



2024 FALL CONFERENCE AT THE ASHORE RESORT  
OCEAN CITY, MARYLAND

# **COUNTY GOVERNMENT DRAINAGE ISSUES CASE STUDIES AND LESSONS LEARNED**

STEVEN WALSH, PE HARFORD COUNTY DPW

September 20, 2024

# BIOGRAPHY

**Steve Walsh** PE, Deputy Director  
Harford County DPW

**Division of Highways**  
**Division of Environment & Sustainability**



35 years local gov't public works experience

Retired Balt Co DPW Director

BS in Civil Engineering 1987 / University of Maryland

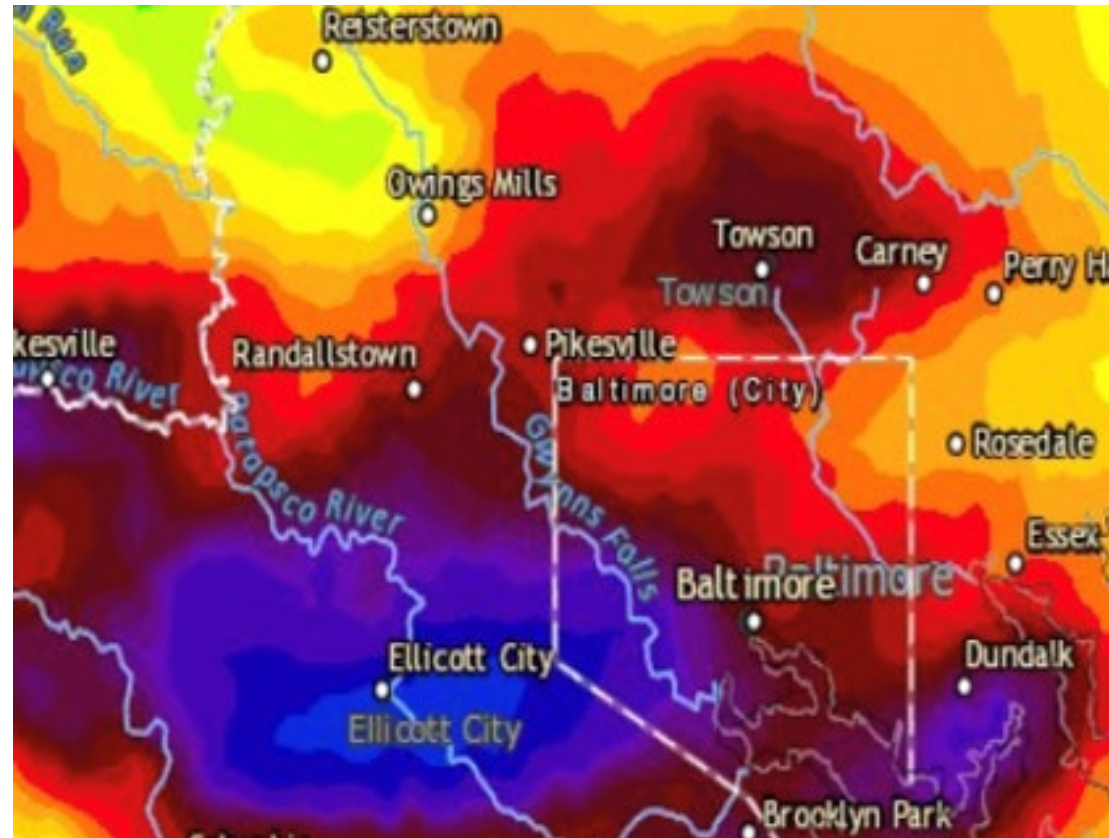
## ABSTRACT

---

- HISTORY
  - DRAINAGE ISSUES OF ALL TYPES (CASE STUDIES)
  - COMPLICATIONS
  - PROJECT PRIORITIZATION
  - LESSONS LEARNED
- 
- 1.0 PDH

# COUNTY GOVERNMENT DRAINAGE ISSUES

## CASE STUDIES AND LESSONS LEARNED





SINCE RECORD KEEPING STARTED  
IN 1873

WETTEST SEPTEMBER 2011 - 13.32"

WETTEST JUNE 2015 - 13.09"

WETTEST JULY 2018 - 16.67"

WETTEST NOVEMBER 2018 - 7.72"

**WETTEST YEAR 2018 – 71"**

# OCEAN HIGHWAY (MD- 528)

- DRAINAGE DRIVEN
- MAKE IT WORK
- SOMETIMES THE  
MANUAL DOESN'T  
WORK



# HOW DID WE GET HERE?



# 1965

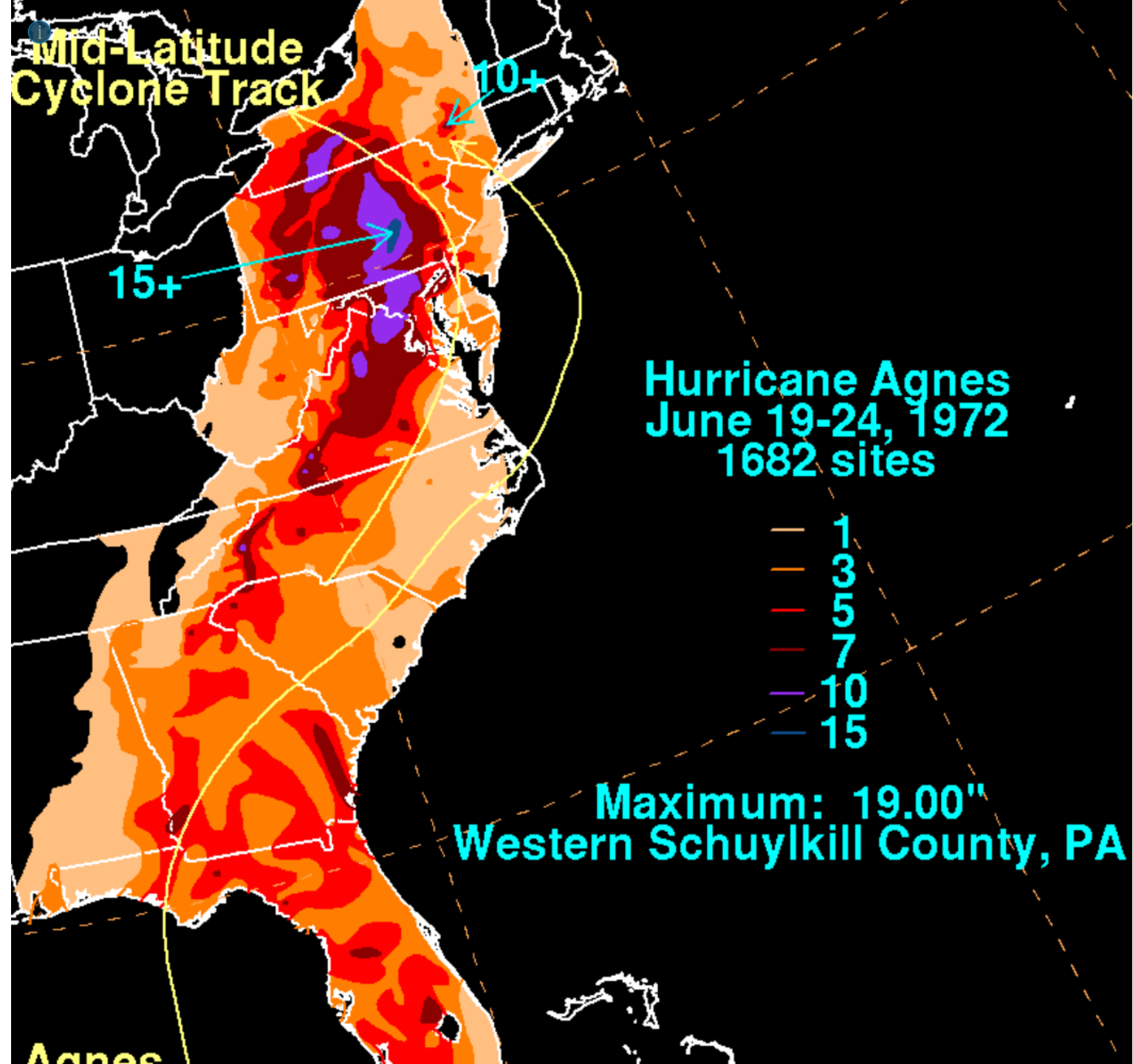
- CONGRESS PASSED THE SOUTHEAST HURRICANE DISASTER RELIEF ACT.
- THE ACT WAS AS A RESULT OF THE EXTENSIVE DAMAGE CAUSED BY HURRICANE BETSY IN THE GULF STATES.
- THE ACT PROVIDED FINANCIAL RELIEF FOR THE FLOODING VICTIMS AND AUTHORIZED A FEASIBILITY STUDY OF A NATIONAL FLOOD INSURANCE PROGRAM.

# 1968

- NFIP AUTHORIZED BY NATIONAL FLOOD INSURANCE ACT

# 1972

- AGNES TROPICAL DEPRESSION
- TOTAL DAMAGES NATIONWIDE ESTIMATED AT \$3.1 BILLION (\$21.7 BILLION IN 2022),
- HURRICANE AGNES WAS THE COSTLIEST DISASTER TO THAT TIME, DROVE THE NEED FOR FLOODPLAIN MANAGEMENT



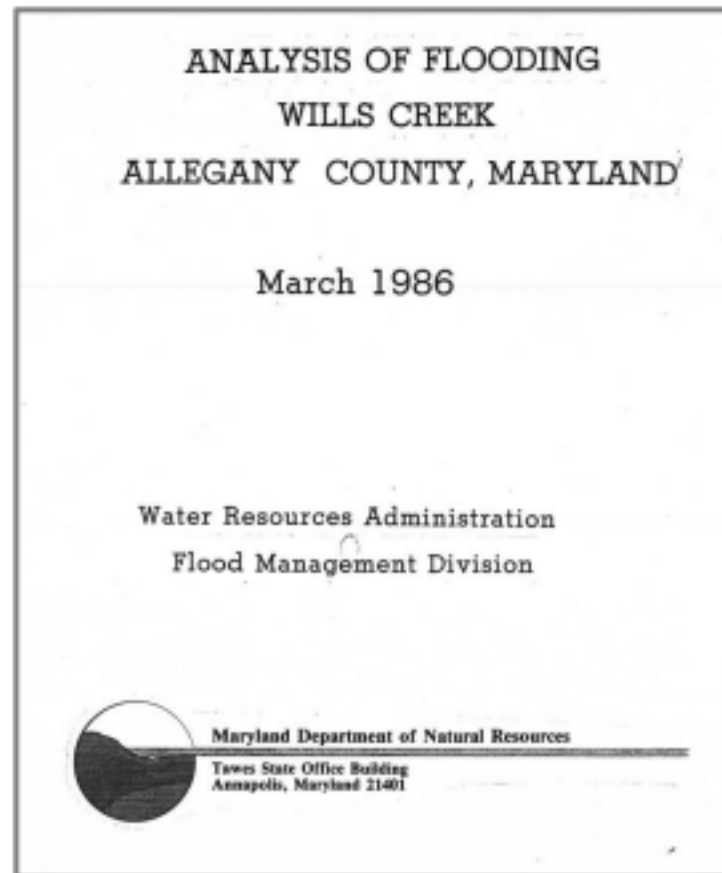
# Watershed Studies & Flood Management Plans



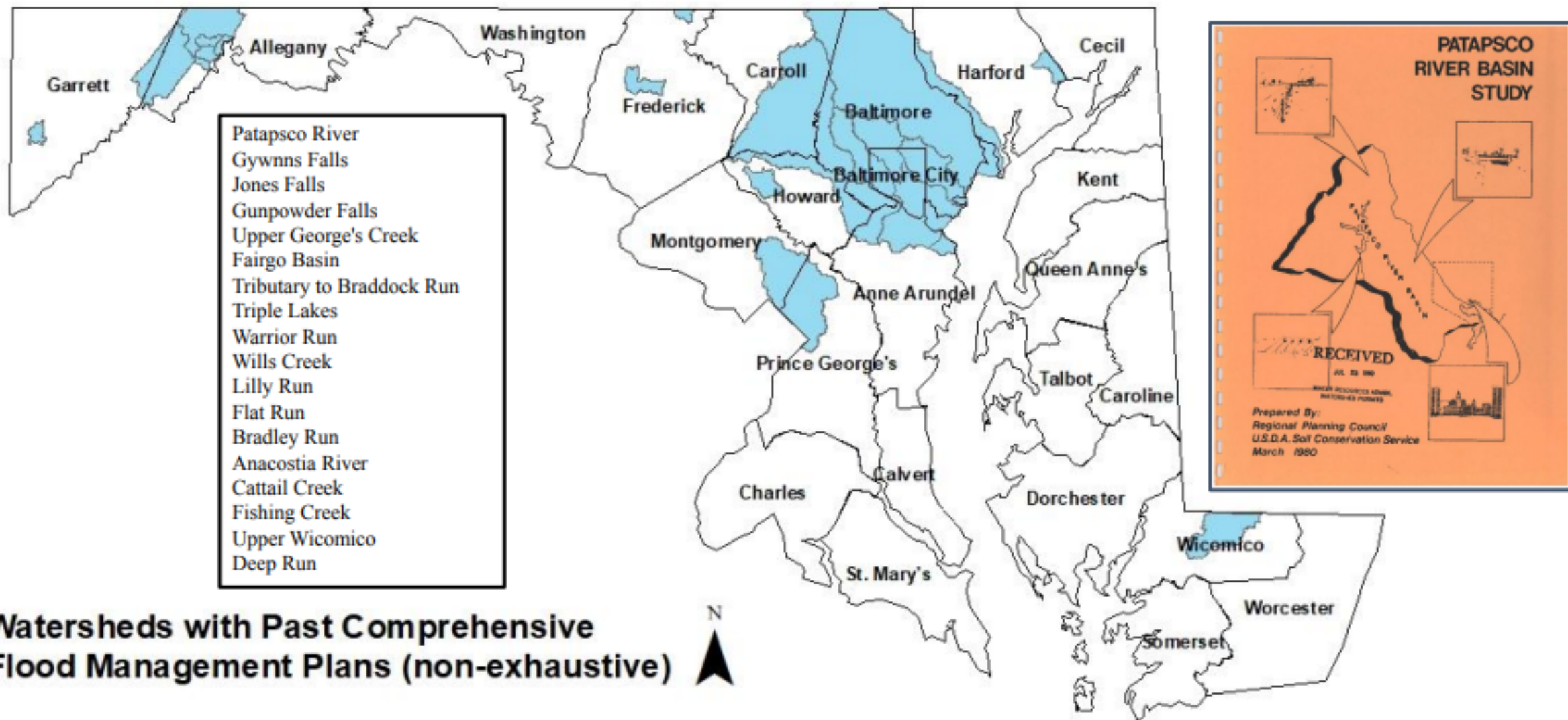
## Flood Hazard Management Act of 1976 (Environment Statute §5-802)

