Developing a Water Availability Study

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Presentation Overview

- Project Purpose and Background
- Study Methodology
- Model Inputs
- Analysis / Scenarios
- Results
- Conclusions

Purpose

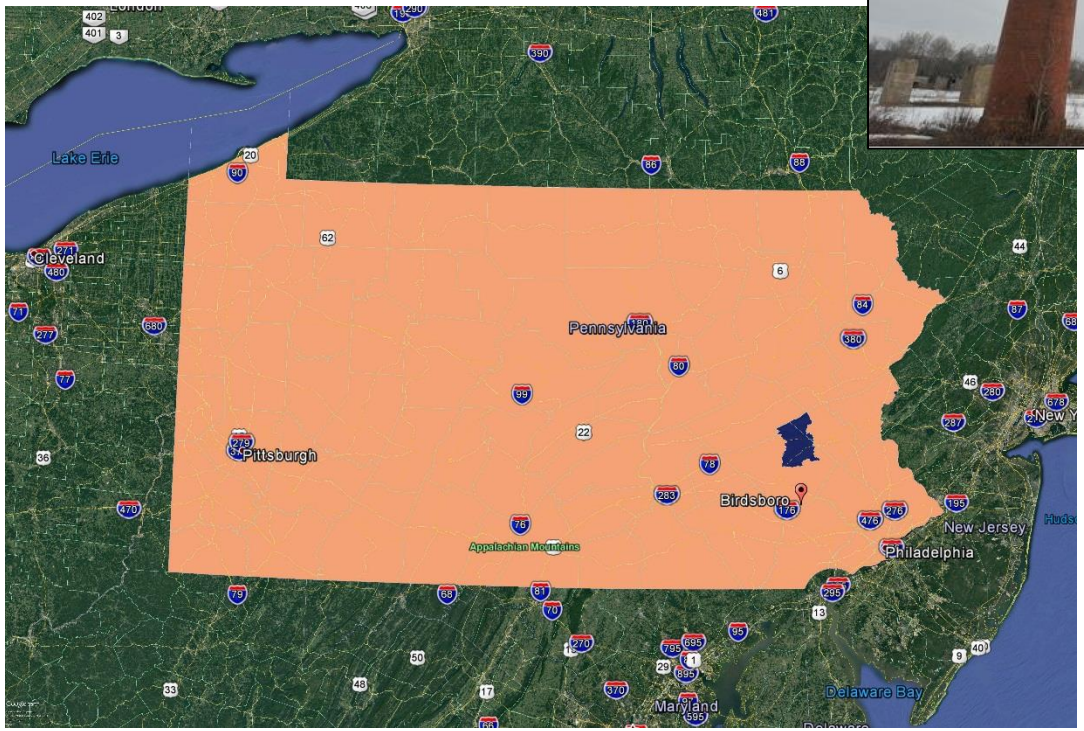
Determine the availability of water from the Reading Area Water Authority water supply reservoir to meet the demand of the proposed Birdsboro Power electric generating facility for DRBC consumptive use permitting

Background

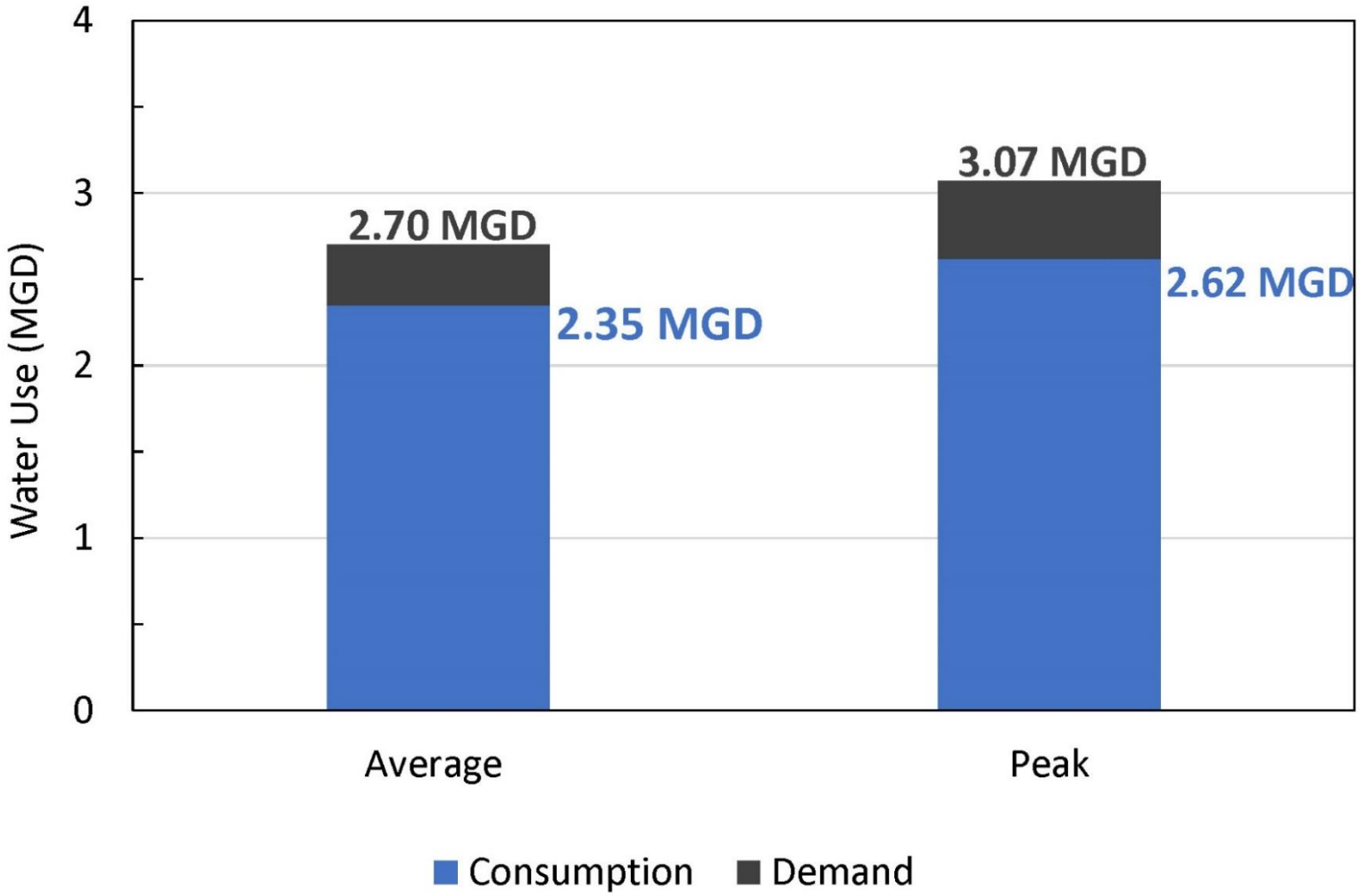
- Proposed Birdsboro Power electric generating plant
- 485-Megawatt (MW) natural gas-fired combined cycle (NGCC) combustion turbine electric plant

