STRAND ASSOCIATES®

Excellence in Engineering Since 1946

Comprehensive Stormwater Master Plan Introduction and Overview

City of Paducah, KY Commission Meeting

February 28, 2017

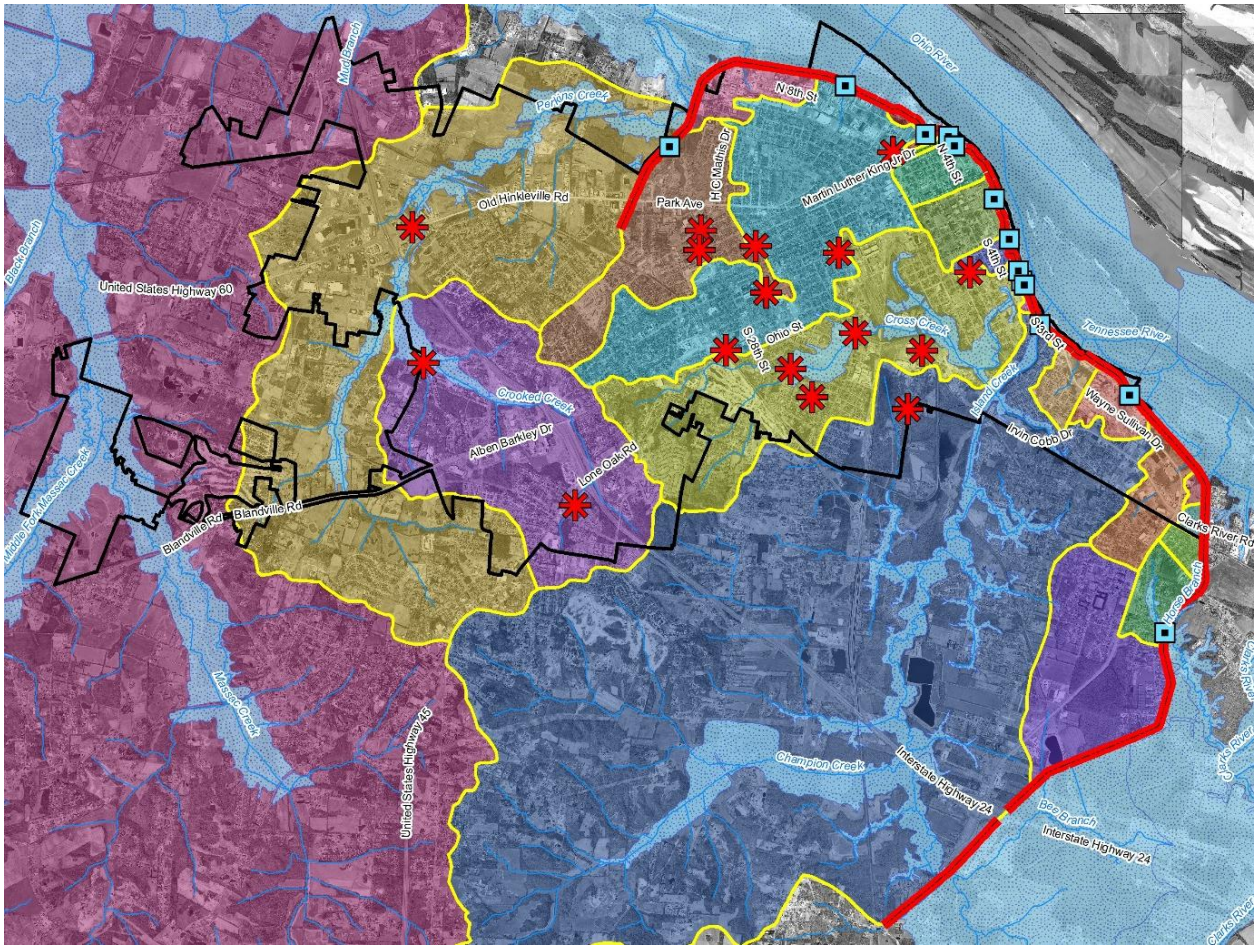
STRAND ASSOCIATES®

BFW
BACON | FARMER | WORKMAN
ENGINEERING & TESTING, INC.

Selecting the SA BFW Team Achieves Confidence in Sound Stormwater and Flood Control Decision-Making

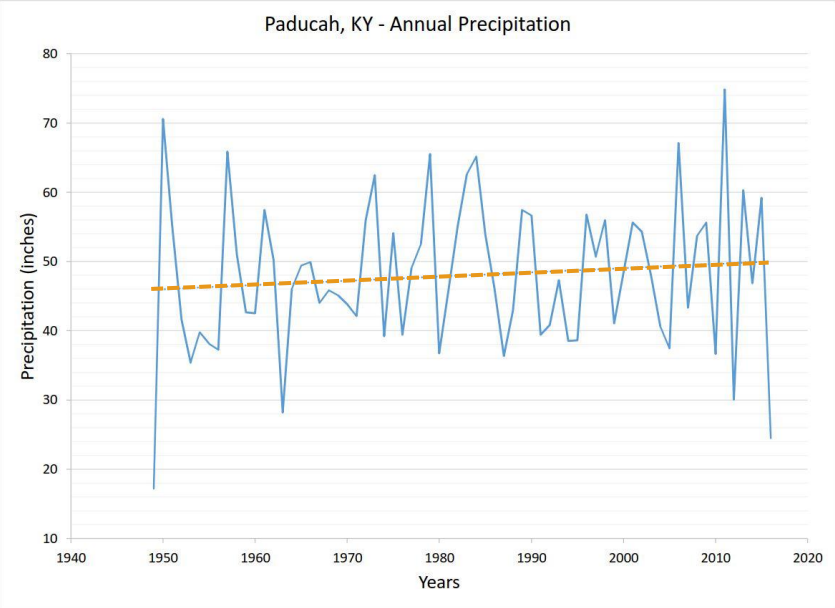
- Firm history brings confidence for successfully-delivered long-term program outcomes
- SA BFW team brings unparalleled local perspective for thorough identification of community concerns
- Stormwater management planning credentials highlight team's ability to deliver an effective capital improvements implementation program
- Work plan approach results in integrated solutions that recognize unique system characteristics
- Collaborative CSMP Approach leads to affordable and implementable action plan

Comprehensive Stormwater Master Plan is Key to Addressing Community Flooding Concerns



- 5 Major Watersheds
- Ohio River
- Flash Flooding
- Riverine Flood Influences
- Community Well Being

Rainfall Data Supports Flood Frequency Trends



Historical Rainfall Trends in Paducah

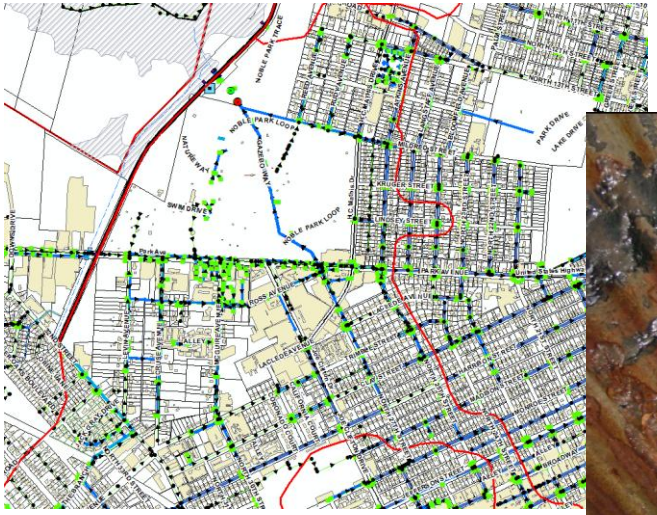
- Local influences
- River-induced influences
- Recurring events
- Homes and businesses

July 7, 2015 Flooding – Main Entrance Western Baptist Hospital

July 7, 2015 - Flooding at Oakcrest Apartments

Conveyance System Review Provides Foundation for Problem Area Understanding

CHALLENGES	RESPONSE
Capacity and Condition of Existing Stormwater Systems	Targeted Evaluations Stormwater System Conditions



Current System GIS Mapping

Corroded CMP Culvert

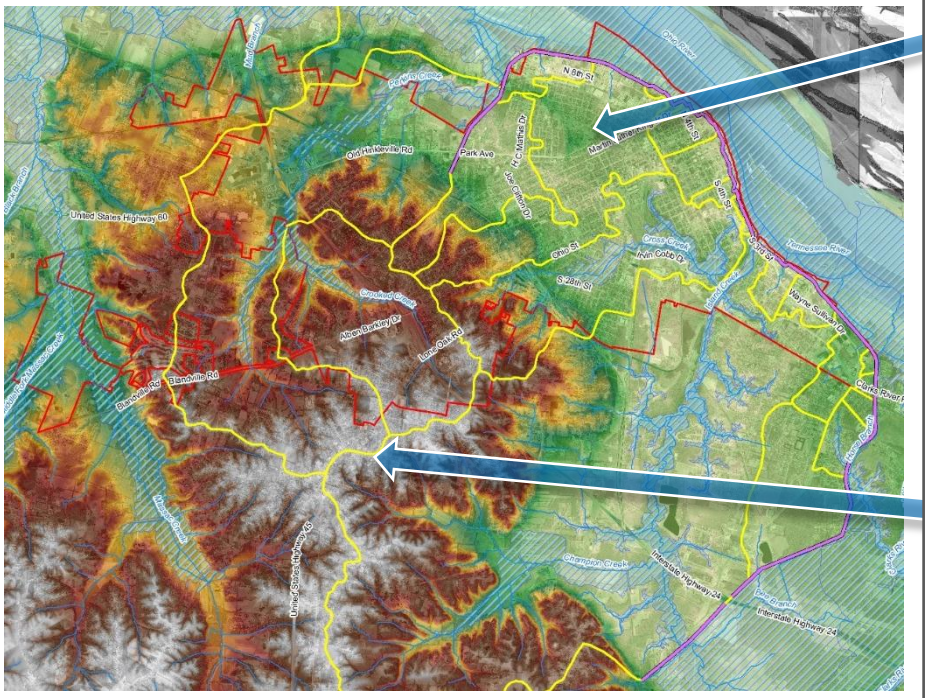
Typical Brick Sewer Televising Footage

STORMWATER SYSTEM EVALUATION NEEDS:

- Size, Type & Locations – Build Upon Current GIS System Mapping
- Condition Assessment – CCTV Program to Identify Deficiencies
- System Capacity/Level of Service – Stormwater Modeling

LIDAR Mapping Uncovers Topographic Opportunities and Constraints

CHALLENGES	RESPONSE
Capacity and Condition of Existing Stormwater Systems	Targeted Evaluations Stormwater System Conditions
Steep Upland Topography, Flat Lowland Topography	Watershed Evaluation Process



LIDAR Topographic Relief Mapping for Study Area

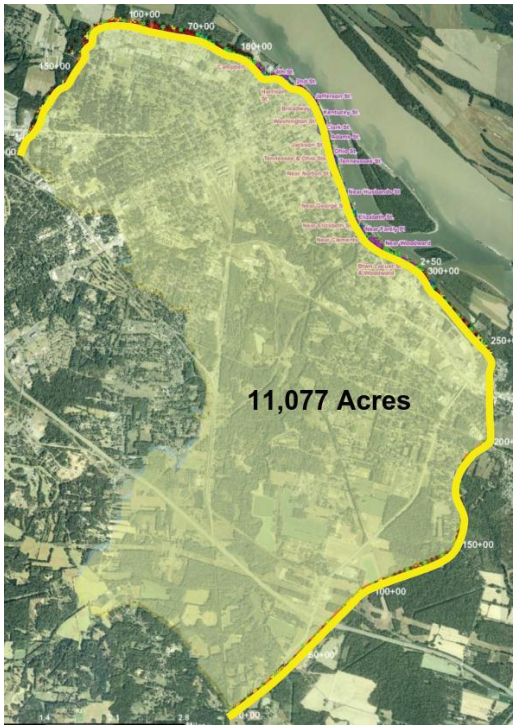
AREAS WITH FLAT LOWLAND TOPOGRAPHY

- Heavily Urbanized, Limited Open Space
- Presence of Combined Sewer Systems
- Lack of Positive Overland Flood Routes
- Reliance on Pumping for Conveyance During High River Levels

AREAS WITH STEEP UPLAND TOPOGRAPHY

- Rapid Storm Response
- Portions are Located Outside of the City
- Potential for Future Development
- Flooding Problems Due to Lack of Adequate Floodplain Conveyance

Floodwall Protected Areas Vulnerable to Multiple Flood Risks



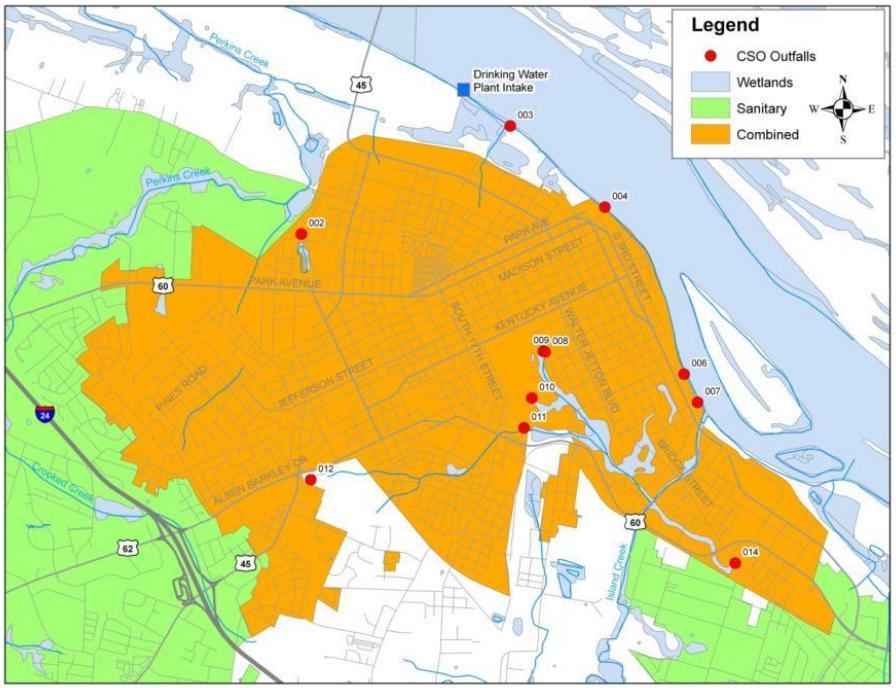
CHALLENGES	RESPONSE
Capacity and Condition of Existing Stormwater Systems	Targeted Evaluations Stormwater System Conditions
Steep Upland Topography, Flat Lowland Topography	Watershed Evaluation Process
Floodwall Interior Drainage, Stormwater Pump Stations	Comprehensive Watershed Modeling

Floodwall Protection:
~11,000 acres
~20,000 people
~$1.2 billion in assets

Floodwall Murals at Kentucky Ave.

