Cape Fear River Water Supply Evaluation

March 22, 2016

Department of Environmental Quality
Division of Water Resources

Todays goal:

- **Review the Draft Cape Fear River Water Supply Evaluation**
- **Review the Draft Jordan Lake Water Supply Allocation Recommendations**

Follow-up:

- **Address questions and concerns**

We CANNOT comment on ongoing litigation.

Cape Fear-Neuse Rivers Hydrologic Model

- **Computer-based representation of flows in the Cape Fear and Neuse Rivers**
- **Uses flow records from 1930 to 2011**
- **Calibrated to reproduce 2010 hydrologic conditions: stream flows, reservoir elevations, etc. (basecase)**
- **Uses local water supply plan and water withdrawal registration data**
- **Future water demands are based on the increase from the 2010 basecase demands**
- **Wastewater discharges are linked to water withdrawals based on proportions in the 2010 basecase model scenario**

Cape Fear River Water Supply Evaluation

Analyzed 2060 estimated demands using the
Cape Fear – Neuse Rivers Hydrologic Model

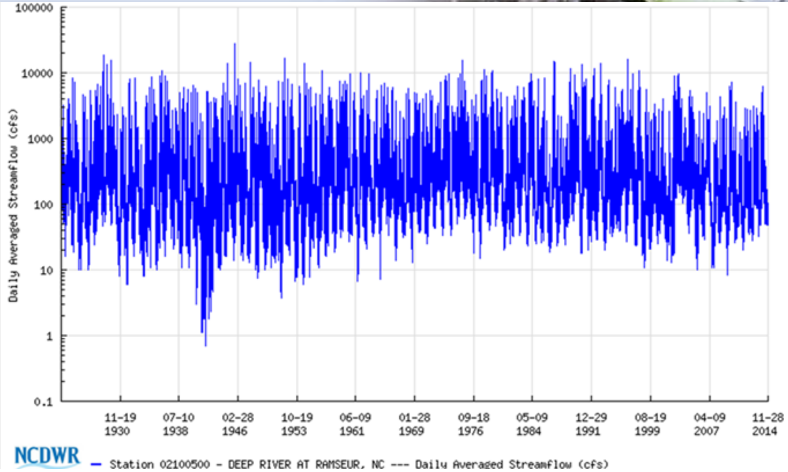
Focuses on the Deep River, Haw River and Cape Fear River Subbasins

Model also includes the Neuse River and Contentnea Creek Subbasins

Water Quantity Modeling includes:

- **Surface water withdrawers**
- **Wastewater discharges**
- **2010 and estimated future water demands**
- **81 years of flow conditions from January 1930 to September 2011**
- **Flow record adjusted for historic withdrawals and discharges and construction of facilities affecting water management**
- **Reservoir management protocols**
- **Water Shortage/Drought Response protocols**
- **Purchase and sales arrangements**

Cape Fear River
Water Supply Evaluation



- **Analyzes the ability of surface water withdrawers to meet their estimated 2060 water demands over the range of flows that occurred from 1930 to 2011**
- **Identifies the magnitude and duration of potential supply shortages**
- **Estimates the potential yield of the Jordan Lake water supply pool under various water use options**
- **Estimates the changes in flow and water quantity conditions for future demand withdrawals under a variety of water supply options**
- **Provides the background for the analysis used for the Jordan Lake water supply pool allocation recommendations**

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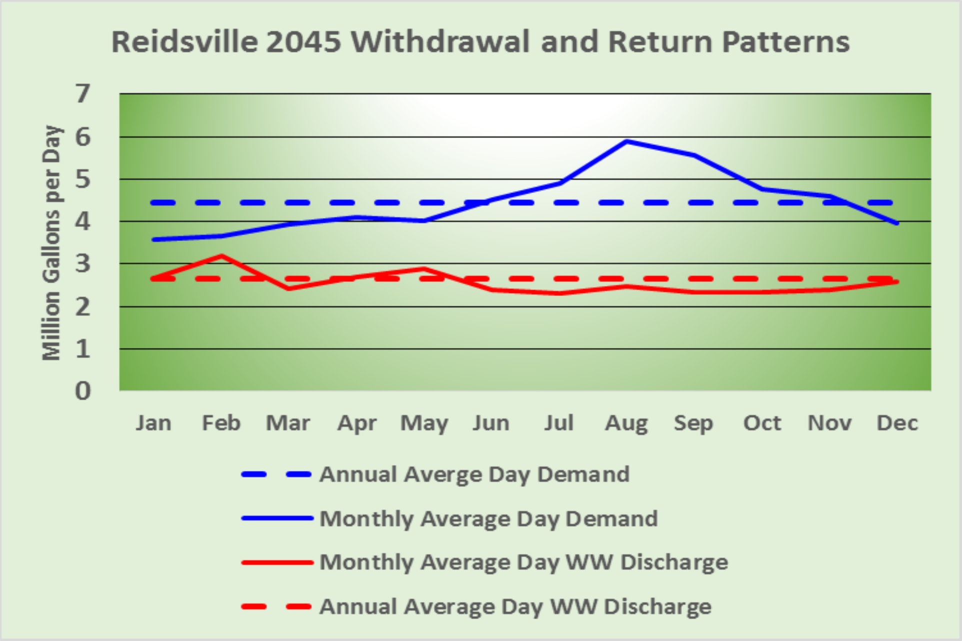
Cape Fear – Neuse River Basins Hydrologic Model

- **Computer based mathematical model customized for Deep River, Haw River, Cape Fear River, Neuse River and Contentnea Creek Subbasins**
- **Calculates surface water quantity impacts of water withdrawals, wastewater returns and changes in management**
- **Does not**:
  - **model water quality**
  - **include flood analysis**
  - **reserve water to protect ecological integrity**
  - **predict future hydrologic conditions**
  - **include tidally influenced river reaches**
- **Starting Point = 2010 water demands, sources and management**
- **Future population and demand estimates from local officials**
- **Future wastewater same percent of withdrawal as 2010**
- **Wastewater discharges to continue at current locations**
- **Agricultural use based on precipitation, crop acreage and livestock counts**
- **Evaluates ability to meet future demands over the range of flows 1930-2011**