- Also known as the Comprehensive Flood Management Grant Program (CFMGP)
- 27 watershed studies and flood management plans complete by 1995

<https://mde.maryland.gov/programs/Water/StormwaterManagementProgram/FloodHazardMitigation/Pages/Past-Plans.aspx>

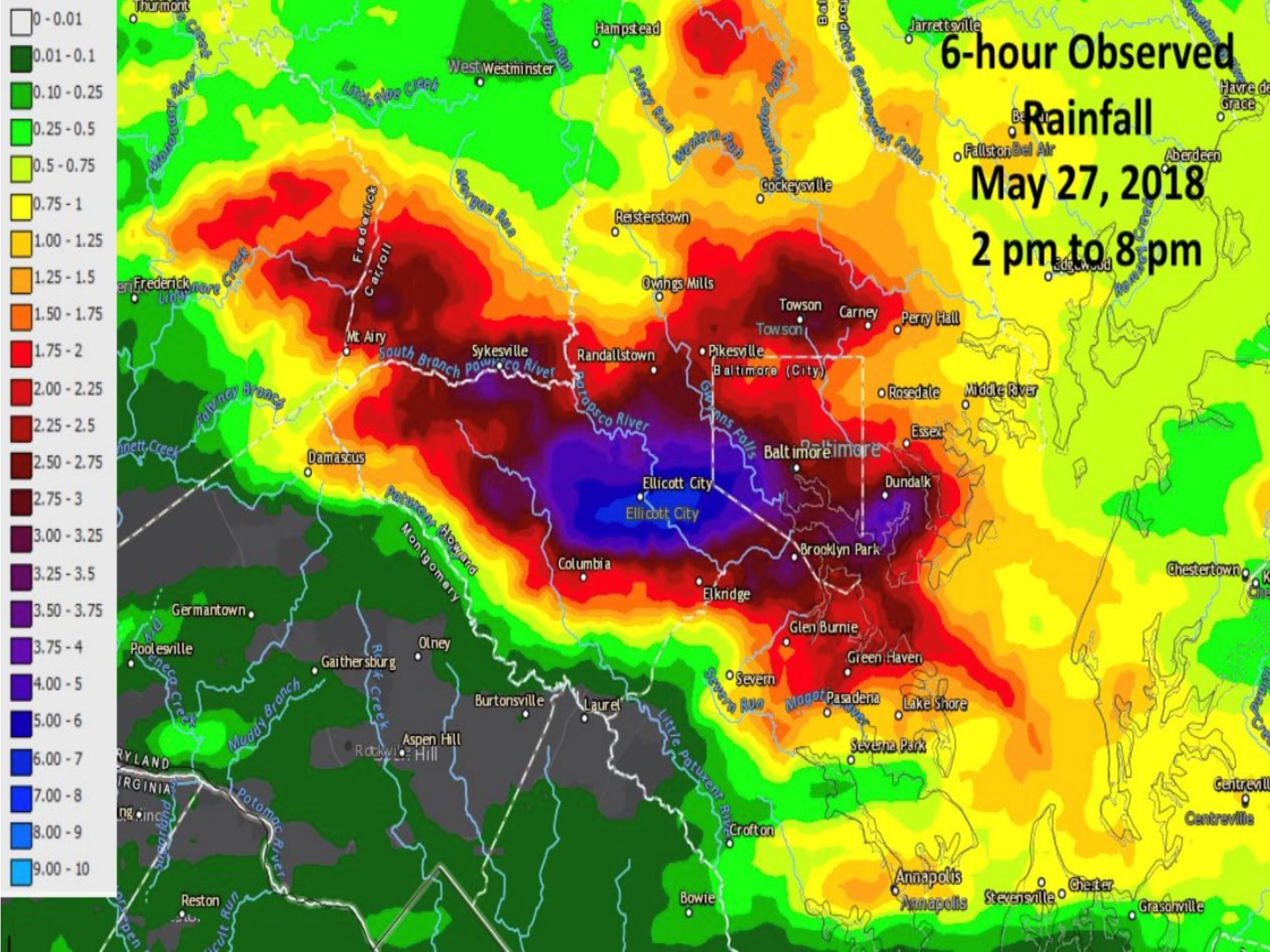






<https://mde.maryland.gov/programs/Water/StormwaterManagementProgram/FloodHazardMitigation/Pages/Past-Plans.aspx>





# BALTIMORE CO - WESTCHESTER ROAD FLOODING 2018













MAKE IT STOP

WHAT CAN THE  
COUNTY DO?

# THE DRAINAGE SYSTEM





LAWN





# SWALES





# STORM DRAIN INLETS



11.28.2008 11:38



# STORM DRAINS





A photograph showing a concrete outfall structure, possibly a culvert or storm drain, partially buried in a wooded area. The structure is a large, rectangular concrete block with a circular opening at the bottom. It is surrounded by fallen leaves, twigs, and other debris. A large, dark, cylindrical pipe is visible in the upper left corner, partially buried in the ground. The overall scene suggests a neglected or abandoned infrastructure project in a natural setting.

OUTFALLS

11/16/2000 13:10





# STORMWATER MANAGEMENT PONDS

PUBLIC / PRIVATE





# CONCRETE CHANNELS

A photograph of a stream flowing over rocks in a forest. The water is clear and turbulent as it cascades over a series of dark, wet rocks. The surrounding forest is dense with green trees and foliage, creating a lush, natural setting. The word "STREAMS" is overlaid in large, bold, yellow capital letters on the lower left portion of the image.

# STREAMS



HOPKINS PARK  
313 AIKEN TERRACE

# IN-STREAM STORMWATER MANAGEMENT

CONSTANT, FRIENDSHIP STORM WATER  
W S ROUTE 24

140

120

110

90

MOBILCON DEVELOPMENT





# BAY SHORELINE





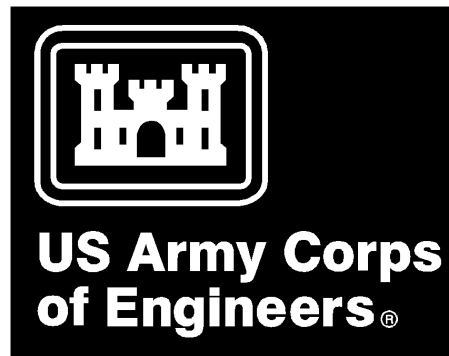
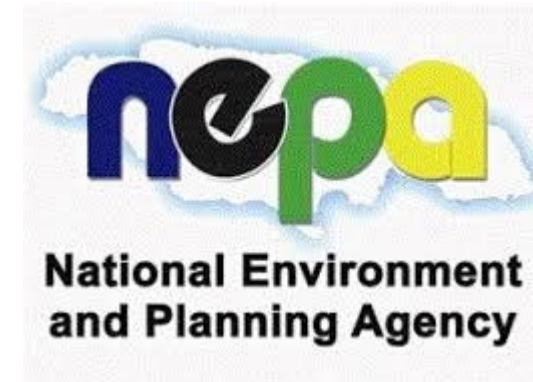
# **JOINT MANAGEMENT OF THE DRAINAGE SYSTEM**

