Detailed Unsteady Flow Model Development for the Little Calumet River Watershed

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MWRDGC

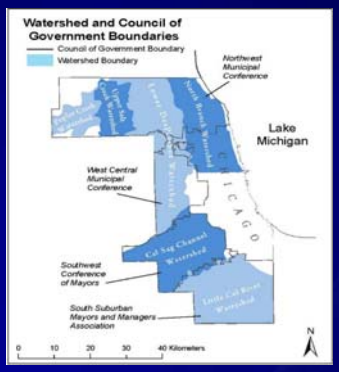
CDM

Agenda

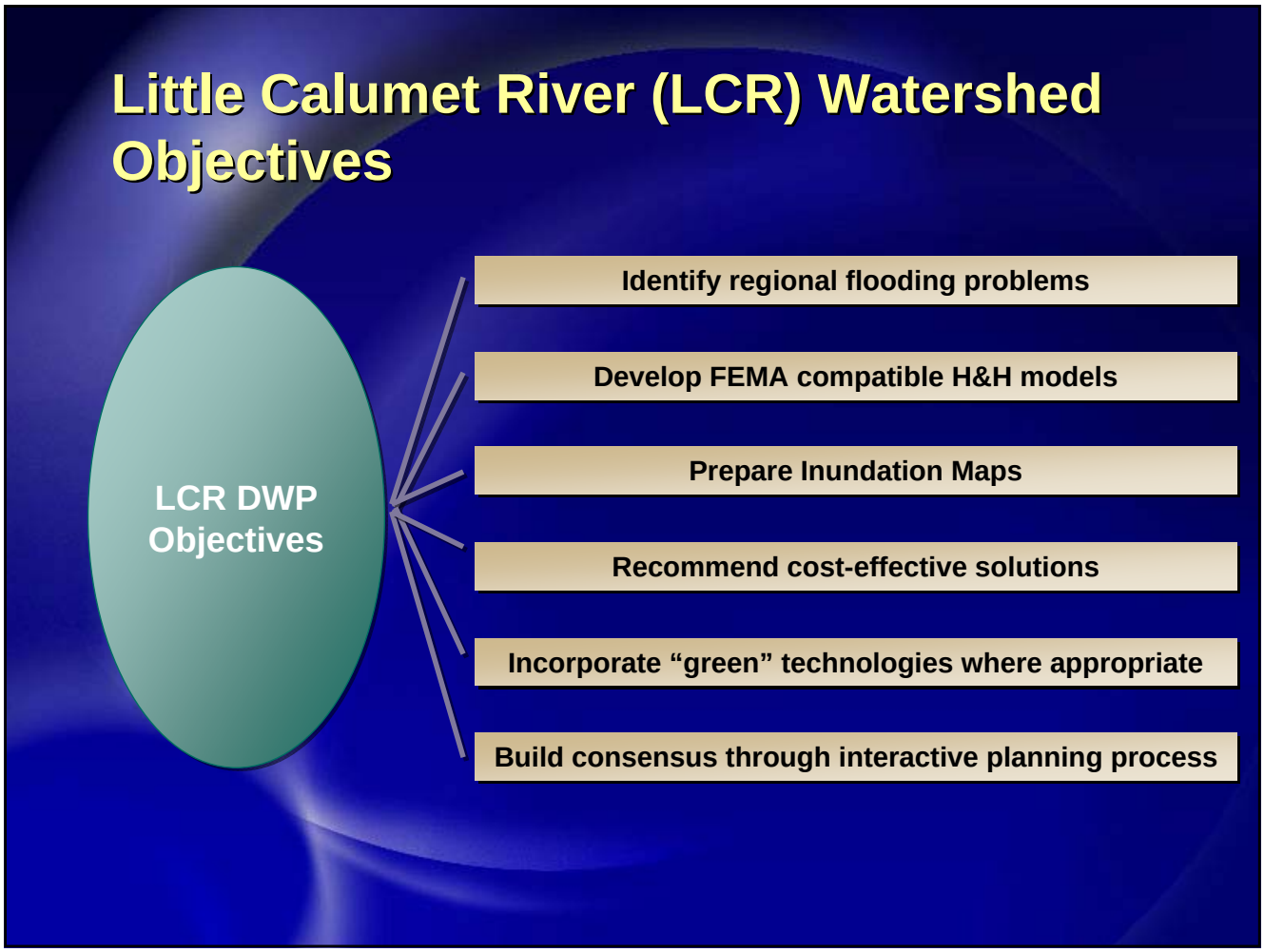
- Metropolitan Water Reclamation District of Greater Chicago (MWRDGC)
- Little Calumet River Watershed Objectives
- Detailed Watershed Plan (DWP) Approach for the Little Calumet River Watershed
- Little Calumet River Watershed Detailed Hydrology and Hydraulic Modeling
- Project Challenges

