Geosyntec consultants

Stony Brook Streamflow Restoration Project

A Case Study of Coordinated Management of Shared Water Resources

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Introduction

- Management of passive infrastructure such as small dams is often based on rough estimates and professional judgement of system response.

Introduction

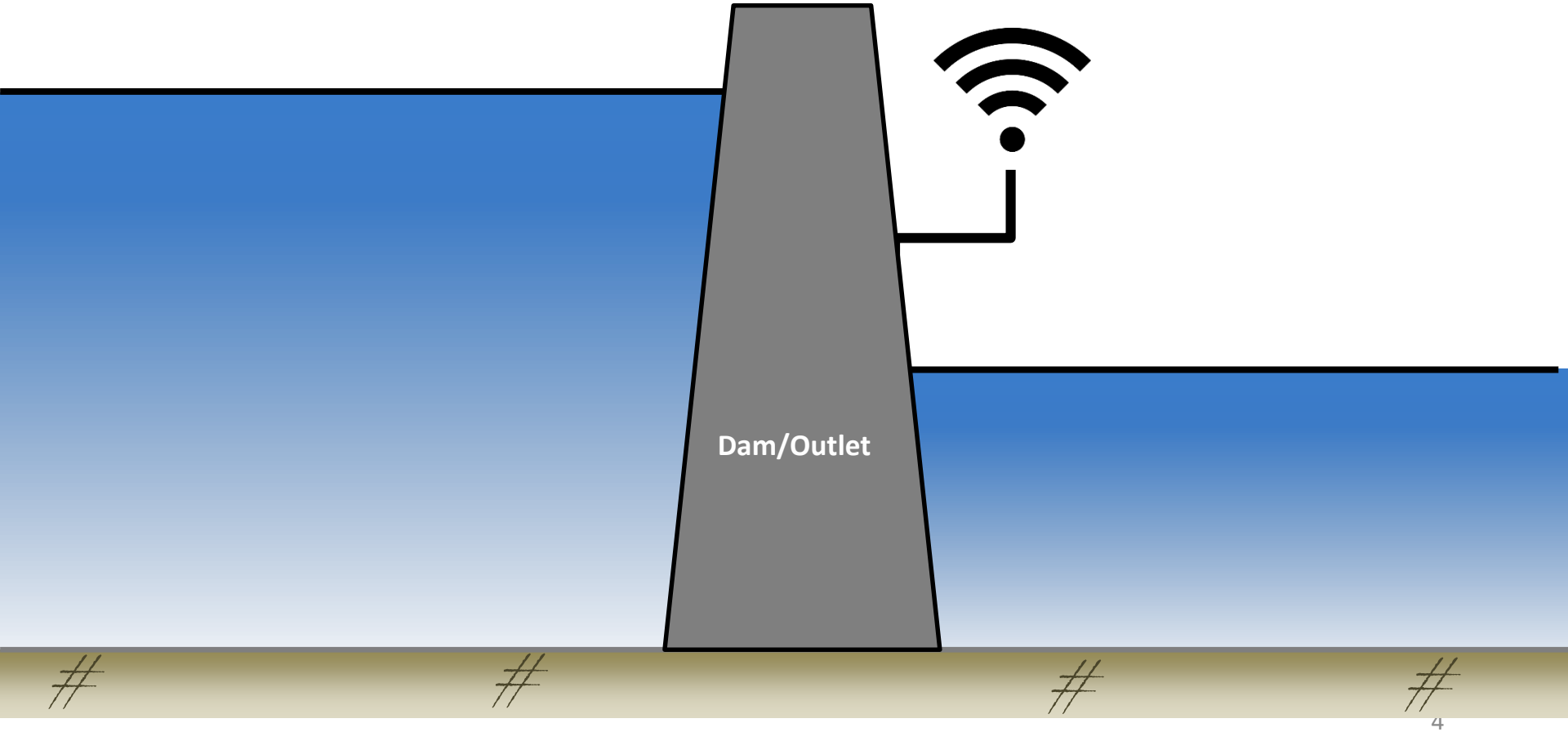
- Poor management can lead to unintended downstream (or upstream) consequences.

Low Flow (Image Credit)

Bank Erosion (Image Credit)

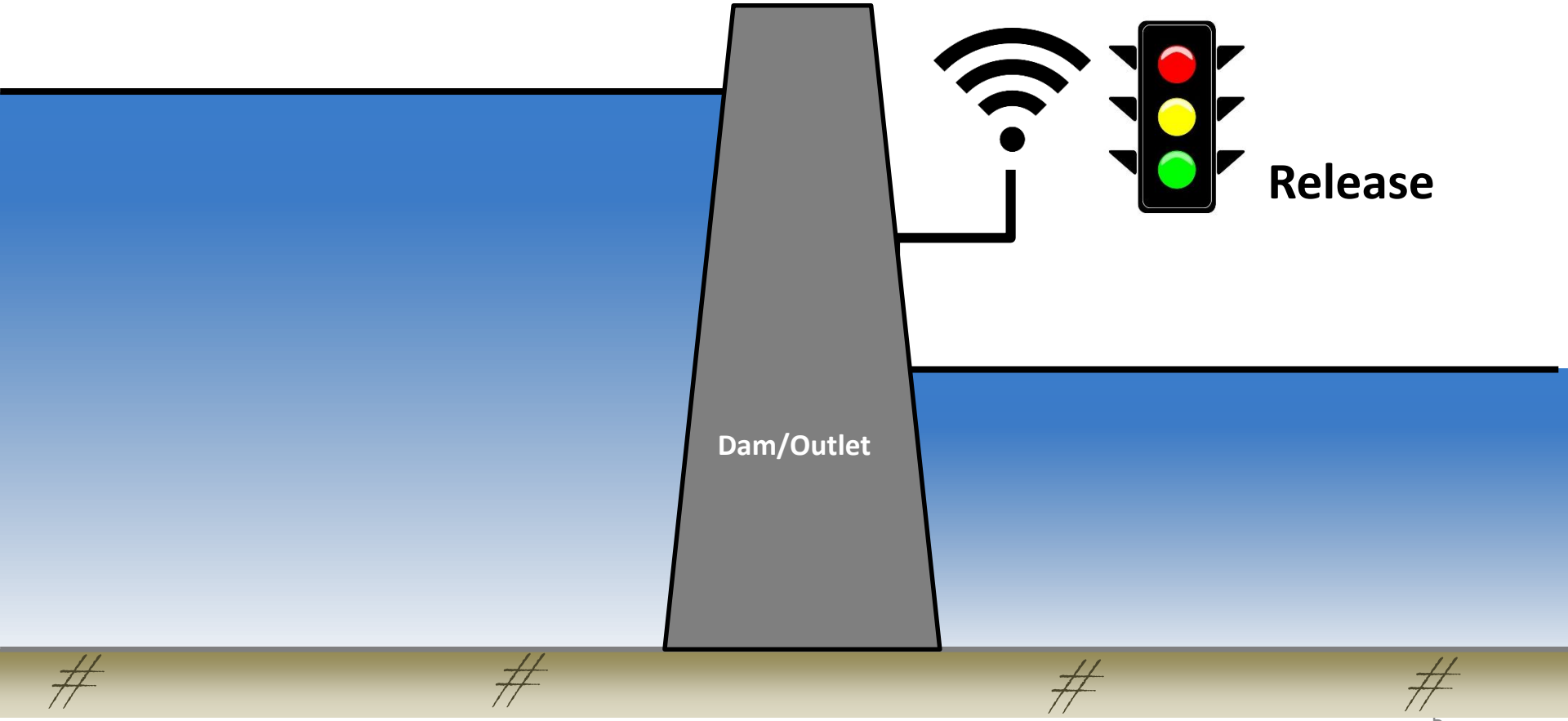
DAM Dashboard Concept

- DAM Dashboard establishes an information network for dams and other infrastructure.



DAM Dashboard Concept

- DAM Dashboard combines monitoring data and forecasts to recommend management actions



Applications / Benefits

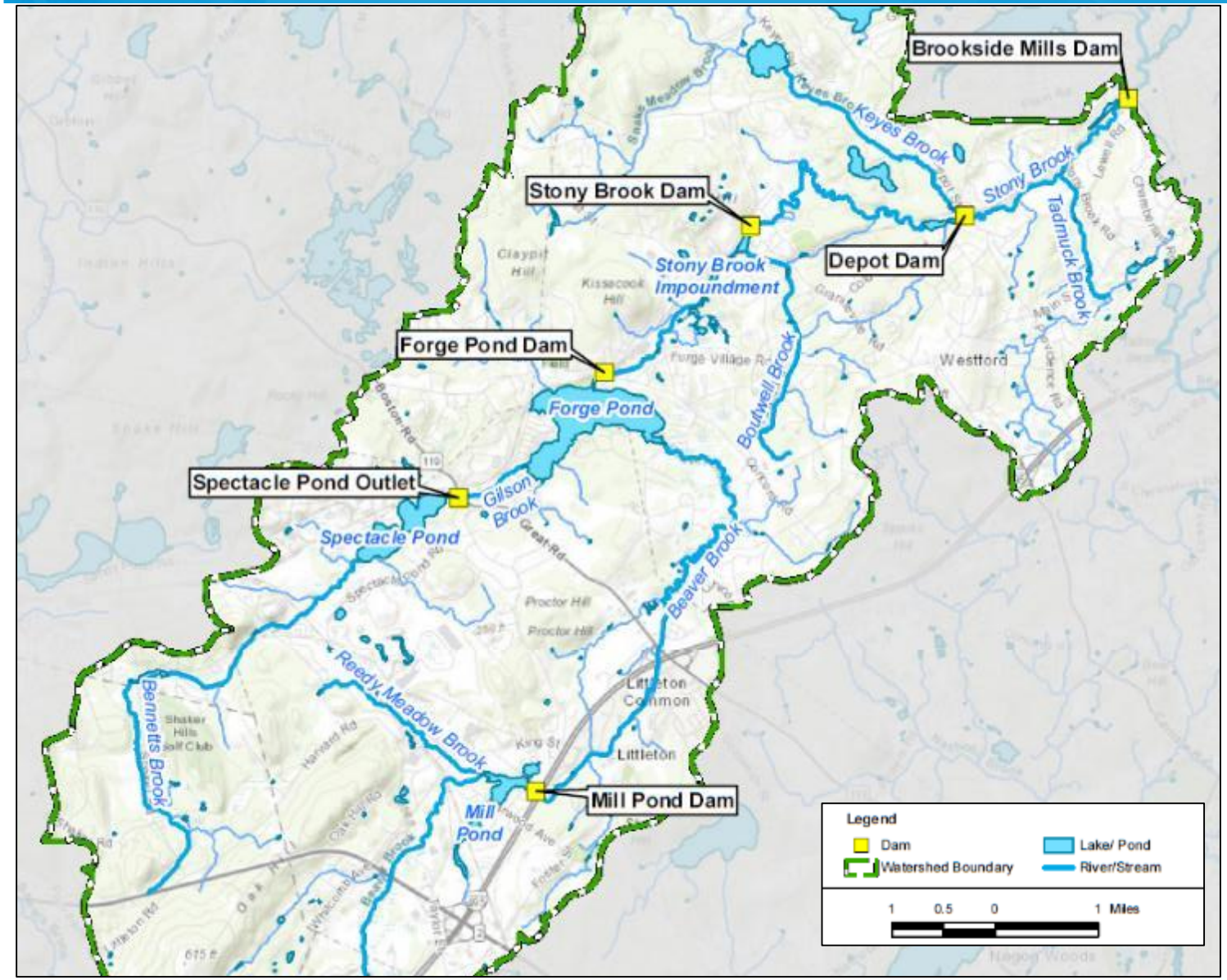
- **DAM Dashboard Goal:** Improve management through informed decision making

