterway
Paradise MHP–Chicago Heights	IL0026794	Chicago Heights	Lansing Ditch
Einoder Sand Pit	IL0062502	Chicago Heights	Lansing Ditch

Note: NPDES facilities were identified from the USEPA Water Discharge Permits Query Form at http://www.epa.gov/enviro/html/pcs/pcs_query_java.html.

3.5.1.3 Wetland and Riparian Areas

Figures 2.3.6 and **2.3.7** contain mapping of wetland and riparian areas in the Little Calumet River Watershed. Wetland areas were identified using National Wetlands Inventory (NWI) mapping. NWI data includes roughly 772 acres of wetland areas in the North Creek subwatershed. Riparian areas are defined as vegetated areas between aquatic and upland ecosystems adjacent to a waterway or body of water that provides flood management, habitat, and water quality enhancement. Identified riparian environments offer potential opportunities for restoration.

3.5.1.4 Floodplain Mapping

The effective FEMA FIS, published in August 2008, uses hydrologic models which were developed by IDNR-OWR in the late 1990s using HEC-1. The hydraulic model was also developed by IDNR-OWR in the late 1990s using HEC-RAS, FEQ and HEC-2. The North Creek detailed study was revised in 2008 from the confluence with Thorn Creek to Lansing Ditch Lynwood Tributary. The HEC-RAS model was not available for review. An FEQ model encompassing North Creek from Wentworth Avenue to the confluence with Lansing Ditch Lynwood Tributary, Lansing Ditch, Lansing Ditch Tributary A, Lansing Ditch West Tributary, Lansing Ditch East Tributary, Lansing Ditch Lynwood Tributary and Lansing Ditch Torrence Tributary was available.

As part of the FEMA Map Modernization Program, the ISWS prepared DFIRMs for Cook County, including the North Creek subwatershed, effective August 2008. **Appendix A** includes a comparison of FEMA's effective floodplain mapping from updated DFIRM panels with inundation areas developed for the DWP.

3.5.1.5 Stormwater Problem Data

Table 3.5.4 summarizes reported problem areas reviewed as a part of the DWP development. The problem area data was obtained primarily from Form B questionnaire response data provided by watershed communities to the District. Problems are classified in **Table 3.5.4** as regional or local. This classification is based on a process described in **Section 2.2.1** of this report.

Table 3.5.4: Community Response Data for North Creek Subwatershed

Problem ID	Municipality	Problems as Reported by Local Municipality	Location	Problem Description	Local/ Regional	Resolution in DWP
BL01	Bloom Township	Storm sewer flow restriction, other	Steger Road from Wallace Avenue to Indiana State Line	Beaver dams, siltation causing restriction	Local	Primarily outside of North Creek watershed; portion within watershed is a local storm sewer system problem
BL02	Bloom Township	Storm sewer flow restriction	Sauk Trail Road from Western Avenue to Torrence Avenue	Siltation of culvert causing restriction	Local	Local drainage problem not located on a regional waterway
BL04	Bloom Township	Storm sewer flow restriction	Glenwood Lansing Road from Glenwood Dyer Road to Indiana State Line	Undersized trunk storm sewer; siltation and vegetation	Local	Problem not located on a regional waterway. This is a local storm sewer system problem
BL07	Bloom Township	Siltation	Stony Island Avenue from Joe Orr Road to 183rd Street	Silt debris accumulating under bridge	Local	Local drainage problem not located on a regional waterway
BL08	Bloom Township	Storm sewer flow restriction	Torrence Avenue from Steger Road to Sauk Trail Road	Undersized storm sewer, high water level at outfall; siltation and vegetation	Local	Problem not located on a regional waterway. This is a local storm sewer problem. Addressing item BL09 (Alternative LDETG1-A4) may alleviate some flow restriction near Sauk Trail Road
BL09	Bloom Township	Overbank flooding	West side of Torrence Avenue, south of Katz Corner Road	Flooding due to roadway overtopping of Katz Corner and backflow to Torrence Avenue	Regional	Increase hydraulic opening of Torrence Avenue and Katz Corner Road crossings (Alternative LDETG1-A4)

Table 3.5.4: Community Response Data for North Creek Subwatershed

Problem ID	Municipality	Problems as Reported by Local Municipality	Location	Problem Description	Local/ Regional	Resolution in DWP
CCH5	Lansing	Overbank flooding	Wentworth Avenue at North Creek	Surcharging of culvert conveying North Creek under subdivision west of Wentworth Avenue due to backflow from North Creek/Lansing Ditch confluence	Regional	Disconnect local system from North Creek conveyance culvert; detain local flows until water level in North Creek subsides (Alternative NOCRG1-A6)
GLW1	Glenwood	Overbank flooding	187th Street/193rd Street/193rd Place/194th Street/Minerva Avenue	Flooding within local subdivision; located on local tributary to North Creek	Local	Problem not located on a regional waterway; this is a local stormwater conveyance problem
GLW4	Glenwood	Bank erosion & sedimentation, storm sewer restriction, water quality, wetland/ riparian areas at risk	Cottage Grove and Glenwood Lansing Road	Local channel and storm sewer system backups	Local	Flooding issue not located on a regional waterway; this is a local problem
LAN1	Lansing	Overbank flooding	South of 188th Street and Torrence Avenue to North of 188th Place and Park Avenue	Overbank flooding in topographically flat area causes overtopping of local roads and flooding on residential properties	Regional	Overtopping of local roadways is a local issue. Sufficient land was not available to address flooded properties in this area. Such properties are candidates for protection using non-structural measures, such as floodproofing or acquisition
LAN2	Lansing	Basement flooding	Between Wildwood Avenue and Greenbay Avenue, and North Creek and 190th Street	Basement backups caused by high water level at outfall for local sewer system	Local	This is a local storm sewer system problem

Table 3.5.4: Community Response Data for North Creek Subwatershed

Problem ID	Municipality	Problems as Reported by Local Municipality	Location	Problem Description	Local/ Regional	Resolution in DWP
LAN3	Lansing	Basement flooding	South Manor to Otto Street, and Burnham Avenue to Wentworth Avenue	Basement backups caused by high water level at outfall for local sewer system and water entering homes via overland flooding.	Local	Problem not located on a regional waterway; this is a local storm sewer system problem.
LAN6	Lansing	Bank erosion and sedimentation	Torrence Avenue to Stony Island	Beaver dams, debris in culverts along North Creek	Channel Maintenance	Removal of debris to be addressed by stream maintenance
LYN1	Lynwood	Overbank flooding, ponding, storm sewer restriction, bank erosion and sedimentation	202nd Street and 203rd Street/ Burnham Avenue	Widespread flooding due to overbank flooding of Lansing Ditch and Lynwood Tributary, undersized hydraulic openings of crossings	Regional	Construct regional detention facility and increase hydraulic opening of undersized hydraulic structures (Alternative NCLDG1-A7)
LYN2	Lynwood	Overbank flooding of local detention facility, basement flooding, ponding, storm sewer restriction, bank erosion and sedimentation at pond.	Joe Orr Road and Bluestem Parkway	Flooding due to local storm sewer system backups and local detention pond performance	Local	Problem not located on a regional waterway; this is a local storm sewer system problem
LYN3	Lynwood	Overbank flooding, basement flooding, ponding, storm sewer restriction, bank erosion and sedimentation	Lincoln Lansing Drainage Ditch and Lake Lynwood	Lack of channel conveyance capacity and undersized hydraulic strictures at crossings causing overbank flooding	Regional	Construct regional detention facility and increase hydraulic opening of undersized hydraulic structures (Alternative NCLDG1-A7)
LYN5	Lynwood	Silt, sedimentation	Near Glenwood Lansing Road and Burnham Avenue	Sedimentation at cross culvert under roadway	Local	Local authority responsible for maintenance of culvert

Table 3.5.4: Community Response Data for North Creek Subwatershed

Problem ID	Municipality	Problems as Reported by Local Municipality	Location	Problem Description	Local/ Regional	Resolution in DWP
SKV1	Sauk Village	Pavement flooding	Route 30 at Torrence Avenue	Pavement flooding of IDOT roadway due to undersized culvert	Local	Roadway flooding issue not located on a regional waterway (less than 0.5 acre drainage area); this is a local problem
SKV2	Sauk Village	Overbank flooding	Torrence Avenue and 223rd Street/ Katz Corner Road	Pavement flooding due to undersized culvert	Regional	Increase hydraulic opening of crossing under Katz Corner Road (Alternative LDETG1-A4)

3.5.1.6 Near Term Planned Projects

On North Creek, Cook County Highway Department has a scheduled project for Wentworth Avenue in Lansing which includes upgrading the existing 4-foot by 4-foot box culvert conveying North Creek under Wentworth Avenue to a 6-foot by 4-foot box culvert. This is consistent with the recommendation in this report to replace and upgrade the culvert to a 6-foot by 4-foot box, as discussed in more detail in the recommendations section.

On Lansing Ditch, the Lansing Municipal Airport is completing a Stormwater Master Plan, prepared by Crawford, Murphy and Tilly, Inc., which details development plans for the property bound by Glenwood Lansing Road on the north, Burnham Avenue on the west, Lansing Ditch on the east, and Lansing Ditch Lynwood Tributary on the south. The preliminary recommendation includes compensatory storage of over 400 acre-feet for Lansing Ditch in the existing farm field southeast of the confluence of Lansing Ditch and Lansing Ditch Lynwood Tributary. This is consistent with the recommendation made in the alternatives analysis section of this report for the placement of a detention facility.