Metropolitan Water Reclamation District of Greater Chicago

- Public Act 93-1049
  - Granted authority to MWRDGC to assume responsibilities of stormwater management for Cook County
- Formed Watershed Planning Councils to act as advisory board to MWRD
- Developed Cook County Stormwater Management Plan (CCSMP)
- Initiated development of six DWPs

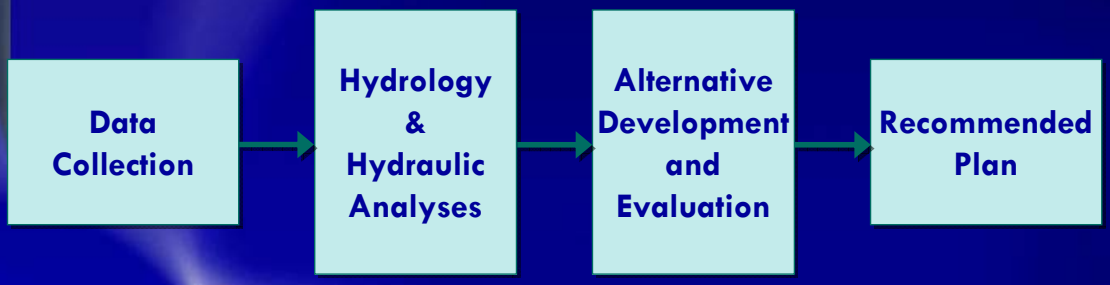


Little Calumet River (LCR) Watershed Objectives



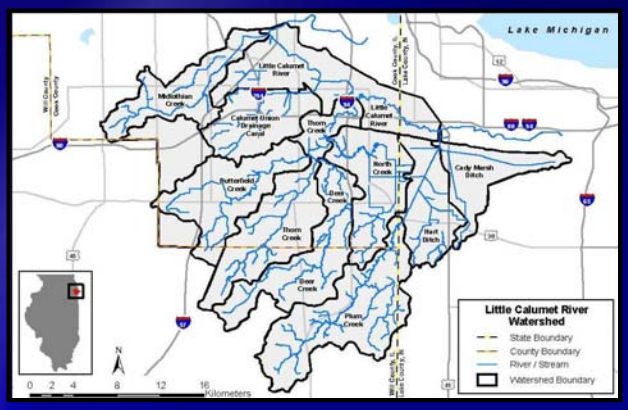
LCR Detailed Watershed Plan Approach

- Traditional approach
  - Data collection
  - Hydrology & Hydraulic analyses
  - Alternative development and evaluation
  - Recommended plan



LCR Detailed Watershed Plan
Watershed Characteristics

- 250 sq mi in IL & IN
- 200 stream miles
- 12 Regional flood control facilities
- 45 Communities
- Average annual damages of $5.8 M