Recently Sliplined Culverts at Noble Park Outfall

Combined Sewer System Areas Present Unique Partnering Considerations



Combined Sewer Service Area

CHALLENGES	RESPONSE
Capacity and Condition of Existing Stormwater Systems	Targeted Evaluations Stormwater System Conditions
Steep Upland Topography, Flat Lowland Topography	Watershed Evaluation Process
Floodwall Interior Drainage, Stormwater Pump Stations	Comprehensive Watershed Modeling
Combined Sewer System Areas	Implementation of Win/Win Partnership Opportunities

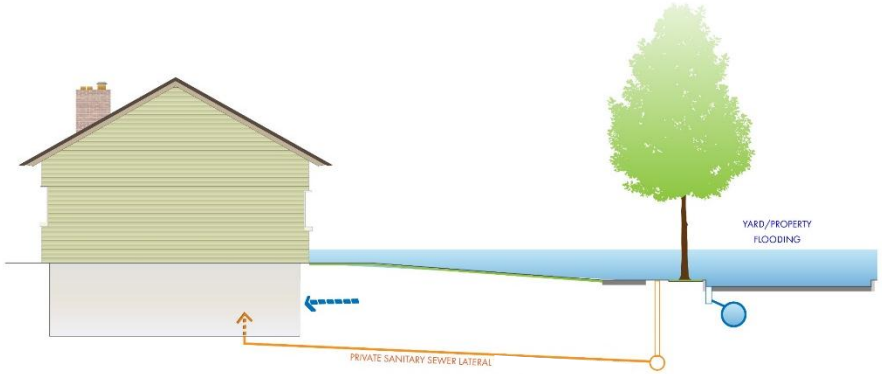
- Separate System
- Combined System

PADUCAH McCRACKEN JSA JOINT SEWER AGENCY

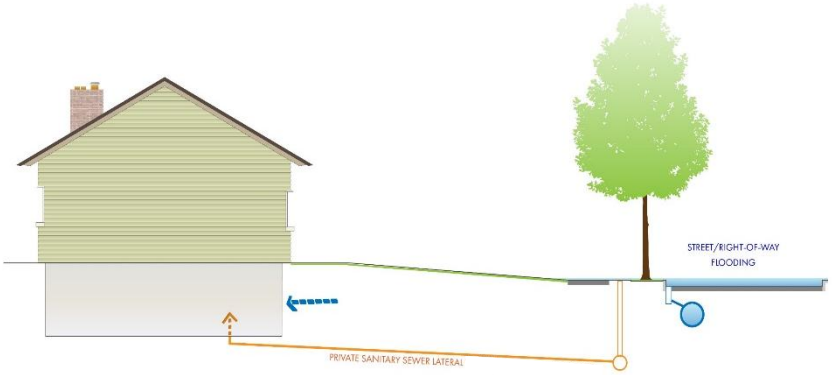
CSO 002 Outfall – Noble Park

"Collaboration: Key to Holistic Approach"

Managing Expectations Key to Development of Feasible Solutions

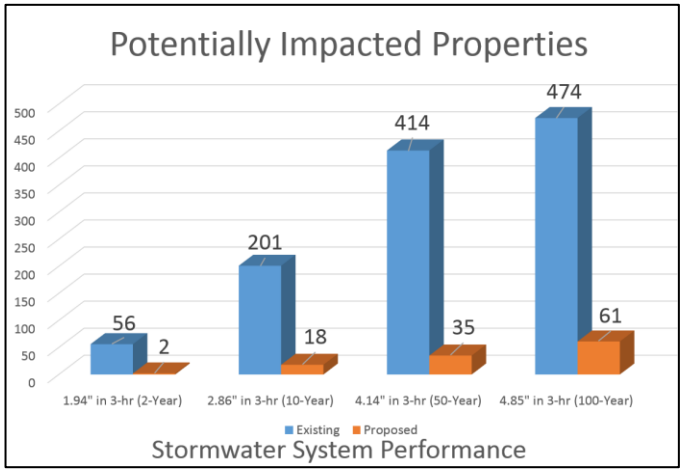


CURRENT LEVEL OF SERVICE



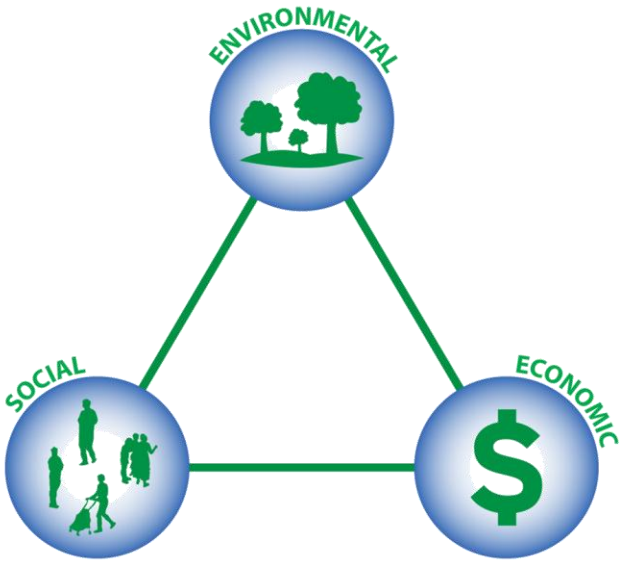
TARGET LEVEL OF SERVICE

CHALLENGES	RESPONSE
Capacity and Condition of Existing Stormwater Systems	Targeted Evaluations Stormwater System Conditions
Steep Upland Topography, Flat Lowland Topography	Watershed Evaluation Process
Floodwall Interior Drainage, Stormwater Pump Stations	Comprehensive Watershed Modeling
Combined Sewer System Areas	Implementation of Win/Win Partnership Opportunities
Public Expectations	Clear Definition of Success

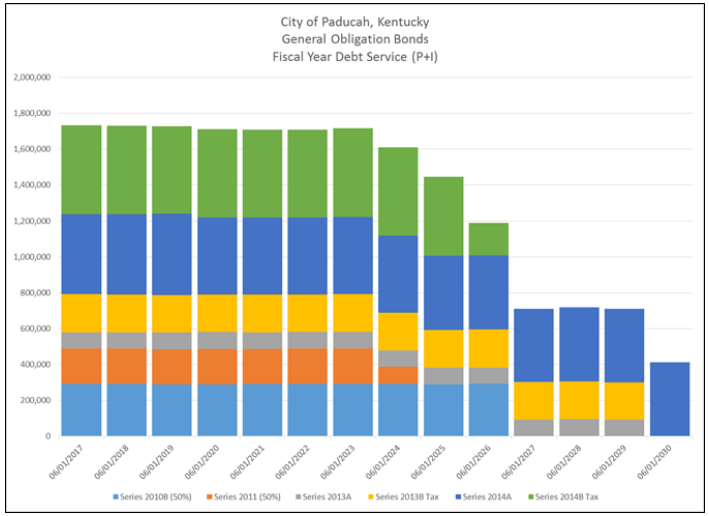


Flood Reduction Benefits for Range of Storm Events – Winnetka, IL

Cost-effective Solutions Foster Support for Financial Commitments



Challenges	Response
Capacity and Condition of Existing Stormwater Systems	Targeted Evaluations Stormwater System Conditions
Steep Upland Topography, Flat Lowland Topography	Watershed Evaluation Process
Floodwall Interior Drainage, Stormwater Pump Stations	Comprehensive Watershed Modeling
Combined Sewer System Areas	Implementation of Win/Win Partnership Opportunities
Public Expectations	Clear Definition of Success
Cost Feasibility	Funding Mechanism Evaluations

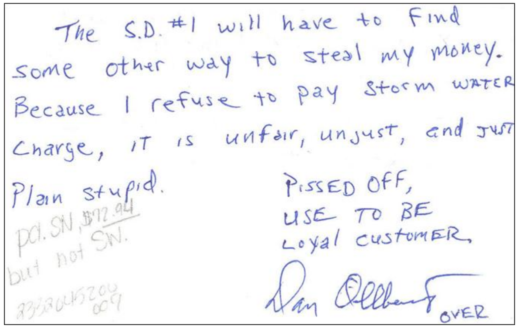


Paducah General Obligation Bonds

POTENTIAL STORMWATER FUNDING OPTIONS:

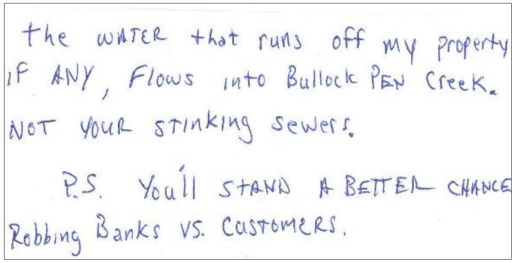
- General Fund Revenues
- Stormwater Utility Fees
- Debt Financing
- Grants/Low Interest Loans
- Hazard Mitigation Grant Program (FEMA)

Misguided Public Perception Requires Carefully Planned Outreach Efforts


The S.D. #1 will have to Find some other way to steal my money. Because I refuse to pay Storm WATER Charge, IT is unfair, unjust, and JUST Plain stupid.

pd. SN $72.94 but not SW.

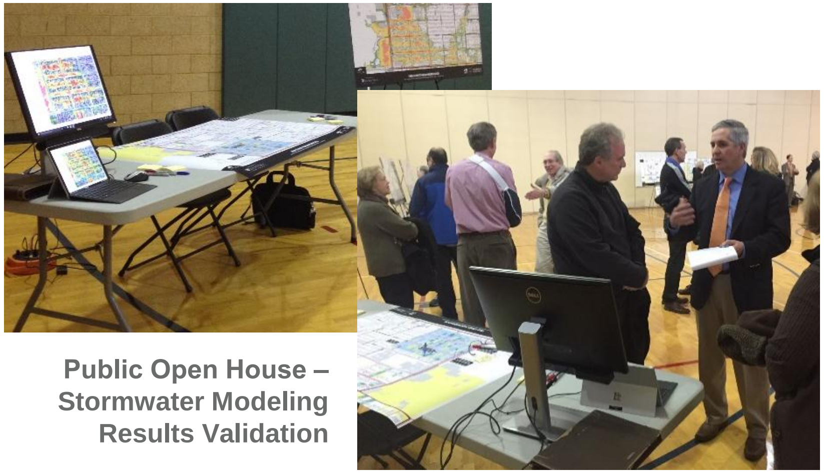
PISSED OFF, USE TO BE LOYAL CUSTOMER, OVER


the WATER that runs off my property IF ANY, Flows into Bullock PEN Creek. NOT YOUR STINKING sewers.

P.S. You'll STAND A BETTER CHANCE Robbing Banks VS. CUSTOMERS.

