Water Availability and the Water Supply Plan

Water Supply Plan Stakeholder Advisory Group

October 12, 2021

NEW JERSEY • DEPARTMENT OF ENVIRONMENTAL PROTECTION

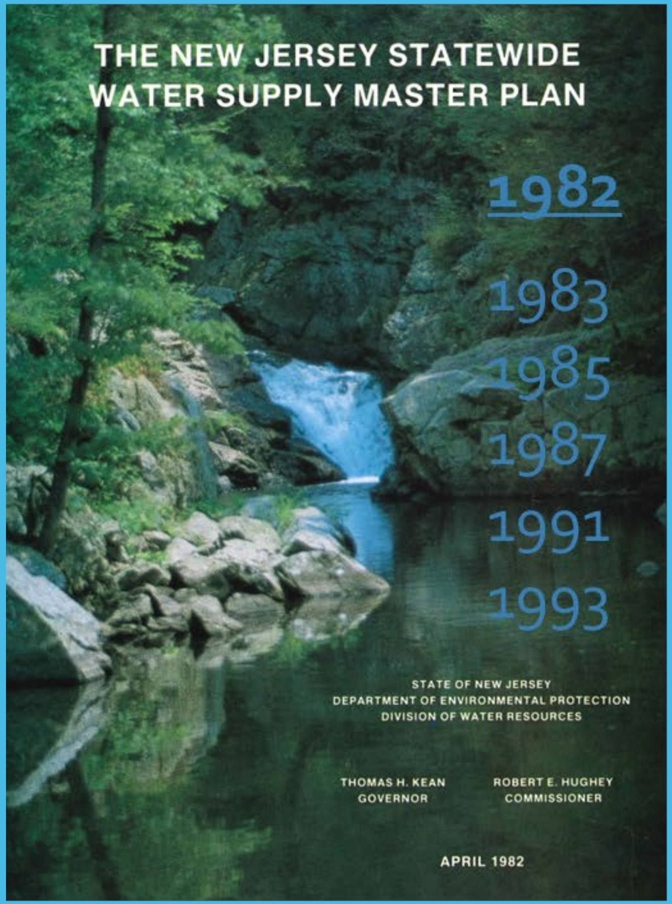
What We'll Cover

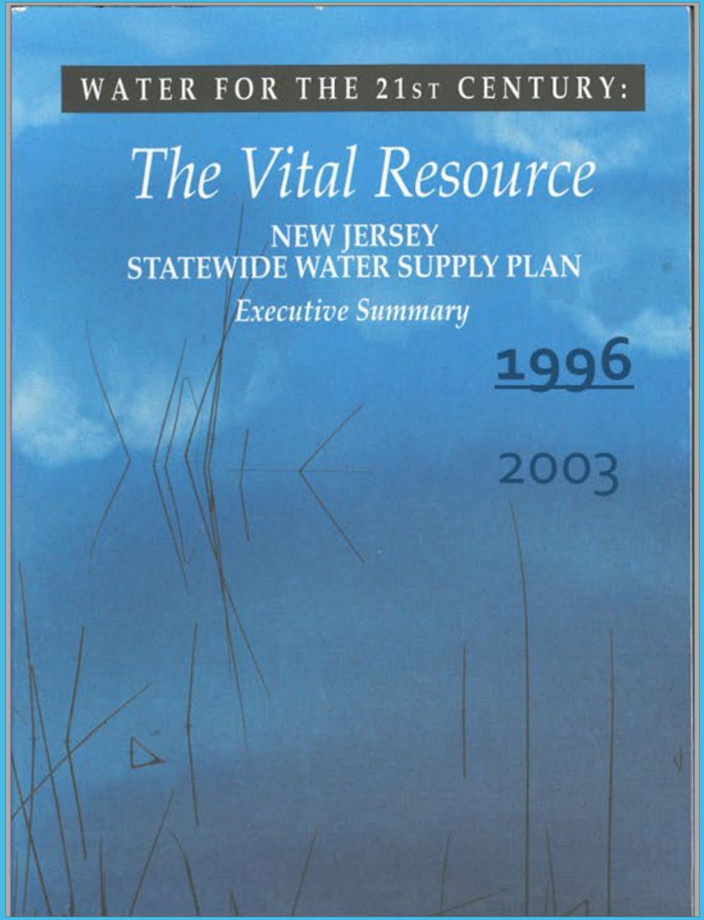
- Welcome and Online Meeting Logistics
- Overview of the 2023-28 Planning Process and Planning Objectives
- Water source and use trends 1990-2020
- Demand Forecasts
- Resource Overview
  - Unconfined Aquifers and the Stream Low Flow Margin Method
  - Reservoirs and Safe Yield
  - Confined Aquifers
- Next steps on water availability
- Wrap up

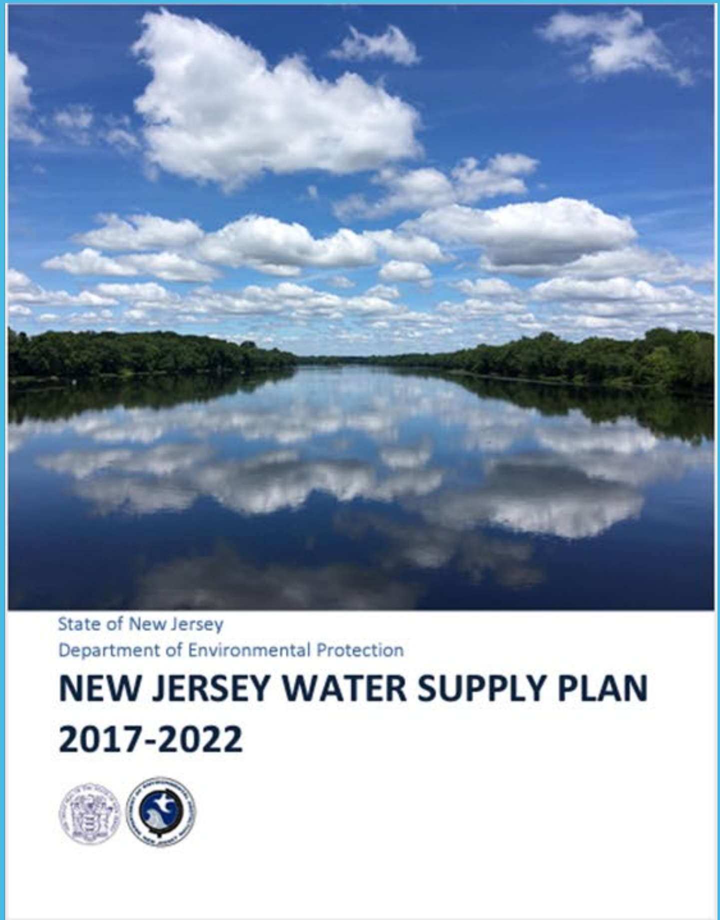
Note that this info is still being finalized and is subject to change.

Water Supply Planning

The 1981 New Jersey Water Supply Management Act (N.J.S.A. 58:1A-1 et. seq.) directs the NJDEP to develop and periodically revise the New Jersey Statewide Water Supply Plan (NJSWSP or Plan) in order to improve the management and protection of the State's water supplies. Previous planning actions taken under different authorities.







Water Supply Overview

- NJ relies on natural surface waters, reservoirs, unconfined aquifers and confined aquifers for drinking water, agricultural irrigation, and self-supplied commercial, industrial and mining uses.
- Main issues
  - Densely populated regions with intensive water demands plus rural areas
  - Total public water demands are flat despite a growing state population – but not for all systems.
  - Some water resources are stressed. Water demands have been reduced in some areas, restricted in others. Some areas need further planning and management.
  - Water for power generation is much reduced

2023-2028 Chapter Headings (tentative)

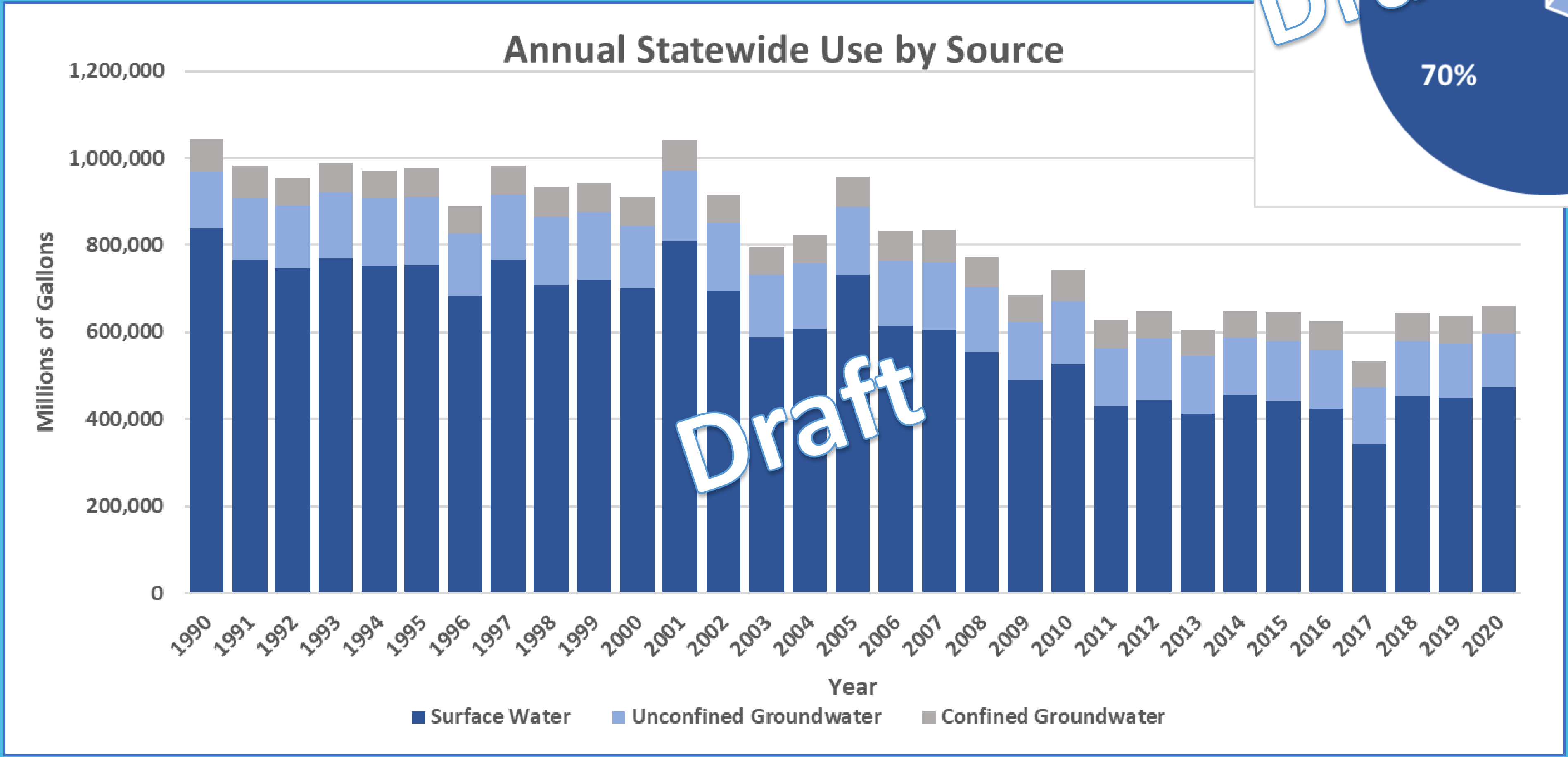
1. Introduction
2. Water Use Characterization and Trends
3. Climate Change Driven Water Availability Impacts
4. Statewide Water Availability
5. Statewide Demands and Balances
6. Safe Drinking Water Issues
7. Statewide Water Resource Protection and Planning Efforts
8. Regional Planning for Deficit Mitigation and Avoidance
9. Planning for an Uncertain Future
10. Water Supply Action Plan
11. Summary, Conclusions, and Recommendations