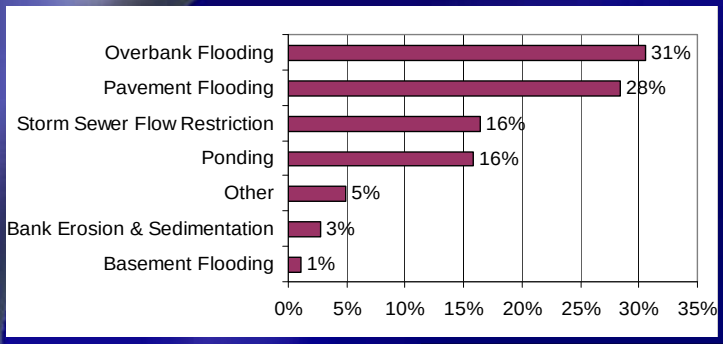


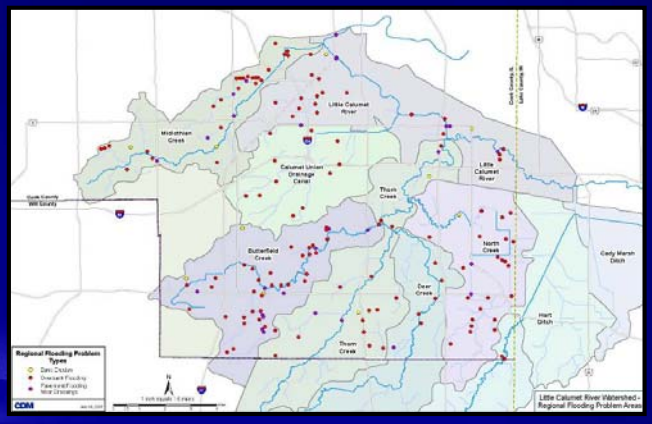
- Ten Sub-watersheds
- Thornton Transitional and Composite Reservoir
- Two way channel flow
- Combined sewer areas
- Overland flow paths

LCR Detailed Watershed Plan
Phase A – Data Collection

- Stormwater flooding problems
- Existing studies
- Existing hydrology & hydraulic models
- Various GIS layers – Cook County, NIPC, etc.
- Field reconnaissance
- Gauge data – MWRDGC, ISWS, USGS & NWS

LCR Detailed Watershed Plan
Phase A – Stormwater Flooding Problems





LCR Detailed Watershed Plan
Reasons for New Detailed Models

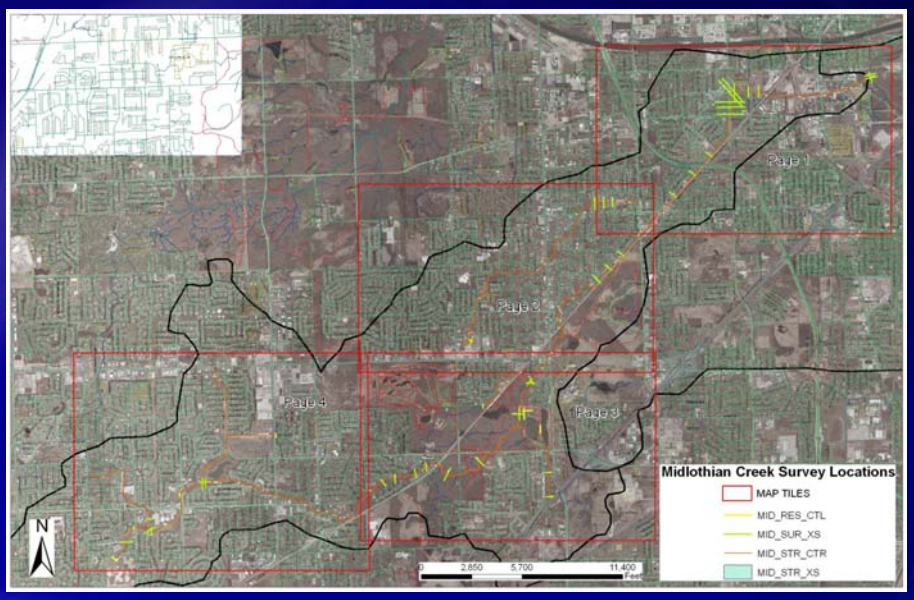
- Hydrology models
  - Variety of existing models TR-20, Regression Equations, & HEC-1
  - Differing rainfall sources TP 40, Bulletin 70
  - Land Use of various periods of time
- Hydraulic models
  - Variety of existing models WSP, UNET, HEC-2, FEQ, & HEC-RAS (steady and unsteady)
  - Survey data
- Stormwater flooding problems