3.5.2 Watershed Analysis

3.5.2.1 Hydrologic Model Development

3.5.2.1.1 Subbasin Delineation. The North Creek subwatershed was delineated based upon LiDAR topographic data developed by Cook County in 2003. There are 38 subbasins ranging in size from 0.005 to 2.81 square miles with an average size of 0.587 square miles.

Hydrologic Parameter Calculations. Curve numbers (CN) were estimated for each subbasin based upon NRCS soil data and 2001 CMAP land use data. This method is further described in **Section 1.3.2**, with lookup values for specific combinations of land use and soil data presented in **Appendix C**. An area-weighted average of the CN was generated for each subbasin.

Clark's unit hydrograph parameters were estimated using the method described in **Section 1.3.2**. **Appendix G** provides a summary of the hydrologic parameters used for subbasins in each subwatershed.

3.5.2.2 Hydraulic Model Development

3.5.2.2.1 Field Data, Investigation, and Existing Model Data The FEMA effective hydraulic model was developed by IDNR-OWR in the late 1990s using HEC-2 and FEQ. A HEC-RAS model was also developed, but was not available for review. The FEQ model encompassing North Creek (from Wentworth Avenue to the confluence with Lansing Ditch Lynwood Tributary), Lansing Ditch, Lansing Ditch Tributary A, Lansing Ditch West Tributary, Lansing Ditch East Tributary, Lansing Ditch Lynwood Tributary and Lansing Ditch Torrence Tributary met District criteria as identified in Section 6.3.3.2 of the CCSMP and was therefore used to support DWP development.

Where available, the HEC-2/FEQ cross section and hydraulic structure information were used, with the Cook County 2-foot contours used in the overbanks. A field reconnaissance was conducted in June 2007. Information was compiled on stream crossings, land use, and channel conditions. Stream crossing data was compared to the data entered into the models. To supplement the model, 54 hydraulic structures throughout the subwatershed, including immediate upstream and downstream cross sections, were surveyed, as well as 21 additional cross sections along North Creek, Torrence Tributary, and Lansing Ditch.

The Manning's n-value at each cross section was estimated using a combination of aerial photography and photographs from field survey and field reconnaissance. The horizontal extent of each type of land cover and the associated n-value for each cross section were manually entered in to the HEC-RAS hydraulic model. The initial n-values were used as a model starting point and were adjusted within the provided ranges during calibration. All the n-values were manually adjusted using the HEC-RAS cross-sectional data editor.

The n-values were increased where buildings are located within the floodplain to account for conveyance loss. The n-values in these areas may range from 0.060 for areas with few buildings to 0.15 for fully developed areas. If significant blockage is caused by buildings in the flood fringe, the developed areas were modeled as ineffective flow. **Table 3.5.5** lists the channel and overbank ranges of n-values that were used for the North Creek subwatershed model.

Table 3.5.5: Channel and Overbank Associated Manning's n-Values[1]

Tributary	Range of Channel n-Values	Range of Overbank n-Values
NOCR	0.05 – 0.06	0.08 – 0.15
NCLD	0.06 – 0.07	0.08 – 0.12
LDET	0.05	0.08 – 0.10
LDTA	0.065	0.08 – 0.12
LDWT	0.06	0.08 – 0.10
LDTT	0.06	0.08 – 0.10
LDLT	0.06 – 0.08	0.08 – 0.12

[1]**Source**: Open Channel Hydraulics, Chow 1959

*3.5.2.2.2 **Boundary Conditions***A downstream boundary condition was required within the North Creek hydraulic model at its confluence with Thorn Creek. The boundary condition was determined by extracting the flow output hydrograph from the HEC-RAS model and inputting it as an upstream flow for the Thorn Creek model. Once the Thorn Creek HEC-RAS model was run, the stage hydrograph at the confluence generated by the Thorn Creek model was used as the downstream boundary condition in the North Creek model. This allowed the modeling of any backwater effects that may be present due to the confluence of the two creeks.

3.5.2.3 Calibration and Verification A detailed calibration was performed for the North Creek subwatershed using historic gage records under the guidelines of Chapter 6 of Cook County Stormwater Management Plan. Three historical storms: July 1996, April 2006 and September 2008, were evaluated based on the stream gage flows, precipitation totals and records of flooding in the North Creek subwatershed and were found to be applicable for calibration and verification.

For the calibration storms, Illinois State Water Survey (ISWS) Cook County precipitation gages, National Weather Service (NWS) recording and non-recording gages, and Community Collaborative Rain, Hail & Snow Network (CoCoRAHS) precipitation amounts were used. Theissen polygons were developed for each storm based on the rain gages available for that storm. The gage weightings for the recording and non-recording gages were computed in ArcGIS for each subbasin. USGS Gage 05536265 on Lansing Ditch near Lansing, IL (the only stream gage in the North Creek subwatershed) was used for calibration. This gage is at latitude 41°31'42" longitude 87°31'45" (NAD27), on the upstream side of the 204th Street crossing, just upstream of the Lansing Ditch and Lansing Ditch Lynwood Tributary flow split. The datum of the gage is 607.16 feet NGVD29 (606.84 NAVD88). Stage data is available at this gage from 5/1/1989 through 9/30/2007.

Runoff hydrographs were developed using HEC-HMS and routed through the North Creek hydraulic model. The stages and flows produced for each calibration storm were compared to the observed stream gage data. During calibration of the North Creek subwatershed model, the curve number, directly connected impervious area percentage, and lag times were adjusted so that the peak flow rate, hydrograph shape

and timing, and total volume matched the observed hydrographs within the CCSMP's criteria.

During calibration, the curve number and directly connected impervious percentage were adjusted by -5% and -10%, respectively. The Clark's storage coefficient R was increased by +25%.

After the final adjustments to the HEC-HMS and HEC-RAS models, the flow and stage comparisons to the observed data were within the CCSMP's criteria. **Table 3.5.6** shows the comparison of the flows and stages for all calibration storms. **Figures 3.5.2** and **3.5.3** show the calibration results for the July 1996 and April 2006, respectively.

Table 3.5.6: North Creek Subwatershed Calibration Results

	Observed		Modeled		CCSMP's Criteria[1]	
Storm Event	**Flow**	**Stage**	**Flow**	**Stage**	**Percentage Difference in Peak Flow**	**Difference in Stage (feet)**
Jul-96	208	616.4	254	616.0	22.0%	0.4
Apr-06	202	616.0	258	616.0	27.7%	0.0
Sep-08	unknown[2]	616.4[3]	252	615.9	unknown[2]	0.5

[1]Flow within 30% and stage within 6 inches.
[2]Flow data not available for September 2008 storm event.
[3]Only peak stage available for September 2008 event.

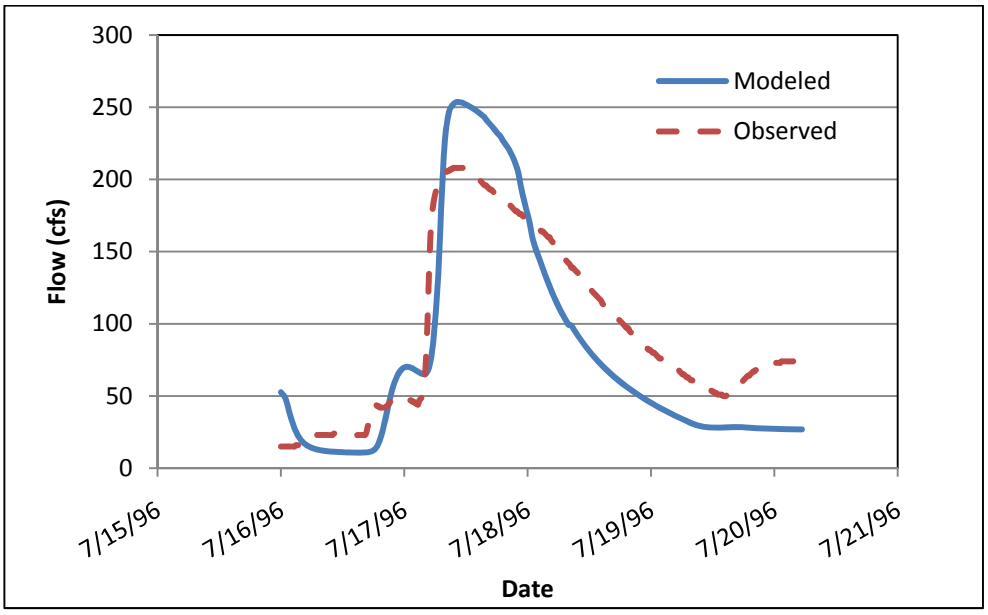

Figure 3.5.2: North Creek Subwatershed Calibration Results, July 1996 Storm Event

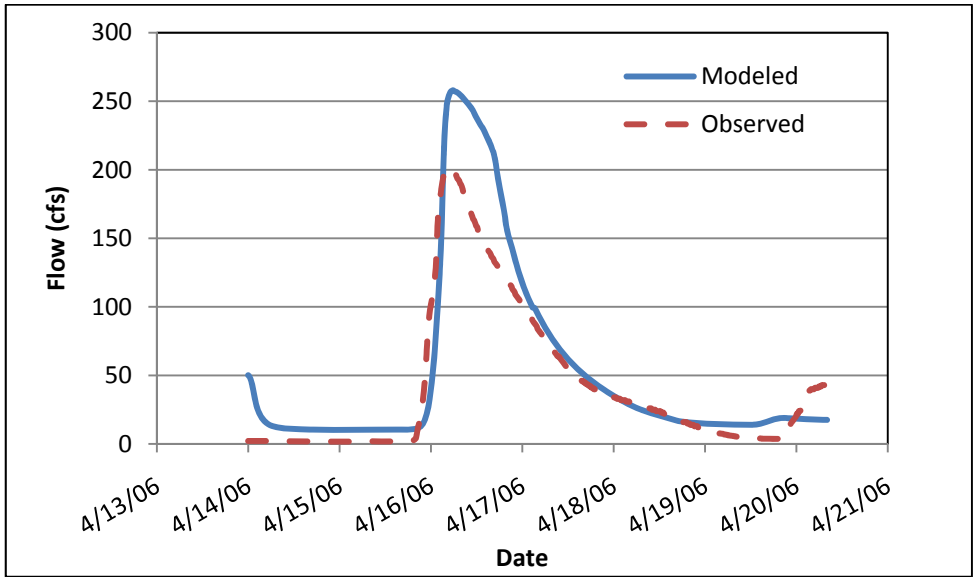

Figure 3.5.3: North Creek Subwatershed Calibration Results, April 2006 Storm Event

The hydraulic model was verified by comparing the hydraulic model results with available high water marks for the September 2008 storm event. High water marks were provided by the Illinois Department of Natural Resources (IDNR). **Table 3.5.7** shows the comparison of the model results to the surveyed high water marks.

