Hazen

Data Collection Report – Yadkin-Pee Dee and Lumber River Basins

February 2021

Table of Contents

Section 1. Introduction

The North Carolina Division of Water Resources (DWR) contracted with Hazen to develop an OASIS model of the Yadkin-Pee Dee and Lumber River Basins. As part of that effort, Hazen collected impairment data on water withdrawals, water discharges, and reservoir operations to support the development of the inflows and the associated simulation run of current basin-wide operations. The objective of the data collection effort was to provide impairment data that spanned the hydrologic period from 1930 to 2018, the most recent year for which all impairment data were available. This report summarizes the data collection effort. This effort has been consistent with previous OASIS models developed for the state, including the Tar, Broad, Cape Fear, Neuse, Roanoke, French Broad, New, and Watauga river basins. Prior data collection has been done by other consultants, including Moffatt and Nichol and HDR, and this report summarizes the key methodological assumptions used in all these past studies.

The objective of the data collection effort is twofold. First, to unregulate or unimpair the historic streamflow gaging records so that the historic inflows are not influenced by past operations. This allows the modeler and policy makers to evaluate the impacts of alternative basin-wide operations. Second, to develop a basecase scenario for current system operations, which would include the current level of water use and wastewater returns in the basins. For consistency, Hazen compared and successfully matched its current estimates with those from HDR that were prepared for the Yadkin-Pee Dee Water Management Group as part of the projection of water needs in the Yadkin-Pee Dee (*YPDWMG Long Range Water Demand Projection Updates TM_ final*, HDR, July 2019). This analysis was done on a sub-basin level in the Yadkin-Pee Dee corresponding to each of the mainstem reservoirs (from the headwaters of the basin down to Kerr Scott, then High Rock, Tuckertown, and so on downstream beyond Blewett Falls to the North Carolina/South Carolina border). The only key difference with the HDR study is in the agricultural water use estimation, in which HDR used a simplified approach based on USGS data. The method we used, as described below, is consistent with past OASIS data collection efforts using agricultural census data and rainfall-dependent calculations. Subsequent comparisons between the two approaches showed good overall agreement.

The summary of the data collection process was provided as a slide deck to the Technical Review Committee (**TRC_Meeting_1_Sept_01_2020.**pptx**,** Sept. 2020 **and Inflow Development_TRC Meeting 1.**pptx, Oct. 2020)

Section 2. Agricultural Water Use Data

The Department of Agriculture (National Agricultural Statistics Service) publishes census data at the federal, state, and county level every five years back to 1930. Additionally, there are surveys conducted on a more frequent basis, but these have been shown in previous data collection efforts by Moffatt and Nichol to be less reliable than the census data.

There are over 35 counties in the two basins combined, a few of which are in Virginia and South Carolina. Part or all of the county drains into the basins, so we mapped the basins and allocated the percent area of each county in the basin to estimate the amount of agriculture water use in the basins. Additional adjustments were made as follows. In general, we assumed water use was uniformly distributed in the county; however, if input from extension agents or other sources suggested otherwise, we would adjust that assumption. An example is golf in Moore County (Pinehurst), which is concentrated in the part that lies in the Lumber basin. The second adjustment was for the ground and surface water contributions to the irrigation. The focus of the data collection is on surface water since the stream gages that are being unregulated measure surface water. We relied on companion USGS water use reports, published every 5 years since the mid-1980s, to estimate the breakdown between ground and surface water use in each basin.

The census reports provide detailed information on cropping patterns (including acreage for irrigated and non-irrigated lands) as well as livestock counts. The level of detail, both in terms of crops and livestock, have increased over time. Electronic census data are only available since 1997, so these were downloaded into spreadsheets. Prior to then, available scanned reports were used to identify trends using select years, including 1930 and 1969, as beginning and intermediate points in the 90+ year inflow record from 1930 to present. These data are summarized in the spreadsheet called **"Ag summary by county_by census year.**xlsx**"**.

From this spreadsheet, for each county, we interpolated linearly to estimate water use between these years. These summaries for each county are captured in the spreadsheets called **"Ag summary by county_[county name].**xlsx**"** and span the inflow record. The allocation in this file between surface and ground water irrigation is based on the spreadsheet called **"summary of USGS data for state and county for 2015 and county for all years.**xlsx**"**.

In general, irrigation was limited prior to the 1950s. The increased availability of lighter weight pipe and technical developments like pivot irrigation soon followed, making irrigation more accessible for larger areas of land. Irrigation basin-wide, however, as a percentage of all the land that is cropped tends to be fairly low. This is shown in Figure 1 for all the North Carolina counties in the two basins based on the 2017 census. Of the land that is cropped and harvested,

only a small fraction on an annual basis is irrigated. Nonetheless, the timing of irrigation often conflicts with surface water availability, so it is important to track agricultural water use when it is most used (summers) and how it affects streamflow.

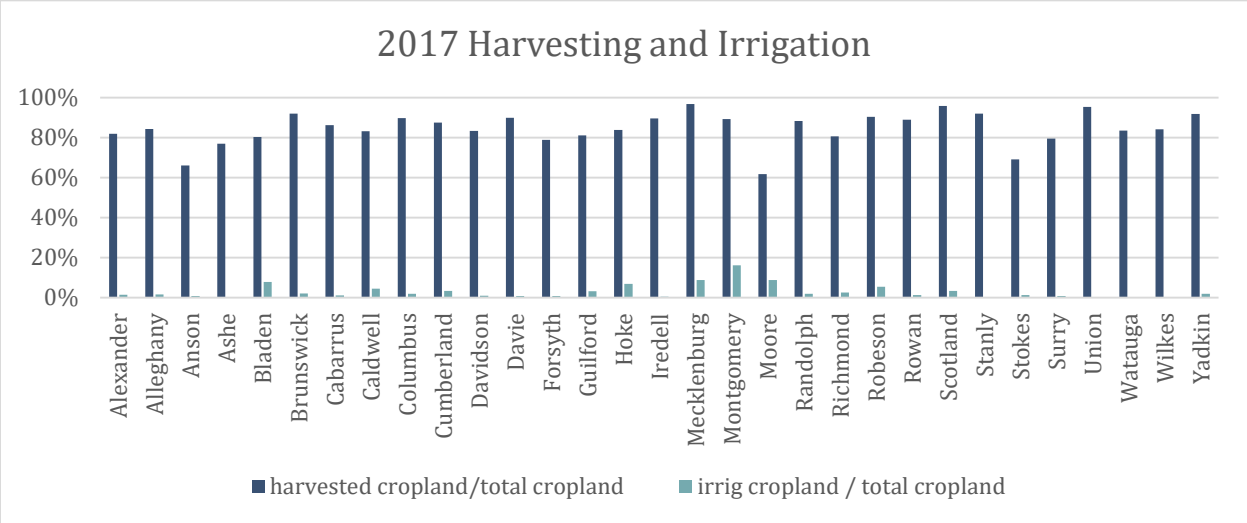

Figure 1: Irrigation Use By County

Consistent with other OASIS models, it is assumed that some crops like fruits are irrigated with a fixed water amount (dependent on time of year) regardless of rainfall, while others like wheat, corn, and cotton account for rainfall. For these crops, water use requirements (using the crop's evapotranspiration curves) are compared to the weekly rainfall and should there be a rainfall deficit, then irrigation makes up the difference. Precipitation records for the historical period from 1930 to present were collected by Hazen based on multiple stations throughout the basin that operated for part or all of this time.