Water Supply	• Drought management • Improve streamflow
Lake Management	• Drawdown compliance • Wetland permit compliance
Flood Control	• Reduce Flood Damage Risk • Minimize Downstream Erosion

Stony Brook Flow Restoration Project

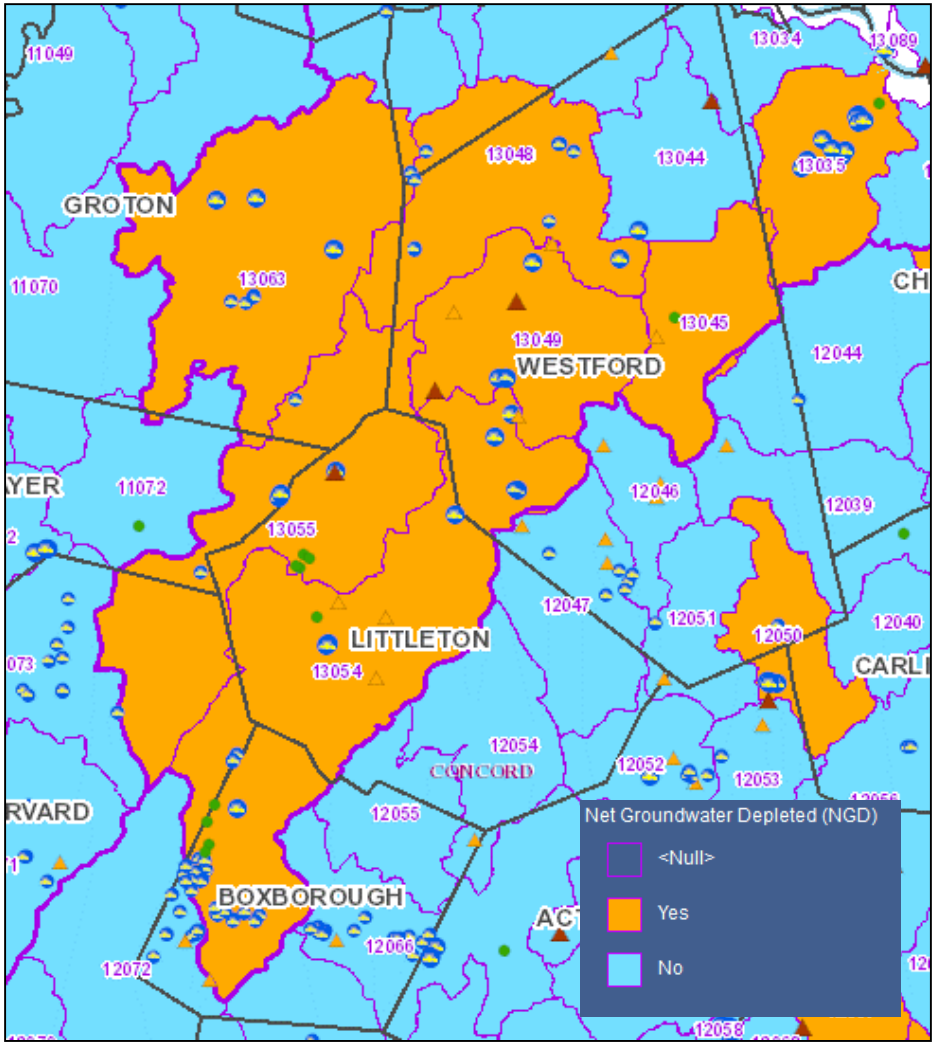
(Pictured: Mill Pond Dam, 4/4/2018)

Study Area


Brookside Mills Dam
Stony Brook Dam
Depot Dam
Forge Pond Dam
Spectacle Pond Outlet
Mill Pond Dam
Keyes Brook
Stony Brook
Tadmuck Brook
Stony Brook Impoundment
Boutwell Brook
Forge Pond
Gilson Brook
Spectacle Pond
Beaver Brook
Reedy Meadow Brook
Bennetts Brook
Mill Pond
Westford
Littleton
Littleton Common
Legend
Dam
Lake/ Pond
Watershed Boundary
River/Stream
1 0.5 0 1 Miles

Project Background / Driver

- Water supply source basins are stressed
- Requirement to minimize impact of groundwater withdrawals



Project Background / Driver

Streamflow along mainstem is often low throughout watershed

(Pictured: Spectacle Pond Outlet, Drought Conditions, 9/27/2016)

Project Purpose & Outcomes

Collaborate with stakeholders to improve streamflow through **coordinated operation** of existing impoundments using decision support tools informed by model results, streamflow data, and weather forecasts.

- Outcomes
  - Calibrated Model
  - Operational Goals
  - Monitoring Network
  - Operational Strategies
  - Decision Support Dashboard
  - **Improved Streamflow Management!**

Stony Brook: Project Workflow

Project Initiation: Goal Setting

(Pictured: Forge Pond Dam, 8/2/2017)

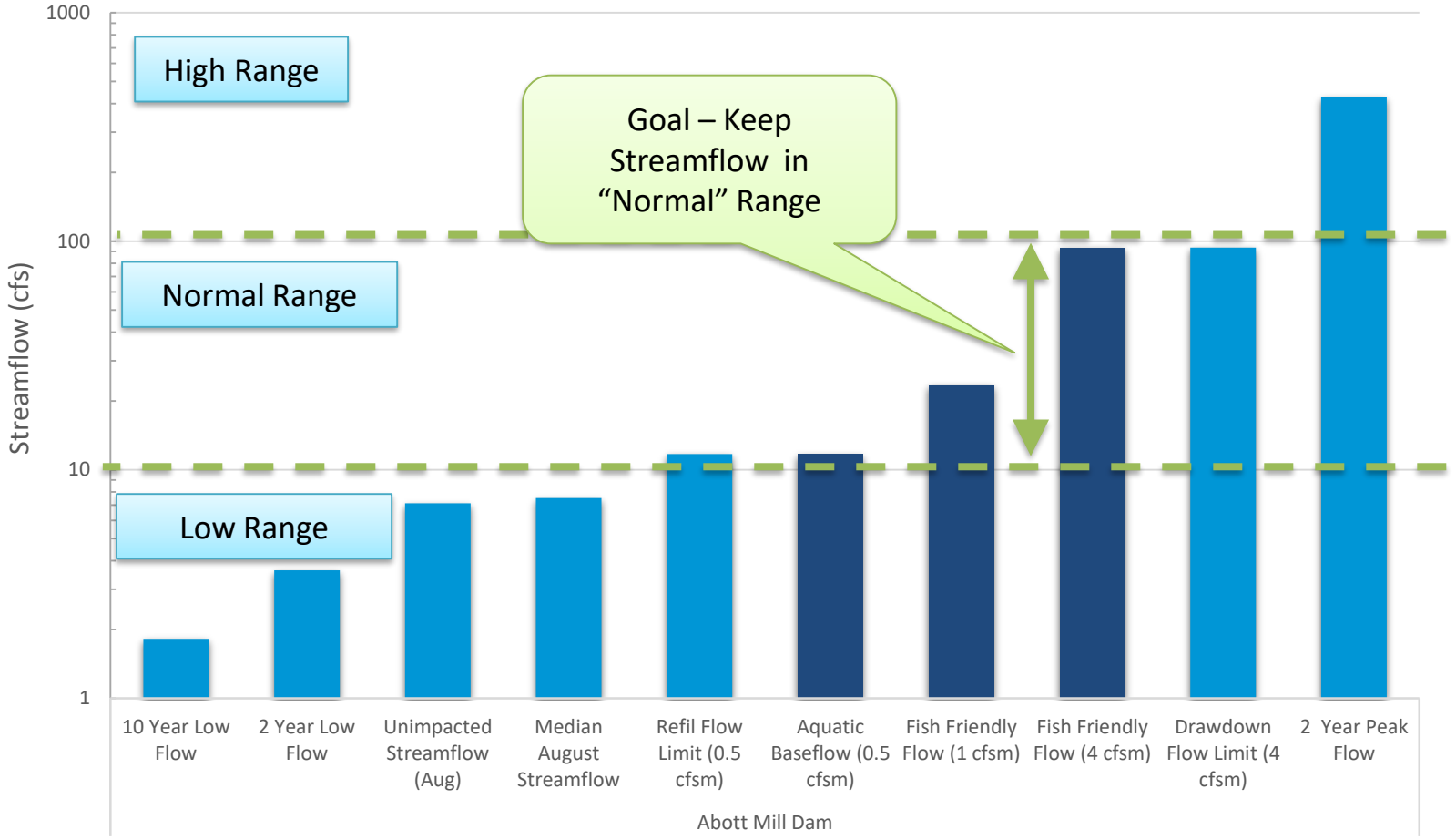
Goal Definitions

- Overarching goal to mimic “natural” streamflow conditions without compromising other in-lake uses and stakeholder concerns