**COUNTY- INFRASTRUCTURE**

**HOA – INFRASTRUCTURE, STORMWATER PONDS,  
STREAMS**

**PRIVATE - INFRASTRUCTURE, STREAMS**

# ENVIRONMENTAL AGENCIES



## **40'S 50'S 60'S**

PIPE STREAMS TO DEVELOP MORE LAND

## **70'S AND 80'S – INCREASED PROTECTION**

ROADWAY DRAINAGE CRITERIA

BRIDGE HYDRAULICS CRITERIA

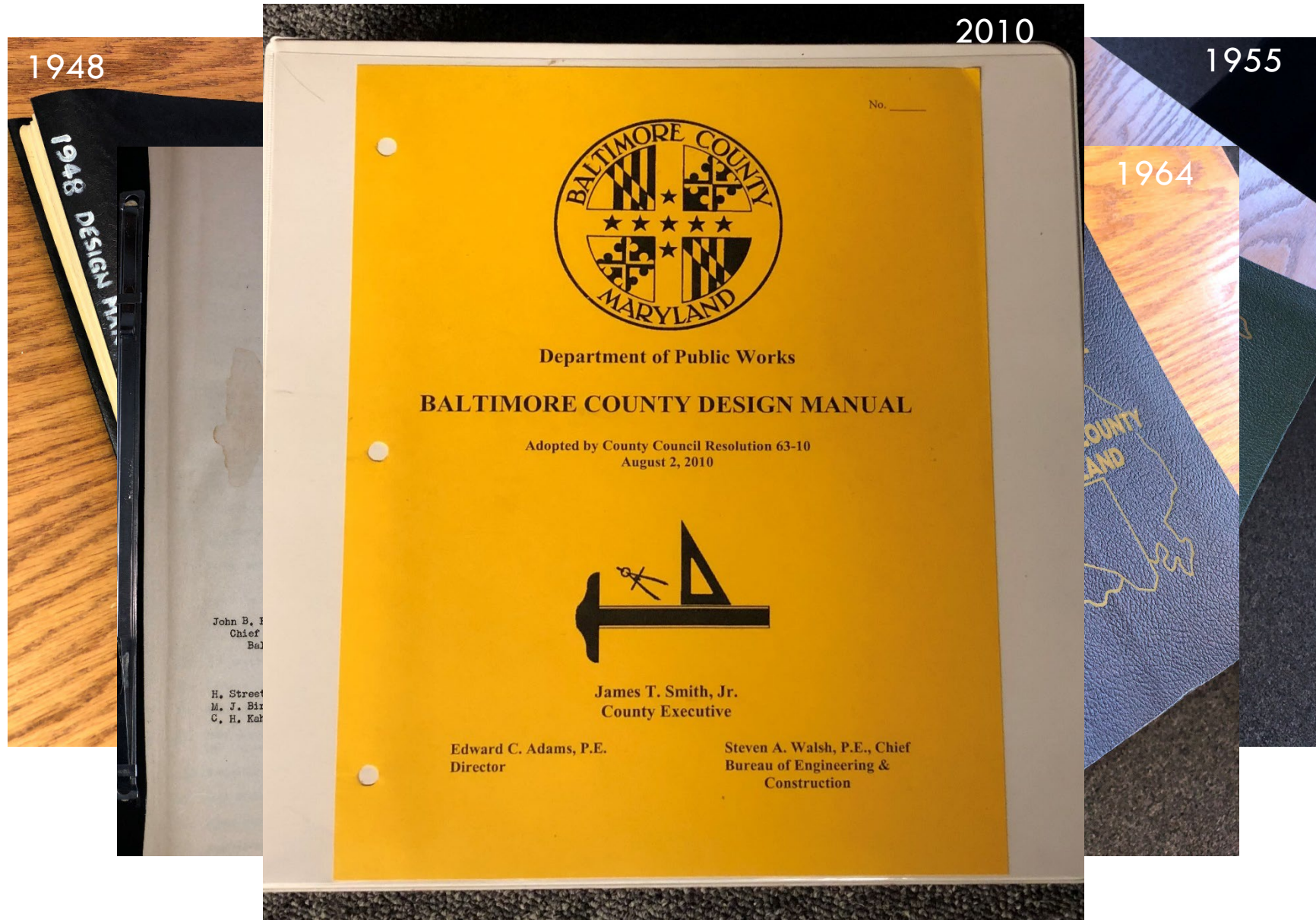
FLOODPLAIN REGULATIONS

SEDIMENT CONTROL REGULATIONS

STORMWATER MANAGEMENT REGULATIONS

ENVIRONMENTAL REGULATIONS

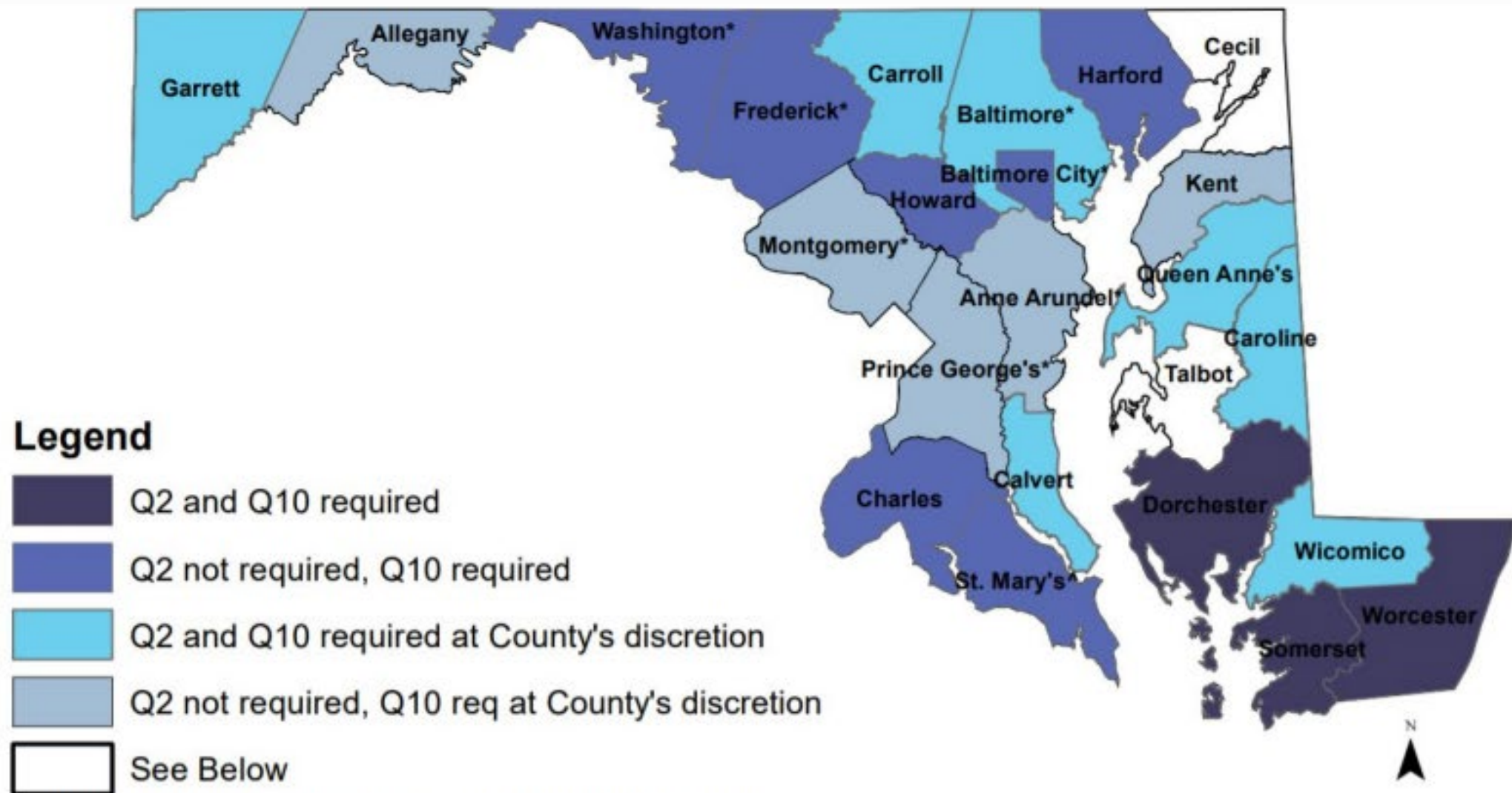
# BALTIMORE COUNTY DESIGN MANUALS



# CURRENT PRACTICES

- STORMWATER MANAGEMENT RULES FOR NEW DEVELOPMENT
  - WATER QUALITY
  - QUANTITY CONTROL
- STORM DRAIN PICKUP AND CONVEYANCE (10 YEAR)
- ROADWAY CULVERT SIZING
- FLOODPLAIN MANAGEMENT - HOMES OUT OF 1% (100 YEAR) FLOODPLAIN





Cecil: Q2 required for Coastal Plain, Q10 required for Piedmont

Talbot: Q2 control requires post-development peak discharge rate be within 10% of pre-development peak discharge rate. Q10 not required

County^: Q100 required

County\*: Q100 required at County's discretion

County: Q100 not required

# BALTIMORE CO - REISTERSTOWN CHARTLEY CHANNEL























UNHAPPY PROPERTY OWNERS

PUBLIC INPUT FOR THE PROJECT TYPE

RESTORATION OR MAINTENANCE?









# LESSON LEARNED

PUBLIC INPUT MAY SURPRISE YOU

# DRAINAGE PROBLEM TYPES



# LOCALIZED FLOODING

BALTIMORE CO - CATONSVILLE 2018

## LOCAL DRAINAGE PROBLEM





# RIVERINE FLOODING

# BALTIMORE CO - GLENDALE FLOODING, 2018





# TIDAL FLOODING



SEP 19 2003





**I'VE BEEN FLOODED**



# WHAT REALLY IS THE PROBLEM?

- HOUSE CONSTRUCTION PROBLEM-WINDOWS OR DOORS ARE LOW
- POOR HOUSE MAINTENANCE/RAIN GUTTERS
- POOR YARD GRADING
- HOUSE SITS BELOW ROAD
- RUNOFF FROM OPEN SECTION ROAD
- NO STORM DRAINS/ NO DESIGNED DRAINAGE

# WHAT REALLY IS THE PROBLEM?

- NO CURB AND GUTTER/ NO WATER COLLECTION
- TOO MUCH RAIN (EXCEEDS THE DESIGN CRITERIA)
- HIGH WATER TABLE, SPRINGS
- BASEMENT WATERPROOFING/SUMP PUMP RUNS ALL THE TIME
- NEIGHBOR BLOCKED THE HISTORIC DRAINAGE COURSE
- CLOGGED PIPE/ STORM DRAIN INLET IN STREET

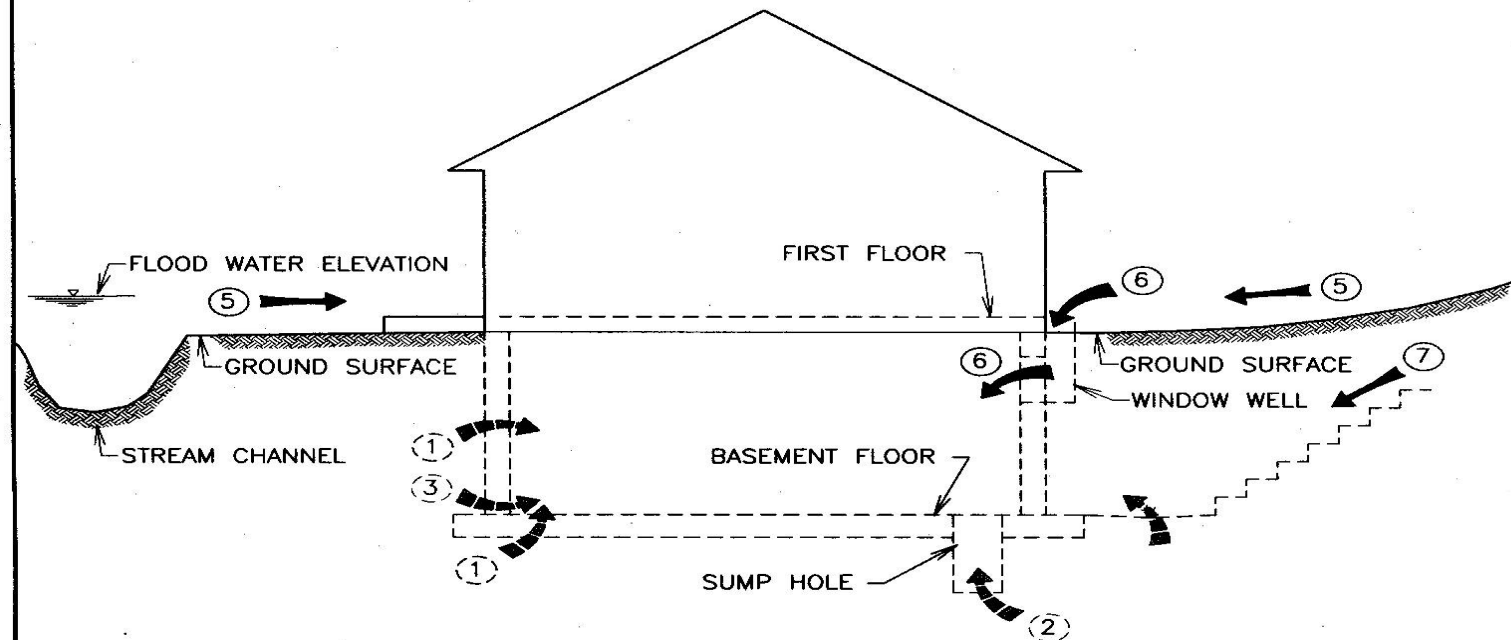


# BASEMENT FLOODING



**COUNTY PROBLEM OR  
HOMEOWNER PROBLEM?**





#### SEEPAGE OCCURS:

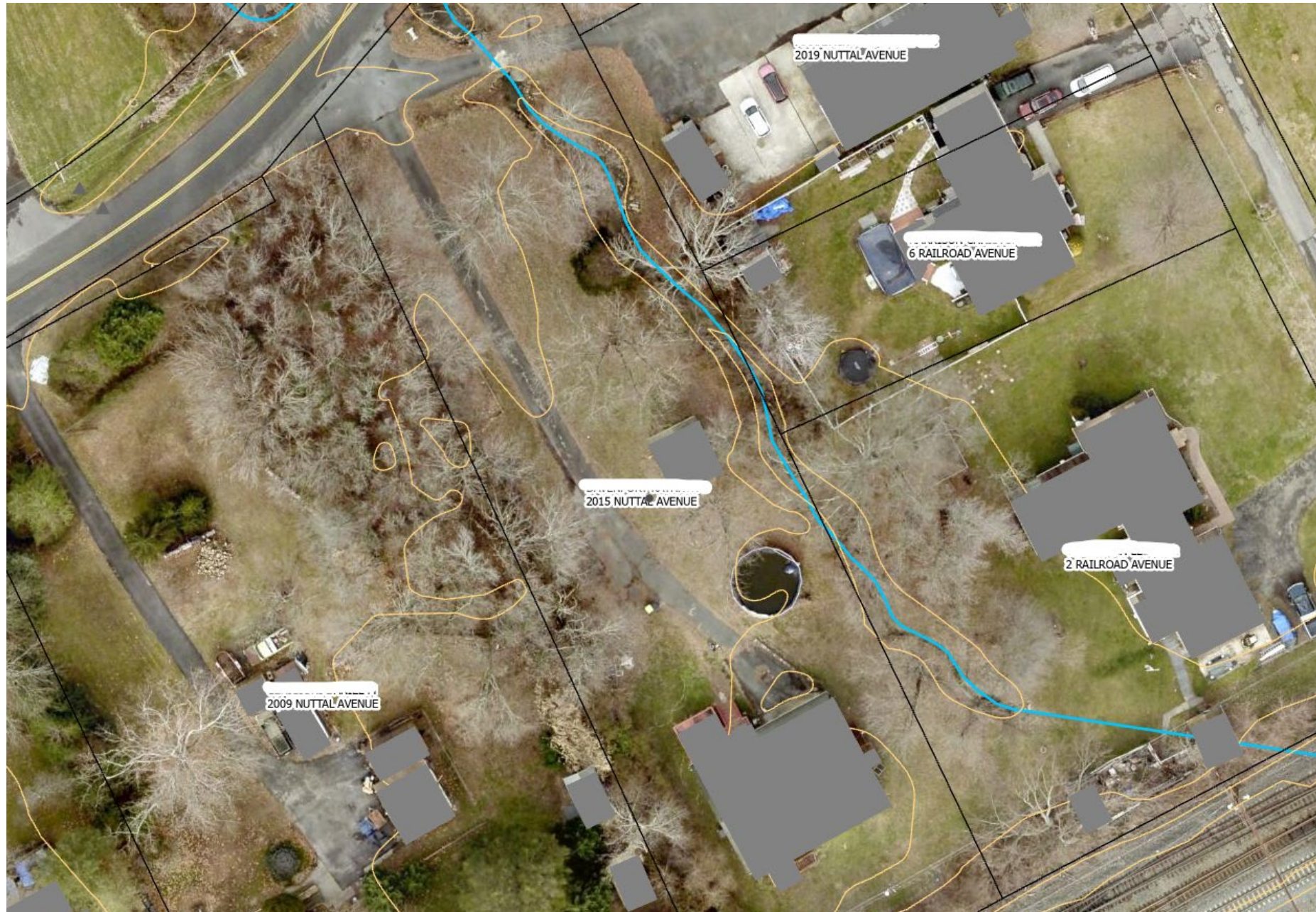
- (1) THROUGH BASEMENT WALLS OR FLOORS
- (2) UP THROUGH SUMP HOLE
- (3) UNDER BASEMENT WALL
- (4) FROM EXTERIOR STEP DRAIN; THROUGH STEPS OR STAIRWELL WALLS

#### FLOODING OCCURS:

- (5) ONLY WHEN ABOVE GROUND OVERFLOW FROM STREAM OR DRAINAGE COURSE REACHES HOUSE
- (6) WHEN WATER ON OUTSIDE OF HOUSE ENTERS HOUSE THROUGH BASEMENT DOOR OR WINDOW
- (7) ABOVE GROUND FLOW RUNS DOWN EXTERIOR STAIRWELL STEPS



# HARFORD CO- NUTTAL AVE





# NUTTAL AVE



# LESSON LEARNED

COMMUNICATE WITH THE BUILDING  
PERMIT PEOPLE



WHO HAS  
RESPONSIBILITY?

IS IT COUNTY'S WATER?