As with previous efforts, we also account for cropping patterns throughout the year. For example, corn is assumed to be planted in mid-April in these basins and harvested in mid-October. The water use requirement peaks in June. The crops with rainfall-dependent irrigation are shown in Figure 2 with their ET curves.

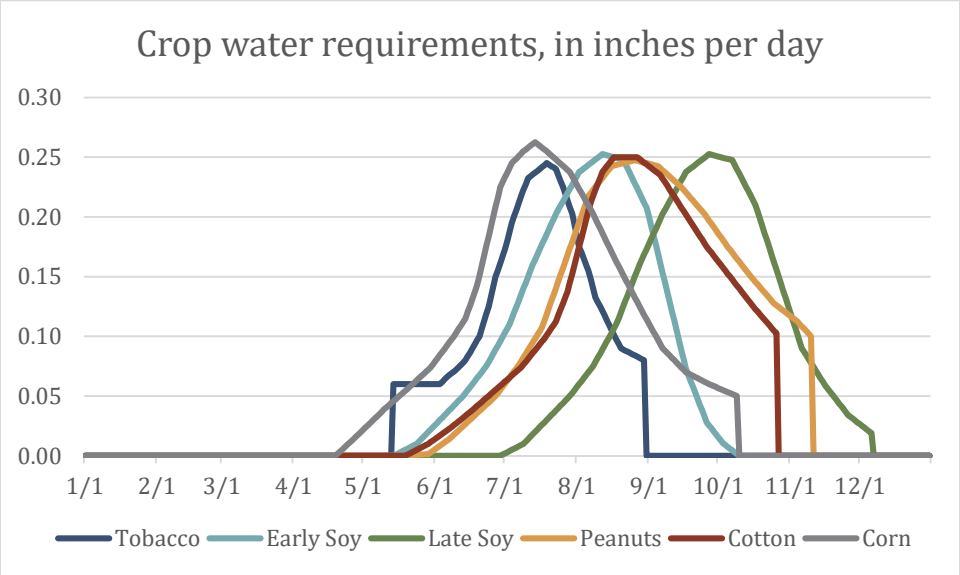

Figure 2: Crop Water Requirements By Crop

As mentioned, the amount allocated to irrigation from surface water and ground water is identified for each county. The total demand for crop irrigation surface water use is the number of acres of land draining to the basin times the irrigation need times the percentage of surface water used.

The total demand for livestock irrigation surface water use (including cattle, poultry, and pigs) is the count of livestock in the county draining to the basin times the irrigation need times the percentage of surface water used. Irrigation need for livestock is based on animal water use

requirements. These water use requirements are fixed year round; for example, dairy cattle are assumed to use 40 gallons per day per head.

Crop and livestock water use requirements (evapotranspiration curves) rely on those estimates from prior OASIS data collection efforts, modified as needed for planting start and end dates that vary based on regional climate differences. Also, assumptions were made consistent with previous reports on when irrigation use started. For example, it is assumed that there was no irrigation of tobacco prior to 1950. These assumptions are detailed in prior basin model reports, including the Broad River Basin and Tar River Basins by Moffatt and Nichol (e.g., "*01_TRBM_Agri_Data_Report_M&N_01-31-2011.pdf***"** for the Tar) and one for the French Broad, New, and Watauga by HDR called "*01_FBRHM&NWRHM_AgIrrig_Data_HDR_Final_Report_20181108.pdf*".

The summary of agricultural water use for crops and livestock (surface water irrigation) in each county is summarized in the previously-referenced spreadsheet called **"Ag_Use_Calculations_By_County_1929_present.**xlsx**".**

This county surface water use is then allocated to the basin based on the percent of land in the basin, again generally assuming equal distribution of agriculture throughout the basin. For consistency, the allocation percentage matches those used in the HDR water use projections study for the Yadkin-Pee Dee (refer to the memo described earlier), in which the water use for agriculture is assigned to the subbasins identified by HDR, starting upstream at Kerr Scott and ending downstream of Blewett Falls.

This allocation from the county level to the subbasin level is done in the OASIS model run in the OCL file called **Agric_Allocation.**ocl. As an example, agriculture water use in the Tillery Reservoir sub-basin is set at 7% of the Davidson County demand, 20% of the Montgomery County demand, 36% of the Randolph County demand, and 18% of the Stanly County demand. A geographical view of the county and basin-wide allocation for both the Yadkin-Pee Dee and Lumber basins is shown in Figure 3.