Power Plant Location Map

- Former Armorcast site, Birdsboro, PA



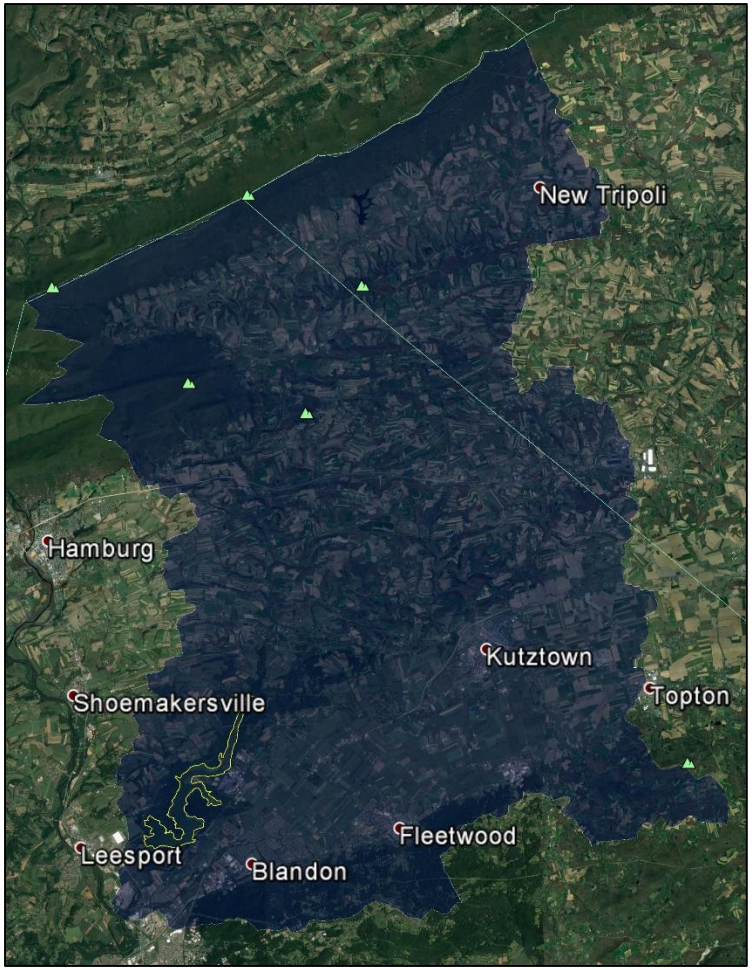
Birdsboro Power Water Use

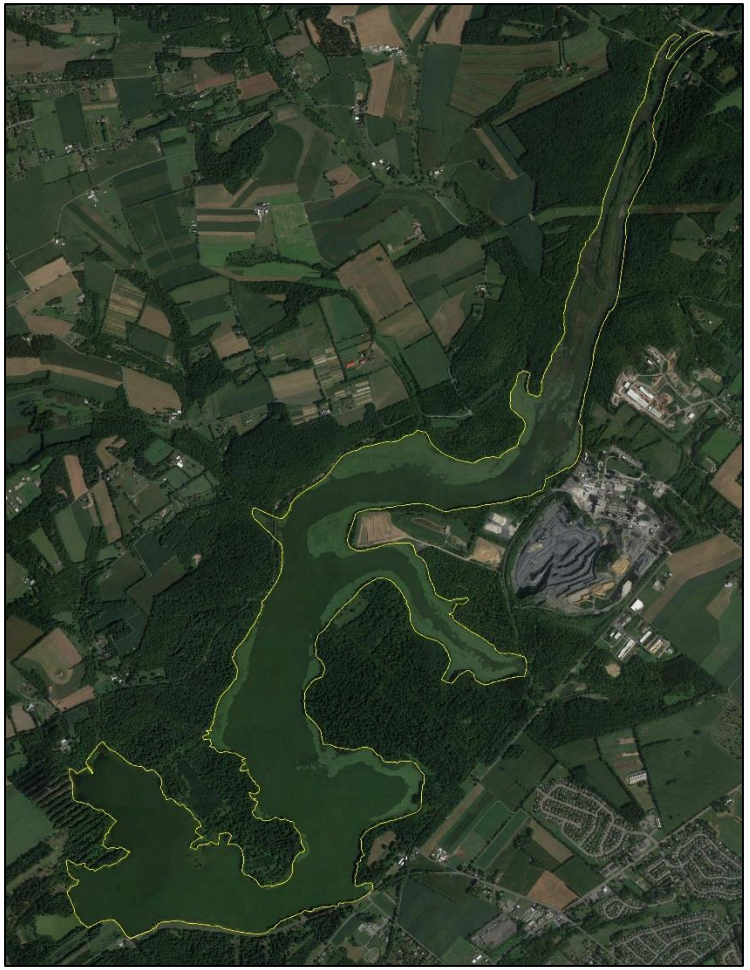


RAWA Water Supply Reservoir

- Lake Ontelaunee
  - Berks County
  - Maiden Creek Watershed > Schuylkill River > Delaware River Basin
- Birdsboro Power located directly on the Schuylkill River (different subwatershed)

Watershed and Reservoir Map

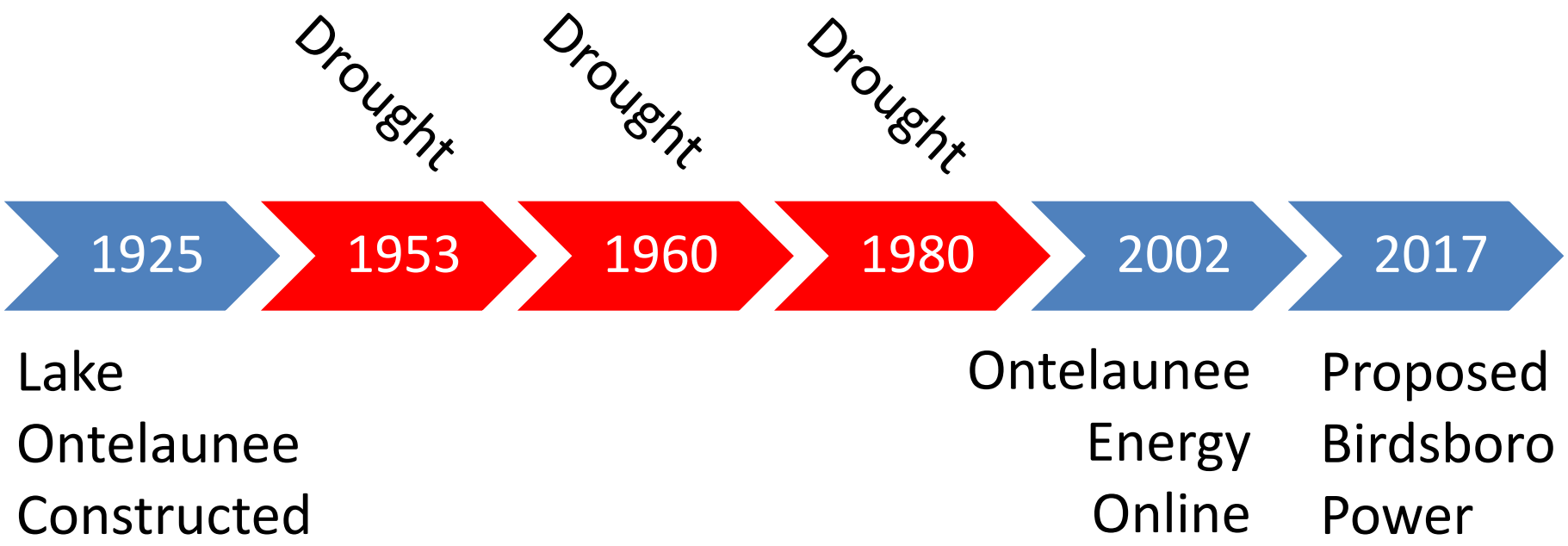




Methodology

- Reservoir simulation study assuming historic flows will occur in the future
- Sequential analysis of reservoir stage, inflow, outflow, withdrawals, operating conditions, and evaporation
- Stream gauge information or surrogate watershed / stream gauge data
- Period of record 1938 – 2016

Major Events



Previous Studies (by Other Consultants)

- Dam Break Study: Ontelaunee Dam, Ontelaunee Hydroelectric Project (FERC, 1995)
- Water Availability Study: Ontelaunee Energy Center (Earth Tech, 2000)
- Water Availability Study: Ontelaunee Energy II LLC (Earth Tech, 2008)
- Water Availability Study: Proposed Berks Hollow Energy Station (Tata and Howard, 2012)