Withdrawals and Return Flows

Modeled Annual Average Surface Water Withdrawals and Return Flows in Million Gallons per Day (MGD)							
Model Node	Surface Water Withdrawer	Wastewater Proportion	2010 Current Conditions	2035 Estimated Demand	2045 Estimated Demand	2060 Estimated Demand	Estimate Type
31	Reidsville Demand_02-79-020		3.530	4.347	4.459	4.666	Demand
	Reidsville nc0046345 and nc0024881	0.594	2.097	2.582	2.649	2.772	WW Return
123	Greensboro Total Demand_02-41-010		35.240	48.485	55.312	67.399	Demand
	Lake Townsend nc0081671	0.132	4.652	6.400	7.301	8.897	WW Return
	North Buffalo Creek nc0024325	0.283	9.973	13.721	15.653	19.074	WW Return
	Ozborne nc0047384	0.737	25.972	35.733	40.765	49.673	WW Return
	Mitchell nc0081426	0.02	0.705	0.970	1.106	1.348	WW Return



- **Each water withdrawal is characterized by an individualized withdrawal and return flow pattern**
- **Municipal demand patterns vary by month**
- **Agricultural withdrawals vary by time of the year and precipitation**

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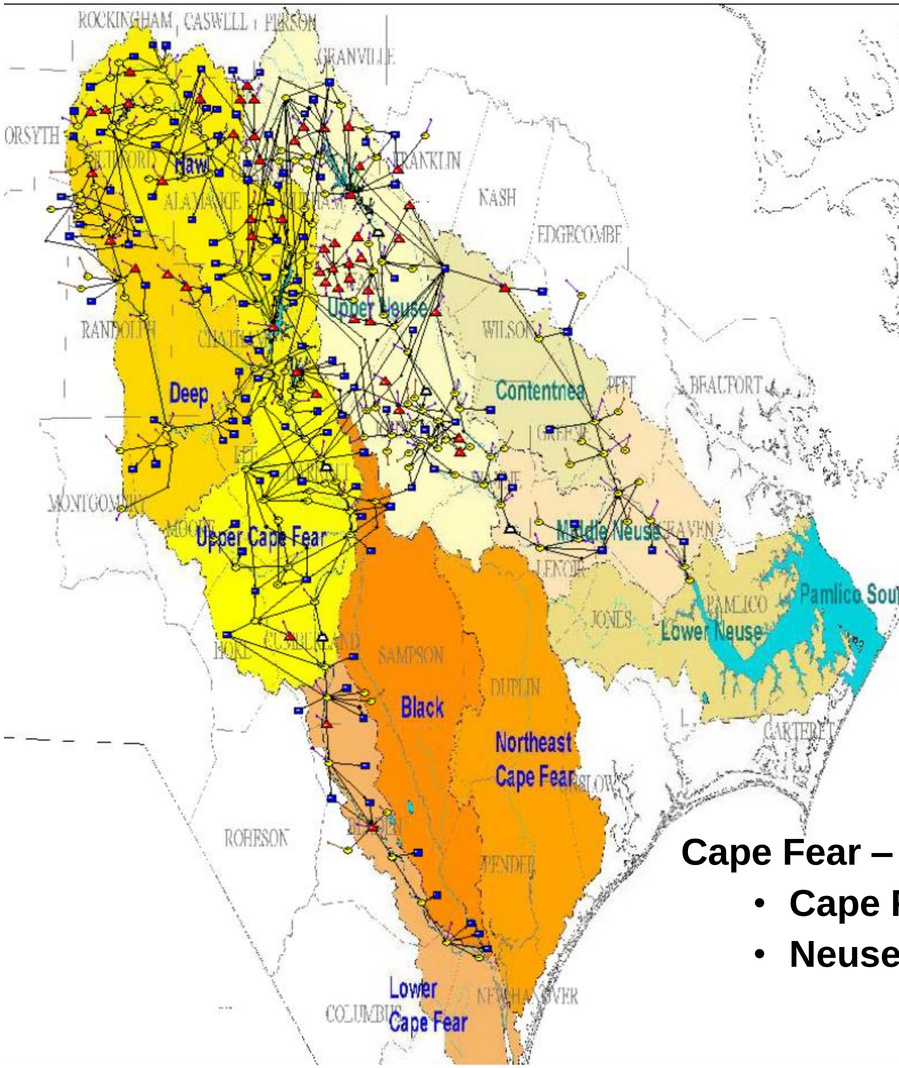
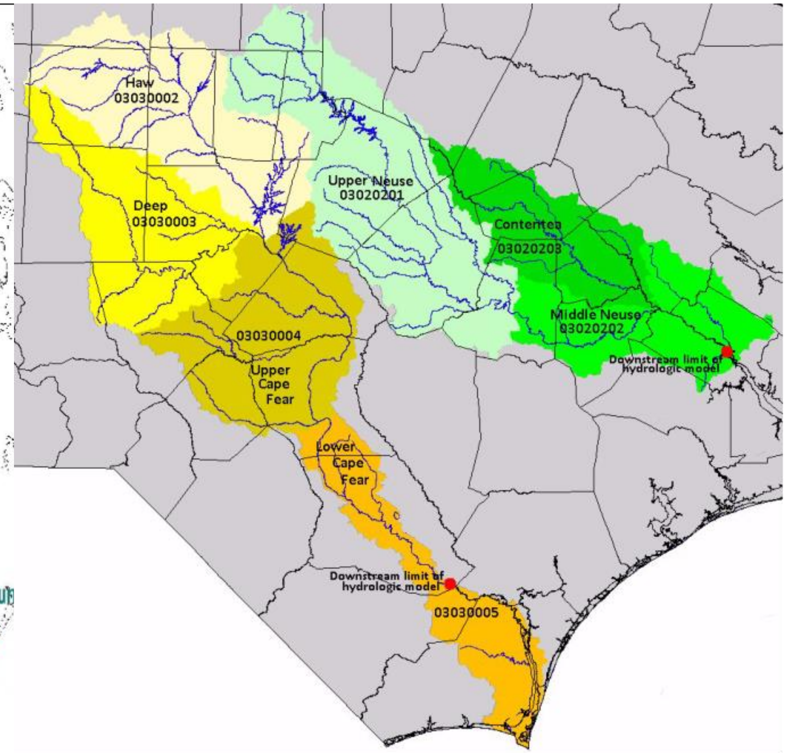
Geographic Scope of Model and Evaluation