LCR Detailed Watershed Plan
Phase B – Hydrology & Hydraulic Modeling

- Field survey
- Development of hydrology & hydraulic models
- Production of 100 year inundation maps
- Alternative Analyses – In progress
- Benefit Cost Analyses – In progress

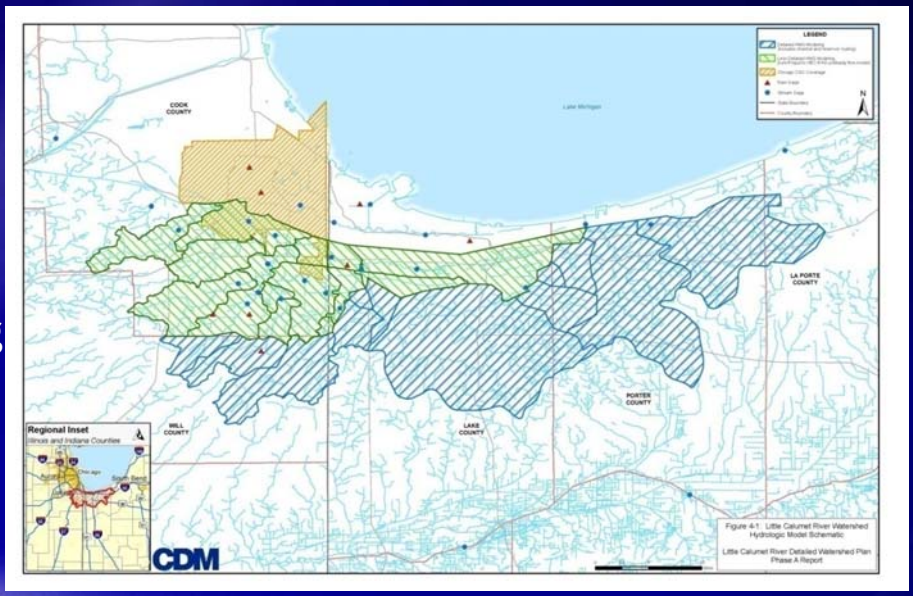
LCR Detailed Watershed Plan
Phase B – Field Survey

- Field survey performed according to FEMA guidelines
- Approximately 1000 XS's were surveyed
- Approximately 350 structures were surveyed



LCR Detailed Watershed Plan
Phase B – Hydrology Model Methodology

- NRCS curve number
- Lag time and time of concentration
- Muskingum-Cunge routing method
- A modified Puls channel routing



LCR Detailed Watershed Plan
Phase B – Hydrology Modeling

- Hydrologic Data Sources
  - NIPC land use & NRCS soil maps
  - USGS land cover for Indiana
  - Cook County DTM
  - Indiana DEM and USGS DEM (Will County)
  - ISWS, NWS & Bulletin 70 precipitation

LCR Detailed Watershed Plan
Phase B – Hydrology Modeling

- Sub-basin delineation using GIS & HEC-GEOHMS tools
  - Delineated drainage areas greater than 1 sq.mi
  - 540 sub-basins delineated
- Hydrographs generated using HEC-HMS

LCR Detailed Watershed Plan
Phase B – Hydraulic Model Methodology

- Unsteady flow methodology

LCR Detailed Watershed Plan
Phase B – Hydraulic Modeling

- Hydraulic Data Sources
  - Recent FIS and Community models
  - 2008 field survey data
  - Cook County DTM
  - Field reconnaissance
  - As-built plans

