

**Little Bear Brook  
Flood Hazard Assessment  
and  
Redevelopment Area Regional  
Stormwater Management Analysis**

**Progress Meeting**

**June 30, 2014**

Princeton Hydro, LLC and SWM Consulting, LLC

# Project Team

- **West Windsor Township**
  - M. Patricia Ward, Community Development Director
  - Francis Guzik, PE – Township Engineer
  - Township Departments
- **Princeton Hydro, LLC**
  - Geoffrey M. Goll, PE – Principal
  - Mary Paist-Goldman, PE – Project Manager
- **Storm Water Management Consulting, LLC**
  - Joseph J. Skupien, PE, PP – Principal

# Project Goals & Scope of Work

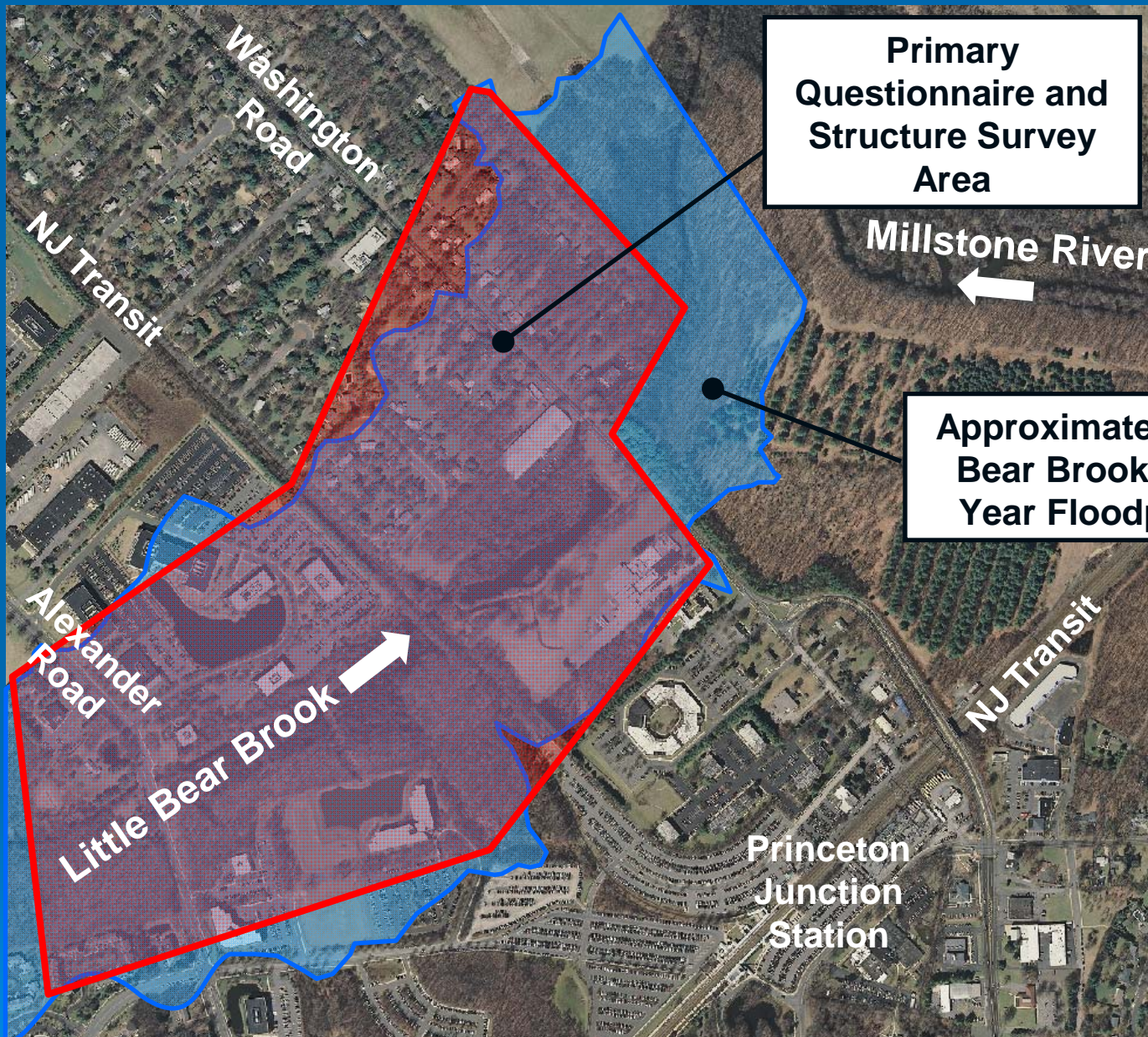
- Goal 1: Little Bear Brook Flood Hazard Assessment
  - Public Meetings and Outreach
  - Compile and Review Existing Data
  - Flood Hazard Assessment
  - Analysis of Flood Mitigation Strategies
  - Action Plan
  - Final Report and Presentation

# Project Goals & Scope of Work

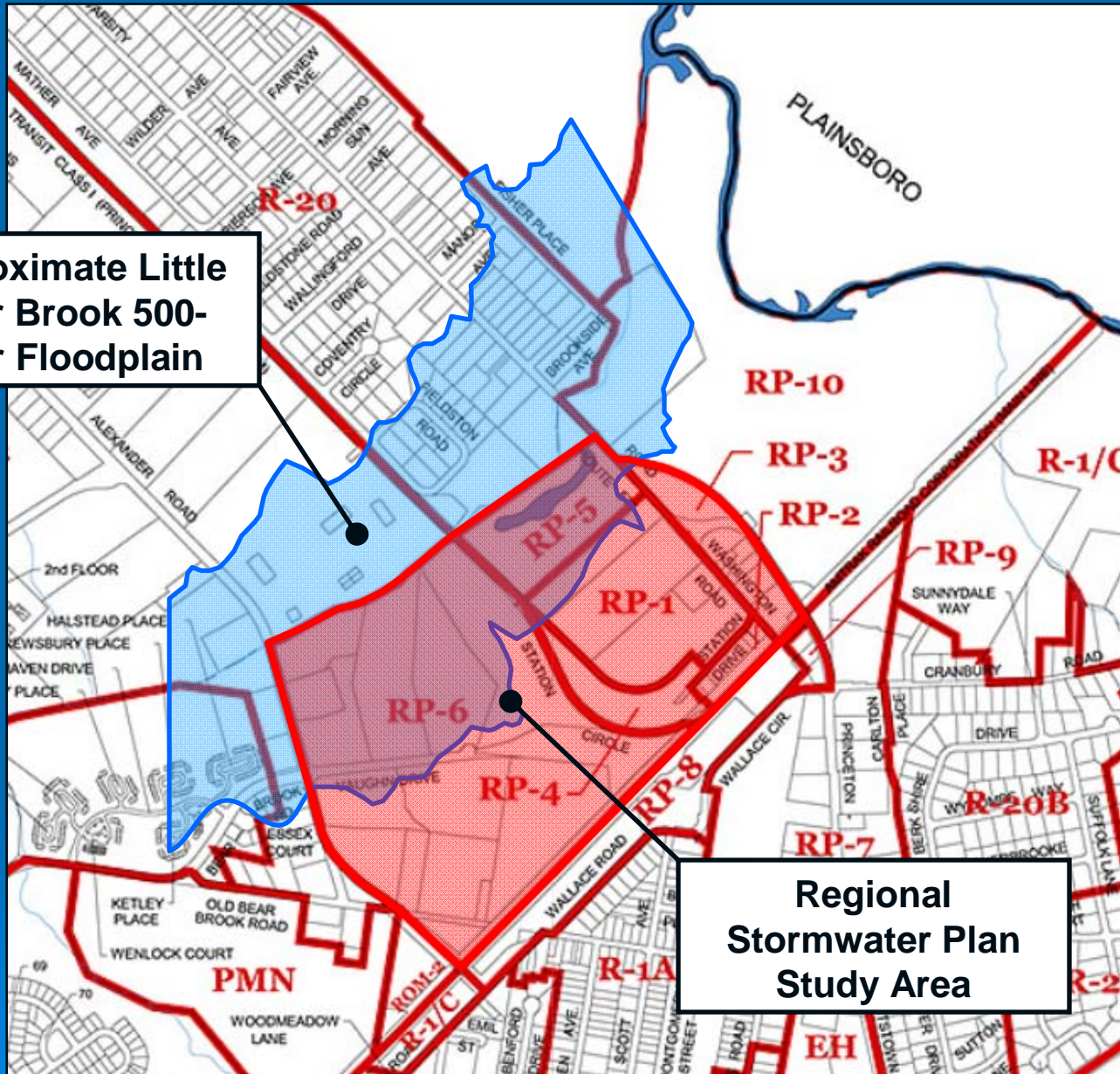
- Goal 2: Redevelopment Area Regional Stormwater Management Plan
  - Public Meetings
  - Aerial Topographic Mapping
  - Maps and Overlays
  - Regional Stormwater Analysis
  - Conceptual Basin Locations and Designs
  - Potential Little Bear Brook Flood Relief
  - Final Report and Presentation

# Little Bear Brook Flood Hazard Assessment Update

Princeton Hydro and SWM Consulting



**Approximate Little Bear Brook 500-Year Floodplain**



**Regional  
Stormwater Plan  
Study Area**

# **LBB - Completed Project Steps**

- **Attended Township Council Meeting**
- **Compiled and Reviewed Existing Data**
- **Prepared Topographic Maps**
- **Prepared and Distributed 82 Little Bear Brook Flood Questionnaire**
- **Analyzed 58 Questionnaire Responses**
- **Performed and Analyzed 40 Little Bear Brook Structure Elevation Surveys**



# LBB - Completed Project Steps

- **Performed Flood Hazard Assessment**
- **Began Analysis of Flood Mitigation Strategies**