Table 3.5.7: Calumet Union Drainage Ditch Subwatershed Verification Results

Storm Event	Location	Field Elevation (feet)	Model Elevation (feet)
Sep-08	Gage 2 - North Creek at Oakwood Avenue (u/s)	609.99	610.07
Sep-08	Gage 3 - Lansing Ditch, Burnham Avenue at 189th Street (u/s)	610.90	610.87
Sep-08	Gage 6 - Lansing Ditch at Lynwood Gage (u/s)	616.43	615.89
Sep-08	Gage 7 - Lansing Ditch, trailer park d/s of US 30 at bridge crossing (d/s)	622.73	623.25
Sep-08	Gage 9 - Lansing Ditch at Sauk Trail Road (d/s)	631.86	631.78

At all locations, the modeled elevation is within 0.5 feet of the observed high water elevation, which is within the MWRDGC's criteria.

3.5.2.4 Existing Conditions Evaluation

3.5.2.4.1 Flood Inundation Areas The existing conditions hydraulic model was run for the 2- through 500-year storm events. A critical duration analysis was performed for the North Creek subwatershed hydraulic model. The 100-year, 1-, 3-, 6-, 12-, 24-, 48- and 72-hour storm events were run to determine the critical duration. The 48-hour storm event was found to be representative of the critical duration downstream of the Mary Woodland Reservoir, Lansing Ditch–Torrence Tributary, and Lansing Ditch Tributary A. The 12-hour duration was found to be representative of the critical

duration storm event for Lansing Ditch upstream of the reservoir, Lansing Ditch East Tributary, and Lansing Ditch West Tributary.

Figure 3.5.1 shows inundation area produced for the 100-year critical duration storm event.

3.5.2.4.2 ***Hydraulic Profiles*** Hydraulic profiles for North Creek and its tributaries are shown in **Appendix H**. Profiles are shown for the 2-, 5-, 10-, 25-, 50-, 100- and 500-year recurrence interval design storm events.

3.5.3 Development and Evaluation of Alternatives

Hydraulic model results were reviewed with inundation mapping to identify locations where property damage due to flooding is predicted. **Table 3.5.8** summarizes problem areas identified through hydraulic modeling of the North Creek subwatershed.

Problem areas that were hydraulically interdependent or otherwise related were grouped for alternatives analysis. Each project group is addressed in terms of combined damages and alternatives/solutions.

Table 3.5.8: Modeled Problem Definition for the North Creek Subwatershed

Problem ID	Group ID	Location	Recurrence Interval (year) of Flooding	Associated Form B	Resolution in DWP
LDET1	LDET-G1	Lansing Ditch East Tributary, Katz Corner Road west of Plum Grove Road, Sauk Village	50,100	BL09, SKV2	LDETG1-A4
NCLD1	NCLD-G1	Lansing Ditch, East of 202nd Street and Burnham Avenue, near Lansing Municipal Airport	10, 25, 50, 100	LYN1	NCLDG1-A7
NCLD2	NCLD-G1	Lansing Ditch Lynwood Tributary, along tributary and Lake Lynwood	50, 100	LYN3	NCLDG1-A7
NCLD3	NCLD-G2	Lansing Ditch, near Bridge Street and Valerie Drive, Chicago Heights	50, 100	n/a	NCLDG2-A7
NCLD4	NCLD-G3	Lansing Ditch, Torrence Avenue and 223rd Street/Sauk Trail Road, Sauk Village	50, 100	n/a	NCLDG3-A4
NOCR1	NOCR-G1	North Creek, Wentworth Avenue to Grand Trunk Railroad, Lansing	2, 5, 10, 25, 50, 100	CCH5	NOCRG1-A6
NOCR2	NOCR-G2	North Creek, North of 188th Street between Oakwood Avenue and Burnham Avenue, Lansing	25, 50, 100	LAN1	Floodproofing/ Acquisition

Damage assessment, technology screening, alternative development and alternative selection were performed by problem grouping, since each group is independent of the other. Each problem group is evaluated in the following sections by problem group ID.

3.5.3.1 LDET-G1 – Lansing Ditch East Tributary Problem Group 1

3.5.3.1.1 Problem Definition

The LDET-G1 problem area consists of overbank flooding in the vicinity of the Katz Corner Road crossing. The location of flooding is from approximately 150 feet upstream of the Katz Corner Road crossing to just downstream. The 50-year flow (466 cfs) and the 100-year flow (590 cfs) exceed the capacity of the existing culverts. The existing culvert crossing consists of two (2), 6-foot span/5.5-foot rise conspan arches and one 5-foot span/3-foot rise conspan arch.

LDET-G1 includes flooding of one structure and overtopping of one arterial roadway crossing. This area is also inundated on the FEMA DFIRM map. The roadway can be overtopped at an approximate elevation 636 feet; the roadway flooding does not occur directly above the culvert, but at the low spot in the road, approximately 175 feet west of the crossing. The 50-year water surface elevation is 636.3 feet, and the 100-year water surface elevation is 637.3 feet.

3.5.3.1.2 Damage Assessment, LDET-G1

Damages were defined following the protocol defined in Chapter 6.6 of the CCSMP. Critical duration analysis was performed to determine the highest flood stages for North Creek and its tributaries. These stages were used to calculate the depth of flooding and to estimate damages at each flooding problem area. The District's Stormwater Planning Database Tool was used to estimate the damages. Property damages for each building structure were calculated and transportation damages were estimated at 15% of the property damages, unless otherwise noted. Recreation damages were estimated based on depth and duration of flooding. **Table 3.5.9** lists the estimated damages for the problem group.

Table 3.5.9: Estimated Damages for North Creek Subwatershed, Problem Group LDET-G1

Problem Group ID	Damage Category	Estimated Damage ($)	Description
LDET-G1	Property	$99,570	Structures at risk of flooding
	Transportation	$14,935	Assumed as 15% of property damage due to flooding
	Recreation	$0	

3.5.3.1.3 Technology Screening, LDET-G1

Several combinations of technologies were analyzed to address the flooding problems associated with LDET-G1. Flood control technologies from Chapter 6 of the CCSMP were considered as potential solutions for the regional flooding problems. **Table**

3.5.10 summarizes the evaluation of these technologies in terms of their potential feasibility for this problem group.

Table 3.5.10: Evaluation of Flood Control Technologies for North Creek Subwatershed, Problem Group LDET-G1

Flood Control Option	Feasibility
Detention Facilities	No. Limited space is available
Conveyance Improvement – Culvert/Bridge Replacement	Yes. Increase the opening at Sauk Trail Road
Conveyance Improvement – Channel Improvement	No. Limited ROW is available
Conveyance Improvements – Diversion	No. No available outfall is downstream
Flood Barriers, Levees/Floodwalls	Yes. May require detention

3.5.3.1.4 Alternative Development

Flood Control Alternatives. Alternative solutions to regional flooding problems were developed and evaluated consistent with the methodology described in **Section 1.4** of this report. **Table 3.5.11** summarizes flood control alternatives developed for Problem Group LDET-G1.

Table 3.5.11: Flood Control Alternatives for Problem Group LDET-G1

Alternative	Location	Description
LDETG1-A1	Individual Residences	Construct a floodwall to protect property. While this is beneficial to the property, it does not address the roadway flooding problem
LDETG1-A2	Katz Corner Road	Upgrade existing crossing from 2, 6-ft span/5.5-ft rise con/span arches and one 5-ft span/3-ft rise con/span arch, to a twin, 10-ft by 7-ft box culvert
LDETG1-A3	Katz Corner Road	Remove debris from upstream side of culvert
LDETG1-A4	Katz Corner Road	Upgrade existing culvert and remove debris (combination of LDETG1-A2 and LDETG1-A3)

Streambank Stabilization Alternatives. No streambank stabilization alternatives were developed for the LDET-G1 Problem Group.

3.5.3.1.5 Alternative Evaluation and Selection

Alternatives included in **Table 3.5.11** were evaluated to determine their effectiveness and produce the data required for the countywide prioritization of watershed projects. Flood control alternatives were modeled to evaluate their impact on water elevations and flood damages. **Table 3.5.13** provides the B/C ratio, net benefits, total project costs, number of structures protected, and other relevant alternative data for the preferred alternative for Problem Group LDET-G1. Alternatives that did not produce a significant change in inundation areas are not listed as benefits were negligible, thus costs were not calculated for these alternatives.