Cape Fear – Neuse River Basins Hydrologic Model

- **Cape Fear – 27 SW withdrawals > 82 water systems**
- **Neuse – 13 SW withdrawals > 36 water systems**

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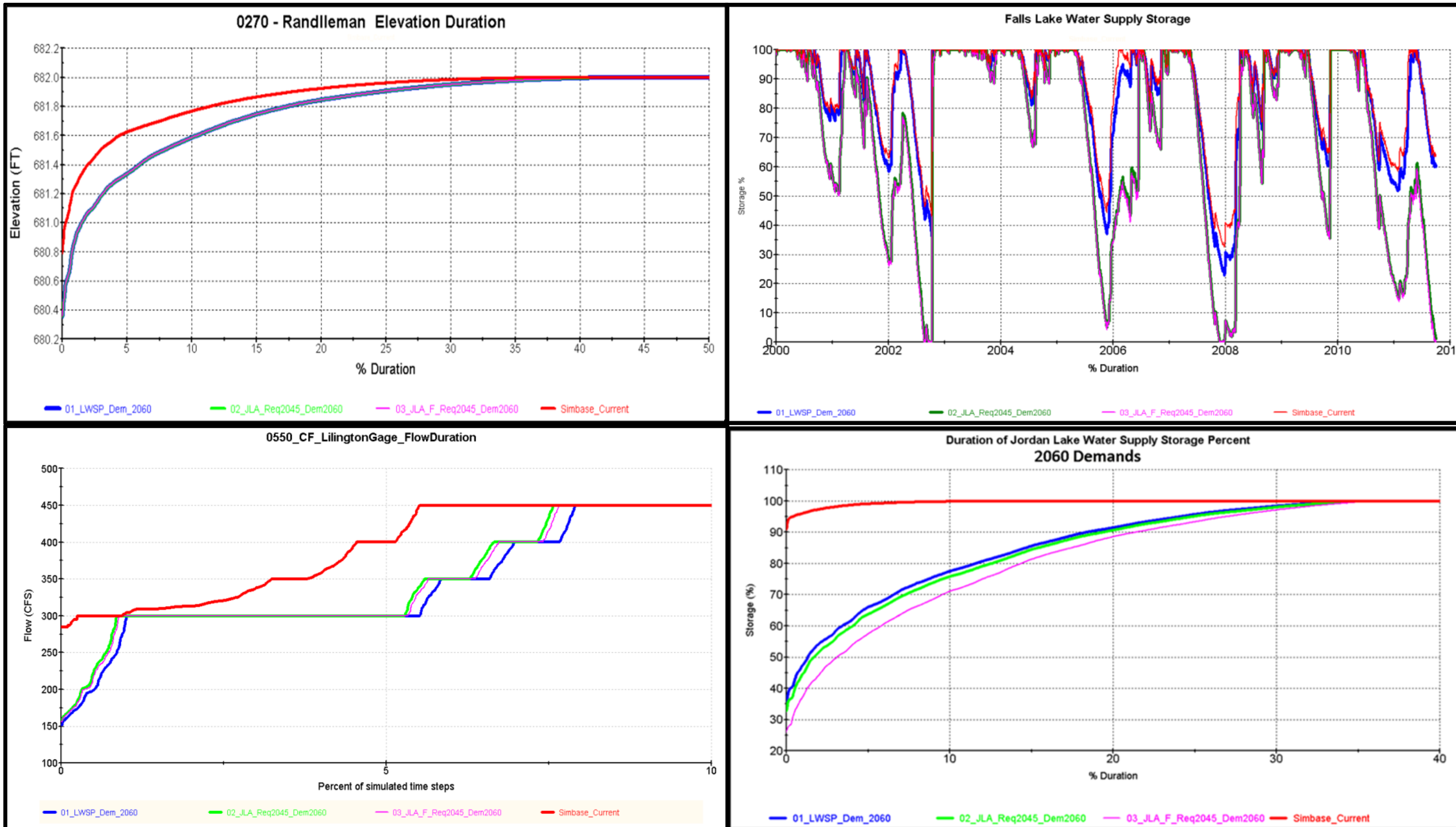
How might conditions change?



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Water Supply Shortage Analysis

Appendix C Summary of Water System Supply Shortages Under Various Model Scenarios

Cape Fear River Basin

Model Node Number	Water System / Shortage Measure	Model Scenarios: 01_JJA_LWSP_Dem2035	01_JJA_LWSP_Dem2045	01_JJA_LWSP_Dem2060	02_JJA_Req2045_Dem2035	02_JJA_Req2045_Dem2045	02_JJA_Req2045_Dem2060	03_JJA_F_Req2045_Dem2035	03_JJA_F_Req2045_Dem2045	03_JJA_F_Req2045_Dem2060	04_JJA_Raleigh_Lillington_Dem2045	Simbase-current	Simbase_Dem2045
0431	Orange Water & Sewer Authority	With Water Shortage Response Plan											
	Max Shortage, mgd / Max shortage Period, days	0	0	0	0	0	0	0	0	0	0	0	5.6/22
	Longest Avg Shortage, mgd / Longest Shortage Period, Days	0	0	0	0	0	0	0	0	0	0	0	5.2/22
	Total Days Short	0	0	0	0	0	0	0	0	0	0	0	22
0471	Cary Apex	With Water Shortage Response Plan											
	Max Shortage, mgd / Max shortage Period, days	0	0	0	0	0	0	0	0	0	0	0	0
	Longest Avg Shortage, mgd / Longest Shortage Period, Days	0	0	0	0	0	0	0	0	0	0	0	0
0473	Chatham County-North	With Water Shortage Response Plan											
	Max Shortage, mgd / Max shortage Period, days	0	0	0	0	0	12.4/1	0	0	16.9/1	0	0	12.5/24
	Longest Avg Shortage, mgd / Longest Shortage Period, Days	0	0	0	0	0	8.9/3	0	0	4.97/33	0	0	10.21/24
	Total Days Short	0	0	0	0	0	3	0	0	152	0	0	136

- Potential Water Supply Shortages were analyzed for each water withdrawer under each of the model scenarios evaluated.