# Some Flood Fundamentals

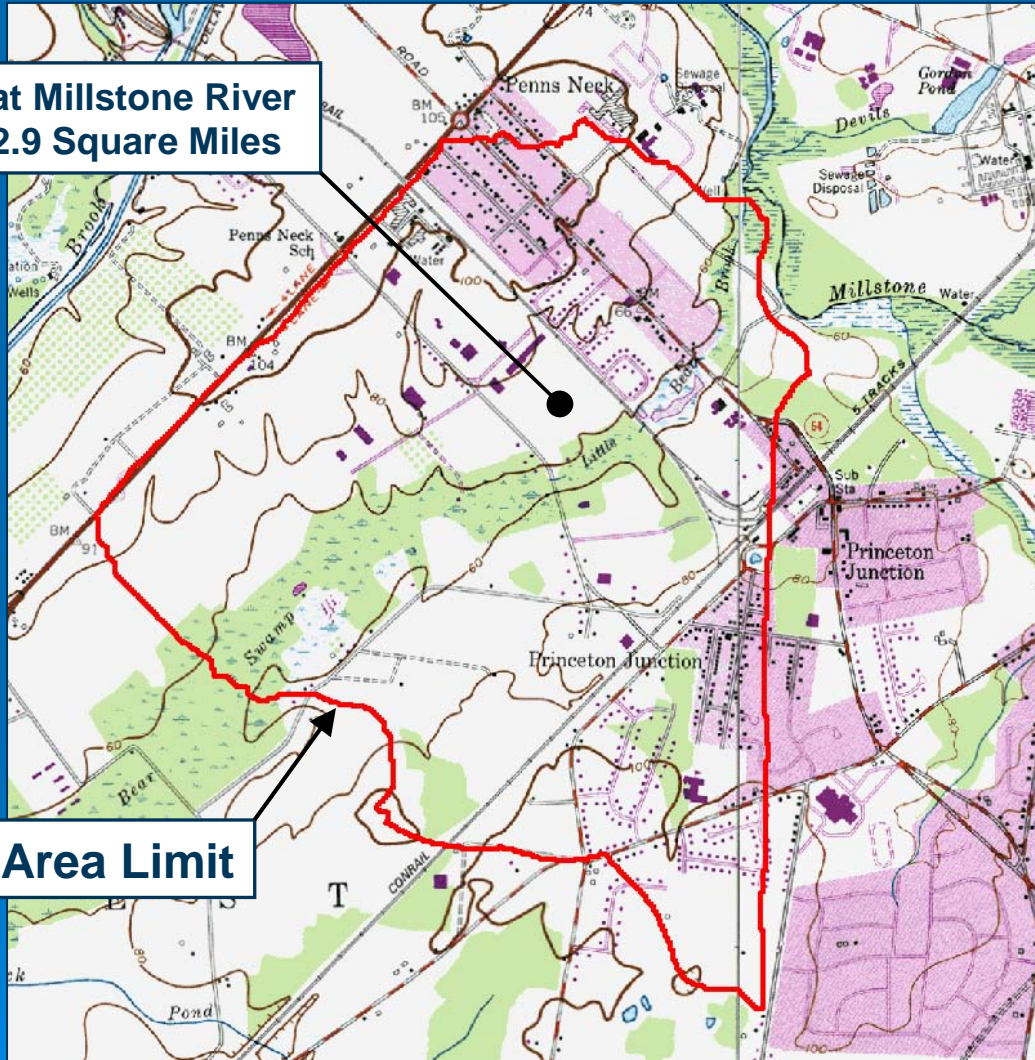
# Albert Einstein

**“For every complex problem, there exists an answer that is simple, concise, and totally wrong.”**

**“The most incomprehensible thing about the universe is that it is comprehensible.**

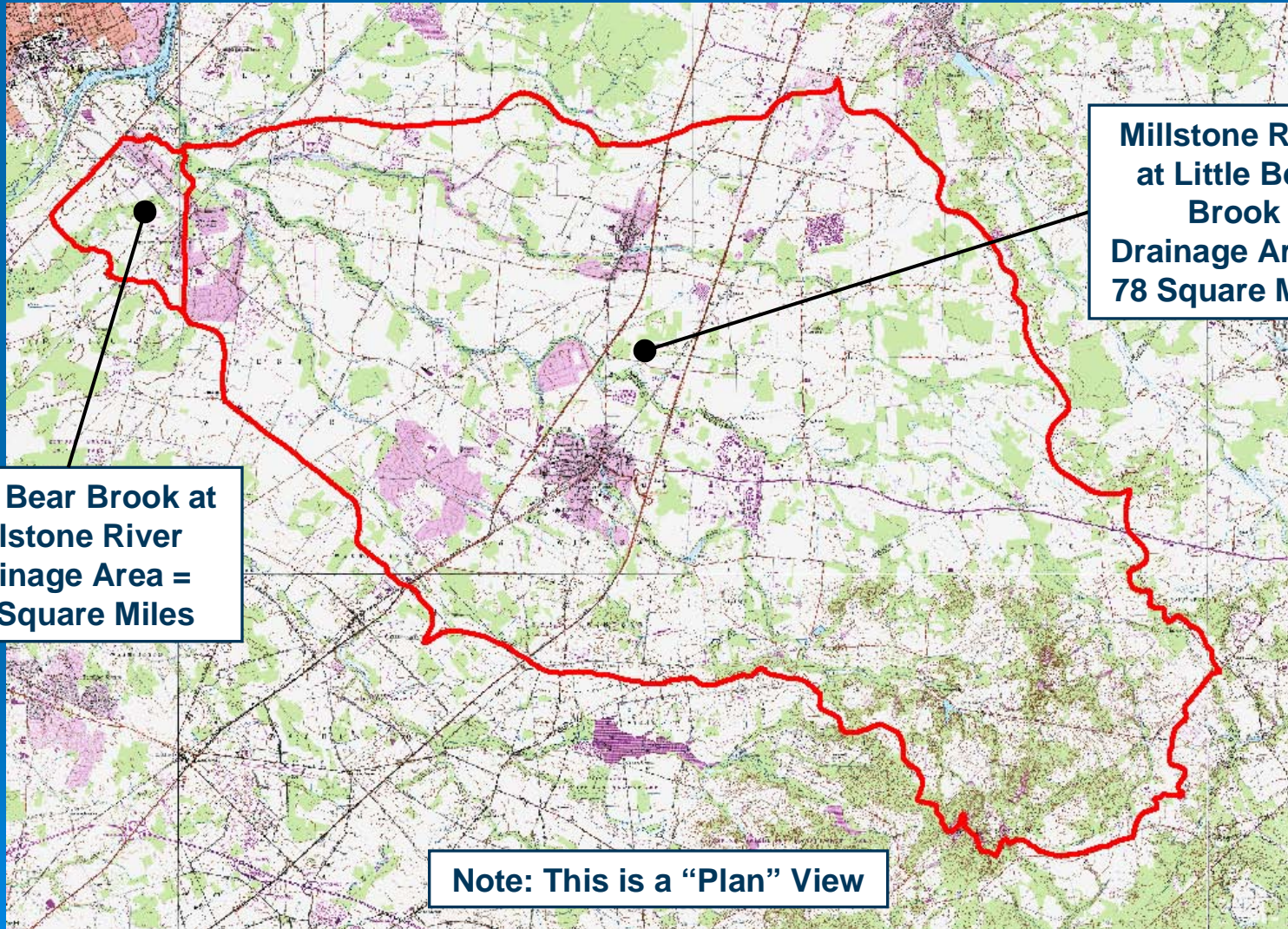
# Watershed or Drainage Area

Little Bear Brook at Millstone River  
Drainage Area = 2.9 Square Miles



Drainage Area Limit

# Watershed or Drainage Area

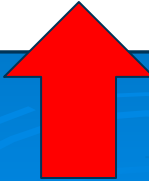



**Little Bear Brook at  
Millstone River  
Drainage Area =  
2.9 Square Miles**

**Millstone River at Little Bear  
Brook  
Drainage Area =  
78 Square Miles**

**Note: This is a "Plan" View**

# USGS Peak Discharge Equations



<b>Q2</b>	<b>=</b>	<b>25.6A<sup>0.89</sup> S<sup>0.25</sup> S<sub>L</sub><sup>-0.56</sup> I<sup>0.25</sup></b>
<b>Q5</b>	<b>=</b>	<b>39.7A<sup>0.88</sup> S<sup>0.26</sup> S<sub>L</sub><sup>-0.54</sup> I<sup>0.22</sup></b>
<b>Q10</b>	<b>=</b>	<b>54.0A<sup>0.88</sup> S<sup>0.27</sup> S<sub>L</sub><sup>-0.53</sup> I<sup>0.20</sup></b>
<b>Q25</b>	<b>=</b>	<b>78.2A<sup>0.86</sup> S<sup>0.27</sup> S<sub>L</sub><sup>-0.52</sup> I<sup>0.18</sup></b>
<b>Q50</b>	<b>=</b>	<b>104A<sup>0.85</sup> S<sup>0.26</sup> S<sub>L</sub><sup>-0.51</sup> I<sup>0.16</sup></b>
<b>Q100</b>	<b>=</b>	<b>136A<sup>0.84</sup> S<sup>0.26</sup> S<sub>L</sub><sup>-0.51</sup> I<sup>0.14</sup></b>

# Flood Frequency and Probability

Flood 'Frequency' Typically Expressed in Years

$$\text{Annual Flood Probability (\%)} = \frac{100}{\text{Flood Frequency (Years)}}$$

100-Year Flood Annual Probability =  $100 / 100 = 1\%$

25-Year Flood Annual Probability =  $100 / 25 = 4\%$

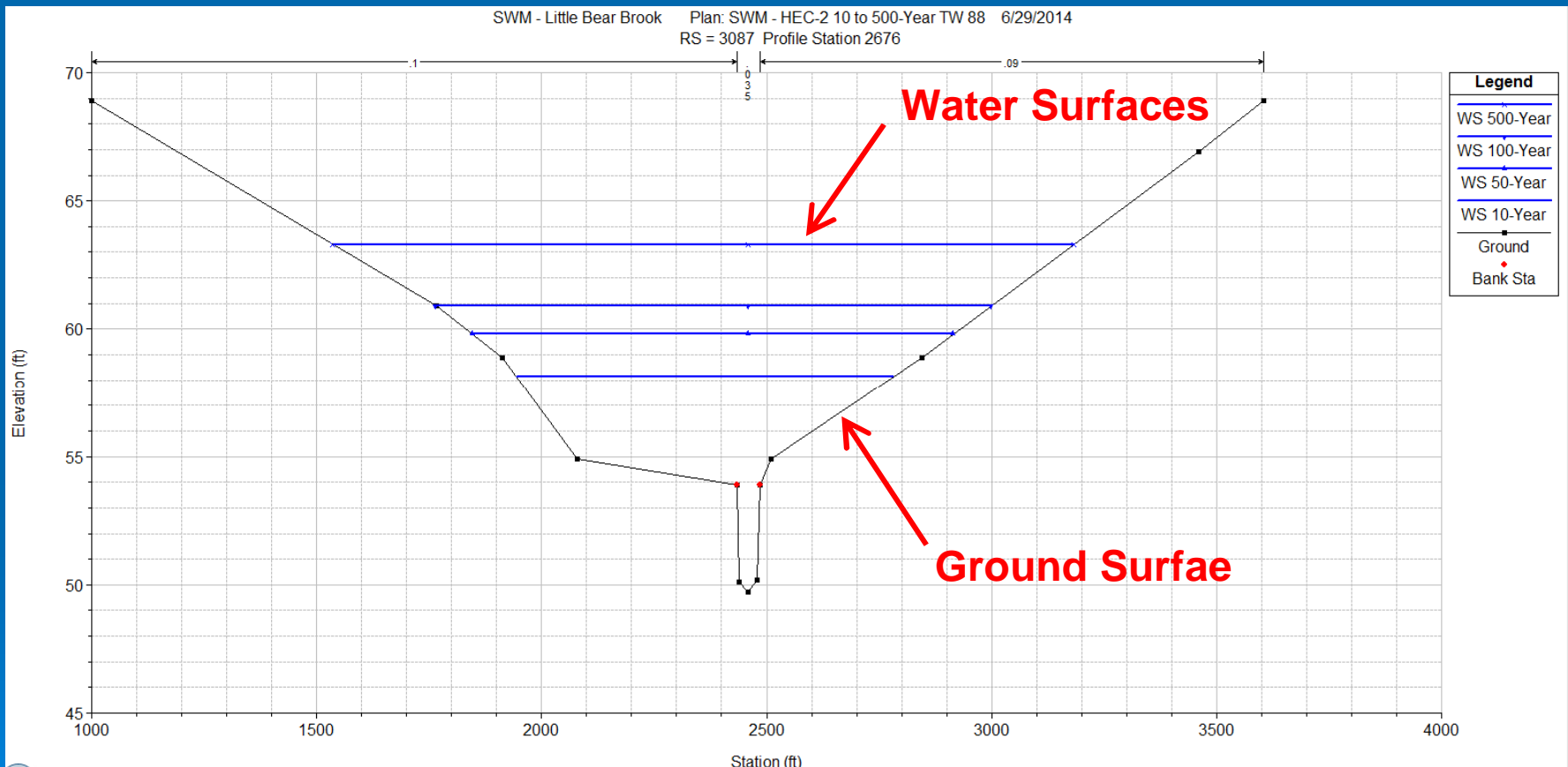
10-Year Flood Annual Probability =  $100 / 10 = 10\%$

