Interbasin Transfer Petition

Union County Yadkin River Water Supply Project

Proposed Interbasin Transfer to the Rocky River Basin

Submitted to:
North Carolina Environmental Management Commission

Submitted by:
Union County Public Works Department

April 29, 2016

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Applicants

Union County, North Carolina, on behalf of its Public Works department and single bulk water customer, the **Town of Wingate**

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Executive Summary

Introduction

Union County (County) currently provides water to residents within the unincorporated portions of the County, as well as all towns and villages within Union County with the exception of the City of Monroe and Town of Marshville. Union County is a wholesale finished water supplier to the Town of Wingate, who owns and operates their own water distribution system.

The County's primary water supply and production is currently delivered from the Catawba River Water Supply Project (CRWSP) in Lancaster County, SC. Additional water supply is provided from the east from Anson County, NC. The CRWSP joint venture includes the Catawba River Water Treatment Plant (CRWTP) which is a regional water treatment facility with a permitted operating capacity of 36 mgd. Union County, NC, and Lancaster County Water and Sewer District, SC, have 50 percent ownership rights of the facilities. The County has an additional 4 mgd wholesale purchase Agreement with Anson County. The County serves customers in both the Catawba River Basin (considered Union County's Catawba River Basin Service Area) and the Yadkin River Basin (considered Union County's Yadkin River Basin Service Area).

The County is seeking to develop a Yadkin Regional Water Supply project (YRWSP) to ensure long-term, sustainable water supply to its current, and projected, future service areas in the Yadkin River Basin. This effort includes securing the required regulatory permits and approvals for delivering additional water to the County's Yadkin River Basin Service Area customers in the Rocky River Basin, which is a part of the greater Yadkin River Basin. Under the current legislative and regulatory framework, the County must obtain an interbasin transfer (IBT) certificate for this project.

Along with unincorporated areas of the County, twelve jurisdictions in the County have the potential to be served with water as a result of the proposed project: The Town of Waxhaw, the Town of Mineral Springs, the Town of Weddington, the Town of Indian Trail, the Town of Stallings, the Town of Hemby Bridge, the Town of Fairview, the Town of Unionville, the Town of Mineral Springs, the Village of Wesley Chapel, and the Village of Lake Park are all currently served with finished water provided by the County. As previously noted, the Town of Wingate currently purchases water wholesale from the County, and is hereby considered a party to the IBT Petition. No communities are anticipated to be served outside of the County's borders; therefore, the service area will not extend beyond the County border.

Purpose and Need for the Proposed Action

Union County has seen significant growth over the past two decades and is expected to continue to have steady growth and development into the foreseeable future. In response to this growth, the County has worked diligently to meet the increasing demands for public water supply and other services. Further, the County has completed an extensive water supply planning effort, and has identified opportunities to provide a long-term, sustainable water supply solution for its citizens and community. In 2011, Union County developed a Comprehensive Water and Wastewater Master Plan (Master Plan) (Black & Veatch, 2011) outlining water

demand projections and system infrastructure needs through the year 2030. Water demands for the YRWSP were developed and subsequently updated from the 2011 Master Plan to reflect more recent data and trends in population growth, per capita water use and water demand peaking factors. The following assumptions, as further detailed in Section 3.0, were used to develop projected future water demands for the YRWSP.

- Projected Population Growth in Union County's Yadkin River Basin Service Area
  - 2.7% annual population growth from 2010 to 2030
  - 2.4% annual population growth from 2031 to 2040
  - 1.8% annual population growth from 2041 to 2050
  - 1.0% annual service area growth from 2010 to 2050
- Per Capita Water Demand
  - 120 gallons per capita per day (gpcd) for future customer water demand projections
  - Includes all residential, commercial, industrial, institutional, process (i.e. in-plant), and non-revenue (e.g. line flushing, water loss) water
- Water Demand Peaking Factors
  - 1.70 Max Day to Annual Average Day peaking factor
  - 1.22 Max Day to Maximum Month Average Day peaking factor

Population Growth

During the early part of the 2000 decade, Union County was the fastest growing county in North Carolina and one of the top 20 fastest growing counties in the entire nation. Growth rates within the County during this time outpaced the balance of the State's growth rate by a factor of 3 to 4. Union County's proximity to the Charlotte metropolitan area and increasing job base and quality of life were key drivers to this high population growth rate. However, since the economic recession in the late 2000 decade, growth rates within the County have been observed at more modest rates of 2 to 3 percent per year.

For purposes of extending the 2011 Master Plan water use projections for the YRWSP, the overall 2.4% county-wide population growth projection approach established in the Master Plan through the year 2030 was maintained. However, recognizing a constant county-wide annual growth rate of 2.4% through the year 2050 is unlikely to continue, projections for the YRWSP were updated to reflect decreasing growth rates in later decades. Additionally, recognizing that development of the YRWSP will provide a reliable source of water for County residents in the Yadkin River Basin Service Area, as well as the development potential which currently exists in this portion of the County, projected population and service area growth rates in this area are considered to be slightly higher than those for the Catawba River Basin Service Area, in the western part of the County. As such, a 1.0% annual service area growth rate in the County's Yadkin River Basin Service Area has been used for future water demand projections.

Historical and projected future population growth for Union County's Yadkin River Basin Service Area, as developed for the YRWSP, are summarized in Table ES-1.

Table ES- 1 Union County Historical and Projected Future Service Population and Water Supply Demands

		Total Union County Water System (Yadkin and Catawba River Basin Service Areas)							Yadkin River Basin Service Area (Rocky River IBT Basin)						
Data Type	Year	Total Population Served		Annual Service Population Growth Rate	Annual Average Day Demand [1] (mgd)	Max. Month Avg. Day Demand (mgd)	Max. Day Demand (mgd)	Per Capita Water Use (Annual Avg. Day) [1] (gpcd)	Yadkin River Basin Service Area Population Served		Annual Population Growth Rate	Projected Annual Service Area Growth Rate	Annual Average Day Demand [2] (mgd)	Max. Month Avg. Day Demand [2] (mgd)	Max. Day Demand [2,3] (mgd)
		Projected	Actual						Projected	Actual					
Historical Data (Per Local Water Supply Plan data, see notes for exceptions)	1997	-	25,825	-	4.55	5.83	6.62	176	-	17,179	-	-	No data	No data	No data
	2002	-	56,833	17.09%	7.34	10.53	11.34	129	-	32,839	13.84%	-	No data	No data	No data
	2007	-	97,666	11.44%	12.44	17.22	23.29	127	-	44,080	6.06%	-	5.57	6.77	9.47
	2008	-	102,501	4.95%	10.56	13.47	21.23	103	-	45,625	3.50%	-	4.82	5.59	8.20
	2009	-	104,995	2.43%	11.00	12.93	17.4	105	-	46,491	1.90%	-	4.76	5.91	8.10
	2010	107,048 [4]	107,893	2.76%	11.80	14.25	20.06	109	47,123 [4]	47,382	1.92%	-	5.10	6.23	8.67
	2011	-	110,214	2.15%	11.28	14.02	17.84	102	-	48,202	1.73%	-	4.99	6.12	8.48
	2012	-	113,339	2.83%	11.53	13.49	17.02	102	-	49,120	1.90%	-	5.14	6.00	8.73
	2013	117,271 [4]	117,033	3.26%	11.38	13.76	16.75	97	52,550 [4]	50,063	1.92%	-	5.00	5.70	8.50
	2014	-	122,141	4.37%	12.46	15.1	18.52	102	-	51,637	3.14%	-	5.45	7.75	9.27
	2015	-	125,693	2.91%	13.17	17.04	20.41	105	-	52,738	2.13%	-	5.47	6.78	9.29
Projected Future	2020	145,228	-	3.10%	15.2	22.8 [5]	27.8 [5]	120 [6]	67,767	-	2.70%	1.00%	7.4	10.2	12.5
	2030	191,880	-	2.82%	20.8	30.6 [5]	37.3 [5]	120 [6]	97,456	-	2.70%	1.00%	10.9	15.2	18.6
	2040	251,251	-	2.73%	28.0	40.5 [5]	49.4 [5]	120 [6]	136,149	-	2.40%	1.00%	15.6	21.7	26.4
	2050	319,760	-	2.44%	36.2	52.0 [5]	63.4 [5]	120 [6]	179,450	-	1.80%	1.00%	20.8	28.9	35.3

Notes:

[1] In addition to the annual average day demand values published in the Union County Local Water Supply Plans (LWSP), 5% process (in-plant) water demand has been assumed for historical demands as this information has not been historically included in LWSP data, as water supplied from the CRWSP and Anson County is considered a wholesale purchase by Union County.
[2] Includes the addition of 15% assumed non-revenue water (unbilled-metered, water loss and process use) to historical billed customer data for Yadkin River Basin Service Area, as historical non-revenue water data is not available by specific water service area.
[3] Historical maximum day demand for Yadkin River Basin Service Area estimated from annual average day demand using 1.7 peaking factor, in the absence of actual data for the service area. Historical peaking factors for the total Union County water system have been as high as 2.3, with values closer to 1.7 over recent years.
[4] Projected population for 2010 and 2013 are based on the 2011 Union County Comprehensive Water and Wastewater Master Plan, and are shown for comparative purposes to actual historical data.
[5] Includes 1.9 mgd (max day) contract supply from Union County to City of Monroe (Catawba River Basin supply); note, this demand is not included in annual average day projections as this is an intermittent use connection.
[6] 120 gpcd is the projected per capita water use rate used for future water supply planning purposes for new system customers. It is based on total system water demand, including revenue and non-revenue water (including in-plant process needs), as based on historical records during abnormally dry, or drought, years and with consideration of other demands on the system. This value may be compared to similar drought conditions in 2002 and 2007, and indicates a targeted reduction (down to 120 gpcd) from the previous values as a result of ongoing water conservation and efficiency measures implemented by Union County.

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Per Capita Water Demand

For purposes of the YRWSP projection updates, a review of the County's historical water use data over the past 10-15years indicates that per capita per day unit water demands (total system demands) have averaged approximately 100 to 130 gpcd, with slightly lower values in the most recent years due to ongoing mandatory water restrictions, increased conservation efforts, and more favorable climate conditions (more annual rainfall and slightly lower annual temperature averages). As such, the water demand projections of the recently completed Master Plan have been reduced for the updated YRWSP projections from 125 gpcd, as indicated in the 2011 Master Plan, to reflect a lower average unit demand of 120 gpcd for future water demands of all new system customers to be served after the Year 2012.

The use of a 120 gpcd unit demand is representative of customer demands within the County over the last decade during historically drier years, which should be used as the basis for water demand planning to secure a sufficient water supply to meet peak year demands. Further, this value includes consideration for process water necessary for a new water treatment plant as part of the proposed YRWSP, which has not previously been included in Union County's historical per capita demand calculations from existing water supplies since these are considered (administratively) finished water purchases from the CRWSP and Anson County.

Historical and projected future per capita water demands for Union County's Yadkin River Basin Service Area, as developed for the YRWSP, are summarized in Table ES- 1.

Water Demand Peaking Factors

In years past, Union County's maximum day to average day water peaking factors have been as high as 2.3. The Master Plan identified the average Max Day to Average Day peaking factor from 2004 to 2009 to be approximately 1.9, which was carried forward in Master Plan water demand projections. In recent years, however, County-wide mandatory and voluntary irrigation restrictions have impacted historical Max Day factors, as irrigation uses are a major driver of the Max Day demands typically occurring during summer months. With irrigation restrictions over the past seven years, the County has been able to achieve Max Day to Average Day peaking factors at an average rate of approximately 1.8.

The Union County Board of Commissioners previously reached consensus in favor of implementing demand management practices in the future to avoid the very high peaking factors (those greater than 2.0) that have been experienced in the past. The County's newly adopted (May 4, 2015) Water Use Ordinance, as further discussed in in this Petition, outlines the specific demand management initiatives now implemented within the County.

Therefore, for purposes of the YRWSP projections, the Max Day to Average Day peaking factor for the future water demands was selected to be the actual average over the past 4 years (non-drought years) of 1.7. An evaluation of North Carolina Division of Water Resource's (DWR) Local Water Supply Plans for comparable utilities within the Piedmont region of North Carolina indicates that since 2007, average Max Day to Average Day peaking factors have ranged from 1.4 to 1.8, which further supports the 1.7 peaking factor used for YRWSP demand projections within Union County.

Projected Future Water Demand in Union County's Yadkin River Basin Service Area
As summarized in Table ES- 1, water needs in the County's Yadkin River Basin Service Area, located in the Rocky River IBT Basin (Basin code 18-4), are projected to increase from a current (2013) maximum month average daily demand of 7.7 mgd to 28.9 mgd by 2050. The projected increase in the County's water demand is a combined result of projected county population growth and Union County water system service area growth.

The County's current 5 mgd grandfathered IBT from the Catawba River Basin (through the CRWSP) and the Anson County water supply are not capable of meeting the projected future demand within the Rocky River IBT Basin; and therefore, the County must secure a reliable water supply from other sources to meet its future demand in this service area. It is the intent of the YRWSP to meet these additional future water demands by supplementing the County's existing grandfathered IBT from the Catawba River Basin.

Description of Proposed Action

Union County is pursuing an IBT certificate to meet the water supply needs of its current and future residents, and on behalf of the wholesale communities served by the County. On August 12, 2013, the County submitted a Notice of Intent to the North Carolina Environmental Management Commission (EMC) regarding its request for an IBT for a maximum month average daily amount of 23 mgd (equivalent to a maximum day amount of 28 mgd) from the Yadkin River IBT Basin (Basin code 18-1) to the Rocky River IBT Basin (Basin code 18-4), both of which are part of the Yadkin River Basin.

While these two IBT basins are each part of the primary Yadkin River Basin, North Carolina IBT Statute G.S. 143-215.22L considers these two IBT basins as separate, and the proposed water transfer to be an interbasin transfer. The requested transfer amount is based on 2050 water demand projections in the County's Yadkin River Basin Service Area. The intent of this IBT is to supplement and/or replace the County's existing water supply sources to meet projected water demands through 2050.

Summary of Preferred Alternative

As indicated in the Final Environmental Impact Statement (FEIS), (HDR, 2015), for the project, Alternative 1A is designated as the preferred alternative after a thorough assessment of each alternative's ability to meet the project's purpose and need of delivering a safe, sustainable water supply to meet the County's current and future water demands in their Yadkin River Basin Service Area, as well as the associated environmental impacts, mitigation measures, technical feasibility, financial impacts, and political and community acceptance. Alternative 1A includes the withdrawal of water from Lake Tillery in the Yadkin River IBT Basin and the transfer of this water into the Rocky River IBT Basin in Union County for treatment and distribution. A portion of the water will be returned via treated wastewater effluent through the Rocky River which empties into the Pee Dee River (Yadkin River IBT Basin) approximately five miles downstream from the Lake Tillery dam.

Alternative 1A, in conjunction with the existing grandfathered IBT from the Catawba River Basin, is capable of delivering the stated future 28.9 mgd maximum month (23.0 mgd from the Yadkin

River Basin, supplemented by up to 5.9 mgd from the existing Catawba supply) and 35.3 mgd maximum day demands (28.0 mgd from the Yadkin River Basin, supplemented by up to 7.3 mgd from the existing Catawba supply) of Union County. The water modeling efforts completed for the FEIS indicate that withdrawal from Lake Tillery has less impact on lake aesthetics and other water withdrawal interests, including during drought conditions and hydropower production, than withdrawal of water from other locations. The environmental impacts of Alternative 1A are similar, or significantly less, than the other alternatives evaluated. Mitigation measures are in place throughout the proposed service area to mitigate these environmental impacts.

The cost of developing a water supply solution for Union County's Yadkin River Basin Service Area is significant and represents a large future capital expenditure for the County. Alternative 1A represents one of the lowest cost project alternatives and has been determined to be a financially feasible option for this water supply. In developing this project, Union County held discussions with numerous entities along the Yadkin-Pee Dee River regarding potential regional partnerships for water supply. In 2013, these discussions subsequently led to the development of an Interlocal Intake and Transmission Agreement between Union County and the Town of Norwood in Stanly County for water withdrawal from a new shared raw water intake in Lake Tillery at the site of the Town of Norwood's current intake. Regional partnership for water supply between the Town of Norwood and Union County is an added mutual benefit of this preferred alternative. Moreover, implementation of the preferred alternative reduces future demands for additional water supply from the Catawba River Basin into the County's Yadkin River Basin service area.

Project Planning and IBT Certification Process

In working toward the development of this preferred alternative for water transfers from Lake Tillery as part of the YRWSP, Union County seeks to ensure a long-term sustainable water supply to their existing and future customers, and the Town of Wingate who has a wholesale contract with the County. The following steps have been undertaken by the County to proactively plan for future demands:

- Completed Rocky River Water Supply Feasibility Study to assess potential water supply opportunities from the Rocky River (2004) (CH2MHill, 2004)
- Completed Union County Comprehensive Water and Wastewater Master Plan to assess the County's water demands, water supply, and water and wastewater infrastructure needs (2011) (Black & Veatch, 2011)
- Completed Eastern Union County Water Supply Project Partner Assessment, Conceptual Study, and Preliminary Permitting and Feasibility Analysis to assess potential water supply opportunities to serve the County's Yadkin River Basin Service Area (2011) (HDR, 2011)
- Discussions and negotiations held with potential regional partners to develop a new water supply for Union County from the Yadkin River Basin (2012)
- Finalized Interlocal Intake and Transmission Agreement with the Town of Norwood for future water supply from Lake Tillery (2013)

- Submitted a Notice of Intent to North Carolina Environmental Management Commission (NC EMC) for IBT from the Yadkin River Basin (18-1) to the Rocky River Basin (18-4) (2013)
- Prepared a Scoping Document for submittal to the North Carolina Environmental Review Clearinghouse(2013)
- As required by the North Carolina IBT general statute, conducted public notification efforts and held public meetings within the source basin (2 meetings, one upstream and downstream of the proposed intake) and receiving basin (1 meeting) of the proposed IBT to gather input from citizens in North Carolina and South Carolina, community organizations, and public agencies (2013)
- Updated initial water demand projections to reflect 2013 statutory changes which now define measurement of IBT as the daily average of a maximum calendar month, based on historical Union County Local Water Supply Plans (LWSPs) and the County's 2011 Comprehensive Water and Wastewater Master Plan (2014)
- Included the updated Union County water demand projections, along with updates for water users throughout the Yadkin River Basin in North and South Carolina, in the evaluation of impacts conducted with the updated Yadkin-Pee Dee River Basin hydrologic model (2014)
- Submitted Draft Environmental Impact Statement (DEIS) to North Carolina Environmental Review Clearinghouse for public review and comment (2015) (HDR, 2015)
- As required by North Carolina IBT general statute, worked with the North Carolina Division of Water Resources (DWR) to conduct public notification efforts and hold a public hearing for the DEIS document (2015)
- Submitted Final Environmental Impact Statement (FEIS) to North Carolina Environmental Review Clearinghouse for public review and comment (2016) (HDR, 2015)
- Submitted FEIS and subsequent Record of Decision (ROD) to North Carolina Environmental Review Clearinghouse for publication (2016)

The next step in the certification process is this petition submittal to the NC EMC for an IBT certificate followed by associated public hearings and opportunity for public comment prior to the NC EMC ruling on the petition. This petition for an IBT certificate includes the following elements in support of the request for IBT:

1. Background of the Union County water supply and the Requested Action
2. Description of Union County water and wastewater infrastructure
3. Present and future water supply needs of Union County and its customers including consumptive and non-consumptive uses
4. Environmental resources discussion including water quality and quantity information for the source reservoir and the receiving rivers and information on aquatic habitat for rare, threatened, and endangered species
5. Water usage data, water conservation, water efficiency, and water stewardship measures utilized by Union County

6. Alternative sources of water to avoid or minimize an increase in IBT
7. Registered water transfers and withdrawals from the source reservoir and planned transfers or withdrawals
8. How the proposed transfer, if added to all other transfers and withdrawals within the source basin, would not reduce the amount of water available for use to a degree that would impair existing uses or existing and planned uses of the water
9. Future water supply needs within the Yadkin River Basin

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Acronyms

APGI	Alcoa Power Generating, Inc.
AWWA	American Water Works Association
BFE	Base flood elevation
BGPA	Bald and Golden Eagle Protection Act of 1940, as amended
C	Candidate
CHEOPS™	Computerized Hydro Electric Operations Planning Software
CWA	Clean Water Act
CRWSP	Catawba River Water Supply Project
CRWTP	Catawba River Water Treatment Plant
DEQ	North Carolina Department of Environmental Quality
DWR	North Carolina Division of Water Resources
E	Endangered
EMC	North Carolina Environmental Management Commission
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FSC	Federal Species of Concern
GIS	Geographic Information System
gpcd	Gallons per capita per day

HPOWEB	North Carolina State Historic Preservation Office GIS Service
HQW	High Quality Waters
HUC	Hydrologic unit code
IBT	Interbasin Transfer
LIP	Low Inflow Protocol
mgd	Million gallons per day
MMDD	Maximum month daily average demand
msl	Mean sea level
NCAC	North Carolina Administrative Code
NC EMC	North Carolina Environmental Management Commission
NMFS	National Marine Fisheries Service
NOI	Notice of Intent to File a Petition
NPDES	National Pollution Discharge Elimination System
NPS	National Park Service
POTW	Publically Owned Treatment Works
SAESH	Significant Aquatic Endangered Species Habitat
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SDWA	Safe Drinking Water Act
SHPO	North Carolina State Historic Preservation Office
T	Threatened
TAZ	Traffic Analysis Zone
TMDL	Total maximum daily load
UCPW	Union County Public Works Department
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UT	Unnamed tributary
WQI	Water Quality Index
WRC	North Carolina Wildlife Resources Commission
WRF	Water Reclamation Facility
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant
YRWSP	Yadkin River Water Supply Project

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1.0 Introduction

1.1. Yadkin River Water Supply Project

In late 2011, Union County (County), through its Public Works Department (UCPW), completed a Comprehensive Water and Wastewater Master Plan (Black & Veatch, 2011). This Master Plan and subsequent water supply studies outline future needs for additional water supply in the County's current and future service areas, and presents alternative scenarios for securing new water supply from the Catawba and/or Yadkin River Basins.

UCPW understands the complexities of delivering additional water supply to its customers due to the County's geography and development patterns (i.e., population centers, proximity to water sources, and river basin boundaries) as well as the regulatory restrictions/hurdles that exist for Interbasin Transfers (IBTs).

In May 2013, the County and the Town of Norwood completed an Interlocal Intake and Transmission Agreement that provided a framework for bringing raw water supply from the Yadkin River Basin into Union County's Yadkin River Basin Service Area. This service area lies within the Rocky River IBT Basin, which is a part of the greater Yadkin River Basin.

The County is now moving forward with the Yadkin River Water Supply Project (YRWSP) to ensure long-term, sustainable water supply to its current, and projected, future service areas in the Yadkin River Basin. This effort includes securing the required regulatory permits and approvals for delivering additional water to the County's customers in the Rocky River IBT Basin, including the evaluation of alternative scenarios that consider new water supply into this area from various sources. Under the current legislative and regulatory framework, the County must obtain an IBT certificate for this project.

Along with unincorporated portions of Union County, there are twelve jurisdictions in the County that have the potential to be served with water as a result of the proposed project. The Town of Waxhaw, the Town of Mineral Springs, the Town of Weddington, the Town of Indian Trail, the Town of Stallings, the Town of Hemby Bridge, the Town of Fairview, the Town of Unionville, the Town of Mineral Springs, the Village of Wesley Chapel, and the Village of Lake Park are all currently served with finished water provided by the County. The Town of Wingate currently purchases water wholesale from the County, and is hereby considered a party to the IBT Petition. No communities are anticipated to be served outside of county borders; therefore the service area will not extend beyond the County boundary.

1.2. The Requested Action

Union County has seen significant growth over the past two decades and is expected to continue to have steady growth and development into the foreseeable future. In response to this growth, the County has worked diligently to meet the increasing demands for public water supply and other services. Further, the County has completed an extensive water supply planning effort, and has identified opportunities to provide a long-term, sustainable water supply solution for its citizens and community.

Union County is pursuing an IBT certificate to meet the water supply needs of its current and future residents, and on behalf of the wholesale communities (Town of Wingate) served by the County. On August 12, 2013, the County submitted a Notice of Intent to the North Carolina Environmental Management Commission (EMC) regarding its request for an IBT for a maximum month average daily amount of 23 mgd (equivalent to a maximum day amount of 28 mgd) from the Yadkin River IBT Basin (Basin code 18-1) to the Rocky River IBT Basin (Basin code 18-4), both of which are part of the Yadkin River Basin. While these two IBT basins are each part of the primary Yadkin River Basin, North Carolina IBT statute considers these two IBT basins as separate, and the proposed water transfer to be an interbasin transfer.

The requested amount is based on 2050 water demand projections in the County's Yadkin River Basin Service Area. The intent of this IBT is to supplement and/or replace the County's existing water supply sources for this service area, to meet projected water demands through 2050. Illustration 1-1 depicts the County's historical, current and projected future water use, including authorized and requested IBT amounts within their Yadkin River Basin Service Area. This illustration additionally outlines how this future water demand is anticipated to be met through the year 2050.

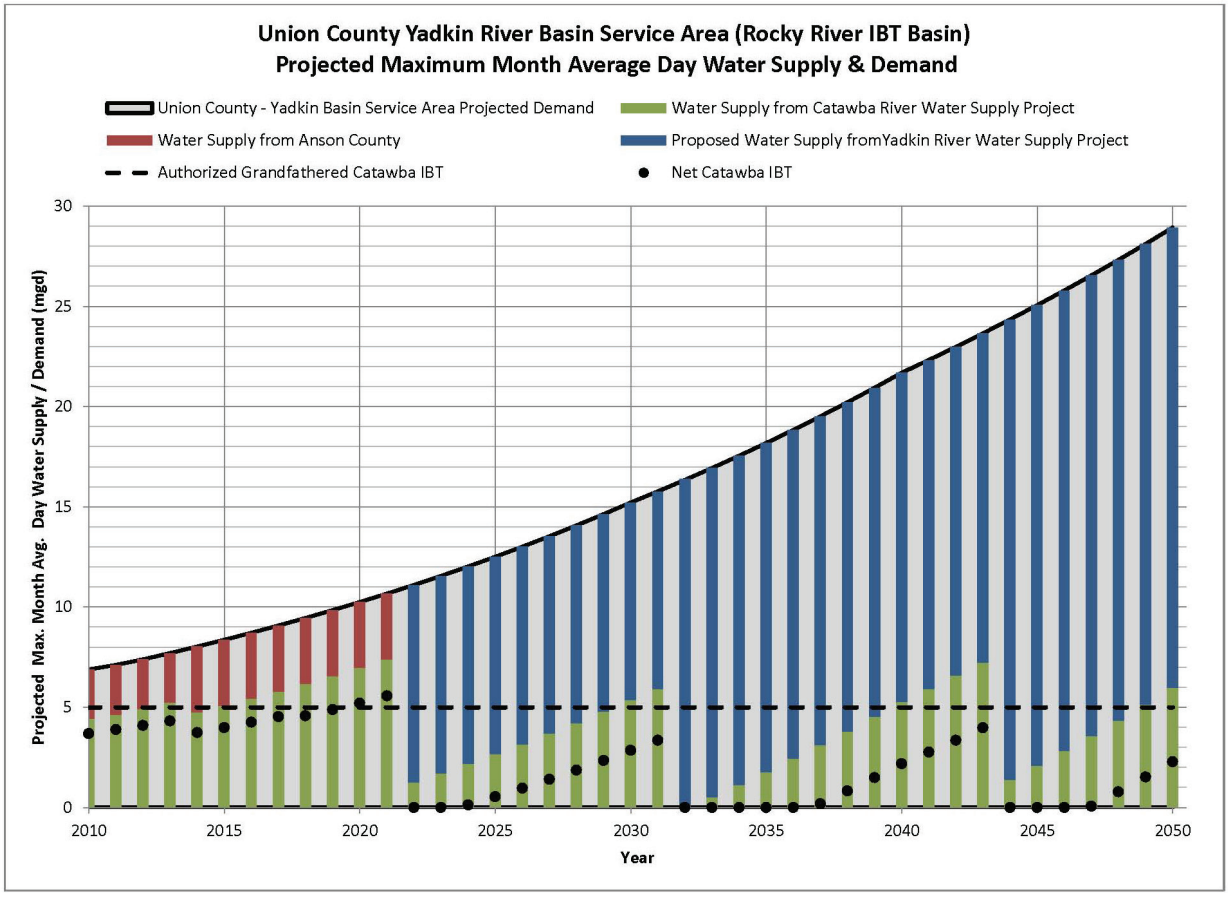

Illustration 1-1 Union County Yadkin River Basin Service Area Projected Water Supply and Demand (HDR, 2015)

Moreover, the proposed transfer will reduce dependency on the County's Catawba River IBT to meet future water demands in the County's Yadkin River Basin Service Area.

1.3. Background

1.3.1. Union County Water Supply

The Union County Water System currently serves customers in both the Catawba River IBT Basin (Catawba River Basin Service Area) and the Rocky River IBT Basin (Yadkin River Basin Service Area) of the Yadkin River Basin as illustrated in Illustration 1-2. The ridgeline between the Catawba River Basin and Yadkin River Basin divides the County, with neither of these two major rivers flowing within the County boundaries.

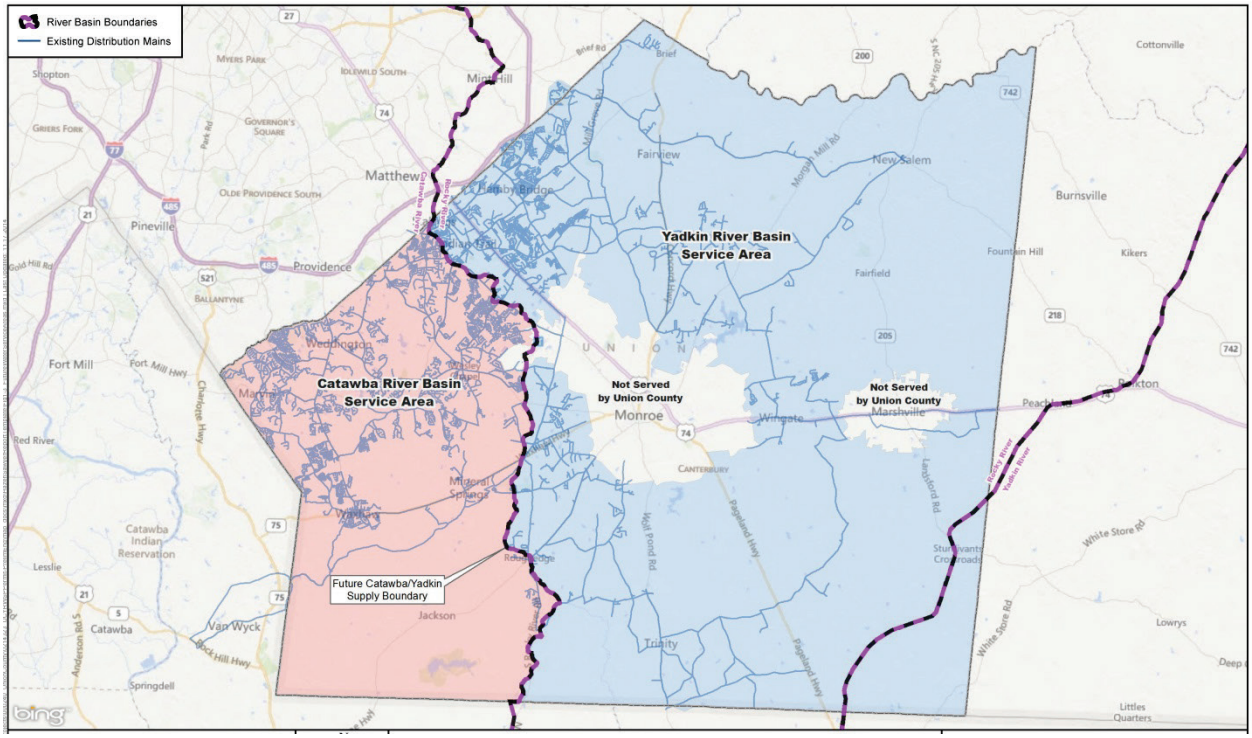

Illustration 1-2 Union County River Basins and Water Service Planning Areas (HDR, 2015)

The County currently holds 5 million gallons per day (mgd) authorized transfer (i.e., a grandfathered IBT amount) of water from the Catawba River Basin to the Rocky River IBT Basin from the State of North Carolina. This value is based upon the definition of a grandfathered IBT as stipulated in North Carolina Administrative Code 15A NCAC 02E .0401(d) where an IBT certificate is not required to transfer water from one river basin to another up to the full capacity of a facility to transfer water from one basin to another if the facility was existing or under construction on July 1, 1993. The full capacity of a facility to transfer water shall be determined as the capacity of the combined system of withdrawal, treatment, transmission, and discharge of water, limited by the element of this system with the least capacity as existing or under construction on July 1, 1993. The County's 5 mgd authorized transfer from the Catawba River Basin to the Rocky River IBT Basin is based upon the capacity of the water transfer infrastructure which was in place within the County as of July 1, 1993, as documented in the County's Grandfathered IBT Worksheet prepared by CH2MHill on behalf of the County and submitted to the North Carolina Division of Water Resources (DWR) on October 19, 2000. This authorized transfer is referred to herein as the grandfathered IBT amount.

To maintain compliance with the Catawba River Basin grandfathered IBT, the County currently returns a portion of the transferred water back into the Catawba River Basin via the Poplin Road wastewater pumping station. The County also has plans to build scalping infrastructure to allow the capability to return additional water to the Catawba River Basin via the Crooked Creek Wastewater Treatment Plant. Additionally, the County currently holds a water purchase agreement (which is up for renewal in 2017) with Anson County for 4 mgd of water supply that is utilized in the County's Yadkin River Basin Service Area.

Adequate water supply can be determined by comparing the existing available supply of current sources to projected future water demands within Union County's Yadkin River Basin Service Area. Existing water supplies available to the County's Yadkin River Basin Service Area include a 5 mgd grandfathered IBT limitation for the transfer of water from the Catawba River Basin to the Yadkin River Basin through finished water provided from the Catawba River Water Treatment Plant in Lancaster County, South Carolina, and an additional water supply of up to 4 mgd provided through a contract with Anson County to supply finished water from the Yadkin River Basin.

Union County's water needs within its Yadkin River Basin Service Area are projected to exceed available supply limits by the Year 2020 and increase from a current maximum month average daily demand of 7.7 mgd to 28.9 mgd by the Year 2050 (equivalent to a current maximum daily demand of 9 mgd to 35.3 mgd by 2050). The County's current grandfathered IBT from the Catawba River Basin through the Catawba River Water Treatment Plant and existing contract with Anson County for finished water supply are not capable of meeting the projected future demand within this service area. Union County is currently approaching its grandfathered IBT limit from the Catawba River Basin, and the initial term of their existing water supply contract with Anson County expired in 2012 and is currently under an auto-renewing cycle up for renewal in 2017, which could be terminated by either party if notice is given to the other party. Furthermore, the County is experiencing significant capacity limitations which exist in water delivery infrastructure from Anson County.

While some of Union County's projected demand is anticipated to continue to be met by the grandfathered Catawba River Basin IBT, this limit is anticipated to be reached within the next five years. As a result, the County must evaluate options to secure a reliable water supply from other sources to meet its future demand in the Rocky River IBT Basin. It is for this reason that Union County requests an IBT certificate to transfer up to 23 mgd of raw water from the Yadkin River IBT Basin (Basin code 18-1) to the Rocky River IBT Basin (Basin code 18-4) of the Yadkin River Basin, as calculated on a maximum month daily average demand (MMDD).

1.3.2. Guiding Legislation

Surface water transfers within North Carolina are regulated by North Carolina Statute G.S. 143-215.22L and North Carolina Administrative Code 15A NCAC 02E .0401. Modifications to G.S. 143-215.22L made through North Carolina Session Law 2013-388 now require an interbasin transfer (IBT) certificate from the North Carolina Environmental Management Commission (EMC) for new water transfers of 2 mgd or more, calculated as a daily average of a calendar month (maximum month average daily demand [MMDD]) and not to exceed 3 million gallons in

any one day, from one river basin to another. IBT certificates are also required if an existing water transfer is increased by 25-percent or more above the average daily amount transferred during the year ending July 1, 1993 if the total transfer, including the increase, is 2 mgd or more per day. Finally, IBT certificates are also required if an existing transfer of water from one river basin to another is increased above a "grandfathered" amount previously defined by statute and determined by the North Carolina Department of Environmental Quality (NCDEQ).

1.3.3. Need for IBT

Union County's need for an IBT certificate to transfer water from the Yadkin River IBT Basin to the Rocky River IBT Basin is founded on three basic conditions:

1) Union County is geographically isolated from any major water supply source (i.e. the Yadkin-Pee Dee and Catawba-Wateree Rivers and surface water reservoirs). The ridge-line between the Yadkin-Pee Dee and Catawba-Wateree River Basins runs directly through Union County and, as such, these water supply sources are located outside of the County, with the Yadkin-Pee Dee River to the east and the Catawba-Wateree River to the west. The only existing large surface water source within Union County is the Rocky River, forming the northern border of Union County, with Cabarrus and Stanly Counties. However, this water source is not currently classified by the State of North Carolina for use as a public water supply and is significantly smaller than either of the other two rivers.
2) Projected population growth within the roughly two-thirds of the County's land area located in the Yadkin River Basin (Rocky River IBT Basin) necessitates that the County have access to a reliable water supply source of sufficient quantity to serve its existing and future customers in this service area.
3) Based on current and projected water demands in Union County's Yadkin River Basin Service Area (Rocky River IBT Basin), its existing 5 mgd authorized water transfer from the Catawba River IBT Basin to the Rocky River IBT Basin is insufficient to meet both near term and long term future water demands in this service area. .

1.3.4. Public Involvement and Agency Coordination

Throughout the development of the Environmental Impact Statement (EIS), there has been the opportunity for public involvement through open meeting forums and public document review and comment periods. Union County is abiding by the public involvement requirements of North Carolina Statute G.S. 143-215.22L as part of the procedure for obtaining an IBT Certificate.

1.3.4.1. Notice of Intent and Public Scoping Meetings

Following issuance of the Notice of Intent to File a Petition (NOI) to the EMC on August 12, 2013, Union County conducted three public scoping meetings for the project. One meeting was held in the source river basin (Yadkin River Basin) upstream of the proposed withdrawal point, one in the source river basin downstream of the proposed withdrawal point, and one in the receiving river basin (Rocky River Basin). The public meetings describing the project and EIS development process were conducted as follows:

<u>Meeting 1 – Receiving Basin</u>

October 3, 2013, 4:30 PM
Stanly County Public Library
133 East Main Street
Albemarle, NC 28001

Meeting 2 – Source Basin (Upstream)
October 14, 2013, 5:00 PM
Rowan-Cabarrus Community College – Salisbury Campus
1333 Jake Alexander Blvd. South
Salisbury, NC 28146-1595

Meeting 3 – Source Basin (Downstream)
October 15, 2013, 5:00 PM
Northeast Technical College – Cheraw Campus
1201 Chesterfield Highway
Cheraw, SC 29520

Public notice of these meetings was published in the September 3, 2013 edition of the North Carolina Register and additional advertisement of the meetings was provided through local and regional newspapers, email and mailed letters, in accordance with the requirements of G.S. 143-215.22L. The purpose of each meeting was to present the project and permitting process to the public and allow discussion to occur between the public and representatives from the County and the engineering consultant. Exhibits, maps, project descriptions and sign-in and comment sheets were at the meeting for use and tracking. It is noted that, at each of these meetings, public attendance was very light. The members of the public who attended were given the opportunity to provide written, verbal or email comments. Each meeting was voice recorded for documentation purposes. Details of meeting notifications and any comments received are located in the Final Environmental Impact Statement (FEIS) appendices.

1.3.4.2. State Environmental Review Clearinghouse Notice of Scoping

A Notice of Scoping for the project was provided to the North Carolina State Environmental Review Clearinghouse on November 12, 2013, in accordance with the State Environmental Policy Act. The purpose of this scoping letter was to gather relevant comments on the proposed action and incorporate them in the water supply alternatives evaluation and environmental analyses which would be completed to develop the draft EIS. This notice included descriptions of the project background, purpose and need, proposed action, area of impact, proposed alternatives and associated figures.

Under the provisions of the North Carolina Environmental Policy Act, this Notice of Scoping was reviewed by the State Clearinghouse on December 30, 2013, and comments were provided by various state resource agencies. Details of the Notice of Scoping and associated comments are located in the FEIS appendices (HDR, 2015).

1.3.4.3. Draft EIS Public Hearing

In accordance with G.S. 143-215.22L and upon submission of the Draft Environmental Impact Statement (DEIS) (HDR, 2015) to the North Carolina Department of Administration State Environmental Review Clearinghouse, notice of public hearing was provided thirty days in advance of a public hearing held by the EMC on the draft document as follows:

Draft EIS Public Hearing
Wednesday, September 16, 2015, 6:00 PM
Norwood Community Building
247 West Turner Street, Norwood, NC 28128

This public hearing and subsequent review period followed an initial DEIS review and comment period for (NCDEQ agencies, North Carolina Wildlife Resources Commission and the U.S. Fish and Wildlife Service in July, 2015.

Supporting environmental documents were made available for public review two weeks prior to the public hearing on the NCDWR website, as well as through the North Carolina Department of Administration State Environmental Review Clearinghouse. Anyone wishing to view the environmental document and submit written comments was given an opportunity to do so. Written comments were initially accepted by the EMC for 30 days after the hearing, through October 16, 2015, and then subsequently extended an additional 30 days through November 16, 2015. After the public hearing the EMC prepared a record of all comments, including written responses to those questions posed in writing. The record also includes complete copies of scientific or technical comments related to the potential impact of the IBT. Details of the public hearing for the DEIS and associated comments are located in FEIS appendices.

1.3.4.4. Adequacy Determination and Record of Decision

Following responses to comments and associated revisions to the DEIS, a Final Environmental Impact Statement (FEIS) (HDR, 2015) was submitted to the NC Environmental Review Clearinghouse for publication on January 12, 2016 and followed by a 30-day public review and comment period, ending on February 11, 2016. Through a formal delegation of authority by the NC EMC, approved on January 14, 2016, NCDEQ completed the Determination of Adequacy as required by IBT statute and issued a Record of Decision (ROD) for the FEIS on April 12, 2016. A copy of the ROD is included in Appendix A of this Petition.

1.3.4.5. IBT Petition - Draft Determination Hearings

Within 90 days after submission of Union County's Petition for an IBT Certificate, the EMC will issue a draft determination on whether or not to grant the certificate. Within 60 days of the issuance of this draft determination, the EMC will hold several public hearings:

- At least one in the affected area of the source river basin,
- At least one in the affected area of the receiving river basin,
- An additional hearing based on various interests of either upstream or downstream parties potentially affected by the proposed transfer (one additional hearing is planned in the source basin, downstream of the proposed withdrawal).

Thirty-day written notice of the public hearing will be provided and written comments on the draft determination will be accepted for a minimum of 30 days following the last public hearing. The EMC will prepare a record of all comments, including written responses to those questions posed in writing. The record will also include complete copies of scientific or technical comments related to the potential impact of the IBT. After this process, the EMC will make a final determination as to whether or not to issue the IBT certificate.

1.3.4.6. YRWSP Public Involvement Program

In addition to abiding by the prescriptive public involvement requirements of North Carolina Statute G.S. 143-215.22L as part of the procedure for obtaining an IBT Certificate, Union County is funding an active public involvement program specifically for its Yadkin Regional Water Supply project to keep stakeholders involved and informed throughout the life of the project. Initiated during the DEIS development, this program is designed to extend through project permitting, design, construction and startup. To-date the program has included outreach to and speaking engagements with many neighboring communities and counties, production of a project website (www.yadkinwater.com) and video, and distribution of educational materials such as brochures, newsletters and frequently asked questions.

2.0 Description of Facilities and the Transfer of Water

2.1. Union County Water Treatment and Distribution Infrastructure

The County's primary water supply and production is currently delivered from the Catawba River Water Supply Project (CRWSP) in Lancaster County, SC. Additional water supply is provided from the east from Anson County, NC. The CRWSP joint venture includes the Catawba River Water Treatment Plant (CRWTP) which is a regional water treatment facility with a permitted operating capacity of 36 mgd. Union County, NC, and Lancaster County Water and Sewer District, SC, have 50 percent ownership rights of the facilities. Both owners have current ownership of 18 mgd capacity from the CRWTP. With the County's ownership stake in this plant, issues of reliability and water quality are proactively addressed by direct negotiation and funding of necessary improvements with an owner's share of the costs. Union County has currently leased an additional 3 mgd of treatment capacity from Lancaster County's capacity allocation in the CRWTP. This additional capacity, however does not address the existing IBT limitation in the Rocky River IBT Basin, but rather seeks to secure additional capacity to serve Union County customers in their Catawba River Basin Service Area.

The CRWSP is currently in the planning stages of another potential expansion. Based upon current demand projections for both owners, additional plant capacity will be needed sometime between 2018 and 2022. Other improvements currently being permitted for construction at this facility include a new river pump station and intake, a new 92-acre off-stream reservoir (1.094 billion gallon storage capacity), and reservoir pump station. This infrastructure is needed to provide a drought buffer during periods of low flow in the Catawba River. An additional expansion of this facility is expected to be needed by 2040 to provide up to 36 mgd of capacity to Union County. Despite the planned expansions at the CRWTP, which are needed to meet the growing demand of the County's customers in their Catawba River Basin Service Area, such expansions do not directly address the projected future water demand growth in the County's Yadkin River Basin Service Area, due to the existing 5 mgd grandfathered IBT limitation for water transfers from the Catawba to Yadkin River Basins.

The County also has a purchase water agreement with Anson County for 4 mgd of maximum day capacity. To-date, negotiations for an extension to this agreement and any increase in capacity between the two counties have been unsuccessful. Water supplied from Anson County currently serves the Town of Wingate and areas of the County with service delivery as far north as northern Unionville and Fairview. Transmission upgrades within Union County along Hwy 74 were completed in May, 2011 to convey the full 4 mgd provided by the existing agreement. However, physical infrastructure limitations within Anson County limit the actual flow to approximately 3 mgd, and would require transmission enhancements within Anson County to transfer the full 4 mgd per the agreement. Additionally, further system enhancements would be needed within both counties to increase the capacity beyond the existing 4 mgd agreement. As a wholesale customer of Anson County, Union County has experienced multiple periods in

recent years of unstable water quality and insufficient supply that has impacted the reliability and dependability of water delivery from this source.

Illustration 2-1 depicts the existing sources of finished water provided to Union County from the CRWTP and Anson County, as well as the existing wastewater treatment facilities within Union County which are either operated or utilized by the County. Additionally, Illustration 2-2 depicts the existing finished water distribution network and pressure zones, respectively, within Union County's system.

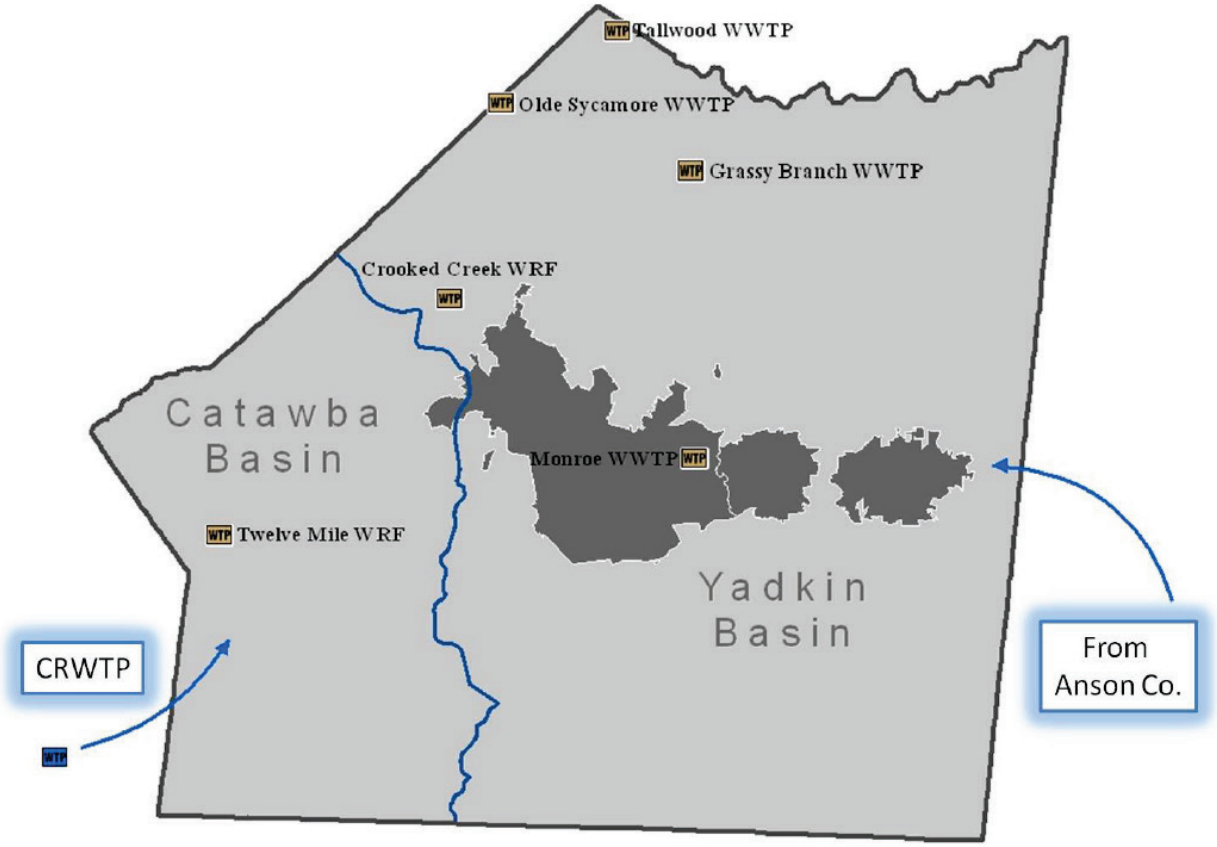

Illustration 2-1 Existing Union County Water Sources and Wastewater Treatment Facilities (Black & Veatch, 2011)

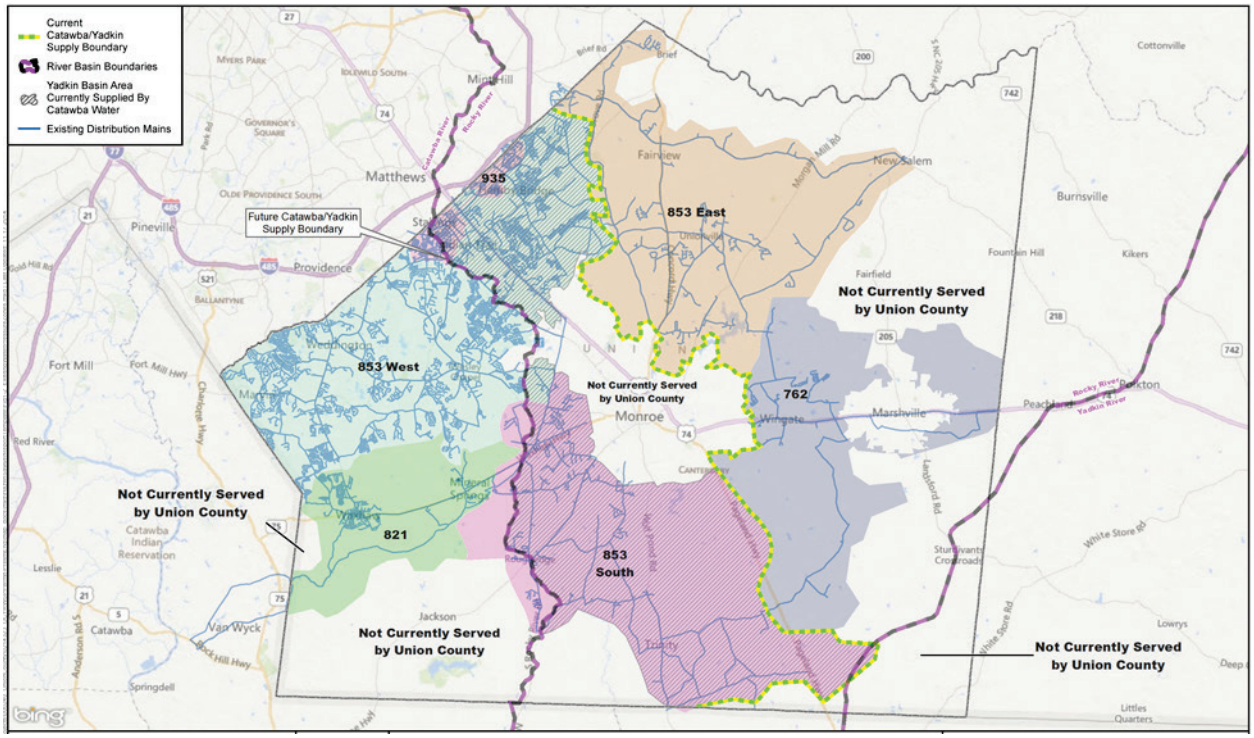

Illustration 2-2 Existing Union County Water Distribution System and Pressure Zones (HDR, 2015)

A key objective outlined in the County's 2011 Comprehensive Water and Wastewater Master Plan (Master Plan) (Black & Veatch, 2011) is securing additional water supply necessary to meet the projected peak day demands with an emphasis on securing this water supply at the lowest cost, greatest reliability, maximum contribution to satisfying the water portion of the IBT equation, and minimal impact to the surrounding environment. While the Master Plan identified the Catawba River as a water supply option to the County, Union County recognizes the inherent challenges, legal and political hurdles and potential environmental affects of increasing its grandfathered IBT from the Catawba River to serve its customers in the Yadkin River Basin Service Area. As such, Union County has initiated the planning and permitting for the Yadkin River Water Supply Project to secure water from the Yadkin River Basin to serve its customers in the Yadkin River Basin Service Area. This proposed water transfer, although considered an IBT according to state regulations, would be between two IBT basins (Yadkin River IBT Basin to the Rocky River IBT Basin) of a major river basin (Yadkin River Basin). Such a transfer is viewed by Union County to be a more logical and acceptable solution to meeting the current and future water demands within this area of the County.

The Master Plan notes that leveraging the use of the Catawba River and CRWSP for the maximum amount of supply available must also be balanced against a Yadkin-Pee Dee River water supply strategy (e.g., Yadkin River Water Supply Project). Relying primarily on the CRWSP would result in the majority of the County's water being supplied from one source, one plant, and one major transmission system. Source water coming from the Yadkin River Basin would provide the County with some level of redundancy, a sustained water quality, and better watershed balance in context of the IBT. Such a water supply also provides additional security should there be drought or contamination issues associated with either supply (Catawba River or Yadkin-Pee Dee River).

As noted previously, the current water supply purveyor for the eastern portion of Union County's Yadkin River Basin Service Area is Anson County, with Union County being a wholesale customer of finished water. There is no investment stake in the Anson County WTP and Union County is essentially unable to influence investments and operating decisions at the plant or in the transmission system needed to deliver the finished water to the point of interconnection with Union County at the County line. Ideally, a secure Yadkin River Basin water strategy would emulate a similar relationship as that with Lancaster County, SC for the CRWSP, where a joint ownership stake exists in the water supply infrastructure and/or provides Union County more control over capital investments and operations. Such a partnership was developed in 2013 between Union County and the Town of Norwood in Stanly County, as part of the Interlocal Intake and Transmission Agreement.

2.2. Union County Wastewater Treatment and Collection

Wastewater conveyance and treatment has several parallel issues to the water supply and transmission in the County. The western portion of the County is where the greater density of the population resides and is where the larger existing wastewater treatment capacity exists. It is also where the greatest potential for treatment capacity expansion exists. In general, treatment plant capacity has followed where the development and resulting population distribution and density dictated that treatment capacity should be provided. The exceptions are several small capacity treatment facilities constructed to serve specific developments or where school requirements dictated local treatment works that the County has inherited for operation.

County owned and operated treatment plants (and associated capacities) include Twelve Mile Creek Water Reclamation Facility (WRF) (6.0 mgd), Crooked Creek WRF (1.9 mgd), Olde Sycamore WRF (0.15 mgd), Tallwood Estates WRF (0.05 mgd), and Grassy Branch WRF (0.05 mgd). Union County is currently in the process of increasing the capacity of the Twelve Mile Creek WRF from 6.0 mgd to 12.0 mgd. Treatment capacity has also been purchased from Charlotte Water at the McAlpine Wastewater Treatment Plant (WWTP) (3.0 mgd) which serves the County's Six Mile wastewater service basin in the County and from the City of Monroe WWTP (2.65 mgd) which serves the eastside including the Towns of Marshville and Wingate through Interlocal wastewater agreements. All capacities are presented as maximum month average day treatment capacities.

The combined wastewater treatment capacity for publically owned water treatment works (POTW) to which Union County currently discharges within the Rocky River IBT Basin (Crooked Creek WRF, Olde Sycamore WRF, Tallwood Estates WRF, Grassy Branch WRF and City of Monroe WWTP) currently equals 4.8 mgd. It is projected that by the year 2050, wastewater flow generated in the County's Yadkin River Basin Service Area and subsequently returned to POTWs within the Rocky River IBT Basin will equal 8.8 mgd (annual average day), necessitating additional wastewater treatment capacity, likely through expansion of existing facilities and/or a capacity allocation increase from the City of Monroe WWTP or construction of a new facility. As the County's Master Plan indicates, public sewer is not anticipated to be the solution for wastewater disposal throughout the entire County. Onsite systems will continue to play a major role for wastewater disposal in the County. Portions of the County are desired and

projected to remain rural in nature and would not receive public sewer, although future public water supply to these areas is much more likely.

In order to develop population projections for areas receiving public sewer service, a “sewer boundary” was developed for the Master Plan, which assumed sewer service would be provided within the boundary and onsite wastewater disposal generally provided outside the boundary. The County’s defined sewer service basins are displayed in Illustration 2-3.

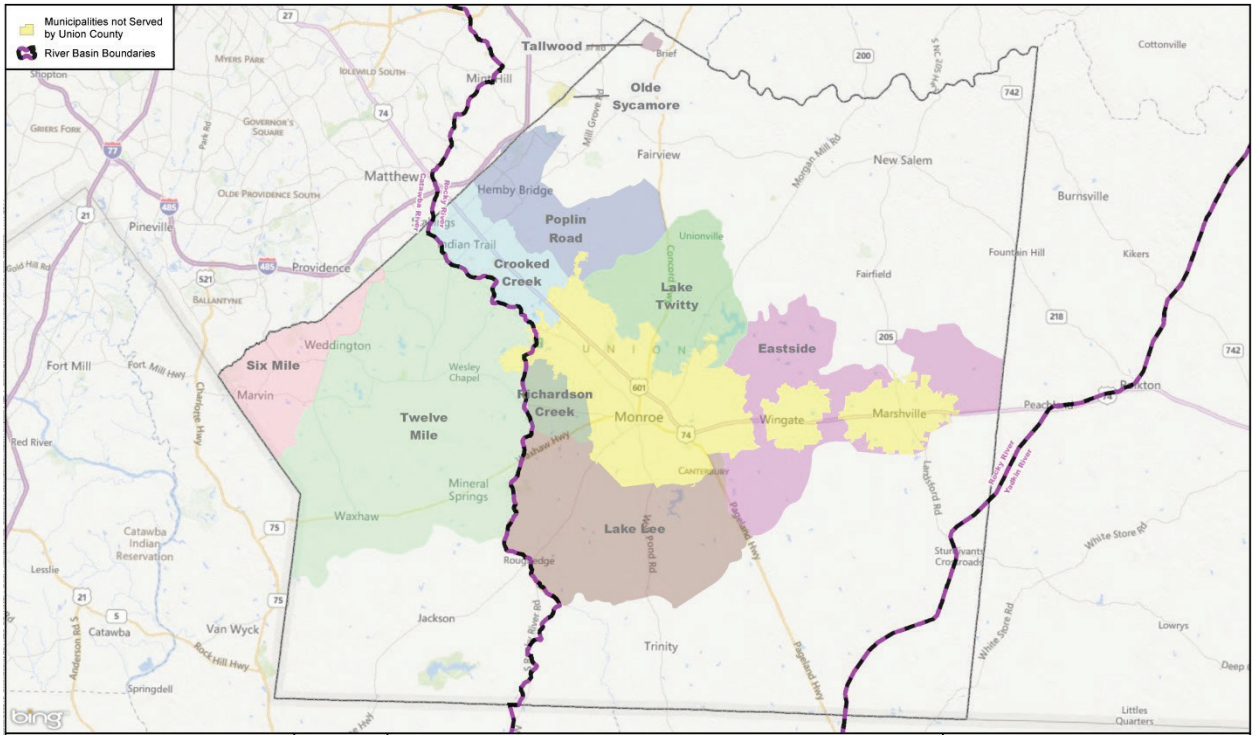

Illustration 2-3 Union County Wastewater Service Basins (HDR, 2015)

2.3. The Transfer of Water

In total, Union County is requesting an IBT certificate to transfer, on an average day of a maximum month (MMD) basis, 23 mgd out of the Yadkin River IBT Basin, into the Rocky River IBT Basin. This transfer is accounted for based on where the water is consumed or discharged. Under the proposed IBT, water will be withdrawn from the Yadkin River IBT Basin at Lake Tillery, transferred through a raw water transmission pipeline into Union County, treated at a new water treatment facility and distributed to customers within the Rocky River IBT Basin of Union County.

Much of this water used by Union County residents in the Rocky River Basin will eventually return to the Yadkin River Basin through treated wastewater effluent from existing Union County wastewater treatment facilities which discharge to tributaries of the Rocky River, which subsequently confluences with the Pee Dee River (Yadkin River Basin) below Lake Tillery. However, since this confluence is downstream of the withdrawal point in Lake Tillery and since water is transferred across IBT boundaries, as defined by North Carolina Statute G.S. 143-215.22L, the entire water withdrawal is considered an IBT.

The requested IBT amount of 23 mgd reflects an approximately 35-year planning period to the Year 2050, to proactively address both near-term and long-term water demand and supply needs. The IBT water balance calculation for the proposed transfer is presented in Table 2-1, on the following page.

When evaluating all existing IBTs to/from the Yadkin River Basin, the basin receives more inflow from water transfers from neighboring basins than it loses due to transfers out of the basin. Due to IBTs from other neighboring river basins (e.g. Catawba River Basin), the Yadkin River Basin has more IBT inflow (from treated wastewater effluent flow) than IBT outflow (from water withdrawal and transfer to neighboring basins). Examples of such transfers of water from the Catawba River Basin into the Yadkin River Basin include the City of Statesville, Town of Mooresville, and Charlotte Water. Through the planning period to the year 2050, with the proposed Union County IBT from the Yadkin River Basin, there is still projected to be a greater amount of water entering this basin as inflow from IBTs than leaving the basin as outflow due to these transfers.

2.4. Consumptive and Nonconsumptive Uses of Water to Be Transferred

The transfer of raw water from the Yadkin River IBT Basin to the Rocky River IBT Basin, as proposed by Union County, will be treated and used for public water supply purposes within Union County's Yadkin River Basin Service Area. The uses of the transferred water include both consumptive and nonconsumptive uses associated with public water supply. Consumptive water use is the water removed from available supplies without being returned to a naturally occurring surface water source, which is no longer available for reuse (such as evaporation or irrigation infiltration). Nonconsumptive water use is water that is not consumed, but rather, discharged back to a naturally occurring surface water source (such as treated wastewater effluent discharge to a stream or river).

Under the current Union County categorical water use percentages, some wastewater will be discharged to publically owned treatment works (POTW) within the Rocky Ricker IBT Basin and is considered non-consumptive water use. Such water uses include residential and commercial plumbing (toilets, faucets, etc.), As indicated in Table 2-1, of the 23 mgd maximum month daily average transfer proposed by the year 2050, 8.8 mgd is projected (on an annual average day basis) to be non-consumptive use, returned back to the receiving basin (Rocky River IBT Basin), subsequently flowing back into the source basin (Yadkin River IBT Basin) at the confluence of the Rocky River with the Pee-Dee River, several miles downstream of the original water withdrawal point.

Also as indicated in Table 2-1, some water supplied from the proposed transfer will not be returned to surface water sources within the Rocky River IBT Basin and is considered as consumptive use. Examples of this water use include human or animal consumption, residential and commercial landscape irrigation, certain industrial processes, and wastewater discharges to residential septic systems. Of the 23 mgd maximum month daily average transfer proposed by the year 2050, 14.2 mgd is projected to be consumptive use within the County's Yadkin River Basin Service Area, and not returned back to surface waters in the receiving basin.

Table 2-1 Interbasin Transfer Water Balance Table – Maximum Month Average Daily Transfer Estimates (unless noted otherwise)

Water System: Union County (PWSID 01-90-413)
Source Basin: Yadkin River (18-1)
Receiving Basin: Rocky River (18-4)

Year (A)	Water System (B)	Withdrawal from Source[1] (MGD) (C)	Consumptive Loss[1]		Wastewater Discharge[1,3]		Total Return to the Source Basin[1] (MGD) (H)=(D)+(F)	Total Surface Water Transfer[1] (MGD) (I)=(C)-(H)	Comments
			Source Basin (MGD) (D)	Receiving Basin[5] (MGD) (E)	Source Basin (MGD) (F)	Receiving Basin (MGD) (G)			
2010	Union County[2]	2.50[7]	0.00	0.10	0.00	2.40	0.00	2.50	Cork Rule Exception applies[6]
2013 (BASE YEAR)	Union County[2]	2.50[7]	0.00	0.00	0.00	2.75	0.00	2.50	Cork Rule Exception applies[6]
2015	Union County[2]	3.30[7]	0.00	0.32	0.00	2.98	0.00	3.30	Cork Rule Exception applies[6]
2020	Union County[2]	3.30[7]	0.00	0.00	0.00	4.07	0.00	3.30	Cork Rule Exception applies[6]
2030	Union County[2]	9.80[8]	0.00	4.30	0.00	5.50	0.00	9.80	Assumes YRWSP operational
2040	Union County[2]	16.40[8]	0.00	9.50	0.00	6.90	0.00	16.40	Assumes YRWSP operational
2050	Union County[2]	23.00[8]	0.00	14.20	0.00	8.80	0.00	23.00	Assumes YRWSP operational

Notes:
[1]All numbers are expressed in million gallons per day (MGD) rounded to two decimal places.
[2]Union County water system includes wholesale water supply to the Town of Wingate.
[3]Wastewater discharge shown based on average annual daily values to more accurately reflect full magnitude of water transfer.
[4]Water use values shown for 2010-2015 are estimated values, based on Union County Master Plan and subsequent projections developed for the EIS document.
[5]Consumptive loss values indicated in the receiving basin through 2020 reflect low values as a portion of wastewater returns to the receiving basin may include returns of supplemental water supplied to the receiving basin through Union County's existing grandfathered Catawba River IBT.
[6]Cork Rule Exception applies for historical and existing Anson County water sales to Union County as the withdrawal (Blewett Falls Lake) is below the Rocky River confluence with the Pee Dee River.
[7]Finished water supply from Anson County to Union County, through existing purchase water agreement.
[8]Proposed Union County withdrawal from Lake Tillery as part of the Yadkin River Water Supply Project.

3.0 Predicted Water Demands and Uses

3.1. Background

During the early part of the 2000 decade, Union County was the fastest growing county in North Carolina and one of the top 20 fastest growing counties in the entire nation. Growth rates within the County during this time outpaced the balance of the State's growth rate by a factor of 3 to 4. Union County's proximity to the Charlotte metropolitan area and increasing job base and quality of life were key drivers to this high population growth rate. However, since the economic recession in the late 2000 decade, growth rates within the County have been observed at more modest rates of 2 to 3 percent per year.

In preparation of the 2011 Master Plan water demand projections, data was reviewed from Union County's previous County planning documents, previous water and sewer Master Plans, County planning projections including the 2025 Comprehensive Plan, State planning projections and forecasts, regional planning projections, spatial population distributions, and corresponding water demand and wastewater flow projections. Additionally, towns, villages and cities within the County were engaged to share their current land use plans and describe their economic development drivers for both the short and long term. The Master Plan used the County's GIS data (community data, water and sewer inventory) to spatially distribute existing population and customers and project growth and future water demand within the County's service areas.

Additional consideration was given to Master Plan population projections and spatial distributions using traffic analysis zones (TAZ) which incorporate household and employment projections developed by local/regional planning organizations. These TAZs were used for Master Plan purposes because they are spatially distributed within topographical areas that often correspond to watersheds and sewer service basins as boundaries are drafted around primary and arterial roads which often follow the ridge lines. Several other factors were also considered in the Master Plan projections including:

- County population versus public water/sewer population components,
- Capacity constraints and impacts to growth.
- Impact of the Monroe Bypass in future planning years; and,
- Potential water supply requirements of major commercial or industrial development in the eastern portion of the County.

Projections for water demands in the 2011 Master Plan were made through the 2030 decade. For purposes of evaluating water supply needs for the Yadkin River Water Supply Project, and subsequent water demand projections, the projection approach established in the Master Plan has been carried forward for this evaluation. However, recognizing that projections outlined in the Master Plan did not extend through the full evaluation period for the Yadkin River Water Supply Project (i.e. through the Year 2050), the previous projections of the Master Plan were extended from 2030 to 2050 for the County and updated, based on more recent historical system data gathered since development of the Master Plan. Such projection updates have also

been reflected in Union County's North Carolina DWR Local Water Supply Plan, beginning with the year 2013 report.

3.2. Population Projections

3.2.1. Population Growth and Allocation

In the development of Master Plan projections, the County's geographic information system (GIS) was used to spatially populate the current and future water service area boundaries for the base year (2010) and future planning years (2015, 2020, and 2030). The Master Plan notes that while the entire County could be considered as a future service area, there were considerations incorporated into water service areas that respected existing and future land use as a core basis for planning. The use of GIS-based land use evaluations also enabled the spatial allocation of the existing and future population growth into watersheds by parcels. Additionally, the Master Plan made considerations for future groundwater well failures/contamination in the County, by making a specific water allocation for the transition of certain onsite well customers to public water.

3.2.2. Population and Service Area

As part of the 2011 Master Plan, a number of local, regional and state planning organizations' forecasts were used to develop a reasonable annual population growth rate to develop projections. Many of those forecasts were developed in the early 2000 decade, prior to the most recent economic recession, resulting in projections with very high rates of growth. The ongoing economic environment since 2008 has dictated population projections that are lower, with rates of growth that are slower.

Due to these considerations, the Master Plan utilized an overall 2.4% annual rate of population growth for the County. However, allocation of the future population was differentially applied to geographic regions in order to reflect the different growth drivers over time, and is consistent with the methodology used in the County's 2025 Comprehensive Plan. For purposes of extending water use projections for the YRWSP, the overall 2.4% county-wide population growth projection approach established in the Master Plan through 2030 was maintained. However, recognizing a constant county-wide annual growth rate of 2.4% through the year 2050 is unlikely to continue, projections for the YRWSP were updated to reflect decreasing growth rates in later decades, as indicated in Table 3-1 and Table 3-2.

Additionally, recognizing that development of the YRWSP will provide a reliable source of water for County residents in the Yadkin River Basin Service Area, as well as the development potential which currently exists in this portion of the County, projected population and service area growth rates in this area are considered to be slightly higher than those for the Catawba River Basin Service Area, in the western part of the County. The Catawba River Basin Service Area is already relatively highly developed, in comparison to the Yadkin River Basin Service Area, and therefore presents less opportunity for long-term sustained population growth and continued development through the year 2050.

Consideration has also been made in water demand projections for future water service area expansion in both the Catawba and Yadkin River Basin Service Areas. Similar to population growth projections, there is less potential for expansion of the County's water service area within the Catawba River Basin, while a more significant opportunity exists in the Yadkin River Basin Service Area, particularly in the northeastern portion of the County. Table 3-1 and Table 3-2 summarize the population and water service area growth rates used to update and extend the previous 2011 Master Plan projections through the year 2050 for the YRWSP.

Table 3-1 Union County Population and Water Service Area Growth Projections

Service Area	Projection Decade(s)	Annual Growth Rate
Catawba River Basin	2010 to 2020	2.4%
	2021 to 2050	1.8%
	Service area growth	0.2%
Yadkin River Basin	**2010 to 2030**	**2.7%**
	2031 to 2040	**2.4%**
	2041 to 2050	**1.8%**
	Service area growth	**1.0%**

Table 3-2 Union County Served Population Projections

Projection Year	Projected Population Served by Union County Water System		
	Catawba River Basin	Yadkin River Basin	System Total
2010	59,925	**47,123**	107,048
2013	64,722	**52,550**	117,271
2020	77,461	**67,767**	145,228
2030	94,424	**97,456**	191,880
2040	115,103	**136,149**	251,251
2050	140,309	**179,450**	319,760

3.3. Average Daily Water Demands

3.3.1. Per Capita Average Unit Water Demand

As the basis of the 2011 Master Plan projections, County data was examined to establish unit water demand rates to convert population forecasts to water demand projections. Available water production records and system operating records were reviewed to determine historical average day, maximum day, and peak hour water demands. Also reviewed were metered water sales records to identify historical customer consumption and unit water consumption. The historical water loss component was calculated by comparing consumption and production records. Water demand on a per capita basis is important to determine future water demands in the system, and have similarly been employed for purposes of the YRWSP evaluations.

As stated in the 2011 Master Plan projections for water demand, the overall gallons per capita per day (gpcd) unit demand was established at 125 gpcd (total system demand divided by estimated persons served for residential accounts), which included irrigation demands. This value was based upon total categorical (residential, commercial, industrial and institutional) billed water consumption plus non-revenue water (unbilled authorized consumption used for line flushing, hydrant testing, and other purposes, plus water losses). Master Plan demand

projections estimated non-revenue water at 15% of the total water demand for future year demand projections. It is noted that from 2007 to 2013, the County's non-revenue water averaged slightly more than 12% of the total system water demand, with 1-2% from unbilled authorized consumption and the remainder from water losses. Union County has implemented a schedule to conduct routine water system audits according to the AWWA M36 Water Audit Method as a means to identify and potentially reduce non-revenue water volumes, particularly water losses. Results of Union County's inaugural FY2014 AWWA M36 water audit reflected a non-revenue water loss rate of 14.9%, with 1.3% due to unbilled authorized consumption and 13.6% due to water loss. Continuation of the annual water audit program, as discussed further in Section 5.3.1, will provide additional data, allowing Union County to better identify and develop additional strategies to target potential reductions in its non-revenue water volumes.

For purposes of developing total system per capita demand rates for the YRWSP evaluations, it has been assumed that in the future, the County's water loss rate may be reduced to between 8-11% with an additional 3-5% of the total per capita demand needed for water treatment processes at the proposed water treatment plant for the YRWSP and 1-2% needed for unbilled authorized consumption. Note that water treatment process volumes have not typically been included in the County's non-revenue water calculation as this water is supplied from sources outside the County. Thus, for purposes of establishing a total per capita demand for the YRWSP, the 15% value previously identified in the Master Plan is dedicated to the non-revenue portion of water production and distribution for the project, including the additional water use necessary for treatment processes at a new Yadkin River Water Treatment Plant, proposed to be located within Union County.

For purposes of the YRWSP projection updates, a review of the County's historical water use data over the past decade indicates that per capita per day unit water demands (total system demands) have averaged between 110 to 120 gpcd, with slightly lower values in the most recent years due to ongoing mandatory water restrictions, increased conservation efforts, and more favorable climate conditions (more annual rainfall and slightly lower annual temperature averages). As such, the water demand projections of the recently completed Master Plan have been reduced for the updated YRWSP projections to reflect an average unit demand of 120 gpcd for future water demands of all new system customers to be served after the Year 2012. The use of a 120 gpcd unit demand is representative of customer demands within the County over the last decade during historically drier years, which should be used as the basis for water demand planning to secure a sufficient water supply to meet peak year demands.

Additionally, the use of the top of the range of historical unit demands allows for the potential for future industrial or commercial/institutional water uses in the demand projections. While such future uses are difficult to quantify, a single new industry which has a large water demand for process purposes can drive up system-wide unit demand rates. Use of the 120 gpcd unit demand for future projections provides the flexibility to meet such future demands should they materialize within the County.

As a portion of this 120 gpcd total system demand, residential water use per capita demand is estimated to be between 70 and 80 gpcd, depending on the climate conditions for a particular

year. This value is based upon historical Union County residential water use which has averaged 65 to 70 percent of the total treated water supply since 1997. This estimated residential per capita water demand value compares favorably with the Catawba-Wateree Water Management Group's 2014 Catawba-Wateree Water Supply Master Plan, which assumed a basin-wide average residential categorical water use rate of 85 gpcd for planning purposes (CWWMG, 2014).

Further, the County's current residential/non-residential categorical water demand ratio is relatively high (approximately 75% to 80% residential), given how the County has developed over time. Based on this fact, as well as future land use plans, planned transportation corridors and large tracts of land available within the County, it is likely that non-residential development will occur over the next 50 years. The County's water supply must be prepared to meet these demands for continued economic development.

3.3.2. Water Demand Summary – Annual Daily Average

Union County water demands are expected to increase by the Year 2050, based upon continued development (both residential and commercial) resulting from the County's proximity to the greater Charlotte metropolitan area, as well as future service expansion of the Union County water system to meet the needs of current County residents without reliable water sources. Projections indicate that specifically within the Yadkin River Basin Service Area, the annual average daily demands will increase from 5.5 mgd in 2013 to 20.8 mgd by the Year 2050. Table 3-3 indicates the projected decadal increases in water demand for Union County's Catawba River and Yadkin River Basin Service Areas, on an annual average daily basis. Detailed projections for Union County water demand are also included in the FEIS document.

Table 3-3 Union County Projected Water Demands by Decade

Planning Year	Annual Average Day Demand (mgd)	
	Catawba [1]	Yadkin
2010	5.6	**4.9**
2013	6.4	**5.5**
2020	8.7	**7.4**
2030	11.0	**10.9**
2040	13.5	**15.6**
2050	16.5	**20.8**

Note:
[1] Catawba demands (2020 to 2050) include 1.9 mgd (max day) contract supply from Union County to City of Monroe (Catawba River Basin supply).

3.4. Maximum Month Average Day Water Demands

3.4.1. Water Demand Peaking Factors

As part of the 2011 Master Plan, Max Day to Average Day peaking factors were identified from historical water production records. The majority – more than 80% – of the water demand in the distribution system has historically been supplied from the Catawba River Water Supply Project (CRWSP). A much smaller portion – less than 20% – has been supplied from Anson County.

Using primarily CRWSP production records, peaking factors as high as 2.3 have been observed in the system. The Master Plan identified the average Max Day to Average Day peaking factor from 2004 to 2009 to be approximately 1.9, which was carried forward in Master Plan water demand projections.

In recent years, however, County-wide mandatory and voluntary irrigation restrictions have impacted historical Max Day factors, as irrigation uses are a major driver of the Max Day demands typically occurring during summer months. With irrigation restrictions over the past seven years, the County has been able to achieve Max Day to Average Day peaking factors at an average rate of 1.8. These factors were observed to be higher during the last major drought (2007-2008), and lower in more recent non-drought years. The Union County Board of Commissioners previously reached consensus in favor of implementing demand management practices in the future to avoid the very high peaking factors (those greater than 2.0) that have been experienced in the past (Black & Veatch, 2011). The County's newly adopted (May 4, 2015) Water Use Ordinance, as further discussed in Section 5.1.1 of this Petition, outlines the specific demand management initiatives now implemented within the County.

Therefore, for purposes of the YRWSP projections, the Max Day to Average Day peaking factor for the future water demands was selected to be the actual average over the past 4 years (non-drought years) of 1.7. An evaluation of North Carolina Division of Water Resource's (DWR) Local Water Supply Plans for comparable utilities within the Piedmont region of North Carolina indicates that since 2007, average Max Day to Average Day peaking factors have ranged from 1.4 to 1.8, which supports the 1.7 peaking factor used for YRWSP demand projections within Union County.

Also, using the 1.7 Max Day to Average Day peaking factor for Union County, the corresponding Max Day to Max Month Average Day peaking factor has been subsequently determined to be 1.22 for purposes of the YRWSP water demand projections.

3.4.2. Water Demand Summary – Maximum Month Daily Average

Application of peaking factors to the annual average daily water demand projections indicate that specifically within the Yadkin River Basin Service Area, the maximum month daily average demands will increase from 7.7 mgd in 2013 to 28.9 mgd by the Year 2050. Table 3-4 indicates the projected decadal increases in water demand for Union County's Catawba River and Yadkin River Basin Service Areas, on a maximum month daily average and maximum day basis. Detailed projections for Union County water demand are also included in the FEIS document.

Table 3-4 Union County Projected Water Demands by Decade

Planning Year	Max Month Avg. Day Demand (mgd)		Max Day Demand (mgd)	
	Catawba [1]	Yadkin	Catawba [1]	Yadkin
2010	8.0	**6.9**	9.7	8.4
2013	8.9	**7.7**	10.8	9.4
2020	12.6	**10.2**	15.3	12.5
2030	15.4	**15.2**	18.8	18.6
2040	18.8	**21.7**	23	26.4

Planning Year	Max Month Avg. Day Demand (mgd)		Max Day Demand (mgd)	
	Catawba [1]	Yadkin	Catawba [1]	Yadkin
2050	23.1	**28.9**	28.1	35.3

Note:
[1] Catawba demands (2020 to 2050) include 1.9 mgd (max day) contract supply from Union County to City of Monroe (Catawba River Basin supply).

3.5. Interbasin Transfer

Of the 28.9 mgd maximum month daily average projected water demand in the County's Yadkin River Basin Service Area by the Year 2050, 23 mgd is projected to be served by the new Yadkin River Water Supply Project through the proposed IBT from the Yadkin River Basin, as requested by this Petition, while the remaining demand is projected to be met by the County's existing grandfathered Catawba River Basin IBT. It is important to note that, while the County's grandfathered IBT from the Catawba is limited to 5 mgd and the amount needed from this IBT in 2050 to meet the system demand is 5.9 mgd, because the County returns a portion of their wastewater discharge generated in the Yadkin River Basin back to the Catawba River Basin, the net IBT from the Catawba to the Yadkin is projected and planned to remain below the existing 5 mgd limit.

4.0 Environmental Resources

Environmental resources are discussed in detail in the FEIS and associated ROD for the proposed IBT. The ROD is included as Appendix A of this Petition. Of particular concern during the evaluation of potential impacts associated with the transfer of water due to IBTs are water quality, water quantity, and aquatic habitat resources. The discussions which follow are focused on these environmental resources and include both the source (Yadkin River Basin (18-1) and receiving (Rocky River (18-4)) Basin, inclusive of the proposed project area for Union County's YRWSP.

4.1. Water Resources

4.1.1. Water Quantity and Water Supply

4.1.1.1. Surface Water Use Classifications

DWR classifies surface waters of the state based on their existing or proposed uses. The primary classification system distinguishes the following three basic usage categories: waters used as a source of water supply for drinking, culinary, or food-processing purposes (Classes WS-I through WS-V), waters used for primary recreation (Class B), and Class C. Class C waters are protected for aquatic life propagation, survival, and maintenance of biological integrity (including fishing and fish), wildlife, secondary contact recreation, and agriculture. All freshwaters in the state of North Carolina have a minimum classification of Class C.

Water supply surface water classifications are further classified into five categories based on the level of protection required for the water supply and the level of development in the watershed. Class WS-I waters offer the most protection to water supplies and are located in natural and undeveloped watersheds in public ownership. Class WS-II waters are located in predominantly underdeveloped watersheds where WS-I classification is not feasible. WS-III classification applies to water supply waters where WS-I and WS-II classification is not feasible and the watershed has low to moderate development. Class WS-IV waters are located in moderately to highly developed watersheds where WS-I through WS-III classification is not feasible. Class WS-V waters are generally upstream and draining to Class WS-IV waters, used by industry to supply their employees with drinking water, or waters formerly used as water supply.

DWR assigns supplemental classifications to provide additional protection, management, or recognition of certain waters in the state. High Quality Waters (HQWs) and Outstanding Resource Waters (ORWs) are protected waters with excellent water quality. Waters needing additional nutrient management due to excessive growth of vegetation are classified as Nutrient Sensitive Waters (NSWs). Swamp waters (Sw) and trout waters (Tr) are also classified to recognize or protect the water's specific characteristics. Critical Areas (CA) are those being defined as being within a half mile of a drinking water reservoir.

The majority of the surface waters in the project area (considered to be from the raw water intake site in Norwood at Lake Tillery and inclusive of the raw water transmission corridor through Stanly County and into Northern Union County, along with a new water treatment facility and finished water distribution in Union County's Yadkin River Basin Service Area) are classified

as C. Two reaches of the Pee Dee River, from the mouth of the Uwharrie River to Norwood Dam and from 0.8 mile downstream of the mouth of Savannah Creek to the Blewett Falls Dam, are designated water supply waters, WS-IV CA, as well as Class B waters. The Pee Dee River from the Norwood Dam to the mouth of Turkey Top Creek is designated as water supply waters, WS-V, and Class B. The classified streams in the project area are listed in Table 4-1. In addition to the named streams, numerous unnamed tributaries (UTs) to the classified streams are located in the project area. A stream that is not specifically classified by DWR or DHEC is assumed to have the same classification as the stream into which it empties, unless that unnamed waterbody is in North Carolina and specifically described in a river basin classification schedule.

Table 4-1 Surface Water Use Classifications in the Project Area

Name	Description	Class
Pee Dee River (including Lake Tillery below normal operating levels)	From mouth of Uwharrie River to Norwood Dam	WS-IV, B; CA
Rocky River	From source to Pee Dee River	C
Coldwater Branch	From source to Rocky River	C
Gilberts Creek	From source to Rocky River	C
Long Creek	From source to Rocky River	C
Horse Branch	From source to Long Creek	C
Long Branch	From source to Long Creek	C
Murray Branch	From source to Rocky River	C
Alligator Branch	From source to Murray Branch	C
Haw Branch	From source to Alligator Branch	C
Hardy Creek	From source to Rocky River	C
Big Cedar Creek	From source to Rocky River	C

4.1.1.2. Surface Water Impoundments (Reservoirs and Hydropower Projects)

The project area is located in the Yadkin-Pee Dee and Catawba River basins. Within these respective basins, the Yadkin-Pee Dee and Catawba Rivers consist of a series of regulated surface water impoundments with primary functions of hydropower generation, water supply, and flood control. The Yadkin-Pee Dee River consists of seven surface water impoundments within North Carolina, while the Catawba River consists of eleven surface water impoundments within North and South Carolina.

W. Kerr Scott Project

W. Kerr Scott Reservoir is the northernmost impoundment of the Yadkin-Pee Dee River system, located in Wilkes County, North Carolina, near the City of Wilkesboro. This reservoir is operated by the US Army Corps of Engineers and does not generate hydropower. The W. Kerr Scott project is authorized for the purposes of flood control, water supply, recreation, and fish and wildlife.

W. Kerr Scott Dam is located on the Yadkin River about five river miles upstream of Wilkesboro, NC. The dam is about 55 miles west of Winston-Salem, NC and about 65 miles north of

Charlotte, NC. W. Kerr Scott Dam is an earthen structure having a top elevation of 1107.5 feet, msl and an overall length of 1,750 feet. The height about the streambed is 148 feet. The drainage area above W. Kerr Scott Dam is 367 square miles. The watershed covers parts of Wilkes, Caldwell, and Watauga counties. W. Kerr Scott Reservoir extends about 9.7 miles up the Yadkin River. At the normal pool elevation of 1030 feet, msl, the length of the shoreline is about 55 miles and the reservoir covers an area of about 1,475 acres. The mean depth at normal pool is about 28 feet, but the depth at the dam is about 65 feet. At the normal pool, there are about 41,000 acre-feet of water stored behind W. Kerr Scott Dam (USACE, 2015).

Yadkin Hydroelectric Project

Alcoa Power Generating, Inc. (APGI) operates the Yadkin Hydroelectric Project, Federal Energy Regulatory Commission (FERC) No. 2197, which is comprised of four hydroelectric stations, dams and reservoirs along a 38-mile stretch of the Yadkin River in central North Carolina. The four reservoirs are High Rock, Tuckertown, Narrows (Badin Lake) and Falls (Alcoa Power Generating Inc., 2015).

High Rock Development

The High Rock development is located on the Yadkin River at river mile 253 in Davidson, Davie, and Rowan counties, North Carolina. Completed in 1927, the High Rock development was the third of the Yadkin Project developments to be built and is the most upstream of the four Yadkin Project developments. The High Rock development consists of a dam, powerhouse, and reservoir. High Rock Reservoir has a normal full pool area of approximately 15,180 acres and a drainage area of 3,973 square miles. The normal full pool elevation of High Rock Reservoir is 623.9 feet (USGS datum) (Alcoa Power Generating Inc., 2015).

Tuckertown Development

The Tuckertown development is located in Rowan, Davidson, Stanly, and Montgomery counties, North Carolina on the Yadkin River at river mile 244.3. Completed in 1962, the Tuckertown development was the last of the Yadkin Project developments to be built. The Tuckertown development consists of a dam, powerhouse, and reservoir. Tuckertown Reservoir has a normal full pool area of 2,560 acres and a drainage area of 4,080 square miles. The normal full pool elevation of Tuckertown Reservoir is 564.7 feet (USGS datum) (Alcoa Power Generating, Inc., 2015).

Narrows Development

The Narrows development is located in Davidson, Stanly and Montgomery counties, North Carolina on the Yadkin River at river mile 236.5. Completed in 1917, the Narrows development was the first of the Yadkin Project developments to be built. Narrows Dam consists of a main dam section and a bypass spillway section. Four steel penstocks convey water from the intake section to the powerhouse. The dam impounds a reservoir (Narrows Reservoir or Badin Lake) that has a normal full pool area of 5,355 acres and a drainage area of 4,180 square miles. The normal full pool elevation of Narrows Reservoir is 509.8 feet (USGS datum) (Alcoa Power Generating Inc., 2015).