Citizen Questionnaires

CHALLENGES	RESPONSE
Capacity and Condition of Existing Stormwater Systems	Targeted Evaluations Stormwater System Conditions
Steep Upland Topography, Flat Lowland Topography	Watershed Evaluation Process
Floodwall Interior Drainage, Stormwater Pump Stations	Comprehensive Watershed Modeling
Combined Sewer System Areas	Implementation of Win/Win Partnership Opportunities
Public Expectations	Clear Definition of Success
Cost Feasibility	Funding Mechanism Evaluations
Public Education & Support	Tailored Public and Stakeholder Engagement Process

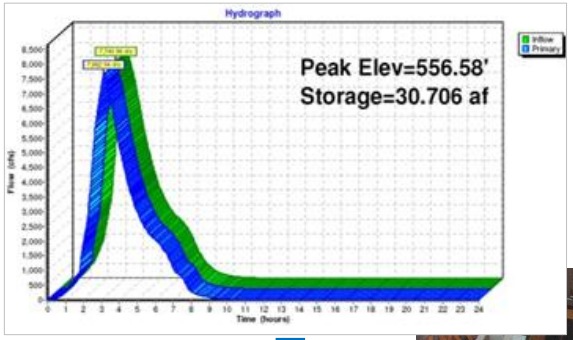


Public Open House – Stormwater Modeling Results Validation

City Commission Input Session

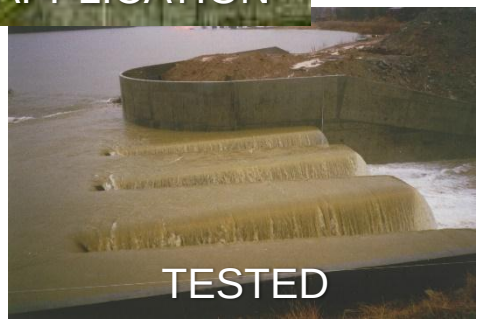
Firm History Brings Confidence for Successfully Delivered Long-term Program Outcomes

- 70 years of service
- 380 employees
- 2 Kentucky offices
- 11 total locations
- Many specialties, including Community Master Planning



Theory

Scale Model

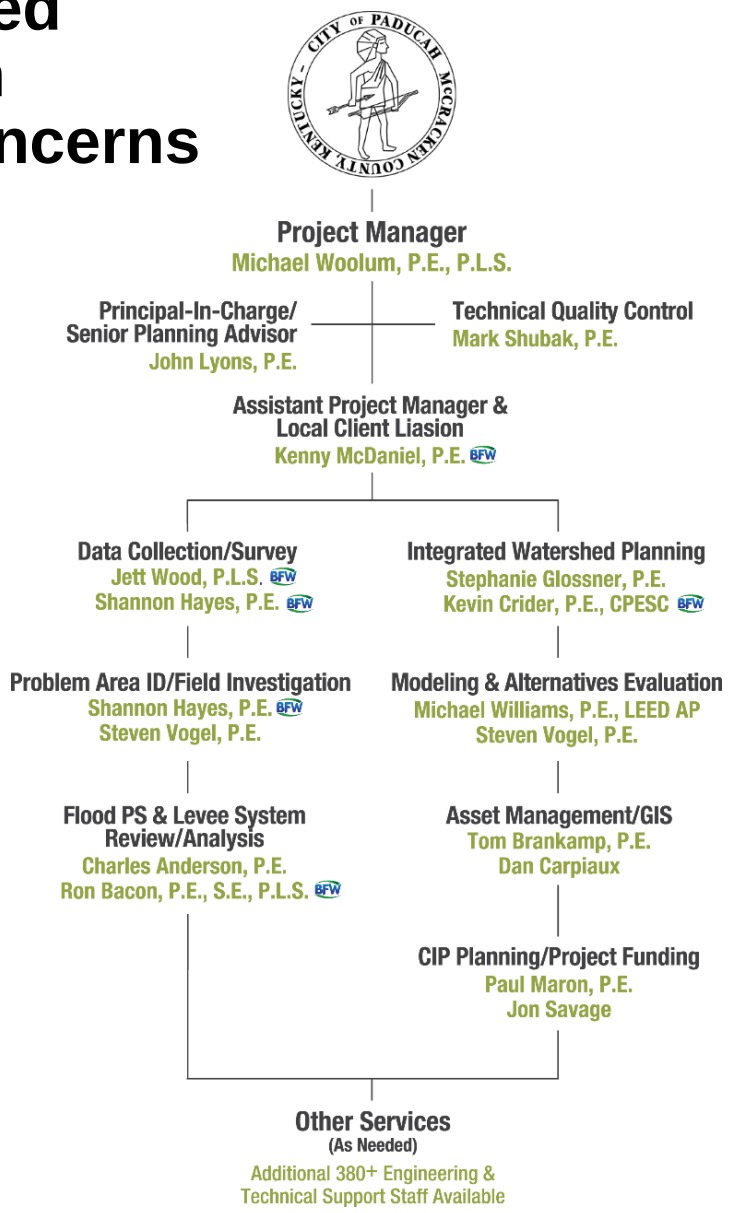


Project Team Brings Unparalleled Local Perspective for Thorough Identification of Community Concerns

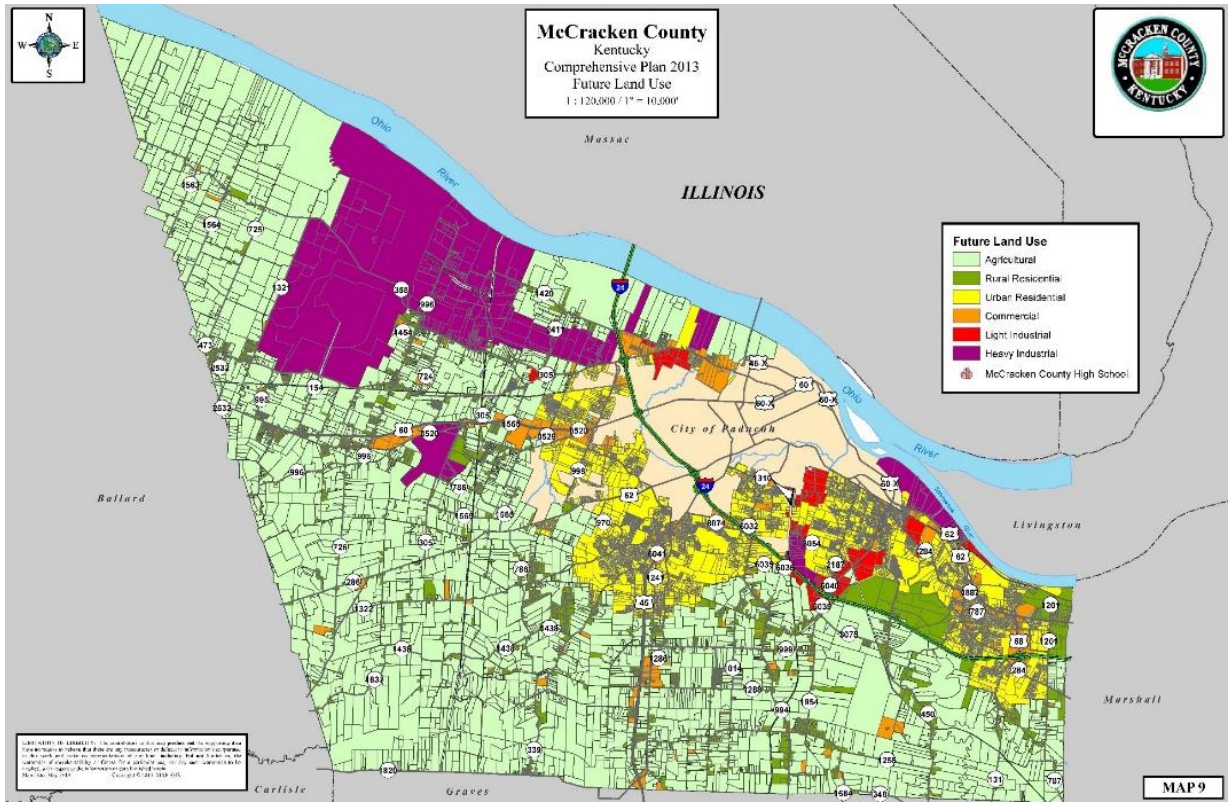
STRAND ASSOCIATES®

BFW
BACON | FARMER | WORKMAN
ENGINEERING & TESTING, INC.

- Problem area identification
- Data collection
- Asset management
- Watershed evaluations
- H & H modelling
- Combined sewer system
- Flood PS & floodwalls



CSMP Credentials Highlight Ability to Deliver an Effective CIP Implementation Program



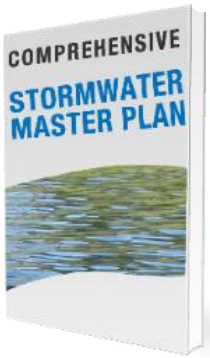
McCracken County Comprehensive Plan

- Watershed Characteristics
- Future Growth
- Design storm(s)
- Event-based Calibration
- Improvement Strategies
- Costing Methodology
- Prioritization Techniques

Major Community Master Planning Achievements Demonstrate Know-how for Getting the Job Done’

- STREAM STABILITY
- WQ/5R/MS4
- ASSET MANAGEMENT
- FLOODING

- ✓ *Cost-Effective*
- ✓ *Multi-Benefit Solutions*
- ✓ *FEMA Funding*
- ✓ *DRA Funding*



Lexington Fayette Urban County Government
Kentucky 1775

Metropolitan Sewer District of greater Cincinnati

msd
Safe, clean waterways

Disconnection Redirection Infiltration Program

Village of Winnetka

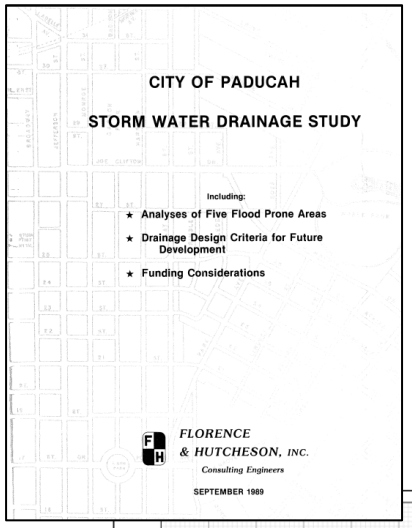
Northeast Ohio Regional Sewer District

Village of Winnetka, Ill.
March 10, 1869

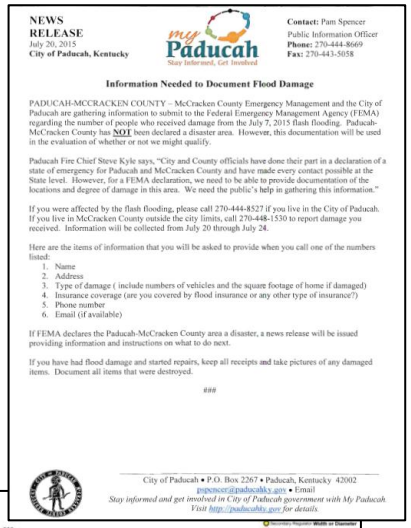
Extensive XP-SWMM Experience Provides City Confidence in Our Stormwater Modeling Results

XP-SWMM Modeling Experience	1-D	2-D
Cincinnati MSD, OH – Lick Run Watershed Design	♦	♦
N. KY SD1 – Boone County – Upper Woolper Creek Watershed Analysis		♦
Dubuque, IA – Upper and Lower Bee Branch Creek Restoration		♦
Frankfort, KY – CSO LTCP	♦	
Galena, IL – Downtown Stormwater Pumping Station		♦
Jeffersonville, IN – Downtown Canal Project Feasibility Study		♦
Kenosha, WI – Forest Park Area Stormwater Management		♦
Madison, WI – Willow Creek Watershed	♦	
N. KY SD1 – Woodlawn Creek Watershed Drainage Improvements	♦	
Columbus, OH – Blueprint Clintonville – Stormwater Management Plan	♦	♦
Oshkosh, WI – Campbell Creek Watershed	♦	♦
Owensboro RWRA – CSO LTCP	♦	
Oshkosh, WI – Sawyer Creek Watershed Alternatives	♦	
Sterling, IL – Locust Street Drainage Improvements	♦	
UW-Madison Arboretum, WI – Phase 3 Stormwater Planning	♦	
UW-Madison, WI – West Campus Stormwater Master Plan	♦	
WisDOT – Verona Road Interchange, Madison, WI		♦

Work Plan Approach Results in Integrated Solutions that Recognize Unique System Characteristics

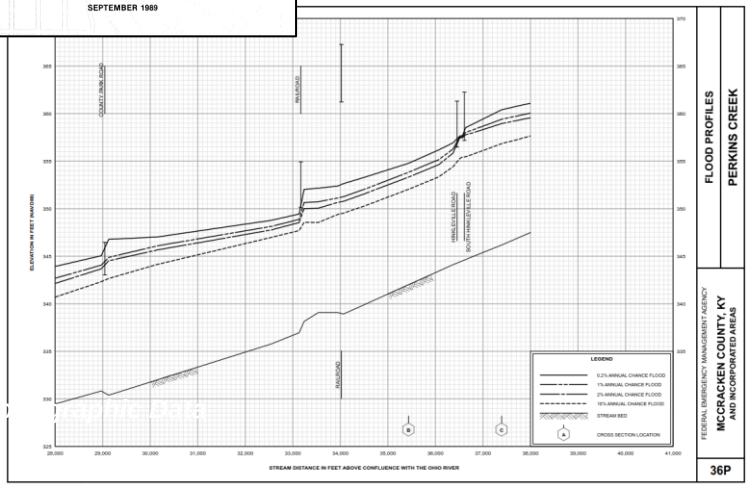


"Scoping study evaluation is key to charting efficient direction"