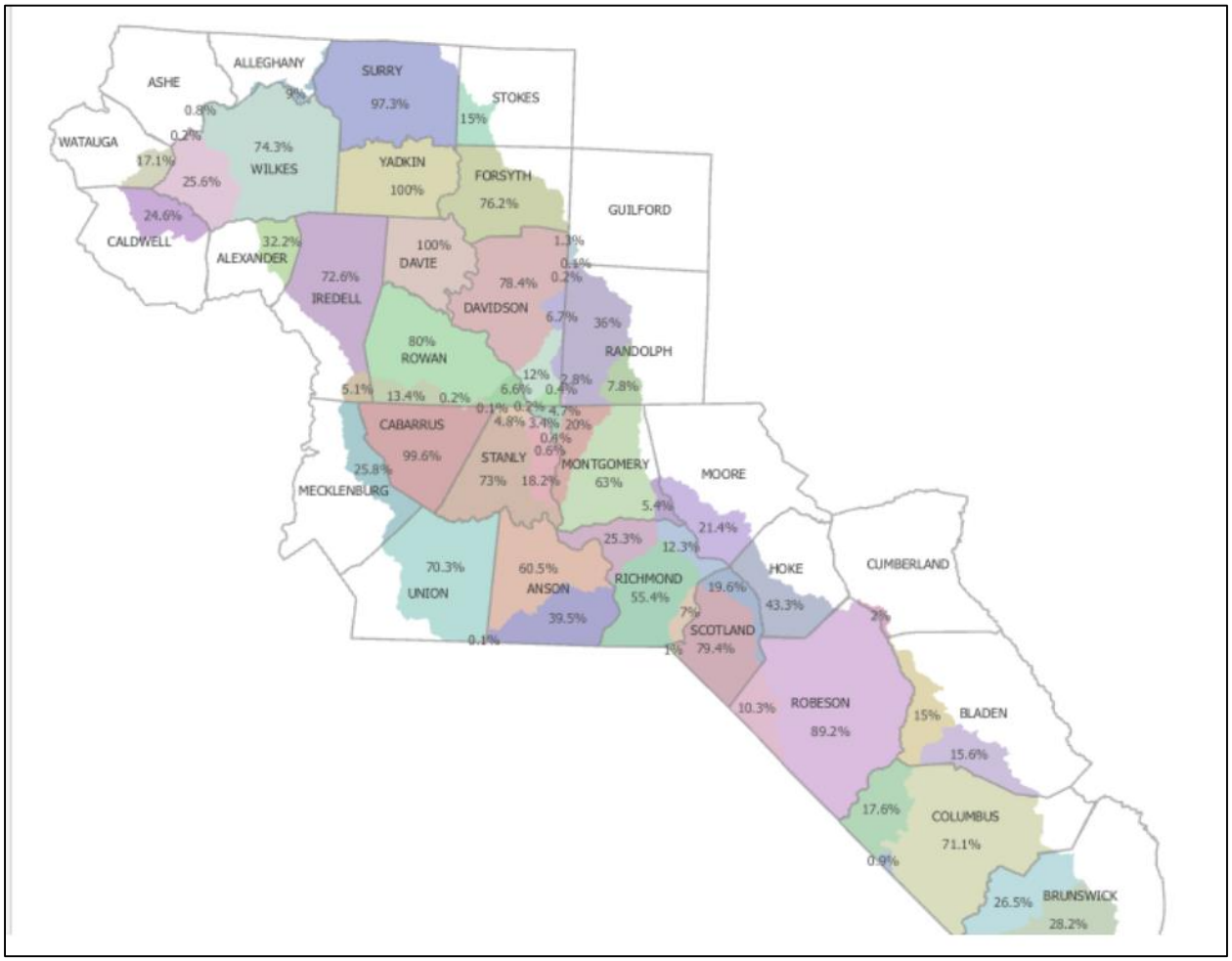

Figure 3: Allocation of Water Use By County in North Carolina to Sub-Basins

Section 3. Municipal and Industrial Water Use Data

DWR provided Hazen with various databases, including the Local Water Supply Plan (LWSP) database for the municipal entities and the Water Registration (WWATR) database for the industrial entities. The entities used in the model are limited to those that withdraw surface water on an average day basis of 100,000 gallons per day (0.1 mgd) or more. Exceptions are made for those with seasonal withdrawals that meet this threshold, but those entities tend to be few in number.

The LWSPs provide monthly data every five years of surface water use starting in 1997, then every year starting in 2007 when annual reporting became a requirement. The WWATR database provides monthly water use data starting in 1999. LWSPs provided particularly valuable information on how much of that water consisted of a withdrawal from the river and how much was purchased from other systems. For inflow development, we are interested in how much water was withdrawn from the river upstream of a gage; that amount would then be added back to the gage flow to estimate the "natural" or unimpaired flow at the gage. We used the purchase information to help with the model basecase run development in which we track both withdrawals and transfers (sales/purchases) between systems.

We filled in gaps in the datasets using linear interpolation. In order to unregulate streamflows prior to these years, we "hindcasted" the annual water use for these entities. This was done based on population (at the county or local level) for the public water suppliers and on GDP (at the industry level) for the industrial withdrawals. We converted the annual hindcasts to monthly estimates by applying a monthly pattern derived from the years of available data. We factored in start and stop dates for the facilities to accurately represent the timing of the surface water withdrawal. For example, if a utility only began withdrawing surface water in the 1980s and prior to that was reliant on groundwater, the hindcast of surface water withdrawal would only extend back to the 1980s. A sample hindcast is shown in Figure 4 for the city of Concord's surface water withdrawal from Coddle Creek:

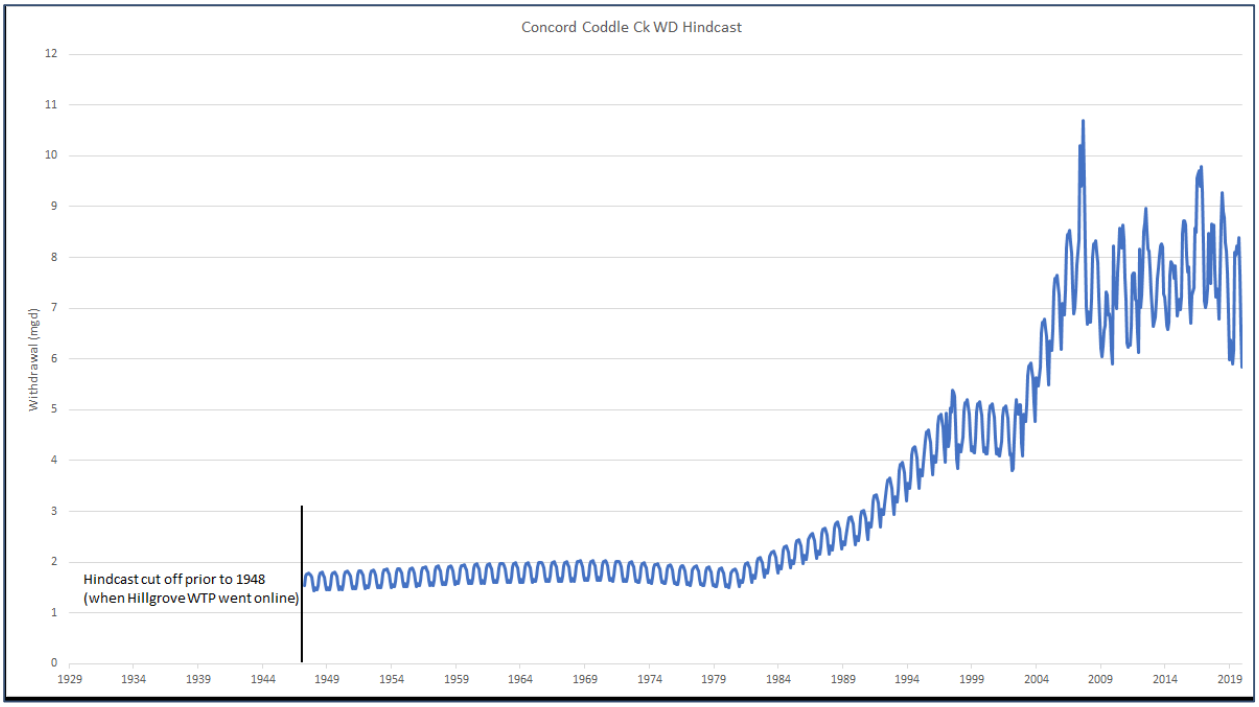

Figure 4: Sample Hindcast of Municipal Surface Water Withdrawals

We also reached out to the utilities directly as needed to confirm or supplement the data in the databases, including facility operational dates. These data are ultimately captured in the inflow development files (detailed in Hazen, 2020, *Appendix B - Finalized Inflow Data Development.docx*) which capture the gaging data, the impairment data, and the resulting unimpairment of the gaging data for the 1930 to present inflow record.

Appendix A in this document provides the entities that are included in the inflow unimpairment and model development process.

Section 4. Municipal and Industrial Discharge Data

DWR also provided Hazen with the NPDES database which captures all water dischargers, including wastewater, water treatment plant process water, and stormwater. As mentioned, the threshold used in the inflow and model development is 0.1 mgd, with consideration for seasonal dischargers. The database provided us with at least monthly data since the mid-1990s. Supplemental data from entities was used as needed, including information from the LWSP database for public entities. Many of the dischargers included in the analysis do not have a companion surface water withdrawal (instead they draw on ground water or purchase water), but they are included in the inflow and model development since they are discharging to the surface water. Some of the dischargers are regional entities, collecting wastewater from multiple systems, like Anson County and the Water and Sewer Authority of Cabarrus County (WSACC).

For inflow development, we are interested in how much water is returned upstream of a gage; that amount would then be subtracted from the gage flow to estimate the "natural" or unimpaired flow at the gage. Hindcasting followed the same approach as with the withdrawals, using either population data for the municipal discharges or GDP for the industrial discharges, and adjusted for facility operational dates.

For consistency with HDR's basin-wide water use projections report referenced earlier, we treated the power plant withdrawals as a net withdrawal – that is, withdrawal less discharge—since the two are assumed to be in close proximity.

.

These data are contained in the inflow development spreadsheets mentioned above. Appendix A in this document provides the entities that are included in the inflow unimpairment and model development process.

Section 5. Reservoir Operations Data

For inflow unimpairment, the change in contents for the reservoirs needs to be quantified. In this case, the change in storage due to net evaporation on the lake, as well as the remaining change in storage (due to water supply withdrawals, minimum releases, and differences in inflows and outflows), must be added back to the flow at any gage that is downstream of the reservoir. A positive change in storage in the reservoir means water was withheld from the downstream gage, so the natural flow at the gage would have been higher without the reservoir in place.

Net evaporation data collection is described in the previously referenced inflow development report (*Appendix B*). For storage data, we reached out to utilities and power companies with reservoirs to quantify change in contents. These operators included some of the larger systems that have more influence on the streamflow, including WSACC, Asheboro, Winston-Salem on the tributaries, and the Corps of Engineers and power companies on the mainstem Yadkin-Pee Dee. Figure 5 provides a graphic of the reservoirs in the basins,and puts into context their relative storage capacities.

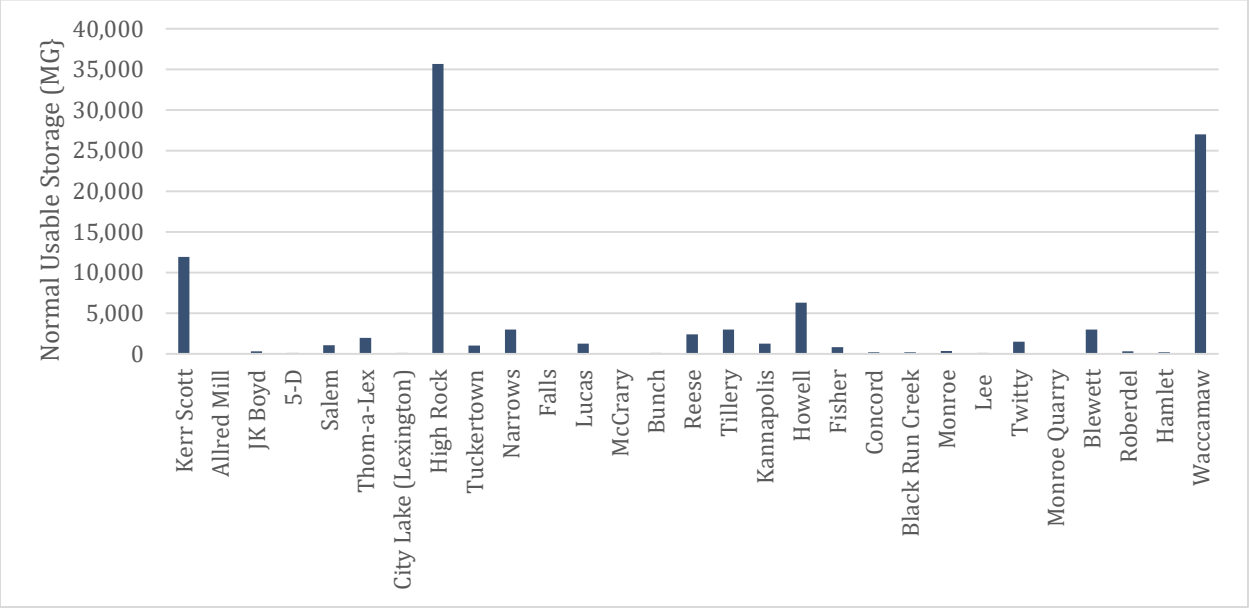

Figure 5: Name and Capacity of Reservoirs in the Yadkin-Pee Dee and Lumber Basins

The critical data apply to the mainstem Yadkin projects given the high level of streamflow regulation. Kerr Scott data are available electronically from the Corps of Engineers website. Cube Carolinas and Duke Energy were able to provide electronic data on reservoir operations from 2000 to present. Prior to this, we were able to retrieve historic monthly change in contents data as published in the USGS water use reports (see sample in Figure 6 below). These data allowed us to unimpair a number of long-term mainstem gages, including the Yadkin College and Rockingham gages on the Yadkin River.