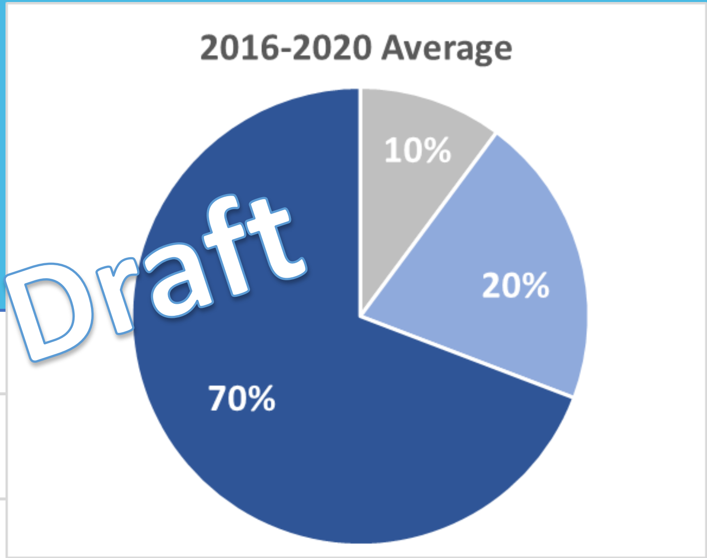
We'll cover these today

Planning Principles

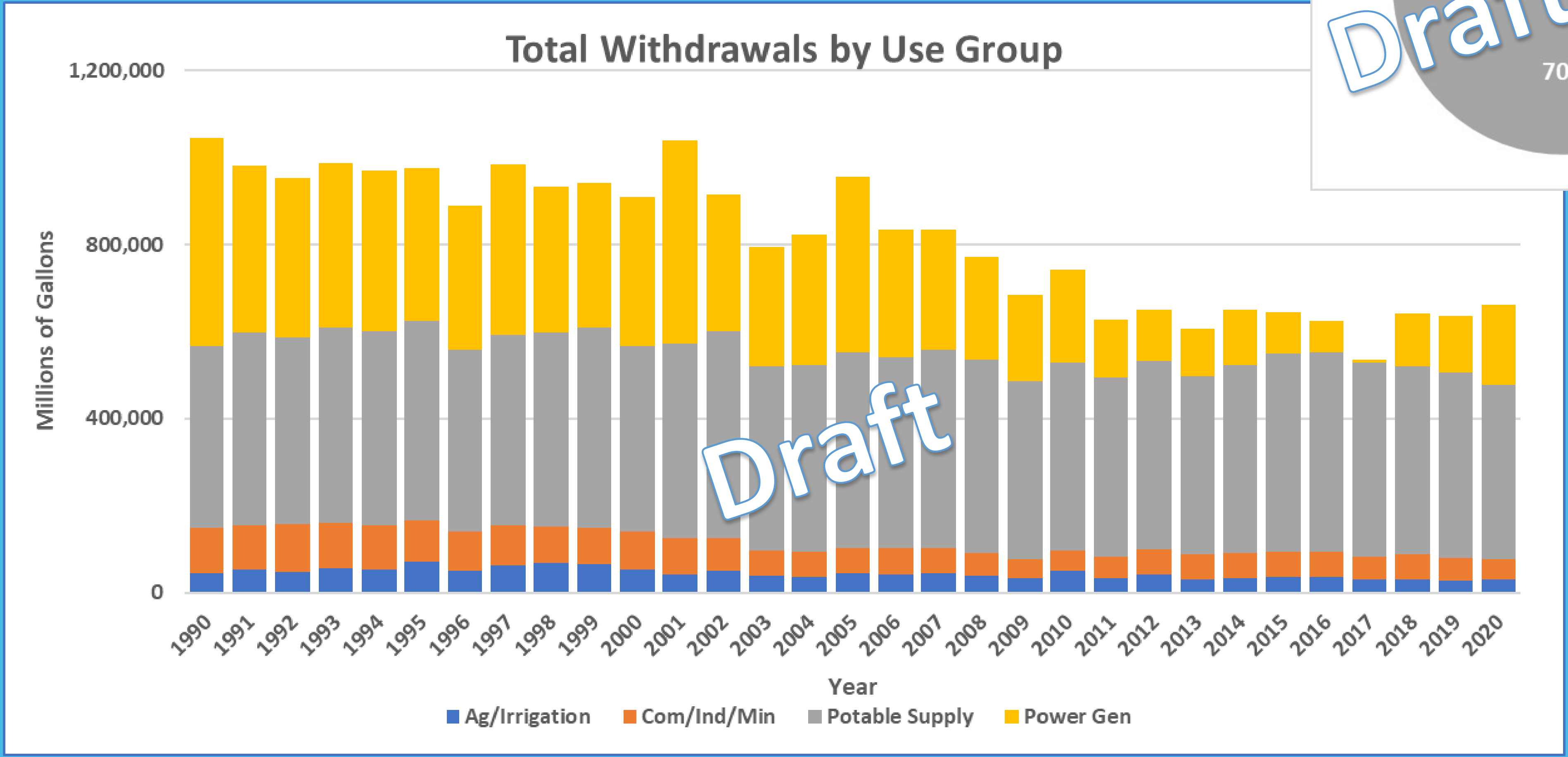
- Water as a public trust resource, for which permission is given to abstract, use, provide to customers
- Equitable access
- Protection is more cost-effective than remedial treatment
- Policies and programs should be feasible and cost-effective, not cosmetic or “feel good” without impact
- Increased costs demand increased proof of effectiveness
- Implementation resources always a constraint – priorities

Source of Water





Use of Water


Total Withdrawals by Use Group
1,200,000
800,000
400,000
0
Millions of Gallons
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
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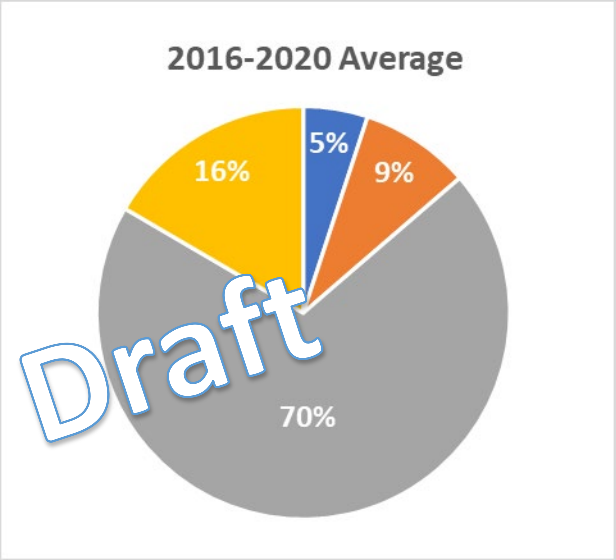
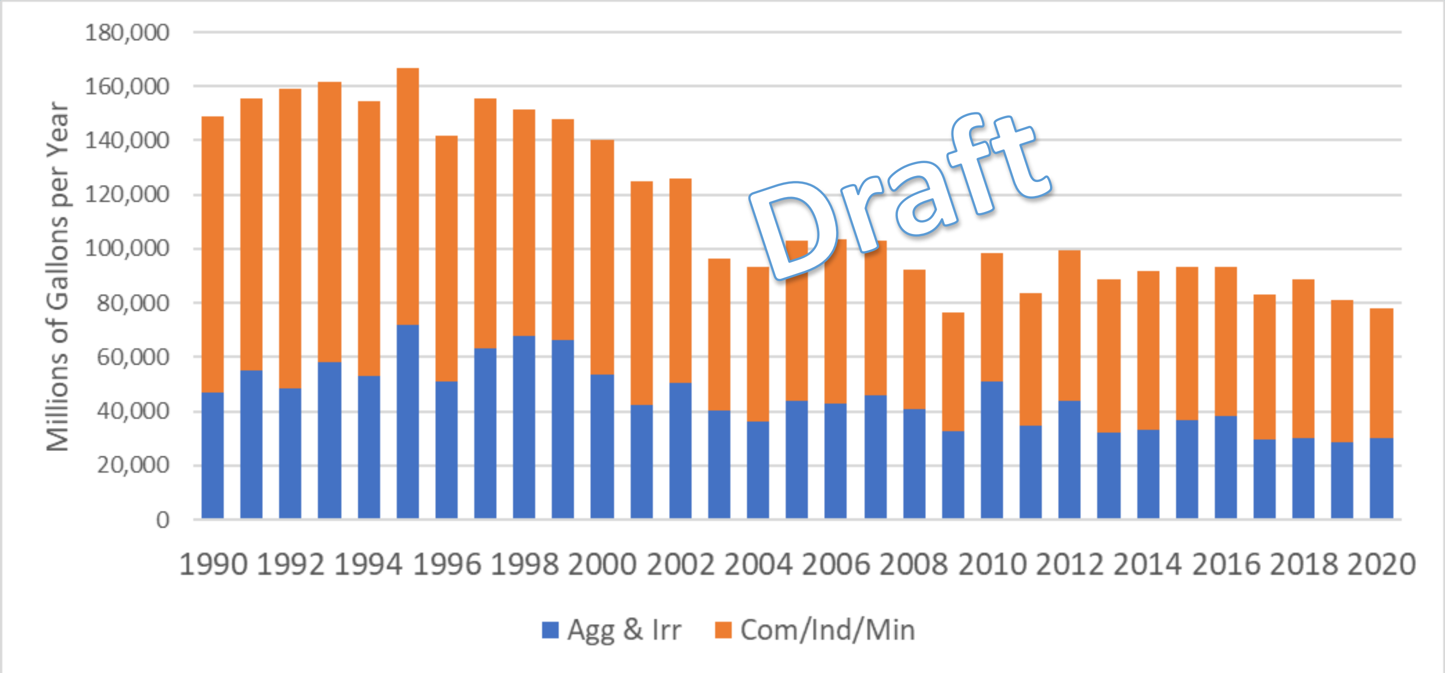
Com/Ind/Min
Potable Supply
Power Gen
Draft


2016-2020 Average
5%
9%
16%
70%
Draft

Demand Forecasts

- Potable supply drives water use in NJ- 70% of total use
- Metropolitan Planning Organizations 2050 Population Forecasts
  - Details follow
- Self-supplied agricultural, irrigation, commercial, industrial, mining and power generation
  - Current use and allocations assumed representative of future conditions
  - Same assumption in 2017 WSP



Potable Demand Forecasts for 2050

- Focus on Public Community Water Systems (PCWS)
- Population Projections to 2050
- Commercial Water Demands from PCWS
- Industrial Water Demands from PCWS
- Scenarios – Per Capita Residential Use
- Scenarios – Water Losses

NJ Population Projections to 2050

- Metropolitan Planning Organizations: Municipal Level
  - Basis for PCWS populations
  - NJTPA, DVRPC, SJTPO
- Current MPO projections pre-date 2020 Census results
- Significant differences for 2020
- Six largest municipalities differ by 5% to 30% (Lakewood)
- Median difference 2%
- Model built to allow updates

Metric	NJ Population
Census 2020 Pop	9,284,560
MPO 2020 Pop	8,942,524
Difference	342,036
MPO 2050 Pop	10,051,165
MPO Change 2050 from 2020	1,108,640
MPO Change 2050 from Census 2020	766,605

Draft

MPO 2050 population is an 8.3% increase from 2020 Census population

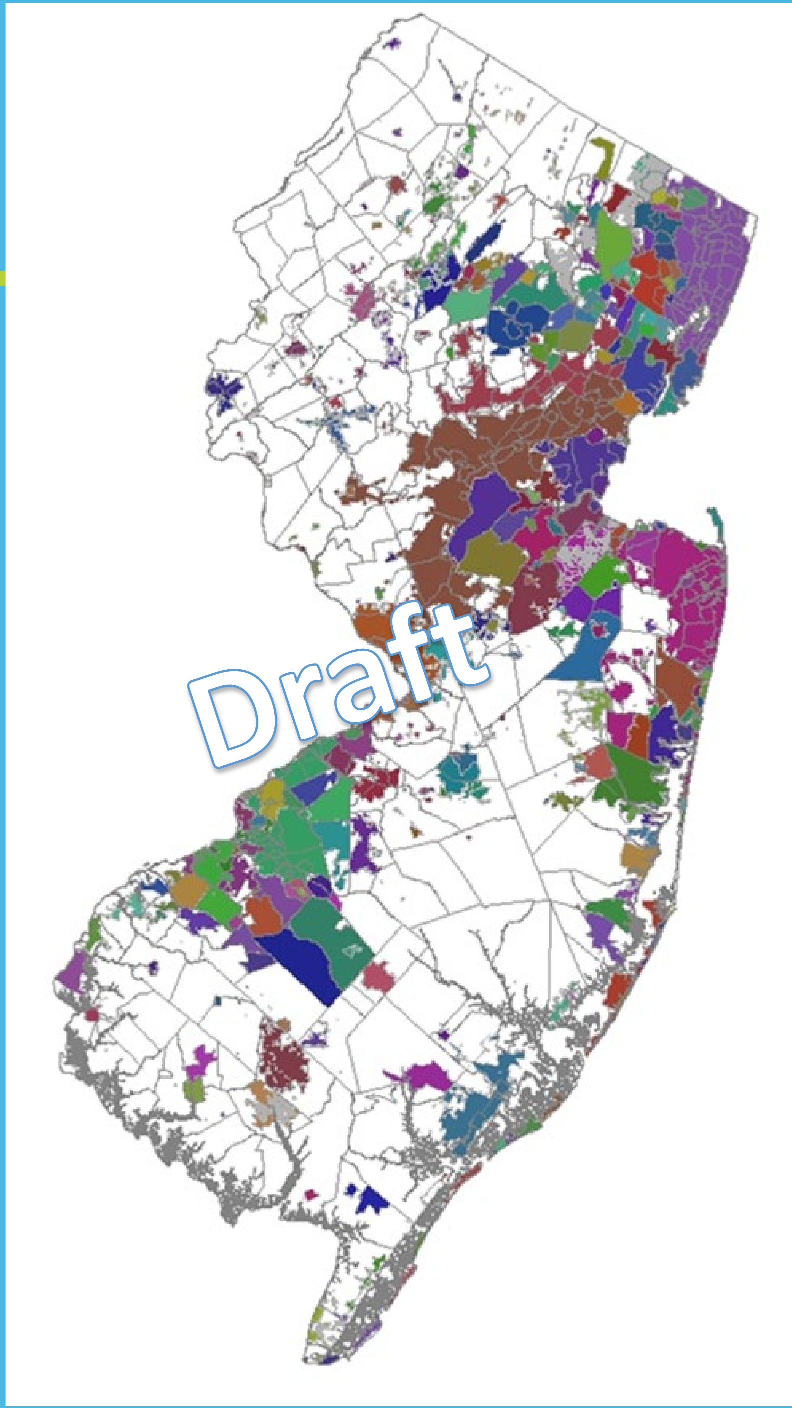
MPO Population Projections by County

- Projected population changes differ greatly among counties
- Four counties projected to increase >100,000. All are entirely or mostly in PCWS service areas
- The two least-populated (2020) counties projected to lose population through 2050

County	MPO Projected Growth 2020-2050
Atlantic	13,127
Bergen	**154,008**
Burlington	29,913
Camden	12,098
Cape May	(428)
Cumberland	12,873
Essex	**120,059**
Gloucester	35,898
Hudson	**181,887**
Hunterdon	5,936
Mercer	28,537
Middlesex	**102,327**
Monmouth	39,411
Morris	27,931
Ocean	**130,114**
Passaic	84,599
Salem	(6,724)
Somerset	26,965
Sussex	6,333
Union	98,369
Warren	5,603
New Jersey	**1,108,835**

PCWS Population Projections

- Municipal & Census populations don’t fit most PCWS service area boundaries
- Dasymetric Analysis: GIS tool to assign populations to PCWS service areas
- Factors in residential density (High, Medium and Low) from NJDEP 2017 Land Use/Land Cover mapping



PCWS Populations

- Used 2020 Census and 2050 MPO Projections
- 92% of 2020 Population served by PCWS
- 92.3% of 2050 Population served by PCWS
- Nearly all in High and Medium residential density

Residential Density (2017 LULC)	**2020** (%)	**2050** (%)
High Density	52.0	53.5
Medium Density	40.8	39.9
Low Density	7.2	6.6