# LEGAL OPINIONS





# BALTIMORE CO - WHITEMARSH

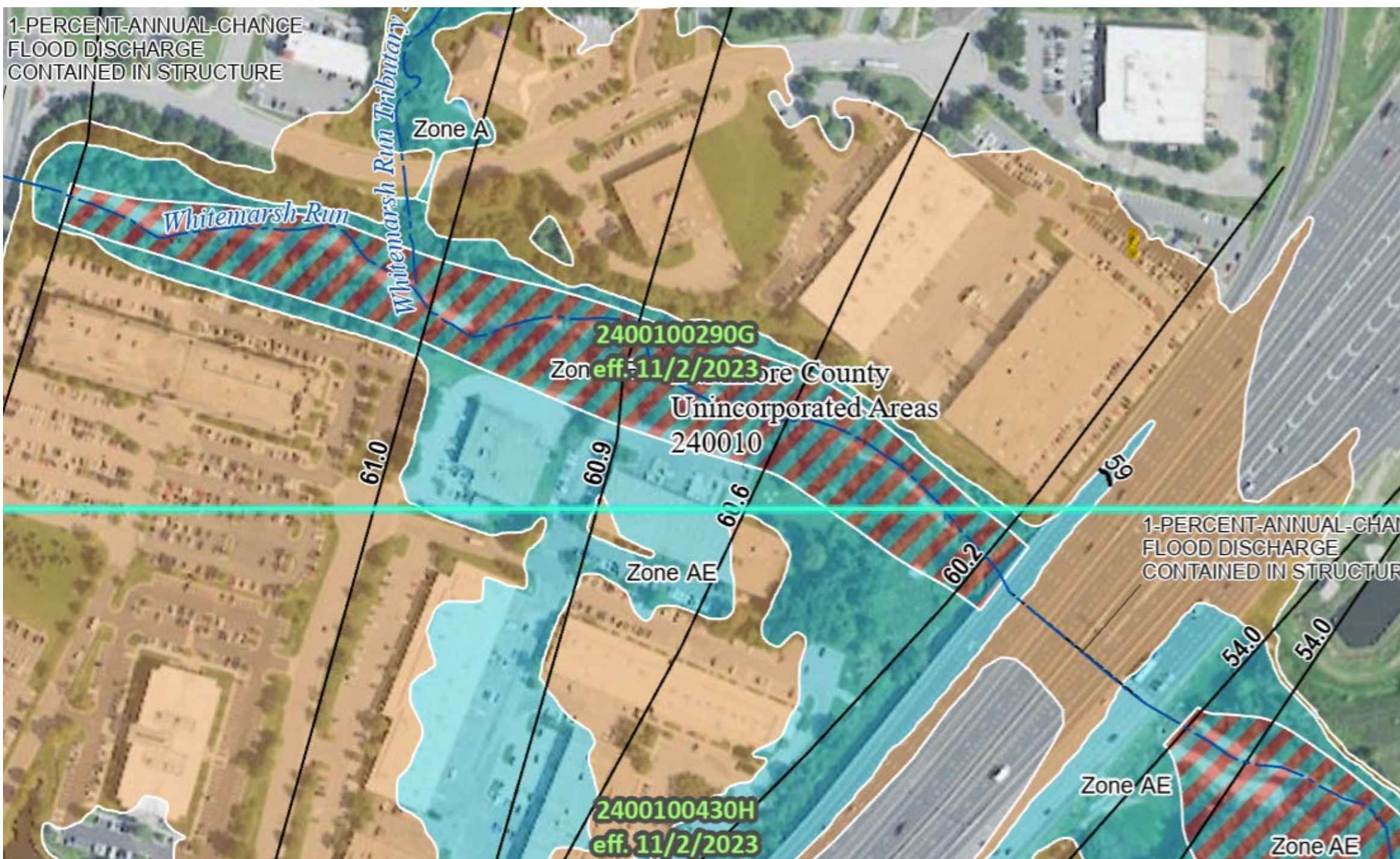


39.375498, -76.467150

Baltimore County  
Unincorporated Areas  
240010



1-PERCENT-ANNUAL-CHANGE  
FLOOD DISCHARGE  
CONTAINED IN STRUCTURE





# LESSON LEARNED

## KEEP GOOD RECORDS

# DRAINAGE - SEGMENTED COUNTY OWNERSHIP

DID THE COUNTY BUILD IT?  
DOES THE COUNTY OWN IT?  
DOES IT SERVE THE PUBLIC?  
WHAT IF IT FAILS?

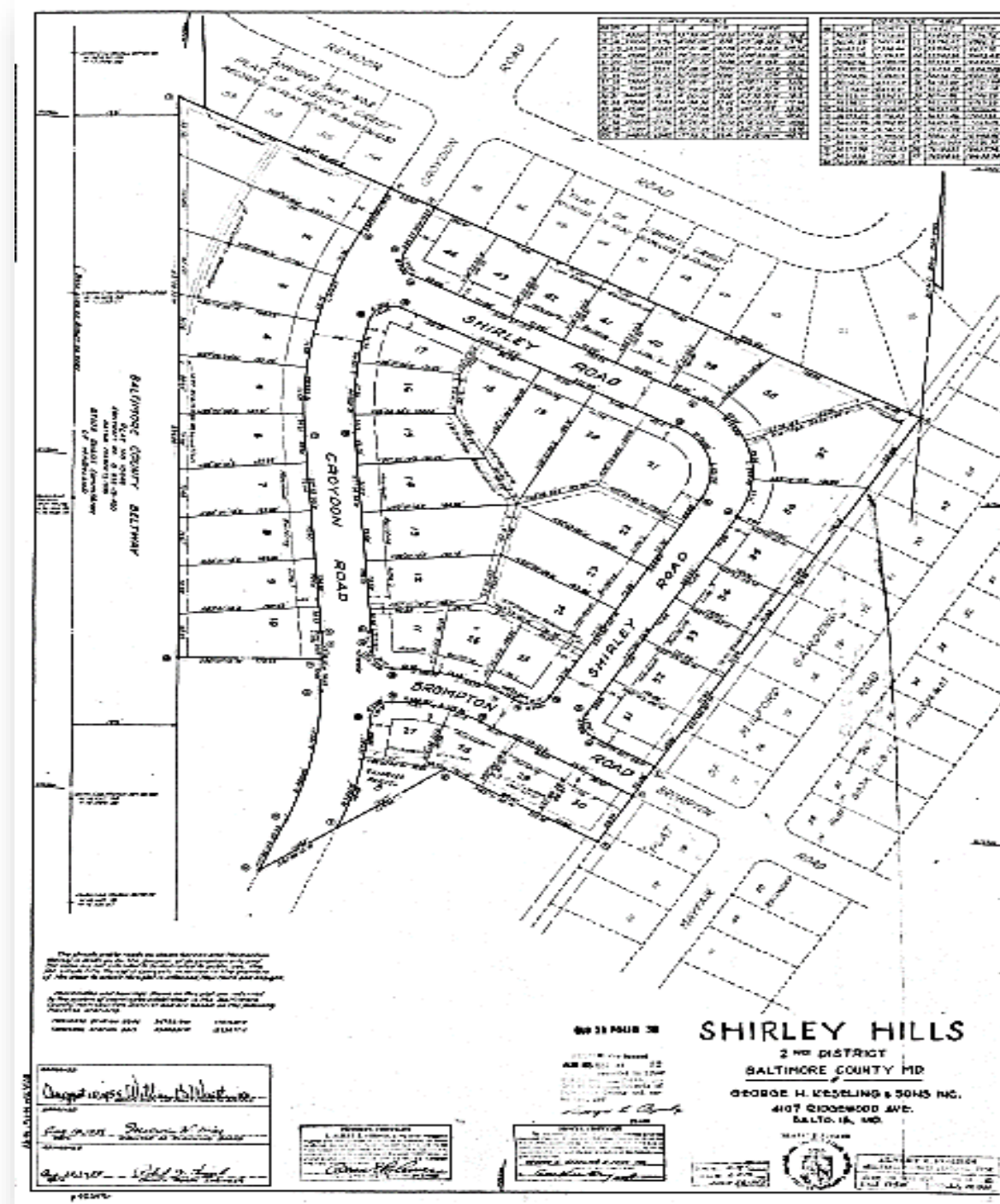




DID THE COUNTY BUILD THIS?

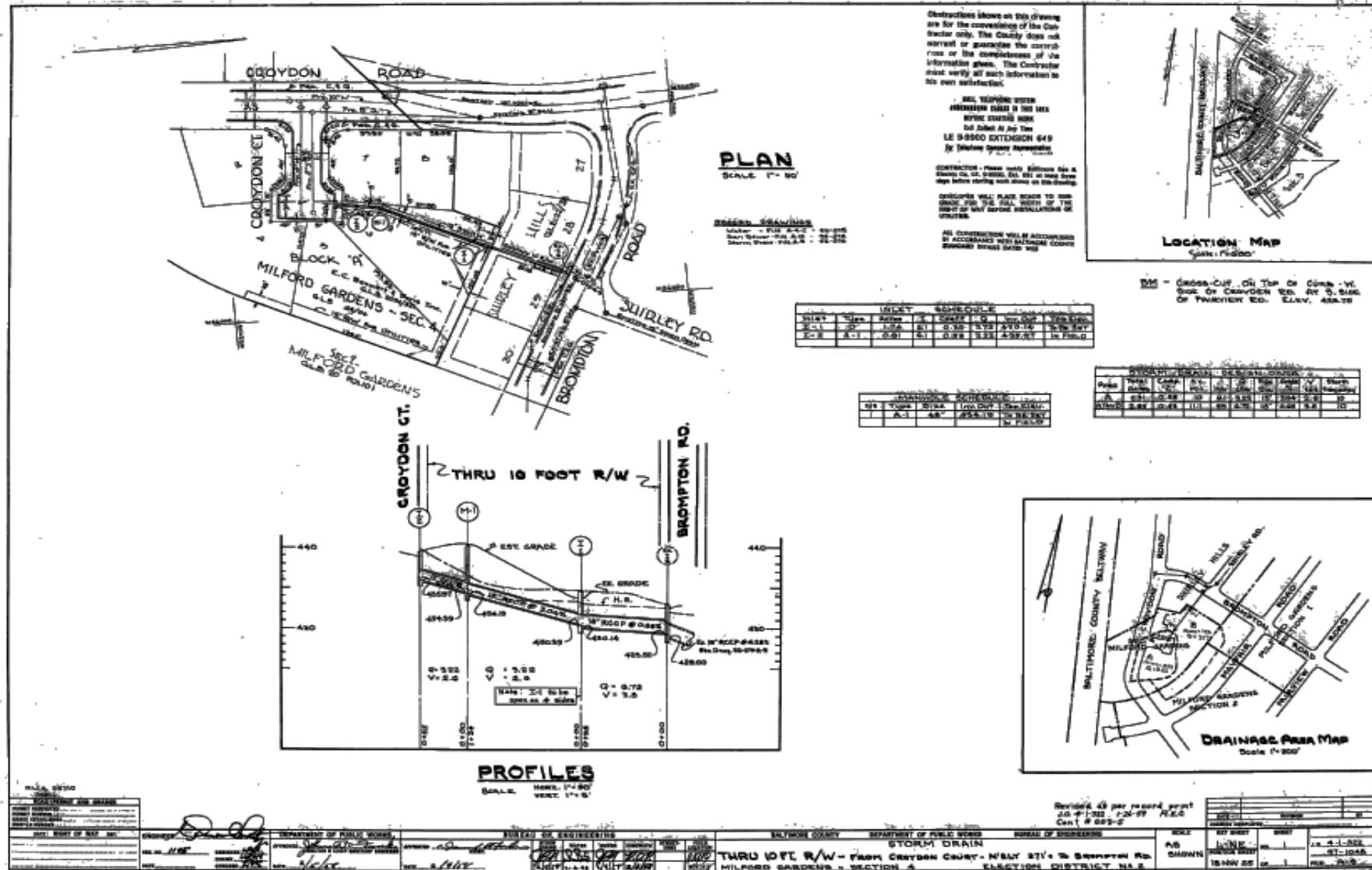
MAYBE, MAYBE NOT

# RIGHT-OF-WAY PLATS, DEEDS, LEGAL REVIEW, INTENTION AT TIME OF DEVELOPMENT





# DRAINAGE PLAN







- Baltimore County Responsibility
- Amtrak's Responsibility
- Private
- State Highway's Responsibility