1224. High Rock Lake at High Rock, N. C.

Location.--Lat 35°36'02", long 80°14'06", at dam on Yadkin River 0.8 mile northwest of High Rock, Davidson County, 2 miles upstream from Lick Creek, and at mile 252.3.

Drainage area.--4,000 sq mi, approximately.

Records available.--November 1927 to September 1960.

Gage.--Water-stage recorder and staff gage. Datum of gage is 30.9 ft (revised) below mean sea level, datum of 1929.

Remarks.--Lake used for hydroelectric power development was first put in operation Nov. 7, 1927. Total capacity is 11,090,000,000 cu ft and usable capacity is 10,230,000,000 cu ft between elevations 625 and 655 ft (top of gates). Figures given herein represent total contents. Records previously published as change in contents, equivalent in cubic feet per second.

Cooperation.--Records furnished by Yadkin, Inc. (formerly Carolina Aluminum Co.).

Contents, in millions of cubic feet, on last day of month

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1928	-	0	7,932	4,461	6,914	8,502	11,025	11,058	10,960	9,725	10,928	11,025
1929	11,025	9,878	8,172	6,552	10,700	11,058	11,025	10,960	11,058	10,505	8,338	5,376
1930	10,992	11,058	11,058	10,895	10,635	10,765	8,784	6,412	10,472	3,195	3,393	2,330
1931	1,072	1,570	3,256	4,604	2,892	5,397	11,025	11,090	8,784	9,158	10,992	8,195
1932	4,543	2,664	4,291	11,090	10,321	10,668	11,025	10,850	10,159	5,363	5,439	3,433
1933	11,058	11,077	10,882	11,070	10,440	10,947	10,824	10,002	8,624	6,842	7,618	9,797
1934	2,538	1,327	1,262	882	4,696	10,973	10,921	11,070	10,315	11,032	11,077	11,025
1935	9,996	9,828	11,064	11,051	11,084	10,739	10,862	10,973	7,706	10,084	7,207	6,904
1936	3,681	3,237	1,001	11,058	10,732	10,992	11,045	9,048	9,158	8,426	9,990	6,142
1937	9,743	4,682	9,365	10,674	11,032	10,512	11,058	10,264	7,539	3,872	9,036	6,004
1938	11,058	9,815	6,250	5,978	4,155	5,055	4,025	4,714	9,042	11,090	9,158	4,899
1939	2,441	4,393	6,066	6,575	11,025	11,090	10,765	7,985	6,203	10,830	10,700	6,528
1940	2,198	1,268	2,064	1,244	3,736	4,155	6,769	7,828	8,255	8,200	10,895	8,420
1941	3,262	6,250	5,978	5,934	4,750	6,672	7,262	2,920	2,920	10,570	9,100	5,586
1942	2,318	1,959	2,581	2,318	6,473	10,103	6,720	10,396	9,014	6,691	8,956	7,565
1943	4,257	5,657	10,128	11,090	9,014	10,895	10,661	7,948	9,347	10,390	9,761	8,830
1944	7,545	6,514	4,328	5,594	11,031	11,051	10,785	9,653	6,551	10,128	6,133	10,875
1945	10,538	9,569	9,112	9,106	11,032	9,996	10,271	9,112	5,363	9,467	6,394	11,090
1946	9,002	7,770	10,999	10,752	10,824	10,960	9,671	10,642	6,188	3,878	5,384	3,745
1947	3,240	2,755	2,174	10,765	6,528	6,624	8,255	7,775	10,505	6,672	4,532	6,909
1948	11,005	11,051	8,646	8,646	10,817	11,058	9,872	10,538	8,530	6,315	8,698	4,485
1949	3,454	11,025	11,058	9,878	10,960	11,050	10,960	9,635	9,455	10,700	11,205	10,378
1950	10,960	10,960	8,640	8,870	9,275	10,830	9,575	10,960	8,530	9,187	9,755	8,200
1951	6,624	5,418	8,812	6,914	7,722	8,755	10,895	9,455	10,065	10,570	9,100	9,575
1952	8,255	7,932	10,378	9,335	9,515	11,090	11,025	9,455	9,575	9,215	10,700	9,042
1953	8,348	10,340	9,695	10,700	10,960	11,025	9,455	10,190	10,609	9,215	9,455	10,002
1954	10,002	9,515	8,090	10,505	10,065	10,190	8,420	8,985	8,640	6,250	7,880	5,376
1955	5,934	4,189	6,066	4,393	7,414	6,624	10,427	8,148	6,110	5,376	5,211	4,899
1956	4,058	2,568	1,638	823	3,672	5,016	9,456	8,364	5,890	5,016	2,441	10,001
1957	8,364	5,172	6,963	3,424	11,018	10,554	10,619	8,869	10,879	9,759	7,161	10,879
1958	9,396	11,018	10,619	11,018	11,018	11,018	11,090	10,490	10,182	9,215	9,336	3,928
1959	2,492	2,492	9,819	10,947	9,456	8,700	10,813	8,813	8,644	10,365	10,748	9,819
1960	10,813	9,336	10,947	10,619	11,018	11,018	11,018	10,947	10,061	9,275	9,096	5,978

Figure 6: USGS Water Data Reports Showing Monthly Reservoir Contents

The reservoir impairment data are included in the inflow development files as described earlier.

Appendix A - Water Withdrawal and Discharge Entities

Table A-1. Municipal withdrawals (LWSP) used for inflow unimpairment and model development