# Another Plan View

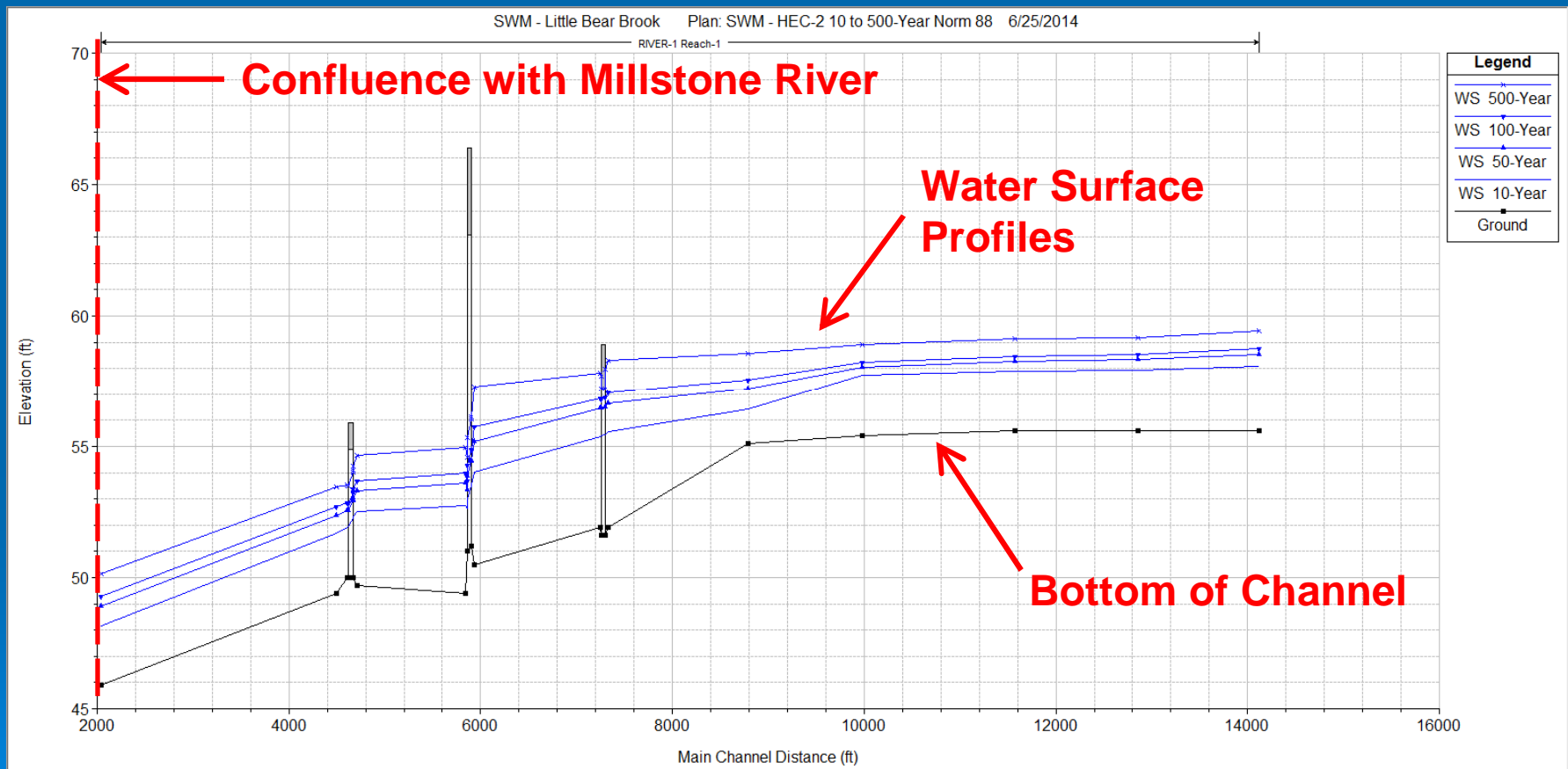




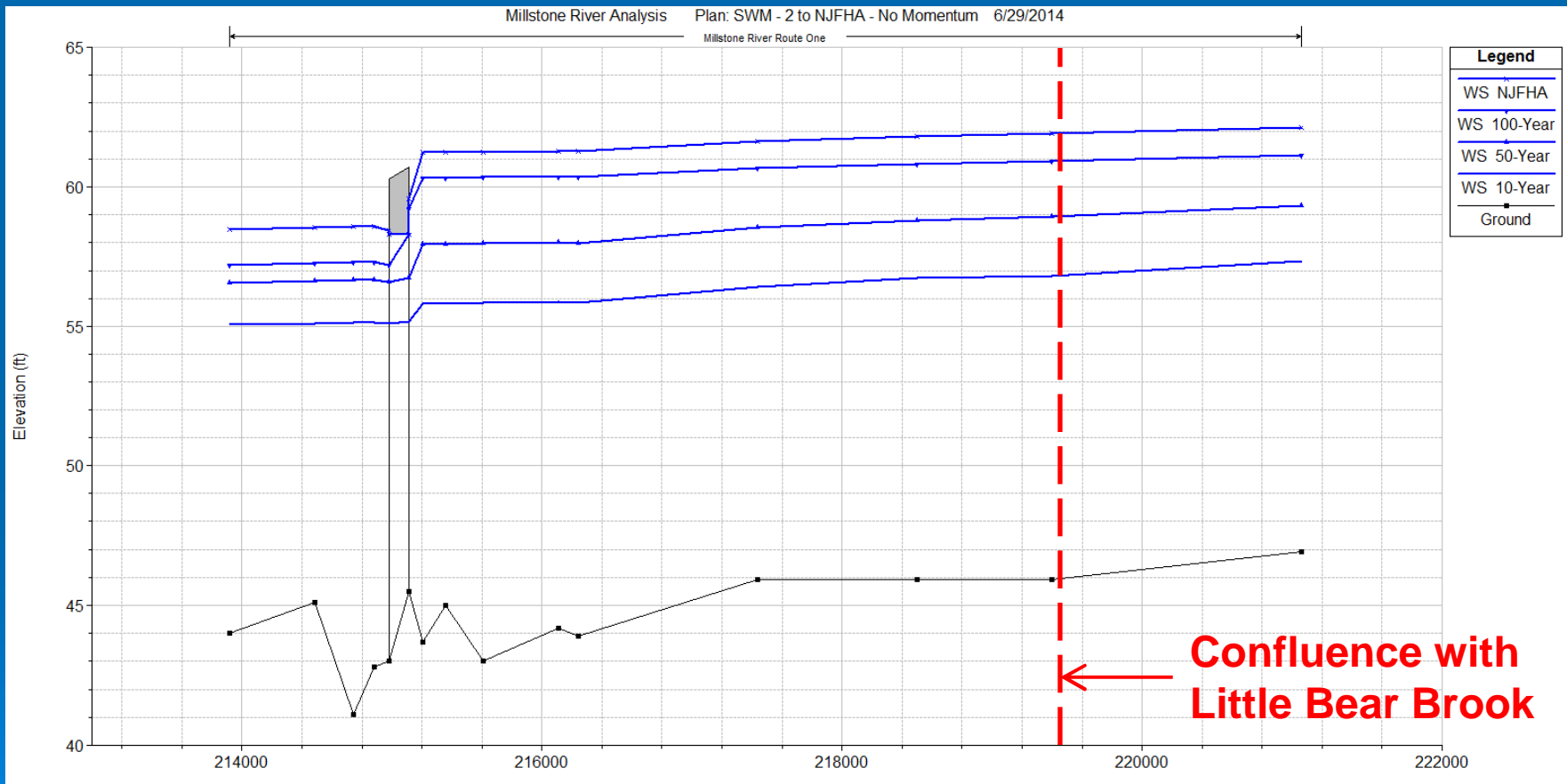
# Cross Section View (Looking Upstream or Downstream)



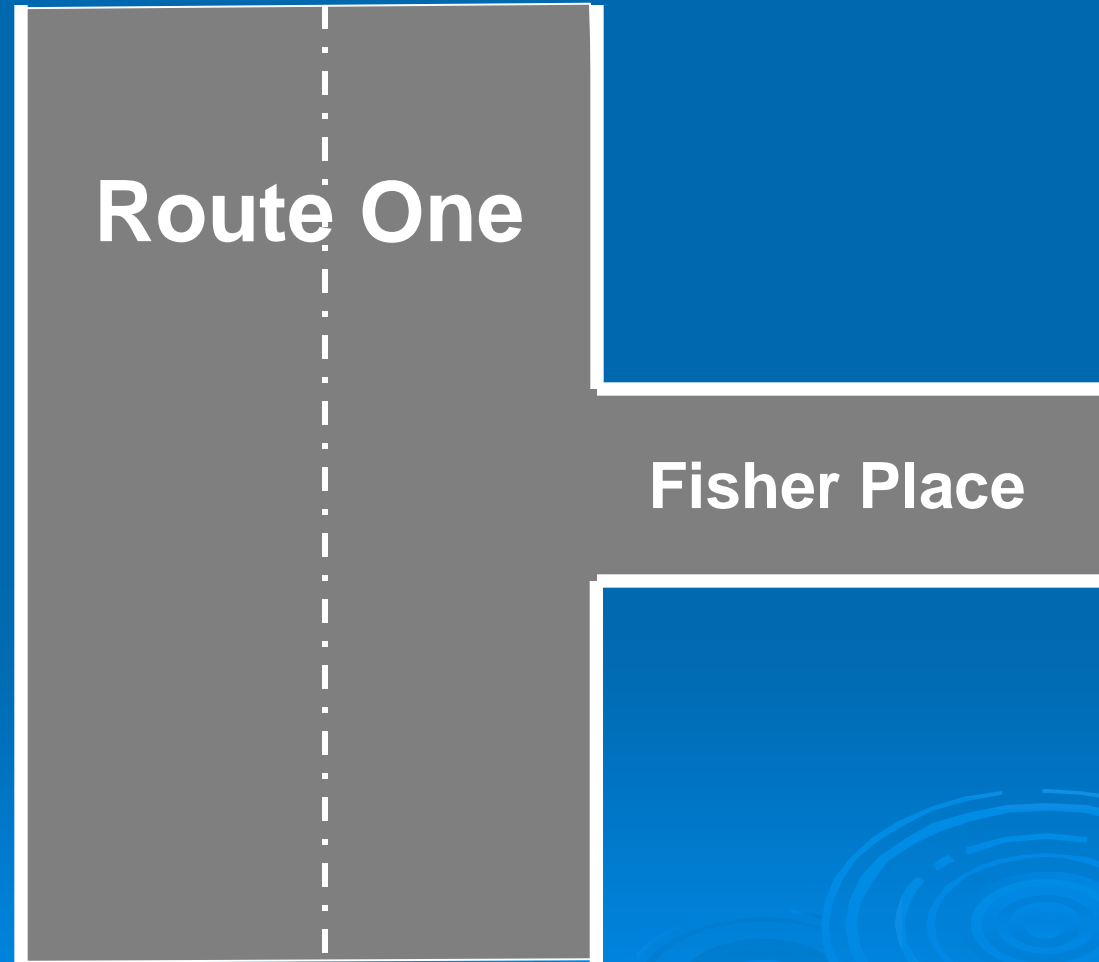
# Profile View (Looking Sideways)