Water Balance Formula

$$\frac{\Delta S}{\Delta T} = \frac{S - S0}{\Delta T} = I \pm GW - L - O - E - MI - CW$$

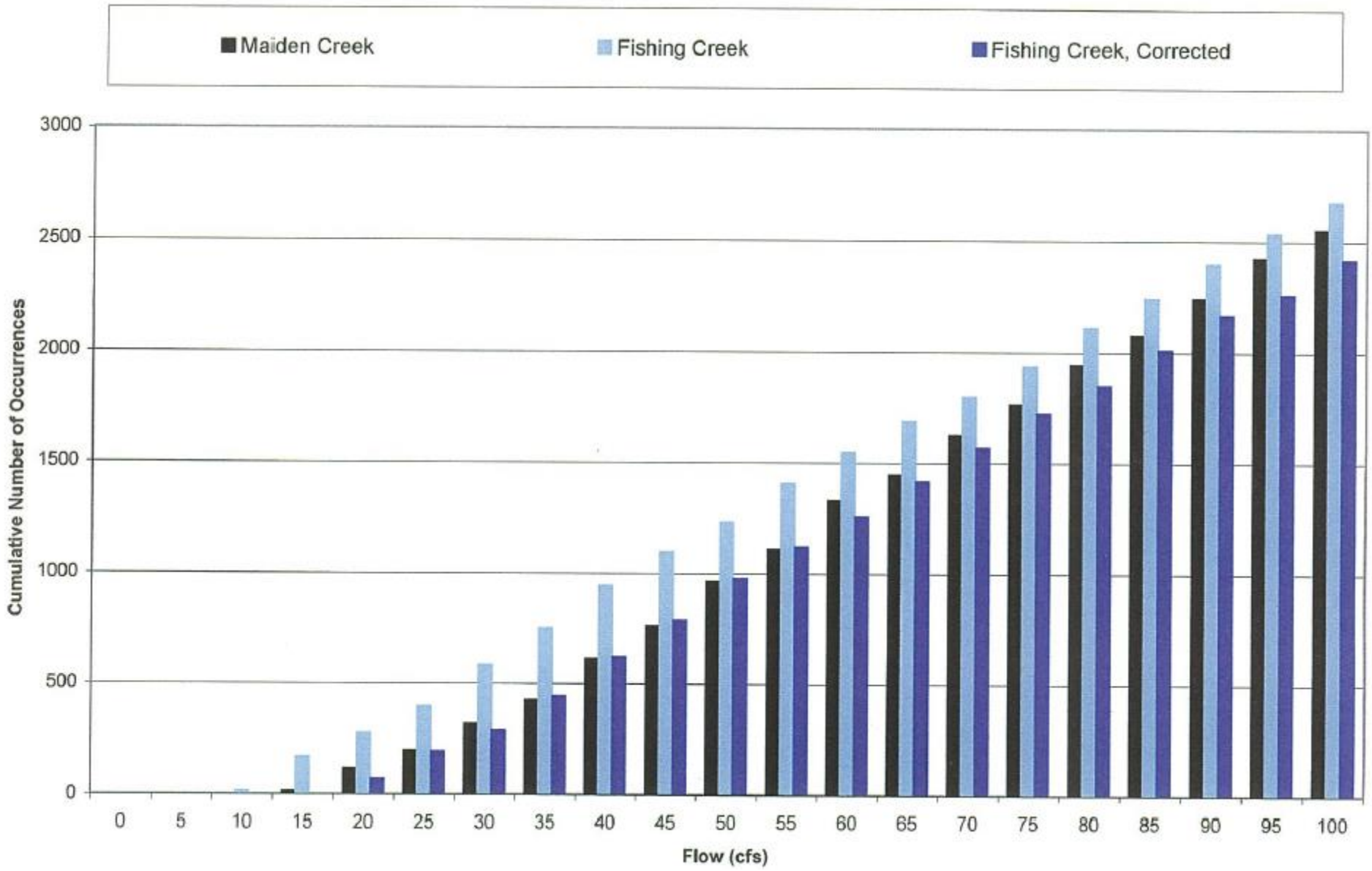
Change in storage over time

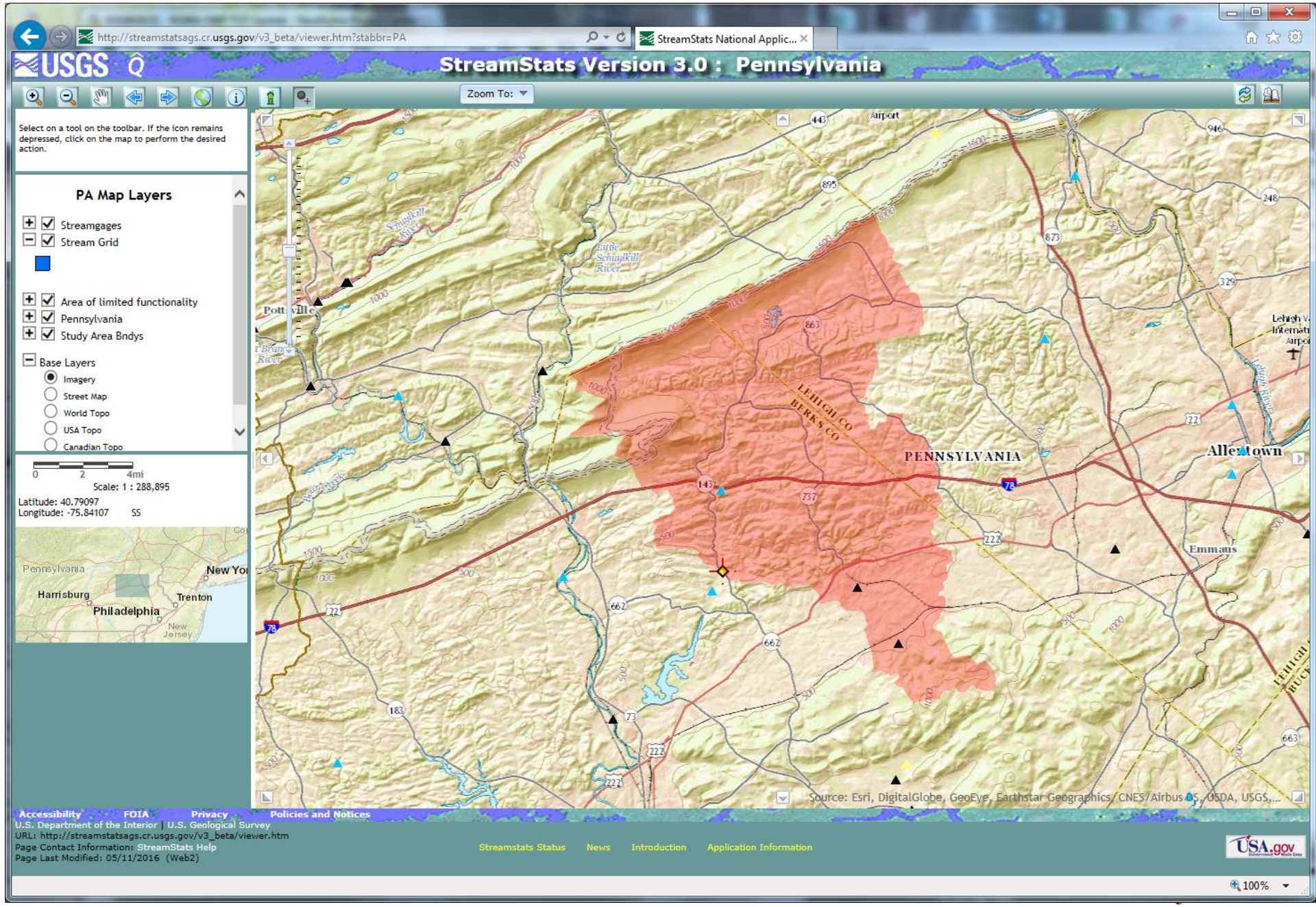
Input

Output

Model Input: Surface Water Inflow

- USGS Gauges on Maiden Creek at Virginville
  - January 1973 to September 1995
  - March 2012 to present
- Fill in data gaps using surrogate watershed
  - USGS Gauge on Fishing Creek near Bloomsburg (1938 to present)
- Calibration procedure – correction factor of 9 CFS added to Fishing Creek data