# DRAINAGE RELATED INQUIRIES

**NUMEROUS-** VIA MAINTENANCE, ENGINEERING,  
ADMINISTRATION, ELECTED OFFICIALS

**SCOPE /DAMAGE** OF ALL TYPES AND SEVERITY



# WATERFRONT DRAINAGE PROBLEM/TIDAL OUTFALL





# BIRDBATHS





# BALTIMORE CO - CLARKS POINT ROAD





# CLARKS POINT ROAD





# CLARKS POINT ROAD





# ICE FROM SUMP PUMP DISCHARGE



# WET BACK YARDS/SPRINGS





# RURAL OPEN SECTION DRAINAGE



TO BERM OR NOT TO BERM



# BLOCKED SWALES IN TOWNHOUSE DEVELOPMENT





# OUTFALL FAILURES





# SINKHOLES

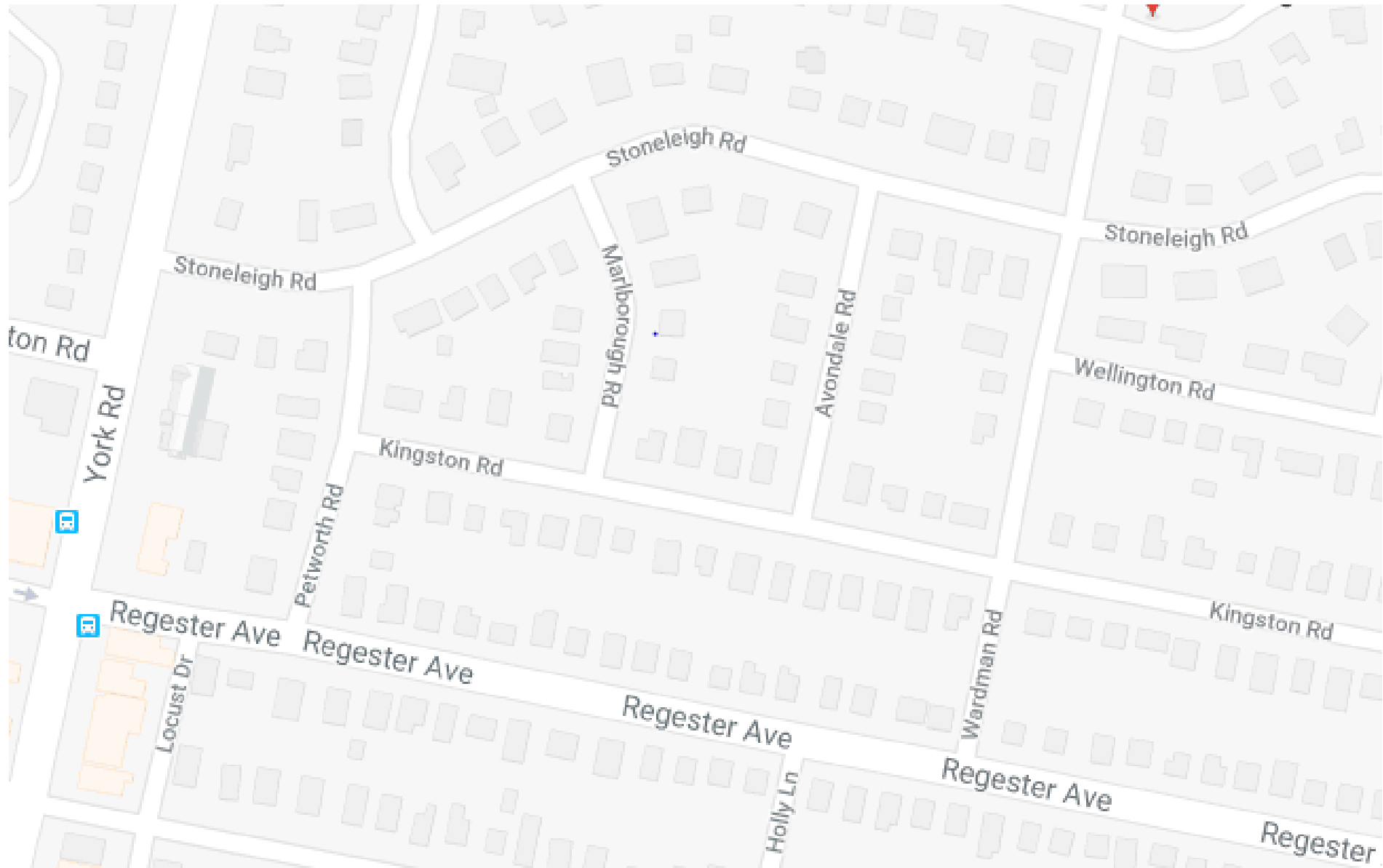


BALTIMORE CO -  
OLD COURT ROAD





# BALTIMORE CO - STONELEIGH



# LESSON LEARNED

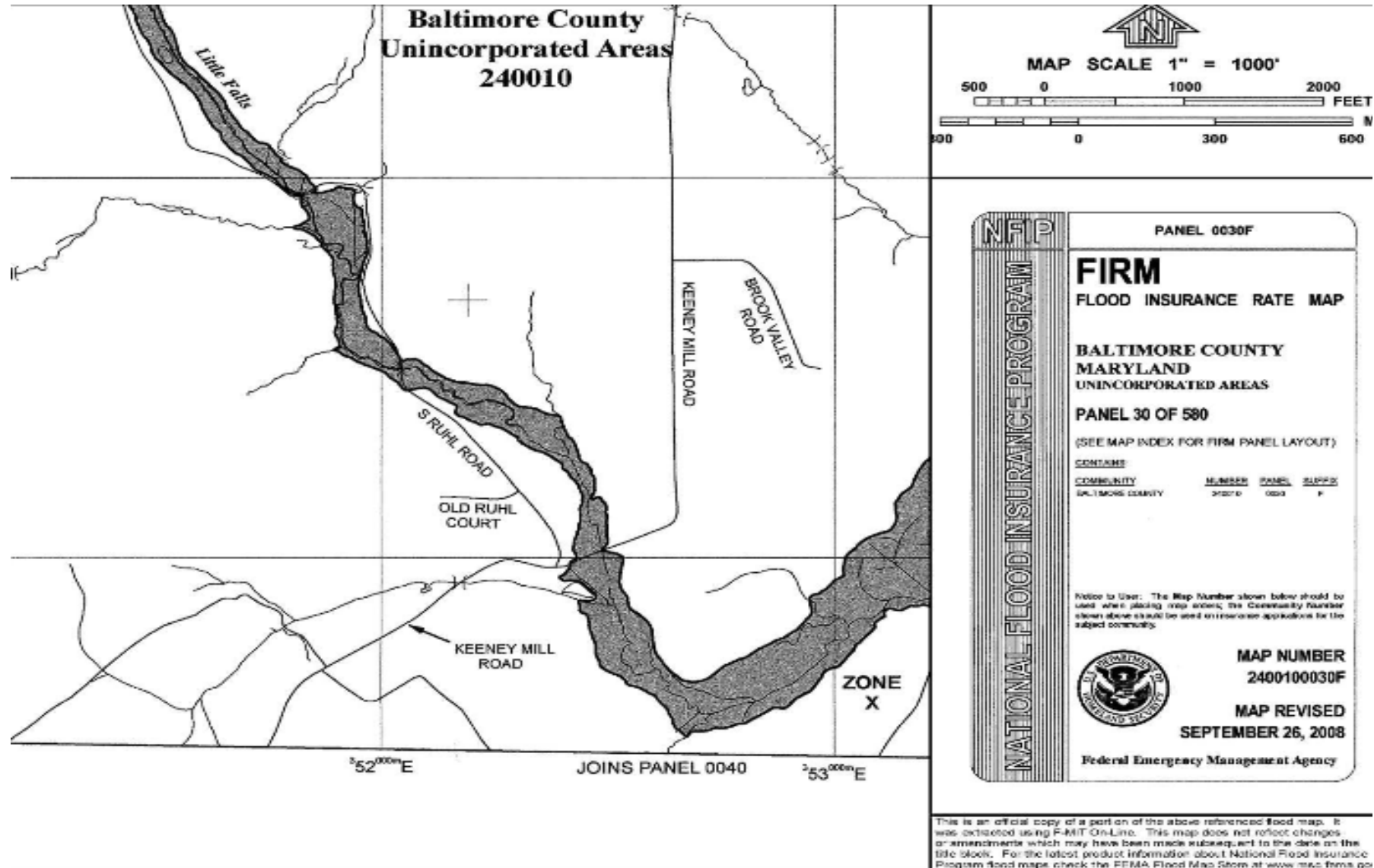
MAP YOUR INFRASTRUCTURE



# FLOODPLAINS

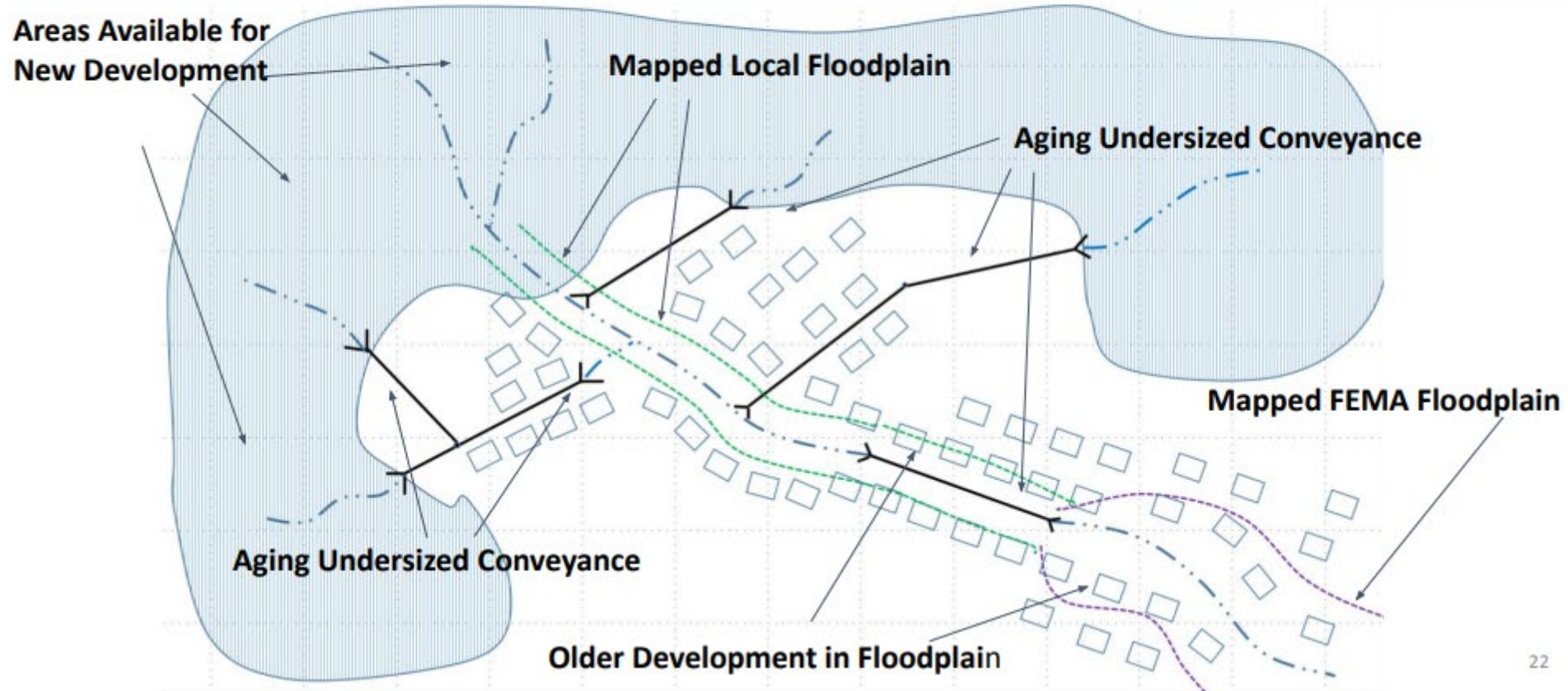


# FEMA FIRM MAP





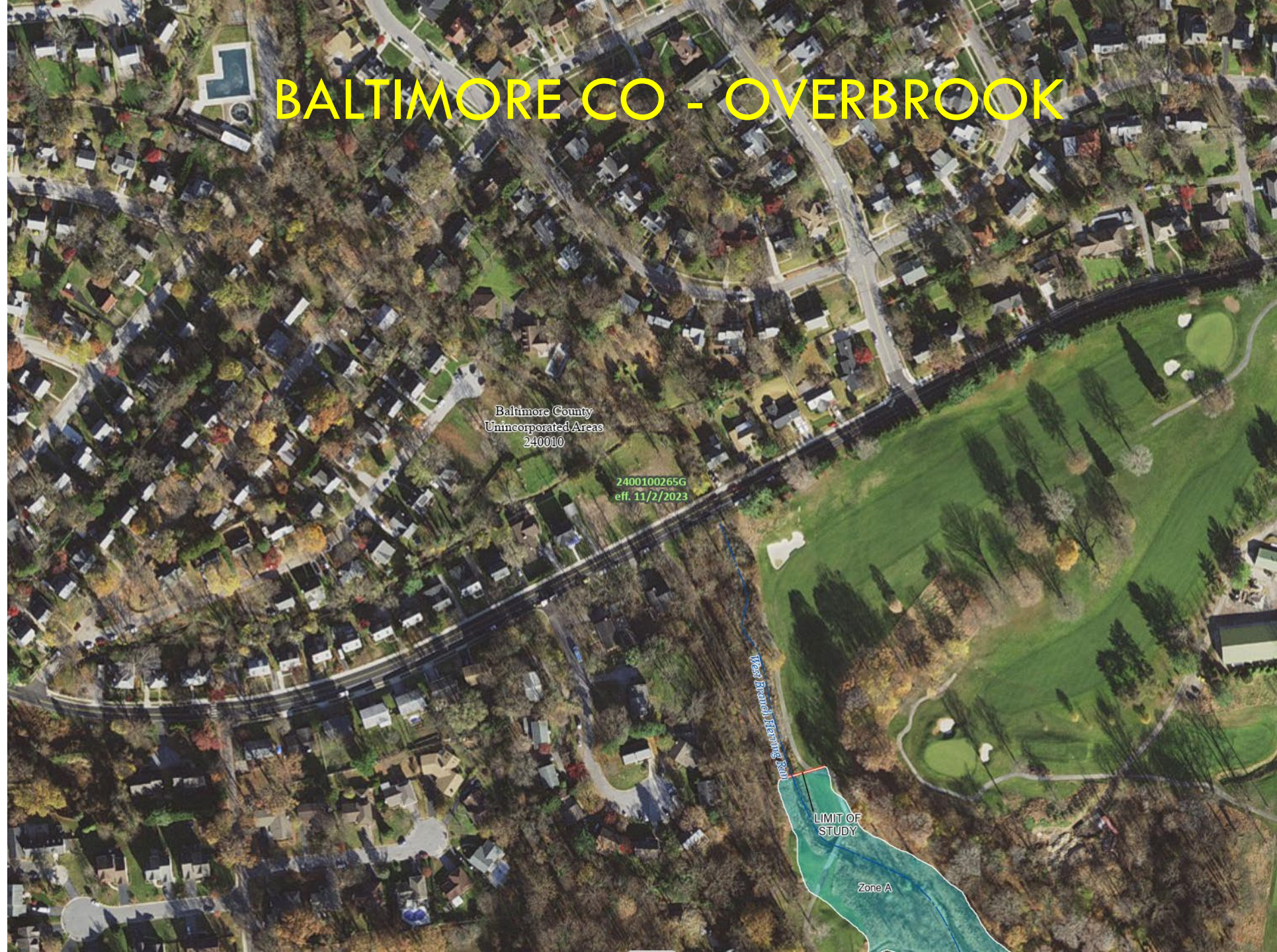
# Regulatory Gaps



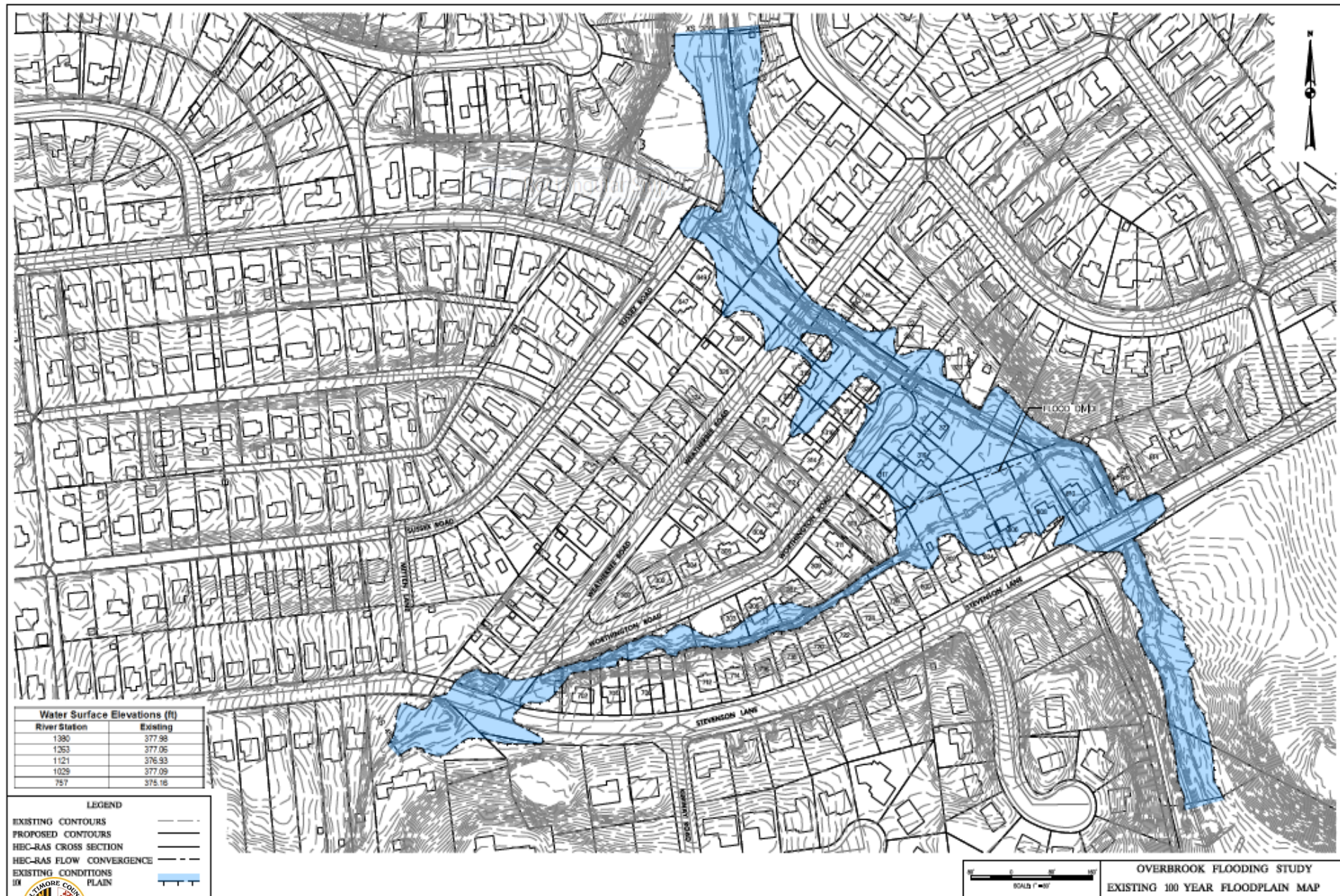
22



# BALTIMORE CO - OVERBROOK







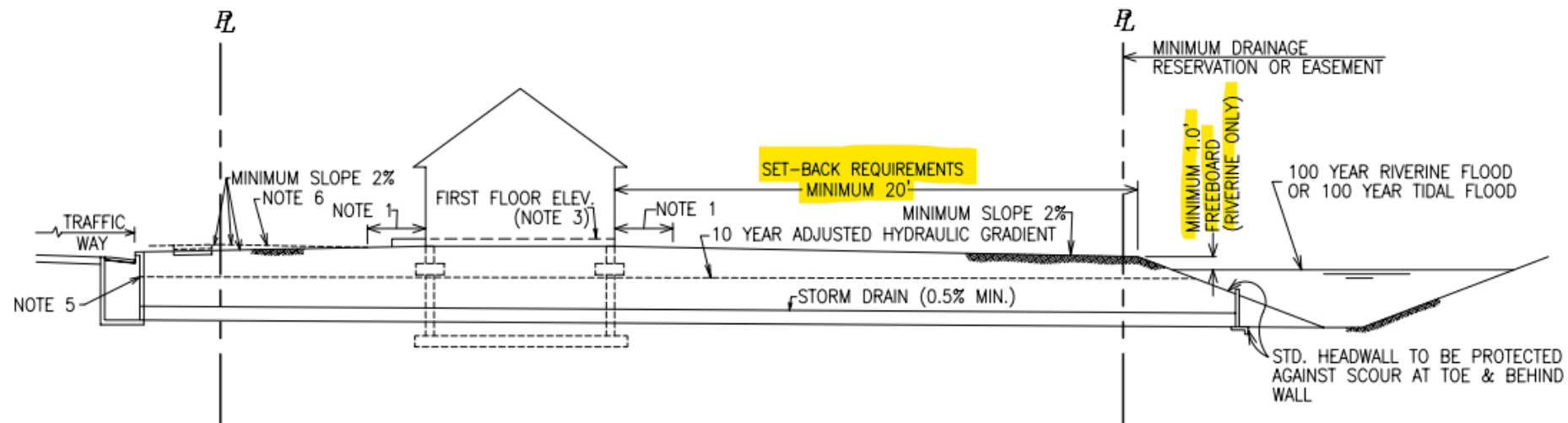






# LESSON LEARNED

- CITIZENS EMOTIONS WILL GET IN THE WAY
- WHAT IS OBVIOUS TO YOU , MAY NOT BE OBVIOUS TO OTHERS
- FLOODPLAIN MANAGEMENT CRITERIA IS IMPORTANT



### NOTES

#### NEW STRUCTURES OR ADDITIONS ADJACENT TO FLOODPLAIN

1. DESIRED SLOPE OF GROUND FOR 10' ADJACENT TO BUILDING IS 5% (ALL SIDES OF BUILDING).
2. THE 20' MINIMUM BUILDING SETBACK SHALL APPLY TO THE FRONT, REAR AND SIDES OF ALL RESIDENTIAL, COMMERCIAL, INDUSTRIAL OR INSTITUTIONAL STRUCTURES.
3. FIRST FLOOR ELEVATION TO BE 2 FEET ABOVE MAXIMUM FLOOD LEVEL OF 100-YEAR STORM (RIVERINE OR TIDAL).
4. BASEMENT CONSTRUCTION BELOW THE MAXIMUM FLOOD SHALL BE IN ACCORDANCE WITH ALL REQUIREMENTS OF THE CURRENT BALTIMORE COUNTY BUILDING CODE.
5. STORM DRAIN SHALL BE SIZED SO THAT 10 YEAR ADJUSTED HYDRAULIC GRADIENT IS 1'-6" MINIMUM BELOW THE ESTABLISHED GRADE (TOP OF CURB).
6. WHEN GROUND SLOPES TOWARD BUILDING, FLOW SHALL BE DIRECTED AROUND SIDES OF BUILDING USING ADEQUATELY SIZED SWALES OR DRAINS.
7. SEE SET-BACK REQUIREMENTS ABOVE. SET-BACK IS MEASURED FROM 100 YEAR FLOODPLAIN PLUS ONE-FOOT VERTICAL FREEBOARD.



DEPARTMENT OF PUBLIC WORKS  
STORM DRAINAGE DESIGN