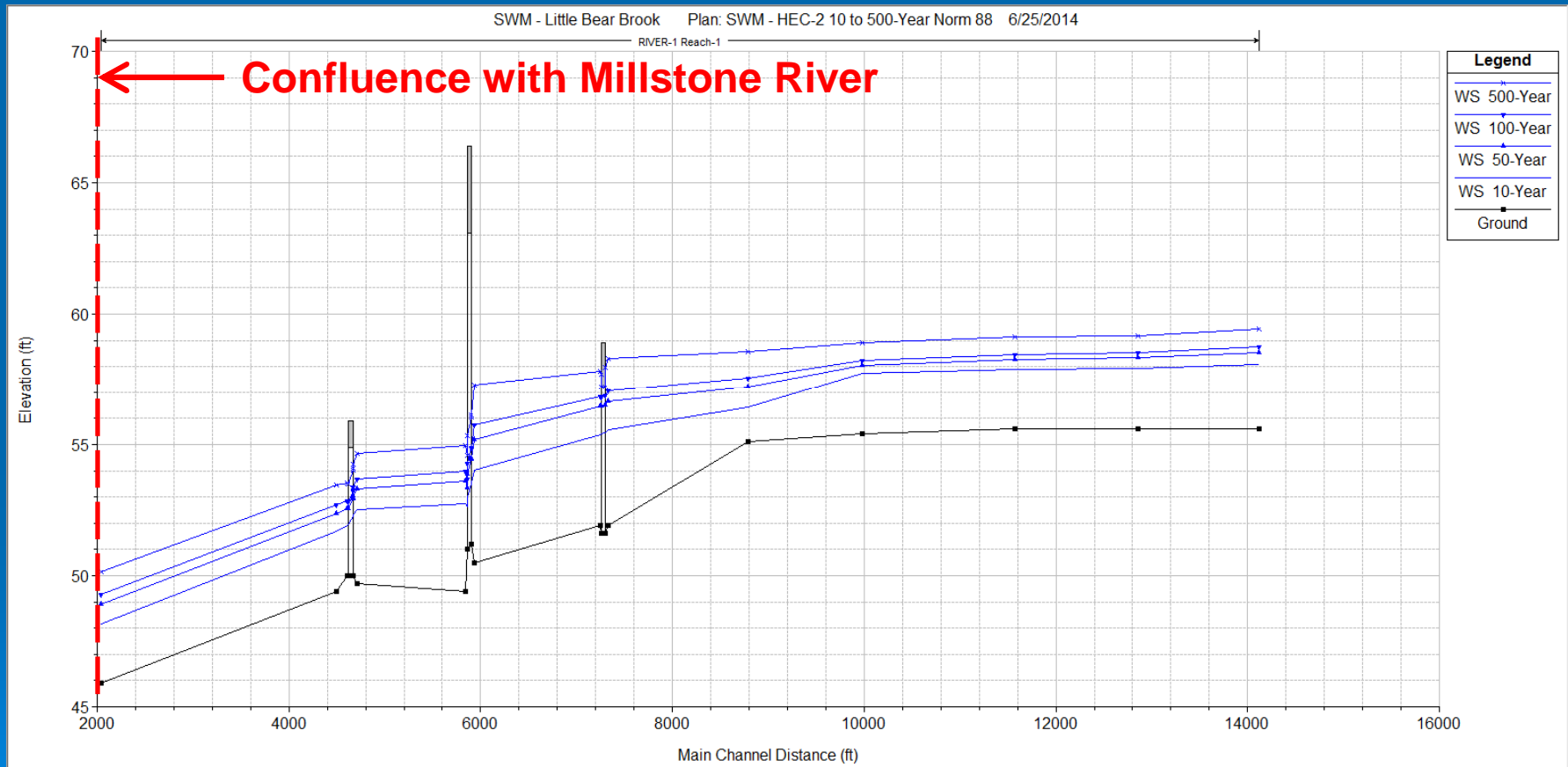
# Millstone River FIS Profiles



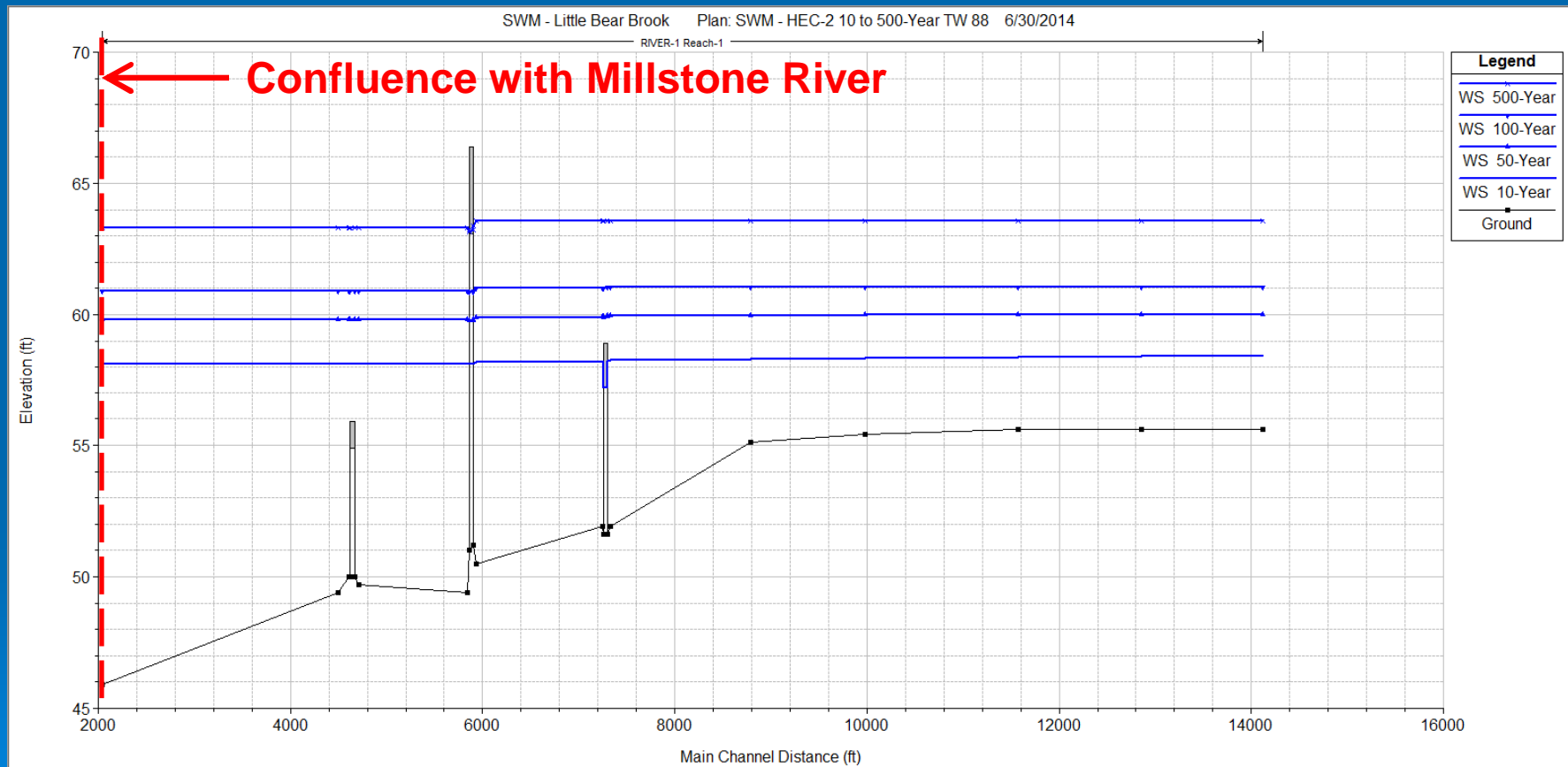
# Confluence



# Little Bear Brook FIS Profiles Without Millstone River



# Little Bear Brook FIS Profiles



# Questionnaire Results

- **58 Responses from 82 Questionnaires**
- **Worst Flooding in 2011 from Tropical Storm Irene**
- **Second Worst in 1999 from Tropical Storm Floyd**
- **Flooding Above First Floor Reported at Six Structures**
- **Road and Yard Flooding Reported Most Frequently**

# Flood Hazard Assessment

- **Assessment Results Based Upon:**
  - **Questionnaire Results**
  - **Interviews with Township Personnel**
  - **FEMA Flood Insurance Study**
  - **NJDEP Floodplain Delineation**
  - **Computer Model Data and Simulations**
  - **May 1, 2014 Storm and Flood Event**



# Flood Hazard Assessment

- Estimated Road Flood Thresholds:
  - Fisher Place – 4-Year Flood
  - Washington Road – 4-Year Flood
  - Alexander Park – 2-Year Flood
  - Alexander Road – 5-Year Flood
  - Similar Yard and Parking Lot Flood Thresholds

# Flood Hazard Assessment

- Estimated Structure Flood Thresholds:
  - Fisher Place – 10-Year Flood
  - Washington Road – 5-Year Flood
  - Alexander Park – >100-Year Flood
  - Alexander Road – 15-Year Flood
- Comments or Information?

# May 1, 2014 Flood Event

- **Total Rainfall Approximately 5.3 Inches in 36 Hours**
- **Approximately 4 Inches in 24 Hours**
- **Approximately 3 Inches in 12 Hours**
- **Approximately 5 to 10-Year (20% to 10% Chance) Storm Event**

# May 1, 2014 Flood Event

- Field Surveyed High Water Elevations:
- Fisher Place = 58.5 NAVD88
- Washington Road = 58.7 NAVD88
- Fieldston Road = 58.5 NAVD88
- Alexander Road = 58.8 NAVD88
- Approximately 10-Year Flood Event