Alternative LDETG1-A4 from **Table 3.5.11** provides the preferred alternative for Problem Group LDET-G1. By increasing the opening area of the crossing with a twin, 10-foot by 7-foot box culvert, the 100-year water surface elevation will be reduced to

636.2 feet, which is 0.1 feet above the natural water surface elevation and 1.1 feet below the existing 100-year elevation.

Table 3.5.12 provides a comparison of the modeled water surface elevation and modeled flow at the time of peak for LDET-G1.

Table 3.5.12: Alternative Condition Flow & WSEL Comparison for Problem Group LDET-G1

Location	Station	Existing Conditions		Alternative LDETG1-A4	
		Max WSEL (feet)	Max Flow (cfs)	Max WSEL (feet)	Max Flow (cfs)
Upstream of Sauk Trail Road	ET1 2971.89	637.57	582	636.48	586

3.5.3.1.6 Data Required for Countywide Prioritization of Watershed Projects

Appendix I presents conceptual level cost estimates for the recommended alternative. **Table 3.5.13** lists the alternative analyzed in detail. The recommended alternative consists of replacement of the existing con/span culvert crossing at Katz Corner Road with a double, 10-foot by 7-foot box culvert. **Figure 3.5.4** shows the location of the recommended alternative and a comparison of the inundation area for existing conditions with the reduced inundation area resulting from the recommended alternative.

Table 3.5.13: North Creek Project Alternative Matrix to Support District CIP Prioritization for Problem Group LDET-G1

Group ID	Alternative ID	Description	B/C Ratio	Net Benefits ($)	Total Project Cost ($)	Cumulative Structures & Roadways Protected	Water Quality Benefit	Involved Community
LDET-G1	LDETG1-A4	Replace crossing	0.29	$82,000	$287,000	9 Structures, 1 Roadway	No impact	Sauk Village

Note: Net Benefits values do not include local benefits or non-economic benefits.

3.5.3.2 NCLD-G1 – Lansing Ditch Problem Group 1

3.5.3.2.1 Problem Definition, NCLD-G1

The NCLD-G1 problem area consists of overbank flooding along both banks of Lansing Ditch approximately 2,700 feet south of 202nd Street, as well as into the Lansing Municipal Airport property north of 202nd Street. Flooding also occurs along Lansing Ditch Lynwood Tributary over both banks from the flow split with Lansing Ditch west to Burnham Avenue as well as from Ash Lane downstream to approximately the private entrance downstream of 201st Street.

The storm sewer for the Lake Lynwood subdivision outlets to Lynwood Tributary at 201st Street. This storm sewer is directly connected to Lake Lynwood; the storm sewer from the neighborhood is routed to the lake, and the lake's outflow is through the hydraulic connection to Lynwood Tributary. The outfall pipe is near the bottom of the Lynwood Tributary cross section, so the sewer can only drain by pressure flow when

the ditch flow line is above the pipe crown elevation. Since the tributary does not have a positive slope throughout the whole reach, it commonly has a high water surface elevation, even during smaller storm events, which may cause reduced outflow capacity of the pipe. This contributes to the sewer backing up through the subdivision, and result in intermittent areas of flooding throughout the subdivision. Since this problem is associated with the subdivision's drainage system, it is considered a local problem and no alternatives have been provided herein. However, overbank flooding of Lynwood Tributary is considered a regional problem, and any alternatives which lower the stage of the tributary will have a positive effect on the subdivision's drainage system.

Along Lansing Ditch, there are two residential structures flooded, and the Lansing Municipal Airport floods, including overtopping of the runways. Along Lynwood Tributary, 57 residential structures are flooded, the majority within the Lake Lynwood subdivision. Ten local streets and one arterial, Burnham Avenue, flood. This area is also inundated on the FEMA DFIRM map, although the DFIRMs show a smaller inundation area in the portion of the watershed bound by Lansing Ditch on the south and Torrence Avenue on the west.

3.5.3.2.2 Damage Assessment, NCLD-G1

Damages were defined following the protocol defined in Chapter 6.6 of the CCSMP. Critical duration analysis was performed to determine the highest flood stages for North Creek and its tributaries. These stages were used to calculate the depth of flooding and then to estimate damages at each flooding problem area. The District's Stormwater Planning Database Tool was used to estimate the damages. Property damages for each building structure were calculated and transportation damages were estimated at 15% of the property damages, unless otherwise noted. Recreation damages were estimated based on depth and duration of flooding. **Table 3.5.14** lists the estimated damages for the problem group.

Table 3.5.14: Estimated Damages for North Creek Subwatershed, Problem Group NCLD-G1

Problem Group ID	Damage Category	Estimated Damage ($)	Description
NCLD-G1	Property	$2,056,000	Structures at risk of flooding
	Transportation	$308,500	Assumed as 15% of property damage due to flooding; flooding on arterial roadways less than 0.5 feet.
	Recreation	$0	

3.5.3.2.3 Technology Screening, NCLD-G1

Several combinations of technologies were analyzed to address the flooding problems at this location. Flood control technologies from Chapter 6 of the CCSMP were considered as potential solutions for the regional flooding problems. **Table 3.5.15** summarizes the evaluation of these technologies in terms of their potential feasibility for this problem group.

Table 3.5.15: Evaluation of Flood Control Technologies for North Creek Subbasin, Problem Group NCLD-G1

Flood Control Option	Feasibility
Detention Facilities	Yes. Potential site for detention in farm fields or increase Mary Woodland Reservoir
Conveyance Improvement – Culvert/Bridge Replacement	Yes. Increase hydraulic capacity of crossings along Lynwood Tributary
Conveyance Improvement – Channel Improvement	Yes. Regrade profile and/or widen cross section along Lynwood Tributary
Conveyance Improvements – Diversion	No. Lynwood Tributary already acts as diversion for Lansing Ditch
Flood Barriers, Levees/Floodwalls	Yes, but will not reduce roadway overtopping

3.5.3.2.4 Alternative Development, NCLD-G1

Flood Control Alternatives. Alternative solutions to regional flooding problems were developed and evaluated consistent with the methodology described in **Section 1.4** of this report. **Table 3.5.16** summarizes flood control alternatives developed for Problem Group NCLD-G1.

Table 3.5.16: Flood Control Alternatives for Problem Group NCLD-G1

Alternative	Location	Description
NCLDG1-A1	Mary Woodland Reservoir	Increase the volume of the existing regional detention facility. Increasing the size of this reservoir had no noticeable effect on downstream peak flows. The reservoir is properly sized to detain the 100-year flow; it is the additional flow from the downstream subbasins that cause the peak flow rates which contribute to flooding
NCLDG1-A2	Lynwood Tributary from Burnham Avenue to North Creek	Regrade Lynwood Tributary to establish positive slope from Burnham Avenue to the confluence with North Creek. Lynwood Tributary was initially constructed to divert water from Lansing Ditch and bypass it to North Creek. By increasing the conveyance capacity of Lynwood Tributary, more water would be diverted from Lansing Ditch, which would result in an increase of flows along the reach and have no positive impact on reducing flooding along the Tributary
NCLDG1-A3	Various sections, Lansing Ditch and Lynwood Tributary	Widen the cross sections to increase the hydraulic capacity of the channels. This alternative did not effectively reduce water surface elevations in the flooding problem area
NCLDG1-A4	Various sections, Lansing Ditch and Lynwood Tributary	Construct levees or floodwalls to restrict the flows to the channels. This alternative did not effectively reduce water surface elevations in the flooding problem area
NCLDG1-A5	Crossings at 198th Street and private drives immediately upstream and downstream of 198th Street	Upgrade opening of culverts to increase hydraulic capacity. Increase private drive upstream of 198th Street from an 11-ft by 6-ft arch to a triple 7-ft by 6.5-ft box culvert; the 198th Street crossing from a triple, 7-ft by 5-ft box culvert to a double, 8-ft by 8.5-ft box culvert, and the crossing downstream of 198th Street from a bridge with a 14-ft span and approximately 7-ft high opening to a double 8-ft by 8.5 ft box culvert

Table 3.5.16: Flood Control Alternatives for Problem Group NCLD-G1

Alternative	Location	Description
NCLDG1-A6	Flow split at Lansing Ditch and Lynwood Tributary, southwest quadrant	Construct detention facility to detain flows above the carrying capacity of Lansing Ditch and Lynwood Tributary. This facility would be in the same location as the one being recommended by Crawford, Murphy & Tilly's stormwater master plan for the airport, but would provide more storage to address impacts further downstream of the airport property. Approximately 700 ac-ft of detention volume is required, which equals an area approximately 1,200 feet by 1,700 feet and 15.5 feet deep (elevation 600.0 to 615.5 feet). A weir would be located on both Lansing Ditch and Lynwood Tributary to divert flows to the pond, with a pump station needed to pump flows out
NCLDG1-A7	Flow split at Lansing Ditch and Lynwood Tributary; crossings on Lynwood Tributary at 198th Street and private drives	Construct detention facility at Lansing Ditch/Lynwood Tributary flow split and upgrade opening of culverts on Lynwood Tributary (combination of alternatives NCLDG1-A5 and NCLDG1-A6)

Streambank Stabilization Alternatives. No streambank stabilization alternatives were developed for the NCLD-G1 Problem Group.