Falls Development

The Falls development is located in Stanly and Montgomery counties, North Carolina on the Yadkin River at river mile 234. Completed in 1919, the Falls development was the second of the Yadkin Project developments to be built and is the most downstream of the four Yadkin Project developments. The Falls development consists of a dam, a gate controlled spillway, powerhouse and reservoir. Falls Reservoir has a normal full pool area of 204 acres and a drainage area of 4,190 square miles. The normal full pool elevation of Falls Reservoir is 332.8 feet (USGS datum) (Alcoa Power Generating Inc., 2015).

Yadkin-Pee Dee Hydroelectric Project

Duke Energy Progress operates the Yadkin-Pee Dee Hydroelectric Project. The Tillery and Blewett Hydroelectric Plants together comprise the Yadkin-Pee Dee River Project. These plants are operated as an integrated unit under FERC Project License No. 2206. The Tillery and Blewett Plants are located in the Southern Piedmont area of North Carolina.

Tillery Development

Lake Tillery is located in Montgomery and Stanly counties and is formed by the dam at the Tillery Hydroelectric Plant on the Pee Dee River. The lake extends approximately 15 miles upstream from the dam to APGI's Falls Hydroelectric Development. At normal operating levels, Lake Tillery is about 72 feet deep at the dam. The reservoir surface area is 5,260 acres at that level (elevation 278.17), and the usable storage with 22 foot drawdown is 88,000 acre-feet (Duke Energy, 2015). The Tillery Hydroelectric Plant is located on the Pee Dee River approximately four miles west of Mt. Gilead, NC, 17 miles south of Narrows Reservoir and 25 miles above the Blewett Plant. The plant began service in 1928, with additions in 1960. It features a dam 2,800 feet long and 86 feet high, that forms Lake Tillery, as well as flood-control gates. Its four generators are capable of producing a total of 87 megawatts. By regulating the river's flow, the Tillery plant also helps to increase the efficiency of the Blewett Plant downstream (Duke Energy, 2015).

Blewett Falls Development

The Blewett Falls impoundment, also known as Blewett Falls Lake, extends approximately 11 miles upstream from the dam. Construction of the Blewett Falls Development began in 1905 and was completed in June 1912. Blewett Falls Lake has a reservoir surface area of 2,866 acres at a normal pool elevation of 178.1' msl and a usable storage capacity of 30,893 acre-feet. The Blewett Falls development is licensed for a drawdown of 17 feet, but generally operates with drawdowns of 2 to 4 feet (Duke Energy, 2014).

The Blewett Hydroelectric Plant is located in Richmond and Anson counties on the Pee Dee River in Lilesville, NC, near the North Carolina/South Carolina border, and was originally constructed to supply power to the textile industry in Rockingham, NC The plant includes a gravity dam that is 60 feet high and 650 feet long, creating Blewett Falls Lake. It houses six generators capable of producing a total of approximately 22 megawatts. In addition, the oil-fired combustion turbines on the site can generate another 52 megawatts. The Blewett Hydroelectric Plant began commercial service in 1912, with additions in 1971 (Duke Energy, 2015).

4.1.2. Water Quality

DWR and DHEC monitor water quality using physical, chemical, and biological sampling and rates each monitored stream segment or lake with respect to its designated usage classification (NCDENR, 2012; SCDHEC, 2012a). Biological monitoring, including benthic macroinvertebrate (benthos) and fish samples, is particularly useful in tracking water quality trends because these organisms reflect long-term interactions among many water quality and habitat parameters, including factors not detected by infrequent physical and chemical sampling. The data collected during ambient water quality monitoring supports evaluations and reporting requirements under the Clean Water Act (CWA). Locations of monitoring sites are identified within the FEIS appendices.

The proposed source waterbody is Lake Tillery, an impoundment on the Pee Dee River. The best use classification assigned to the reach of the Pee Dee River that includes Lake Tillery is WS-IV, B; CA. The receiving river is Rocky River, which has a best use classification of C. Rocky River empties into the Pee Dee River downstream of Norwood Dam, which impounds Lake Tillery. The reach of the Pee Dee River into which Rocky River flows is designated as WS-V, B.

Per Section 303(d) of the CWA, if a surface water quality standard is exceeded and the impaired waters do not have a total maximum daily load (TMDL) approved by the EPA, an integrated reporting category of “5” is assigned to those waters, and the waters are incorporated into the Section 303(d) list. All waters in NC are Category 5 designated due to mercury. Additionally, several streams in the proposed YRWSP project area and/or Union County water service area have been designated as Category 5 waters for parameters other than mercury (NCDENR, 2012; SCDHEC, 2012a) Little Long Creek in Stanly County, NC, and a reach of Lanes Creek extending from the Marshville Water Supply Dam (located 0.1 mile downstream of Beaverdam Creek) to Rocky River have been designated as Category 5 due to a Fair bioclassification resulting from benthic community sampling. Long Creek in Stanly County and a reach of Richardson Creek extending from Watson Creek to Negro Head Creek (Salem Creek) have been designated as Category 5 for aquatic life due to a standard violation of copper levels. A reach of Rocky River extending from the mouth of Dutch Buffalo Creek to the mouth of Island Creek is designated as Category 5 for aquatic life due to standard violations of copper, zinc, and turbidity standards. If a TMDL is approved for the parameter resulting in the impairment of the Category 5 waters, then the waterbody would be reclassified as Category 4 waters. Listed waters are illustrated within the FEIS appendices.

Impaired waters that have an EPA-approved TMDL or other management strategy in place to address the impairment are assigned an integrated reporting category of “4.” Two streams in the Union County service area have been designated as Category 4 waters (NCDENR, 2012; SCDHEC, 2012a). Duck Creek, a tributary to Goose Creek, has been designated as Category 4 for aquatic life due to a fair bioclassification based on benthic community sampling results. A reach of Goose Creek extending from SR 1524 to Rocky River is rated as Category 4 for aquatic life due to a standard violation of turbidity limits. A reach of Rocky River has a TMDL for fecal coliform. However, the reach of Rocky River with the TMDL is in Iredell County and is the county line between Mecklenburg and Cabarrus counties. The reach ends approximately 58

river miles upstream of the proposed project crossing of Rocky River and of the intake proposed under Alternative 5. The YRWSP is not anticipated to affect or be affected by the TMDL and associated water quality impairment.

Point-source dischargers located throughout North and South Carolina are regulated through the National Pollutant Discharge Elimination System (NPDES) program and may be required to register for a permit. Two major NPDES permit holders (i.e., authorized to discharge in excess of 1 mgd) are located in the project area (NCDENR, 2014; SCDHEC, 2014). The major dischargers in the project area are the Twelve Mile Creek WWTP and the Crooked Creek WWTP #2. Both facilities are owned by Union County and are currently operated by Charlotte Mecklenburg Utilities. One major NPDES discharger, the City of Monroe WWTP, is located within the project area. Minor dischargers are permitted to discharge less than 1 mgd or are not limited. There are nine minor dischargers in the immediate vicinity of a proposed pipe corridor. The minor dischargers include two WTPs, two WWTPs, three small domestic wastewater discharges, and two groundwater remediation sites.

Significant Aquatic Endangered Species Habitats (SAESH) are designated by North Carolina Wildlife Resources Commission (WRC) to enhance planning, siting, and impact analysis for areas that are determined to be critical due to the presence of endangered or threatened aquatic species populations. SAESHs have been designated for three named streams in the Union County water service area and numerous UTs thereto. The designated streams are Goose Creek, Duck Creek, and Waxhaw Creek and UTs to these three streams.

No wild and scenic rivers are listed in the YRWSP project area or Union County water service area. There are no areas designated as fish nursery areas or anadromous fish spawning areas in the vicinity of the project and water service areas. No ORWs or High Quality Waters (HQW) are listed in the project and water service areas.

4.2. Aquatic and Wildlife Habitat and Resources

Federal law, under the provisions of Section 7 of the Endangered Species Act (ESA) of 1973, as amended, requires that any action likely to adversely affect a federally protected species be subject to review by USFWS. Federal species of concern are not protected under the ESA. Species not afforded protection under the ESA may receive additional protection under separate federal laws.

The YRWSP project area is located in the portions of Stanly, and Union Counties, North Carolina with Anson County, North Carolina located downstream of the proposed project. The USFWS lists of federally protected species were updated July 14, 2015 for Anson County, April 2, 2015 for Mecklenburg and Stanly counties, March 25, 2015 for Union County, and February 18, 2015 for Lancaster County. As state-listed species are not afforded legal protection, species that are listed by the state agencies only are not discussed further herein. Each species included on the USFWS Endangered Species, Threatened Species, Federal Species of Concern, and Candidate Species list and their state and federal status are provided in Table 4-2.

Aquatic habitat for rare, threatened, and endangered species is provided by the source waterbody and by streams traversed by the pipe corridor associated with the Preferred Alternative. Within the source waterbody, habitat is provided for four FSCs, three of which are designated as endangered by the state. The four species include American eel (no state designation), yellow lampmussel, Savannah lilliput, and Carolina creekshell. Two additional FSCs may be supported by habitat available in streams along the pipe corridor. These two species are the Carolina darter (state Special Concern species) and brook floater (no state designation).

Table 4-2 Aquatic Species Identified Within and Downstream of the Project Area by USFWS for Anson, Stanly and Union Counties, North Carolina

Scientific Name	Common Name	State Status	Federal Status	County of Occurrence
Vertebrates				
Acipenser brevirostrum	Shortnose sturgeon	E	E	A
Acipenser oxyrinchus oxyrinchus	Atlantic sturgeon	-	E	A
Anguilla rostrata	American eel	-	FSC	A, S, U
Etheostoma collis collis	Carolina darter	SC	FSC	A, S, U
Moxostoma robustum	Robust redhorse	E	FSC	A, S [1, 4], U [1, 4]
Moxostoma sp. 2	Carolina redhorse	-	FSC	A, S
Invertebrates				
Alasmidonta varicosa	Brook floater	-	FSC	A, S
Fusconaia masoni	Atlantic pigtoe	E	FSC	U
Lampsilis cariosa	Yellow lampmussel	E	FSC	A, S [4], U
Lasmigona decorata	Carolina heelsplitter	E	E	U
Toxolasma pullus	Savannah lilliput	E	FSC	S [4], U
Villosa vaughaniana	Carolina creekshell	E	FSC	A, S, U

Key to County of Occurrence:
A – Anson County, NC
S – Stanly County, NC
U – Union County, NC

Key to Federal Status:
E– Endangered. A taxon "in danger of extinction throughout all or a significant portion of its range."
T – Threatened. A taxon likely to become endangered within the foreseeable future throughout all or a significant portion of its range.
C – Candidate. A taxon under consideration for official listing for which there is sufficient information to support listing.
FSC – Federal species of concern. A species under consideration for listing, for which there is insufficient information to support listing.
BGPA – Bald and Golden Eagle Protection Act. The bald eagle was de-listed from the Federal List of Threatened and Endangered wildlife, and the primary law protecting the bald eagle became the BGPA.
[1] – Historic: The species was last observed in the county more than 50 years ago.
[2] – Probable/Potential: The species is considered likely to occur in this county based on the proximity of known records (in adjacent counties), the presence of potentially suitable habitat, or both.
[3] – Obscure: The date and/or location of observation is uncertain.

Key to State Status:

E – Endangered: "Any species or higher taxon of plant whose continued existence as a viable component of the State's flora is determined to be in jeopardy" (GS 19B 106:202.12).

T – Threatened: "Any resident species of plant which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (GS 19B 106:202.12).

SC – Special Concern: Any species of plant in North Carolina which requires monitoring but which may be collected and sold under regulations adopted under the provisions of the Plant Protection and Conservation Act (GS 19B 106:202.12).

SR – Significantly Rare: Species which are rare in North Carolina, generally with 1-100 populations in the state, frequently substantially reduced in numbers by habitat destruction (and sometimes also by direct exploitation or disease).

-L – Limited: The range of the species is limited to North Carolina and adjacent state (endemic or near endemic). These are species, which may have 20-50 populations in North Carolina, but fewer than 100 populations rangewide. The preponderance of their distribution is in North Carolina, and their fate depends largely on conservation here.

-T – Throughout: These species are rare throughout their ranges (fewer than 100 populations total).

[4] – Species is listed for the county by the state only. USFWS does not include the species on its list for the county.

[5] – Historic: Either the element has not been found in recent surveys in the region; or it has not been surveyed recently enough to be confident they are still present; or the occurrence is thought to be destroyed.

4.2.1. Vertebrates

Shortnose sturgeon *(Acipenser brevirostrum)*

The shortnose sturgeon, a member of the family Acipenseridae, is a small species of sturgeon and seldom exceeds 3.3 feet in length. Shortnose sturgeon have an elongated, flattened body and a subterminal mouth with barbells, which are suited to their bottom feeding and generally benthic existence. The shortnose sturgeon is found sporadically in coastal rivers along the East Coast from Canada to Florida. These are anadromous fish; however, as the adults seldom travel from their natal river and associated estuary, each river's population is genetically distinct. The preferred habitat of the shortnose sturgeon is deep pools with soft substrates and vegetated bottoms. The shortnose sturgeon spawn in fast-moving, freshwater, riverine reaches with gravel bottoms. Current threats to habitat are from discharges, dredging, or disposal of materials into rivers, or related development activities involving estuarine and riverine mudflats. Shortnose sturgeon occurs in most major river systems along the eastern seaboard of the United States. However, data are lacking for the rivers of North Carolina (NMFS and USFWS, 1998).

Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*)

Atlantic sturgeon is an estuarine-dependent fish that can reach a length of 14 feet and weight of 800 pounds. Their coloration is bluish-black to olive brown dorsally, paler sides, and a white belly. Dermal scutes are arranged in five major rows. Atlantic sturgeon differ from shortnose sturgeon in larger body, smaller mouth, different mouth shape, and scutes. Atlantic sturgeon are benthic feeders, generally consuming crustaceans, worms, and mollusks. The fish are anadromous, spawning in freshwaters and migrating to estuarine or marine waters for the remainder of the year. The fish will travel from their natal rivers. Atlantic sturgeon generally inhabit estuarine or nearshore marine waters not exceeding 165 feet in depth, preferring gravel and sand substrates.

American eel (*Anguilla rostrata*)

The American eel has an elongated, snakelike body with a small, pointed head. The American eel has no pelvic fins, but has one long dorsal fin that extends more than half of the body. The dorsal fin is continuous with the caudal and anal fin. Coloration varies with age and ranges from yellow to olive-brown during the adult form. The adult males are dark brown and gray dorsally, with a silver to white ventral side. Adults reach lengths up to 5 feet (Page & Burr, 1991). The American eel is a catadromous species that spawn in the Atlantic Ocean and ascend stream and rivers in North and South America. The American eel is found in the Atlantic Ocean, Great Lakes, Mississippi River, the Gulf Basin, and south to South America. American eel lives in freshwater as an adult, usually in larger rivers or lakes, primarily swimming near the bottom in search of food. American eel hunts mainly at night and resides in crevices or other shelter to avoid light during the day, and often buries in substrate consisting of mud, sand, or gravel (Landau, 1992).

Carolina darter (*Etheostoma collis collis*)

The Carolina darter is a small fish that grows to only 2½ inches in length and is endemic to the Piedmont of Virginia and the Carolinas. It is typically found in pools and very slow runs of small upland creeks and rivulets. Habitats are often against the banks or in backwater areas over beds of sand, mud, or rubble substrate covered by silt or detritus. It forages on microcrustaceans and small insect larvae. Spawning occurs in early spring and peaks at the end of March. The fish inhabits small streams from the Roanoke River basin in Virginia to the Santee River system in South Carolina.

Robust redhorse (*Moxostoma robustum*)

The robust redhorse is a 10- to 19-inch long fish, weighing up to 10 pounds with a stout body and thick lips. The caudal and dorsal fins are red or slate-colored, and other fins are cream or yellow to red. Preferred habitat for this fish is medium to large creeks and rivers, usually in deep and fast water, over gravel, rock, and boulders. Clean, silt-free, gravel beds in shallow waters are required for breeding, which occurs during May. The name *Moxostoma robustum* has been misapplied in the past to the smallfin redhorse, which is now identified as the brassy jumprock in the genus *Scartomyzon*. Small populations (one or two fishes) of the true robust redhorse have been found in the Pee Dee River in North Carolina and the Savannah River downstream of Augusta, Georgia. A large population, and potentially the only breeding population, of the robust redhorse is found in the Oconee River south of Milledgeville, Georgia.

Carolina redhorse (*Moxostoma* sp. 2)

The Carolina redhorse is a species of freshwater ray-finned fish in the Catostomidae family. Species within the Catostomidae family have mouths located on the underside of the head, thick fleshy distensible lips, and paired fins attached low on the body (Rohde, Arndt, Lindquist, & Parnell, 1994). The Carolina redhorse is found in medium sized rivers with moderate gradient and prefers deep pool areas along shorelines that contain woody debris. The Carolina redhorse is only known to be present in the Pee Dee and Cape Fear River basins.

4.2.2. Invertebrates

Brook floater (*Alasmidonta varicosa*)

The brook floater is a freshwater mussel that has a kidney-shaped shell, an abruptly curved anterior margin, and a straight to slightly concave ventral margin. The shell of the brook floater is firm but not thick and contains numerous short, low corrugations or ridges on the posterior slope that tend to be oriented radially. Adult brook floaters are essentially sessile, although passive movement downstream may occur. The brook floater typically occurs in riffles and rapids of creeks and small rivers among rock in gravel substrates and in sandy shoals.

Atlantic pigtoe (*Fusconaia masoni*)

The Atlantic pigtoe is a freshwater mussel with a shell that reaches a length of 2.3 inches. The mussel has a medium, rhomboidal shaped shell that has a distinctive, angular posterior ridge. The periostracum is yellowish brown to greenish brown, and the nacre color ranges from iridescent blue or white to salmon. The adults are essentially sessile. Some passive movement downstream may occur. The Atlantic pigtoe inhabits relatively fast waters with high quality riverine/large creek habitat. The Atlantic pigtoe is typically found in headwater or rural watersheds in sand or gravel substrates below riffles.

Yellow lampmussel (*Lampsilis cariosa*)

The yellow lampmussel is a bright yellow, medium-sized freshwater mussel with an inflated shell and smooth periostracum with rays that are restricted to the posterior slope, if present. The shell of the yellow lampmussel is heavy with well-developed dentition. The adults of the yellow lampmussel are essentially sessile, although some passive movement downstream may occur. The yellow lampmussel is typically found in medium to large streams and rivers in areas with good current and in areas underlain by sand, silt, cobble, and gravel.

Carolina heelsplitter (*Lasmigona decorata*)

The Carolina heelsplitter is a relatively large, freshwater mussel endemic to several river drainages in North and South Carolina. The shells are ovate to trapezoidal in shape, up to 4½ inches in length and 1½ inches in width. The outer surface is greenish brown to dark brown with faint darker rays. The interior nacre is pearly to bluish white, grading to orange or orange mottled in the area of the umbo. The species is reported to inhabit small to large streams and rivers. They are usually found near stable, well-shaded stream banks in muddy sand, muddy gravel, or mixed sand and gravel. The current range is a very fragmented, relict distribution within the known historic range. Historically, the range included the Catawba and Pee Dee systems in North Carolina, and the Pee Dee, Savannah and possibly the Saluda River systems in South Carolina. Only four small populations are currently known to exist: two in Union County, North Carolina and two in South Carolina.

Within the project study area, one population has been recently documented by USFWS. The population is located within Goose Creek and Duck Creek, which are traversed by one project alternative. The Carolina Heelsplitter (Lasmigona decorata) 5-Year Review: Summary and Evaluation 2012 (USFWS) listed the Goose Creek/Duck Creek population as consisting of 10 to 17 individuals based on a 2011 survey conducted in these streams. The population was documented

as declining based on the 2011 survey results. Critical habitat has been designated for the Carolina heelsplitter within the potential construction area for the proposed project. The critical habitat includes Goose Creek from the NC Highway 218 bridge to its confluence with Rocky River and Duck Creek from the Mecklenburg/Union County line to its confluence with Goose Creek. The alignment for Alternative 7 follows NC Highway 218, coinciding with the upstream most extent of the Goose Creek critical habitat. Other project alternatives are not expected to impact this critical habitat area.

Savannah lilliput (*Toxolasma pullus*)

The savannah lilliput is a small freshwater mussel with an oval or elliptical shell and a double posterior ridge. The ridge is usually angular but may be broadly rounded. Females have a broader, more truncated posterior end than males of the species. The outer surface of the shell is usually blackish but may be brownish, greenish, or olive with very fine, obscure green rays. The inner surface of the shell is bluish white with pink to purplish iridescence at the posterior end. This mussel has been recorded from the Neuse River in North Carolina south to the Altamaha River in Georgia. The savannah lilliput is found in shallow water along the banks of rivers, streams, ponds, and lakes. The savannah lilliput moves up and down the banks as the water levels fluctuate.

Carolina creekshell (*Villosa vaughaniana*)

The Carolina creekshell is a freshwater mussel for which the shell morphology can be used to determine gender. The male shell is elliptical and approximately 2.4 inches in length and the female shell is ovate and approximately 2.2 inches in length. Male Carolina creekshells have a gently curved ventral margin, and the female has a distinct posterior basal swelling and a straight ventral margin. The outer shell of the Carolina creekshell is moderately shiny and greenish yellow to dark brownish yellow with numerous continuous green rays. The inner surface of the shell of the Carolina creekshell is shiny iridescent white or bluish white. The anterior margin of the shell is rounded in both sexes, and the posterior end is pointed about two-thirds of the way from the ventral margin. The Carolina creekshell is endemic to North and South Carolina, is found in mud or sand near stream banks, and is occasionally found in gravelly sand in the main channel of streams and medium rivers.

5.0 Water Demand Management and Conservation

5.1. Water Shortage Response Plan(s)

5.1.1. Union County Water Use Ordinance

In 1992, Union County adopted a Water Conservation Ordinance that outlined conservation measures required when water demand by customers connected to the Union County water system reached a point where continued or increased demand equaled or exceeded the treatment and/or transmission capacity of the system or portions, thereof. This ordinance was revised and amended over the years, including 2002, 2007, 2008, and 2009.

Union County remained in a Stage 2 Water Shortage Condition, as defined by the Water Conservation Ordinance, from 2009 until this Ordinance's revision in early 2015. During this time, Union County imposed mandatory water use restrictions limiting lawn irrigation to no more than two days per week per customer. Such restrictions were imposed by Union County, while not in a drought, primarily due to capacity concerns to meet the system's water demand on peak days. Such restrictions were considered to be very stringent during non-drought periods and proved successful in reducing the County's peak day water demands during their implementation.

Building upon these restrictions, Union County developed a new Water Use Ordinance (Ordinance) and an accompanying Water Shortage Response Plan to replace and improve on the existing Water Conservation Ordinance, while setting more stringent baseline water restrictions, as compared to the previous Water Use Ordinance. These new documents were approved by the Union County Board of Commissioners and officially adopted on May 4, 2015.

When water demand results in a condition whereby customers cannot be supplied with adequate water to protect their health, safety, or property, then the demand must be substantially curtailed to relieve the water shortage. This Ordinance applies only to potable water supplied through the Union County water system, and not to reuse or reclaimed water. In addition to the water conservation measures outlined in the Ordinance, the County has the authority to establish a rate structure that increases the cost of potable water commensurate with the escalation of water shortage conditions.

The County's Water Use Ordinance is applicable during times of drought, where raw water supply is at risk, and when there are other capacity limitations within the County's water treatment and distribution system due to high demands or system emergencies. The Ordinance has five levels of water shortage conditions, including Stage 0, 1, 2, 3 and 4, which are issued with increasing severity according to the applicable water shortage. During times of drought, Stages for water shortage conditions are defined by set triggers for the Low Inflow Protocol (see Section 5.1.2) and outlined in the County's Water Shortage Response Plan. During times of other capacity limitations, water shortage conditions are defined by triggers for system demand as a percent of capacity, as outlined in the County's Water Shortage Response Plan. Copies of

the County's Water Use Ordinance and accompanying Water Shortage Response Plan may be found in Appendix B.

Stage 0 is a newly defined stage included in the Water Use Ordinance and limits customer use of spray irrigation systems to a maximum of 3 days per week at all times. Additionally, customers are encouraged to adhere to a list of recommended voluntary water conservation measures.

In a Stage 1 Water Shortage Condition, customers are encouraged to limit spray irrigation to a maximum of 2 days per week and voluntarily conserve water through additional recommended conservation measures. Also, in a Stage 1 Water Shortage Condition, the transport of water outside of Union County is unlawful, with certain listed exclusions.

In a Stage 2 Water Shortage Condition, mandatory limits on spray irrigation are increased to allow each customer a maximum of only 2 days per week. Some other outdoor water uses are also prohibited, such as filling new swimming pools and residential vehicle washing, while others are encouraged to be limited, including flushing and hydrant testing or the use of water for dust control.

In the event of a Stage 3 Water Shortage Condition and in addition to the voluntary and mandatory guidelines already in effect, each customer would be permitted to use spray irrigation a maximum of 1 day per week. It would also be unlawful to wash public buildings, sidewalks and streets, use water for construction dust control, conduct non-essential water system flushing/hydrant testing, fill any swimming pools/ponds or serve drinking water in food establishments except upon request.

If a Stage 4 Water Shortage Condition is declared, in addition to the restrictions set forth under other stages, water use is further restricted to make it unlawful to use water outside a structure for any purpose other than responding to a fire emergency. Certain exclusions to the restrictions for each stage exist.

It is important to note that the Water Use Ordinance includes provisions of the Low Inflow Protocols (LIP) as described in the proceeding sections, but is generally more restrictive than the LIPs, particularly with regards to baseline water use restrictions when not in drought. The purpose of this Ordinance is two-fold in addressing potential water shortages related to capacity limitations and drought.

5.1.2. Low Inflow Protocol for the Catawba-Wateree Hydroelectric Project

In addition to the Water Use Ordinance, Union County is a party to the 2006 Comprehensive Relicensing Agreement with Duke Energy and the Federal Energy Regulatory Commission (FERC) which requires adherence to the Low Inflow Protocol (LIP) for the Catawba-Wateree Hydroelectric Project by owners of large public water supply intakes located in the reservoirs and main stem of the Catawba River. As joint owner of the Catawba River Water Treatment Plant in Lancaster County, South Carolina, Union County must abide by the restrictions set forth in the LIP during drought conditions. The purpose of this LIP is to establish procedures for reductions in water use during periods of low inflow to the Catawba-Wateree Hydroelectric

Project. The LIP was developed on the basis that all parties with interests in water quantity will share the responsibility to establish priorities and to conserve the limited water supply (Duke Energy, 2015).

The following table summarizes the required water use reduction goals applicable to Union County, based on water use restrictions for customers, as defined by the LIP for the Catawba-Wateree Hydroelectric Project. Increasing LIP stages correspond to worsening drought conditions as outlined in the LIP.

Table 5-1 Catawba-Wateree Low Inflow Protocol Water Use Reduction Requirements by LIP Stage

LIP Stage	Water Use Reduction Requirement
Normal	Normal Conditions; no water use reduction required
Stage 0	Low Inflow Watch; no water use reduction required
Stage 1	Request voluntary water use restrictions in accordance with Water Use Ordinance; water use reduction goal of 3-5% from the amount that would otherwise be expected.
Stage 2	Require mandatory water use restrictions in accordance with Water Use Ordinance; water use reduction goal of 5-10% from the amount that would otherwise be expected.
Stage 3	Require increased mandatory water use restrictions in accordance with Water Use Ordinance; water use reduction goal of 10-20% from the amount that would otherwise be expected.
Stage 4	Require emergency water use restrictions in accordance with Water Use Ordinance and restrict all outdoor water use; water use reduction goal of 20-30% from the amount that would otherwise be expected.

5.1.3. Low Inflow Protocol for the Yadkin & Yadkin-Pee Dee River Hydroelectric Projects

The fundamental goal of this LIP, developed as part of the 2007 Relicensing Settlement Agreement for the Yadkin Hydroelectric Project, is to take staged actions in the Yadkin-Pee Dee River Basin needed to delay the point at which available water storage in the Yadkin Hydroelectric Project (operated by Alcoa Power Generating Inc. (APGI), FERC No. 2197) and the Yadkin-Pee Dee Hydroelectric Project (operated by Duke Energy Progress, FERC No. 2206) reservoirs is fully depleted while maintaining downstream flows. This LIP is intended to provide additional time to increase the probability that precipitation will restore streamflow and reservoir water elevations to normal ranges. The amount of additional time that is gained during implementation of this LIP depends on the diagnostic accuracy of the trigger points, the amount of regulatory flexibility available to operate the projects, and the effectiveness of the projects' operators and the water users in working together to implement required actions and achieve significant water use reductions. It is assumed that water users in the Yadkin-Pee Dee River Basin not subject to the LIP must comply with all applicable State and local drought response requirements (Duke Energy, 2014).

If granted an IBT certificate to transfer water from one of the reservoirs of the Yadkin-Pee Dee River Basin governed by the LIP, Union County would also be required to abide by such LIP requirements. Any designated owner or joint-owner of raw water intake and pumping facilities which withdraw from storage in one of the hydroelectric projects' reservoirs and have an instantaneous withdrawal capacity of one million gallons per day or more are required to abide

by the LIP requirements, as stipulated in the LIP for the Yadkin and Yadkin-Pee Dee Hydroelectric Project. The following table summarizes the required water use reduction goals which would be applicable to Union County, based on water use restrictions for customers, as defined by the LIP for the Yadkin and Yadkin-Pee Dee Hydroelectric Projects. Increasing LIP stages correspond to worsening drought conditions as outlined in the LIP.

Table 5-2 Yadkin-Pee Dee Low Inflow Protocol Water Use Reduction Requirements by LIP Stage

LIP Stage	Water Use Reduction Requirement
Normal	Normal Conditions; no water use reduction required
Stage 0	Low Inflow Watch; no water use reduction required
Stage 1	Request voluntary water use restrictions in accordance with Water Use Ordinance; water use reduction goal approximately 5% from the amount that would otherwise be expected.
Stage 2	Require mandatory water use restrictions in accordance with Water Use Ordinance; water use reduction goal of approximately 10% from the amount that would otherwise be expected.
Stage 3	Require emergency water use restrictions in accordance with Water Use Ordinance; water use reduction goal of approximately 20% from the amount that would otherwise be expected.
Stage 4	Coordinate with the Yadkin Drought Management Advisory Group (YAD-DMAG) and DWR to determine if additional water use reduction measures can be implemented.

5.2. Water Use Reduction Measures

These three existing water conservation and demand management ordinances and protocols, all relatively recently adopted and applicable to Union County, require stringent water use reduction measures. For example, the County has recently revised their Water Conservation Ordinance to a new Water Use Ordinance that permanently limits outdoor landscape watering and lawn irrigation to three (3) days per week during normal climate conditions in an effort to maintain the lower peak day demands that the County has experienced following the 2006-2008 drought. Upon its adoption by the County Board of Commissioners, such baseline water use restrictions are now some of the most stringent in North Carolina. Based on an analysis of historical water usage, the Water Use Ordinance exceeds the reduction goals included in the Catawba-Wateree LIP.

If granted an IBT certificate for water transfers from the Yadkin River IBT Basin to the Rocky River IBT Basin of the Yadkin River Basin, Union County would be subject to two LIPs: the Catawba-Wateree LIP and the Yadkin-Pee Dee LIP. The triggers for varying stages of drought differ somewhat for each LIP. However, as Union County will be subject to both LIPs, its Water Use Ordinance and Water Shortage Response Plan will defer to the most stringent drought stage in effect at the time, once the YRWSP is operational. For example, if the Yadkin-Pee Dee LIP is in Stage 2, but at the same time, the Catawba-Wateree LIP is in Stage 1, Union County will recognize Stage 2 conditions throughout the County as part of its Water Use Ordinance and Water Shortage Response Plan.

While very similar in their water use reduction goals for corresponding stages of drought, there are several slight differences. Whereas the Catawba-Wateree LIP provides a target range for

water use reductions from Stages 1 through 4, the Yadkin-Pee Dee LIP provides a set reduction goal for each Stage, which is generally the upper bound of the reduction goal ranges outlined in the Catawba-Wateree LIP.

Since the Union County water system serves customers within both the Catawba and Yadkin River Basins, it is committed to promoting a consistent message related to water use reduction measures during times of drought in order to comply with both the Catawba-Wateree and Yadkin-Pee Dee LIPs. Such coordination of messages throughout the water system will also be important to effectively link both LIPs with the County's Water Use Ordinance. As such, the water use reduction goals outlined in Table 5-3are recommended for the entirety of the Union County water system, and represent the upper threshold of both LIPs by stage.

Table 5-3 Proposed Union County Low Inflow Protocol Water Use Reduction Goals by LIP Stage

LIP Stage	Union County Water Shortage Condition	Water Use Reduction Type	Water Use Reduction Goal
Normal	-	None	N/A
Stage 0	-	None	N/A
Stage 1	Stage 1	Voluntary	5%
Stage 2	Stage 2	Mandatory	10%
Stage 3	Stage 3	Emergency Mandatory	20%
Stage 4	Stage 4	Emergency Mandatory	>20%

While such reduction goals are not expected to reduce the overall projected water demand for Union County's Yadkin River Water Supply Project and subsequent IBT, these conservation measures are intended to help reduce maximum day and maximum month peaking factors that may be experienced during future droughts, and avoid the high peaking factors that were previously experienced by the County during the 2006-2009 drought. Adherence to the LIPs and County Ordinance will help ensure the average annual day to max day peaking factor used as the basis of projections for the Yadkin River Water Supply Project remain at or below 1.7. Additionally, these goals seek to promote a collaborative environment between Union County and other water users within both the Catawba and Yadkin River Basins during periods of low inflow to both basins.

The Union County water demand projections previously discussed in Section 3.0 have been based upon historical water use data and peaking factors since the 2006-2008 drought. As such, they are developed upon data generated while the County maintained mandatory water use restrictions under the Stage 2 Water Shortage Condition. Inherently, the effect of water conservation and demand management is already built into the water demand projections established as part of the YRWSP.

5.3. Water Stewardship Efforts

5.3.1. Water Quantity Stewardship

In addition to the County's Water Use Ordinance and use of the LIP for water conservation and demand management during water shortage conditions, Union County has also implemented a

series of programs focused on water stewardship with a primary focus on the County's commitment to water conservation and efficiency. Examples of these County initiatives include:

- Tiered billing rates (inclining block rate structure)
- Water use restrictions through the Water Use Ordinance
- AWWA M36 water audit program
- Meter replacement and testing program
- Leak detection program
- Public education and awareness program
- Involvement in basin-wide regional water supply planning initiatives

Tiered Billing Rates

Union County utilizes what is known as an "inclining block rate structure" in its gallonage charge for billing of water and wastewater customers. In this structure, for each increasing "block" of consumption the customer is charged at a higher rate, so the more water used there is a higher rate paid for that water. Union County's rate consists of five blocks, or tiers, of water consumption. Tier one is for the first 3,000 gallons/month of usage, Tier two, is for the next 4,000 gallons of usage (3,001 to 7,000 gallons), Tier Three for the next 3,000 gallons (7,001 to 10,000 gallons), Tier Four for the next 5,000 gallons (10,001 to 15,000 gallons) and Tier Five, for all consumption above 15,000 gallons, per month (Union County, 2016).

This inclining rate structure is designed to promote water conservation and to also have those customers that use the most water pay their proportionate share of the cost of providing the infrastructure necessary to meet these higher levels of demand. The County's tiered rates apply to individually-metered residential customers including conventional single-family homes and apartments, condominiums and townhouse that have individually metered residential units. Sewer usage is not separately metered; it is based upon customer water consumption. Residential sewer usage is capped at 12,000 gallons/month (Union County, 2016).

Water Use Ordinance and Water Shortage Response Plan

As detailed in Section 5.1.1, on May 4, 2015, the Union County Board of County Commissioners approved a new Water Use Ordinance and Water Shortage Response Plan. The Water Use Ordinance maintains and protects the public health, safety and welfare by establishing long-term demand management strategies to effectively manage a limited resource by requiring efficient and responsible use of water within Union County. The Ordinance also establishes measurements and procedures for reducing potable water use during times of water shortage resulting from drought, capacity limitations, and system emergencies.

AWWA M36 Water Audit Program

Union County recently began a process to conduct annual water system audits according to the AWWA M36 Water Audit Method as a means to identify and potentially reduce "Non-revenue" Water volumes, particularly water losses. Since implemented in fiscal year 2014, the intent of these routine water audits is to quantify the components of County's "Revenue Water" and "Non-Revenue Water" and identify ways to reduce apparent and real losses.

According to AWWA, “Non-Revenue Water” reflects the distributed volume of water that is not reflected in customer billings. Non-revenue Water, however, is specifically defined as the sum of Unbilled Authorized Consumption (water for firefighting, flushing, etc.) plus Apparent Losses (customer meter inaccuracies, unauthorized consumption and systematic data handling errors) plus Real Losses (system leakage and storage tank overflows). In this way, the term "Non-revenue Water” includes the sum of the varied and disparate types of losses and authorized unbilled consumption typically occurring in water utilities (AWWA, 2012).

The goal of Union County’s water audit program is to identify the most effective water loss management practices, from options such as resolving potential customer billing and metering errors and reducing unauthorized water use, to potentially more complex measures such as system leak identification and repair, where the audit indicates this to be a beneficial water loss management solution.

As reflected in results from Union County’s first (FY2014) water audit indicated that, for the July, 2013 to June, 2014 time period, the County’s revenue water (billed authorized consumption) represented 85.1% of the total Union County water supply. Non-revenue water (unbilled authorized consumption, apparent losses, and real losses) represented 14.9% of the Union County water supply. Of this non-revenue water, unbilled authorized consumption (unbilled metered consumption and unbilled unmetered consumption) equaled 1.3% and water losses (apparent and real) equaled 13.6% of the Union County water supply. Of the water losses, apparent losses (unauthorized consumption, customer metering inaccuracies and systematic data handling errors) represented 1% and real losses (leakage on mains, tanks or service connections) represented 12.6% of the Union County Water Supply.

Data is currently being evaluated as part of the audit for FY2015, which will be completed later in 2016. With additional years of audit data, it will be possible for Union County to identify trends and sources of water losses and implement strategies to effectively reduce both real and apparent losses to the lower target levels previously identified in Section 3.3.1.

AWWA Free Water Audit Software: Water Balance

WAS v5.0

Water Audit Report for:	Union County (01-90-413)
Reporting Year:	2014 7/2013 - 6/2014
Data Validity Score:	56

Own Sources (Adjusted for known errors) 3,534.207	Water Exported 116.760	Billed Water Exported			
		Authorized Consumption 3,601.957	Billed Authorized Consumption 3,549.831	Billed Metered Consumption (water exported is removed) 3,549.531	Revenue Water 3,549.831
				Billed Unmetered Consumption 0.300	
			Unbilled Authorized Consumption 52.126	Unbilled Metered Consumption 0.000	Non-Revenue Water (NRW) 620.252
				Unbilled Unmetered Consumption 52.126	
	Water Supplied 4,170.083	Water Losses 568.126	Apparent Losses 42.216	Unauthorized Consumption 10.425	
				Customer Metering Inaccuracies 22.917	
				Systematic Data Handling Errors 8.874	
Water Imported 752.636			Real Losses 525.910	Leakage on Transmission and/or Distribution Mains Not broken down	
				Leakage and Overflows at Utility's Storage Tanks Not broken down	
				Leakage on Service Connections Not broken down	

Illustration 5-1 Water Balance Results of Union County's First (FY2014) AWWA M36 Water Audit

Meter Testing and Replacement Program

Union County has received Board approval to initiate a large meter testing and replacement program, with the intent of identifying and replacing aging and/or malfunctioning water meters for its customers. The goal of this program is three-fold: to improve accuracy of its customer billing; to expedite the meter reading process; and to reduce apparent water loss rates resulting from metering errors. The initial large meter testing work is scheduled to be conducted before the end of FY16 and will include professional services in the field testing of water meters 2-inches or greater in size (6-inch max), documentation of all test results, and recommendations of repairs needed to restore meters to accuracy limits defined by the American Water Works Association. Results of this testing will then allow Union County to make necessary repairs to or replace malfunctioning meters.

Leak Detection Program

Union County is currently in the process of developing a leak detection program. Since the County is at an early stage of this development and has only performed an AWWA Water Audit on two years' worth of data, the County is currently gathering the baseline data to evaluate what percentage of its water loss is from real loss or apparent loss. Once the County has several years of additional water audit data, it will be possible to distinguish the overall water loss between apparent losses from data handling errors and meter inaccuracies and real losses due to system leakage. Once additional data is obtained from the audit program, it will be possible for Union County to determine if an effectively deployed leak detection program will significantly reduce real water losses and the most effective leak detection measures to employ.

Public Education and Awareness Program

Union County actively communicates with its customers informative brochures and inserts included in customer bills and through County website content. Theses public education and awareness measures raise awareness among Union County customers as to the value of water and the need for water use efficiency by providing information about measures to reduce water consumption through conservation techniques and County ordinances.

Information included in these public education and awareness publications typically includes reminders about Union County's Water Use Ordinance restrictions on outdoor spray irrigation to a maximum of three days per week during normal conditions and less days during drought conditions, along with the applicable irrigation schedule by customer billing cycle. Additionally, these publications include recommendations for ways customers can conserve water outdoors (e.g. drought-tolerant landscaping, water-wise irrigation techniques, etc.) and indoors (e.g. low-flow plumbing fixtures, laundry and dish washing techniques, etc.).

Basin-wide Regional Water Supply Planning

Union County is an active member of both the Catawba-Wateree Water Management Group (CWWMG) and the Yadkin-Pee Dee River Basin Association (YPDRBA) and is actively participating in planning for the potential formation of a Yadkin-Pee Dee Water Management Group.

Catawba-Wateree Water Management Group (CWWMG)

Incorporated in late 2007, this 501(c)(3) non-profit group came out of the three and one-half year stakeholder process associated with Duke Energy's re-licensing of the Catawba-Wateree Hydro Project, part of a Comprehensive Re-licensing Agreement (CRA) that defines how the basin will be managed for the next 40 to 50 years. The CWWMG has 19 members; one member representing each of the 18 public water utilities in North and South Carolina which operate large water intakes on either a reservoir in the Catawba-Wateree Hydroelectric Project or on the main stem of the river, and one member representing Duke Energy Carolinas, LLC (Duke Energy). CWWMG members meet regularly to formulate strategies and projects to help understand and address the basin's water challenges. The CWWMG exists to identify, fund, and manage projects that help extend and enhance the capacity of the Catawba-Wateree River to meet human water needs (water supply, power production, industry, agriculture, and commerce) while maintaining the ecological health of the waterway (CWWMG, 2016). The focus of this group is primarily on water supply issues.

Yadkin-Pee Dee River Basin Association (YRDRBA)

The Yadkin-Pee Dee River Basin Association is an advocacy group dedicated to preserving and improving water quality in the Yadkin-Pee Dee River and its tributaries so that they remain a viable water-supply source. To accomplish this, the association works to present a collective voice by pooling financial resources and expertise in a sustainable and cost-effective manner; engage members and stakeholders in activities that enhance and preserve water quality in the Yadkin-Pee Dee River Basin; collect and analyze information and develop, evaluate and implement strategies to reduce, control and manage pollutant discharge; and work in

cooperation with stakeholders to provide technical, management, regulatory and legal recommendations regarding the implementation of cost-effective strategies and appropriate effluent limitations on discharges into the Yadkin-Pee Dee River. The association was formed in 1998 to give wastewater dischargers in the basin a unified voice in dealing with state agencies that affect the basin and its waters. As such, membership is restricted to entities that hold permits to discharge treated wastewater into the Yadkin/Pee Dee River or its tributaries. Currently there are 29 members -- 25 public and four private. The focus of this group is primarily on water issues related to wastewater discharge (YRDRBA, 2016).

Yadkin-Pee Dee Water Management Group

Within the last year, the concept of developing another group within the Yadkin-Pee Dee River Basin, focused more directly on issues related to water supply, has been gaining traction among public water utilities throughout the basin. Initial planning meetings have been ongoing to establish such a group. Union County has been actively participating in these planning meetings.

5.3.2. Water Quality Stewardship – Programs and Ordinances

Existing local, state, and federal programs and ordinances are in place to mitigate the potential for direct and indirect impacts from the proposed IBT and associated construction activities, particularly with regards to water quality. Such ordinances, as detailed in the FEIS, pertain to stormwater, floodplain, riparian buffer, erosion and sedimentation control, wetland protection, open space and parks, water use, land use, historic preservation, tree preservation, endangered species protection, and regional transportation planning measures.

In late 2014, Union County adopted a new Unified Development Ordinance (UDO) (Union County, 2014) that serves to update its previous Land Use Ordinance. The latest version of the draft UDO document was adopted in October, 2014 with additional amendments approved in November, 2014. Included in the UDO are new riparian buffer regulations in the Twelve Mile Creek WRF service area and measures to protect and preserve existing communities of Schweinitz's Sunflower and their habitats.

Ten of the communities implement regulations that limit fill within the floodplain to the minimum level designated by FEMA. Three communities implement floodplain regulations that are more protective than FEMA minimum standards: unincorporated Union County, Lake Park, and Hemby Bridge. For two of these communities, Union County and Hemby Bridge, fill is not allowed within the floodplain except for essential services such as utilities and roadways. Lake Park allows fill in the floodplain as long as all living spaces are elevated three feet above the base flood elevation (BFE).

Union County and the Towns of Fairview, Hemby Bridge, Indian Trail, and Stallings all have portions of their jurisdictions located in the Goose Creek watershed. The Goose Creek watershed provides habitat for a federally listed endangered species, the Carolina heelsplitter (*Lasmigona decorata*). NCDEQ administers a site-specific water quality management plan for the Goose Creek watershed per 15A NCAC 02B .0600-.0609 for the maintenance and recovery of water quality in the watershed to sustain and protect the listed species. These regulations

include stormwater control requirements, a prohibition on new NPDES discharges in the watershed, and riparian buffers. The Goose Creek Management regulations were included in the analysis of mitigation measures for those jurisdictions located in the Goose Creek watershed.

5.4. Interbasin Transfer Compliance and Monitoring Plan

The proposed compliance and monitoring plan for the requested interbasin transfer certificate includes the following four elements, which are described in the sections below:

- Quarterly Reports
- Annual Reports
- Status Reports
- Drought Management Reporting and Coordination (reference Section 5.1)

The details of monitoring and compliance will be specified in a Compliance and Monitoring Plan approved by DWR.

5.4.1. Quarterly Reports

At the end of each quarter, Union County will calculate the daily IBT amounts for that quarter and provide this information to DWR in quarterly reports. The reports will be submitted to DWR within 30 days of the end of the month following the completion of each quarter. Union County will submit four quarterly reports to DWR each year.

5.4.2. Annual Reports

At the end of each calendar year, the monthly IBT reports will be summarized in an annual report to DWR. The annual report will also document compliance with conditions, if any, that the EMC includes in the IBT certificate.

5.4.3. Status Reports

At the end of each calendar year, if requested by DWR, Union County will provide status reports on specific measures or other activities discussed in the EIS or IBT petition. DWR will identify the specific measures/activities to be addressed.

5.4.4. Drought Management Reporting and Coordination

Drought management reporting and coordination will be in compliance with the provisions outlined in the LIPs, as discussed in Section 5.1, and in coordination with both the CW-DMAG and YAD-DMAG and DWR.

6.0 Water Supply and Interbasin Transfer Alternatives

6.1. Background

The Union County water and sanitary sewer service areas are located within the Catawba River Basin and the Rocky River IBT Basin of the Yadkin River Basin. While the County's service areas are within the Catawba and Yadkin River Basins, neither of the rivers' main stems flow through the County as indicated in Illustration 6-1. The Rocky River forms the northern border of the County, but is not currently classified by the State of North Carolina for water supply uses.

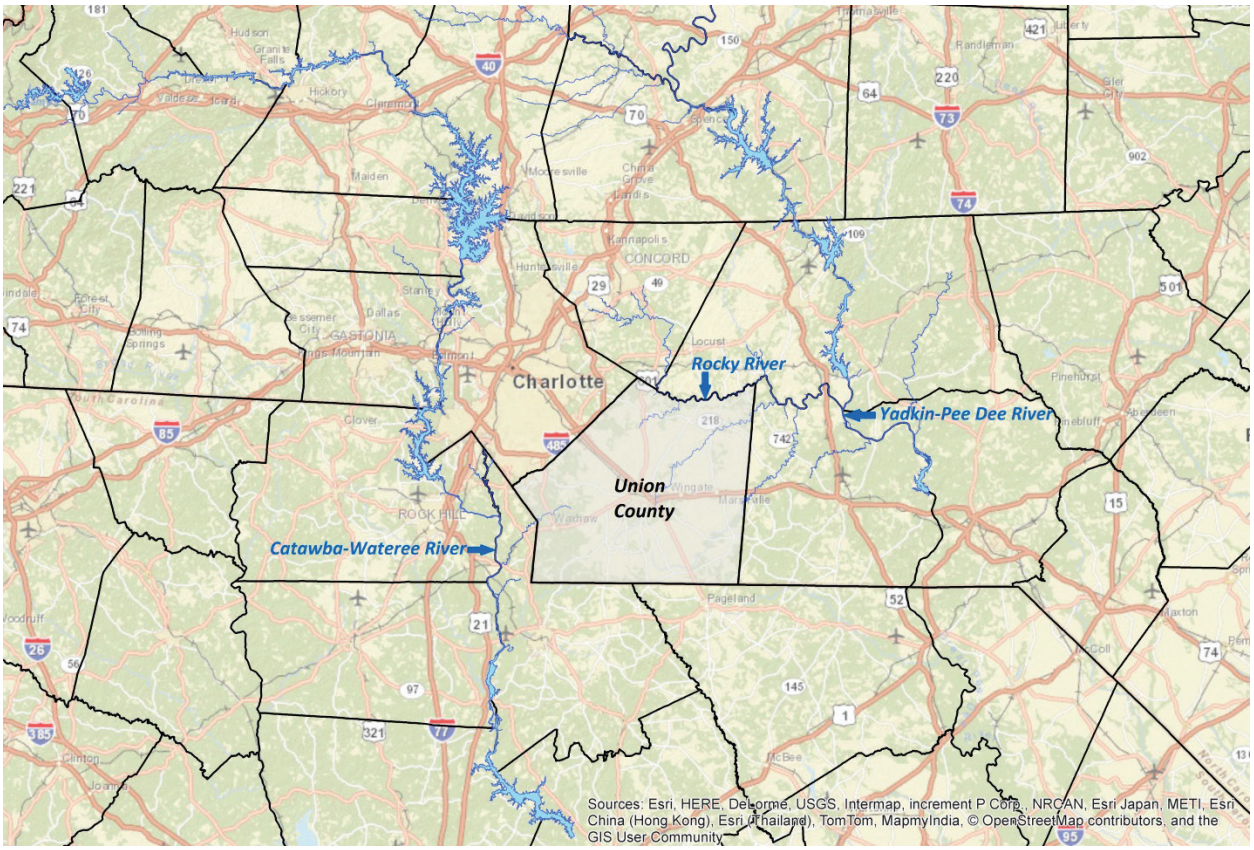

Illustration 6-1 Union County, North Carolina and Surrounding Major Rivers

Union County's location between the two major rivers (Yadkin-Pee Dee and Catawba), and federally regulated (through the Federal Energy Regulatory Commission (FERC)) surface water reservoirs along each river, logically make them the primary sources for potential future water supply within Union County. Illustration 6-2 depicts the FERC regulated reservoirs along the Yadkin-Pee Dee River, operated by Alcoa Power Generating Inc. (APGI) and Duke Energy Progress. Illustration 6-3 depicts the FERC regulated reservoirs along the Catawba River, operated by Duke Energy, Carolinas LLC.

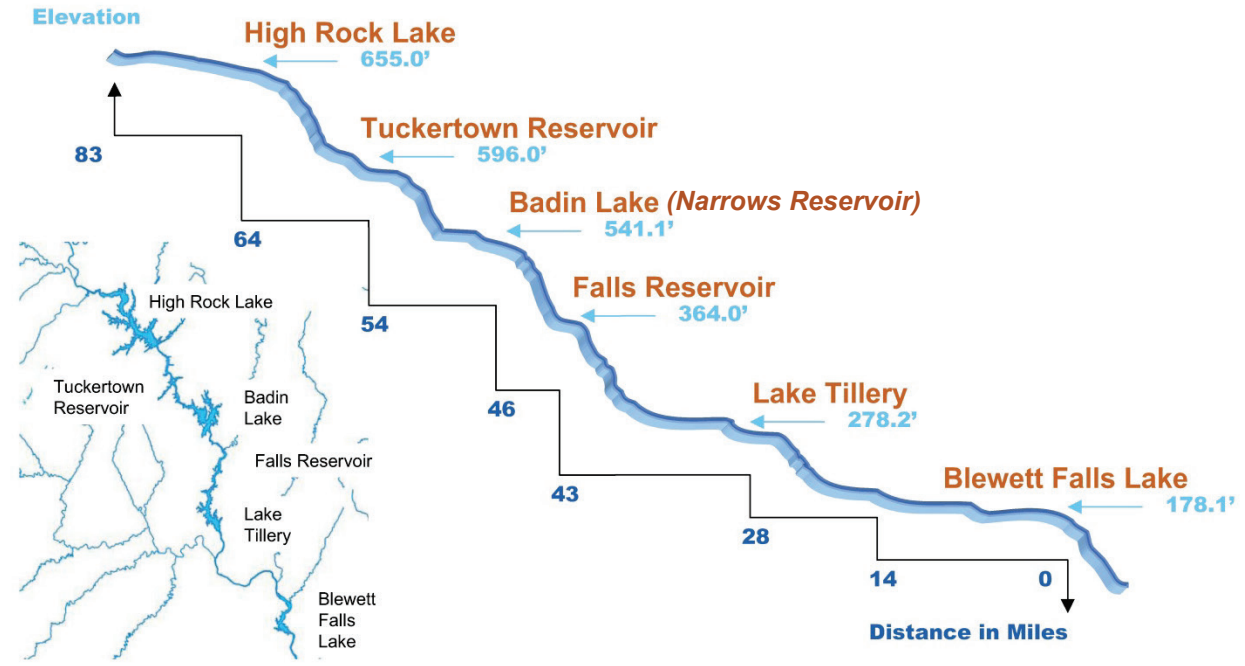

Illustration 6-2 Yadkin-Pee Dee River Basin Reservoirs (CH2MHill, 2006) (Note: W. Kerr Scott Reservoir not shown)

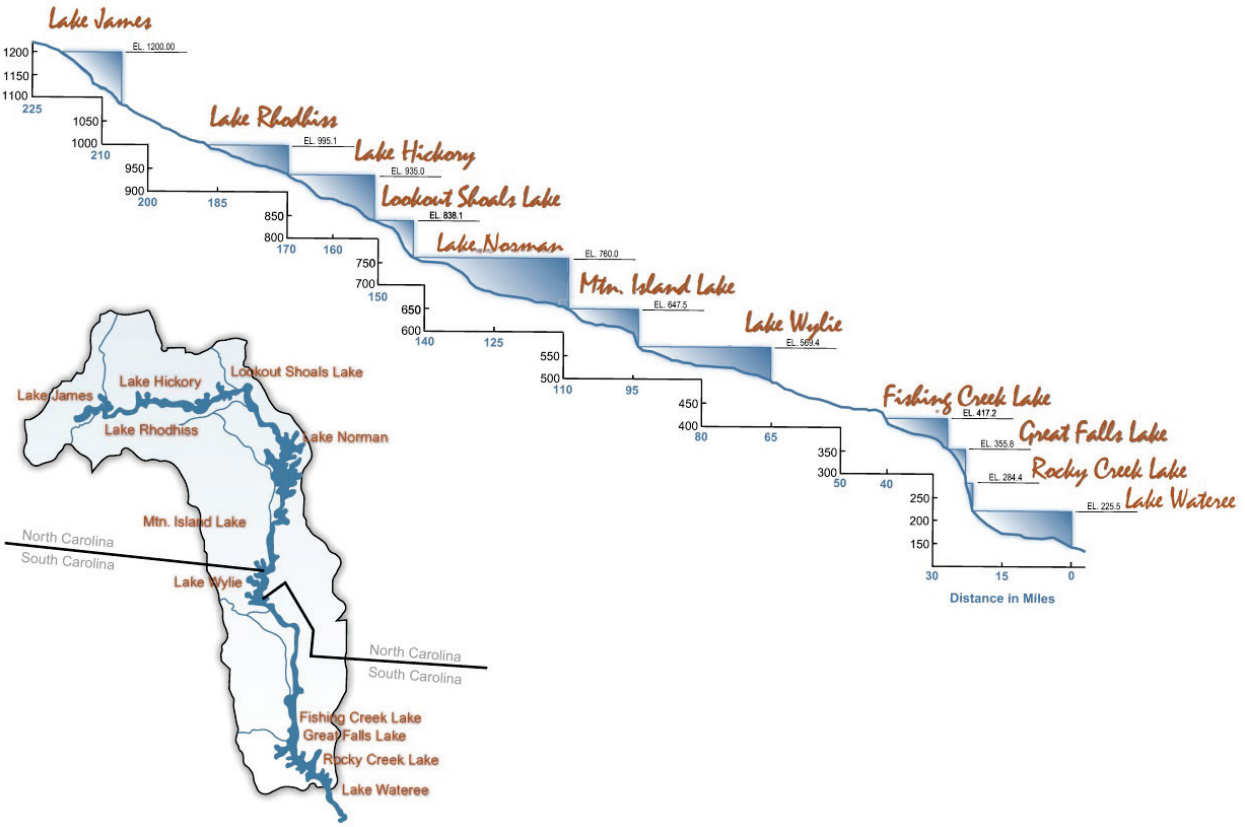

Illustration 6-3 Catawba-Wateree River Basin Reservoirs (CH2MHill, 2004)

As previously discussed and depicted in Illustration 1-2, Union County currently has two water service areas: the Catawba River Basin Service Area and the Yadkin River Basin Service Area. Union County is currently seeking to secure a reliable water supply to serve projected near-term and long-term future customer demand in its Yadkin River Basin Service Area within the Rocky River IBT Basin. Water transfers into the Rocky River IBT Basin from either the Yadkin River IBT Basin or from the Catawba River IBT Basin will necessitate an interbasin transfer certificate from the State of North Carolina.

Both the Yadkin-Pee Dee and Catawba Rivers are potential water supply sources to help eliminate the County's projected water supply deficit in its Yadkin River Basin Service Area (Rocky River IBT Basin). Both raw water and finished water alternatives have been identified to address the projected 23 mgd (based on maximum month daily demands) water supply shortfall in this service area by the year 2050. Alternatives for raw water would require raw water intake, pumping, transmission and treatment infrastructure. Alternatives for finished water would require infrastructure for finished water transmission and wholesale purchase agreements with regional water suppliers.

6.2. Alternatives Analysis

The general categories of alternatives for the Union County YRWSP include identifying water supplies in the receiving basin (Rocky River IBT Basin), identifying water supplies in the other neighboring basins (Yadkin River IBT Basin or Catawba River IBT Basin), managing water demand, and returning water to the source basin. These alternatives were selected to meet the requirements of the IBT rules (NCGS 143-215.22L) and consider comments received during the initial scoping process. Alternatives were screened, based on their ability to meet 2050 water supply needs, environmental considerations, and cost considerations.

Twelve (12) alternatives for Union County's Yadkin River Water Supply Project, including the No Action Alternative, were identified and evaluated within the FEIS. A total of eight (8) potential surface water alternatives were identified. Additional non-surface water alternatives were also identified as potential measures for minimizing the requested interbasin transfer, and are also explored within the FEIS. The surface water supply alternatives which have been evaluated and their relative locations are shown in Illustration 6-4.

The following Sections 6.2.1 and 6.2.2 include a summary of both Surface Water Supply and Interbasin Transfer Minimization alternatives evaluated as part of the FEIS. Table 6-1 and Table 6-2, which follow these alternative descriptions, provide a summary if temporary and permanent direct impacts and indirect impacts for the YRWSP alternatives and a conceptual cost opinion for YRWSP alternatives, respectively. As detailed in the FEIS, existing local, state, and federal programs and ordinances will mitigate the potential for direct and indirect impacts from the proposed action. Stormwater, floodplain, riparian buffer, erosion and sedimentation control, wetland protection, open space and parks, water use, land use, historic preservation, tree preservation, endangered species protection, and regional transportation planning measures are addressed by such programs and ordinances.

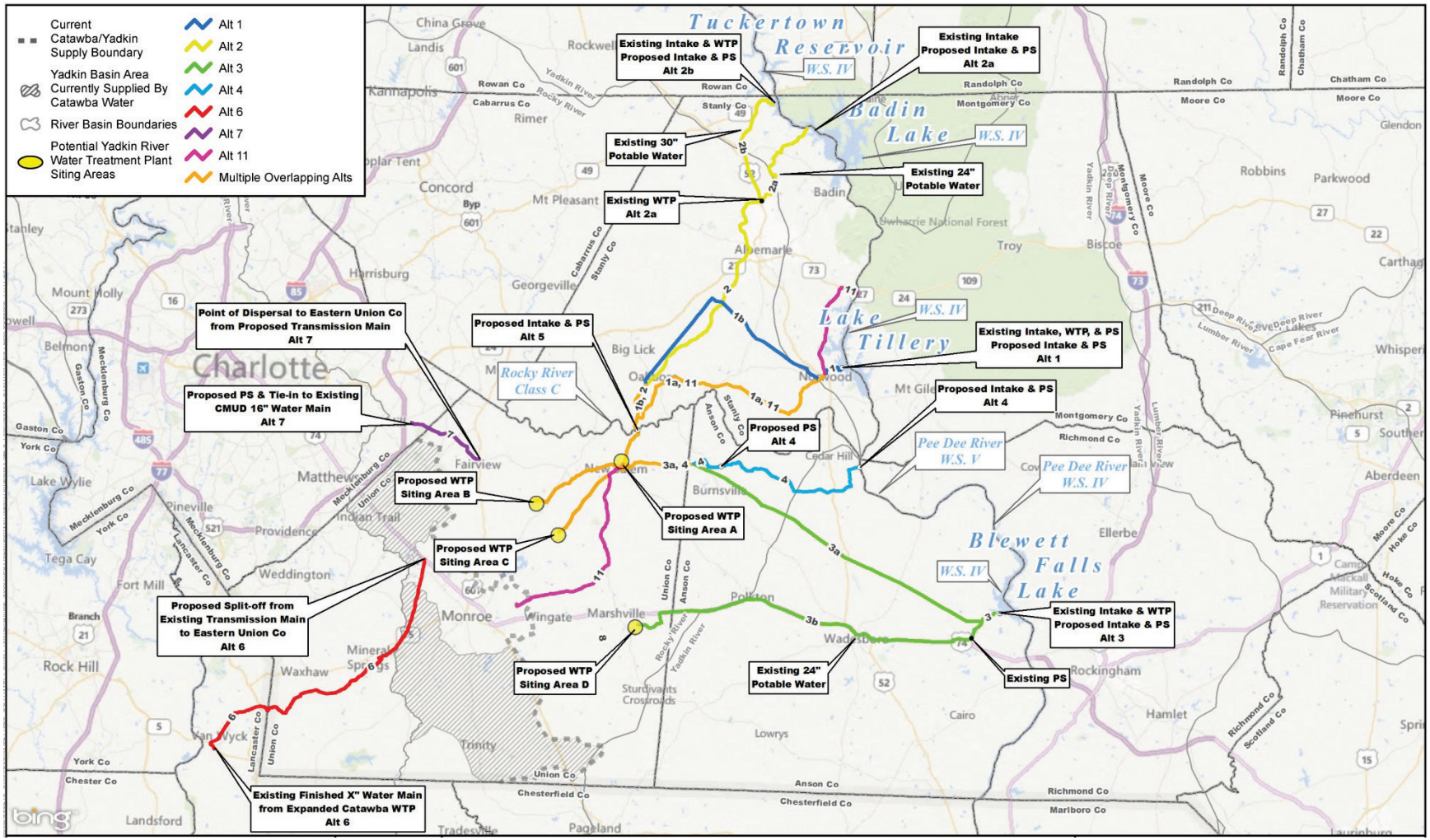

Illustration 6-4 Yadkin Regional Water Supply Project – Surface Water Alternatives (HDR, 2015)

6.2.1. Surface Water Supply Alternatives

6.2.1.1. Alternative 1A

Description

- Pee Dee River raw water supply from **Lake Tillery** (23 mgd IBT from the Yadkin River IBT Basin to the Rocky River IBT Basin) with a new water treatment plant in Union County.
- Raw water transmission alignment from Lake Tillery to the new water treatment plant in northern Union County primarily following road Right-of-Ways.

Summary

- Ability to meet water demands – **Meets purpose and need.** This alternative meets the 2050 water demand needs for the YRWSP within Union County's Yadkin River Basin Service Area.
- Environmental impacts – Table 6-1 summarizes and quantifies the environmental effects, as presented in the FEIS, of this alternative, as compared with other alternatives. Impacts, as shown in this table, are generally similar to or less than other alternatives due to shorter length of required raw water transmission main for the project.
- Cost – As indicated in Table 6-2, at $239.7M, this alternative represents the lowest cost alternative of those evaluated, with the exception of Alternative 5 (see further discussion of this alternative for its limitations).

This alternative meets the 2050 water demand needs for the YRWSP within Union County's Yadkin River Basin Service Area. As described in the FEIS document, the environmental impacts of Alternative 1A are similar, or significantly less, than the other alternatives evaluated. Alternative 1A represents one of the lowest cost project alternatives and has been determined to be a financially feasible option for this water supply.

6.2.1.2. Alternative 1B

Description

- Pee Dee River raw water supply from **Lake Tillery** (23 mgd IBT from the Yadkin River IBT Basin to the Rocky River IBT Basin) with a new water treatment plant in Union County.
- Raw water transmission alignment from Lake Tillery to new WTP in northern Union County primarily following power utility easements.

Summary:

- Ability to meet water demands – **Meets purpose and need.** This alternative meets the 2050 water demand needs for the YRWSP within Union County's Yadkin River Basin Service Area.
- Environmental impacts – Table 6-1 summarizes and quantifies the environmental effects, as presented in the FEIS, of this alternative, as compared with other alternatives. Impacts, as shown in this table, are generally similar to or slightly greater than

Alternative 1A, primarily due to a longer length of required raw water transmission main for the project.

- Cost – As indicated in Table 6-2, this alternative is similar in cost to Alternative 1A, with slightly higher costs due to longer raw water transmission alignment length.

As described in the FEIS document, the environmental impacts of Alternative 1B are similar to the other alternatives evaluated. Alternative 1B represents one of the lowest cost project alternatives and has been determined to be a financially feasible option for this water supply.

6.2.1.3. Alternative 2A

Description

- Yadkin River raw water supply from **Narrows Reservoir (Badin Lake)** (23 mgd IBT from Yadkin River IBT Basin to Rocky River IBT Basin) with a new water treatment plant in Union County.

Summary

- Ability to meet water demands – **Meets purpose and need.** This alternative meets the 2050 water demand needs for the YRWSP within Union County's Yadkin River Basin Service Area.
- Environmental impacts – Table 6-1 summarizes and quantifies the environmental effects, as presented in the FEIS, of this alternative, as compared with other alternatives. Impacts, as shown in this table, are generally similar to or slightly greater than Alternative 1A, primarily due to a longer length of required raw water transmission main for the project.
- Cost - As indicated in Table 6-2, at an estimated $294.1M, this alternative is 23% more costly than Alternative 1A.

6.2.1.4. Alternative 2B

Description

- Yadkin River raw water supply from **Tuckertown Reservoir** (23 mgd IBT from Yadkin River IBT Basin to Rocky River IBT Basin) with a new water treatment plant in Union County.

Summary

- Ability to meet water demands – **Meets purpose and need.** This alternative meets the 2050 water demand needs for the YRWSP within Union County's Yadkin River Basin Service Area.
- Environmental impacts – Table 6-1 summarizes and quantifies the environmental effects, as presented in the FEIS, of this alternative, as compared with other alternatives. Impacts, as shown in this table, are generally similar to or slightly greater than Alternative 1A, primarily due to a longer length of required raw water transmission main for the project.
- Cost - As indicated in Table 6-2, at an estimated $294.0M, this alternative is 23% more costly than Alternative 1A.

6.2.1.5. Alternative 3A

Description:

- Pee Dee River raw water supply from **Blewett Falls Lake** (14.2 mgd IBT from Yadkin River IBT Basin to Rocky River IBT Basin) with a new water treatment plant in Union County.
- Raw water transmission alignment from Blewett Falls Lake to new WTP in northern Union County primarily following power and natural gas utility easements.
- 23 mgd maximum month average withdrawal, of which 14.2 mgd is considered an IBT due to the Cork Rule Exception, because of the projected future volume of Union County treated wastewater effluent which discharges within the Rocky River IBT Basin and ultimately returns to the Yadkin River Basin at the confluence of the Rocky River and Pee-Dee River several miles upstream of Blewett Falls Lake.

Summary

- Ability to meet water demands **– Meets purpose and need.** This alternative meets the 2050 water demand needs for the YRWSP within Union County's Yadkin River Basin Service Area.
- Environmental impacts – Table 6-1 summarizes and quantifies the environmental effects, as presented in the FEIS, of this alternative, as compared with other alternatives. Impacts, as shown in this table, are generally similar to or slightly greater than Alternative 1A, primarily due to a longer length of required raw water transmission main for the project.
- Cost - As indicated in Table 6-2, at an estimated $282.2M, this alternative is 18% more costly than Alternative 1A.

6.2.1.6. Alternative 3B

Description

- Pee Dee River raw water supply from **Blewett Falls Lake** (14.2 mgd IBT from Yadkin River IBT Basin to Rocky River IBT Basin) with a new water treatment plant in Union County.
- Raw water transmission alignment from Blewett Falls Lake to new WTP in eastern Union County primarily following US-74 Right-of-Way.
- 23 mgd maximum month average withdrawal, of which 14.2 mgd is considered an IBT due to the Cork Rule Exception, because of the projected future volume of Union County treated wastewater effluent which discharges within the Rocky River IBT Basin and ultimately returns to the Yadkin River Basin at the confluence of the Rocky River and Pee-Dee River several miles upstream of Blewett Falls Lake.

Summary

- Ability to meet water demands – **Meets purpose and need.** This alternative meets the 2050 water demand needs for the YRWSP within Union County's Yadkin River Basin Service Area.

- Environmental impacts – Table 6-1 summarizes and quantifies the environmental effects, as presented in the FEIS, of this alternative, as compared with other alternatives. Impacts, as shown in this table, are generally similar to or slightly greater than Alternative 1A, primarily due to a longer length of required raw water transmission main for the project.
- Cost – As indicated in Table 6-2, at an estimated $248.1M, this alternative is similar in cost to Alternative 1A, with a 4% higher cost.

6.2.1.7. Alternative 4

Description

- Raw water supply from the **main stem of the Pee Dee River** (14.2 mgd IBT from Yadkin River IBT Basin to Rocky River IBT Basin) with a new water treatment plant in Union County.
- 23 mgd maximum month average withdrawal, of which 14.2 mgd is considered an IBT due to the Cork Rule Exception, because of the projected future volume of Union County treated wastewater effluent which discharges within the Rocky River IBT Basin and ultimately returns to the Yadkin River Basin at the confluence of the Rocky River and Pee-Dee River several miles upstream of proposed Pee Dee River withdrawal point for this alternative.

Summary

- Ability to meet water demands – **Meets purpose and need.** This alternative meets the 2050 water demand needs for the YRWSP within Union County's Yadkin River Basin Service Area.
- Environmental impacts – Table 6-1 summarizes and quantifies the environmental effects, as presented in the FEIS, of this alternative, as compared with other alternatives. Impacts, as shown in this table, are generally similar to or slightly greater than Alternative 1A, primarily due to a longer length of required raw water transmission main and need for construction of a terminal water storage reservoir for the project due for this run-of-river intake option.
- Cost - As indicated in Table 6-2, at an estimated $322.2M, this alternative represents the second highest cost of those evaluated, due to the water withdrawal infrastructure and terminal reservoir for water storage needed for this run-of-river intake option. This alternative is 34% more costly than Alternative 1A.

6.2.1.8. Alternative 5

Description

- Raw water supply from the **Rocky River within Union County** (23 mgd maximum month average withdrawal; non-IBT alternative) with a new water treatment plant in Union County.

Summary

- Ability to meet water demands – **Does not meet need.** The Rocky River is currently classified as a Class C water resource and would need to be re-classified to Water

Supply (WS) status before being utilized as a municipal water source. Further, the Rocky River has an insufficient flow to meet the Union County YRWSP water demands. Union County's 23 mgd water demand exceeds 20% of the 7Q10 flow (equal to 4.6 cfs or 2.9 mgd) within the river by 793%, indicating insufficient flow to support the proposed withdrawal.

- Environmental impacts – Table 6-1 summarizes and quantifies the environmental effects, as presented in the FEIS, of this alternative, as compared with other alternatives. Due to limited flow and shallow depths within the Rocky River, a low profile dam is likely needed to ensure adequate depth for the raw water intake. Upstream inundation due to this impoundment may have adverse impacts on multiple environmental resources. Alternately, if a collector well type intake were used, adverse impacts to groundwater resources in the surrounding area are likely to occur.
- Cost – While this alternative represents the lowest cost alternative at $190.6M, as indicated in Table 6-2, the alternative does not meet the project needs due to flow limitations of the Rocky River. This alternative is estimated to be 21% less costly than Alternative 1A. The lower cost is representative of a significantly shorter raw water transmission main length.

6.2.1.9. Alternative 6

Description

- **Expansion of the Catawba River Water Supply Project (CRWSP**) (modification to existing grandfathered IBT amount for a larger IBT (21.6 mgd) from the Catawba River Basin to the Rocky River IBT Basin of the Yadkin River Basin).
- 28.9 mgd maximum month average withdrawal, of which 21.6 mgd is considered an IBT due to the Cork Rule Exception, because of the projected future volume of Union County treated wastewater effluent from the County's Twelve Mile Water Reclamation Facility which ultimately returns to the Catawba River Basin at the confluence of Twelve Mile Creek and the Catawba River just upstream of CRWSP withdrawal point.

Summary

- Ability to meet water demands – **Meets purpose and need.** This alternative meets the 2050 water demand needs for the YRWSP within Union County's Yadkin River Basin Service Area.
- Environmental impacts – Table 6-1 summarizes and quantifies the environmental effects, as presented in the FEIS, of this alternative, as compared with other alternatives. Impacts, as shown in this table, are generally similar to or slightly greater than Alternative 1A, primarily due more adverse impacts to surface water resources within the Catawba River IBT Basin for this alternative, as compared to those alternatives from the Yadkin River IBT Basin.
- Cost - As indicated in Table 6-2, at an estimated $252.0M, this alternative is 5% more costly than Alternative 1A, for CRWSP expansion solely to meet the needs of Union County's Yadkin River Basin Service Area.

6.2.1.10. Alternative 7

Description

- **Interconnection with Charlotte Water** (21.6 mgd IBT from Catawba River Basin to the Rocky River IBT Basin of the Yadkin River Basin).
- 16.6 mgd proposed finished water purchase from Charlotte Water.
- 12.3 mgd proposed supply from Union County's existing CWRSP water source.
- 28.9 mgd combined maximum month average supply, of which 21.6 mgd is considered an IBT due to the Cork Rule Exception, because of the projected future volume of Union County treated wastewater effluent from the County's Twelve Mile Water Reclamation Facility which ultimately returns to the Catawba River Basin at the confluence of Twelve Mile Creek and the Catawba River just upstream of CRWSP withdrawal point.

Summary

- Ability to meet water demands – **Meets purpose and need.** This alternative meets the 2050 water demand needs for the YRWSP within Union County's Yadkin River Basin Service Area.
- Environmental impacts –Table 6-1 summarizes and quantifies the environmental effects, as presented in the FEIS, of this alternative, as compared with other alternatives. Impacts, as shown in this table, are generally similar to or slightly greater than Alternative 1A, primarily due more adverse impacts to surface water resources within the Catawba River IBT Basin for this alternative, as compared to those alternatives from the Yadkin River IBT Basin. Adverse impacts to the Carolina Heelsplitter population in the Goose Creek critical habitat area are also possible due to the proposed transmission alignment of this alternative.
- Cost - As indicated in Table 6-2, at an estimated $261.1M, this alternative is 9% more costly than Alternative 1A.

6.2.2. Interbasin Transfer Minimization Alternatives

6.2.2.1. Alternative 8

Description

- Minimize IBT through raw water supply using **municipal groundwater withdrawal** within Union County with a new water treatment plant in Union County.
- 23 mgd maximum month average day water withdrawal from groundwater sources in Union County.

Summary

- Ability to meet water demands – **Does not meet need in a practical manner**. Limited numbers of high productivity wells within the County's geologic formations mean that the County would require an extensive network of groundwater wells of average production. Due to the required spacing of individual wells, the amount of land (presumably existing agricultural land) and cost required to develop such an extensive network of wells (of up to 560 wells) is not preferred to other surface water alternatives as a result of the potential site development impacts of this alternative. Even the use of groundwater to

supplement surface water supplies does not justify the cost and land impacts that would be necessary to develop groundwater as a reliable source of water supply for Union County.

- Environmental impacts - Table 6-1 summarizes the environmental effects of this alternative as presented in the FEIS. To meet the demand, the potential development area needed for groundwater well network is estimated to be up to 28,300 acres, potentially resulting in significant environmental impacts due to the large impact area. Additionally, groundwater in various areas of Union County, particularly in the northern portions of the Rocky River IBT Basin has been determined to contain concentrations of arsenic, radon and nitrate above the US EPA and State of North Carolina limitations.
- Cost – As indicated in Table 6-2, at an estimated $294.6M, this alternative represents one of the higher cost project alternatives and is 23% more costly than Alternative 1A. Groundwater used for large scale public supply purposes in the County would likely require water treatment to a similar level as surface water sources to remove potential contaminants. Therefore, it is estimated that water treatment for groundwater would require similar facilities and costs as those proposed for surface water alternatives.

6.2.2.2. Alternative 9

Description

- **Water demand management/conservation**

Summary

- Ability to meet water demands – **Does not meet need.**
- Union County currently employs a robust water demand management/conservation program, as indicated in using strategies previously described in Section 5.0
- The Union County water demand projections previously discussed in Section 3.0 have been based upon historical water use data and peaking factors following the 2006-2009 drought. As such, they were developed upon data generated while the County maintained mandatory water use restrictions. Inherently, the effect of water conservation and demand management is already built into the water demand projections established for this project.
- Further options, beyond those already in place or being implemented by the County, for reducing water demand of the requested IBT through conservation and demand management would be difficult to identify, quantify and ultimately implement as part of this Alternative.

6.2.2.3. Alternative 10

Description

- **Direct potable reuse**
- Up to 4.6 mgd water supply from Direct Potable Reuse to supplement 23 mgd maximum month average day water demands.
- 18.4 mgd surface water supply still required to meet 2050 projected water demands.

Summary

- Ability to meet water demands – **Does not meet need**. North Carolina Session Law SL2014-113 establishes a public policy of the State that supports the reuse of treated wastewater or reclaimed water, under a very specific set of circumstances, and if a reclaimed water system is permitted and operated under G.S. 143-215.1. However, SL2014-113 also indicates that there are additional rules yet to be established or adopted by the EMC regarding water reuse, particularly direct distribution of reclaimed water as potable water, as identified in section 143-355.5.b. While water reuse may be a beneficial water source in the future for some areas of the state with limited water resources under limited conditions, it is not a reasonable alternative for Union County, given projected water demands and the availability of surface water from the neighboring Yadkin-Pee Dee River and its reservoirs. Additionally, SL2014-113 permits only 20% of the total water volume to be reclaimed water. As such this option would only serve as a small supplement (up to 4.6 mgd of the 23 mgd needed supply) to the surface water needs which would be required to meet Union County's water demands, resulting in an 18.4 mgd IBT.
- Environmental impacts - The provision, under criteria outlined in SL2014-113 for water reuse, for a constructed pretreatment mixing basin of sufficient size to mix raw water with reclaimed water (limited to 20% of the total water volume) would have environmental impacts beyond those of the other traditional surface water supply alternatives evaluated.
- Cost - It is important to note that criteria outlined in SL2014-113 for water reuse would require an extensive capital and operational investment for Union County. Advanced water treatment technology for direct potable reuse, along with the remaining need for developing a surface water supply and treatment facility as part of this alternative would likely represent the most significant cost for any of the alternatives. Actual costs for this alternative were not developed due to lack of rules regarding direct potable reuse within the current water reuse legislation, making this alternative infeasible.

6.2.2.4. Alternative 11

Description

- **Indirect Potable Reuse - Water returns** (treated wastewater effluent) from the Rocky River IBT Basin back to the Yadkin River IBT Basin.
- Return up to 6.6 mgd annual average day of Union County's treated wastewater effluent from the City of Monroe WWTP back to the headwater of Lake Tillery, to take advantage of the Cork Rule Exception (water returned upstream of withdrawal point) to minimize required IBT.

Summary

- Ability to meet water demands – **Does not meet need in a practical manner.** The 2050 wastewater flow projection of 6.6 mgd is only 40% of the 16.5 mgd average daily water need and only 29% of the 23 mgd maximum month average day water need for the YRWSP. The use of IPR in Union County would serve only to partially reduce (not

eliminate) the total amount of the IBT from the Yadkin River IBT Basin to the Rocky River IBT Basin, resulting in a 16.4 mgd IBT.

- Environmental impacts - Table 6-1 summarizes the environmental effects of this alternative as presented in the FEIS. Evaluation of potential discharges to major feeder streams to Lake Tillery (Mountain Creek and Jacob's Creek) indicate that estimated 7Q10 flows are zero or near zero, which would limit the ability to permit a new discharge into these waters. Additionally, assimilative capacity concerns are an issue for large wastewater discharges into such tributary streams. However, any benefits afforded to water quantity (due to IBT reduction) in Lake Tillery are likely to be outweighed by water quality and environmental impacts of a new wastewater discharge and associated sanitary sewer transmission infrastructure required as part of this alternative.
- Cost – As indicated in Table 6-2, this alternative represents the highest cost alternative at $377.2M, significantly greater than others evaluated for this project and 57% higher than Alternative 1A. This is due to the required surface water supply infrastructure coupled with wastewater outfall infrastructure from Union County to the headwater streams of Lake Tillery.

6.2.2.5. Alternative 12

Description

- **No Action Alternative**
- The No Action Alternative (NAA) would not involve additional public water supply by Union County Public Works to the County's Yadkin River Basin Service Area within the Rocky River IBT Basin.
- While the Union County Public Works water supply would not increase under this alternative, the County's population within this service area is still projected to increase, driven by economic growth and development within the region.
- Without a reliable water supply source for the Yadkin River Basin Service Area, future water supply within this area would have to be supplied either from the existing Catawba River Water Supply Project, through groundwater wells, or service connections to other water systems within the Rocky River IBT Basin.

Summary

- Ability to meet water demands – **Does not meet need.**
- Meeting the water supply demands for future population growth in the Yadkin River Basin Service Area through the Catawba River Water Supply Project is not possible under the limitations of the County's existing grandfathered 5 mgd Catawba River Basin to the Yadkin River Basin.
- Supporting such projected population growth through individual private groundwater well installations would place an additional strain on the current groundwater supply within the County.
- Neighboring systems in the Rocky River IBT Basin do not have the physical capacity to provide Union County with an adequate supply of water to meet current or future demands in the County's Yadkin River Basin Service Area.

- An inability for Union County to provide reliable public water supply service to the Yadkin River Basin Service Area could result in a need to impose population growth and property development moratoria within the County due to limitations of County services (i.e. water service). The negative effects of such moratoria, as evidenced in other areas where they have been implemented, are often significant and long lasting, slowing or stalling the economic growth of the area and leading to the loss of jobs and businesses.