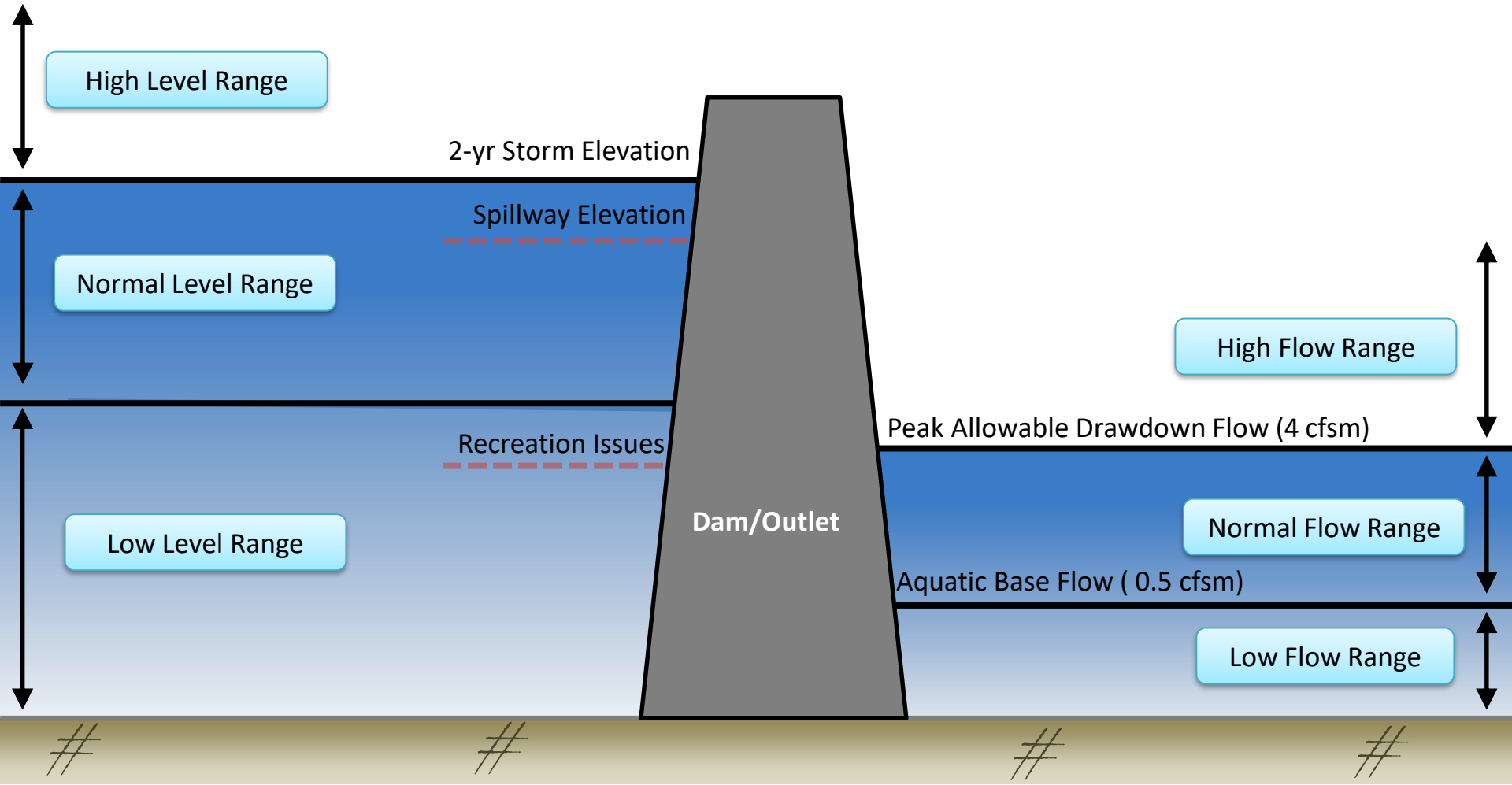
Goals
Mimic Natural Conditions
Maintain Streamflow
Improve Storm Resiliency
Protect Fish Populations
Control Vegetation
Maintain Recreational Uses

Indicator Threshold Definitions

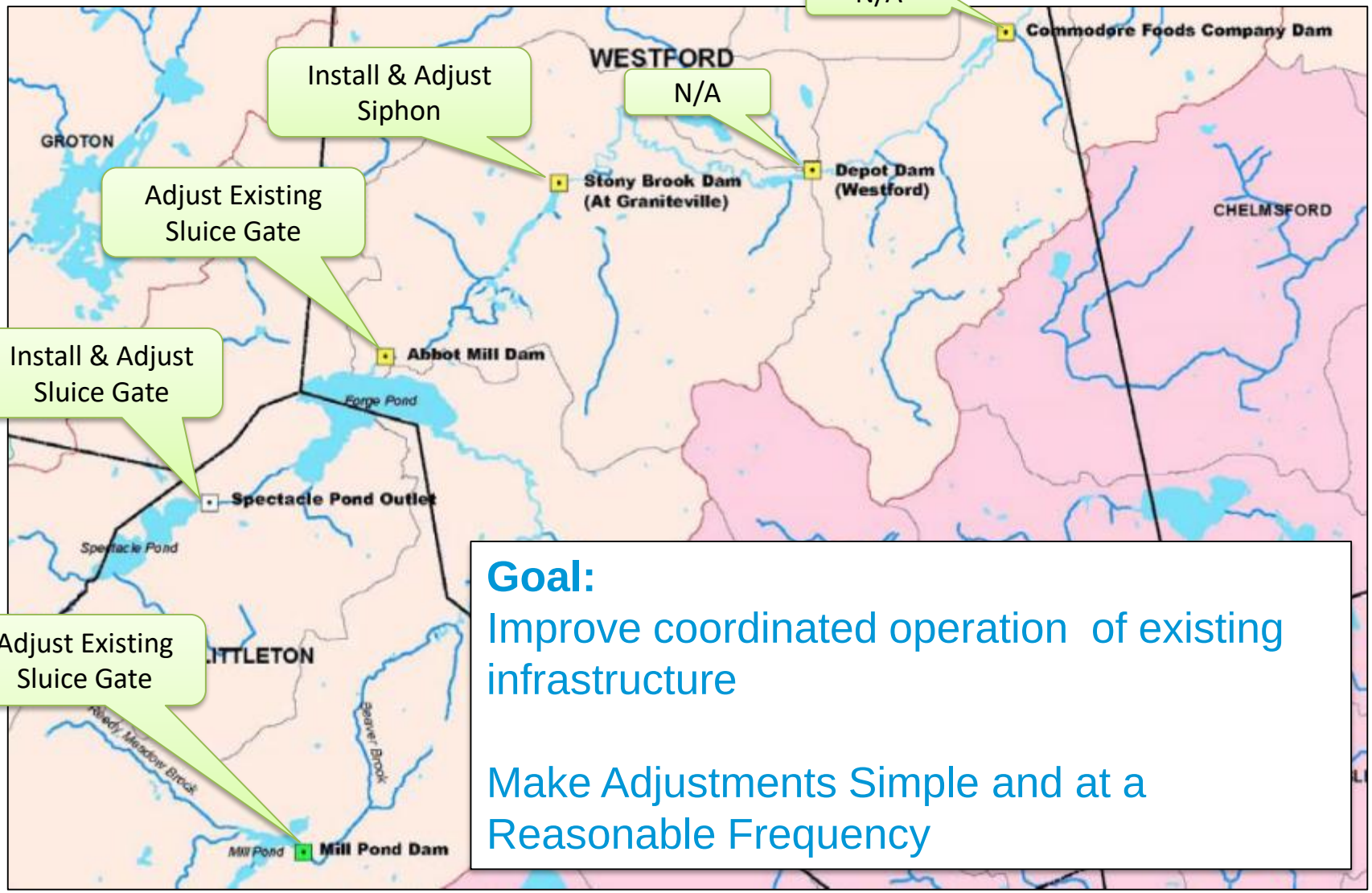
- Developed Simplified Streamflow and Water Level Thresholds to Evaluate Goals at Each Impoundment



Example Indicator Thresholds



Potential Operational Adjustments



Goal:

Improve coordinated operation of existing infrastructure

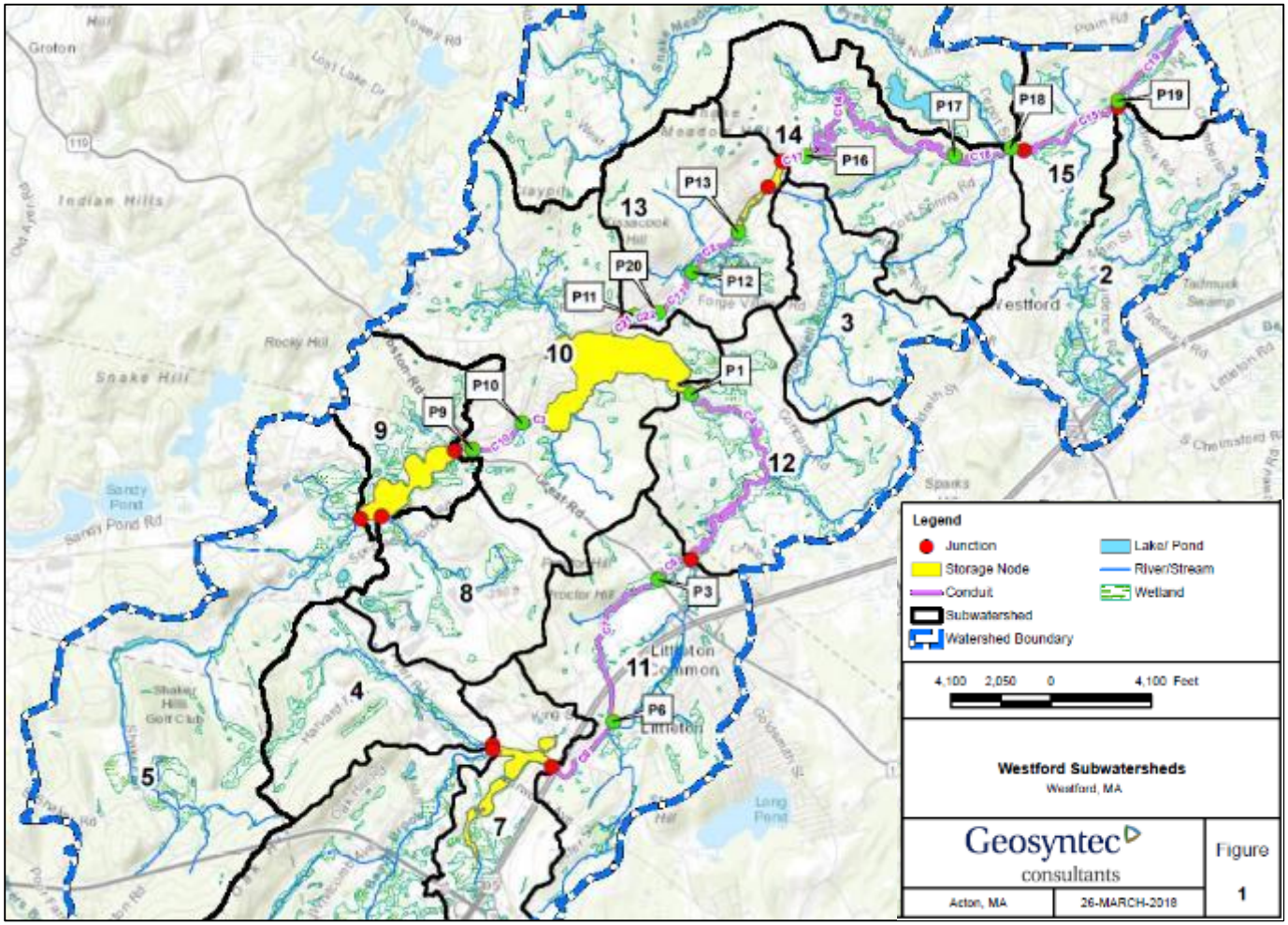
Make Adjustments Simple and at a Reasonable Frequency

Model Development

(Pictured: Stony Brook Dam, 4/5/2018)

