Stream Restoration and Detention Basin Retrofits in St. Peters, MO

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Project Location – St. Peters, MO
Today’s Discussion

- Background on the St. Peters Master Plan
- Overview of Stream Restoration Concepts
  - Stream Restoration Projects
- Overview of Detention Basin Retrofit Concepts
  - Detention Basin Retrofit Projects
- Lessons Learned
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Physical Drivers

- Flooding
- Creek bank erosion
- Detention basin issues (opportunities)
- Water quality issues
Regulatory Drivers

- Old Master Plan from 2002
- Changes were predicted to EPA stormwater rules for November 2012
  - On-site
  - Natural methods
- TMDL sensitivity
Timeline

• **2011** – Stormwater Management Plan is conducted
• **February 2012** – Funding campaign begins
• **August 2012** – Ballot issue for funding passes
• **2013** – First projects are designed
• **2014** – First projects begin construction
• **2016** – 16 projects completed to date
2011 Stormwater Management Plan

• Hydraulic & hydrologic model updates
• Stream assessment survey
• Detention basin assessment & model
• Ordinance review
• Capital Improvement Plan
Stream Assessment

- Channel stability
  - Bank soil conditions and visual erosion
- Aquatic habitat quality
  - Stream flow and habitat structure
- Terrestrial habitat quality
  - Types, diversity, and condition of vegetation
- Water quality
  - Aquatic invertebrates used as an indicator

Source: City of St. Peters Website
Stream Assessment

Type 1: Highest Quality

Spencer Creek near Birchwood Drive

< 1% or 0.5 miles

Type 2: High Quality

Tributary near Frontiers Edge Court

12.4% or 5 miles
Stream Assessment

Type 3: Restorable
Spencer Creek downstream of McClay Road
62.9% or 26 miles

Type 4: Low Quality
East Spencer Creek upstream of Oaktree Retirement Community
23.3% or 9.5 miles
Stream Assessment

Type 5: Lowest Quality

East Spencer Creek downstream of Jungermann Road

< 1% or 0.5 miles
Stream Assessment

LEGEND

- Watersheds
- Stream Network
  - Type 1: Highest Quality (1%)
  - Type 2: High Quality (12%)
  - Type 3: Restorable (63%)
  - Type 4: Low Quality (23%)
  - Type 5: Lowest Quality (1%)
  - Street Network
Stream Assessment Classification

Miles

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Preservation  Restoration
Preservation Measures

- Education and outreach
  - Educate public
  - Seek volunteers to assist

- Projects
  - Remove and control invasive vegetation
  - Replant native vegetation
  - Thin forest canopy where necessary
Restoration Measures

• Education and outreach
  ▫ Educate public

• Projects
  ▫ Install grade control structures
  ▫ Stabilize creek banks
  ▫ Remove and control invasive vegetation
  ▫ Replant native vegetation
Detention Basin Assessment
Capital Improvement Plan

- 100 projects identified costing a total of $125,000,000
- Categorized into groups:
  - Flooding
  - Stream Stability
  - Detention Basin
  - Preservation
- Projects chosen by:
  - High priority
  - Low cost-benefit ratio
  - Preservation of resources
Funding Options

- Increase property taxes
  - Would hurt those on fixed income
  - Not provide enough revenue
- A stormwater utility fee based on impervious area
  - Expensive for businesses, churches, and schools
  - MSD tried this
- Increase Parks and Stormwater Sales Tax
  - Would need to increase by 4/10 of 1%
  - Also paid by non-residents
  - Least cost option to residents
Parks and Stormwater Sales Tax Campaign

- Informational flyers
- FAQs
- St. Peters TV channel
- Meet with HOAs
- Clear explanation of benefits
Proposition P Passes

- 68.2% voted yes on Proposition P
After the Vote

- August 7, 2012 – Proposition P passes
- January 1, 2013 – Sales tax goes into effect
- 2013 – Projects begin
  - Meet with residents to explain the projects and get feedback
  - If residents/HOAs show intent to provide easements, design begins
  - Design brought to residents/HOA at 30%
  - Residents/HOA sign a formal stormwater management agreement
- 2013-2015 – My Hometown Magazine stories and St. Peters Website keep residents informed of the ongoing work
  - www.stpetersmo.net/proposition-p.aspx
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Natural vs. Urban Streams

**Natural Streams**

- Pervious watersheds
- Significant retention of water within soils and wetlands
- Sinuous stream channels
- Native soil and vegetation

**Urban Streams**

- Increased impervious surface
- Increased channel density
- Straightened/channelized
- Vegetation removal
The Result

Source: Mud Creek Case Study, The University of North Carolina
Channel Evolution

1. Channel incision
   - Channel bed dug out, becomes deeper

2. Bank erosion
   - Erodes outsides of turns and deposits on insides
   - Not all erosion is bad

3. Walls collapse

4. Return to stable state

Channel Evolution Model

Diagram showing stages of channel evolution:
- Stage I: W:D~4.0-7.0
- Stage II: W:D~3.0-4.0
- Stage III: W:D~5.0
- Stage IV: W:D~6.0
- Stage V: W:D~8.0

Note: Size of cross section arrows indicate relative importance and direction of dominant processes.