# Surveyed HW Elevations



Princeton Hydro and SWM Consulting

# Surveyed HW Elevations



Princeton Hydro and SWM Consulting

# Surveyed HW Elevations

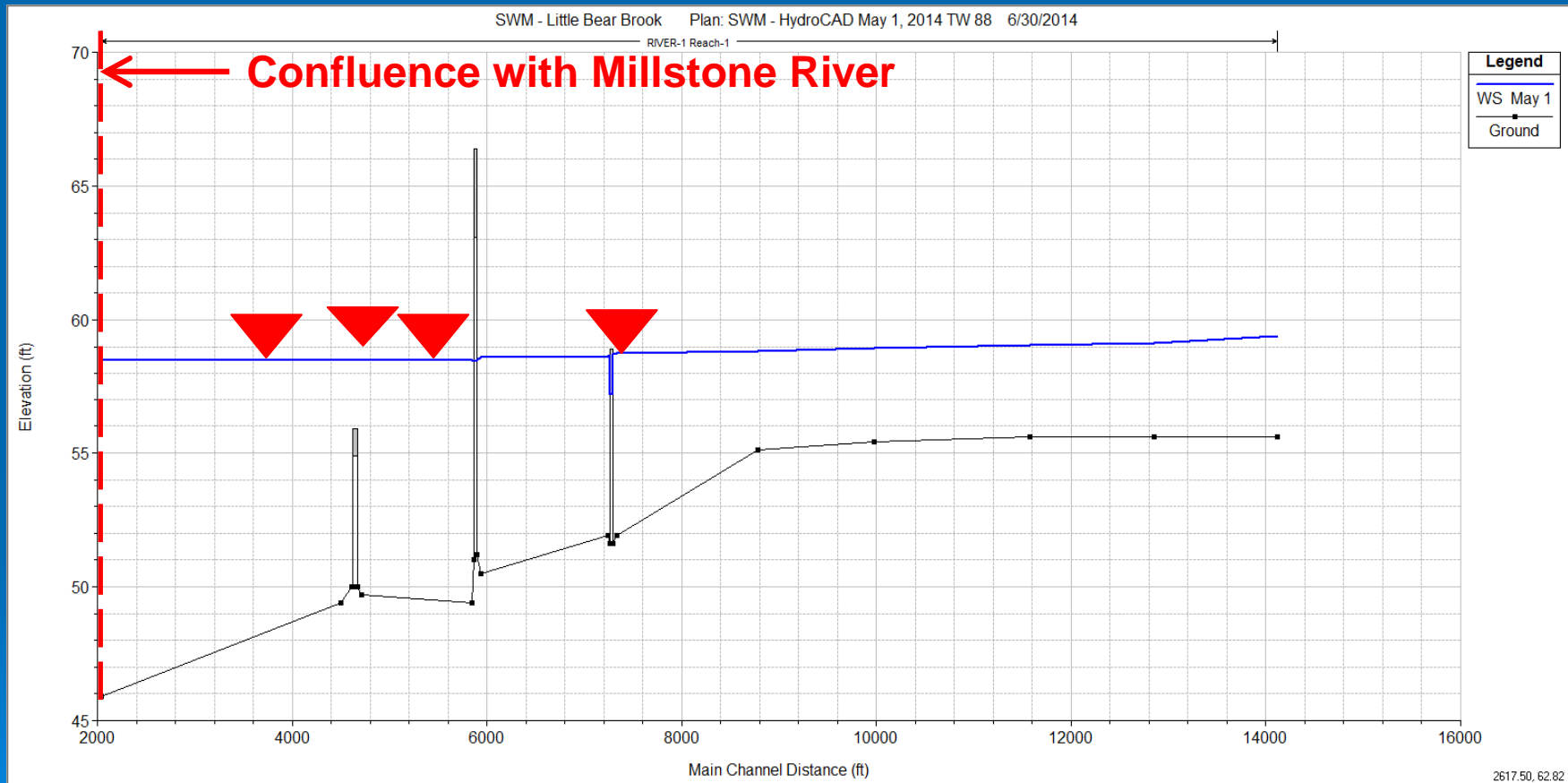


# Surveyed HW Elevations

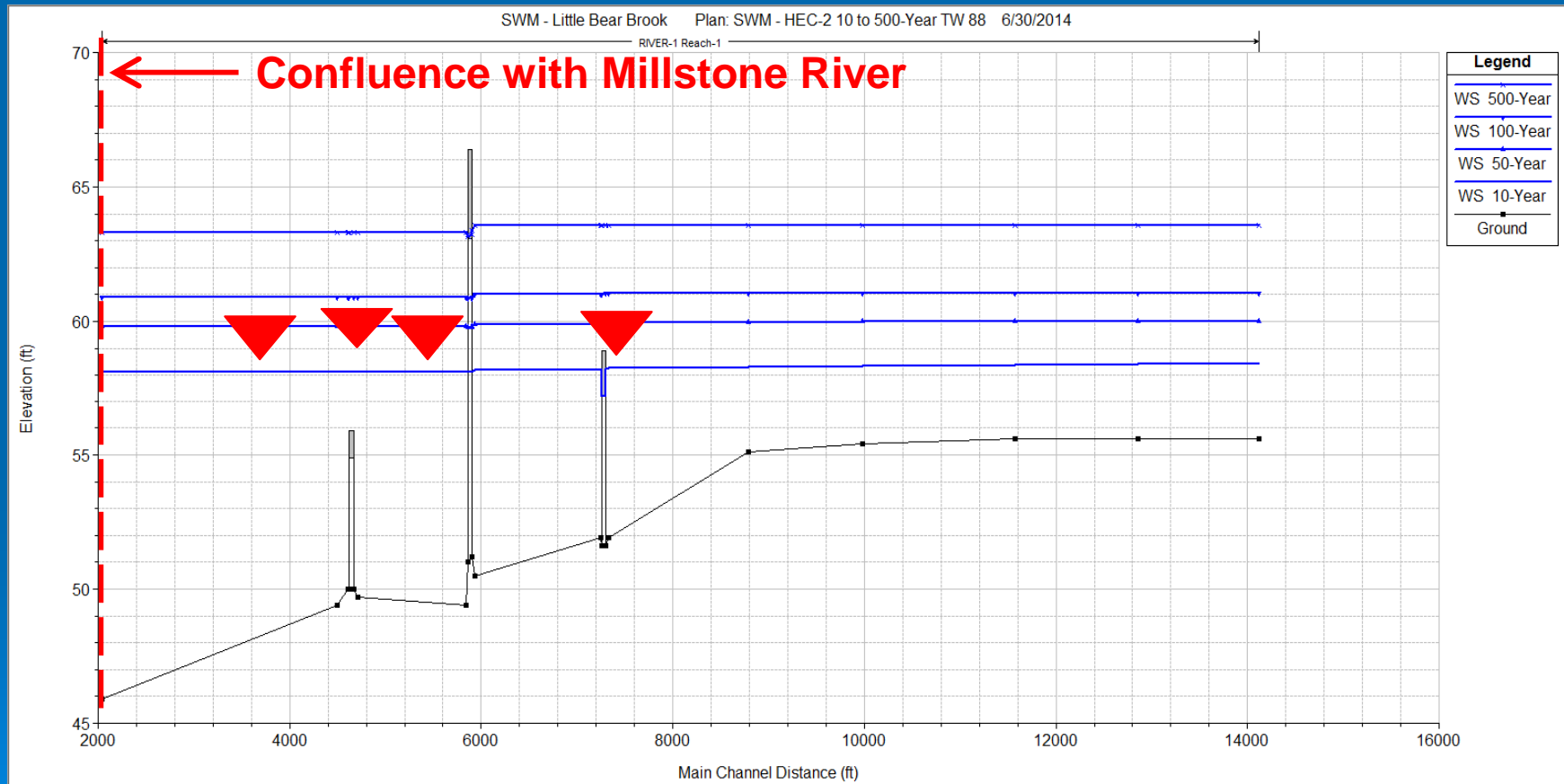




# Little Bear Brook HWMs and Computed WS Profile – May 1, 2014



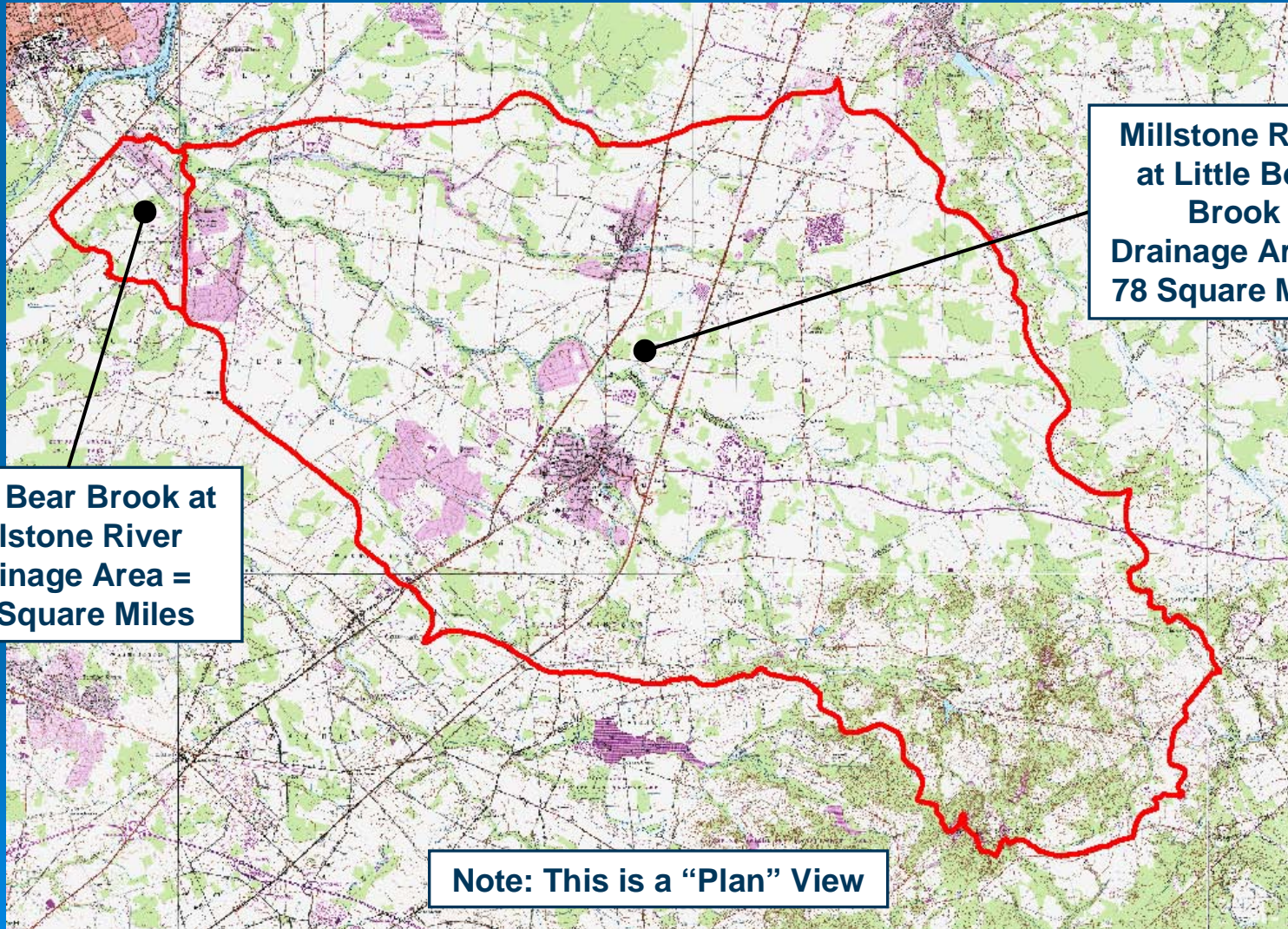
# Little Bear Brook FIS Profiles



# Flood Mitigation Strategies

- **What is the Primary Source of the Flooding?**
  - **Little Bear Brook?**
  - **Millstone River?**
  - **Inadequate Bridges and Culverts?**
  - **Downstream Structures?**

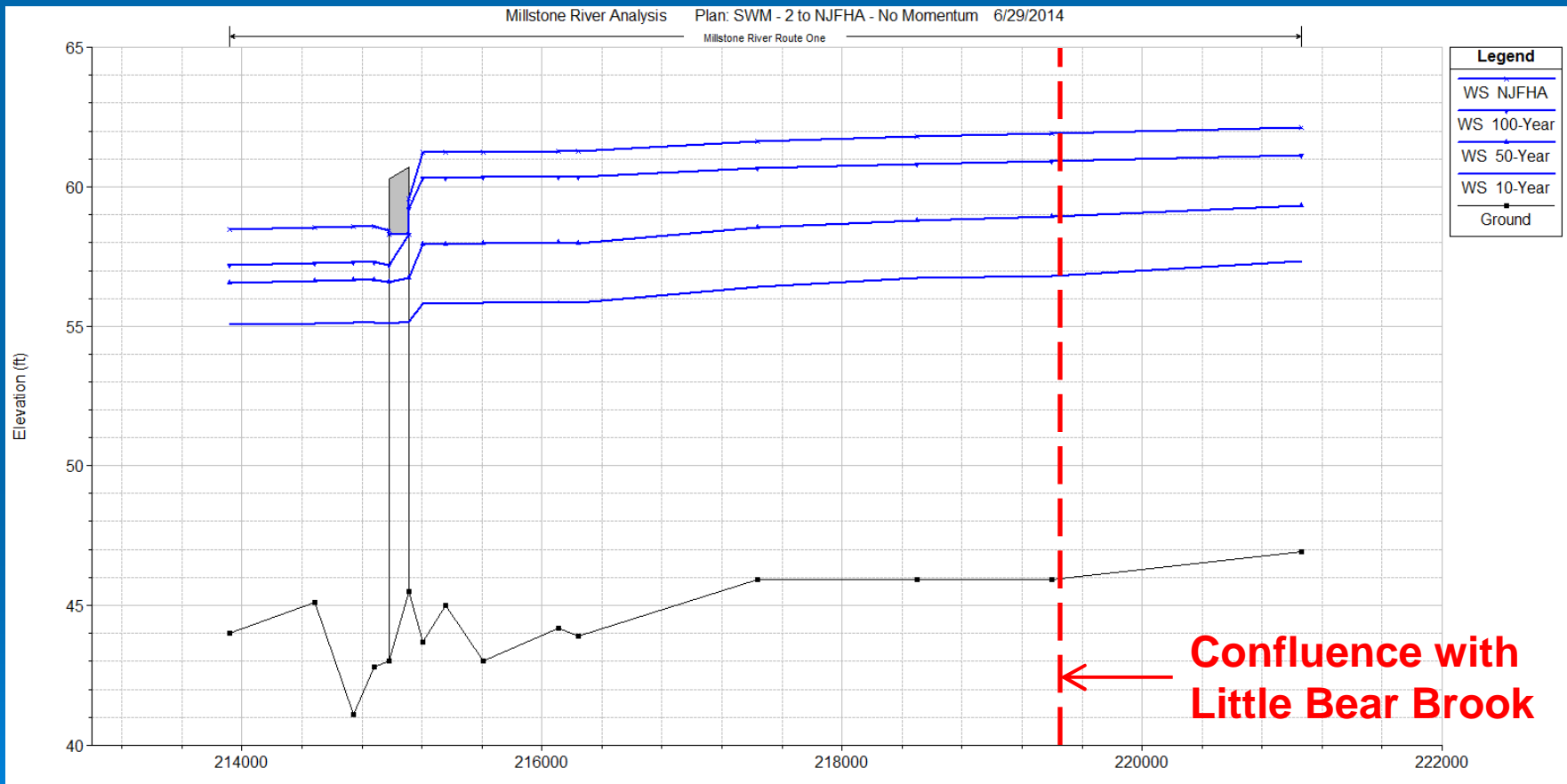
# Watershed or Drainage Area



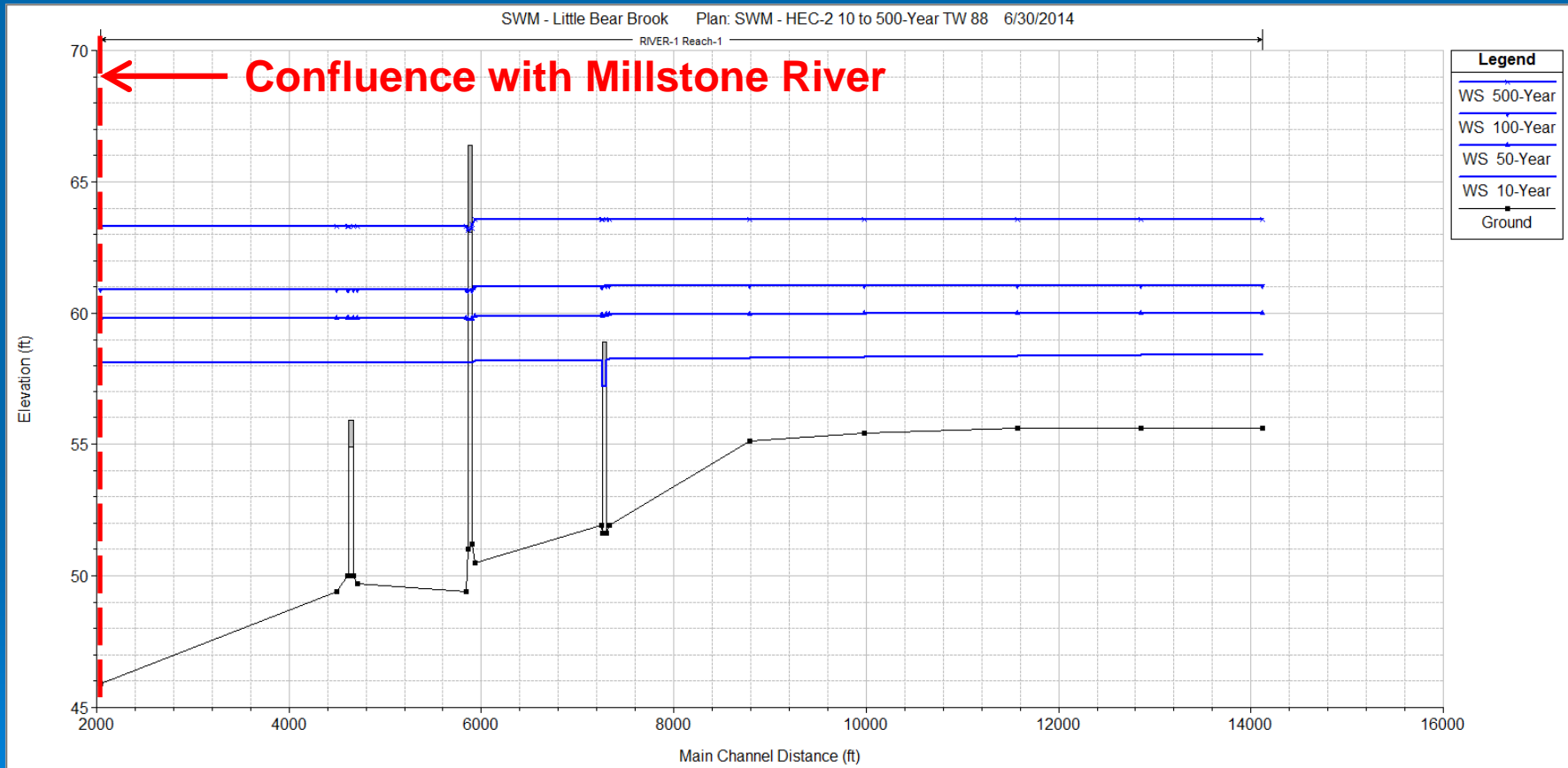
# USGS Watershed Data

Characteristic	Little Bear Brook	Millstone River
<b>Drainage Area (SM)</b>	<b>2.9</b>	<b>78</b>
<b>Flow Length (Miles)</b>	<b>2.8</b>	<b>23</b>
<b>% Forest Cover</b>	<b>8</b>	<b>12</b>
<b>% Urban Land Cover</b>	<b>62</b>	<b>36</b>
<b>% Wetlands</b>	<b>18</b>	<b>25</b>
<b>Peak 10-Year Flow</b>	<b>472</b>	<b>2910</b>
<b>Peak 100- Year Flow</b>	<b>821</b>	<b>5090</b>

