The Evolution of APWA section 5600
"Design Criteria for Storm Sewer Appurtenances"

A presentation for:

KC URBAN STORWATER CONFERENCE

Presented by:

Bill Cunningham, PE
Retired Engineer

Chad Johnson, PE
Olsson Associates

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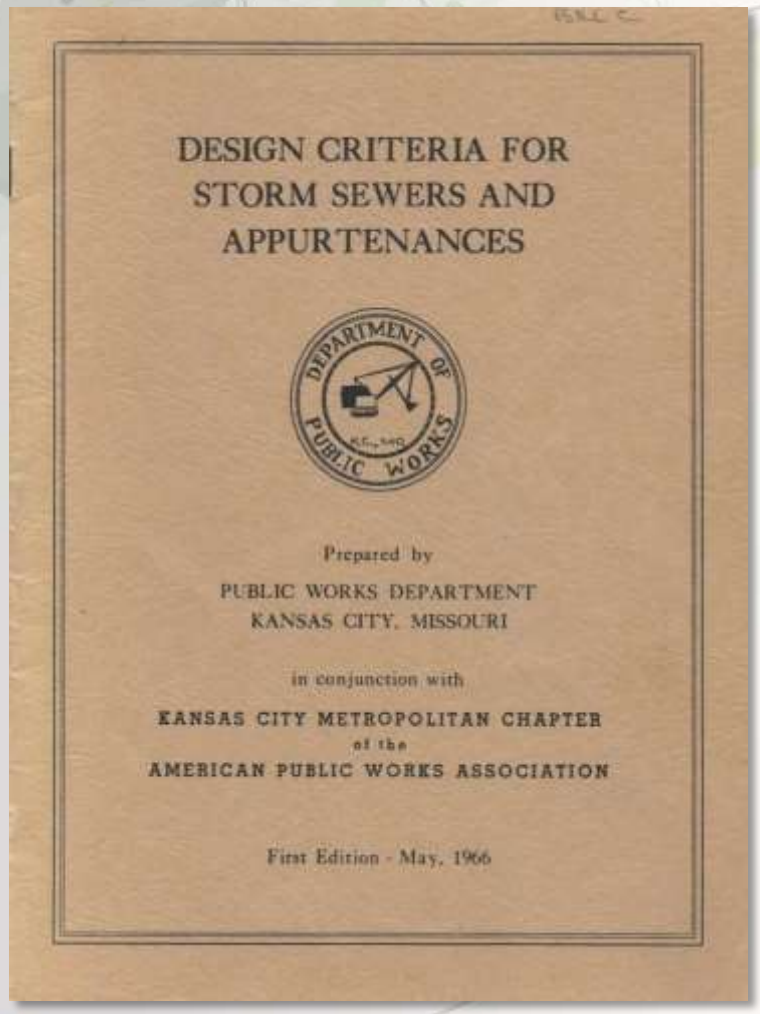
The first APWA Guidelines 1966