Table 6-1 Summary of FEIS Temporary and Permanent Direct Impacts and Indirect Impacts for YRWSP Alternatives (HDR, 2015)

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	1A	1B	2A	2B	3A	3B	4	5	6	7	8	11	WTP A	WTP B	WTP C
Topography and Geology	Direct, Temporary	No impacts	Minor from pipe installation	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor from grading for construction of WTP	Same as Alternative 1A	Same as Alternative 1A
	Direct, Permanent	No impacts	Minor from grading for raw water intake, pump station and access road	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor from grading for WTP, raw water intake, pump station and access road	Same as Alternative 1A	Minor from grading for low-head dam, raw water intake, pump station and access road	Minor from grading for raw water intake and WTP expansion, pump station, and access road	Minor from grading for pump station and access road	Minor from grading for WTP and groundwater well installation	Minor from grading for discharge, pump station and access road	Minor from grading for WTP	Same as WTP A	Same as WTP A
	Indirect	Same as Alternative 1A	Minor from new development	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Soils	Direct, Temporary	No impacts	Minor from: ○ Impacts from land clearing, excavation and grading ○ Fuel, oil, and other emissions from construc-tion vehicles	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Direct, Permanent	No impacts	Minor from construction of raw water intake, pump station, and access road	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor from construction of WTP, raw water intake, pump station, and access road	Same as Alternative 1A	Minor from construction of low-head dam, raw water intake, pump station, and access road	Minor from construction of raw water intake and WTP expansion, pump station, and access road	Minor from construction of pump station and access road	Minor from construction of WTP and groundwater well installation	Minor from construction of discharge, pump station, and access road	Minor from construction of WTP	Same as WTP A	Same as WTP A
	Indirect	Same as Alternative 1A	Minor from new development	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Land Use	Direct, Temporary	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts
	Direct, Permanent	No impacts	Moderate from conversion of wooded/ undeveloped areas and residential, commercial, and agricultural uses to permanent utility use	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	1A	1B	2A	2B	3A	3B	4	5	6	7	8	11	WTP A	WTP B	WTP C
Land Use (con't)	Indirect	Same as Alternative 1A	Minor from new development	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Public Lands and Scenic, Recreational Areas, and State Natural Areas	Direct, Temporary	No impacts	Minor to 5.3 miles of bike routes and 7.2 acres of other areas from transmission line	Minor to 0.3 mile of bike routes and 6.5 acres of other areas from transmission line	Minor to 14.0 miles of bike routes and 5.6 acres of other areas from transmission line	Minor to 14.0 miles of bike routes and 9.4 acres of other areas from transmission line	Minor to 46.5 acres from transmission line	Minor to 15.5 acres from transmission line	Minor to 0.5 acre from transmission line	Minor to 5.5 acres from transmission line	No impacts	Minor to 0.6 acre from transmission line	Impacts from well field are not known	Minor to10.6 miles of bike routes and 8.4 acres of other areas from transmission line	No impacts	No impacts	Minor to 7.2 acres from transmission line
	Direct, Permanent	No impacts	No impacts	No impacts	No impacts	No impacts	Minor to 0.5 acre of Pee Dee River State Game Land from pump station and access road	Minor to 0.8 acre of Pee Dee River State Game Land from pump station and access road	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts
	Indirect	Same as Alternative 1A	Minor from conversion of adjacent land uses	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Prime or Unique Agricultural Land	Direct, Temporary	No impacts	Minor to 18.9 acres from pipe installation	Minor to 22.8 acres from pipe installation	Minor to 30.8 acres from pipe installation	Minor to 23.1 acres from pipe installation	Minor to 25.4 acres from pipe installation	Minor to 6.2 acres from pipe installation	Minor to 25.5 acres from pipe installation	No impacts	Minor to 41.4 acres from pipe installation	Minor to 4.8 acres from pipe installation	Minor to 5.2 acres from pipe installation	Minor to 41.9 acres from pipe installation	No impacts	Minor to 2.5 acres from pipe installation	Minor to 3.6 acres from pipe installation
	Direct, Permanent	No impacts	No impacts	No impacts	No impacts	Minor to less than 0.1 acre from pump station and access road	No impacts	Impact from WTP is not known	Minor to 0.9 acre from access road	No impacts	No impacts	No impacts	Impacts from WTP and well field are not known	No impacts	No impacts	Impacts from WTP is not known	Impacts from WTP is not known
	Indirect	Same as Alternative 1A	Minor from conversion of agricultural land to residential and commercial use	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Areas of Archaeological or Historic Value	Direct, Temporary	No impacts	○ No impacts to historic sites ○ Impacts to archaeological resources unknown, but unlikely	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	1A	1B	2A	2B	3A	3B	4	5	6	7	8	11	WTP A	WTP B	WTP C
Areas of Archaeological or Historic Value (con't)	Direct, Permanent	No impacts	o No impacts to historic sites o Impacts to archaeological resources unknown but unlikely	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Indirect	Same as Alternative 1A	Minor from new development	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Air Quality	Direct, Temporary	No impacts	Minor from increase in airborne particulates during project construction	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Direct, Permanent	No impacts	Negligible from intermittent generator operation	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Indirect	Same as Alternative 1A	Minor from new development	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Noise Levels	Direct, Temporary	No impacts	Minor nuisance noise associated with project construction	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Direct, Permanent	No impacts	Negligible from intermittent generator operation	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Indirect	Same as Alternative 1A	Negligible from increased overall noise in service area	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**11**	**WTP A**	**WTP B**	**WTP C**
Floodways and 100 year Floodplains	Direct, Temporary	No impacts	Minor impacts from construction to 13.5 acres of 100-year floodplain	Minor impacts from construction to 32.2 acres of 100-year floodplain	Minor impacts from construction to: o 1.6 acres of floodway o 21.2 acres of 100-year floodplain	Minor impacts from construction to: o 1.0 acre of floodway o 19.9 acres of 100-year floodplain	Minor impacts from construction to 86.9 acres of 100-year floodplain	Minor impacts from construction to: o 6.7 acres of floodway o 49.3 acres of 100-year floodplain	Minor impacts from construction to 33.4 acres of 100-year floodplain	Minor impacts from construction to 1.7 acres of 100-year floodplain	Minor impacts from construction to: o 0.6 acre of floodway o 7.6 acres of 100-year floodplain	Minor impacts from construction to: o 0.2 acre of floodway o 4.7 acres of 100-year floodplain	Minor impacts from construction to 0.2 acre of 100-year floodplain	Minor impacts from construction to: o 0.6 acre of floodway o 28.1 acres of 100-year floodplain	No impacts	No impacts	Minor impacts from construction to 0.8 acre of 100-year floodplain
	Direct, Permanent	No impacts	Minor impacts to 0.1 acre of 100-year floodplain	Minor impacts to 0.1 acre of 100-year floodplain	Minor impacts to 0.3 acre of 100-year floodplain	No impacts	Minor impacts to 2.0 acres of 100-year floodplain	Minor impacts to 2.0 acres of 100-year floodplain	Minor impacts to 0.2 acre of 100-year floodplain	Minor impacts to 0.5 acre of 100-year floodplain	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts
	Indirect	Same as Alternative 1A	Negligible from: o Potential loss of 100-year floodplain from development o Topography changes from development o Isolation of floodplain due to stream channel entrenchment	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Wetlands	Direct, Temporary	No impacts	No impacts	Minor impacts to 7.5 acres of forested wetland from transmission line	Minor impacts to 0.6 acre of forested wetland from transmission line	Minor impacts to 0.6 acre of forested wetland from transmission line	Minor impacts from transmission line to: o 44.8 acres of forested wetland o 8.7 acres of non-forested wetland	Minor impacts from transmission line to: o 2.8 acres of forested wetland o 0.5 acre of non-forested wetland	No impacts	No impacts	Minor impacts from transmission line to: o 0.5 acre of forested wetland o 0.1 acre of non-forested wetland	Minor impacts from transmission line to 0.1 acre of forested wetland	No impacts from transmission line Impacts from well field are not known	Minor impacts to 0.9 acre of forested wetland from transmission line	No impacts	No impacts	No impacts
	Direct, Permanent	No impacts	No impacts	Minor impacts to 0.5 acre of forested wetland from transmission line	No impacts	No impacts	Minor impacts to 3.2 acres of forested wetland from transmission line	No impacts	No impacts	o No impacts associated with transmission line or pump station. o Impacts due to low-head dam unknown	Minor impacts to less than 0.1 acre of forested wetland from transmission line	No impacts	Minor impacts expected, but not quantified	No impacts	No impacts	No impacts	No impacts

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**11**	**WTP A**	**WTP B**	**WTP C**
Wetlands (con't)	Indirect	Same as Alternative A1	Minor from: o Wetland loss via development o Loss of habitat and fragmentation o Loss of wetland function from pollutant loading	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1	Same as Alternative A1
Surface Water Resources	Direct, Temporary	No impacts	Minor from transmission line to: o 2,848 feet of perennial streams from 11 crossings o 11,014 feet of intermittent streams from 20 crossings o 0.3 acre of buffer	Minor from transmission line to: o 5,857 feet of perennial streams from 14 crossings o 10,598 feet of intermittent streams from 31 crossings o 1.7 acre of buffer	Minor from transmission line to: o 2,339 feet of perennial streams from 11 crossings o 9,498 feet of intermittent streams from 22 crossings o 1.0 acre of buffer	Minor from transmission line to: o 1,914 feet of perennial streams from 9 crossings o 9,572 feet of intermittent streams from 27 crossings o 0.9 acre of buffer	Minor from transmission line to: o 5,242 feet of perennial streams from 20 crossings o 8,194 feet of intermittent streams from 22 crossings o 4.1 acres of buffer	Minor from transmission line to: o 4,634 feet of perennial streams from 16 crossings o 7,683 feet of intermittent streams from 24 crossings o 8.2 acres of buffer	Minor from transmission line to: o 1,715 feet of perennial streams from 7 crossings o 6,979 feet of intermittent streams from 14 crossings o 11.6 acres of buffer	Minor from transmission line to 1,343 feet of intermittent streams from 3 crossings	Minor from transmission line to: o 1,509 feet of perennial streams from 7 crossings o 3,913 feet of intermittent streams from 18 crossings o 3.8 acres of buffer	o No impacts due to use of trenchless construction methods for installation of the installation line across 2 perennial streams and 7 intermittent streams o 6.4 acres of buffer	Minor from transmission line to: o 407 feet of perennial streams from 2 crossings o 1,530 feet of intermittent streams from 5 crossings	Minor from transmission line to: o 4,508 feet of perennial streams from 18 crossings o 17,449 feet of intermittent streams from 25 crossings o 3.7 acres of buffer	No impacts	Minor from transmission line to 1,438 feet of intermittent streams from 5 crossings	Minor from transmission line to 3,426 feet of intermittent streams from 11 crossings
	Direct, Permanent	No impacts	Minor to: o 50 feet of Pee Dee River from raw water intake o Less than 0.1 acre of buffer from raw water intake and transmission line	Minor to: o 50 feet of Pee Dee River for raw water intake o 0.1 acre of buffer	Minor to: o 50 feet of Yadkin River for raw water intake o 0.1 acre of buffer	Minor to: o 50 feet of Yadkin River for raw water intake o 0.1 acre of buffer	Minor to: o 50 feet of Pee Dee River for raw water intake o 0.2 acre of buffer	Minor to: o 50 feet of Pee Dee River for raw water intake o 0.3 acre of buffer	Minor to: o 50 feet of Pee Dee River for raw water intake o 0.6 acre of buffer	o Minor impacts to 100 feet of Rocky River for raw water intake and low-head dam or Ranney wells o Unknown impacts to 6,000 feet of Rocky River due to low-head dam effects	Minor to: o 50 feet of Catawba River for raw water intake expansion o 0.2 acre of buffer	Minor impacts to 0.3 acre of buffer	No impacts	Minor to: o 50 feet of Pee Dee River for discharge o 0.2 acre of buffer	No impacts	No impacts	No impacts

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**11**	**WTP A**	**WTP B**	**WTP C**
Surface Water Resources (con't)	Indirect	Same as Alternative 1A	Minor from: o Water quality degradation due to increase in stormwater runoff o Alteration of natural hydrography o Alteration of channel morphology o Increased natural utilization of buffers due to increase in stormwater	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Surface Water Quantity and Quality	Lake Levels - Aesthetics	No Impacts	Negligible to minor direct, permanent impacts to lake levels due to lower average lake elevations	Same as Alternative 1A	Minor to moderate direct, permanent impacts to lake levels from water withdrawals	Minor to moderate direct, permanent impacts to lake levels from water withdrawals	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor direct, permanent impacts to lake levels due to lower average lake elevations	Minor to moderate direct, permanent impacts to lake levels due to lower average lake elevations	Extent of impacts unknown; groundwater withdrawal likely to impact surface water through groundwater-surface water interaction, similar to Alternative 1A	Same as Alternative 1A	No impacts	No impacts	No impacts
	Lake Levels – Water Withdrawals	No Impacts	Negligible impact to water withdrawals based on restricted operation at lake located intakes	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor impact to water withdrawals based on restricted operation at lake located intakes	Minor impact to water withdrawals based on restricted operation at lake located intakes	Extent of impacts unknown; groundwater withdrawal likely to impact surface water through groundwater-surface water interaction, similar to Alternative 1A	Same as Alternative 1A	No impacts	No impacts	No impacts

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	1A	1B	2A	2B	3A	3B	4	5	6	7	8	11	WTP A	WTP B	WTP C
Surface Water Quantity and Quality (con't)	Reservoir Outflows	No Impacts	Negligible to minor direct, permanent impacts due to increased days below specified reservoir release values	Same as Alternative 1A	Minor to moderate direct, permanent impacts due to increased days below specified reservoir release values	Minor to moderate direct, permanent impacts due to increased days below specified reservoir release values	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Negligible impact to reservoir outflows based on days below specified reservoir release values	Negligible to minor direct, permanent impacts due to increased days below specified reservoir release values	Extent of impacts unknown; groundwater withdrawal likely to impact surface water through groundwater-surface water interaction, similar to Alternative 1A	Same as Alternative 1A	No impacts	No impacts	No impacts
	Water Quantity Mgmt	No Impacts	Negligible impact to water quantity management, based on time in LIP stages	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor impact to water quantity management, based on increased time in more severe LIP stages	Minor to moderate impact to water quantity management, based on increased time in more severe LIP stages	Extent of impacts unknown; groundwater withdrawal likely to impact surface water through groundwater-surface water interaction, similar to Alternative 1A	Same as Alternative 1A	No impacts	No impacts	No impacts
	Hydropower Generation	No Impacts	Negligible to minor direct, permanent impacts to lake levels due to lower average lake elevations	Same as Alternative 1A	Minor to moderate direct, permanent impacts to lake levels from water withdrawals	Minor to moderate direct, permanent impacts to lake levels from water withdrawals	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor direct, permanent impacts to lake levels due to lower average lake elevations	Minor to moderate direct, permanent impacts to lake levels due to lower average lake elevations	Extent of impacts unknown; groundwater withdrawal likely to impact surface water through groundwater-surface water interaction, similar to Alternative 1A	Same as Alternative 1A	No impacts	No impacts	No impacts
Groundwater Resources	Direct, Temporary	No impacts	Negligible from construction of transmission line, raw water intake, pump station and access road	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Negligible from construction of transmission line, WTP, raw water intake, pump station and access road	Same as Alternative 1A	Negligible from construction of transmission line, low-head dam, raw water intake, pump station and access road	Negligible from construction of transmission line, raw water intake and WTP expansion, pump station, and access road	Negligible from construction for transmission line, pump station, and access road	Negligible from construction of transmission line, WTP, and groundwater well installation	Negligible from construction of transmission line, discharge, pump station, and access road	Negligible from construction of WTP	Negligible from construction of WTP and transmission line	Negligible from construction of WTP and transmission line
	Direct, Permanent	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	Moderate if Ranney well option is selected	Moderate if Ranney well option is selected	No impacts	No impacts	Major from extraction of 28 mgd of raw water from 1,295 wells	No impacts	No impacts	No impacts	No impacts

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**11**	**WTP A**	**WTP B**	**WTP C**
Groundwater Resources (con't)	Indirect	Same as Alternative 1A	Minor from: o Potential for contamination leading to reduction in use for drinking water o Reduction in groundwater inflow contribution to stream base flow, particularly during droughts	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Shellfish or Fish and Habitats	Direct, Temporary	No impacts	Minor from erosion and sedimentation during construction	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Negligible from erosion and sedimentation during construction	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 7	Same as Alternative 1A	Same as Alternative 1A
	Direct, Permanent	No impacts	Minor from raw water intake	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Minor from low-head dam and raw water intake	Same as Alternative 1A	No impacts	Anticipated to be negligible from infrastructure footprint	Minor from discharge	No impacts	Same as Alternative 8	Same as Alternative 8
	Indirect	Same as Alternative 1A	Minor from: o Aquatic habitat degradation o Change in stream morphology o Reduction in aquatic diversity o Reduction in long-term population sustainability	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Forest Resources	Direct, Temporary	No impacts	Minor impacts to 130 acres for transmission corridor	Minor impacts to 226 acres for transmission corridor	Minor impacts to 129 acres for transmission corridor	Minor impacts to: o 126 acres for transmission corridor o 1 acre for access road	Minor impacts to: o 325 acres for transmission corridor o Less than 1 acre for access road	Minor impacts to: o 116 acres for transmission corridor o Less than 1 acre for access road	Minor impacts to 121 acres for transmission corridor	Minor impacts to 4 acres for transmission corridor	Minor impacts to 56 acres for transmission corridor	Minor impacts to 34 acres for transmission corridor	Minor impacts to 14 acres for transmission corridor Impacts from WTP and well field are not known	Minor impacts to 163 acres for transmission corridor	No impacts	Minor impacts to 18 acres for transmission corridor	Minor impacts to 27 acres for transmission corridor

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**11**	**WTP A**	**WTP B**	**WTP C**
Forest Resources (con't)	Direct, Permanent	No impacts	Minor impacts to 11 acres for transmission corridor	Minor impacts to 18 acres for transmission corridor	Minor impacts to 1 acre for transmission corridor	Minor impacts to: o 9 acres for transmission corridor o Less than 0.5 acre for pump station o Less than 0.5 acre for access road	Minor impacts to: o 27 acres for transmission corridor o Less than 0.5 acre for pump station o Less than 0.5 acre for access road	Minor impacts to: o 3 acres for transmission corridor o Less than 0.5 acre for pump station o Less than 0.5 acre for access road o Impacts not known for WTP	Minor impacts to: o 11 acres for transmission corridor o Less than 0.5 acre for pump station	Minor impacts to less than 0.5 acre for transmission corridor	Minor impacts to 7 acres for transmission corridor	Minor impacts to 3 acres for transmission corridor	Minor impacts to: o 1 acre for transmission corridor o Impacts not known for WTP or well field	Minor impacts to 13 acres for transmission corridor	Impacts not known for WTP	Minor impacts to: o 1 acre for transmission corridor o Impacts not known for WTP	Minor impacts to: o 2 acres for transmission corridor o Impacts not known for WTP
	Indirect	Same as Alternative 1A	Minor from: o Conversion to other land uses o Habitat fragmentation o Potential reduction in air quality	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Wildlife and Natural Vegetation	Direct, Temporary	No impacts	o Minor during construction in project areas o Potential impacts to threatened or endangered species are unknown	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Direct, Permanent	No impacts	o Minor with less than 30 percent of the total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with 30 percent and fifth largest impact on wildlife habitat based on the percentage of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with less than 25 percent of the total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with less than 20 percent of the total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with 36 percent and second largest impact on wildlife habitat based on percentage of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with 37 percent and largest impact on wildlife habitat based on percentage of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with 35 percent and fourth largest impact on wildlife habitat based on percentage of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with less than 25 percent of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with 35 percent and third largest impact on wildlife habitat based on percentage of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with less than 25 percent of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with less than 20 percent of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with less than 25 percent of total project corridor located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with 30 percent of total WTP area located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with less than 30 percent of total project corridor and 65 percent of the total WTP area located on forested land o Potential impacts to threatened or endangered species are unknown	o Minor with less than 35 percent of total project corridor and less than 30 percent of total WTP area located on forested land o Potential impacts to threatened or endangered species are unknown

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	1A	1B	2A	2B	3A	3B	4	5	6	7	8	11	WTP A	WTP B	WTP C
Wildlife and Natural Vegetation (con't)	Indirect	Same as Alternative 1A	Minor from: o Reduction in habitat o Habitat fragmentation o Reduction in species diversity and tolerance o Reduction in long-term population sustainability	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Environmental Justice	Direct, Temporary	No impacts	No dis-proportionate impacts to minority or low-income populations	No dis-proportionate impacts to minority or low-income populations	No dis-proportionate impacts to minority or low-income populations	o No dis-proportionate impacts to minority or low-income populations	o Minor dis-proportionate impacts from 9.4 miles of pipe corridor traversing 3 block groups with minority populations greater than 50 percent o No disproportion ate impacts to low-income populations	Minor dis-pro-portionate impacts as 10 of 15 block groups in which pipe corridor is located are comprised of minority populations greater than 50 percent o No disproportion ate impacts to low-income populations	o No dis-proportionate impacts to minority or low-income populations	No dis-proportionate impacts to minority or low-income populations	o No dis-proportionate impacts to minority or low-income populations	No dis-proportionate impacts to minority or low-income populations	o Minor dis-proportionate impacts from well field having two block groups with minority populations greater than 50 percent o No disproportion ate impacts to low-income populations	Minor dis-proportionate impacts from pipe corridor traversing one block group comprised of minority population greater than 50 percent o No disproportion ate impacts to low-income populations	No dis-proportionate impacts to minority or low-income populations	No dis-proportionate impacts to minority or low-income populations	No dis-proportionate impacts to minority or low-income populations
	Direct, Permanent	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts
	Indirect	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts
Introduction of Toxic Substances	Direct, Temporary	Same as Alternative 1A	Minor from increase in storage and use of hazardous and toxic materials, and generation and disposal of hazardous waste during construction activities	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A

Environmental Resource	Duration of Impact	Alternative [1]															
		No-Action (12)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5**	**6**	**7**	**8**	**11**	**WTP A**	**WTP B**	**WTP C**
Introduction of Toxic Substances (con't)	Direct, Permanent	Same as Alternative 1A	Minor from increase in storage and use of hazardous and toxic materials, and generation and disposal of hazardous waste during operations	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
	Indirect	Same as Alternative 1A	Minor from: o Increase in likelihood of contamination o Impacts to human health	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A	Same as Alternative 1A
Total Project Cost			$239.7 M	Costs similar to Alternative 1A	$294.1 M	$294.0 M	$282.2 M	$248.9 M	$332.2 M	$190.6 M	$252.0 M	$261.1 M	$294.6 M	$377.2 M			

[1] It should be noted Alternative 9 is located exclusively within areas currently in use as water treatment facilities. This alternative does not require new infrastructure or the use of land outside of the treatment facilities, so direct impacts to natural resources are not anticipated. As such, a discussion of direct impacts for Alternative 9 is not provided. Alternative 10, direct potable reuse, is also not assessed in this evaluation due to this alternative being eliminated from consideration based on current regulatory framework.

Table 6-2 Union County YRWSP – Conceptual Cost Opinion (in Millions of $) for YRWSP Alternatives (HDR, 2015)

Project Cost Item	ALTERNATIVE[1]												
	1A	2A	2B	3A	3B	4	5	6	7	8	9	10	11[2]
Raw Water Intake & Pump Station	$7.9	$7.9	$7.9	$7.9	$7.9	$8.2	$19.9	$10.2	$9.1	$155.4	NA	NA	See Alt 1
Raw Water Transmission	$152.7	$206.5	$206.4	$194.9	$162.4	$203.0	$49.3	-	$16.9	$61.6	NA	NA	See Alt 1
Raw Water Transmission - Land	$1.8	$2.4	$2.4	$2.1	$1.7	$2.2	$0.6	-	-	$0.7	NA	NA	See Alt 1
Terminal Reservoir	-	-	-	-	-	$30.7	$42.2	-	-		NA	NA	-
Terminal Reservoir – Land	-	-	-	-	-	$0.8	$1.3	-	-	-	NA	NA	-
Water Treatment Plant	$76.6	$76.6	$76.6	$76.6	$76.6	$76.6	$76.6	$60.4	$65.0	$76.6	NA	NA	See Alt 1
Water Treatment Plant – Land	$0.7	$0.7	$0.7	$0.7	$0.3	$0.7	$0.7	-	-	$0.3	NA	NA	See Alt 1
Finished Water Transmission to WTP Site C/D (excluding land)[3]	-	-	-	-	-	-	-	$181.4	$170.1		NA	NA	-
Wastewater Returns to Tillery	-	-	-	-	-	-	-	-	-	-	NA	NA	$137.5
TOTAL	**$239.7**	**$294.1**	**$294.0**	**$282.2**	**$248.9**	**$322.2**	**$190.6**	**$252.0**	**$261.1**	**$294.6**	**NA**	**NA**	**$377.2**
Ranking by Cost (Lowest to Highest)	2	8	7	6	3	9	1	4	5	6	NA	NA	10

Notes:

[1]Alternative Cost Descriptions:

- Alternative 1A - Water supply from Lake Tillery with transmission to WTP Site Area C (note - Alternative 1B project cost is similar, but raw water transmission costs and land are higher due to increased length of alignment)
- Alternative 2A - Water supply from Narrows Reservoir with transmission to WTP Site Area C
- Alternative 2B - Water supply from Tuckertown Reservoir with transmission to WTP Site Area C
- Alternative 3A - Water supply from Blewett Falls Lake with transmission to WTP Site Area C
- Alternative 3B - Water supply from Blewett Falls Lake with transmission to WTP Site Area D
- Alternative 4 - Water supply from Pee Dee River with transmission to WTP Site Area C
- Alternative 5 - Water supply from Rocky River with transmission to WTP Site Area C
- Alternative 6 - Water supply from Catawba River Water Supply Project (Catawba River)
- Alternative 7 - Water supply from Charlotte Water (Mountain Island Lake) and Catawba River Water Supply Project (Catawba River)
- Alternative 8 - Water supply from groundwater with transmission to WTP Site Area D
- Alternative 9 - Water demand management / conservation
- Alternative 10 - Direct potable reuse
- Alternative 11 - Wastewater returns to Lake Tillery (total cost shown includes Alternative 1 water supply plus Alternative 11 costs

[2] Wastewater returns to Lake Tillery is an additive cost to the selected water supply alternatives. For comparison, it has been added to Alternative 1.

[3] Costs determined for Alternatives 6 & 7 to provide a basis of comparison against the other alternatives.

6.3. Preferred Alternative

Alternative 1A, as depicted in Illustration 6-5 on the proceeding page, was determined to be the Preferred Alternative after a thorough FEIS assessment of each alternative's ability to meet the project's purpose and need of delivering a safe, sustainable water supply to meet the County's current and future water demands in their Yadkin River Basin Service Area, as well as the associated environmental impacts, mitigation measures, technical feasibility, financial impacts, and political and community acceptance. Alternative 1A includes the withdrawal of water from Lake Tillery in the Yadkin River IBT Basin and the transfer of this water into the Rocky River IBT Basin in Union County for treatment and distribution. A portion of the water will be returned via treated wastewater effluent through the Rocky River which discharges into the Pee Dee River (Yadkin River IBT Basin) approximately five miles downstream from the Lake Tillery dam.

Alternative 1A, in conjunction with the existing grandfathered IBT from the Catawba River Basin, is capable of delivering the stated 28.9 mgd maximum month average day projected 30-year demands (23.0 mgd from the Yadkin River Basin, supplemented by up to 5.9 mgd from the existing Catawba supply) and 35.3 mgd maximum day demands (28.0 mgd from the Yadkin River Basin, supplemented by up to 7.3 mgd from the existing Catawba supply) of Union County. The water modeling efforts completed for this EIS indicate that withdrawal from Lake Tillery has less impact on lake aesthetics, other water withdrawal interests (including during drought conditions), and hydropower production than withdrawal of water from other locations. Further, as described in the FEIS document, the environmental impacts of Alternative 1A are similar, or significantly less, than the other alternatives evaluated.

An evaluation of project costs is summarized in Table 6-2. The cost of developing a water supply solution for Union County's Yadkin River Basin Service Area is significant and represents a large future capital expenditure for the County. As illustrated in Table 6-2, Alternative 1A represents one of the lowest cost project alternatives and has been determined to be a financially feasible option for this water supply. In developing this project, Union County held discussions with numerous entities along the Yadkin-Pee Dee River regarding potential partnerships for water supply. Of all those contacted, the Town of Norwood was the only political jurisdiction who expressed a desire to participate in a partnership with mutual benefits for both parties. Currently, Union County and the Town of Norwood have an Interlocal Intake and Transmission Agreement in place for water withdrawal from a common raw water intake in Lake Tillery at the site of the Town of Norwood's current intake. The progress realized on water supply regionalization between the Town of Norwood and Union County makes this the most politically acceptable alternative, as well.

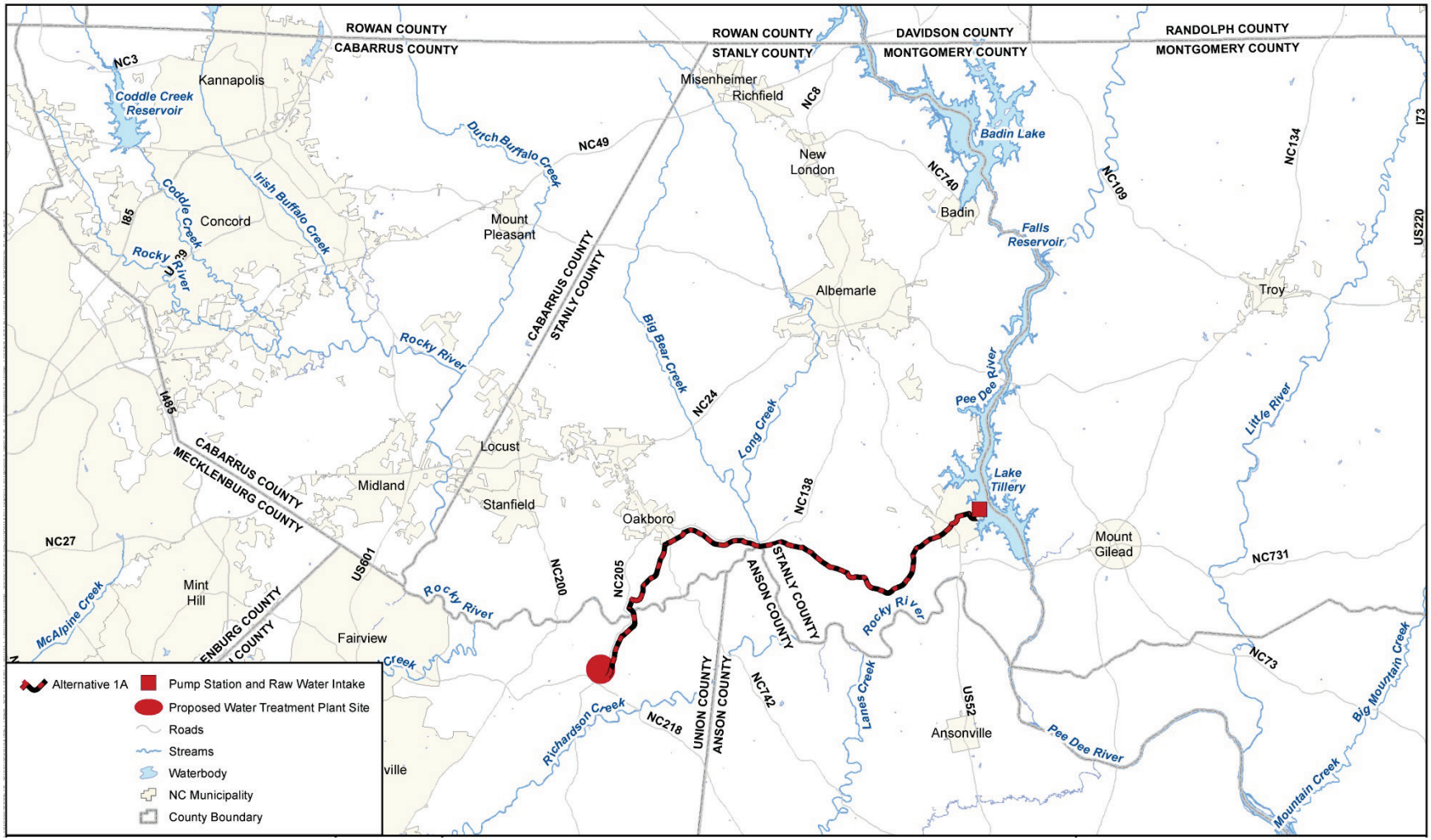

Illustration 6-5 Yadkin Regional Water Supply Preferred Alternative 1A

Table 6-3, below, provides a brief, practical review of the key differentiators between alternatives and the rationale for selecting the Preferred Alternative. Summaries are based upon information highlighted in Section 6.2, Table 6-1, Table 6-2, and as detailed in the FEIS for the project. As illustrated and summarized in this table, Alternative 1A is recommended as the Preferred Alternative for Union County's Yadkin River Water Supply Project.

Table 6-3 Review of Key Differentiators for Project Alternatives

Alt.	Description	Key Differentiators in Comparison to Alternative 1
1A	Lake Tillery to Union County	**Preferred Alternative**
1B	Lake Tillery to Union County	▪ Longer raw water transmission lengths with greater environmental impacts. ▪ More costly than Preferred Alternative (longer transmission main).
2A, 2B	Narrows Reservoir (2A) or Tuckertown Reservoir (2B) to Union County	▪ More significant consequences for water interests in the Yadkin River Basin including lake elevations, reservoir discharges, hydropower generation and surface water quality. ▪ Less politically acceptable. ▪ Longer raw water transmission lengths. ▪ More costly than Preferred Alternative (23% more).
3A, 3B	Blewett Falls Reservoir to Union County via Alternative Transmission Routes (3A, 3B)	▪ More significant consequences for water interests in the Yadkin River Basin including reservoir discharges during drought periods. ▪ Less politically acceptable. ▪ Longer raw water transmission lengths. ▪ More costly than Preferred Alternative (18% and 4% more, respectively).
4	Pee Dee River to Union County	▪ More significant environmental consequences associated with raw water storage (i.e. terminal reservoir). ▪ Source water not classified for public drinking water supply by NC. ▪ More costly than Preferred Alternative (34% more)
5	Rocky River to Union County	▪ May not meet the purpose and need for overall water demand. ▪ Source water not classified as a drinking water source by NC. ▪ More significant environmental consequences associated with raw water collection (i.e. low head dam) and storage (i.e. terminal reservoir).
6	Catawba River to Union County via Existing Catawba River Water Supply Project	▪ Places additional demands on existing high-demand surface waters. ▪ More significant environmental consequences for surface water quantity and quality interests in the Catawba River Basin. ▪ Likely would not be acceptable from a political/community perspective. ▪ More costly than Preferred Alternative (5% more).
7	Catawba River to Union County via Charlotte Water's Mountain Island Lake Withdrawal	▪ Places additional demands on existing high-demand surface waters. ▪ More significant environmental consequences for surface water quantity and quality interests in the Catawba River Basin. ▪ Likely would not be acceptable from a political/community perspective. ▪ More costly than Preferred Alternative (9% more).
8	Groundwater Supply	▪ Potentially has more significant environmental consequences associated with magnitude of groundwater well system. ▪ Requires extensive, prohibitive land acquisition to meet purpose & need ▪ More costly than Preferred Alternative (23% more).
9	Water Demand Management and Conservation	▪ Does not meet the purpose and need (i.e., will not supply projected water demand). ▪ Demand management and conservation reflected in historical water demand and future projections for Union County.

Alt.	Description	Key Differentiators in Comparison to Alternative 1
10	Direct Potable Reuse	▪ Does not meet the purpose and need (i.e., will not supply projected water demand). While regulatory framework was recently (2014) created to make this alternative possible in North Carolina, rules governing direct distribution of reclaimed water as potable water have not yet been established. ▪ Likely cost prohibitive and not accepted politically or by the community.
11	Alternative 1 with Wastewater Returns to Lake Tillery	▪ Has greater environmental consequences associated with wastewater return transmission mains and treated effluent discharge to Lake Tillery. ▪ Provides little additional environmental benefits. ▪ Is cost prohibitive from a capital cost perspective (57% more costly than Preferred Alternative); long-term cost and environmental impacts from continuous pumping of wastewater effluent.
12	No Action Alternative	▪ Does not meet purpose and need. ▪ Development and population growth within the County will continue to occur, but with less planning and mitigation. ▪ Additional strains put on other water supply sources (e.g. groundwater).

7.0 Water Withdrawals from the Source Basin

The Yadkin-Pee Dee River stretches from its headwaters near Blowing Rock, North Carolina, to Winyah Bay, east of Georgetown, South Carolina, where it discharges to the Atlantic Ocean. The extent of the watershed includes a small portion of Carroll County and Patrick County in Virginia, with the majority of the basin extending through North and South Carolina. In North Carolina, the watershed is known as the Yadkin River Basin, and known as the Pee Dee River Basin in South Carolina. Water uses from these watersheds include many public water systems and registered water withdrawals (industrial, thermal electric power, etc.) along with other uses such as agriculture.

In accordance with the requirements of G.S. 143-215.22L, Table 7-1 lists the North Carolina registered systems as provided by DWR. Additionally, these water uses have been included within the CHEOPS^{TM} model used for evaluation of water resource impacts as part of the FEIS and as described in Section 8.1 of this Petition.

Table 7-1 lists the public water systems while Table 7-2 lists all registered water withdrawals in the North Carolina portion of the Yadkin River Basin (18-1), based on data provided by DWR. There are no known withdrawals within the small portion of the basin in the Commonwealth of Virginia. However, in South Carolina there are several known public water systems and withdrawals within the basin which utilize the Pee Dee River for water supply, as listed in Table 7-3.

Currently, there is one existing NC IBT certificate for regulated water transfers from the Yadkin River Basin. The Cities of Concord and Kannapolis have an IBT certificate to transfer a maximum of 10 mgd from the Yadkin River basin to the Rocky River basin.

Other public water systems which currently utilize Lake Tillery (proposed Union County water supply source as part of this IBT) as a water supply source include Montgomery County and the Town of Norwood.

Table 7-1 Public Water Systems (Municipal) in the North Carolina Portion of the Yadkin River Basin

Public Water System ID	System Name	Stream	Reservoir Source	County
03-04-010	Anson County	Pee Dee River	Blewett Falls Lake	Anson
01-84-010	City of Albemarle	Yadkin River	Narrows Reservoir (Badin Lake)	Stanly
01-84-010	City of Albemarle	Yadkin River	Tuckertown Reservoir	Stanly
01-80-065	City of Kannapolis	Second Creek	-	Rowan
02-85-010	City of King	Yadkin River	-	Stokes
02-29-010	City of Lexington	Abbotts Creek	Lake Thom-A-Lex	Davidson
02-29-010	City of Lexington	Leonards Creek	City Lake	Davidson
02-86-010	City of Mount Airy	Lovills Creek	Allred Mill Reservoir	Surry
02-86-010	City of Mount Airy	Stewarts Creek	James K. Boyd Reservoir	Surry
02-86-025	City of Pilot Mountain	Toms Creek	-	Surry
03-77-015	City of Rockingham	-	City Pond	Richmond
03-77-015	City of Rockingham	-	Roberdel Lake	Richmond
01-80-010	City of Salisbury	Yadkin/S. Yadkin River		Rowan
02-29-020	City of Thomasville	Abbots Creek	Lake Thom-A-Lex	Davidson
03-04-020	City of Wadesboro	Jones Creek	City Pond	Anson
02-34-010	City of Winston-Salem	Salem Creek	Salem Lake	Forsyth
02-34-010	City of Winston-Salem	Yadkin River	W. Kerr Scott Reservoir	Forsyth
02-29-025	Davidson Water, Inc.	Yadkin River	-	Davidson
02-30-015	Davie County	Yadkin River	-	Davie
03-77-010	Hamlet Water System	-	Hamlet Water Lake	Richmond
03-62-010	Montgomery County	Pee Dee River	Lake Tillery	Montgomery
03-77-109	Richmond County	Pee Dee River	Blewett Falls Lake	Richmond
02-29-030	Town of Denton	Yadkin River	Tuckertown Reservoir	Davidson
02-86-020	Town of Elkin	Elkin Creek	Elkin Reservoir	Surry
02-86-020	Town of Elkin	Yadkin River	-	Surry
02-99-010	Town of Jonesville	Yadkin River	-	Yadkin
01-80-038	Town of Landis	Below Lake Corriher	Town Reservoir	Rowan
01-80-038	Town of Landis	Flat Rock Branch	Lake Corriher	Rowan
01-80-038	Town of Landis	Grants Creek tributary	Lake Wright	Rowan
01-97-010	Town of North Wilkesboro	Reddies River	-	Wilkes
01-84-015	Town of Norwood	Pee Dee River	Lake Tillery	Stanly
01-97-025	Town of Wilkesboro	Yadkin River	-	Wilkes
02-99-015	Town of Yadkinville	South Deep Creek	Yadkinville Reservoir	Yadkin

Table 7-2 Registered Water Withdrawals in the North Carolina Portion of the Yadkin River Basin

ID	Facility Name	Use Type	Use Sub-Type	County
0057-0011	Buck Steam Station	Industrial	Energy	Rowan
0171-0001	Sapona Country Club	Industrial	Energy	Davidson
0199-0000	Cabarrus Quarry	Energy	Thermal-electric	Cabarrus
0199-0006	Gold Hill Quarry	Recreation	Golf course	Cabarrus
0199-0010	Smith Grove Quarry	Mining	Mineral extraction	Davie
0199-0012	North Quarry	Mining	Mineral extraction	Forsyth
0199-0013	East Forsyth Quarry	Mining	Mineral extraction	Forsyth
0199-0019	Clear Creek Quarry	Mining	Mineral extraction	Mecklenburg
0199-0020	Rockingham Quarry	Mining	Mineral extraction	Richmond
0199-0024	115 Quarry	Mining	Mineral extraction	Wilkes
0199-0027	Elkin Quarry	Mining	Mineral extraction	Surry
0219-0010	Bakers Quarry	Mining	Mineral extraction	Union
0219-0012	Bonds Quarry	Mining	Mineral extraction	Cabarrus
0219-0019	Salem Stone Quarry	Mining	Mineral extraction	Forsyth
0219-0021	Thomasville Quarry	Mining	Mineral extraction	Davidson
0219-0027	Kannapolis Quarry	Mining	Mineral extraction	Rowan
0219-0030	Mallard Creek Quarry	Mining	Mineral extraction	Mecklenburg
0338-0001	Monroe Plant	Mining	Mineral extraction	Union
0378-0063	Windsor Chase	Mining	Mineral extraction	Mecklenburg
0378-0070	Lamplighter Village East	Industrial	Metal/Plastic / Fiberglass manufacturing	Mecklenburg
0378-0079	Country Hills	Public Water Supply	Drinking water	Mecklenburg
0378-0086	Country Club Annex	Public Water Supply	Drinking water	Forsyth
0378-0087	Grandview	Public Water Supply	Drinking water	Forsyth
0420-0003	Hedrick Mine	Public Water Supply	Drinking water	Anson
0013-0001	Salem Glen Country Club	Public Water Supply	Drinking water	Davidson
0019-0001	Tanglewood Park	Mining	Mineral extraction	Forsyth
0001-0001	Louisiana Pacific Corporation	Recreation	Golf course	Wilkes
0600-0001	Laurelmor	Recreation	Golf course	Watauga
0639-0001	Cedarbrook Country Club, Inc.	Industrial		Surry
0647-0001	Oak Valley Golf Club	Recreation	Golf course	Davie
0678-0001	Stone Mountain Golf Club Inc.	Recreation	Golf course	Wilkes
0692-0001	Fox Den Country Club, LLC	Recreation	Golf course	Iredell
0702-0001	Old North State Club	Recreation	Golf course	Stanly
0705-0001	True Elkin, Inc.	Recreation	Golf course	Surry
0236-0001	Willow Creek Golf Club	Recreation	Golf course	Davidson
0761-0001	Meadowlands Golf Club	Industrial		Davidson
0378-0105	Bradfield Farms	Recreation	Golf course	Mecklenburg
0378-0106	Heathfield	Recreation	Golf course	Mecklenburg
0378-0107	Larkhaven	Public Water Supply	Drinking water	Mecklenburg
0218-0019	Allen Woods Village	Public Water Supply	Drinking water	Surry
0218-0038	Bannertown Hills	Public Water Supply	Drinking water	Surry
0218-0061	Bostian Heights	Public Water Supply	Drinking water	Rowan
0786-0001	Blue Ridge Tissue Corp - Patterson Mill	Public Water Supply	Drinking water	Caldwell
0218-0075	British Woods	Public Water Supply	Drinking water	Surry
0218-0115	Colonial Woods	Industrial	Wood/Paper products	Surry

ID	Facility Name	Use Type	Use Sub-Type	County
0218-0119	Copperfield/Reston Woods	Public Water Supply	Drinking water	Yadkin
0218-0139	Crestview (Rowan)	Public Water Supply	Drinking water	Rowan
0218-0143	Cross Creek	Public Water Supply	Drinking water	Surry
0218-0149	Dearon Village	Public Water Supply	Drinking water	Surry
0218-0152	Deerfield (Surry)	Public Water Supply	Drinking water	Surry
0218-0165	Eagle Landing	Public Water Supply	Drinking water	Rowan
0218-0182	Farm (The)	Public Water Supply	Drinking water	Surry
0218-0220	Green Heights	Public Water Supply	Drinking water	Surry
0789-0001	Piney Point Golf Club	Public Water Supply	Drinking water	Stanly
0218-0228	Greenwood - Surry	Public Water Supply	Drinking water	Surry
0218-0256	Hickory Creek - Surry	Recreation	Golf course	Surry
0218-0261	Hillcrest	Public Water Supply	Drinking water	Surry
0218-0268	Hollows, The	Public Water Supply	Drinking water	Surry
0218-0282	Hunting Creek	Public Water Supply	Drinking water	Yadkin
0218-0287	Inglewood	Public Water Supply	Drinking water	Surry
0218-0292	Janets Retreat	Public Water Supply	Drinking water	Surry
0218-0305	Kimberly Courts	Public Water Supply	Drinking water	Rowan
0218-0309	Knollview	Public Water Supply	Drinking water	Rowan
0218-0356	Meadow View Estates	Public Water Supply	Drinking water	Surry
0218-0367	Mill Creek	Public Water Supply	Drinking water	Yadkin
0218-0372	Mitchell Bluff	Public Water Supply	Drinking water	Surry
0218-0382	Mountain View	Public Water Supply	Drinking water	Surry
0218-0407	Old Farm	Public Water Supply	Drinking water	Rowan
0218-0440	Pine Lakes	Public Water Supply	Drinking water	Surry
0218-0441	Pine Meadows	Public Water Supply	Drinking water	Rowan
0218-0461	Reeves Woods	Public Water Supply	Drinking water	Surry
0218-0510	Shade Tree Acres	Public Water Supply	Drinking water	Rowan
0218-0525	Snow Hill	Public Water Supply	Drinking water	Surry
0253-0001	Sandhill Turf Inc.	Public Water Supply	Drinking water	Montgomery
0218-0535	South Ridge	Public Water Supply	Drinking water	Surry
0218-0545	Spencer Forest	Agricultural	Sod/Turf production	Rowan
0218-0554	Springfield	Public Water Supply	Drinking water	Surry
0218-0563	State Road	Public Water Supply	Drinking water	Surry
0218-0575	Stonington	Public Water Supply	Drinking water	Forsyth
0218-0604	Timberlake - Surry	Public Water Supply	Drinking water	Surry
0218-0627	Walnut Tree	Public Water Supply	Drinking water	Surry
0218-0632	Wedgewood	Public Water Supply	Drinking water	Surry
0218-0639	Westcliff	Public Water Supply	Drinking water	Rowan
0218-0641	Westhaven MHP	Public Water Supply	Drinking water	Rowan
0218-0643	Westridge	Public Water Supply	Drinking water	Surry
0218-0645	Westwood MHP	Public Water Supply	Drinking water	Rowan
0218-0657	Willow Creek - Stokes	Public Water Supply	Drinking water	Stokes
0218-0665	Windgate	Public Water Supply	Drinking water	Surry
0218-0668	Windmill Ridge	Public Water Supply	Drinking water	Rowan
0218-0673	Woodbridge - Surry	Public Water Supply	Drinking water	Surry
0218-0675	Woodcreek	Public Water Supply	Drinking water	Surry
0802-0001	Warrior Golf Club	Public Water Supply	Drinking water	Rowan
0810-0001	Bermuda Run Country Club	Public Water Supply	Drinking water	Davie
0187-0003	High Rock Powerhouse	Recreation	Golf course	Stanly
0187-0004	Tuckertown Powerhouse	Recreation	Golf course	Montgomery
0187-0005	Narrows Powerhouse	Energy	Thermal-electric	Stanly

ID	Facility Name	Use Type	Use Sub-Type	County
0187-0006	Falls Powerhouse	Energy	Thermal-electric	Stanly
0356-0004	Norman Sand Company	Energy	Thermal-electric	Montgomery
0006-0006	Rowan Loop	Energy	Thermal-electric	Rowan
0006-0007	Davidson Loop	Mining	Mineral extraction	Davidson
0422-0002	Interface, Inc.	Energy	Temporary pipeline testing	Surry
0057-0021	Buck Combined Cycle Station	Energy	Temporary pipeline testing	Rowan

Table 7-3 Permitted Water Withdrawals in the South Carolina Portion of the Yadkin River Basin (that is Pee Dee River Basin)

ID	System/Facility Name	County
13GC001	South Carolina Department of Parks Recreation & Tourism	Chesterfield
13GC003	White Plains Country Club	Chesterfield
13IN002	Hanson Aggregates Southeast LLC	Chesterfield
13MI003	Hanson Aggregates Southeast LLC	Chesterfield
SDWIS	Town of Cheraw	Chesterfield
16IN004	Galey & Lord Industries LLC	Darlington
16IN005	Sonoco Products Company	Darlington
16IN006	Nucor Corporation	Darlington
16PN001	Progress Energy Company Inc.	Darlington
21GC001	Florence Country Club	Florence
21IN001	Rocktenn CP LLC	Florence
SDWIS	City of Florence	Florence
26GC007	Dunes Golf & Beach Club	Horry
SDWIS	City of Georgetown	Georgetown
26GC011	National Golf Management LLC	Horry
26GC014	GGG of Myrtle Beach LLC	Horry
26GC017	Burroughs & Chapin Company Inc.	Horry
26GC019	Myrtle Beach Farms	Horry
26GC029	River Hills Golf & Country Club	Horry
26GC030	River Oaks Golf Plantation LLC	Horry
26GC032	Shaftsbury Glen Golf and Fish Club	Horry
26GC039	GGG of Myrtle Beach LLC	Horry
26GC040	National Golf Management LLC	Horry
26GC049	Arrowhead Country Club	Horry
26GC058	Signature Golf LLC	Horry
26GC061	BRCG LLC	Horry
26GC064	Fife Golf Management LLC	Horry
26GC067	National Golf Management LLC	Horry
26PT001	Santee Cooper	Horry
26WS009	Grand Strand Water & Sewer Authority	Horry
26WS053	Grand Strand Water & Sewer Authority	Horry
34IN005	Domtar Paper Company LLC	Marlboro
34MI001	Hanson Aggregates Southeast LLC	Marlboro
SDWIS	City of Bennettsville	Marlboro

8.0 Impacts Analysis for the Proposed Transfer

8.1. CHEOPS™ Model Platform

8.1.1. Background

As part of the technical evaluations conducted for Union County's YRWSP, the County and Duke Energy contracted with HDR Engineering, Inc. of the Carolinas (HDR) to update an existing operations model of the Yadkin River Basin in North Carolina. The existing water quantity / hydro operations model was originally developed to support the Yadkin–Pee Dee Hydroelectric Project (No. 2206) Federal Energy Regulatory Commission (FERC) relicensing using the CHEOPS™ (Computerized Hydro Electric Operations Planning Software) platform and included the six hydroelectric developments on the Yadkin–Pee Dee River from High Rock reservoir through Blewett Falls reservoir, all in North Carolina (HDR, 2014b).

CHEOPS™ is designed to evaluate the effects of operational changes and physical modifications at multi-development hydroelectric projects. The model, as developed for relicensing, included the Duke Energy Progress-owned Yadkin-Pee Dee Hydroelectric Project, FERC No. 2206, which includes the Tillery and Blewett Falls Developments, and the upstream Alcoa Power Generating, Inc. (APGI)-owned Yadkin Hydroelectric Project, FERC No. 2197, which includes the High Rock, Tuckertown, Narrows, and Falls Developments. The relicensing operations model has been updated as part of this EIS to include the most-upstream reservoir, W. Kerr Scott, owned by the U.S. Army Corps of Engineers (USACE) (HDR, 2014a).

The seven aforementioned Duke Energy Progress, APGI, and USACE facilities are collectively referred to herein as "the system." This expanded model is intended to be used as a tool to assist in evaluating water quantity distribution between the seven reservoirs due to changes in model inputs including various operational modifications and possible interbasin transfers (IBT) (HDR, 2014b). Such evaluations have been performed by reviewing relative changes between proposed operational modifications (YRWSP alternatives) within the system. The Yadkin-Pee Dee Basin CHEOPS™ model was specifically used as part of the FEIS to evaluate the direct effects of the proposed water withdrawals for Alternatives 1, 2A, 2B, 3, 4, 5 and 11 on water quantity, and support subsequent analysis on water quality.

While Duke Energy Progress relied on the CHEOPS™ model platform during their FERC relicensing for the Yadkin-Pee Dee River Hydroelectric Project, APGI relied on the OASIS™ model platform for water supply evaluations associated with FERC relicensing of their Yadkin Hydroelectric Project. The OASIS™ platform is similar to that of CHEOPS™. However, the CHEOPS™ model was used for purposes of this IBT evaluations due-in-part to recent hydrology updates made to the model through 2013 to include the most recent drought during 2006-2009, and incorporation of both the APGI and Duke Energy Progress system operating rules defined in their FERC relicensing applications and settlement agreements.

While the CHEOPS™ model was initially constructed for Duke Energy Progress' (formerly Progress Energy) Federal Energy Regulatory Commission (FERC) relicensing process for its

Yadkin-Pee Dee Hydroelectric Project, the following updates were completed for this IBT process and used by Union County for evaluation of alternatives in the FEIS:

- A 59-year hydrological record from 1955 through 2013.
- Inflow adjustments based on historical reservoir operations, modified to eliminate negative inflow values from the data set.
- Inclusion of net daily evaporation from reservoirs.
- Basin-wide water withdrawals and return flow projections for all users through 2060 were developed specifically for the Union County YRWSP FEIS evaluations. The evaluations for the FEIS are based on current (Year 2012) and future (Year 2050) water demands, as 2050 is the projection period used for Union County's YRWSP. However, basin-wide water demand projections were also extended an additional ten years to 2060 for updating the CHEOPS™ model to provide an approximate 5-decade projection period to allow flexibility for potential future uses of the model.
- Inclusion of the Low Inflow Protocol (LIP) for the Yadkin and Yadkin-Pee Dee River Hydroelectric Projects for procedures on how the Yadkin-Pee Dee River reservoir system, as a whole, will be operated when inflow into the reservoirs is not enough to meet normal water demands while also maintaining lake levels within their normal ranges.

A detailed Yadkin-Pee Dee Basin CHEOPS™ Operations Model Study Model Logic and Verification Report may be found in FEIS appendices. It is also noted that, for purposes of the FEIS, surface water alternatives in the Catawba River Basin were also evaluated using a similar CHEOPS™ model for that basin. Similar detailed information on the Catawba-Wateree Basin CHEOPS™ model may also be found in the FEIS appendices.

8.1.2. Scenario Name and Details - Union County YRWSP IBT

While all surface water supply alternatives were modeled using the CHEOPS™ platform, for the alternatives evaluation included the FEIS, the following list describes the modeling scenario runs which are applicable for the proposed Union County IBT from Lake Tillery (Alternative 1) and the baseline conditions to which the alternative is to be compared.

- **BLY-2012 (Yadkin Baseline-2012)**
  - Existing 5 mgd (net) Union County grandfathered Catawba IBT from Catawba River, withdrawn at CRWTP between Lake Wylie and Fishing Creek Reservoir
  - No additional IBT for Union County's YRWSP
  - Current (Year 2012) basin-wide water demands (withdrawals/returns)
- **BLY-2050 (Yadkin Baseline-2050)**
  - Existing 5 mgd (net) Union County grandfathered Catawba IBT from Catawba River, withdrawn at CRWTP between Lake Wylie and Fishing Creek Reservoir
  - No additional IBT for Union County's YRWSP
  - Future (Year 2050) basin-wide water demands (withdrawals/returns)
  - Includes future impact of climate change in future years resulting in an increased temperature of 2.3 deg F (0.6 deg F increase per decade) and lake surface evaporation increases of 7.8% (equivalent to an increase of 2% per decade), as

compared to the 2012 baseline. This impact is consistent with the climate change impact considered by the Catawba-Wateree Water Management Group in preparation of the Catawba-Wateree Water Supply Master Plan baseline planning scenario, and is consistent with modeled climate change scenarios for this region of the United States.

- **A1-2012 (Alternative 1-2012)**
  - 23 mgd (maximum month daily average demand (MMDD)) IBT (net) from Pee Dee River, withdrawn at Lake Tillery
  - Current (Year 2012) basin-wide water demand (withdrawals/returns) with Union County YRWSP projected Year 2050 IBT
  - Used to compare effects of Alternative 1 to BLY-2012 (Yadkin Baseline-2012) scenario under current basin-wide water demand.
- **A1-2050 (Alternative 1-2050)**
  - 23 mgd (MMDD) IBT (net) from Pee Dee River, withdrawn at Lake Tillery
  - Future (Year 2050) basin-wide water demand (withdrawals/returns) with Union County YRWSP projected Year 2050 IBT
  - Used to compare effects of Alternative 1 to BLY-2050 (Yadkin Baseline-2050) scenario under future projected basin-wide water demand.
  - Includes future impact of climate change identified in scenario BLY-2050.

8.1.3. Use of Model Results

The model results were used to analyze impacts of the proposed surface water supply alternatives for the Union County YRWSP on specific parameters. Model results were analyzed for the following parameters:

- Lake Levels
  - Aesthetics
    - Effect of IBT alternatives on lake aesthetics, based on lake elevation
  - Water Withdrawal
    - Effect of IBT alternatives on water supply/withdrawal by other water users, based on lake elevation and storage.
- Reservoir Outflows (Downstream releases)
  - Effect of IBT alternatives on reservoir outflow for each of the reservoirs in the system
- Water Quantity Management (LIP Occurrence)
  - Effect of IBT alternatives on system-wide occurrence of various LIP levels
- Hydropower Generation
  - Effect of IBT alternatives on Duke Energy Progress and APGI hydropower generation

Three distinct hydrologic periods were analyzed within the model for each scenario, and included the following:

- Full Period of Record (59-year hydrology, 1955-2013)
- Drought 1 (5-year low inflow period (Drought of Record), 1999-2003)
- Drought 2 (4-year low inflow period; most recent significant drought), 2006-2009)

Under these parameters, the results of the modeling are summarized in a set of Performance Measure Sheets (PMS) for comparison purposes to assess the impacts of IBT quantity on the system and its reservoirs, as compared to "baseline" conditions under both current and future water demands throughout the Yadkin River Basin. This assessment and development of performance metrics were based on HDR's recently enhanced CHEOPS™ model and the operating agreements used as the basis for the FERC license applications for the Yadkin and Yadkin-Pee Dee Hydroelectric Projects filed with FERC in April 2006, and the Comprehensive Settlement Agreements for the relicensing of the Yadkin and Yadkin-Pee Dee Hydroelectric Projects dated February, 2007 and June, 2007, respectively.

The original concept of the PMS was developed during the relicensing process for the Duke Energy Catawba-Wateree Hydroelectric Project. Since the 11 reservoirs and numerous diverse stakeholders to the system all had different metrics of interest and differing opinions on how to rate differences between operating regimes (as computed and measured as output to model scenarios), the PMS concept was developed. In this concept, each reservoir basin is evaluated with general criteria such as reservoir elevations, outflows, powerhouse generation, and time spent in Low Inflow Protocol (LIP) stages. Since recreational boaters and parties who withdraw water for consumptive uses have different criteria, general categories were developed. These different categories allow for the setting of the elevation or flow of interest, and the variance around that value which is considered acceptable, moderately acceptable, or not acceptable. Each stakeholder in the relicensing process had an opportunity to participate in the identification of categories and setting of the metric values to best represent their interests.

Additional experience in the PMS development process was gained during the Keowee-Toxaway relicensing for Duke Energy's Jocassee, and Keowee hydroelectric developments. During this relicensing process, stakeholder inputs were sought and utilized in measuring the impacts from one operating regime to another.

During the Union County IBT model development process, HDR worked with Union County, Duke Energy and NCDWR representatives to identify likely metrics and conditions which may be of concern to stakeholders. The metrics of this PMS contain the licensed flow/discharge requirements, amount of time spent at or near the maximum pool elevation(s), target elevation(s), minimum elevation(s) and critical elevation(s), amount of time spent in LIP stages, and hydropower generation.

The results summarized in the following sections of this Petition are for the purposes of comparing the potential impacts of the proposed Union County IBT from Lake Tillery to the baseline conditions under both current (2012) and projected future (2050) water demands

throughout the Yadkin River Basin. Further, the PMS reflecting results and comparisons of all surface water alternatives evaluated as part of the FEIS, for both Yadkin and Catawba River Basins, may be found in Appendix C of this Petition. Additional modeling output may also be referenced within the FEIS and its associated appendices.

8.2. Lake Level - Aesthetics

Often of important consideration to lakeside property owners and parties with recreational interests for particular lakes is the effect of water withdrawals on lake elevations and, subsequently, lake aesthetics. Given this consideration, the effect of each Union County surface water supply alternative from the Yadkin River Basin was evaluated in CHEOPS™ for their effect on lake elevations, relative to the operating rule/guide curve, full pond elevation, and/or normal minimum elevation for a particular reservoir, as a percentage of time the end of day elevations are within a particular range of the reservoir rule/guide curve or full pond elevation.

8.2.1. Lake Tillery

Percent of Time Adherence to Target Elevation

Table 8-1 indicates the modeled impacts to Lake Tillery elevations as the result of Union County's proposed IBT withdrawal from the lake based on current (Year 2012) basin-wide water demands (ALT 1 - 2012 with Union IBT as compared to Baseline 2012) and projected future (Year 2050) basin-water water demands (ALT 1 - 2050 with Union IBT as compared to Baseline 2050). The specific performance measures evaluated includes the percent of time the end of day reservoir levels were within a given range of their full pond, normal winter minimum, and normal summer minimum elevations, as indicated in the table, for the POR, Drought 1 and Drought 2 time periods.

Results of these performance measures indicate no modeled impact of the proposed Union County IBT under current (Year 2012) basin-wide water demands for the POR, Drought 1 or Drought 2 periods. Results of these performance measures do indicate slight negative impacts of the proposed Union County IBT under projected future (Year 2050) basin-wide water demands for adherence to the full pond elevation and normal summer minimum elevation during the Drought 1 time period, only.

Table 8-1 Lake Tillery – Modeled Impacts to Lake Elevations (Adherence to Target Elevations)

Performance Measures	Criterion [1] % of time end of day reservoir level within:	Modeled Period [2]	Scenario Result Comparison [3]			
			Baseline 2012	ALT 1 - 2012 with Union IBT	Baseline 2050	ALT 1 - 2050 with Union IBT
Adherence to reservoir full pond elevation (EL 278.2 ft. msl) *(Jan. 1 to Dec. 31)*	+/- 1 ft of full pond	POR	100%	100%	100%	100%
		D1	100%	100%	100%	98%
		D2	99%	99%	99%	99%
	+/- 2 ft of full pond	POR	100%	100%	100%	100%
		D1	100%	100%	100%	100%
		D2	100%	100%	100%	100%
	+/- 3 ft of full pond	POR	100%	100%	100%	100%
		D1	100%	100%	100%	100%
		D2	100%	100%	100%	100%

Performance Measures	Criterion [1] % of time end of day reservoir level within:	Modeled Period [2]	Scenario Result Comparison [3]			
			Baseline 2012	ALT 1 - 2012 with Union IBT	Baseline 2050	ALT 1 - 2050 with Union IBT
Adherence to reservoir normal winter min. elevation (EL 273.2 ft. msl) *(Dec. 16 to Feb. 28)*	+/- 1 ft of normal min. elevation	POR	0%	0%	0%	0%
		D1	0%	0%	0%	0%
		D2	0%	0%	0%	0%
	+/- 2 ft of normal min. elevation	POR	0%	0%	0%	0%
		D1	0%	0%	0%	0%
		D2	0%	0%	0%	0%
	+/- 3 ft of normal min. elevation	POR	0%	0%	0%	0%
		D1	0%	0%	0%	0%
		D2	0%	0%	0%	0%
Adherence to reservoir normal summer min. elevation (EL 275.7 ft. msl) *(Mar. 1 to Dec. 15)*	+/- 1 ft of normal min. elevation	POR	0%	0%	0%	0%
		D1	1%	1%	1%	2%
		D2	0%	0%	0%	0%
	+/- 2 ft of normal min. elevation	POR	37%	37%	37%	37%
		D1	37%	37%	38%	39%
		D2	38%	38%	38%	38%
	+/- 3 ft of normal min.elevation	POR	100%	100%	100%	100%
		D1	100%	100%	100%	100%
		D2	100%	100%	100%	100%

Notes:

[1] For criterion that measure on an hourly or daily basis, unless stated otherwise: a) If an hourly criteria occurs during the average of four contiguous 15-minute periods, then it counts as 1 hour; b) If a daily criterion occurs for 5 contiguous 1-hour periods, then it counts as 1 day. Also, daytime flows are assumed to be flows provided between 7:00 am and 7:00 pm. To the extent possible, each criterion is defined in terms of percents and averages/yr so that the same criterion is useful regardless of the length of the hydrology period (i.e., 1-yr, 3-yr, full period of record, etc.)

[2] POR = Period of Record (1955-2013); D1 = Drought 1 (1999-2003); D2 = Drought 3 (2006-2009)

[3] For scenario results comparison, black values indicate no modeled change/impact for Alternative 1 (Union County IBT) as compared to baseline scenario; red values indicate modeled negative impact for Alternative 1 (Union County IBT) as compared to the baseline scenario; green values indicate modeled positive impact for Alternative 1 (Union County IBT) as compared to the baseline scenario.

Actual Lake Elevation Impact

As indicated in Table 8-2, model results do not indicate a distinguishable difference in annual average Lake Tillery elevations for the Period of Record (POR, 1955-2013), Drought 1 (1999-2003) and Drought 2 (2006-2009) periods as compared to the baseline operations with current basin-wide water demands. Modeling additionally indicates that with the 2050 demands of the Union County IBT, there is no distinguishable difference in annual average Lake Tillery elevations for the POR, Drought 1 and Drought 2 periods when compared to the baseline operations with future (Year 2050) basin-wide water demands.

Table 8-2 Lake Tillery – Average Annual Modeled Lake Elevation

Modeled Period [1]	Scenario Result Comparison – Annual Average Lake Elevation (ft msl) [2]			
	Baseline 2012	ALT 1 - 2012 with Union IBT	Baseline 2050	ALT 1 - 2050 with Union IBT
POR	278.0’	278.0’	278.0’	278.0’
D1	278.0’	278.0’	278.0’	278.0’
D2	278.0’	278.0’	278.0’	278.0’

Notes:
[1] POR = Period of Record (1955-2013); D1 = Drought 1 (1999-2003); D2 = Drought 3 (2006-2009)
[2] For scenario results comparison, black values indicate no modeled change/impact for Alternative 1 (Union County IBT) as compared to baseline scenario; red values indicate modeled negative impact for Alternative 1 (Union County IBT) as compared to the baseline scenario; green values indicate modeled positive impact for Alternative 1 (Union County IBT) as compared to the baseline scenario.

However, some impacts are observed in the monthly average Lake Tillery elevations. A summary description of these lake elevation impacts is also included in Table 8-3. Illustrations 8-1 through 8-6 graphically summarize the modeled Lake Tillery monthly average lake elevation impacts.

Table 8-3 Summary of Modeled Lake Tillery Monthly Average Lake Elevation Impacts

Illustration	Description	Summary of Impacts
8-1	**Period of Record** (1955-2013) under Current (2012) Basin-Wide Water Demand Projections	No detectable impact to average monthly lake elevations throughout the Period of Record due to proposed Union County IBT when added to current (2012) basin-wide water demands.
8-2	**Period of Record** (1955-2013) under Future (2050) Basin-Wide Water Demand Projections	A single detectable impact to monthly lake elevations throughout the Period of Record due to proposed Union County IBT when added projected future (2050) basin-wide water demands. This event is during the 2002 Drought of Record and indicates a maximum impact of 9-inches during a single month (August, 2002). The impact is largely due to the additional projected future basin-wide water demands (including potential future power generating facilities) and climate change, coupled with the proposed Union County IBT, and modeled as occurring during the most intense part of the Drought of Record when the system is most stressed. Despite the impacts, the modeled average monthly lake elevation during August, 2002 is EL 276.95’ msl, remaining 1’-3” above the Lake Tillery normal summer minimum elevation (EL 275.7’ msl), and well within the summer operating rules for the lake.
8-3	**Drought 1** (1999-2003) under Current (2012) Basin-Wide Water Demand Projections	No detectable impact to average monthly lake elevations throughout Drought 1 due to proposed Union County IBT when added to current (2012) basin-wide water demands.

Illustration	Description	Summary of Impacts
8-4	**Drought 1** (1999-2003) under Future (2050) Basin-Wide Water Demand Projections	A single detectable impact to monthly lake elevations throughout Drought 1 (1999-2003) due to proposed Union County IBT when added to projected future (2050) basin-wide water demands. This event is during the 2002 Drought of Record and indicates a maximum impact of 9-inches during the month of August, 2002. Elevation impacts of 1-inch, 9-inches, and 3-inches are noted during this drought from July through September, 2002, respectively, with an additional 1-inch impact in December, 2002. Impacts are largely due to the large additional projected future basin-wide water demands (including potential future power generating facilities) and climate change, coupled with the proposed Union County IBT, and modeled as occurring during the most intense part of the Drought of Record when the system is most stressed. Despite the impacts, the modeled average monthly lake elevation during August, 2002 is EL 276.95' msl, remaining 1'-3" above the Lake Tillery normal summer minimum elevation (EL 275.7' msl), and well within the summer operating rules for the lake.
8-5	**Drought 2** (2006-2009) under Current (2012) Basin-Wide Water Demand Projections	No detectable impact to average monthly lake elevations throughout Drought 2 due to proposed Union County IBT when added to current (2012) basin-wide water demands.
8-6	**Drought 2** (2006-2009) under Future (2050) Basin-Wide Water Demand Projections	No detectable impact to average monthly lake elevations throughout Drought 2 due to proposed Union County IBT when added to projected future (2050) basin-wide water demands.

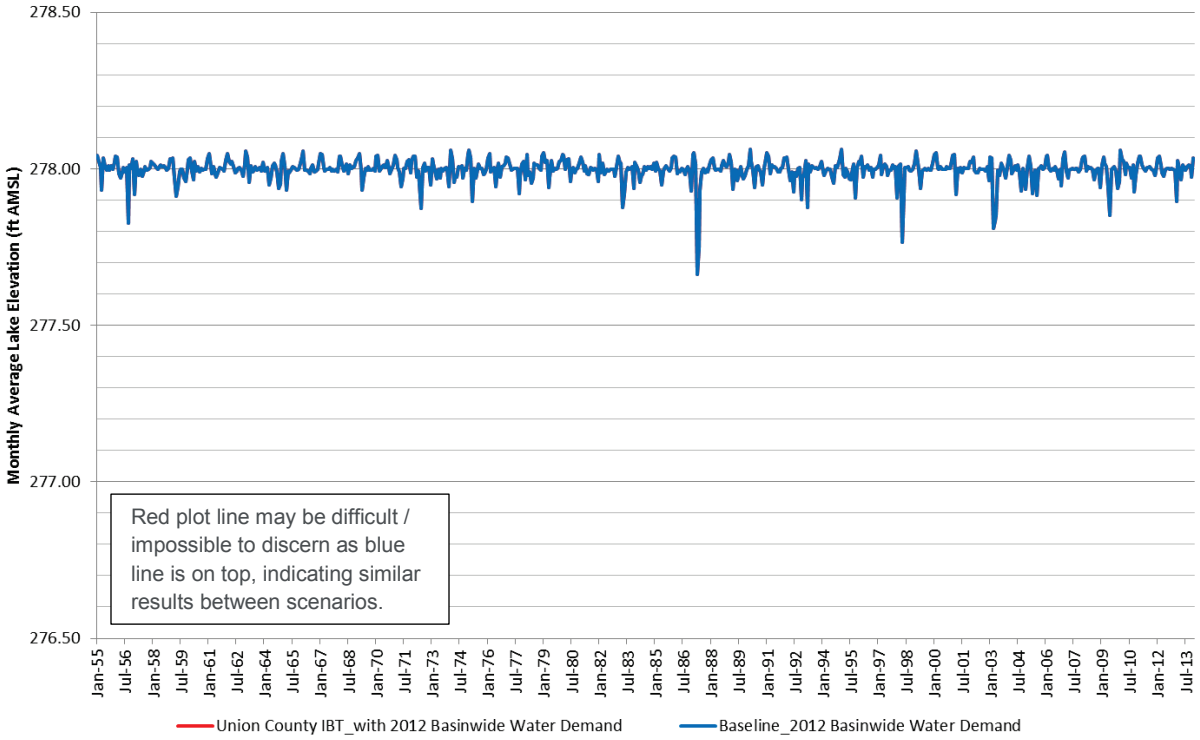

Illustration 8-1 Lake Tillery Monthly Average Modeled Lake Elevations – Period of Record (1955-2013) under Current (Year 2012) Basin-Wide Water Demand Projections

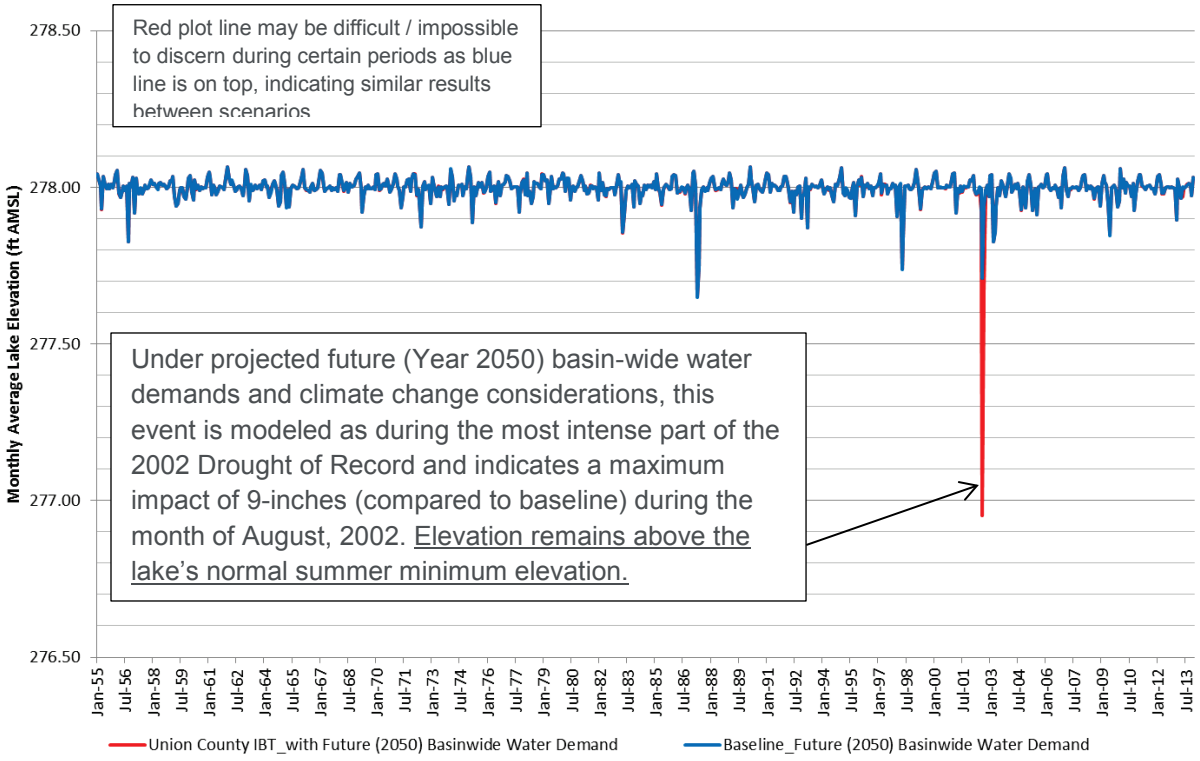

Illustration 8-2 Lake Tillery Monthly Average Modeled Lake Elevations – Period of Record (1955-2013) under Future (Year 2050) Basin-Wide Water Demand Projections

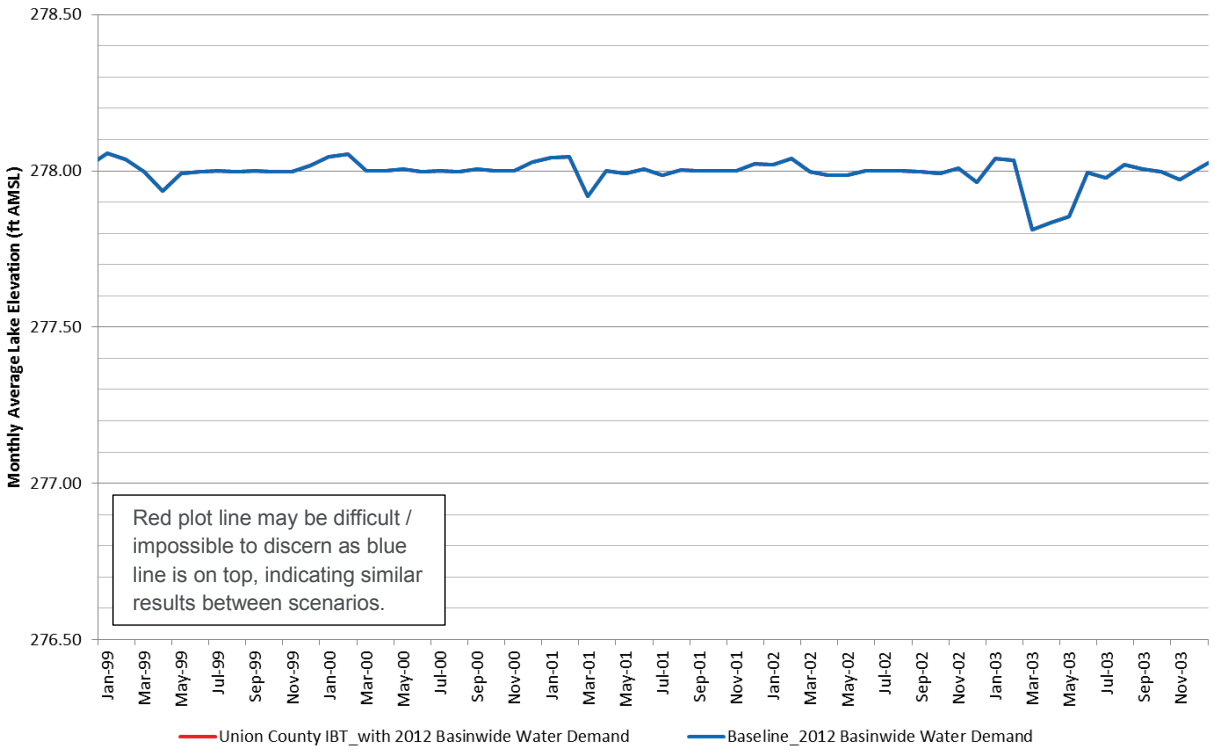

Illustration 8-3 Lake Tillery Monthly Average Modeled Lake Elevations – Drought 1 (1999-2003) under Current (Year 2012) Basin-Wide Water Demand Projections

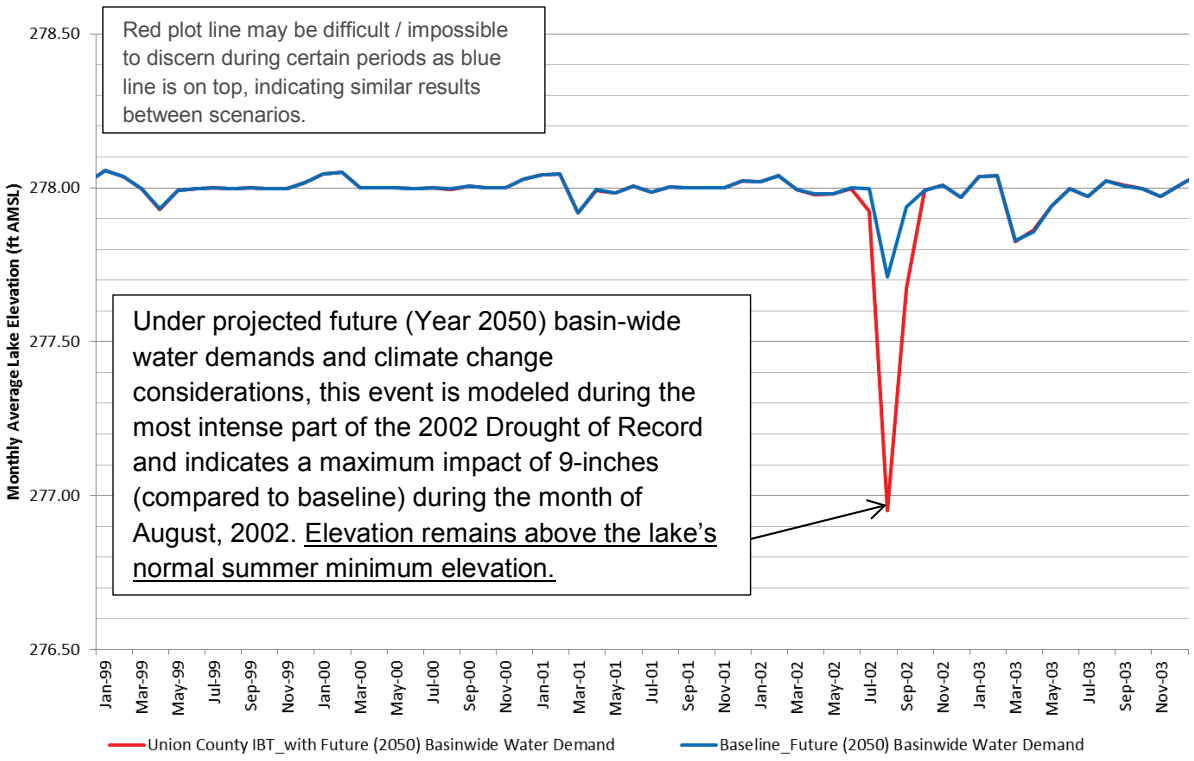

Illustration 8-4 Lake Tillery Monthly Average Modeled Lake Elevations – Drought 1 (1999-2003) under Future (Year 2050) Basin-Wide Water Demand Projections

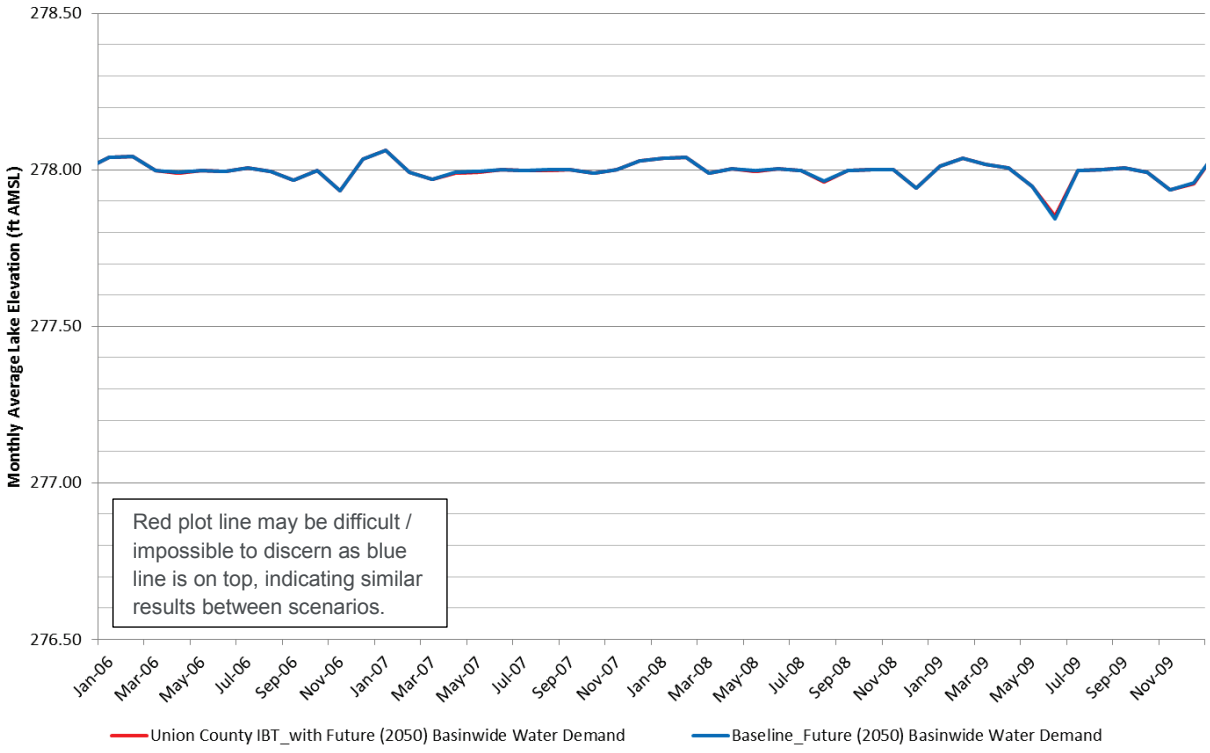

Illustration 8-5 Lake Tillery Monthly Average Modeled Lake Elevations – Drought 2 (2006-2009) under Current (Year 2012) Basin-Wide Water Demand Projections

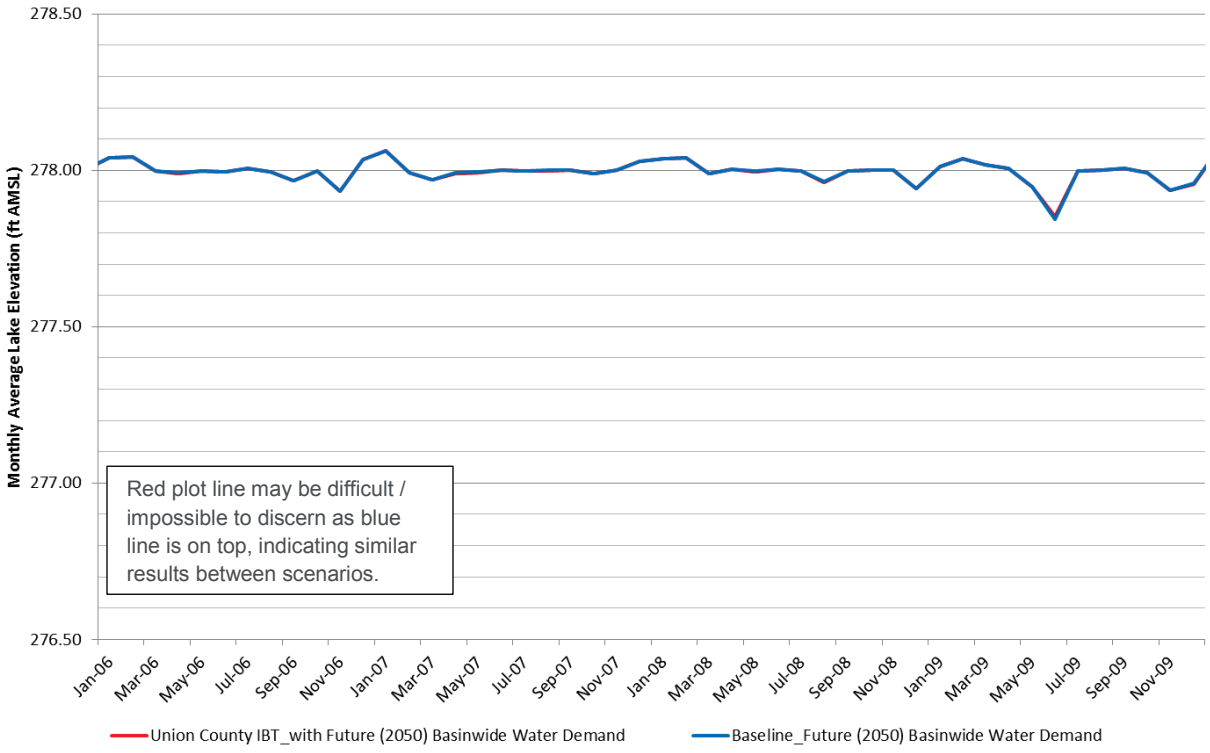

Illustration 8-6 Lake Tillery Monthly Average Modeled Lake Elevations – Drought 2 (2006-2009) under Future (Year 2050) Basin-Wide Water Demand Projections

Impact to Recreational Facilities – Public Boat Ramps

The five following public boat access areas are located on Lake Tillery: Swift Island, Stony Mountain, Norwood, Lilly's Bridge, and Morrow Mountain State Park. As a result of Duke Energy's merger with Progress Energy, Duke Energy Progress only has ramp elevation information for the Norwood access area, based on recent survey data. The ramps at Norwood become unusable at 3.4' feet below full pond (unusable at EL 274.8' msl). The bottom of this ramp is at EL 271.8 msl', or about 6.4' below full pond. Generally, the other ramps on Lake Tillery become unusable when there is approximately 3 feet and less water depth at the end of the ramp. Duke Energy Progress indicates all boat ramps remain accessible down to the normal summer minimum lake operating level of EL 275.7' msl or below during the recreation season.

As indicated in the modeling results in the preceding sections, the lowest modeled lake elevation is EL 276.95' msl, remaining 1'-3" above the Lake Tillery normal summer minimum elevation (EL 275.7' msl), well within the summer operating rules for the lake, and over two feet above the usable level for the Norwood access area. As all ramps are accessible down to the normal summer minimum lake elevation or below, no impacts to public boat access areas on Lake Tillery are expected as a result of the proposed Union County IBT.

8.2.2. Blewett Falls Lake (downstream impoundment)

Percent of Time Adherence to Target Elevation

Table 8-4 indicates the modeled impacts to Blewett Falls Lake elevations as the result of Union County's proposed IBT withdrawal from Lake Tillery, upstream, based on current (Year 2012) basin-wide water demands (ALT 1 - 2012 with Union IBT as compared to Baseline 2012) and projected future (Year 2050) basin-water water demands (ALT 1 - 2050 with Union IBT as compared to Baseline 2050). The specific performance measures evaluated includes the percent of time the end of day reservoir levels were within a given range of their full pond, normal winter minimum, and normal summer minimum elevations, as indicated in the table, for the POR, Drought 1 and Drought 2 time periods.

Results of these performance measures indicate slight negative impacts of the proposed Union County IBT under current (Year 2012) basin-wide water demands for the POR and Drought 1 periods for adherence to the full pond elevation, but no impact for the normal winter or normal summer minimum elevations. Results of these performance measures also indicate slight negative impacts of the proposed Union County IBT under projected future (Year 2050) basin-wide water demands for adherence to the full pond, normal winter minimum, and normal summer minimum elevations.

It is important to note, however, that modeling (as presented in the FEIS) indicates any of the proposed Union County withdrawal alternatives (including the non-IBT Alternative 5 Rocky River withdrawal) from Duke Energy Progress' Yadkin-Pee Dee Hydroelectric Project or tributaries flowing to Blewett Falls Lake would have some impact on the elevation of Blewett Falls Lake, based on the operational rules related to system inflow for the hydropower project.

Table 8-4 Blewett Falls Lake – Modeled Impacts to Lake Elevations (Adherence to Target Elevations)

Performance Measures	Criterion [1] % of time end of day reservoir level within:	Modeled Period [2]	Scenario Result Comparison [3]			
			Baseline 2012 ALT 1	2012 with Union IBT	Baseline 2050 ALT 1	2050 with Union IBT
Adherence to reservoir full pond elevation (EL 178.1 ft. msl) *(Jan 1 to Dec. 31)*	+/- 1 ft of full pond	POR	10%	10%	10%	10%
		D1	7%	7%	6%	6%
		D2	6%	6%	7%	7%
	+/- 2 ft of full pond	POR	76%	75%	76%	76%
		D1	81%	80%	77%	76%
		D2	79%	79%	79%	78%
	+/- 3 ft of full pond	POR	81%	81%	81%	81%
		D1	86%	86%	82%	81%
		D2	83%	83%	84%	83%
Adherence to reservoir normal min. elevation (EL 172.1 ft. msl) *(Jan 1 to Dec. 31)*	+/- 1 ft of normal min. elevation	POR	0%	0%	0%	1%
		D1	1%	1%	2%	4%
		D2	0%	0%	0%	0%
	+/- 2 ft of normal min. elevation	POR	10%	10%	10%	10%
		D1	8%	8%	12%	12%
		D2	11%	11%	10%	11%
	+/- 3 ft of normal min.elevation	POR	23%	23%	23%	23%
		D1	18%	18%	22%	23%
		D2	21%	21%	21%	21%

Notes:
[1] For criterion that measure on an hourly or daily basis, unless stated otherwise: a) If an hourly criteria occurs during the average of four contiguous 15-minute periods, then it counts as 1 hour; b) If a daily criterion occurs for 5 contiguous 1-hour periods, then it counts as 1 day. Also, daytime flows are assumed to be flows provided between 7:00 am and 7:00 pm. To the extent possible, each criterion is defined in terms of percents and averages/yr so that the same criterion is useful regardless of the length of the hydrology period (i.e., 1-yr, 3-yr, full period of record, etc.)
[2] POR = Period of Record (1955-2013); D1 = Drought 1 (1999-2003); D2 = Drought 3 (2006-2009)
[3] For scenario results comparison, black values indicate no modeled change/impact for Alternative 1 (Union County IBT) as compared to baseline scenario; red values indicate modeled negative impact for Alternative 1 (Union County IBT) as compared to the baseline scenario; green values indicate modeled positive impact for Alternative 1 (Union County IBT) as compared to the baseline scenario.

Actual Lake Elevation Impact

As indicated in Table 8-5, with the 2050 demands of the Union County IBT, model results do not indicate a distinguishable difference in actual annual average Blewett Falls Lake elevations for the POR, Drought 1 and Drought 2 periods when compared to the baseline operations with current basin-wide water demands. However, with the 2050 demands of the Union County IBT, annual average Blewett Falls Lake elevations for the Drought 1 period would be 1-inch lower, as compared to baseline operations with future (Year 2050) basin-wide water demands.

Table 8-5 Lake Tillery – Average Annual Modeled Lake Elevation

Modeled Period [1]	Scenario Result Comparison – Annual Average Lake Elevation (ft msl) [2]			
	Baseline 2012	ALT 1 - 2012 with Union IBT	Baseline 2050	ALT 1 - 2050 with Union IBT
POR	176.5’	176.5’	176.5’	176.5’
D1	176.6’	176.6’	176.4’	176.3’
D2	176.5’	176.5’	176.5’	176.5’

Notes:
[1] POR = Period of Record (1955-2013); D1 = Drought 1 (1999-2003); D2 = Drought 3 (2006-2009)
[2] For scenario results comparison, black values indicate no modeled change/impact for Alternative 1 (Union County IBT) as compared to baseline scenario; red values indicate modeled negative impact for Alternative 1 (Union County IBT) as compared to the baseline scenario; green values indicate modeled positive impact for Alternative 1 (Union County IBT) as compared to the baseline scenario.

However, it is important to note that, as presented in the FEIS, modeling indicates the proposed Union County withdrawal alternatives (including the non-IBT Alternative 5 Rocky River withdrawal) from Duke Energy Progress’ Yadkin-Pee Dee Hydroelectric Project or tributaries flowing to Blewett Falls Lake would have a similar effect on the annual average elevation of Blewett Falls Lake, based on the operational rules related to system inflow for the hydropower project. Furthermore, during both the POR and Drought 2 periods, there are no modeled differences in average lake elevations for the Union County IBT as compared to the baseline condition.