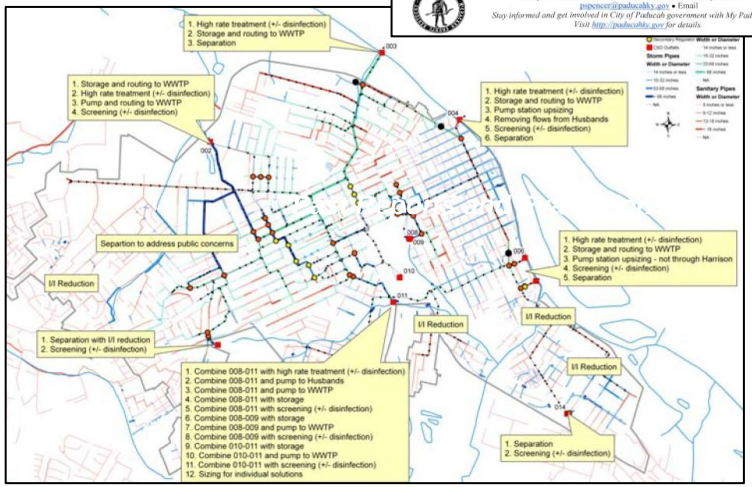


Past Reports and Evaluations

Flood Damage and City Complaint Database



FEMA Flood Studies for Perkins, Crooked & Cross Creek

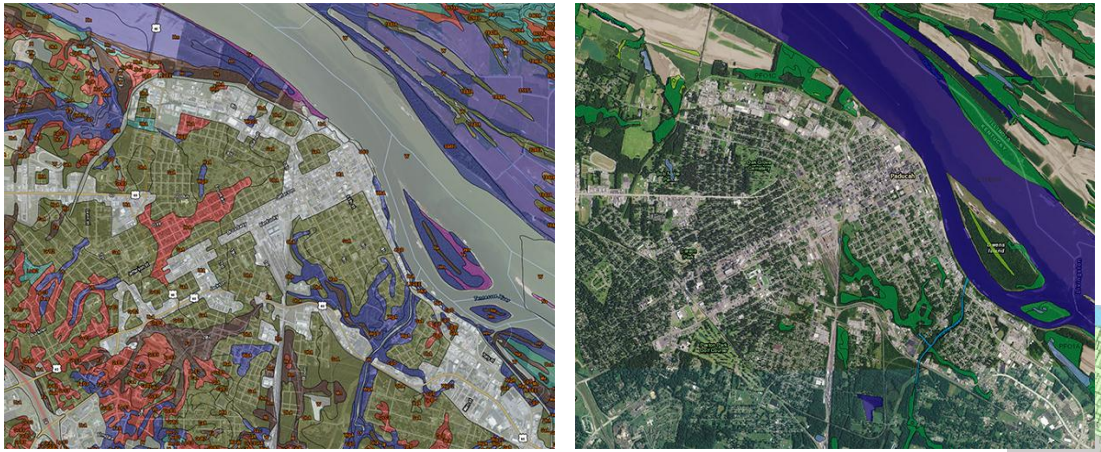


JSA XPSWMM Modeling of CSS

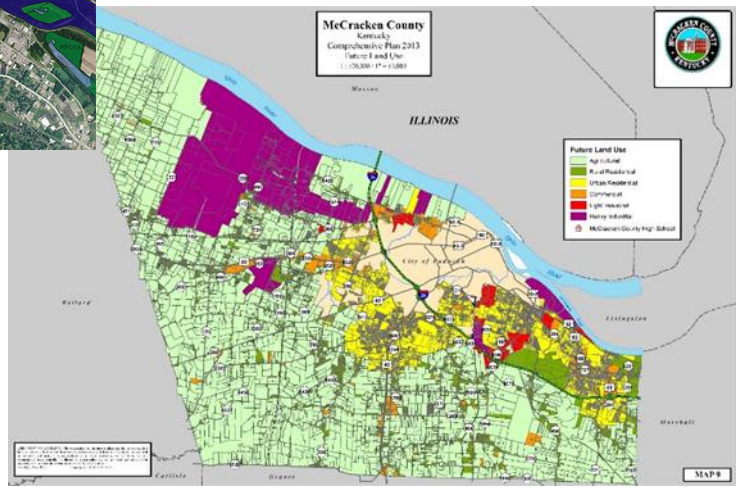
Our Process Asks Questions that Others Don't

Comprehensive Inventory and Analysis

- Natural Systems
- Built Systems
- Community Character
- Policy Issues
- Existing and Planned Projects
- Stakeholders



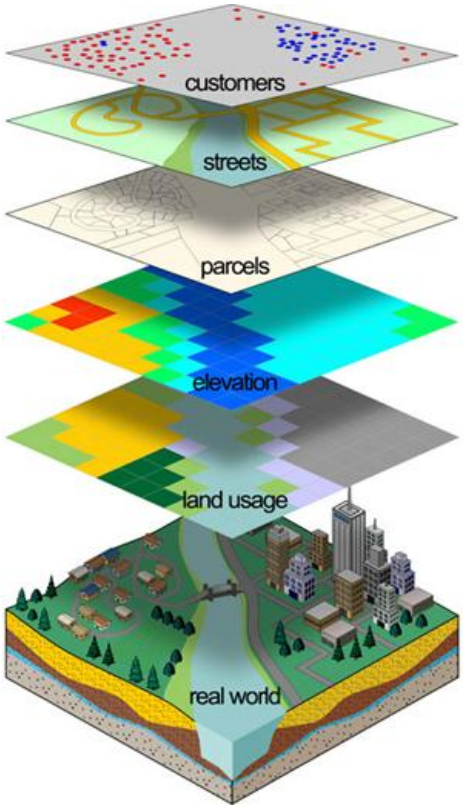
Paducah Natural Systems – Hydrologic Soils Groups (left), Wetlands (right)

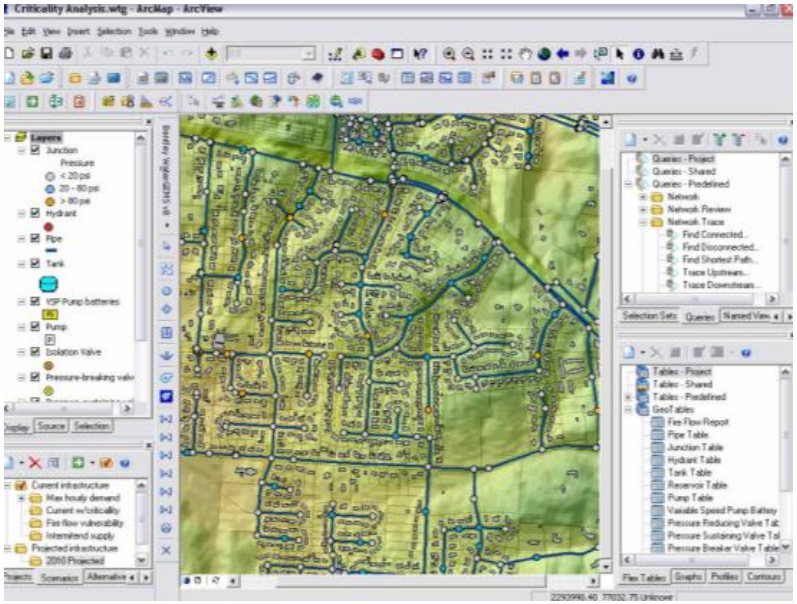


Paducah Comprehensive Plan Informs Future Planning Considerations

Data Collection Approach Establishes Framework for CSMP and Future Asset Management Program

- Field investigation
- Enhanced GIS shapefile
- Structure data (x, y & z)
- Condition assessment
- Open channel evaluations

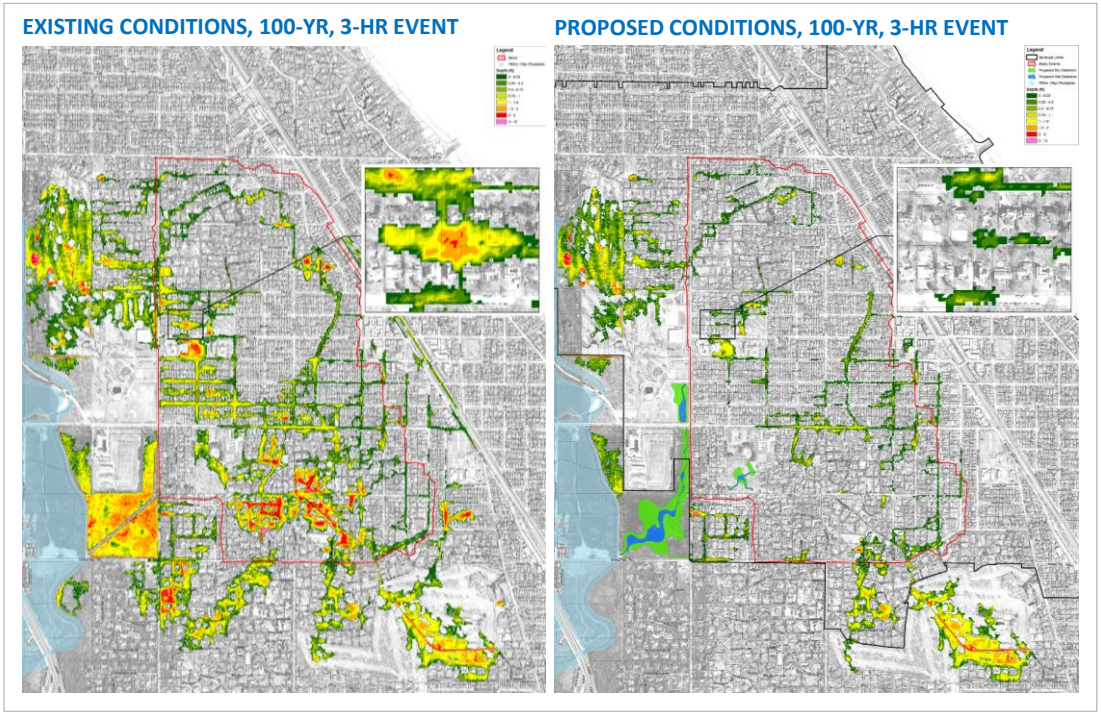




State-of-the-Art XP-SWMM 2D Modeling Platform Provides Accurate and Illustrative Results

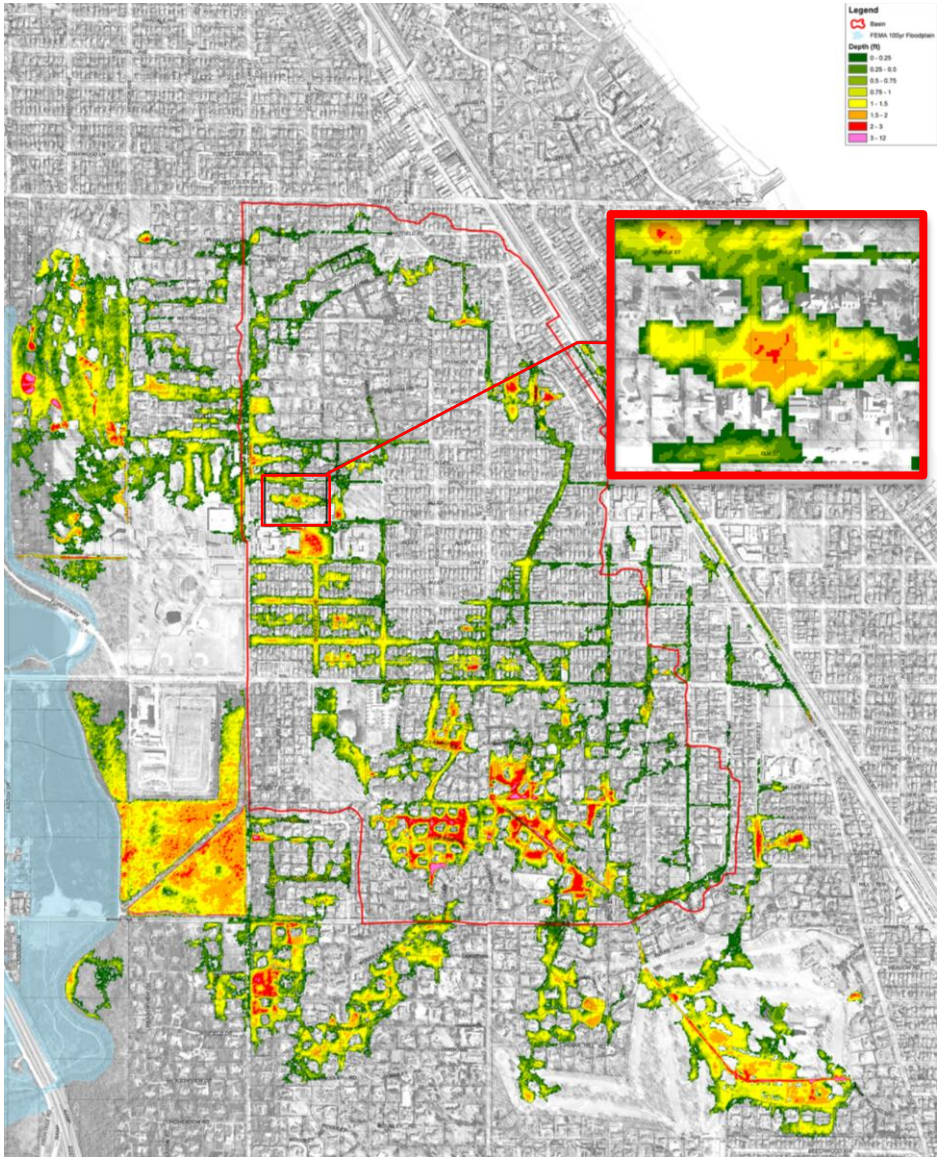
ADVANTAGES INCLUDE:

- Proper Representation of Flood Storage Volume
- Accurate Simulation of Overland Flood Routes
- Visual Flooding Extent and Depths – Invaluable Tool for Communicating Results to the Public