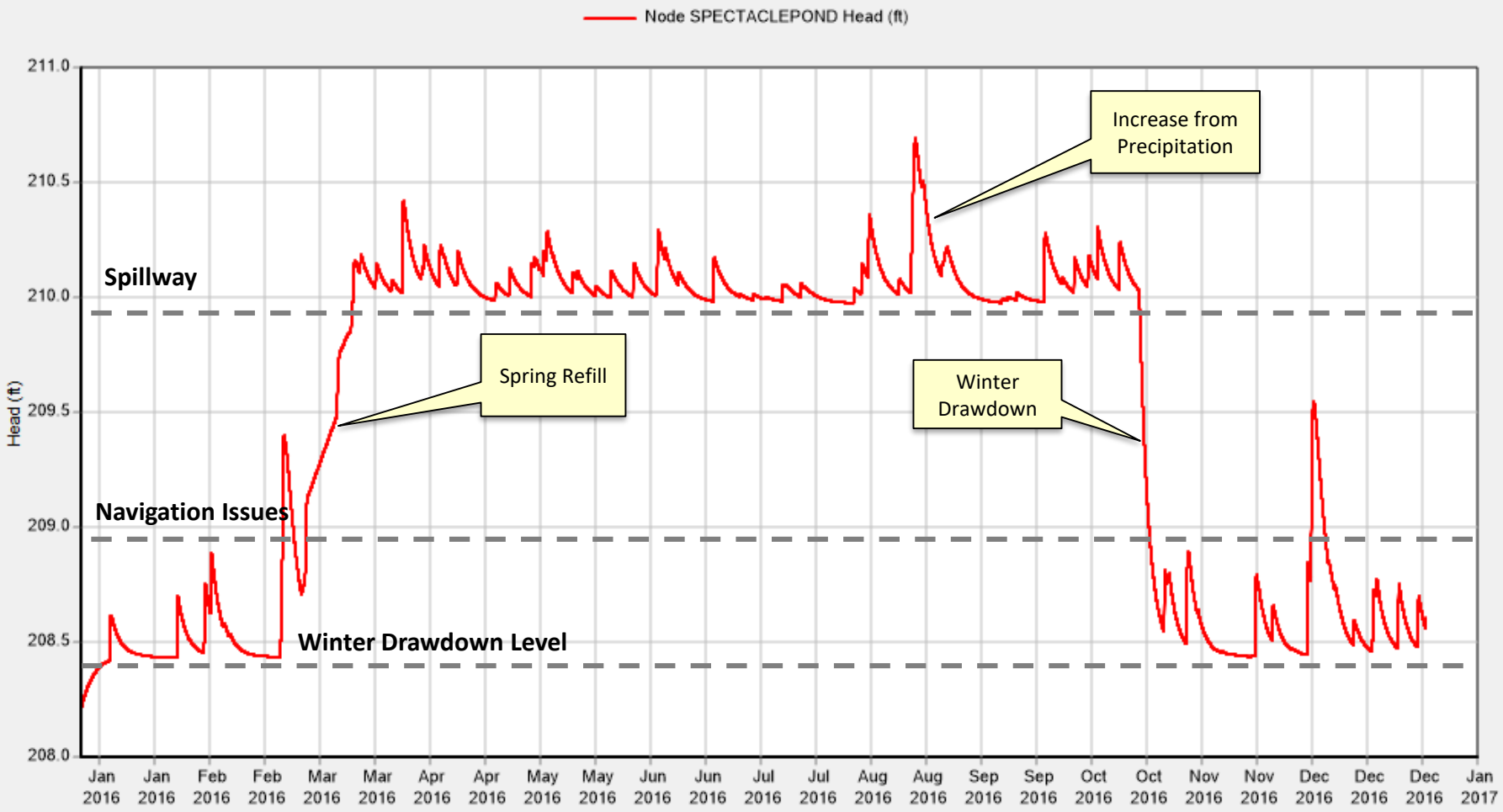
Existing Conditions Model

- Developed to enable testing of evaluation strategies (Model: EPA SWMM 5.1)



Existing Conditions Simulations – Spectacle Pond

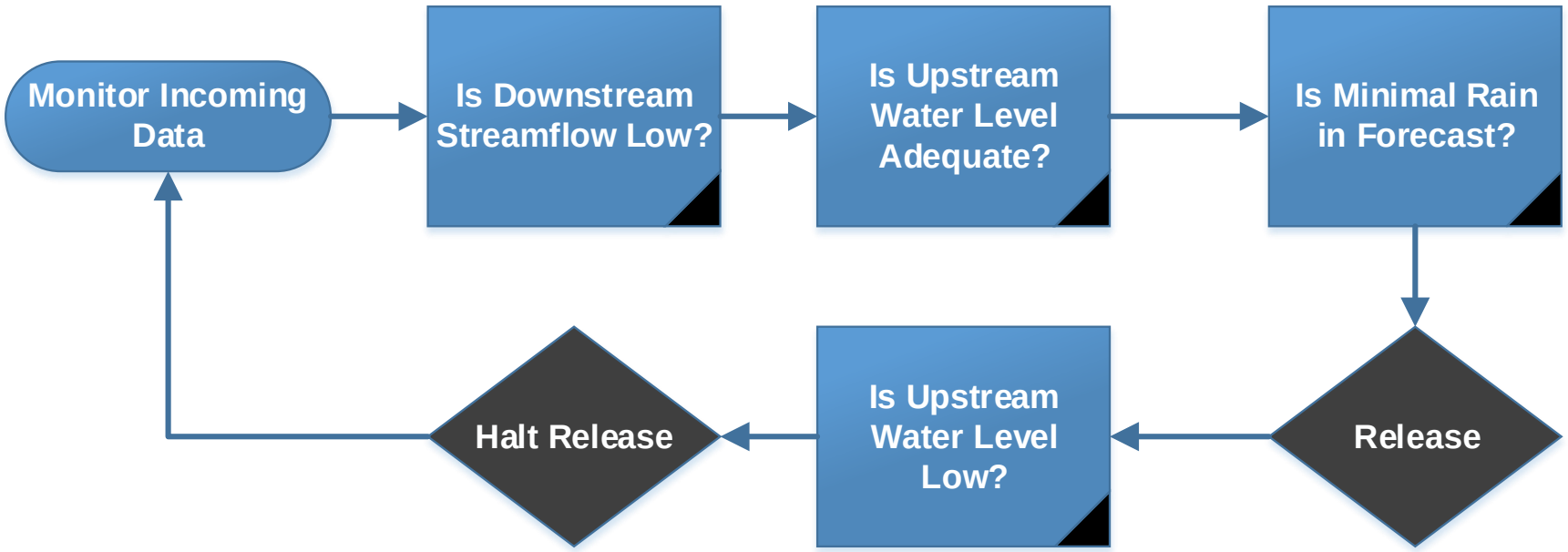
- Simulations take into account seasonal drawdown and refill