Impacts are also observed in the modeled monthly average Blewett Falls Lake elevations as summarized in Table 8-6 and graphically reflected in Illustrations 8-7 through 8-12.

Table 8-6 Summary of Modeled Blewett Falls Lake Monthly Average Lake Elevation Impacts

Illustration	Description	Summary of Impacts
8-7	**Period of Record** (1955-2013) under Current (2012) Basin-Wide Water Demand Projections	No detectable impact to average monthly lake elevations throughout the Period of Record due to proposed Union County IBT when added to current (2012) basin-wide water demands.
8-8	**Period of Record** (1955-2013) under Future (2050) Basin-Wide Water Demand Projections	Several small, but detectable, impacts to monthly lake elevations throughout the Period of Record due to proposed Union County IBT when added to projected future (2050) basin-wide water demands. At the lowest modeled lake elevation, occurring in August, 2002, there is an approximate impact of 3-inches due to the proposed Union County IBT, as compared to baseline conditions (EL 172.1’ msl compared to EL 172.4’, respectively). Impacts are largely due to the large additional projected future basin-wide water demands (including potential future thermal power generating facilities) and climate change, coupled with the proposed Union County IBT. Despite the impacts, the minimum modeled average monthly lake elevation, occurring during August, 2002, is EL 172.1’ msl, which is equal to the Blewett Falls Lake normal minimum elevation, and within the normal operating rules for the lake.
8-9	**Drought 1** (1999-2003) under Current (2012) Basin-Wide Water Demand Projections	No detectable impact to average monthly lake elevations throughout Drought 1 due to proposed Union County IBT when added to current (2012) basin-wide water demands.

Illustration	Description	Summary of Impacts
8-10	**Drought 1** (1999-2003) under Future (2050) Basin-Wide Water Demand Projections	Several small, but detectable, impacts to monthly lake elevations throughout Drought 1 (1999-2003) due to proposed Union County IBT when added to projected future (2050) basin-wide water demands. At the lowest modeled lake elevation, occurring in August, 2002, there is an approximate impact of 3-inches due to the proposed Union County IBT, as compared to baseline conditions (EL 172.1' msl compared to EL 172.4', respectively). Impacts are largely due to the large additional projected future basin-wide water demands (including potential future thermal power generating facilities) and climate change, coupled with the proposed Union County IBT, and modeled as occurring during the most intense part of the Drought of Record, when the system is most stressed. Despite the impacts, the minimum modeled average monthly lake elevation, occurring during August, 2002, is EL 172.1' msl, which is equal to the Blewett Falls Lake normal minimum elevation, and within the normal operating rules for the lake.
8-11	**Drought 2** (2006-2009) under Current (2012) Basin-Wide Water Demand Projections	No detectable impact to average monthly lake elevations throughout Drought 2 due to proposed Union County IBT when added to current (2012) basin-wide water demands.
8-12	**Drought 2** (2006-2009) under Future (2050) Basin-Wide Water Demand Projections	Two small, but detectable, impacts to average monthly lake elevations throughout Drought 2 due to proposed Union County IBT when added to future (2050) basin-wide water demands. These impacts occur from August to October, 2007 (approximate 4-inch impact) and in August of 2008 (approximate 2 inch impact). Impacts are largely due to the large additional projected future basin-wide water demands (including potential future thermal power generating facilities), coupled with the proposed Union County IBT. It is important to note that there is no difference in the lowest modeled lake elevation (EL. 174.1' msl) during this Drought 2 period (occurring in March, 2009) between the baseline and proposed Union County IBT scenarios, and the lake remains 2 feet above its normal minimum level.

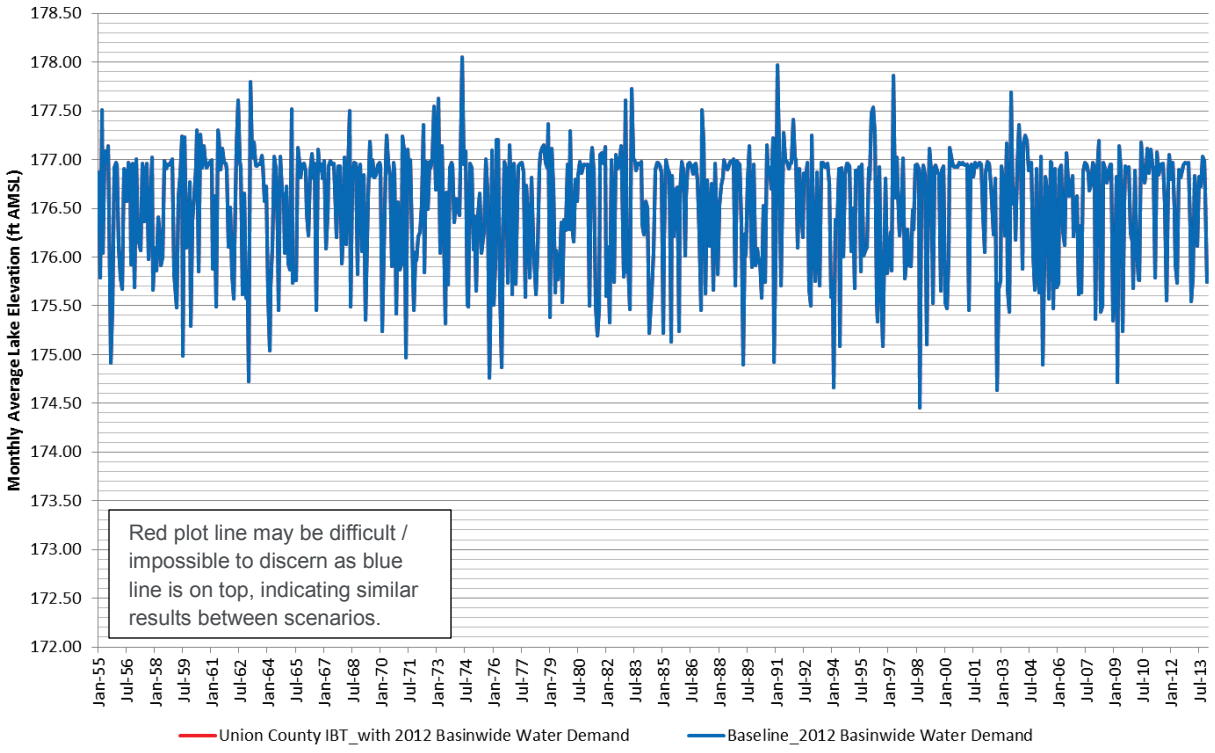

Illustration 8-7 Blewett Falls Lake Monthly Average Modeled Lake Elevations – Period of Record (1955-2013) under Current (Year 2012) Basin-Wide Water Demand Projections

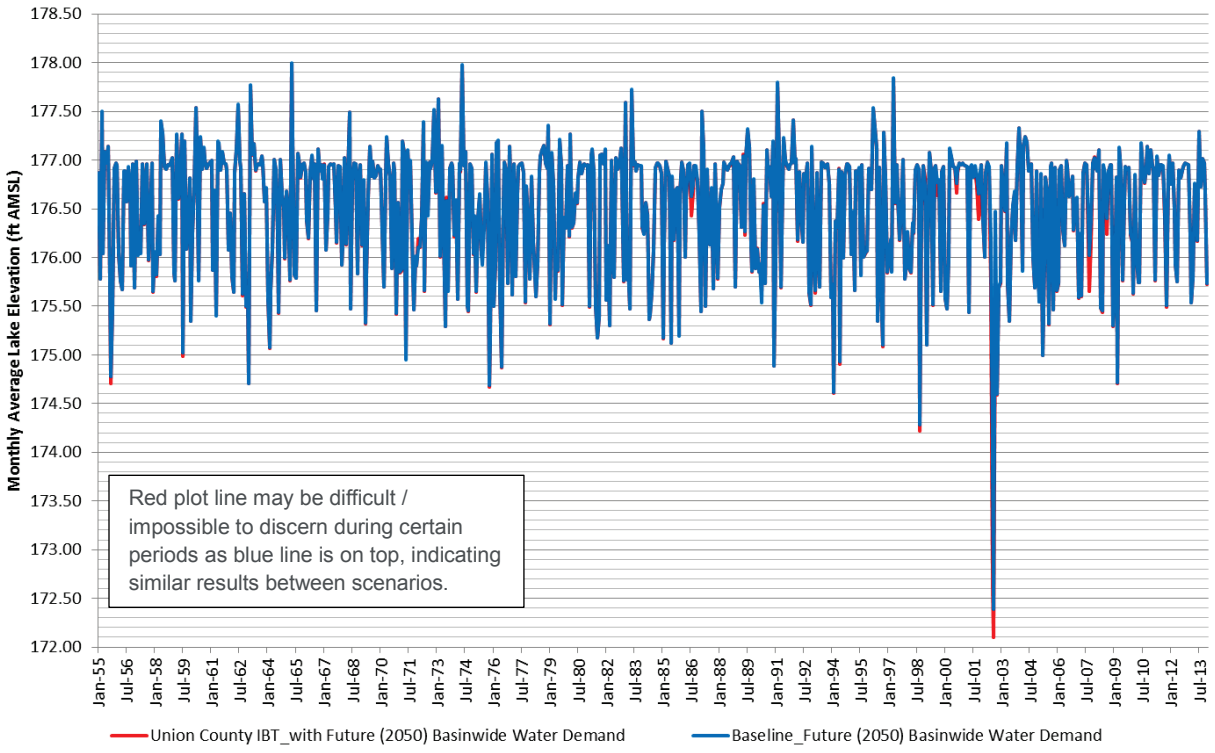

Illustration 8-8 Blewett Falls Lake Monthly Average Modeled Lake Elevations – Period of Record (1955-2013) under Future (Year 2050) Basin-Wide Water Demand Projections

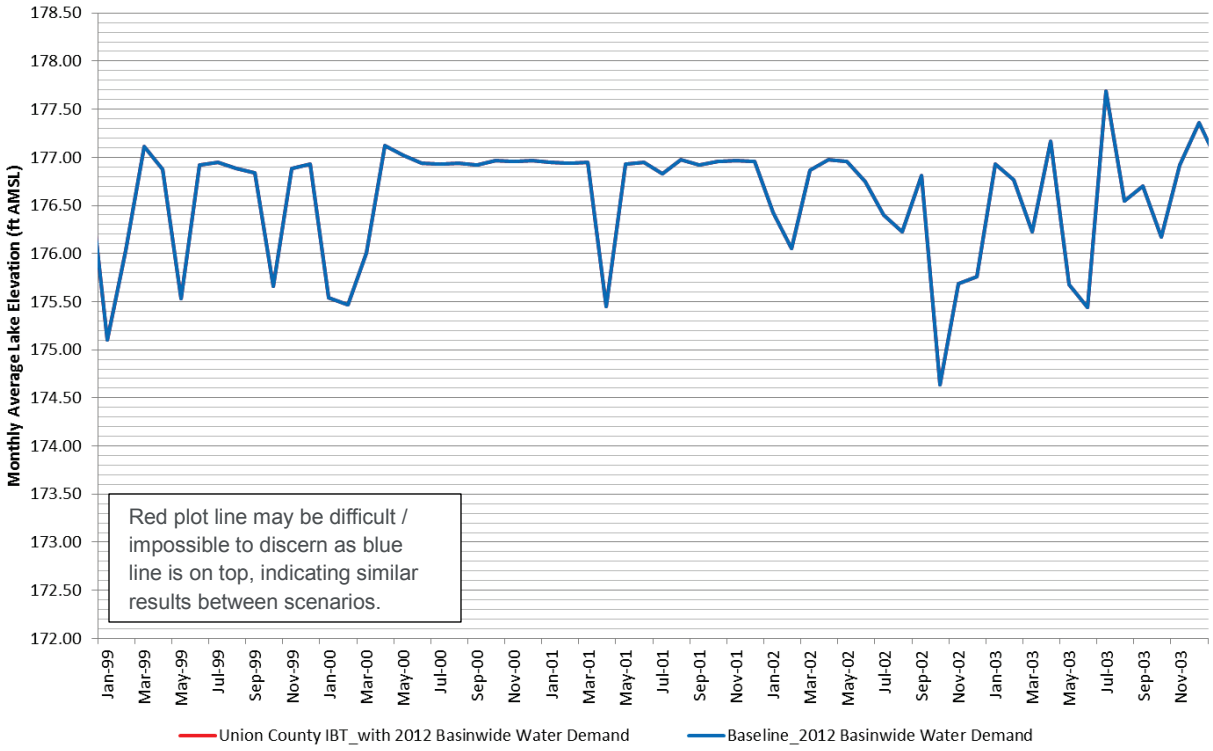

Illustration 8-9 Blewett Falls Lake Monthly Average Modeled Lake Elevations – Drought 1 (1999-2003) under Current (Year 2012) Basin-Wide Water Demand Projections

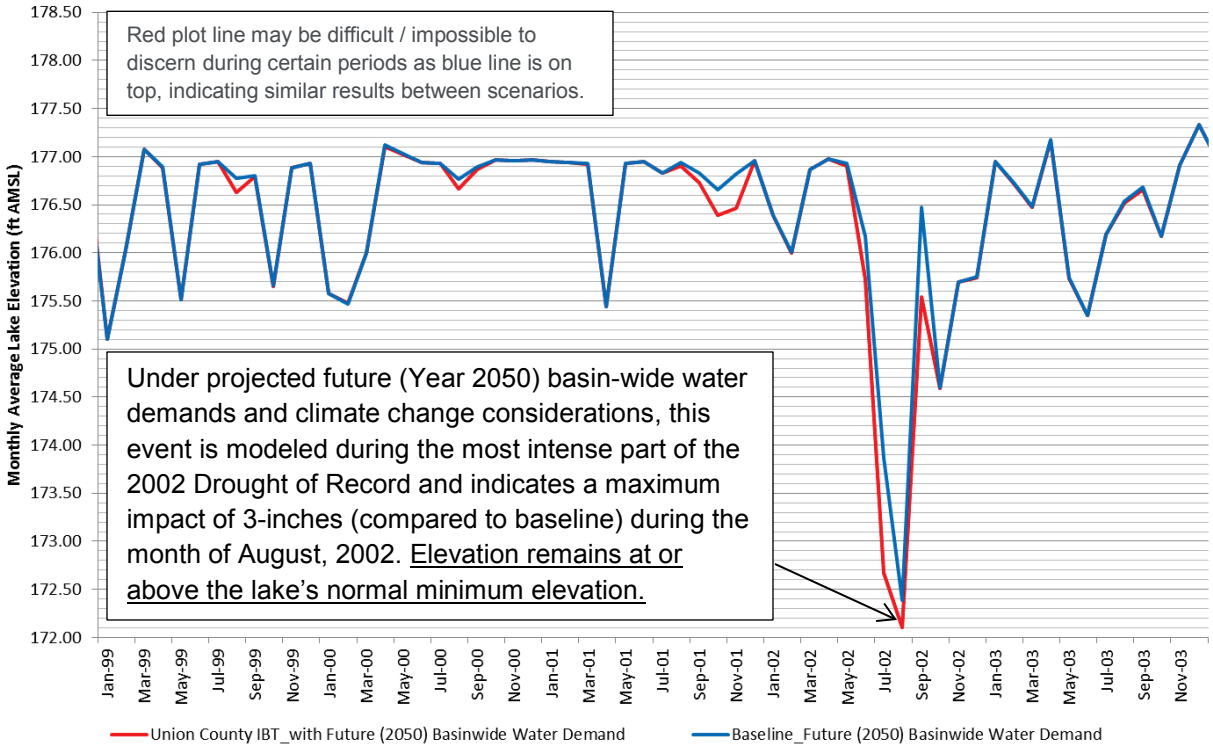

Illustration 8-10 Blewett Falls Lake Monthly Average Modeled Lake Elevations – Drought 1 (1999-2003) under Future (Year 2050) Basin-Wide Water Demand Projections

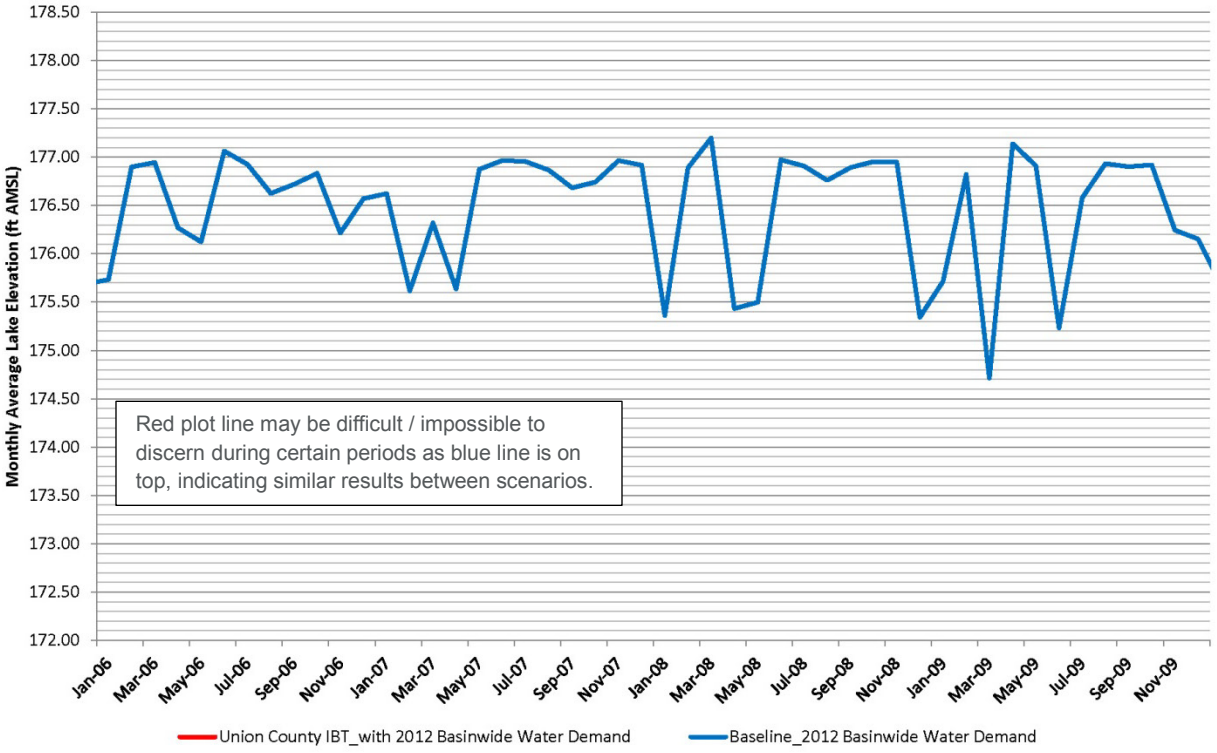

Illustration 8-11 Blewett Falls Lake Monthly Average Modeled Lake Elevations – Drought 2 (2006-2009) under Current (Year 2012) Basin-Wide Water Demand Projections

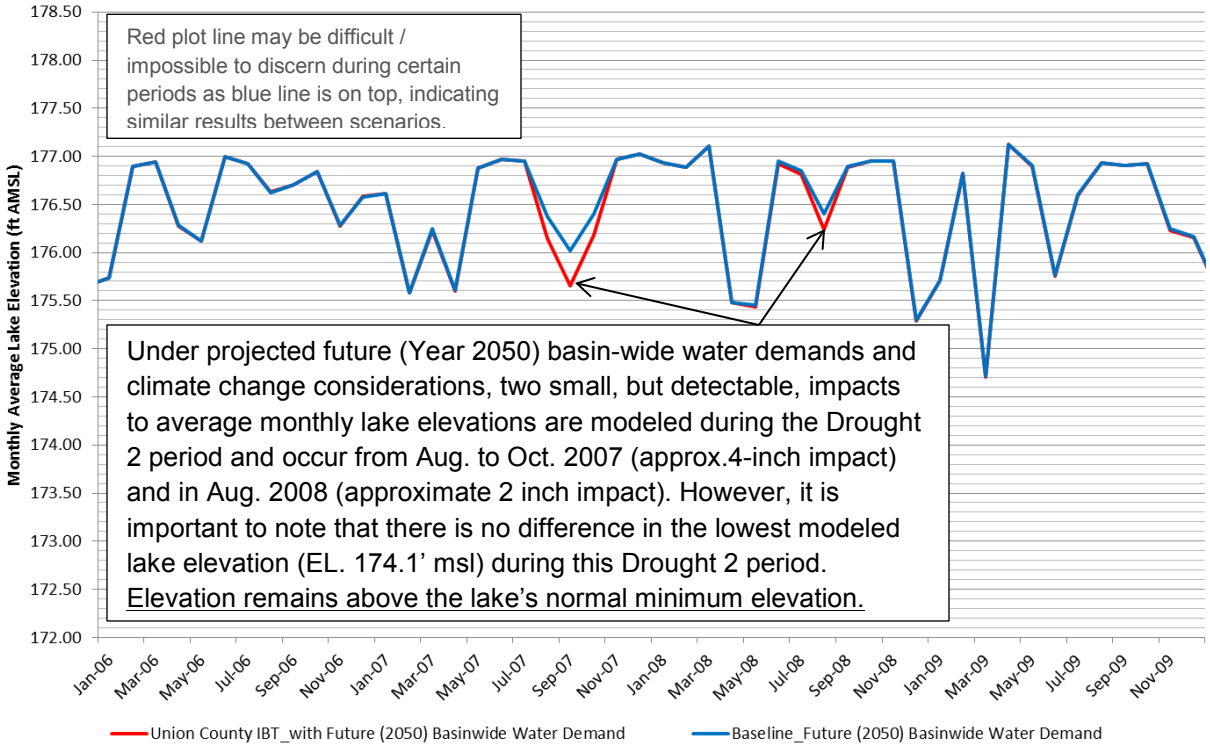

Illustration 8-12 Blewett Falls Lake Monthly Average Modeled Lake Elevations – Drought 2 (2006-2009) under Future (Year 2050) Basin-Wide Water Demand Projections

Impact to Recreational Facilities – Public Boat Ramps

The two following public boat access areas are located on Blewett Falls Lake: Pee Dee Access Area, Grassy Island. As a result of Duke Energy's merger with Progress Energy, Duke Energy Progress does not have specific usable boat ramp elevations for these facilities based on survey data. However, the ramps on Blewett Falls Lake generally become unusable when there is approximately 3 feet and less water depth at the end of the ramp. Duke Energy Progress indicates all boat ramps remain accessible down to the normal minimum lake operating level of EL 172.1' msl or below during the recreation season.

As indicated in the modeling results in the preceding sections, the lowest modeled lake elevation is EL 172.1' msl, which is equal to the Blewett Falls Lake normal minimum elevation, and within the normal operating rules for the lake. As all ramps are accessible down to the normal minimum lake elevation or below, no impacts to public boat access areas on Blewett Falls Lake are expected as a result of the proposed Union County IBT.

8.2.3. Lake Aesthetics - Summary

As indicated in the results tables and illustrations presented in the preceding sections, the CHEOPS™ modeling results for the proposed Union County IBT water withdrawals from Lake Tillery show few negative impacts on Duke Energy Progress operated lake (Lake Tillery or Blewett Falls Lake) elevations, when compared to the respective baseline scenario. Small reductions in elevations were noted in these reservoirs for small percentages of time, typically resulting in annual average elevation differences less than ¼ -inch, even with the higher Year-2050 basin-wide water use projections and during extreme drought periods. Similarly, the maximum monthly average lake elevation impact was modeled to be approximately 9-inches at Lake Tillery and 3-inches at Blewett Falls Lake during the most extreme modeled drought conditions, with both lakes remaining at or above their normal minimum elevations during these periods. Additionally, no impacts to public boating access areas are expected as a result of the proposed Union County IBT.

8.3. Lake Level – Withdrawals

Of important consideration to owners of water supply intakes in the Yadkin River Basin lake system is the effect of water withdrawals on lake elevations related to operability of these intakes. In times of reduced system inflow (i.e. droughts), water supply intakes may be vulnerable to inoperability (not being able to take in water from the source) or reduced operability because of falling lake levels. Additional water withdrawals within the lake system increase outflows from the system and can subsequently exacerbate the effect of low lake levels on intake operability.

Given this consideration, the effect of each Union County surface water supply alternative from the Yadkin River Basin was evaluated in CHEOPS™ for their effect on lake elevations, relative to the critical intake elevations in each reservoir. The critical intake is defined as the highest intake in each reservoir, which represents the first intake that could be exposed due to falling lake levels during times of low inflow. This evaluation was completed to determine if any of the IBT alternatives negatively affected lake levels such that other water supply intakes were jeopardized.

Modeling results indicate there to be no impacts to water supply intakes due to restricted intake operation to any of the Yadkin River Basin intakes due to Union County's proposed IBT, as compared to the baseline scenarios for both current and future projected basin-wide water use. Furthermore, under no instance were there any days in which modeled lake elevations were low enough to restrict water supply intake operation on any reservoir. Additionally, minimum modeled lake elevations remain well above all existing lake intakes.

Table 8-7 Lake Tillery and Blewett Falls Lake – Modeled Impacts to Water Withdrawal Intakes

Performance Measures	Criterion [1]	Modeled Period [2]	Scenario Result Comparison [3]			
			Baseline 2012	ALT 1 2012 with Union IBT	Baseline 2050	ALT 1 2050 with Union IBT
LAKE TILLERY Restricted operation at lake-located intakes *(Jan. 1 to Dec. 31)*	# days reservoir elevation < critical level (268.2 ft. msl) for shallowest public water supply and hydropower intake operation	POR	0	0	0	0
		D1	0	0	0	0
		D2	0	0	0	0
BLEWETT FALLS LAKE Restricted operation at lake-located intakes *(Jan. 1 to Dec. 31)*	# days reservoir elevation < critical level (168 ft. msl) for shallowest public water supply intake operation	POR	0	0	0	0
		D1	0	0	0	0
		D2	0	0	0	0

Notes:
[1] For criterion that measure on an hourly or daily basis, unless stated otherwise: a) If an hourly criteria occurs during the average of four contiguous 15-minute periods, then it counts as 1 hour; b) If a daily criterion occurs for 5 contiguous 1-hour periods, then it counts as 1 day. Also, daytime flows are assumed to be flows provided between 7:00 am and 7:00 pm. To the extent possible, each criterion is defined in terms of percents and averages/yr so that the same criterion is useful regardless of the length of the hydrology period (i.e., 1-yr, 3-yr, full period of record, etc.)
[2] POR = Period of Record (1955-2013); D1 = Drought 1 (1999-2003); D2 = Drought 3 (2006-2009)
[3] For scenario results comparison, black values indicate no modeled change/impact for Alternative 1 (Union County IBT) as compared to baseline scenario; red values indicate modeled negative impact for Alternative 1 (Union County IBT) as compared to the baseline scenario; green values indicate modeled positive impact for Alternative 1 (Union County IBT) as compared to the baseline scenario.

8.4. Reservoir Release

For ecological considerations and certain recreational interests in the Yadkin River Basin the effect of water withdrawals on reservoir discharges (downstream releases) from these lakes is of importance. In times of reduced system inflow (i.e. droughts), the ecological health or recreational uses (e.g. kayaking or canoeing) of the waterway can be negatively affected.

During normal periods (i.e. normal inflow), both the APGI and Duke Energy Progress hydroelectric projects are required to make certain downstream releases from the reservoirs under the operating agreements between the two entities and as required under their respective FERC licenses. During periods of reduced inflow to the system, the LIP specifies reductions to these release requirements, based on particular drought stages, while seeking to provide discharges at a level sufficient to maintain the ecological health of the waterway. However, additional water withdrawals within the lake system may subsequently result in reservoir discharges lower than those required under the FERC licenses for the operation of the lake system.

Given this consideration, the effect of each Union County surface water supply alternative from the Yadkin River Basin was evaluated in CHEOPS™ for their effect on discharges, relative to the required downstream releases from these reservoirs. This evaluation was completed to determine if any of the IBT alternatives negatively affected downstream releases such that the waterway's ecological health and certain recreational interests would be jeopardized, as compared to the baseline conditions within the Yadkin River Basin without the proposed IBT.

8.4.1. Lake Tillery

Table 8-8 indicates the modeled impacts to flow releases from Lake Tillery as the result of Union County's proposed IBT withdrawal from the lake based on current (Year 2012) basin-wide water demands (ALT 1 - 2012 with Union IBT as compared to Baseline 2012) and projected future (Year 2050) basin-water water demands (ALT 1 - 2050 with Union IBT as compared to Baseline 2050). The specific performance measure criterion evaluated include the continuous minimum flow release for fish spawning, continuous minimum flow, and lowest daily average flow, in accordance with the reservoir operating criteria and as indicated in the table, for the POR, Drought 1 and Drought 2 time periods.

Under both current (Year 2012) and projected future (Year 2050) basin-wide water demands, some impacts on downstream releases from Lake Tillery were observed under the proposed Union County IBT during the POR, Drought 1 and Drought 2 periods, as more days were spent below the spring spawning and continuous minimum flow release targets, compared to the baseline. However, in no case does the lowest modeled daily average flow drop below the 330 cfs minimum flow level for the reservoir. As reflected in Table 8-8, these impacts are generally found to be several days more for the continuous minimum flows and several cfs less for the lowest daily average flow with a proposed Union County IBT withdrawal from the Yadkin River Basin.

In the CHEOPS™ model and in actual operation, under any required operating parameter for Blewett Falls will be supported by Tillery since they are the same FERC licensee. An example is when the total Blewett Falls outflows (continuous flow requirement, withdrawals and losses due to evaporation and leakage) cannot be met on any given day from the sum of Blewett Falls usable storage and inflows, Tillery will be scheduled to release sufficient flow to allow Blewett Falls to make the required release without having to violate its minimum elevation rule. Thus, when inflows to Blewett Falls are reduced due to withdrawals from the Rocky River, Tillery may

need to release additional flows during low flow periods to ensure Blewett Falls' outflows are met.

Table 8-8 Lake Tillery - Modeled Impacts to Flow Release from Lake Tillery

Performance Measure	Criterion [1]	Modeled Period [2]	Scenario Result Comparison [3]			
			Baseline 2012 ALT 1	2012 with Union IBT	Baseline 2050 ALT 1	2050 with Union IBT
Flow Release From Lake Tillery	# days ≤ 725 cfs continuous min.flow (8 consecutive weeks) for fish spawning *(Mar. 15 to May 15)*	POR	2,141	2,156	2,164	2,161
		D1	218	218	220	221
		D2	205	207	210	210
	# days ≤ 330 cfs continuous min.flow *(Jan.1 to Dec. 31)*	POR	14,000	14,023	14,122	14,133
		D1	1,326	1,327	1,326	1,326
		D2	1,072	1,073	1,074	1,076
	Lowest daily average flow (cfs) *(Jan. 1 to Dec. 31)*	POR	708	679	380	330
		D1	751	725	380	330
		D2	927	906	866	845

Notes:
[1] For criterion that measure on an hourly or daily basis, unless stated otherwise: a) If an hourly criteria occurs during the average of four contiguous 15-minute periods, then it counts as 1 hour; b) If a daily criterion occurs for 5 contiguous 1-hour periods, then it counts as 1 day. Also, daytime flows are assumed to be flows provided between 7:00 am and 7:00 pm. To the extent possible, each criterion is defined in terms of percents and averages/yr so that the same criterion is useful regardless of the length of the hydrology period (i.e., 1-yr, 3-yr, full period of record, etc.)
[2] POR = Period of Record (1955-2013); D1 = Drought 1 (1999-2003); D2 = Drought 3 (2006-2009)
[3] For scenario results comparison, black values indicate no modeled change/impact for Alternative 1 (Union County IBT) as compared to baseline scenario; red values indicate modeled negative impact for Alternative 1 (Union County IBT) as compared to the baseline scenario; green values indicate modeled positive impact for Alternative 1 (Union County IBT) as compared to the baseline scenario.

Illustration 8-13 and Illustration 8-14 reflect the reservoir discharge flow exceedance curves (percent of time at a particular discharge flow) for Lake Tillery throughout the Period of Record (1955-2013) for current (Year 2012) and projected future (Year 2050) basin-wide water demands, respectively, under baseline conditions (blue lines) and with the Union proposed County IBT (red lines). As indicated by both graphs, there is no distinguishable difference in the discharge flow exceedance values for the Union County IBT, as compared to the baseline conditions (lines overlap).

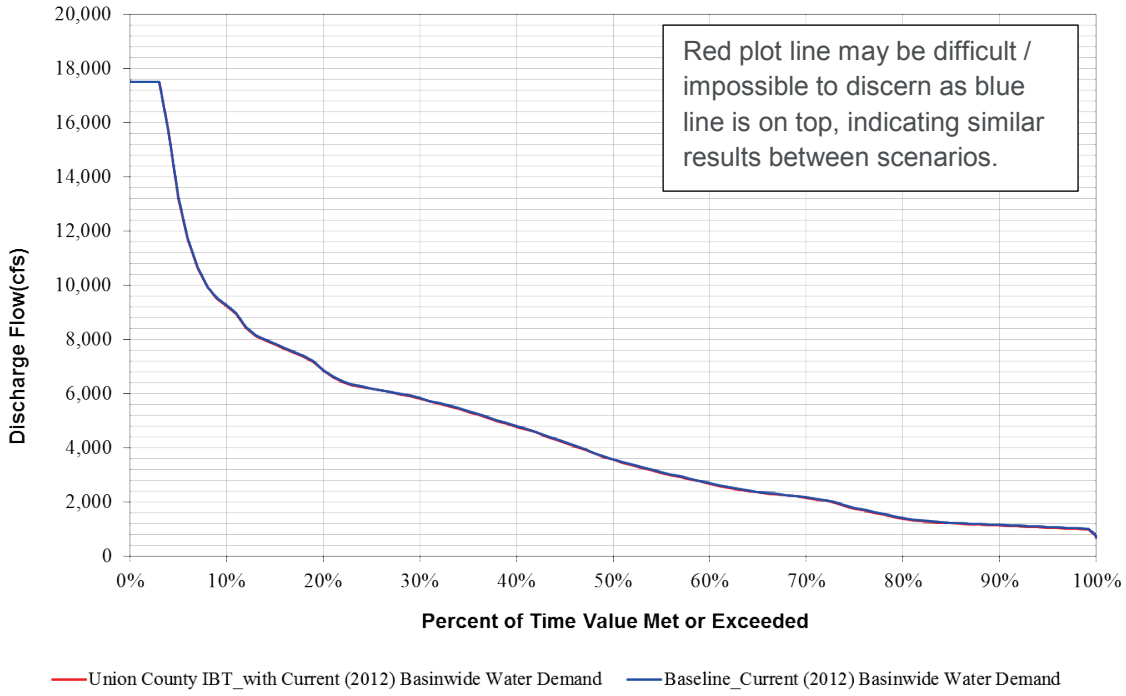

Illustration 8-13 Lake Tillery Discharge Flow Exceedance Curve – Period of Record (1955-2013) under Current (Year 2012) Basin-Wide Water Demand Projections

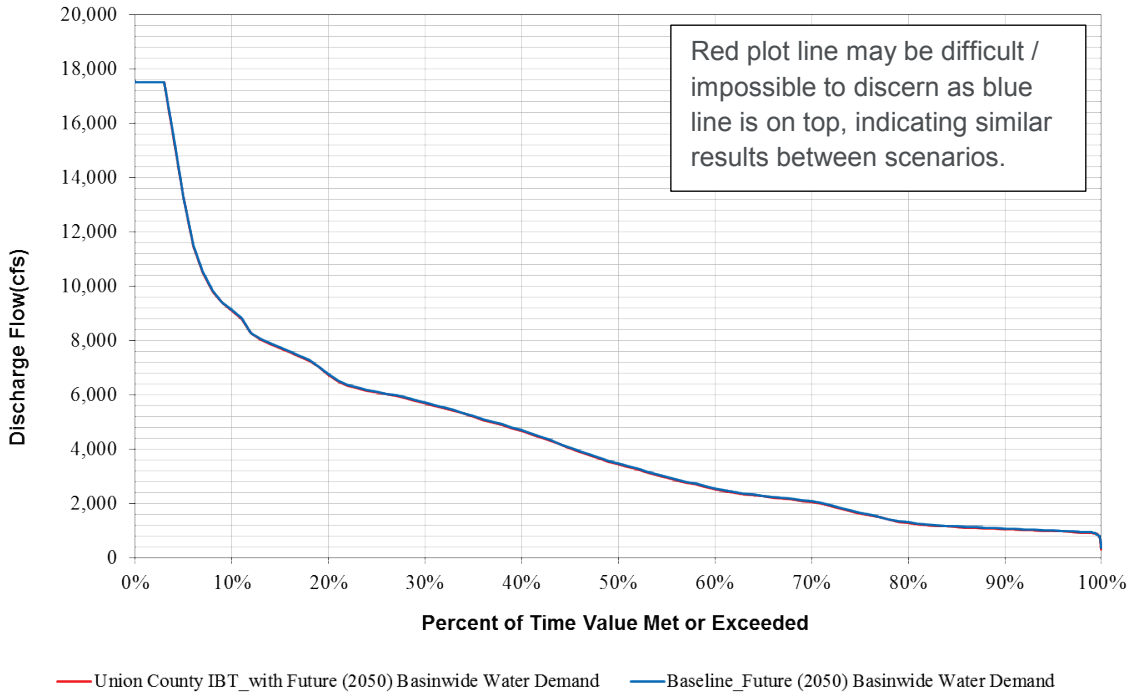

Illustration 8-14 Lake Tillery Discharge Flow Exceedance Curve – Period of Record (1955-2013) under Future (Year 2050) Basin-Wide Water Demand Projections

8.4.2. Blewett Falls Lake

Table 8-9 indicates the modeled impacts to flow releases from Blewett Falls Lake as the result of Union County's proposed IBT withdrawal from the upstream Lake Tillery based on current (Year 2012) basin-wide water demands (ALT 1 - 2012 with Union IBT as compared to Baseline 2012) and projected future (Year 2050) basin-water water demands (ALT 1 - 2050 with Union IBT as compared to Baseline 2050). The specific performance measure criterion evaluated include the seasonal continuous flow targets, critical flow, LIP continuous flow target, and lowest daily average flow, in accordance with the reservoir operating criteria and as indicated in the table, for the POR, Drought 1 and Drought 2 time periods.

Similar to the modeled impacts in discharges from Lake Tillery, some impacts to downstream releases were observed in Blewett Falls Lake under the proposed Union County IBT during the POR, Drought 1, and Drought period, under both current (Year 2012) and projected future (Year 2050) basin-wide water demand scenarios, as several more days were spent below the normal continuous flow targets throughout the year. However, in no case does the lowest modeled daily average flow drop below the 925 cfs critical flow level for the reservoir. Additionally, under current (Year 2012) basin-wide water demand, modeling indicates the proposed Union County IBT to provide a slight benefit to the continuous flow targets, with less days below the targets during some of the evaluation periods (POR, Drought 1, and/or Drought 2), as compared to the baseline scenario.

In general, all surface water alternatives from the Yadkin River Basin (including the Rocky River IBT Basin) evaluated as part of the FEIS resulted in some impact to Blewett Falls release targets based on the operational rules for the reservoir and hydropower operation. Even

withdrawals from the Rocky River would result in a similar impact to Blewett Falls' releases due to reduced inflow (from the Rocky River) to the Yadkin-Pee Dee Hydroelectric Project reservoirs. Of important note, impacts to flow release targets from Blewett Falls Lake, under the proposed IBT withdrawal from Lake Tillery, are slightly less during times of drought than any of the other surface water alternatives evaluated in the Yadkin River Basin.

Table 8-9 Blewett Falls Lake - Modeled Impacts to Flow Release from Blewett Falls Lake

Performance Measure	Criterion [1]	Modeled Period [2]	Scenario Result Comparison [3]			
			Baseline 2012 ALT 1	2012 with Union IBT	Baseline 2050 ALT 1	2050 with Union IBT
Flow Release From Blewett Falls Lake	# days ≤ 2,400 cfs continuous flow target *(2/1 to 5/15)*	POR	1,995	2,002	2,060	2,067
		D1	284	284	285	285
		D2	277	276	277	277
	# days ≤ 1,800 cfs continuous flow target *(5/16 to 5/31)*	POR	508	508	528	531
		D1	64	64	65	65
		D2	57	56	57	57
	# days ≤ 1,200 cfs continuous flow target *(6/1 to 6/31)*	POR	7,903	7,866	8,084	8,098
		D1	837	832	850	852
		D2	683	683	694	696
	# days ≤ critical flow (925 cfs instantaneous flow) *(1/1 to 12/31)*	POR	19	19	22	23
		D1	19	19	22	23
		D2	0	0	0	0
	# days < LIP continuous flow target *(1/1 to 12/31)*	POR	0	0	0	0
		D1	0	0	0	0
		D2	0	0	0	0
	Lowest daily average flow (cfs) *(1/1 to 12/31)*	POR	940	937	925	925
		D1	940	937	925	925
		D2	1,200	1,200	1,200	1,200

Notes:
[1] For criterion that measure on an hourly or daily basis, unless stated otherwise: a) If an hourly criteria occurs during the average of four contiguous 15-minute periods, then it counts as 1 hour; b) If a daily criterion occurs for 5 contiguous 1-hour periods, then it counts as 1 day. Also, daytime flows are assumed to be flows provided between 7:00 am and 7:00 pm. To the extent possible, each criterion is defined in terms of percents and averages/yr so that the same criterion is useful regardless of the length of the hydrology period (i.e., 1-yr, 3-yr, full period of record, etc.)
[2] POR = Period of Record (1955-2013); D1 = Drought 1 (1999-2003); D2 = Drought 3 (2006-2009)
[3] For scenario results comparison, black values indicate no modeled change/impact for Alternative 1 (Union County IBT) as compared to baseline scenario; red values indicate modeled negative impact for Alternative 1 (Union County IBT) as compared to the baseline scenario; green values indicate modeled positive impact for Alternative 1 (Union County IBT) as compared to the baseline scenario.

Illustration 8-15 and Illustration 8-16 reflect the reservoir discharge flow exceedance curves (percent of time at a particular discharge flow) for Blewett Falls Lake throughout the Period of Record (1955-2013) for current (Year 2012) and projected future (Year 2050) basin-wide water demands, respectively, under baseline conditions (blue lines) and with the Union County proposed IBT (red lines). As indicated by both graphs, there is no distinguishable difference in the discharge flow exceedance values for the Union County IBT, as compared to the baseline conditions (lines overlap).

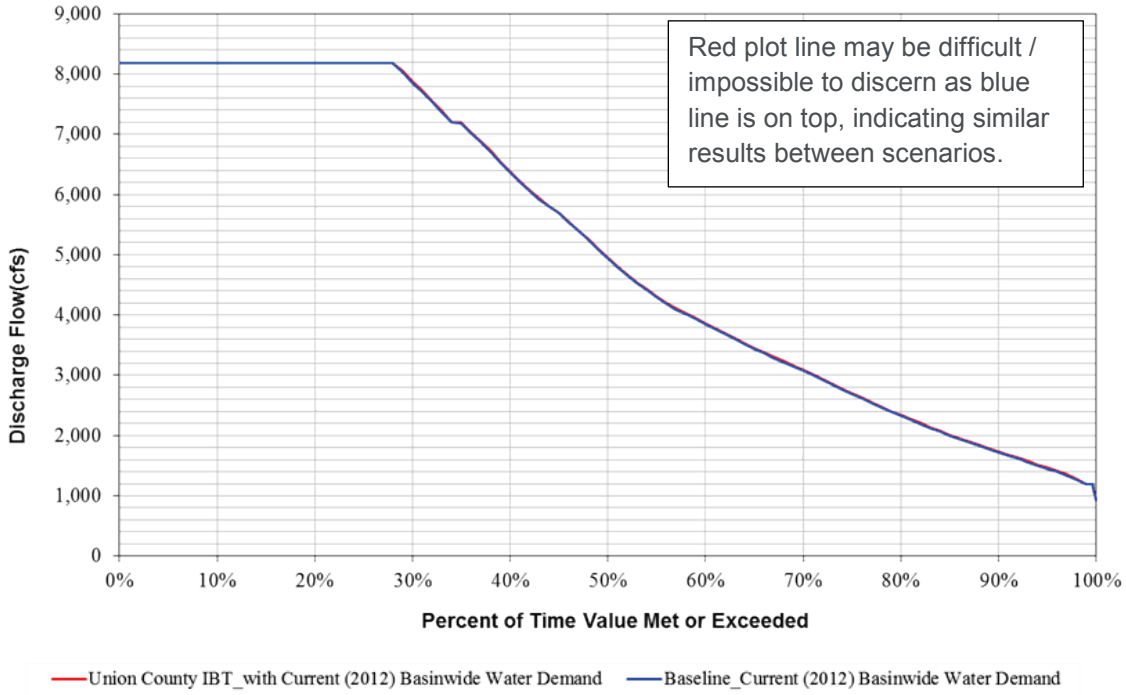

Illustration 8-15 Blewett Falls Lake Discharge Flow Exceedance Curve – Period of Record (1955-2013) under Current (Year 2012) Basin-Wide Water Demand Projections

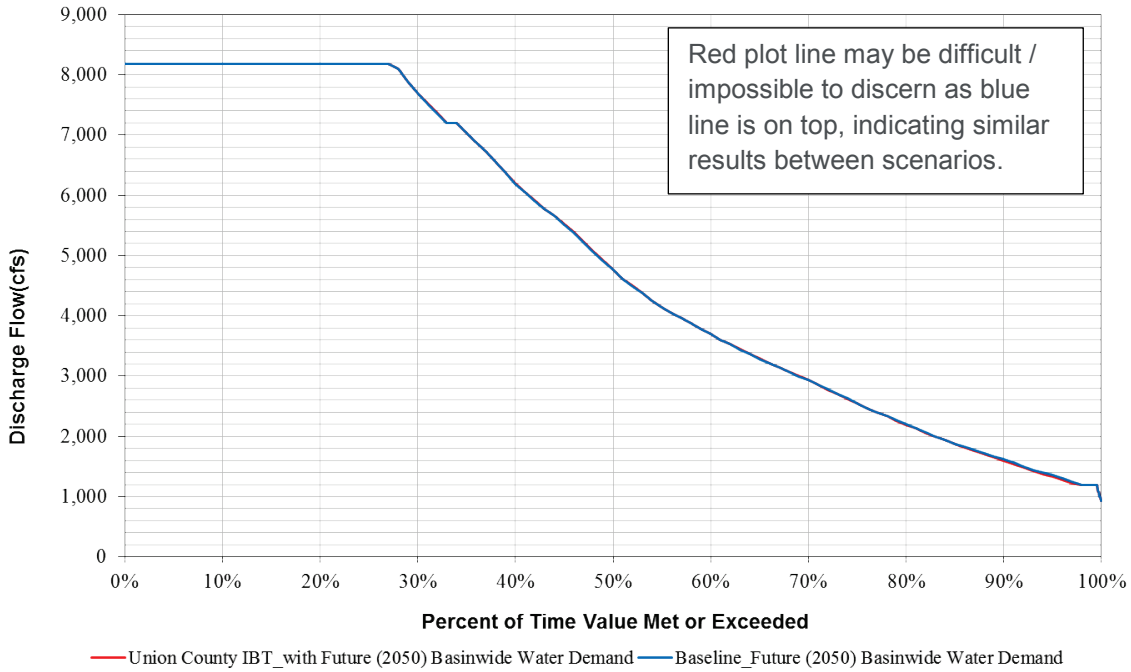

Illustration 8-16 Blewett Falls Lake Discharge Flow Exceedance Curve – Period of Record (1955-2013) under Future (Year 2050) Basin-Wide Water Demand Projections

8.4.3. Flow Regime below Blewett Falls Lake

While the CHEOPS™ modeling includes each reservoir in the Yadkin-Pee Dee River Basin from W. Kerr Scott downstream to Blewett Falls Lake, it does not directly model water quantity below the Blewett Falls dam. However, it is important to evaluate the potential impacts of IBT alternatives on the flow regime below Blewett Falls Lake, for purposes of this EIS evaluation. Therefore, as part of the modeling effort, CHEOPS™ model developers also developed an Excel-based post-processing routine for the riverine section of the Pee Dee River downstream of Blewett Falls Lake to the North Carolina – South Carolina State Line. This post-processing routine evaluates the impacts of each alternative to flow in the river at the North Carolina – South Carolina border, taking into consideration flow discharge from Blewett Falls Lake, flow accretion in the riverine section, as well as water withdrawals and discharges from other water users along this extent of the river.

From the results of this evaluation, the following flow duration (exceedance) curves were developed to compare the IBT alternatives to the baseline conditions for both current (Year 2012) and projected future (Year 2050) baseline conditions for the POR under current basin-wide water demands (Illustration 8-17), POR under future basin-wide water demands (Illustration 8-18).

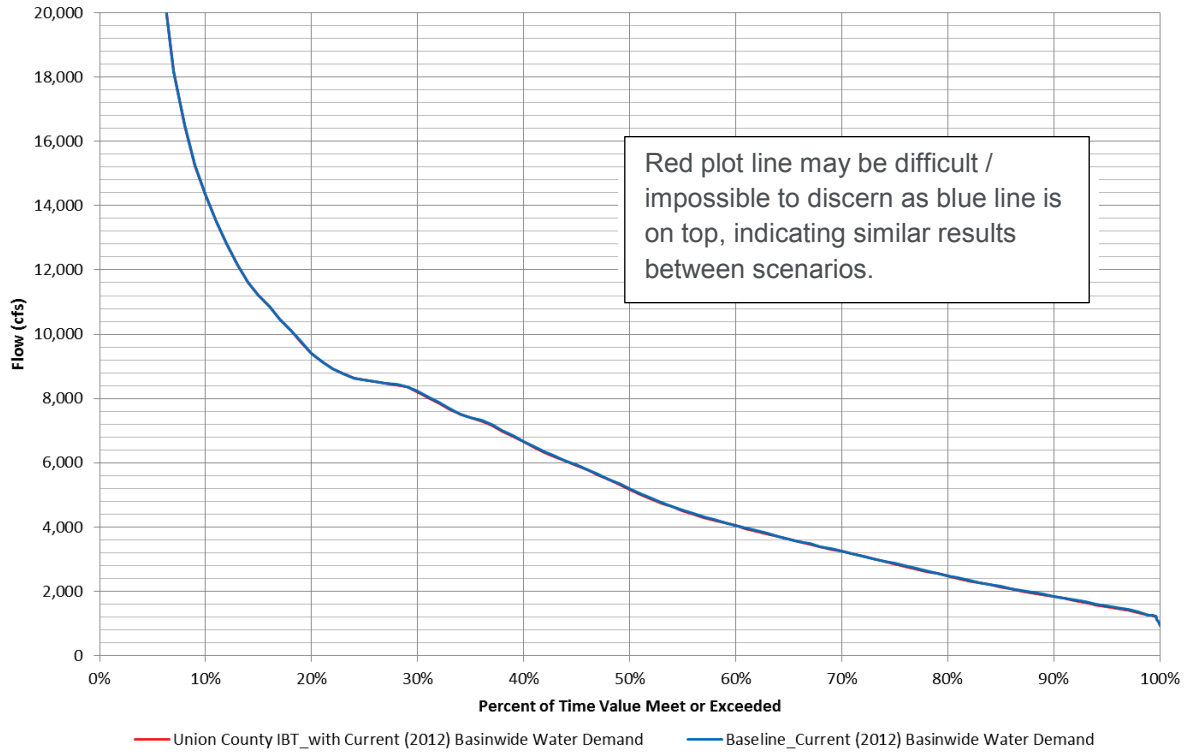

Illustration 8-17 Period of Record Simulated Pee-Dee River Flow for All Months at the NC/SC border under Current (Year 2012) Basin-Wide Water Demands with Union County IBT Alternatives.

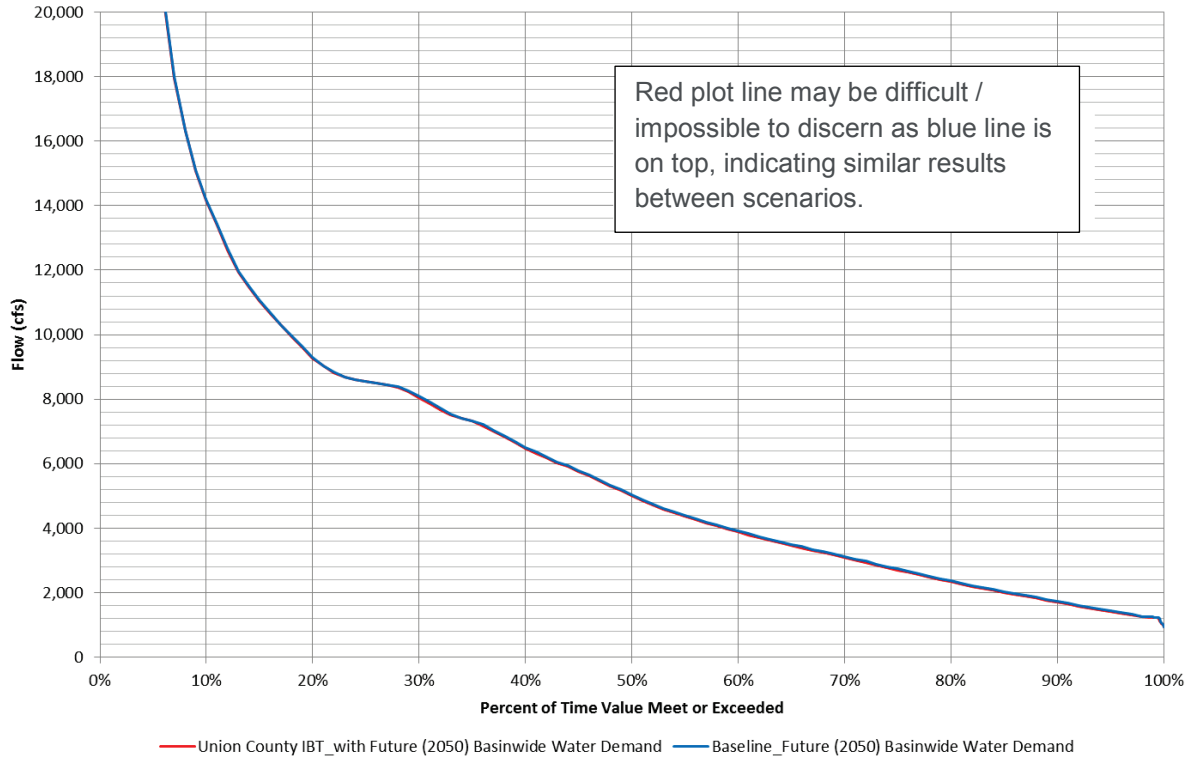

Illustration 8-18 Period of Record Simulated Pee-Dee River Flow for All Months at the NC/SC border under Future (Year 2050) Basin-Wide Water Demands with Union County IBT Alternatives.

Review of these duration curves indicate that under both current (Year 2012) and projected future (Year 2050) basin-wide water demands (Illustration 8-17 and Illustration 8-18, respectively), there are no distinguishable impacts to the flow regime downstream of Blewett Falls Lake as a result of the proposed Union County IBT.

8.4.4. Reservoir Releases - Summary

As indicated in the results tables and illustrations presented in the preceding sections, the CHEOPS™ modeling results for the proposed Union County IBT water withdrawals from Lake Tillery show few negative impacts on downstream releases from Duke Energy Progress operated lakes (Lake Tillery or Blewett Falls Lake), when compared to the respective baseline scenario. Some increases in number of days with modeled flow at or below a specific flow threshold and decreases in lowest modeled average daily flows were noted as a result of the proposed Union County IBT when compared to the baseline scenario. However, under certain criteria, some benefits to flow releases were also modeled as a result of the proposed Union County IBT withdrawal from Lake Tillery and as a function of the system operating rules for the Yadkin-Pee Dee hydroelectric project. Additionally, under no condition does the average daily modeled flow release drop below the critical or minimum flow value for either reservoir. Furthermore, evaluation of the flow regime below the Blewett Falls development, as analyzed at the North Carolina – South Carolina border, indicate no distinguishable impacts to flow below Blewett Falls Lake resulting from the proposed Union County IBT withdrawal from Lake Tillery.

8.5. Water Quantity Management (LIP Occurrence)

In addition to water quantity metrics related to lake elevations, water supply intake operation and reservoir discharges; water quantity management metrics were also evaluated to determine if proposed Union County IBT alternatives would impact the occurrence of the Yadkin-Pee Dee Low Inflow Protocol (LIP). Metrics evaluated included the percent of time in Normal Conditions (non-drought periods with no LIP in effect), number of years attaining particular LIP Stages (0 to 4), and number of years with more than 60 days in particular LIP Stages. The results of this analysis indicate that, based on these criteria, there is no detectable impact to LIP occurrence due to the proposed Union County IBT, as compared to the baseline conditions.

As indicated in Table 8-10, under current (Year 2012) basin-wide water demands, over the POR, the system is in Normal Conditions 99% of the time (out of 21,550 possible days) for both the baseline conditions and also with the proposed Union County IBT. Additionally, over the POR, there is only a single year in which LIP Stages 0, 1, 2 and 3 are attained and remain in a particular stage for more than 60 days. Stage 4 is not attained under either the baseline case or with the proposed Union County IBT. During the Drought 1 Drought of Record period, under the baseline case and also with the proposed Union County IBT, the system is in Normal Conditions 88% of the five year period (out of 1,826 possible days) and in LIP Stages 0 to 3 12% of the period. During the Drought 2 period, under the baseline case and also with the proposed IBT, the system is in Normal Conditions 100% of the period (out of 1,461 possible days) with no LIP Stage declared.

As indicated in Table 8-10, under projected future (Year 2050) basin-wide water demands, over the POR, the system is in Normal Conditions 99% of the time for both the baseline conditions

and proposed Union County IBT. Additionally, over the POR, there are two years in which LIP Stage 0 is attained and only a single year in which Stages 1, 2 and 3 are attained and remain in a particular stage for more than 60 days. Stage 4 is not attained under any of the baseline case or proposed IBT. During the Drought 1 Drought of Record period, under both the baseline case and proposed Union County IBT, the system is in Normal Conditions 87% of the five year period and in LIP Stages 0 to 3 13% of the period (representing a difference of 1% from the current basin-wide water demand baseline case identified in the previous paragraph). During the Drought 2 period, under the baseline case and proposed Union County IBT, the system is in Normal Conditions 100% of the period with no LIP Stage declared.

Table 8-10 Low Inflow Protocol – Modeled Impacts to Water Quantity Management

Performance Measure	Criterion [1]	Modeled Period [2]	Scenario Result Comparison [3]			
			Baseline 2012 ALT 1	2012 with Union IBT	Baseline 2050 ALT 1	2050 with Union IBT
LIP Drought Stage [4] *(Jan. 1 to Dec. 31)*	% of time in Normal Conditions	POR	99%	99%	99%	99%
		D1	88%	88%	87%	87%
		D2	100%	100%	100%	100%
	# years attaining LIP Stage 0	POR	1	1	2	2
		D1	1	1	2	2
		D2	0	0	0	0
	# years with more than 60 days in LIP Stage 0	POR	1	1	1	1
		D1	1	1	1	1
		D2	0	0	0	0
	# years attaining LIP Stage 1	POR	1	1	1	1
		D1	1	1	1	1
		D2	0	0	0	0
	# years with more than 60 days in LIP Stage 1	POR	1	1	1	1
		D1	1	1	1	1
		D2	0	0	0	0
	# years attaining LIP Stage 2	POR	1	1	1	1
		D1	1	1	1	1
		D2	0	0	0	0
	# years with more than 60 days in LIP Stage 2	POR	1	1	1	1
		D1	1	1	1	1
		D2	0	0	0	0
	# years attaining LIP Stage 3	POR	1	1	1	1
		D1	1	1	1	1
		D2	0	0	0	0
	# years with more than 60 days in LIP Stage 3	POR	0	0	0	0
		D1	0	0	0	0
		D2	0	0	0	0

Performance Measure	Criterion [1]	Modeled Period [2]	Scenario Result Comparison [3]			
			Baseline 2012 ALT 1	2012 with Union IBT	Baseline 2050 ALT 1	2050 with Union IBT
LIP Drought Stage [4] *(Jan. 1 to Dec. 31) (con't)*	# years attaining LIP Stage 4	POR	0	0	0	0
		D1	0	0	0	0
		D2	0	0	0	0
	# years with more than 60 days in LIP Stage 4	POR	0	0	0	0
		D1	0	0	0	0
		D2	0	0	0	0

Notes:
[1] For criterion that measure on an hourly or daily basis, unless stated otherwise: a) If an hourly criteria occurs during the average of four contiguous 15-minute periods, then it counts as 1 hour; b) If a daily criterion occurs for 5 contiguous 1-hour periods, then it counts as 1 day. Also, daytime flows are assumed to be flows provided between 7:00 am and 7:00 pm. To the extent possible, each criterion is defined in terms of percents and averages/yr so that the same criterion is useful regardless of the length of the hydrology period (i.e., 1-yr, 3-yr, full period of record, etc.)
[2] POR = Period of Record (1955-2013); D1 = Drought 1 (1999-2003); D2 = Drought 3 (2006-2009)
[3] For scenario results comparison, black values indicate no modeled change/impact for Alternative 1 (Union County IBT) as compared to baseline scenario; red values indicate modeled negative impact for Alternative 1 (Union County IBT) as compared to the baseline scenario; green values indicate modeled positive impact for Alternative 1 (Union County IBT) as compared to the baseline scenario.
[4] LIP - Low Inflow Protocol for the Yadkin and Yadkin-Pee Dee River Hydroelectric Projects (Alcoa and Duke Energy Progress)

8.6. Hydropower

Impacts of each proposed Union County IBT alternative from the Yadkin River Basin on hydropower generation were also evaluated. Impacts to APGI's Yadkin Hydroelectric Project, consisting of hydroelectric generating stations on High Rock Lake, Tuckertown Reservoir, Narrows Reservoir and Falls Reservoir, and Duke Energy Progress' Yadkin-Pee Dee Hydroelectric Project, consisting of hydroelectric generating stations on Lake Tillery and Blewett Falls Lake were evaluated through the CHEOPS™ model. Impacts to average hydropower megawatts produced per year and the average equivalent number of homes per year that could be powered by each hydro project were evaluated. Increases in system water withdrawals can reduce the available water storage by which APGI and Duke Energy Progress are able to access from the reservoirs they operate, in order to produce hydropower. Such reductions to hydropower production would result in slight increases in fossil-based power generation to continue meeting energy demands. As such, this is an important metric to evaluate in the comparison of IBT alternatives for Union County.

As indicated in Table 8-11, under both current (Year 2012) and projected future (Year 2050) basin-wide water demands, some impacts on hydropower generation in Duke Energy Progress's Yadkin-Pee Dee Hydroelectric Project were noted in the model analysis, for a proposed Union County IBT withdrawal from Lake Tillery. The IBT results in decreased hydropower generation for the Yadkin-Pee Dee Hydroelectric Project, as compared to baseline conditions, by approximately 0.5% under both the current and future basin-wide water demands for the Period of Record and less than 1% during Drought 1 and Drought 2 periods. It should be noted that for any of the withdrawal alternatives from the Yadkin River Basin, as evaluated in

the FEIS, including those from APGI operated reservoirs, Duke Energy Progress operated reservoirs, or tributaries thereto, some decrease in hydropower generation capacity for the Yadkin-Pee Dee Hydroelectric Project is expected due to decreased inflow from APGI reservoirs and tributaries to Lake Tillery and Blewett Falls Lake (including the Rocky River) or increased outflow (withdrawals) from the Duke Energy Progress lakes.

Table 8-11 APGI and Duke Energy Progress - Modeled Impacts to Hydropower Generation

Performance Measures	Criterion [1]	Modeled Period [2]	Scenario Result Comparison [3]			
			Baseline 2012 ALT 1	2012 with Union IBT	Baseline 2050 ALT 1	2050 with Union IBT
APGI Effect on APGI hydropower generation *(Jan. 1 to Dec. 31)*	Avg. MWh/yr of hydropower produced	POR	835,503	835,505	828,305	828,308
		D1	626,889	626,890	620,372	620,382
		D2	620,402	620,404	612,821	612,822
	Avg. equivalent # homes/year powered by the hydro project [4]	POR	63,296	63,296	62,750	62,751
		D1	47,492	47,492	46,998	46,999
		D2	47,000	47,000	46,426	46,426
Duke Energy Progress Effect on Duke Energy Progress hydropower generation *(Jan. 1 to Dec. 31)*	Avg. MWh/yr of hydropower produced	POR	339,230	337,799	332,093	330,410
		D1	251,980	250,468	244,544	242,766
		D2	249,888	248,386	242,354	240,548
	Avg. equivalent # homes/ year powered by the hydro project [4]	POR	25,699	25,591	25,159	25,031
		D1	19,089	18,975	18,526	18,391
		D2	18,931	18,817	18,360	18,223

Notes:

[1] For criterion that measure on an hourly or daily basis, unless stated otherwise: a) If an hourly criteria occurs during the average of four contiguous 15-minute periods, then it counts as 1 hour; b) If a daily criterion occurs for 5 contiguous 1-hour periods, then it counts as 1 day. Also, daytime flows are assumed to be flows provided between 7:00 am and 7:00 pm. To the extent possible, each criterion is defined in terms of percents and averages/yr so that the same criterion is useful regardless of the length of the hydrology period (i.e., 1-yr, 3-yr, full period of record, etc.)

[2] POR = Period of Record (1955-2013); D1 = Drought 1 (1999-2003); D2 = Drought 3 (2006-2009)

[3] For scenario results comparison, black values indicate no modeled change/impact for Alternative 1 (Union County IBT) as compared to baseline scenario; red values indicate modeled negative impact for Alternative 1 (Union County IBT) as compared to the baseline scenario; green values indicate modeled positive impact for Alternative 1 (Union County IBT) as compared to the baseline scenario.

[4] Calculated by [(Total Scenario MWh / 13.2 MWh per home) / the # of years in the scenario]. Power produced by the hydro projects is actually supplied to the electric system grid and is used by electric customers (including residential, industrial and commercial customers), as is power produced at other Duke Energy Progress and/or APGI generating stations. This criterion of average equivalent homes per year is intended to simply make the total energy production potential of the hydro projects more understandable to stakeholders and to put a perspective around potential differences in hydropower production between various scenarios. This measure does not imply that any number of homes will go without power if a particular scenario is chosen.

The generation comparison histograms, as depicted in the following illustrations (Illustration 8-19 through Illustration 8-22), generally reflect the differences between the baseline conditions and with the proposed Union County IBT for both Lake Tillery and Blewett Falls Lake hydropower generation over the Period of Record or during the Drought 1 and Drought 2 periods. These graphs indicate slightly lower hydropower generation at both facilities throughout the Period of Record for the Union County IBT (red lines) as compared to the baseline conditions (blue lines) for both current (2012) and future (2050) basinwide water demands.

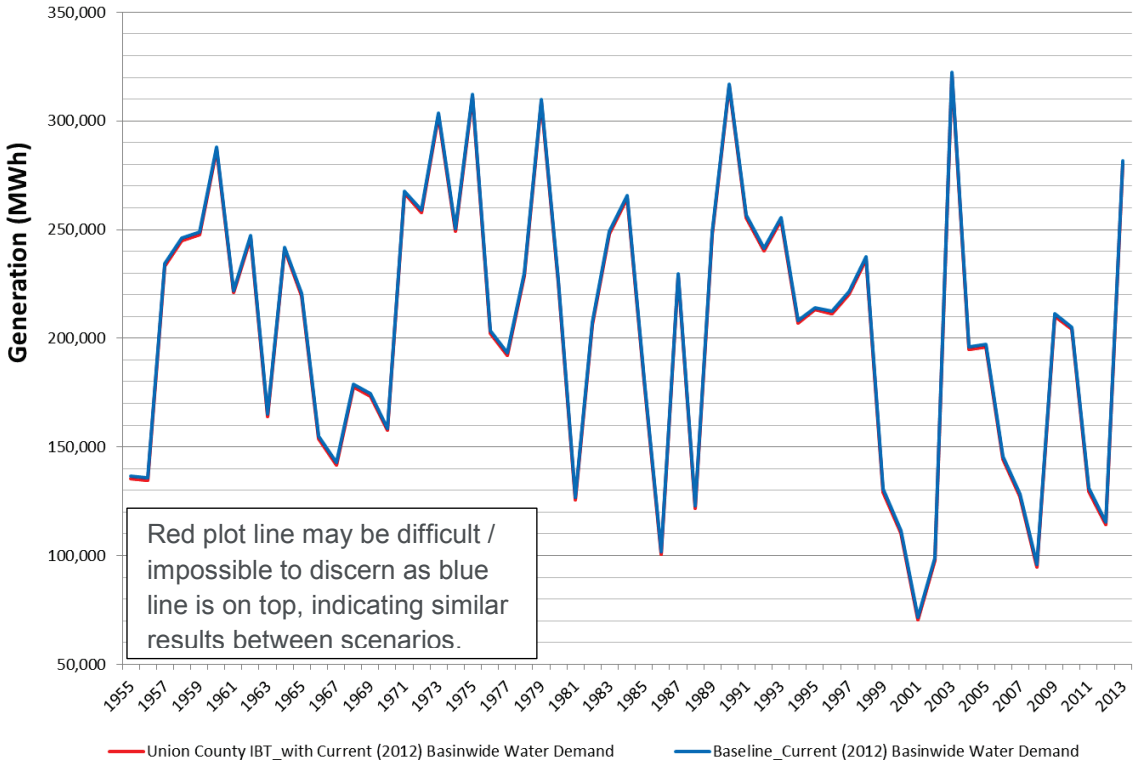

Illustration 8-19 Lake Tillery Annual Hydropower Generation - Period of Record (1955-2013) under Current (Year 2012) Basin-Wide Water Demand Projections

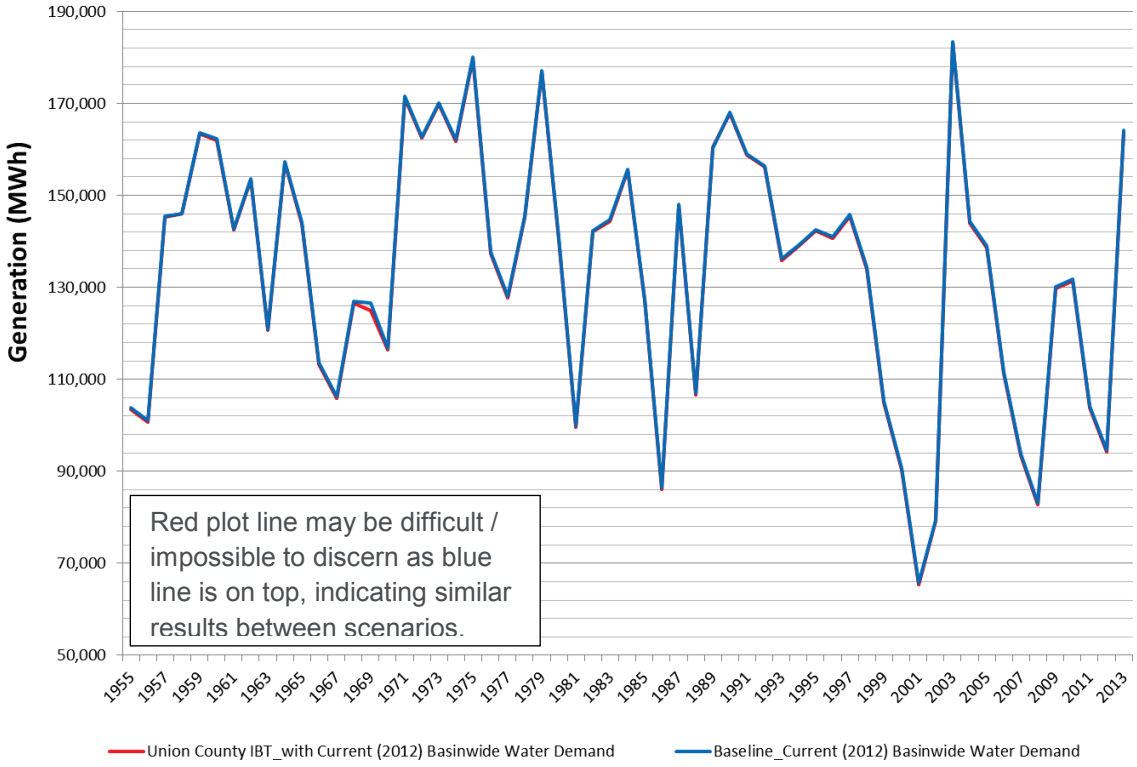

Illustration 8-20 Blewett Falls Lake Annual Hydropower Generation - Period of Record (1955-2013) under Current (Year 2012) Basin-Wide Water Demand Projections

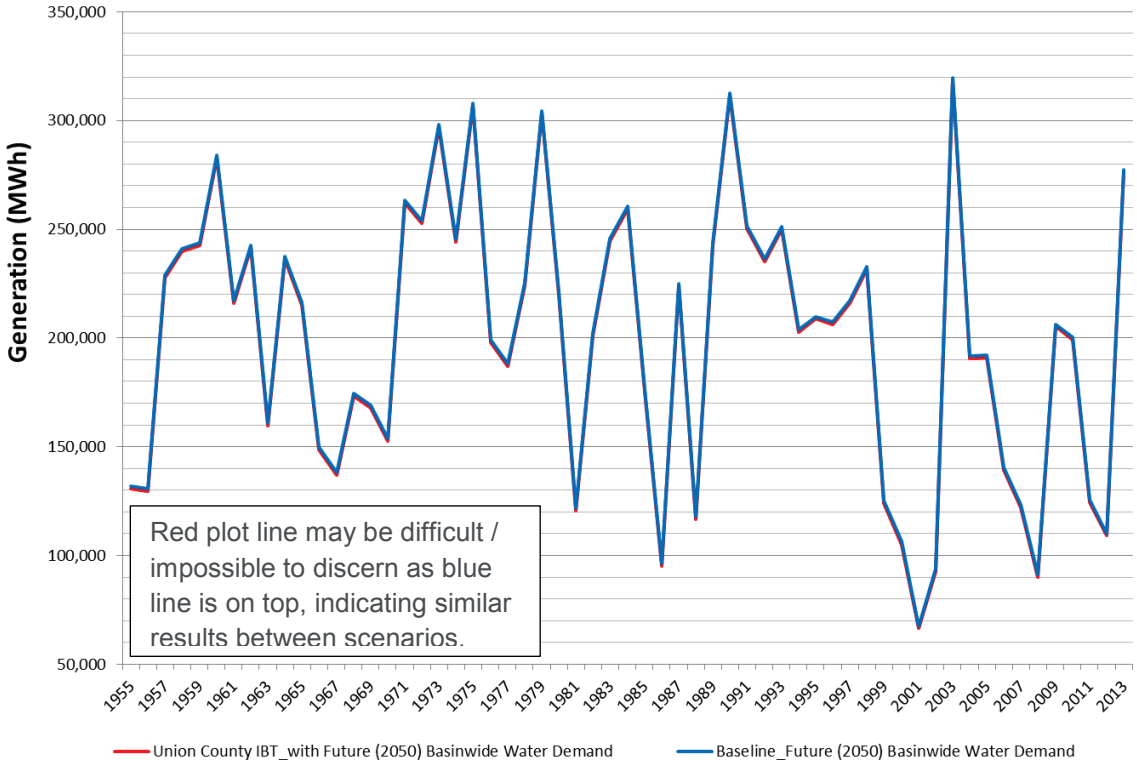

Illustration 8-21 Lake Tillery Annual Hydropower Generation - Period of Record (1955-2013) under Future (Year 2050) Basin-Wide Water Demand Projections

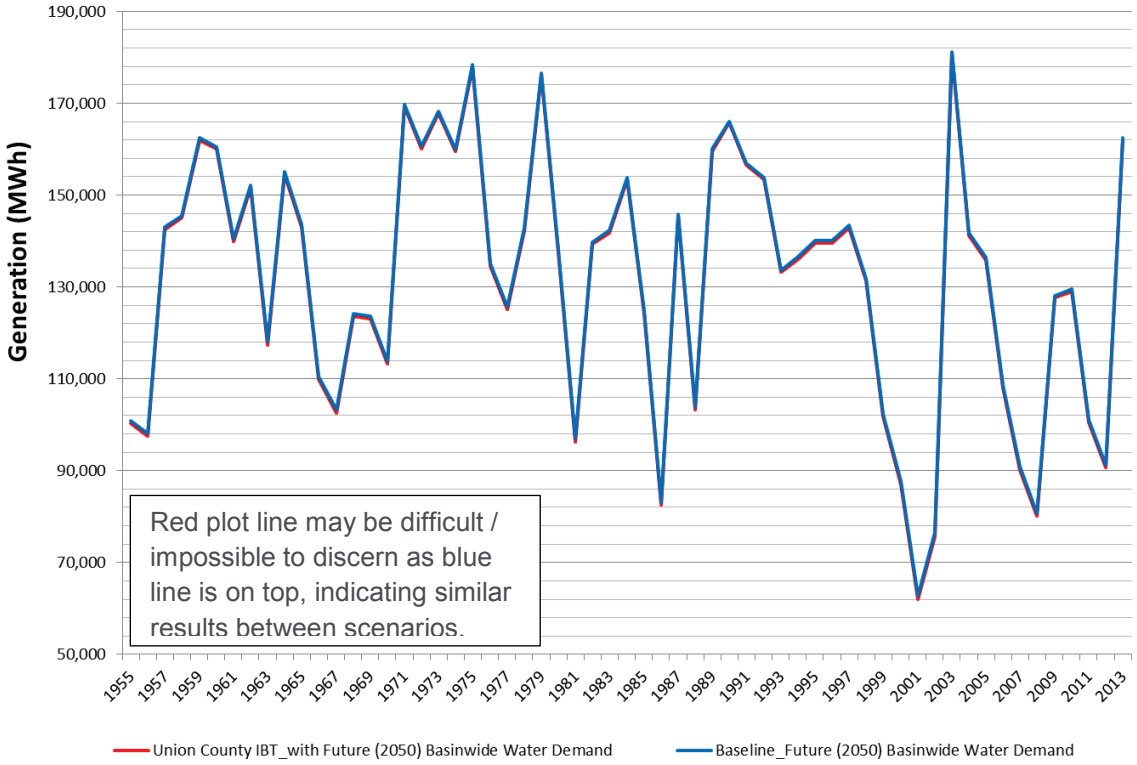

Illustration 8-22 Blewett Falls Lake Annual Hydropower Generation - Period of Record (1955-2013) under Future (Year 2050) Basin-Wide Water Demand Projections

9.0 Future Water Supply Needs in the Yadkin River Basin

Future water supply needs in the Yadkin River Basin including public water supply, agricultural, industrial, recreational and hydropower uses are included in the updated CHEOPS™ model used for the FEIS analysis supporting Union County's IBT request.

9.1. Yadkin River Basin Water Demand Growth

To account for this projected population, economic and water demand growth throughout the Yadkin-Pee Dee River Basin, the CHEOPS™ water quantity modeling for the proposed Union County IBT evaluated two conditions for water use through the basin: 1) Basin-wide water demands under current (Year 2012) water use and 2) Basin-wide water demands under future (Year 2050) water use. In doing this, potential impacts of the Union County IBT were able to be assessed, both now and in the future, while accounting for projected future increases in water needs by other entities which may currently withdraw water from Yadkin-Pee Dee River and its impounded reservoirs or others who may have needs for water in the future. The basis for the water demand projections, using North Carolina Local Water Supply Plans, state and federal population growth data and other sources, is summarized in the FEIS and described in detail in FEIS appendices.

Consideration for competing water demands in the Yadkin system was made as long term future water demands were considered as part of the modeling effort for the FEIS. Basin-wide water withdrawals and return flows for all users, by decade through the year 2060, were developed specifically for the Union County YRWSP FEIS evaluations. The evaluations are based on current (Year 2012) and future (Year 2050) water demands, as 2050 is the projection period used for Union County's YRWSP. However, basin-wide water demand projections were also extended an additional ten years to 2060 for updating the CHEOPS™ model to provide an approximate 5-decade projection period to allow flexibility for potential future uses of the model.

The basin-wide water demands used for this modeling effort are based on the projections developed by HDR as part of the CHEOPS™ update for the FEIS. Projections of water demands included municipal water supply, power plant cooling, agricultural/irrigation, and industry. These demands include other IBTs that are certified, grandfathered, or anticipated but not certified. The model requires that withdrawals be supplied as annual average withdrawal values. Since the withdrawal is not the same for every day of the year, the annual average values are adjusted to produce monthly use patterns and thus simulate seasonal water use patterns. In the CHEOPS™ model, each withdrawal's monthly distribution is based on the historical pattern for that water user. Details on the methodology and results for the basin-wide water supply projections for water supply modeling are summarized in a Technical Memorandum included as Appendix D of this Petition.

Illustration 9-1 and Table 9-1 provide a summary of the baseline water use projections for the Yadkin River Basin, as presented in the Technical Memorandum in Appendix D. These figures indicate a projected growth in annual average day net water withdrawals (withdrawals minus

returns) from 73.7 mgd for the Base Year (2012) to 150.5 mgd by the year 2050. A slight reduction in net withdrawals from 2050 to 2060 is also indicated, primarily due to projected wastewater return volumes increasing more rapidly than water withdrawal rates during that time period primarily due to transfers from neighboring river basins into the Yadkin River Basin. Large increases in water withdrawals shown in future years are the result of water use for future power generating facilities in the Yadkin River Basin. It is noted that these values shown for the baseline water use within the Yadkin River Basin do not include the proposed Union County IBT.

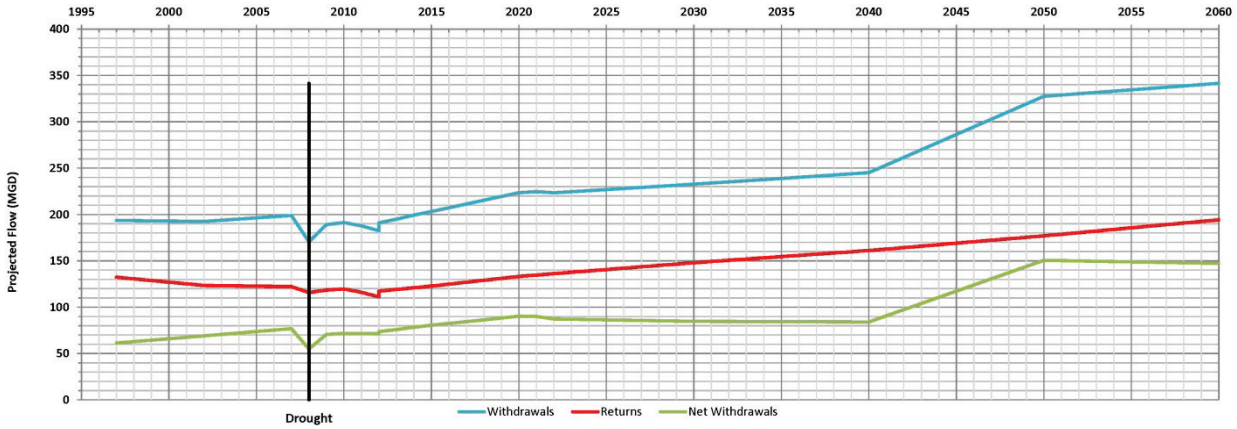

Illustration 9-1 Baseline Projected Water Use in the Yadkin River Basin, not Including the Proposed Union County IBT

Table 9-1 Baseline Projected Water Use in the Yadkin River Basin, not Including the Proposed Union County IBT

Water Use Type	Projected Annual Average Day Water Use (in mgd)						
	Base Year (2012)	2015	2020	2030	2040	2050	2060
Withdrawals	191.0	203.2	223.5	232.6	245.1	327.5	341.4
Returns	117.3	122.7	133.2	147.9	161.1	176.9	194.2
Net Withdrawals	**73.7**	**80.5**	**90.3**	**84.7**	**84.0**	**150.5**	**147.2**

Illustration 9-2 and Table 9-2 provide a summary of the water use projections for the Yadkin River Basin, inclusive of the proposed Union County IBT, as presented in the Technical Memorandum in Appendix D. These figures indicate a projected growth in annual average day net water withdrawals (withdrawals minus returns) from 73.7 mgd for the Base Year (2012) to 160.7 mgd by the year 2050. A slight reduction in net withdrawals from 2050 to 2060 is also indicated, primarily due to projected wastewater return volumes increasing more rapidly than water withdrawal rates during that time period, primarily due to transfers from neighboring river basins into the Yadkin River Basin. Large increases in water withdrawals shown in future years are the result of water use for future power generating facilities in the Yadkin River Basin.

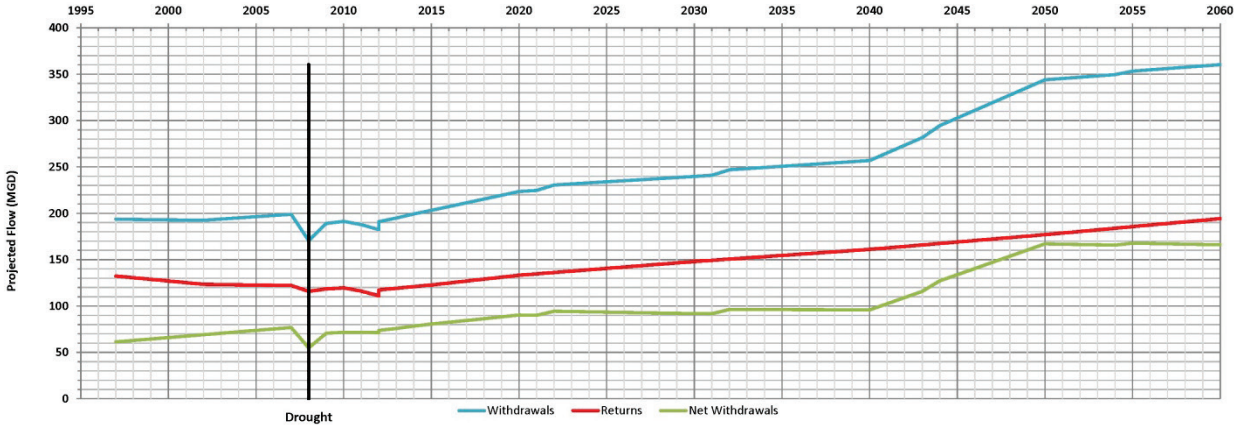

Illustration 9-2 Projected Water Use in the Yadkin River Basin, Including the Proposed Union County IBT

Table 9-2 Projected Water Use in the Yadkin River Basin, Including the Proposed Union County IBT

Water Use Type	Projected Annual Average Day Water Use (in mgd)						
	Base Year (2012)	2015	2020	2030	2040	2050	2060
Withdrawals	191.0	203.2	223.5	239.7	256.9	343.9	360.3
Returns	117.3	122.7	133.2	147.9	161.1	176.9	194.2
Net Withdrawals	**73.7**	**80.5**	**90.3**	**91.8**	**95.8**	**167.0**	**166.1**

9.2. Yadkin River Basin Reservoir Operating Rules

The system operating rules defined in the Federal Energy Regulatory Commission relicensing applications and Settlement Agreements for the two Yadkin-Pee Dee River Basin hydropower projects, including the Alcoa (APGI) operated Yadkin Hydroelectric Project and Duke Energy Progress operated Yadkin-Pee Dee Hydroelectric Project, are incorporated into the CHEOPS™ model used as part of the extensive water quantity modeling completed for the FEIS. These operating rules define the required operational parameters for reservoirs between High Rock Lake and Blewett Falls Lake, with consideration given to minimum lake levels, required downstream releases and operations during periods of normal, high and low inflow. For operation of the reservoirs during low inflow periods (drought), the modeling specifically incorporates the approved basin-wide drought plan, the Low Inflow Protocol.

9.3. Yadkin River Basin Drought Effects

The modeling for the FEIS evaluated each Union County water supply alternative from the Yadkin River Basin under these defined reservoir operating rules, for the full period of hydrology from 2055 to 2013, with consideration given to two very significant drought periods (1999 to 2003 (Drought of Record) and 2006 to 2009). Furthermore, the effect of potentially more severe future droughts was also evaluated as part of the water quantity modeling effort through the

incorporation of future climate change impacts to surface water by modeling increased reservoir evaporation due to future increasing temperatures.

Modeling of the project alternatives as part of the FEIS for the projected future Year 2050 includes consideration for the future impact of climate change resulting in an increased temperature of 2.3 deg F (0.6 deg F increase per decade) and lake surface evaporation increases of 7.8% (equivalent to an increase of 2% per decade), as compared to the 2012 baseline. This impact is consistent with the climate change impact considered by the Catawba-Wateree Water Management Group in preparation of the Catawba-Wateree Water Supply Master Plan baseline planning scenario, and is consistent with modeled climate change scenarios for this region of the United States. (HDR, 2015)

Modeling results incorporating these factors, as previously discussed and quantified in Section 8.0, indicates that, under the proposed Union County withdrawal, there currently is and will continue to be sufficient available water for release from Lake Tillery to maintain Blewett Falls Lake levels and releases below the dam, without negatively impacting upstream water sources.

9.4. No Adverse Impact to Future Water Supply Needs

Through the incorporation of future basin-wide water demand projections for current and potential future water withdrawers and returners to the Yadkin River Basin, under a variety of inflow conditions, the FEIS effectively evaluates the impact of Union County's proposed IBT, with due consideration given to other projected future water uses throughout the basin to conclude that all users modeled are able to meet current and future water supply needs from the Yadkin-Pee Dee River and its associated reservoirs through the period of study for this document.

Results show that the river basin, given its large size and water storage, is able to meet future water needs through the planning period. Analysis conducted to evaluate the IBT request and presented in the FEIS and associated ROD support this conclusion.