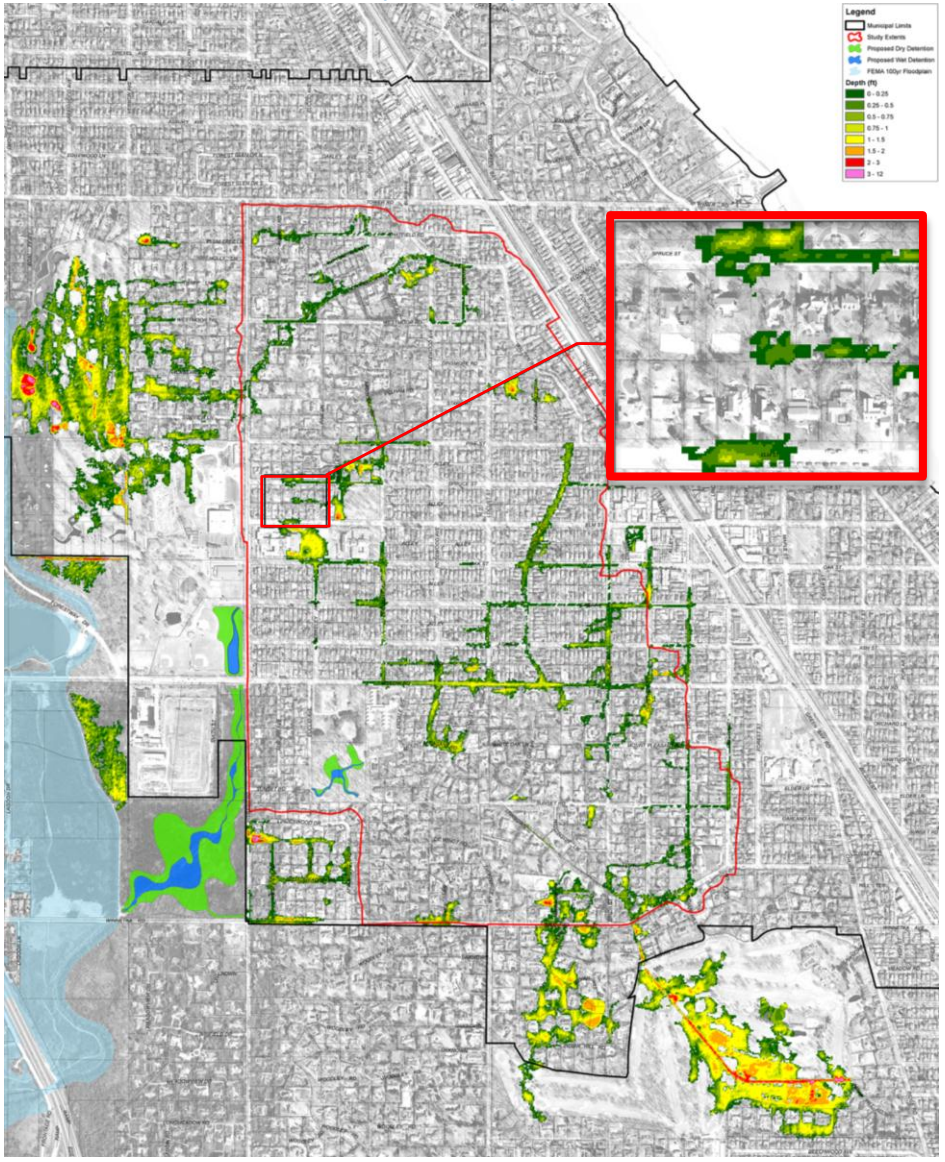


XP-SWMM 2d existing vs. proposed flooding depths and extents results.

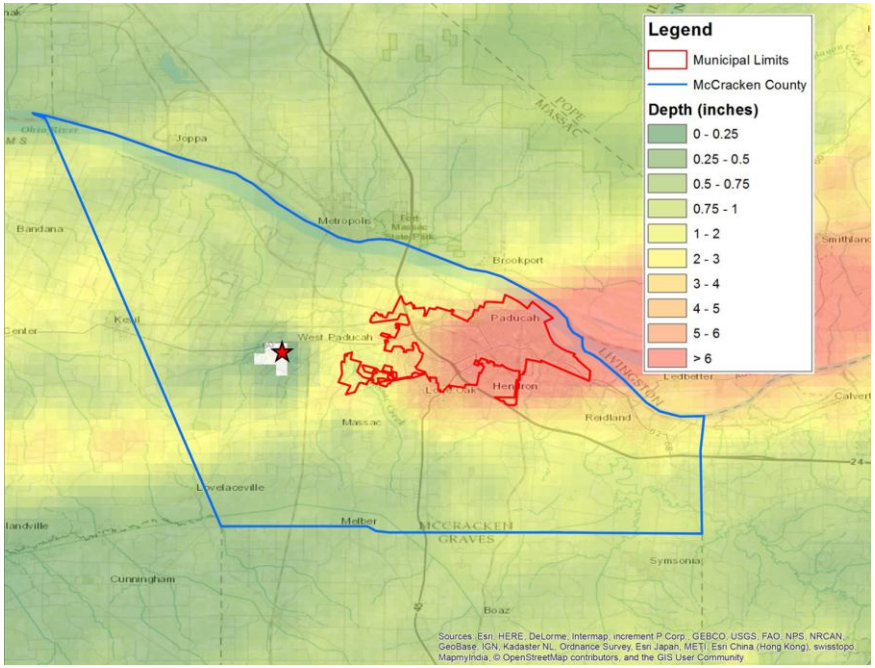
EXISTING CONDITIONS, 100-YR, 3-HR EVENT



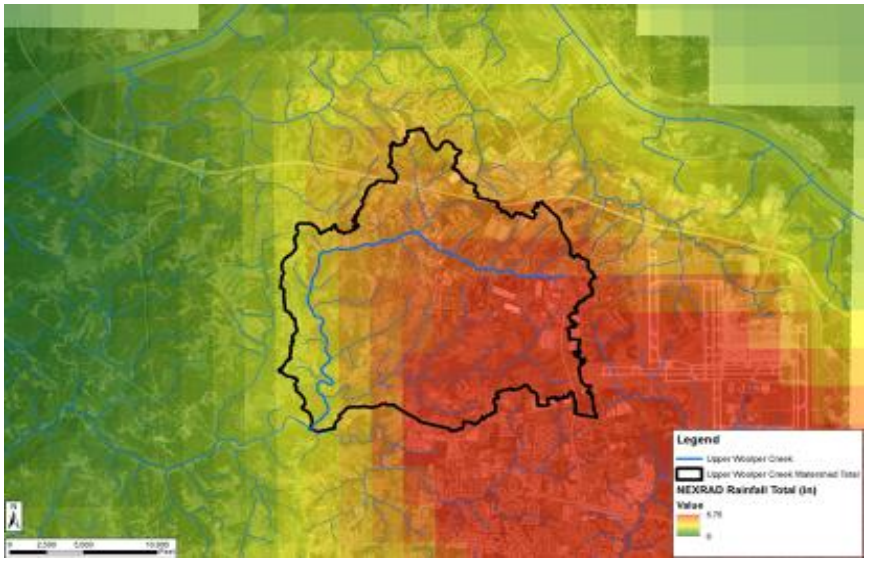
PROPOSED CONDITIONS, 100-YR, 3-HR EVENT



Proven Model Calibration and Validation Techniques Provide Reliable Foundation for Sizing of Improvements



NEXRAD Imagery of the July 2015 Event Over Paducah



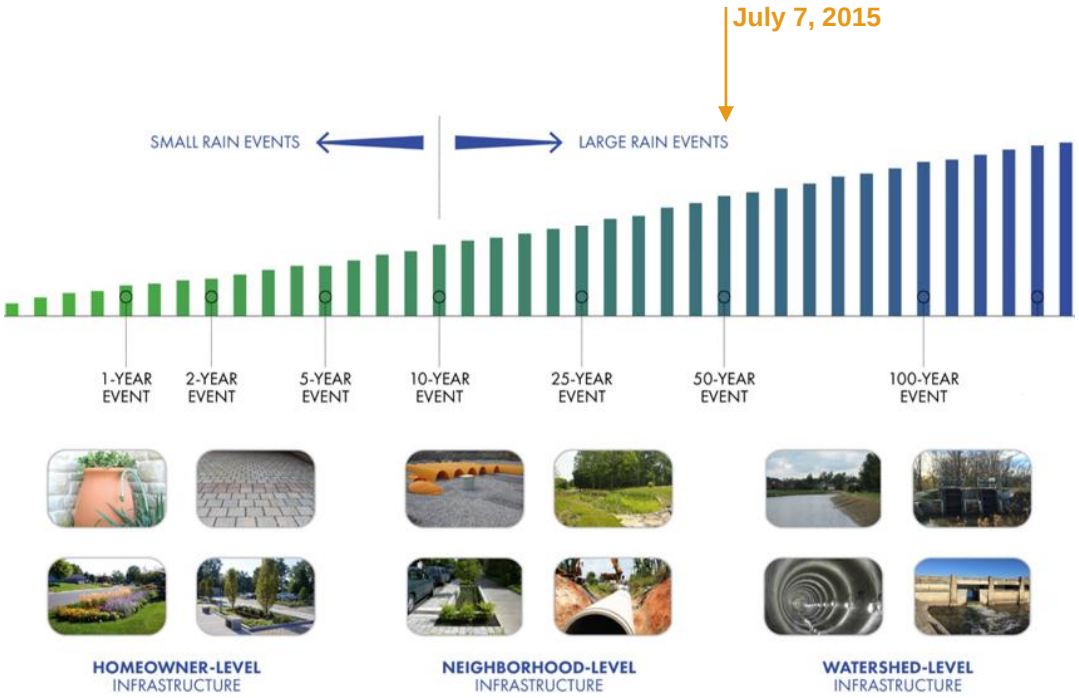
Woolper Creek Modeling Benefits from NEXRAD

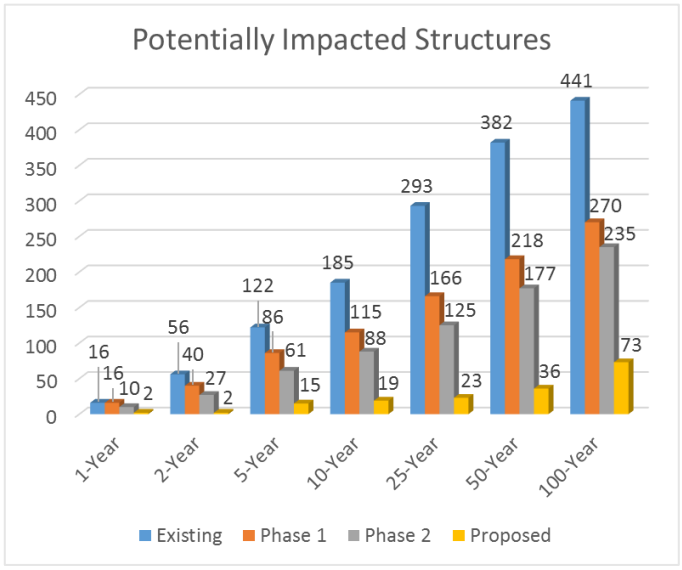
"Documented modeling results can increase public confidence in study"

Flood Control Alternatives Needs to Consider Local Context and Reflect Realistic Costs

- Sizing of Controls/LOS
- Feasibility and Constructability
- Cost of Proposed Controls
- Reduction in Property Flooding

Cost-Benefit Analysis Helps Justify Potential Flood Control Expenditures





Example of Potentially Impacted Structures Graphic

Relevant Case Studies

Rapid Run Watershed – Cincinnati, OH

FEMA / CSO Solution
Open channel conveyance

Winnetka, IL

Flat topo, Levee, CSS
Robust public engagement

Bee Branch – Dubuque, IA

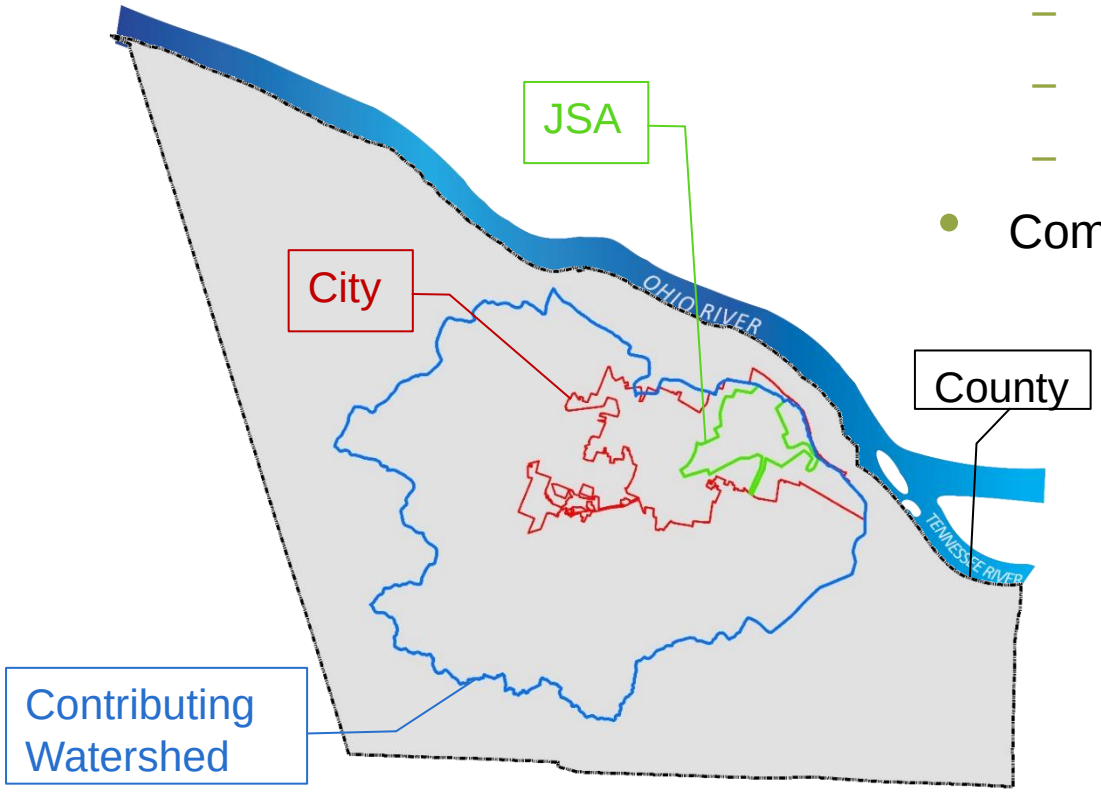
Levee/Floodwall
Mississippi River
Flood Buyouts