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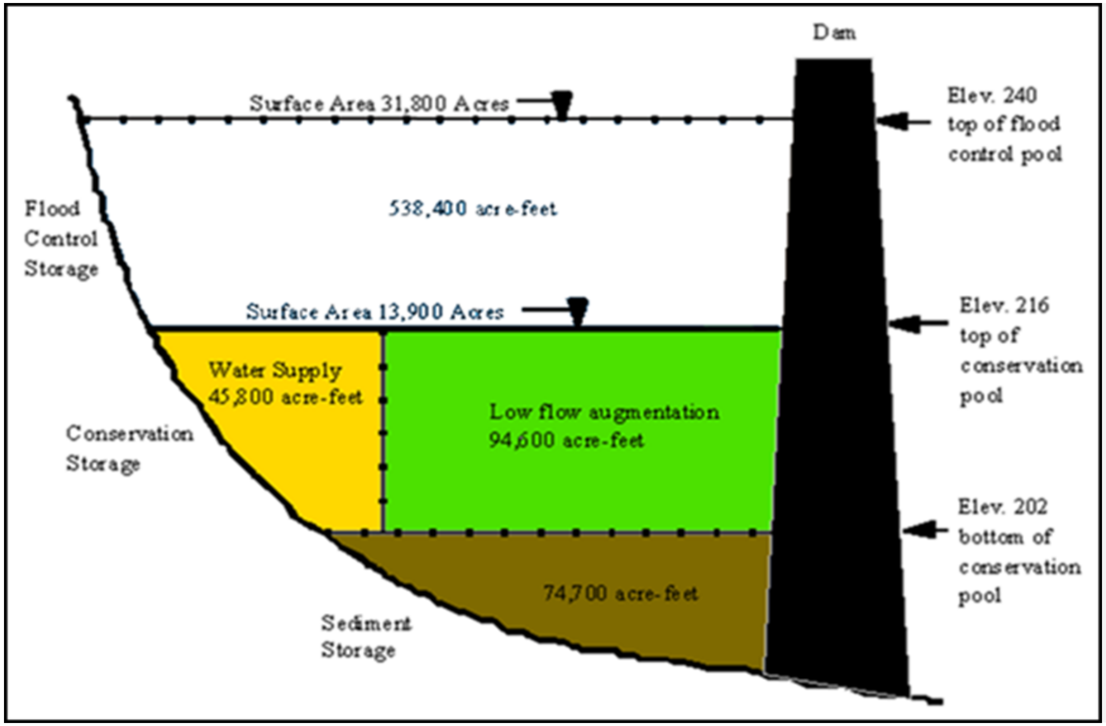
Jordan Lake Storage Divided into 4 separate accounts

Flood Control -- manage downstream flows during high precipitation events

Water Supply -- allocated by EMC

Water Quality -- augment downstream flows to meet management target

Sediment Storage -- compensation for storage loss due to sedimentation



Flood Storage

216-240 ft-msl

Water Supply 32.62%
202-216 ft-msl

Water Quality 67.38%
202-216 ft-msl

Sediment Storage
below 202 ft-msl

ft-msl = feet mean sea level

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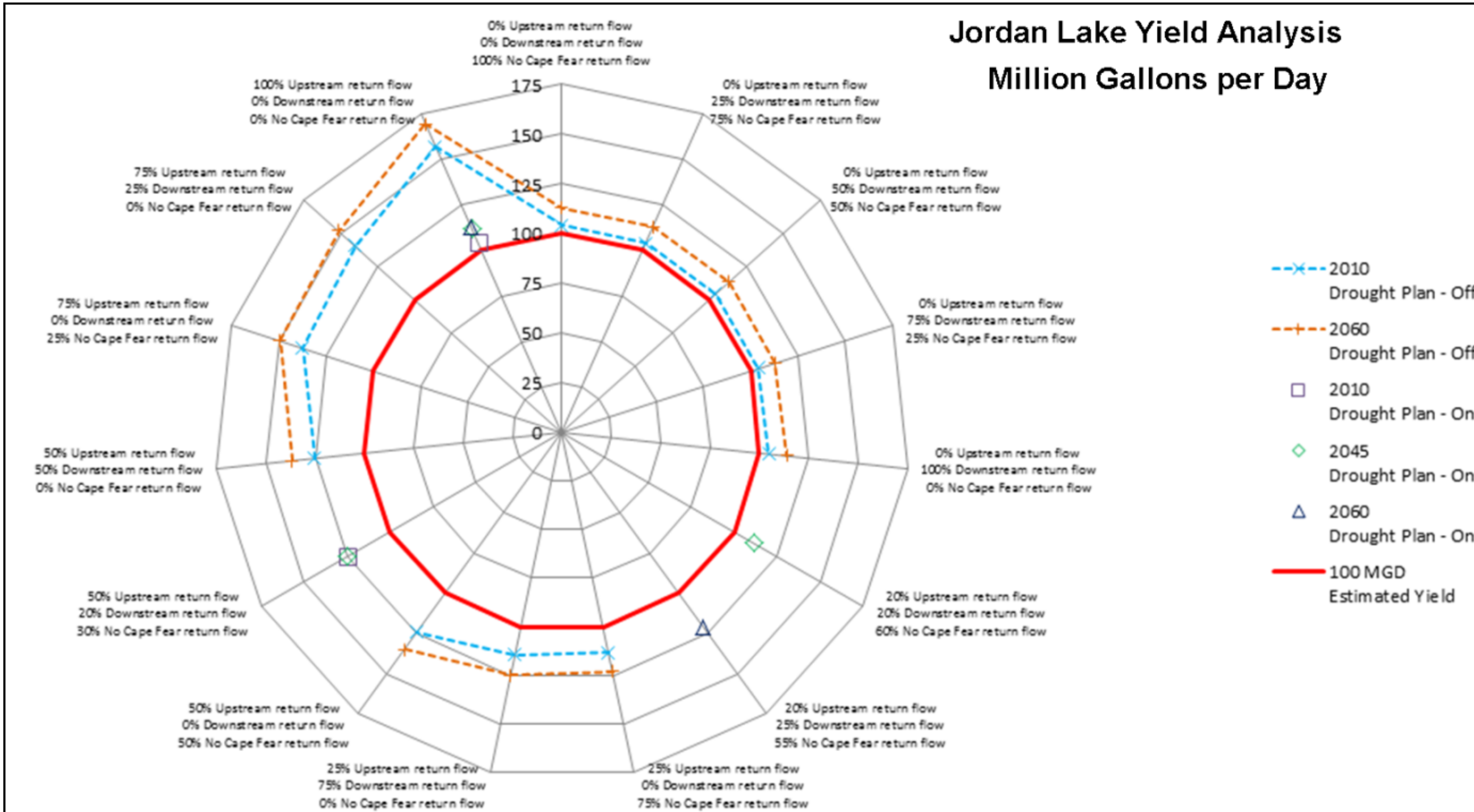
Jordan Lake Water Supply Yield