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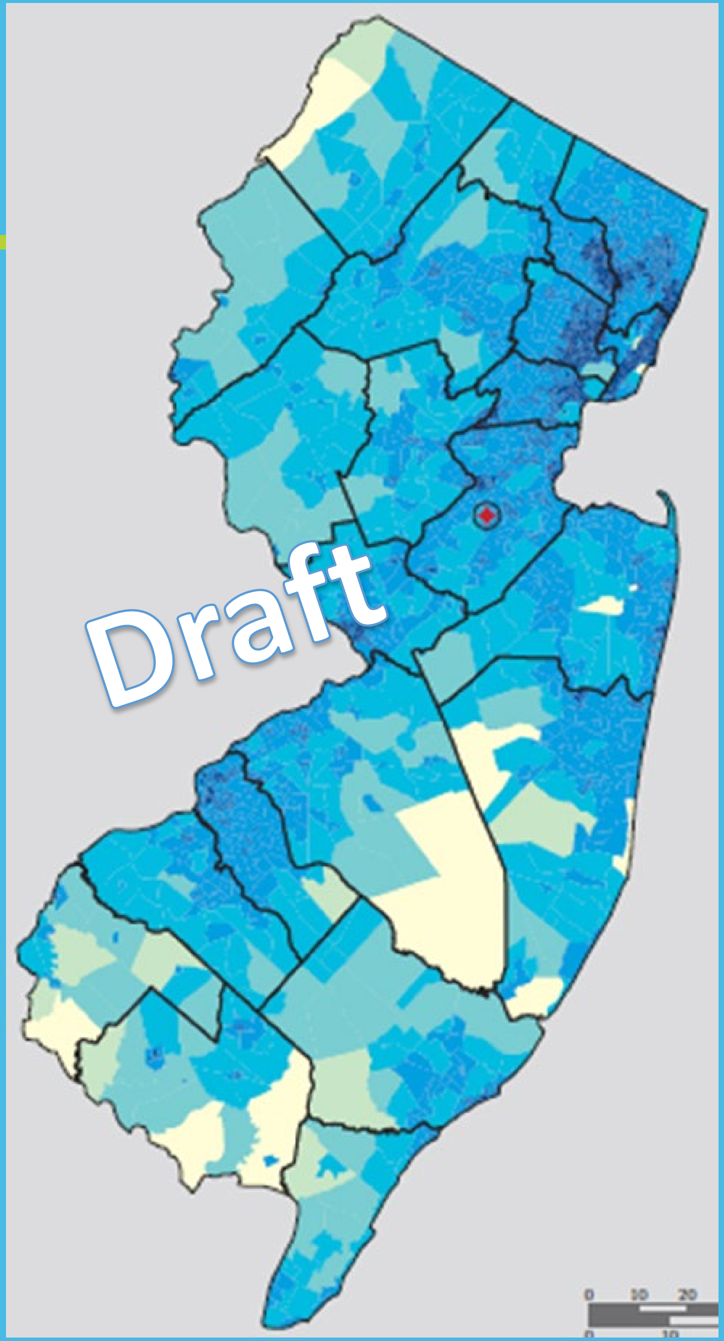


Residential Per Capita Demands (2018 Report)

Residential Density/Region	2010 CP	2010 PM	2010 HL	2050 CP	2050 PM	2050 HL
High Density (HD) Annual	47.92	58.46	42.04	43.13	49.89	37.84
Medium Density (MD) Annual	59.04	61.2	53.52	53.14	60.79	48.17
Low Density (LD) Annual	93.27	73.95	61.09	87.10	66.56	54.98
High Density (HD) Summer	53.49	62.61	42.47	52.96	52.96	38.22
Medium Density (MD) Summer	75.88	76.62	59.42	68.29	68.96	53.48
Low Density (LD) Summer	141.05	108.92	81.75	128.51	98.03	73.58
High Density (HD) Non-Summer	45.13	56.27	41.82	40.62	46.23	37.64
Medium Density (MD) Non-Summer	50.59	53.17	50.62	45.53	52.09	45.56
Low Density (LD) Non-Summer	69.36	56.61	50.84	62.93	50.95	45.76

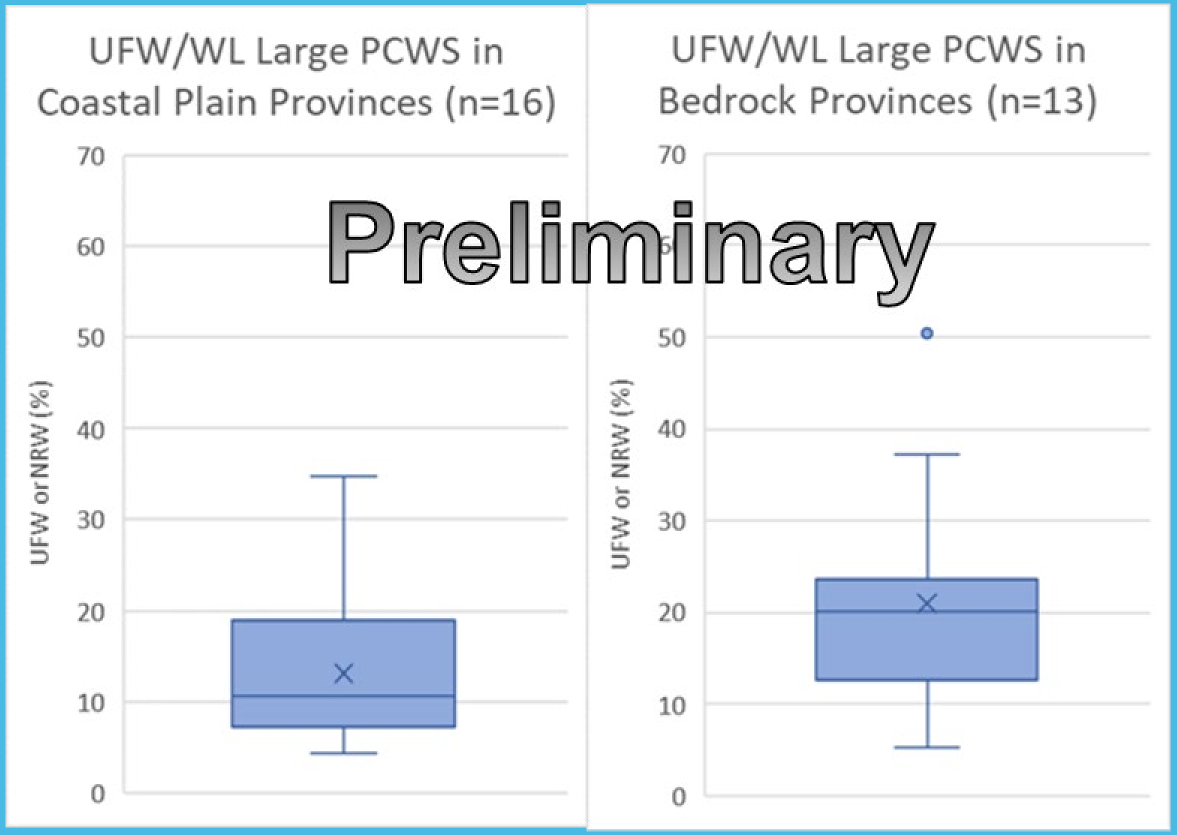
Derived from monthly customer demand data representing nearly 3.6 million residents, 45% of the total PCWS service population. Mount Laurel MUA, Newark Water & Sewer, New Jersey American Water (28 systems), Passaic Valley Water Commission (PVWC), Ridgewood Water Department, Roxbury Township Water, and Suez-New Jersey (Hackensack and Franklin Lakes systems). All data provided under confidentiality agreements.

Commercial and Industrial Demands

- Very limited data on commercial and industrial reliance on PCWS
- One of the major areas of assumptions to be tested, using a combination of % Residential demands (WQAA reporting) and Water Losses
- 2018 Report developed a mathematical relationship between commercial and industrial land use and water demands, based on available data from a few PCWS
- Commercial Demands: assumed to change in line with residential population changes
- Industrial Demands: assumed to be static through 2050. Unknown.

Water Losses

- Updated data sets from NJDEP and DRBC
- Analysis drafted and statistical analysis in progress
- DRBC data: Real water losses ~90% of total water losses
- Continuing finding of major differences between coastal and bedrock PCWS overall



Model Scenarios

- Similar to 2018 Report

Demand Starting Point	No Conservation Scenario		Conservation Scenario	
	Nominal Water Loss	Optimal Water Loss	Nominal Water Loss	Optimal Water Loss
Recent Peak Annual	Highest	Mid-range	Mid-range	Mid-range
Recent Average Annual	Mid-range	Mid-range	Mid-range	Lowest

- **No Conservation**: Static per capita residential demands
- **Conservation**: Declining per capita residential demands
- **Nominal Water Loss**: All utilities achieve 2018/2019 average percentile water loss by PCWS size category and geophysical location
- **Optimal Water Loss**: All utilities achieve 2018/2019 25th percentile water loss by PCWS size category and geophysical location
- Both water losses: Real water loss assumed to be 90% of assigned total water loss

Model Results – Very Preliminary

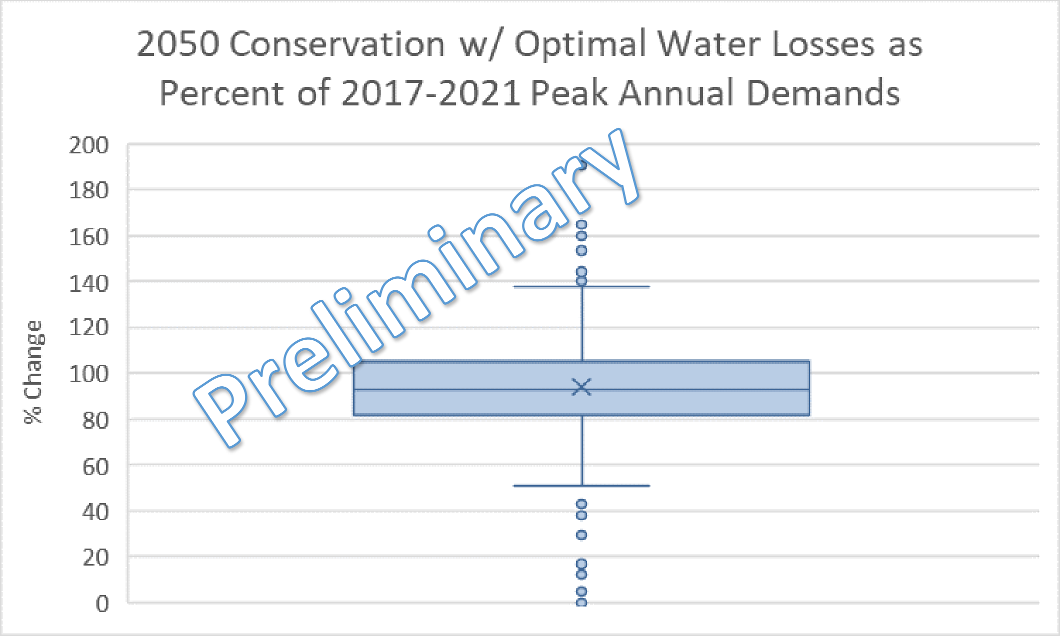
Metric/Scenario	Aggregate Volumes (MGD)		% Of Recent
Peak Annual Demands 2017-2021 (MGD)	1203.034		
2016-2020 Average Annual Demands (MGD)	945.561		
2050 Population Extrapolation from D/S Demands	1293.522		107.52
2050 Population Extrapolations from NJWaTr Demands	1016.868		107.54
	Nominal Water Losses	**Optimal Water Losses**	**Optimal % Of Recent**
2050 No Conservation Scenario Extrapolations from D/S Demands	1088.528	1083.955	90.10
2050 No Conservation Scenario Extrapolations from NJWaTr Demands	870.553	866.911	91.68
2050 Conservation Extrapolations from D/S Demands	999.459	995.266	82.73
2050 Conservation Extrapolations from NJWaTr Demands	798.483	795.150	84.09

Key Statewide Findings: Both Water Losses and residential conservation are major factors in future PCWS demands

PCWS Results

- Largest 10 PCWS (by demand) provide >50% of all water: both peak and average demands
- Lowest demand scenario still has some PCWS with higher peak demands, but not most PCWS
- Driven by population increases
- Only 10 of the largest 50 PCWS show increased peak demands for the lowest demand scenario, and all less than 10% increase
- Nearly all PCWS show increases in scenario with no conservation or change in water losses

New Jersey American Water - Raritan System
Suez Water New Jersey - Haworth
Passaic Valley Water Commission
Newark Water Department
New Jersey American Water - Western Division
New Jersey American Water - Passaic Basin
New Jersey American Water - Coastal North
Jersey City MUA
Middlesex Water Company



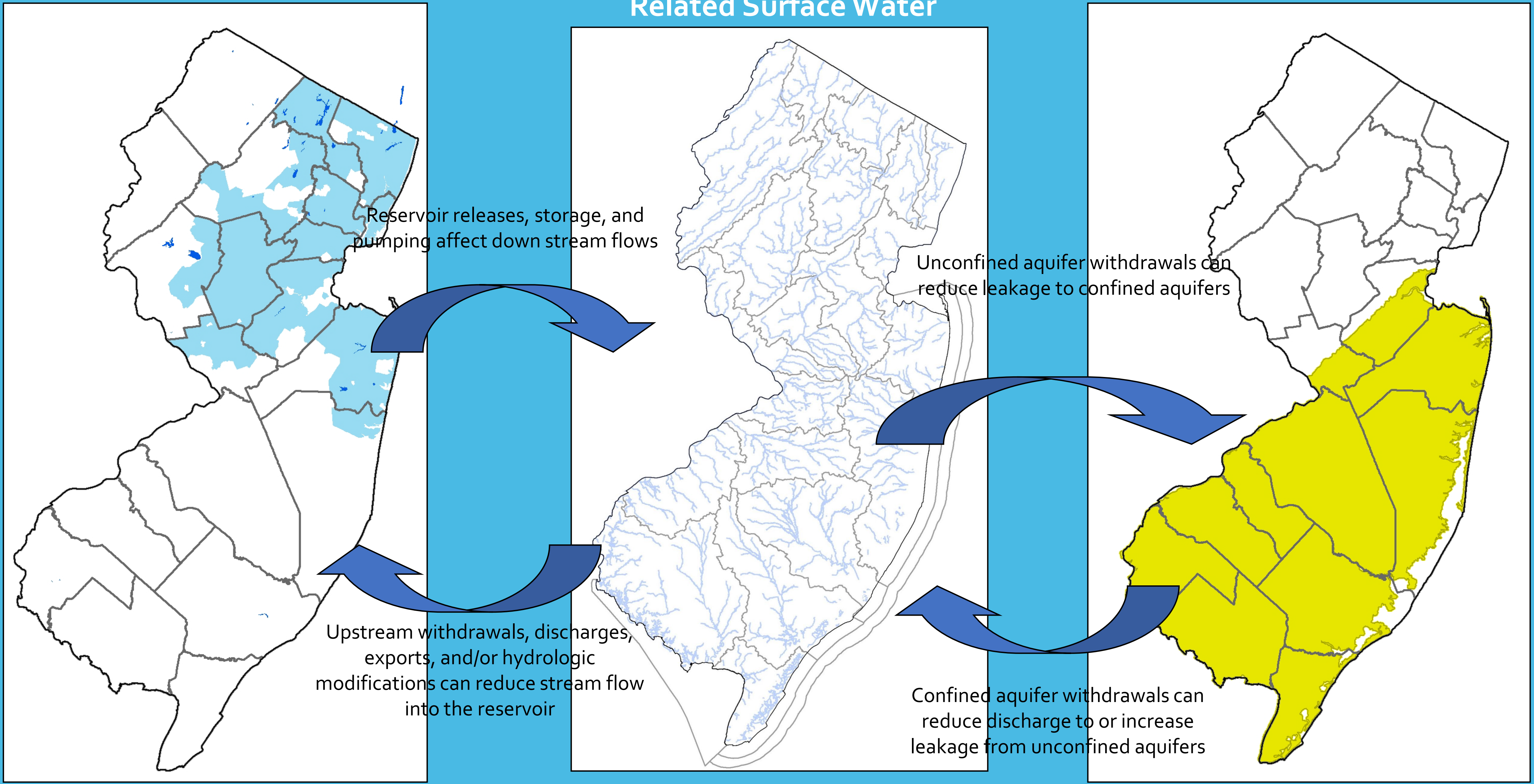
Questions and Comments?