LCR Detailed Watershed Plan
Phase B – Hydraulic Modeling

- Eight detailed hydraulic models for LCR has been developed
- All 12 regional flood control facilities were included in the models
- All overland flow paths were included in the models
- Modeled using HEC-RAS 4.0

LCR Detailed Watershed Plan
Phase B – Calibration

- Calibration Storms
  - July 1996**
  - July 2003
  - May 2004
  - April 2006**
  - April 2007
  - August 2007

** Flood of record in most of the sub-watersheds

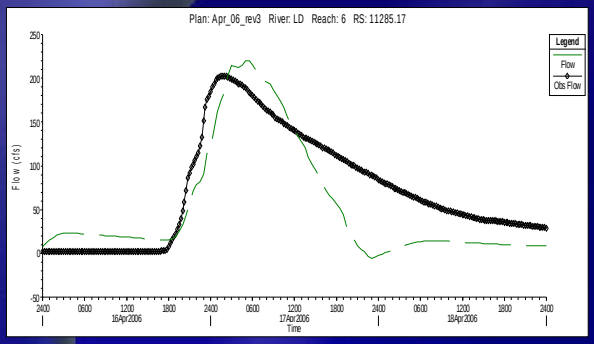
- CCSMP requirements:
  - Water surface elevations within six inches
  - Volume and peak flow rates within 30%

North Creek Sub-watershed

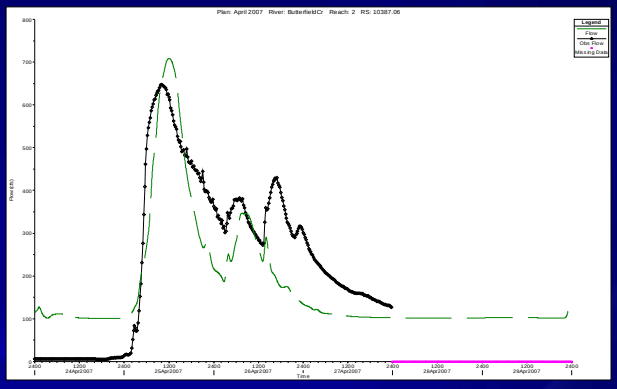
Storm	Modeled Flow	Observed Flow (cfs)	Modeled Stage (ft)	Observed Stage (ft)
July 1996	210	208	615.9	616.4
April 2006	221	202	615.9	616.0
April 2007	65	61	613.9	613.3

LCR Detailed Watershed Plan
Phase B – Calibration Comparisons

North Creek Sub-watershed

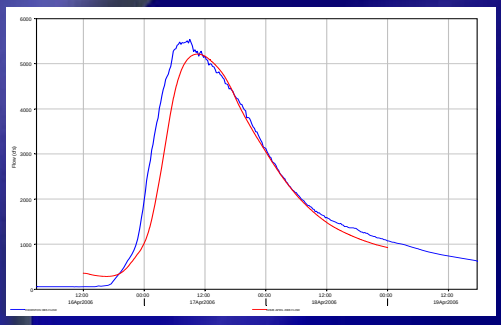


Butterfield Creek Sub-watershed

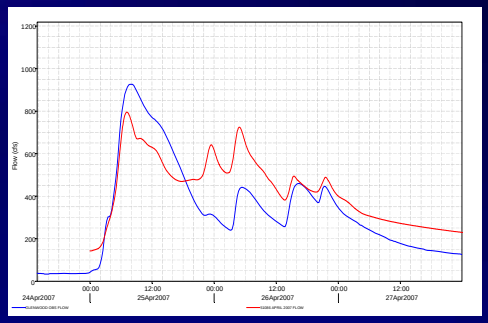


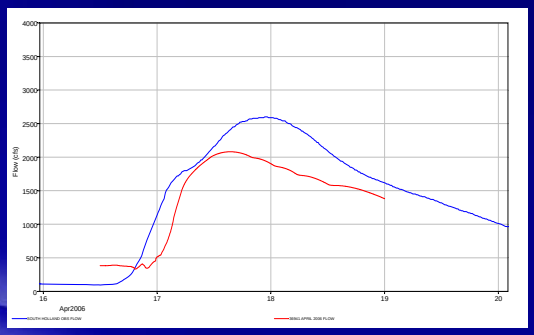
LCR Detailed Watershed Plan
Phase B – Calibration Comparisons