DESIGN CRITERIA FOR
STORM SEWERS AND
APPURTENANCES

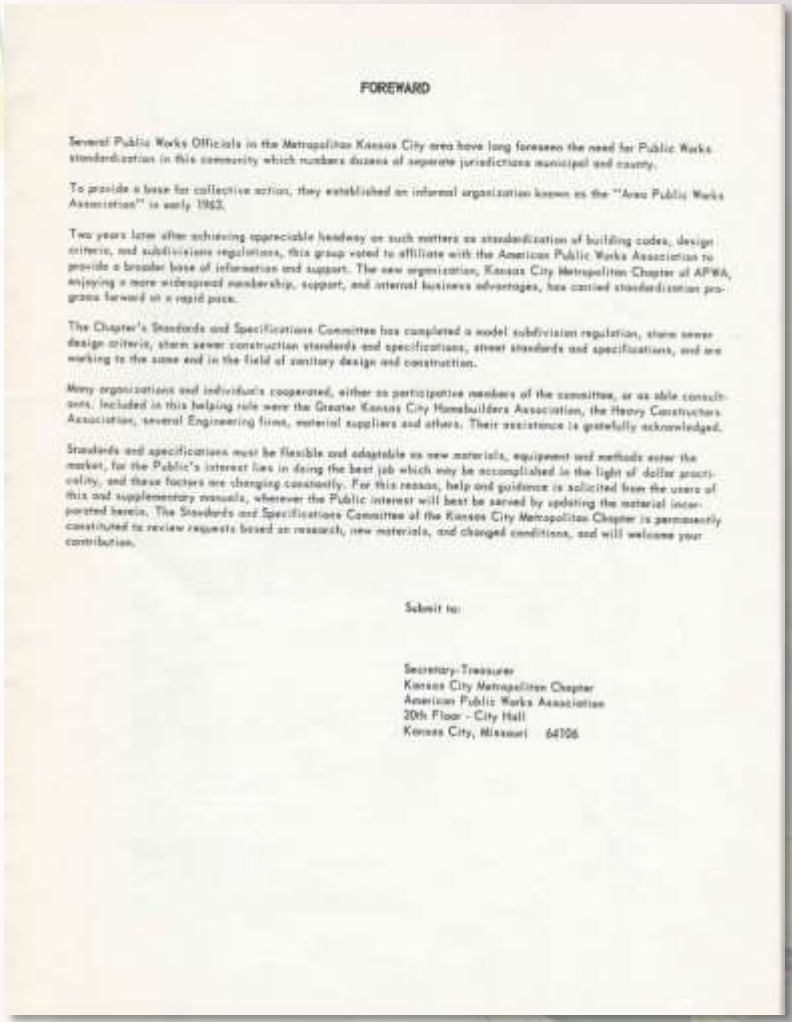
Prepared by

PUBLIC WORKS DEPARTMENT
KANSAS CITY, MISSOURI

in conjunction with

KANSAS CITY METROPOLITAN CHAPTER
of the
AMERICAN PUBLIC WORKS ASSOCIATION

First Edition - May, 1966



FOREWARD

Several Public Works Officials in the Metropolitan Kansas City area have long foreseen the need for Public Works standardization in this community which numbers dozens of separate jurisdictions municipal and county.

To provide a base for collective action, they established an informal organization known as the "Area Public Works Association" in early 1963.

Two years later after achieving appreciable headway on such matters as standardization of building codes, design criteria, and subdivisions regulations, this group voted to affiliate with the American Public Works Association to provide a broader base of information and support. The new organization, Kansas City Metropolitan Chapter of APWA, enjoying a more widespread membership, support, and internal business advantages, has carried standardization progress forward at a rapid pace.

The Chapter's Standards and Specifications Committee has completed a model subdivision regulation, storm sewer design criteria, storm sewer construction standards and specifications, street standards and specifications, and are working to the same end in the field of sanitary design and construction.

Many organizations and individuals cooperated, either as participative members of the committee, or as able consultants. Included in this helping role were the Greater Kansas City Homebuilders Association, the Heavy Constructors Association, several Engineering firms, material suppliers and others. Their assistance is gratefully acknowledged.

Standards and specifications must be flexible and adaptable as new materials, equipment and methods enter the market, for the Public's interest lies in doing the best job which may be accomplished in the light of dollar practicality, and these factors are changing constantly. For this reason, help and guidance is solicited from the users of this and supplementary manuals, wherever the Public interest will best be served by updating the material incorporated herein. The Standards and Specifications Committee of the Kansas City Metropolitan Chapter is permanently constituted to review requests based on research, new materials, and changed conditions, and will welcome your contribution.