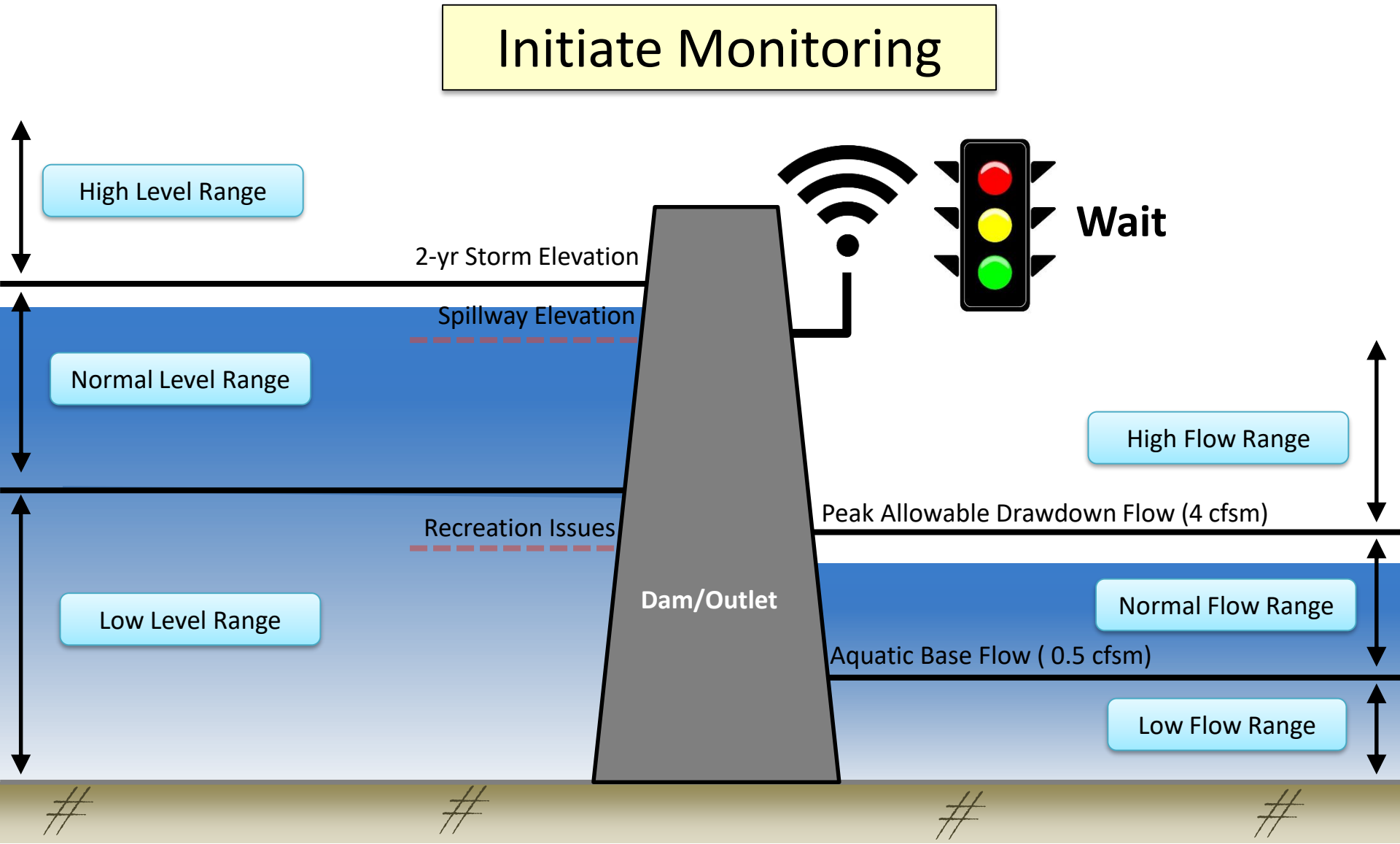
Operational Strategy Development

- Developed three (3) model iterations to test potential streamflow improvements

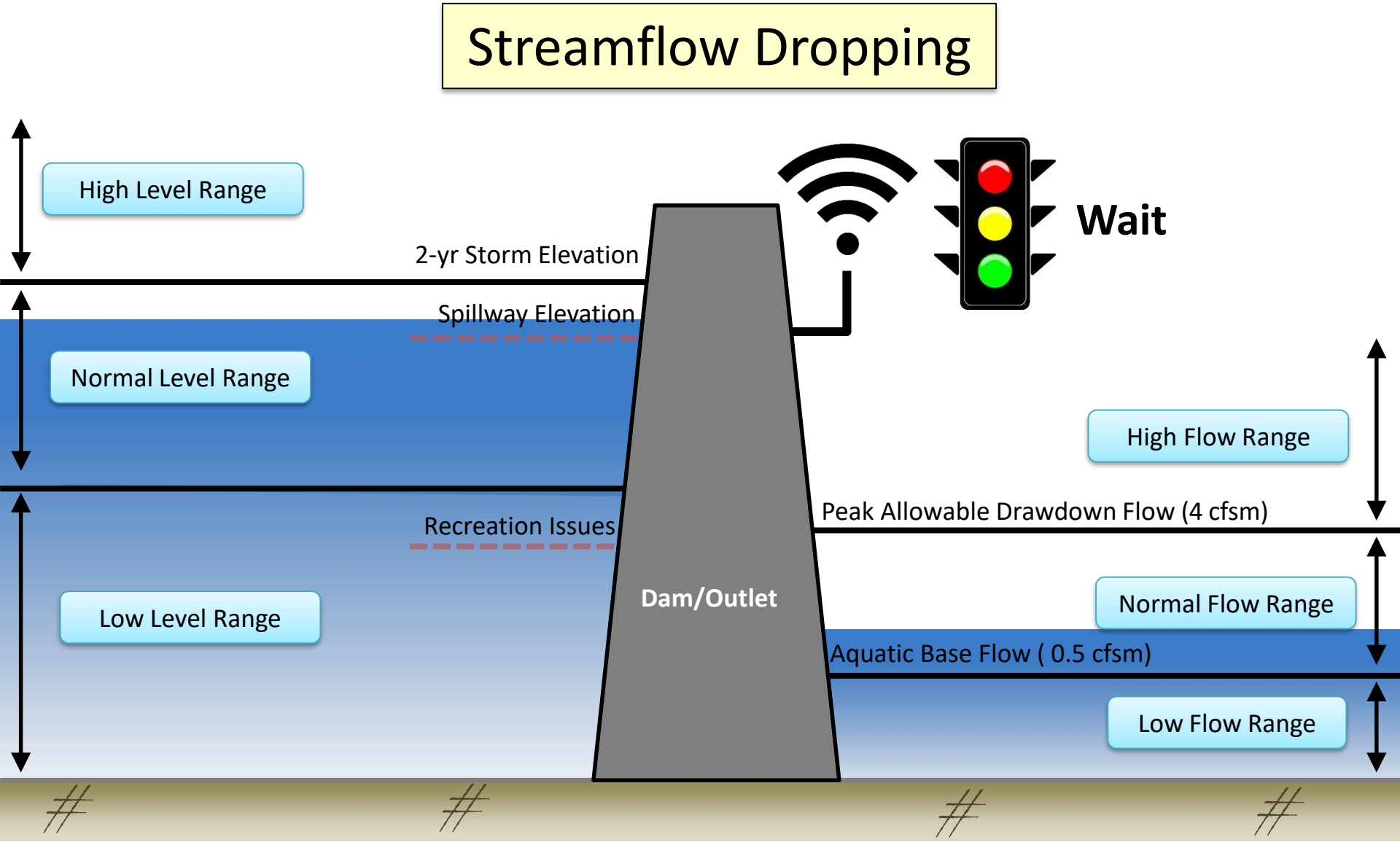
- Simplified logic sequence for selected iteration:



Example Logic Sequence

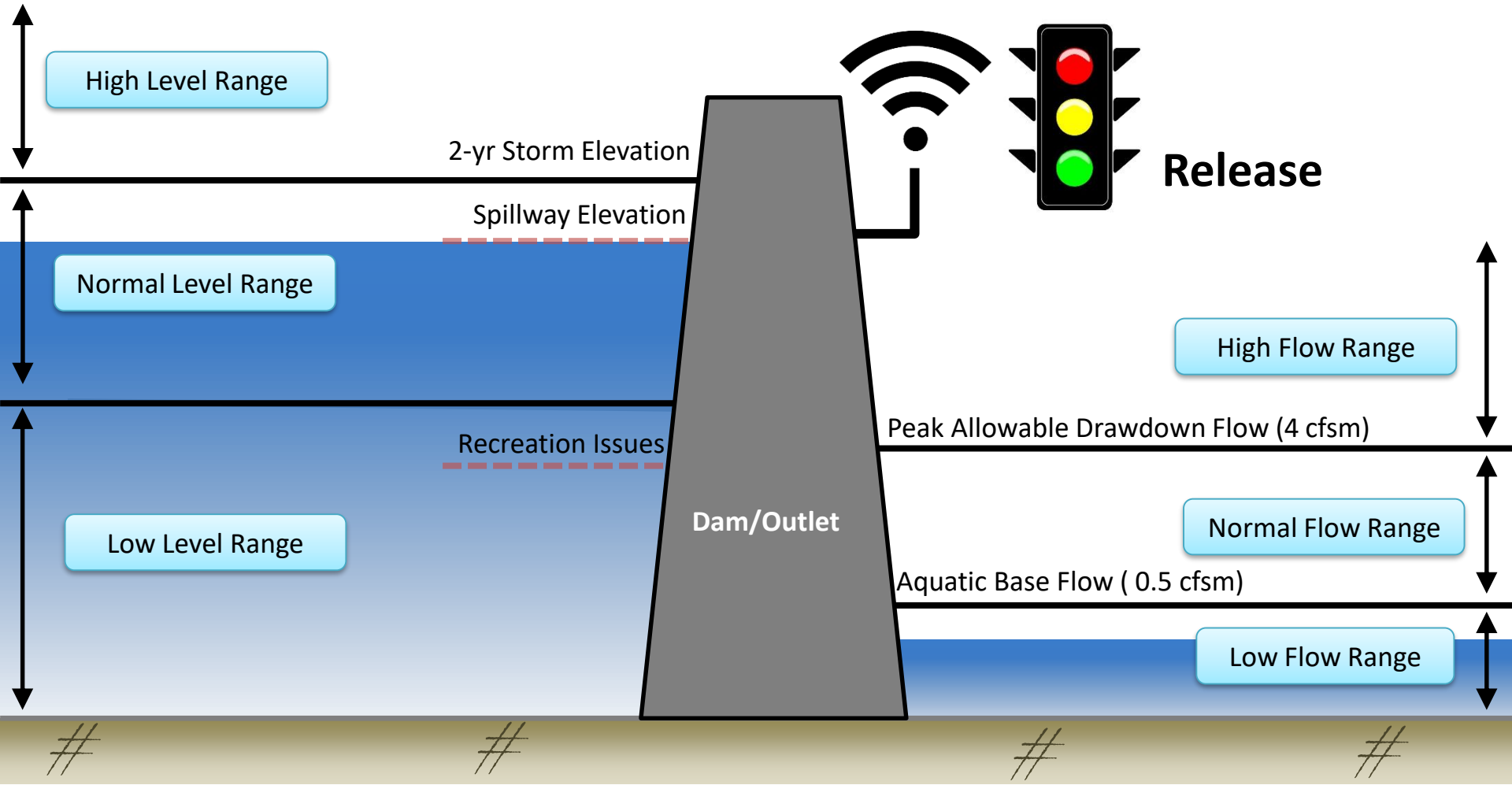


Example Logic Sequence



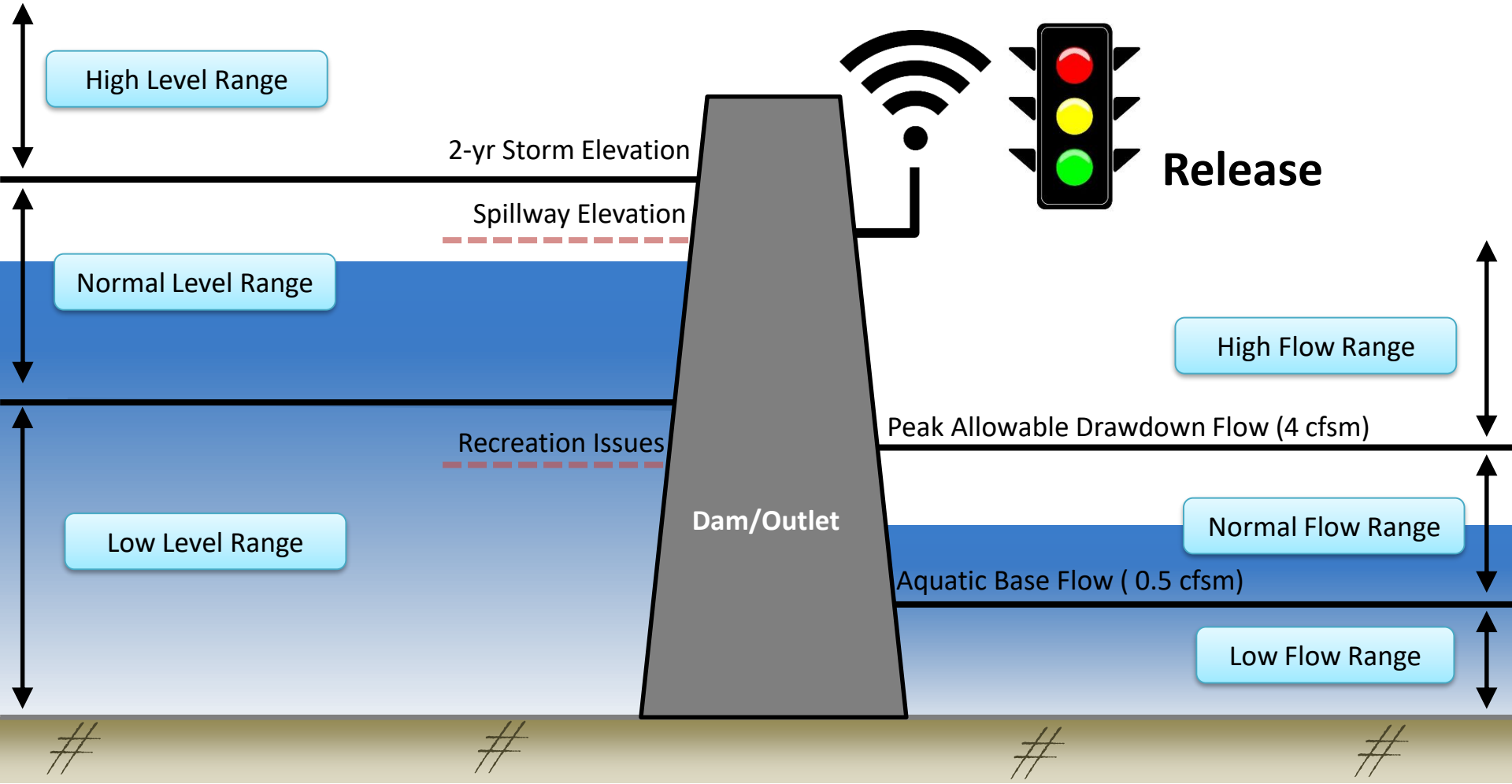
Example Logic Sequence

Low Flow Reached, Initiate Release



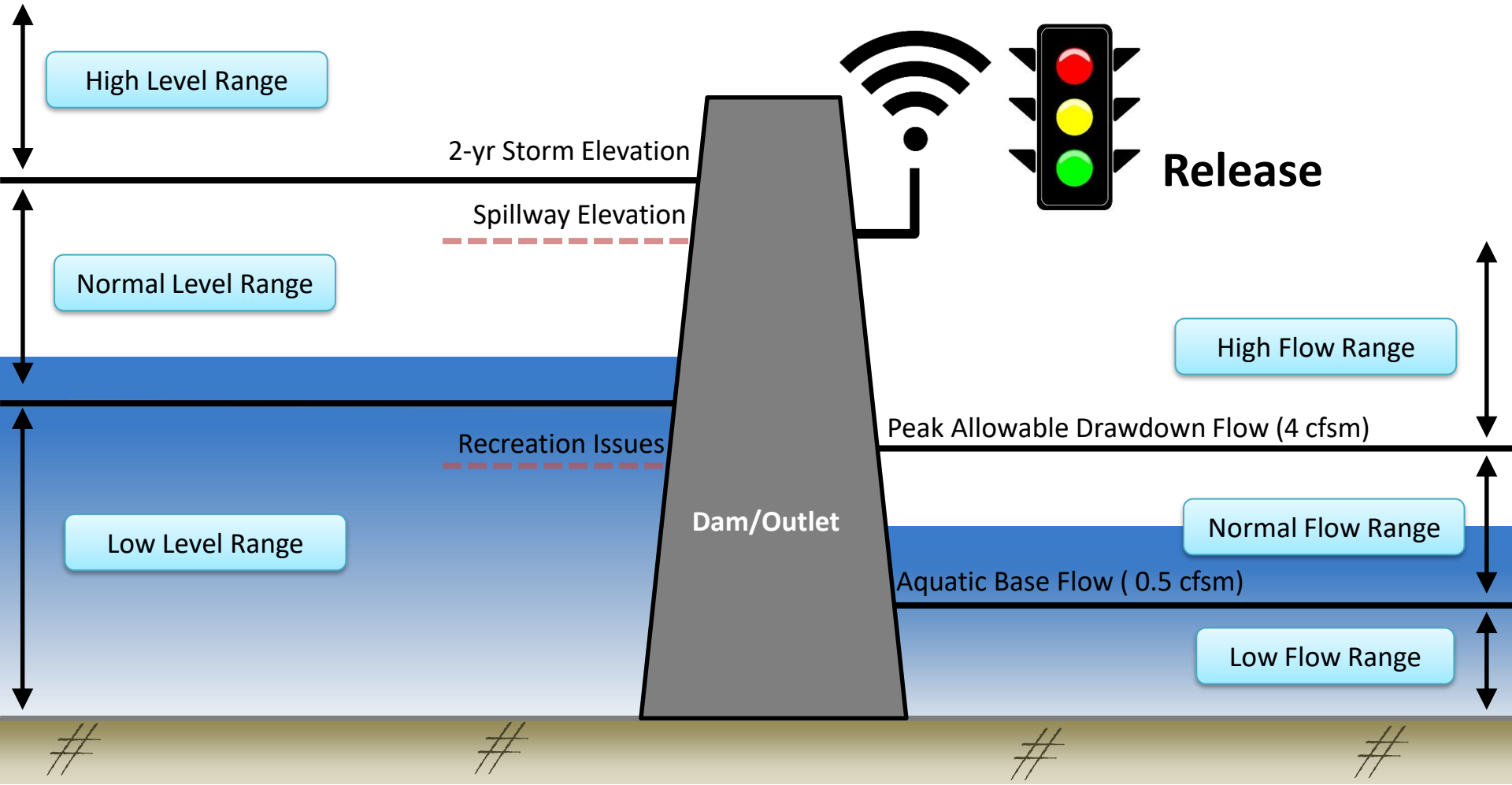
Example Logic Sequence

Normal Flow Reached, Continue Releasing



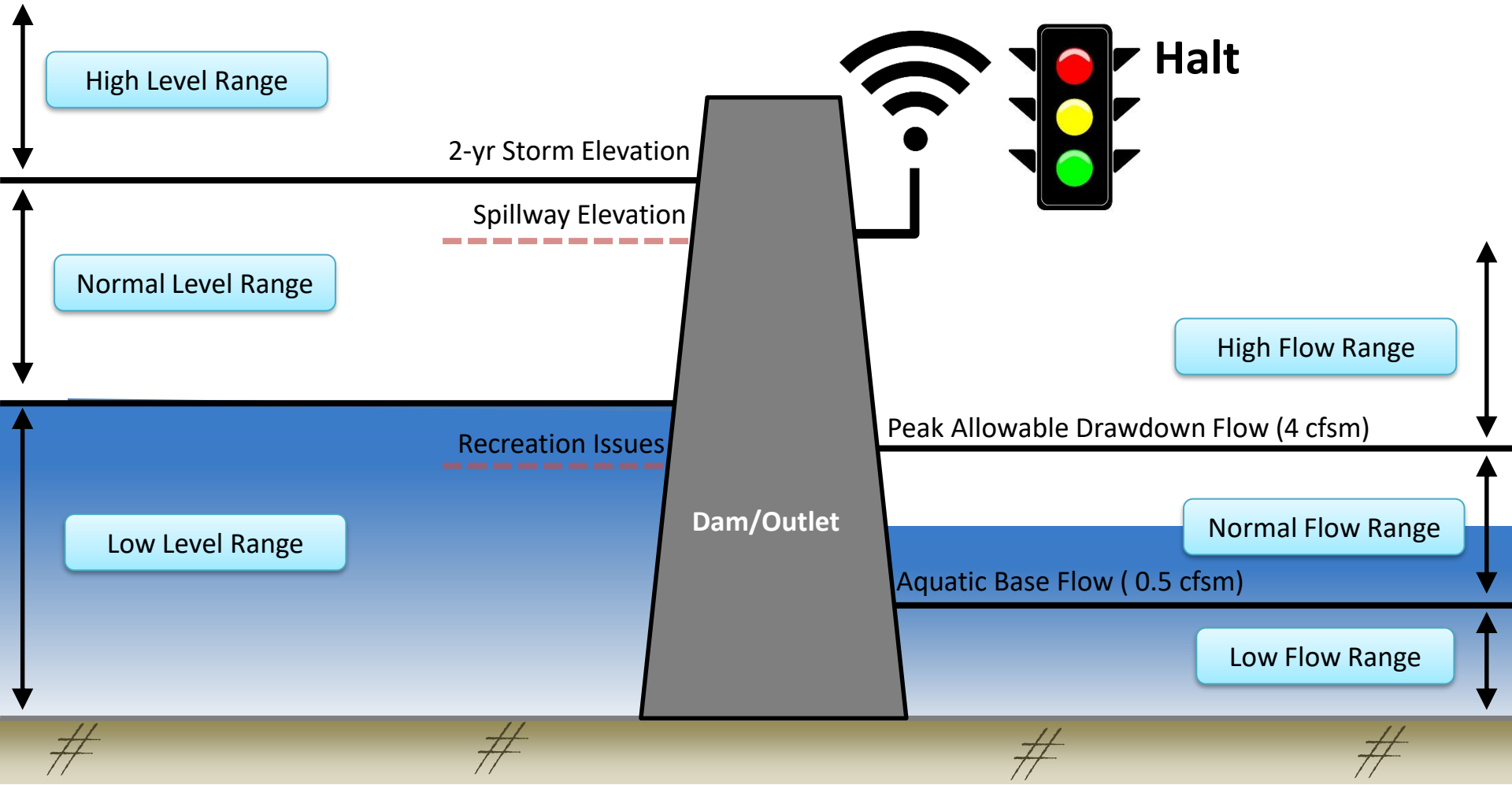
Example Logic Sequence

Approaching Low Water Level



Example Logic Sequence

Low Water Level Reached, Halt Release



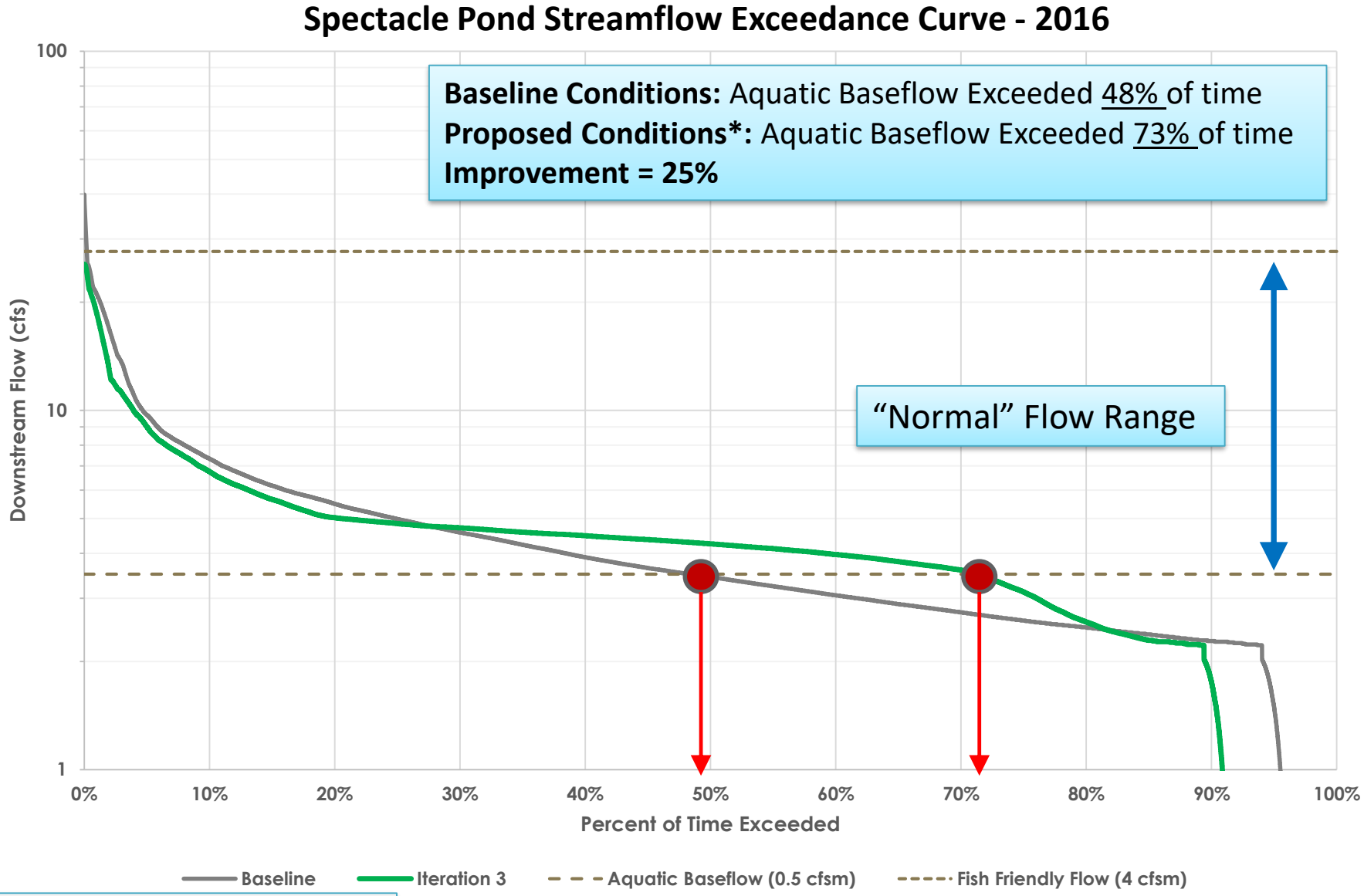
Results

(Pictured: Depot Dam, 4/5/2018)

Result Takeaways

1. Streamflow improvements were simulated at all locations.
2. All impoundments are susceptible to low downstream flow resulting from prolonged dry periods.
3. Model simulations are sensitive – empirical testing is needed to validate results.