Water Availability: ‘Natural’

Reservoir Systems – Safe Yield

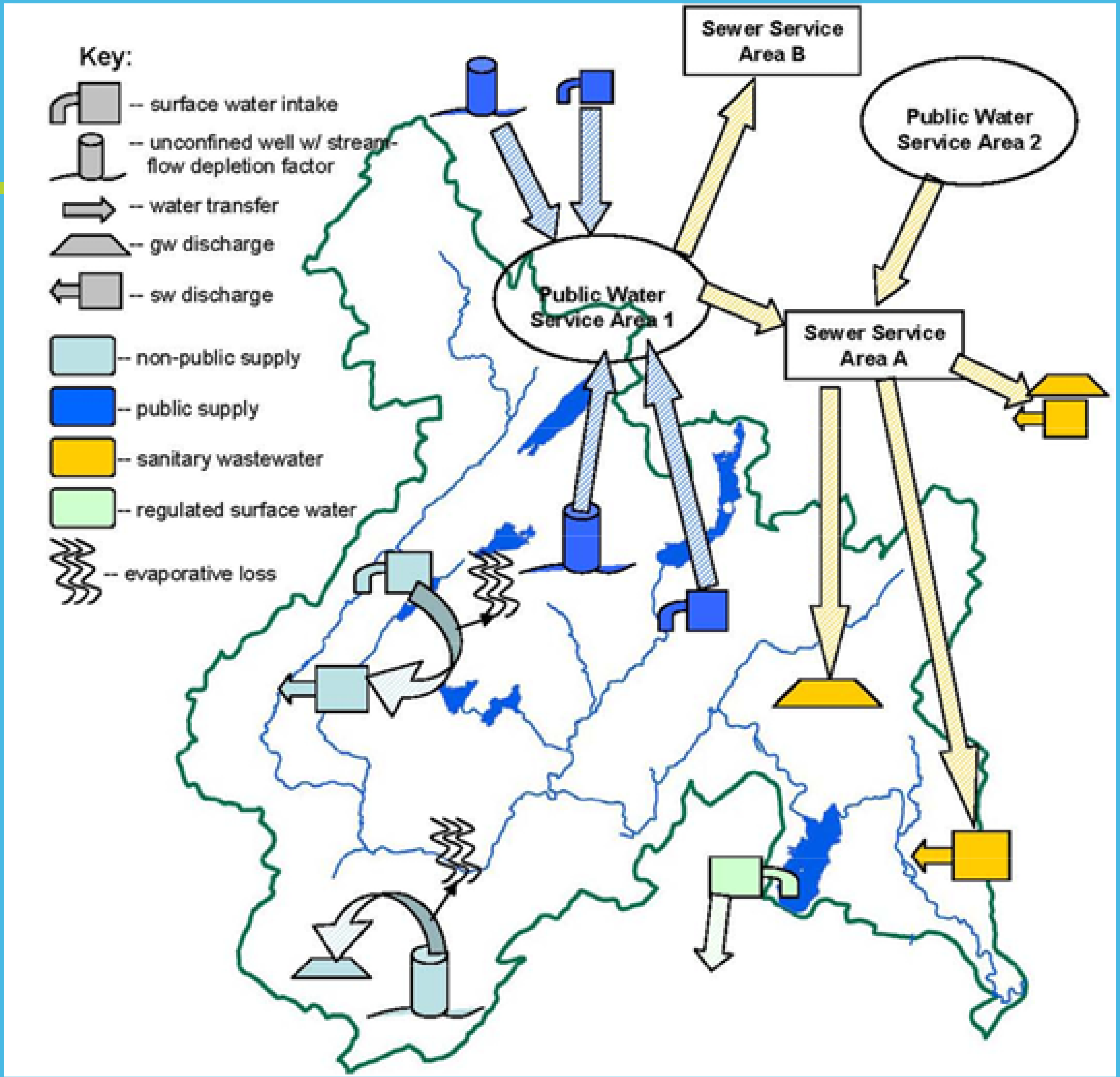
Unconfined Aquifers and Related Surface Water

Confined Aquifers



Unconfined Aquifers and Surface Water

- Stream Low Flow Margin Method
  - Based upon ELOHA- ecoflow goals
  - Assumes 25% of the difference between September median and 7Q10 flows available for loss
  - Calculate net water loss with observed data and allocations
  - Identify areas where water use may be excessive
- Planning/screening level method
- First used in 2017 WSP
  - Similar method used by Highlands
  - May be adopted by Pinelands



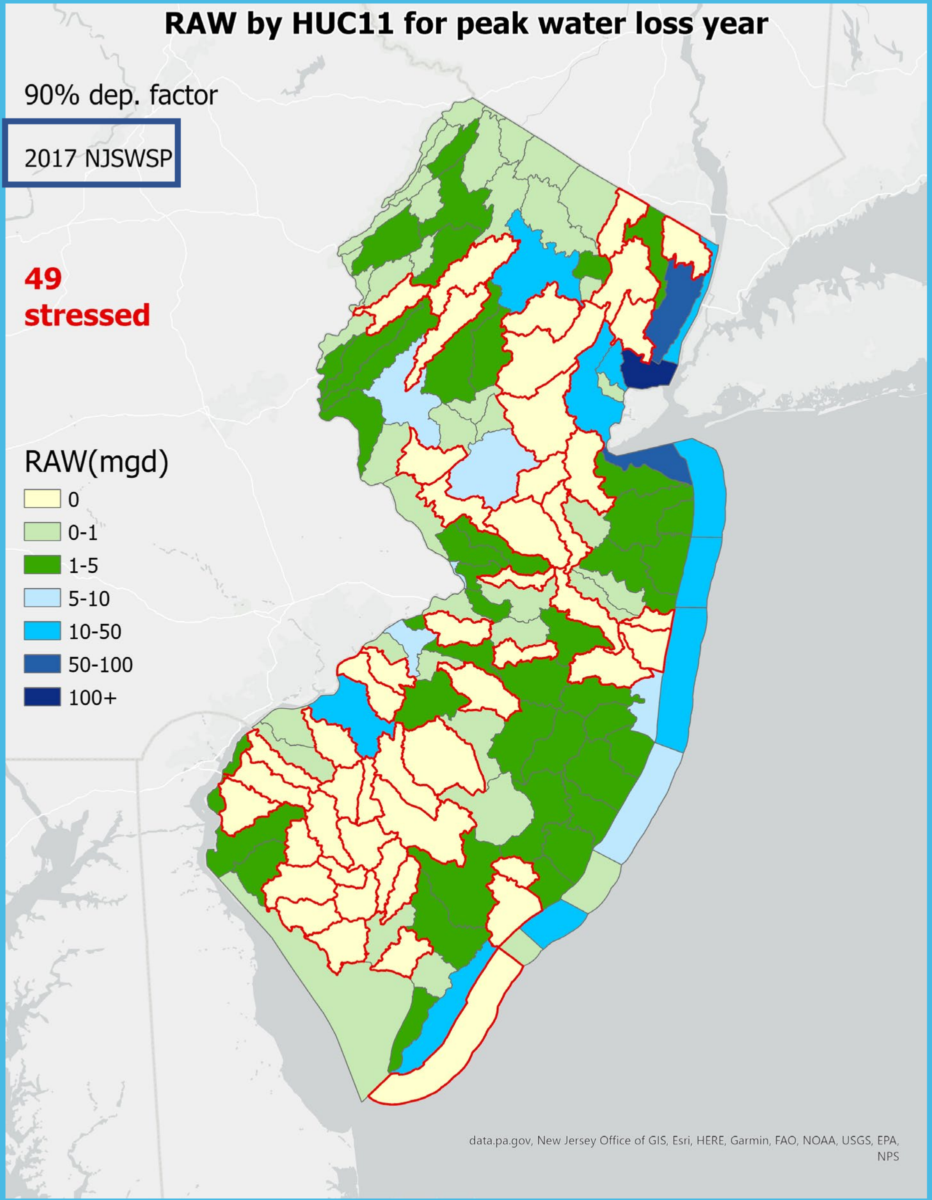
Stream Low Flow Margin Method: Anticipated Updates and Calibrations

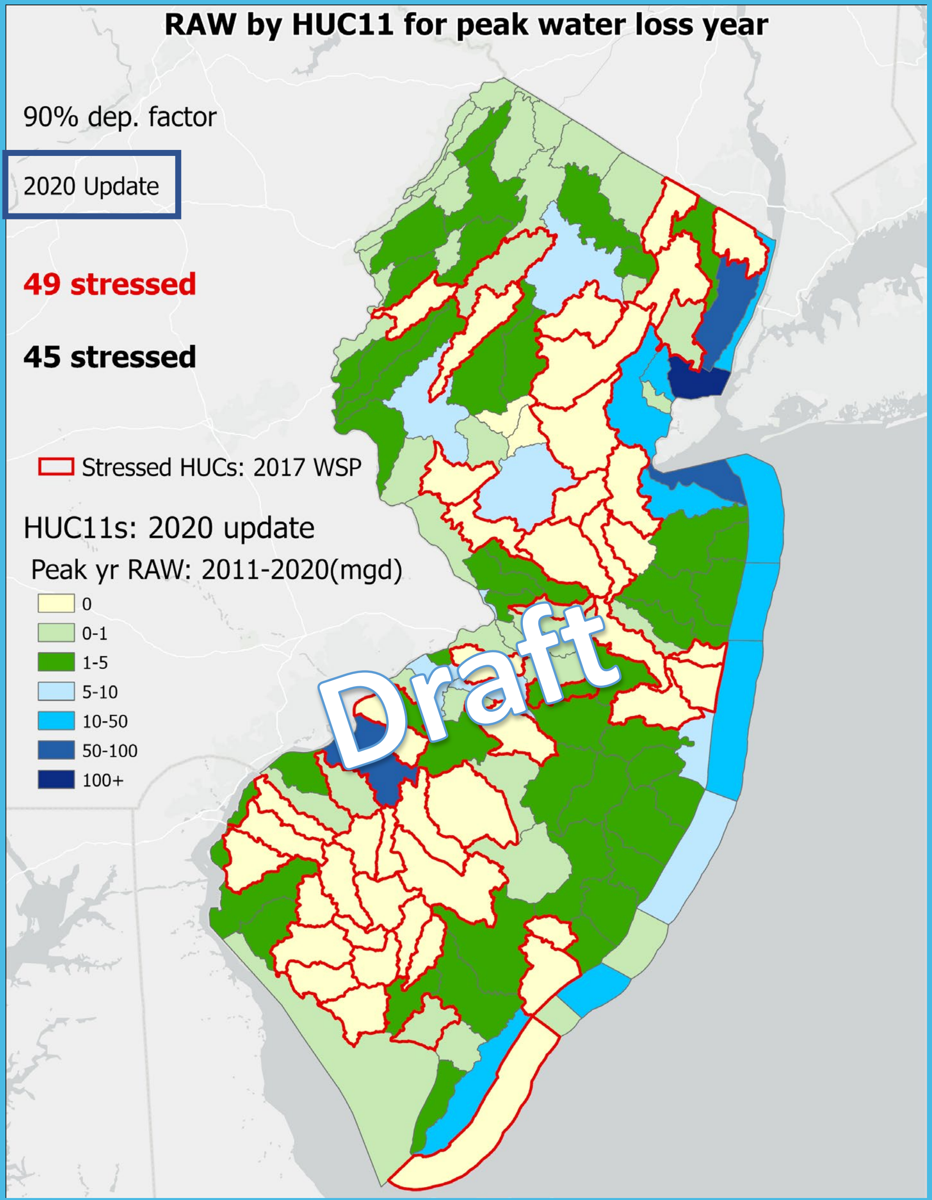
- Utilize the most recent water use data and analyze the effectiveness of LFM as a water supply accounting method.

- Is LFM correctly identifying areas (HUC 11s) where observed data suggest there are streamflow issues?
  - If not, can we adjust LFM so that it more accurately reflects streamflow conditions?
  - Remaining Available Water (RAW) will be used to identify stressed HUCs.
  - Note: RAW is synonymous with net availability

- USGS recent streamflow trends study is being used to evaluate and calibrate LFM.
  - Future iterations of LFM may consider additional observed data sources, such as macroinvertebrates or water quality.