Submit to:

Secretary-Treasurer
Kansas City Metropolitan Chapter
American Public Works Association
20th Floor - City Hall
Kansas City, Missouri 64106

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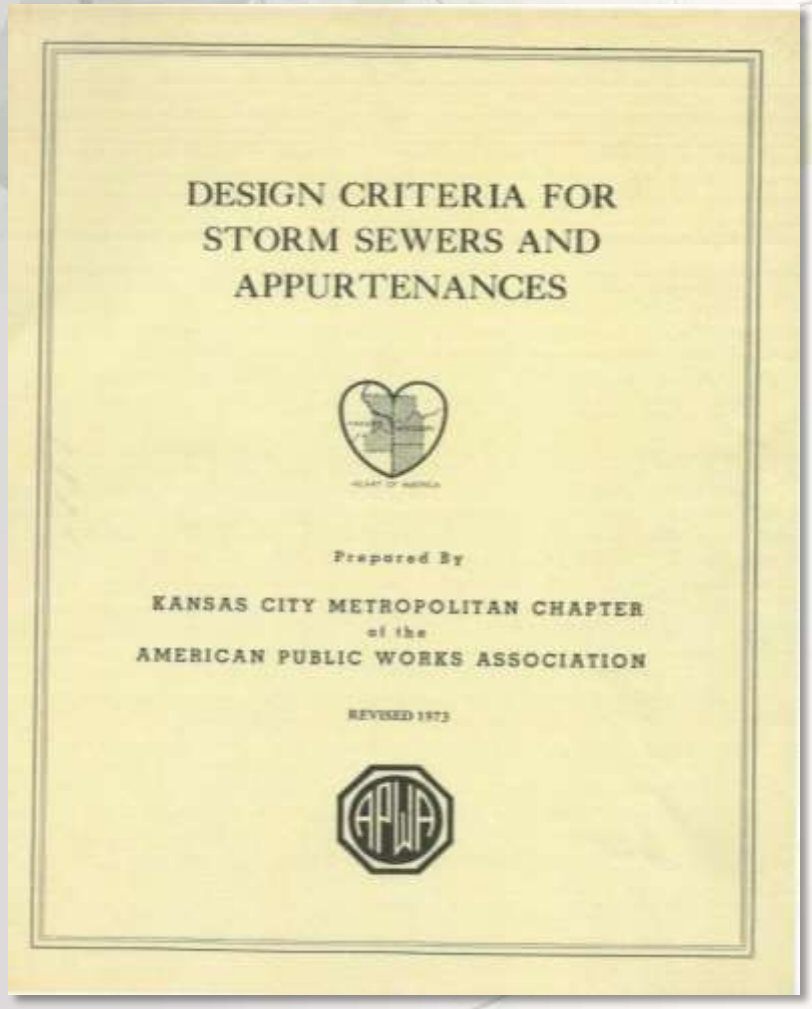
First Update 1973



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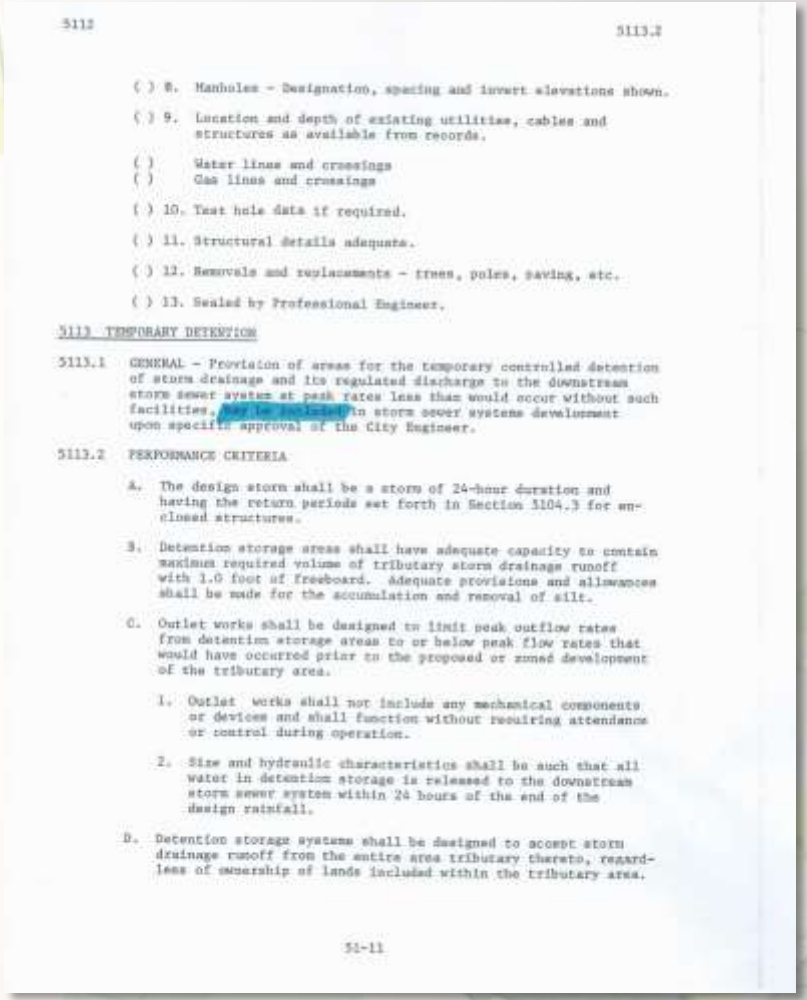