Example Model Results - Streamflow



*Proposed Conditions = Iteration 3

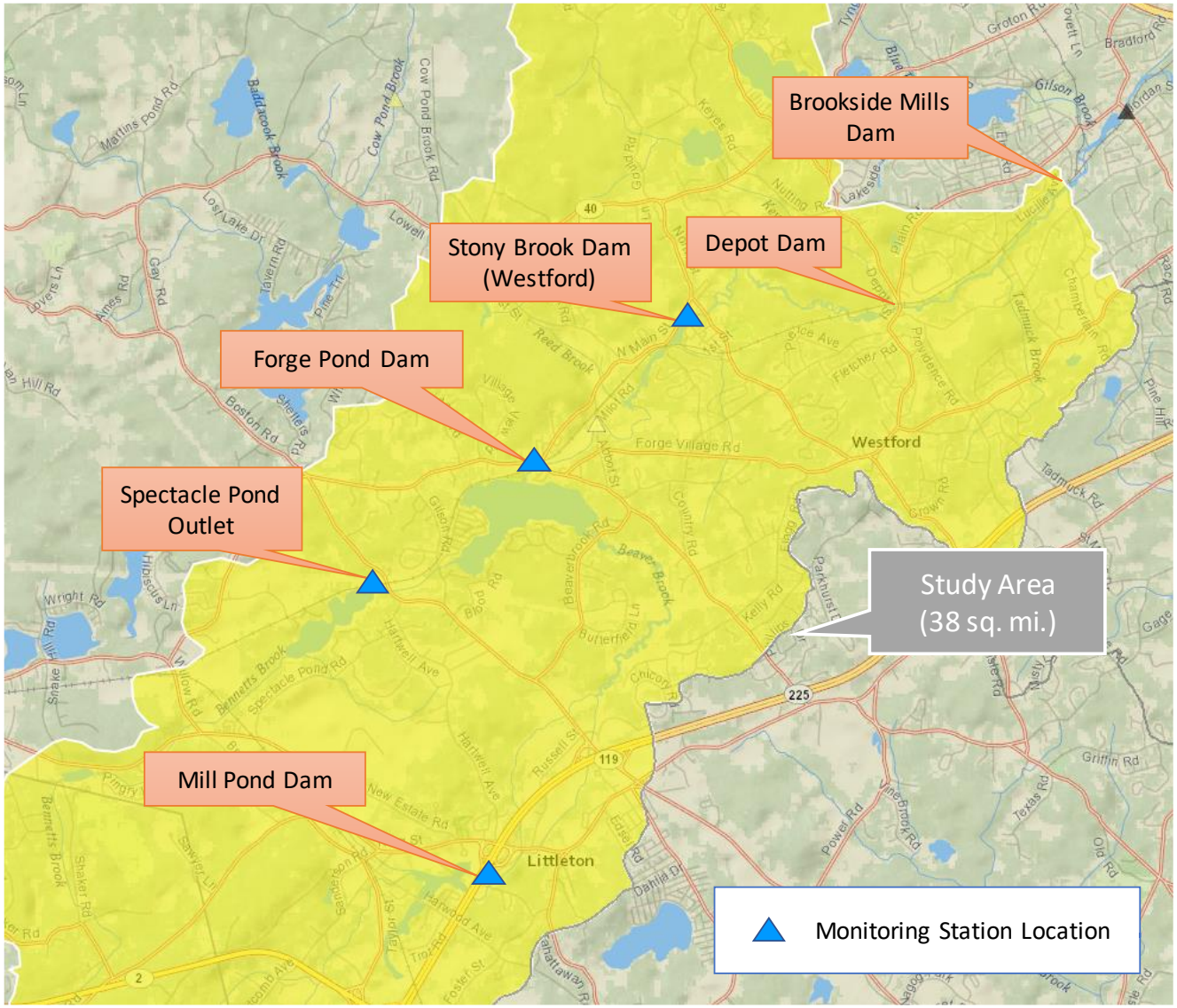
Streamflow Exceedance Results

Year	Impoundment	Percent of Time Simulated Downstream Streamflow is "Normal"				Percent Improvement from Baseline		
		Baseline	Iteration 1	Iteration 2	Iteration 3 (Recommended)	Iteration 1	Iteration 2	Iteration 3 (Recommended)
2016	Mill Pond Dam	37%	60%	54%	55%	23%	17%	18%
	Spectacle Pond Outlet	48%	73%	63%	71%	25%	15%	23%
	Forge Pond Dam	54%	62%	60%	63%	8%	6%	9%
	Stony Brook Dam	56%	76%	68%	74%	20%	12%	18%
	Depot Dam	50%	70%	59%	59%	20%	9%	9%
	Brookside Mills Dam	47%	67%	53%	53%	20%	6%	6%
2017	Mill Pond Dam	64%	74%	67%	73%	10%	3%	9%
	Spectacle Pond Outlet	61%	75%	65%	69%	14%	4%	8%
	Forge Pond Dam	75%	83%	78%	82%	8%	3%	7%
	Stony Brook Dam	72%	77%	76%	74%	5%	4%	2%
	Depot Dam	74%	80%	78%	78%	6%	4%	4%
	Brookside Mills Dam	77%	84%	80%	83%	7%	3%	6%

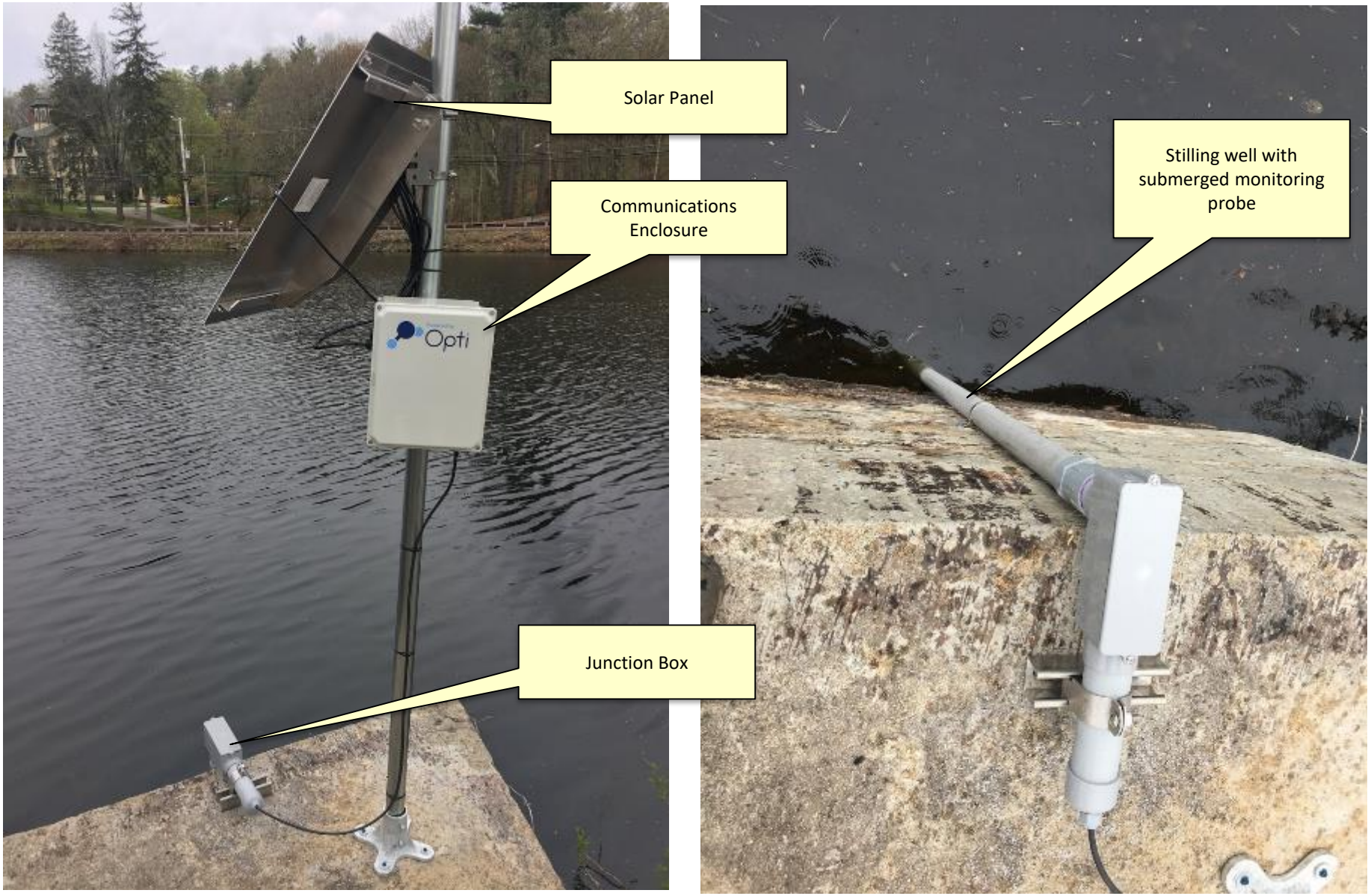
Monitoring and Decision Support

(Pictured: Brookside Mills Dam, 4/5/2018)