Stream Low Flow Margin Method Results:



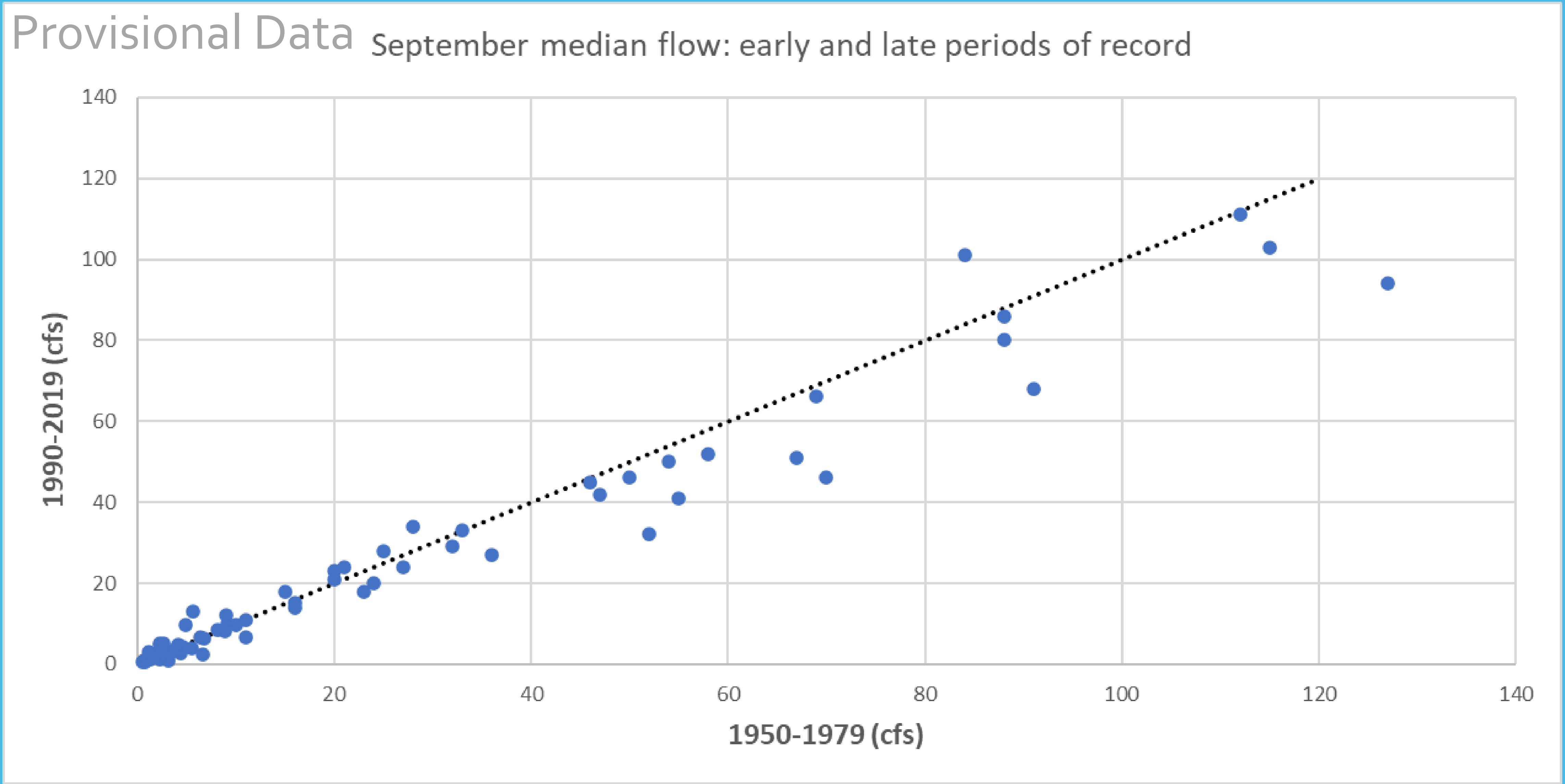


Stream Low Flow Margin Method:
USGS recent flow trends report

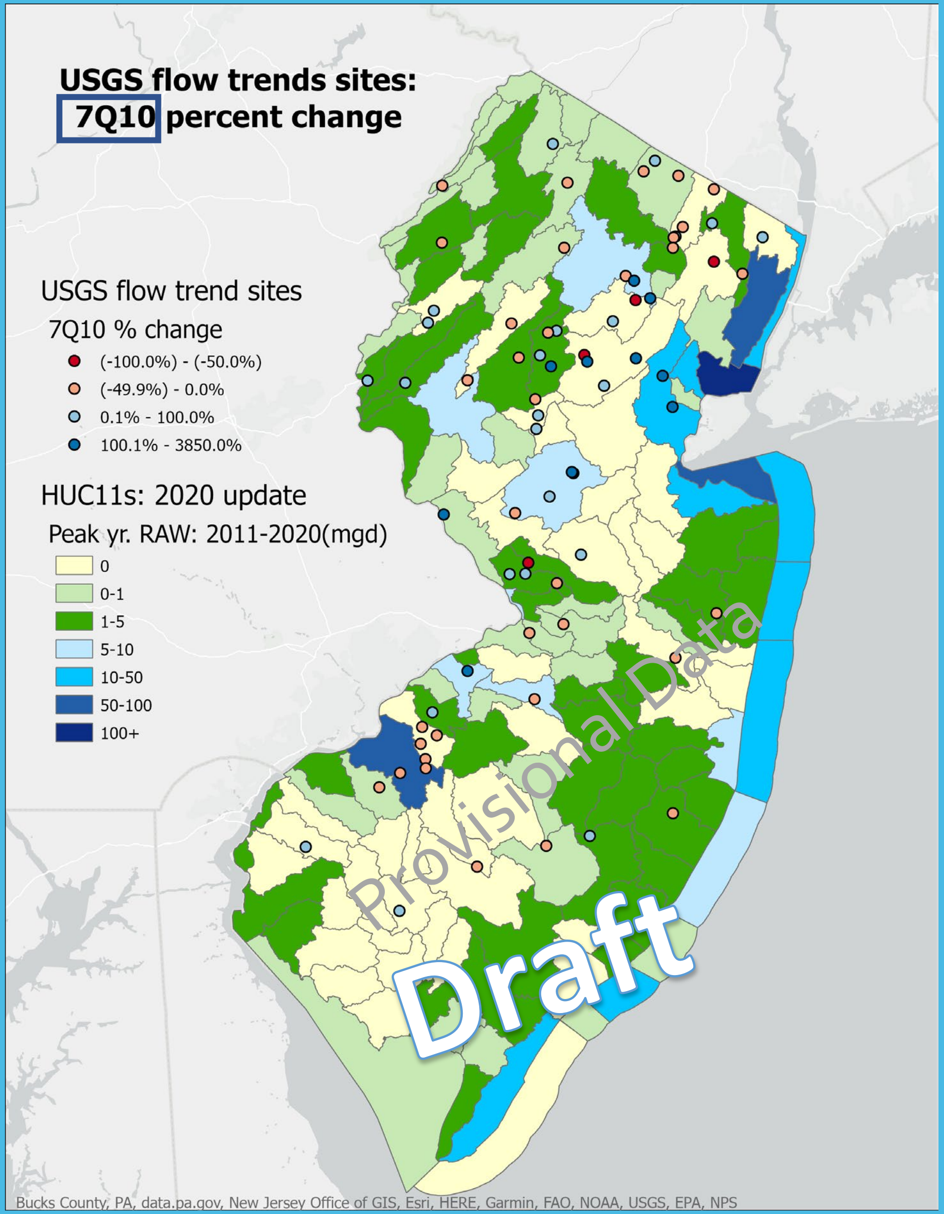
- Compared distributions of flow statistics at chosen sites between two periods of record: 1950-1979 vs. 1990-2019
  - Do changes in streamflow stats correspond to LFM results?
  - Do lower 7Q10 or Sept median flows in the recent period correspond to limited HUCs?

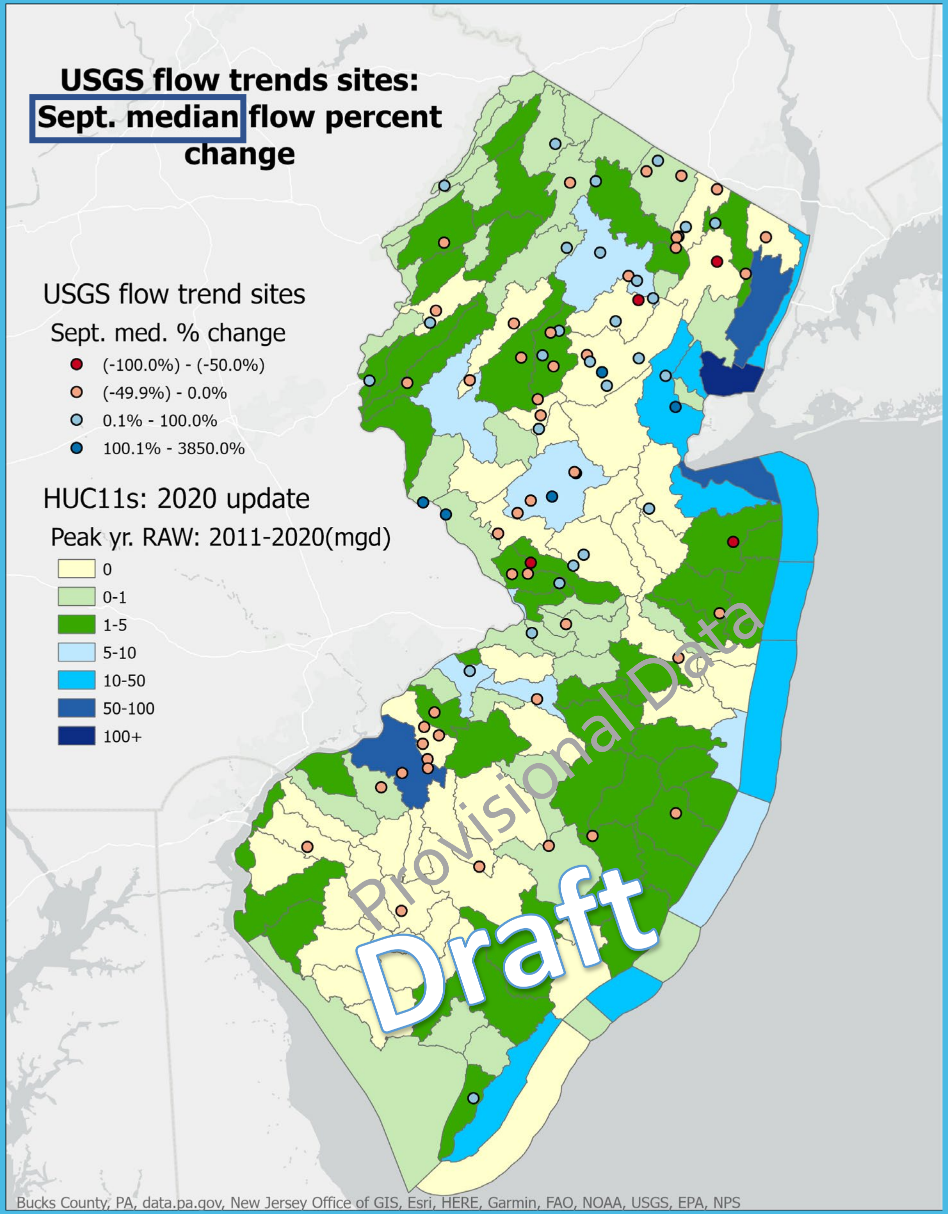
- Major findings based on unregulated, continuous record sites
  - September median flows are statistically different between early and late time periods; either higher or lower
  - 7Q10 flows are NOT statistically different
  - Mixed results…

Stream Low Flow Margin Method:



Stream Low Flow Margin Method:





Stream Low Flow Margin Method:
Baseflow depletion factor

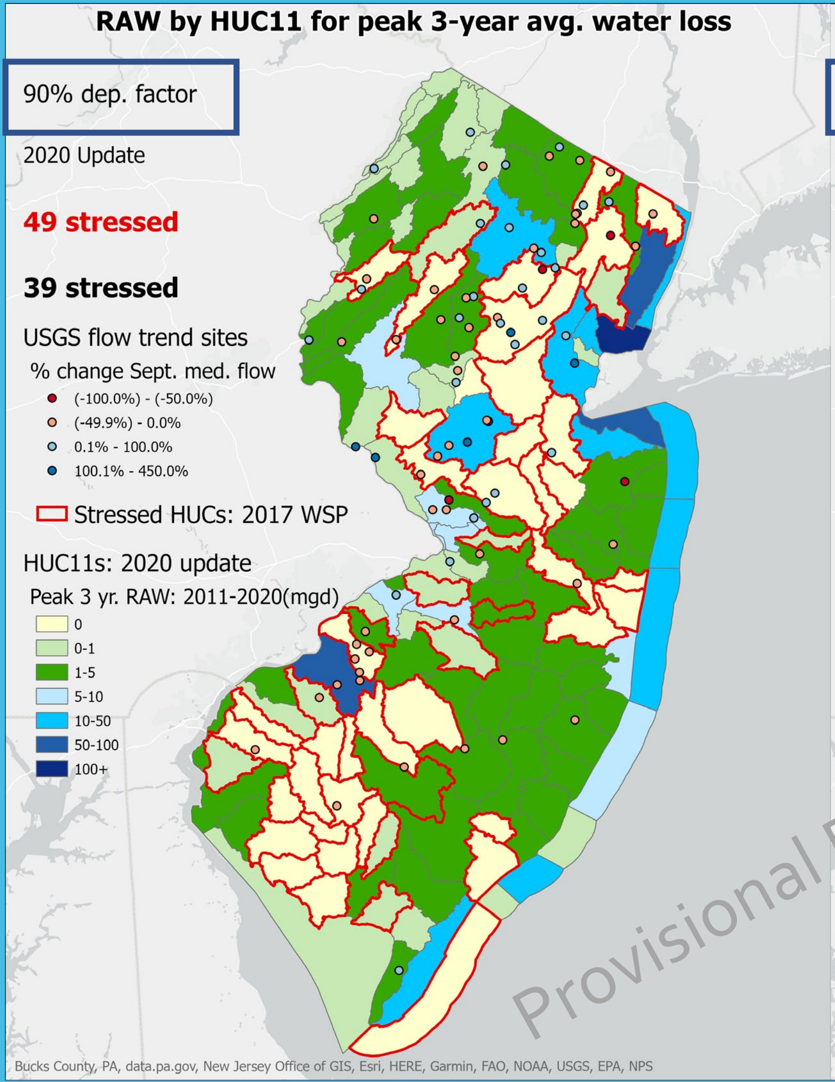
- LFM was built to assume that 90% of unconfined groundwater withdrawals result in equivalent baseflow depletion.
  - Several modeling studies were evaluated to quantify groundwater diversion impacts on baseflow. Results varied from 63% to 98%.
  - A 90% baseflow depletion factor is applied to net groundwater loss for the HUC 11 where withdrawal occurs.
- The effect of pumping on groundwater storage and streamflow is complicated and difficult to quantify. The 90% factor may be overestimating the impacts of pumping.
  - This depletion factor could be adjusted if it improves LFM’s fit to the streamflow trends.