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Appendices

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A

APPENDIX A: Record of Decision – IBT Environmental Impact Statement

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RECORD OF DECISION
ENVIRONMENTAL IMPACT STATEMENT (EIS)

Union County Yadkin River Water Supply Project
Proposed Interbasin Transfer to the Rocky River Basin

UNION COUNTY, NORTH CAROLINA

PREPARED BY:
NORTH CAROLINA DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF WATER RESOURCES

March 9, 2016

CONTACT PERSON:

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SUMMARY

An Environmental Impact Statement (EIS) has been prepared for Union County for the proposed Yadkin River Water Supply Project (project). The proposed project will ensure long-term, sustainable water supply to the County's current and projected future service areas in the Rocky River IBT Basin. Under the current legislative and regulatory framework, Union County must obtain an interbasin transfer (IBT) certificate for this project. Union County is pursuing an IBT certificate to transfer a maximum month average daily amount of 23 million gallons per day (mgd) from the Yadkin River IBT Basin to the Rocky River IBT Basin. The requested amount is based on 2050 water demand projections in the County's Rocky River IBT Basin Service Area.

The preferred alternative to meet this water supply demand would include the withdrawal of water from Lake Tillery in the Yadkin River IBT Basin in Stanly County and the transfer of this water to the Rocky River IBT Basin in Union County for treatment and distribution. A significant portion of the transferred water would ultimately be discharged into the Rocky River Basin as treated wastewater, with the remainder lost to consumption on the land within the Rocky River Basin. The water modeling efforts completed for this EIS indicate that withdrawal from Lake Tillery would have less impact on lake aesthetics and other water withdrawal interests, including during drought conditions and hydropower production, than sourcing the water from other locations. The environmental impacts of the preferred alternative are similar, or significantly less, than the other alternatives evaluated for the proposed project.

This Record of Decision also serves as the Adequacy Determination required pursuant to N.C.G.S. §143-215.22L (f). The Environmental Management Commission voted to delegate this function to the Department of Environmental Quality during its January 14, 2016 meeting.

PURPOSE AND NEED

The purpose of the proposed project is to meet Union County's projected water supply demands through 2050. Water supply demands in the County's Rocky River IBT Basin are projected to increase from a current (2013) maximum month average daily demand of 7.7 mgd to 28.9 mgd by 2050. The projected increase in the County's water demand is a combined result of projected population growth and anticipated Union County water system service area growth. Population is projected to increase from 52,550 in 2013 to 179,450 in 2050 in the Rocky River IBT Basin Service Area. The County's current grandfathered IBT in the amount of 5.0 mgd from the Catawba River Basin and the current water purchase agreement with Anson County are not capable of meeting the projected future demand within the Rocky River IBT Basin; therefore, the County must secure a reliable water supply from other sources to meet its future demand.

ALTERNATIVES ANALYSIS

A total of twelve alternatives for Union County's Yadkin River Water Supply Project, including the No Action Alternative, were identified for evaluation in the EIS; the EIS provides a full discussion of these alternatives. A brief summary of the alternatives is provided below:

- **Alternative 1**: Pee Dee River raw water supply from Lake Tillery (IBT from Yadkin River IBT Basin to Rocky River IBT Basin) with a new water treatment plant in Union County. A new raw water intake and pump station is proposed as part of an agreement between Union County and the Town of Norwood. This alternative also includes the construction of a new water treatment plant; three potential site areas have been identified within the northeastern portion of Union County.
    - **Alternative 1A (preferred alternative)**: Raw water transmission alignment from Lake Tillery to new water treatment plant in northern Union County primarily following roadway right-of-way corridors through Stanly County into Union County.
    - **Alternative 1B**: Raw water transmission alignment from Lake Tillery to new water treatment plant in northern Union County primarily following existing power utility easements.
- **Alternative 2A**: Yadkin River raw water supply from Narrows Reservoir (Badin Lake) (IBT from Yadkin River IBT Basin to Rocky River IBT Basin) with a new water treatment plant in Union County. A new intake and pumping station would need to be constructed, adjacent to the City of Albemarle's existing raw water intake facility on Narrows Reservoir (Badin Lake).
- **Alternative 2B**: Yadkin River raw water supply from Tuckertown Reservoir (IBT from Yadkin River IBT Basin to Rocky River IBT Basin) with a new water treatment plant in Union County. A new intake and pumping station would need to be constructed, adjacent to the City of Albemarle's existing raw water intake facility on Tuckertown Reservoir.
- **Alternative 3**: Pee Dee River raw water supply from Blewett Falls Lake (IBT from Yadkin River IBT Basin to Rocky River IBT Basin) with a new water treatment plant in Union County. Major improvements to the existing water supply infrastructure between Anson and Union County would be required to meet projected future water demands for Union County.
    - **Alternative 3A**: Raw water transmission alignment from Blewett Falls Lake to a new water treatment plant in northern Union County primarily following power and natural gas utility easements.
    - **Alternative 3B**: Raw water transmission alignment from Blewett Falls Lake to a new water treatment plant in eastern Union County primarily following US-74 right-of-way.
- **Alternative 4**: Raw water supply from the main stem of the Pee Dee River (IBT from Yadkin River IBT Basin to Rocky River IBT Basin) with a new water treatment plant in Union County. This alternative proposes the installation of a new raw water intake located just downstream of the confluence of the Rocky River with the Pee Dee River, south of Lake Tillery. Reclassification of this section of the Pee Dee River would be required for the proposed intake location for this alternative, in order for it to be used for public water supply.
- **Alternative 5**: Raw water supply from the Rocky River within Union County (non-IBT alternative) with a new water treatment plant in Union County. The Rocky River is currently not classified for water supply by the State of North Carolina and would therefore need to be re-classified before being utilized as a municipal water source.
- **Alternative 6**: Expansion of the Catawba River Water Supply Project (modification to existing grandfathered IBT amount for a larger IBT from the Catawba River Basin to the Rocky River IBT Basin). Increasing the transfer of water from the Catawba River Basin to meet Union County's 2050 demands would exceed the combined IBT limit of 20 mgd, shared between Union County, NC and Lancaster County, SC, as imposed by South Carolina through the surface water withdrawal permit for the Catawba River Water Supply Project.
- **Alternative 7**: Interconnection with Charlotte Water (IBT from Catawba River Basin to the Rocky River IBT Basin). This water sale would require an IBT certificate. The additional water demand from sales to Union County would increase Charlotte Water's projected demand as a

percent of water supply to 97% by 2050. This could require expansion of Charlotte Water's intake(s), water treatment facilities and distribution system in order to meet the increased system demand by adding Union County as a wholesale customer.

- **Alternative 8**: Raw water supply through groundwater withdrawal within Union County with a new water treatment plant in Union County. Concerns with groundwater yield, groundwater quality, and development costs and logistics for a large-scale well network within the county severely limit the potential viability of this water supply alternative.
- **Alternative 9**: Water demand management/conservation. There are three existing water conservation and demand management ordinances and protocols that are applicable to Union County, including a new Water Use Ordinance adopted in May 2015. Conservation achieved through these measures is not expected to significantly reduce the overall future water demand for Union County, but it is expected to reduce maximum day and maximum month peaking factors that may be experienced during future droughts.
- **Alternative 10**: Direct potable reuse. Currently, direct potable reuse as would be implemented by Union County, is not permitted for potable water supply in North Carolina. Therefore, direct potable reuse is not a viable alternative water source at this time for Union County to serve its current existing and future customers.
- **Alternative 11**: Evaluation of water returns (wastewater) from the Rocky River IBT Basin back to the Yadkin River IBT Basin. Consideration of this alternative would serve as an IBT minimization strategy for Alternative 1. Alternative 11 is based on an assumed new NPDES (National Pollution Discharge Elimination System) discharge into the Pee Dee River at Lake Tillery. It is estimated that the IBT under Alternative 1 could be reduced by approximately 29% to 35% depending on projection year and actual future wastewater flows generated. However, any benefits gained from increased water quantity in Lake Tillery may be outweighed by water quality and environmental impacts associated with a new wastewater discharge and the associated sanitary sewer transmission infrastructure.
- **Alternative 12**: No Action Alternative. This alternative would not involve additional water supply service by Union County to new development in the Rocky River IBT Basin, even though the County's population within the service area is projected to increase. Without a reliable water supply source, future water supply within this area would have to be supplied either from the existing Catawba River Water Supply Project (will not be possible to meet future demand since County is currently approaching the existing IBT limit), through groundwater wells (would place additional strain on groundwater supply, and some parts of Union County have elevated concentrations of groundwater contaminants), or service connections to other water systems within the Rocky River IBT Basin (current and potential connections have not demonstrated the ability to meet Union County's projected future demand).

PREFERRED ALTERNATIVE

Alternative 1A was selected as the preferred alternative to meet the project's purpose and need of delivering a safe, sustainable water supply to meet the County's current and future water demands in their Rocky River IBT Basin service area. Alternative 1A involves the withdrawal of water from Lake Tillery in the Yadkin River IBT Basin and the transfer of water via roadway right-of-ways through southern Stanly County to the Rocky River IBT Basin in Union County for treatment, distribution, and ultimately treated discharge. The direct impacts to resources from the subsequent water transmission line have been estimated based upon existing data sources that were used to evaluate the subsequent infrastructure

associated with all of the alternatives. The water line alignment may change, based upon the field verified size and location of resources, if an IBT Certificate is granted allowing for the basin transfer.

The environmental impacts of Alternative 1A are similar, or significantly less, than the other alternatives evaluated. The water modeling efforts completed for this EIS indicate that withdrawal from Lake Tillery has fewer impacts than withdrawal of water from other locations. Stringent measures are in place throughout the existing and proposed service areas to mitigate potential environmental impacts that may result from the proposed project. Additionally, Alternative 1A represents one of the lowest cost project alternatives and has been determined to be a financially feasible option for this water supply.

ENVIRONMENTAL IMPACTS

All means of avoiding or minimizing environmental and cultural impacts outlined in the EIS will be incorporated into the proposed project. Summaries of potential impacts and mitigative actions for the preferred alternative are presented below.

No direct impacts, except for the potential water quantity/quality issues, are expected to occur as a result of the selection of the source of water related to the transfer of water from one river basin to another. However, direct impacts to other resources may occur with the associated water transmission line. All water line impacts from the various alternatives are conceptual; therefore, no field studies have been conducted for the actual infrastructure alignment. Direct impacts associated with the proposed water lines will be evaluated in subsequent environmental documentation and/or permitting. Per the Clean Water Act, these impacts will be avoided, minimized, and mitigated, in that order, to the maximum extent practicable.

Topography and soils: The construction-related effects will be minimized to the extent practicable via the implementation of an Erosion and Sediment Control Plan, which requires approval by DEQ prior to the commencement of work.

Land Cover and Land Use: No rezoning is required for implementation of the proposed project.

Wetlands and Floodplains: Steps will be taken to minimize any impacts to the 100-year floodplain during construction, and upon completion the disturbed area will be graded to match the existing elevation and surface contours to eliminate a permanent modification of the 100-year floodplain.

Water Quality and Quantity: No field studies were conducted for this EIS; therefore, impacts to resources are estimated. Once the preferred alternative is agreed upon, further investigation into the exact location of jurisdictional surface waters will be conducted and the design will be adjusted as needed to avoid and minimize impacts to these resources. Compliance with Sections 401 and 404 of the Clean Water Act will require authorizations from DWR and the U.S. Army Corps of Engineers, respectively, for potential impacts to jurisdictional surface waters. Riparian buffers are protected along the proposed corridor; activities in riparian buffers are restricted by ordinances that are applicable to the unincorporated areas of Union County that are in a water supply watershed. The preferred alternative represents negligible impacts to current and future water quality of waters within the Yadkin River Basin, including Lake Tillery, and the Rocky River Basin. Treated wastewater discharges into the Rocky River Basin will be permitted through the National Pollutant Discharge Elimination System (NPDES).

The Yadkin River Basin CHEOPS™ model was used to evaluate the impacts of the proposed 23 mgd withdrawal for the Union County Yadkin River Water Supply Plan from various locations in the Yadkin Basin. Direct impacts on water quantity for the preferred alternative were evaluated for impacts to lake levels (for both lake aesthetics and water withdrawals), reservoir discharges, water quantity management, and hydropower generation. Results reflect negligible impacts to the baseline scenario (year 2012) due to the proposed Union County IBT. The primary differences in metrics observed were between the 2050 and 2012 evaluations from projected basin-wide water demand increases in the future, not the proposed Union County IBT.

Groundwater: No direct impacts to groundwater are expected to occur.

Wildlife and Aquatic Resource Habitats: An Erosion and Sediment Control Plan will be developed and implemented during construction to minimize temporary impacts to aquatic resources.

Rare and Protected Species: Habitat is potentially present within the conceptual water line corridor and pump station areas for one endangered species and two candidate species. The endangered species is Michaux's sumac (*Rhus michauxii*) and the candidate species are Georgia aster (*Symphyotrichum georgianum*) and Yadkin River goldenrod (*Solidago plumosa*). No federally protected species (threatened or endangered) are known to exist within the conceptual water line corridor; however, the presence or absence of federally protected species will be determined during subsequent field studies once the preferred water source alternative is agreed upon. If a population of a federally protected species is found to be present, the United States Fish and Wildlife Service (USFWS) and North Carolina Wildlife Resources Commission will be contacted to confirm the species identification and extent of the population. Union County will coordinate with the agencies to identify measures to avoid impacting the species.

According to the USFWS, an existing population of the federally endangered freshwater mussel Carolina heelsplitter (*Lasmigona decorata*) is known to exist in three watersheds of Union County's Yadkin River Basin service area (Rocky River IBT Basin): Goose Creek, Duck Creek, and Waxhaw Creek. Concerns over indirect and cumulative impacts to this protected species have led Union County to enact stringent stormwater controls and other mitigation measures to reduce sediment pollution into these waters. Additionally, a *Site Specific Water Quality Management Plan for the Goose Creek Watershed* was created and implemented to reduce surface water impacts within the Goose Creek watershed from development pressures. Though there are long-term concerns over continued development throughout the service area, these mitigation measures have been deemed sufficient protection measures by resource agencies including the United States Fish and Wildlife Service, North Carolina Wildlife Resources Commission, and North Carolina Division of Water Resources to allow for continued development activities within the watersheds.

Public, Scenic, and Recreational Areas: Impacts associated with the permanent easement from the conceptual water transmission line include conversion of forest to herbaceous and scrub-shrub land covers.

Archeological or Historical Resources: State Historic Preservation Office correspondence states that it is extremely unlikely that they will request an archaeological survey if the preferred alternative is confined to existing, previously disturbed right-of-way. Coordination with the Office of State Archaeology will

occur to determine if potential areas of concern are present and whether an archaeological survey is required within the project area. No direct or indirect, permanent or temporary impacts to historic structures or districts are anticipated to occur from the preferred alternative.

Prime Agricultural Lands: Any direct impacts to prime agricultural lands are expected to be temporary from implementation of the preferred alternative.

Air Quality: All direct impacts to air quality are expected to be temporary and minor during construction. All construction activities will follow requirements outlined in construction permits and best management practices.

Noise Levels: In order to reduce disturbances to adjacent properties, construction will be limited to daylight hours in accordance with local noise ordinances. In emergency situations, a generator may be required to provide power to the pump station and water treatment plant, which will result in a short-term increase in noise levels.

Hazardous and Toxic Substances: A short-term increase in the storage, use, and disposal of hazardous and toxic waste will occur during construction activities associated with the preferred alternative. Long-term operation of the proposed water treatment plant, pump stations, and transmission lines is expected to result in the negligible generation of hazardous or toxic substances.

SECONDARY AND CUMULATIVE IMPACTS

Within the receiving basin, the potential secondary and cumulative impacts associated with the preferred alternative would primarily be attributed to Union County's projected urban growth and land use changes associated with population increases in the service area, entirely within the receiving basin. Due to the current growth patterns observed in Union County it is anticipated that population increases and the associated secondary and cumulative impacts will occur regardless of whether or not the proposed transfer is granted. Mitigation for secondary and cumulative impacts related to stormwater, floodplains, riparian buffers, surface waters, wetlands, open spaces and parks, water usage, land management, historic preservation, tree preservation, endangered species protection, wastewater treatment, and regional transportation planning measures will be provided, as directed by the state and federal programs and local ordinances for each community impacted by the proposed project, where applicable.

Within the source basin, the potential secondary and cumulative impacts associated with the preferred alternative would primarily be attributed to withdrawals from Lake Tillery, potentially reducing flows in the Pee Dee River downstream. Hydrologic modeling has shown that any downstream flow impacts would be minimal due to the management of the lake and inputs from the Rocky River, which empties into the Pee Dee River approximately 5.0 miles downstream of the Lake Tillery Dam. A majority of the water transferred will be discharged into the Rocky River through treated wastewater returns. Thereby, further reducing any potential impacts to water users and aquatic wildlife and habitat in the Pee Dee River.

EIS REVIEW AND COMMENT

The EIS has been properly advertised and reviewed by State and Federal agencies. Extensive public input has been considered in the planning process. Comments from agencies and citizens have been incorporated into the proposed project. A copy of this *Record of Decision* will be sent to the Clearinghouse, all review agencies, and a notice of its availability will be published in the Environmental Bulletin.

4/12/16

Donald R. van der Vaart (Date)
Secretary, Department of Environmental Quality

B

APPENDIX B: Water Shortage Response Plan

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Section 1.0 - Purpose

The purpose of this Water Shortage Response Plan ("Plan") is to maintain and protect the public health, safety and welfare of Union County ("County") residents by establishing short and long-term demand management strategies to effectively manage the limited resource of the water supply in the County. This Plan aids in effectively managing the water supply in the County by requiring efficient and responsible use of water within the County and by establishing measures and procedures for reducing potable water use during times of water shortage resulting from drought, capacity limitations, and system emergencies.

The water demand management strategies set forth in this Plan reduce the rate of increase in overall water use through year-round water conservation practices that maximize the County's existing and planned water supply sources and reduce seasonal peak day demands that result in the need for costly expansion of water treatment, storage, and transmission facilities. The implementation of voluntary and mandatory water reduction measures within the Union County water utility service area extends the available water supply with regard for domestic water use, sanitation and fire protection, and minimizes the adverse impacts in the event a water shortage is declared.

This Plan is also designed to be in accordance with the Catawba-Wateree Low Inflow Protocol ("CW-LIP") for the Catawba-Wateree River Basin. The CW-LIP was developed pursuant to the Comprehensive Relicensing Agreement for the Catawba-Wateree Hydro Project (FERC Project No. 2232) dated December 22, 2006 (the "Relicensing Agreement"), to which Union County is a party. The Relicensing Agreement establishes the CW-LIP as the agreed-upon methodology to deal with water shortages during periods of drought. Thus, Union County, as a signatory to the Relicensing Agreement, is required to comply with the CW-LIP. The CW-LIP establishes a policy for how Duke Energy Carolinas, LLC, regional water users, and other stakeholders will operate water systems during periods of drought by progressing through a series of staged water use restrictions during worsening drought conditions. The goal of the CW-LIP is to delay the point at which the Catawba River's usable water storage is fully depleted and to provide additional time to allow precipitation to restore stream flow, reservoir levels and groundwater levels to normal ranges.

As a publicly owned water system, the operation of the County's water utility system is subject to N.C.G.S. § 143-355(l) and N.C.G.S. § 143-355.2, requiring an approved Water Shortage Response Plan as part of the Local Water Supply Plan. A Water Shortage Response Plan must include specific requirements as set forth in rules governing water use during droughts and

water emergencies (15A NCAC § 02E.0607) and Article 38 of Chapter 143 of the North Carolina General Statutes. The Union County Water Use Ordinance (the "Ordinance") authorizes the implementation of this Plan and incorporates this Plan into the Ordinance.

Section 2.0 - Applicability

The provisions of this Plan apply to all persons, customers, and property utilizing water supplied through the County's water system; however, it does not apply to reuse or reclaimed water. This Plan also does not apply to private drinking water wells, as that term is defined in N.C.G.S. § 87-85, or ponds.

Section 3.0 - Definitions

Bona Fide Farm Use means water uses for the production and activities relating or incidental to the production of crops, grains, fruits, vegetables, ornamental and flowering plants, dairy, livestock, poultry, and all other forms of agriculture, as defined in N.C.G.S. § 106-581.1.

County means Union County, North Carolina

County Manager means, for the purposes of this Plan, the person currently occupying the position of Union County Manager (which includes a County Manager with an acting or interim designation), or in the absence of such a person, the Executive Director of Public Works.

Customer means a person, company, organization, or any other entity (individuals, corporations, partnerships, associations, and all other legal entities) using water supplied by the County's water utility, or in whose name an account for water utility service is maintained by the County.

CW-LIP means the Catawba-Wateree Low Inflow Protocol for the Catawba River Basin, as developed pursuant to the Relicensing Agreement.

Duke Energy means Duke Energy Carolinas, LLC and any successor in interest entity.

Essential Water Use means the use of water necessary for firefighting, health, and safety, and sustaining human and animal life. Specifically, for certain types of water uses set forth below, the following is considered Essential Water Use:

a. Domestic Use- Water use necessary to sustain human life and the lives of domestic pets, as well as to maintain minimum standards of hygiene and sanitation.

b. Commercial Use- Water use integral to the production of goods and/or services by any establishment having profit as its primary aim, except as otherwise specifically prohibited by this Plan.
c. Industrial Use- Water use in processes designed to convert materials of lower value into forms having greater usability and value, except as otherwise specifically prohibited by this Plan.
d. Institutional Use- Water use by government; public and private educational institutions; churches and places of worship; water utilities; and other public organizations, except as otherwise specifically prohibited by this Plan.
e. Health Care Facility Use- Water use in patient care and rehabilitation, including swimming pools used for patient care and rehabilitation, in nursing homes, and other care facilities.
f. Public Use- Water use for firefighting, including testing and drills by a fire department if performed in the interest of public safety; water system operations; and water necessary to satisfy federal, state, and local public health, safety, or environmental protection requirements.
g. Correctional Facility Use- Water use necessary to sustain human life and to maintain minimum standards of hygiene and sanitation.

MGD means million gallons per day.

Non-Essential Water Use means any use of water that does not meet the definition of Essential Water Use.

Ordinance means the current Union County Water Use Ordinance.

Plan means this Water Shortage Response Plan.

Rate Ordinance means the Ordinance Setting Charges, Fees, Rates and Deposits for Customers Served by the Union County Water and Sewer System.

Relicensing Agreement means the Comprehensive Relicensing Agreement for the Catawba-Wateree Hydro Project (FERC Project No. 2232) dated December 22, 2006.

Spray Irrigation System means a system of application of water to landscaping by means of a device, other than a hand-held hose or watering container, which projects water through the air in the form of particles or droplets.

UCPW means the Union County Public Works Department.

US Drought Monitor means a website hosted and maintained by the National Drought Mitigation Center that indicates what parts of the country are in a drought and the severity of such droughts.

Section 4.0. - Declaration and Implementation

The County Manager, upon notification from the Executive Director of Public Works of a water shortage as described in this Plan and the Ordinance, is authorized by the Ordinance to declare a water shortage, designate a water shortage stage, and implement the water use reduction measures or restrictions corresponding with such a stage, as such measures and restrictions are outlined in this Plan and the Ordinance. The County Manager, the Executive Director of Public Works, and UCPW are responsible for the implementation of this Plan.

Current Contact Information:

County Manager
Ms. Cynthia Coto, ICMA-CM
500 North Main Street, Suite 918
Monroe, NC 28112
Phone: 704-292-2625
Email: cindy.coto@co.union.nc.us

Executive Director of Public Works
Mr. Edward Goscicki, PE
500 North Main Street, Suite 600
Monroe, NC 28112
Phone: 704-296-4212
Email: Edward.goscicki@unioncountync.gov

Section 5.0. - Notification

When a water shortage has been declared, and whenever the water shortage stage changes, the County Manager will notify the Board of County Commissioners at its next regular meeting. At a minimum, the following notification options will be used to notify Customers of required response measures when a water shortage stage is declared or changed (based upon the new stage):

Stages 0 and 1

- County website (www.co.union.nc.us)
- County employee email announcements
- Social media
- Utility bill inserts

Stage 2

- County website (www.co.union.nc.us)
- County employee email announcements

- Social media
- Utility bill inserts
- Press releases to local television, radio, and/or print media

Stages 3 and 4

- County website (www.co.union.nc.us)
- County employee email announcements
- Social media
- Utility bill inserts
- Press releases to local television, radio, and/or print media
- Reverse 911 Notification System, if such system is currently available to UCPW

Additional means of notification may be used including, but not limited to,:

- Independent mailings to Customers outside of utility bills
- Take-home fliers at Union County Public Schools
- County vehicle magnets

Section 6.0 - Determination of a Water Shortage

A water shortage is a condition that exists when the demands and requirements of water Customers served by the Union County water system cannot be satisfied without depleting the available supply of treated water or the available water supply to or below a critical level; i.e., the level at which water is available for Essential Water Use.

Providing a reliable supply of water requires being prepared for water shortages of varying severity and duration, which may be caused by conditions such as drought, exceeding plant capacity, water quality problems, or disruptions in facility operations. For this Plan, water shortage conditions specific to the County have been categorized into three types: Resource Limitations, Capacity Limitations, and System Emergencies.

Prescribed indicators determine the severity or stage of a water shortage. These indicators are based on the ability of the County to meet water demands and are influenced by several components of the County's water supply system: the water source, raw water intake and pipeline, treatment plant, storage tanks, and distribution system. When a specific indicator's criterion is met, the corresponding water shortage stage is recommended and declared.

In determining a water shortage stage and the corresponding restrictions, consideration will be given, as applicable, to water shortage levels and available sources of supply, available usable

storage on hand, draw-down rates, the projected supply capability, outlook for precipitation, daily water use patterns, and availability of water from other sources.

A summary of indicators for five water shortage stages, from a Stage 0 Water Shortage (year-round water conservation) to a Stage 4 Water Shortage (water shortage emergency), are summarized for each type of water shortage in the following sections. These water shortage stages are intended to achieve system-wide water use reductions. If multiple indicators are met for more than one type of water shortage stage, the more severe of the indicators provided will determine the stage to be declared. For example, if Duke Energy, through the CW-LIP, declares a Stage 1 Water Shortage and other conditions cause the County to be in a Stage 2 Water shortage, then a Stage 2 Water Shortage will be declared until the County recovers from the Stage 2 Water Shortage or a more severe stage is declared.

It is possible that water shortage stages may not necessarily be implemented sequentially if water supply and/or demand conditions worsen rapidly. Likewise, recovery of water shortage stages may not always occur sequentially, depending on how quickly supply and/or demand conditions improve.

Section 6.1 - Resource Limitations

The County receives approximately 80% of its water from the Catawba River, which is dependent primarily on rainfall for replenishment. This leaves the County vulnerable to extended deficiencies in precipitation, known as drought, which can deplete the reservoirs along the Catawba River and impact the amount of water available for the County to withdraw. Drought can also have a significant impact on the lifestyle, ecology, and agriculture of a region. It is important in times of drought, when Customers often use more water than average, for the County to more closely monitor and control water usage to ensure the adequate short-term availability of water as well as to protect the environment.

CW-LIP

As a joint-owner of a large water intake located on the main stem of the Catawba River, Union County participated in Duke Energy's Federal Energy Regulatory Commission (FERC) relicensing process for the Catawba River and became a signatory stakeholder for the Relicensing Agreement. The Relicensing Agreement established rules and guidelines for how the Catawba-Wateree River system will be operated for the next fifty years, ending in year 2058. One major element of the Relicensing Agreement is the implementation of the CW-LIP, which establishes a policy for how Duke Energy and other Catawba River stakeholders will operate during periods of drought. This CW-LIP requires regional water users to move through a series of staged water use restrictions during worsening drought conditions. The goal of the CW-LIP is to delay the

point at which the Catawba-Wateree River system's usable water storage is fully depleted and provide additional time to allow precipitation to restore stream flow, reservoir levels, and groundwater levels to normal ranges. As a signatory stakeholder, Union County has agreed to comply with the prescribed requirements defined in the CW-LIP.

The CW-LIP describes indicators defined by worsening hydrologic conditions. These indicators use specific measurements to determine the various water shortage stages of low inflow conditions or water shortages. A summary of indicators for the various water shortage stages is provided in the table below. When Duke Energy declares a water shortage stage based on the CW-LIP indicators, the County shall also declare the same stage, or a more severe stage if other conditions apply in the County.

CW-LIP Indicators

Stage	Storage Index [1]		US Drought Monitor 3-Month Numeric Average		Stream Gage 6-Month Rolling Average as a percent of the Historical Average[2]
0[3]	90% < SI < 100% TSI		DM ≥ 0		≤ 85%
1	75% < SI ≤ 90% TSI	**and**	DM ≥ 1	**or**	≤ 78%
2	57% < SI ≤ 75% TSI	**and**	DM ≥ 2	**or**	≤ 65%
3	42% < SI ≤ 57% TSI	**and**	DM ≥ 3	**or**	≤ 55%
4	SI ≤ 42% TSI	**and**	DM ≥ 4	**or**	≤ 40%

[1] The ratio of Remaining Usable Storage to Total Usable Storage at a given point in time.
[2] The sum of the rolling 6-month average for the Monitored United States Geological Survey ("USGS") Streamflow Gages as a percentage of the period of record rolling average for the same historical 6-month period for the Monitored USGS Streamflow Gages.
[3] Stage 0 is triggered when any two of the three indicator points are reached.

During recovery from a water shortage stage, the progression of stages will be reversed. All three indicator points identified on the above table for the lower water shortage stage must be met or exceeded before returning to that lower stage (except as indicated in the table above regarding a Stage 0 Water Shortage).

North Carolina Drought Management Advisory Council

The North Carolina Drought Management Advisory Council ("NCDMAC") has statutory authority and is responsible for issuing drought advisories tailored to local conditions. The NCDMAC can issue drought classification and response actions by county. If the US Drought Monitor of North

Carolina shows more than one drought designation in a county, the drought classification for the county is the highest drought designation that applies to at least twenty five percent (25%) of the land area of the county.

The NCDMAC may recommend a drought designation for a county that is different from the designation based on the U.S. Drought Monitor of North Carolina if the depiction of drought does not accurately reflect localized conditions. In recommending a drought designation that differs from the U.S. Drought Monitor designation, NCDMAC will consider stream flows, ground water levels, the amount of water stored in reservoirs, weather forecasts, the time of year and other factors that are relevant to determining the location and severity of drought conditions. The NCDMAC makes recommendations that the County will take into consideration. When the NCDMAC declares a water shortage stage, the County shall also declare the same stage, or a more severe stage, if other conditions apply in the County.

Section 6.2 - Capacity Limitations

A water treatment plant's capacity is designed to meet the distribution system's anticipated maximum daily demand at a relatively constant flow rate with storage tanks in the distribution system intended to handle fluctuations in demand throughout the day. Customer demand for potable water will also fluctuate seasonally, often using more water in the spring and summer to promote lawn and other plant growth. Sometimes a combination of dry weather and high temperatures occurring during the summer can lead to unexpectedly high Customer demand. For example, during the drought of record in 2007, the County's demand exceeded the treatment capacity at the Catawba River Water Treatment Plant for several days during a two-week period.

The County continues to grow and connect new Customers to the water distribution system; however, adding additional capacity to a water treatment plant is a slow and expensive process. To ensure the County's ability to meet Customer demand for both Essential Water Use and Non-Essential Water Use, the County must declare water shortage stage if the water demand is nearing available treatment capacity on a regular basis.

The water shortage stage, and duration of such a stage, will depend on the extent to which Customer water demands approach or exceed Union County's capacity to meet those demands and how much the water use restrictions successfully reduce short-term demands. If the daily demands of the water system exceed a specified percentage of total available capacity for a specified period of time as described in the table below, the corresponding water shortage stage shall be declared.

Capacity Limitation Indicators

Stage	Union County Designation	Daily Demand
0	Year-Round Water Conservation	
1	Moderate Water Shortage	Demand > 80% of available capacity for the average of a 7 day period
2	Severe Water Shortage	Demand > 90% of available capacity for the average of a 7 day period
3	Extreme Water Shortage	Demand > 100% of available capacity for the average of a 7 day period
4	Exceptional Water Shortage	If demand continues to exceed available capacity such that an Extreme Water Shortage (Stage 3) is in effect due to such capacity limitations for thirty (30) consecutive days

When the recovery criteria shown in the table below for that water shortage stage have been met, the Public Works Executive Director will advise that the County Manager declare a reduced stage with the corresponding water use restrictions. It may be possible to reduce by more than one water shortage stage if the necessary recovery criteria have been met for intermediate stages.

Recovery from Capacity Limitations

Stage	Union County Designation	Recovery
0	Year-Round Water Conservation	
1	Moderate Water Shortage	Below 80% of available capacity for 90 consecutive days
2	Severe Water Shortage	Below 85% of available capacity for 60 consecutive days
3	Extreme Water Shortage	Below 90% of available capacity for 30 consecutive days
4	Exceptional Water Shortage	Below 95% of available capacity for 30 consecutive days

Section 6.3 - System Emergencies

The integrity of the water supply, treatment facilities, and distribution system are critical to meeting the potable water demands of the County. If there are major disruptions to any of

these components, it may be necessary to initiate water restrictions to ensure that basic needs are met. Such events include, but are not limited to:

- Water source contamination
- Water treatment plant disruptions
- Water distribution system disruptions

System emergencies typically require an immediate response and may require a major reduction of water use in a short period of time. Because each emergency event is different and varies in degree of severity and duration, no pre-determined water shortage stage can be identified for every event.

If the Executive Director of Public Works determines a system emergency condition exists that warrants the need to implement a water shortage stage, he/she will recommend to the County Manager a stage and associated water use restrictions that are deemed necessary and appropriate given the nature, extent, and expected duration of the emergency condition. The County Manager may declare a water shortage stage and associated water use restrictions that are deemed necessary and appropriate for the emergency condition.

As additional information becomes available regarding the system emergency, the water shortage stage initially declared may be quickly modified or resolved. When the factors determining the water shortage conditions have improved, the Executive Director of Public Works will recommend that the County Manager declare a reduced water shortage stage. The County Manager may then declare a reduced water shortage stage and associated water use restrictions that are deemed necessary and appropriate for the changed conditions.

As joint-owners of the Catawba River Water Treatment Plant, Union County and Lancaster County Water & Sewer District are developing the "Raw Water Intake Contingency Plan for the Union-Lancaster Catawba River Water Treatment Plant". The purpose of the raw water intake contingency plan is to mitigate disruptions in the quality or quantity of available source water or integrity of the raw water intake structure with minimal impacts to both distribution systems. These measures will reduce the County's vulnerability to raw water concerns and also reduce raw water-related incidents requiring a declaration of a system emergency water shortage.

Section 7.0 - Water Shortage Stage Measures and Restrictions

To ensure that water demand is reduced to a sustainable level after the declaration of a water shortage stage, water use measures and restrictions need to be enforced. Regardless of the

type of water shortage, each stage requires the same estimated reduction in demand so each stage has one set of corresponding actions that will be taken to conserve water. The water use measures and restrictions corresponding to each water shortage stage are set forth in the sections below.

Section 7.1 - Year-Round Water Conservation (Stage 0 Water Shortage)

This water shortage stage is intended to manage the County's long-term water resources by promoting water use efficiency. In the past, the County water system has experienced a high water demand peaking factor, measured as a ratio between the highest demand day of the year and the average demand over the entire year. This is reflective of the County's above average proportion of residential users and high irrigation use when compared with other utilities.

In 2008, the County's peaking factor exceeded 2.0. While Customers were under no water restrictions and had unlimited water use available, the County experienced several days in May 2007 with the daily demand exceeding the maximum capacity of 18 million MGD from the Catawba River Water Treatment Plant. The highest daily usage measured was 21.3 MGD. A water treatment plant is designed to meet an anticipated maximum day demand; however, this volume should only be needed or approached a few days per year. By reducing the maximum day demand, the County can push back the time frame when additional source water is needed and the water treatment plant needs to be expanded. Developing a new water source and the construction of new treatment process units or a new water treatment plant are very expensive, so rate increases corresponding with financing new infrastructure can be reduced by delaying their development.

As a part of the 2011 Comprehensive Water & Wastewater Master Plan, the County determined that steps would need to be taken to limit this water demand peaking factor to 1.7 to ensure adequate water supply in the future and to bring the County in line with peer water system utilities in North Carolina. Without water use restrictions, the County's water system will continue to have days where the maximum day demand exceeds the water treatment plant capacity, especially during periods of hot and dry weather. Additionally, these high demands place stress on the distribution system.

Therefore, this Plan and the Ordinance establish the implementation of mandatory and voluntary year-round water use restrictions and water conservation measures. These water use restrictions and water conservation measures are in effect under normal conditions and will serve as Stage 0 Water Shortage restrictions (Stage 0 Water Shortage is the minimum water shortage stage that will always be in effect in the County if there is no declaration of a

heightened stage). When a Stage 0 Water Shortage is in place, all Customers shall be required to adhere to the following mandatory water use restrictions:

Mandatory Water Use Restrictions

- Customer Spray Irrigation System use shall be limited to three (3) days per week.
- Customers shall at all times comply with the Spray Irrigation System schedule for use set forth in Section 7.7 of this Plan.

Limiting Spray Irrigation System use to 3 days per week is sufficient to meet the irrigation needs of lawns and other plants and reduces the likelihood of accidental over-watering. Those Customers using drip irrigation or any handheld watering methods are still allowed to water any day and time. Customers regularly engaged in the sale of plants, shrubbery, trees and flowers are permitted to use water by any method at any time for irrigation of their commercial stock.

In addition to the mandatory maximum of three (3) days per week for Spray Irrigation System use schedule, voluntary water conservation practices are also encouraged year-round at this water shortage stage. These voluntary measures, which are encouraged, but not required, are described below:

Voluntary Water Conservation Measures

a. Use flow-restrictive, water-saving devices and methods. Faucets should not be left running while shaving, brushing teeth, or washing dishes. Showers should be limited to no more than five (5) minutes and baths should be avoided if not medically necessary. Toilets should be flushed after multiple usages.
b. Limit the use of clothes and dish washing machines to running only full loads.
c. Inspect and repair all leaks and defective components of water delivery systems in any structures (faucets, toilets, equipment, etc.) in a timely manner.
d. Reuse household water to water plants.

Section 7.2 - Moderate Water Shortage (Stage 1 Water Shortage)

At this water shortage stage, the County has concern about the available water supply and Customers are encouraged to adopt water saving measures intended to reduce overall water use. The primary purpose of this water shortage stage is to increase education and awareness of the limited water resources and to encourage additional voluntary water conservation measures to reduce the need for further mandatory restrictions. In the event a Stage 1 Water Shortage is declared, all Customers shall comply with the following mandatory water use restrictions:

Mandatory Water Use Restrictions

- Comply with all Stage 0 Water Shortage Mandatory Water Use Restrictions.
- The transport of water from within the County to outside of the County where such water has been drawn by tanker truck from a hydrant of the County water utility system is prohibited; provided, however, that transport outside of the County shall be allowed for emergency fire protection and Bona Fide Farm Uses.

Customers using drip irrigation or any handheld watering methods are still allowed to water any day and time. Customers regularly engaged in the sale of plants, shrubbery, trees and flowers are permitted to use water by any method at any time for irrigation of their commercial stock.

In addition to the mandatory water use restrictions, additional voluntary water conservation measures are also encouraged at this water shortage stage. These voluntary measures, which are encouraged, but not required, are described below:

Voluntary Water Conservation Measures

a. Implement all Voluntary Water Conservation Measures set forth for a Stage 0 Water Shortage.
b. Limit Spray Irrigation System use to no more than two (2) days per week, using the designated schedule as set forth in Section 7.7 of this Plan.
c. Use spring-activated nozzles when watering lawns and gardens by hand with a hose.
d. Limit residential vehicle, or any other type of mobile equipment, washing to the designated Spray Irrigation System use days set forth in Section 7.7 of this Plan.

Section 7.3 – Severe Water Shortage (Stage 2 Water Shortage)

This water shortage stage reflects an increase in concern over water supply leading to additional mandatory restrictions. Moving to this water shortage stage is intended to bring Customers' and UCPW employees' attention to the increasing severity of the water shortage. Additional mandatory restrictions are necessary when voluntary measures are not effective in the previous water shortage stages in reducing water system demand. In the event a Stage 2 Water Shortage is declared, all Customers shall comply with the following mandatory water use restrictions:

Mandatory Water Use Restrictions

- Comply with all Stage 1 Water Shortage Mandatory Water Use Restrictions.

- Limit Spray Irrigation System use to no more than two (2) days per week and only between the hours of 12:00 a.m. until 8:00 a.m. and 8:00 p.m. until 12:00 a.m., on the days identified in Section 7.7 of this Plan.
- Eliminate personal vehicle washing unless using a commercial carwash.
- Eliminate the filling of new swimming pools and fountains (unless considered Essential Water Use as defined herein).
- Eliminate public building, sidewalk, and street washing activities (unless considered Essential Water Use as defined herein).
- Limit construction uses of water (e.g. dust control).
- Limit flushing and hydrant testing programs, except as necessary to maintain water quality or in other special circumstances.

Customers using drip irrigation or any handheld watering methods are still allowed to water any day and time. Customers regularly engaged in the sale of plants, shrubbery, trees, and flowers are permitted to use water by any method at any time for irrigation of their commercial stock.

Unless otherwise declared as mandatory at this state, Customers are encouraged, but not required, to implement voluntary water conservation measures set forth in this Plan for a Stage 1 Water Shortage.

Section 7.4 - Extreme Water Shortage (Stage 3 Water Shortage)

This water shortage stage is a point at which the County is greatly concerned about the current and future supply of water. Immediate additional water conservation measures and water use restrictions are essential to avoid major restrictions or water rationing. This can be of particular concern during a severe drought with no significant predicted rainfall. It is important for UCPW employees and Customers to understand the rare nature of the situation and to react accordingly. At this water shortage stage, mandatory requirements become more restrictive in an effort to lessen the impacts of worsening conditions and delay or prevent a water shortage emergency. In the event a Stage 3 Water Shortage is declared, all Customers shall comply with the following mandatory water use restrictions:

Mandatory Water Use Restrictions

- Comply with all Stage 2 Water Shortage Mandatory Water Use Restrictions, unless a more stringent requirement is imposed below.

- Limit Spray Irrigation System use to no more than one (1) day per week and only between the hours of 12:00 a.m. until 8:00 a.m. and 8:00 p.m. until 12:00 a.m., on the day identified in Section 7.7 of this Plan.
- Eliminate the filling of all swimming pools, hot tubs, fountains, and decorative ponds (except when necessary to support aquatic life or considered Essential Water use as defined herein).
- Eliminate construction uses of water (e.g. dust control).
- Eliminate flushing and hydrant testing programs, except as necessary to maintain water quality or in other special circumstances.
- Eliminate the serving of drinking water from the County water system in restaurants, cafeterias, and other food establishments (except upon patron request).
- Eliminate variances for landscape irrigation.

Customers using drip irrigation or any handheld watering methods are still allowed to water any day and time. Customers regularly engaged in the sale of plants, shrubbery, trees, and flowers are permitted to use water by any method at any time for irrigation, but only in amounts necessary to prevent the loss of their commercial stock.

In addition to the mandatory water use restrictions, additional voluntary water conservation practices are also encouraged at this water shortage stage. These voluntary measures, which are encouraged, but not required, are described below:

Voluntary Water Conservation Measures

a. Implement all Voluntary Water Conservation Measures set forth for a Stage 2 Water Shortage.
b. Encourage industrial/manufacturing process changes that reduce water use.

Section 7.5 - Exceptional Water Shortage (Stage 4 Water Shortage)

This water shortage stage involves severe water use restrictions and is reserved for situations where the public water supply is threatened and the County must act to ensure there is an adequate supply for Essential Water Use. This water shortage stage brings attention to the exceptionally serious nature of the water shortage and includes rapid notifications listed in Section 5.0 of this Plan. UCPW and other County staff will prepare to implement emergency plans to respond to water outages according to the County's Emergency Response Plan. In the event a Stage 4 Water Shortage is declared, all Customers shall comply with the following mandatory water use restrictions:

Mandatory Water Use Restrictions

- Comply with all Stage 3 Water Shortage Mandatory Water Use Restrictions, unless a more stringent requirement is imposed below.
- Prohibit all Non-Essential Water Use (including the prohibition of all residential irrigation, irrigation of commercial stock, and filling of ponds to sustain aquatic life).
- Prohibit the use of water outside a structure for any use other than a fire emergency.
- Require the use of disposable utensils and plates at all restaurants, cafeterias, and other food establishments.

In addition to the mandatory water use restrictions, additional voluntary water conservation practices are also encouraged at this water shortage stage. These voluntary measures, which are encouraged, but not required, are described below:

Voluntary Water Conservation Measures

a. Implement all Voluntary Water Conservation Measures set forth for a Stage 3 Water Shortage.
b. Continue to encourage industrial/manufacturing process changes that reduce water use. The County will prioritize and meet with large commercial and industrial/manufacturing large water customers to discuss strategies for water use reduction measures.

Section 7.6- Additional Water Use Regulation Authority

Pursuant to the Ordinance, the County Manager, acting in the best interests of the health, safety, and welfare of the citizens of Union County, may further regulate water usage on the following bases: (i) time of day; (ii) day of week; (iii) Customer type, including, without limitation, residential, commercial, industrial, and institutional uses; and (iv) physical attribute, such as address.

Section 7.7 - Irrigation Schedules

A Customer is only permitted to use a Spray Irrigation System on the designated irrigation day(s) assigned to them as set forth in the table below. The Customer's billing cycle number (corresponding with the table below) can be found on the Customer bill.

Billing Cycle	Stages 0 and 1 3-day per week	Stage 2 2-day per week	Stage 3 1-day
1	Mon-Wed-Sat	Mon-Wed	Wed
2	Sun-Tue-Thu	Sun-Thu	Sun
3	Mon-Thu-Sat	Mon-Thu	Thu
4	Tue-Thu-Sat	Tue-Thu	Tue
5	Sun-Wed-Fri	Sun-Wed	Sun
6	Mon-Wed-Sat	Mon-Wed	Mon
7	Sun-Wed-Fri	Sun-Wed	Wed
8	Sun-Tue-Fri	Tue-Fri	Tue
9	Sun-Tue-Fri	Tue-Fri	Fri
10	Mon-Thu-Sat	Mon-Thu	Mon

Section 7.8- Water Conservation Rates

During a declared water shortage due to resource or capacity limitations, water rates increase to ensure adequate operating revenue and to encourage conservation. Rate increases are not utilized in response to a system emergency water shortage condition.

The County utilizes an increasing block rate structure for residential and irrigation water usage. The rates for all user types are defined in the Rate Ordinance. The Rate Ordinance increases all water usage rates during certain water shortage stages. The current rates are shown in the table below; however, the rates are only shown to be illustrative. Customers will be charged the rates established in the then current Rate Ordinance corresponding to the water shortage stage in effect at the time bills are rendered. If a system emergency occurs while in a water shortage situation, the rates applied shall be those corresponding to the current water shortage response due to resource or capacity limitations.

		Standard Rates / Water Shortage Stage I			Water Shortage Stage II			Water Shortage Stage III			Water Shortage Stage IV		
		2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017
Residential													
Tier 1	0 - 3,000 gallons	$ 1.95	$ 2.10	$ 2.20	$ 1.95	$ 2.10	$ 2.20	$ 1.95	$ 2.10	$ 2.20	$ 2.62	$ 2.80	$ 2.99
Tier 2	3,001 - 7,000 gallons	2.65	2.80	3.00	2.65	2.80	3.00	2.65	2.80	3.00	3.95	4.25	4.53
Tier 3	7,001 - 10,000 gallons	3.75	4.00	4.25	3.75	4.00	4.25	7.76	8.16	8.50	8.39	9.15	9.52
Tier 4	10,001 - 15,000 gallons	5.85	6.05	6.20	9.44	9.73	9.91	16.11	16.62	16.90	17.40	17.99	18.28
Tier 5	> 15,000 gallons	10.10	10.10	10.10	16.35	16.16	16.15	27.94	27.62	27.60	30.20	29.90	29.85
Irrigation													
Tier 1	0 - 3,000 gallons	$ 3.75	$ 4.00	$ 4.25	$ 3.75	$ 4.00	$ 4.25	$ 7.76	$ 8.16	$ 8.50	$ 8.39	$ 9.04	$ 9.52
Tier 2	3,001 - 7,000 gallons	3.75	4.00	4.25	3.75	4.00	4.25	7.76	8.16	8.50	8.39	9.04	9.52
Tier 3	7,001 - 10,000 gallons	3.75	4.00	4.25	3.75	4.00	4.25	7.76	8.16	8.50	8.39	9.04	9.52
Tier 4	10,001 - 15,000 gallons	5.85	6.05	6.20	9.44	9.73	9.91	16.11	16.62	16.90	17.40	17.99	18.28
Tier 5	> 15,000 gallons	10.10	10.10	10.10	16.35	16.16	16.15	27.94	27.62	27.60	30.20	29.90	29.85
Non-Residential													
	Flat Rate	$ 2.70	$ 2.90	$ 3.05	$ 2.86	$ 3.06	$ 3.22	$ 3.12	$ 3.33	$ 3.50	$ 3.74	$ 3.97	$ 4.18
Wholesale													
	Flat Rate	$ 2.25	$ 2.40	$ 2.55	$ 2.38	$ 2.53	$ 2.69	$ 2.60	$ 2.76	$ 2.93	$ 3.12	$ 3.29	$ 3.49

Section 8.0 - Enforcement and Penalties

Compliance with the provisions of this Plan is required and authorized by the Ordinance and enforced by personnel of UCPW, independent contractors engaged by UCPW for such purpose, and such other personnel as designated by the County Manager. Enforcement measures and procedures, issuance of violations, and penalties for violation of the water restrictions put in place are further prescribed in the Ordinance. Customers are responsible for any use of water that passes through their service connection. Knowledge of the prevailing restrictions and proper functioning of an automatic Spray irrigation System is the responsibility of the property owner and resident. Any Customer who violates, or permits the violation of, any mandatory water restriction set forth in this Plan or the Ordinance is subject to civil penalties and/or termination of service. Civil penalties for such violations are set forth in the table below. Customers who violate conditions of a variance are also subject to the enforcement penalties.

Stage	Union County Designation	1st Violation	2nd Violation	3rd Violation	4th Violation	5th and Additional Violations
0	Year-Round Water Conservation	Warning	Warning	$250	$500*	$1000*
1	Moderate Water Shortage	Warning	$100	$500	$500*	$1000*
2	Severe Water Shortage	Warning	$200	$500	$500*	$1,000*
3	Extreme Water Shortage	$100	$500	$750	$1000*	$1,500*
4	Exceptional Water Shortage	$200	$500	$1,000	$1,000*	$2,000*

*Includes termination of service

Each day that a violation of a mandatory water restriction occurs or continues to occur after delivery of notice will be considered a separate and distinct violation. Violations will be accumulated by Customers on a calendar year basis for purposes of accrual of civil penalties. The Customer shall remain liable for payment of all civil penalties regardless of when accrued. Violations of any mandatory water use restrictions of any water shortage stage shall accumulate with violations of other stages. Should a Customer move, or cease and renew service, during a calendar year, the Customer's violations shall continue to accumulate as if such move or cessation had not occurred.

Further information and detail regarding enforcement of civil penalties, termination of service, and procedures related thereto are contained in the Ordinance.

Section 9.0 - Appeals

A Customer who receives a notice of violation indicating that the Customer is subject to a civil penalty or the Customer's water service is subject to termination may appeal the violation or pending termination by filing a written notice of appeal in accordance with the procedures and requirements set forth in the Ordinance. The consideration and resolution of all appeals will also be in accordance with the Ordinance.

Section 10.0 - Variances

UCPW is authorized to issue variances in accordance with this Plan and the Ordinance, permitting any Customer satisfying the requirements of this Plan and the Ordinance to use water for a purpose that would otherwise be prohibited by water use restrictions then in effect.

UCPW may issue variances during Stage 0, Stage 1 and Stage 2 provided that each of the following conditions is satisfied: (i) the Customer applies for a variance using forms provided by UCPW; (ii) the Customer pays a variance registration fee in such amount as determined by the Executive Director of Public Works, not to exceed fifty dollars ($50.00); (iii) the application pertains to a new lawn and/or landscape installed incident to new construction, or to newly installed replacement sod, complete reseeding, or natural ground cover within the parameters of an established lawn; (iv) if pertaining to new lawn and/or landscape installed incident to new construction, the Customer applies for a variance either before issuance of a certificate of occupancy or within ninety (90) days after issuance of a certificate of occupancy relative to this new construction; and (v) the Customer submits with the application such supporting documentation as required by UCPW to substantiate that these conditions have been satisfied.

Upon receipt of a variance from UCPW, the Customer may be permitted to water such newly installed lawn and/or landscape, or such newly installed replacement sod, complete reseeding, or natural ground cover, for a period not to exceed forty-five (45) days from the date of issuance of the variance. During the period that the variance is in effect, the Customer shall post signage provided by UCPW to signify the Customer's temporary exempt status from water use restrictions otherwise in effect. The Customer shall post such sign within two (2) feet of the driveway entrance. In any variance issued, UCPW may impose such conditions and restrictions as are appropriate to require that water used from the County water system be minimized to the extent practical.

Variances issued shall terminate upon the earlier occurrence of the following: (i) forty-five (45) days from the date of issuance; or (ii) declaration by the County Manager of a Stage 3 or State 4 Water Shortage. In addition, the County Manager may, upon the recommendation of the Executive Director of Public Works, direct that UCPW cease issuance of new variances in the event it is determined that further issuance will likely result in increased demand that will equal or exceed the treatment and/or transmission capacity of the system or portions thereof.

Any Customer receiving a variance who violates the terms thereof shall be subject to a civil penalty set forth in this Plan and the Ordinance and to revocation of the variance. Any person who has violated the terms of any variance or any mandatory water use restrictions imposed

pursuant to this Plan or the Ordinance may be denied a variance, notwithstanding any provision of this Plan or the Ordinance to the contrary.

Section 11.0- Maintenance of Spray Irrigation Systems

The County recognizes that irrigation systems utilizing water from the County water system should be properly maintained in order to maximize efficiency and prevent waste. Additionally, the County recognizes that such maintenance may occur on days and at such times as would otherwise be prohibited under the Ordinance and this Plan. However, during the period that a Stage 2 or Stage 3 Water Shortage is in effect, an existing Spray Irrigation System may be operated on such days and at such times as would otherwise be prohibited, provided that the requirements for such irrigation system maintenance set forth in the Ordinance are met. The allowance for such operations, issuance of violations and penalties, and appeals are provided for in the Ordinance.

Section 12.0- Plan Evaluation and Effectiveness

The effectiveness of this Plan will be determined by measuring system-wide water use reductions during declared water shortage stages. In addition to water supply and usage, the frequency of implementing water shortage stages within the parameters set forth in the Plan will also be evaluated. If the frequency of implementation of water shortage stages is found to be too great, or if the duration is found to be excessive, then modifications to the Plan, or adjustments to the water supply infrastructure will be considered and proposed. The number of citations issued during a water shortage may also be used to determine if the level and severity of citations is sufficient to achieve the water usage reductions necessary.

All mandatory drought response activities undertaken by the participating members of the Catawba Wateree Drought Management Group, as written in the CW-LIP, will also serve as an expansive and detailed examination of the effectiveness of measures enacted. The table below indicates the potential expected reduction from normal use, or the amount that would otherwise be expected, for each water shortage stage as defined in the CW-LIP in effect as of the adoption date of this Plan.

Water Use Reduction Goals from the CW-LIP

Stage	Percent Reduction Goals
0	
1	3-5%
2	5-10%
3	10-20%
4	30% or more

For the purposes of determining "normal water use", consideration may be given to one or more of the following:

- Historical maximum daily, weekly, and monthly flows during drought conditions.
- Increased customer base (e.g. population growth, service area expansion) since the historical flow comparison.
- Changes in major water users (e.g. industrial shifts) since the historical flow comparison.
- Climatic conditions for the comparison period.
- Changes in water use since the historical flow comparison.
- Other system specific considerations.

The County has implemented a more aggressive approach than the CW-LIP by implementing a year-round, three (3) days per week Spray Irrigation System use schedule (Stage 0 Water Shortage restriction). The reduction goals listed above are compared to unrestricted water use and are not in addition to the reductions expected from year-round water conservation measures.

Section 13.0 - Public Review and Revisions of Plan

This Plan, as well as the Ordinance, will be reviewed and revised as needed to adapt to new circumstances affecting water supply and demand, following implementation of emergency restrictions. Review will be conducted at a minimum of every five years in conjunction with updating the County's Local Water Supply Plan.

Adoption of this Plan, or revisions thereto, will follow the normal processes for approval at a meeting of the Union County Board of Commissioners. The proposed Plan, or revisions thereto, will be publicized in advance on the County's website, as well as be publicized online as part of the meeting agenda at which adoption of this Plan, or revisions thereto, will be considered for

adoption. The public will then have the opportunity to comment on revisions to the Plan through written comment submitted to UCPW or during the public comment period at the Board of Commissioners' meeting.

The public will also have the option to review and comment on the provisions of the Plan at any time. The Plan will be available online through the County's website for the public to view, as well as on file in the Clerk to the Board of Commissioners' office. The public may send comments to the contact person as set forth on the County's website along with this Plan.

Section 14.0 - Effective Date

This Water Shortage Response Plan is effective upon adoption by the Union County Board of Commissioners on this the 4th day of May, 2015.

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Union County Water Use Ordinance

May 4, 2015

Article I. Purpose

BE IT ORDAINED by the Union County Board of Commissioners that the purpose of this Ordinance is to maintain and protect the public health, safety, and welfare of Union County ("County") residents by establishing short and long-term demand management strategies to effectively manage the limited resource of the water supply in the County. This Ordinance effectively manages the water supply in the County by requiring efficient and responsible use of water within the County and by establishing measures and procedures for reducing potable water use during times of water shortage resulting from drought, capacity limitations, and system emergencies.

The water demand management strategies set forth in this Ordinance reduce the rate of increase in overall water use through year-round water conservation practices that maximize the County's existing and planned water supply sources and reduce seasonal peak day demands that result in the need for costly expansion of water treatment, storage, and transmission facilities. The implementation of voluntary and mandatory water reduction measures within the County water service area extends the available water supply with regard for domestic water use, sanitation and fire protection, and minimizes the adverse impacts in the event a water shortage is declared.

This Ordinance is also designed to be in accordance with the Catawba-Wateree Low Inflow Protocol ("CW-LIP") for the Catawba-Wateree River Basin. The CW-LIP was developed pursuant to the Comprehensive Relicensing Agreement for the Catawba-Wateree Hydro Project (FERC Project No. 2232) dated December 22, 2006 (the "Relicensing Agreement"), to which Union County is a party. The Relicensing Agreement establishes the CW-LIP as the agreed-upon methodology to deal with water shortages during periods of drought. Thus, Union County, as a signatory to the Relicensing Agreement, is required to comply with the CW-LIP. The CW-LIP establishes a policy for how Duke Energy Carolinas, LLC, regional water users, and other stakeholders will operate water systems during periods of drought by progressing through a series of staged water use restrictions during worsening drought conditions. The goal of the CW-LIP is to delay the point at which the Catawba River's usable water storage is fully depleted and to provide additional time to allow precipitation to restore stream flow, reservoir levels, and groundwater levels to normal ranges.

The Union County Water Shortage Response Plan ("WSRP"), adopted by the Union County Board of Commissioners on May 4, 2015, is hereby adopted and incorporated into this Ordinance by reference. The WSRP is also made an exhibit to this Ordinance. An official copy of the WSRP shall be available for public inspection in the office of the Clerk to the Union County Board of Commissioners. If there is any conflict between the WSRP and this Ordinance, the provisions of this Ordinance shall control.

Article II. Applicability

The provisions of this Ordinance apply to all persons, customers, and property utilizing water supplied through the County's water utility system; however, it does not apply to reuse or reclaimed water. Water uses from private drinking water wells, as that term is defined in N.C.G.S. § 87-85 and ponds are not regulated by this Ordinance. This Ordinance also supersedes the Union County Water Conservation Ordinance originally adopted by the Union County Board of Commissioners on July 13, 1992, as subsequently amended and/or restated by any amendments or restatements thereto.

Article III. Definitions

Bona Fide Farm Use means water uses for the production and activities relating or incidental to the production of crops, grains, fruits, vegetables, ornamental and flowering plants, dairy, livestock, poultry, and all other forms of agriculture, as defined in N.C.G.S. § 106-581.1.

County means Union County, North Carolina.

County Manager means, for the purposes of this Ordinance, the person currently occupying the position of Union County Manager (which includes a County Manager with an acting or interim designation), or in the absence of such a person, the Executive Director of Public Works.

Customer means a person, company, organization, or any other entity (individuals, corporations, partnerships, associations, and all other legal entities) using water supplied by the County's water utility, or in whose name an account for water utility service is maintained by the County.

CW-LIP means the Catawba-Wateree Low Inflow Protocol for the Catawba River Basin, as developed pursuant to the Relicensing Agreement.

Essential Water Use means the use of water necessary for firefighting, health, and safety, and sustaining human and animal life. Specifically, for certain types of water uses set forth below, the following is considered Essential Water Use:

a. Domestic Use- Water use necessary to sustain human life and the lives of domestic pets, as well as to maintain minimum standards of hygiene and sanitation.
b. Commercial Use- Water use integral to the production of goods and/or services by any establishment having profit as its primary aim, except as otherwise specifically prohibited by this Ordinance.
c. Industrial Use- Water use in processes designed to convert materials of lower value into forms having greater usability and value, except as otherwise specifically prohibited by this Ordinance.
d. Institutional Use- Water use by government; public and private educational institutions, churches and places of worship; water utilities; and other public organizations; except as otherwise specifically prohibited by this Ordinance.

e. Health Care Facility Use- Water use in patient care and rehabilitation, including swimming pools used for patient care and rehabilitation, in nursing homes, and other care facilities.
f. Public Use- Water use for firefighting, including testing and drills by a fire department if performed in the interest of public safety; water system operations; and water necessary to satisfy federal, state, and local public health, safety, or environmental protection requirements.
g. Correctional Facility Use- Water use necessary to sustain human life and to maintain minimum standards of hygiene and sanitation.

Non-Essential Water Use means any use of water that does not meet the definition of Essential Water Use.

Ordinance refers to this Union County Water Use Ordinance.

Rate Ordinance means the Ordinance Setting Charges, Fees, Rates and Deposits for Customers Served by the Union County Water and Sewer System.

Relicensing Agreement means the Comprehensive Relicensing Agreement for the Catawba-Wateree Hydro Project (FERC Project No. 2232) dated December 22, 2006.

Spray Irrigation System means a system of application of water to landscaping by means of a device, other than a hand-held hose or watering container, which projects water through the air in the form of particles or droplets.

UCPW means the Union County Public Works Department.

WSRP means the Water Shortage Response Plan adopted by the Union County Board of Commissioners on May 4, 2015.

Article IV. Declaration of a Water Shortage

In the event that a water shortage of any degree occurs, as such an event triggering a water shortage is set forth in this Ordinance and the WSRP, the Executive Director of Public Works shall notify the County Manager of said water shortage. The County Manager is authorized by this Ordinance to declare a water shortage, designate a water shortage stage, and implement the water use reduction measures or restrictions corresponding with such a stage, as such water use reduction measures or restrictions are outlined in this Ordinance. The County Manager shall report the declaration of a water shortage, as well as the water shortage stage, to the Board of Commissioners at its next regular meeting.

In designating any water shortage stage pursuant to this Ordinance, the County Manager may limit the applicability of the requirements of this Ordinance to certain sections of the County, whether by township or other description, as appropriate.

The declaration of a water shortage and designation of a water shortage stage becomes effective immediately upon issuance by the County Manager, unless otherwise stated in such declaration. When

a water shortage stage is declared or changed, the stage shall remain in effect until reduced or rescinded by the County Manager, upon recommendation of the Executive Director of Public Works, when it is deemed that the condition(s) which caused the water shortage has abated. Any declaration of a water shortage, or any designated change in a water shortage stage, shall be promptly and extensively publicized in a manner corresponding with the updated and current designated stage, in the manner of notification set forth in the WSRP.

Article V. Determination of a Water Shortage

A water shortage refers to a condition that exists when the demands and requirements of water Customers served by the Union County water system cannot be satisfied without depleting the available supply of treated water or the available water supply to or below a critical level; i.e., the level at which water is available for Essential Water Use. Conditions contributing to a water shortage may include, but are not limited to, the following:

- Resource Limitations
- Capacity Limitations
- System Emergencies

A water shortage stage is determined by the criteria set forth in the WSRP, or as otherwise provided in this Ordinance.

Article VI. Water Shortage Stage Measures and Restrictions

A. Year-Round Water Conservation (Stage 0 Water Shortage)

This Ordinance establishes the implementation of mandatory and voluntary year-round water use restrictions and conservation measures. These water use restrictions and water conservation measures are in effect under normal conditions and will serve as Stage 0 Water Shortage restrictions (Stage 0 Water Shortage is the minimum water shortage stage that will always be in effect in the County if there is no declaration of a heightened stage). In the event a Stage 0 Water Shortage is in place, all Customers shall be required to adhere to the following mandatory water use restrictions:

Mandatory Water Use Restrictions

- Customer Spray Irrigation System use shall be limited to three (3) days per week.
- Customers shall at all times comply with the Spray Irrigation System schedule for use set forth in the declaration of water shortage stage and in the WSRP.

Those Customers using drip irrigation or any handheld water methods are still allowed to water any day and time. Customers regularly engaged in the sale of plants, shrubbery, trees, and flowers are permitted to use water by any method at any time for irrigation of their commercial stock.

Voluntary water conservation measures for this water shortage stage, as described in the WSRP, shall also be encouraged, but not required.

B. MODERATE Water Shortage (Stage 1 Water Shortage)

In the event a Stage 1 Water Shortage is declared, all Customers shall be required to adhere to the following mandatory water use restrictions:

Mandatory Water Use Restrictions

- Comply with all Stage 0 Water Shortage Mandatory Water Use Restrictions.
- The transport of water from within the County to outside of the County where such water has been drawn by tanker truck from a hydrant of the County water utility system is prohibited; provided, however, that transport outside of the County shall be allowed for emergency fire protection and Bona Fide Farm Uses.

Those Customers using drip irrigation or any handheld water methods are still allowed to water any day and time. Customers regularly engaged in the sale of plants, shrubbery, trees, and flowers are permitted to use water by any method at any time for irrigation of their commercial stock.

Voluntary water conservation measures, as described for this water shortage stage in the WSRP, shall also be encouraged, but not required.

C. SEVERE Water Shortage (Stage 2 Water Shortage)

In the event a Stage 2 Water Shortage is declared, all Customers shall be required to adhere to the following mandatory water use restrictions:

Mandatory Water Use Restrictions

- Comply with all Stage 1 Water Shortage Mandatory Water Use Restrictions.
- Limit Spray Irrigation System use to no more than two (2) days per week and only between the hours of 12:00 a.m. until 8:00 a.m. and 8:00 p.m. until 12:00 a.m., on the days identified in the WSRP
- Eliminate personal vehicle washing unless using a commercial carwash.
- Eliminate the filling of new swimming pools and fountains (unless considered Essential Water Use as defined herein).
- Eliminate public building, sidewalk, and street washing activities (unless considered Essential Water Use as defined herein).
- Limit construction uses of water (e.g. dust control)
- Limit flushing and hydrant testing programs, except as necessary to maintain water quality and in other special circumstances.

Those Customers using drip irrigation or any handheld water methods are still allowed to water any day and time. Customers regularly engaged in the sale of plants, shrubbery, trees, and flowers are permitted to use water by any method at any time for irrigation of their commercial stock.

Unless otherwise declared mandatory, Customers are encouraged, but not required, to implement voluntary water conservation measures set forth for a Stage 1 Water Shortage in the WSRP.

D. EXTREME Water Shortage (Stage 3 Water Shortage)

In the event a Stage 3 Water Shortage is declared, all Customers shall be required to adhere to the following mandatory water use restrictions:

Mandatory Water Use Restrictions

- Comply with all Stage 2 Water Shortage Mandatory Water Use Restrictions, unless a more stringent requirement is imposed below.
- Limit Spray Irrigation System use to no more than one (1) day per week and only between the hours of 12:00 a.m. until 8:00 a.m. and 8:00 p.m. until 12:00 a.m., on the day identified in the WSRP.
- Eliminate the filling of all swimming pools, hot tubs, fountains, and decorative ponds (except when necessary to support aquatic life or considered Essential Water Use as defined herein).
- Eliminate construction uses of water (e.g. dust control)
- Eliminate flushing and hydrant testing programs, except as necessary to maintain water quality and in other special circumstances.
- Eliminate the serving of drinking water from the County water system in restaurants, cafeterias, and other food establishments (except upon patron request).
- Eliminate variances for landscape irrigation.

Those Customers using drip irrigation or any handheld water methods are still allowed to water any day and time. Customers regularly engaged in the sale of plants, shrubbery, trees, and flowers are permitted to use water by any method at any time for irrigation of their commercial stock, but only in amounts necessary to prevent the loss of their commercial stock.

Voluntary water conservation measures, as described for this water shortage stage in the WSRP, shall also be encouraged, but not required.

E. EXCEPTIONAL Water Shortage (Stage 4 Water Shortage)

In the event a Stage 4 Water Shortage is declared, all Customers shall be required to adhere to the following mandatory water use restrictions:

Mandatory Water Use Restrictions

- Comply with all Stage 3 Water Shortage Mandatory Water Use Restrictions, unless a more stringent requirement is imposed below.
- Prohibit all Non-Essential Water Use as defined herein (including the prohibition of all residential irrigation, irrigation of commercial stock, and filling of ponds to sustain aquatic life).
- Prohibit the use of water outside a structure for any use other than a fire emergency.

- Require the use of disposable utensils and plates at all restaurants, cafeterias, and other food establishments.

Voluntary water conservation measures, as described for this water shortage stage in the WSRP, shall also be encouraged, but not required.

Article VII. Additional Water Use Regulation Authority

The County Manager, acting in the best interests of the health, safety, and welfare of the citizens of Union County, may further regulate water usage on the following bases: (i) time of day; (ii) day of week; (iii) Customer type, including, without limitation, residential, commercial, industrial, and institutional uses; and (iv) physical attribute, such as address.

Article VIII. Water Conservation Rates

During a declared water shortage due to resource or capacity limitations, water rates increase to ensure adequate operating revenue and to encourage conservation. Rate increases are not utilized in response to a system emergency water shortage condition. The rates for all user types are defined in the Rate Ordinance. Customers will be charged the rates established in the then current Rate Ordinance corresponding to the water shortage stage in effect at the time bills are rendered. If a system emergency occurs while in a water shortage situation, the rates applied shall be those corresponding to the current water shortage response due to resource or capacity limitations.

Article IX. Compliance Required in the Event of Water Supply Shortage

In addition to any other violation of law prescribed in this Ordinance, if the County Manager declares a water shortage stage as described in this Ordinance, it shall be unlawful for any person, firm or corporation to use or permit the use of water from the County water system in a manner inconsistent with the provisions of this Ordinance.

Article X. Enforcement and Penalties

A. Compliance with the provisions of this Ordinance shall be enforced by UCPW personnel, independent contractors engaged by UCPW for such purpose, and such other personnel as designated by the County Manager.

B. The use of water from the County water system by a Customer in violation of any mandatory water use restriction at any water shortage stage imposed pursuant to this Ordinance is unlawful. Further, the refusal or failure of a Customer or other person acting on the Customer's behalf to cease immediately a violation of a water use restriction, after being directed to do so by a person authorized to enforce the provisions of this Ordinance, is unlawful. Each Customer is responsible for any use of water that passes through the service connection associated with the Customer's account or otherwise passes through the Customer's private water system.

C. Any Customer who violates, or permits the violation of, any mandatory water use restriction imposed pursuant to this Ordinance shall be subject to civil penalties and/or termination of service as follows in the table below:

Stage	Union County Designation	1st Violation	2nd Violation	3rd Violation	4th Violation	5th and Additional Violations
0	Year-Round Water Conservation	Warning	Warning	$250	$500*	$1000*
1	Moderate Water Shortage	Warning	$100	$500	$500*	$1000*
2	Severe Water Shortage	Warning	$200	$500	$500*	$1,000*
3	Extreme Water Shortage	$100	$500	$750	$1000*	$1,500*
4	Exceptional Shortage Emergency	$200	$500	$1,000	$1,000*	$2,000*

*Includes termination of service

Each day that a violation of a mandatory water use restriction occurs or continues to occur after delivery of notice pursuant to subarticle (H) below shall be considered a separate and distinct violation.

D. Violations shall be accumulated by Customers on a calendar year basis for purposes of accrual of civil penalties. For example, a second violation of a Stage 1 Water Shortage water use restriction by a Customer during a calendar year shall result in a civil penalty of one hundred dollars ($100), but the next subsequent violation, if incurred by that same Customer during the following calendar year, shall result in a warning for a first violation. Notwithstanding the foregoing, the Customer shall remain liable for payment of all civil penalties regardless of when accrued. Violations of any mandatory water use restrictions of any water shortage stage shall accumulate with violations of other stages. Should a Customer move, or cease and renew service, during a calendar year, the Customer's violations shall continue to accumulate as if such move or cessation had not occurred.

E. Each civil penalty associated with a first, second, or third violation and assessed against a Customer pursuant to this Ordinance shall be added to the Customer's water bill and shall be paid in the same manner as the payment of water bills. A Customer’s partial payment of a water bill shall be applied first to satisfaction of the civil penalties. Failure to pay all or any portion of a water bill, including

any civil penalty assessed pursuant to this Ordinance, by the due date indicated on the bill may result in the termination of water service.

F. Each civil penalty associated with a fourth or subsequent violation and assessed against a Customer pursuant to this Ordinance shall be added to the Customer's water bill, but shall be payable within ten (10) calendar days of delivery of notice of violation. Failure to pay all or any portion of a civil penalty associated with a fourth or subsequent violation assessed pursuant to this Ordinance by the tenth day following delivery of the notice of violation shall result in termination of water service, unless such action is stayed pending appeal.

G. The violation of any water use restriction or provision of this Ordinance may be enforced by all remedies authorized by law for noncompliance with County ordinances, including without limitation the assessment of a civil penalty and action for injunction, order of abatement or other equitable relief; provided, however, that no violation of any water use restriction or provision of this Ordinance shall be a basis for imposing any criminal remedy. The Board of Commissioners may release billing information, as such term is defined in N.C.G.S. 132-1.1(c), of Customers who violate, or have violated, the provisions of this Ordinance, when the Board in its sole discretion and acting pursuant to N.C.G.S. 132-1.1(c)(2), determines that the release of such billing information during times of mandatory water conservation is necessary to assist the County to maintain the integrity and quality of services it provides.

H. UCPW shall send notice of first, second, and third violations to the Customer by regular U.S. mail at the Customer's billing address on file with UCPW. Such notice shall be deemed to have been delivered three days from the date mailed. In the event of a fourth or subsequent violation, UCPW shall send notice of the violation and intent to terminate water service by regular U.S. mail and by certified mail, return receipt requested, to the Customer's billing address on file with UCPW. Such notice shall be deemed to have been delivered on the earlier of (i) three days from the date of mailing by regular U.S. mail, or (ii) the date indicated on the return receipt.

I. The notice of violation shall specify the following:

1. The nature of the violation and the date and time it occurred;
2. The method by which payment of any civil penalty may be paid, including a statement indicating that it will be included on the Customer's next water bill;
3. A warning that additional or continued violations may result in increased penalties, including termination of water service;
4. A warning that failure to pay a water bill, including any civil penalty assessed pursuant to this Ordinance, may result in termination of water service;
5. The telephone number at UCPW where the Customer may direct any questions or comments; and

6. Information indicating the manner in which the Customer may appeal a violation or a pending termination pursuant to Article XII of this Ordinance.

Article XI. Termination of Service

In addition to the payment of any civil penalty assessed pursuant to Article X of this Ordinance, a Customer shall be subject to termination or restriction of water service following four (4) or more violations of any water use restrictions or other provision imposed pursuant to this Ordinance. Water service will not be restored at such service connection until the Customer pays all the Customer's outstanding obligations, including, without limitation, all charges for water service, all civil penalties and other fees charged in accordance with the provisions of this Ordinance, and the current disconnect processing fee. In the event water service is terminated a second time for violations pertaining to use of water obtained by the Customer through an irrigation meter, service to such irrigation meter shall remain terminated for the remainder of the calendar year. A Customer may appeal such a termination of service pursuant to Article XII of this Ordinance.

Article XII. Appeals

A Customer who receives a notice of violation for a first, second, or third violation may appeal the violation by written notice to UCPW indicating through supporting documentation the factual basis for the Customer's position that either (i) the violation was issued in error, or (ii) the Customer had no opportunity to prevent the violation. The appeal must be delivered to UCPW at the specified address within fifteen (15) calendar days of delivery of the notice of violation. The Executive Director of Public Works or his/her designee shall conduct such review of the appeal as may be necessary to determine whether the documentation provided by the Customer supports the Customer's assertion that the violation was issued in error or the Customer had no opportunity to prevent the violation. The Executive Director of Public Works or his/her designee shall respond in writing within twenty (20) business days of receipt of the appeal.

A Customer who receives a notice of violation for a fourth or subsequent violation of the Ordinance indicating that the Customer's water service is subject to termination pursuant to this Article may appeal the pending termination of water service by filing a written notice of appeal with the Executive Director of Public Works, or in absence, his or her designee. The notice of appeal must be delivered to UCPW at the specified address within ten (10) calendar days from delivery of the notice of violation and must include a copy of the notice of violation being appealed. A hearing shall be held on such appeal within ten (10) business days of UCPW's receipt of the notice of appeal, or by such other date as mutually agreed upon by UCPW and the Customer.

Article XIII. Variances

A. UCPW is authorized to issue variances in accordance with this Article permitting any Customer satisfying the requirements of this Article to use water for a purpose that would otherwise be prohibited by water use restrictions then in effect.

B. UCPW may issue variances during Stage 0, Stage 1 and Stage 2 provided that each of the following conditions is satisfied: (i) the Customer applies for a variance using forms provided by UCPW; (ii) the Customer pays a variance registration fee in such amount as determined by the Executive Director of Public Works, not to exceed fifty dollars ($50.00); (iii) the application pertains to a new lawn and/or landscape installed incident to new construction, or to newly installed replacement sod, complete reseeding, or natural ground cover within the parameters of an established lawn; (iv) if pertaining to new lawn and/or landscape installed incident to new construction, the Customer applies for a variance either before issuance of a certificate of occupancy or within ninety (90) days after issuance of a certificate of occupancy relative to this new construction; and (v) the Customer submits with the application such supporting documentation as required by UCPW to substantiate that these conditions have been satisfied.

C. Upon receipt of a variance from UCPW, the Customer may be permitted to water such newly installed lawn and/or landscape, or such newly installed replacement sod, complete reseeding, or natural ground cover, for a period not to exceed forty-five (45) days from the date of issuance of the variance. During the period that the variance is in effect, the Customer shall post signage provided by UCPW to signify the Customer's temporary exempt status from water use restrictions otherwise in effect. The Customer shall post such sign within two (2) feet of the driveway entrance. In any variance issued pursuant to this Article, UCPW may impose such conditions and restrictions as are appropriate to require that water used from the County water system be minimized to the extent practical.

D. Variances issued pursuant to this Article shall terminate upon the earlier occurrence of the following: (i) forty-five (45) days from the date of issuance; or (ii) declaration by the County Manager of a Stage 3 or State 4 Water Shortage. In addition, the County Manager may, upon the recommendation of the Executive Director of Public Works, direct that UCPW cease issuance of new variances in the event it is determined that further issuance will likely result in increased demand that will equal or exceed the treatment and/or transmission capacity of the system or portions thereof.

E. Any Customer receiving a variance pursuant to this Article who violates the terms thereof shall be subject to a civil penalty pursuant to Article X(C) of this Ordinance and to revocation of the variance. Any person who has violated the terms of any variance issued pursuant to this Article or any mandatory water use restrictions imposed pursuant to this Ordinance may be denied a variance, notwithstanding any provision of this Article to the contrary.

Article XIV. Irrigation Systems Requirements

A. All non-residential accounts shall have a separate service for irrigation which is metered separately. All residential properties platted and recorded after July 1, 2009, are required by N.C.G.S. § 143-355.4 to have a separate meter for in-ground irrigation systems.

B. Irrigation systems shall not be allowed to operate during periods of rainfall.

C. All automatic Spray Irrigation Systems with a timer shall be equipped with rain sensors as approved by Union County. Rain sensors shall be activated to prevent the Spray Irrigation System from operating after one fourth (1/4) inch of rain has fallen.

Article XV. Maintenance of Spray Irrigation Systems

A. The County recognizes that irrigation systems utilizing water from the County water system should be properly maintained in order to maximize efficiency and prevent waste. Additionally, the County recognizes that such maintenance may occur on days and at such times as would otherwise be prohibited under this Ordinance and the WSRP. However, during the period that a Stage 2 or Stage 3 Water Shortage is in effect, existing irrigation systems may be operated on such days and at such times as would otherwise be prohibited, provided that all of the following requirements are satisfied.

   1. Such operation must be incident to bona fide maintenance and/or repair of an existing irrigation system performed by a professional irrigation contractor in the business of performing such work. UCPW may require registration of such contractors, and may require on a given project that the contractor establish, to the satisfaction of UCPW, the need for such maintenance or repair.

   2. The irrigation contractor shall post signage provided by UCPW at the drive entrance to the property during such time, and only such time, that maintenance and/or repair services are being provided. Such signs shall be at all times the property of UCPW, and UCPW may charge a reasonable fee for provision of signs. The irrigation contractor shall not transfer, loan, or otherwise allow use of UCPW signs by anyone other than employees of the irrigation contractor and shall immediately report any lost or stolen signs to UCPW.

   3. The irrigation contractor shall remain on-site at all times while the irrigation system is in operation for maintenance and/or repair.

B. Any irrigation contractor who violates the requirements of this Article shall be subject to a civil penalty in the amount of five hundred dollars ($500) and shall forfeit the opportunity afforded pursuant to this Article to provide maintenance and/or repair of irrigation systems during dates

and times that watering is prohibited by a Stage 2 or Stage 3 Water Shortage declaration. In the event an irrigation contractor fails to comply with these requirements, UCPW shall send notice of violation indicating imposition of the civil penalty and demanding return of the UCPW signs assigned to him. Such notice shall be sent by certified mail, return receipt requested, to the contractor's billing address on file with UCPW.

C. An irrigation contractor who receives a notice of violation may appeal such decision by filing a written notice of appeal with the Executive Director of Public Works, or his or her designee. The notice of appeal must be delivered to the Executive Director of Public Works or his/her designee within ten (10) calendar days from delivery of the notice of violation and must include a copy of the notice of violation being appealed. A hearing shall be held on such appeal within ten (10) business days of receipt of the notice of appeal, or by such other date as mutually agreed upon by the Executive Director of Public Works, or his/her designee, and the contractor.

Article XVI. Severability

If any article, section, subdivision, subarticle, clause, or provision of this Ordinance shall be adjudged invalid, such adjudication shall apply only to such article, section, subdivision, subarticle, clause, or provision so adjudged, and the remainder of this Ordinance may be declared valid once effective.

Article XVII. Effective Date

This Ordinance is effective upon adoption by the Union County Board of Commissioners on this the 4TH day of May, 2015.

Water Shortage Response Plan
Town of Wingate, North Carolina
September 20, 2010

The procedures herein are written to reduce potable water demand and supplement existing drinking water supplies whenever existing water supply sources are inadequate to meet current demands for potable water.

I. Authorization

The Wingate Town Administrator shall enact the following water shortage response provisions whenever the trigger conditions outlined in Section IV are met. In his or her absence, the Public Works Director will assume this role.

Mr. Dryw Blanchard
Wingate Town Administrator
Phone: (704) 233-4411
E-mail: admin@wingatenc.com

Mr. James Jones
Town of Wingate Public Works Director
Phone: (704) 233-4042
E-mail: Brower@wingatenc.com

II. Notification

The following notification methods will be used to inform water system employees and customers of a water shortage declaration: employee e-mail announcements, notices at municipal buildings, notices in water bills and on the Town of Wingate website http://wingate.govoffice.com/. Required water shortage response measures will be communicated through PSA announcements on local radio and cable stations, and on the Town of Wingate website. Declaration of emergency water restrictions or water rationing will be communicated to all customers by telephone through use of reverse 911.

III. Levels of Response

Five levels of water shortage response are outlined in the table below. The five levels of water shortage response are: voluntary reductions, mandatory reductions I and II, emergency reductions and water rationing. A detailed description of each response level and corresponding water reduction measures follow below.

Stage	Response	Description
1	Voluntary Reductions	Water users are encouraged to reduce their water use and improve water use efficiency; however, no penalties apply for noncompliance. Water supply conditions indicate a potential for shortage.
2	Mandatory Reductions I	Water users must abide required water use reduction and efficiency measures; penalties apply for noncompliance. Water supply conditions are significantly lower than the seasonal norm and water shortage conditions are expected to persist.
3	Mandatory Reductions II	Same as in Stage 2
4	Emergency Reductions	Water supply conditions are substantially diminished and pose an imminent threat to human health or environmental integrity.
5	Water Rationing	Water supply conditions are substantially diminished and remaining supplies must be allocated to preserve human health and environmental integrity.

In Stage 1, Voluntary Reductions, all water users will be asked to reduce their normal water use by 5%. Customer education and outreach programs will encourage water conservation and efficiency measures including: irrigating landscapes at a minimum of two days per week, a maximum of one inch per week; preventing water waste, runoff and watering impervious surfaces; washing only full loads in clothes and dishwashers; using spring-loaded nozzles on garden hoses; and identifying and repairing all water leaks.

In Stage 2, Mandatory Reductions I, all customers are expected to reduce their water use by 10% in comparison to their previous month's water bill. In addition to continuing to encourage all voluntary reduction actions, the following restrictions apply: irrigation is limited to a half inch per week between 8PM and 8AM one day a week; outdoor use of drinking water for washing impervious surfaces is prohibited; and all testing and training purposes requiring drinking water (e.g. fire protection) will be limited.

In Stage 3, Mandatory Reductions II, customers must continue actions from all previous stages and further reduce water use by 20% compared to their previous month's water bill. All outdoor water use is banned. Prioritize and meet with commercial and industrial large water customers and meet to discuss strategies for water reduction measures including development of an activity schedule and contingency plans. Additionally, in Stage 3, a drought surcharge of 1.5 times the normal water rate applies.

In Stage 4, Emergency Reductions, customers must continue all actions from previous stages and further reduce their water use by 25% compared to their previous month's

water bill. A ban on all use of drinking water except to protect public health and safety is implemented and drought surcharges increase to 2 times the normal water rate.

The goal of Stage 5, Water Rationing, is to provide drinking water to protect public health (e.g. residences, residential health care facilities and correctional facilities). In Stage 5, all customers are only permitted to use water at the minimum required for public health protection. Firefighting is the only allowable outdoor water use and pickup locations for distributing potable water will be announced according to Wingate's Emergency Response Plan. Drought surcharges increase to 5 times the normal water rate.

IV. Triggers

Wingate is provided water solely by purchase from the Union County. When Union County declares a water shortage Wingate is required to do so as well. During this time Wingate Public Works Director will stay in close contact with Union County and follow their triggers.

Return to Normal

When water shortage conditions have abated and the situation is returning to normal, water conservation measures employed during each phase should be decreased in reverse order of implementation. Permanent measures directed toward long-term monitoring and conservation should be implemented or continued so that the community will be in a better position to prevent shortages and respond to recurring water shortage conditions.

V. Enforcement

The provisions of the water shortage response plan will be enforced by Town of Wingate Public Works department and police personnel. Violators may be reported to the Town's phone line or the e-mail contact listed on the town's website. Citations are assessed according to the following schedule depending on the number of prior violations and current level of water shortage.

Water Shortage Level	First Violation	Second Violation	Third Violation
Voluntary Reductions	N/A	N/A	N/A
Mandatory Reductions (Stages 2 and 3)	Warning	$250	Discontinuation of Service
Emergency Reductions	$250	Discontinuation of Service	Discontinuation of Service
Water Rationing	$500	Discontinuation of Service	Discontinuation of Service

Drought surcharge rates are effective in Stages 3, 4 and 5.

VI. Public Comment

Customers will have multiple opportunities to comment on the provisions of the water shortage response plan. First, a draft plan will be will be available at Town Hall for customers to view. A notice will be included in customer water bill notifying them of such. Also a draft plan will be published on the Town of Wingate website. Notice will be printed in all customer water bills to collect comments on the draft. All subsequent revisions to the draft plan will be published at least 30 days prior to an adoption vote by Wingate's Town Commissioners.

VII. Variance Protocols

Applications for water use variance requests are available from the Town of Wingate website and Town Public Works Office. All applications must be submitted to the Public Works Office for review by the Public Works Director or his or her designee. A decision to approve or deny individual variance requests will be determined within two weeks of submittal after careful consideration of the following criteria: impact on water demand, expected duration, alternative source options, social and economic importance, purpose (i.e. necessary use of drinking water) and the prevention of structural damage.

VIII. Effectiveness

The effectiveness of the Wingate water shortage response plan will be determined by comparing the stated water conservation goals with observed water use reduction data. Other factors to be considered include frequency of plan activation, any problem periods without activation, total number of violation citations, desired reductions attained and evaluation of demand reductions compared to the previous year's seasonal data.

IX. Revision

The water shortage response plan will be reviewed and revised as needed to adapt to new circumstances affecting water supply and demand, following implementation of emergency restrictions, and at a minimum of every five years in conjunction with the updating of our Local Water Supply Plan. Further, a water shortage response planning work group will review procedures following each emergency or rationing stage to recommend any necessary improvements to the plan to Wingate's Town Commissioners. The Town of Wingate Public Works Director is responsible for initiating all subsequent revisions.