Thorn Creek Sub-watershed



Thorn Creek Sub-watershed



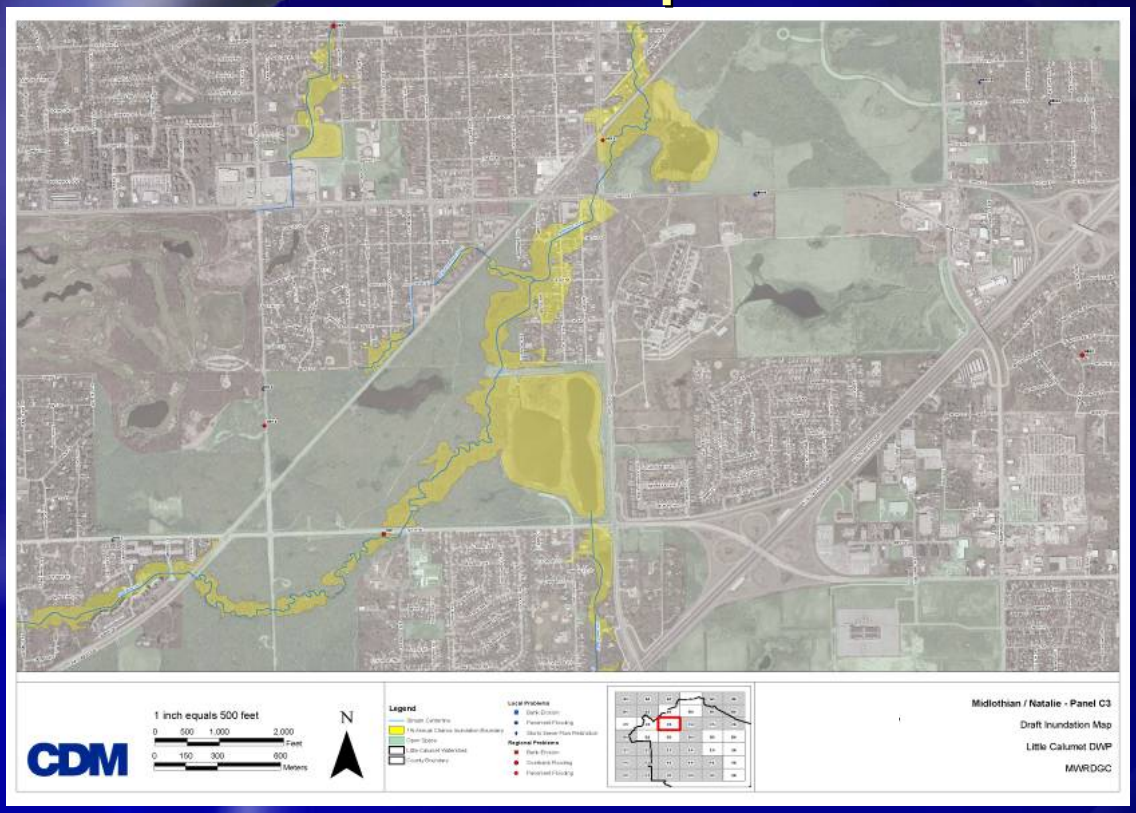


Little Calumet River Sub-watershed

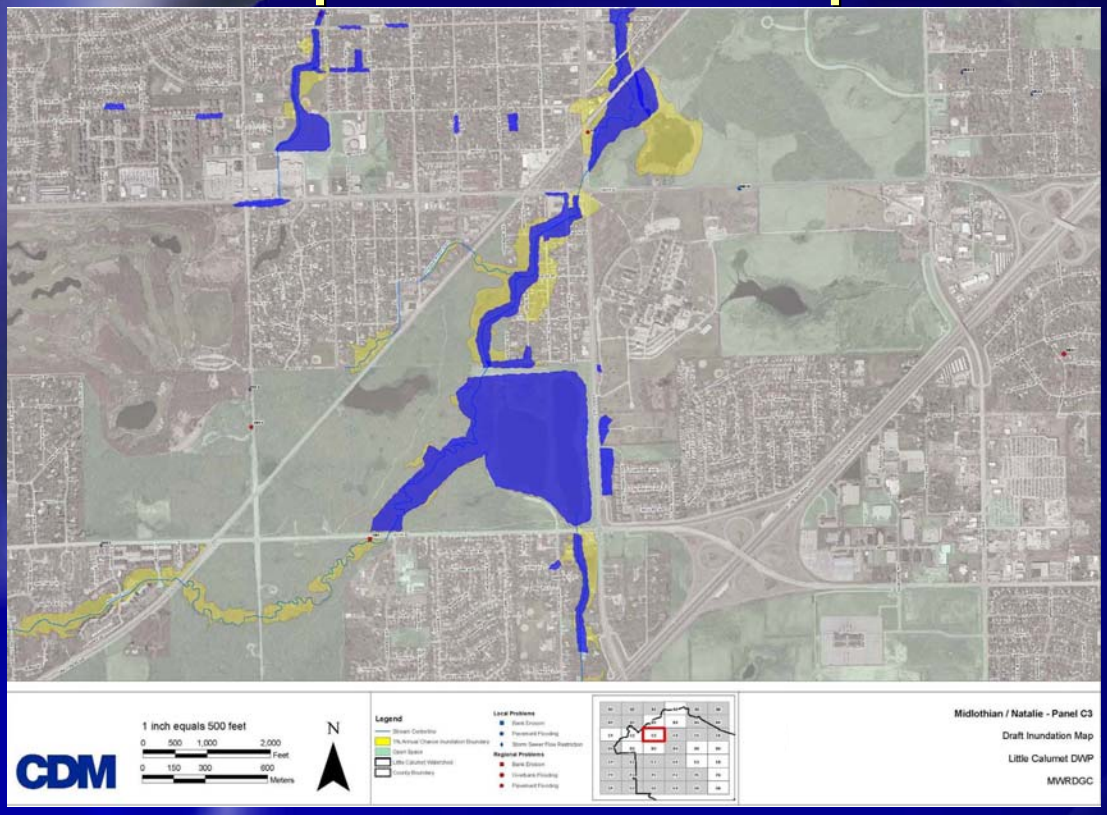
LCR Detailed Watershed Plan
Phase B – Existing Conditions Analyses

- Existing Conditions Analyses
  - Modeled the 2- through 100-yr frequency events for the 1- to 48-hour duration storms
  - Established critical durations for the sub-watersheds
  - Produced preliminary inundation maps from calibrated models
  - Presented inundation maps at the local community workshops for feedback