5112 5113.2

( ) 8. Manholes - Designation, spacing and invert elevations shown.

( ) 9. Location and depth of existing utilities, cables and structures as available from records.

( ) Water lines and crossings
( ) Gas lines and crossings

( ) 10. Test hole data if required.

( ) 11. Structural details adequate.

( ) 12. Removals and replacements - trees, poles, paving, etc.

( ) 13. Sealed by Professional Engineer.

5113 TEMPORARY DETENTION

5113.1 GENERAL - Provision of areas for the temporary controlled detention of storm drainage and its regulated discharge to the downstream storm sewer system at peak rates less than would occur without such facilities, may be included in storm sewer systems development upon specific approval of the City Engineer.

5113.2 PERFORMANCE CRITERIA

A. The design storm shall be a storm of 24-hour duration and having the return periods set forth in Section 5104.3 for enclosed structures.

B. Detention storage areas shall have adequate capacity to contain maximum required volume of tributary storm drainage runoff with 1.0 foot of freeboard. Adequate provisions and allowances shall be made for the accumulation and removal of silt.

C. Outlet works shall be designed to limit peak outflow rates from detention storage areas to or below peak flow rates that would have occurred prior to the proposed or zoned development of the tributary area.

1. Outlet works shall not include any mechanical components or devices and shall function without requiring attendance or control during operation.

2. Size and hydraulic characteristics shall be such that all water in detention storage is released to the downstream storm sewer system within 24 hours of the end of the design rainfall.

D. Detention storage systems shall be designed to accept storm drainage runoff from the entire area tributary thereto, regardless of ownership of lands included within the tributary area.

