City of Paducah
Storm Water & Drainage

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Storm Water & Drainage Engineer
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Outline

• Paducah’s Geography
• Existing Storm System
• Responsibility
• Problem
• Solution
• Funding
• Other Kentucky Communities
Paducah’s Geography

• Majority of drainage problems that the City experiences originate from the natural geography of the City
• Located on the Ohio River at the mouth of the Tennessee River, natural floodplain for the Ohio River
• 46 miles upstream from the confluence of the Ohio and Mississippi Rivers
• Nearly 204,000 square miles (over 130 million acres) of land drain to Paducah through the Ohio River
• 46 square miles (almost 30k acres) drain through the city limits through Cross Creek, Crooked Creek, Perkins Creek, and Island Creek to the Ohio River.
Paducah’s Geography
System Makeup

- The present storm water infrastructure is operated and maintained by the Engineering and Public Works Department of which includes:
  - 110 miles of separate storm sewer
  - Over 6000 storm inlets (40% of inlets are connected to the combined sewer system)
  - 313 miles of streams – only small portion of these creeks are owned by the City
  - 9 miles of river
- Flood protection system is an integral part of the storm water system. The Floodwall Division is responsible for operating and maintaining:
  - 3 miles of concrete floodwall
  - over 9 miles of earthen levee
  - 12 pump stations.
- Paducah is on a network of combined sewers.
  - Unique situation ownership of the combined sewer network
  - City operates and maintains storm inlet and laterals that tie into the trunk lines of the combined sewer network owned and operated by JSA
  - 69 miles of combined sewer
Responsibility

• The City of Paducah Engineering & Public Works Department is responsible for:
  o Public health, safety and welfare
  o Water quality from storm water runoff
  o Adequately maintaining, operating, upgrading, and replacing existing storm water and drainage systems
  o Reducing the effects from flooding
  o Complying with Paducah’s Storm Water Phase II Small Municipal Separate Storm Sewer System (SMS4) General Permit regulated by the Kentucky Division of Water (KDOW)
What is Storm Water Runoff?

- Occurs when precipitation from rain or snowmelt flows over the ground.
- Natural undeveloped environment, rainfall is either absorbed in the soil, evaporates or slowly runs off.
- Rooftops and paved areas prevent the water from being absorbed into the ground and causes faster runoff rates and more volume of runoff.

![Diagram showing the differences between natural ground cover and impervious cover in terms of evapotranspiration and infiltration.]
Problem

Problem:
- Current storm water system is aging and needs to be upgraded and/or replaced in areas to provide public health, safety, and welfare from flooding events
- Systems are over capacity/under designed and inundated with small/frequent rain events
- Insufficient funding at present: $60k annually

Cause:
- Greatest population growth in the 1920s & '30s
- Development increased during this time period increasing impervious surface areas and eliminating past ponding areas
- Storm water management was an afterthought during these times unlike today’s requirements through our Ordinances on new development
- Lack of dedicated resources to adequately maintain and update storm conveyance systems
- Lack of identity of storm water management in City budget and organizational structure

Historical population

<table>
<thead>
<tr>
<th>Census</th>
<th>Pop.</th>
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<tr>
<td>1830</td>
<td>105</td>
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<td>1850</td>
<td>2,428</td>
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<td>1860</td>
<td>4,590</td>
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<td>1870</td>
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<td>1890</td>
<td>12,797</td>
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<td>1900</td>
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<td>22,760</td>
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<td>1920</td>
<td>24,735</td>
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<td>1940</td>
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<td>1950</td>
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<td>1960</td>
<td>34,479</td>
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<td>1970</td>
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<td>1980</td>
<td>29,315</td>
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<td>1990</td>
<td>27,256</td>
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<td>2000</td>
<td>26,307</td>
</tr>
<tr>
<td>2010</td>
<td>25,024</td>
</tr>
<tr>
<td>Est. 2014</td>
<td>24,978</td>
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</table>
Paducah’s Storm Sewer System Timeline

• Original Infrastructure – 1900’s
• Works Progress Administration – 1934 – 1942
• Floodwall constructed - 1939 -1949
• Paducah Storm Relief Sewers – 1950s - 1960s
• Majority of Paducah storm sewers are 60 – 100 years old and are over capacity
Men working on combined sewer line during Works Progress Administration 1934-1942
Compaction during Works Progress Administration 1934-1942
Excavating with men, mules and slip scrapers during Works Progress Administration 1934-1942
Men working on sewer line during Works Progress Administration 1934-1942
Manufacturing brick by mixing clay using a mule driven mud-wheel during Works Progress Administration 1934-1942
Manufacturing brick by mixing clay using a mule driven mud-wheel during Works Progress Administration 1934-1942
Original System Design

• Early 1900’s System Design:
  o Designed for average storm period of 15 years
  o One-hour rainfall intensity for 15 year storm = 2.0”
  o Time of concentration = 15 minutes
  o Runoff Coefficient varied from .11 to .22

• Deficiencies:
  o 15 year storm return period used in design is usually better than those recommended. However, storm data in early 1900’s for 15 year storm return is a 5 year storm return period based on today’s data.
  o Time of concentration used throughout design is too high for majority of the system causing under-designed flows = under-designed storm system
  o Runoff coefficients used are extremely low from what they should be today which causes for under-designed flows = under-designed storm system
What is the solution?