3.5.3.2.5 Alternative Evaluation and Selection, NCLD-G1

Alternatives included in **Table 3.5.16** were evaluated to determine their effectiveness and produce data required for the countywide prioritization of watershed projects. Flood control alternatives were modeled to evaluate their impact on water elevations and flood damages. **Table 3.5.18** provides the B/C ratio, net benefits, total project costs, number of structures protected, and other relevant alternative data for the preferred alternative. Alternatives that did not produce a significant change in inundation areas are not listed as benefits were negligible, thus costs were not calculated for these alternatives.

Alternative NCLDG1-A7 from **Table 3.5.16** provides the preferred alternative for this problem group. The crossings at 198th Street and at the private drives immediately upstream and downstream of 198th Street have a considerably smaller opening area than the other culverts along Lansing Ditch, and also have low crown elevations. This causes water in the channel to back up and overtop the banks and the roadways. Upgrading the culverts will reduce head on the culverts and decrease the maximum water surface elevation. This must be done in conjunction with upstream detention. A 700 acre-foot detention facility located near the flow split of Lansing Ditch and Lynwood Tributary will reduce peak flow rates through both reaches and decrease instances of flooding.

The Lansing Municipal Airport has plans to expand on the parcel of land north of Lynwood Tributary, so this area was not considered for placement of the detention facility. Additionally, Joe Orr Road is proposed to be expanded, so the area south of 204th Street was not considered available. Due to FAA regulations regarding the placement of open water near runways, the land south of the airport runway on the east side on Lansing Ditch was not considered. Distances from the runway will still

need to be considered with the current placement, but it is not prohibitive to its construction. A pipeline runs along 204th Street, further limiting the expansion south of the pond.

Table 3.5.17 provides a comparison of the modeled water surface elevation and modeled flow at the time of peak for NCLD-G1.

Table 3.5.17: Alternative Condition Flow & WSEL Comparison for Problem Group NCLD-G1

Location	Station	Existing Conditions		Alternative NCLDG1-A7	
		Max WSEL (feet)	Max Flow (cfs)	Max WSEL (feet)	Max Flow (cfs)
Lansing Ditch, 204th Street (upstream)	LD5 12732	618.63	378	615.96	102
Lansing Ditch, 201st Street (upstream of flow diversion)	LD5 11401	616.46	308	614.85	108
Lynwood Tributary, Burnham Avenue (upstream)	LT1 11652	615.73	172	614.67	81
Lynwood Tributary, 201st Street (upstream)	LT1 5658	614.56	280	613.44	239
Lynwood Tributary, 198th Street (upstream)	LT1 3861	612.90	341	612.49	315

3.5.3.2.6 Data Required for Countywide Prioritization of Watershed Projects, NCLD-G1

Appendix I presents conceptual level cost estimates for the recommended alternative. **Table 3.5.18** lists the alternative analyzed in detail. The recommended alternative consists of the construction of a 700 acre-foot detention facility at the flow split of Lansing Ditch with Lynwood Tributary, as well as the upgrading of the crossings at 198th Street, the private drive upstream of 198th Street, and the private drive downstream of 198th Street. **Figure 3.5.5** shows the location of the recommended alternative and a comparison of the inundation area for existing conditions with the reduced inundation area resulting from the recommended alternative.

Table 3.5.18: North Creek Project Alternative Matrix to Support District CIP Prioritization for Problem Group NCLD-G1

Group ID	Alternative ID	Description	B/C Ratio	Net Benefits ($)	Total Project Cost ($)	Cumulative Structures & Roadways Protected	Water Quality Benefit	Involved Community
NCLD-G	NCLDG1-A7	Upgrade 3 crossings, construct 700 ac-ft detention basin	0.03	$2,364,000	$69,500,000	49 Structures, 10 Roadways	Positive	Lansing, Lynwood

Note: Net Benefits values do not include local benefits or non-economic benefits.

3.5.3.3 NCLD-G2 – Lansing Ditch Problem Group 2

3.5.3.3.1 Problem Definition, NCLD-G2

The NCLD-G2 problem area consists of overbank flooding near Bridge Street and associated street flooding in the mobile home park located east of Glenwood Dyer Road in Bloom Township. Overbank flooding occurs just downstream of Glenwood Dyer Road through the Bridge Street crossing to approximately 650 feet downstream of the Bridge Street crossing.

When Bridge Street is flooded, a portion of the mobile home park east of the Bridge Street/Valerie Drive intersection has no access. Bridge Street overtops during the 100-year storm, and the 2- through 100-year storm events have water surface elevations above the crown of the cross-road culverts. Approximately 40 mobile homes are within the 100-year inundation area. Bridge Street and six other side streets also fall within the inundation area. Portions of the channel banks are below the overtopping elevation of Bridge Street, so some flooding will occur even if Bridge Street is not overtopped. The inundation mapping in this portion of the reach encompasses a slightly smaller area than the FEMA DFIRM.

The restriction at the Bridge Street crossing caused by the low crown elevation of the culverts and the relatively small opening area contributes to the flooding in the area. This area was not reported to the District on a Form B report, but was indicated as a flooding concern during community workshops.

3.5.3.3.2 Damage Assessment, NCLD-G2

Damages were defined following the protocol defined in Chapter 6.6 of the CCSMP. Critical duration analysis was performed to determine the highest flood stages for North Creek and its tributaries. These stages were used to calculate the depth of flooding and then to estimate damages at each flooding problem area. The District's Stormwater Planning Database Tool was used to estimate the damages. Property damages for each building structure were calculated and transportation damages were estimated at 15% of the property damages, unless otherwise noted. Recreation damages were estimated based on depth and duration of flooding. **Table 3.5.19** lists the estimated damages for the problem group.

Table 3.5.19: Estimated Damages for North Creek Subwatershed, Problem Group NCLD-G2

Problem Group ID	Damage Category	Estimated Damage ($)	Description
NCLD-G2	Property	$1,039	Structures at risk of flooding
	Transportation	$150	Assumed as 15% of property damage due to flooding
	Recreation	$0	

3.5.3.3.3 Technology Screening, NCLD-G2

Several combinations of technologies were analyzed to eliminate the flooding problems at this location. Flood control technologies from Chapter 6 of the CCSMP were considered as potential solutions for the regional flooding problems. **Table**

3.5.20 summarizes the evaluation of these technologies in terms of their potential feasibility for this problem group.

Table 3.5.20: Evaluation of Flood Control Technologies for North Creek Subwatershed, Problem Group NCLD-G2

Flood Control Option	Feasibility
Detention Facilities	Yes. Increase the volume of Mary Woodland Reservoir
Conveyance Improvement – Culvert/Bridge Replacement	Yes. Increase the hydraulic capacity of crossing at Bridge Street
Conveyance Improvement – Channel Improvement	Yes. Widen the cross section along Lansing Ditch
Conveyance Improvements – Diversion	No. There is no available outfall for diversion
Flood Barriers, Levees/Floodwalls	Yes. This will not reduce roadway overtopping

3.5.3.3.4 Alternative Development, NCLD-G2

Flood Control Alternatives. Alternative solutions to regional flooding problems were developed and evaluated consistent with the methodology described in **Section 1.4** of this report. **Table 3.5.21** summarizes flood control alternatives developed for Problem Group NCLD-G2.

Table 3.5.21: Flood Control Alternatives for Problem Group NCLD-G2

Alternative	Location	Description
NCLDG2-A1	Mary Woodland Reservoir	Increase the volume of the existing regional detention facility. Increasing the size of this reservoir had no noticeable effect on downstream peak flows. The reservoir is properly sized to detain the 100-year flow; it is the additional flow from the downstream subbasins that cause the peak flow rates which contribute to flooding
NCLDG2-A2	Lansing Ditch near Bridge Street and Geneva Drive	Widen the cross section of Lansing Ditch to provide a greater hydraulic capacity in the reach. Widening the cross section of the reach within the available open space along the ditch does not provide the required capacity to reduce peak water surface elevation
NCLDG2-A3	Lansing Ditch near Bridge Street and Geneva Drive	Construct a floodwall to keep the flows within the channel. Constructing a floodwall will protect some of the properties, but will increase the peak water surface elevation at the point where the bridge overtops
NCLDG2-A4	Lansing Ditch, Bridge Street crossing	Upsize the crossing at Bridge Street. Upgrade the existing Bridge Street crossing from two, 6.2-ft W x 3.4-ft H con/span arches to two, 7-ft W x 5-ft H culvert
NCLDG2-A5	Lansing Ditch, Linda Lane (Geneva Drive) crossing	Upsize the crossing at Linda Lane. Backwater from this crossing contributes to the decreased capacity of the Bridge Street crossing. Replace the existing Linda Lane crossing, an 11 foot width bridge opening with a depth of approximately 6 ft; with a 19-ft span crossing with the low chord raised one ft
NCLDG2-A6	Throughout Mobile Home Park	Relocate mobile homes situated on vulnerable sites. A number of mobile homes are located directly adjacent to the banks of Lansing Ditch. These homes should be relocated to different pads within the mobile home park. A flood easement is recommended in the area of the pads remaining in the inundation area

Table 3.5.21: Flood Control Alternatives for Problem Group NCLD-G2

Alternative	Location	Description
NCLDG2-A7	Lansing Ditch – Bridge Street and Linda Lane crossings; various sites throughout Mobile Home Park	Upsize crossings at Bridge Street and Linda Lane, and relocate mobile homes situated on sites which remain vulnerable (combination of alternatives NCLDG2-A4, NCLDG2-A5 and NCLDG2-A6)

Streambank Stabilization Alternatives. No streambank stabilization alternatives were developed for the NCLD-G2 Problem Group.