51-11

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The “Gray” Solution

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Circa 1983

DIVISION V
DESIGN CRITERIA

SECTION 5600 STORM DRAINAGE SYSTEMS AND FACILITIES

Approved and Adopted this 26th day of October, 1983

Kansas City Metropolitan Chapter
of the American Public Works Association

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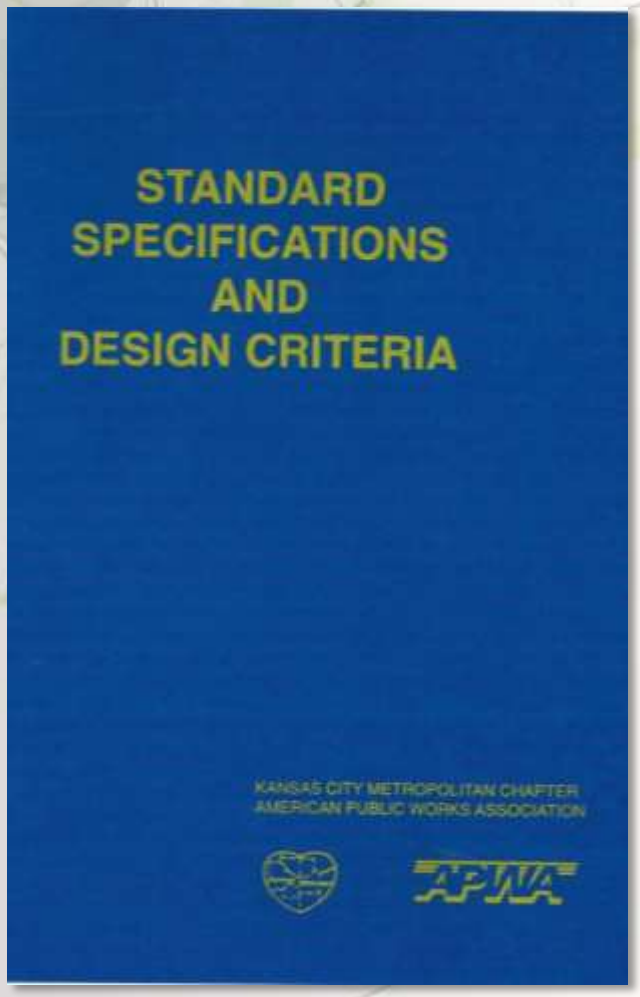
Circa 1990