C

APPENDIX C: CHEOPS™ Modeling Results - Performance Measure Sheets

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	A	B	C	D	E	F	G	H	I	J
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2012**	**UC-Base_2050**	**UC-Alt6_UC2050_2012**	**UC-Alt7_UC2050_2012**
2		**Lake James (including the Catawba River Bypassed Reach, Paddy Creek Bypassed Reach and the Bridgewater Regulated River Reach)**					(1999-2003)	(1999-2003)	(1999-2003)	(1999-2003)
3		*Fish & Aquatic Interests*								
4	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	387	350	387	387
5			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	506	504	506	506
8			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	39%	33%	39%	38%
10	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	34%	28%	34%	34%
11			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	26%	21%	26%	25%
12	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	112	129	112	116
18		*Recreation Interests*								
19	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 93.5 ft) during higher use months	1-Mar	31-Oct	25	43	65	43	49
20			Avg. days/yr lake level below critical level for public boat ramps (< 92.0 ft) (Note 3)	1-Jan	31-Dec	3	6	21	6	6
21	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<93.0 ft) (Note 4)	1-Jan	31-Dec	3	51	88	52	61
22	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	10%	12%	10%	10%
27		*Water User Interests*								
28	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for hydro unit operation (< 61 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
31			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 275.35) for the evaluation period (Note 12)	1-Jan	31-Dec	15	95	95	95	95
32		*Other Interests*								
33	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	16%	11%	16%	15%
34			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 98.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	39%	30%	39%	36%
37		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	42%	30%	42%	40%
39			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	20%	24%	20%	21%
40	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	13	13	13	13
41			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0	0
44	FA22, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or below 175 cfs released from the hydro development (Note 14)	1-Jan	31-Dec	10%	72%	74%	72%	72%
45										
46		**Lake Rhodhiss**								
47		*Fish & Aquatic Interests*								
48	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	526	636	522	521
49			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	721	882	715	728
52			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	81%	79%	80%	79%
54	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	71%	68%	71%	70%
55			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	63%	58%	63%	61%
56	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	34	48	35	37
57		*Recreation Interests*								
58	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 94.0 ft) during higher use months	1-Mar	31-Oct	25	18	30	18	20
59			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0	0
60	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	107	129	107	115
61	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	14%	19%	14%	14%
62		*Water User Interests*								
63	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 89.4 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
64			Days below critical level for hydro unit operation (< 79.1 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
65		*Other Interests*								
66	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	24%	21%	24%	25%
67			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 97.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	32%	29%	32%	33%
70		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	31%	28%	31%	32%
72			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
73	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	4	4	4	4
74			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0	0
75										
76		**Lake Hickory (Including the Oxford Regulated River Reach)**								
77		*Fish & Aquatic Interests*								
78	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	296	548	270	265
79			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	833	1,134	798	752
82			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	83%	74%	83%	79%
84	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	74%	69%	74%	71%
85			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	62%	54%	62%	60%
86	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	42	56	43	46
87	FA22, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or below 225 cfs released from the hydro development (Note 14)	1-Jan	31-Dec	10%	44%	48%	44%	44%
89		*Recreation Interests*								
90	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 94.0 ft) during higher use months	1-Mar	31-Oct	25	7	14	7	10
91			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0	0
92	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	120	149	121	125
93	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	14%	14%	14%	14%
94	R101, R111, R121, R124, R127, HOWQ44	Maximize days/yr of boating opportunities in the regulated river reach	Avg. days/yr of daytime flows ≥ 2500, ≤ 5500 cfs released from the hydro development for at least 2 hrs/day during higher use months (Note 20)	1-Mar	31-Oct	25	108	125	110	110
95		*Water User Interests*								
96	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 94 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
97			Days below critical level for hydro unit operation (< 73 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
99			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 230) for the evaluation period (Note 12)	1-Jan	31-Dec	25	120	107	120	120
100		*Other Interests*								
101	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	18%	18%	17%	19%
102			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 97.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	31%	28%	33%	32%
105		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	30%	30%	33%	32%
107			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
108	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	0	0	0	0
110										
111		**Lookout Shoals Lake (including the Lookout Shoals Regulated River Reach)**								
112		*Fish & Aquatic Interests*								
113	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	494	697	534	776
114			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	1,099	1,259	1,267	1,331
117			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	87%	81%	86%	86%
119	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	79%	82%	78%	77%
120			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	74%	65%	74%	70%
121	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	29	44	30	34
124		*Recreation Interests*								
125	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 92.0 ft) during higher use months	1-Mar	31-Oct	25	0	1	0	0
126			Avg. days/yr lake level below critical level for public boat ramps (< 92.0 ft) (Note 3)	1-Jan	31-Dec	3	0	1	0	0
127	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	81	112	83	94
128		Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	10%	13%	10%	10%
129		*Water User Interests*								
130	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 74.9 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
131			Days below critical level for hydro unit operation (< 72.9 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
132		*Other Interests*								
133	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	17%	17%	16%	18%
134			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 97.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	27%	27%	26%	28%
137		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	25%	24%	23%	25%
139			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
140	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	66	64	66	66
141			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0	0
143										

	A	B	C	D	E	F	G	H	I	J
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2012**	**UC-Base_2050**	**UC-Alt6_UC2050_2012**	**UC-Alt7_UC2050_2012**
144		**Lake Norman**								
145		*Fish & Aquatic Interests*								
146	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	0	0	0	0
147			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	132	4	152	155
150			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	73%	54%	73%	73%
152	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	73%	58%	72%	72%
153			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	63%	37%	63%	60%
154	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	25	71	26	27
155		*Recreation Interests*								
156	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 96.0 ft) during higher use months	1-Mar	31-Oct	25	26	79	28	28
157			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0	0
158	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<95.0 ft) (Note 4)	1-Jan	31-Dec	3	18	79	24	28
159	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	14%	19%	14%	15%
160		*Water User Interests*								
161	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest thermal power station operation (< 90 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
162			Days below critical level for shallowest public water supply intake operation (< 85 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
163			Days below critical level for shallowest industrial intake operation (< 75 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
164			Days below critical level for hydro unit operation (< 65 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
165		*Other Interests*								
166	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	23%	25%	23%	23%
168			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	96%	79%	94%	93%
170		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	63%	65%	63%	65%
172			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
173	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	0	0	0	0
174										
175		**Mt Island Lake (including the Mt Island Bypassed Reach)**								
176		*Fish & Aquatic Interests*								
177	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	305	277	302	291
178			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	462	525	451	397
181			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	63%	34%	65%	63%
183	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	51%	25%	53%	49%
184			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	38%	17%	38%	34%
185	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	79	136	77	83
186		*Recreation Interests*								
187	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 91.0 ft) during higher use months	1-Mar	31-Oct	25	0	0	0	0
188			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0	0
189	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<96.0 ft) (Note 4)	1-Jan	31-Dec	3	160	274	158	169
190	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	17%	17%	17%	17%
191		*Water User Interests*								
192	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest thermal power station operation (< 94.3 ft) (Note 3)	1-Jan	31-Dec	1	1	1	1	1
193			Days below critical level for shallowest public water supply intake operation (< 88 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
194			Days below critical level for hydro unit operation (< 77.5 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
195		*Other Interests*								
196	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 96.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	30%	26%	31%	33%
198			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 96.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	72%	88%	72%	75%
200		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	63%	84%	63%	67%
202			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
203	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	8	6	8	8
204			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0	0
205										
206		**Lake Wylie (including the Wylie Regulated River Reach)**								
207		*Fish & Aquatic Interests*								
208	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	97	105	99	101
209			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	187	189	162	173
212			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	74%	67%	75%	73%
214	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	52%	50%	53%	52%
215			Percent of time of lake levels >= 97 ft during the growing season	1-Apr	30-Sep	10%	63%	61%	63%	63%
216			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	33%	30%	33%	32%
217	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	79	83	79	80
218	FA22, FA25, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or above 2000 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%				
219			Percent of hours at or above 1080 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%				
224		*Recreation Interests*								
225	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 95.5 ft) during higher use months	1-Mar	31-Oct	25	92	96	92	93
226			Avg. days/yr lake level below critical level for public boat ramps (< 95.5 ft) (Note 3)	1-Jan	31-Dec	3	150	157	149	153
227	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	212	224	213	216
228	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	18%	18%	18%	18%
233		*Water User Interests*								
234	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest industrial intake operation (< 92.6 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
235			Days below critical level for shallowest public water supply intake operation (< 92 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
236			Days below critical level for shallowest thermal power station operation (< 90 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
237			Days below critical level for hydro unit operation (< 74 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
242	WQ189	Maximize low flows to maintain waste assimilation capacity of the regulated river reach.	Percent of days at or above approximate 7Q10 flow (450 cfs) released from the hydro development (RM 139.63) (Note 9)	1-Jan	31-Dec	5%	100%	100%	100%	100%
243			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 139.63) for the evaluation period (Note 12)	1-Jan	31-Dec	45	860	720	860	860
244		*Other Interests*								
245	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	25%	26%	25%	25%
247			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 97.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	74%	67%	74%	73%
249		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	36%	37%	35%	36%
251			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	20%	26%	19%	20%
252	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	0	0	0	0
254										
255		**Total Project Hydropower & Water Quantity Management**								
259	FA40, HOWQ41, HOWQ42, HOWQ58	Minimize inefficiencies in using water stored for generation	Percent of hydropower generation lost due to unplanned spills (Note 8)	1-Jan	31-Dec	1%	4%	4%	4%	4%
260			Percent of hydropower generation lost due to other non-power generation uses (Note 9)	1-Jan	31-Dec	1%	13%	14%	13%	13%
261	FA40, HOWQ41, HOWQ58	Maximize hydropower generation	Avg. MWH/yr of hydropower produced	1-Jan	31-Dec	31,000	907,563	856,993	903,277	903,657
262			Average equivalent # of homes per year that could be powered by the Hydro Project (Note 11)	1-Jan	31-Dec	2,500	68,755	64,924	68,430	68,459
263	HOWQ58, HOWQ41,HOWQ45	Maximize hydropower value	Avg. hydro generation value in Normalized Dollars/yr (Note 8)	1-Jan	31-Dec	$20,000	$484,362	$460,278	$482,315	$483,042
264										
265		Background	Performance Measure has improved vs. the Baseline Scenario							
266		Background	Performance Measure has declined vs. the Baseline Scenario							
267		White Background	There is no significant difference between the scenario and the Baseline Scenario by definition of MISC							
268										

	A	B	C	D	E	F	G	H	I	J
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2012**	**UC-Base_2050**	**UC-Alt6_UC2050_2012**	**UC-Alt7_UC2050_2012**
2		**Lake Wylie (including the Wylie Regulated River Reach)**					(1999-2003)	(1999-2003)	(1999-2003)	(1999-2003)
3		*Fish & Aquatic Interests*								
4	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	97	105	99	101
5			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	187	189	162	173
8			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	74%	67%	75%	73%
10	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	52%	50%	53%	52%
11			Percent of time of lake levels >= 97 ft during the growing season	1-Apr	30-Sep	10%	63%	61%	63%	63%
12			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	33%	30%	33%	32%
13	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	79	83	79	80
14	FA22, FA25, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or above 2000 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%				
15			Percent of hours at or above 1080 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%				
20		*Recreation Interests*								
21	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 95.5 ft) during higher use months	1-Mar	31-Oct	25	92	96	92	93
22			Avg. days/yr lake level below critical level for public boat ramps (< 95.5 ft) (Note 3)	1-Jan	31-Dec	3	150	157	149	153
23	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	212	224	213	216
24	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	18%	18%	18%	18%
29		*Water User Interests*								
30	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest industrial intake operation (< 92.6 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
31			Days below critical level for shallowest public water supply intake operation (< 92 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
32			Days below critical level for shallowest thermal power station operation (< 90 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
33			Days below critical level for hydro unit operation (< 74 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
39			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 139.63) for the evaluation period (Note 12)	1-Jan	31-Dec	45	860	720	860	860
40		*Other Interests*								
41	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	25%	26%	25%	25%
43			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 97.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	74%	67%	74%	73%
45		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	36%	37%	35%	36%
47			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	20%	26%	19%	20%
48	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	0	0	0	0
50										
51		**Fishing Creek Reservoir**								
52		*Fish & Aquatic Interests*								
53	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	215	388	207	231
54			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	515	740	484	558
57			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	96%	95%	96%	96%
59	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	98%	97%	98%	98%
60			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	95%	95%	95%	95%
61	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	2	1	2	1
62		*Recreation Interests*								
63	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 95.0 ft) during higher use months	1-Mar	31-Oct	25	0	0	0	0
64			Avg. days/yr lake level below critical level for public boat ramps (< 95.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0	0
65	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	11	11	11	11
66	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	12%	12%	12%	11%
67		*Water User Interests*								
68	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 95 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
69			Days below critical level for shallowest industrial intake operation (< 90.8 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
70			Days below critical level for hydro unit operation (< 77.9 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
71		*Other Interests*								
72	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	12%	12%	12%	13%
74			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 97.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	100%	100%	100%	100%
76		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	100%	100%	100%	100%
78			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
79	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	2	2	3	1
80										
81		**Great Falls-Dearborn Reservoir (including the Great Falls Long Bypassed Reach and the Great Falls Short Bypassed Reach)**								
82		*Fish & Aquatic Interests*								
83	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	380	580	519	526
84			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	933	1,237	1,095	1,145
87			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	89%	89%	90%	89%
89	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	92%	93%	92%	91%
90			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	90%	91%	90%	90%
91	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	3	3	4	2
92		*Recreation Interests*								
93	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 98.0 ft) during higher use months	1-Mar	31-Oct	25	39	37	39	39
94			Avg. days/yr lake level below critical level for public boat ramps (< 97.0 ft) (Note 3)	1-Jan	31-Dec	3	37	35	37	38
95	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<98.0 ft) (Note 4)	1-Jan	31-Dec	3	56	55	57	58
96	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	19%	18%	17%	17%
97		*Water User Interests*								
98	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for hydro unit operation (< 87.2 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
99		*Other Interests*								
100	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	23%	22%	23%	23%
102			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	100%	100%	100%	100%
104		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	23%	21%	23%	23%
106			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
107	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	32	26	31	30
108			Days lake level above 103 ft	1-Jan	31-Dec	1	1	2	0	1
109										
110		**Cedar Creek Reservoir**								
111		*Fish & Aquatic Interests*								
112	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	329	373	214	264
113			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	614	811	557	598
116			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	95%	95%	96%	95%
118	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	95%	95%	96%	96%
119			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	94%	94%	95%	94%
120	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	0	0	0	0
121		*Recreation Interests*								
122	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 98.5 ft) during higher use months	1-Mar	31-Oct	25	23	21	22	22
123			Avg. days/yr lake level below critical level for public boat ramps (< 96.0 ft) (Note 3)	1-Jan	31-Dec	3	1	2	1	1
124	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	16	13	14	16
125	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	6%	6%	6%	6%
126		*Water User Interests*								
127	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for hydro unit operation (< 80.3 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
128		*Other Interests*								
129	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	13%	15%	14%	14%
131			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	100%	100%	100%	100%
133		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	15%	15%	15%	16%
135			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
136	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	1	2	2	2
137			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0	0
138										

	A	B	C	D	E	F	G	H	I	J
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2012**	**UC-Base_2050**	**UC-Alt6_UC2050_2012**	**UC-Alt7_UC2050_2012**
139		**Lake Wateree (including the Wateree Regulated River Reach)**								
140		*Fish & Aquatic Interests*								
141	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	322	356	329	357
142			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	953	990	1,025	933
145			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	59%	52%	58%	56%
147	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	76%	64%	75%	74%
148			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	86%	80%	86%	85%
149	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	8	18	8	8
150	FA22, FA25, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or above 2000 cfs at Node 1 (RM 74.54) (Note 14)	1-Jan	31-Dec	10%				
151			Percent of hours at or above 1200 cfs at Node 1 (RM 74.54) (Note 14)	1-Jan	31-Dec	10%				
157		*Recreation Interests*								
158	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 96.0 ft) during higher use months	1-Mar	31-Oct	25	16	35	16	17
159			Avg. days/yr lake level below critical level for public boat ramps (< 93.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0	0
160	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	29	55	30	31
161	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	10%	12%	10%	11%
164		*Water User Interests*								
165	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 92.5 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
166			Days below critical level for hydro unit operation (< 74 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
169			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 74.54) for the evaluation period (Note 12)	1-Jan	31-Dec	53	930	807	930	930
170		*Other Interests*								
171	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	10%	12%	10%	11%
173			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	100%	98%	100%	100%
175		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	16%	18%	17%	16%
177			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
178	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	16	15	16	16
179			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0	0
181										
182		**Total Project Hydropower & Water Quantity Management**								
186	FA40, HOWQ41, HOWQ42, HOWQ58	Minimize inefficiencies in using water stored for generation	Percent of hydropower generation lost due to unplanned spills (Note 8)	1-Jan	31-Dec	1%	4%	4%	4%	4%
187			Percent of hydropower generation lost due to other non-power generation uses (Note 9)	1-Jan	31-Dec	1%	13%	14%	13%	13%
188	FA40, HOWQ41, HOWQ58	Maximize hydropower generation	Avg. MWH/yr of hydropower produced	1-Jan	31-Dec	31,000	907,563	856,993	903,277	903,657
189			Average equivalent # of homes per year that could be powered by the Hydro Project (Note 11)	1-Jan	31-Dec	2,500	68,755	64,924	68,430	68,459
190	HOWQ58, HOWQ41,HOWQ45	Maximize hydropower value	Avg. hydro generation value in Normalized Dollars/yr (Note 8)	1-Jan	31-Dec	$20,000	$484,362	$460,278	$482,315	$483,042
191										
192		Background	Performance Measure has improved vs. the Baseline Scenario							
193		Background	Performance Measure has declined vs. the Baseline Scenario							
194		White Background	There is no significant difference between the scenario and the Baseline Scenario by definition of MISC							
195										

Notes

1 CIS # are the Composite Interest Statement numbers taken from Rev 3 of the Composite Interest Statement document dated 10/27/04 for the interests that are both (1) directly related to water quantity management and (2) reasonably measurable using CHEOPS. The following CIS #'s represent interests that are directly related to water quantity, but that will be dealt with differently as noted, and therefore will not be tabulated individually:

CIS #	Composite Interest Statement (Rev 3 - 10/27/04)	Disposition
FA16	Provide run-of-river flows through every dam.	Scenario design readily identifies whether or not interest is met.
FA36	Mimic day, month, and annual natural flow patterns including natural floods in riverine and bypass areas.	Scenario design readily identifies whether or not interest is met.
FA38	Restore run-of-river flows to the Great Falls.	Scenario design readily identifies whether or not interest is met.
R125	Provide predictable recreation releases on river sections (i.e., allow recreation users to plan ahead for river use).	Scenario design readily identifies whether or not interest is met.
R126	Provide predictable recreation releases on bypass sections including the Great Falls bypass.	Scenario design readily identifies whether or not interest is met.
HOWQ51	Tie the low inflow protocol to both water conservation and energy conservation.	LIP design determines if interest is met.
HOWQ52	Assure that the low inflow protocol fully protects aquatic resources, water quality, and recreation.	LIP design determines if interest is met.

2 For criterion that measure on an hourly or daily basis, unless stated otherwise:

a. If an hourly criterion occurs during the average of four contiguous 15-minute periods, then it counts as 1 hour.

b. If a daily criterion occurs for 5 contiguous 1-hour periods, then it counts as 1 day.

Also, daytime flows are assumed to be flows provided between 7:00 am and 7:00 pm. To the extent possible, each Criterion is defined in terms of percents and averages/yr so that the same Criterion is useful regardless of the length of the hydrology period (i.e., 1-yr, 3-yr, full period of record, etc.)

3 Critical lake elevations per Attachment F of Draft AIP dated 10/15/04.

4 See App. C of Draft Reservoir Level Study Report dated 11/10/04 for average monthly lake levels during post-Cowans Ford era.
Areas within the lakes are considered boatable if the water depth is greater than or equal to 3 ft.
Lake surface areas are determined using Area-Volume Curves (i.e., a set of curves for each lake that graph both lake surface area and lake volume verses water depth).

5 Low Inflow Protocol (LIP) Trigger Point considerations.

6 Low Inflow Protocol (LIP) Trigger Point considerations.

7 Developed areas include areas with roads, houses and other man-made structures.

8 Includes lost hydropower generation due to unplanned spilling of water at hydro station dams.
This measure does not include energy losses from evaporation, dam leakage or groundwater recharge.

9 Includes lost hydropower due to minimum flow and recreation flow releases that bypass the hydro station and public water supply and industrial withdrawals.
This measure does not include energy losses from evaporation, dam leakage or groundwater recharge.

10 Normalized dollar value of hydropower generated in a given year =

[∑ (MWH x market value for each hour)]/(Highest hourly market price in that year)

11 Flow rates needed to provide for basic navigation. These flow rates are determined by the Instream Flow Study and/or the Recreation Flow Study. In SC, the flow rates are based on meeting SCDNR's navigation criteria.
In NC, the flow rates are based on Rec 02 studies.

12 7Q10 Flow rate = Lowest average flow rate over a 7-day period that statistically is likely to occur once every 10 years.
The approximate 7Q10 flow rates listed in this document are from Table 6.1-1, Summary of Catawba-Wateree Project Hydrology as shown in Duke Power's First Stage Consultation Document dated 2003.

13 Absolute Lake level variation is determined from hourly checks against the measure using 15-minute reservoir data averaged per hour.
The number of hours that exceed the starting reservoir elevation are recorded for each 14 day period between the start and end date.
The starting elevation (midnight reservoir elevation) is reset each 14-day period and the total hourly count for all test periods is recorded for each scenario.

14 Calculated by (Total Scenario MWh / 13.2 MWh per home) / the # of years in the scenario
The MISC of 3000 homes per year is roughly 2% of the average equivalent homes/yr under the Baseline conditions.
Power produced by the hydro project is actually supplied to Duke Power's electric system grid and is used by Duke Power's electric customers (including residential, industrial and commercial customers), as is power produced at other Duke Power generating stations. This criterion of average equivalent homes per year is intended to simply make the total energy production potential of the hydro project more understandable to stakeholder team members and to put a perspective around potential differences in hydropower production between various operational scenarios. This measure does not imply that any number of homes will go without power if a particular scenario is chosen.

15 Lowest 7-day average flow rate is determined from a rolling 7-day average of the average daily flow (cfs).
Where a average daily flow rate is determined from 15-minute flow (cfs) data averaged per 24 hour-day.

16 Habitat flows were estimates based on field experience with the subject reaches.

17 Floodplain Ecology inundation and maintenance flows for the river reach below Lake James were based on summary results presented in "Assessment of Hydraulic Geometry and Channel-Maintaining Discharges in the Catawba River Below Lake James", October 2001.

18 Floodplain Ecology inundation flows are initial estimates to be reviewed by the appropriate RC.

19 Maintenance flows for the river reach below Wylie and Wateree were based on geomorphic bankfull estimates for IFIM cross sections
Wylie Cross section at River Mile 137.5
Wateree Cross section at River Mile 67.6

20 Recreation flows are initial estimates to be reviewed by the appropriate RC.

21 Flooding flows are initial estimates based on the full hydraulic turbine capacity discharge plus
Oxford- One gate full open at reservoir = 100
Lookout- Discharge over spillway at reservoir = 103
Wylie- One gate full open at reservoir = 100
Wateree- Discharge over spillway at reservoir = 103
*Exception Lake James Bank full estimates per reference in Note 17

22 MISC = Minimum Increment of Significant Change. The MISC has the same units (i.e., days, days/yr, percent, etc.) as does the Criterion on that same row of the spreadsheet. If the output of two scenarios for a particular Criterion does not differ by more than the MISC, then there is no significant difference between those two scenarios as far as the Criterion in question is concerned. The following guidelines were used to establish the MISC numbers:
a. As a general rule, MISC numbers are set at 10% of the possible total for that Criterion considering the Start/Stop dates.
b. MISC numbers for Criterion that have the most negative outcomes if reached are typically set at less than 10% of the possible total for that Criterion.
c. Adjustments to the MISC numbers (up or down) have also been made depending on the desires of the stakeholders that primarily have the interests that are being measured by a particular Criterion.

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CHEOPS Performance Measures Evaluation Spreadsheet

	A	B	C	D	E	F	G	H	I
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2050**	**UC-Alt6_2050**	**UC-Alt7_2050**
2		**Lake James (including the Catawba River Bypassed Reach, Paddy Creek Bypassed Reach and the Bridgewater Regulated River Reach)**					(1999-2003)	(1999-2003)	(1999-2003)
3		*Fish & Aquatic Interests*							
4	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	350	340	350
5			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	504	503	504
8			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	33%	33%	47%
10	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	28%	28%	39%
11			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	21%	21%	25%
12	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	129	128	120
18		*Recreation Interests*							
19	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 93.5 ft) during higher use months	1-Mar	31-Oct	25	65	73	51
20			Avg. days/yr lake level below critical level for public boat ramps (< 92.0 ft) (Note 3)	1-Jan	31-Dec	3	21	21	33
21	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<93.0 ft) (Note 4)	1-Jan	31-Dec	3	88	93	88
22	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	12%	12%	11%
27		*Water User Interests*							
28	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for hydro unit operation (< 61 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
31			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 275.35) for the evaluation period (Note 12)	1-Jan	31-Dec	15	95	95	95
32		*Other Interests*							
33	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	11%	12%	12%
34			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 98.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	30%	29%	34%
37		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	30%	31%	35%
39			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	24%	25%	23%
40	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	13	13	13
41			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0
44	FA22, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or below 175 cfs released from the hydro development (Note 14)	1-Jan	31-Dec	10%	74%	73%	72%
45									
46		**Lake Rhodhiss**							
47		*Fish & Aquatic Interests*							
48	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	636	660	527
49			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	882	921	741
52			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	79%	78%	83%
54	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	68%	66%	71%
55			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	58%	57%	60%
56	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	48	49	44
57		*Recreation Interests*							
58	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 94.0 ft) during higher use months	1-Mar	31-Oct	25	30	31	31
59			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0
60	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	129	132	121
61	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	19%	19%	16%
62		*Water User Interests*							
63	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 89.4 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
64			Days below critical level for hydro unit operation (< 79.1 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
65		*Other Interests*							
66	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	21%	21%	20%
67			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 97.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	29%	30%	30%
70		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	28%	28%	29%
72			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
73	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	4	4	4
74			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0
75									
76		**Lake Hickory (Including the Oxford Regulated River Reach)**							
77		*Fish & Aquatic Interests*							
78	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	548	568	335
79			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	1,134	1,175	867
82			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	74%	69%	81%
84	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	69%	62%	73%
85			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	54%	51%	56%
86	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	56	58	54
87	FA22, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or below 225 cfs released from the hydro development (Note 14)	1-Jan	31-Dec	10%	48%	48%	46%
89		*Recreation Interests*							
90	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 94.0 ft) during higher use months	1-Mar	31-Oct	25	14	14	14
91			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0
92	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	149	156	143
93	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	14%	14%	14%
94	R101, R111, R121, R124, R127, HOWQ44	Maximize days/yr of boating opportunities in the regulated river reach	Avg. days/yr of daytime flows ≥ 2500, ≤ 5500 cfs released from the hydro development for at least 2 hrs/day during higher use months (Note 20)	1-Mar	31-Oct	25	125	127	119
95		*Water User Interests*							
96	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 94 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
97			Days below critical level for hydro unit operation (< 73 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
99			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 230) for the evaluation period (Note 12)	1-Jan	31-Dec	25	107	103	120
100		*Other Interests*							
101	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	18%	20%	18%
102			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 97.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	28%	30%	27%
105		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	30%	32%	28%
107			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
108	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	0	0	0
110									
111		**Lookout Shoals Lake (including the Lookout Shoals Regulated River Reach)**							
112		*Fish & Aquatic Interests*							
113	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	697	1,135	556
114			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	1,259	1,646	1,341
117			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	81%	72%	84%
119	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	82%	71%	82%
120			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	65%	60%	63%
121	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	44	48	48
124		*Recreation Interests*							
125	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 92.0 ft) during higher use months	1-Mar	31-Oct	25	1	1	0
126			Avg. days/yr lake level below critical level for public boat ramps (< 92.0 ft) (Note 3)	1-Jan	31-Dec	3	1	1	0
127	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	112	128	123
128		Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	13%	14%	11%
129		*Water User Interests*							
130	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 74.9 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
131			Days below critical level for hydro unit operation (< 72.9 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
132		*Other Interests*							
133	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	17%	20%	16%
134			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 97.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	27%	30%	27%
137		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	24%	28%	23%
139			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
140	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	64	65	64
141			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0
143									

Hydrology Condition / Period = _____

CHEOPS Performance Measures Evaluation Spreadsheet

James to Wylie

	A	B	C	D	E	F	G	H	I
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2050**	**UC-Alt6_2050**	**UC-Alt7_2050**
144		**Lake Norman**							
145		*Fish & Aquatic Interests*							
146	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	0	0	0
147			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	4	6	4
150			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	54%	52%	67%
152	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	58%	57%	74%
153			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	37%	36%	43%
154	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	71	70	56
155		*Recreation Interests*							
156	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 96.0 ft) during higher use months	1-Mar	31-Oct	25	79	76	57
157			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0
158	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<95.0 ft) (Note 4)	1-Jan	31-Dec	3	79	75	41
159	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	19%	19%	15%
160		*Water User Interests*							
161	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest thermal power station operation (< 90 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
162			Days below critical level for shallowest public water supply intake operation (< 85 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
163			Days below critical level for shallowest industrial intake operation (< 75 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
164			Days below critical level for hydro unit operation (< 65 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
165		*Other Interests*							
166	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	25%	25%	28%
168			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	79%	80%	89%
170		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	65%	66%	70%
172			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
173	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	0	0	0
174									
175		**Mt Island Lake (including the Mt Island Bypassed Reach)**							
176		*Fish & Aquatic Interests*							
177	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	277	277	277
178			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	525	769	294
181			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	34%	34%	34%
183	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	25%	25%	25%
184			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	17%	17%	15%
185	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	136	135	131
186		*Recreation Interests*							
187	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 91.0 ft) during higher use months	1-Mar	31-Oct	25	0	0	0
188			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0
189	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<96.0 ft) (Note 4)	1-Jan	31-Dec	3	274	273	265
190	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	17%	17%	17%
191		*Water User Interests*							
192	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest thermal power station operation (< 94.3 ft) (Note 3)	1-Jan	31-Dec	1	1	1	1
193			Days below critical level for shallowest public water supply intake operation (< 88 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
194			Days below critical level for hydro unit operation (< 77.5 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
195		*Other Interests*							
196	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 96.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	26%	25%	29%
198			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 96.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	88%	88%	90%
200		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	84%	84%	85%
202			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
203	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	6	8	8
204			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0
205									
206		**Lake Wylie (including the Wylie Regulated River Reach)**							
207		*Fish & Aquatic Interests*							
208	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	105	106	110
209			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	189	209	203
212			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	67%	68%	60%
214	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	50%	50%	44%
215			Percent of time of lake levels >= 97 ft during the growing season	1-Apr	30-Sep	10%	61%	61%	57%
216			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	30%	30%	27%
217	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	83	86	88
218	FA22, FA25, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or above 2000 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%			
219			Percent of hours at or above 1080 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%			
224		*Recreation Interests*							
225	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 95.5 ft) during higher use months	1-Mar	31-Oct	25	96	99	101
226			Avg. days/yr lake level below critical level for public boat ramps (< 95.5 ft) (Note 3)	1-Jan	31-Dec	3	157	160	163
227	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	224	224	231
228	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	18%	18%	18%
233		*Water User Interests*							
234	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest industrial intake operation (< 92.6 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
235			Days below critical level for shallowest public water supply intake operation (< 92 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
236			Days below critical level for shallowest thermal power station operation (< 90 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
237			Days below critical level for hydro unit operation (< 74 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
242	WQ189	Maximize low flows to maintain waste assimilation capacity of the regulated river reach.	Percent of days at or above approximate 7Q10 flow (450 cfs) released from the hydro development (RM 139.63) (Note 9)	1-Jan	31-Dec	5%	100%	100%	100%
243			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 139.63) for the evaluation period (Note 12)	1-Jan	31-Dec	45	720	720	860
244		*Other Interests*							
245	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	26%	25%	26%
247			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 97.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	67%	67%	65%
249		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	37%	37%	38%
251			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	26%	26%	28%
252	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	0	0	0
254									
255		**Total Project Hydropower & Water Quantity Management**							
259	FA40, HOWQ41, HOWQ42, HOWQ58	Minimize inefficiencies in using water stored for generation	Percent of hydropower generation lost due to unplanned spills (Note 8)	1-Jan	31-Dec	1%	4%	4%	4%
260			Percent of hydropower generation lost due to other non-power generation uses (Note 9)	1-Jan	31-Dec	1%	14%	14%	14%
261	FA40, HOWQ41, HOWQ58	Maximize hydropower generation	Avg. MWH/yr of hydropower produced	1-Jan	31-Dec	31,000	856,993	852,000	845,071
262			Average equivalent # of homes per year that could be powered by the Hydro Project (Note 11)	1-Jan	31-Dec	2,500	64,924	64,545	64,021
263	HOWQ58, HOWQ41,HOWQ45	Maximize hydropower value	Avg. hydro generation value in Normalized Dollars/yr (Note 8)	1-Jan	31-Dec	$20,000	$460,278	$457,668	$456,304
264									
265		Background	Performance Measure has improved vs. the Baseline Scenario						
266		Background	Performance Measure has declined vs. the Baseline Scenario						
267		White Background	There is no significant difference between the scenario and the Baseline Scenario by definition of MISC						
268									

CHEOPS Performance Measures Evaluation Spreadsheet

	A	B	C	D	E	F	G	H	I
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2050**	**UC-Alt6_2050**	**UC-Alt7_2050**
2		**Lake Wylie (including the Wylie Regulated River Reach)**					(1999-2003)	(1999-2003)	(1999-2003)
3		*Fish & Aquatic Interests*							
4	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	105	106	110
5			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	189	209	203
8			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	67%	68%	60%
10	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	50%	50%	44%
11			Percent of time of lake levels >= 97 ft during the growing season	1-Apr	30-Sep	10%	61%	61%	57%
12			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	30%	30%	27%
13	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	83	86	88
14	FA22, FA25, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or above 2000 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%			
15			Percent of hours at or above 1080 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%			
20		*Recreation Interests*							
21	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 95.5 ft) during higher use months	1-Mar	31-Oct	25	96	99	101
22			Avg. days/yr lake level below critical level for public boat ramps (< 95.5 ft) (Note 3)	1-Jan	31-Dec	3	157	160	163
23	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	224	224	231
24	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	18%	18%	18%
29		*Water User Interests*							
30	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest industrial intake operation (< 92.6 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
31			Days below critical level for shallowest public water supply intake operation (< 92 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
32			Days below critical level for shallowest thermal power station operation (< 90 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
33			Days below critical level for hydro unit operation (< 74 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
39			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 139.63) for the evaluation period (Note 12)	1-Jan	31-Dec	45	720	720	860
40		*Other Interests*							
41	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	26%	25%	26%
43			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 97.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	67%	67%	65%
45		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	37%	37%	38%
47			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	26%	26%	28%
48	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	0	0	0
50									
51		**Fishing Creek Reservoir**							
52		*Fish & Aquatic Interests*							
53	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	388	355	215
54			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	740	677	581
57			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	95%	95%	96%
59	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	97%	97%	98%
60			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	95%	95%	95%
61	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	1	2	2
62		*Recreation Interests*							
63	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 95.0 ft) during higher use months	1-Mar	31-Oct	25	0	0	0
64			Avg. days/yr lake level below critical level for public boat ramps (< 95.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0
65	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	11	12	12
66	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	12%	12%	12%
67		*Water User Interests*							
68	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 95 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
69			Days below critical level for shallowest industrial intake operation (< 90.8 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
70			Days below critical level for hydro unit operation (< 77.9 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
71		*Other Interests*							
72	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	12%	12%	12%
74			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 97.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	100%	100%	100%
76		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	100%	100%	100%
78			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
79	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	2	2	3
80									
81		**Great Falls-Dearborn Reservoir (including the Great Falls Long Bypassed Reach and the Great Falls Short Bypassed Reach)**							
82		*Fish & Aquatic Interests*							
83	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	580	528	518
84			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	1,237	1,134	1,069
87			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	89%	89%	90%
89	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	93%	92%	93%
90			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	91%	91%	92%
91	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	3	3	3
92		*Recreation Interests*							
93	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 98.0 ft) during higher use months	1-Mar	31-Oct	25	37	38	36
94			Avg. days/yr lake level below critical level for public boat ramps (< 97.0 ft) (Note 3)	1-Jan	31-Dec	3	35	36	32
95	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<98.0 ft) (Note 4)	1-Jan	31-Dec	3	55	55	52
96	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	18%	18%	18%
97		*Water User Interests*							
98	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for hydro unit operation (< 87.2 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
99		*Other Interests*							
100	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	22%	21%	20%
102			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	100%	100%	100%
104		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	21%	21%	20%
106			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
107	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	26	27	27
108			Days lake level above 103 ft	1-Jan	31-Dec	1	2	1	0
109									
110		**Cedar Creek Reservoir**							
111		*Fish & Aquatic Interests*							
112	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	373	437	430
113			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	811	730	727
116			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	95%	94%	94%
118	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	95%	95%	95%
119			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	94%	94%	94%
120	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	0	0	0
121		*Recreation Interests*							
122	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 98.5 ft) during higher use months	1-Mar	31-Oct	25	21	23	23
123			Avg. days/yr lake level below critical level for public boat ramps (< 96.0 ft) (Note 3)	1-Jan	31-Dec	3	2	2	1
124	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	13	17	14
125	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	6%	6%	6%
126		*Water User Interests*							
127	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for hydro unit operation (< 80.3 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
128		*Other Interests*							
129	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	15%	14%	13%
131			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	100%	100%	100%
133		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	15%	15%	14%
135			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
136	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	2	2	1
137			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0
138									

CHEOPS Performance Measures Evaluation Spreadsheet

	A	B	C	D	E	F	G	H	I
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2050**	**UC-Alt6_2050**	**UC-Alt7_2050**
139		**Lake Wateree (including the Wateree Regulated River Reach)**							
140		*Fish & Aquatic Interests*							
141	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	356	384	355
142			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	990	1,025	923
145			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	52%	50%	71%
147	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	64%	63%	83%
148			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	80%	79%	90%
149	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	18	19	5
150	FA22, FA25, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or above 2000 cfs at Node 1 (RM 74.54) (Note 14)	1-Jan	31-Dec	10%			
151			Percent of hours at or above 1200 cfs at Node 1 (RM 74.54) (Note 14)	1-Jan	31-Dec	10%			
157		*Recreation Interests*							
158	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 96.0 ft) during higher use months	1-Mar	31-Oct	25	35	38	11
159			Avg. days/yr lake level below critical level for public boat ramps (< 93.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0
160	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	55	56	22
161	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	12%	12%	10%
164		*Water User Interests*							
165	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 92.5 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
166			Days below critical level for hydro unit operation (< 74 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
169			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 74.54) for the evaluation period (Note 12)	1-Jan	31-Dec	53	807	807	896
170		*Other Interests*							
171	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	12%	11%	7%
173			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	98%	99%	100%
175		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	18%	19%	13%
177			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
178	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	15	15	16
179			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0
181									
182		**Total Project Hydropower & Water Quantity Management**							
186	FA40, HOWQ41, HOWQ42, HOWQ58	Minimize inefficiencies in using water stored for generation	Percent of hydropower generation lost due to unplanned spills (Note 8)	1-Jan	31-Dec	1%	4%	4%	4%
187			Percent of hydropower generation lost due to other non-power generation uses (Note 9)	1-Jan	31-Dec	1%	14%	14%	14%
188	FA40, HOWQ41, HOWQ58	Maximize hydropower generation	Avg. MWH/yr of hydropower produced	1-Jan	31-Dec	31,000	856,993	852,000	845,071
189			Average equivalent # of homes per year that could be powered by the Hydro Project (Note 11)	1-Jan	31-Dec	2,500	64,924	64,545	64,021
190	HOWQ58, HOWQ41,HOWQ45	Maximize hydropower value	Avg. hydro generation value in Normalized Dollars/yr (Note 8)	1-Jan	31-Dec	$20,000	$460,278	$457,668	$456,304
191									
192		Background	Performance Measure has improved vs. the Baseline Scenario						
193		Background	Performance Measure has declined vs. the Baseline Scenario						
194		White Background	There is no significant difference between the scenario and the Baseline Scenario by definition of MISC						
195									

Notes

1 CIS # are the Composite Interest Statement numbers taken from Rev 3 of the Composite Interest Statement document dated 10/27/04 for the interests that are both (1) directly related to water quantity management and (2) reasonably measurable using CHEOPS. The following CIS #'s represent interests that are directly related to water quantity, but that will be dealt with differently as noted, and therefore will not be tabulated individually:

CIS #	Composite Interest Statement (Rev 3 - 10/27/04)	Disposition
FA16	Provide run-of-river flows through every dam.	Scenario design readily identifies whether or not interest is met.
FA36	Mimic day, month, and annual natural flow patterns including natural floods in riverine and bypass areas.	Scenario design readily identifies whether or not interest is met.
FA38	Restore run-of-river flows to the Great Falls.	Scenario design readily identifies whether or not interest is met.
R125	Provide predictable recreation releases on river sections (i.e., allow recreation users to plan ahead for river use).	Scenario design readily identifies whether or not interest is met.
R126	Provide predictable recreation releases on bypass sections including the Great Falls bypass.	Scenario design readily identifies whether or not interest is met.
HOWQ51	Tie the low inflow protocol to both water conservation and energy conservation.	LIP design determines if interest is met.
HOWQ52	Assure that the low inflow protocol fully protects aquatic resources, water quality, and recreation.	LIP design determines if interest is met.

2 For criterion that measure on an hourly or daily basis, unless stated otherwise:

a. If an hourly criterion occurs during the average of four contiguous 15-minute periods, then it counts as 1 hour.

b. If a daily criterion occurs for 5 contiguous 1-hour periods, then it counts as 1 day.

Also, daytime flows are assumed to be flows provided between 7:00 am and 7:00 pm. To the extent possible, each Criterion is defined in terms of percents and averages/yr so that the same Criterion is useful regardless of the length of the hydrology period (i.e., 1-yr, 3-yr, full period of record, etc.)

3 Critical lake elevations per Attachment F of Draft AIP dated 10/15/04.

4 See App. C of Draft Reservoir Level Study Report dated 11/10/04 for average monthly lake levels during post-Cowans Ford era.
Areas within the lakes are considered boatable if the water depth is greater than or equal to 3 ft.
Lake surface areas are determined using Area-Volume Curves (i.e., a set of curves for each lake that graph both lake surface area and lake volume verses water depth).

5 Low Inflow Protocol (LIP) Trigger Point considerations.

6 Low Inflow Protocol (LIP) Trigger Point considerations.

7 Developed areas include areas with roads, houses and other man-made structures.

8 Includes lost hydropower generation due to unplanned spilling of water at hydro station dams.
This measure does not include energy losses from evaporation, dam leakage or groundwater recharge.

9 Includes lost hydropower due to minimum flow and recreation flow releases that bypass the hydro station and public water supply and industrial withdrawals.
This measure does not include energy losses from evaporation, dam leakage or groundwater recharge.

10 Normalized dollar value of hydropower generated in a given year =

[∑ (MWH x market value for each hour)]/(Highest hourly market price in that year)

11 Flow rates needed to provide for basic navigation. These flow rates are determined by the Instream Flow Study and/or the Recreation Flow Study. In SC, the flow rates are based on meeting SCDNR's navigation criteria.
In NC, the flow rates are based on Rec 02 studies.

12 7Q10 Flow rate = Lowest average flow rate over a 7-day period that statistically is likely to occur once every 10 years.
The approximate 7Q10 flow rates listed in this document are from Table 6.1-1, Summary of Catawba-Wateree Project Hydrology as shown in Duke Power's First Stage Consultation Document dated 2003.

13 Absolute Lake level variation is determined from hourly checks against the measure using 15-minute reservoir data averaged per hour.
The number of hours that exceed the starting reservoir elevation are recorded for each 14 day period between the start and end date.
The starting elevation (midnight reservoir elevation) is reset each 14-day period and the total hourly count for all test periods is recorded for each scenario.

14 Calculated by (Total Scenario MWh / 13.2 MWh per home) / the # of years in the scenario
The MISC of 3000 homes per year is roughly 2% of the average equivalent homes/yr under the Baseline conditions.
Power produced by the hydro project is actually supplied to Duke Power's electric system grid and is used by Duke Power's electric customers (including residential, industrial and commercial customers), as is power produced at other Duke Power generating stations. This criterion of average equivalent homes per year is intended to simply make the total energy production potential of the hydro project more understandable to stakeholder team members and to put a perspective around potential differences in hydropower production between various operational scenarios. This measure does not imply that any number of homes will go without power if a particular scenario is chosen.

15 Lowest 7-day average flow rate is determined from a rolling 7-day average of the average daily flow (cfs).
Where a average daily flow rate is determined from 15-minute flow (cfs) data averaged per 24 hour-day.

16 Habitat flows were estimates based on field experience with the subject reaches.

17 Floodplain Ecology inundation and maintenance flows for the river reach below Lake James were based on summary results presented in "Assessment of Hydraulic Geometry and Channel-Maintaining Discharges in the Catawba River Below Lake James", October 2001.

18 Floodplain Ecology inundation flows are initial estimates to be reviewed by the appropriate RC.

19 Maintenance flows for the river reach below Wylie and Wateree were based on geomorphic bankfull estimates for IFIM cross sections
Wylie Cross section at River Mile 137.5
Wateree Cross section at River Mile 67.6

20 Recreation flows are initial estimates to be reviewed by the appropriate RC.

21 Flooding flows are initial estimates based on the full hydraulic turbine capacity discharge plus
Oxford- One gate full open at reservoir = 100
Lookout- Discharge over spillway at reservoir = 103
Wylie- One gate full open at reservoir = 100
Wateree- Discharge over spillway at reservoir = 103
*Exception Lake James Bank full estimates per reference in Note 17

22 MISC = Minimum Increment of Significant Change. The MISC has the same units (i.e., days, days/yr, percent, etc.) as does the Criterion on that same row of the spreadsheet. If the output of two scenarios for a particular Criterion does not differ by more than the MISC, then there is no significant difference between those two scenarios as far as the Criterion in question is concerned. The following guidelines were used to establish the MISC numbers:
a. As a general rule, MISC numbers are set at 10% of the possible total for that Criterion considering the Start/Stop dates.
b. MISC numbers for Criterion that have the most negative outcomes if reached are typically set at less than 10% of the possible total for that Criterion.
c. Adjustments to the MISC numbers (up or down) have also been made depending on the desires of the stakeholders that primarily have the interests that are being measured by a particular Criterion.

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Hydrology Condition / Period = _____

CHEOPS Performance Measures Evaluation Spreadsheet

James to Wylie

	A	B	C	D	E	F	G	H	I	J
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2012**	**UC-Base_2050**	**UC-Alt6_UC2050_2012**	**UC-Alt7_UC2050_2012**
2		**Lake James (including the Catawba River Bypassed Reach, Paddy Creek Bypassed Reach and the Bridgewater Regulated River Reach)**					(2006-2009)	(2006-2009)	(2006-2009)	(2006-2009)
3		*Fish & Aquatic Interests*								
4	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	278	81	102	102
5			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	434	387	431	432
8			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	50%	32%	50%	50%
10	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	60%	40%	60%	60%
11			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	51%	41%	51%	51%
12	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	74	81	74	74
18		*Recreation Interests*								
19	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 93.5 ft) during higher use months	1-Mar	31-Oct	25	44	57	44	44
20			Avg. days/yr lake level below critical level for public boat ramps (< 92.0 ft) (Note 3)	1-Jan	31-Dec	3	40	49	39	39
21	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<93.0 ft) (Note 4)	1-Jan	31-Dec	3	59	74	60	60
22	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	13%	26%	13%	13%
27		*Water User Interests*								
28	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for hydro unit operation (< 61 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
31			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 275.35) for the evaluation period (Note 12)	1-Jan	31-Dec	15	95	95	95	95
32		*Other Interests*								
33	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	11%	12%	11%	11%
34			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 98.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	61%	57%	61%	61%
37		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	49%	48%	49%	49%
39			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	8%	7%	8%	8%
40	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	10	7	10	10
41			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0	0
44	FA22, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or below 175 cfs released from the hydro development (Note 14)	1-Jan	31-Dec	10%	60%	64%	60%	60%
45										
46		**Lake Rhodhiss**								
47		*Fish & Aquatic Interests*								
48	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	28	272	36	28
49			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	126	377	99	155
52			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	77%	77%	76%	75%
54	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	82%	79%	82%	80%
55			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	70%	71%	70%	69%
56	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	24	25	23	24
57		*Recreation Interests*								
58	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 94.0 ft) during higher use months	1-Mar	31-Oct	25	25	23	25	26
59			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0	0
60	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	82	79	81	83
61	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	18%	18%	18%	18%
62		*Water User Interests*								
63	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 89.4 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
64			Days below critical level for hydro unit operation (< 79.1 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
65		*Other Interests*								
66	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	21%	19%	21%	22%
67			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 97.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	26%	25%	26%	27%
70		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	26%	24%	25%	26%
72			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
73	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	7	7	7	7
74			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0	0
75										
76		**Lake Hickory (Including the Oxford Regulated River Reach)**								
77		*Fish & Aquatic Interests*								
78	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	0	115	0	0
79			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	162	156	168	154
82			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	67%	74%	67%	67%
84	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	73%	78%	73%	73%
85			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	64%	68%	64%	64%
86	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	26	26	26	26
87	FA22, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or below 225 cfs released from the hydro development (Note 14)	1-Jan	31-Dec	10%	29%	29%	29%	29%
89		*Recreation Interests*								
90	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 94.0 ft) during higher use months	1-Mar	31-Oct	25	6	4	6	7
91			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0	0
92	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	114	100	114	114
93	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	14%	14%	14%	14%
94	R101, R111, R121, R124, R127, HOWQ44	Maximize days/yr of boating opportunities in the regulated river reach	Avg. days/yr of daytime flows ≥ 2500, ≤ 5500 cfs released from the hydro development for at least 2 hrs/day during higher use months (Note 20)	1-Mar	31-Oct	25	69	69	69	68
95		*Water User Interests*								
96	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 94 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
97			Days below critical level for hydro unit operation (< 73 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
99			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 230) for the evaluation period (Note 12)	1-Jan	31-Dec	25	103	100	103	103
100		*Other Interests*								
101	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	23%	20%	24%	23%
102			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 97.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	28%	28%	28%	28%
105		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	27%	27%	27%	27%
107			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
108	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	0	0	0	0
110										
111		**Lookout Shoals Lake (including the Lookout Shoals Regulated River Reach)**								
112		*Fish & Aquatic Interests*								
113	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	120	114	118	121
114			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	299	273	298	298
117			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	81%	86%	83%	82%
119	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	88%	87%	90%	89%
120			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	74%	75%	74%	74%
121	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	28	28	28	28
124		*Recreation Interests*								
125	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 92.0 ft) during higher use months	1-Mar	31-Oct	25	3	5	3	4
126			Avg. days/yr lake level below critical level for public boat ramps (< 92.0 ft) (Note 3)	1-Jan	31-Dec	3	9	11	9	10
127	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	84	78	83	84
128		Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	13%	15%	13%	14%
129		*Water User Interests*								
130	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 74.9 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
131			Days below critical level for hydro unit operation (< 72.9 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
132		*Other Interests*								
133	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	16%	15%	16%	16%
134			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 97.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	21%	20%	20%	21%
137		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	20%	19%	19%	20%
139			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
140	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	60	56	60	60
141			Days lake level above 103 ft	1-Jan	31-Dec	1	2	2	2	2
143										

Hydrology Condition / Period = _____

CHEOPS Performance Measures Evaluation Spreadsheet

James to Wylie

	A	B	C	D	E	F	G	H	I	J
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2012**	**UC-Base_2050**	**UC-Alt6_UC2050_2012**	**UC-Alt7_UC2050_2012**
144		**Lake Norman**								
145		*Fish & Aquatic Interests*								
146	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	0	0	0	0
147			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	0	0	0	0
150			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	52%	26%	52%	51%
152	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	66%	36%	66%	66%
153			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	54%	38%	53%	53%
154	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	50	60	50	51
155		*Recreation Interests*								
156	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 96.0 ft) during higher use months	1-Mar	31-Oct	25	36	54	37	38
157			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	0	23	0	6
158	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<95.0 ft) (Note 4)	1-Jan	31-Dec	3	69	76	69	70
159	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	21%	23%	21%	21%
160		*Water User Interests*								
161	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest thermal power station operation (< 90 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
162			Days below critical level for shallowest public water supply intake operation (< 85 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
163			Days below critical level for shallowest industrial intake operation (< 75 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
164			Days below critical level for hydro unit operation (< 65 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
165		*Other Interests*								
166	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	12%	23%	12%	12%
168			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	82%	79%	82%	81%
170		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	67%	66%	67%	66%
172			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
173	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	5	0	4	4
174										
175		**Mt Island Lake (including the Mt Island Bypassed Reach)**								
176		*Fish & Aquatic Interests*								
177	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	0	0	0	0
178			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	130	107	167	172
181			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	66%	65%	66%	65%
183	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	72%	71%	72%	72%
184			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	63%	62%	63%	63%
185	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	55	57	55	55
186		*Recreation Interests*								
187	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 91.0 ft) during higher use months	1-Mar	31-Oct	25	0	0	0	0
188			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0	0
189	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<96.0 ft) (Note 4)	1-Jan	31-Dec	3	114	116	114	113
190	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	17%	17%	17%	17%
191		*Water User Interests*								
192	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest thermal power station operation (< 94.3 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
193			Days below critical level for shallowest public water supply intake operation (< 88 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
194			Days below critical level for hydro unit operation (< 77.5 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
195		*Other Interests*								
196	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 96.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	22%	21%	21%	21%
198			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 96.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	40%	41%	40%	40%
200		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	38%	38%	38%	38%
202			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
203	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	10	10	10	10
204			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0	0
205										
206		**Lake Wylie (including the Wylie Regulated River Reach)**								
207		*Fish & Aquatic Interests*								
208	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	0	0	0	0
209			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	0	0	0	0
212			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	60%	72%	61%	58%
214	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	64%	62%	64%	61%
215			Percent of time of lake levels >= 97 ft during the growing season	1-Apr	30-Sep	10%	81%	78%	81%	78%
216			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	57%	55%	57%	56%
217	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	33	35	33	33
218	FA22, FA25, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or above 2000 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%				
219			Percent of hours at or above 1080 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%				
224		*Recreation Interests*								
225	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 95.5 ft) during higher use months	1-Mar	31-Oct	25	36	36	36	36
226			Avg. days/yr lake level below critical level for public boat ramps (< 95.5 ft) (Note 3)	1-Jan	31-Dec	3	64	64	63	64
227	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	113	122	112	116
228	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	18%	18%	18%	18%
233		*Water User Interests*								
234	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest industrial intake operation (< 92.6 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
235			Days below critical level for shallowest public water supply intake operation (< 92 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
236			Days below critical level for shallowest thermal power station operation (< 90 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
237			Days below critical level for hydro unit operation (< 74 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
242	WQ189	Maximize low flows to maintain waste assimilation capacity of the regulated river reach.	Percent of days at or above approximate 7Q10 flow (450 cfs) released from the hydro development (RM 139.63) (Note 9)	1-Jan	31-Dec	5%	100%	100%	100%	100%
243			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 139.63) for the evaluation period (Note 12)	1-Jan	31-Dec	45	720	700	720	720
244		*Other Interests*								
245	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	25%	27%	25%	27%
247			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 97.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	85%	85%	85%	85%
249		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	34%	39%	34%	35%
251			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	12%	11%	12%	12%
252	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	0	1	0	0
254										
255		**Total Project Hydropower & Water Quantity Management**								
259	FA40, HOWQ41, HOWQ42, HOWQ58	Minimize inefficiencies in using water stored for generation	Percent of hydropower generation lost due to unplanned spills (Note 8)	1-Jan	31-Dec	1%	5%	4%	5%	5%
260			Percent of hydropower generation lost due to other non-power generation uses (Note 9)	1-Jan	31-Dec	1%	17%	20%	17%	17%
261	FA40, HOWQ41, HOWQ58	Maximize hydropower generation	Avg. MWH/yr of hydropower produced	1-Jan	31-Dec	31,000	931,212	851,315	926,057	926,215
262			Average equivalent # of homes per year that could be powered by the Hydro Project (Note 11)	1-Jan	31-Dec	2,500	70,546	64,494	70,156	70,168
263	HOWQ58, HOWQ41,HOWQ45	Maximize hydropower value	Avg. hydro generation value in Normalized Dollars/yr (Note 8)	1-Jan	31-Dec	$20,000	$484,378	$445,738	$481,776	$481,609
264										
265		Background	Performance Measure has improved vs. the Baseline Scenario							
266		Background	Performance Measure has declined vs. the Baseline Scenario							
267		White Background	There is no significant difference between the scenario and the Baseline Scenario by definition of MISC							
268										

CHEOPS Performance Measures Evaluation Spreadsheet

	A	B	C	D	E	F	G	H	I	J
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2012**	**UC-Base_2050**	**UC-Alt6_UC2050_2012**	**UC-Alt7_UC2050_2012**
2		**Lake Wylie (including the Wylie Regulated River Reach)**					(2006-2009)	(2006-2009)	(2006-2009)	(2006-2009)
3		*Fish & Aquatic Interests*								
4	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	0	0	0	0
5			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	0	0	0	0
8			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	60%	72%	61%	58%
10	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	64%	62%	64%	61%
11			Percent of time of lake levels >= 97 ft during the growing season	1-Apr	30-Sep	10%	81%	78%	81%	78%
12			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	57%	55%	57%	56%
13	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	33	35	33	33
14	FA22, FA25, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or above 2000 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%				
15			Percent of hours at or above 1080 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%				
20		*Recreation Interests*								
21	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 95.5 ft) during higher use months	1-Mar	31-Oct	25	36	36	36	36
22			Avg. days/yr lake level below critical level for public boat ramps (< 95.5 ft) (Note 3)	1-Jan	31-Dec	3	64	64	63	64
23	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	113	122	112	116
24	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	18%	18%	18%	18%
29		*Water User Interests*								
30	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest industrial intake operation (< 92.6 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
31			Days below critical level for shallowest public water supply intake operation (< 92 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
32			Days below critical level for shallowest thermal power station operation (< 90 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
33			Days below critical level for hydro unit operation (< 74 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
39			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 139.63) for the evaluation period (Note 12)	1-Jan	31-Dec	45	720	700	720	720
40		*Other Interests*								
41	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	25%	27%	25%	27%
43			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 97.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	85%	85%	85%	85%
45		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	34%	39%	34%	35%
47			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	12%	11%	12%	12%
48	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	0	1	0	0
50										
51		**Fishing Creek Reservoir**								
52		*Fish & Aquatic Interests*								
53	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	245	91	306	195
54			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	684	402	661	578
57			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	90%	94%	90%	90%
59	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	98%	98%	98%	98%
60			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	92%	93%	92%	92%
61	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	2	2	1	2
62		*Recreation Interests*								
63	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 95.0 ft) during higher use months	1-Mar	31-Oct	25	0	0	0	0
64			Avg. days/yr lake level below critical level for public boat ramps (< 95.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0	0
65	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	18	15	18	18
66	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	16%	15%	16%	17%
67		*Water User Interests*								
68	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 95 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
69			Days below critical level for shallowest industrial intake operation (< 90.8 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
70			Days below critical level for hydro unit operation (< 77.9 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
71		*Other Interests*								
72	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	15%	15%	15%	15%
74			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 97.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	100%	100%	100%	100%
76		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	100%	100%	100%	100%
78			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
79	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	0	0	0	0
80										
81		**Great Falls-Dearborn Reservoir (including the Great Falls Long Bypassed Reach and the Great Falls Short Bypassed Reach)**								
82		*Fish & Aquatic Interests*								
83	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	591	511	668	617
84			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	818	801	983	911
87			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	86%	88%	87%	86%
89	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	94%	95%	95%	94%
90			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	90%	90%	90%	89%
91	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	4	5	5	5
92		*Recreation Interests*								
93	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 98.0 ft) during higher use months	1-Mar	31-Oct	25	24	21	23	25
94			Avg. days/yr lake level below critical level for public boat ramps (< 97.0 ft) (Note 3)	1-Jan	31-Dec	3	39	37	38	42
95	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<98.0 ft) (Note 4)	1-Jan	31-Dec	3	58	54	57	59
96	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	20%	18%	19%	20%
97		*Water User Interests*								
98	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for hydro unit operation (< 87.2 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
99		*Other Interests*								
100	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	22%	20%	22%	22%
102			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	100%	100%	100%	100%
104		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	22%	20%	22%	22%
106			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
107	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	25	27	25	27
108			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0	0
109										
110		**Cedar Creek Reservoir**								
111		*Fish & Aquatic Interests*								
112	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	201	321	311	300
113			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	564	593	683	630
116			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	90%	93%	90%	90%
118	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	97%	97%	97%	97%
119			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	90%	92%	91%	90%
120	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	0	0	0	0
121		*Recreation Interests*								
122	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 98.5 ft) during higher use months	1-Mar	31-Oct	25	20	13	19	19
123			Avg. days/yr lake level below critical level for public boat ramps (< 96.0 ft) (Note 3)	1-Jan	31-Dec	3	1	2	1	1
124	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	23	20	23	23
125	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	6%	6%	6%	6%
126		*Water User Interests*								
127	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for hydro unit operation (< 80.3 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
128		*Other Interests*								
129	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	19%	18%	19%	18%
131			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	100%	100%	100%	100%
133		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	20%	18%	20%	20%
135			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
136	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	0	0	0	0
137			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0	0
138										

CHEOPS Performance Measures Evaluation Spreadsheet

	A	B	C	D	E	F	G	H	I	J
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2012**	**UC-Base_2050**	**UC-Alt6_UC2050_2012**	**UC-Alt7_UC2050_2012**
139		**Lake Wateree (including the Wateree Regulated River Reach)**								
140		*Fish & Aquatic Interests*								
141	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	23	157	10	2
142			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	142	252	121	100
145			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	66%	64%	67%	66%
147	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	77%	66%	76%	75%
148			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	88%	74%	82%	88%
149	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	14	44	13	14
150	FA22, FA25, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or above 2000 cfs at Node 1 (RM 74.54) (Note 14)	1-Jan	31-Dec	10%				
151			Percent of hours at or above 1200 cfs at Node 1 (RM 74.54) (Note 14)	1-Jan	31-Dec	10%				
157		*Recreation Interests*								
158	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 96.0 ft) during higher use months	1-Mar	31-Oct	25	29	68	26	29
159			Avg. days/yr lake level below critical level for public boat ramps (< 93.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0	0
160	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	36	91	36	36
161	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	11%	13%	11%	11%
164		*Water User Interests*								
165	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 92.5 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
166			Days below critical level for hydro unit operation (< 74 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
169			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 74.54) for the evaluation period (Note 12)	1-Jan	31-Dec	53	807	800	807	807
170		*Other Interests*								
171	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	5%	3%	12%	5%
173			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	99%	97%	99%	99%
175		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	20%	19%	21%	21%
177			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
178	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	13	11	13	13
179			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0	0
181										
182		**Total Project Hydropower & Water Quantity Management**								
186	FA40, HOWQ41, HOWQ42, HOWQ58	Minimize inefficiencies in using water stored for generation	Percent of hydropower generation lost due to unplanned spills (Note 8)	1-Jan	31-Dec	1%	5%	4%	5%	5%
187			Percent of hydropower generation lost due to other non-power generation uses (Note 9)	1-Jan	31-Dec	1%	17%	20%	17%	17%
188	FA40, HOWQ41, HOWQ58	Maximize hydropower generation	Avg. MWH/yr of hydropower produced	1-Jan	31-Dec	31,000	931,212	851,315	926,057	926,215
189			Average equivalent # of homes per year that could be powered by the Hydro Project (Note 11)	1-Jan	31-Dec	2,500	70,546	64,494	70,156	70,168
190	HOWQ58, HOWQ41,HOWQ45	Maximize hydropower value	Avg. hydro generation value in Normalized Dollars/yr (Note 8)	1-Jan	31-Dec	$20,000	$484,378	$445,738	$481,776	$481,609
191										
192		Background	Performance Measure has improved vs. the Baseline Scenario							
193		Background	Performance Measure has declined vs. the Baseline Scenario							
194		White Background	There is no significant difference between the scenario and the Baseline Scenario by definition of MISC							
195										

Notes

1 CIS # are the Composite Interest Statement numbers taken from Rev 3 of the Composite Interest Statement document dated 10/27/04 for the interests that are both (1) directly related to water quantity management and (2) reasonably measurable using CHEOPS. The following CIS #'s represent interests that are directly related to water quantity, but that will be dealt with differently as noted, and therefore will not be tabulated individually:

CIS #	Composite Interest Statement (Rev 3 - 10/27/04)	Disposition
FA16	Provide run-of-river flows through every dam.	Scenario design readily identifies whether or not interest is met.
FA36	Mimic day, month, and annual natural flow patterns including natural floods in riverine and bypass areas.	Scenario design readily identifies whether or not interest is met.
FA38	Restore run-of-river flows to the Great Falls.	Scenario design readily identifies whether or not interest is met.
R125	Provide predictable recreation releases on river sections (i.e., allow recreation users to plan ahead for river use).	Scenario design readily identifies whether or not interest is met.
R126	Provide predictable recreation releases on bypass sections including the Great Falls bypass.	Scenario design readily identifies whether or not interest is met.
HOWQ51	Tie the low inflow protocol to both water conservation and energy conservation.	LIP design determines if interest is met.
HOWQ52	Assure that the low inflow protocol fully protects aquatic resources, water quality, and recreation.	LIP design determines if interest is met.

2 For criterion that measure on an hourly or daily basis, unless stated otherwise:

a. If an hourly criterion occurs during the average of four contiguous 15-minute periods, then it counts as 1 hour.

b. If a daily criterion occurs for 5 contiguous 1-hour periods, then it counts as 1 day.

Also, daytime flows are assumed to be flows provided between 7:00 am and 7:00 pm. To the extent possible, each Criterion is defined in terms of percents and averages/yr so that the same Criterion is useful regardless of the length of the hydrology period (i.e., 1-yr, 3-yr, full period of record, etc.)

3 Critical lake elevations per Attachment F of Draft AIP dated 10/15/04.

4 See App. C of Draft Reservoir Level Study Report dated 11/10/04 for average monthly lake levels during post-Cowans Ford era.
Areas within the lakes are considered boatable if the water depth is greater than or equal to 3 ft.
Lake surface areas are determined using Area-Volume Curves (i.e., a set of curves for each lake that graph both lake surface area and lake volume verses water depth).

5 Low Inflow Protocol (LIP) Trigger Point considerations.

6 Low Inflow Protocol (LIP) Trigger Point considerations.

7 Developed areas include areas with roads, houses and other man-made structures.

8 Includes lost hydropower generation due to unplanned spilling of water at hydro station dams.
This measure does not include energy losses from evaporation, dam leakage or groundwater recharge.

9 Includes lost hydropower due to minimum flow and recreation flow releases that bypass the hydro station and public water supply and industrial withdrawals.
This measure does not include energy losses from evaporation, dam leakage or groundwater recharge.

10 Normalized dollar value of hydropower generated in a given year =

[∑ (MWH x market value for each hour)]/(Highest hourly market price in that year)

11 Flow rates needed to provide for basic navigation. These flow rates are determined by the Instream Flow Study and/or the Recreation Flow Study. In SC, the flow rates are based on meeting SCDNR's navigation criteria.
In NC, the flow rates are based on Rec 02 studies.

12 7Q10 Flow rate = Lowest average flow rate over a 7-day period that statistically is likely to occur once every 10 years.
The approximate 7Q10 flow rates listed in this document are from Table 6.1-1, Summary of Catawba-Wateree Project Hydrology as shown in Duke Power's First Stage Consultation Document dated 2003.

13 Absolute Lake level variation is determined from hourly checks against the measure using 15-minute reservoir data averaged per hour.
The number of hours that exceed the starting reservoir elevation are recorded for each 14 day period between the start and end date.
The starting elevation (midnight reservoir elevation) is reset each 14-day period and the total hourly count for all test periods is recorded for each scenario.

14 Calculated by (Total Scenario MWh / 13.2 MWh per home) / the # of years in the scenario
The MISC of 3000 homes per year is roughly 2% of the average equivalent homes/yr under the Baseline conditions.
Power produced by the hydro project is actually supplied to Duke Power's electric system grid and is used by Duke Power's electric customers (including residential, industrial and commercial customers), as is power produced at other Duke Power generating stations. This criterion of average equivalent homes per year is intended to simply make the total energy production potential of the hydro project more understandable to stakeholder team members and to put a perspective around potential differences in hydropower production between various operational scenarios. This measure does not imply that any number of homes will go without power if a particular scenario is chosen.

15 Lowest 7-day average flow rate is determined from a rolling 7-day average of the average daily flow (cfs).
Where a average daily flow rate is determined from 15-minute flow (cfs) data averaged per 24 hour-day.

16 Habitat flows were estimates based on field experience with the subject reaches.

17 Floodplain Ecology inundation and maintenance flows for the river reach below Lake James were based on summary results presented in "Assessment of Hydraulic Geometry and Channel-Maintaining Discharges in the Catawba River Below Lake James", October 2001.

18 Floodplain Ecology inundation flows are initial estimates to be reviewed by the appropriate RC.

19 Maintenance flows for the river reach below Wylie and Wateree were based on geomorphic bankfull estimates for IFIM cross sections
Wylie Cross section at River Mile 137.5
Wateree Cross section at River Mile 67.6

20 Recreation flows are initial estimates to be reviewed by the appropriate RC.

21 Flooding flows are initial estimates based on the full hydraulic turbine capacity discharge plus
Oxford- One gate full open at reservoir = 100
Lookout- Discharge over spillway at reservoir = 103
Wylie- One gate full open at reservoir = 100
Wateree- Discharge over spillway at reservoir = 103
*Exception Lake James Bank full estimates per reference in Note 17

22 MISC = Minimum Increment of Significant Change. The MISC has the same units (i.e., days, days/yr, percent, etc.) as does the Criterion on that same row of the spreadsheet. If the output of two scenarios for a particular Criterion does not differ by more than the MISC, then there is no significant difference between those two scenarios as far as the Criterion in question is concerned. The following guidelines were used to establish the MISC numbers:
a. As a general rule, MISC numbers are set at 10% of the possible total for that Criterion considering the Start/Stop dates.
b. MISC numbers for Criterion that have the most negative outcomes if reached are typically set at less than 10% of the possible total for that Criterion.
c. Adjustments to the MISC numbers (up or down) have also been made depending on the desires of the stakeholders that primarily have the interests that are being measured by a particular Criterion.

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Hydrology Condition / Period = _____

CHEOPS Performance Measures Evaluation Spreadsheet

James to Wylie

	A	B	C	D	E	F	G	H	I
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2050**	**UC-Alt6_2050**	**UC-Alt7_2050**
2		**Lake James (including the Catawba River Bypassed Reach, Paddy Creek Bypassed Reach and the Bridgewater Regulated River Reach)**					(2006-2009)	(2006-2009)	(2006-2009)
3		*Fish & Aquatic Interests*							
4	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	81	102	102
5			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	387	431	430
8			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	32%	26%	26%
10	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	40%	35%	35%
11			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	41%	39%	39%
12	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	81	83	97
18		*Recreation Interests*							
19	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 93.5 ft) during higher use months	1-Mar	31-Oct	25	57	57	59
20			Avg. days/yr lake level below critical level for public boat ramps (< 92.0 ft) (Note 3)	1-Jan	31-Dec	3	49	49	52
21	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<93.0 ft) (Note 4)	1-Jan	31-Dec	3	74	75	77
22	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	26%	26%	28%
27		*Water User Interests*							
28	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for hydro unit operation (< 61 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
31			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 275.35) for the evaluation period (Note 12)	1-Jan	31-Dec	15	95	95	95
32		*Other Interests*							
33	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	12%	12%	9%
34			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 98.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	57%	56%	48%
37		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	48%	48%	39%
39			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	7%	8%	8%
40	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	7	7	7
41			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0
44	FA22, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or below 175 cfs released from the hydro development (Note 14)	1-Jan	31-Dec	10%	64%	64%	64%
45									
46		**Lake Rhodhiss**							
47		*Fish & Aquatic Interests*							
48	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	272	428	282
49			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	377	586	392
52			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	77%	72%	72%
54	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	79%	75%	75%
55			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	71%	69%	69%
56	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	25	27	28
57		*Recreation Interests*							
58	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 94.0 ft) during higher use months	1-Mar	31-Oct	25	23	24	25
59			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0
60	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	79	86	85
61	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	18%	18%	19%
62		*Water User Interests*							
63	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 89.4 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
64			Days below critical level for hydro unit operation (< 79.1 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
65		*Other Interests*							
66	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	19%	20%	20%
67			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 97.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	25%	26%	25%
70		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	24%	25%	25%
72			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
73	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	7	7	7
74			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0
75									
76		**Lake Hickory (Including the Oxford Regulated River Reach)**							
77		*Fish & Aquatic Interests*							
78	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	115	87	267
79			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	156	241	332
82			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	74%	69%	67%
84	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	78%	72%	72%
85			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	68%	66%	65%
86	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	26	29	30
87	FA22, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or below 225 cfs released from the hydro development (Note 14)	1-Jan	31-Dec	10%	29%	31%	30%
89		*Recreation Interests*							
90	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 94.0 ft) during higher use months	1-Mar	31-Oct	25	4	5	5
91			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0
92	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	100	109	99
93	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	14%	14%	14%
94	R101, R111, R121, R124, R127, HOWQ44	Maximize days/yr of boating opportunities in the regulated river reach	Avg. days/yr of daytime flows ≥ 2500, ≤ 5500 cfs released from the hydro development for at least 2 hrs/day during higher use months (Note 20)	1-Mar	31-Oct	25	69	74	73
95		*Water User Interests*							
96	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 94 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
97			Days below critical level for hydro unit operation (< 73 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
99			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 230) for the evaluation period (Note 12)	1-Jan	31-Dec	25	100	100	133
100		*Other Interests*							
101	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	20%	20%	20%
102			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 97.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	28%	29%	28%
105		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	27%	28%	27%
107			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
108	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	0	0	0
110									
111		**Lookout Shoals Lake (including the Lookout Shoals Regulated River Reach)**							
112		*Fish & Aquatic Interests*							
113	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	114	668	424
114			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	273	901	651
117			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	86%	79%	80%
119	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	87%	82%	82%
120			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	75%	73%	73%
121	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	28	30	31
124		*Recreation Interests*							
125	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 92.0 ft) during higher use months	1-Mar	31-Oct	25	5	5	5
126			Avg. days/yr lake level below critical level for public boat ramps (< 92.0 ft) (Note 3)	1-Jan	31-Dec	3	11	11	12
127	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	78	84	85
128		Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	15%	15%	15%
129		*Water User Interests*							
130	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 74.9 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
131			Days below critical level for hydro unit operation (< 72.9 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
132		*Other Interests*							
133	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	15%	16%	15%
134			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 97.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	20%	22%	21%
137		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	19%	21%	20%
139			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
140	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	56	56	56
141			Days lake level above 103 ft	1-Jan	31-Dec	1	2	2	2
143									

Hydrology Condition / Period = _____

CHEOPS Performance Measures Evaluation Spreadsheet

James to Wylie

	A	B	C	D	E	F	G	H	I
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2050**	**UC-Alt6_2050**	**UC-Alt7_2050**
144		**Lake Norman**							
145		*Fish & Aquatic Interests*							
146	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	0	0	0
147			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	0	0	0
150			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	26%	25%	25%
152	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	36%	25%	25%
153			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	38%	34%	31%
154	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	60	68	68
155		*Recreation Interests*							
156	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 96.0 ft) during higher use months	1-Mar	31-Oct	25	54	70	70
157			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	23	23	27
158	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<95.0 ft) (Note 4)	1-Jan	31-Dec	3	76	76	77
159	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	23%	23%	23%
160		*Water User Interests*							
161	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest thermal power station operation (< 90 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
162			Days below critical level for shallowest public water supply intake operation (< 85 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
163			Days below critical level for shallowest industrial intake operation (< 75 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
164			Days below critical level for hydro unit operation (< 65 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
165		*Other Interests*							
166	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	23%	18%	18%
168			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	79%	79%	79%
170		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	66%	62%	62%
172			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
173	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	0	0	0
174									
175		**Mt Island Lake (including the Mt Island Bypassed Reach)**							
176		*Fish & Aquatic Interests*							
177	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	0	0	0
178			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	107	105	82
181			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	65%	57%	55%
183	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	71%	65%	64%
184			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	62%	59%	59%
185	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	57	60	61
186		*Recreation Interests*							
187	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 91.0 ft) during higher use months	1-Mar	31-Oct	25	0	0	0
188			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0
189	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<96.0 ft) (Note 4)	1-Jan	31-Dec	3	116	124	125
190	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	17%	17%	17%
191		*Water User Interests*							
192	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest thermal power station operation (< 94.3 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
193			Days below critical level for shallowest public water supply intake operation (< 88 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
194			Days below critical level for hydro unit operation (< 77.5 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
195		*Other Interests*							
196	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 96.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	21%	22%	21%
198			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 96.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	41%	44%	45%
200		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	38%	41%	42%
202			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
203	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	10	10	10
204			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0
205									
206		**Lake Wylie (including the Wylie Regulated River Reach)**							
207		*Fish & Aquatic Interests*							
208	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	0	0	0
209			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	0	0	0
212			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	72%	69%	68%
214	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	62%	55%	52%
215			Percent of time of lake levels >= 97 ft during the growing season	1-Apr	30-Sep	10%	78%	72%	69%
216			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	55%	52%	51%
217	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	35	37	39
218	FA22, FA25, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or above 2000 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%			
219			Percent of hours at or above 1080 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%			
224		*Recreation Interests*							
225	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 95.5 ft) during higher use months	1-Mar	31-Oct	25	36	39	42
226			Avg. days/yr lake level below critical level for public boat ramps (< 95.5 ft) (Note 3)	1-Jan	31-Dec	3	64	67	70
227	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	122	132	137
228	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	18%	18%	18%
233		*Water User Interests*							
234	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest industrial intake operation (< 92.6 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
235			Days below critical level for shallowest public water supply intake operation (< 92 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
236			Days below critical level for shallowest thermal power station operation (< 90 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
237			Days below critical level for hydro unit operation (< 74 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
242	WQ189	Maximize low flows to maintain waste assimilation capacity of the regulated river reach.	Percent of days at or above approximate 7Q10 flow (450 cfs) released from the hydro development (RM 139.63) (Note 9)	1-Jan	31-Dec	5%	100%	100%	100%
243			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 139.63) for the evaluation period (Note 12)	1-Jan	31-Dec	45	700	700	700
244		*Other Interests*							
245	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	27%	29%	29%
247			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 97.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	85%	85%	85%
249		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	39%	41%	41%
251			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	11%	11%	11%
252	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	1	0	0
254									
255		**Total Project Hydropower & Water Quantity Management**							
259	FA40, HOWQ41, HOWQ42, HOWQ58	Minimize inefficiencies in using water stored for generation	Percent of hydropower generation lost due to unplanned spills (Note 8)	1-Jan	31-Dec	1%	4%	4%	4%
260			Percent of hydropower generation lost due to other non-power generation uses (Note 9)	1-Jan	31-Dec	1%	20%	19%	19%
261	FA40, HOWQ41, HOWQ58	Maximize hydropower generation	Avg. MWH/yr of hydropower produced	1-Jan	31-Dec	31,000	851,315	851,726	850,945
262			Average equivalent # of homes per year that could be powered by the Hydro Project (Note 11)	1-Jan	31-Dec	2,500	64,494	64,525	64,465
263	HOWQ58, HOWQ41,HOWQ45	Maximize hydropower value	Avg. hydro generation value in Normalized Dollars/yr (Note 8)	1-Jan	31-Dec	$20,000	$445,738	$445,079	$445,517
264									
265		Background	Performance Measure has improved vs. the Baseline Scenario						
266		Background	Performance Measure has declined vs. the Baseline Scenario						
267		White Background	There is no significant difference between the scenario and the Baseline Scenario by definition of MISC						
268									

CHEOPS Performance Measures Evaluation Spreadsheet

	A	B	C	D	E	F	G	H	I
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2050**	**UC-Alt6_2050**	**UC-Alt7_2050**
2		**Lake Wylie (including the Wylie Regulated River Reach)**					(2006-2009)	(2006-2009)	(2006-2009)
3		*Fish & Aquatic Interests*							
4	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	0	0	0
5			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	0	0	0
8			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	72%	69%	68%
10	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	62%	55%	52%
11			Percent of time of lake levels >= 97 ft during the growing season	1-Apr	30-Sep	10%	78%	72%	69%
12			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	55%	52%	51%
13	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	35	37	39
14	FA22, FA25, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or above 2000 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%			
15			Percent of hours at or above 1080 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%			
20		*Recreation Interests*							
21	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 95.5 ft) during higher use months	1-Mar	31-Oct	25	36	39	42
22			Avg. days/yr lake level below critical level for public boat ramps (< 95.5 ft) (Note 3)	1-Jan	31-Dec	3	64	67	70
23	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	122	132	137
24	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	18%	18%	18%
29		*Water User Interests*							
30	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest industrial intake operation (< 92.6 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
31			Days below critical level for shallowest public water supply intake operation (< 92 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
32			Days below critical level for shallowest thermal power station operation (< 90 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
33			Days below critical level for hydro unit operation (< 74 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
39			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 139.63) for the evaluation period (Note 12)	1-Jan	31-Dec	45	700	700	700
40		*Other Interests*							
41	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	27%	29%	29%
43			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 97.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	85%	85%	85%
45		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	39%	41%	41%
47			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	11%	11%	11%
48	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	1	0	0
50									
51		**Fishing Creek Reservoir**							
52		*Fish & Aquatic Interests*							
53	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	91	68	80
54			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	402	306	390
57			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	94%	94%	94%
59	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	98%	98%	98%
60			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	93%	93%	93%
61	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	2	1	2
62		*Recreation Interests*							
63	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 95.0 ft) during higher use months	1-Mar	31-Oct	25	0	0	0
64			Avg. days/yr lake level below critical level for public boat ramps (< 95.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0
65	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	15	14	14
66	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	15%	15%	15%
67		*Water User Interests*							
68	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 95 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
69			Days below critical level for shallowest industrial intake operation (< 90.8 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
70			Days below critical level for hydro unit operation (< 77.9 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
71		*Other Interests*							
72	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	15%	15%	15%
74			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 97.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	100%	100%	100%
76		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	100%	100%	100%
78			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
79	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	0	0	1
80									
81		**Great Falls-Dearborn Reservoir (including the Great Falls Long Bypassed Reach and the Great Falls Short Bypassed Reach)**							
82		*Fish & Aquatic Interests*							
83	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	511	624	521
84			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	801	992	852
87			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	88%	88%	89%
89	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	95%	95%	95%
90			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	90%	90%	90%
91	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	5	5	5
92		*Recreation Interests*							
93	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 98.0 ft) during higher use months	1-Mar	31-Oct	25	21	21	21
94			Avg. days/yr lake level below critical level for public boat ramps (< 97.0 ft) (Note 3)	1-Jan	31-Dec	3	37	39	36
95	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<98.0 ft) (Note 4)	1-Jan	31-Dec	3	54	55	54
96	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	18%	17%	18%
97		*Water User Interests*							
98	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for hydro unit operation (< 87.2 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
99		*Other Interests*							
100	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	20%	21%	21%
102			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	100%	100%	100%
104		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	20%	20%	20%
106			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
107	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	27	25	26
108			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0
109									
110		**Cedar Creek Reservoir**							
111		*Fish & Aquatic Interests*							
112	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	321	228	347
113			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	593	546	663
116			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	93%	94%	93%
118	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	97%	97%	97%
119			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	92%	92%	91%
120	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	0	0	0
121		*Recreation Interests*							
122	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 98.5 ft) during higher use months	1-Mar	31-Oct	25	13	13	15
123			Avg. days/yr lake level below critical level for public boat ramps (< 96.0 ft) (Note 3)	1-Jan	31-Dec	3	2	1	1
124	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	20	19	20
125	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	6%	6%	6%
126		*Water User Interests*							
127	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for hydro unit operation (< 80.3 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
128		*Other Interests*							
129	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	18%	18%	18%
131			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	100%	100%	100%
133		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	18%	18%	19%
135			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
136	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	0	0	0
137			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0
138									

CHEOPS Performance Measures Evaluation Spreadsheet

	A	B	C	D	E	F	G	H	I
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2050**	**UC-Alt6_2050**	**UC-Alt7_2050**
139		**Lake Wateree (including the Wateree Regulated River Reach)**							
140		*Fish & Aquatic Interests*							
141	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	157	157	158
142			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	252	252	254
145			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	64%	64%	65%
147	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	66%	66%	67%
148			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	74%	73%	74%
149	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	44	44	44
150	FA22, FA25, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or above 2000 cfs at Node 1 (RM 74.54) (Note 14)	1-Jan	31-Dec	10%			
151			Percent of hours at or above 1200 cfs at Node 1 (RM 74.54) (Note 14)	1-Jan	31-Dec	10%			
157		*Recreation Interests*							
158	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 96.0 ft) during higher use months	1-Mar	31-Oct	25	68	68	68
159			Avg. days/yr lake level below critical level for public boat ramps (< 93.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0
160	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	91	91	91
161	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	13%	13%	11%
164		*Water User Interests*							
165	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 92.5 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
166			Days below critical level for hydro unit operation (< 74 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
169			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 74.54) for the evaluation period (Note 12)	1-Jan	31-Dec	53	800	800	800
170		*Other Interests*							
171	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	3%	3%	2%
173			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	97%	95%	100%
175		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	19%	16%	19%
177			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
178	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	11	11	11
179			Days lake level above 103 ft	1-Jan	31-Dec	1	0	0	0
181									
182		**Total Project Hydropower & Water Quantity Management**							
186	FA40, HOWQ41, HOWQ42, HOWQ58	Minimize inefficiencies in using water stored for generation	Percent of hydropower generation lost due to unplanned spills (Note 8)	1-Jan	31-Dec	1%	4%	4%	4%
187			Percent of hydropower generation lost due to other non-power generation uses (Note 9)	1-Jan	31-Dec	1%	20%	19%	19%
188	FA40, HOWQ41, HOWQ58	Maximize hydropower generation	Avg. MWH/yr of hydropower produced	1-Jan	31-Dec	31,000	851,315	851,726	850,945
189			Average equivalent # of homes per year that could be powered by the Hydro Project (Note 11)	1-Jan	31-Dec	2,500	64,494	64,525	64,465
190	HOWQ58, HOWQ41,HOWQ45	Maximize hydropower value	Avg. hydro generation value in Normalized Dollars/yr (Note 8)	1-Jan	31-Dec	$20,000	$445,738	$445,079	$445,517
191									
192		Background	Performance Measure has improved vs. the Baseline Scenario						
193		Background	Performance Measure has declined vs. the Baseline Scenario						
194		White Background	There is no significant difference between the scenario and the Baseline Scenario by definition of MISC						
195									

Notes

1 CIS # are the Composite Interest Statement numbers taken from Rev 3 of the Composite Interest Statement document dated 10/27/04 for the interests that are both (1) directly related to water quantity management and (2) reasonably measurable using CHEOPS. The following CIS #'s represent interests that are directly related to water quantity, but that will be dealt with differently as noted, and therefore will not be tabulated individually:

CIS #	Composite Interest Statement (Rev 3 - 10/27/04)	Disposition
FA16	Provide run-of-river flows through every dam.	Scenario design readily identifies whether or not interest is met.
FA36	Mimic day, month, and annual natural flow patterns including natural floods in riverine and bypass areas.	Scenario design readily identifies whether or not interest is met.
FA38	Restore run-of-river flows to the Great Falls.	Scenario design readily identifies whether or not interest is met.
R125	Provide predictable recreation releases on river sections (i.e., allow recreation users to plan ahead for river use).	Scenario design readily identifies whether or not interest is met.
R126	Provide predictable recreation releases on bypass sections including the Great Falls bypass.	Scenario design readily identifies whether or not interest is met.
HOWQ51	Tie the low inflow protocol to both water conservation and energy conservation.	LIP design determines if interest is met.
HOWQ52	Assure that the low inflow protocol fully protects aquatic resources, water quality, and recreation.	LIP design determines if interest is met.

2 For criterion that measure on an hourly or daily basis, unless stated otherwise:

a. If an hourly criterion occurs during the average of four contiguous 15-minute periods, then it counts as 1 hour.

b. If a daily criterion occurs for 5 contiguous 1-hour periods, then it counts as 1 day.

Also, daytime flows are assumed to be flows provided between 7:00 am and 7:00 pm. To the extent possible, each Criterion is defined in terms of percents and averages/yr so that the same Criterion is useful regardless of the length of the hydrology period (i.e., 1-yr, 3-yr, full period of record, etc.)

3 Critical lake elevations per Attachment F of Draft AIP dated 10/15/04.

4 See App. C of Draft Reservoir Level Study Report dated 11/10/04 for average monthly lake levels during post-Cowans Ford era.
Areas within the lakes are considered boatable if the water depth is greater than or equal to 3 ft.
Lake surface areas are determined using Area-Volume Curves (i.e., a set of curves for each lake that graph both lake surface area and lake volume verses water depth).

5 Low Inflow Protocol (LIP) Trigger Point considerations.

6 Low Inflow Protocol (LIP) Trigger Point considerations.

7 Developed areas include areas with roads, houses and other man-made structures.

8 Includes lost hydropower generation due to unplanned spilling of water at hydro station dams.
This measure does not include energy losses from evaporation, dam leakage or groundwater recharge.

9 Includes lost hydropower due to minimum flow and recreation flow releases that bypass the hydro station and public water supply and industrial withdrawals.
This measure does not include energy losses from evaporation, dam leakage or groundwater recharge.

10 Normalized dollar value of hydropower generated in a given year =

[∑ (MWH x market value for each hour)]/(Highest hourly market price in that year)

11 Flow rates needed to provide for basic navigation. These flow rates are determined by the Instream Flow Study and/or the Recreation Flow Study. In SC, the flow rates are based on meeting SCDNR's navigation criteria.
In NC, the flow rates are based on Rec 02 studies.