3.5.3.3.5 Alternative Evaluation and Selection, NCLD-G2

Alternatives included in **Table 3.5.21** were evaluated to determine their effectiveness and produce data required for the countywide prioritization of watershed projects. Flood control alternatives were modeled to evaluate their impact on water elevations and flood damages. **Table 3.5.23** provides the B/C ratio, net benefits, total project costs, number of structures protected, and other relevant alternative data for the preferred alternative. Alternatives that did not produce a significant change in inundation areas are not listed as benefits were negligible, thus costs were not calculated for these alternatives.

Alternative NCLDG2-A7 from **Table 3.5.21** provides the preferred alternative for this problem group. Under this recommendation, the 100-year water surface elevation at Bridge Street is 623.8 feet, and the overtopping elevation of the roadway is 623.9 feet. Ideally, a minimum one foot of freeboard would be provided; however this would require the roadway to be raised a minimum of two feet, which would require considerable roadway reconstruction. Since Bridge Street is not a major arterial, rather a residential side street, and it is recommended for upgrading for the purpose of eliminating a point where access is cut off, the current recommendation is considered adequate.

Table 3.5.22 provides a comparison of the modeled water surface elevation and modeled flow at the time of peak for NCLD-G2.

Table 3.5.22: Alternative Condition Flow & WSEL Comparison for Problem Group NCLD-G2

Location	Station	Existing Conditions		Alternative NCLDG2-A7	
		Max WSEL (feet)	Max Flow (cfs)	Max WSEL (feet)	Max Flow (cfs)
Bridge Street	LD5 19460	623.89	171	623.76	176
Geneva Drive	LD5 18262	623.47	228	623.27	235

3.5.3.3.6 Data Required for Countywide Prioritization of Watershed Projects, NCLD-G2

Appendix I presents conceptual level cost estimates for the recommended alternative. **Table 3.5.23** lists the alternative analyzed in detail. The recommended alternative consists of upgrading the Bridge Street and Linda Lane crossings and relocating

mobile homes located close to the banks of Lansing Ditch to other parcels within the mobile home park. **Figure 3.5.6** shows the location of the recommended alternative and a comparison of the inundation area for existing conditions with the reduced inundation area resulting from the recommended alternative.

Table 3.5.23: North Creek Project Alternative Matrix to Support District CIP Prioritization for Problem Group NCLD-G2

Group ID	Alternative ID	Description	B/C Ratio	Net Benefits ($)	Total Project Cost ($)	Cumulative Structures Protected	Water Quality Benefit	Involved Community
NCLD-G2	NCLDG2-A7	Upgrade 2 crossings, relocate mobile homes	< 0.01	$1,000	$357,000	2 Structures, 1 Roadway	No Impact	Bloom Township

Note: Net Benefits values do not include local benefits or non-economic benefits.

3.5.3.4 NCLD-G3 – Lansing Ditch Problem Group 3

3.5.3.4.1 Problem Definition, NCLD-G3

The NCLD-G3 problem area consists of overbank flooding near the Torrence Avenue crossing south of Sauk Trail Road in Sauk Village. The roadway overtops for the 100-year storm and causes backwater for the 25- and 50-year events. Also, the structure immediately downstream of the Torrence Avenue crossing at Sauk Trail Road causes backwater for the 50- and 100-year events, though this crossing is not overtopped.

A commercial center on the southeast quadrant of Torrence Avenue and Sauk Trail Road is within the 100-year inundation area, as are two residential structures. Torrence Avenue and one residential side street are also in the inundation area. This area is in the 100-year floodplain per the FEMA DFIRM.

The roadway topping elevation on Torrence Avenue is 653.1 feet, and the 100-year water surface elevation at the crossing is 635.2 feet. The channel bank elevation upstream of Torrence Avenue is approximately 634.0 feet on the right bank and 635.0 feet on the left bank, causing the channel to overtop before the roadway. Downstream of the crossing, the left channel bank is at an approximate elevation of 632.0 feet and the right channel bank is 634.0 feet. The commercial center along the left bank has a first floor elevation of 634.0 feet, the same as the 100-year water surface elevation.

3.5.3.4.2 Damage Assessment, NCLD-G3

Damages were defined following the protocol defined in Chapter 6.6 of the CCSMP. Critical duration analysis was performed to determine the highest flood stages for North Creek and its tributaries. These stages were used to calculate the depth of flooding and then to estimate damages at each flooding problem area. The District's Stormwater Planning Database Tool was used to estimate the damages. Property damages for each building structure were calculated and transportation damages were estimated at 15% of the property damages, unless otherwise noted. Recreation damages were estimated based on depth and duration of flooding. **Table 3.5.24** lists the estimated damages for the problem group.

Table 3.5.24: Estimated Damages for North Creek Subwatershed, Problem Group NCLD-G3

Problem Group ID	Damage Category	Estimated Damage ($)	Description
NCLD-G3	Property	$1,524,000	Structures at risk of flooding
	Transportation	$228,570	Assumed as 15% of property damage due to flooding; flooding of arterial routes less than 0.5 ft depth
	Recreation	$0	

3.5.3.4.3 Technology Screening, NCLD-G3

Several combinations of technologies were analyzed to eliminate the flooding problems at this location. Flood control technologies from Chapter 6 of the CCSMP were considered as potential solutions for the regional flooding problems. **Table 3.5.25** summarizes the evaluation of these technologies in terms of their potential feasibility for this problem group.

Table 3.5.25: Evaluation of Flood Control Technologies for North Creek Subwatershed, Problem Group NCLD-G3

Flood Control Option	Feasibility
Detention Facilities	No. Limited space available
Conveyance Improvement – Culvert/Bridge Replacement	Yes. Increase hydraulic capacity of crossing at Sauk Trail and Torrence Avenue
Conveyance Improvement – Channel Improvement	No. Limited ROW available
Conveyance Improvements – Diversion	No. No available outfall for diversion
Flood Barriers, Levees/Floodwalls	Yes, but will not reduce roadway overtopping

3.5.3.4.4 Alternative Development, NCLD-G3

Flood Control Alternatives. Alternative solutions to regional flooding problems were developed and evaluated consistent with the methodology described in **Section 1.4** of this report. **Table 3.5.26** summarizes flood control alternatives developed for Problem Group NCLD-G3.

Table 3.5.26: Flood Control Alternatives for Problem Group NCLD-G3

Alternative	Location	Description
NCLDG3-A1	Lansing Ditch upstream of Torrence Avenue	Construct a floodwall to keep flood waters in the channel. This is not recommended as it will increase the stage at the Torrence Avenue crossing
NCLDG3-A2	Torrence Avenue crossing	Increase the opening area of the Torrence Avenue crossing from a 10-ft width by 5-ft height box culvert to two, 8.6-ft width by 6-ft height box culverts
NCLDG3-A3	Sauk Trail Road crossing	Increase the opening area of the Sauk Trail Road crossing from a bridge with a 20-ft width and an average depth of 8.5 ft to a span of 29 ft. Increasing the opening area at Torrence Avenue will require the opening area at Sauk Trail Road to be increased as well

Table 3.5.26: Flood Control Alternatives for Problem Group NCLD-G3

Alternative	Location	Description
NCLDG3-A4	Torrence Avenue and Sauk Trail Road crossings	Increase opening area of Torrence Avenue and Sauk Trail Road crossings (combination of alternatives NCLDG3-A3 and NCLDG3-A4)

Streambank Stabilization Alternatives. No streambank stabilization alternatives were developed for the NCLD-G3 Problem Group.

3.5.3.4.5 Alternative Evaluation and Selection, NCLD-G3

Alternatives included in **Table 3.5.26** were evaluated to determine their effectiveness and produce data required for the countywide prioritization of watershed projects. Flood control alternatives were modeled to evaluate their impact on water elevations and flood damages. **Table 3.5.28** provides the B/C ratio, net benefits, total project costs, number of structures protected, and other relevant alternative data for the preferred alternative. Alternatives that did not produce a significant change in inundation areas are not listed as benefits were negligible, and thus costs were not calculated for these alternatives.

Alternative NCLDG3-A4 from **Table 3.5.26** provides the preferred alternative for this problem group. Under this recommendation, the 100-year water surface elevation at Torrence Avenue decreases from 635.2 feet under existing conditions to 634.3 feet; the overtopping elevation of the roadway is 635.1 feet. The 100-year water surface elevation at the Sauk Trail Road crossing decreases from 633.3 feet to 632.9 feet.

Table 3.5.27 provides a comparison of the modeled water surface elevation and modeled flow at the time of peak for NCLD-G3.

Table 3.5.27: Alternative Condition Flow & WSEL Comparison for Problem Group NCLD-G3

Location	Station	Existing Conditions		Alternative NCLDG3-A4	
		Max WSEL (feet)	Max Flow (cfs)	Max WSEL (feet)	Max Flow (cfs)
Upstream of Torrence	LD1 31000	635.23	395	634.34	395
Downstream of Torrence, upstream of confluence with Lansing Ditch East Tributary	LD1 30054	633.83	396	633.61	396
Upstream of Sauk Trail Road	LD2 29664	633.28	1,049	632.90	1,060

3.5.3.4.6 Data Required for Countywide Prioritization of Watershed Projects, NCLD-G3

Appendix I presents conceptual level cost estimates for the recommended alternative. **Table 3.5.28** lists the alternative analyzed in detail. The recommended alternative consists of upgrading the Torrence Avenue and Sauk Trail Road crossings over Lansing Ditch. **Figure 3.5.7** shows the location of the recommended alternative and a comparison of the inundation area for existing conditions with the reduced inundation area resulting from the recommended alternative.