NC desired storage to reliably yield 100 mgd



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Potential Jordan Lake Water Supply Pool Yield

Estimated Jordan Lake Water Supply Yield									
Model Set Up	Return Flow Assumption			2010 Basecase Scenario			2060 Demand Scenario		
	% on Watershed	% Below Dam	% Out of Basin	Estimated Water Supply Yield (MGD)	Jordan Lake Minimum Elevation (ft-msl)	Minimum Water Supply Storage (%) 2/24/1934	Estimated Water Supply Yield (MGD)	Jordan Lake Minimum Elevation (ft-msl)	Minimum Water Supply Storage (%) 2/24/1934
1	0	0	100	104.06	202.65	0.65	112.92	203.03	0.79
2	100	0	0	156.94	204.30	1.07	169.66	204.06	1.18
3	0	100	0	104.98	203.55	0.74	113.84	203.36	1.60
4	50	50	0	125.44	203.88	2.69	136.69	203.67	0.96
5	50	0	50	124.19	202.69	0.86	134.86	203.07	0.87
6	0	50	50	104.00	202.65	0.71	112.92	203.03	0.73
7	25	75	0	114.63	203.70	1.17	124.81	203.50	0.81
8	25	0	75	113.25	202.67	0.73	122.91	203.05	0.85
9	75	25	0	140.31	204.07	0.95	151.45	203.86	0.97
10	0	25	75	103.99	202.65	0.75	112.92	203.03	0.77
11	75	0	25	137.56	202.71	0.89	149.55	203.04	1.02
12	0	75	25	104.00	202.65	0.70	112.92	203.03	0.71

Potential Jordan Lake Water Quality Pool Status

Estimated Minimum Water Quality Pool Storage									
	Return Flow Assumption			2010 Basecase Scenario			2060 Demand Scenario		
Model Set Up	% on Watershed	% Below Dam	% Out of Basin	Minimum Water Quality Storage (%)	Date of Minimum Water Quality Storage	Number Days Water Quality = 0	Minimum Water Quality Storage (%)	Date of Minimum Water Quality Storage	Number Days Water Quality = 0
1	0	0	100	0.02	8/22/2002	0	0.00	8/9/2002	10
2	100	0	0	14.04	11/30/1953	0	9.94	2/24/1934	0
3	0	100	0	9.15	2/24/1934	0	4.08	2/24/1934	0
4	50	50	0	11.94	2/24/1934	0	7.03	2/24/1934	0
5	50	0	50	0.21	10/20/2007	0	0.11	8/22/2002	0
6	0	50	50	0.08	10/23/2007	0	0.00	8/21/2002	4
7	25	75	0	10.75	2/24/1934	0	5.99	2/24/1934	0
8	25	0	75	0.08	8/22/2002	0	0.03	8/22/2002	0
9	75	25	0	13.63	11/30/1953	0	8.43	2/24/1934	0
10	0	25	75	0.02	8/24/2002	0	0.00	8/14/2002	7
11	75	0	25	0.35	12/11/2007	0	0.26	8/29/2002	0
12	0	75	25	0.12	12/13/2007	0	0.08	12/11/2007	0

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Identified Supply Issues 2060

- Greensboro will need more water from Randleman Reservoir which will require supporting the Piedmont Triad Regional Water Authority to increase the capacity of the water treatment plant.
  - The increased water treatment capacity will provide increased reliability for all users of Randleman Reservoir
- Modeling indicates that Graham and Mebane may face a 3-week shortage meeting 2060 estimated demands during a repeat of the drought conditions in 2007-2008 or 1934
- Carthage may have difficulty reliably withdrawing its predicted 2060 demand amount from the existing source in Nicks Creek during some low flow periods. Carthage indicated in its local water supply plan the intention to convert an existing emergency connection with Southern Pines to a regular use sources. This is likely to address the potential shortages shown by the modeling.
- Chatham County – North system may face supply shortage if demand grows as expected by 2060. They have applied for an increased allocation from Jordan Lake but allocations are limited by rule to 30-year needs.