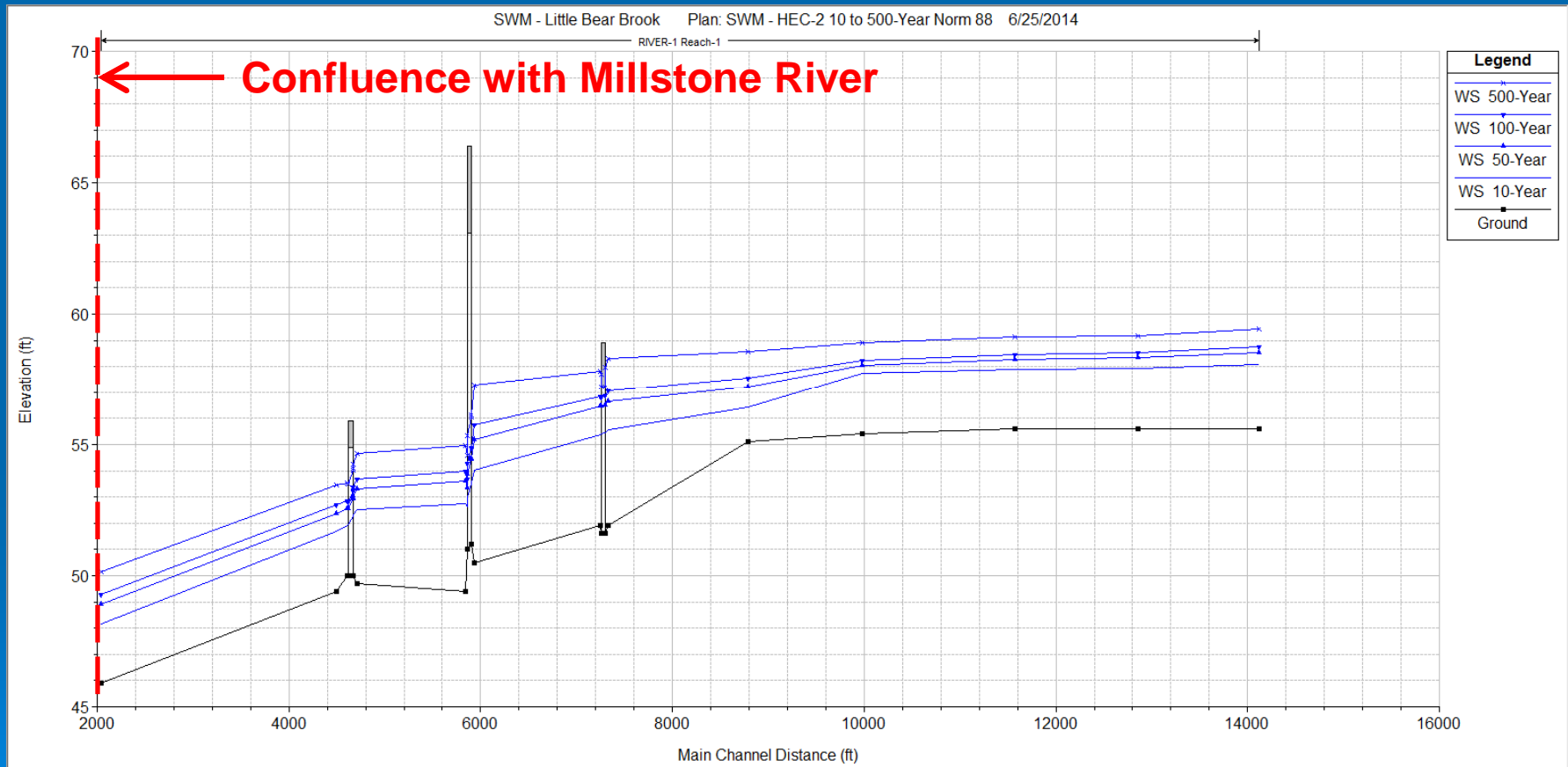
# Millstone River FIS Profiles



# Little Bear Brook FIS Profile

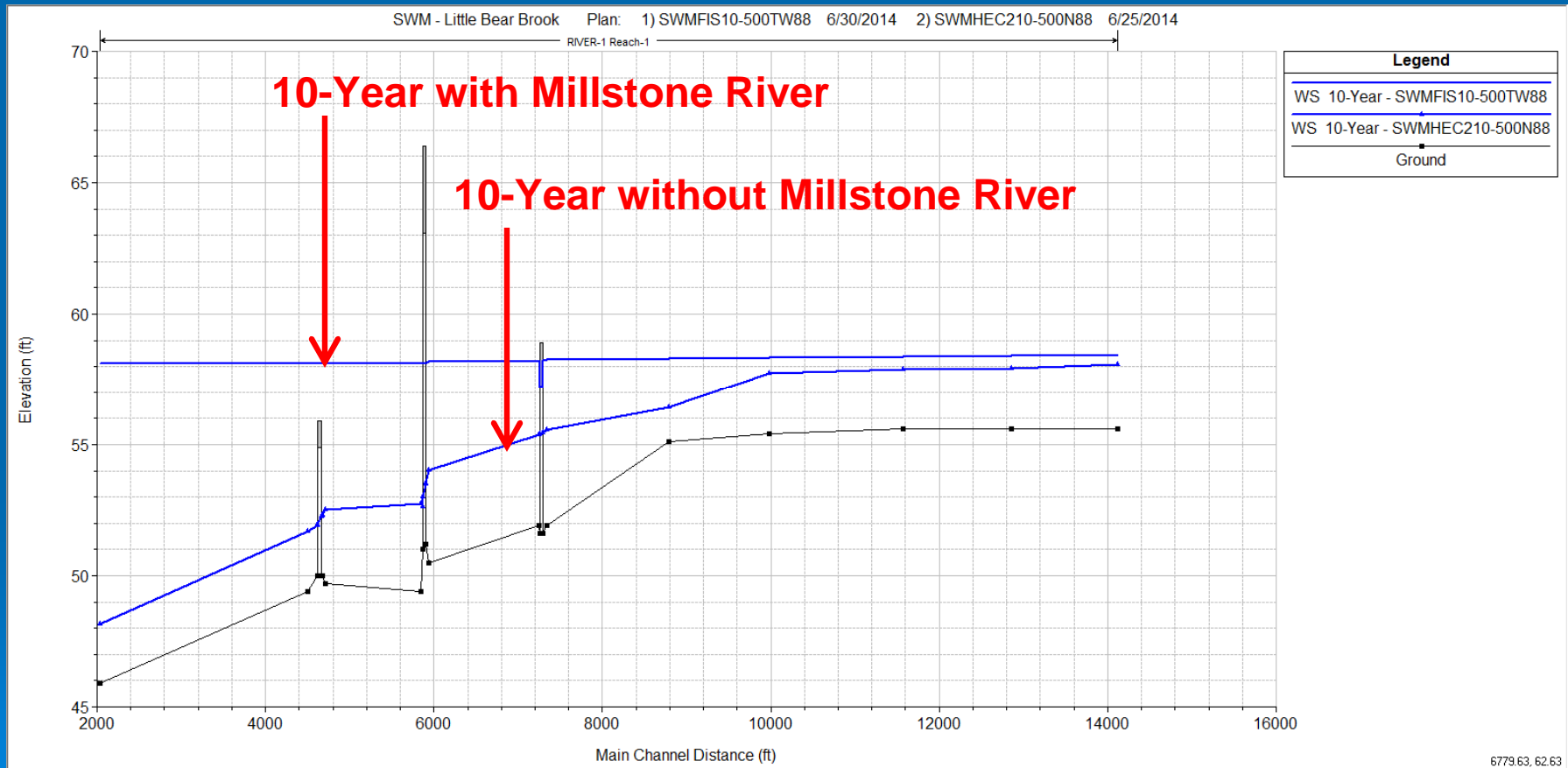


# Little Bear Brook FIS Profiles Without Millstone River

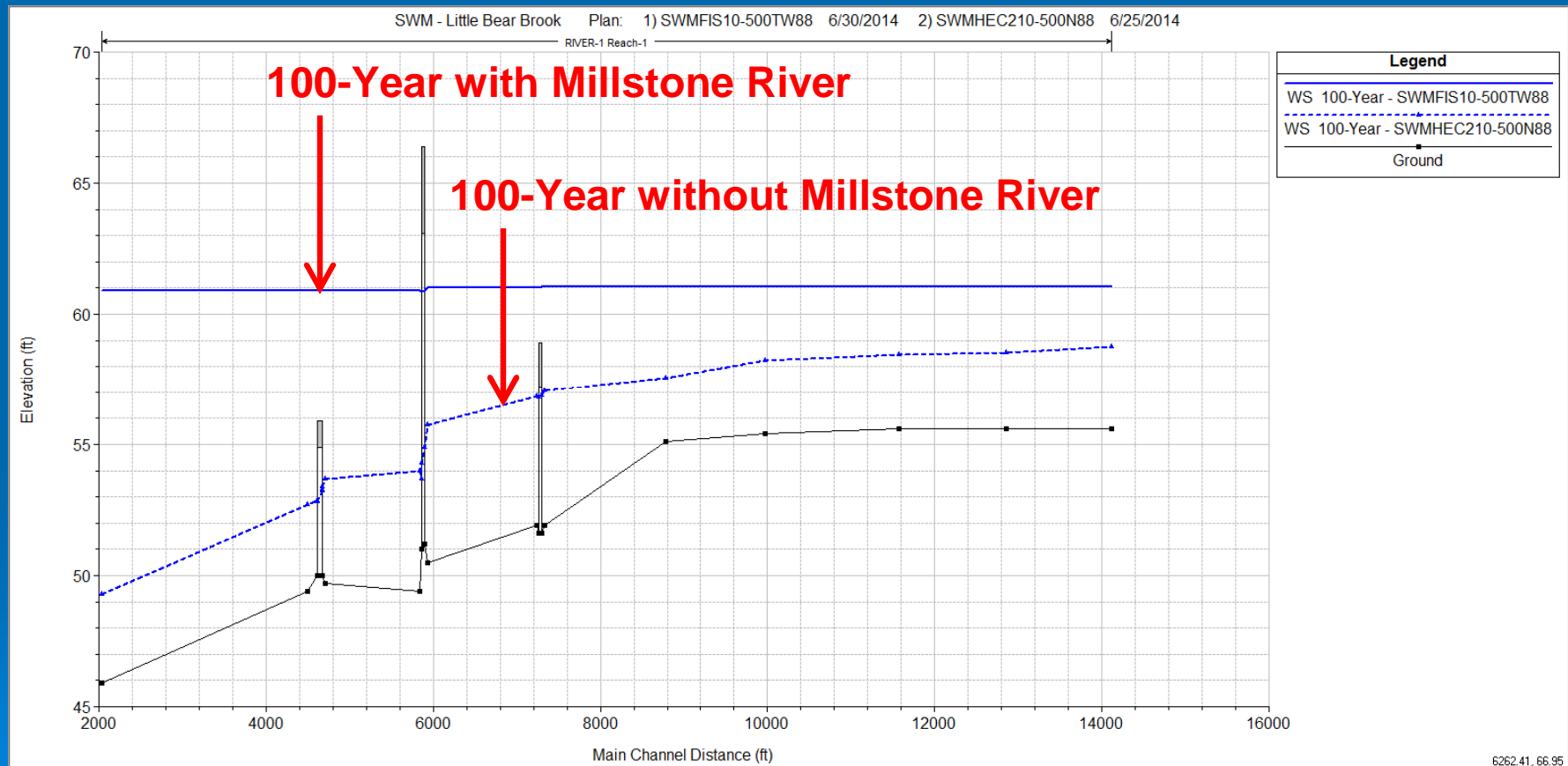




# Little Bear Brook FIS Profiles Without and With Millstone



# Little Bear Brook FIS Profiles Without and With Millstone



# Why the Millstone River?

- **Much Larger Drainage Area and Flows at Same Ground Elevation**
- **Downstream Influences?**
  - **Carnegie Lake Dam?**
  - **Delaware & Raritan Canal Culvert?**
  - **Route One Bridge?**