Table 3.5.28: North Creek Project Alternative Matrix to Support District CIP Prioritization for Problem Group NCLD-G3

Group ID	Alternative ID	Description	B/C Ratio	Net Benefits ($)	Total Project Cost ($)	Cumulative Structures & Roadways Protected	Water Quality Benefit	Involved Community
NCLD-G3	NCLDG3-A4	Upgrade two crossings	< 0.01	$10,000	$2,180,000	12 Structures, 1 Roadway	No Impact	Sauk Village

Note: Net Benefits values do not include local benefits or non-economic benefits.

3.5.3.5 NOCR-G1 – North Creek Problem Group 1

3.5.3.5.1 Problem Definition, NOCR-G1

The NOCR-G1 problem area consists of flooding through a residential subdivision. North Creek enters a series of culverts at Wentworth Avenue in Lansing. Flow is conveyed in pipe for approximately 1,000 feet, then passes under a railroad crossing, and daylights downstream of the railroad. North Creek flows as open channel for 325 feet, where it enters a culvert at Louise Drive, and daylights 850 feet downstream near the confluence with Lansing Ditch.

Flow in North Creek downstream of Wentworth Avenue surcharges into the residential streets, causing flooding. The low point elevation is 609.4 feet on Sherman Street. Water will surcharge onto the street for the 10-year (water surface elevation 609.5 feet) through 100-year (water surface elevation 610.9 feet) storm events. Additionally, for the 2- and 5-year events, roadway flooding still occurs because the sewer system which directly connects to North Creek has limited capacity, and stormwater which cannot enter the conveyance system instead ponds in the street.

The inundation area along North Creek between the railroad tracks and Wentworth Avenue, which is contained in a culvert, does not appear on the FEMA DFIRM map. However, this area experiences flooding which was confirmed at community workshops and during a field visit to the site after the September 2008 storm event. 56 residential properties are within the 100-year inundation area along North Creek between the railroad and Wentworth Avenue, as well as four residential streets. Upstream of Wentworth Avenue, the Lansing Country Club golf course and two commercial properties adjacent to the golf club are within the inundation area. Downstream of the railroad tracks, 21 residential properties are within the inundation area, as well as three residential streets.

Once North Creek enters the culvert at Wentworth Avenue, it passes through a series of different sized culverts until its outfall. These culverts are aging and the exact sizes are unknown. Also, the upstream reach of North Creek receives considerable backwater from the confluence of North Creek and Lansing Ditch. Flows from the upstream reach of North Creek (North Creek Reach 1) cannot subside until the downstream reach (North Creek Reach 2) has receded.

3.5.3.5.2 Damage Assessment, NOCR-G1

Damages were defined following the protocol defined in Chapter 6.6 of the CCSMP. Critical duration analysis was performed to determine the highest flood stages for North Creek and its tributaries. These stages were used to calculate the depth of flooding and then to estimate damages at each flooding problem area. The District's Stormwater Planning Database Tool was used to estimate the damages. Property damages for each building structure were calculated and transportation damages were estimated at 15% of the property damages, unless otherwise noted. Recreation damages were estimated based on depth and duration of flooding. **Table 3.5.29** lists the estimated damages for the problem group.

Table 3.5.29: Estimated Damages for North Creek Subwatershed, Problem Group NOCR-G1

Problem Group ID	Damage Category	Estimated Damage ($)	Description
NOCR-G1	Property	$607,000	Structures at risk of flooding
	Transportation	$91,000	Assumed as 15% of property damage due to flooding
	Recreation	$0	

3.5.3.5.3 Technology Screening, NOCR-G1

Several combinations of technologies were analyzed to eliminate the flooding problems at this location. Flood control technologies from Chapter 6 of the CCSMP were considered as potential solutions for the regional flooding problems. **Table 3.5.30** summarizes the evaluation of these technologies in terms of their potential feasibility for this problem group.

Table 3.5.30: Evaluation of Flood Control Technologies for North Creek Subwatershed, Problem Group NOCR-G1

Flood Control Option	Feasibility
Detention Facilities	Yes. Potential for detention site upstream of Wentworth Avenue
Conveyance Improvement – Culvert/Bridge Replacement	Yes. Increase open area of culvert from Wentworth to Railroad
Conveyance Improvement – Channel Improvement	Yes. Increase capacity of downstream reach
Conveyance Improvements – Diversion	No. Too much infrastructure in way of constructing diversion culvert, little to no fall available
Flood Barriers, Levees/Floodwalls	No. Channel contained in culvert

3.5.3.5.4 Alternative Development, NOCR-G1

Flood Control Alternatives. Alternative solutions to regional flooding problems were developed and evaluated consistent with the methodology described in **Section 1.4** of this report. **Table 3.5.31** summarizes flood control alternatives developed for Problem Group NOCR-G1.

Table 3.5.31: Flood Control Alternatives for Problem Group NOCR-G1

Alternative	Location	Description
NOCRG1-A1	Ponds on Lansing Country Club property	Increase the detention volume of the in-line ponds upstream of Wentworth Avenue on the Lansing Country Club property to reduce the peak flows downstream. This option does not have benefits because the flooding is from the downstream head on the system, not the peak flows coming from upstream
NOCRG1-A2	Culvert from Wentworth Avenue to Grand Trunk Railroad	Replace the culvert from Wentworth to the Grand Trunk Railroad tracks to increase the carrying capacity of North Creek. While the culvert does need to be slightly increased in size and replaced due to age (see NOCRG1-A4), significantly increasing the size of the culvert will not resolve the flooding problem. Hydraulic modeling of the system indicates that the source of the flooding is from water backing up from the North Creek/Lansing Ditch confluence. Because of this high downstream head, water originating upstream of the confluence cannot drain out until the downstream water surface elevation has subsided
NOCRG1-A3	North Creek from confluence with Lansing Ditch to Torrence Avenue	Increase the capacity of North Creek downstream of the North Creek/Lansing Ditch junction to reduce created head upstream. To reduce the backflow into the upstream portion of North Creek, the creek would need to be re-graded from the junction with Lansing Ditch, through Erfert Park, and through a portion of the Cook County Forest Preserve; even with this effort, the problem would not be fully corrected
NOCRG1-A4	Culvert from Wentworth Avenue to Grand Trunk Railroad	Replace the aging culvert from conveying North Creek from Wentworth Avenue to the Grand Trunk Railroad tracks. The existing culvert system, which consists of a combination of culvert sizes, should be replaced with a 4-ft by 6-ft culvert
NOCRG1-A5	Upstream of Wentworth Avenue	This is a locally-funded and constructed option. Separate the storm sewer system in the residential neighborhood so it does not directly connect to the culvert conveying North Creek, and route the system to the proposed detention basin. Substantial roadway and residential property flooding occurs because the North Creek culvert surcharges in the residential streets through the inlet structures, and the flows originating in the subdivision cannot enter the conveyance system and add additional ponding volume on the streets and yards. A new storm sewer system should be constructed to convey flows from Sherman, William, and Bernadine Streets east, across Wentworth Avenue, to a proposed detention facility adjacent to the Lansing Country Club. The storm sewer cannot be connected to the north, because this is a combined sewer area, and it cannot be conveyed west, because significant infrastructure would be required to cross the railroad and ultimately discharge to North Creek in the Forest Preserve property Construct a 12 ac-ft detention basin to detain the volume from a new storm sewer until the downstream head in North Creek subsides to a point where the Creek can receive additional flow volume. The volume of the basin is designed to detain the entire 100-year flow volume from the residential subdivision. The flow would outlet, via pump station, to North Creek upstream of Wentworth Avenue when the water surface elevation in the creek has subsided

Table 3.5.31: Flood Control Alternatives for Problem Group NOCR-G1

Alternative	Location	Description
NOCRG1-A6	Vicinity of Wentworth Avenue to Railroad Tracks.	Replace the aging culvert from Wentworth Avenue to the railroad tracks with a single, 4-ft by 6-ft box culvert. This will not have any substantial benefits towards decreasing peak flood stages in the problem area, but will decrease the chance of future problems due to failing infrastructure. To fully address the problem, a locally-funded and constructed project must be undertaken to separate the local storm sewer from the North Creek conveyance culvert. This alternative is a combination of alternatives NOCRG1-A4 and NOCRG1-A5.

Streambank Stabilization Alternatives. No streambank stabilization alternatives were developed for the NOCR-G1 Problem Group.

3.5.3.5.5 Alternative Evaluation and Selection, NOCR-G1

Alternatives included in **Table 3.5.31** were evaluated to determine their effectiveness and produce data required for the countywide prioritization of watershed projects. Flood control alternatives were modeled to evaluate their impact on water elevations and flood damages. **Table 3.5.33** provides the B/C ratio, net benefits, total project costs, number of structures protected, and other relevant alternative data for the preferred alternative. Alternatives that did not produce a significant change in inundation areas are not listed as benefits were negligible, thus costs were not calculated for these alternatives.

Alternative NOCRG1-A6 from **Table 3.5.31** provides the preferred alternative for this problem group. A portion of the project must be undertaken by the local agency to achieve this solution. Work must be performed by the local agency on the local storm sewer system to disconnect it from the culvert conveying North Creek and reconnect it upstream at a proposed detention facility. Under this recommendation, the 100-year water surface elevation along North Creek upstream of Burnham Avenue is not significantly increased; however, temporarily disconnecting the local system from the creek reduces the backflow volume into the reach and prevents the surcharging of North Creek through the storm sewer system. Because of the age and combination of sizes of the culverts conveying North Creek from Wentworth Avenue to the railroad tracks, it is recommended that the District replace this culvert at the same time a local project is performed to increase the integrity of the system.