Identified Supply Issues 2060

- City of Raleigh Public Utilities Department water needs are included in this analysis because of the interconnections with water utilities in the Haw River Basin and they submitted an application for an allocation from Jordan Lake.
- Raleigh has been pursuing several options to increase their current raw water supplies. All of the options being considered involve extensive environmental reviews and regulatory requirements that need significant time to resolve before construction can begin.
- Modeling indicates Raleigh may face shortages of 13 mgd for up to 6 months trying to meet estimated 2045 demands from existing sources.
- Raleigh will need additional sources of water to reliably meet estimated 2060 water demands.
- Raleigh applied for a 4.7% allocation from the water supply pool in Jordan Lake. Modeling indicates that adding this volume of water to existing sources in combination with an aggressive water shortage response plan will address some of the potential shortages.

Conclusions

- The projections of future water supply sources includes increased use of water from the Jordan Lake water supply pool.
- The modeling results are inextricably linked to the wastewater return flows estimated in the model. If the wastewater return proportions vary from those modeled the conclusions will change.
- The model DOES NOT reserve water to protect ecological integrity. If this becomes a requirement in the future the modeling results and conclusions will change.
- Therefore the model provides no guidance as to potential impacts to aquatic habitats from water supply withdrawals.
- Water Quality may present difficulties treating raw water to drinking water standards.
- The presence of critical habitat my limit the ability to withdraw the desire amount of water at the desired locations.
- Modeling indicates that except for the issues highlighted on the previous slides the water systems using surface water from the Deep River, Haw River, Cape Fear River, Neuse River and Contentnea Creek Subbasins are not expected to face flow related shortages over the range of flow conditions captured by the 81 years of historic data.

Nothing Compares
NORTH CAROLINA

Jordan Lake Water Supply Allocation Recommendations

March 2016

Department of Environmental Quality
Division of Water Resources

Why was Jordan Lake Built

1945 Flooding of Fayetteville and surrounding area

1945 Fayetteville flood stage = 35’ msl

on September 21, 1945 the Cape Fear River reached 68.9 ‘ msl

(Photo: Fayetteville Observer from the Bill Belch Collection)

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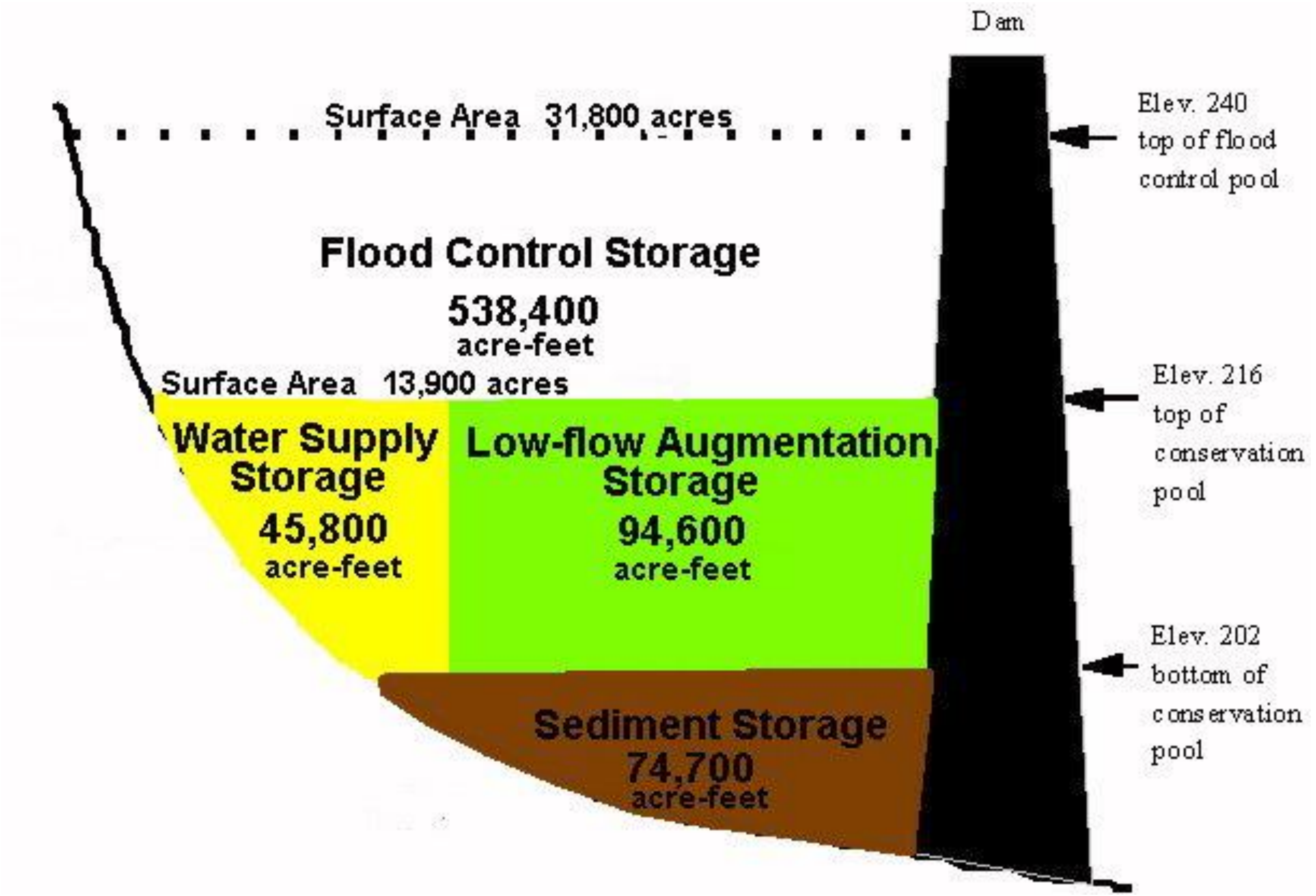
Generalized Jordan Lake Storage Schematic