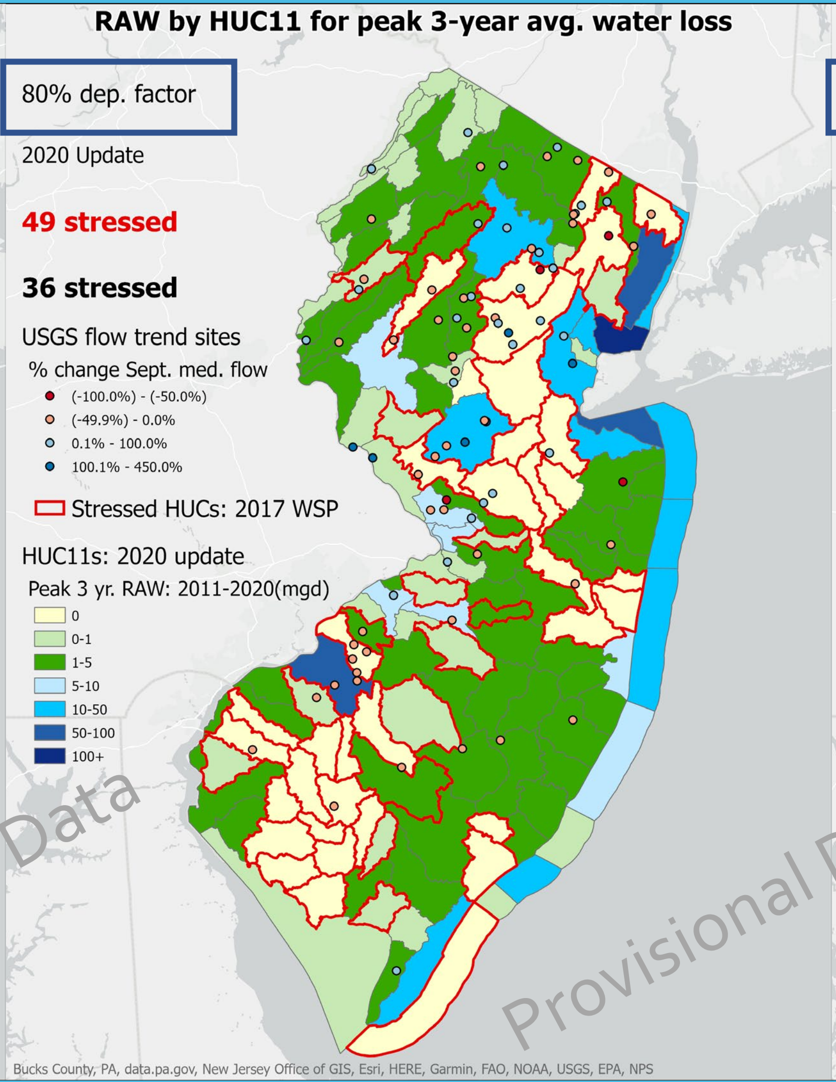
Stream Low Flow Margin Method:
Period of record (POR)

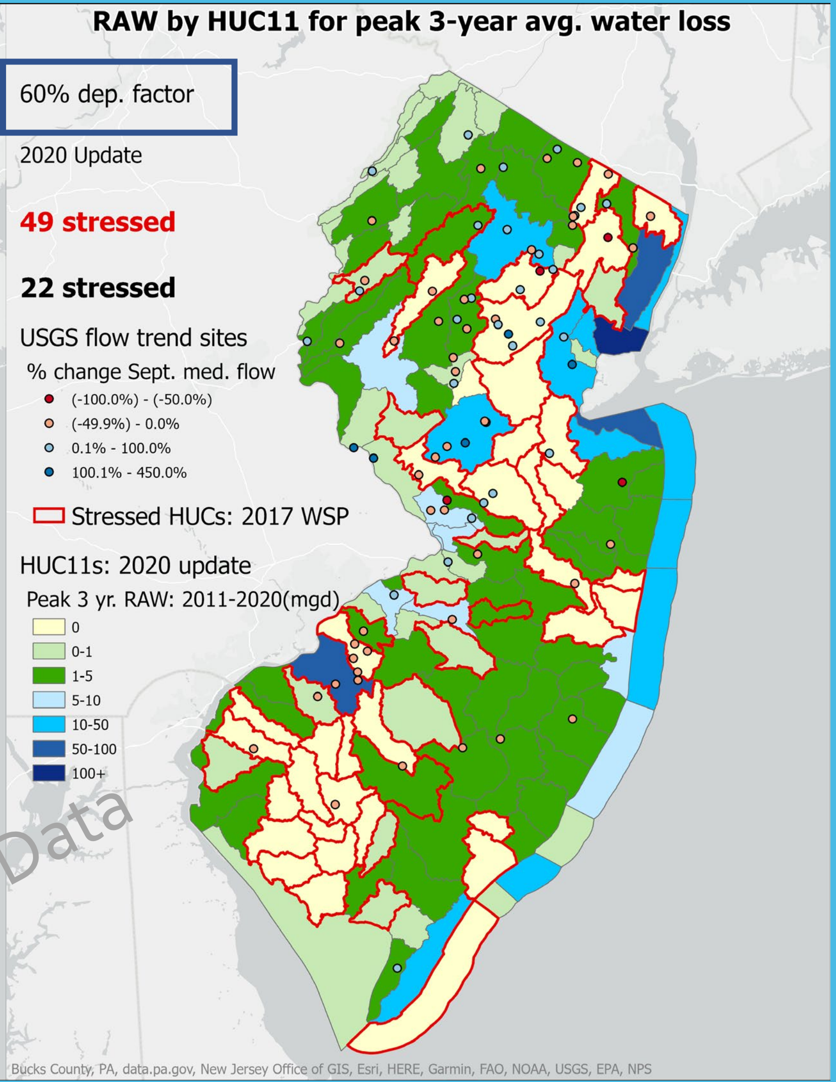
- From what POR should data be collected to capture a representative peak water loss scenario?
  - 2017 WSP: used 2000-2015
  - 2023 WSP update: will have data through 2020
  - Does water use data from before 2010 reflect current/recent peak use trends?

- To this point, the individual year with the greatest loss for a given HUC 11 has been used to calculate its RAW.
  - Is the 3-year rolling avg. with greatest loss a better input to calculate RAW?
  - 3-year avg. may better match the impact of pumping on baseflow.

Stream Low Flow Margin Method:







Stream Low Flow Margin Method:
Agricultural water use pilot study

- Preliminary analysis of metered vs estimated data suggest that withdrawals may be overestimated.
- There is significant water loss to agricultural irrigation in many of the stressed HUCs located in southern NJ
  - 2017 WSP primary cause

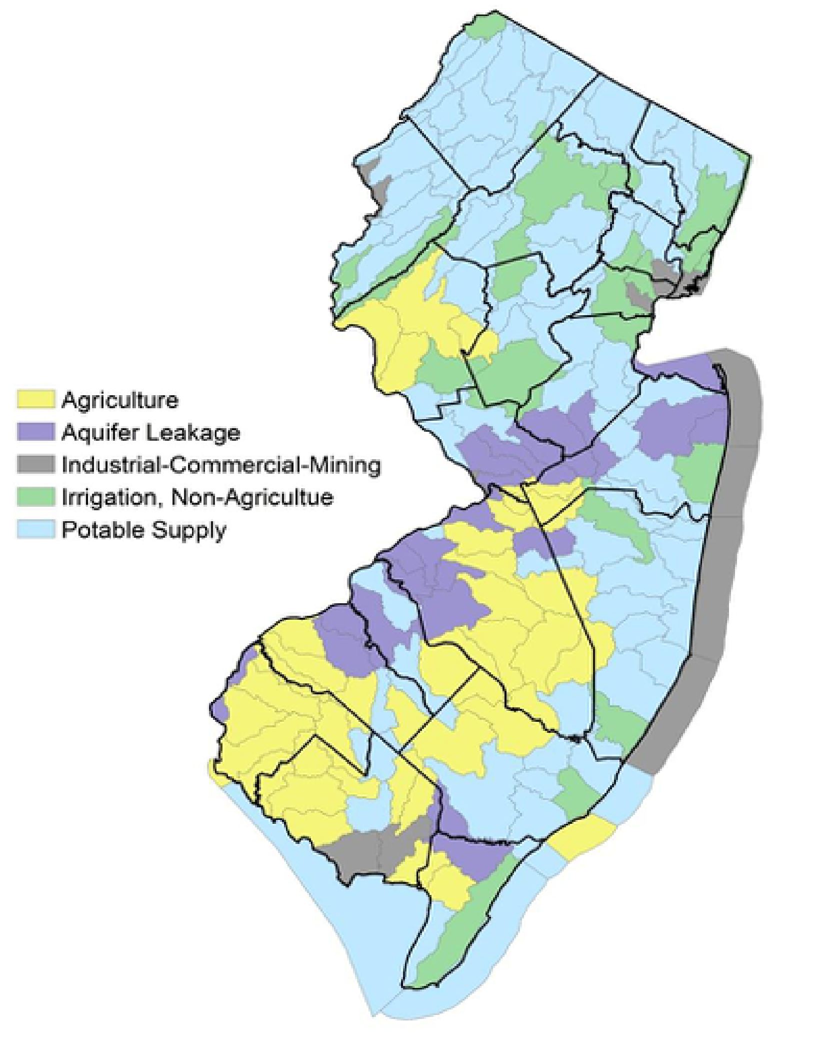
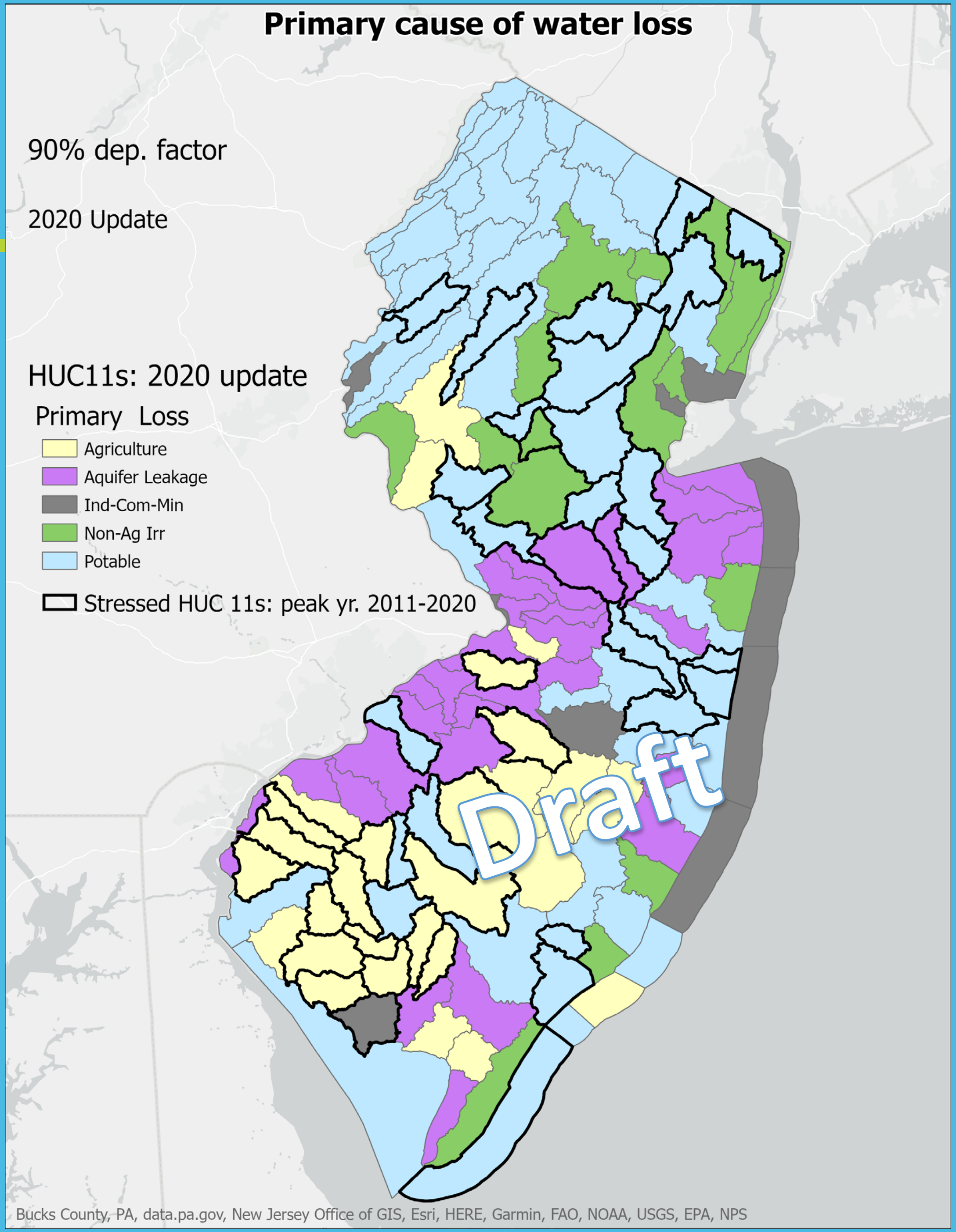


Figure 3.7 Primary causes of depletive and consumptive loss at peak use rates used in analysis.

Stream Low Flow Margin Method:

- Primary source of water loss for stressed HUCs:
  - Potable supply: **25 HUCs**
  - Agriculture: **16 HUCs**
  - Aquifer leakage: **2 HUCs**
  - Industrial, Commercial or Mining: **1 HUC**
  - Non-ag irrigation: **1 HUC**