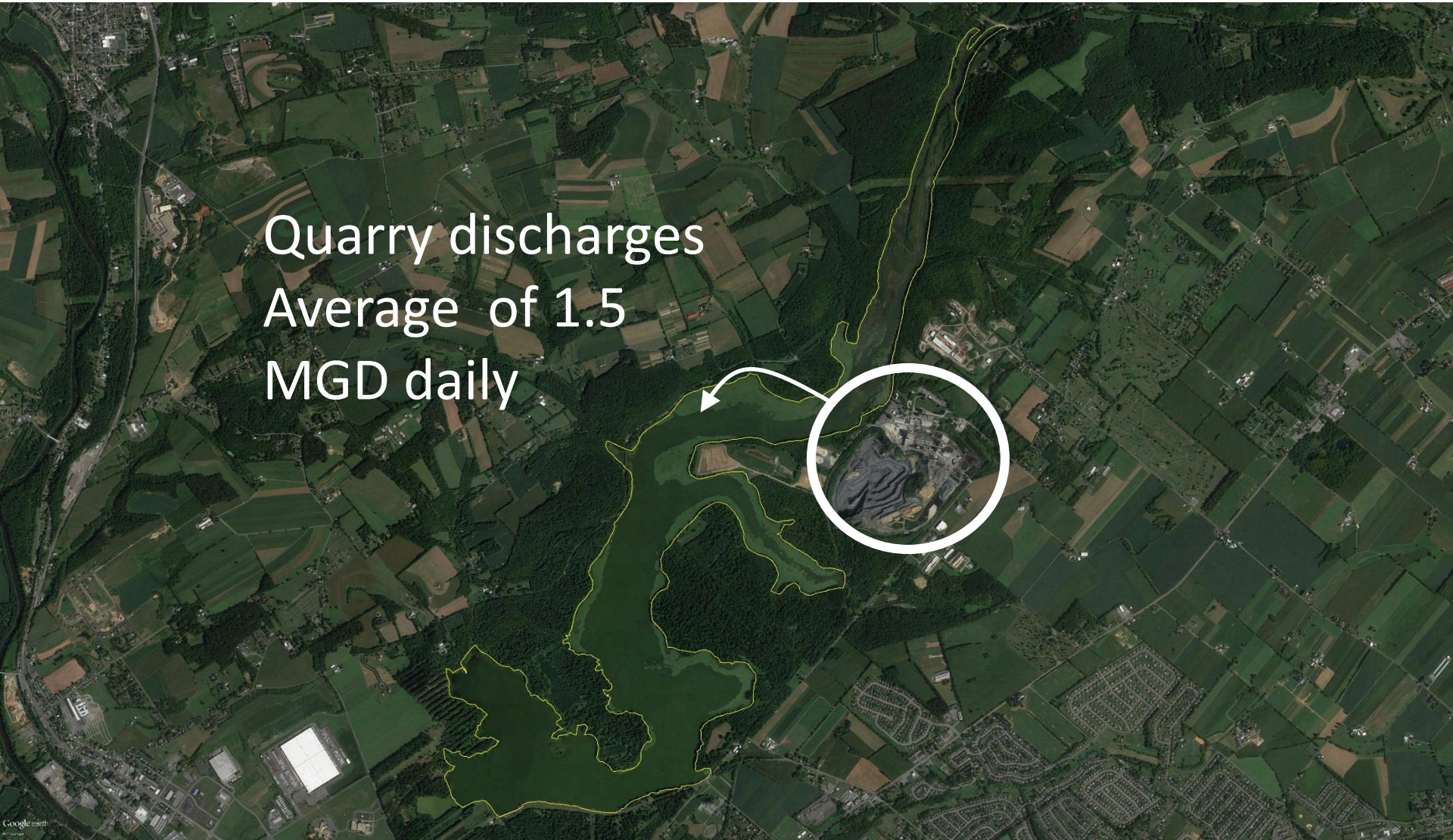

Maiden Creek
Fishing Creek
Fishing Creek, Corrected
Cumulative Number of Occurrences
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
Flow (cfs)


http://streamstatsags.cr.usgs.gov/v3_beta/viewer.htm?stabbr=PA
StreamStats National Applic...
USGS
StreamStats Version 3.0 : Pennsylvania
Zoom To:
Select on a tool on the toolbar. If the icon remains depressed, click on the map to perform the desired action.
PA Map Layers
Streamgages
Stream Grid
Area of limited functionality
Pennsylvania
Study Area Bndys
Base Layers
Imagery
Street Map
World Topo
USA Topo
Canadian Topo
0 2 4mi
Scale: 1 : 288,895
Latitude: 40.79097
Longitude: -75.84107 SS
Pennsylvania
Harrisburg
Philadelphia
Trenton
New Jersey
PENNSYLVANIA
LEHIGH CO
BERKS CO
Allentown
Emmaus
Airport
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS,...
Accessibility FOIA Privacy Policies and Notices
U.S. Department of the Interior | U.S. Geological Survey
URL: http://streamstatsags.cr.usgs.gov/v3_beta/viewer.htm
Page Contact Information: StreamStats Help
Page Last Modified: 05/11/2016 (Web2)
Streamstats Status News Introduction Application Information
USA.gov
100%