LCR Detailed Watershed Plan
Phase B – Inundation Map



LCR Detailed Watershed Plan
Phase B – September 2008 comparison

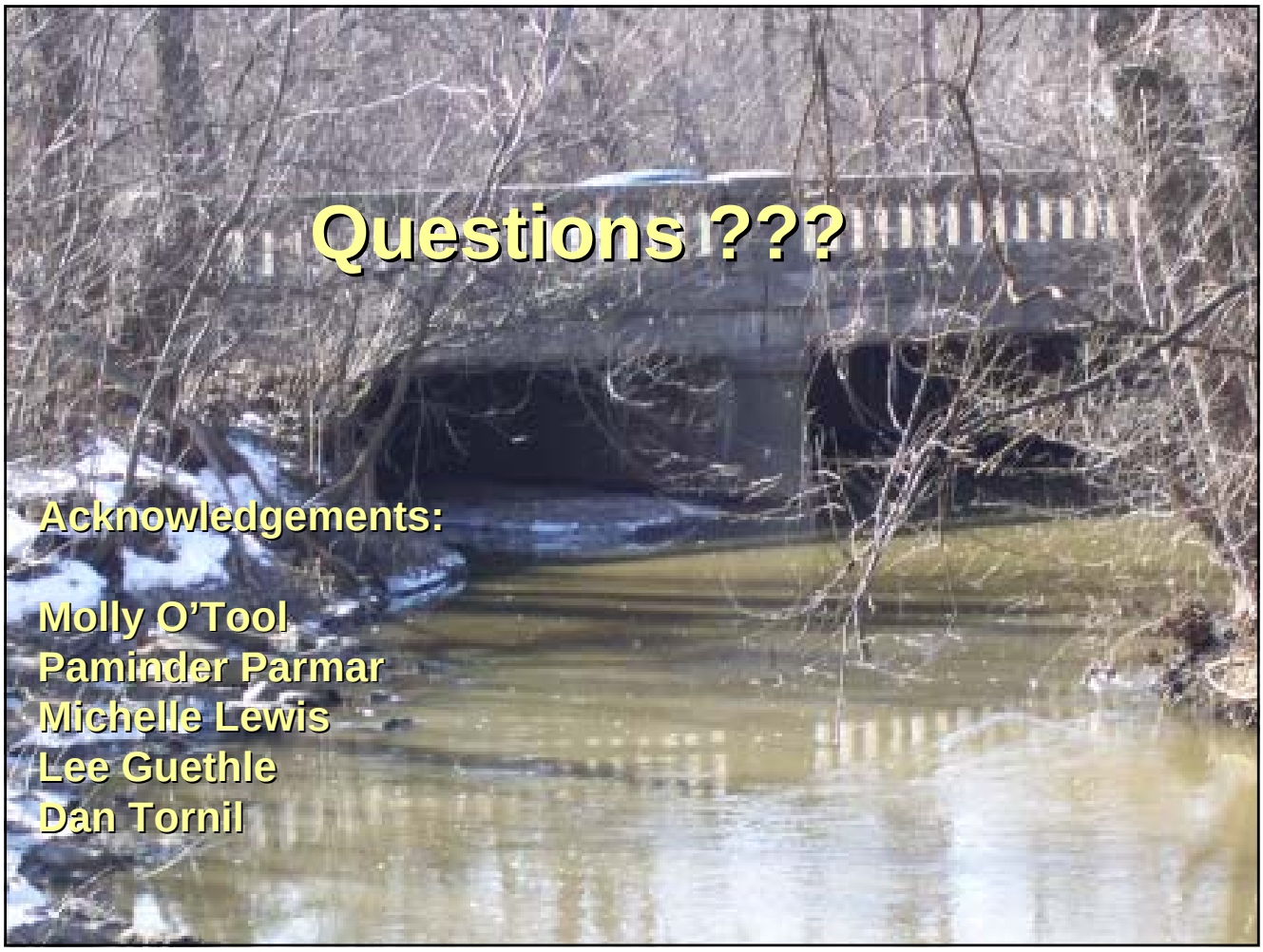


LCR Detailed Watershed Plan
Phase B – Alternative / Benefit Cost Analyses

- Number of problems does not equal to number of solutions (grouping)
- Costs for the recommended alternatives will be developed
- Damages will be estimated for 2 through 100 year storms for existing and proposed alternative conditions
- Benefit Cost Analyses will be performed using the District's Stormwater Planning Database

LCR Detailed Watershed Plan Project Challenges

- Coordination with 45 communities and various agencies
- Unsteady modeling
- Multiple critical durations
- Acceptance of new inundation areas


Questions ???
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