DIVISION V
DESIGN CRITERIA

SECTION 5600 STORM DRAINAGE SYSTEMS AND FACILITIES

Approved and Adopted this 21 day of March 1990

Kansas City Metropolitan Chapter
of the American Public Works Association

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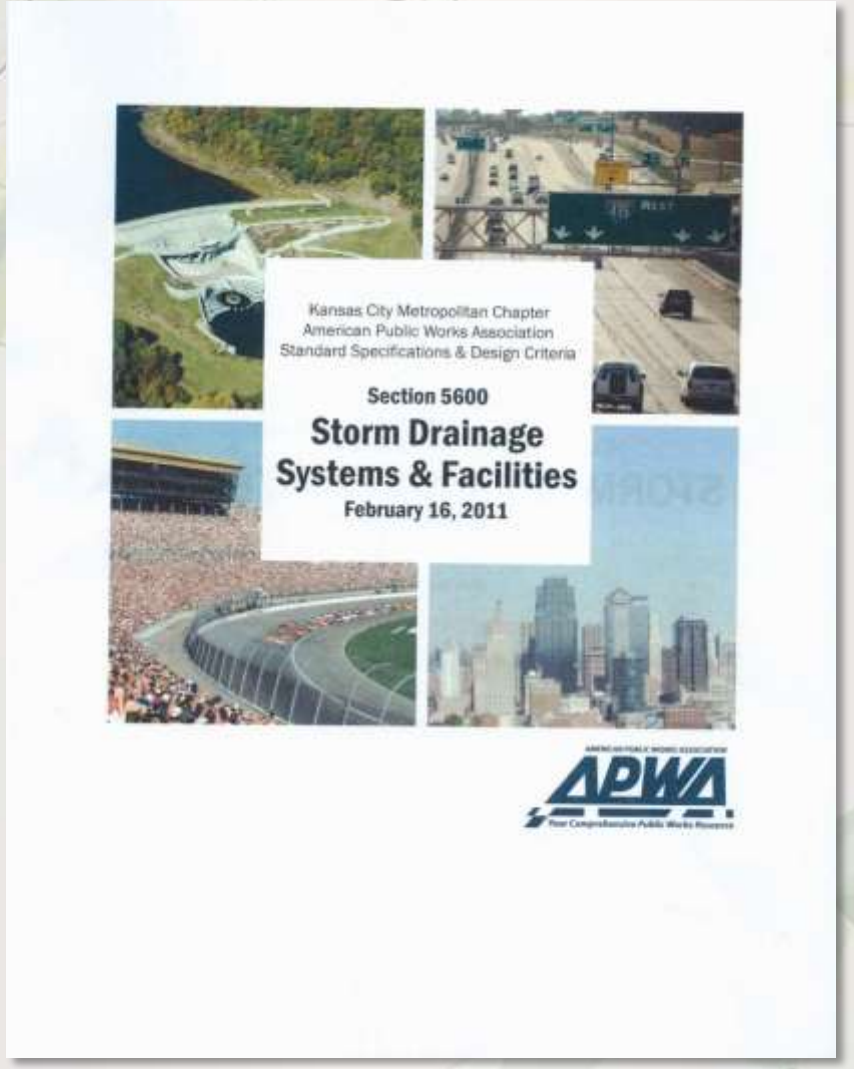
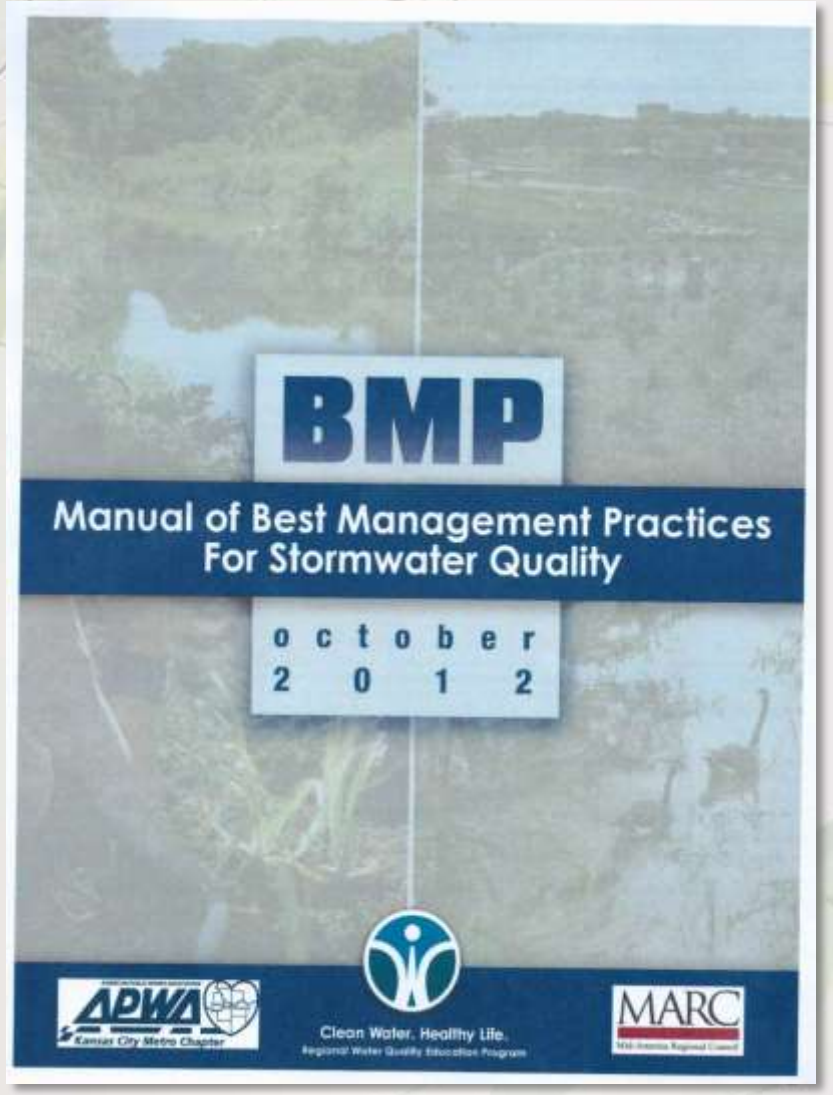
Circa 2011 to Current



BMP Manual and 5600 Cross Referenced



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Bioengineered Channel

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THEY'RE MISBEHAVING AGAIN - WHAT DO WE DO THIS TIME? - FLOOD OR GLOBAL WARMING?
Baloo
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State of the Practice