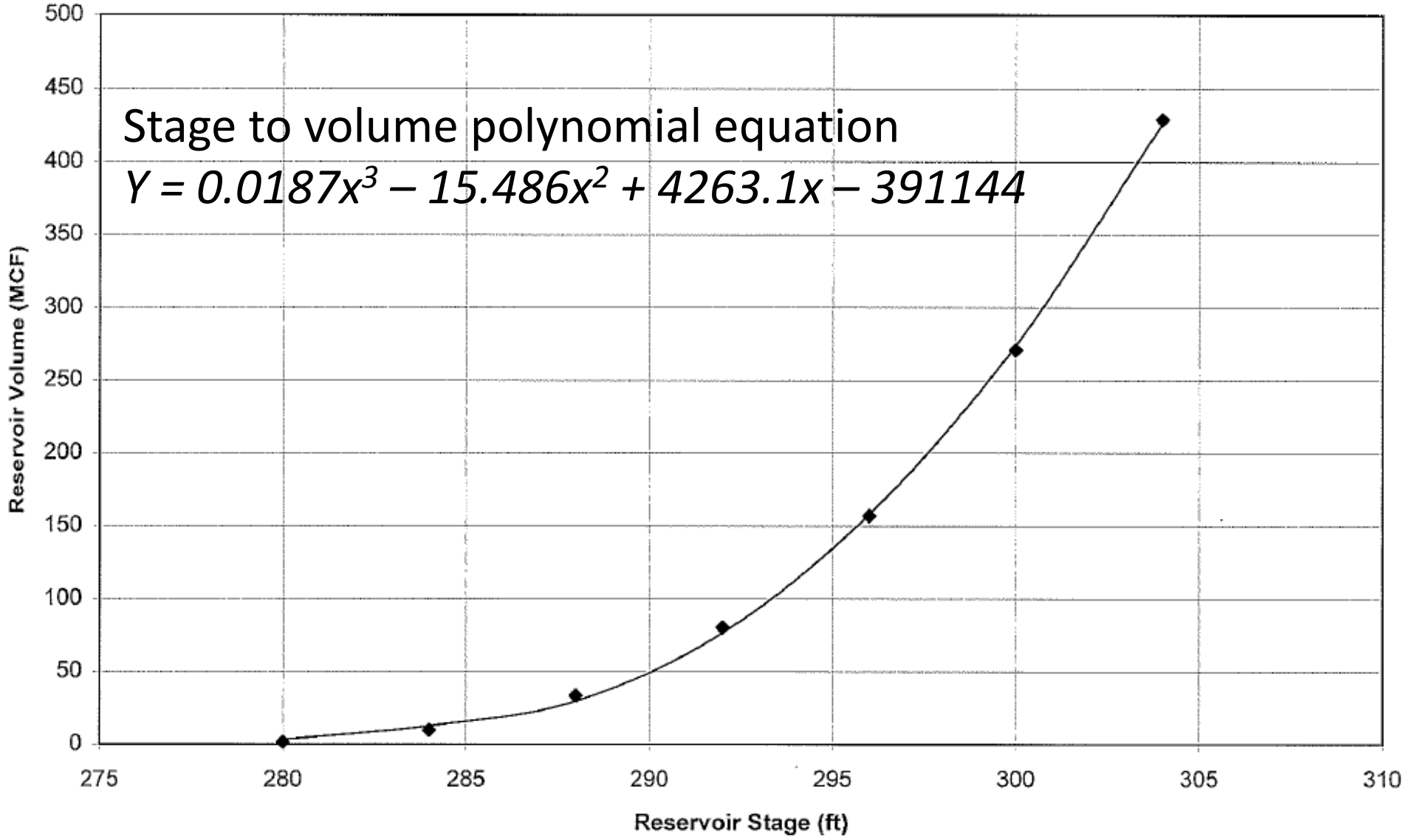
Model Input: Groundwater Exchange

- Losses due to seepage through dam considered small / offset by direct groundwater input
- Assume majority of groundwater baseflow is to tributaries entering the lake
- Conservative input of 15 CFS (50-yr drought flow) for tributaries