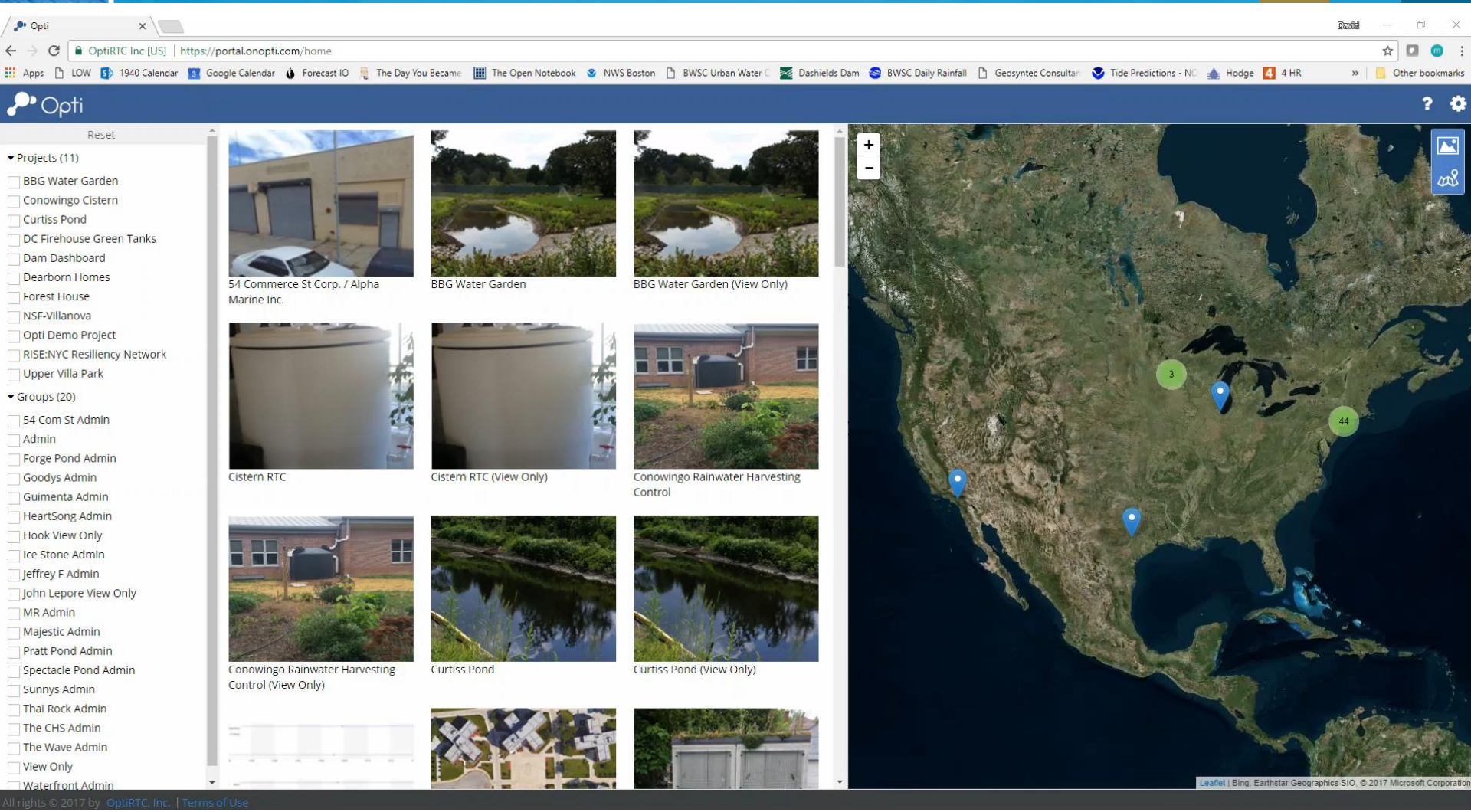
Monitoring Station Locations



Stony Brook Monitoring Station



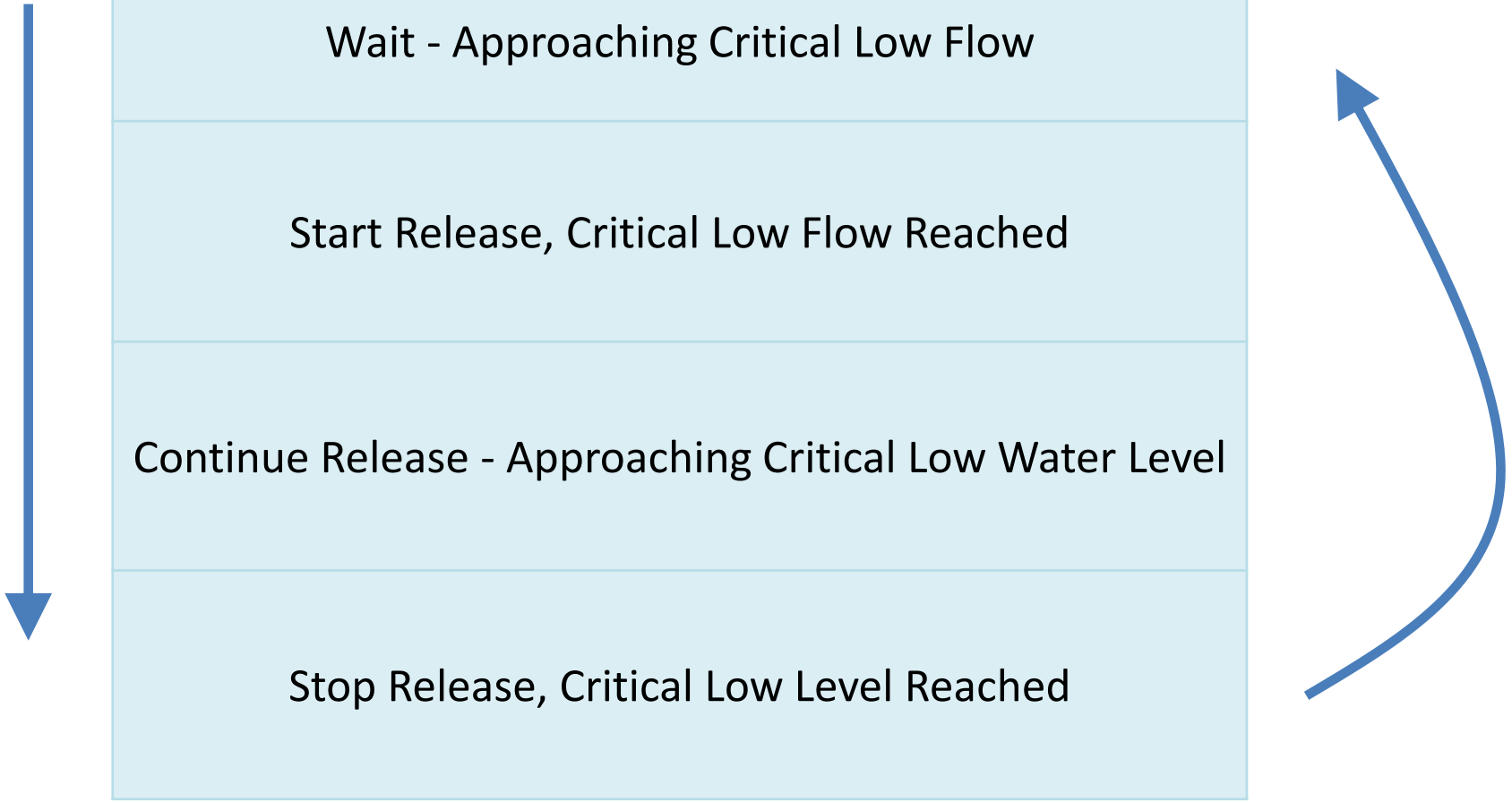
Dashboard Demonstration



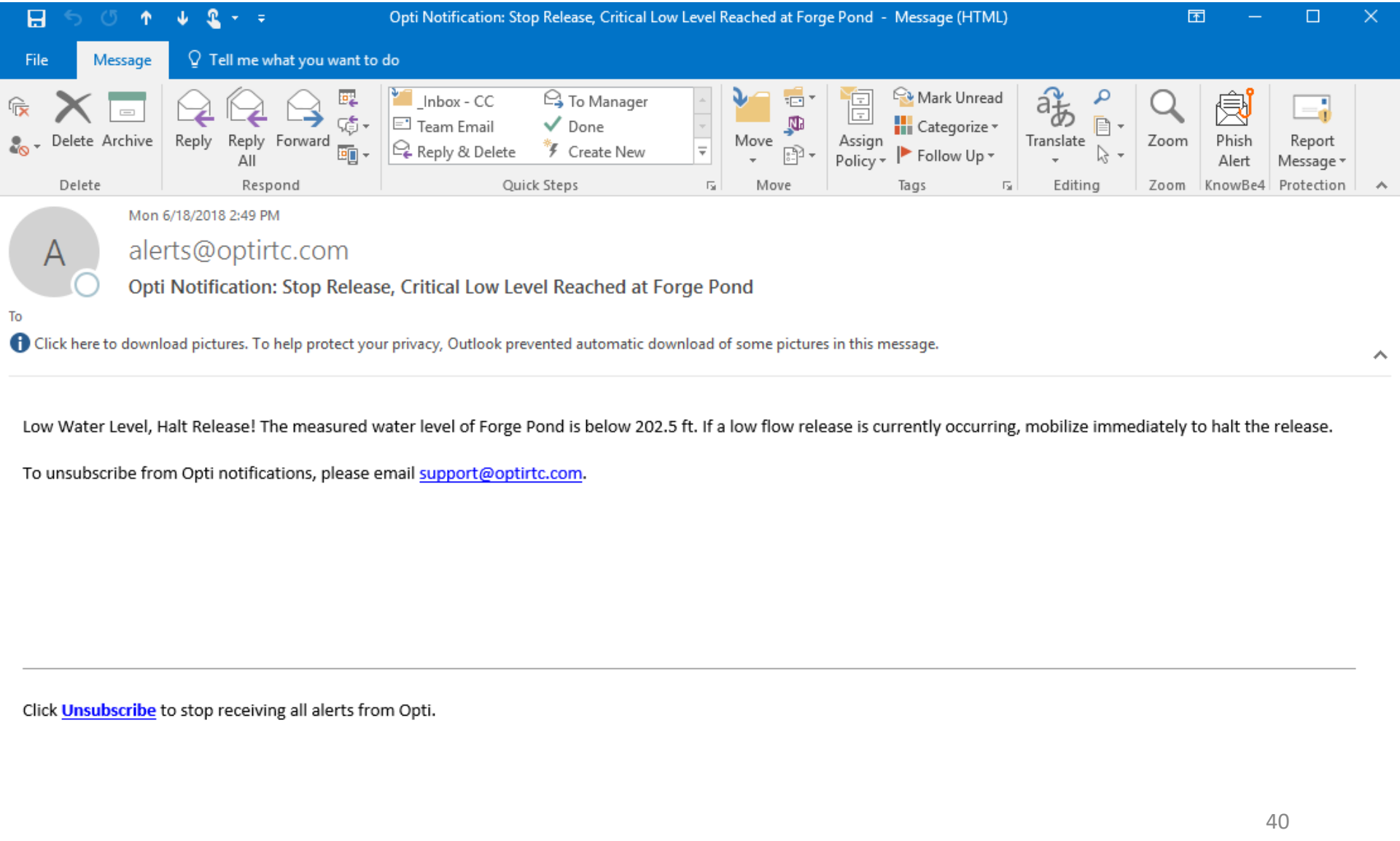
Decision Support Dashboards

- Provide continuous monitoring data
  - Water level, discharge estimates, etc.
- Provide forecast data and predictions
  - Precipitation (7-day)
  - Predicted impoundment inflow (7-day)
- Provide decision support email alerts
  - Based on recommended model Iteration 3
  - E.g., Approaching Critical Streamflow, Initiate Release
- All stakeholders can opt to receive selected alerts

Alert Sequence – Low Flow Releases



Example Email Alert – Forge Pond



Next Steps

(Pictured: Upstream Channel, Depot Dam, 4/5/2018)

Next Steps

- **Selected as DER Priority River Restoration Project**

Division of Ecological Restoration
Streamflow Restoration Program

- **Obtained Additional Funding through Water Management Act Grant Program**

MassDEP

(Pictured: Stony Brook Impoundment, 4/5/2018)

Next Steps

- Perform streamflow gauging and additional calibration / validation of model
- Perform baseline stream biota sampling
- Perform low flow feasibility evaluation
  - Obtain owner approval for all locations
  - Obtain state and local approval
- Perform empirical testing and evaluate effectiveness of recommendations
  - Release openings, release thresholds, forecast thresholds etc.
- Evaluate potential for automated controls
- Expand study area

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