Water System	PWSID	County	OASIS Node #	OASIS Node Name	OASIS WD Arc #	OASIS WD Arc Name
Albemarle	01-84-010	Stanly	625	Albermarle 01-84-010	610.622	Albemarle Jack F Neel WD
Albemarle	01-84-010	Stanly	625	Albermarle 01-84-010	640.622	Albemarle US 52 HWY WD
Anson Co	03-04-010	Anson	975	Anson Co. 03-04-010	920.966	Anson WD
Asheboro	02-76-010	Randolph	685	Asheboro 02-76-010	690.685	Asheboro Lake Bunch WD
Asheboro	02-76-010	Randolph	685	Asheboro 02-76-010	670.685	Asheboro Lake Lucas WD
Asheboro	02-76-010	Randolph	685	Asheboro 02-76-010	680.685	Asheboro Lake Reese WD
Concord	01-13-010	Cabarrus	785	Concord 01-13-010	770.779	Concord Coddle Ck WD
Concord	01-13-010	Cabarrus	785	Concord 01-13-010	780.779	Concord Hillgrove WD (Lake Fisher)
Concord	01-13-010	Cabarrus	785	Concord 01-13-010	790.779	Concord Hillgrove WD (Lake Concord)
Davidson Water	02-29-025	Davidson	425	Davidson Water 02-29-025	400.419	Davidson Water WD
Davie Co	02-30-015	Davie	375	Davie County 02-30-015	305.366	Davie Co Cooleemee WD
Davie Co	02-30-015	Davie	375	Davie County 02-30-015	365.366	Davie Co Sparks Rd WD
Denton	02-29-030	Davidson	615	Denton 02-29-030	605.615	Denton WD
Dobson	02-86-030	Surry	135	Dobson 02-86-030	130.135	Dobson WD
Elkin	02-86-020	Surry	75	Elkin 02-86-020	80.75	Elkin WD
Energy United Water	01-02-015	Alexander	n/a	*Not included - inactive*	n/a	n/a
Hamlet Water System	03-77-010	Richmond	985	Hamlet 03-77-010	980.982	Hamlet WD
Jonesville	02-99-010	Yadkin	115	Jonesville 02-99-010	100.115	Jonesville WD
Kannapolis	01-80-065	Rowan	775	Kannapolis 01-80-065	760.771	Kannapolis - Kann. Lake WD
Kannapolis	01-80-065	Rowan	775	Kannapolis 01-80-065	320.771	Kannapolis Back Ck WD
Kannapolis	01-80-065	Rowan	775	Kannapolis 01-80-065	770.771	Kannapolis Lake Howell WD
King	02-85-010	Stokes	345	King 02-85-010	340.345	King WD
Landis	01-80-038	Rowan	n/a	*Not included - inactive*	n/a	n/a
Lexington	02-29-010	Davidson	565	Lexington 02-29-010	560.565	Lake Thom-A-Lex WD
Lumberton	03-78-010	Robeson	1315	Lumberton 03-78-010	1300.1312	Lumberton WD
Mocksville	02-30-010	Davie	295	Mocksville 02-30-010	276.295	Mocksville WD

Water System	PWSID	County	OASIS Node #	OASIS Node Name	OASIS WD Arc #	OASIS WD Arc Name
Monroe	01-90-010	Union	855	Monroe 01-90-010	860.849	Monroe Lake Twitty WD
Montgomery Co	03-62-010	Montgomery	705	Montgomery 03-62-010	700.705	Montgomery WD
Mount Airy	02-86-010	Surry	185	Mt Airy 02-86-010	180.185	Mt. Airy F.G. Dogget WD
Mount Airy	02-86-010	Surry	185	Mt Airy 02-86-010	170.185	Mt. Airy S.L. Spencer WD
Mt. Pleasant	01-13-020	Cabarrus	825	Mount Pleasant 01-13-020	826.825	Mount Pleasant Dutch Buffalo Ck WD
North Wilkesboro	01-97-010	Wilkes	35	North Wilkesboro 01-97-010	30.35	North Wilkesboro WD
Norwood	01-84-015	Stanly	715	Norwood 01-84-015	700.715	Norwood WD
Pilot Mountain	02-86-025	Surry	205	Pilot Moutain 02-86-025	190.205	Pilot Mountain WD
Richmond County	03-77-109	Richmond	925	Richmond Co. 03-77-109	920.924	Richmond WD
Rockingham	03-77-015	Richmond	955	Rockingham 03-77-015	960.952	Rockingham City Pond WD
Rockingham	03-77-015	Richmond	955	Rockingham 03-77-015	950.952	Rockingham Roberdel Lake WD
Salisbury	01-80-010	Rowan	465	Salisbury 01-80-010	450.462	Salisbury WD
Southern Pines	03-63-010	Moore	1025	Southern Pines 03-63-010	1014.1025	Southern Pines WD
Statesville	01-49-010	Iredell	255	Statesville 01-49-010	250.255	Statesville WD
Thomasville	02-29-020	Davidson	555	Thomasville 02-29-020	560.555	Thomasville WD
Wadesboro	03-04-020	Anson	965	Wadesboro 03-04-020	970.956	Wadesboro WD
Wilkesboro	01-97-025	Wilkes	25	Wilkesboro 01-97-025	20.22	Wilkesboro WD
Winston-Salem	02-34-010	Forsyth	395	Winston Salem 02-34-010	385.389	Winston Salem Yadkin Idols Dam WD
Winston-Salem	02-34-010	Forsyth	395	Winston Salem 02-34-010	341.389	Winston Salem Yadkin Swann Dam WD
Winston-Salem	02-34-010	Forsyth	395	Winston Salem 02-34-010	380.389	Winston Salem Salem Lake WD
Yadkinville	02-99-015	Yadkin	355	Yadkinville 02-99-015	354.355	Yadkinville WD

Table A-2. Industrial withdrawals (WWATR) used for inflow unimpairment and model development

OWNER	FACILITY	ID	County	OASIS Node #	OASIS Node Name
APAC	Candor Sand Plant	0865-0001	Montgomery	1005	APAC Candor Sand Plant 0865-0001
ATI Allvac	Monroe Plant	0338-0001	Union	875	ATI Allvac Demand 0338-0001
Blue Ridge Tissue Corp	Blue Ridge Tissue Corp - Patterson Mill	0786-0001	Caldwell	5	Blue Ridge Patterson Mill 0786-0001
BV Hedrick	Aquadale Plant	0356-0003	Stanly	885	Hedrick Aquadale Quarry 0356-0003
BV Hedrick	Hedrick Mine	0420-0003	Anson	945	Hedrick G&S Mine 0420-0003
BV Hedrick	Norman Sand Company	0356-0004	Montgomery	915	Hedrick Norman Sand Co Demand 0356-0004
Cascades	West Point Home Filter/Waste Treatment	0095-0001	Scotland	1055	Cascades Wagram Plant 0095-0001
Covia	Marston Facility	0194-0004	Richmond	1205	Covia Marston Facility 0194-0004
Duke Energy	Weatherspoon Steam Electric Power Plant	0033-0010	Robeson	1325	Duke Weatherspoon Plant 0033-0010
Duke Energy	Buck Combined Cycle Station	0057-0021	Rowan	525	Duke Energy - Buck Comb. Cycle Station 0057-0021
Duke Energy	Buck Steam Station	0057-0011	Rowan	n/a	Not included - inactive last 5 yrs
Durafiber Technologies	Durafiber Technologies - Salisbury	0841-0001	Rowan	n/a	Not included - inactive - combine w/ Performance Fibers 0383-0002 for hindcast/UIF
Flowe Farms 2 LLC	Flowe Farms 2 LLC	0838-0001	Cabarrus	845	Flowe Farms 0838-0001
Interface, Inc.	Interface, Inc.	0422-0001	Surry	n/a	Not included - inactive last 5 yrs
Invista, Sarl	Invista, Sarl	0358-0001	Rowan	n/a	Not included - inactive last 5 yrs
Louisiana Pacific Corporation	Louisiana Pacific Corporation	0001-0001	Wilkes	55	Louisiana Pacific 0001-0001
Performance Fibers, Inc.	Performance Fibers - Salisbury Facility	0383-0002	Rowan	n/a	combined w/ Durafiber 0841-0001 for hindcast/UIF
The Fork LLC	The Fork, LLC	0007-0001	Stanly	905	The Fork Farm & Stables 0007-0001
True Textiles, Inc.	True Elkin, Inc.	0705-0001	Surry	65	True Textiles Elkin 0705-0001