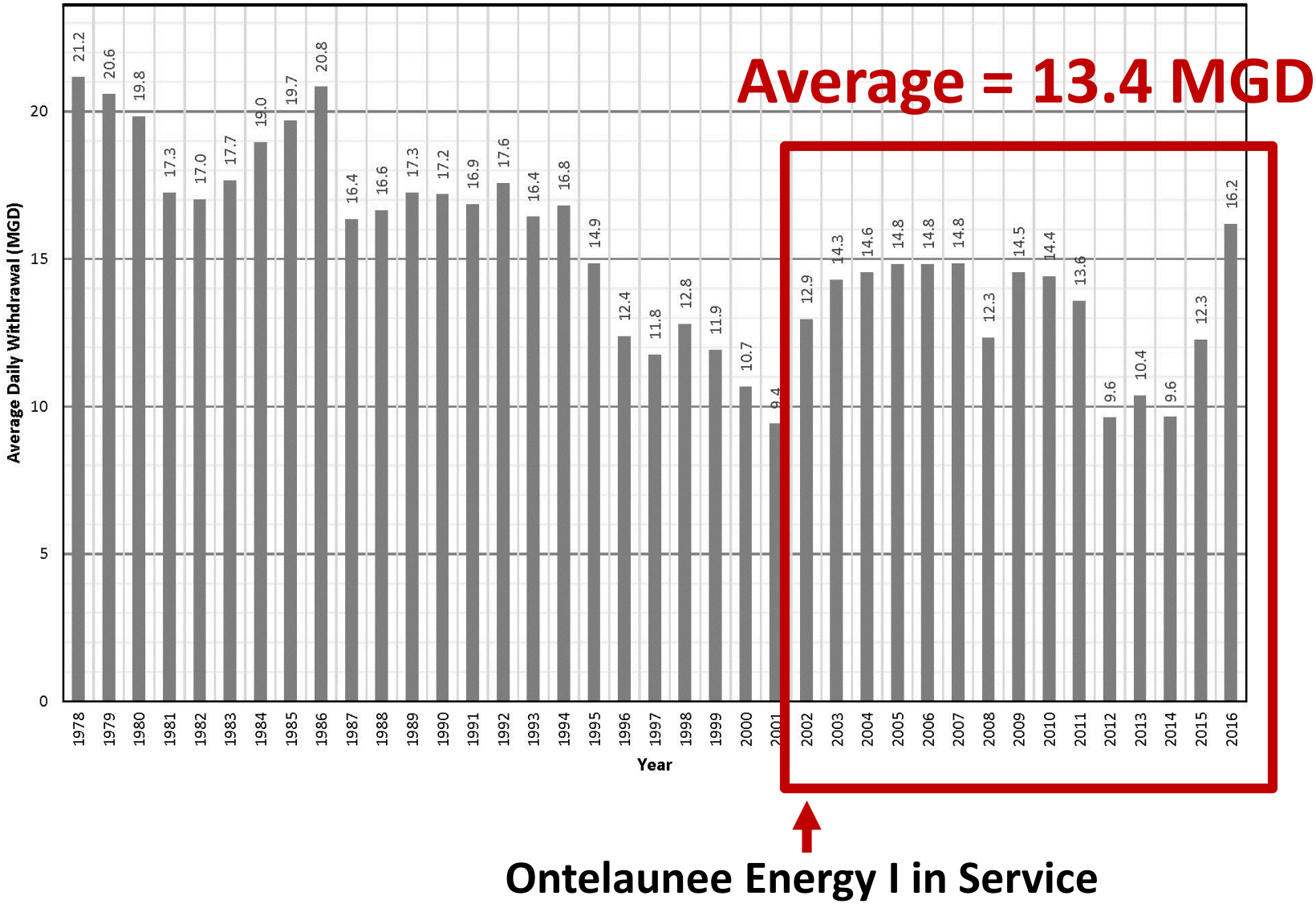
Model Inflow: Quarry Discharge to Lake



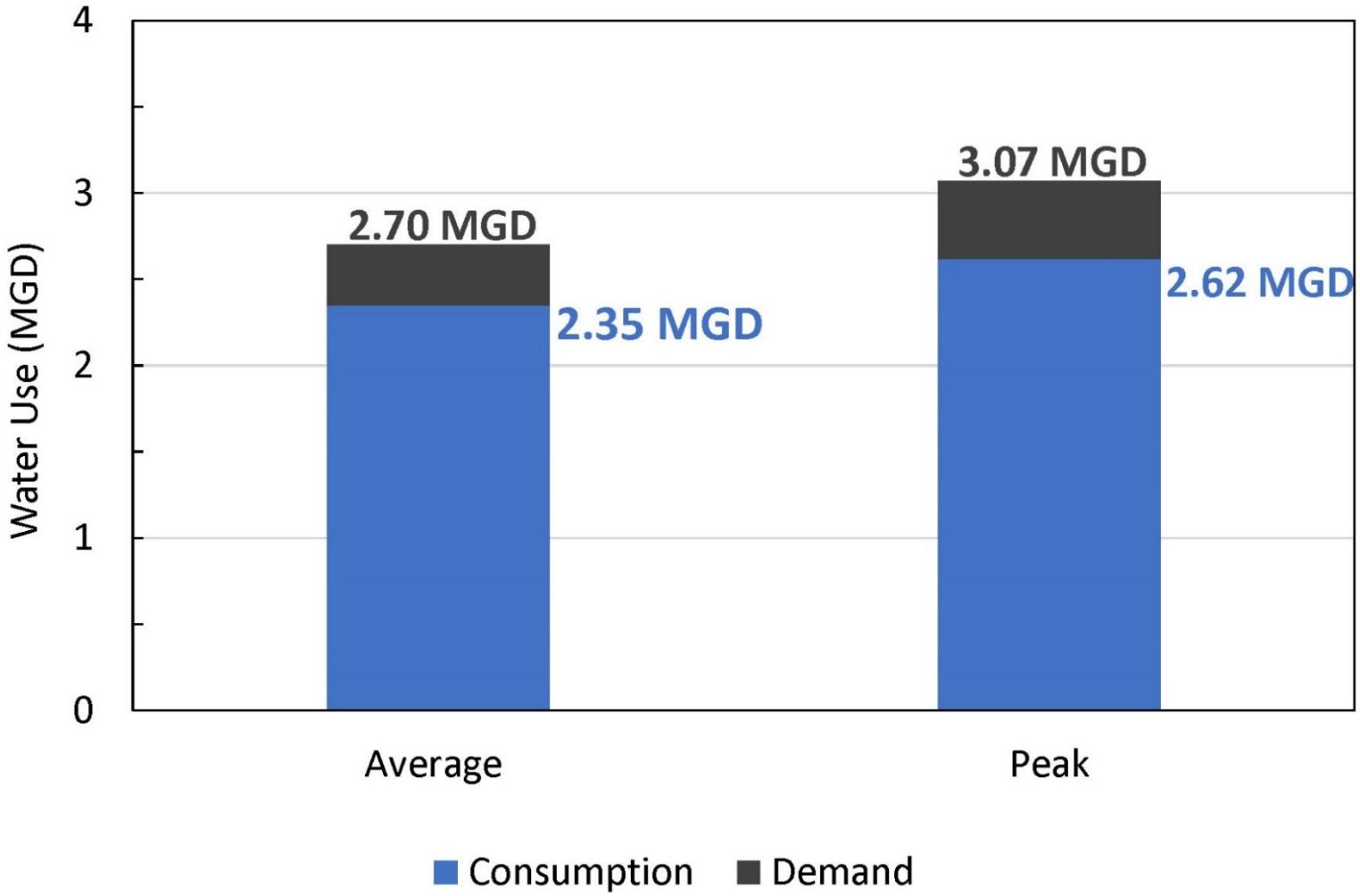
Model Outflow: Spillway Discharge



Model Outflow: Existing Withdrawals



Model Outflow: Birdsboro Power



Model Outflow: Evaporation

Month	Evaporation Rate *(inch/month)*	Data Source
January	0.85	New London, CT, Study
February	0.93	New London, CT, Study
March	1.51	New London, CT, Study
April	2.16	NWS / SRBC
May	4.84	NWS / SRBC
June	5.40	NWS / SRBC
July	5.95	NWS / SRBC
August	4.84	NWS / SRBC
September	3.60	NWS / SRBC
October	2.23	NWS / SRBC
November	1.66	New London, CT, Study
December	1.34	New London, CT, Study

5.6 MGD

Model Analysis: Daily Stage Calculation

Common Weir Equation

$$Q = CLH^{3/2}$$

Where:

Q = Flow over spillway

C = 3.66 (calibrated dimensionless coefficient)

L = Effective length of spillway

H = Height of water surface above spillway

Model Analysis: Conservation Release

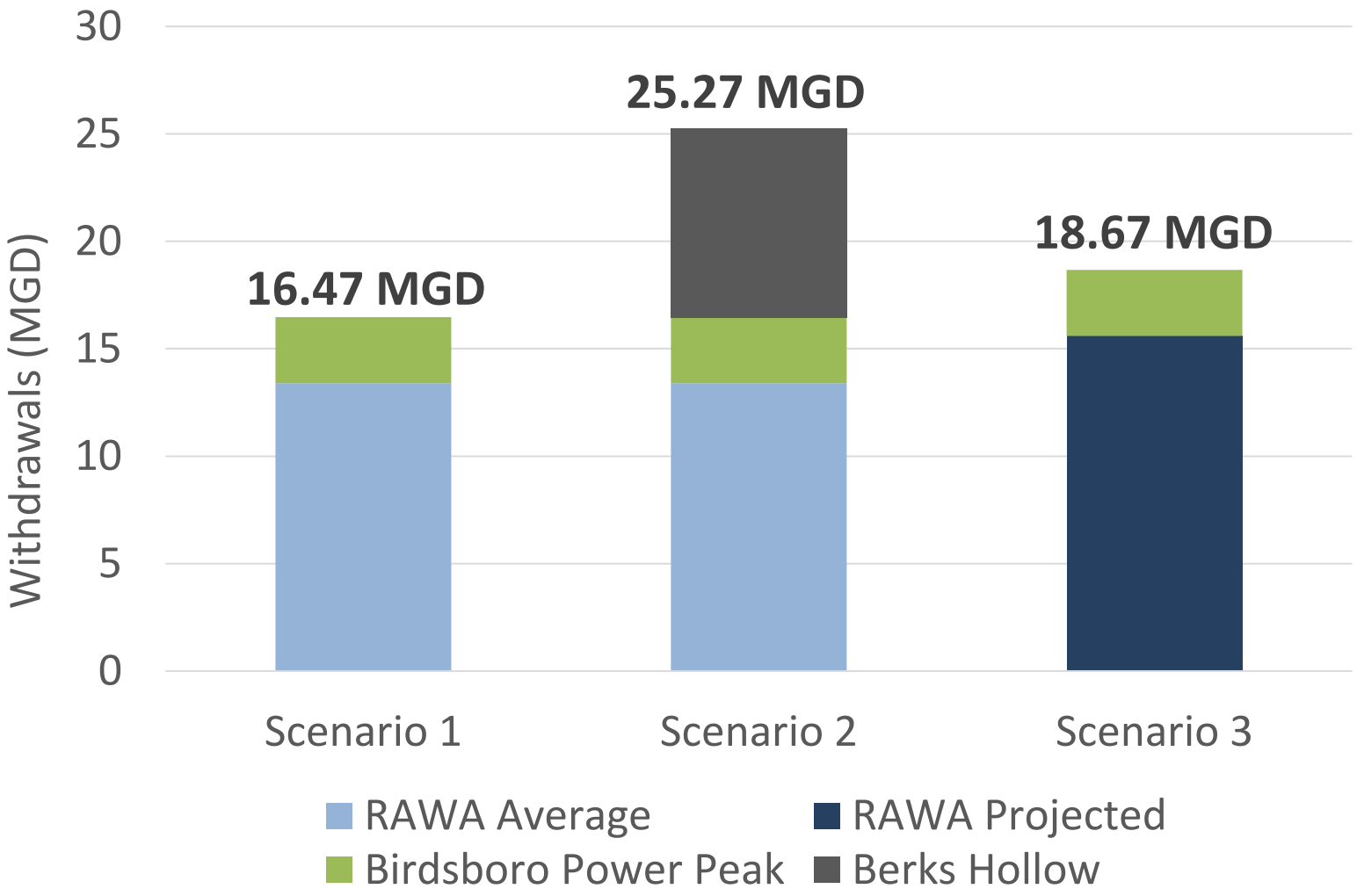
Required for downstream fishery

Reservoir Stage ***(Ft AMSL, NGVD 29)***	**Reservoir Inflow** ***(CFS)***	**Conservation Release** ***(CFS)***
> 302 Ft	*Not Applicable*	51 CFS
300 to 302 Ft	*Not Applicable*	36 CFS
< 300 Ft	≤ 28.8 CFS	28.8 CFS
< 300 Ft	< 28.8 CFS	Reservoir Inflow Rate