Woodlawn Creek – Newport, KY

Construction of a dam
Allowed downstream development
Removed homes from floodplain

Comprehensive Solutions Extend Beyond Political and Jurisdictional Boundaries

- Look Beyond Study Area
- Consider Partnerships
  - JSA
  - Paducah Parks Services
  - Delta Regional Authority
  - County
- Common Sense Approach



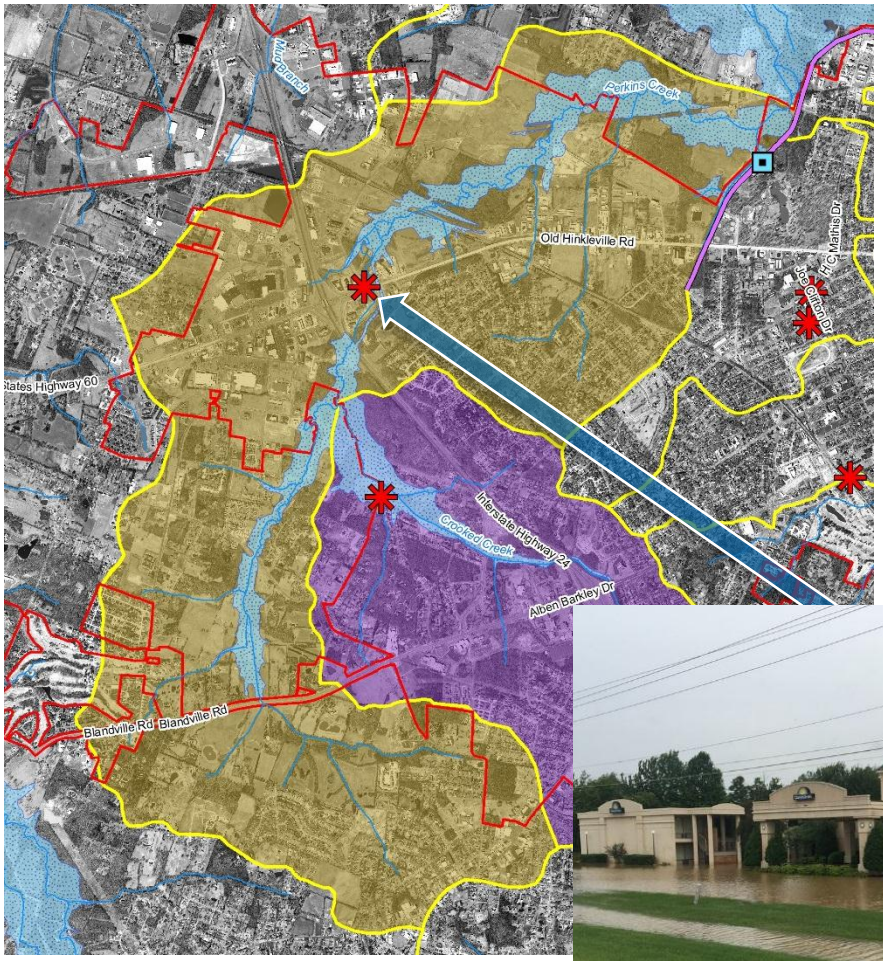
Our Preliminary Understanding and Observations

CROOKED CREEK WATERSHED

Areas Affected: Buckner Ln., Oakcrest Dr., Oakcrest Apts.

July 7, 2015 – Buckner Lane

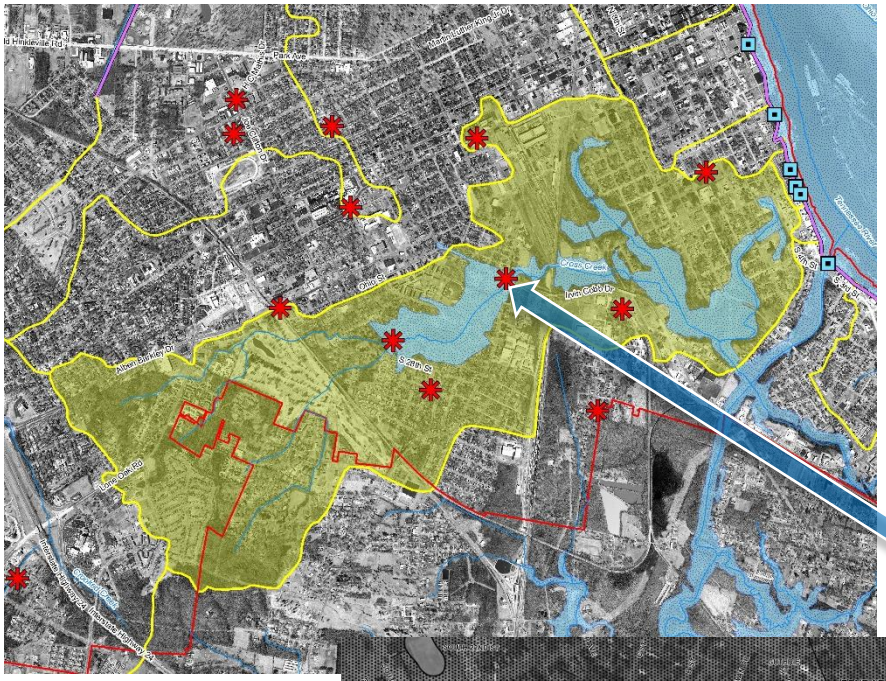
Perkins Creek Watershed

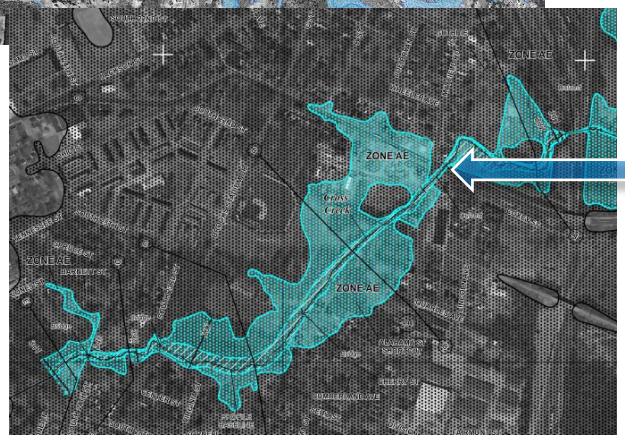


Areas Affected: Days Inn, Hinkleville Rd. (US 60)

July 7, 2015 – Days Inn Along US 60.

Cross Creek Watershed



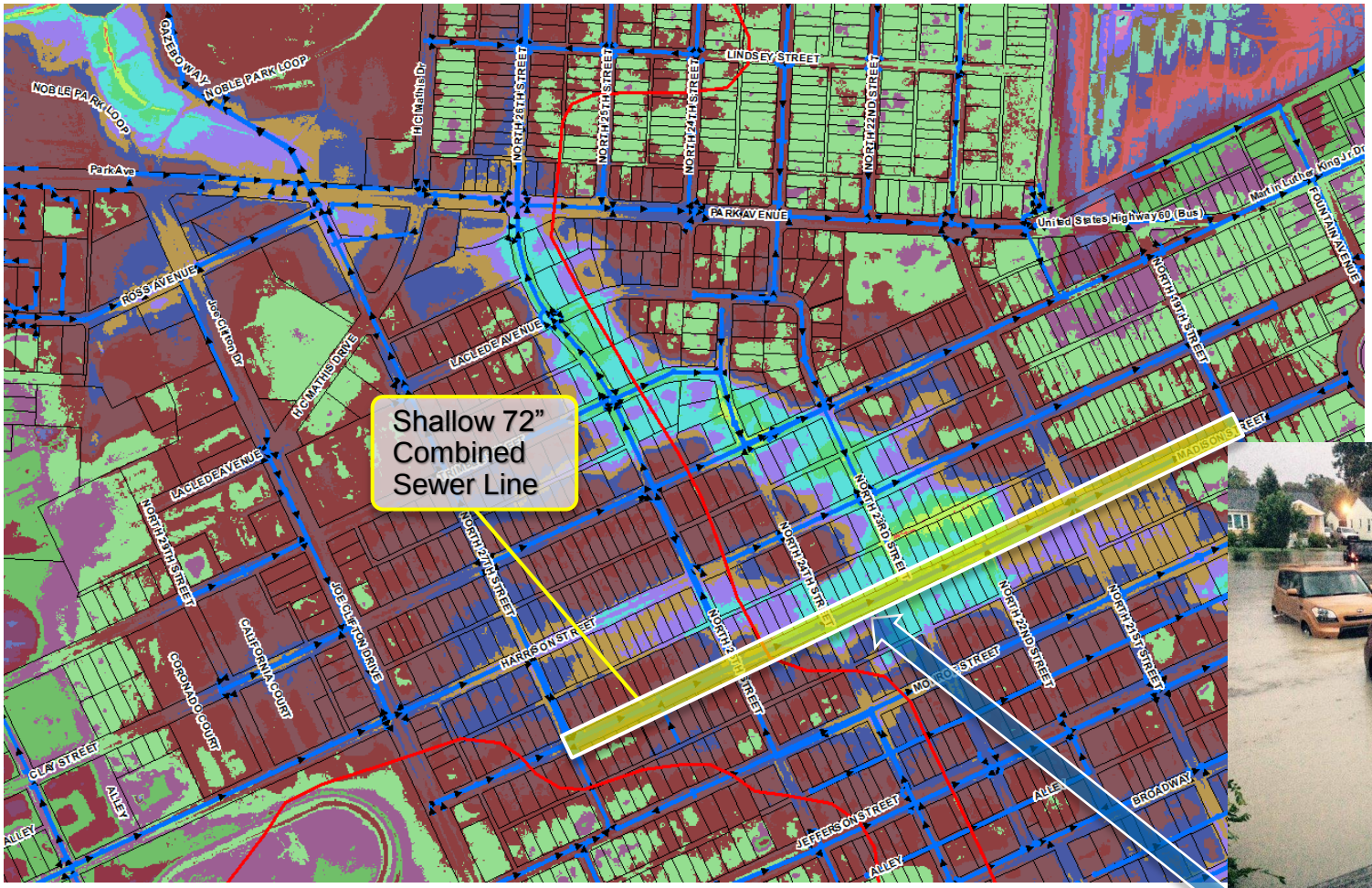


Areas Affected: 21st & Old Mayfield Rd., S. 24th St. Culvert, Morgan School Neighborhood

July 7, 2015 – 21st & Old Mayfield Rd.

Noble Park – PS No. 1 Watershed

Areas affected: Noble Park, Madison St., Monroe St., 25th St.

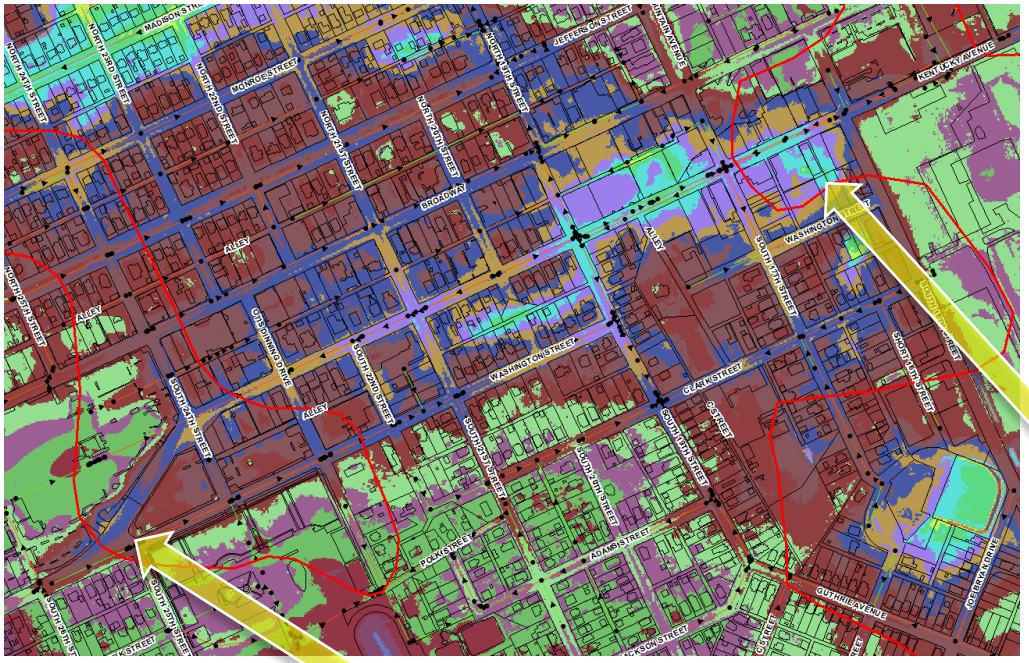


LIDAR Topographic Data Indicates Lack of Overland Flood Route Over Park Ave.

July 7, 2015 – Madison St.