Table A-3. Municipal and Industrial Discharges (NPDES) used for inflow unimpairment and model development

Owner Organization Name/Entity	Facility Name	Permit Number	County	OASIS Node #	OASIS Arc #	OASIS Node/Arc Name
Allegheny Technologies Inc	ATI Specialty Materials - Monroe Plant	NC0045993	Union		875.857	ATI Allvac WWTP NC0045993
Anson County	Anson County Regional WWTP	NC0041408	Anson	973		Anson Co. Regional WWTP NC0041408
Anson County	Anson County WTP	NC0074390	Anson		975.92	Anson Co. WTP NC0074390
Aqua North Carolina Inc	Country Wood WWTP	NC0065684	Union	853		AquaNC Country Wood WWTP NC0065684
B V Hedrick Gravel & Sand Company	Aquadale Quarry	NC0028169	Stanly		885.88	Hendrick Aquadale Quarry WW NC0028169
Badin Business Park LLC	Badin Business Park	NC0004308	Stanly	653		Badin Business Park WW NC0004308
Blue Ridge Tissue Corporation	Patterson Mill	NC0006254	Caldwell	5		Blue Ridge Patterson Mill 0786-0001
Boyle Company John	Boyle & Company (John)	NC0005282	Iredell			Not included - inactive
Brunswick County	Carolina Shores WWTP	NC0044873	Brunswick	1773		Carolina Shores WWTP NC0044873
Burlington Industries LLC	Richmond Plant	NC0043320	Richmond	963		Burlington Ind WW NC0043320
Carolina Mirror Company LLC	Carolina Mirror WWTP	NC0006696	Wilkes			Not included - inactive
Carolina Stalite Company	Carolina Stalite Company	NC0080586	Rowan	823		Carolina Stalite Co WW NC0080586
Carolina Water Service Inc of NC	Hemby Acres WWTP	NC0035041	Union	873		Carolina WS - Hemby WWTP NC0035041
Carolina Water Service Inc of NC	Bradfield Farms WWTP	NC0064734	Cabarrus	813		Carolina WS - Bradfield Farms WWTP NC0064734
Charlotte Water	Mallard Creek WWTP	NC0030210	Mecklenburg	763		Charlottle Mallard Creek WWTP NC0030210
City of Albemarle	Long Creek WWTP	NC0024244	Stanly		625.836	Albemarle WWTP NC0024244
City of Albemarle	Highway 52 WTP	NC0044024	Stanly		625.64	Albemarle Hwy 52 WTP NC0044024
City of Albemarle	Tuckertown WTP	NC0075701	Stanly		625.61	Albemarle Tuckertown WTP NC0075701
City of Charlotte	Cabarrus Woods WWTP	NC0035033	Mecklinburg	803		Charlotte Cabarrus Woods WWTP NC0035033
City of Concord	Coddle Creek WTP	NC0083119	Cabarrus		785.784	Concord Coddle Ck WTP NC0083119
City of Hamlet	Hamlet WWTP	NC0047562	Richmond		985.983	Hamlet WWTP NC0047562
City of High Point	Westside WWTP	NC0024228	Davidson	573		High Point Westside WWTP NC0024228
City of Kannapolis	Kannapolis WTP	NC0006220	Rowan		775.822	Kannapolis WTP NC0006220
City of King	King WTP	NC0088897	Forsyth		345.34	King WTP NC0088897
City of Laurinburg	Leith Creek WWTP	NC0020656	Scotland	1213		Laurinburg Leith Ck WWTP NC0020656
City of Lexington	Lexington WTP #1 & 2	NC0028037	Davidson		565.574	Lexington WTP NC0028037
City of Lexington	Lexington Regional WWTP	NC0055786	Davidson		565.577	Lexington WWTP NC0055786
City of Lumberton	Lumberton WWTP	NC0024571	Robeson		1315.132	Lumberton WWTP NC0024571
City of Monroe	Monroe WWTP	NC0024333	Union		855.857	Monroe WWTP NC0024333
City of Monroe	John Glenn WTP	NC0080381	Union		855.86	Monroe WTP NC0080381
City of Mount Airy	Mount Airy WWTP	NC0021121	Surry		185.188	Mt Airy WWTP NC0021121
City of Rockingham	Rockingham WWTP	NC0020427	Richmond		955.962	Rockingham WWTP NC0020427