Table 3.5.32 provides a comparison of the modeled water surface elevation and modeled flow at the time of peak for NOCR-G1.

Table 3.5.32: Alternative Condition Flow & WSEL Comparison for Problem Group NOCR-G1

Location	Station	Existing Conditions		Alternative NOCRG1-A6	
		Max WSEL (feet)	Max Flow (cfs)	Max WSEL (feet)	Max Flow (cfs)
Upstream of Wentworth Avenue	NC1 38538	610.96	26	610.88	24
Downstream of Railroad Crossing	NC1	610.73	26	610.66	24

3.5.3.5.6 Data Required for Countywide Prioritization of Watershed Projects, NOCR-G1

Appendix I presents conceptual level cost estimates for the recommended alternative. **Table 3.5.33** lists the alternative analyzed in detail. The recommended alternative consists of replacing the culvert conveying North Creek from Wentworth Avenue to the Grand Trunk Railroad with a 6-foot by 4-foot culvert and constructing a 12 acre-foot detention basin for temporary storage. Local efforts would require disconnecting the local storm sewer and routing it to the proposed detention facility. The costs for the entire project, not just the District's portion, were calculated in order to get the alternative's B/C ratio. **Figure 3.5.8** shows the location of the recommended alternative and a comparison of the inundation area for existing conditions with the reduced inundation area resulting from the recommended alternative.

Table 3.5.33: North Creek Project Alternative Matrix to Support District CIP Prioritization for Problem Group NOCR-G1

Group ID	Alternative ID	Description	B/C Ratio	Net Benefits ($)	Total Project Cost ($)	Cumulative Structures & Roadways Protected	Water Quality Benefit	Involved Community
NOCR-G1	NOCRG1-A6	Replace culvert, construct detention facility	0.05	$388,000	$7,126,000	14 Structures, 4 Roadways	Positive	Lansing

Note: Net Benefits values do not include local benefits or non-economic benefits.

3.5.3.6 NOCR-G2 – North Creek Problem Group 2

3.5.3.6.1 Problem Definition, NOCR-G2

The NOCR-G2 problem area consists of overbank flooding of North Creek from the Grand Trunk Western Railroad tracks on the north to 188th Street on the south, and from Oakwood Avenue to Burnham Avenue. Erfert Park, located between Chicago Avenue and Burnham Avenue along North Creek, is able to contain the majority of the inundation area east of Chicago Avenue, but residential properties along the border of the park also experience flooding. Chicago Avenue is inundated for the 25-year and above storm event, and Oakwood Avenue is inundated for the 50-year and above event.

Along Chicago Avenue and Oakwood Avenue, residences have been built in low-lying areas near the creek and are frequently subject to flooding. A typical first floor elevation of the residences in the inundation area is approximately 609.7 feet, which is lower than the 50-year (609.9 feet) and 100-year (610.2 feet) water surface elevations.

Chicago Avenue has an overtopping elevation of 609.3 feet, and overtops for the 25-year storm (water surface elevation 609.5 feet) and above. Oakwood Avenue has an overtopping elevation of 609.5 feet, and overtops for the 50-year storm event (water surface elevation 609.9 feet) and above.

The topography of the overbank area along Reach 2 of North Creek is flat, with little relief through the residential neighborhoods. North Creek has a shallow slope of only 0.08% from the crossing at Burnham Avenue to 850 feet downstream of Oakwood Avenue. The Creek has a negative bed slope for a length of almost a half a mile. This causes the carrying capacity of the creek to be limited. The low carrying capacity of the creek channel combined with the large tributary area to the reach contributes to the overbank flooding experienced along the reach.

3.5.3.6.2 Damage Assessment, NOCR-G2

Damages were not calculated since the proposed alternative for BTCR-G4 is a non-structural measure such as floodproofing or acquisition only.

3.5.3.6.3 Technology Screening, NOCR-G2

Several combinations of technologies were analyzed to eliminate the flooding problems at this location. Flood control technologies from Chapter 6 of the CCSMP were considered as potential solutions for the regional flooding problems. **Table 3.5.34** summarizes the evaluation of these technologies in terms of their potential feasibility for this problem group.

Table 3.5.34: Evaluation of Flood Control Technologies for North Creek Subwatershed, Problem Group NOCR-G2

Flood Control Option	Feasibility
Detention Facilities	Yes. There is a potential site in Erfert Park
Conveyance Improvement – Culvert/Bridge Replacement	Yes. Increase the opening areas of Oakwood and Chicago Avenue crossings
Conveyance Improvement – Channel Improvement	Yes. Widen the floodplain downstream of Chicago Avenue
Conveyance Improvements – Diversion	No. There is too much infrastructure in way of constructing diversion culvert, little to no fall available
Flood Barriers, Levees/Floodwalls	Yes

3.5.3.6.4 Alternative Development, NOCR-G2

Flood Control Alternatives. Alternative solutions to regional flooding problems were developed and evaluated consistent with the methodology described in **Section 1.4** of this report. **Table 3.5.35** summarizes flood control alternatives developed for Problem Group NOCR-G2.

Table 3.5.35: Flood Control Alternatives for Problem Group NOCR-G2

Alternative	Location	Description
NOCRG2-A1	Erfert Park, Lansing	Provide detention in Erfert Park. Due to the large flow volume that would need to be detained, this option is not feasible
NOCRG2-A2	North Creek from Burnham Avenue to downstream of Oakwood Avenue	Regrade North Creek. The option was explored to regrade North Creek to provide a consistent positive slope and widen the creek with the addition of a floodplain shelf. Extensive regrading would be required, and in order to provide a creek with sufficient width for the floodplain shelf, two of the most severely flooded structures would need to be acquired, and the water surface elevation would still be above that required to provide necessary benefit
NOCRG2-A3	Chicago Avenue and Oakwood Avenue crossings	Increase the hydraulic openings of the Chicago Avenue and Oakwood Avenue crossings. These crossings are low and are flooded by as much as two feet during the 100-year storm event. Increasing the opening area will not provide a positive benefit
NOCRG2-A4	North Creek from Burnham Avenue to downstream of Oakwood Avenue	Construct floodwalls along North Creek. Overtopping will still occur at Chicago Avenue and Oakwood Avenue, and thus floodwaters will still be able to reach the homes which are flooded. Compensatory storage would need to be provided to mitigate the increase in flood elevations; this would need to be done downstream within the Forest Preserve property

Streambank Stabilization Alternatives. No streambank stabilization alternatives were developed for the NOCR-G2 Problem Group.

3.5.3.6.5 Alternative Evaluation and Selection, NOCR-G2

Alternatives included in **Table 3.5.35** were evaluated to determine their effectiveness and produce data required for the countywide prioritization of watershed projects. Flood control alternatives were modeled to evaluate their impact on water elevations and flood damages. None of the alternatives analyzed feasibly produced the required significant changes in inundation areas, thus benefits and costs were not calculated for this problem group.

Five properties are at risk of flooding in the 100-year event. At least two of the properties are repetitively flooded, and are located in low spots along the channel. Since the properties receiving structure damages were built in naturally low-lying areas and are relatively small in number, they are candidates for protection using non-structural flood control measures, such as floodproofing or acquisition. The decision to acquire vs. floodproof should be taken on a case-by-case basis and be based on actual surveyed first floor elevations. For the homes along the north side of 188th Place, inundation mapping suggests that it is only the yards of these properties that are inundated and not the structures. This solution does not address the local street and basement flooding in the residential neighborhood south of 188th Place, as this is a local issue. The overtopping of Oakwood Avenue and Chicago Avenue are not addressed, since these roadways do not constrict the 100-year flow of North Creek and are local roadways which have alternative routes that residents can take to exit their neighborhoods. **Figure 3.5.9** shows the location of the properties at risk of flooding.

3.5.4 Recommended Alternatives, North Creek Subwatershed

Table 3.5.36 summarizes the recommended alternatives for the North Creek subwatershed. The District will use data presented here to support prioritization of a countywide stormwater CIP.

Table 3.5.36: North Creek Project Alternative Matrix to Support District CIP Prioritization, All Problem Groups

Group ID	Alternative ID	Description	B/C Ratio	Net Benefits ($)	Total Project Cost ($)	Cumulative Structures & Roadways Protected	Water Quality Benefit	Involved Community
LDET-G1	LDETG1-A4	Replace crossing	0.29	$82,000	$287,000	9 Structures, 1 Roadway	No impact	Sauk Village
NCLD-G1	NCLDG1-A7	Upgrade 3 crossings, construct 700 ac-ft detention basin	0.03	$2,364,000	$69,500,000	49 Structures, 10 Roadways	Positive	Lansing, Lynwood
NCLD-G2	NCLDG2-A7	Upgrade 2 crossings, relocate mobile homes	< 0.01	$1,000	$357,000	2 Structures, 1 Roadway	No impact	Bloom Township
NCLD-G3	NCLDG3-A4	Upgrade two crossings	< 0.01	$10,000	$2,180,000	12 Structures, 1 Roadway	No impact	Sauk Village
NOCR-G1	NOCRG1-A6	Replace culvert, construct detention facility	0.05	$388,000	$7,126,000	14 Structures, 4 Roadways	Positive	Lansing

Note: Net Benefits values do not include local benefits or non-economic benefits.