Background

- During the design of the B. Everett Jordan Project the State of North Carolina requested the inclusion of water supply storage capable of yielding 100 million gallons per day
- NC assumed responsibility for paying the additional cost associated with the water supply component (32.62% of Conservation Storage)
- NC General Statute § 143-354(a)(11) gives the Environmental Management Commission authority to allocate water supply storage in Jordan Lake to local governments
- Long-range planning by regional water utilities identified future needs that exceed currently available water supplies
- Jordan Lake Partnership petitioned DWR to initiate a fourth round of water supply allocations
- February 2010 the EMC gave the Division the go-ahead for Round 4
- November 2014 Applications submitted to the Division
- 2015 DWR modeled information in applications and interpreted results
- January 2016 draft allocation recommendations based on information provided in allocation applications and hydrologic modeling of surface water sources

Summary of Allocation Guidelines

- **Allocation Decisions**
  - **Limited to 30-year planning horizon (2045)**
  - **Limit diversions off the Jordan Lake watershed to 50% of the water supply yield**
  - **Based on need for water and commitment to pay for allocation**
  - **Rules governing allocations request additional information from applicants**
    - **Yield of current sources**
    - **Alternative sources**
    - **Service population projections**
    - **Future water demand projections**
    - **How will allocation be used**
    - **Monitoring requirements**
    - **Arrangements to share water**
  - **Allocations can be rescinded or reassigned by the EMC**
  - **If an allocation would lead to a diversion off the watershed and the need for an Interbasin Transfer Certificate the EMC will "coordinate" the review the diversion with the review of the allocation request.**

Requested Allocations

63% water supply storage allocated

DWR received

- **10 applications for**
- **13 local governments**

105.9% Total Round 4 allocation requests

Jordan Lake Water Supply Pool		
Applicant	Current Allocation Percent	JLA-4 Requested Allocation Percent
Cary Apex Morrisville RTP	39	46.2
Chatham Co North*	6	13
Durham*	10	16.5
Holly Springs	2	2
Hillsborough	0	1
OWASA*	5	5
Orange Co	1	1.5
Pittsboro*	0	6
Raleigh	0	4.7
Fayetteville	0	10
Total Percent	63.0	105.9
* Western Intake Partners		

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Population Estimates

Applicants Estimated Service Population					
JLA-4 Applicants	**County Served**	**2010**	**2035**	**2045**	**2060**
Cary-Apex-Morrisville-WakeCoRTP	Wake / Chatham	182,600	309,600	344,150	360,600
Chatham Co-North	Chatham	10,200	49,450	65,350	94,000
Pittsboro	Chatham	3,700	69,250	83,500	96,800
Durham	Durham	246,180	350,922	393,924	458,426
Hillsborough	Orange	12,216	22,150	26,600	33,800
Holly Springs	Wake	24,700	68,371	81,931	103,261
Orange County	Orange	132	11,897	17,185	25,115
OWASA	Orange	79,400	115,700	129,950	149,700
Raleigh	Wake	485,219	879,441	1,048,700	1,316,200
Fayetteville PWC	Cumberland	199,102	350,574	398,380	440,390
	Total Service Population	1,243,449	2,227,355	2,589,670	3,078,292

Estimated County Population				
County	**2010**	**2035**	**2045**	**2060**
CHATHAM	63,751	93,544	105,802	124,189
CUMBERLAND	327,445	375,428	396,220	427,407
DURHAM	271,297	397,205	446,627	520,761
ORANGE	134,303	178,148	196,202	223,284
WAKE	906,909	1,433,761	1,657,599	1,993,356
Total Estimated Population	1,703,705	2,478,086	2,802,450	3,288,996
http://www.osbm.state.nc.us/ncosbm/facts_and_figures/socioeconomic-data.shtm				
Estimated 1990-2034 & extensions				

Water Demands *(MGD)*

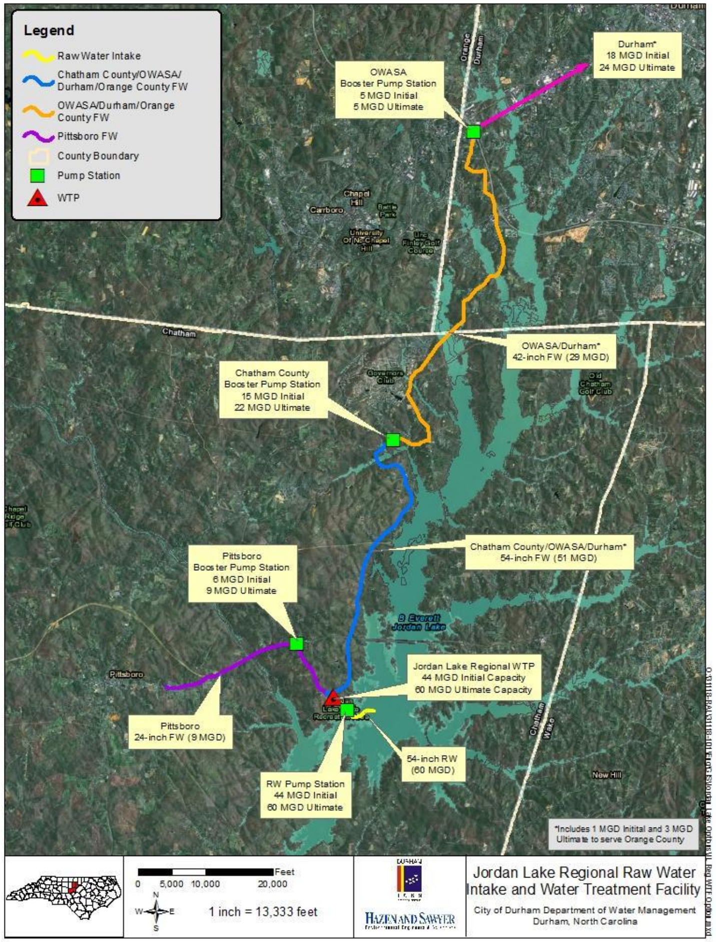
(Million Gallons per Day)