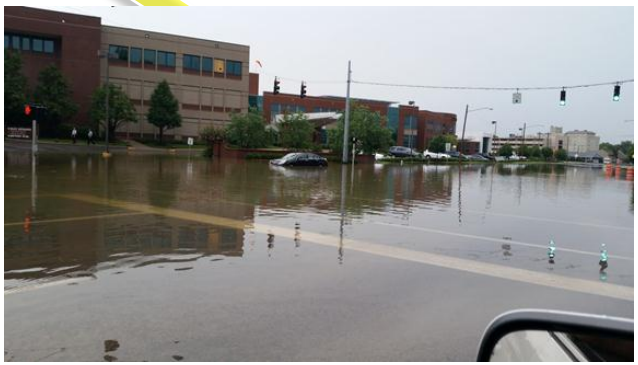
"Flooding in Combined Sewer System Service Area"

Other Downtown Areas



Park Ave. & 9th St., 10th & Olive St., McCracken Co. Jail, 16th St. & Kentucky Ave., Baptist Hospital

July 7, 2015 Flooding – 16th & Kentucky Ave.



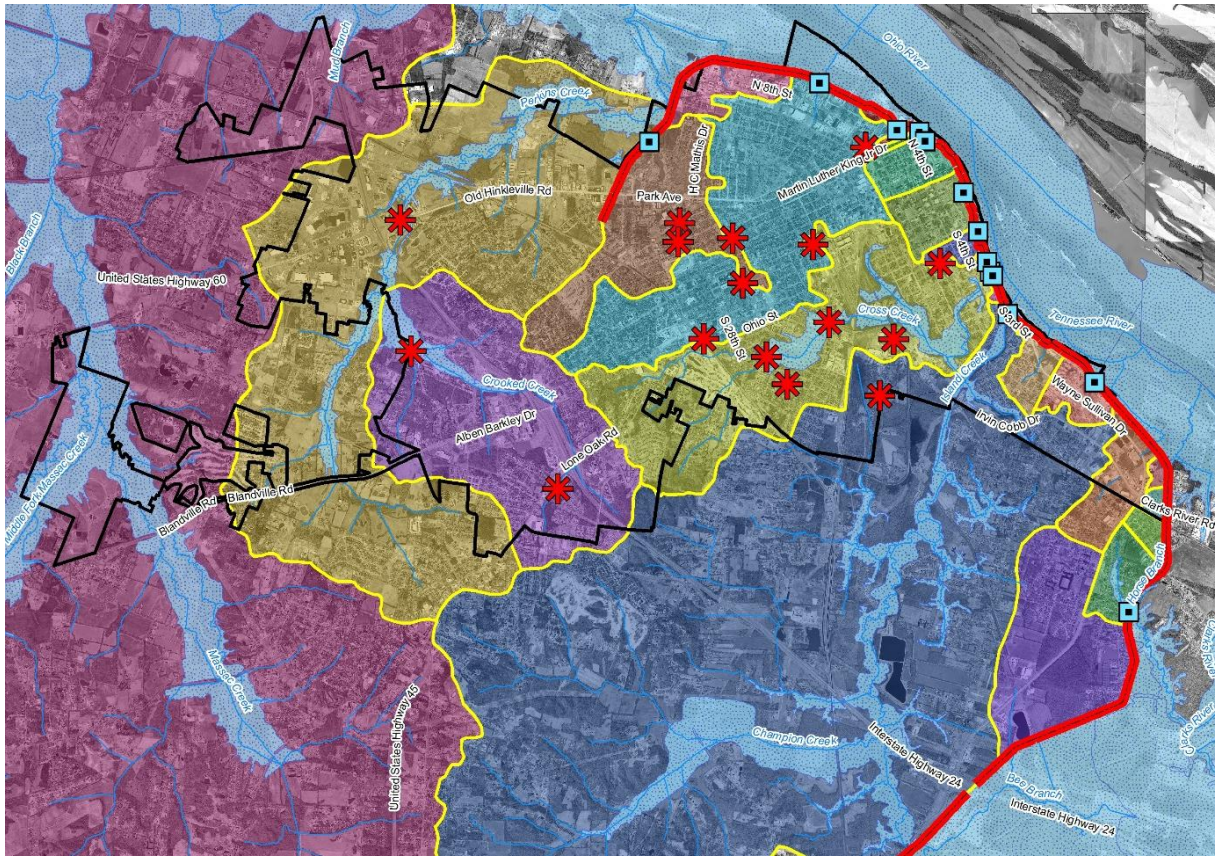
July 7, 2015 Flooding – Main Entrance Western Baptist Hospital

Traditional Solutions Form the Backbone of Improvement Strategies

- Wet Detention/Retention
- Dry Detention
- Underground Storage
- Pump/Lift Stations
- Surface/Roadway Storage
- Maximizing Existing Infrastructure
- Storm Sewer Upgrades/Sewer Separation
- Consider Property Buyouts

Our CSMP Approach Leads to Affordable and Implementable Action Plan

Key Master Planning Considerations Guide Approach



Overall Study Map Showing Areas of Existing Flooding

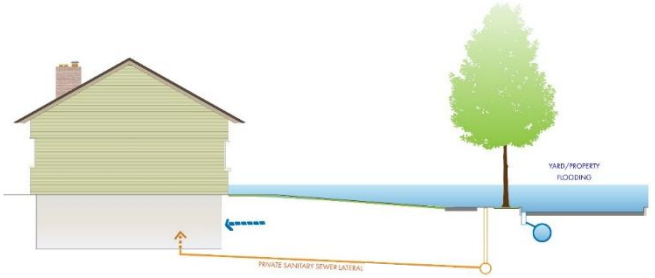
- Project Drivers
- Goals & Objectives
- Expected Outcomes
- Others

STRAND ASSOCIATES®

BFW BACON | FARMER | WORKMAN ENGINEERING & TESTING, INC.

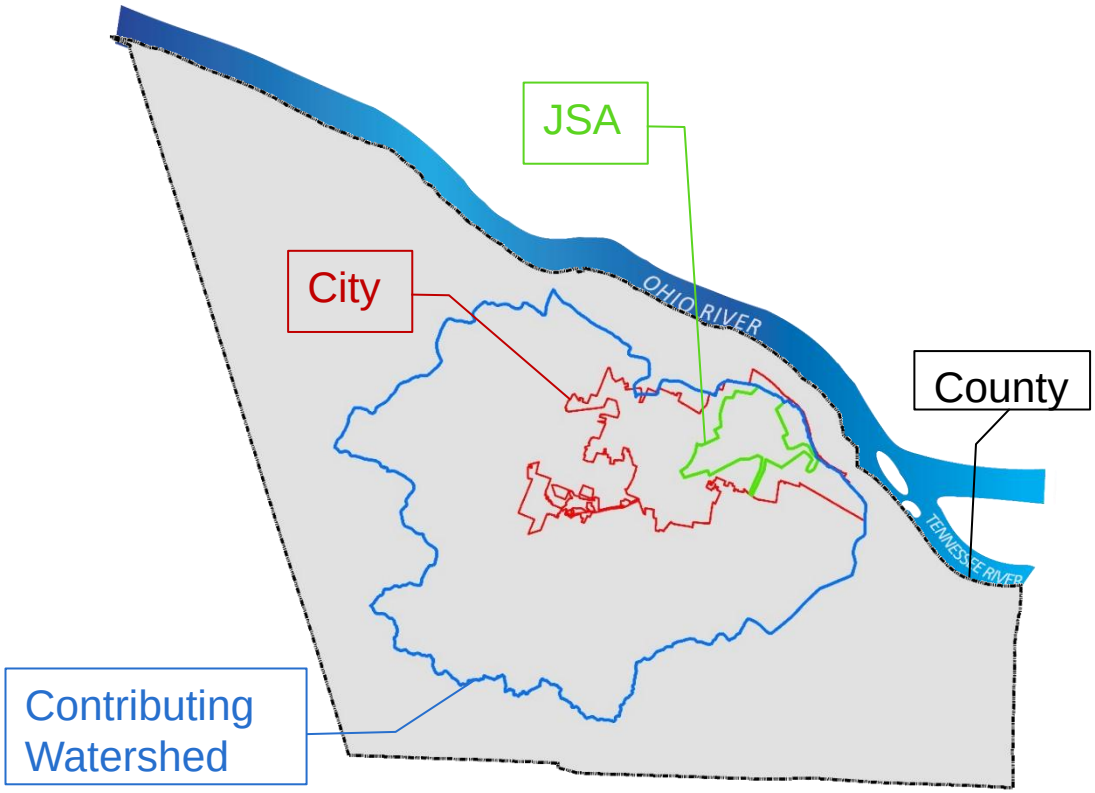
Project Objectives

- What will City achieve through the Master Plan?
  - Flood Mitigation CIP
    - Surface Flooding
    - Water in Basement (WIB)
    - CSOs
    - PS/Floodwall
  - Asset Management Program
    - Long Term CIP
    - O&M
  - Basis for Funding Mechanism
  - Future Growth/Development Considerations



Study Area

- What are the limits of study area?
  - Targeted Problem Areas
  - Separate Storm Sewer Area
  - Combined Sewer System
  - City of Paducah
  - County
  - Watershed



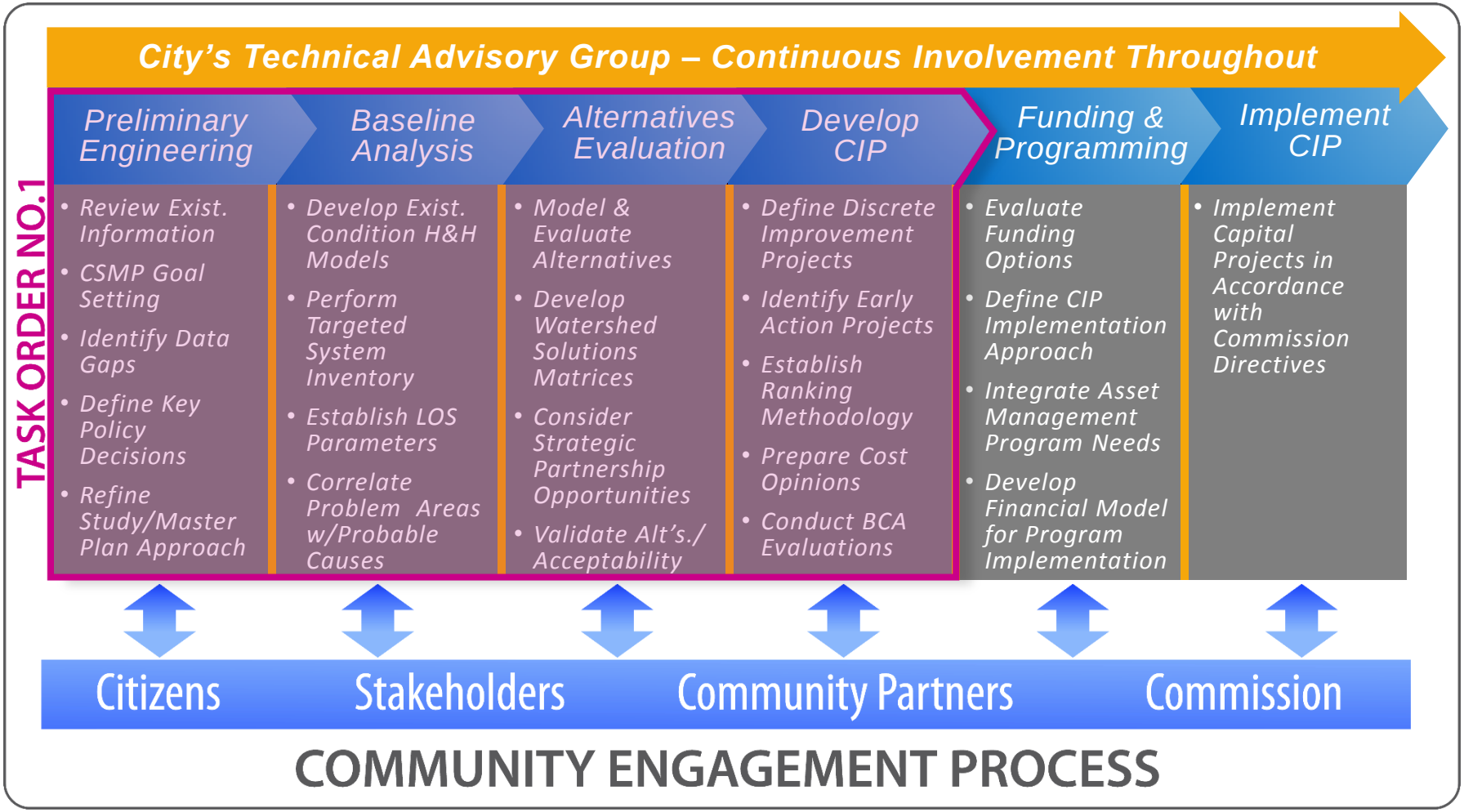
Community Engagement

- Define Organizational Structure & Stakeholder Involvement Approach?
  - Technical Advisory Group (TAG)
    - City Engineer's Office
    - JSA/County
    - Strand/BFW
  - Stormwater Advisory Committee (SWAC)
  - Citizen/Public Involvement
  - City Manager/City Commission
    - Policy Decisions
    - Implementation Methodology

City Commission Input Session

Project Implementation Overview

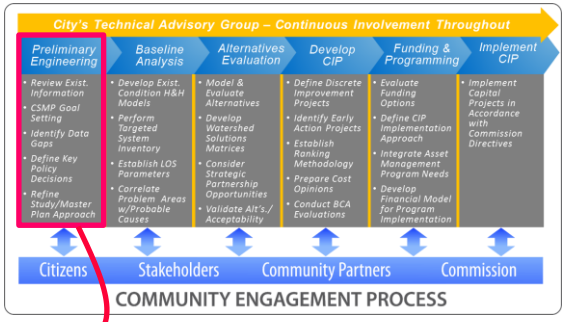
What does the Master Planning Process Look Like?