# Carnegie Lake Dam – April 31st

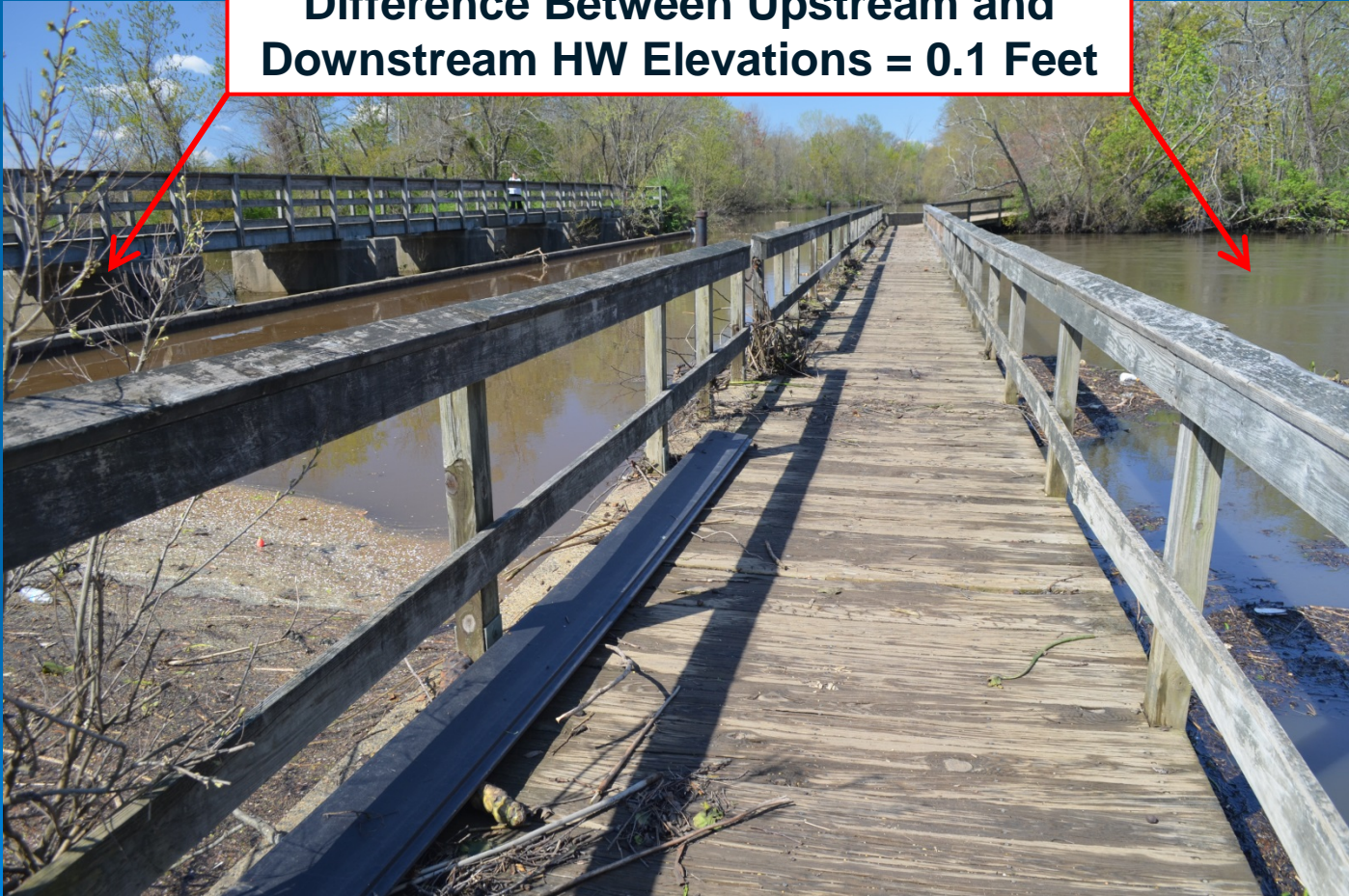


# Carnegie Lake Dam – May 1st



# D & R Canal Culvert

**Difference Between Upstream and  
Downstream HW Elevations = 0.1 Feet**

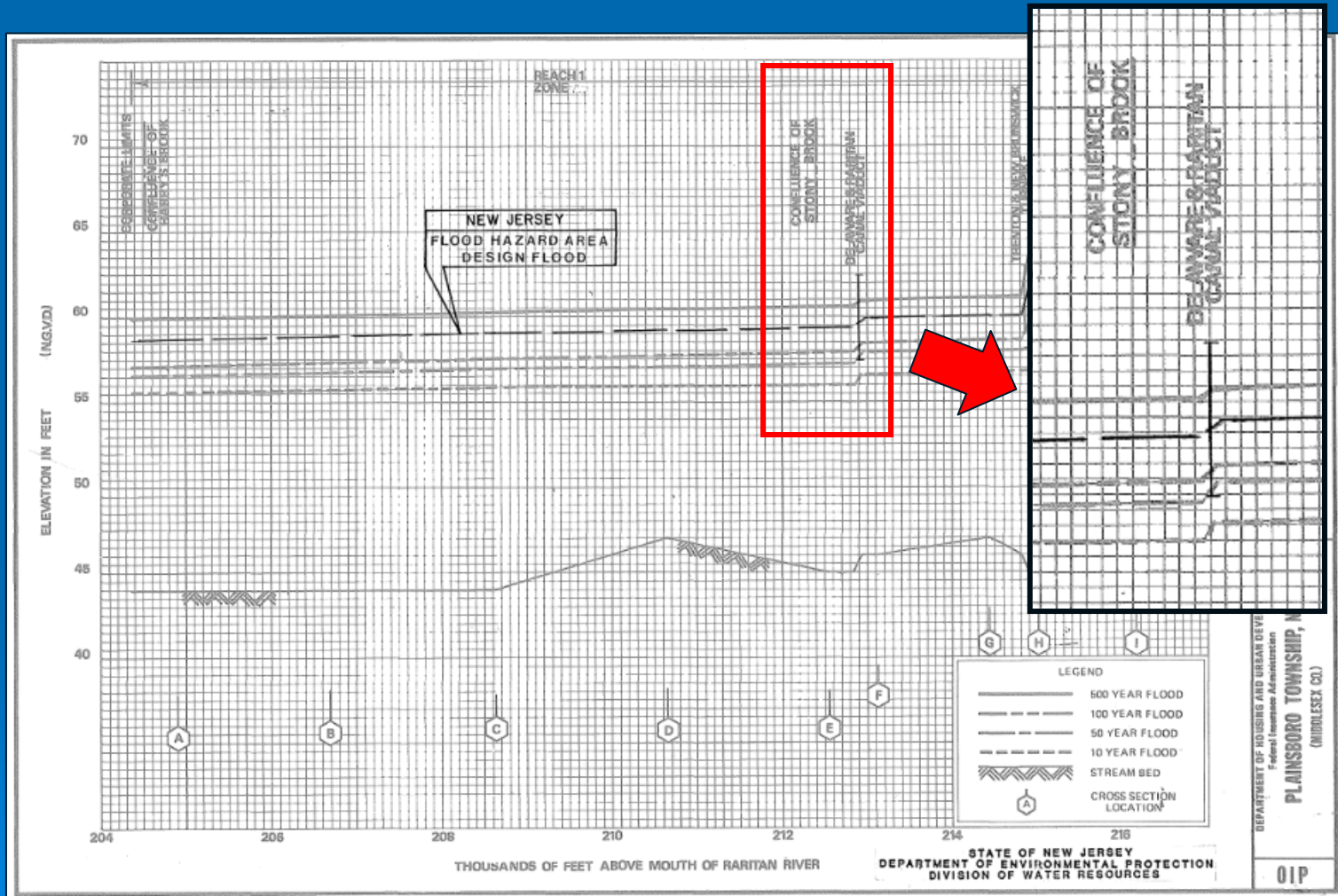


# D & R Canal Culvert

**Difference Between Upstream and  
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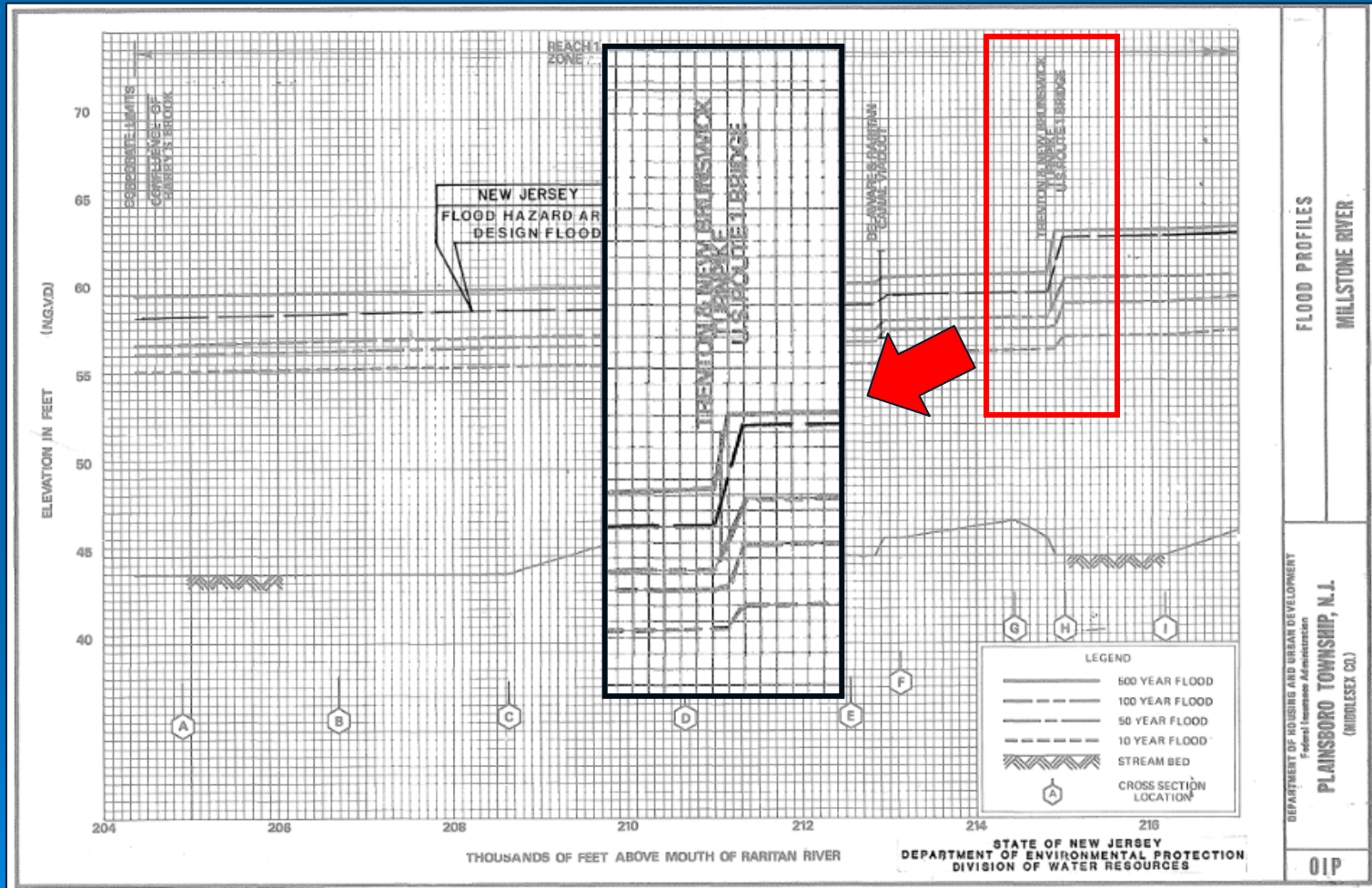


# D & R Canal Culvert





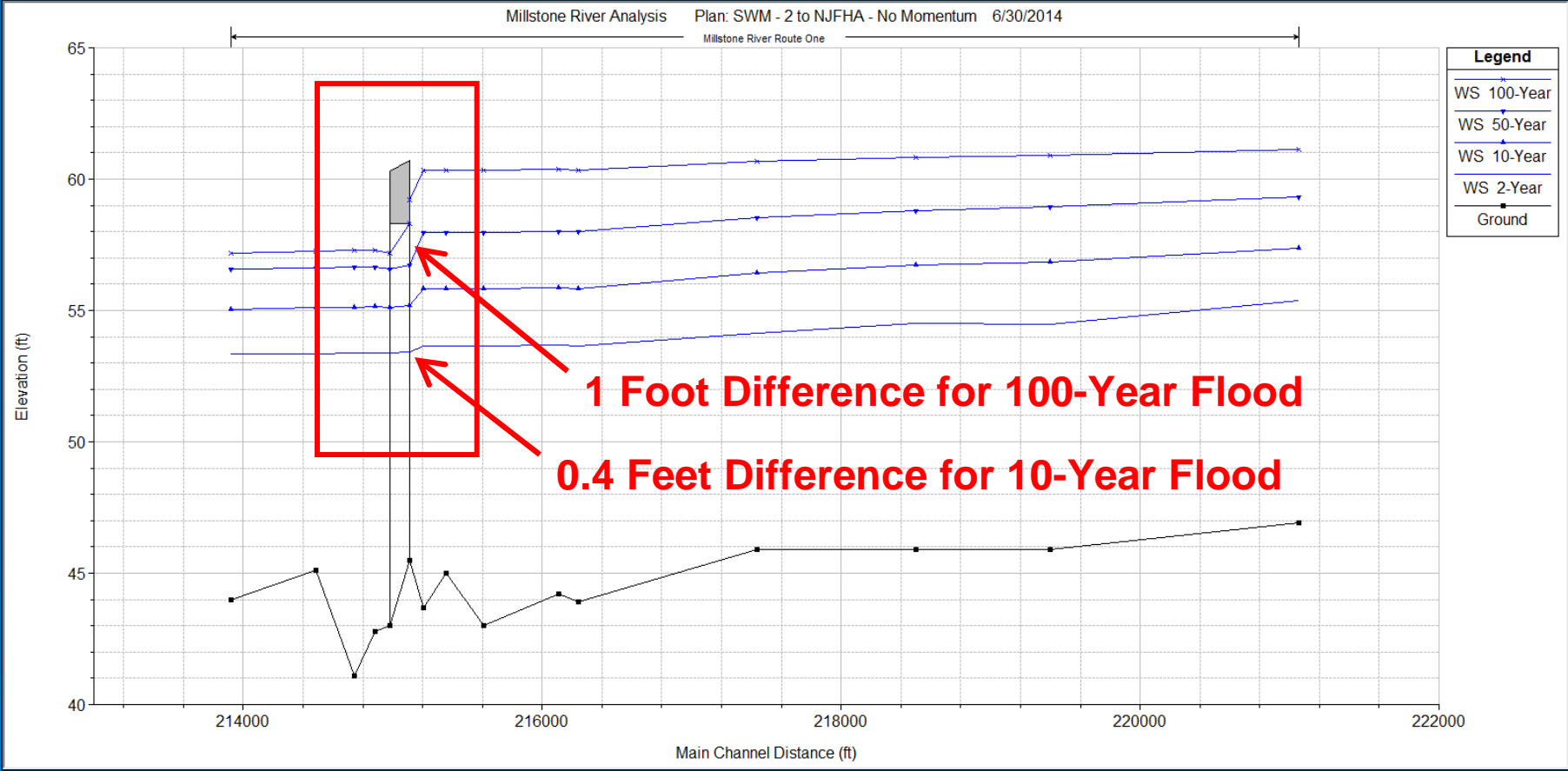
# D & R Canal Culvert



# Millstone River HEC-RAS Computer Model at Route One

- **Based Upon NJDOT HEC-RAS  
Computer Model of 2009 Replacement  
Bridge**
- **Some Bridge Parameters Modified to  
Better Match Bridge Type**
- **Results Checked with May 1, 2014 High  
Water Elevations**