Applicants Estimated Average Day Demand (MGD)					
JLA-4 Applicants	**County Served**	**2010**	**2035**	**2045**	**2060**
Cary-Apex-Morrisville-WakeCoRTP	Wake / Chatham	20.72	40.82	45.82	48.33
Chatham Co-North	Chatham	2.16	10.13	13.03	18.12
Pittsboro	Chatham	0.56	8.41	9.92	11.24
Durham	Durham	25.27	36.12	39.98	44.37
Hillsborough	Orange	1.17	2.87	3.22	3.70
Holly Springs	Wake	1.98	6.23	7.24	8.78
Orange County	Orange	0.02	2.01	2.81	3.92
OWASA	Orange	7.86	10.24	11.32	12.91
Raleigh	Wake	52.75	84.76	97.02	115.01
Fayetteville PWC	Cumberland	28.01	55.03	65.41	78.92
Total Estimated Average Day Demand		140.50	256.62	295.77	345.30

Estimated System Demand based on Estimated County Population (MGD)				
Based on projected county population figures and average				
2010 system wide per capita use of applicants in each county				
County	**2010**	**2035**	**2045**	**2060**
CHATHAM	11.60	17.02	19.25	22.60
CUMBERLAND	46.07	52.82	55.75	60.14
DURHAM	27.85	40.77	45.85	53.46
ORANGE	16.90	22.42	24.69	28.10
WAKE	91.40	144.49	167.05	200.89
Total Estimated Demand	193.82	277.53	312.59	365.18

Western Jordan Lake Intake Proposal

- Western Jordan Lake Intake and Water Treatment Plant
- Partners
  - Durham
  - Orange Water and Sewer Authority
  - Pittsboro
  - Chatham County-North
- Construct Intake, WTP and transmission lines to access allocations if approved
- Optimizes use of water supply storage
  - Estimated yield > 100 mgd
  - Current raw water pumping capacity 80 mgd



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Contact Information

Jordan Lake Water Level and Water Supply Storage Minimums							
Model Scenario	Jordan Lake Water Level		Jordan Lake Water Supply Pool Critical Period (<100%)				
	Minimum Level, feet mean sea level	Date of Minimum Level	Minimum Water Supply Storage %	Minimum Water Supply Period	Days in Minimum Supply Period	Longest Critical Period	Days in Critical Period
Simbase_Current	209.7	8/30/2002	90.9	7/9/1953 - 12/9/1953	154	7/9/1953 - 12/9/1953	154
01_LWSP_Dem2045	208.0	12/1/1953	42.2	7/7/1953 - 1/15/1954	193	5/17/1933 - 3/4/1934	292
03_JLA_F_Req2045_Dem2045	207.4	12/1/1953	28.7	5/17/1934 - 3/5/1934	293	5/17/1934 - 3/5/1934	293
04_JLA_Raleigh_Lilington_Dem2045	208.0	12/1/1953	43.1	7/7/1953 - 1/15/1954	193	7/7/1953 - 1/15/1954	193

Jordan Lake Water Quality Storage and Lillington Streamflow Minimums						
Model Scenario	Jordan Lake Water Quality Pool (Flow Augmentation Pool)		Streamflow at Lilington ** (cubic feet per second)			
	Minimum Water Quality Storage %	Date of Minimum Water Quality Storage	Lowest daily average flow, cfs	Date of Lowest Flow	Years with 1 or more days <600 cfs	Total number of days * <600 cfs
Simbase_Current	20.8	8/30/2002	284.6	10/1/2007	61	4,274
01_LWSP_Dem2045	29.5	10/23/2007	171.1	8/19/2002	64	4,987
03_JLA_F_Req2045_Dem2045	30.1	10/23/2007	174.5	8/19/2002	65	4,974
04_JLA_Raleigh_Lilington_Dem2045	29.3	10/23/2007	167.6	8/19/2002	64	5,010

Recommendations

Allocation of Jordan Lake Water Supply Pool			
Applicant	Current Allocation	Requested Allocation	Draft Recommendation
	Allocation Percent	Allocation Percent	Allocation Percent
Cary Apex Morrisville RTP	39	46.2	46.2
Chatham County-North*	6	13	13
Durham*	10	16.5	16.5
Fayettteville PWC	0	10	0
Hillsborough	0	1	1
Holly Springs	2	2	2
Orange County	1	1.5	1.5
Orange Water&Sewer Authorit	5	5	5
Pittsboro*	0	6	6
Raleigh	0	4.7	4.7
Total Percent	63	105.9	95.9
* Western Intake Partners			

- Recommend approval of requested allocations except Fayetteville PWC
- Modeling indicates Fayetteville does not face flow related shortages through 2060 from existing sources
- Raleigh has not initiated the process to review a diversion off the watershed.
- Raleigh’s proposal for a Cape Fear River withdrawal and WW discharge may be able to provide the requested amount of water without an allocation

Next Steps

- **Copies of the:**
  - **Applications and supporting documents**
  - **Draft Cape Fear River Water Supply Evaluation**
  - **Draft Jordan Lake Water Supply Allocation Recommendations**

  Are available on the Division's website at:

  http://deq.nc.gov/about/divisions/water-resources/planning/basin-planning/map-page/cape-fear-river-basin-landing/jordan-lake-water-supply-allocation/jordan-lake-water-supply-allocation-round-4

- **Suggestions and comments on the draft documents can be submitted to the Division through May 18th by email to**

  jla4-cfrwse@lists.ncmail.net

or by mail to

Jordan Lake Comments
Division of Water Resources
1611 Mail Service Center
Raleigh, NC 27699-1611

Contact Information

Questions?

Reference Slides Follow

Jordan Lake Drought Protocol

Flow-Aug. Pool	Minimum Release	Release water to meet Lillington target flow of:
>100 %	40 cfs	600 cfs
80-100 %	40 cfs	600 cfs
60-80 %	40 cfs	450-600 cfs
40-60 %	40 cfs	300-450 cfs
20-40 %	200 cfs	
0-20 %	100 cfs	