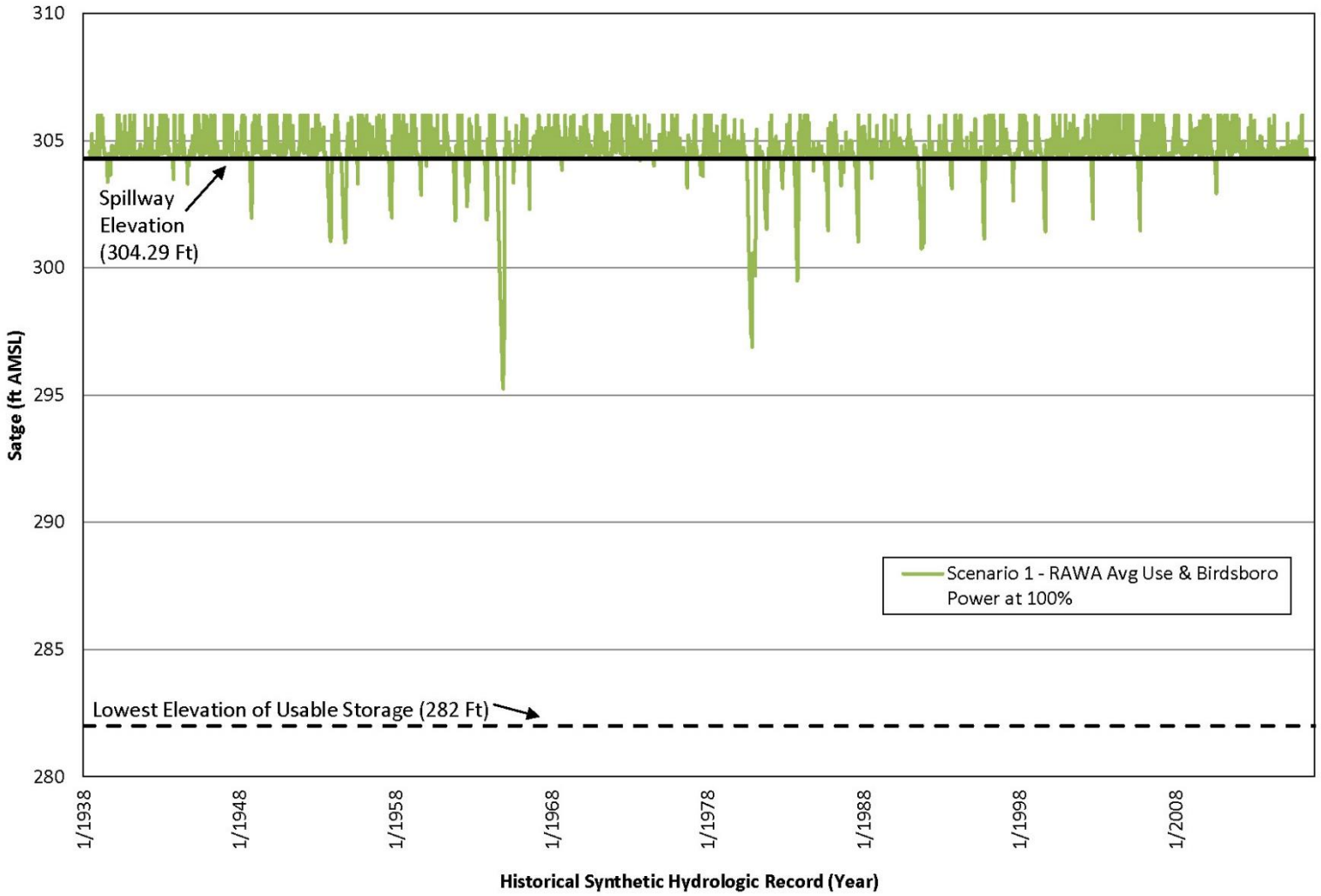
Model Analysis: Excel Macro

- Daily analysis for >28,500 days!
- Analytical Excel sheet: Goal seek and macro (i.e. auto routine / loop)
  - Solve the ratings curve polynomial regression
  - Check if conservation release was needed and apply
  - Pass previous days storage to next day