## TYPICAL SECTION THROUGH LOT SHOWING MINIMUM DRAINAGE REQUIREMENTS

ISSUED: \_\_\_\_\_  
REVISED: FEBRUARY, 1985  
REVISED: MARCH, 2005

PLATE

**DF-1**



# DRAINAGE PROJECT PRIORITIZATION

INFRASTRUCTURE FAILURE

PUBLIC SAFETY

RIVERINE HOUSE FLOODING

SIGNIFICANT PROPERTY DAMAGE

SYSTEM PRESERVATION OR CAPACITY IMPROVEMENT



# SYSTEM PRESERVATION





# HARFORD CO – TOLLGATE ROAD









# HARFORD CO - SEDGEFIELD CT









# DRAINAGE PROJECT PROCESS

DOCUMENT COMPLAINT

INVESTIGATION

ADVICE , MAINTENANCE SOLUTION

STUDY (ROUGH OR DETAILED) / COSTS

CAPITAL PROJECT, IDENTIFY FUNDING (WHAT PROGRAM?)

DESIGN/PERMIT/ACQUIRE LAND RIGHTS

CONSTRUCTION

PROJECT FUNDING



MONEYYY!!!



SINCE RECORD KEEPING STARTED  
IN 1873

WETTEST SEPTEMBER 2011 - 13.32"

WETTEST JUNE 2015 - 13.09"

WETTEST JULY 2018 - 16.67"

WETTEST NOVEMBER 2018 - 7.72"

**WETTEST YEAR 2018 – 71"**

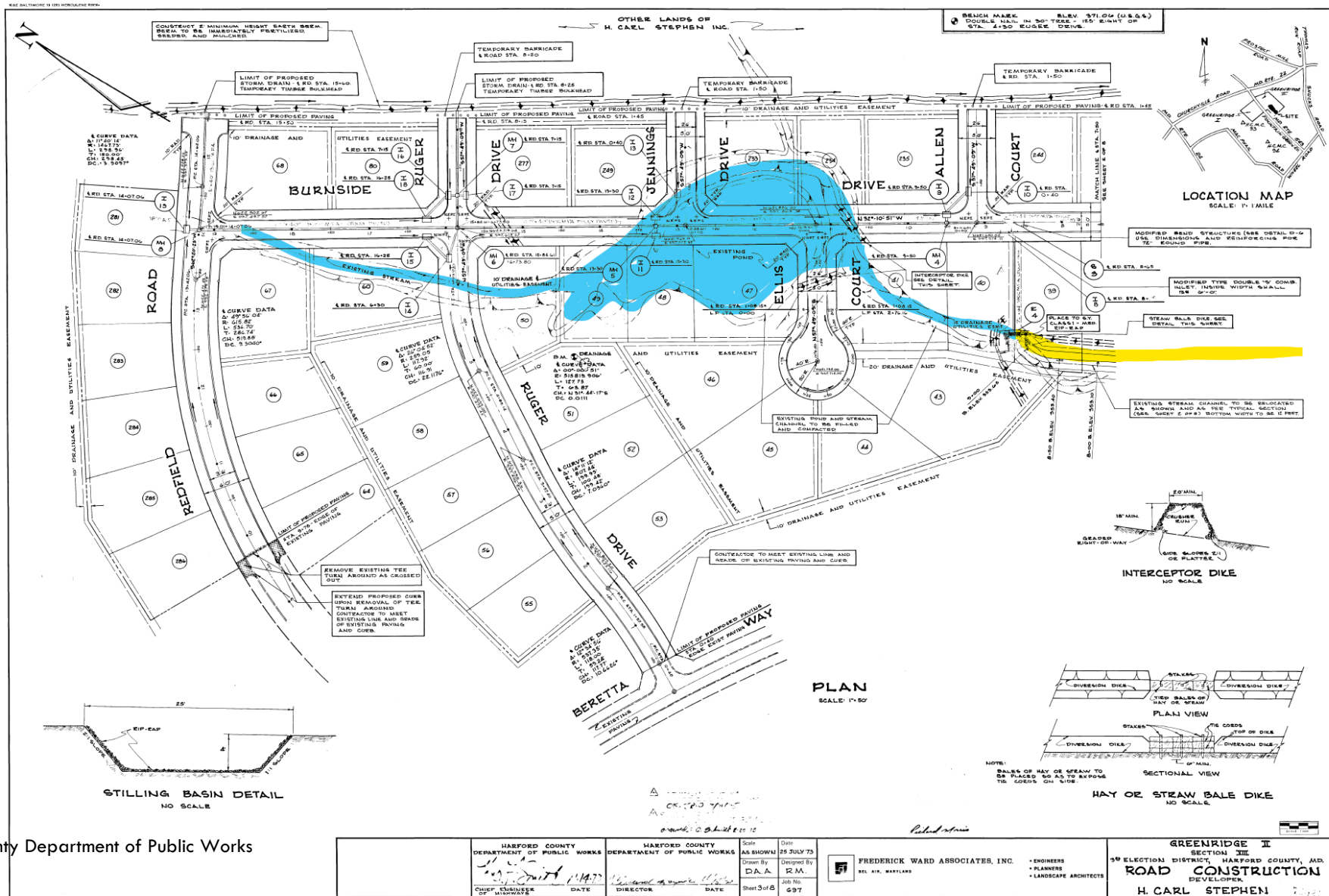
# HARFORD CO/ CHURCHVILLE - JUNE 3, 2021

**PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)<sup>1</sup>**

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	(C
5-min	0.346 (0.308-0.390)	0.414 (0.367-0.467)	0.490 (0.435-0.552)	0.545 (0.483-0.614)	0.614 (0.541-0.691)	0.663 (0.582-0.746)	0.712 (0.623-0.803)	0.757 (0.659-0.855)	0.813 (0.701-0.923)	(C
10-min	0.552 (0.491-0.623)	0.662 (0.588-0.747)	0.785 (0.697-0.884)	0.872 (0.772-0.982)	0.978 (0.862-1.10)	1.06 (0.927-1.19)	1.13 (0.990-1.28)	1.20 (1.04-1.36)	1.29 (1.11-1.46)	
15-min	0.690 (0.614-0.779)	0.832 (0.739-0.939)	0.993 (0.882-1.12)	1.10 (0.977-1.24)	1.24 (1.09-1.40)	1.34 (1.17-1.50)	1.43 (1.25-1.61)	1.51 (1.32-1.71)	1.62 (1.40-1.84)	
30-min	0.946 (0.842-1.07)	1.15 (1.02-1.30)	1.41 (1.25-1.59)	1.60 (1.42-1.80)	1.84 (1.62-2.07)	2.01 (1.77-2.27)	2.19 (1.92-2.47)	2.36 (2.05-2.66)	2.58 (2.22-2.92)	
60-min	1.18 (1.05-1.33)	1.44 (1.28-1.63)	1.81 (1.61-2.04)	2.08 (1.84-2.34)	2.44 (2.16-2.75)	2.73 (2.40-3.07)	3.02 (2.64-3.40)	3.30 (2.88-3.73)	3.70 (3.25-4.2)	
2-hr	1.43 (1.28-1.60)	1.74 (1.55-1.95)	2.20 (1.96-2.46)	2.56 (2.27-2.85)	3.05 (2.70-3.40)	3.46 (3.04-3.85)	3.88 (3.39-4.33)	4.33 (3.75-4.84)	4.96 (4.25-5.7)	
	1.54	1.88	2.38	2.78	3.33	3.78	4.26	4.77	5.50	