12 7Q10 Flow rate = Lowest average flow rate over a 7-day period that statistically is likely to occur once every 10 years.
The approximate 7Q10 flow rates listed in this document are from Table 6.1-1, Summary of Catawba-Wateree Project Hydrology as shown in Duke Power's First Stage Consultation Document dated 2003.

13 Absolute Lake level variation is determined from hourly checks against the measure using 15-minute reservoir data averaged per hour.
The number of hours that exceed the starting reservoir elevation are recorded for each 14 day period between the start and end date.
The starting elevation (midnight reservoir elevation) is reset each 14-day period and the total hourly count for all test periods is recorded for each scenario.

14 Calculated by (Total Scenario MWh / 13.2 MWh per home) / the # of years in the scenario
The MISC of 3000 homes per year is roughly 2% of the average equivalent homes/yr under the Baseline conditions.
Power produced by the hydro project is actually supplied to Duke Power's electric system grid and is used by Duke Power's electric customers (including residential, industrial and commercial customers), as is power produced at other Duke Power generating stations. This criterion of average equivalent homes per year is intended to simply make the total energy production potential of the hydro project more understandable to stakeholder team members and to put a perspective around potential differences in hydropower production between various operational scenarios. This measure does not imply that any number of homes will go without power if a particular scenario is chosen.

15 Lowest 7-day average flow rate is determined from a rolling 7-day average of the average daily flow (cfs).
Where a average daily flow rate is determined from 15-minute flow (cfs) data averaged per 24 hour-day.

16 Habitat flows were estimates based on field experience with the subject reaches.

17 Floodplain Ecology inundation and maintenance flows for the river reach below Lake James were based on summary results presented in "Assessment of Hydraulic Geometry and Channel-Maintaining Discharges in the Catawba River Below Lake James", October 2001.

18 Floodplain Ecology inundation flows are initial estimates to be reviewed by the appropriate RC.

19 Maintenance flows for the river reach below Wylie and Wateree were based on geomorphic bankfull estimates for IFIM cross sections
Wylie Cross section at River Mile 137.5
Wateree Cross section at River Mile 67.6

20 Recreation flows are initial estimates to be reviewed by the appropriate RC.

21 Flooding flows are initial estimates based on the full hydraulic turbine capacity discharge plus
Oxford- One gate full open at reservoir = 100
Lookout- Discharge over spillway at reservoir = 103
Wylie- One gate full open at reservoir = 100
Wateree- Discharge over spillway at reservoir = 103
*Exception Lake James Bank full estimates per reference in Note 17

22 MISC = Minimum Increment of Significant Change. The MISC has the same units (i.e., days, days/yr, percent, etc.) as does the Criterion on that same row of the spreadsheet. If the output of two scenarios for a particular Criterion does not differ by more than the MISC, then there is no significant difference between those two scenarios as far as the Criterion in question is concerned. The following guidelines were used to establish the MISC numbers:
a. As a general rule, MISC numbers are set at 10% of the possible total for that Criterion considering the Start/Stop dates.
b. MISC numbers for Criterion that have the most negative outcomes if reached are typically set at less than 10% of the possible total for that Criterion.
c. Adjustments to the MISC numbers (up or down) have also been made depending on the desires of the stakeholders that primarily have the interests that are being measured by a particular Criterion.

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Hydrology Condition / Period = _____

CHEOPS Performance Measures Evaluation Spreadsheet

James to Wylie

	A	B	C	D	E	F	G	H	I	J
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2012**	**UC-Base_2050**	**UC-Alt6_UC2050_2012**	**UC-Alt7_UC2050_2012**
2		**Lake James (including the Catawba River Bypassed Reach, Paddy Creek Bypassed Reach and the Bridgewater Regulated River Reach)**					(1929-2010)	(1929-2010)	(1929-2010)	(1929-2010)
3		*Fish & Aquatic Interests*								
4	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	6,084	6,959	7,168	5,946
5			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	13,467	13,934	14,234	13,616
8			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	36%	32%	38%	36%
10	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	40%	35%	41%	40%
11			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	35%	32%	36%	34%
12	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	83	90	82	85
18		*Recreation Interests*								
19	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 93.5 ft) during higher use months	1-Mar	31-Oct	25	16	20	16	16
20			Avg. days/yr lake level below critical level for public boat ramps (< 92.0 ft) (Note 3)	1-Jan	31-Dec	3	6	8	6	6
21	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<93.0 ft) (Note 4)	1-Jan	31-Dec	3	20	26	20	21
22	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	14%	26%	14%	14%
27		*Water User Interests*								
28	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for hydro unit operation (< 61 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
31			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 275.35) for the evaluation period (Note 12)	1-Jan	31-Dec	15	75	75	75	75
32		*Other Interests*								
33	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	18%	16%	17%	17%
34			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 98.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	55%	52%	56%	55%
37		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	57%	54%	57%	57%
39			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	6%	7%	6%	6%
40	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	316	296	321	313
41			Days lake level above 103 ft	1-Jan	31-Dec	1	9	10	9	9
44	FA22, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or below 175 cfs released from the hydro development (Note 14)	1-Jan	31-Dec	10%	62%	63%	61%	62%
45										
46		**Lake Rhodhiss**								
47		*Fish & Aquatic Interests*								
48	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	9,319	9,387	9,532	9,040
49			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	19,930	19,789	19,978	19,849
52			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	56%	55%	58%	56%
54	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	56%	53%	58%	56%
55			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	54%	52%	55%	53%
56	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	18	22	18	18
57		*Recreation Interests*								
58	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 94.0 ft) during higher use months	1-Mar	31-Oct	25	4	7	4	4
59			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0	0
60	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	125	133	122	126
61	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	18%	19%	18%	18%
62		*Water User Interests*								
63	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 89.4 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
64			Days below critical level for hydro unit operation (< 79.1 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
65		*Other Interests*								
66	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	45%	45%	43%	45%
67			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 97.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	52%	52%	51%	52%
70		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	51%	51%	50%	51%
72			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
73	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	305	304	312	303
74			Days lake level above 103 ft	1-Jan	31-Dec	1	25	25	25	25
75										
76		**Lake Hickory (Including the Oxford Regulated River Reach)**								
77		*Fish & Aquatic Interests*								
78	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	4,643	5,724	5,262	4,715
79			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	15,571	16,889	15,935	15,772
82			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	53%	52%	55%	53%
84	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	54%	51%	55%	54%
85			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	50%	48%	51%	50%
86	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	21	24	20	21
87	FA22, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or below 225 cfs released from the hydro development (Note 14)	1-Jan	31-Dec	10%	39%	40%	39%	39%
89		*Recreation Interests*								
90	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 94.0 ft) during higher use months	1-Mar	31-Oct	25	1	2	1	1
91			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0	0
92	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	146	153	141	147
93	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	14%	14%	14%	14%
94	R101, R111, R121, R124, R127, HOWQ44	Maximize days/yr of boating opportunities in the regulated river reach	Avg. days/yr of daytime flows ≥ 2500, ≤ 5500 cfs released from the hydro development for at least 2 hrs/day during higher use months (Note 20)	1-Mar	31-Oct	25	143	148	141	143
95		*Water User Interests*								
96	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 94 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
97			Days below critical level for hydro unit operation (< 73 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
99			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 230) for the evaluation period (Note 12)	1-Jan	31-Dec	25	103	100	103	103
100		*Other Interests*								
101	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	43%	43%	42%	43%
102			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 97.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	54%	53%	52%	53%
105		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	53%	53%	52%	53%
107			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
108	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	0	1	0	0
110										
111		**Lookout Shoals Lake (including the Lookout Shoals Regulated River Reach)**								
112		*Fish & Aquatic Interests*								
113	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	13,758	14,937	13,306	14,108
114			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	26,946	26,964	26,019	27,259
117			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	66%	65%	68%	67%
119	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	65%	63%	67%	65%
120			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	62%	61%	64%	62%
121	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	26	29	25	27
124		*Recreation Interests*								
125	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 92.0 ft) during higher use months	1-Mar	31-Oct	25	0	0	0	0
126			Avg. days/yr lake level below critical level for public boat ramps (< 92.0 ft) (Note 3)	1-Jan	31-Dec	3	0	1	0	0
127	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	117	123	113	118
128		Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	13%	15%	13%	14%
129		*Water User Interests*								
130	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 74.9 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
131			Days below critical level for hydro unit operation (< 72.9 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
132		*Other Interests*								
133	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	37%	36%	35%	37%
134			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 97.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	49%	49%	47%	49%
137		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	46%	47%	44%	46%
139			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
140	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	1,628	1,569	1,673	1,625
141			Days lake level above 103 ft	1-Jan	31-Dec	1	59	59	59	59
143										
144		**Lake Norman**								
145		*Fish & Aquatic Interests*								
146	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	2,178	2,155	2,534	2,178
147			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	3,400	3,360	3,984	3,420
150			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	50%	45%	51%	49%
152	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	61%	54%	62%	60%
153			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	46%	41%	47%	46%
154	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	32	38	31	32
155		*Recreation Interests*								
156	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 96.0 ft) during higher use months	1-Mar	31-Oct	25	15	22	16	15
157			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	0	1	0	0
158	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<95.0 ft) (Note 4)	1-Jan	31-Dec	3	25	32	25	26
159	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	21%	23%	21%	21%
160		*Water User Interests*								
161	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest thermal power station operation (< 90 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
162			Days below critical level for shallowest public water supply intake operation (< 85 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0

Hydrology Condition / Period = _____

CHEOPS Performance Measures Evaluation Spreadsheet

James to Wylie

	A	B	C	D	E	F	G	H	I	J
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2012**	**UC-Base_2050**	**UC-Alt6_UC2050_2012**	**UC-Alt7_UC2050_2012**
163			Days below critical level for shallowest industrial intake operation (< 75 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
164			Days below critical level for hydro unit operation (< 65 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
165		*Other Interests*								
166	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	37%	38%	37%	37%
168			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	94%	92%	94%	93%
170		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	82%	82%	82%	82%
172			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
173	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	10	6	11	10
174										
175		**Mt Island Lake (including the Mt Island Bypassed Reach)**								
176		*Fish & Aquatic Interests*								
177	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	9,300	9,689	9,447	9,120
178			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	19,984	20,459	20,843	20,055
181			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	43%	37%	43%	43%
183	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	43%	36%	44%	44%
184			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	43%	37%	43%	42%
185	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	60	77	59	61
186		*Recreation Interests*								
187	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 91.0 ft) during higher use months	1-Mar	31-Oct	25	0	0	0	0
188			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0	0
189	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<96.0 ft) (Note 4)	1-Jan	31-Dec	3	128	161	125	130
190	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	17%	30%	17%	17%
191		*Water User Interests*								
192	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest thermal power station operation (< 94.3 ft) (Note 3)	1-Jan	31-Dec	1	4	32	5	4
193			Days below critical level for shallowest public water supply intake operation (< 88 ft) (Note 3)	1-Jan	31-Dec	1	0	2	0	0
194			Days below critical level for hydro unit operation (< 77.5 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
195		*Other Interests*								
196	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 96.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	43%	41%	42%	43%
198			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 96.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	71%	75%	71%	71%
200		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	60%	65%	59%	60%
202			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
203	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	256	224	274	253
204			Days lake level above 103 ft	1-Jan	31-Dec	1	29	28	32	28
205										
206		**Lake Wylie (including the Wylie Regulated River Reach)**								
207		*Fish & Aquatic Interests*								
208	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	2,652	3,104	2,941	2,779
209			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	8,709	8,920	9,051	8,795
212			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	43%	41%	45%	43%
214	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	41%	37%	42%	40%
215			Percent of time of lake levels >= 97 ft during the growing season	1-Apr	30-Sep	10%	58%	55%	59%	57%
216			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	38%	35%	40%	38%
217	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	27	33	26	26
218	FA22, FA25, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or above 2000 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%				
219			Percent of hours at or above 1080 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%				
224		*Recreation Interests*								
225	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 95.5 ft) during higher use months	1-Mar	31-Oct	25	32	40	31	32
226			Avg. days/yr lake level below critical level for public boat ramps (< 95.5 ft) (Note 3)	1-Jan	31-Dec	3	40	52	40	40
227	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	172	182	168	173
228	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	18%	21%	18%	18%
233		*Water User Interests*								
234	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest industrial intake operation (< 92.6 ft) (Note 3)	1-Jan	31-Dec	1	0	20	0	0
235			Days below critical level for shallowest public water supply intake operation (< 92 ft) (Note 3)	1-Jan	31-Dec	1	0	20	0	0
236			Days below critical level for shallowest thermal power station operation (< 90 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
237			Days below critical level for hydro unit operation (< 74 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
242	WQ189	Maximize low flows to maintain waste assimilation capacity of the regulated river reach.	Percent of days at or above approximate 7Q10 flow (450 cfs) released from the hydro development (RM 139.63) (Note 9)	1-Jan	31-Dec	5%	100%	100%	100%	100%
243			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 139.63) for the evaluation period (Note 12)	1-Jan	31-Dec	45	720	700	720	720
244		*Other Interests*								
245	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	50%	49%	49%	50%
247			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 97.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	95%	92%	95%	95%
249		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	60%	60%	59%	60%
251			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	4%	6%	4%	4%
252	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	1	3	3	1
254										
255		**Total Project Hydropower & Water Quantity Management**								
259	FA40, HOWQ41, HOWQ42, HOWQ58	Minimize inefficiencies in using water stored for generation	Percent of hydropower generation lost due to unplanned spills (Note 8)	1-Jan	31-Dec	1%	5%	5%	5%	5%
260			Percent of hydropower generation lost due to other non-power generation uses (Note 9)	1-Jan	31-Dec	1%	8%	9%	9%	8%
261	FA40, HOWQ41, HOWQ58	Maximize hydropower generation	Avg. MWH/yr of hydropower produced	1-Jan	31-Dec	31,000	1,393,697	1,331,102	1,385,359	1,388,625
262			Average equivalent # of homes per year that could be powered by the Hydro Project (Note 11)	1-Jan	31-Dec	2,500	105,583	100,841	104,951	105,199
263	HOWQ58, HOWQ41,HOWQ45	Maximize hydropower value	Avg. hydro generation value in Normalized Dollars/yr (Note 8)	1-Jan	31-Dec	$20,000	$752,115	$719,510	$745,446	$749,502
264										
265		Background	Performance Measure has improved vs. the Baseline Scenario							
266		Background	Performance Measure has declined vs. the Baseline Scenario							
267		White Background	There is no significant difference between the scenario and the Baseline Scenario by definition of MISC							
268										

Hydrology Condition / Period = _____

CHEOPS Performance Measures Evaluation Spreadsheet

Wylie to Wateree

	A	B	C	D	E	F	G	H	I	J
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2012**	**UC-Base_2050**	**UC-Alt6_UC2050_2012**	**UC-Alt7_UC2050_2012**
2		**Lake Wylie (including the Wylie Regulated River Reach)**					(1929-2010)	(1929-2010)	(1929-2010)	(1929-2010)
3		*Fish & Aquatic Interests*								
4	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	2,652	3,104	2,941	2,779
5			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	8,709	8,920	9,051	8,795
8			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	43%	41%	45%	43%
10	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	41%	37%	42%	40%
11			Percent of time of lake levels >= 97 ft during the growing season	1-Apr	30-Sep	10%	58%	55%	59%	57%
12			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	38%	35%	40%	38%
13	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	27	33	26	26
14	FA22, FA25, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or above 2000 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%				
15			Percent of hours at or above 1080 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%				
20		*Recreation Interests*								
21	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 95.5 ft) during higher use months	1-Mar	31-Oct	25	32	40	31	32
22			Avg. days/yr lake level below critical level for public boat ramps (< 95.5 ft) (Note 3)	1-Jan	31-Dec	3	40	52	40	40
23	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	172	182	168	173
24	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	18%	21%	18%	18%
29		*Water User Interests*								
30	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest industrial intake operation (< 92.6 ft) (Note 3)	1-Jan	31-Dec	1	0	20	0	0
31			Days below critical level for shallowest public water supply intake operation (< 92 ft) (Note 3)	1-Jan	31-Dec	1	0	20	0	0
32			Days below critical level for shallowest thermal power station operation (< 90 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
33			Days below critical level for hydro unit operation (< 74 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
39			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 139.63) for the evaluation period (Note 12)	1-Jan	31-Dec	45	720	700	720	720
40		*Other Interests*								
41	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	50%	49%	49%	50%
43			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 97.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	95%	92%	95%	95%
45		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	60%	60%	59%	60%
47			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	4%	6%	4%	4%
48	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	1	3	3	1
50										
51		**Fishing Creek Reservoir**								
52		*Fish & Aquatic Interests*								
53	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	10,551	10,640	10,554	10,385
54			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	21,620	21,470	21,142	21,247
57			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	75%	74%	76%	75%
59	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	76%	74%	76%	76%
60			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	75%	74%	76%	75%
61	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	9	10	9	9
62		*Recreation Interests*								
63	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 95.0 ft) during higher use months	1-Mar	31-Oct	25	0	0	0	0
64			Avg. days/yr lake level below critical level for public boat ramps (< 95.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0	0
65	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	65	66	62	64
66	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	17%	19%	17%	18%
67		*Water User Interests*								
68	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 95 ft) (Note 3)	1-Jan	31-Dec	1	0	0	1	2
69			Days below critical level for shallowest industrial intake operation (< 90.8 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
70			Days below critical level for hydro unit operation (< 77.9 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
71		*Other Interests*								
72	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	40%	40%	38%	40%
74			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 97.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	100%	100%	100%	100%
76		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	99%	99%	99%	99%
78			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
79	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	6	13	8	11
80										
81		**Great Falls-Dearborn Reservoir (including the Great Falls Long Bypassed Reach and the Great Falls Short Bypassed Reach)**								
82		*Fish & Aquatic Interests*								
83	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	22,310	20,980	20,788	22,398
84			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	33,862	32,564	32,005	34,348
87			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	74%	75%	75%	74%
89	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	78%	78%	79%	78%
90			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	76%	76%	77%	76%
91	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	8	8	8	8
92		*Recreation Interests*								
93	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 98.0 ft) during higher use months	1-Mar	31-Oct	25	96	96	94	96
94			Avg. days/yr lake level below critical level for public boat ramps (< 97.0 ft) (Note 3)	1-Jan	31-Dec	3	85	84	83	84
95	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<98.0 ft) (Note 4)	1-Jan	31-Dec	3	139	139	136	139
96	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	21%	22%	21%	22%
97		*Water User Interests*								
98	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for hydro unit operation (< 87.2 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
99		*Other Interests*								
100	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	51%	51%	49%	51%
102			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	100%	100%	100%	100%
104		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	50%	51%	49%	50%
106			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
107	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	703	685	723	701
108			Days lake level above 103 ft	1-Jan	31-Dec	1	6	11	9	6
109										
110		**Cedar Creek Reservoir**								
111		*Fish & Aquatic Interests*								
112	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	10,432	10,317	10,358	10,222
113			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	20,959	20,194	20,772	20,765
116			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	72%	71%	73%	72%
118	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	73%	72%	74%	73%
119			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	71%	71%	73%	71%
120	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	0	1	0	1
121		*Recreation Interests*								
122	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 98.5 ft) during higher use months	1-Mar	31-Oct	25	103	105	100	103
123			Avg. days/yr lake level below critical level for public boat ramps (< 96.0 ft) (Note 3)	1-Jan	31-Dec	3	2	2	2	2
124	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	74	74	70	74
125	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	7%	7%	7%	7%
126		*Water User Interests*								
127	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for hydro unit operation (< 80.3 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
128		*Other Interests*								
129	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	47%	48%	46%	48%
131			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	100%	100%	100%	100%
133		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	49%	50%	47%	49%
135			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
136	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	39	38	36	39
137			Days lake level above 103 ft	1-Jan	31-Dec	1	3	3	3	3
138										
139		**Lake Wateree (including the Wateree Regulated River Reach)**								
140		*Fish & Aquatic Interests*								
141	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	945	1,173	951	960
142			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	6,515	7,277	6,908	6,547
145			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	85%	84%	85%	84%
147	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	90%	89%	90%	90%
148			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	95%	93%	94%	94%
149	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	3	5	3	3
150	FA22, FA25, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or above 2000 cfs at Node 1 (RM 74.54) (Note 14)	1-Jan	31-Dec	10%				
151			Percent of hours at or above 1200 cfs at Node 1 (RM 74.54) (Note 14)	1-Jan	31-Dec	10%				
157		*Recreation Interests*								
158	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 96.0 ft) during higher use months	1-Mar	31-Oct	25	6	9	6	6
159			Avg. days/yr lake level below critical level for public boat ramps (< 93.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0	0
160	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	12	17	12	12
161	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	11%	13%	11%	11%
164		*Water User Interests*								
165	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 92.5 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0

Hydrology Condition / Period = _____

CHEOPS Performance Measures Evaluation Spreadsheet

	A	B	C	D	E	F	G	H	I	J
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2012**	**UC-Base_2050**	**UC-Alt6_UC2050_2012**	**UC-Alt7_UC2050_2012**
166			Days below critical level for hydro unit operation (< 74 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0	0
169			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 74.54) for the evaluation period (Note 12)	1-Jan	31-Dec	53	807	800	807	807
170		*Other Interests*								
171	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	4%	4%	4%	4%
173			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	99%	99%	99%	99%
175		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	12%	12%	13%	13%
177			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%	0%
178	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	390	379	402	382
179			Days lake level above 103 ft	1-Jan	31-Dec	1	18	19	18	18
181										
182		**Total Project Hydropower & Water Quantity Management**								
186	FA40, HOWQ41, HOWQ42, HOWQ58	Minimize inefficiencies in using water stored for generation	Percent of hydropower generation lost due to unplanned spills (Note 8)	1-Jan	31-Dec	1%	5%	5%	5%	5%
187			Percent of hydropower generation lost due to other non-power generation uses (Note 9)	1-Jan	31-Dec	1%	8%	9%	9%	8%
188	FA40, HOWQ41, HOWQ58	Maximize hydropower generation	Avg. MWH/yr of hydropower produced	1-Jan	31-Dec	31,000	1,393,697	1,331,102	1,385,359	1,388,625
189			Average equivalent # of homes per year that could be powered by the Hydro Project (Note 11)	1-Jan	31-Dec	2,500	105,583	100,841	104,951	105,199
190	HOWQ58, HOWQ41,HOWQ45	Maximize hydropower value	Avg. hydro generation value in Normalized Dollars/yr (Note 8)	1-Jan	31-Dec	$20,000	$752,115	$719,510	$745,446	$749,502
191										
192		Background	Performance Measure has improved vs. the Baseline Scenario							
193		Background	Performance Measure has declined vs. the Baseline Scenario							
194		White Background	There is no significant difference between the scenario and the Baseline Scenario by definition of MISC							
195										

Stakeholder Interest Evaluation Spreadsheet

1 CIS # are the Composite Interest Statement numbers taken from Rev 3 of the Composite Interest Statement document dated 10/27/04 for the interests that are both (1) directly related to water quantity management and (2) reasonably measurable using CHEOPS. The following CIS #'s represent interests that are directly related to water quantity, but that will be dealt with differently as noted, and therefore will not be tabulated individually:

CIS #	Composite Interest Statement (Rev 3 - 10/27/04)	Disposition
FA16	Provide run-of-river flows through every dam.	Scenario design readily identifies whether or not interest is met.
FA36	Mimic day, month, and annual natural flow patterns including natural floods in riverine and bypass areas.	Scenario design readily identifies whether or not interest is met.
FA38	Restore run-of-river flows to the Great Falls.	Scenario design readily identifies whether or not interest is met.
R125	Provide predictable recreation releases on river sections (i.e., allow recreation users to plan ahead for river use).	Scenario design readily identifies whether or not interest is met.
R126	Provide predictable recreation releases on bypass sections including the Great Falls bypass.	Scenario design readily identifies whether or not interest is met.
HOWQ51	Tie the low inflow protocol to both water conservation and energy conservation.	LIP design determines if interest is met.
HOWQ52	Assure that the low inflow protocol fully protects aquatic resources, water quality, and recreation.	LIP design determines if interest is met.

2 For criterion that measure on an hourly or daily basis, unless stated otherwise:

a. If an hourly criterion occurs during the average of four contiguous 15-minute periods, then it counts as 1 hour.

b. If a daily criterion occurs for 5 contiguous 1-hour periods, then it counts as 1 day.

Also, daytime flows are assumed to be flows provided between 7:00 am and 7:00 pm. To the extent possible, each Criterion is defined in terms of percents and averages/yr so that the same Criterion is useful regardless of the length of the hydrology period (i.e., 1-yr, 3-yr, full period of record, etc.)

3 Critical lake elevations per Attachment F of Draft AIP dated 10/15/04.

4 See App. C of Draft Reservoir Level Study Report dated 11/10/04 for average monthly lake levels during post-Cowans Ford era.
Areas within the lakes are considered boatable if the water depth is greater than or equal to 3 ft.
Lake surface areas are determined using Area-Volume Curves (i.e., a set of curves for each lake that graph both lake surface area and lake volume verses water depth).

5 Low Inflow Protocol (LIP) Trigger Point considerations.

6 Low Inflow Protocol (LIP) Trigger Point considerations.

7 Developed areas include areas with roads, houses and other man-made structures.

8 Includes lost hydropower generation due to unplanned spilling of water at hydro station dams.
This measure does not include energy losses from evaporation, dam leakage or groundwater recharge.

9 Includes lost hydropower due to minimum flow and recreation flow releases that bypass the hydro station and public water supply and industrial withdrawals.
This measure does not include energy losses from evaporation, dam leakage or groundwater recharge.

10 Normalized dollar value of hydropower generated in a given year =

11 Flow rates needed to provide for basic navigation. These flow rates are determined by the Instream Flow Study and/or the Recreation Flow Study. In SC, the flow rates are based on meeting SCDNR's navigation criteria. In NC, the flow rates are based on Rec 02 studies.

12 7Q10 Flow rate = Lowest average flow rate over a 7-day period that statistically is likely to occur once every 10 years. The approximate 7Q10 flow rates listed in this document are from Table 6.1-1, Summary of Catawba-Wateree Project Hydrology as shown in Duke Power's First Stage Consultation Document dated 2003.

13 Absolute Lake level variation is determined from hourly checks against the measure using 15-minute reservoir data averaged per hour. The number of hours that exceed the starting reservoir elevation are recorded for each 14 day period between the start and end date. The starting elevation (midnight reservoir elevation) is reset each 14-day period and the total hourly count for all test periods is recorded for each scenario.

14 Calculated by (Total Scenario MWh / 13.2 MWh per home) / the # of years in the scenario
The MISC of 3000 homes per year is roughly 2% of the average equivalent homes/yr under the Baseline conditions.
Power produced by the hydro project is actually supplied to Duke Power's electric system grid and is used by Duke Power's electric customers (including residential, industrial and commercial customers), as is power produced at other Duke Power generating stations. This criterion of average equivalent homes per year is intended to simply make the total energy production potential of the hydro project more understandable to stakeholder team members and to put a perspective around potential differences in hydropower production between various operational scenarios. This measure does not imply that any number of homes will go without power if a particular scenario is chosen.

15 Lowest 7-day average flow rate is determined from a rolling 7-day average of the average daily flow (cfs). Where a average daily flow rate is determined from 15-minute flow (cfs) data averaged per 24 hour-day.

16 Habitat flows were estimates based on field experience with the subject reaches.

17 Floodplain Ecology inundation and maintenance flows for the river reach below Lake James were based on summary results presented in "Assessment of Hydraulic Geometry and Channel-Maintaining Discharges in the Catawba River Below Lake James", October 2001.

18 Floodplain Ecology inundation flows are initial estimates to be reviewed by the appropriate RC.

19 Maintenance flows for the river reach below Wylie and Wateree were based on geomorphic bankfull estimates for IFIM cross sections

	Wylie	Cross section at River Mile 137.5
	Wateree	Cross section at River Mile 67.6

20 Recreation flows are initial estimates to be reviewed by the appropriate RC.

21 Flooding flows are initial estimates based on the full hydraulic turbine capacity discharge plus

	Oxford-	One gate full open at reservoir = 100
	Lookout-	Discharge over spillway at reservoir = 103
	Wylie-	One gate full open at reservoir = 100
	Wateree-	Discharge over spillway at reservoir = 103
*Exception	Lake James	Bank full estimates per reference in Note 17

22 MISC = Minimum Increment of Significant Change. The MISC has the same units (i.e., days, days/yr, percent, etc.) as does the Criterion on that same row of

Hydrology Condition / Period = _____

CHEOPS Performance Measures Evaluation Spreadsheet

James to Wylie

	A	B	C	D	E	F	G	H	I
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2050**	**UC-Alt6_2050**	**UC-Alt7_2050**
2		**Lake James (including the Catawba River Bypassed Reach, Paddy Creek Bypassed Reach and the Bridgewater Regulated River Reach)**					(1929-2010)	(1929-2010)	(1929-2010)
3		*Fish & Aquatic Interests*							
4	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	6,959	7,068	7,006
5			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	13,934	14,017	13,653
8			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	32%	32%	34%
10	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	35%	35%	36%
11			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	32%	32%	32%
12	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	90	90	89
18		*Recreation Interests*							
19	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 93.5 ft) during higher use months	1-Mar	31-Oct	25	20	21	20
20			Avg. days/yr lake level below critical level for public boat ramps (< 92.0 ft) (Note 3)	1-Jan	31-Dec	3	8	8	9
21	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<93.0 ft) (Note 4)	1-Jan	31-Dec	3	26	27	26
22	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	26%	26%	28%
27		*Water User Interests*							
28	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for hydro unit operation (< 61 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
31			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 275.35) for the evaluation period (Note 12)	1-Jan	31-Dec	15	75	75	75
32		*Other Interests*							
33	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	16%	16%	16%
34			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 98.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	52%	52%	52%
37		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	54%	54%	54%
39			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	7%	7%	7%
40	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	296	298	297
41			Days lake level above 103 ft	1-Jan	31-Dec	1	10	10	10
44	FA22, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or below 175 cfs released from the hydro development (Note 14)	1-Jan	31-Dec	10%	63%	63%	62%
45									
46		**Lake Rhodhiss**							
47		*Fish & Aquatic Interests*							
48	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	9,387	9,512	8,792
49			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	19,789	20,000	19,080
52			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	55%	55%	56%
54	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	53%	53%	54%
55			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	52%	52%	52%
56	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	22	22	22
57		*Recreation Interests*							
58	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 94.0 ft) during higher use months	1-Mar	31-Oct	25	7	7	7
59			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0
60	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	133	133	132
61	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	19%	19%	19%
62		*Water User Interests*							
63	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 89.4 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
64			Days below critical level for hydro unit operation (< 79.1 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
65		*Other Interests*							
66	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	45%	45%	44%
67			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 97.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	52%	52%	51%
70		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	51%	51%	50%
72			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
73	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	304	302	304
74			Days lake level above 103 ft	1-Jan	31-Dec	1	25	25	26
75									
76		**Lake Hickory (Including the Oxford Regulated River Reach)**							
77		*Fish & Aquatic Interests*							
78	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	5,724	5,811	5,575
79			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	16,889	16,946	15,965
82			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	52%	52%	54%
84	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	51%	50%	52%
85			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	48%	48%	48%
86	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	24	25	24
87	FA22, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or below 225 cfs released from the hydro development (Note 14)	1-Jan	31-Dec	10%	40%	40%	40%
89		*Recreation Interests*							
90	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 94.0 ft) during higher use months	1-Mar	31-Oct	25	2	2	2
91			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0
92	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	153	153	151
93	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	14%	14%	14%
94	R101, R111, R121, R124, R127, HOWQ44	Maximize days/yr of boating opportunities in the regulated river reach	Avg. days/yr of daytime flows ≥ 2500, ≤ 5500 cfs released from the hydro development for at least 2 hrs/day during higher use months (Note 20)	1-Mar	31-Oct	25	148	149	146
95		*Water User Interests*							
96	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 94 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
97			Days below critical level for hydro unit operation (< 73 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
99			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 230) for the evaluation period (Note 12)	1-Jan	31-Dec	25	100	100	120
100		*Other Interests*							
101	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	43%	43%	43%
102			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 97.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	53%	53%	53%
105		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	53%	53%	52%
107			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
108	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	1	1	1
110									
111		**Lookout Shoals Lake (including the Lookout Shoals Regulated River Reach)**							
112		*Fish & Aquatic Interests*							
113	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	14,937	15,518	14,199
114			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	26,964	27,835	26,962
117			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	65%	65%	66%
119	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	63%	63%	64%
120			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	61%	60%	61%
121	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	29	30	30
124		*Recreation Interests*							
125	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 92.0 ft) during higher use months	1-Mar	31-Oct	25	0	0	0
126			Avg. days/yr lake level below critical level for public boat ramps (< 92.0 ft) (Note 3)	1-Jan	31-Dec	3	1	1	1
127	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	123	124	123
128		Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	15%	15%	15%
129		*Water User Interests*							
130	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 74.9 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
131			Days below critical level for hydro unit operation (< 72.9 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
132		*Other Interests*							
133	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	36%	36%	36%
134			Percent of days lake level within +/- 2 ft of existing maximum guide curve (i.e. 97.0 ft +/- 2 ft.)	1-Jan	31-Dec	5%	49%	49%	48%
137		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	47%	46%	46%
139			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
140	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	1,569	1,572	1,592
141			Days lake level above 103 ft	1-Jan	31-Dec	1	59	59	59
143									
144		**Lake Norman**							
145		*Fish & Aquatic Interests*							
146	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	2,155	2,155	2,158
147			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	3,360	3,368	3,464
150			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	45%	45%	46%
152	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	54%	53%	55%
153			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	41%	41%	41%
154	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	38	39	38
155		*Recreation Interests*							
156	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 96.0 ft) during higher use months	1-Mar	31-Oct	25	22	23	22

Hydrology Condition / Period = _____

CHEOPS Performance Measures Evaluation Spreadsheet

James to Wylie

	A	B	C	D	E	F	G	H	I
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2050**	**UC-Alt6_2050**	**UC-Alt7_2050**
157			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	1	1	1
158	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<95.0 ft) (Note 4)	1-Jan	31-Dec	3	32	32	30
159	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	23%	23%	23%
160		*Water User Interests*							
161	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest thermal power station operation (< 90 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
162			Days below critical level for shallowest public water supply intake operation (< 85 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
163			Days below critical level for shallowest industrial intake operation (< 75 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
164			Days below critical level for hydro unit operation (< 65 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
165		*Other Interests*							
166	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	38%	38%	38%
168			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	92%	92%	92%
170		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	82%	82%	82%
172			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
173	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	6	6	7
174									
175		**Mt Island Lake (including the Mt Island Bypassed Reach)**							
176		*Fish & Aquatic Interests*							
177	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	9,689	9,417	8,596
178			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	20,459	21,246	19,489
181			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	37%	36%	37%
183	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	36%	36%	37%
184			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	37%	37%	37%
185	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	77	76	77
186		*Recreation Interests*							
187	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 91.0 ft) during higher use months	1-Mar	31-Oct	25	0	0	0
188			Avg. days/yr lake level below critical level for public boat ramps (< 91.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0
189	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<96.0 ft) (Note 4)	1-Jan	31-Dec	3	161	159	161
190	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	30%	30%	32%
191		*Water User Interests*							
192	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest thermal power station operation (< 94.3 ft) (Note 3)	1-Jan	31-Dec	1	32	32	34
193			Days below critical level for shallowest public water supply intake operation (< 88 ft) (Note 3)	1-Jan	31-Dec	1	2	2	5
194			Days below critical level for hydro unit operation (< 77.5 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
195		*Other Interests*							
196	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 96.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	41%	41%	41%
198			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 96.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	75%	75%	75%
200		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	65%	65%	65%
202			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
203	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	224	224	235
204			Days lake level above 103 ft	1-Jan	31-Dec	1	28	28	29
205									
206		**Lake Wylie (including the Wylie Regulated River Reach)**							
207		*Fish & Aquatic Interests*							
208	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	3,104	3,035	3,101
209			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	8,920	9,253	8,969
212			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	41%	41%	41%
214	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	37%	37%	37%
215			Percent of time of lake levels >= 97 ft during the growing season	1-Apr	30-Sep	10%	55%	54%	54%
216			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	35%	35%	35%
217	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	33	33	35
218	FA22, FA25, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or above 2000 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%			
219			Percent of hours at or above 1080 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%			
224		*Recreation Interests*							
225	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 95.5 ft) during higher use months	1-Mar	31-Oct	25	40	42	43
226			Avg. days/yr lake level below critical level for public boat ramps (< 95.5 ft) (Note 3)	1-Jan	31-Dec	3	52	53	55
227	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	182	182	182
228	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	21%	21%	23%
233		*Water User Interests*							
234	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest industrial intake operation (< 92.6 ft) (Note 3)	1-Jan	31-Dec	1	20	19	25
235			Days below critical level for shallowest public water supply intake operation (< 92 ft) (Note 3)	1-Jan	31-Dec	1	20	19	25
236			Days below critical level for shallowest thermal power station operation (< 90 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
237			Days below critical level for hydro unit operation (< 74 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
242	WQ189	Maximize low flows to maintain waste assimilation capacity of the regulated river reach.	Percent of days at or above approximate 7Q10 flow (450 cfs) released from the hydro development (RM 139.63) (Note 9)	1-Jan	31-Dec	5%	100%	100%	100%
243			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 139.63) for the evaluation period (Note 12)	1-Jan	31-Dec	45	700	700	700
244		*Other Interests*							
245	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	49%	49%	48%
247			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 97.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	92%	93%	92%
249		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	60%	60%	59%
251			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	6%	6%	7%
252	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	3	1	1
254									
255		**Total Project Hydropower & Water Quantity Management**							
259	FA40, HOWQ41, HOWQ42, HOWQ58	Minimize inefficiencies in using water stored for generation	Percent of hydropower generation lost due to unplanned spills (Note 8)	1-Jan	31-Dec	1%	5%	5%	5%
260			Percent of hydropower generation lost due to other non-power generation uses (Note 9)	1-Jan	31-Dec	1%	9%	9%	10%
261	FA40, HOWQ41, HOWQ58	Maximize hydropower generation	Avg. MWH/yr of hydropower produced	1-Jan	31-Dec	31,000	1,331,102	1,326,906	1,323,722
262			Average equivalent # of homes per year that could be powered by the Hydro Project (Note 11)	1-Jan	31-Dec	2,500	100,841	100,523	100,282
263	HOWQ58, HOWQ41,HOWQ45	Maximize hydropower value	Avg. hydro generation value in Normalized Dollars/yr (Note 8)	1-Jan	31-Dec	$20,000	$719,510	$717,244	$714,937
264									
265		Background	Performance Measure has improved vs. the Baseline Scenario						
266		Background	Performance Measure has declined vs. the Baseline Scenario						
267		White Background	There is no significant difference between the scenario and the Baseline Scenario by definition of MISC						
268									

Hydrology Condition / Period = _____

CHEOPS Performance Measures Evaluation Spreadsheet

Wylie to Wateree

	A	B	C	D	E	F	G	H	I
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2050**	**UC-Alt6_2050**	**UC-Alt7_2050**
2		**Lake Wylie (including the Wylie Regulated River Reach)**					(1929-2010)	(1929-2010)	(1929-2010)
3		*Fish & Aquatic Interests*							
4	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	3,104	3,035	3,101
5			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	8,920	9,253	8,969
8			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	41%	41%	41%
10	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	37%	37%	37%
11			Percent of time of lake levels >= 97 ft during the growing season	1-Apr	30-Sep	10%	55%	54%	54%
12			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	35%	35%	35%
13	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	33	33	35
14	FA22, FA25, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or above 2000 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%			
15			Percent of hours at or above 1080 cfs at Node 1 (RM 139.63) (Note 14)	1-Jan	31-Dec	10%			
20		*Recreation Interests*							
21	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 95.5 ft) during higher use months	1-Mar	31-Oct	25	40	42	43
22			Avg. days/yr lake level below critical level for public boat ramps (< 95.5 ft) (Note 3)	1-Jan	31-Dec	3	52	53	55
23	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	182	182	182
24	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	21%	21%	23%
29		*Water User Interests*							
30	HOWQ43, HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest industrial intake operation (< 92.6 ft) (Note 3)	1-Jan	31-Dec	1	20	19	25
31			Days below critical level for shallowest public water supply intake operation (< 92 ft) (Note 3)	1-Jan	31-Dec	1	20	19	25
32			Days below critical level for shallowest thermal power station operation (< 90 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
33			Days below critical level for hydro unit operation (< 74 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
39			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 139.63) for the evaluation period (Note 12)	1-Jan	31-Dec	45	700	700	700
40		*Other Interests*							
41	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	49%	49%	48%
43			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 97.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	92%	93%	92%
45		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	60%	60%	59%
47			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	6%	6%	7%
48	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	3	1	1
50									
51		**Fishing Creek Reservoir**							
52		*Fish & Aquatic Interests*							
53	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	10,640	10,830	10,878
54			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	21,470	21,322	21,431
57			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	74%	74%	75%
59	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	74%	74%	74%
60			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	74%	74%	75%
61	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	10	10	10
62		*Recreation Interests*							
63	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 95.0 ft) during higher use months	1-Mar	31-Oct	25	0	0	0
64			Avg. days/yr lake level below critical level for public boat ramps (< 95.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0
65	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	66	67	65
66	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	19%	19%	19%
67		*Water User Interests*							
68	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 95 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
69			Days below critical level for shallowest industrial intake operation (< 90.8 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
70			Days below critical level for hydro unit operation (< 77.9 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
71		*Other Interests*							
72	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 97.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	40%	40%	40%
74			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 97.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	100%	100%	100%
76		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	99%	99%	99%
78			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
79	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	13	14	13
80									
81		**Great Falls-Dearborn Reservoir (including the Great Falls Long Bypassed Reach and the Great Falls Short Bypassed Reach)**							
82		*Fish & Aquatic Interests*							
83	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	20,980	20,113	19,939
84			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	32,564	31,652	31,352
87			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	75%	75%	75%
89	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	78%	78%	78%
90			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	76%	76%	77%
91	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	8	8	8
92		*Recreation Interests*							
93	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 98.0 ft) during higher use months	1-Mar	31-Oct	25	96	96	94
94			Avg. days/yr lake level below critical level for public boat ramps (< 97.0 ft) (Note 3)	1-Jan	31-Dec	3	84	83	81
95	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<98.0 ft) (Note 4)	1-Jan	31-Dec	3	139	138	137
96	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	22%	22%	22%
97		*Water User Interests*							
98	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for hydro unit operation (< 87.2 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
99		*Other Interests*							
100	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	51%	51%	51%
102			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	100%	100%	100%
104		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	51%	51%	50%
106			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
107	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	685	686	687
108			Days lake level above 103 ft	1-Jan	31-Dec	1	11	7	8
109									
110		**Cedar Creek Reservoir**							
111		*Fish & Aquatic Interests*							
112	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	10,317	10,585	10,145
113			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	20,194	20,241	20,064
116			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	71%	71%	72%
118	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	72%	72%	73%
119			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	71%	71%	71%
120	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	1	0	1
121		*Recreation Interests*							
122	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 98.5 ft) during higher use months	1-Mar	31-Oct	25	105	105	103
123			Avg. days/yr lake level below critical level for public boat ramps (< 96.0 ft) (Note 3)	1-Jan	31-Dec	3	2	2	2
124	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	74	75	73
125	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	7%	7%	7%
126		*Water User Interests*							
127	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for hydro unit operation (< 80.3 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
128		*Other Interests*							
129	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	48%	48%	47%
131			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	100%	100%	100%
133		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	50%	50%	49%
135			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
136	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100 ft	1-Jan	31-Dec	1	38	35	34
137			Days lake level above 103 ft	1-Jan	31-Dec	1	3	3	3
138									
139		**Lake Wateree (including the Wateree Regulated River Reach)**							
140		*Fish & Aquatic Interests*							
141	FA22	Minimize lake level variation during spawning season	Incidents of absolute lake level drops >=2 ft over 14 day-period (Note 10)	1-Mar	31-May	85	1,173	1,181	1,147
142			Incidents of absolute lake level drops >=1 ft over 14 day-period (Note 10)	1-Mar	31-May	85	7,277	7,010	6,911
145			Percent of time of lake levels >= 98 ft	1-Mar	31-Jul	10%	84%	84%	85%
147	FA22	Maximize days of lake levels supporting littoral habitat	Percent of time of lake levels >= 98 ft during the growing season	1-Apr	30-Sep	10%	89%	88%	90%
148			Percent of time of lake levels >= 98 ft	1-Jan	31-Dec	10%	93%	93%	94%
149	FA22	Minimize days of littoral habitat loss	Incidents/yr of lake levels <= 96 ft for at least 2 consecutive days	1-Jan	31-Dec	10	5	5	4
150	FA22, FA25, FA31, FA34, FA35, FA39	Provide for aquatic habitat in the regulated river reach	Percent of hours at or above 2000 cfs at Node 1 (RM 74.54) (Note 14)	1-Jan	31-Dec	10%			
151			Percent of hours at or above 1200 cfs at Node 1 (RM 74.54) (Note 14)	1-Jan	31-Dec	10%			

CHEOPS Performance Measures Evaluation Spreadsheet

	A	B	C	D	E	F	G	H	I
1	**CIS #** (Note 1)	**Performance Measures**	**Criterion** (Note 2)	**Start Date**	**End Date**	**MISC** (note 22)	**UC-Base_2050**	**UC-Alt6_2050**	**UC-Alt7_2050**
157		*Recreation Interests*							
158	R111, R122, R127, R145	Minimize days/yr of restricted lake boat launching	Avg. days/yr lake level below critical level for highest public boat ramp (< 96.0 ft) during higher use months	1-Mar	31-Oct	25	9	9	7
159			Avg. days/yr lake level below critical level for public boat ramps (< 93.0 ft) (Note 3)	1-Jan	31-Dec	3	0	0	0
160	R111, R122, R127, R145	Minimize days/yr of potentially restricted dock access	Avg. days/yr lake level below lowest avg. monthly level in post-Cowans Ford era (<97.0 ft) (Note 4)	1-Jan	31-Dec	3	17	17	14
161	R111, R122, R127, R145	Minimize reservoir area with restricted lake navigation	Percent of the lake's full pond surface area that is not boatable when lake level is at the lowest average monthly elevation (Note 4)	1-Jan	31-Dec	5%	13%	13%	11%
164		*Water User Interests*							
165	HOWQ53, HOWQ54, HOWQ55, HOWQ56, HOWQ57, HOWQ58	Minimize days of restricted operation at lake-located intakes	Days below critical level for shallowest public water supply intake operation (< 92.5 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
166			Days below critical level for hydro unit operation (< 74 ft) (Note 3)	1-Jan	31-Dec	1	0	0	0
169			Lowest 7-day average flowrate (cfs) released from the hydro development (RM 74.54) for the evaluation period (Note 12)	1-Jan	31-Dec	53	800	800	800
170		*Other Interests*							
171	HOWQ46	Maximize days of near "full pool" lake levels	Percent of days lake level within +/- 1 ft of existing maximum guide curve (i.e. 98.0 ft +/- 1 ft.)	1-Jan	31-Dec	5%	4%	4%	4%
173			Percent of days lake level within +/- 3 ft of existing maximum guide curve (i.e. 98.0 ft +/- 3 ft.)	1-Jan	31-Dec	5%	99%	99%	99%
175		Maximize adherence to lake level target	Percent of days lake level within +/- 2 ft of target	1-Jan	31-Dec	5%	12%	12%	12%
177			Percent of days lake level < Normal Minimum Elevation	1-Jan	31-Dec	10%	0%	0%	0%
178	HOWQ47, HOWQ48, HOWQ49	Minimize days of flooding of developed areas (Note 7)	Days lake level above 100.2 ft	1-Jan	31-Dec	1	379	379	383
179			Days lake level above 103 ft	1-Jan	31-Dec	1	19	19	20
181									
182		**Total Project Hydropower & Water Quantity Management**							
186	FA40, HOWQ41, HOWQ42, HOWQ58	Minimize inefficiencies in using water stored for generation	Percent of hydropower generation lost due to unplanned spills (Note 8)	1-Jan	31-Dec	1%	5%	5%	5%
187			Percent of hydropower generation lost due to other non-power generation uses (Note 9)	1-Jan	31-Dec	1%	9%	9%	10%
188	FA40, HOWQ41, HOWQ58	Maximize hydropower generation	Avg. MWH/yr of hydropower produced	1-Jan	31-Dec	31,000	1,331,102	1,326,906	1,323,722
189			Average equivalent # of homes per year that could be powered by the Hydro Project (Note 11)	1-Jan	31-Dec	2,500	100,841	100,523	100,282
190	HOWQ58, HOWQ41,HOWQ45	Maximize hydropower value	Avg. hydro generation value in Normalized Dollars/yr (Note 8)	1-Jan	31-Dec	$20,000	$719,510	$717,244	$714,937
191									
192		Background	Performance Measure has improved vs. the Baseline Scenario						
193		Background	Performance Measure has declined vs. the Baseline Scenario						
194		White Background	There is no significant difference between the scenario and the Baseline Scenario by definition of MISC						
195									

Stakeholder Interest Evaluation Spreadsheet

1 CIS # are the Composite Interest Statement numbers taken from Rev 3 of the Composite Interest Statement document dated 10/27/04 for the interests that are both (1) directly related to water quantity management and (2) reasonably measurable using CHEOPS. The following CIS #'s represent interests that are directly related to water quantity, but that will be dealt with differently as noted, and therefore will not be tabulated individually:

CIS #	Composite Interest Statement (Rev 3 - 10/27/04)	Disposition
FA16	Provide run-of-river flows through every dam.	Scenario design readily identifies whether or not interest is met.
FA36	Mimic day, month, and annual natural flow patterns including natural floods in riverine and bypass areas.	Scenario design readily identifies whether or not interest is met.
FA38	Restore run-of-river flows to the Great Falls.	Scenario design readily identifies whether or not interest is met.
R125	Provide predictable recreation releases on river sections (i.e., allow recreation users to plan ahead for river use).	Scenario design readily identifies whether or not interest is met.
R126	Provide predictable recreation releases on bypass sections including the Great Falls bypass.	Scenario design readily identifies whether or not interest is met.
HOWQ51	Tie the low inflow protocol to both water conservation and energy conservation.	LIP design determines if interest is met.
HOWQ52	Assure that the low inflow protocol fully protects aquatic resources, water quality, and recreation.	LIP design determines if interest is met.

2 For criterion that measure on an hourly or daily basis, unless stated otherwise:

a. If an hourly criterion occurs during the average of four contiguous 15-minute periods, then it counts as 1 hour.

b. If a daily criterion occurs for 5 contiguous 1-hour periods, then it counts as 1 day.

Also, daytime flows are assumed to be flows provided between 7:00 am and 7:00 pm. To the extent possible, each Criterion is defined in terms of percents and averages/yr so that the same Criterion is useful regardless of the length of the hydrology period (i.e., 1-yr, 3-yr, full period of record, etc.)

3 Critical lake elevations per Attachment F of Draft AIP dated 10/15/04.

4 See App. C of Draft Reservoir Level Study Report dated 11/10/04 for average monthly lake levels during post-Cowans Ford era.
Areas within the lakes are considered boatable if the water depth is greater than or equal to 3 ft.
Lake surface areas are determined using Area-Volume Curves (i.e., a set of curves for each lake that graph both lake surface area and lake volume verses water depth).

5 Low Inflow Protocol (LIP) Trigger Point considerations.

6 Low Inflow Protocol (LIP) Trigger Point considerations.

7 Developed areas include areas with roads, houses and other man-made structures.

8 Includes lost hydropower generation due to unplanned spilling of water at hydro station dams.
This measure does not include energy losses from evaporation, dam leakage or groundwater recharge.

9 Includes lost hydropower due to minimum flow and recreation flow releases that bypass the hydro station and public water supply and industrial withdrawals.
This measure does not include energy losses from evaporation, dam leakage or groundwater recharge.

10 Normalized dollar value of hydropower generated in a given year =

11 Flow rates needed to provide for basic navigation. These flow rates are determined by the Instream Flow Study and/or the Recreation Flow Study. In SC, the flow rates are based on meeting SCDNR's navigation criteria. In NC, the flow rates are based on Rec 02 studies.

12 7Q10 Flow rate = Lowest average flow rate over a 7-day period that statistically is likely to occur once every 10 years. The approximate 7Q10 flow rates listed in this document are from Table 6.1-1, Summary of Catawba-Wateree Project Hydrology as shown in Duke Power's First Stage Consultation Document dated 2003.

13 Absolute Lake level variation is determined from hourly checks against the measure using 15-minute reservoir data averaged per hour. The number of hours that exceed the starting reservoir elevation are recorded for each 14 day period between the start and end date. The starting elevation (midnight reservoir elevation) is reset each 14-day period and the total hourly count for all test periods is recorded for each scenario.

14 Calculated by (Total Scenario MWh / 13.2 MWh per home) / the # of years in the scenario
The MISC of 3000 homes per year is roughly 2% of the average equivalent homes/yr under the Baseline conditions.
Power produced by the hydro project is actually supplied to Duke Power's electric system grid and is used by Duke Power's electric customers (including residential, industrial and commercial customers), as is power produced at other Duke Power generating stations. This criterion of average equivalent homes per year is intended to simply make the total energy production potential of the hydro project more understandable to stakeholder team members and to put a perspective around potential differences in hydropower production between various operational scenarios. This measure does not imply that any number of homes will go without power if a particular scenario is chosen.

15 Lowest 7-day average flow rate is determined from a rolling 7-day average of the average daily flow (cfs). Where a average daily flow rate is determined from 15-minute flow (cfs) data averaged per 24 hour-day.

16 Habitat flows were estimates based on field experience with the subject reaches.

17 Floodplain Ecology inundation and maintenance flows for the river reach below Lake James were based on summary results presented in "Assessment of Hydraulic Geometry and Channel-Maintaining Discharges in the Catawba River Below Lake James", October 2001.

18 Floodplain Ecology inundation flows are initial estimates to be reviewed by the appropriate RC.

19 Maintenance flows for the river reach below Wylie and Wateree were based on geomorphic bankfull estimates for IFIM cross sections

	Wylie	Cross section at River Mile 137.5
	Wateree	Cross section at River Mile 67.6

20 Recreation flows are initial estimates to be reviewed by the appropriate RC.

21 Flooding flows are initial estimates based on the full hydraulic turbine capacity discharge plus

	Oxford-	One gate full open at reservoir = 100
	Lookout-	Discharge over spillway at reservoir = 103
	Wylie-	One gate full open at reservoir = 100
	Wateree-	Discharge over spillway at reservoir = 103
*Exception	Lake James	Bank full estimates per reference in Note 17

22 MISC = Minimum Increment of Significant Change. The MISC has the same units (i.e., days, days/yr, percent, etc.) as does the Criterion on that same row of

Performance Measures Sheet - Current (Year 2012) Yadkin Basin Water Demands with Union County Future (Year 2050) Demands - Period of Record (1955-2013)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario: BLY 2012	A1 2012 UC2050	A2A 2012 UC2050	A2B 2012 UC2050	A3 2012 UC2050	A4 2012 UC2050	A5 2012 UC2050	A11 2012 UC2050
	W. Kerr Scott Reservoir				(1955-2013) (Note 4)	(1955-2013) (Note 4)	(1955-2013) (Note 4)	(1955-2013) (Note 4)	(1955-2013) (Note 4)	(1955-2013) (Note 4)	(1955-2013) (Note 4)	(1955-2013) (Note 4)
	Elevation - Aesthetics											
1	Evaluate adherence to reservoir guide curve (EL 1030.0 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir guide curve	1-Jan	31-Dec	98%	98%	98%	98%	98%	98%	98%	98%
2		Percent of time end of day reservoir level within +/- 2 ft of reservoir guide curve	1-Jan	31-Dec	99%	99%	99%	99%	99%	99%	99%	99%
3		Percent of time end of day reservoir level within +/- 3 ft of reservoir guide curve	1-Jan	31-Dec	99%	99%	99%	99%	99%	99%	99%	99%
	Elevation - Water Withdrawal											
4	Evaluate days of restricted operation at lake-located intakes (future)	Number of days reservoir elevation below operational minimum elevation for withdrawal pool (EL 1000.0 ft. msl)	1-Jan	31-Dec	0	0	0	0	0	0	0	0
	High Rock Lake											
	Elevation - Aesthetics											
5	Evaluate adherence to reservoir operating rule curve	Percent of time end of day reservoir level within +/- 1 ft of reservoir operating curve	1-Jan	31-Dec	98%	98%	98%	98%	98%	98%	98%	98%
6		Percent of time end of day reservoir level within +/- 2 ft of reservoir operating curve	1-Jan	31-Dec	99%	99%	99%	99%	99%	99%	99%	99%
7		Percent of time end of day reservoir level within +/- 3 ft of reservoir operating curve	1-Jan	31-Dec	99%	99%	99%	99%	99%	99%	99%	99%
	Elevation - Water Withdrawal											
8	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (613.9 ft. msl) for shallowest water supply intake (power) operation	1-Jan	31-Dec	92	92	92	92	92	92	92	92
9		Number of days reservoir elevation below level (613.4 ft. msl) for proposed new shallowest water supply intake (power) operation	1-Jan	31-Dec	87	87	87	87	87	87	87	87
	Flow											
10	Flow Release From High Rock Lake	Number of days at or below 2,000 cfs daily average max. flow	1-Feb	15-May	829	829	828	829	829	829	829	829
11		Number of days at or below 1,500 cfs daily average max. flow	16-May	31-May	186	186	186	186	186	186	186	186
12		Number of days at or below 1,000 cfs daily average max. flow	1-Jun	31-Jan	0	0	0	0	0	0	0	0
13		Number of days below 770 cfs critical daily average max. flow	1-Jan	31-Dec	1,445	1,445	1,440	1,418	1,445	1,445	1,445	1,445
14		Number of days below LIP daily average max. flow target	1-Jan	31-Dec	4,547	4,547	4,548	4,402	4,547	4,547	4,547	4,547
15		Lowest daily average flow (cfs)	1-Jan	31-Dec	30	30	30	30	30	30	30	30
	Tuckertown Reservoir											
	Elevation - Aesthetics											
16	Evaluate adherence to reservoir full pond elevation (EL 564.7 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	97%	97%	97%	95%	97%	97%	97%	97%
17		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	98%	100%	100%	100%	100%
18		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	99%	100%	100%	100%	100%
19	Evaluate adherence to reservoir normal minimum elevation (EL 561.7 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	0%	0%	0%	2%	0%	0%	0%	0%
20		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	11%	11%	11%	13%	11%	11%	11%	11%
21		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%
	Elevation - Water Withdrawal											
22	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (560.7 ft. msl) for shallowest public water supply intake operation	1-Jan	31-Dec	2	2	2	66	2	2	2	2

Performance Measures Sheet - Current (Year 2012) Yadkin Basin Water Demands with Union County Future (Year 2050) Demands - Period of Record (1955-2013)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario: BLY 2012	A1 2012 UC2050	A2A 2012 UC2050	A2B 2012 UC2050	A3 2012 UC2050	A4 2012 UC2050	A5 2012 UC2050	A11 2012 UC2050
	Narrows Reservoir (Badin Lake)											
	Elevation - Aesthetics											
23	Evaluate adherence to reservoir full pond elevation (EL 509.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	62%	62%	55%	62%	62%	62%	62%	62%
24		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	98%	99%	100%	100%	100%	100%
25		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	99%	100%	100%	100%	100%	100%
26	Evaluate adherence to reservoir normal minimum elevation (EL 504.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	3%	3%	4%	3%	3%	3%	3%	3%
27		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	8%	8%	9%	8%	8%	8%	8%	8%
28		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	9%	9%	11%	9%	9%	9%	9%	9%
	Elevation - Water Withdrawal											
29	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (486.8 ft. msl)for shallowest public water supply intake operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0
	Falls Reservoir											
	Elevation - Aesthetics											
30	Evaluate adherence to reservoir full pond elevation (EL 332.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	38%	38%	38%	38%	38%	38%	38%	38%
31		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	58%	58%	58%	58%	58%	58%	58%	58%
32		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	68%	68%	67%	68%	68%	68%	68%	68%
33	Evaluate adherence to reservoir normal minimum elevation (EL 328.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	35%	35%	35%	35%	35%	35%	35%	35%
34		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	48%	48%	48%	48%	48%	48%	48%	48%
35		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	66%	66%	66%	66%	66%	66%	66%	66%
	Elevation - Water Withdrawal											
36	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (322.8 ft. msl) for shallowest water supply intake (hydropower) operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0
	Flow											
37	Flow Release From Falls Reservoir	Number of days at or below 2,000 cfs daily average flow	1-Feb	15-May	783	783	790	792	783	783	783	783
38		Number of days at or below 1,500 cfs daily average flow	16-May	31-May	201	201	209	210	201	201	201	201
39		Number of days at or below 1,000 cfs daily average flow	1-Jun	31-Jan	0	0	0	0	0	0	0	0
40		Number of days below critical flow (770 cfs daily average flow)	1-Jan	31-Dec	0	0	0	0	0	0	0	0
41		Number of days below LIP daily average flow target	1-Jan	31-Dec	0	0	0	0	0	0	0	0
42		Lowest daily average flow (cfs)	1-Jan	31-Dec	770	770	770	770	770	770	770	770

Performance Measures Sheet - Current (Year 2012) Yadkin Basin Water Demands with Union County Future (Year 2050) Demands - Period of Record (1955-2013)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario: BLY 2012	A1 2012 UC2050	A2A 2012 UC2050	A2B 2012 UC2050	A3 2012 UC2050	A4 2012 UC2050	A5 2012 UC2050	A11 2012 UC2050
	Lake Tillery											
	Elevation - Aesthetics											
43	Evaluate adherence to reservoir full pond elevation (EL 278.2 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%
44		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%
45		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%
46	Evaluate adherence to reservoir normal winter minimum elevation (EL 273.2 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	16-Dec	28-Feb	0%	0%	0%	0%	0%	0%	0%	0%
47		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	16-Dec	28-Feb	0%	0%	0%	0%	0%	0%	0%	0%
48		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	16-Dec	28-Feb	0%	0%	0%	0%	0%	0%	0%	0%
49	Evaluate adherence to reservoir normal summer minimum elevation (EL 275.7 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Mar	15-Dec	0%	0%	0%	0%	0%	0%	0%	0%
50		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Mar	15-Dec	37%	37%	37%	37%	37%	37%	37%	37%
51		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Mar	15-Dec	100%	100%	100%	100%	100%	100%	100%	100%
	Flow											
52	Flow Release From Lake Tillery	Number of days at or below 725 cfs continuous minimum flow (8 consecutive weeks) for fish spawning	15-Mar	15-May	2,141	2,156	2,185	2,185	2,143	2,143	2,143	2,144
53		Number of days at or below 330 cfs continuous minimum flow	1-Jan	31-Dec	14,000	14,023	14,067	14,046	14,000	14,000	14,000	14,007
54		Lowest daily average flow (cfs)	1-Jan	31-Dec	708	679	662	662	708	708	708	689
	Elevation - Water Withdrawal											
55	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (268.2 ft. msl) for shallowest public water supply and hydropower intake operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0
	Blewett Falls Lake											
	Elevation - Aesthetics											
56	Evaluate adherence to reservoir full pond elevation (EL 178.1 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	10%	10%	10%	10%	10%	10%	10%	10%
57		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	76%	75%	76%	76%	75%	75%	75%	76%
58		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	81%	81%	81%	81%	81%	81%	81%	81%
59	Evaluate adherence to reservoir normal minimum elevation (EL 172.1 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	0%	0%	0%	0%	0%	0%	0%	0%
60		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	10%	10%	10%	10%	10%	10%	10%	10%
61		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	23%	23%	23%	23%	23%	23%	23%	23%
	Elevation - Water Withdrawal											
62	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (168 ft. msl) for shallowest public water supply intake operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0
	Flow											
63	Flow Release From Blewett Falls Lake	Number of days at or below 2,400 cfs continuous flow target	1-Feb	15-May	1,995	2,002	2,005	2,007	2,004	2,004	2,004	2,003
64		Number of days at or below 1,800 cfs continuous flow target	16-May	31-May	508	508	508	510	510	510	510	508
65		Number of days at below 1,200 cfs continuous flow target	1-Jun	31-Jan	7,903	7,866	7,870	7,860	7,985	7,985	7,985	7,913
66		Number of days at or below critical flow (925 cfs instantaneous flow)	1-Jan	31-Dec	19	19	19	19	19	19	19	19
67		Number of days below LIP continuous flow target	1-Jan	31-Dec	0	0	0	0	0	0	0	0
68		Lowest daily average flow (cfs)	1-Jan	31-Dec	940	937	941	941	937	937	937	937

Performance Measures Sheet - Current (Year 2012) Yadkin Basin Water Demands with Union County Future (Year 2050) Demands - Period of Record (1955-2013)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario: BLY 2012	A1 2012 UC2050	A2A 2012 UC2050	A2B 2012 UC2050	A3 2012 UC2050	A4 2012 UC2050	A5 2012 UC2050	A11 2012 UC2050
	Water Quantity Management											
69	LIP Drought Stage (Note 2)	Percent of time in Normal Conditions	1-Jan	31-Dec	99%	99%	99%	99%	99%	99%	99%	99%
70		Number of years attaining LIP Stage 0	1-Jan	31-Dec	1	1	1	1	1	1	1	1
71		Number of years with more than 60 days in LIP Stage 0	1-Jan	31-Dec	1	1	1	1	1	1	1	1
72		Number of years attaining LIP Stage 1	1-Jan	31-Dec	1	1	1	1	1	1	1	1
73		Number of years with more than 60 days in LIP Stage 1	1-Jan	31-Dec	1	1	1	1	1	1	1	1
74		Number of years attaining LIP Stage 2	1-Jan	31-Dec	1	1	1	1	1	1	1	1
75		Number of years with more than 60 days in LIP Stage 2	1-Jan	31-Dec	1	1	1	1	1	1	1	1
76		Number of years attaining LIP Stage 3	1-Jan	31-Dec	1	1	1	1	1	1	1	1
77		Number of years with more than 60 days in LIP Stage 3	1-Jan	31-Dec	0	0	0	0	0	0	0	0
78		Number of years attaining LIP Stage 4	1-Jan	31-Dec	0	0	0	0	0	0	0	0
79		Number of years with more than 60 days in LIP Stage 4	1-Jan	31-Dec	0	0	0	0	0	0	0	0
	Alcoa Hydropower											
80	Effect on Alcoa hydropower generation	Avg. MWh/yr of hydropower produced	1-Jan	31-Dec	835,503	835,505	832,111	831,311	835,502	835,502	835,502	835,504
81		Average equivalent # of homes per year that could be powered by the hydro project (Note 3)	1-Jan	31-Dec	63,296	63,296	63,039	62,978	63,296	63,296	63,296	63,296
	Duke Energy-Progress Hydropower											
82	Effect on Duke Energy hydropower generation	Avg. MWh/yr of hydropower produced	1-Jan	31-Dec	339,230	337,799	337,835	337,862	338,910	338,910	338,910	338,256
83		Average equivalent # of homes per year that could be powered by the hydro project (Note 3)	1-Jan	31-Dec	25,699	25,591	25,594	25,596	25,675	25,675	25,675	25,625

Performance Measures Sheet - Current (Year 2012) Yadkin Basin Water Demands with Union County Future (Year 2050) Demands - Drought 1 (1999-2003)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario: BLY 2012	A1 2012 UC2050	A2A 2012 UC2050	A2B 2012 UC2050	A3 2012 UC2050	A4 2012 UC2050	A5 2012 UC2050	A11 2012 UC2050
	W. Kerr Scott Reservoir				(1999-2003) (Note 5)	(1999-2003) (Note 5)	(1999-2003) (Note 5)	(1999-2003) (Note 5)	(1999-2003) (Note 5)	(1999-2003) (Note 5)	(1999-2003) (Note 5)	(1999-2003) (Note 5)
	Elevation - Aesthetics											
1	Evaluate adherence to reservoir guide curve (EL 1030.0 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir guide curve	1-Jan	31-Dec	96%	96%	96%	96%	96%	96%	96%	96%
2		Percent of time end of day reservoir level within +/- 2 ft of reservoir guide curve	1-Jan	31-Dec	98%	98%	98%	98%	98%	98%	98%	98%
3		Percent of time end of day reservoir level within +/- 3 ft of reservoir guide curve	1-Jan	31-Dec	99%	99%	99%	99%	99%	99%	99%	99%
	Elevation - Water Withdrawal											
4	Evaluate days of restricted operation at lake-located intakes (future)	Number of days reservoir elevation below operational minimum elevation for withdrawal pool (EL 1000.0 ft. msl)	1-Jan	31-Dec	0	0	0	0	0	0	0	0
	High Rock Lake											
	Elevation - Aesthetics											
5	Evaluate adherence to reservoir operating rule curve	Percent of time end of day reservoir level within +/- 1 ft of reservoir operating curve	1-Jan	31-Dec	82%	82%	82%	82%	82%	82%	82%	82%
6		Percent of time end of day reservoir level within +/- 2 ft of reservoir operating curve	1-Jan	31-Dec	88%	88%	88%	88%	88%	88%	88%	88%
7		Percent of time end of day reservoir level within +/- 3 ft of reservoir operating curve	1-Jan	31-Dec	90%	90%	90%	90%	90%	90%	90%	90%
	Elevation - Water Withdrawal											
8	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (613.9 ft. msl) for shallowest water supply intake (power) operation	1-Jan	31-Dec	92	92	92	92	92	92	92	92
9		Number of days reservoir elevation below level (613.4 ft. msl) for proposed new shallowest water supply intake (power) operation	1-Jan	31-Dec	87	87	87	87	87	87	87	87
	Flow											
10	Flow Release From High Rock Lake	Number of days at or below 2,000 cfs daily average max. flow	1-Feb	15-May	172	172	170	171	172	172	172	172
11		Number of days at or below 1,500 cfs daily average max. flow	16-May	31-May	41	41	41	41	41	41	41	41
12		Number of days at or below 1,000 cfs daily average max. flow	1-Jun	31-Jan	0	0	0	0	0	0	0	0
13		Number of days below 770 cfs critical daily average max. flow	1-Jan	31-Dec	90	90	90	66	90	90	90	90
14		Number of days below LIP daily average max. flow target	1-Jan	31-Dec	789	789	787	673	789	789	789	789
15		Lowest daily average flow (cfs)	1-Jan	31-Dec	339	339	339	339	339	339	339	339
	Tuckertown Reservoir											
	Elevation - Aesthetics											
16	Evaluate adherence to reservoir full pond elevation (EL 564.7 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	82%	82%	82%	72%	82%	82%	82%	82%
17		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	96%	96%	96%	82%	96%	96%	96%	96%
18		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	90%	100%	100%	100%	100%
19	Evaluate adherence to reservoir normal minimum elevation (EL 561.7 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	4%	4%	4%	16%	4%	4%	4%	4%
20		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	26%	26%	27%	35%	26%	26%	26%	26%
21		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%
	Elevation - Water Withdrawal											
22	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (560.7 ft. msl) for shallowest public water supply intake operation	1-Jan	31-Dec	0	0	0	64	0	0	0	0

Performance Measures Sheet - Current (Year 2012) Yadkin Basin Water Demands with Union County Future (Year 2050) Demands - Drought 1 (1999-2003)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario: BLY 2012	A1 2012 UC2050	A2A 2012 UC2050	A2B 2012 UC2050	A3 2012 UC2050	A4 2012 UC2050	A5 2012 UC2050	A11 2012 UC2050
	Narrows Reservoir (Badin Lake)											
	Elevation - Aesthetics											
23	Evaluate adherence to reservoir full pond elevation (EL 509.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	41%	41%	36%	41%	41%	41%	41%	41%
24		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	95%	95%	83%	93%	95%	95%	95%	95%
25		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	94%	100%	100%	100%	100%	100%
26	Evaluate adherence to reservoir normal minimum elevation (EL 504.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	4%	4%	6%	4%	4%	4%	4%	4%
27		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	8%	8%	15%	9%	8%	8%	8%	8%
28		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	13%	13%	26%	15%	13%	13%	13%	13%
	Elevation - Water Withdrawal											
29	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (486.8 ft. msl)for shallowest public water supply intake operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0
	Falls Reservoir											
	Elevation - Aesthetics											
30	Evaluate adherence to reservoir full pond elevation (EL 332.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	25%	25%	25%	25%	25%	25%	25%	25%
31		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	39%	39%	38%	39%	39%	39%	39%	39%
32		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	46%	46%	45%	46%	46%	46%	46%	46%
33	Evaluate adherence to reservoir normal minimum elevation (EL 328.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	55%	55%	56%	56%	55%	55%	55%	55%
34		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	66%	66%	66%	66%	66%	66%	66%	66%
35		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	78%	78%	78%	78%	78%	78%	78%	78%
	Elevation - Water Withdrawal											
36	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (322.8 ft. msl) for shallowest water supply intake (hydropower) operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0
	Flow											
37	Flow Release From Falls Reservoir	Number of days at or below 2,000 cfs daily average flow	1-Feb	15-May	169	169	174	174	169	169	169	169
38		Number of days at or below 1,500 cfs daily average flow	16-May	31-May	41	41	41	41	41	41	41	41
39		Number of days at or below 1,000 cfs daily average flow	1-Jun	31-Jan	0	0	0	0	0	0	0	0
40		Number of days below critical flow (770 cfs daily average flow)	1-Jan	31-Dec	0	0	0	0	0	0	0	0
41		Number of days below LIP daily average flow target	1-Jan	31-Dec	0	0	0	0	0	0	0	0
42		Lowest daily average flow (cfs)	1-Jan	31-Dec	770	770	770	770	770	770	770	770

Performance Measures Sheet - Current (Year 2012) Yadkin Basin Water Demands with Union County Future (Year 2050) Demands - Drought 1 (1999-2003)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario: BLY 2012	A1 2012 UC2050	A2A 2012 UC2050	A2B 2012 UC2050	A3 2012 UC2050	A4 2012 UC2050	A5 2012 UC2050	A11 2012 UC2050
	Lake Tillery											
	Elevation - Aesthetics											
43	Evaluate adherence to reservoir full pond elevation (EL 278.2 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%
44		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%
45		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%
46	Evaluate adherence to reservoir normal winter minimum elevation (EL 273.2 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	16-Dec	28-Feb	0%	0%	0%	0%	0%	0%	0%	0%
47		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	16-Dec	28-Feb	0%	0%	0%	0%	0%	0%	0%	0%
48		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	16-Dec	28-Feb	0%	0%	0%	0%	0%	0%	0%	0%
49	Evaluate adherence to reservoir normal summer minimum elevation (EL 275.7 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Mar	15-Dec	1%	1%	1%	1%	1%	1%	1%	1%
50		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Mar	15-Dec	37%	37%	37%	37%	37%	37%	37%	37%
51		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Mar	15-Dec	100%	100%	100%	100%	100%	100%	100%	100%
	Flow											
52	Flow Release From Lake Tillery	Number of days at or below 725 cfs continuous minimum flow (8 consecutive weeks) for fish spawning	15-Mar	15-May	218	218	222	218	218	218	218	218
53		Number of days at or below 330 cfs continuous minimum flow	1-Jan	31-Dec	1,326	1,327	1,331	1,329	1,326	1,326	1,326	1,327
54		Lowest daily average flow (cfs)	1-Jan	31-Dec	751	725	751	751	751	751	751	733
	Elevation - Water Withdrawal											
55	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (268.2 ft. msl) for shallowest public water supply and hydropower intake operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0
	Blewett Falls Lake											
	Elevation - Aesthetics											
56	Evaluate adherence to reservoir full pond elevation (EL 178.1 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	7%	7%	7%	7%	7%	7%	7%	7%
57		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	81%	80%	82%	82%	79%	79%	79%	80%
58		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	86%	86%	86%	86%	86%	86%	86%	86%
59	Evaluate adherence to reservoir normal minimum elevation (EL 172.1 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	1%	1%	1%	1%	1%	1%	1%	1%
60		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	8%	8%	8%	8%	8%	8%	8%	8%
61		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	18%	18%	18%	18%	18%	18%	18%	18%
	Elevation - Water Withdrawal											
62	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (168 ft. msl) for shallowest public water supply intake operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0
	Flow											
63	Flow Release From Blewett Falls Lake	Number of days at or below 2,400 cfs continuous flow target	1-Feb	15-May	284	284	287	287	283	283	283	285
64		Number of days at or below 1,800 cfs continuous flow target	16-May	31-May	64	64	64	64	64	64	64	64
65		Number of days at below 1,200 cfs continuous flow target	1-Jun	31-Jan	837	832	834	832	841	841	841	836
66		Number of days at or below critical flow (925 cfs instantaneous flow)	1-Jan	31-Dec	19	19	19	19	19	19	19	19
67		Number of days below LIP continuous flow target	1-Jan	31-Dec	0	0	0	0	0	0	0	0
68		Lowest daily average flow (cfs)	1-Jan	31-Dec	940	937	941	941	937	937	937	937

Performance Measures Sheet - Current (Year 2012) Yadkin Basin Water Demands with Union County Future (Year 2050) Demands - Drought 1 (1999-2003)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario: BLY 2012	A1 2012 UC2050	A2A 2012 UC2050	A2B 2012 UC2050	A3 2012 UC2050	A4 2012 UC2050	A5 2012 UC2050	A11 2012 UC2050
	Water Quantity Management											
69	LIP Drought Stage (Note 2)	Percent of time in Normal Conditions	1-Jan	31-Dec	88%	88%	88%	88%	88%	88%	88%	88%
70		Number of years attaining LIP Stage 0	1-Jan	31-Dec	1	1	1	1	1	1	1	1
71		Number of years with more than 60 days in LIP Stage 0	1-Jan	31-Dec	1	1	1	1	1	1	1	1
72		Number of years attaining LIP Stage 1	1-Jan	31-Dec	1	1	1	1	1	1	1	1
73		Number of years with more than 60 days in LIP Stage 1	1-Jan	31-Dec	1	1	1	1	1	1	1	1
74		Number of years attaining LIP Stage 2	1-Jan	31-Dec	1	1	1	1	1	1	1	1
75		Number of years with more than 60 days in LIP Stage 2	1-Jan	31-Dec	1	1	1	1	1	1	1	1
76		Number of years attaining LIP Stage 3	1-Jan	31-Dec	1	1	1	1	1	1	1	1
77		Number of years with more than 60 days in LIP Stage 3	1-Jan	31-Dec	0	0	0	0	0	0	0	0
78		Number of years attaining LIP Stage 4	1-Jan	31-Dec	0	0	0	0	0	0	0	0
79		Number of years with more than 60 days in LIP Stage 4	1-Jan	31-Dec	0	0	0	0	0	0	0	0
	Alcoa Hydropower											
80	Effect on Alcoa hydropower generation	Avg. MWh/yr of hydropower produced	1-Jan	31-Dec	626,889	626,890	623,456	622,811	626,889	626,889	626,889	626,890
81		Average equivalent # of homes per year that could be powered by the hydro project (Note 3)	1-Jan	31-Dec	47,492	47,492	47,232	47,183	47,492	47,492	47,492	47,492
	Duke Energy-Progress Hydropower											
82	Effect on Duke Energy hydropower generation	Avg. MWh/yr of hydropower produced	1-Jan	31-Dec	251,980	250,468	250,553	250,579	251,663	251,663	251,663	251,002
83		Average equivalent # of homes per year that could be powered by the hydro project (Note 3)	1-Jan	31-Dec	19,089	18,975	18,981	18,983	19,065	19,065	19,065	19,015

Performance Measures Sheet - Current (Year 2012) Yadkin Basin Water Demands with Union County Future (Year 2050) Demands - Drought 2 (2006-2009)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario: BLY 2012	A1 2012 UC2050	A2A 2012 UC2050	A2B 2012 UC2050	A3 2012 UC2050	A4 2012 UC2050	A5 2012 UC2050	A11 2012 UC2050
	W. Kerr Scott Reservoir				(2006-2009) (Note 6)	(2006-2009) (Note 6)	(2006-2009) (Note 6)	(2006-2009) (Note 6)	(2006-2009) (Note 6)	(2006-2009) (Note 6)	(2006-2009) (Note 6)	(2006-2009) (Note 6)
	Elevation - Aesthetics											
1	Evaluate adherence to reservoir guide curve (EL 1030.0 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir guide curve	1-Jan	31-Dec	98%	98%	98%	98%	98%	98%	98%	98%
2		Percent of time end of day reservoir level within +/- 2 ft of reservoir guide curve	1-Jan	31-Dec	99%	99%	99%	99%	99%	99%	99%	99%
3		Percent of time end of day reservoir level within +/- 3 ft of reservoir guide curve	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%
	Elevation - Water Withdrawal											
4	Evaluate days of restricted operation at lake-located intakes (future)	Number of days reservoir elevation below operational minimum elevation for withdrawal pool (EL 1000.0 ft. msl)	1-Jan	31-Dec	0	0	0	0	0	0	0	0
	High Rock Lake											
	Elevation - Aesthetics											
5	Evaluate adherence to reservoir operating rule curve	Percent of time end of day reservoir level within +/- 1 ft of reservoir operating curve	1-Jan	31-Dec	91%	91%	91%	91%	91%	91%	91%	91%
6		Percent of time end of day reservoir level within +/- 2 ft of reservoir operating curve	1-Jan	31-Dec	95%	95%	95%	95%	95%	95%	95%	95%
7		Percent of time end of day reservoir level within +/- 3 ft of reservoir operating curve	1-Jan	31-Dec	98%	98%	98%	98%	98%	98%	98%	98%
	Elevation - Water Withdrawal											
8	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (613.9 ft. msl) for shallowest water supply intake (power) operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0
9		Number of days reservoir elevation below level (613.4 ft. msl) for proposed new shallowest water supply intake (power) operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0
	Flow											
10	Flow Release From High Rock Lake	Number of days at or below 2,000 cfs daily average max. flow	1-Feb	15-May	100	100	101	101	100	100	100	100
11		Number of days at or below 1,500 cfs daily average max. flow	16-May	31-May	18	18	18	18	18	18	18	18
12		Number of days at or below 1,000 cfs daily average max. flow	1-Jun	31-Jan	0	0	0	0	0	0	0	0
13		Number of days below 770 cfs critical daily average max. flow	1-Jan	31-Dec	84	84	79	79	84	84	84	84
14		Number of days below LIP daily average max. flow target	1-Jan	31-Dec	496	496	499	472	496	496	496	496
15		Lowest daily average flow (cfs)	1-Jan	31-Dec	30	30	30	30	30	30	30	30
	Tuckertown Reservoir											
	Elevation - Aesthetics											
16	Evaluate adherence to reservoir full pond elevation (EL 564.7 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	93%	93%	93%	87%	93%	93%	93%	93%
17		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	90%	100%	100%	100%	100%
18		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	98%	100%	100%	100%	100%
19	Evaluate adherence to reservoir normal minimum elevation (EL 561.7 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	0%	0%	0%	10%	0%	0%	0%	0%
20		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	16%	16%	16%	22%	16%	16%	16%	16%
21		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%
	Elevation - Water Withdrawal											
22	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (560.7 ft. msl) for shallowest public water supply intake operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0

Performance Measures Sheet - Current (Year 2012) Yadkin Basin Water Demands with Union County Future (Year 2050) Demands - Drought 2 (2006-2009)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario: BLY 2012	A1 2012 UC2050	A2A 2012 UC2050	A2B 2012 UC2050	A3 2012 UC2050	A4 2012 UC2050	A5 2012 UC2050	A11 2012 UC2050
	Narrows Reservoir (Badin Lake)											
	Elevation - Aesthetics											
23	Evaluate adherence to reservoir full pond elevation (EL 509.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	46%	46%	37%	45%	46%	46%	46%	46%
24		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	91%	97%	100%	100%	100%	100%
25		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	99%	100%	100%	100%	100%	100%
26	Evaluate adherence to reservoir normal minimum elevation (EL 504.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	5%	5%	6%	6%	5%	5%	5%	5%
27		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	8%	8%	10%	8%	8%	8%	8%	8%
28		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	8%	8%	18%	12%	8%	8%	8%	8%
	Elevation - Water Withdrawal											
29	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (486.8 ft. msl)for shallowest public water supply intake operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0
	Falls Reservoir											
	Elevation - Aesthetics											
30	Evaluate adherence to reservoir full pond elevation (EL 332.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	24%	24%	22%	22%	24%	24%	24%	24%
31		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	44%	44%	42%	43%	44%	44%	44%	44%
32		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	54%	54%	52%	53%	54%	54%	54%	54%
33	Evaluate adherence to reservoir normal minimum elevation (EL 328.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	48%	48%	50%	50%	48%	48%	48%	48%
34		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	62%	62%	63%	63%	62%	62%	62%	62%
35		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	78%	78%	79%	79%	78%	78%	78%	78%
	Elevation - Water Withdrawal											
36	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (322.8 ft. msl) for shallowest water supply intake (hydropower) operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0
	Flow											
37	Flow Release From Falls Reservoir	Number of days at or below 2,000 cfs daily average flow	1-Feb	15-May	94	94	92	91	94	94	94	94
38		Number of days at or below 1,500 cfs daily average flow	16-May	31-May	23	23	26	26	23	23	23	23
39		Number of days at or below 1,000 cfs daily average flow	1-Jun	31-Jan	0	0	0	0	0	0	0	0
40		Number of days below critical flow (770 cfs daily average flow)	1-Jan	31-Dec	0	0	0	0	0	0	0	0
41		Number of days below LIP daily average flow target	1-Jan	31-Dec	0	0	0	0	0	0	0	0
42		Lowest daily average flow (cfs)	1-Jan	31-Dec	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000

Performance Measures Sheet - Current (Year 2012) Yadkin Basin Water Demands with Union County Future (Year 2050) Demands - Drought 2 (2006-2009)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario: BLY 2012	A1 2012 UC2050	A2A 2012 UC2050	A2B 2012 UC2050	A3 2012 UC2050	A4 2012 UC2050	A5 2012 UC2050	A11 2012 UC2050
	Lake Tillery											
	Elevation - Aesthetics											
43	Evaluate adherence to reservoir full pond elevation (EL 278.2 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	99%	99%	99%	99%	99%	99%	99%	99%
44		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%
45		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%
46	Evaluate adherence to reservoir normal winter minimum elevation (EL 273.2 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	16-Dec	28-Feb	0%	0%	0%	0%	0%	0%	0%	0%
47		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	16-Dec	28-Feb	0%	0%	0%	0%	0%	0%	0%	0%
48		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	16-Dec	28-Feb	0%	0%	0%	0%	0%	0%	0%	0%
49	Evaluate adherence to reservoir normal summer minimum elevation (EL 275.7 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Mar	15-Dec	0%	0%	0%	0%	0%	0%	0%	0%
50		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Mar	15-Dec	38%	38%	38%	38%	38%	38%	38%	38%
51		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Mar	15-Dec	100%	100%	100%	100%	100%	100%	100%	100%
	Flow											
52	Flow Release From Lake Tillery	Number of days at or below 725 cfs continuous minimum flow (8 consecutive weeks) for fish spawning	15-Mar	15-May	205	207	208	207	207	207	207	207
53		Number of days at or below 330 cfs continuous minimum flow	1-Jan	31-Dec	1,072	1,073	1,073	1,077	1,072	1,072	1,072	1,072
54		Lowest daily average flow (cfs)	1-Jan	31-Dec	927	906	927	927	927	927	927	917
	Elevation - Water Withdrawal											
55	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (268.2 ft. msl) for shallowest public water supply and hydropower intake operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0
	Blewett Falls Lake											
	Elevation - Aesthetics											
56	Evaluate adherence to reservoir full pond elevation (EL 178.1 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	6%	6%	6%	6%	6%	6%	6%	6%
57		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	79%	79%	80%	80%	79%	79%	79%	79%
58		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	83%	83%	84%	84%	83%	83%	83%	83%
59	Evaluate adherence to reservoir normal minimum elevation (EL 172.1 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	0%	0%	0%	0%	0%	0%	0%	0%
60		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	11%	11%	11%	11%	11%	11%	11%	11%
61		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	21%	21%	20%	20%	21%	21%	21%	21%
	Elevation - Water Withdrawal											
62	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (168 ft. msl) for shallowest public water supply intake operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0
	Flow											
63	Flow Release From Blewett Falls Lake	Number of days at or below 2,400 cfs continuous flow target	1-Feb	15-May	277	276	276	276	277	277	277	277
64		Number of days at or below 1,800 cfs continuous flow target	16-May	31-May	57	56	56	56	56	56	56	56
65		Number of days at below 1,200 cfs continuous flow target	1-Jun	31-Jan	683	683	684	684	688	688	688	684
66		Number of days at or below critical flow (925 cfs instantaneous flow)	1-Jan	31-Dec	0	0	0	0	0	0	0	0
67		Number of days below LIP continuous flow target	1-Jan	31-Dec	0	0	0	0	0	0	0	0
68		Lowest daily average flow (cfs)	1-Jan	31-Dec	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200

Performance Measures Sheet - Current (Year 2012) Yadkin Basin Water Demands with Union County Future (Year 2050) Demands - Drought 2 (2006-2009)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario: BLY 2012	A1 2012 UC2050	A2A 2012 UC2050	A2B 2012 UC2050	A3 2012 UC2050	A4 2012 UC2050	A5 2012 UC2050	A11 2012 UC2050
	Water Quantity Management											
69	LIP Drought Stage (Note 2)	Percent of time in Normal Conditions	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%
70		Number of years attaining LIP Stage 0	1-Jan	31-Dec	0	0	0	0	0	0	0	0
71		Number of years with more than 60 days in LIP Stage 0	1-Jan	31-Dec	0	0	0	0	0	0	0	0
72		Number of years attaining LIP Stage 1	1-Jan	31-Dec	0	0	0	0	0	0	0	0
73		Number of years with more than 60 days in LIP Stage 1	1-Jan	31-Dec	0	0	0	0	0	0	0	0
74		Number of years attaining LIP Stage 2	1-Jan	31-Dec	0	0	0	0	0	0	0	0
75		Number of years with more than 60 days in LIP Stage 2	1-Jan	31-Dec	0	0	0	0	0	0	0	0
76		Number of years attaining LIP Stage 3	1-Jan	31-Dec	0	0	0	0	0	0	0	0
77		Number of years with more than 60 days in LIP Stage 3	1-Jan	31-Dec	0	0	0	0	0	0	0	0
78		Number of years attaining LIP Stage 4	1-Jan	31-Dec	0	0	0	0	0	0	0	0
79		Number of years with more than 60 days in LIP Stage 4	1-Jan	31-Dec	0	0	0	0	0	0	0	0
	Alcoa Hydropower											
80	Effect on Alcoa hydropower generation	Avg. MWh/yr of hydropower produced	1-Jan	31-Dec	620,402	620,404	616,761	615,945	620,401	620,401	620,401	620,403
81		Average equivalent # of homes per year that could be powered by the hydro project (Note 3)	1-Jan	31-Dec	47,000	47,000	46,724	46,663	47,000	47,000	47,000	47,000
	Duke Energy-Progress Hydropower											
82	Effect on Duke Energy hydropower generation	Avg. MWh/yr of hydropower produced	1-Jan	31-Dec	249,888	248,386	248,666	248,677	249,549	249,549	249,549	248,843
83		Average equivalent # of homes per year that could be powered by the hydro project (Note 3)	1-Jan	31-Dec	18,931	18,817	18,838	18,839	18,905	18,905	18,905	18,852

Notes

1 For criterion that measure on an hourly or daily basis, unless stated otherwise:

a. If an hourly criteria occurs during the average of four contiguous 15-minute periods, then it counts as 1 hour.

b. If a daily criterion occurs for 5 contiguous 1-hour periods, then it counts as 1 day.