Where do we start?
Storm Water Master Plan

• “Master Plan Report” on Sanitary, Storm & Combined Sewers completed in 1961 – 55 years ago
• Storm Water Drainage Study completed in 1989, only looked at analyses of 5 flood prone areas
• City of Paducah, our storm system, industry standards & design, and development has all changed in the last 55 years
• City is overdue for a holistic study of the storm water system, policies & ordinances, and funding mechanisms
Storm Water Master Plan

• A document that provides a clear and concise explanation of the City’s existing storm water management program
• Presents a detailed investigation into key components of storm water as it is related to the City of Paducah
• Establishes storm water management goals for the future
• Creates tools to meet or exceed established goals
• Provides a foundation for future policy decisions
Storm Water Master Plan

- Clear and concise explanation of the City’s existing storm water management program.
  - Schedule kickoff meeting
  - Gather data
  - Conduct interviews with City personnel familiar with the system
  - Schedule site visits with city personnel
  - Develop a database used to assess condition of City’s current system
Storm Water Master Plan

- Detailed investigation into key components of storm water.
  - Analyze all basins and systems to determine hydraulic constraints, predicted flows and quantify effects of flood storage areas
  - Identify major open channels which connect into the City’s storm system
  - Provide a table listing the major reaches and their respective modeling characteristics
  - Identify locations that show potential strategic value as detention, water quality, or controlled flood storage areas based on geography, ownership, capacity, land value, and development potential
Storm Water Master Plan

• Establish goals for the future.
  o Group identified improvements into projects for capital improvement planning
  o Prioritize capital projects for the next XX years
  o Perform an analysis on the City’s staffing level to determine operations, engineering, and administration to adequately maintain and manage the City’s surface water collection system
Storm Water Master Plan

• Create tools to meet or exceed goals
  o Storm Water Master Plan
    • Maps of City’s storm water system, identified deficiencies, and proposed improvements
    • Population projections and storm water demand
    • Charts, graphs, and figures conveying technical information and analysis
    • Justification for recommended work to be accomplished
    • System condition assessment database
    • Storm Water System Capital Improvement Plan
    • System Development Charge and Rate Study
Storm Water Master Plan

• Provide a foundation for future policy decisions
  o Review and recommend updates to the City’s Ordinances & policies as they relate to storm water management and conveyance with new development
  o Recommend changes to design policies and provide supporting data for amending City requirements
Storm Water Master Plan

Project Tasks
1. Project Management
2. Data Gathering
3. System Condition Assessment
4. Hydraulic Modeling
5. Storm Water System Capital Improvement Plan
6. Staffing Level Analysis
7. System Development Charge & Rate Study
8. Storm Water Master Plan
9. City’s Plan Review Policies Regarding Storm Water Management Requirements of Private Development
Possible Solutions

1. Let someone else deal with it...
2. Occupational Tax or Property Tax – Generally public is not in favor of raising taxes
3. Business or Building License Fee – Would not produce enough revenue
4. Site Plan/Erosion Control/Right of Way Permit Fee – Would not produce enough revenue
5. Special Assessment Fee – Special benefit to specific properties
6. User Fee – System expansion to those paying fee that do not have storm sewers
7. Storm Water Utility
Storm Water Utility

• Create a Storm Water Utility under JSA KRS 76.005-76.240

• Primary Role:
  o Own, manage, control and operate separate storm water facilities within the City of Paducah

• Establish a Paducah Surface and Storm Water Utility Fee
  o Under and pursuant to provisions of KRS 91A.510-91A.530
  o City has authority to establish a separate and independent storm water utility under the management and control of the Paducah-McCracken County Joint Sewer Agency (JSA) by City of Paducah Ordinances Ch. 114-257

• Benefits:
  o Can generate funds to alleviate costs of an improvement
  o All users are subject to fee
  o Legal authority already exists to create Storm Water Utility
  o Fees shall be uniform for residential classification

• Obstacles:
  o Fees shall not generate revenues or profits in excess of the reasonable costs associated with providing a public service
  o Takes political effort to pass
  o Subject to court challenges
  o If not properly advertised, can create opposition from the development community
Equivalent Residential Unit (ERU)

• ERU – Most widely used method of funding in Storm Water Utilities
  o Impervious surface area impedes natural infiltration of water causing higher runoff rates and volumes
  o ERU should be based on the average residential impervious area within the City of Paducah
  o Properties should be required to pay a monthly storm water utility fee based on their contribution to storm water runoff

• Property Class
  o Class A Properties – residential $X.XX a month (based on average residential impervious area equal to XXXX square feet)
  o Class B Properties – commercial, charged by dividing the impervious area of a property by the average residential impervious area and rounding to the next highest ERU
## Kentucky Communities:

<table>
<thead>
<tr>
<th>COMMUNITY</th>
<th>ERU (FT2)</th>
<th>MONTHLY FEE</th>
<th>FEE TYPE</th>
<th>YEAR CREATED</th>
<th>POPULATION</th>
<th>ORGANIZED</th>
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<tbody>
<tr>
<td>HENDERSON (2nd Class)</td>
<td>3,000</td>
<td>$2.00</td>
<td>Stormwater Utility Fee</td>
<td>1998</td>
<td>28,757</td>
<td>Water &amp; Sewer Commission of the City of Henderson – Storm Water Utility</td>
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<tr>
<td>HOPKINSVILLE (2nd Class)</td>
<td>3,350</td>
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<td>Stormwater Management Fee</td>
<td>2006</td>
<td>31,577</td>
<td>Surface and Storm Water Utility</td>
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<td>LEXINGTON (Urban)</td>
<td>2,500</td>
<td>$4.63</td>
<td>Water Quality Management Fee</td>
<td>2009</td>
<td>295,803</td>
<td>Lexington-Fayette Urban County Government</td>
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<td>LOUISVILLE (1st Class)</td>
<td>2,500</td>
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<td>Drainage Service Charge</td>
<td>1987</td>
<td>597,337</td>
<td>Metropolitan Sewer District</td>
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<tr>
<td>MURRAY (3rd CLASS)</td>
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<td>Stormwater Utility Fee</td>
<td>2004</td>
<td>17,741</td>
<td>Murray Municipal Utilities</td>
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<td>RADCLIFF (2nd Class)</td>
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<td>21,688</td>
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<tr>
<td>WARREN CO. (excludes Bowling Green)</td>
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<td>$4.00 residential $10.00 commercial</td>
<td>Stormwater Management Fee</td>
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<td>DANVILLE (3rd Class)</td>
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<td>User Fee</td>
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<td>GLASGOW (3rd Class)</td>
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<td>Stormwater Management Fee</td>
<td>2012</td>
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<td>City of Glasgow</td>
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<tr>
<td>PADUCAH (2nd Class)</td>
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<td>25,024</td>
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Equivalent Residential Unit

<table>
<thead>
<tr>
<th>City</th>
<th>Price</th>
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<tbody>
<tr>
<td>Henderson</td>
<td>$2.00</td>
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<tr>
<td>Hopkinsville</td>
<td>$3.00</td>
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<tr>
<td>Lexington</td>
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<tr>
<td>Murray</td>
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<td>Warren Co.</td>
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<tr>
<td>Paducah</td>
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</table>

Average: $3.60
Murray Example:

- City collects storm water utility fees under Murray Municipal Utilities where it has charges for gas, water, sewer, and storm sewer services
- Collects fee on active water service accounts – typical
- Residential flat fee of $1.50 per ERU
- 1 ERU = 3,000 ft\(^2\)
- Commercial billed based on square footage measurement at $1.50 per ERU + $1.00 per ERU for additional area over and above 60,000 ft\(^2\)
  - Fees may seem to be unfair to large developments because more impervious = more runoff to system = $$$
  - Credits are typically given for storm water quantity and storm water quality structures incorporated into the design of the development (i.e. detention & retention ponds)
- Multi-family (duplex, tri-plex, four-plex, condominiums, mobile home parks and other properties containing more than one dwelling unit but less than five dwelling units shall be charged .5 ERU per dwelling unit
National Averages

- 1,491 Storm Water Utilities in the United States
- Median monthly storm water utility fee is $3.50 for those communities using the equivalent residential unit (ERU) system
- Median ERU is 2,842 square feet impervious
Steps

1. Storm Water Master Plan – Guidance on Funding
2. Create a new ordinance under Chapter 50 Article V: Stormwater Utility
   1. Regulations in KRS 91A and KRS 76 allow for the City to establish the equivalent residential unit method of billing for drainage facilities
3. Establish an ERU
4. Establish billing procedures
5. Legal Review
6. Transfer operation, control, maintenance and assets of all surface drainage responsibilities to the Paducah Surface and Stormwater Utility Fund (PSSU)
   1. Could help with expenses of floodwall operation and maintenance as required by USACE
7. JSA release the management and control of this utility by a change in the JSA agreement to the City of Paducah
Conclusion

- The City’s storm water and drainage systems are in need of maintenance, upgrades, and in some cases replacement.
- A Storm Water Master Plan is essential in laying the framework for implementation.
- The Storm Water fee will help the City manage storm water expenses more efficiently without sacrificing services to the citizens of Paducah.
- A path forward for Paducah’s future regarding improving its storm water infrastructure has been presented before you this evening. Initiating the path forward requires visionary thinking and ultimately tough decision making by the policy makers.
The path forward regarding Paducah’s future improvements to its storm water infrastructure has been presented before you this evening. Initiating the path forward requires visionary thinking and ultimately tough financial decision making by the policy makers.