# HARFORD CO - BURNSIDE DRIVE





# BURNSIDE DRIVE 2021



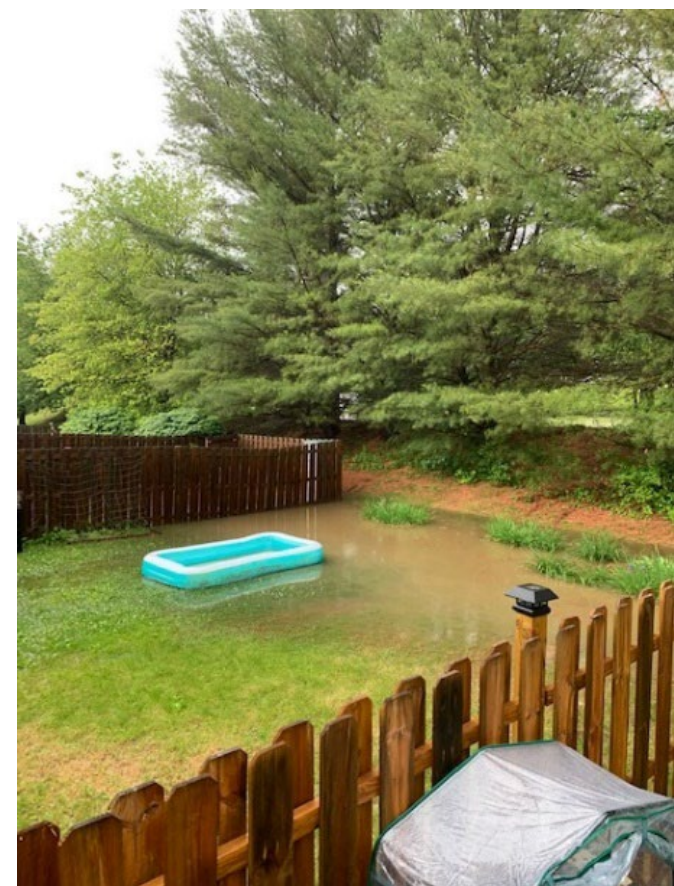


# BURNSIDE DRIVE 2021





# THOMAS RUN ROAD 2021





AND THE RESPONSE IS

....