Also, daytime flows are assumed to be flows provided between 7:00 am and 7:00 pm. To the extent possible, each criterion is defined in terms of percents and averages/yr so that the same criterion is useful regardless of the length of the hydrology period (i.e., 1-yr, 3-yr, full period of record, etc.)

2 LIP - Low Inflow Protocol for the Yadkin and Yadkin-Pee Dee River Hydroelectric Projects (Alcoa and Duke Energy Progress)

3 Calculated by [(Total Scenario MWh / 13.2 MWh per home) / the # of years in the scenario]
Power produced by the hydro projects is actually supplied to the electric system grid and is used by electric customers (including residential, industrial and commercial customers), as is power produced at other Duke Energy Progress and/or APGI generating stations. This criterion of average equivalent homes per year is intended to simply make the total energy production potential of the hydro projects more understandable to stakeholders and to put a perspective around potential differences in hydropower production between various scenarios. This measure does not imply that any number of homes will go without power if a particular scenario is chosen.

4 1955 thru 2013, inclusive (59 years)
21,550 days (59 years * 365.25 days/year)
2,068,776 15-minute time steps (59 years * 365.25 days/year * 24 hours/day * 4 time steps/hour)

5 1999 thru 2003 Drought, inclusive (5 years)
1,826 days (5 years * 365.25 days/year)
175,320 15-minute time steps (5 years * 365.25 days/year * 24 hours/day * 4 time steps/hour)

6 2006 thru 2009 Drought, inclusive (4 years)
1,461 days (4 years * 365.25 days/year)
140,256 15-minute time steps (4 years * 365.25 days/year * 24 hours/day * 4 time steps/hour)

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Performance Measures Sheet - Future (Year 2050) Yadkin Basin Water Demands
Period of Record (1955-2013)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario: BLY 2012	BLY 2050	A1 2050	A2A 2050	A2B 2050	A3 2050	A4 2050	A5 2050	A11 2050
	W. Kerr Scott Reservoir				(1955-2013) (Note 4)	(1955-2013) (Note 4)	(1955-2013) (Note 4)	(1955-2013) (Note 4)	(1955-2013) (Note 4)	(1955-2013) (Note 4)	(1955-2013) (Note 4)	(1955-2013) (Note 4)	(1955-2013) (Note 4)
	Elevation - Aesthetics												
1	Evaluate adherence to reservoir guide curve (EL 1030.0 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir guide curve	1-Jan	31-Dec	98%	98%	98%	98%	98%	98%	98%	98%	98%
2		Percent of time end of day reservoir level within +/- 2 ft of reservoir guide curve	1-Jan	31-Dec	99%	99%	99%	99%	99%	99%	99%	99%	99%
3		Percent of time end of day reservoir level within +/- 3 ft of reservoir guide curve	1-Jan	31-Dec	99%	99%	99%	99%	99%	99%	99%	99%	99%
	Elevation - Water Withdrawal												
4	Evaluate days of restricted operation at lake-located intakes (future)	Number of days reservoir elevation below operational minimum elevation for withdrawal pool (EL 1000.0 ft. msl)	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
	High Rock Lake												
	Elevation - Aesthetics												
5	Evaluate adherence to reservoir operating rule curve	Percent of time end of day reservoir level within +/- 1 ft of reservoir operating curve	1-Jan	31-Dec	98%	97%	97%	97%	97%	97%	97%	97%	97%
6		Percent of time end of day reservoir level within +/- 2 ft of reservoir operating curve	1-Jan	31-Dec	99%	98%	98%	98%	98%	98%	98%	98%	98%
7		Percent of time end of day reservoir level within +/- 3 ft of reservoir operating curve	1-Jan	31-Dec	99%	99%	99%	99%	99%	99%	99%	99%	99%
	Elevation - Water Withdrawal												
8	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (613.9 ft. msl) for shallowest water supply intake (power) operation	1-Jan	31-Dec	92	95	95	95	95	95	95	95	95
9		Number of days reservoir elevation below level (613.4 ft. msl) for proposed new shallowest water supply intake (power) operation	1-Jan	31-Dec	87	92	92	92	92	92	92	92	92
	Flow												
10	Flow Release From High Rock Lake	Number of days at or below 2,000 cfs daily average max. flow	1-Feb	15-May	829	833	833	835	836	833	833	833	833
11		Number of days at or below 1,500 cfs daily average max. flow	16-May	31-May	186	190	190	190	190	190	190	190	190
12		Number of days at or below 1,000 cfs daily average max. flow	1-Jun	31-Jan	0	0	0	0	0	0	0	0	0
13		Number of days below 770 cfs critical daily average max. flow	1-Jan	31-Dec	1,445	1,416	1,416	1,408	1,392	1,416	1,416	1,416	1,416
14		Number of days below LIP daily average max. flow target	1-Jan	31-Dec	4,547	4,594	4,594	4,596	4,432	4,594	4,594	4,594	4,594
15		Lowest daily average flow (cfs)	1-Jan	31-Dec	30	30	30	30	30	30	30	30	30
	Tuckertown Reservoir												
	Elevation - Aesthetics												
16	Evaluate adherence to reservoir full pond elevation (EL 564.7 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	97%	96%	96%	96%	94%	96%	96%	96%	96%
17		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	100%	99%	99%	99%	97%	99%	99%	99%	99%
18		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	100%	99%	100%	100%	100%	100%
19	Evaluate adherence to reservoir normal minimum elevation (EL 561.7 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	0%	1%	1%	1%	3%	1%	1%	1%	1%
20		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	11%	12%	12%	12%	14%	12%	12%	12%	12%
21		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Elevation - Water Withdrawal												
22	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (560.7 ft. msl) for shallowest public water supply intake operation	1-Jan	31-Dec	2	2	2	17	84	2	2	2	2

Performance Measures Sheet - Future (Year 2050) Yadkin Basin Water Demands
Period of Record (1955-2013)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario: BLY 2012	BLY 2050	A1 2050	A2A 2050	A2B 2050	A3 2050	A4 2050	A5 2050	A11 2050
	Narrows Reservoir (Badin Lake)												
	Elevation - Aesthetics												
23	Evaluate adherence to reservoir full pond elevation (EL 509.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	62%	56%	56%	53%	56%	56%	56%	56%	56%
24		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	100%	98%	98%	97%	98%	98%	98%	98%	98%
25		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	99%	99%	100%	100%	100%	100%
26	Evaluate adherence to reservoir normal minimum elevation (EL 504.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	3%	3%	3%	4%	4%	3%	3%	3%	3%
27		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	8%	9%	9%	10%	9%	9%	9%	9%	9%
28		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	9%	10%	10%	12%	11%	10%	10%	10%	10%
	Elevation - Water Withdrawal												
29	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (486.8 ft. msl)for shallowest public water supply intake operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
	Falls Reservoir												
	Elevation - Aesthetics												
30	Evaluate adherence to reservoir full pond elevation (EL 332.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	38%	38%	38%	38%	37%	38%	38%	38%	38%
31		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	58%	58%	58%	57%	57%	58%	58%	58%	58%
32		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	68%	67%	67%	67%	67%	67%	67%	67%	67%
33	Evaluate adherence to reservoir normal minimum elevation (EL 328.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	35%	35%	35%	36%	36%	35%	35%	35%	35%
34		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	48%	49%	49%	49%	49%	49%	49%	49%	49%
35		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	66%	66%	66%	66%	66%	66%	66%	66%	66%
	Elevation - Water Withdrawal												
36	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (322.8 ft. msl) for shallowest water supply intake (hydropower) operation	1-Jan	31-Dec	0	1	1	0	1	1	1	1	1
	Flow												
37	Flow Release From Falls Reservoir	Number of days at or below 2,000 cfs daily average flow	1-Feb	15-May	783	788	788	804	805	788	788	788	788
38		Number of days at or below 1,500 cfs daily average flow	16-May	31-May	201	205	205	216	215	205	205	205	205
39		Number of days at or below 1,000 cfs daily average flow	1-Jun	31-Jan	0	0	0	0	0	0	0	0	0
40		Number of days below critical flow (770 cfs daily average flow)	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
41		Number of days below LIP daily average flow target	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
42		Lowest daily average flow (cfs)	1-Jan	31-Dec	770	770	770	770	770	770	770	770	770

Performance Measures Sheet - Future (Year 2050) Yadkin Basin Water Demands
Period of Record (1955-2013)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario: BLY 2012	BLY 2050	A1 2050	A2A 2050	A2B 2050	A3 2050	A4 2050	A5 2050	A11 2050
	Lake Tillery												
	Elevation - Aesthetics												
43	Evaluate adherence to reservoir full pond elevation (EL 278.2 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%	100%
44		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%	100%
45		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%	100%
46	Evaluate adherence to reservoir normal winter minimum elevation (EL 273.2 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	16-Dec	28-Feb	0%	0%	0%	0%	0%	0%	0%	0%	0%
47		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	16-Dec	28-Feb	0%	0%	0%	0%	0%	0%	0%	0%	0%
48		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	16-Dec	28-Feb	0%	0%	0%	0%	0%	0%	0%	0%	0%
49	Evaluate adherence to reservoir normal summer minimum elevation (EL 275.7 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Mar	15-Dec	0%	0%	0%	0%	0%	0%	0%	0%	0%
50		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Mar	15-Dec	37%	37%	37%	37%	37%	37%	37%	37%	37%
51		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Mar	15-Dec	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Flow												
52	Flow Release From Lake Tillery	Number of days at or below 725 cfs continuous minimum flow (8 consecutive weeks) for fish spawning	15-Mar	15-May	2,141	2,164	2,161	2,189	2,191	2,166	2,166	2,166	2,162
53		Number of days at or below 330 cfs continuous minimum flow	1-Jan	31-Dec	14,000	14,122	14,133	14,174	14,174	14,115	14,115	14,115	14,128
54		Lowest daily average flow (cfs)	1-Jan	31-Dec	708	380	330	380	380	330	330	330	330
	Elevation - Water Withdrawal												
55	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (268.2 ft. msl) for shallowest public water supply and hydropower intake operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
	Blewett Falls Lake												
	Elevation - Aesthetics												
56	Evaluate adherence to reservoir full pond elevation (EL 178.1 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	10%	10%	10%	10%	10%	10%	10%	10%	10%
57		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	76%	76%	76%	76%	76%	76%	76%	76%	76%
58		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	81%	81%	81%	81%	81%	81%	81%	81%	81%
59	Evaluate adherence to reservoir normal minimum elevation (EL 172.1 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	0%	0%	1%	0%	0%	1%	1%	1%	1%
60		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	10%	10%	10%	10%	10%	10%	10%	10%	10%
61		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	23%	23%	23%	23%	23%	23%	23%	23%	23%
	Elevation - Water Withdrawal												
62	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (168 ft. msl) for shallowest public water supply intake operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
	Flow												
63	Flow Release From Blewett Falls Lake	Number of days at or below 2,400 cfs continuous flow target	1-Feb	15-May	1,995	2,060	2,067	2,065	2,065	2,076	2,076	2,076	2,076
64		Number of days at or below 1,800 cfs continuous flow target	16-May	31-May	508	528	531	525	527	532	532	532	534
65		Number of days at or below 1,200 cfs continuous flow target	1-Jun	31-Jan	7,903	8,084	8,098	8,094	8,089	8,244	8,244	8,244	8,152
66		Number of days at or below critical flow (925 cfs instantaneous flow)	1-Jan	31-Dec	19	22	23	22	22	23	23	23	23
67		Number of days below LIP continuous flow target	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
68		Lowest daily average flow (cfs)	1-Jan	31-Dec	940	925	925	925	925	925	925	925	925

Performance Measures Sheet - Future (Year 2050) Yadkin Basin Water Demands
Period of Record (1955-2013)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario: BLY 2012	BLY 2050	A1 2050	A2A 2050	A2B 2050	A3 2050	A4 2050	A5 2050	A11 2050
	Water Quantity Management												
69	LIP Drought Stage (Note 2)	Percent of time in Normal Conditions	1-Jan	31-Dec	99%	99%	99%	99%	99%	99%	99%	99%	99%
70		Number of years attaining LIP Stage 0	1-Jan	31-Dec	1	2	2	2	2	2	2	2	2
71		Number of years with more than 60 days in LIP Stage 0	1-Jan	31-Dec	1	1	1	1	1	1	1	1	1
72		Number of years attaining LIP Stage 1	1-Jan	31-Dec	1	1	1	1	1	1	1	1	1
73		Number of years with more than 60 days in LIP Stage 1	1-Jan	31-Dec	1	1	1	1	1	1	1	1	1
74		Number of years attaining LIP Stage 2	1-Jan	31-Dec	1	1	1	1	1	1	1	1	1
75		Number of years with more than 60 days in LIP Stage 2	1-Jan	31-Dec	1	1	1	1	1	1	1	1	1
76		Number of years attaining LIP Stage 3	1-Jan	31-Dec	1	1	1	1	1	1	1	1	1
77		Number of years with more than 60 days in LIP Stage 3	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
78		Number of years attaining LIP Stage 4	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
79		Number of years with more than 60 days in LIP Stage 4	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
	Alcoa Hydropower												
80	Effect on Alcoa hydropower generation	Avg. MWh/yr of hydropower produced	1-Jan	31-Dec	835,503	828,305	828,308	824,956	824,142	828,306	828,306	828,306	828,307
81		Average equivalent # of homes per year that could be powered by the hydro project (Note 3)	1-Jan	31-Dec	63,296	62,750	62,751	62,497	62,435	62,750	62,750	62,750	62,751
	Duke Energy-Progress Hydropower												
82	Effect on Duke Energy hydropower generation	Avg. MWh/yr of hydropower produced	1-Jan	31-Dec	339,230	332,093	330,410	330,439	330,450	331,566	331,566	331,566	330,855
83		Average equivalent # of homes per year that could be powered by the hydro project (Note 3)	1-Jan	31-Dec	25,699	25,159	25,031	25,033	25,034	25,119	25,119	25,119	25,065

Performance Measures Sheet - Future (Year 2050) Yadkin Basin Water Demands
Drought 1 (1999-2003)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario								
					BLY 2012	BLY 2050	A1 2050	A2A 2050	A2B 2050	A3 2050	A4 2050	A5 2050	A11 2050
	W. Kerr Scott Reservoir				(1999-2003) (Note 5)	(1999-2003) (Note 5)	(1999-2003) (Note 5)	(1999-2003) (Note 5)	(1999-2003) (Note 5)	(1999-2003) (Note 5)	(1999-2003) (Note 5)	(1999-2003) (Note 5)	(1999-2003) (Note 5)
	Elevation - Aesthetics												
1	Evaluate adherence to reservoir guide curve (EL 1030.0 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir guide curve	1-Jan	31-Dec	96%	96%	96%	96%	96%	96%	96%	96%	96%
2		Percent of time end of day reservoir level within +/- 2 ft of reservoir guide curve	1-Jan	31-Dec	98%	98%	98%	98%	98%	98%	98%	98%	98%
3		Percent of time end of day reservoir level within +/- 3 ft of reservoir guide curve	1-Jan	31-Dec	99%	98%	98%	98%	98%	98%	98%	98%	98%
	Elevation - Water Withdrawal												
4	Evaluate days of restricted operation at lake-located intakes (future)	Number of days reservoir elevation below operational minimum elevation for withdrawal pool (EL 1000.0 ft. msl)	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
	High Rock Lake												
	Elevation - Aesthetics												
5	Evaluate adherence to reservoir operating rule curve	Percent of time end of day reservoir level within +/- 1 ft of reservoir operating curve	1-Jan	31-Dec	82%	81%	81%	80%	80%	81%	81%	81%	81%
6		Percent of time end of day reservoir level within +/- 2 ft of reservoir operating curve	1-Jan	31-Dec	88%	87%	87%	87%	86%	87%	87%	87%	87%
7		Percent of time end of day reservoir level within +/- 3 ft of reservoir operating curve	1-Jan	31-Dec	90%	89%	89%	89%	89%	89%	89%	89%	89%
	Elevation - Water Withdrawal												
8	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (613.9 ft. msl) for shallowest water supply intake (power) operation	1-Jan	31-Dec	92	95	95	95	95	95	95	95	95
9		Number of days reservoir elevation below level (613.4 ft. msl) for proposed new shallowest water supply intake (power) operation	1-Jan	31-Dec	87	92	92	92	92	92	92	92	92
	Flow												
10	Flow Release From High Rock Lake	Number of days at or below 2,000 cfs daily average max. flow	1-Feb	15-May	172	173	173	176	176	173	173	173	173
11		Number of days at or below 1,500 cfs daily average max. flow	16-May	31-May	41	41	41	41	41	41	41	41	41
12		Number of days at or below 1,000 cfs daily average max. flow	1-Jun	31-Jan	0	0	0	0	0	0	0	0	0
13		Number of days below 770 cfs critical daily average max. flow	1-Jan	31-Dec	90	75	75	69	57	75	75	75	75
14		Number of days below LIP daily average max. flow target	1-Jan	31-Dec	789	784	784	780	649	784	784	784	784
15		Lowest daily average flow (cfs)	1-Jan	31-Dec	339	375	375	375	375	375	375	375	375
	Tuckertown Reservoir												
	Elevation - Aesthetics												
16	Evaluate adherence to reservoir full pond elevation (EL 564.7 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	82%	76%	76%	76%	69%	76%	76%	76%	76%
17		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	96%	90%	90%	90%	79%	90%	90%	90%	90%
18		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	100%	98%	98%	97%	87%	98%	98%	98%	98%
19	Evaluate adherence to reservoir normal minimum elevation (EL 561.7 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	4%	10%	10%	10%	19%	10%	10%	10%	10%
20		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	26%	32%	32%	32%	35%	32%	32%	32%	32%
21		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Elevation - Water Withdrawal												
22	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (560.7 ft. msl) for shallowest public water supply intake operation	1-Jan	31-Dec	0	0	0	15	82	0	0	0	0

Performance Measures Sheet - Future (Year 2050) Yadkin Basin Water Demands Drought 1 (1999-2003)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario: BLY 2012	BLY 2050	A1 2050	A2A 2050	A2B 2050	A3 2050	A4 2050	A5 2050	A11 2050
	Narrows Reservoir (Badin Lake)												
	Elevation - Aesthetics												
23	Evaluate adherence to reservoir full pond elevation (EL 509.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	41%	36%	36%	33%	35%	36%	36%	36%	36%
24		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	95%	85%	85%	75%	80%	85%	85%	85%	85%
25		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	100%	97%	97%	86%	94%	97%	97%	97%	97%
26	Evaluate adherence to reservoir normal minimum elevation (EL 504.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	4%	4%	4%	10%	6%	4%	4%	4%	4%
27		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	8%	12%	12%	22%	14%	12%	12%	12%	12%
28		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	13%	23%	23%	33%	28%	23%	23%	23%	23%
	Elevation - Water Withdrawal												
29	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (486.8 ft. msl)for shallowest public water supply intake operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
	Falls Reservoir												
	Elevation - Aesthetics												
30	Evaluate adherence to reservoir full pond elevation (EL 332.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	25%	25%	25%	25%	25%	25%	25%	25%	25%
31		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	39%	38%	38%	37%	37%	38%	38%	38%	38%
32		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	46%	45%	45%	44%	44%	45%	45%	45%	45%
33	Evaluate adherence to reservoir normal minimum elevation (EL 328.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	55%	56%	56%	58%	58%	56%	56%	56%	56%
34		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	66%	67%	67%	67%	67%	67%	67%	67%	67%
35		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	78%	78%	78%	79%	79%	78%	78%	78%	78%
	Elevation - Water Withdrawal												
36	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (322.8 ft. msl) for shallowest water supply intake (hydropower) operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
	Flow												
37	Flow Release From Falls Reservoir	Number of days at or below 2,000 cfs daily average flow	1-Feb	15-May	169	176	176	181	179	176	176	176	176
38		Number of days at or below 1,500 cfs daily average flow	16-May	31-May	41	41	41	41	41	41	41	41	41
39		Number of days at or below 1,000 cfs daily average flow	1-Jun	31-Jan	0	0	0	0	0	0	0	0	0
40		Number of days below critical flow (770 cfs daily average flow)	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
41		Number of days below LIP daily average flow target	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
42		Lowest daily average flow (cfs)	1-Jan	31-Dec	770	770	770	770	770	770	770	770	770

Performance Measures Sheet - Future (Year 2050) Yadkin Basin Water Demands Drought 1 (1999-2003)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario: BLY 2012	BLY 2050	A1 2050	A2A 2050	A2B 2050	A3 2050	A4 2050	A5 2050	A11 2050
	Lake Tillery												
	Elevation - Aesthetics												
43	Evaluate adherence to reservoir full pond elevation (EL 278.2 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	98%	100%	100%	98%	98%	98%	98%
44		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%	100%
45		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%	100%
46	Evaluate adherence to reservoir normal winter minimum elevation (EL 273.2 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	16-Dec	28-Feb	0%	0%	0%	0%	0%	0%	0%	0%	0%
47		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	16-Dec	28-Feb	0%	0%	0%	0%	0%	0%	0%	0%	0%
48		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	16-Dec	28-Feb	0%	0%	0%	0%	0%	0%	0%	0%	0%
49	Evaluate adherence to reservoir normal summer minimum elevation (EL 275.7 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Mar	15-Dec	1%	1%	2%	1%	1%	2%	2%	2%	2%
50		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Mar	15-Dec	37%	38%	39%	38%	38%	39%	39%	39%	39%
51		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Mar	15-Dec	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Flow												
52	Flow Release From Lake Tillery	Number of days at or below 725 cfs continuous minimum flow (8 consecutive weeks) for fish spawning	15-Mar	15-May	218	220	221	222	219	220	220	220	220
53		Number of days at or below 330 cfs continuous minimum flow	1-Jan	31-Dec	1,326	1,326	1,326	1,333	1,331	1,326	1,326	1,326	1,328
54		Lowest daily average flow (cfs)	1-Jan	31-Dec	751	380	330	380	380	330	330	330	330
	Elevation - Water Withdrawal												
55	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (268.2 ft. msl) for shallowest public water supply and hydropower intake operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
	Blewett Falls Lake												
	Elevation - Aesthetics												
56	Evaluate adherence to reservoir full pond elevation (EL 178.1 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	7%	6%	6%	6%	6%	6%	6%	6%	6%
57		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	81%	77%	76%	77%	77%	76%	76%	76%	76%
58		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	86%	82%	81%	82%	82%	81%	81%	81%	81%
59	Evaluate adherence to reservoir normal minimum elevation (EL 172.1 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	1%	2%	4%	2%	2%	4%	4%	4%	4%
60		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	8%	12%	12%	11%	11%	12%	12%	12%	12%
61		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	18%	22%	23%	22%	22%	23%	23%	23%	23%
	Elevation - Water Withdrawal												
62	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (168 ft. msl) for shallowest public water supply intake operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
	Flow												
63	Flow Release From Blewett Falls Lake	Number of days at or below 2,400 cfs continuous flow target	1-Feb	15-May	284	285	285	287	286	286	286	286	286
64		Number of days at or below 1,800 cfs continuous flow target	16-May	31-May	64	65	65	64	64	65	65	65	65
65		Number of days at or below 1,200 cfs continuous flow target	1-Jun	31-Jan	837	850	852	850	851	862	862	862	859
66		Number of days at or below critical flow (925 cfs instantaneous flow)	1-Jan	31-Dec	19	22	23	22	22	23	23	23	23
67		Number of days below LIP continuous flow target	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
68		Lowest daily average flow (cfs)	1-Jan	31-Dec	940	925	925	925	925	925	925	925	925

Performance Measures Sheet - Future (Year 2050) Yadkin Basin Water Demands Drought 1 (1999-2003)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario: BLY 2012	BLY 2050	A1 2050	A2A 2050	A2B 2050	A3 2050	A4 2050	A5 2050	A11 2050
	Water Quantity Management												
69	LIP Drought Stage (Note 2)	Percent of time in Normal Conditions	1-Jan	31-Dec	88%	87%	87%	87%	87%	87%	87%	87%	87%
70		Number of years attaining LIP Stage 0	1-Jan	31-Dec	1	2	2	2	2	2	2	2	2
71		Number of years with more than 60 days in LIP Stage 0	1-Jan	31-Dec	1	1	1	1	1	1	1	1	1
72		Number of years attaining LIP Stage 1	1-Jan	31-Dec	1	1	1	1	1	1	1	1	1
73		Number of years with more than 60 days in LIP Stage 1	1-Jan	31-Dec	1	1	1	1	1	1	1	1	1
74		Number of years attaining LIP Stage 2	1-Jan	31-Dec	1	1	1	1	1	1	1	1	1
75		Number of years with more than 60 days in LIP Stage 2	1-Jan	31-Dec	1	1	1	1	1	1	1	1	1
76		Number of years attaining LIP Stage 3	1-Jan	31-Dec	1	1	1	1	1	1	1	1	1
77		Number of years with more than 60 days in LIP Stage 3	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
78		Number of years attaining LIP Stage 4	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
79		Number of years with more than 60 days in LIP Stage 4	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
	Alcoa Hydropower												
80	Effect on Alcoa hydropower generation	Avg. MWh/yr of hydropower produced	1-Jan	31-Dec	626,889	620,372	620,382	617,134	616,463	620,379	620,379	620,379	620,380
81		Average equivalent # of homes per year that could be powered by the hydro project (Note 3)	1-Jan	31-Dec	47,492	46,998	46,999	46,753	46,702	46,998	46,998	46,998	46,999
	Duke Energy-Progress Hydropower												
82	Effect on Duke Energy hydropower generation	Avg. MWh/yr of hydropower produced	1-Jan	31-Dec	251,980	244,544	242,766	242,958	243,018	243,948	243,948	243,948	243,177
83		Average equivalent # of homes per year that could be powered by the hydro project (Note 3)	1-Jan	31-Dec	19,089	18,526	18,391	18,406	18,410	18,481	18,481	18,481	18,422

Performance Measures Sheet - Future (Year 2050) Yadkin Basin Water Demands
Drought 2 (2006-2009)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario: BLY 2012	BLY 2050	A1 2050	A2A 2050	A2B 2050	A3 2050	A4 2050	A5 2050	A11 2050
	W. Kerr Scott Reservoir				(2006-2009) (Note 6)	(2006-2009) (Note 6)	(2006-2009) (Note 6)	(2006-2009) (Note 6)	(2006-2009) (Note 6)	(2006-2009) (Note 6)	(2006-2009) (Note 6)	(2006-2009) (Note 6)	(2006-2009) (Note 6)
	Elevation - Aesthetics												
1	Evaluate adherence to reservoir guide curve (EL 1030.0 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir guide curve	1-Jan	31-Dec	98%	98%	98%	98%	98%	98%	98%	98%	98%
2		Percent of time end of day reservoir level within +/- 2 ft of reservoir guide curve	1-Jan	31-Dec	99%	99%	99%	99%	99%	99%	99%	99%	99%
3		Percent of time end of day reservoir level within +/- 3 ft of reservoir guide curve	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Elevation - Water Withdrawal												
4	Evaluate days of restricted operation at lake-located intakes (future)	Number of days reservoir elevation below operational minimum elevation for withdrawal pool (EL 1000.0 ft. msl)	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
	High Rock Lake												
	Elevation - Aesthetics												
5	Evaluate adherence to reservoir operating rule curve	Percent of time end of day reservoir level within +/- 1 ft of reservoir operating curve	1-Jan	31-Dec	91%	91%	91%	90%	90%	91%	91%	91%	91%
6		Percent of time end of day reservoir level within +/- 2 ft of reservoir operating curve	1-Jan	31-Dec	95%	95%	95%	94%	94%	95%	95%	95%	95%
7		Percent of time end of day reservoir level within +/- 3 ft of reservoir operating curve	1-Jan	31-Dec	98%	97%	97%	97%	97%	97%	97%	97%	97%
	Elevation - Water Withdrawal												
8	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (613.9 ft. msl) for shallowest water supply intake (power) operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
9		Number of days reservoir elevation below level (613.4 ft. msl) for proposed new shallowest water supply intake (power) operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
	Flow												
10	Flow Release From High Rock Lake	Number of days at or below 2,000 cfs daily average max. flow	1-Feb	15-May	100	101	101	101	101	101	101	101	101
11		Number of days at or below 1,500 cfs daily average max. flow	16-May	31-May	18	19	19	19	19	19	19	19	19
12		Number of days at or below 1,000 cfs daily average max. flow	1-Jun	31-Jan	0	0	0	0	0	0	0	0	0
13		Number of days below 770 cfs critical daily average max. flow	1-Jan	31-Dec	84	72	72	72	72	72	72	72	72
14		Number of days below LIP daily average max. flow target	1-Jan	31-Dec	496	527	527	527	497	527	527	527	527
15		Lowest daily average flow (cfs)	1-Jan	31-Dec	30	30	30	30	30	30	30	30	30
	Tuckertown Reservoir												
	Elevation - Aesthetics												
16	Evaluate adherence to reservoir full pond elevation (EL 564.7 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	93%	88%	88%	89%	85%	88%	88%	88%	88%
17		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	100%	95%	95%	95%	92%	95%	95%	95%	95%
18		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	100%	98%	100%	100%	100%	100%
19	Evaluate adherence to reservoir normal minimum elevation (EL 561.7 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	0%	5%	5%	5%	8%	5%	5%	5%	5%
20		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	16%	20%	20%	19%	23%	20%	20%	20%	20%
21		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Elevation - Water Withdrawal												
22	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (560.7 ft. msl) for shallowest public water supply intake operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0

Performance Measures Sheet - Future (Year 2050) Yadkin Basin Water Demands Drought 2 (2006-2009)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario: BLY 2012	BLY 2050	A1 2050	A2A 2050	A2B 2050	A3 2050	A4 2050	A5 2050	A11 2050
	Narrows Reservoir (Badin Lake)												
	Elevation - Aesthetics												
23	Evaluate adherence to reservoir full pond elevation (EL 509.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	46%	39%	39%	34%	38%	39%	39%	39%	39%
24		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	100%	93%	93%	90%	92%	93%	93%	93%	93%
25		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	95%	100%	100%	100%	100%	100%
26	Evaluate adherence to reservoir normal minimum elevation (EL 504.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	5%	5%	5%	6%	6%	5%	5%	5%	5%
27		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	8%	9%	9%	13%	9%	9%	9%	9%	9%
28		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	8%	15%	15%	19%	16%	15%	15%	15%	15%
	Elevation - Water Withdrawal												
29	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (486.8 ft. msl)for shallowest public water supply intake operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
	Falls Reservoir												
	Elevation - Aesthetics												
30	Evaluate adherence to reservoir full pond elevation (EL 332.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	24%	22%	22%	22%	22%	22%	22%	22%	22%
31		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	44%	41%	41%	41%	41%	41%	41%	41%	41%
32		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	54%	52%	52%	50%	50%	52%	52%	52%	52%
33	Evaluate adherence to reservoir normal minimum elevation (EL 328.8 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	48%	50%	50%	52%	52%	50%	50%	50%	50%
34		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	62%	64%	64%	64%	64%	64%	64%	64%	64%
35		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	78%	79%	79%	80%	80%	79%	79%	79%	79%
	Elevation - Water Withdrawal												
36	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (322.8 ft. msl) for shallowest water supply intake (hydropower) operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
	Flow												
37	Flow Release From Falls Reservoir	Number of days at or below 2,000 cfs daily average flow	1-Feb	15-May	94	91	91	97	97	91	91	91	91
38		Number of days at or below 1,500 cfs daily average flow	16-May	31-May	23	25	25	27	27	25	25	25	25
39		Number of days at or below 1,000 cfs daily average flow	1-Jun	31-Jan	0	0	0	0	0	0	0	0	0
40		Number of days below critical flow (770 cfs daily average flow)	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
41		Number of days below LIP daily average flow target	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
42		Lowest daily average flow (cfs)	1-Jan	31-Dec	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000

Performance Measures Sheet - Future (Year 2050) Yadkin Basin Water Demands Drought 2 (2006-2009)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario: BLY 2012	BLY 2050	A1 2050	A2A 2050	A2B 2050	A3 2050	A4 2050	A5 2050	A11 2050
	Lake Tillery												
	Elevation - Aesthetics												
43	Evaluate adherence to reservoir full pond elevation (EL 278.2 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	99%	99%	99%	99%	99%	99%	99%	99%	99%
44		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%	100%
45		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%	100%
46	Evaluate adherence to reservoir normal winter minimum elevation (EL 273.2 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	16-Dec	28-Feb	0%	0%	0%	0%	0%	0%	0%	0%	0%
47		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	16-Dec	28-Feb	0%	0%	0%	0%	0%	0%	0%	0%	0%
48		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	16-Dec	28-Feb	0%	0%	0%	0%	0%	0%	0%	0%	0%
49	Evaluate adherence to reservoir normal summer minimum elevation (EL 275.7 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Mar	15-Dec	0%	0%	0%	0%	0%	0%	0%	0%	0%
50		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Mar	15-Dec	38%	38%	38%	38%	38%	38%	38%	38%	38%
51		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Mar	15-Dec	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Flow												
52	Flow Release From Lake Tillery	Number of days at or below 725 cfs continuous minimum flow (8 consecutive weeks) for fish spawning	15-Mar	15-May	205	210	210	212	213	210	210	210	210
53		Number of days at or below 330 cfs continuous minimum flow	1-Jan	31-Dec	1,072	1,074	1,076	1,075	1,075	1,075	1,075	1,075	1,076
54		Lowest daily average flow (cfs)	1-Jan	31-Dec	927	866	845	866	866	866	866	866	856
	Elevation - Water Withdrawal												
55	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (268.2 ft. msl) for shallowest public water supply and hydropower intake operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
	Blewett Falls Lake												
	Elevation - Aesthetics												
56	Evaluate adherence to reservoir full pond elevation (EL 178.1 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir full pond	1-Jan	31-Dec	6%	7%	7%	6%	6%	7%	7%	7%	7%
57		Percent of time end of day reservoir level within +/- 2 ft of reservoir full pond	1-Jan	31-Dec	79%	79%	78%	79%	79%	78%	78%	78%	78%
58		Percent of time end of day reservoir level within +/- 3 ft of reservoir full pond	1-Jan	31-Dec	83%	84%	83%	84%	84%	83%	83%	83%	83%
59	Evaluate adherence to reservoir normal minimum elevation (EL 172.1 ft. msl)	Percent of time end of day reservoir level within +/- 1 ft of reservoir normal minimum elevation	1-Jan	31-Dec	0%	0%	0%	0%	0%	0%	0%	0%	0%
60		Percent of time end of day reservoir level within +/- 2 ft of reservoir normal minimum elevation	1-Jan	31-Dec	11%	10%	11%	11%	10%	11%	11%	11%	11%
61		Percent of time end of day reservoir level within +/- 3 ft of reservoir normal minimum elevation	1-Jan	31-Dec	21%	21%	21%	21%	21%	21%	21%	21%	21%
	Elevation - Water Withdrawal												
62	Evaluate days of restricted operation at lake-located intakes	Number of days reservoir elevation below critical level (168 ft. msl) for shallowest public water supply intake operation	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
	Flow												
63	Flow Release From Blewett Falls Lake	Number of days at or below 2,400 cfs continuous flow target	1-Feb	15-May	277	277	277	277	277	279	279	279	279
64		Number of days at or below 1,800 cfs continuous flow target	16-May	31-May	57	57	57	57	57	57	57	57	57
65		Number of days at or below 1,200 cfs continuous flow target	1-Jun	31-Jan	683	694	696	694	695	701	701	701	699
66		Number of days at or below critical flow (925 cfs instantaneous flow)	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
67		Number of days below LIP continuous flow target	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
68		Lowest daily average flow (cfs)	1-Jan	31-Dec	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200

Performance Measures Sheet - Future (Year 2050) Yadkin Basin Water Demands Drought 2 (2006-2009)

Line Number	Performance Measures	Criterion (Note 1)	Start Date	End Date	Model Scenario: BLY 2012	BLY 2050	A1 2050	A2A 2050	A2B 2050	A3 2050	A4 2050	A5 2050	A11 2050
	Water Quantity Management												
69	LIP Drought Stage (Note 2)	Percent of time in Normal Conditions	1-Jan	31-Dec	100%	100%	100%	100%	100%	100%	100%	100%	100%
70		Number of years attaining LIP Stage 0	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
71		Number of years with more than 60 days in LIP Stage 0	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
72		Number of years attaining LIP Stage 1	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
73		Number of years with more than 60 days in LIP Stage 1	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
74		Number of years attaining LIP Stage 2	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
75		Number of years with more than 60 days in LIP Stage 2	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
76		Number of years attaining LIP Stage 3	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
77		Number of years with more than 60 days in LIP Stage 3	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
78		Number of years attaining LIP Stage 4	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
79		Number of years with more than 60 days in LIP Stage 4	1-Jan	31-Dec	0	0	0	0	0	0	0	0	0
	Alcoa Hydropower												
80	Effect on Alcoa hydropower generation	Avg. MWh/yr of hydropower produced	1-Jan	31-Dec	620,402	612,821	612,822	609,284	608,443	612,821	612,821	612,821	612,822
81		Average equivalent # of homes per year that could be powered by the hydro project (Note 3)	1-Jan	31-Dec	47,000	46,426	46,426	46,158	46,094	46,426	46,426	46,426	46,426
	Duke Energy-Progress Hydropower												
82	Effect on Duke Energy hydropower generation	Avg. MWh/yr of hydropower produced	1-Jan	31-Dec	249,888	242,354	240,548	240,586	240,548	241,745	241,745	241,745	241,022
83		Average equivalent # of homes per year that could be powered by the hydro project (Note 3)	1-Jan	31-Dec	18,931	18,360	18,223	18,226	18,223	18,314	18,314	18,314	18,259

Notes

1 For criterion that measure on an hourly or daily basis, unless stated otherwise:

a. If an hourly criteria occurs during the average of four contiguous 15-minute periods, then it counts as 1 hour.

b. If a daily criterion occurs for 5 contiguous 1-hour periods, then it counts as 1 day.

Also, daytime flows are assumed to be flows provided between 7:00 am and 7:00 pm. To the extent possible, each criterion is defined in terms of percents and averages/yr so that the same criterion is useful regardless of the length of the hydrology period (i.e., 1-yr, 3-yr, full period of record, etc.)

2 LIP - Low Inflow Protocol for the Yadkin and Yadkin-Pee Dee River Hydroelectric Projects (Alcoa and Duke Energy Progress)

3 Calculated by [(Total Scenario MWh / 13.2 MWh per home) / the # of years in the scenario]
Power produced by the hydro projects is actually supplied to the electric system grid and is used by electric customers (including residential, industrial and commercial customers), as is power produced at other Duke Energy Progress and/or APGI generating stations. This criterion of average equivalent homes per year is intended to simply make the total energy production potential of the hydro projects more understandable to stakeholders and to put a perspective around potential differences in hydropower production between various scenarios. This measure does not imply that any number of homes will go without power if a particular scenario is chosen.

4 1955 thru 2013, inclusive (59 years)
21,550 days (59 years * 365.25 days/year)
2,068,776 15-minute time steps (59 years * 365.25 days/year * 24 hours/day * 4 time steps/hour)

5 1999 thru 2003 Drought, inclusive (5 years)
1,826 days (5 years * 365.25 days/year)
175,320 15-minute time steps (5 years * 365.25 days/year * 24 hours/day * 4 time steps/hour)

6 2006 thru 2009 Drought, inclusive (4 years)
1,461 days (4 years * 365.25 days/year)
140,256 15-minute time steps (4 years * 365.25 days/year * 24 hours/day * 4 time steps/hour)

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APPENDIX D: Technical Memorandum - Yadkin River Basin Future Water Demand Projections

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Technical Memorandum

PROJECT: Union County Yadkin River Water Supply Project – Permitting and Preliminary Engineering

DATE: October 23, 2014

SUBJECT: Water Supply Projections for Water Supply Modeling – Basis and Results

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BACKGROUND

As part of the comprehensive evaluation for securing a reliable water supply to serve customers in its Yadkin River Basin service area, the Union County Public Works Department (UCPW) has authorized HDR to provide Permitting and Preliminary Engineering assistance for the County's Yadkin River Water Supply Project (YRWSP). One of the tasks is to provide technical evaluations to support these permitting efforts. As part of these evaluations, HDR will develop a water supply model for a portion of the Yadkin River Basin (Basin). This modeling effort requires net withdrawal (withdrawals minus returns) projections for water use within each watershed of the Basin. Those using the Yadkin River Basin for water supply purposes can generally be grouped into the following major categories:

- ***Public Water Supplies and Wastewater Utilities*** – Municipal and other utility agencies with systems that withdraw and treat water for public consumption and residential, commercial, and industrial use, as well as those systems that treat wastewater and return it to a surface water source.
- ***Direct Industrial*** – These industrial users have direct withdrawals and/or returns from surface water sources and utilize water in their manufacturing processes.
- ***Thermal-Electric Power*** – The thermal-electric power facilities within the Basin that use water for cooling and other energy production needs.
- ***Agricultural and Irrigation*** – Agricultural and irrigation (A&I) users include farms, golf courses, and other facilities that use water for livestock production, irrigation, and other purposes.

For the purposes of the water quantity model, the Basin was delineated into seven incremental watersheds. Additionally, an eighth watershed, from below Blewett Falls Lake to the North Carolina – South Carolina state line, is being evaluated for water use outside of the water quantity model through a post-processing routine. These watersheds are listed below from the most upstream reservoir to the most downstream reservoir in the Yadkin Basin.

- W. Kerr Scott Reservoir
- High Rock Lake
- Tuckertown Reservoir
- Narrows Reservoir (Badin Lake)

- Falls Reservoir
- Lake Tillery
- Blewett Falls Lake
- Downstream of Blewett Falls Lake to NC-SC state line (evaluated through post-processing routine)

The boundaries of the Basin and watershed locations being used in the modeling effort are provided in Figure 1. As can be seen from the map, only a very small portion of the Basin being modeled is located within South Carolina. The area of the Basin within South Carolina was examined through aerial mapping sources and there appears to be no major water users in that area. Additionally, the United States Environmental Protection Agency's (USEPA) National Pollutant Discharge Elimination System (NPDES) website was evaluated for the portion of Chesterfield County within the Basin, and there are no discharges in that area. The South Carolina Department of Health and Environmental Controls (SCDHEC) was also contacted to determine if any withdrawals or returns exist in that portion of the state, and concurred that there are none. Based on this evaluation, South Carolina was not included in the evaluation of water uses for modeling purposes, with the exception of the A&I category, as described below.

As shown in Figure 1, there is a model subbasin within North Carolina ("Downstream of Blewett Falls Lake") that appears to lie outside the Yadkin River Basin. However, Figure 2 shows how this subbasin area is in fact included in the Yadkin River Basin, as part of the Lower Pee Dee River Basin, according to the subbasin delineations published by the North Carolina Department of Natural Resources (NCDENR) Division of Water Resources (NCDWR). This sub-basin is below the Federal Energy Regulatory Commission (FERC) regulated reservoirs and thus was considered in the modeling effort through a post-processing routine.

Also shown on Figure 1 is a small portion of the Basin is within the Commonwealth of Virginia. The area shown is rural, and no major water users have been identified within this area; therefore, Virginia was not included in the evaluation of water use, except for the A&I category.

This document summarizes the entities being evaluated, the sources for historical data, the methodology for developing water supply projections to determine net withdrawals for each watershed in the CHEOPS water quantity model for the Basin, and the results of the water supply projections.

PROJECTION METHODOLOGY

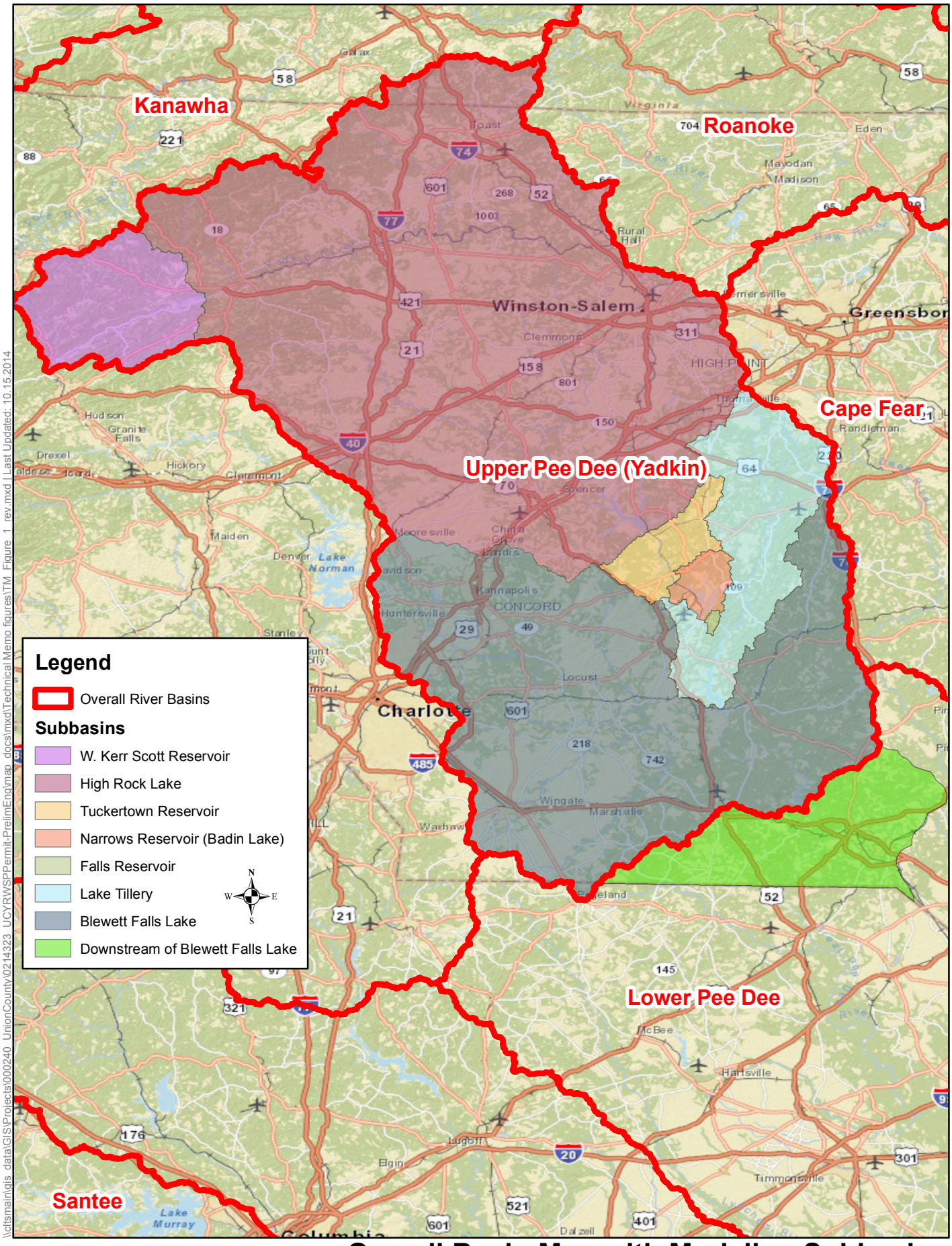
The proceeding sections describe how historical data was gathered and projections developed for each of the four water user categories. In compiling the list of current users, the focus was on those users that currently withdraw or return from a surface water source an average annual daily rate of 100,000 gpd or more from the Basin. While numerous users may withdraw or return water at rates less than 100,000 gpd, their impact on net withdrawal from the watersheds of each reservoir was considered insignificant for the long-term water quantity modeling effort. Also, the net withdrawal produced by these users would be very small relative to the overall net withdrawal resulting from the users documented in the projections.

For the North Carolina users, several databases were provided by the North Carolina Department of Natural Resources (NCDENR) Division of Water Resources (NCDWR). The databases included information from the Local Water Supply Plans (1997 to 2012), Water Withdrawal and Transfer

Registrations (1999 to 2012), and NPDES discharge data (1997 to 2014). This data was used to determine the appropriate entities to include in the evaluation, intake and discharge locations, and to obtain monthly historical water use data.

The historical water use data in the NDDWR databases was not used directly as a model input. Rather, the historical databases were aggregated into one Excel reference file, which was used to compile the model input values for both historical and projected flows. For historical flows, gaps in the data (missing months) were filled in by interpolating between known data points. For projection values, the average value from 2010 to 2012 in a given month was used as the basis ("Base Year") for making projections. Water withdrawal and returns were projected to the year 2060.

In the databases received by NCDWR, the data is separated by subbasin. However, these subbasin divisions are different than those watersheds being used for the water quantity model. Figure 2 shows the modeling watersheds with the NCDWR subbasins overlaid for reference. Figure 3 shows all of the water users being considered in this evaluation, with the modeling watersheds and County boundaries shown for reference. The entity list with the name of the facilities is also shown on Figure 3.



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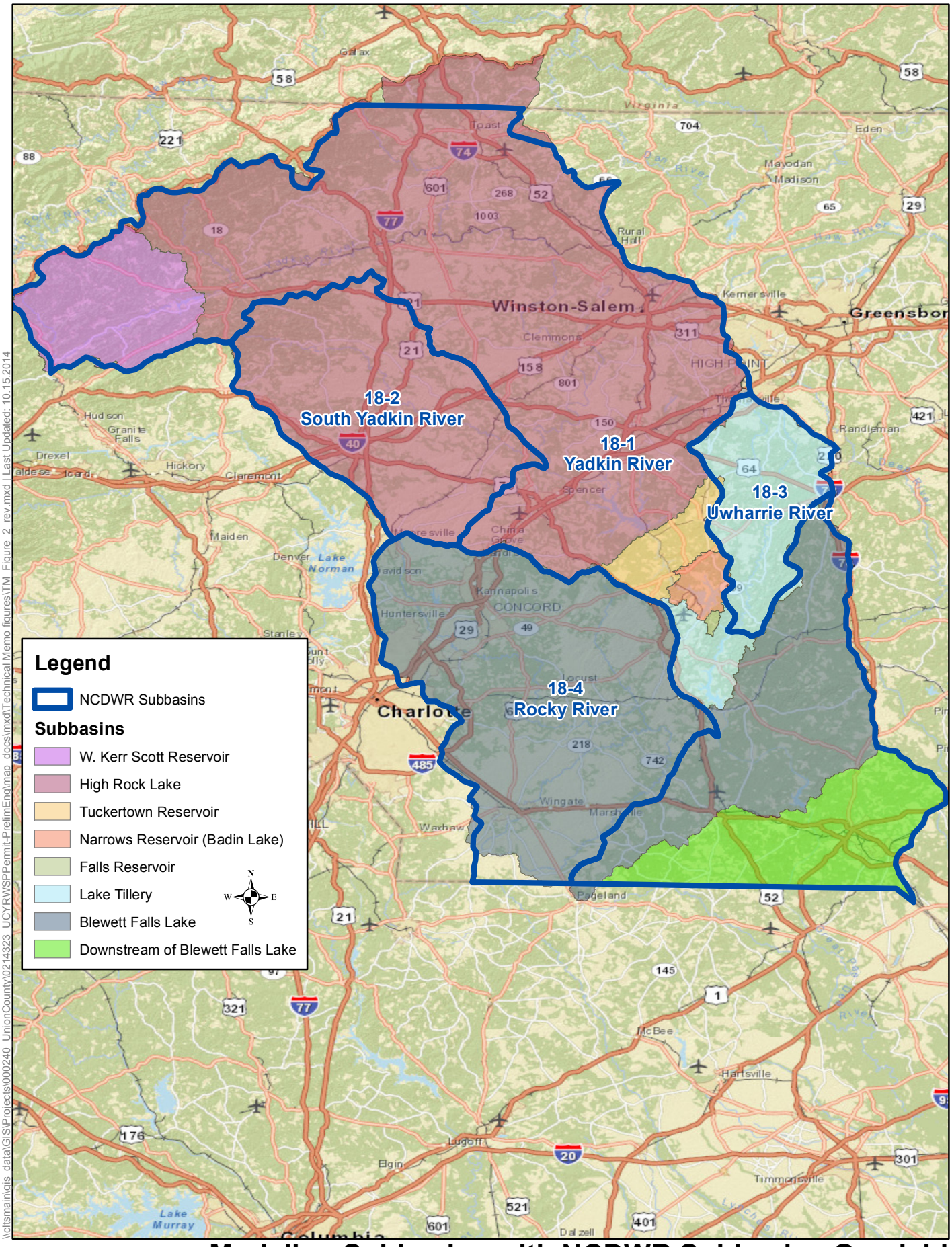
Overall Basin Map with Modeling Subbasins

Figure 1



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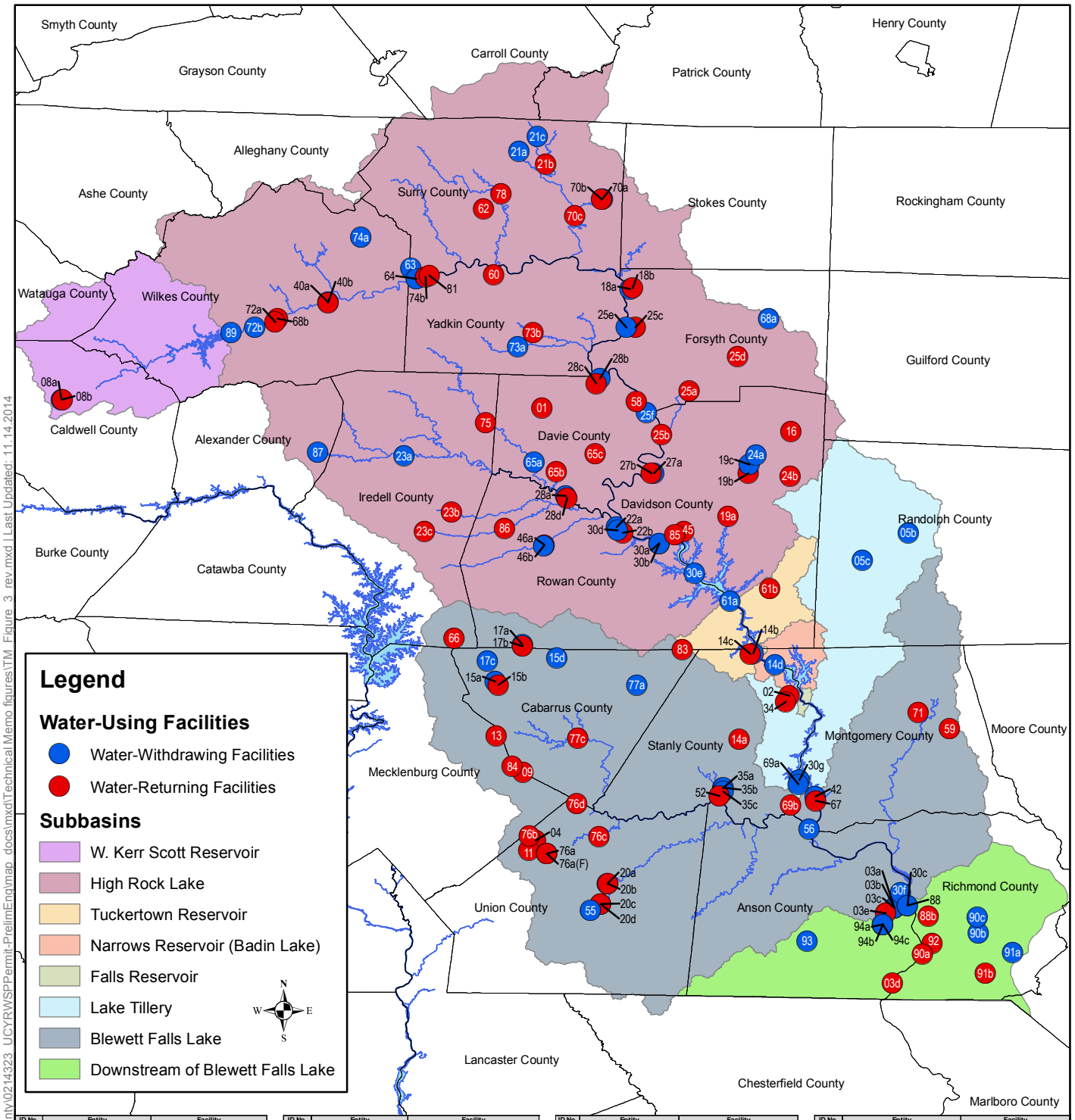
Modeling Subbasins with NCDWR Subbasins Overlaid

Figure 2



ID No.	Entity	Facility
01	Allegheny Technologies, Inc	ATI Allvac Monroe Plant
02	Aluminum Company Of America	Badin Works
03a-e	Anson County	Anson County Filtration Plant
04	Aqua North Carolina, Inc	Country Wood WWTP
05b	Asheboro	W. L. Brown Jr WTP (Lake Lucas)
05c	Asheboro	W. L. Brown Jr WTP (Lake Reese)
08a/b	Blue Ridge Tissue Corp	Patterson Mill
09	Bradfield Farms Water Company	Bradfield Farms WWTP
11	Carolina Water Service Inc of NC	Hemby Acres WWTP
13	CMUD	Mallard Creek WWTP
14a	City of Albemarle	Long Creek WWTP
14b/c	City of Albemarle	Tuckertown WTP
14d	City of Albemarle	US 52 HWY WTP
15a/b	City of Concord	Coddle Creek WTP
15d	City of Concord	Hillgrove WTP (Lake Fisher)
16	City of High Point	Westside WWTP
17a/b/c	City of Kannapolis	City of Kannapolis WTP
18a/b	City of King	City of King WTP
19a	City of Lexington	Lexington Regional WWTP
19b	City of Lexington	Lexington WTP #1 & 2
19c	City of Lexington	Lexington WTP (Lake Thom-A-Lex)
20a/b	City of Monroe	John Glenn WTP
20c/d	City of Monroe	Monroe WWTP
21a	City of Mount Airy	F. G. Doggett WTP
21b	City of Mount Airy	Mount Airy WWTP
21c	City of Mount Airy	S. L. Spencer WTP
22a	City of Salisbury	Salisbury WTP
22b	City of Salisbury	Salisbury-Rowan WWTP

ID No.	Entity	Facility
23a	City of Statesville	City of Statesville WTP (S. Yadkin River)
23b	City of Statesville	Fourth Creek WWTP
23c	City of Statesville	Third Creek WWTP
24a	City of Thomasville	City of Thomasville WTP
24b	City of Thomasville	Hamby Creek WWTP
25a	City of Winston-Salem	Archie Elledge WWTP
25b	City of Winston-Salem	Muddy Creek WWTP
25c/e	City of Winston-Salem	P. W. Swann WTP
25d	City of Winston-Salem	R. A. Thomas WTP
25f	City of Winston-Salem	R.W. Neilson WTP
27a	Davidson Water Inc	C. O. Pickle WP
27b	Davidson Water Inc	Davidson Water WTP
28a	Davie County	Cooleemee WTP
28b/c	Davie County	Sparks Road WTP
28d	Davie County	Cooleemee WWTP
30a	Duke Energy Carolinas, LLC	Buck Steam Station
30b	Duke Energy Carolinas, LLC	Buck Combined Cycle Station
30c	Duke Energy Carolinas, LLC	Smith Energy Complex
30d	Duke Energy Carolinas, LLC	Additional Combined Cycle Station #1
30e	Duke Energy Carolinas, LLC	Additional Combined Cycle Station #2
30f	Duke Energy Carolinas, LLC	Additional Nuclear Plant #1
30g	Duke Energy Carolinas, LLC	Additional Nuclear Plant #2
34	Greater Badin W&SD	Badin WWTP
35a/b/c	Hedrick Industries	Aquadale Quarry
40a	Louisiana Pacific Corporation	Louisiana Pacific Corporation
40b	Louisiana Pacific Corporation	LP Roaring River WWTP
42	Montgomery County	Montgomery County WTP

ID No.	Entity	Facility
45	PPG Ind. Fiber Glass Products	PPG Industries Fiber Glass Products
46a/b	Performance Fibers, Inc	Salisbury Facility
52	Stanly County	West Stanly WWTP
55	Teledyne Allvac	Monroe Plant
56	The Fork, LLC	The Fork, LLC
58	Town of Bermuda Run	Bermuda Run WWTP
59	Town of Biscoe	Biscoe WWTP
60	Town of Boonville	Boonville WWTP
61a	Town of Denton	Denton WP
61b	Town of Denton	Denton WWTP
62	Town of Dobson	Dobson WWTP
63	Town of Elkin	Elkin Municipal WTP
64	Town of Jonesville	Jonesville WP
65a	Town of Mocksville	Hugh A. Lagle WTP
65b	Town of Mocksville	Bear Creek WWTP
65c	Town of Mocksville	Dutchman Creek WWTP
66	Town of Mooresville	Rocky River WWTP
67	Town of Mount Gilead	Mount Gilead WWTP
68a	Town of North Wilkesboro	North Wilkesboro WP
68b	Town of North Wilkesboro	Thurman Street WWTP
69a	Town of Norwood	Norwood WTP
69b	Town of Norwood	Norwood WWTP
70a/b	Town of Pilot Mountain	Pilot Mountain WTP
70c	Town of Pilot Mountain	Pilot Mountain WWTP
71	Town of Troy	Troy WWTP
72a	Town of Wilkesboro	Cub Creek WWTP
72b	Town of Wilkesboro	Wilkesboro WFP

ID No.	Entity	Facility
73a	Town of Yadkinville	Yadkinville WTP
73b	Town of Yadkinville	Yadkinville WWTP
74a	True Textiles, Inc	True Elkin, Inc.
74b	True Textiles, Inc	304 East Main Street Plant
75	Tyson Foods, Inc	Harmony Plant
76a	Union County Public Works	Crooked Creek WWTP #2
76b	Union County Public Works	Hunley Creek WWTP
76c	Union County Public Works	Grassy Branch WWTP
76d	Union County Public Works	Tallwood Estates WWTP
77a	WSA of Cabarrus County	Mt. Pleasant WTF
77c	WSA of Cabarrus County	Rocky River WWTP (WSACC)
78	Wayne Farms LLC Bruckie Ashburn	Dobson Plant
81	Yadkin Valley Sewer Authority, Inc	Yadkin Valley S.A. WWTP
83	Carolina Stalite Company	Carolina Stalite Company
84	City of Charlotte	Cabarrus Woods WWTP
85	Norfolk Southern Railway Company	Linwood Yard
86	Town of Cleveland	Cleveland WWTP
87	Energy United Water	Energy United Water WTP
88/88b	Richmond County	Richmond County WTP
89	Wilkes County	Wilkes County WTP (Future)
90a	City of Rockingham	Rockingham WWTP
90b/c	City of Rockingham	Rockingham WTP
91a	City of Hamlet	Hamlet WTP
91b	City of Hamlet	Hamlet WWTP
92	Burlington Industries LLC	Richmond Plant
93	Town of Wadesboro	Town of Wadesboro WTP
94a/b/c	B.V. Hedrick Gravel And Sand Co.	Hedrick Mine (Pump House 1/2/3)

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Water-Using Entities Considered in the Current Study

Figure 3

Public Water Supplies and Wastewater Utilities

- Historical Data Source: Databases provided by NCDWR. Monthly withdrawal and discharge data for each year from 2007-2012 were analyzed to determine annual averages. Monthly coefficients based on the monthly average divided by the annual average were calculated using the historical data record of each entity for use in the water quantity model.

- Projection Methodology

    - Projections for water withdrawals were based on the projected annual growth rate (AGR) of the County being served for the majority of the entities. The projected AGR takes into account historical population data for the state from the 2010 Census and population projections prepared by the North Carolina State Office of Budget and Management. For larger entities in the basin, the projections from the Local Water Supply Plans were used. This alternate methodology was chosen because growth was assumed to occur in the larger cities at a faster rate than the overall County AGR. Local Water Supply Plan projections were not used for all withdrawal entities because some entities' projections appeared intuitively incorrect – either overly aggressive (i.e., growth rates far exceeding historic values) or overly conservative (i.e., negative growth rates). Using the Census AGR values (or if the Census AGR was low, a minimum AGR of 0.25%) for these entities provided a reasonable growth projection without giving undue weight to any one entity's projections. The notes in each of the detailed entity sheets denote whether an AGR projection or a Local Water Supply Plan projection was used for that entity.

    - For water treatment plant backwash returns, the average historical backwash return as a percentage of water use from 2010 to 2012 was applied to the water withdrawal projections.

    - The wastewater treatment plant projections for returns were based on the projected annual growth rate for the County being served or the average historical return as a percentage of water use from 2010 to 2012 applied to the water withdrawal projections, depending on the methodology used for the withdrawal projections.

Direct Industrial

- Historical Data Source – Databases provided by NCDWR. Monthly withdrawal and discharge data for each year from 2007-2012 were analyzed to determine annual averages. Monthly coefficients based on the monthly average divided by the annual average were calculated using the historical data record of each entity for use in the water quantity model.

- Projection Methodology – The projections for industrial withdrawals and returns were based on the specific industry and the gross state product (GSP) for that industrial sector. Historical data from the Bureau of Economic Analysis from 1997-2012 was used to calculate a long term GSP growth percentage for the specific industry sector. The overall GSP growth percentage for industry in North Carolina was also used as a reference. If the industrial sector showed a negative GSP growth percentage, a zero percentage growth was assigned in the projections to be conservative. An estimate for future industry was also added to the projections. This assumed 0.5 MGD per year in the smaller basins (Tuckertown Reservoir, Badin Lake and Falls Reservoir), 1 MGD per year in the larger basins (High Rock Lake, Lake Tillery and Blewett Falls Lake) and no future industry in the W. Kerr Scott Reservoir basin.

Thermal Electric Power

- The only thermal-electric power facility in the Basin that meets the criteria for water supply evaluation outlined in this document is Duke Energy's Buck Combined Cycle facility. Duke Energy provided historical use and projections for this facility. The Smith Energy Complex (Duke Energy combined cycle facility) also receives water from the Yadkin basin through the Richmond County water system. Historical data for the Smith Energy Complex was received from Richmond County and projections were provided by Duke Energy. Future power facility projections were also provided by Duke Energy. These included two potential future additional combined cycle stations, one in High Rock Lake and one in an upstream tributary of High Rock Lake, and two potential future nuclear plants, one in Blewett Falls Lake and one in Lake Tillery.

Agricultural and Irrigation (A&I)

- Historical Data Source: Data were obtained from the U.S. Geological Survey (USGS) in five-year increments for North Carolina, South Carolina and Virginia, on a per-county basis (USGS, 2014). The USGS data provided crop plus golf (combined) and livestock surface water withdrawals between 1990 and 2000. In 2005, water usage data were further disaggregated into separate crop, livestock, and golf course surface water withdrawal categories.

- Projection Methodology: A&I users required a multi-step process to project usage within the Basin. Data on specific agricultural and irrigation withdrawals are limited. Therefore, the following approach was used to forecast A&I usage. It should be noted that the A&I forecasts incorporate four main assumptions.

    - A&I water withdrawals are completely consumptive (i.e., no surface returns). The majority of A&I water used for irrigation and livestock is consumed and is not returned to the Basin.

    - A&I water withdrawals for a given county are consumed uniformly over that county's land area. In the absence of more detailed land use data, A&I water use is assumed to be distributed equally throughout the county.

    - The percentage of a county's land area within a particular reservoir's watershed is commensurate with the percentage of that county's total A&I water withdrawal taken from that watershed. For example, if 25 percent of a county's land area resides within a particular watershed, it was assumed 25 percent of that county's A&I water demand is satisfied by the reservoir associated with that watershed. In the absence of more detailed land use data and changing land use in the Basin, this approach was used.

    - Private irrigation by individual residential properties directly from Project reservoirs is considered to represent a negligible impact on the net withdrawals from the Project reservoirs. While there may be numerous residential irrigation users, their average daily withdrawals are relatively small relative to other user types in this evaluation. Additionally, because these properties are adjacent, or nearly adjacent, to the reservoirs, much of the water withdrawn is likely transferred into the groundwater and feeds back into the reservoirs.

  Projections were completed for each watershed within the Basin. For example, A&I usage was calculated for Lake Tillery separately from Blewett Falls Lake. A GIS database was developed to determine the percentage of each county that lies in each watershed within the Basin.

The water withdrawal trends for A&I were evaluated from 1990 through 2005. The A&I water use reported in the USGS database varies considerably between reporting years, and no definitive trend in water use (increase or decrease) exists. Therefore, the use of an AGR for water use projections is not relevant for the A&I category. Instead, to forecast A&I water withdrawals for each county, the greatest water withdrawal from the 1990, 1995, 2000, and 2005 USGS datasets was selected as the county water use for all future A&I consumption, by category. For each category (golf, crop, and livestock), these values were multiplied by the percentage of each county that lies within each reservoir's watershed. This value serves as the basis for A&I water use projections for each watershed, and is the same value for each projection decade (i.e., no increase or decrease in A&I water use over the Study Period).

A monthly coefficient was established for the A&I water withdrawals to account for irrigation use trends during the irrigation season of each year. North Carolina Agricultural Use Data from 2009-2011 was used from the North Carolina Department of Agriculture and Consumer Services. Data for irrigation and livestock withdrawals, not including aquaculture, was used. The monthly coefficient was developed by taking the 2009-2011 average monthly withdrawals divided by the total average yearly withdrawals for those years.

RESULTS

The following summarizes the withdrawals, returns and net withdrawal projections for the Yadkin-Pee Dee River Basin using the methodology described above. The first set of results is summarized based on each of the major user categories for the entire basin. Figure 4 shows the projections for the Public Water Supplies and Wastewater Utilities. As this figure shows, the withdrawals and returns grow at a similar rate to 2060, resulting in the net withdrawal remaining fairly constant through the projection period. One of the reasons for this is there are several entities that withdraw water from outside of the basin, but return it within the basin. Also, for those entities that the wastewater returns were projected based on the average return as a percentage of water use, the percentages were fairly high, with many exceeding 90%. This could be indicative of systems with high inflow and infiltration in the collection system.

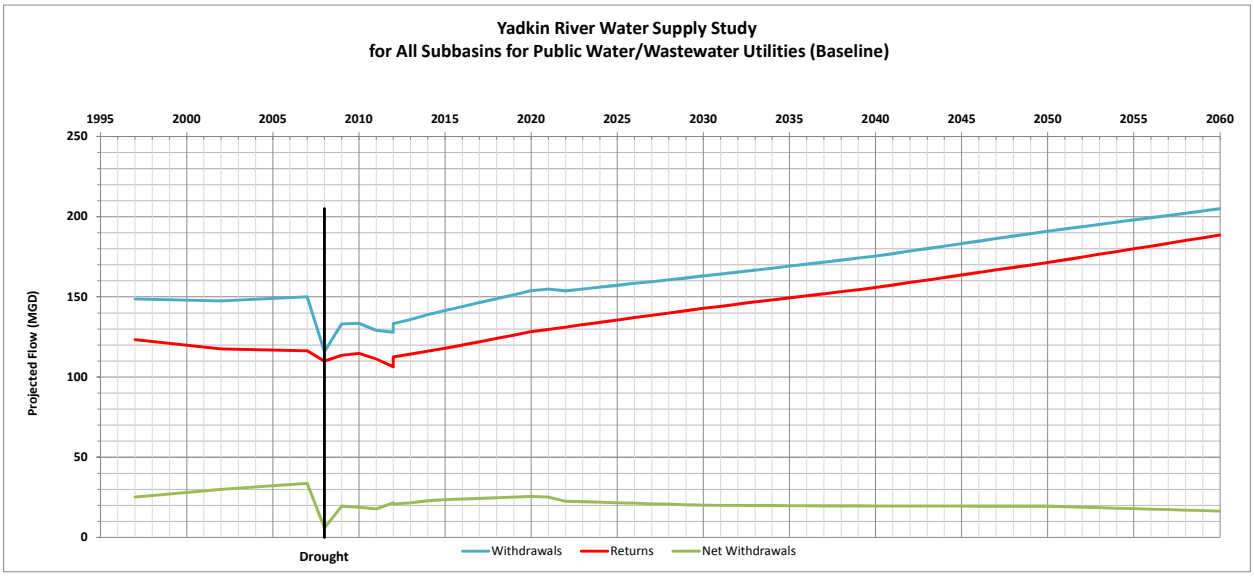

Figure 4

Figure 5 provides the projections for the Direct Industrial category. All but one of the existing industries had a negative GSP for the industrial sector. Zero percent growth was used for these industries, as shown by the constant projections. The future industrial flows were added in 2020, thus the increase to industrial flows shown at that time. The irregular shape of the historical data in years 2007 to 2012 is driven by the Hedrick Mine in the Downstream of Blewett Falls Lake subbasin; Hedrick's flows fluctuated greatly during that time period.

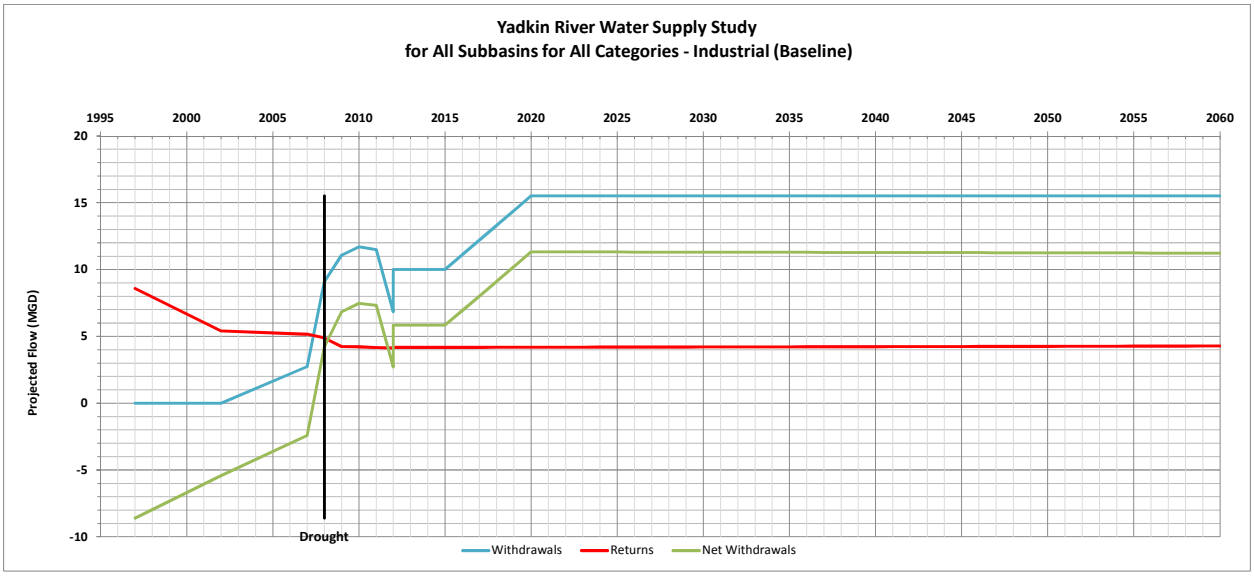

Figure 5

Figure 6 shows the projections for the Power category. All power use is shown as a net withdrawal. These projections include an additional combined cycle plant in the time frame of 2020 to 2049 and an additional combined cycle plant and two nuclear plants in 2050.

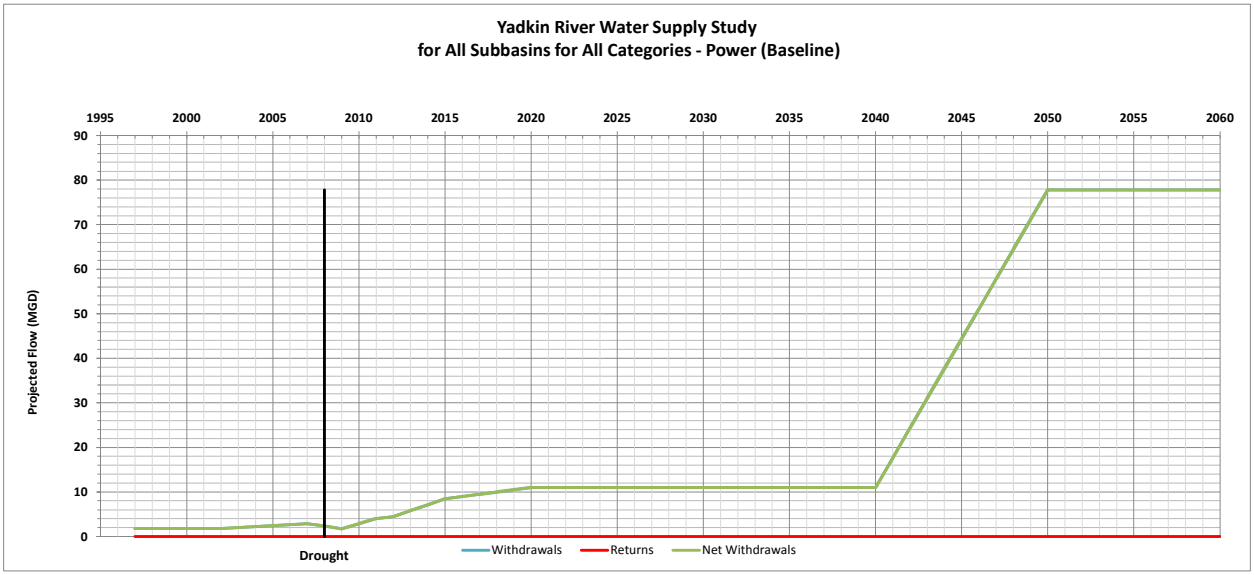

Figure 6

Figure 7 shows the results of the Agricultural and Irrigation (A&I) projections. All A&I use was considered a net withdrawal. The AI& projections were developed based on a constant net withdrawal over the projection period using the greatest withdrawal data from the USGS data as the basis.

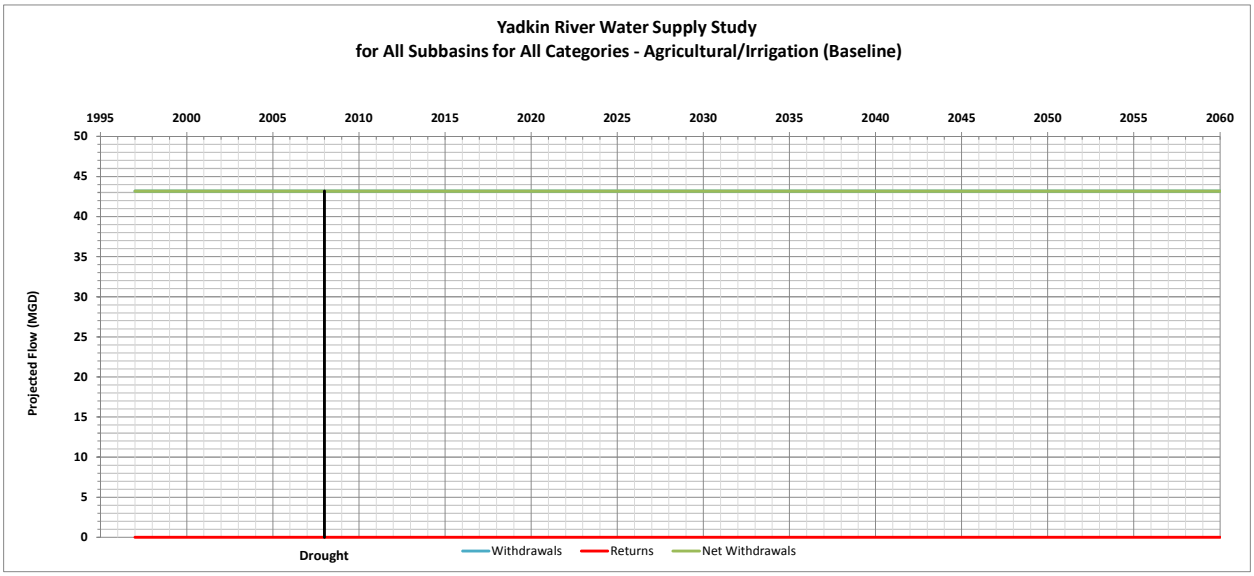

Figure 7

Figure 8 provides the withdrawals, returns and net withdrawals for all categories by subbasin for the Base Year, which is the average of 2010 to 2012.

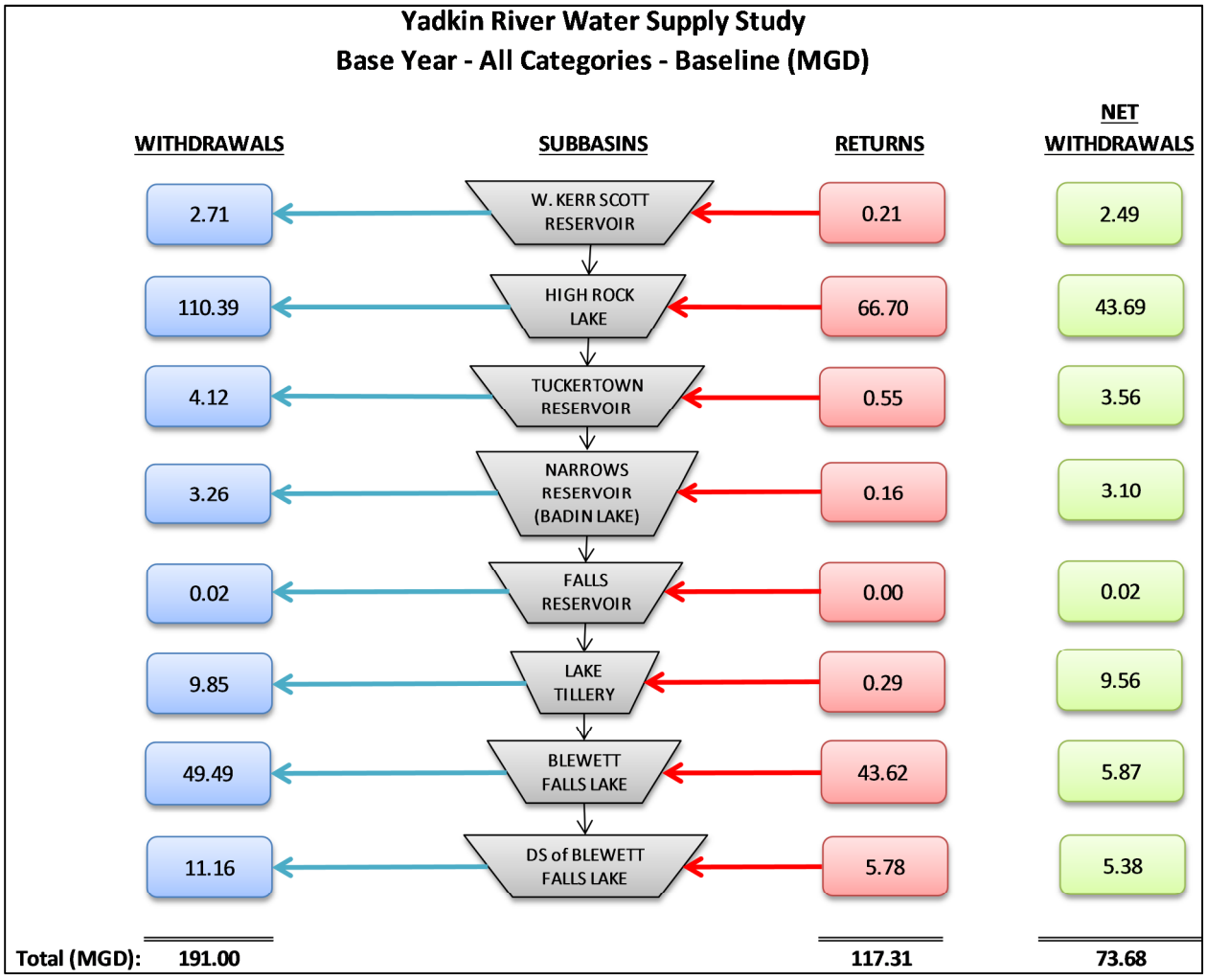

Figure 8

Figure 9 provides the withdrawals, returns and net withdrawals for all categories by subbasin in 2060.

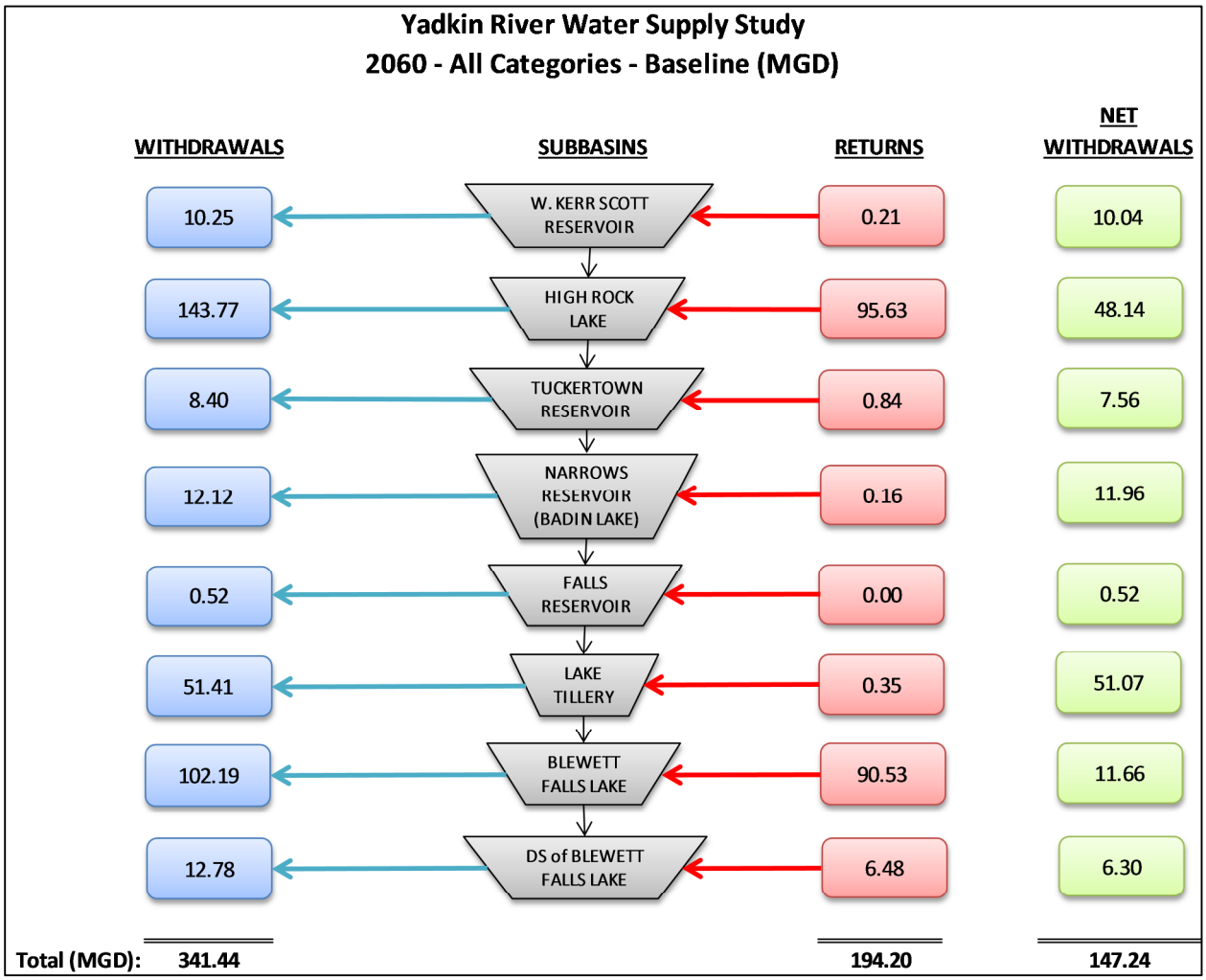

Figure 9

SUMMARY

The projected net withdrawals depicted in Figure 8 and Figure 9, above, are driven by a series of circumstances and assumptions captured in the model. One circumstance is the high rate of return exhibited by public water and wastewater utilities - many entities return more than 90% of the water that they withdraw. This value is higher than typical, but can be partially explained by high inflow and infiltration (I&I) in the wastewater collection systems. Additionally, there is significant inter-basin transfer (IBT) occurring from the Catawba River Basin to the Yadkin River Basin. This inflates the return flow values and creates the appearance of higher-than-actual rates of return for some public utilities. Finally, the rural nature of the Yadkin River Basin means there are few large municipalities or industries to withdraw water for consumptive use (e.g. lawn irrigation); this reduces the net withdrawals compared to more highly-developed basins in the state.

One factor that drives the projections toward higher consumptive use is the increase in projected withdrawals for power facilities beginning in the base year and increasing step-wise through 2060 as new facilities come online. Power utilities within the region project the need for these new facilities to meet increasing base load power demands throughout their service areas as future population increases. These power facility flows represent a large fraction of the projected withdrawals in 2060 for the Lake Tillery and Blewett Falls Lake basins, and a smaller but still significant fraction of the 2060 High Rock Lake basin withdrawals.

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