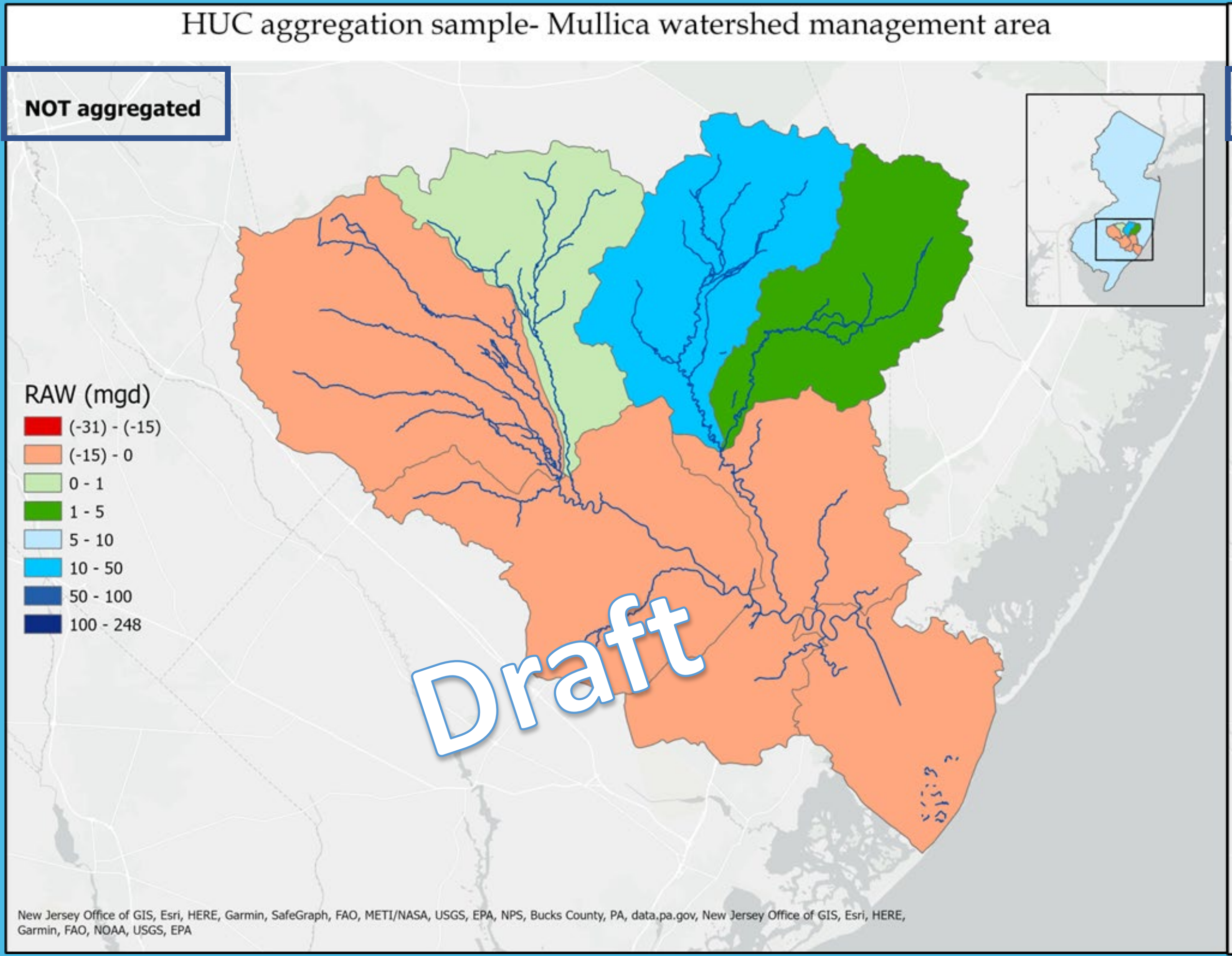


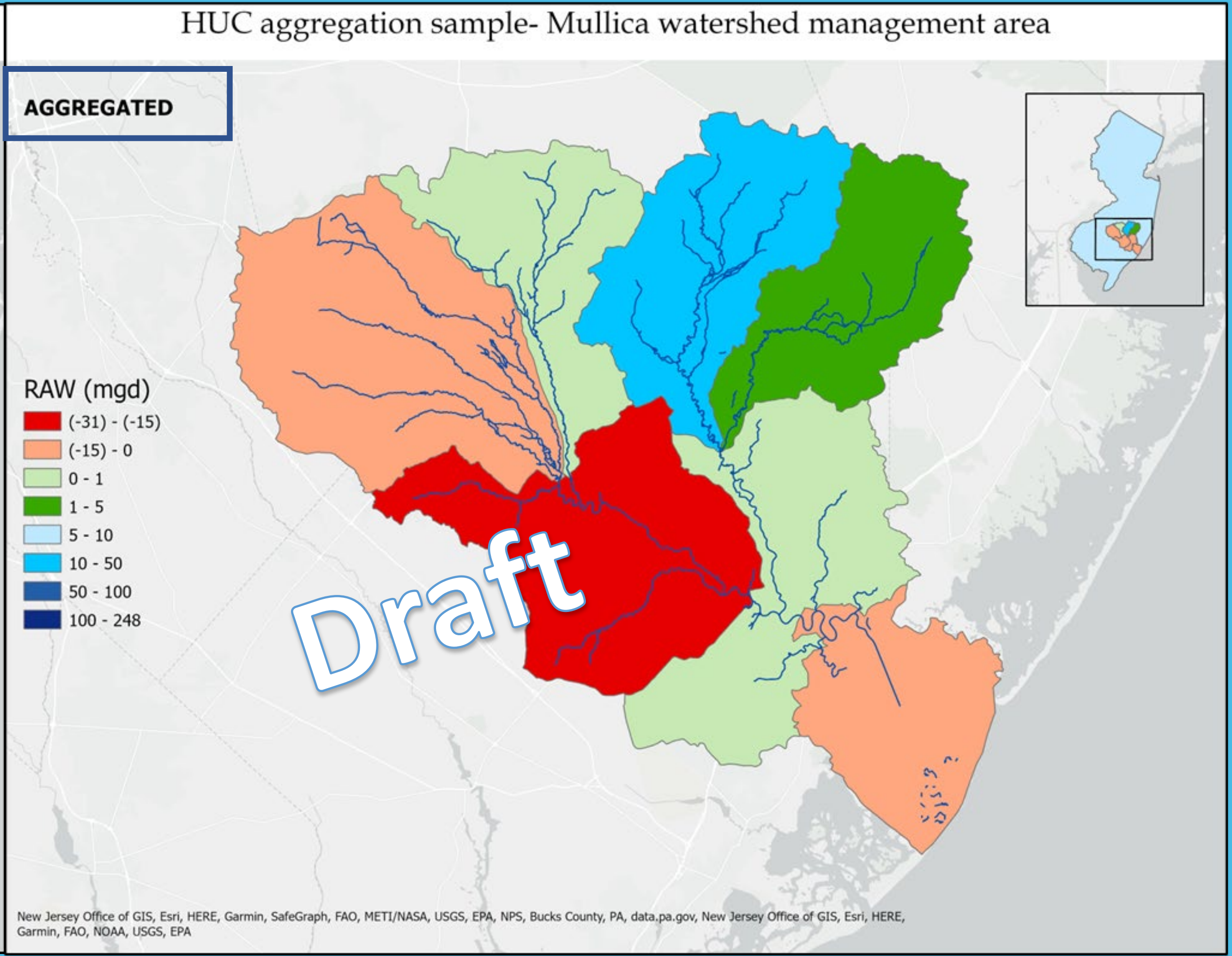
Stream Low Flow Margin Method:
HUC Aggregation

- Currently, LFM calculates RAW for each HUC 11 independently from upstream or downstream HUCs.

- Should the upstream HUCs' RAW surpluses and deficits be incorporated when determining a given downstream HUC’s RAW?

Stream Low Flow Margin Method:





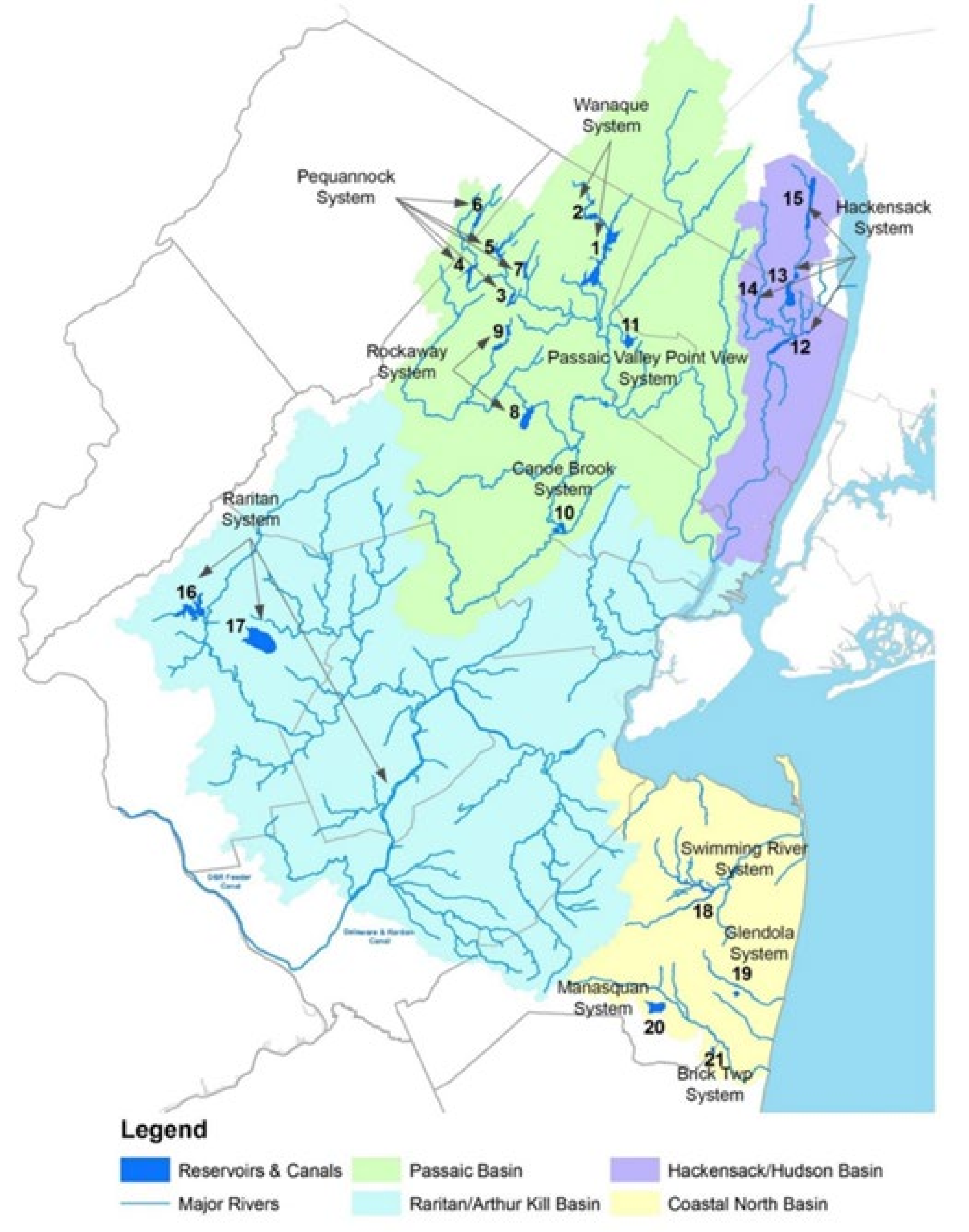
Unconfined Aquifer and Surface Water Availability Summary

- Post 2017 WSP assessment suggested that method may need calibration/editing to better match observed data:
  - USGS recent flow trends results mixed
  - Annual precip increasing since ~1980: net effect of precip vs runoff vs ET
- NJDEP Suggestions:
  - What years are representative of current peak water use: POR, 2011-2020, 2016-2020, etc?
  - Should years be lumped, e.g. 3-yr running average, to better capture peak impacts on streamflow?
  - Should the baseflow depletion factor be adjusted?
  - Use the HUC11 aggregation approach?
  - Others?
- Water use variable but generally lower- fewer limited HUC11s expected

Questions and Comments?

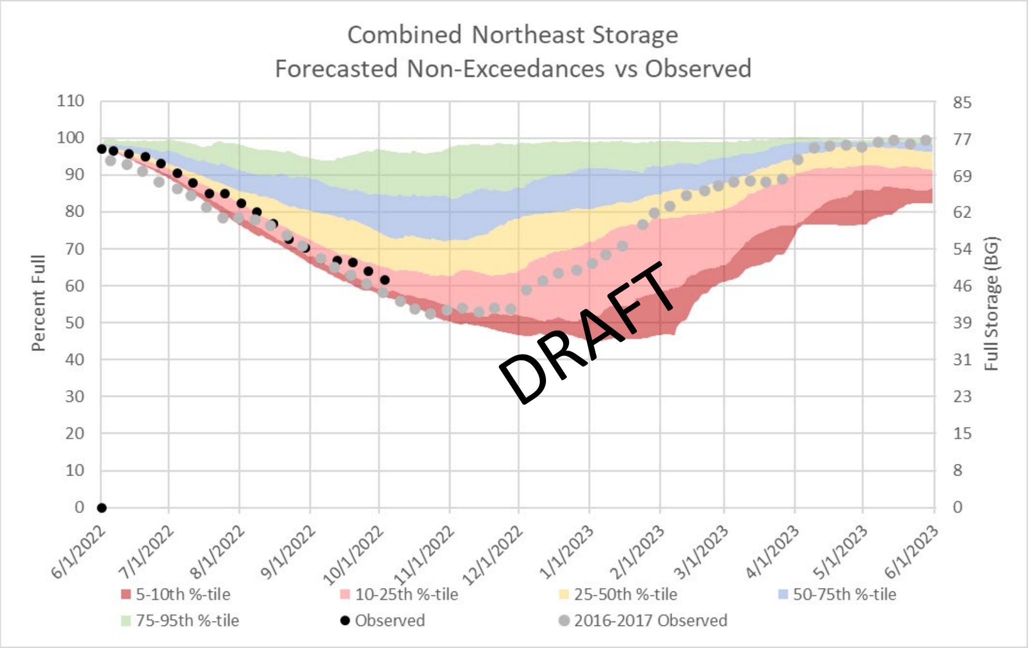
Reservoir Systems

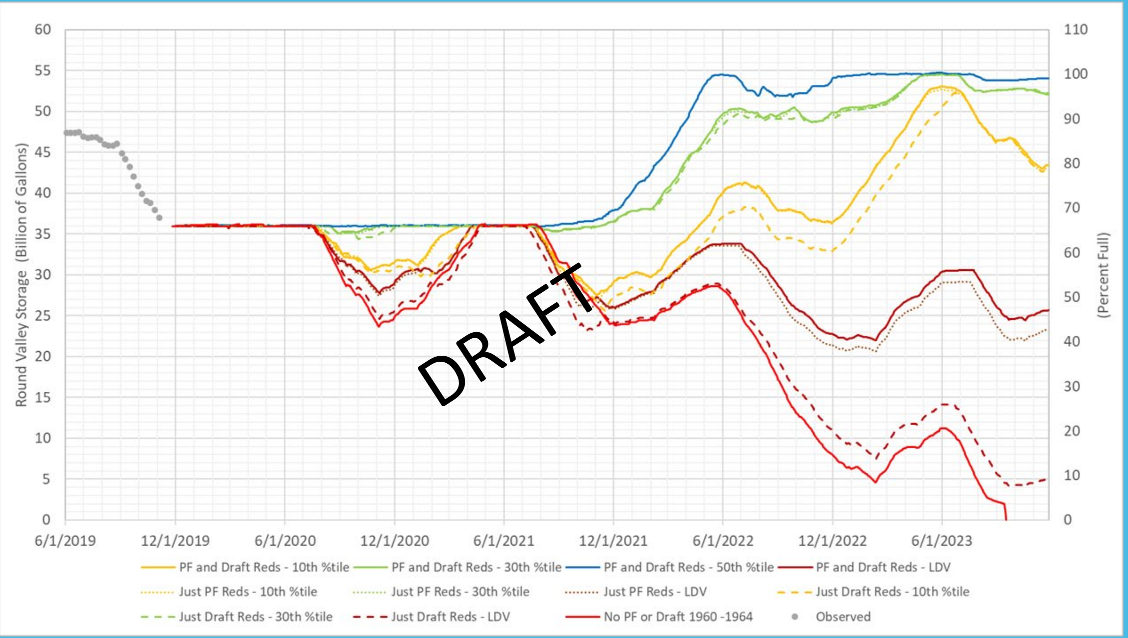
- ~770 mgd of safe yield from 7 major and several smaller reservoir systems
- Interconnected systems serving over 4 million people in 8+ counties
- Availability defined by safe yield
  - N.J.A.C. 7:19-6.3
  - SY Guidance Manual- 2011
  - Limits identified in water allocation permits- some unused allocation/SY available
  - Future uncertainty