- Detention strategies historically focused on extreme event flood control (10-100 year control).
- Updates ~10 years ago added 1-year control (match exist.)
- Focus is now controlling smaller storms. Why?...
  - ✓NPDES requirements
  - ✓Resident concerns
  - ✓Focus on streams & lakes

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APWA 5600 **History**

- **1990 Criteria**
  - Max site discharge rate in 100-year event = 1.8 cfs/acre.
- **2003/2006 Criteria**
  - Max site release rates for the 99%, 10% & 1% storm events limited to pre-developed conditions.
- **2011 (current) Criteria**
  - strategy options
    - comprehensive, frequent event, flood control
    - set cfs/ac allowable release rates
    - WQv control added to 50% storm for stream protection

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APWA “Hydrologic Controls” Subcommittee

- Improve Section 5600 detention requirements:
  - Strategies for different communities and watersheds (greenfield vs. urban core)
  - “Match existing” can harm streams.
  - Ideal strategy to protect streams
  - Variabilities in determining “existing conditions”
  - Detention strategies yielding best flood reduction downstream?
  - How far downstream is reasonable to expect benefits? (compare to “10% rule”)

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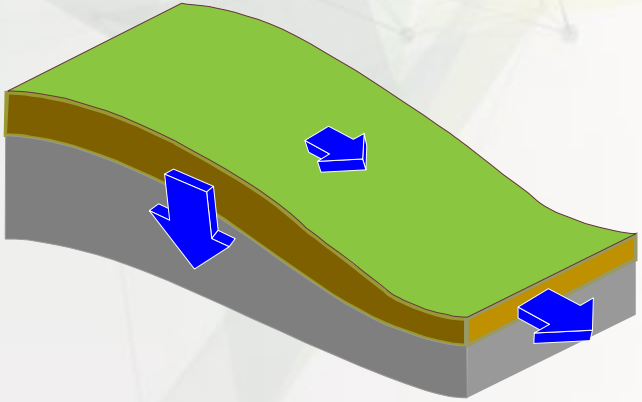
Stream Protection: Hydro-Geomorphic Analysis

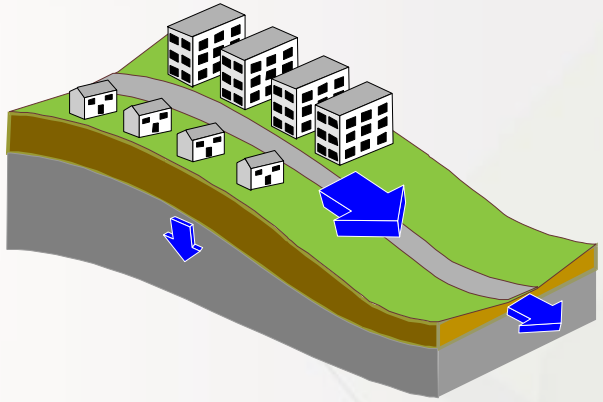
Before Development



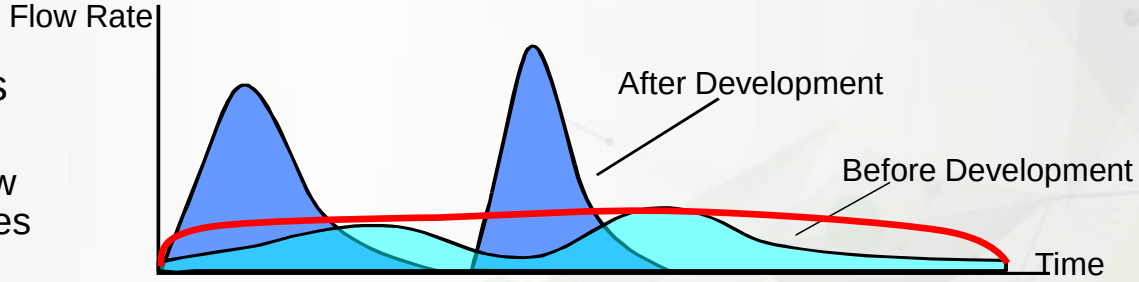
Increase in:
- Imperviousness
- Drainage Slope
- Direct Runoff

Decrease in:
- Evapotranspiration
- Recharge
- Base Flow

After Development



Hydrologic Responses to Development
- increased rates of flow
- increased flow volumes



Source: Roesner et al.