# Millstone River HEC-RAS Model



# Millstone River at Route One



# Potential Mitigation Strategies

- Investigation to Estimate Strategy's Potential to Reduce Flood Risk
- Investigation to be Based Upon Existing Available Study Data
- Objectives of Investigation are to Both Identify Strategies That:
  - Have Potential to Reduce Flood Risk
  - Do Not Have Potential to Reduce Risk

# Potential Mitigation Strategies

- **Potential Strategies to be Investigated Include:**
  - **Reduce Millstone Flows via Upstream Storage**
  - **Lower Downstream Starting WS Elevations**
  - **Increase Route One Bridge Capacity**
  - **Levees, Floodwalls, and Road Raisings**
  - **Enhanced Flood Warning System**
  - **Wet and Dry Structure Floodproofing**

# Little Bear Brook Summary

- **Flood Assessment Study Based Upon:**
  - **New Topographic Mapping**
  - **Property Owner Questionnaires**
  - **Interviews with Township Officials**
  - **Structure Elevation Surveys**
  - **FEMA and NJDEP Waterway and Flood Plain Data and Models**
  - **Rainfall and High Water Data for May 1, 2014 Rainfall and Flood Event**

# Little Bear Brook Summary

- **Findings to Date Include:**
  - **Road, Yard, and Parking Lot Flooding Most Chronic (2 to 5-Year+ Frequency)**
  - **Structure Flooding Occurs During Larger, Less Frequent Events (10 to 25-Year+ Frequency)**
  - **Millstone River is Primary Flooding Source**
  - **Little Bear Brook may Worsen Problem During Extreme Events (50 to 100-Year+ Frequency)**



# Little Bear Brook Summary

- **Potential Strategies to be Investigated Include:**
  - **Reduce Millstone Flows via Upstream Storage**
  - **Lower Downstream Starting WS Elevations**
  - **Increase Route One Bridge Capacity**
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# Little Bear Brook Summary

- Objectives of Investigation are to Both Identify Strategies That:
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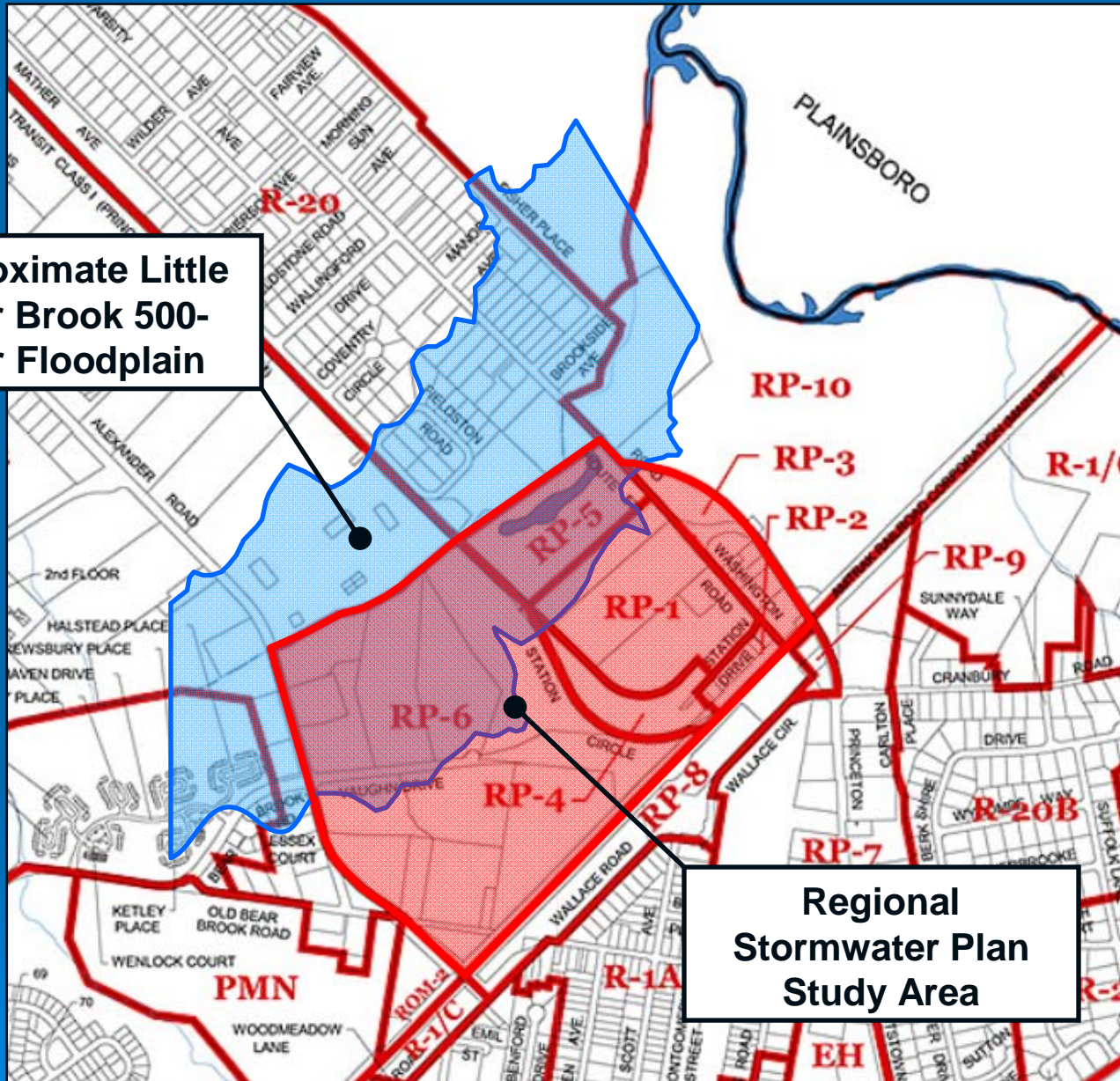
# Redevelopment Area Regional Stormwater Management Plan Update

Princeton Hydro and SWM Consulting

# Project Goals & Scope of Work

- **Goal 2: Redevelopment Area Regional Stormwater Management Plan**
  - **Public Meetings**
  - **Aerial Topographic Mapping**
  - **Maps and Overlays**
  - **Regional Stormwater Analysis**
  - **Conceptual Basin Locations and Designs**
  - **Potential Little Bear Brook Flood Relief**
  - **Final Report and Presentation**

**Approximate Little Bear Brook 500-Year Floodplain**



**Regional Stormwater Plan Study Area**

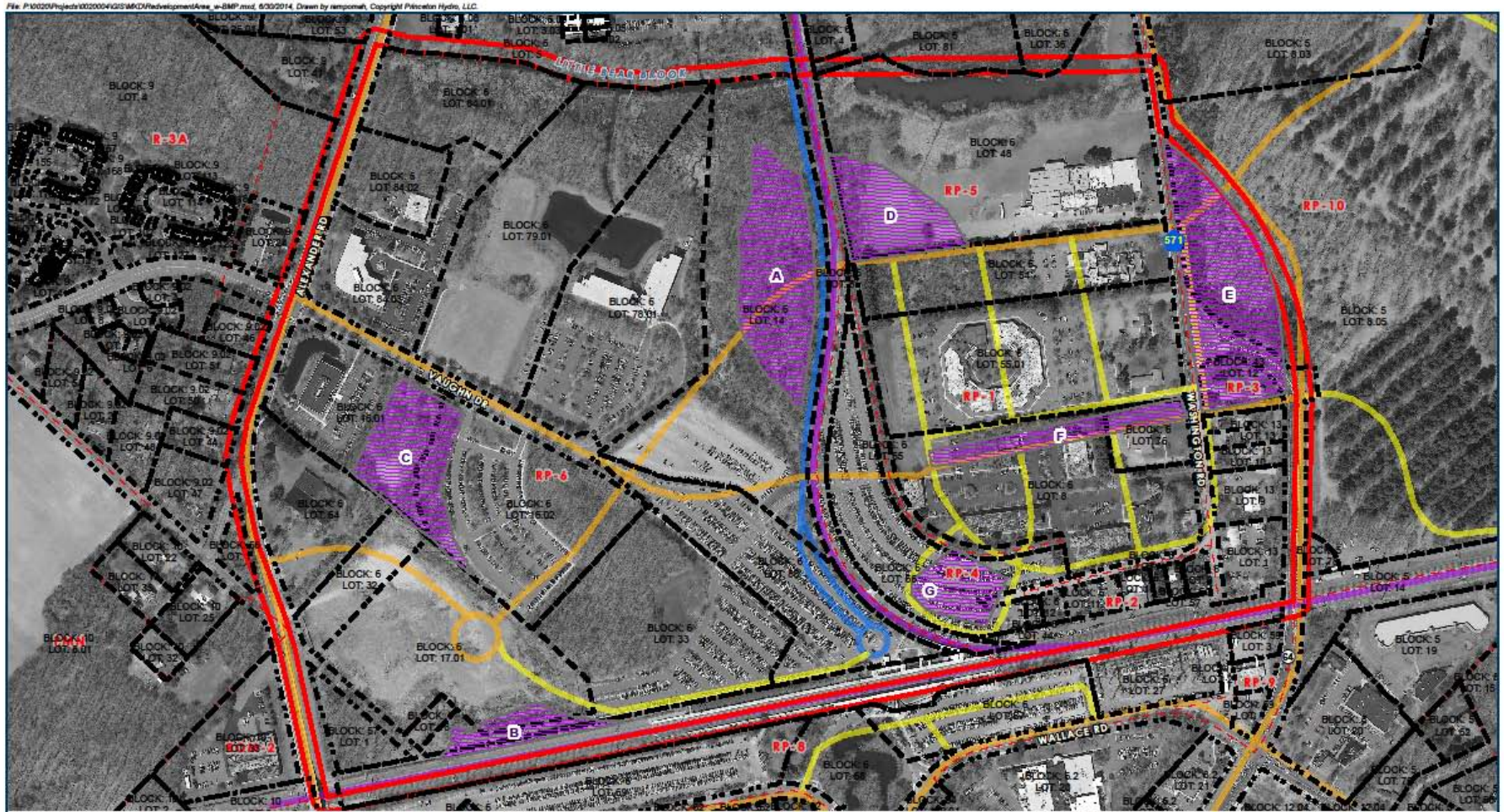
# Redevelopment Area Regional Stormwater Analysis

- **Build-out Analysis Results**
- **Conceptual Basin Location Discussion**
- **Review of Next Steps to Progress  
Conceptual Designs**

# Build-out Analysis

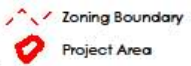
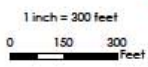
- Analyzed runoff in HydroCAD for existing conditions and full-buildout of the redevelopment area
- Regional Stormwater BMP
  - ~7 acres, 3 foot depth
  - ~4 acres, 6 foot depth
- Included environmental constraints
  - T&E Habitat
  - Soils (including depth to SHWT)
  - Geology
  - Wetlands and Transition Areas
  - Floodplain

# Conceptual Basin Locations



## REDEVELOPMENT AREA LAYOUT

REGIONAL STORMWATER MANAGEMENT ANALYSIS  
 REDEVELOPMENT AREA  
 WEST WINDSOR TOWNSHIP  
 MERCER COUNTY, NEW JERSEY



### Legend



Princeton Hydro



**NOTES**  
 1. Zoning boundary and project area (RP zones 1 - 6) obtained from West Windsor Township.  
 2. Streams and water bodies obtained from NJDEP GIS website.  
 3. Proposed road configuration digitized from Township of West Windsor Redevelopment Plan for Princeton Junction, Figure L, Roads and Circulation, March 23, 2009 (2009-04).  
 Coordinate System: NAD 1983 StatePlane New Jersey FIPS 2600 Feet  
 Projection: Township Meridian



# Conceptual Basin Locations



## REDEVELOPMENT AREA LAYOUT

REGIONAL STORMWATER MANAGEMENT ANALYSIS  
REDEVELOPMENT AREA  
WEST WINDSOR TOWNSHIP  
MERCER COUNTY, NEW JERSEY



1 inch = 300 feet  
0 150 300 Feet



Zoning Boundary



Project Area



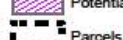
Stream



Water Body



Potential Stormwater BMP Location



Parcels

### Legend

Princeton Hydro



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Coordinate System: NAD 1983 StatePlane New Jersey FIPS 2605 Feet  
Projection: Transverse Mercator

# Review of Next Steps to Progress Conceptual Designs

- Finalize Conceptual Basin Locations
- Complete field investigation
- Prepare preliminary engineering design plans
- Final report

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