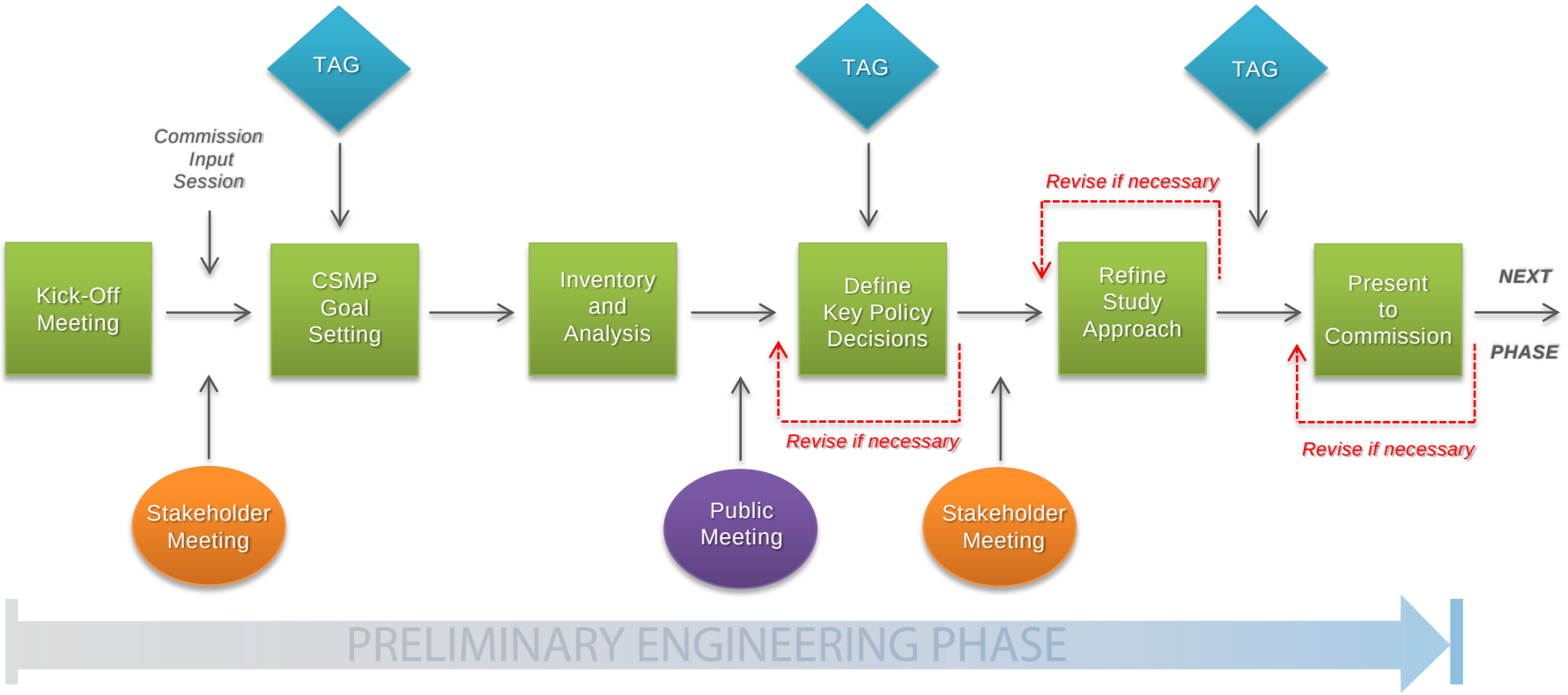


Communication Approach

Draft Communication Strategy for Preliminary Engineering Phase

How will you communicate throughout various phases of the master plan process?





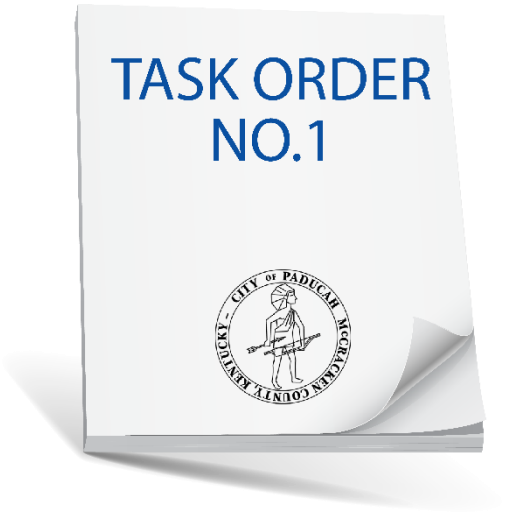
"Similar approach to be used for subsequent phases"

"TAG (7), SWAC (3), Public (3), Commission (3)

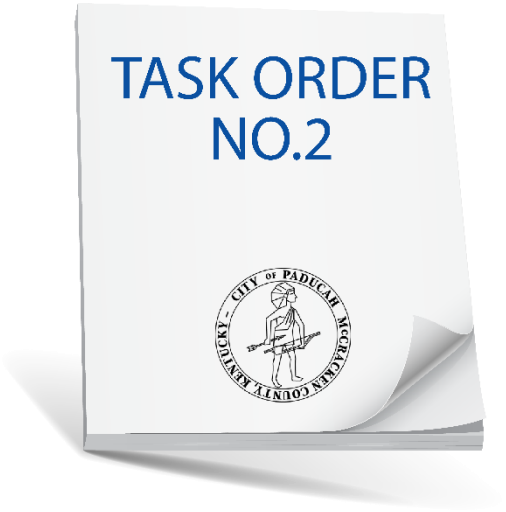
CSMP Deliverables

What will the deliverables include?

- Identification of 10 Priority Flood Areas
- Analysis of 20 Flood Mitigation Alternatives
- Benefit Cost Analysis/Prioritized Ranking
- Development of Capital Project Program



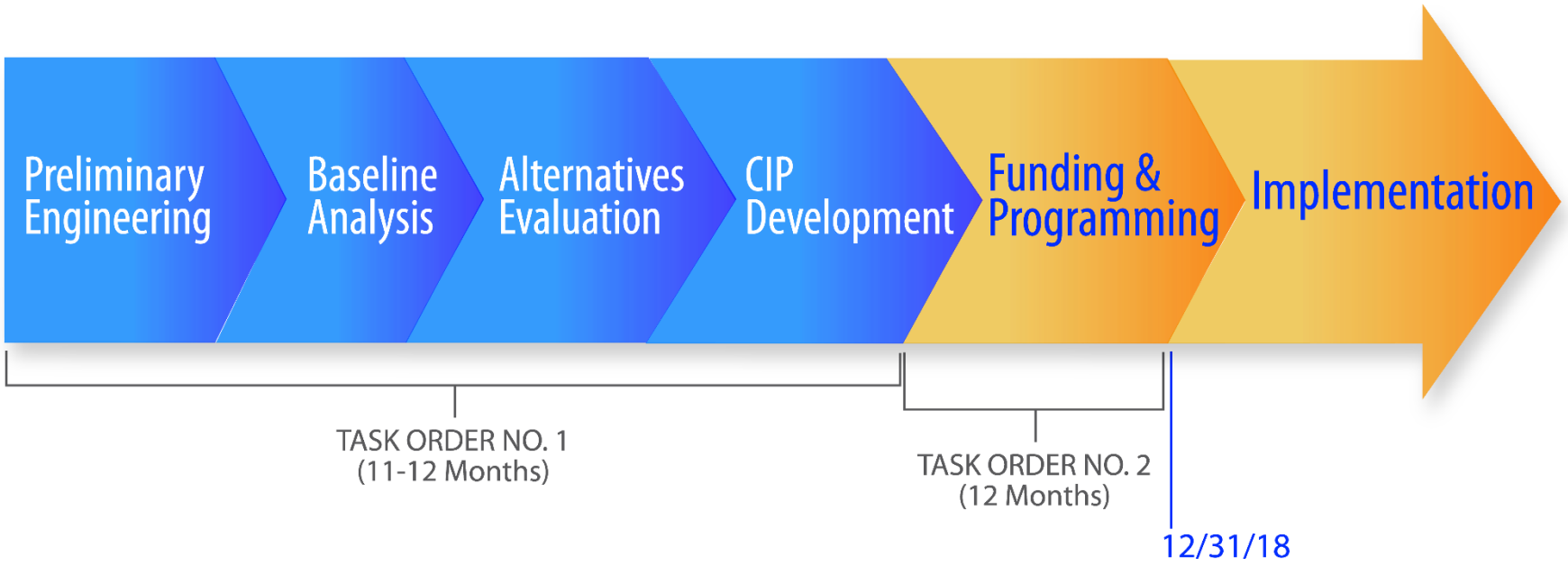
- Evaluation of Funding Options
- Asset Management Program Needs Analysis
- CIP Implementation Plan
- Early Action Projects



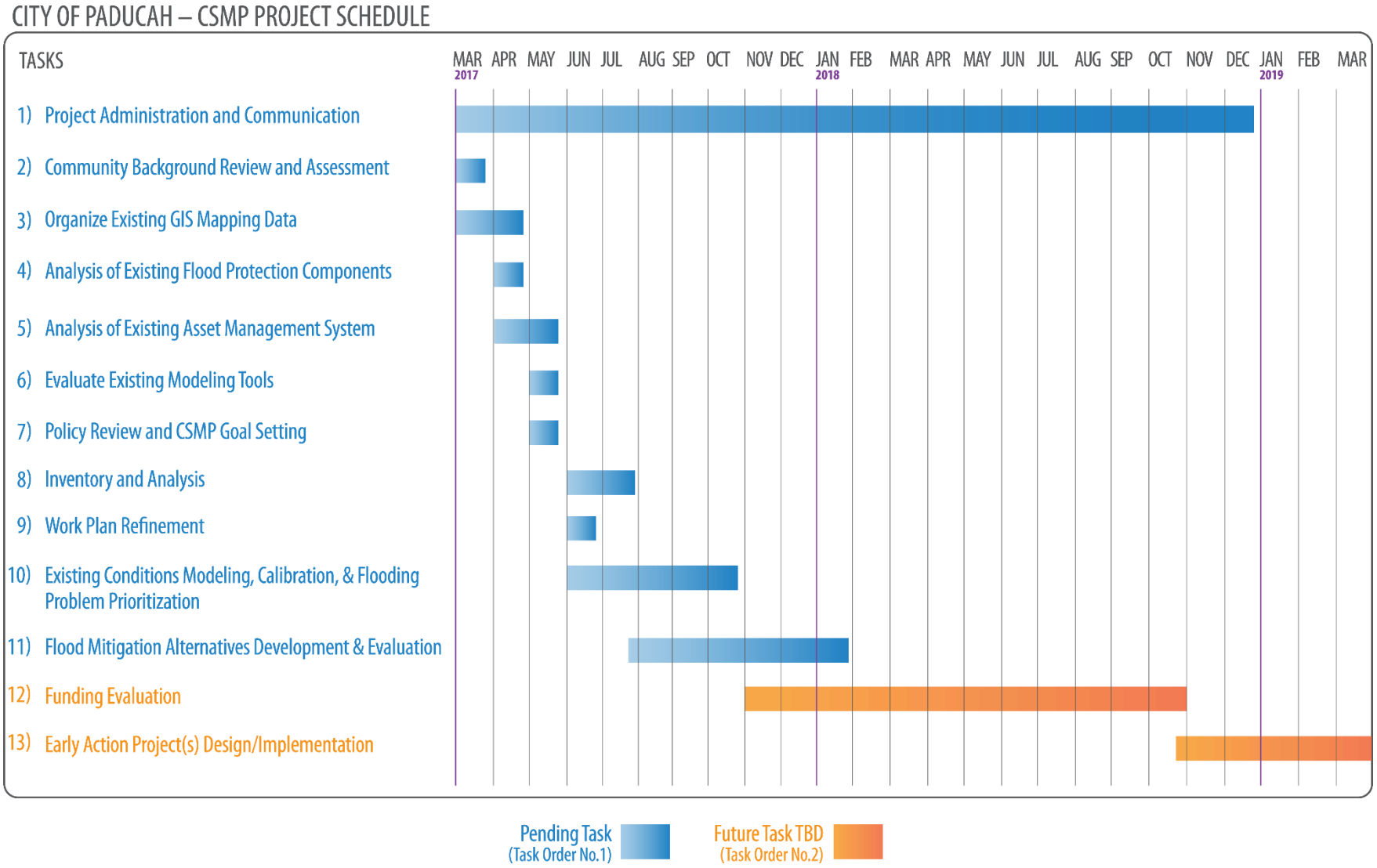
Schedule

What are the Expectations for Schedule?

- Preliminary Engineering Evaluation
- Completion of Master Plan
- Identification of Early Action Projects
- Determination of Funding Approach
- Implementation of Master Plan Projects



Schedule


CITY OF PADUCAH – CSMP PROJECT SCHEDULE
TASKS
MAR 2017
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN 2018
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN 2019
FEB
MAR
1) Project Administration and Communication
2) Community Background Review and Assessment
3) Organize Existing GIS Mapping Data
4) Analysis of Existing Flood Protection Components
5) Analysis of Existing Asset Management System
6) Evaluate Existing Modeling Tools
7) Policy Review and CSMP Goal Setting
8) Inventory and Analysis
9) Work Plan Refinement
10) Existing Conditions Modeling, Calibration, & Flooding Problem Prioritization
11) Flood Mitigation Alternatives Development & Evaluation
12) Funding Evaluation
13) Early Action Project(s) Design/Implementation
Pending Task (Task Order No.1)
Future Task TBD (Task Order No.2)