**WE ARE SORRY**

**500 YEAR STORM**

**BUILT IN 1969**

**WE'LL PROVIDE MAINTENANCE**

**WE ARE SORRY**

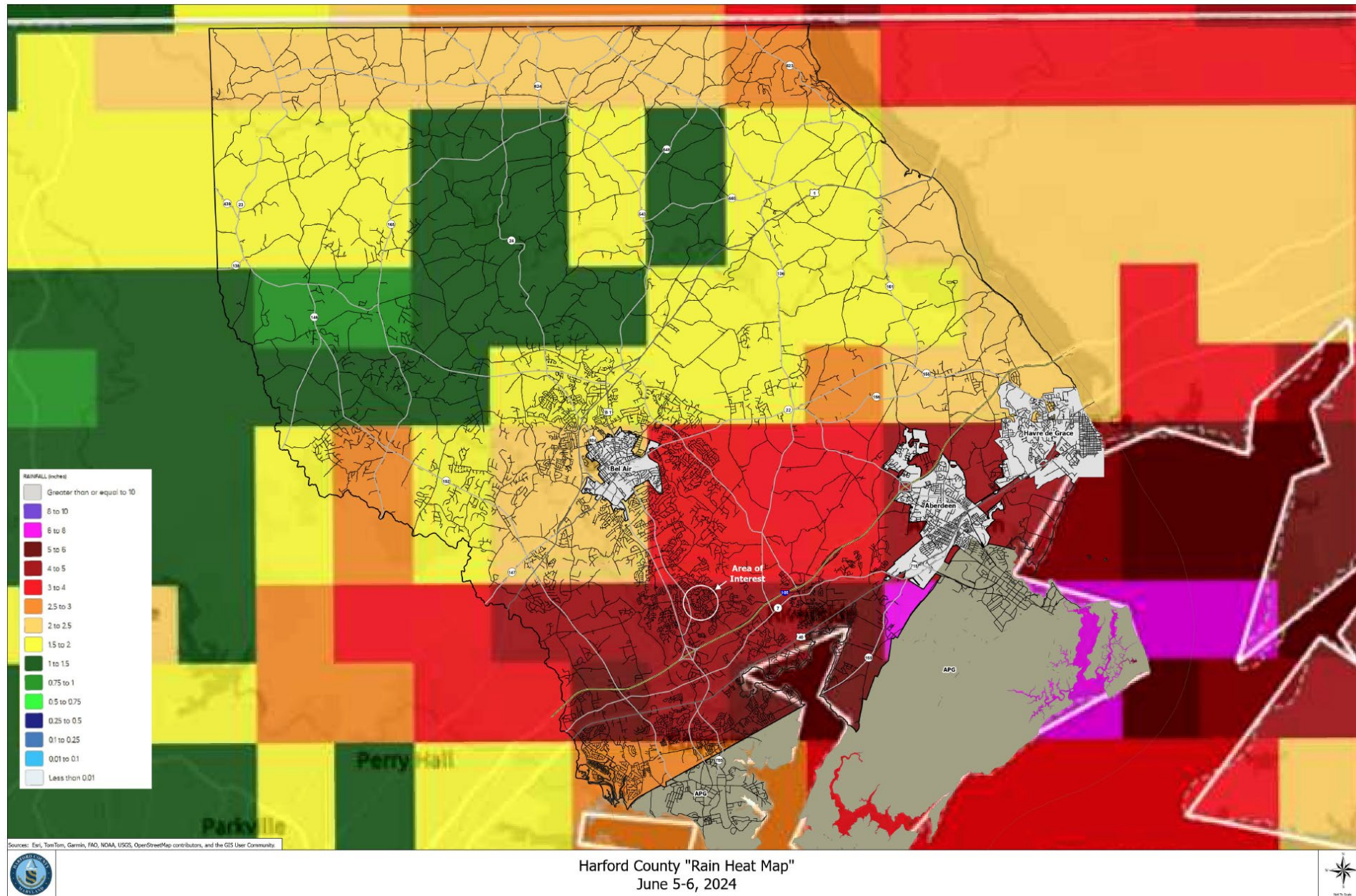


# LESSON LEARNED

CONSISTENT CLEAR MESSAGING TO  
THE PUBLIC

BLAME IT ON THE BUDGET

# JUNE 5 2024 - ABINGDON HARFORD COUNTY



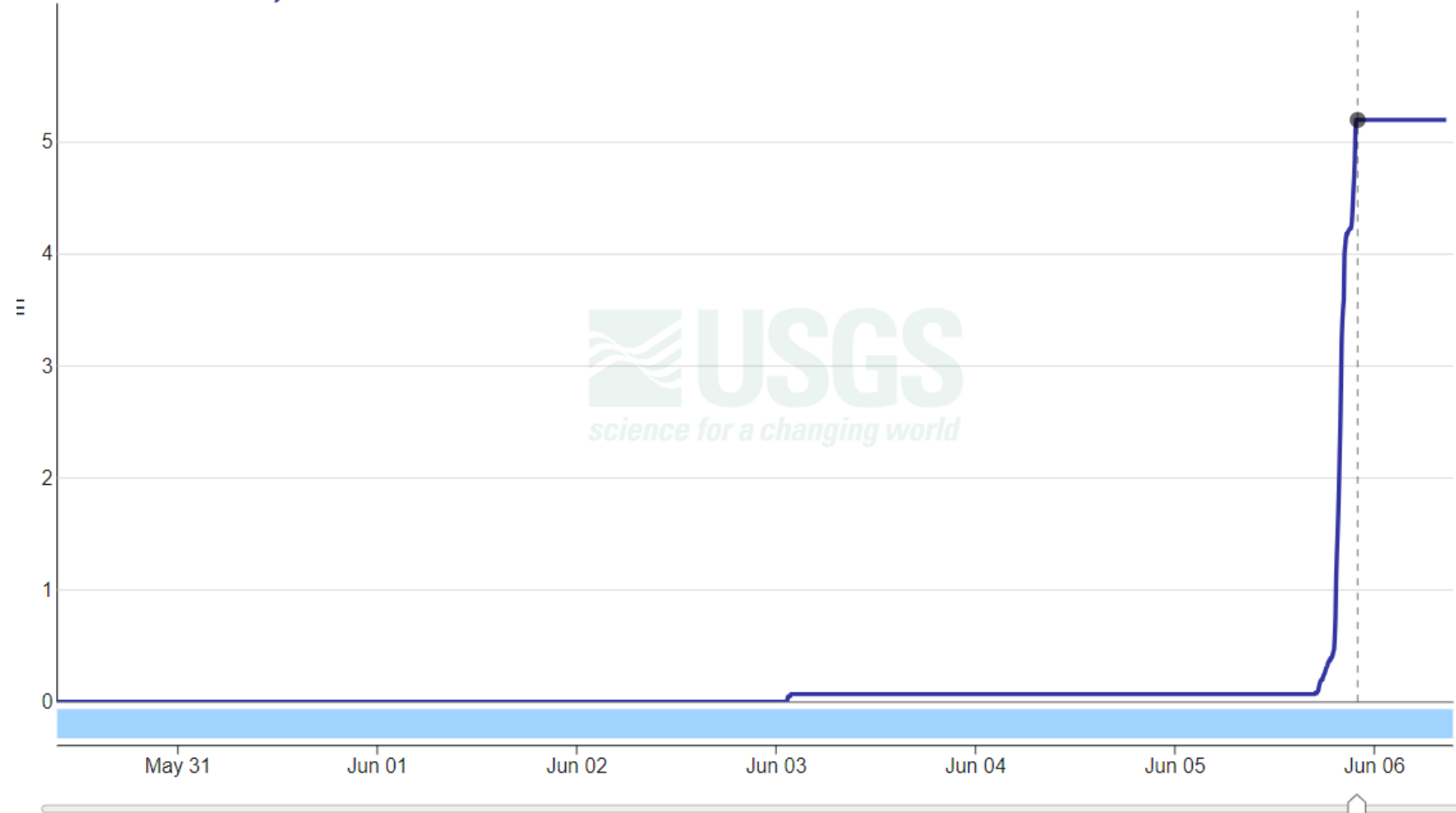


# Rain Gage IN Winters Run Basin Near Bel Air

## MD - 392913076203601

May 30, 2024 - June 6, 2024  
Precipitation, total, inches

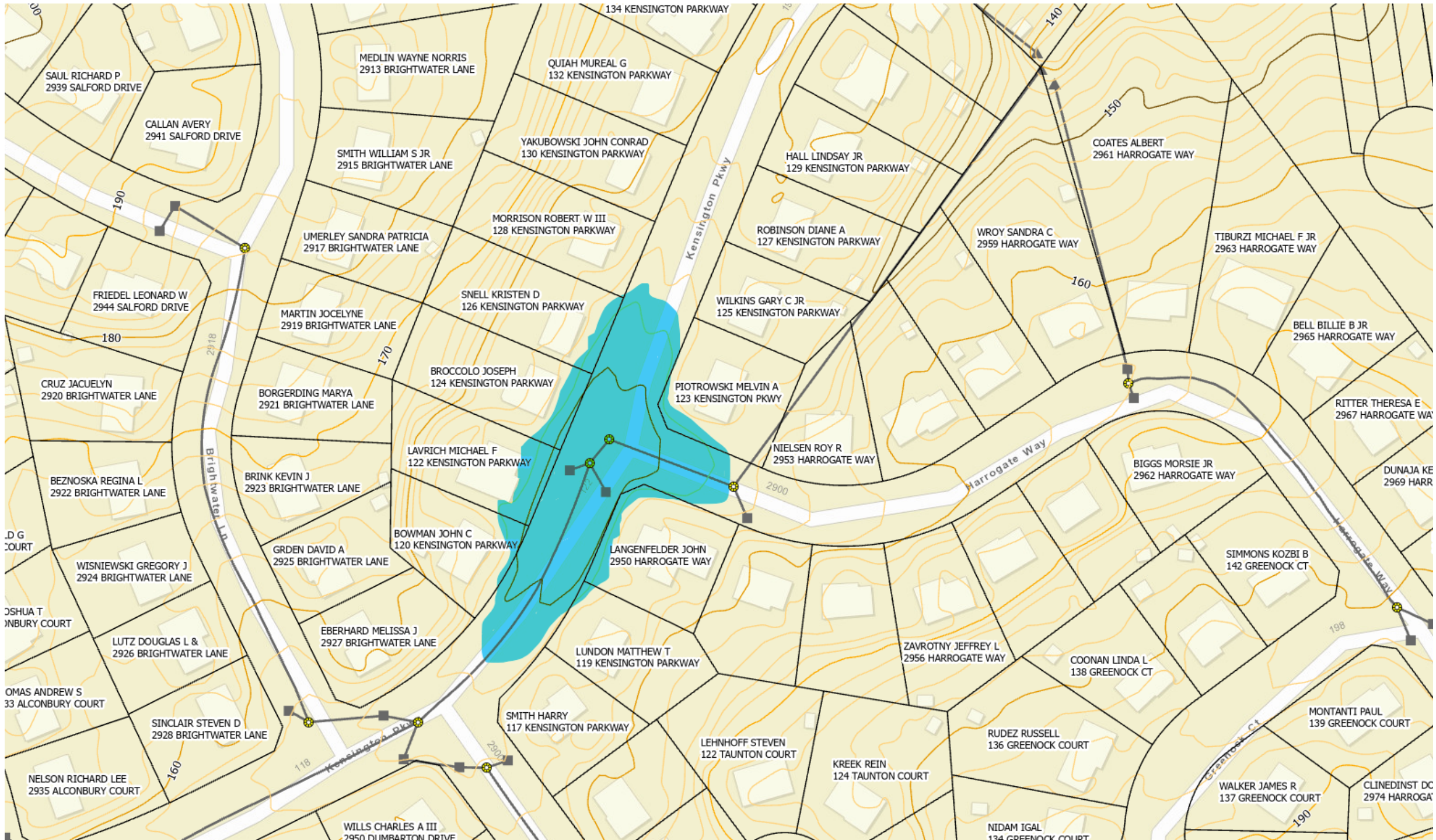
5.20 in - Jun 05, 2024 10:00:00 PM EDT



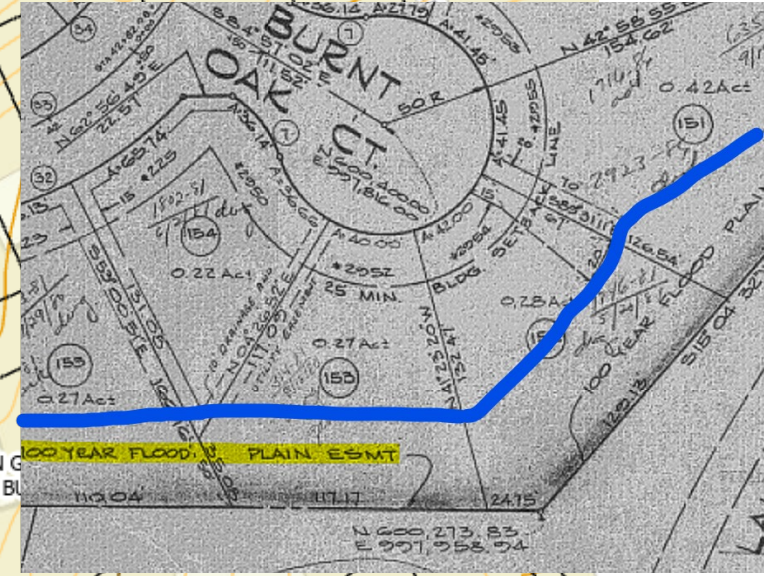
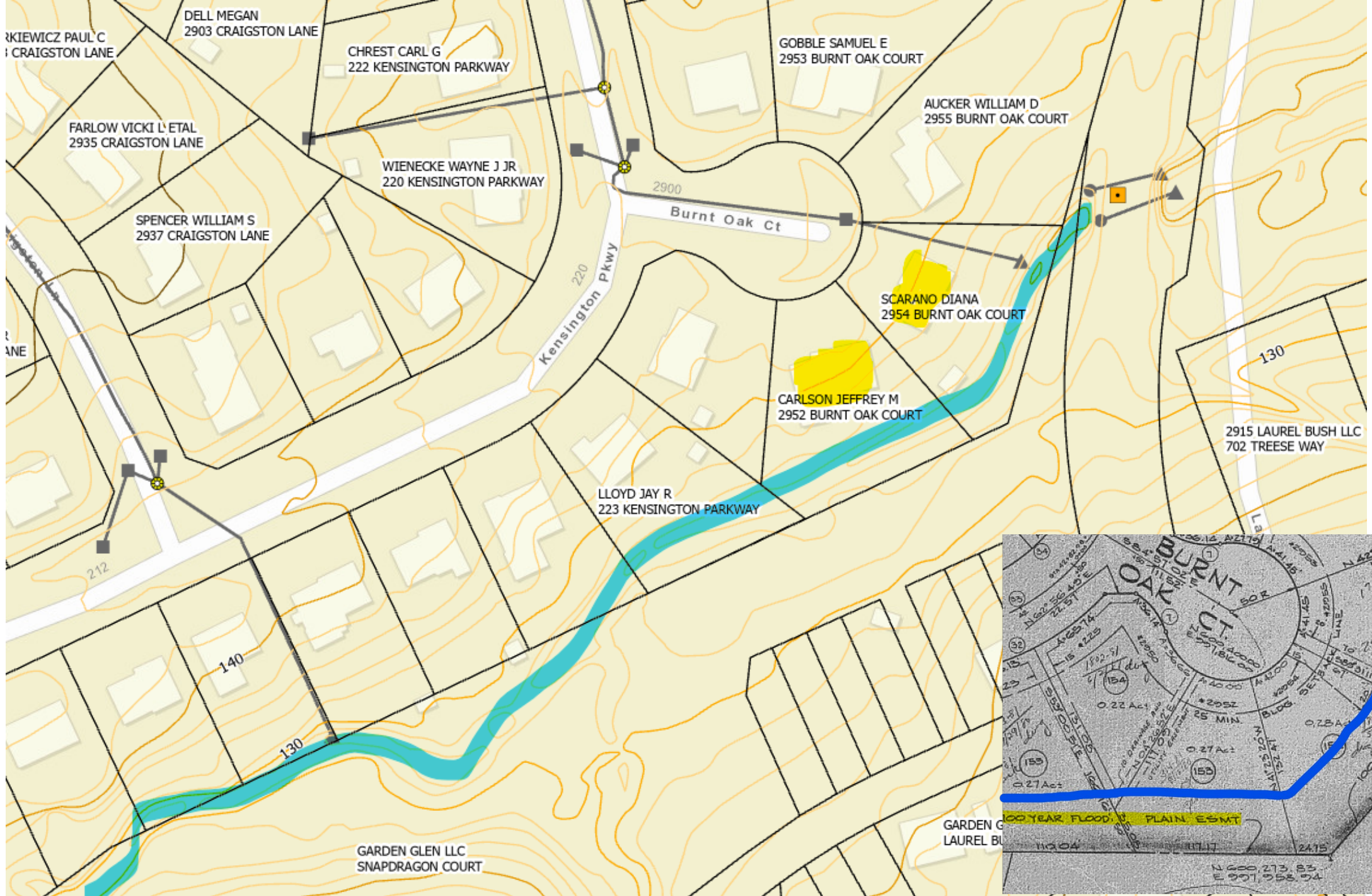
JUNE 5 2024













# WHERE WE NEED TO GO



## **Advancing Stormwater Resiliency in Maryland (A-StoRM) Maryland's Stormwater Management Climate Change Action Plan**

### **FY 2021 Data**

Prepared for:

Bill Ferguson, Senate President  
Maryland General Assembly

Adrienne A. Jones, House Speaker  
Maryland General Assembly

A photograph of a city skyline with various buildings of different heights and colors, including a prominent red brick building and several modern glass skyscrapers.

# Resilience

Resilience is the capacity of individuals, communities and systems to **survive, adapt and grow** in the face of stress and shocks and even transform when conditions require it.

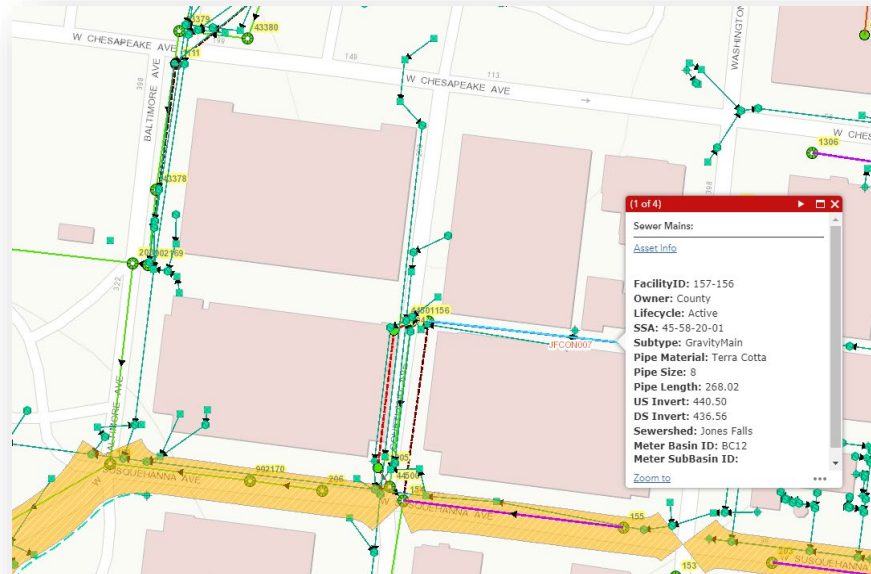


# RESILIENCY- ONGOING

- STRONG FLOODPLAIN REGULATIONS/  
FREEBOARD
- IMPROVED FEMA MAPPING
- HOME PURCHASE
- PLAN FOR SEAL LEVEL RISE - FREEBOARD
- ENGINEERING DECISIONS
  - IDENTIFICATION OF CRITICAL FACILITIES

# UTILITY ASSET MANAGEMENT

*Monitoring and maintaining system components to achieve the greatest return while providing the best possible service to our customers.*



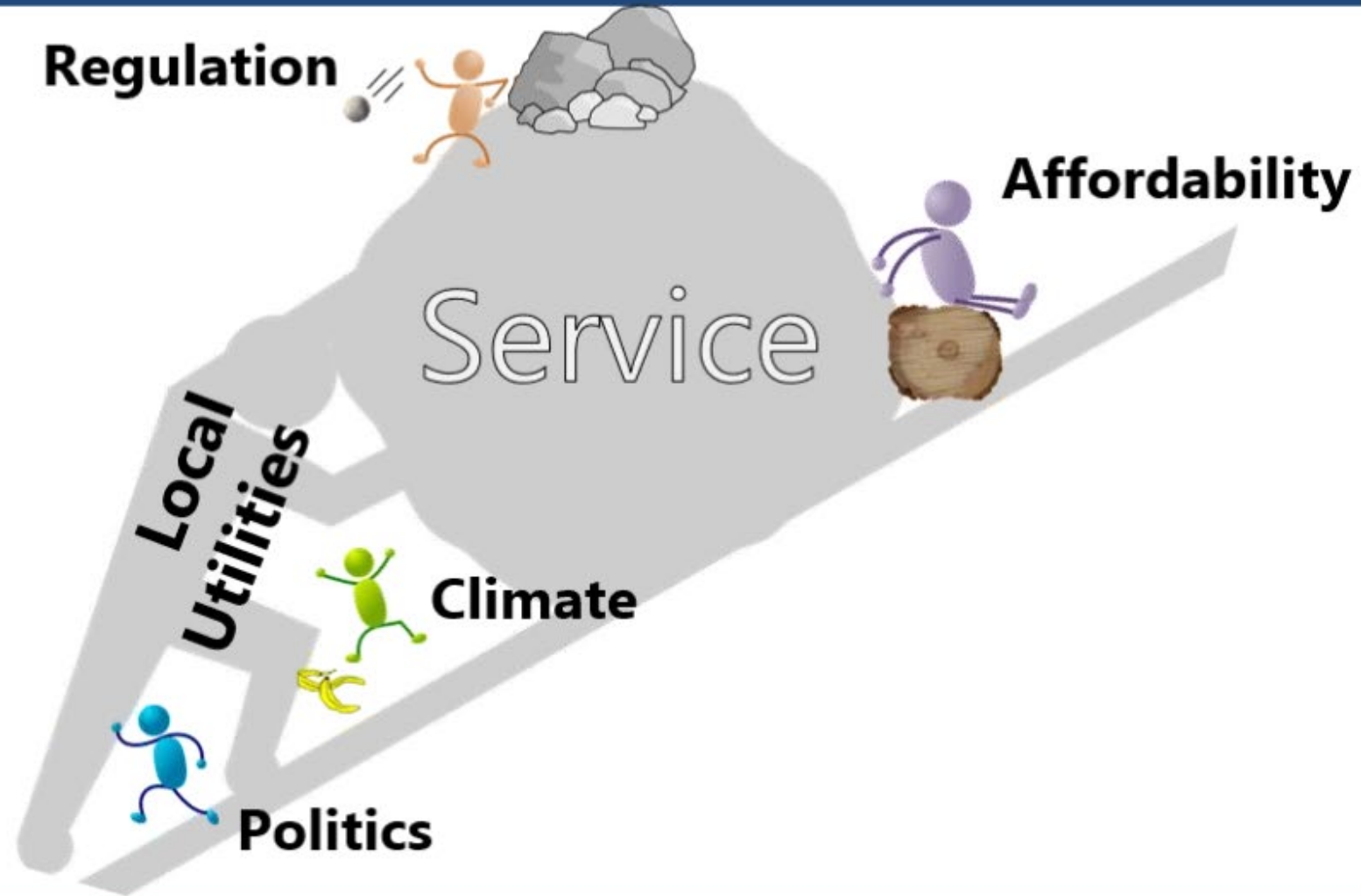
Likelihood	5	Medium	High	High	Extreme	Extreme
	4	Medium	Medium	High	High	Extreme
	3	Low	Medium	Medium	High	High
	2	Low	Low	Medium	Medium	High
	1	Low	Low	Low	Medium	Medium
		1	2	3	4	5
Consequence						



# GREEN INFRASTRUCTURE



# Challenges





# LESSONS LEARNED

- FOCUS ON **EDUCATION** AND WHAT HOMEOWNERS CAN DO TO PROTECT THEMSELVES
- THINK PROGRAMMATICALLY IN TERMS OF **FUNDING**
- DISCUSS EXPECTED LEVELS OF SERVICE/ RISKS OF FLOODING
- LOOK AT FLOODPLAIN MANAGEMENT PROGRAM / **FREEBOARD**
- MAP YOUR SYSTEMS

# LESSONS LEARNED

- MINIMIZE ISSUES AT BUILDING PERMIT STAGE
- **HONESTLY** DISCUSS EXISTING RISKS, COSTS AND BENEFITS OF INDIVIDUAL PROJECTS
- DEVELOP DRAINAGE MASTERPLANS WITH PUBLIC INPUT
- EXPLORE GRANT OPPORTUNITIES
- SPEND TIME ON COMMUNICATION STRATEGIES



# **REMEMBER**

- YOU WORK WITHIN AN ORGANIZATION, EVERYONE HAS A BOSS
- WHAT IS OBVIOUS TO YOU , MAY NOT BE OBVIOUS TO OTHERS
- CONTINUE TO DISCUSS DRAINAGE ISSUES IN PUBLIC FORUMS
- YOU WON'T AGREE WITH SOME DECISIONS

QUESTIONS?

Steve Walsh

Harford County DPW

**410-638-3509**

**sawalsh@harfordcounty.gov**