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Dr. McEnroe 2005 Paper

- Hypothetical 200-acre watershed, Q100 impacts:
  - Developed undetained = +66%
  - Detention across entire watershed, 3 cfs/ac = -36%
  - Detention in upper 2/3, 3 cfs/ac = -17%
  - Detention all sites, 5 cfs/ac = +7%
  - Detention in upper 2/3, 5 cfs/ac = +9%

- Larger Watersheds, 3 cfs/ac control on new developments:
  - 14 sq. mi. drainage area = +40% Q100
  - 5 sq. mi. drainage area = +8% Q100
  - 1-2 sq. mi. approx. “break even point”

Committee Findings

- Local agencies prefer set allowable release rate for detention facilities rather than “match existing” method.
- Based on analysis of local rain and stream gage data, regional regression equations, and various technical papers (McEnroe, Urbonas, others), the ranges for release rates to provide downstream benefit are:
  - 0.3 to 0.7 cfs/acre in the 2-year event
  - 2.0 to 3.0 cfs/acre in the 100-year event

Detention Strategies

5601.5. City/agency evaluate watersheds and assign one of 3 strategies:

1. Comprehensive Control (default): Stream Protection and Flood Control.
2. Frequent Event Control for Stream Protection
3. Extreme Event Flood Control

1. Comprehensive Control

- Peak runoff control provided for 50%, 10% and 1% chance storms
- Control to 0.5, 2.0 and 3.0 cfs/ac, respectively
- Extended detention of the 90% mean annual event storm
- Provides broad protection of the receiving system.

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1. Comprehensive Control

Application:

- Downstream system is a natural stream
- Local authority has identified downstream flooding of buildings, roads and infrastructure
- Existing conditions
- Future ultimate build-out conditions.

2. Frequent Event Control

- Protect downstream channels from erosion and water quality degradation:
  - Runoff control for the 50% and 10% storms (control to 0.5 and 2.0 cfs/ac)
  - Extended detention control of the 90% mean annual event

2. Frequent Event Control

Application:

- Mostly undeveloped watersheds
- natural streams to be protected
- downstream flooding of existing structures not present
- downstream structures protected from future flooding through floodplain setback policy.

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3. Extreme Event Flood Control

- Detention provided solely to reduce peak runoff rates in 10% and 1% events (controlled to 2.0 and 3.0 cfs/ac) for downstream flood reduction.
- Over-detention of peak release rates provides cumulative benefit for a reasonable distance downstream. Strategy does **not** protect stream channels and banks from erosion.

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3. Extreme Event Flood Control

Application:

- Reduction of peak flood levels where flooding of downstream structures has been identified
- Redevelopment and in-fill situations
- Existing stream conditions already poor or amored

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Volume Comparisons

Criteria	Release Rates	Storage Vol. (ac-ft)
1991 APWA	Q100 = 1.8 cfs/ac (approx. ex. Q10)	**4.0**
2006 APWA	Match exist. 1-, 10-, 100-yr peak Q	**3.0**
2011 Comprehensive Strategy	Control* WQv, 2-, 10-, 100-yr	**4.9**
2011 Extreme Event Strategy	Control* 10-, 100-yr	**3.7**
2011 Frequent Event Strategy w/ 10-year control	Control* WQV, 2-, 10-yr	**3.2**

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Looking Ahead: Potential Future Changes

- Growing knowledge of stream responses to urbanization → detention and stream buffer updates
- Hydrology/rainfall data (NOAA 14)
- Reasonable levels of service, ensuring value
- Closer coordination with or incorporation of the BMP Manual.
- Watershed Based Solutions – Wetlands and Buffers?

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Questions?