Terms:
- Oversteepened reach
- Primary nickpoint
- Plunge pool
- Secondary nickpoints
- Aggradational zone
- Precursor nickpoint

Direction of flow indicated.
Channel Options

Channel Straightening and Hard Engineering

Natural Stream Restoration
Goals

- Create a stable channel under a variety of flow conditions
- Improve water quality
- Improve aesthetics
- No impact to flood conveyance
- Reduce future maintenance costs
- Create habitats
Stream Restoration Solutions

- **Stabilize bank**
  - Native vegetation
  - Toe protection through rock
  - Soil lifts
  - Geocells
  - Logs placed in bank

- **Dissipate energy**
  - Tree roots placed in stream
  - Log steps
  - Riffles and pools
  - Step pools
Erosion Resistance (Native Vegetation)
Stream Solutions: Grade and Shape
Stream Solutions: Soil Lifts
Stream Solutions: Geocells
Stream Solutions: Log Bank Stabilization
Stream Solutions: Tree Roots
Stream Solutions: Log Steps

[Image of a stream with logs and text diagram of stream features like plunge pool and scour pool]
Stream Solutions: Riffles and Pools

Profile

Water surface
high flow

low flow

Plan
Stream Solutions: Step Pools
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Overall Decision Factors

- Public input and preferences
- Urban stream geomorphology
- Stormwater BMPs
- Volume and rate of water
- Soil infiltration capacity
- Maintenance
- Physical constraints of streams, basins, and pipes

Blend ecologically sensitive solutions with the preferred aesthetic of the residents.
North Reach

Country Crossing Subdivision
Mount Ellen Court
Crescent Hills
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Old vs. New Criteria

Old Detention Basins

- Rate control only design factor
- Empty within 6 to 12 hours after a storm

New or Retrofitted Basins

- Quantity and quality of stormwater most important
- Lengthened storage time; from 24 to 48 hours after a storm
Common Problems

- Water quality not addressed
- Runoff from small storms not controlled
- Maintenance issues
  - Outlet blockages
  - Clogged low-flow channels
  - Mowing costs
  - Standing water
  - Floatables and debris
  - Sedimentation
Benefits of Retrofits

- Improve water quality
- Protect streams from polluted runoff
- More effectively control runoff from small, frequent storms
- Enhance and naturalize the landscape
- Reduce maintenance
The Retrofit Concept

**Basic Steps:**

- Remove concrete low-flow channel
- Excavate basin bottom
- Install infiltration and filtration practices, if applicable
- Grade to increase flow path and prevent “short-circuiting”
- Modify the outlet control structure
- Install sediment forebay(s) and safety benches around permanent pools
- Replace grass with native species
Native Vegetation

- Big Bluestem
- Gum Weed
- Canada Wild Rye
- Pale Purple Coneflower
- Switchgrass
Infiltration & Enhanced Filtration

Infiltration:

![Diagram of infiltration system with labels like inflow, stilling basin, embankment, emergency spillway, etc.]

Enhanced Filtration:

![Diagram of enhanced filtration system with labels like overflow grate, water level control weir, Minnesota filter, etc.]

[Image of a natural setting with a pond and a pathway, possibly related to infiltration practices.]
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Dry Detention Retrofits
Dry Detention Retrofit – Key Features

- Forebay
- Filter
- Modify Outlet
- Infiltration Trench
- Native Plantings
**Existing:**

- 0.3 acre dry detention
- 7.3 acre watershed (fully developed residential)
- 2 discrete inflow locations
- Detains 25-yr/24-hr event at pre-development discharge rate

Mount Ellen Court
May 16, 2013
Mount Ellen Court
August 4, 2014

Results:
EOPC = $63,080
Low Bid = $59,343
Achieved:
Higher level of flood protection
0.35 acre-feet greater volume
Over 200% of Water Quality Volume required
Existing:
• 0.5 acre dry detention
• 18.5 acre watershed (fully developed residential)
• 2 discrete inflow locations
• Detains 25-yr/24-hr event at pre-development discharge rate
Results:

EOPC = $154,195
Low Bid = $145,061

Achieved:

- Higher level of flood protection
- 0.5 acre-feet greater volume
- Over 120% of Water Quality Volume required
Existing:
- 0.5 acre dry detention
- 9.3 acre watershed (fully developed residential)
- 4 discrete inflow locations
- Detains 25-yr/24-hr event at pre-development discharge rate
Results:
EOPC = $77,097
Low Bid = $72,530
Achieved:
• Higher level of flood protection
• 0.7 acre-feet greater volume
• Over 300% of Water Quality Volume required
Wet Basin Retrofit Examples
Outline

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Lessons Learned

- Asset management of natural systems –
  - Economic, Environmental, and Social Benefits
- Ironically, often takes human intervention to preserve and restore natural systems
- Natural systems must clear higher bar –
  - New level of stakeholders and responsibility
- Concepts need to be visual
  - Think representative photos, renderings, and real in the ground projects to show
- Construction observation at key milestones
- Think about maintenance strategies
Thank you!

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