NJ RiverWare Model

- Computer model of surface water supply systems
- Developed with multiple briefings for and input from purveyors
  - Operations, permits, inflows and hydraulics for the Passaic, Hackensack and Raritan basins
  - Developing coastal north systems
- Tool to inform operations
- Address both department and purveyor needs
  - Permit modifications
  - Drought/emergency management
- Outputs that inform and improve decision making
- Living model

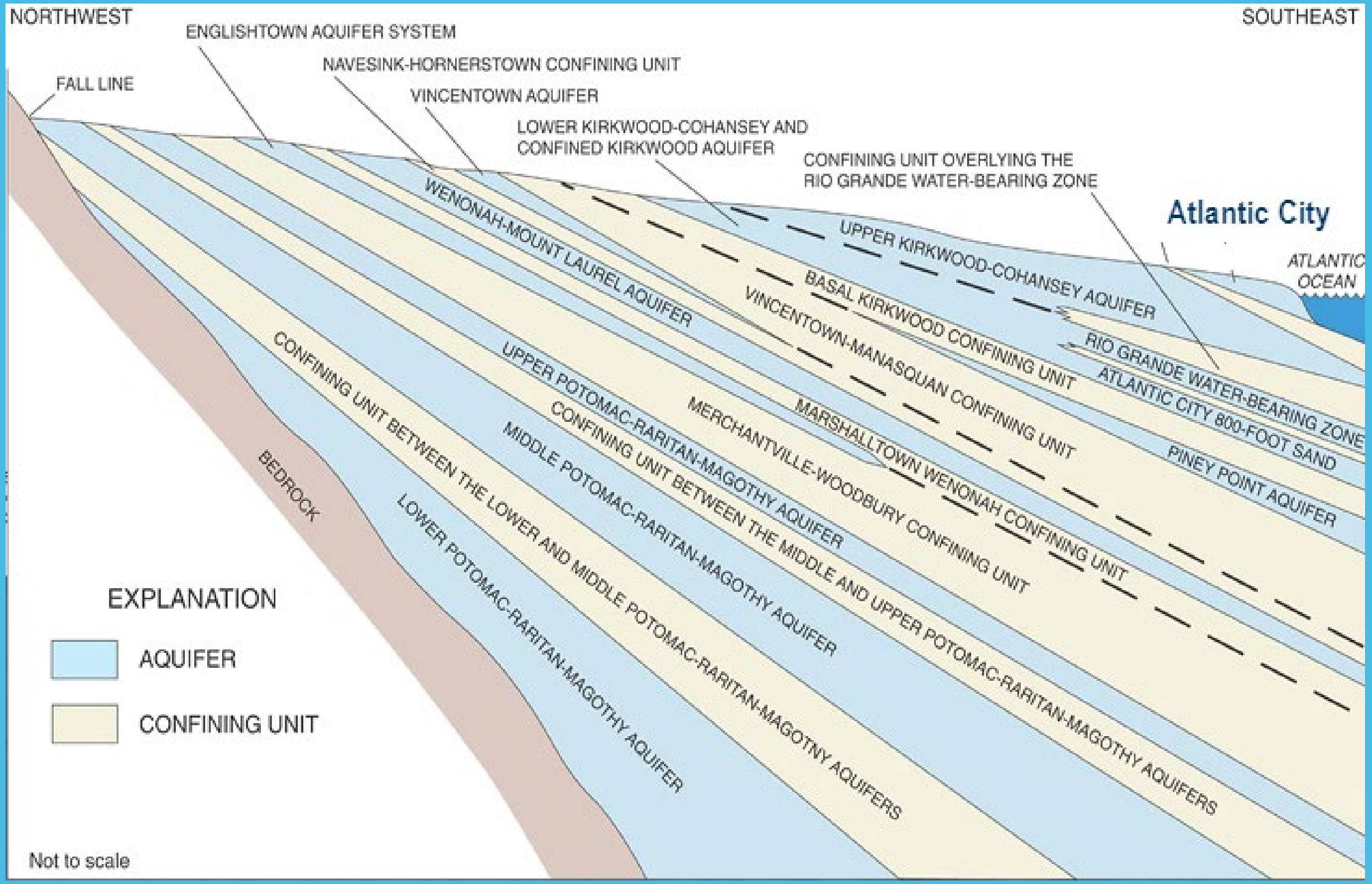




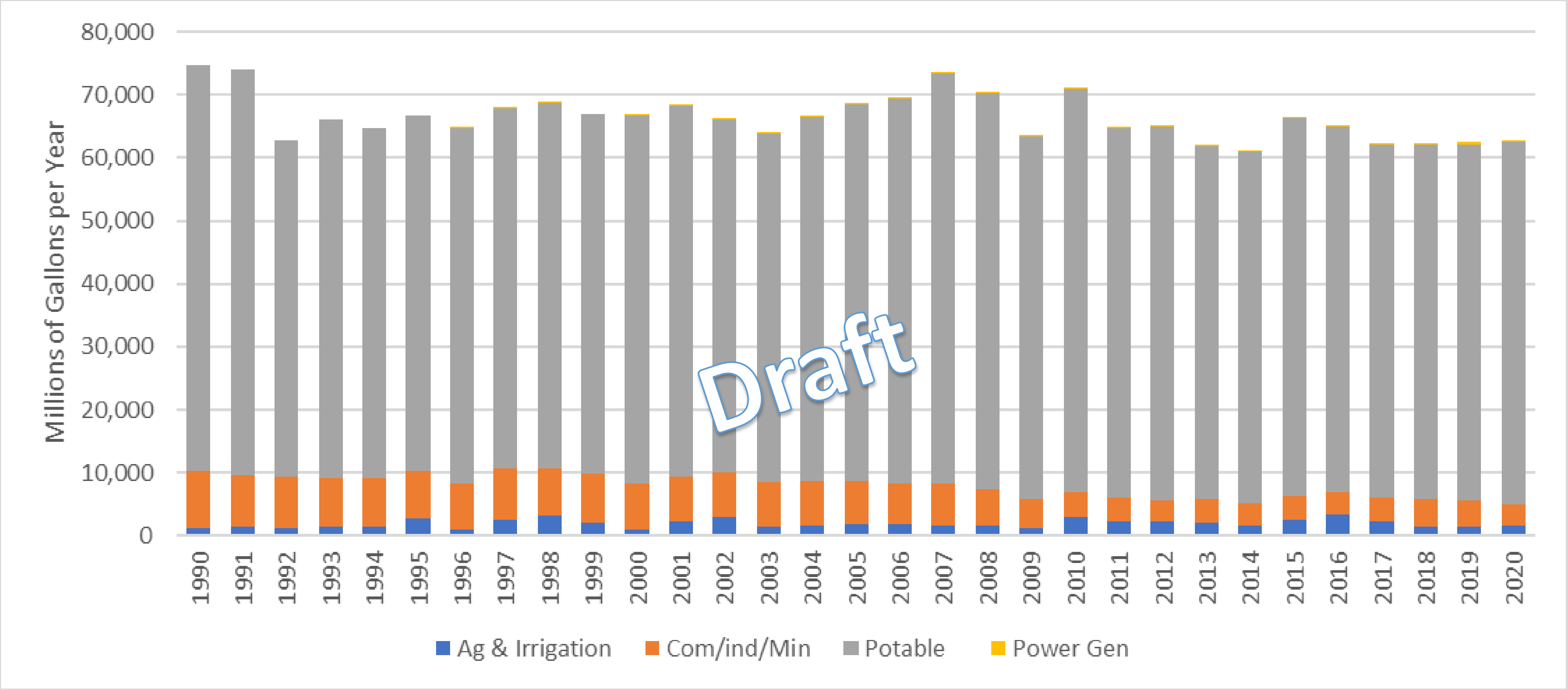
Questions and Comments?

Confined Aquifers

- NJ Coastal Plain Aquifer System
- Monitor for:
  - Excessive drawdown
  - Saltwater and saltwater intrusion
  - Well interference
- Critical Areas 1 and 2
- USGS groundwater models
- Synoptic Monitoring Network
- 2017 WSP identified limited availability- aquifer and location specific allocation evals needed

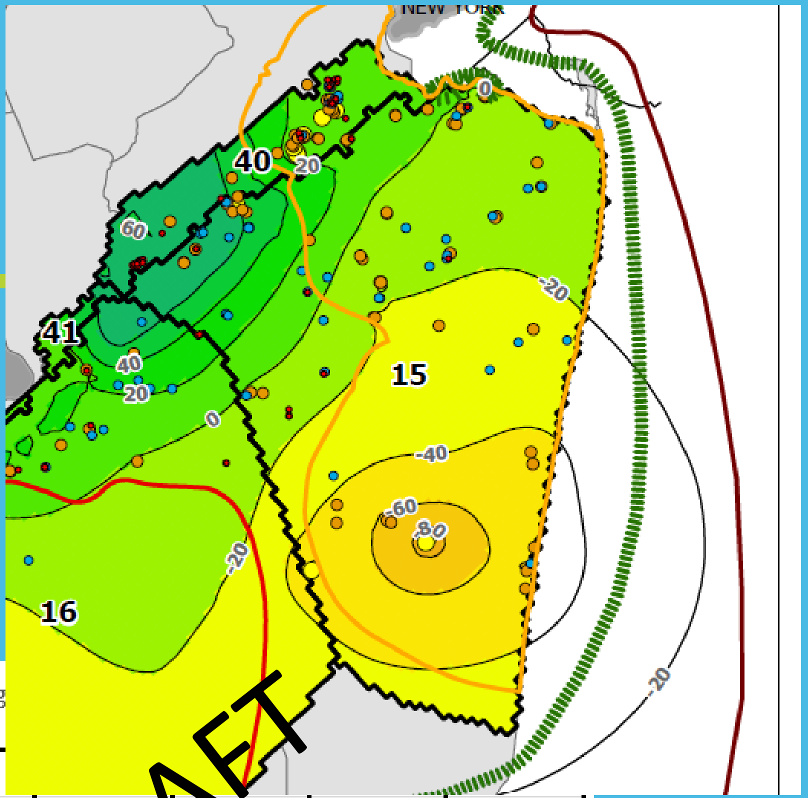


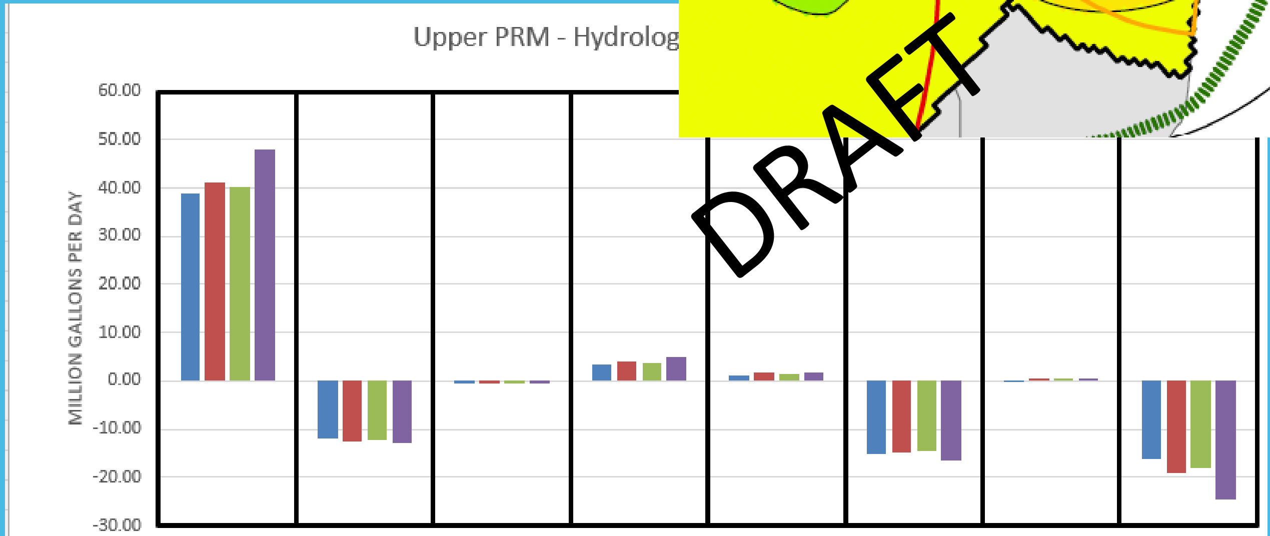
Confined Aquifer Use



Confined Aquifer Evaluations

- Synoptic Water Level Evaluation:
  - 2013 vs 2018 levels and 250 mg/L chloride
- Update confined aquifer hydrologic budget area modeling analysis
  - Current vs 2040 pumping scenarios
    - Rutgers 2018 x2 scenarios
    - Full allocation





	Flow from overlying aquifer	Flow to underlying aquifer	Lateral flow to 250-mg/L isochlor	Lateral Flow from Offshore	Lateral Flow from HBA 16	Lateral Flow to HBA 40	STORAGE	WELLS
Base	38.94	-11.78	-0.43	3.31	1.21	-15.19	-0.03	-16.03
nomWL	41.19	-12.60	-0.49	4.00	1.65	-14.71	0.00	-19.05
optWL	40.16	-12.26	-0.50	3.72	1.54	-14.58	0.00	-18.08
fullAllocation	47.90	-13.01	-0.44	4.96	1.89	-16.58	0.00	-24.72

Confined Aquifer Summary

- Confined aquifer allocations not significantly different since 2017
- Confined aquifer statewide withdrawals steady over last 20+ years
- Sea-Level Rise and impacts on potable aquifers
  - Majority of Atlantic coast potable supplies from deeper confined aquifers
  - Raritan Bay, Cape May and lower Delaware estuary impacted by saltwater…
  - A lot of recent and on-going research that needs to be evaluated from a planning perspective…

Questions and Comments?

Net Water Availability Next Steps

- Stream Low Flow Margin
  - Initial calibration still under development- feedback today appreciated
  - Full allocation scenario needed
- Reservoir System safe yields
  - evaluate as needed
- Confined Aquifers
  - Provisional data available from USGS studies
  - Final results expected by Jan 2021 for synthesis into draft
- Climate Change impacts to water availability
  - Safe yield, groundwater recharge, and saltwater intrusion into potable supply aquifers
  - Stakeholder meeting scheduled for November 9th (tentative)

Questions and Comments?

Thank You

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Water Supply Plan Team

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- Rutgers University Team:
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