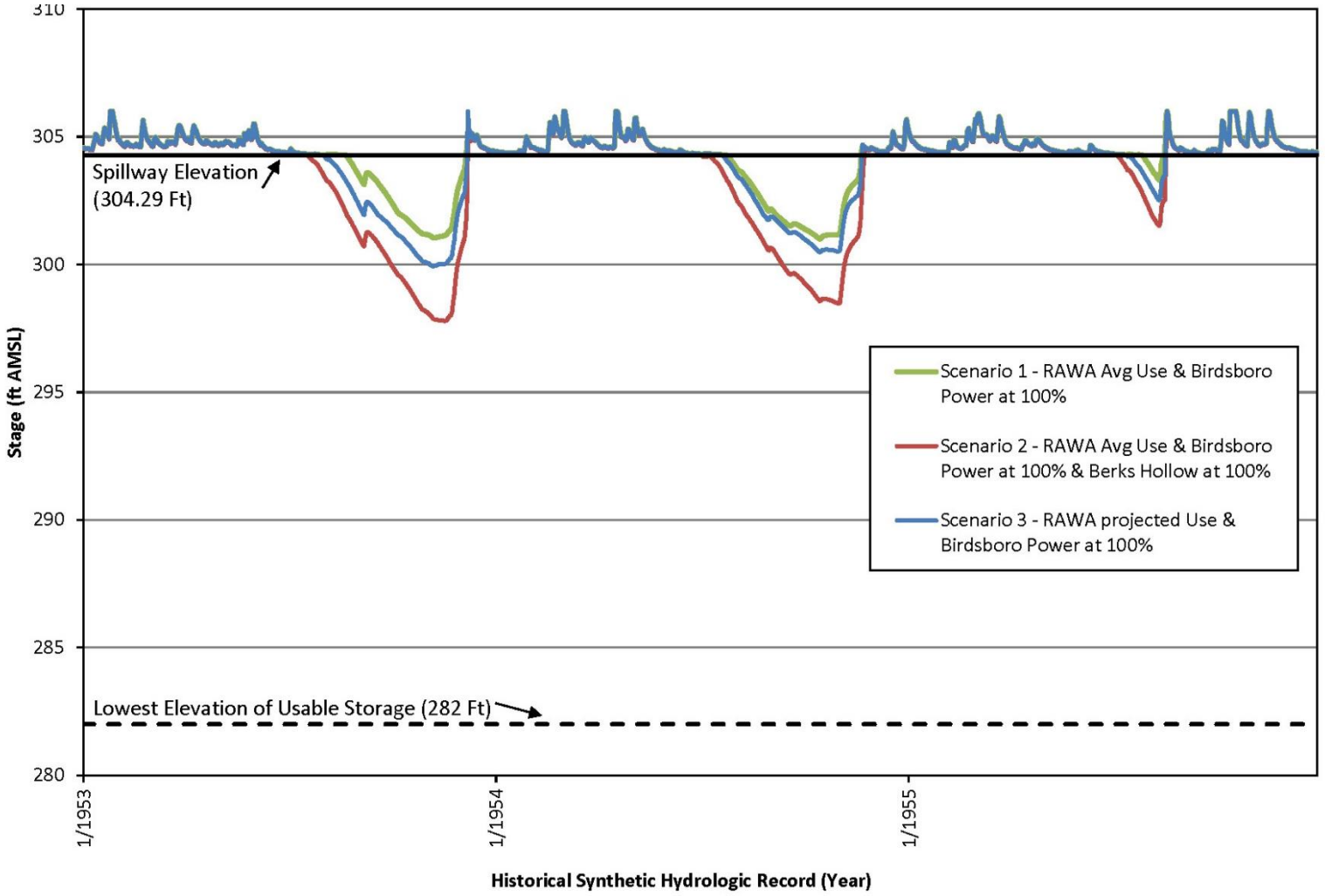
Model Scenarios



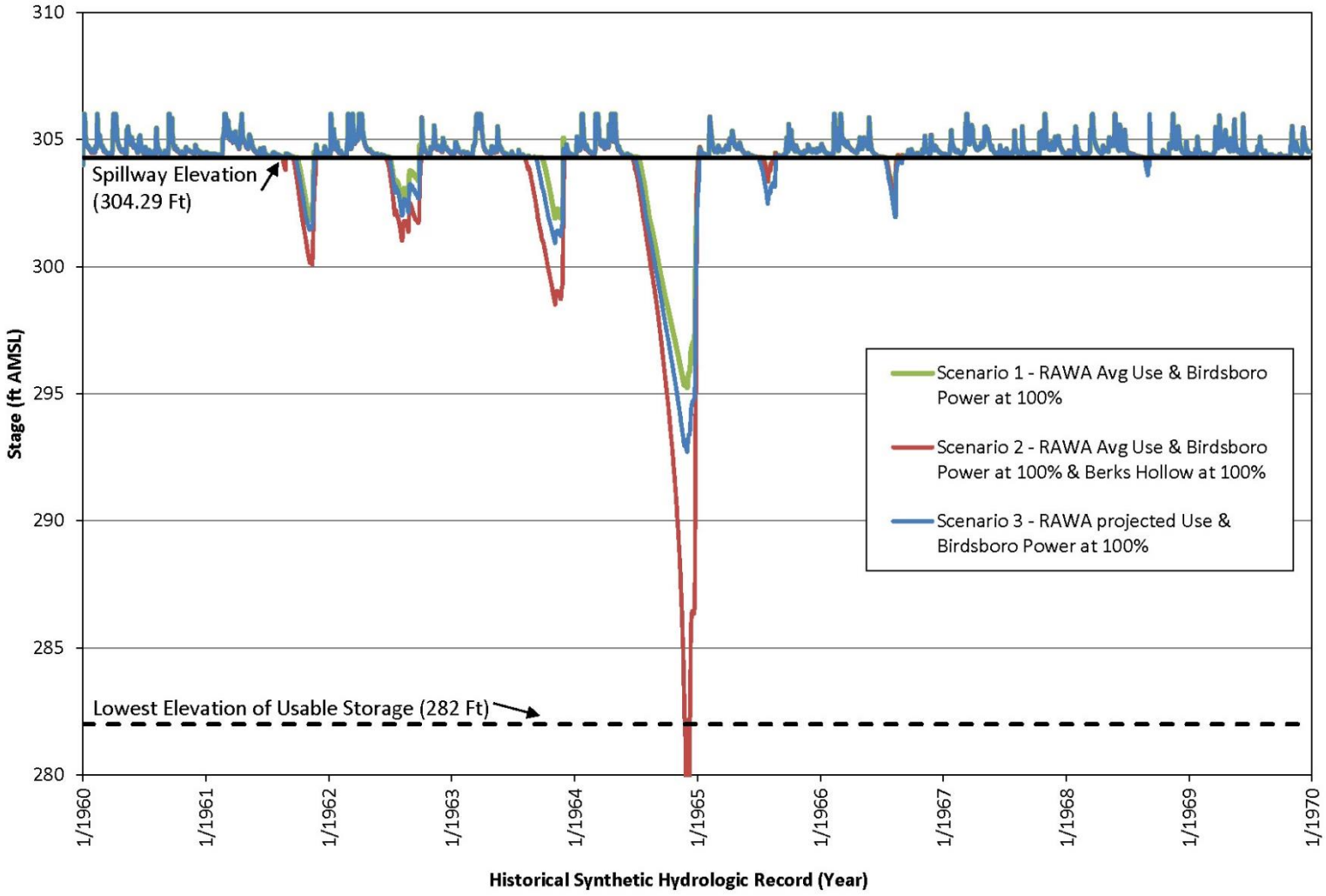
Predicted Stage 1938 - 2016



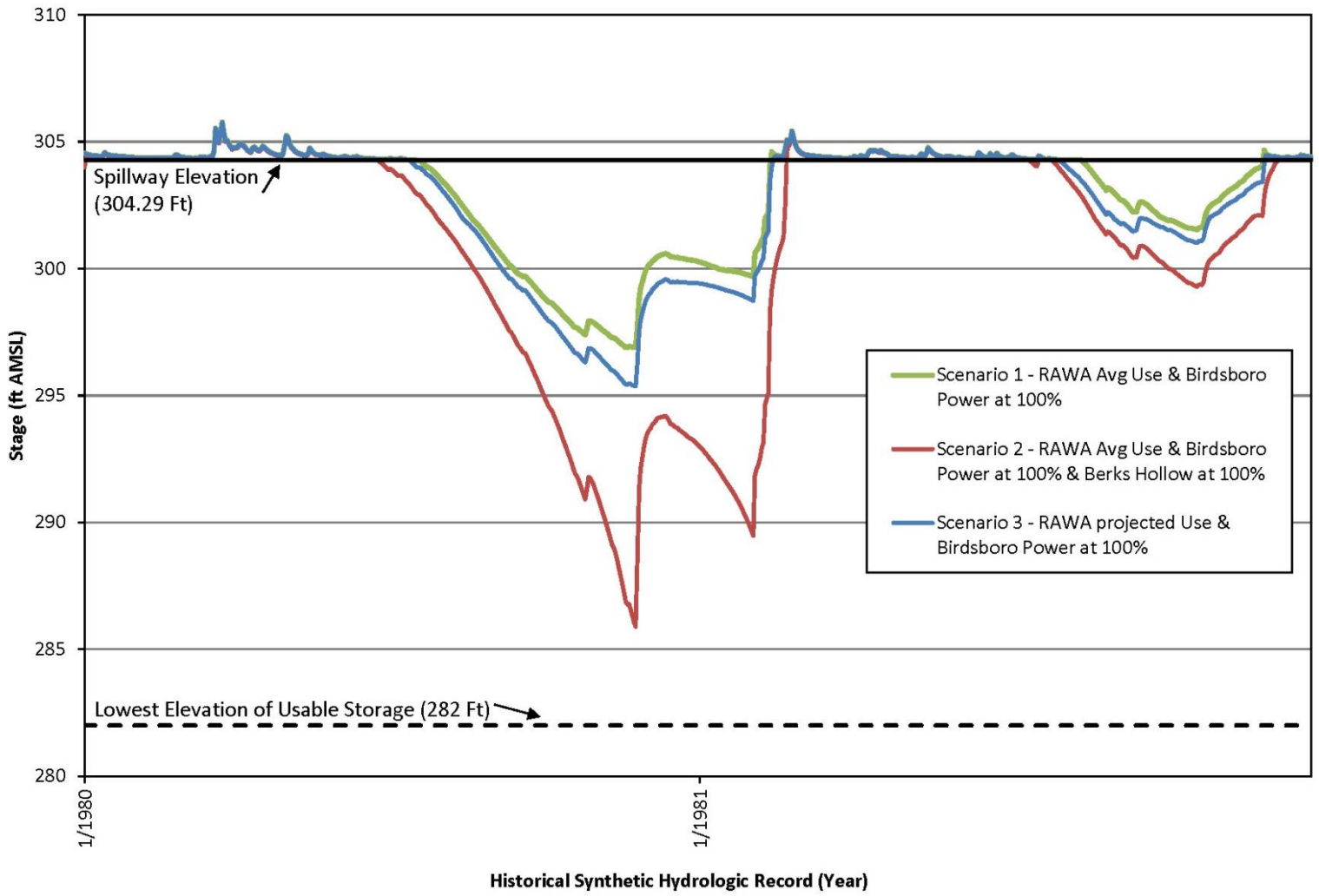
Predicted Stage 1953 - 1955



Predicted Stage 1960's



Predicted Stage 1980-1981



Model Conclusions

- Lake Ontelaunee has sufficient capacity to support Birdsboro Power's water use in addition to RAWA's current and projected needs
- *Note: Berks Hollow's docket was rescinded removing their water use from consideration*
- The current conservation release and proposed Birdsboro Power withdrawals do not have an adverse impact on the storage of the lake