Owner Organization Name/Entity	Facility Name	Permit Number	County	OASIS Node #	OASIS Arc #	OASIS Node/Arc Name
City of Salisbury	City of Salisbury WWTP	NC0023884	Rowan		465.5	Salisbury WWTP NC0023884
City of Salisbury	Town Creek WWTP	NC0023892	Rowan			Not included - inactive
City of Salisbury	Sowers Ferry Road WWTP	NC0025593	Rowan			Not included - inactive
City of Southport	Southport WWTP	NC0021334	Brunswick			Not included - inactive
City of Statesville	Third Creek WWTP	NC0020591	Iredell		255.319	Statesville Third Ck WWTP NC0020591
City of Statesville	Fourth Creek WWTP	NC0031836	Iredell		255.32	Statesville Fourth Ck WWTP NC0031836
City of Thomasville	Hamby Creek WWTP	NC0024112	Davidson		555.574	Thomasville WWTP NC0024112
City of Thomasville	City of Thomasville WTP	NC0088200	Davidson		555.56	Thomasville WTP NC0088200
City of Whiteville	Whiteville WRF	NC0021920	Columbus	1713		Whiteville WRF NC0021920
City of Winston-Salem	Archie Elledge WWTP	NC0037834	Forsyth		395.39	Winston Salem Archie E WWTP NC0037834
City of Winston-Salem	Muddy Creek WWTP	NC0050342	Forsyth		395.394	Winston Salem Mud Ck WWTP NC0050342
City of Winston-Salem	R.A. Thomas WTP	NC0079821	Forsyth		395.38	Winston Salem R.A. Thomas WTP NC0079821
City of Winston-Salem	R.W. Neilson WTP	NC0086011	Forsyth		395.385	R.W. Neilson WTP NC0086011
City of Winston-Salem	P.W. Swann WTP	NC0086762	Forsyth		395.341	Winston Salem P.W. Swann WTP NC0086762
Color/Tex Finishing Corp	Color Tex Finishing Corporation	NC0005487	Rowan			Not included - inactive
Davidson Water Inc	Davidson Water WTP	NC0084425	Davidson		425.4	Davidson Water WTP NC0084425
Davie County	Cooleemee WWTP	NC0024872	Davie		375.31	Davie Co WWTP NC0024872
Davie County	Sparks Road WTP	NC0084212	Davie		375.365	Davie Co Sparks Rd WTP NC0084212
Duke Energy Carolinas LLC	Buck Steam Station	NC0004774	Rowan		525.5	Duke Combined Cycle St. WW NC0004774
Duke Energy Progress LLC	Weatherspoon Steam Electric Plant	NC0005363	Robeson		1325.133	Duke Weatherspoon WW NC0005363
Duvaltex US Inc	Duvaltex	NC0005312	Surry		65.12	Duvaltex (fmrly TrueText) WWTP NC0005312
Electric Glass Fiber America LLC	PPG Industries Fiber Glass Products, Inc.	NC0004626	Davidson	513		PPG WWTP NC0004626
Georgia-Pacific Wood Products LLC	Whiteville Plywood Plant	NC0005801	Columbus			Not included - plant closed
Greater Badin Water & Sewer District	Badin WWTP	NC0074756	Stanly	663		Badin W&S WWTP NC0074756
Laurinburg-Maxton Airport Commission	Laurinburg Industrial WWTP	NC0044725	Scotland	1093		Laurinburg-Maxton Airport WWTP NC0044725
Louisiana-Pacific Corporation	LP Roaring River WWTP	NC0005266	Wilkes		55.06	Louisiana Pacific WWTP NC000526
Lumberton Cellulose LLC	Lumberton Mill	NC0005321	Robeson			Not included - inactive
Lumberton Energy Holdings LLC	Lumberton Energy Holdings LLC	NC0004618	Robeson	1323		Lumberton Energy Holdings LLC NC0004618
Moore County	Moore County WPCF	NC0037508	Moore	1023		Moore County WPCF NC0037508
Mountaire Farms of North Carolina Corp	Mountaire Farms - Lumber Bridge WWTF	NC0040185	Robeson			Not included - inactive
NC Department of Public Safety	McCain Correctional Hospital WWTP	NC0035904	Hoke	1033		McCain Correctional Hospital WWTP NC0035904
Norfolk Southern Railway Company	Linwood Yard	NC0029246	Davidson	503		Norfolk Southern WW NC0029246
North Carolina Granite Corp	North Carolina Granite Corporation	NC0006483	Surry			Not included - inactive

Owner Organization Name/Entity	Facility Name	Permit Number	County	OASIS Node #	OASIS Arc #	OASIS Node/Arc Name
Pilkington North America Inc	Plant 75	NC0049514	Scotland	1223		Plinkington Inc WWTP NC0049514
R J Reynolds Tobacco Company	Tobaccoville plant	NC0055093	Forsyth			Not included - inactive
Richmond County	Richmond County WTP	NC0081281	Richmond		925.92	Richmond Co WTP NC0081281
River Run Utility Company Inc	River Run Country Club WWTP	NC0067920	Mecklinburg			Not included - inactive
Robeson County Water Department	Maxton WTP	NC0048577	Robeson		1115.11	Robeson Co Maxton WTP NC0048577
Rockwell Town	Rockwell, Town-Southside WW	NC0021768	Rowan			Not included - inactive
Salisbury Investments I LLC	Edge Water Treating, LLC	NC0004944	Rowan	323		Edge Water Treating (fmrly Durafiber) NC0004944
Scotland County	Wagram Plant	NC0005762	Scotland		1055.11	Cascades Wagram WWTP NC0005762
Stanly County	West Stanly WWTP	NC0043532	Stanly	893		Stanly Co West Stanly WWTP NC0043532
Town of Bermuda Run	Bermuda Run WWTP	NC0055158	Davie	373		Bermuda Run WWTP NC0055158
Town of Biscoe	Biscoe WWTP	NC0021504	Montgomery	913		Biscoe WWTP NC0021504
Town of Bladenboro	Bladenboro WWTP	NC0026352	Bladen	1433		Bladenboro WWTP NC0026352
Town of Boonville	Boonville WWTP	NC0020931	Yadkin	163		Boonville WWTP NC0020931
Town of Chadbourn	Chadbourn WWTP	NC0021865	Columbus	1723		Chadbourne WWTP NC0021865
Town of Clarkton	Clarkton WWTP	NC0021610	Bladen	1703		Clarkton WWTP NC0021610
Town of Cleveland	Cleveland WWTP	NC0049867	Rowan	313		Cleveland WWTP NC0049867
Town of Denton	Denton WWTP	NC0026689	Davidson		615.61	Denton WWTP NC0026689
Town of Dobson	Dobson WWTP	NC0021326	Surry		135.154	Dobson WWTP NC0021326
Town of Fair Bluff	Fair Bluff WWTP	NC0020729	Columbus			Not included - inactive
Town of Fairmont	Fairmont WWTP	NC0021059	Robeson			Not included - inactive
Town of Fairmont	Fairmont Regional WWTP	NC0086550	Robeson	1523		Fairmont Regional WWTP NC0086550
Town of Lake Waccamaw	Lake Waccamaw WWTP	NC0021881	Columbus	1743		Lake Waccamaw WWTP NC0021881
Town of Landis	Landis WTP	NC0027502	Rowan			Not included - inactive
Town of Maxton	Maxton WWTP	NC0027120	Robeson	1233		Maxton WWTP NC0027120
Town of Mocksville	Dutchman Creek WWTP	NC0021491	Davie		295.44	Mocksville Dutch Ck WWTP NC0021491
Town of Mocksville	Bear Creek WWTP	NC0050903	Davie			Not included - inactive
Town of Mocksville	Hugh A. Lagle WTP	NC0089290	Davie		295.276	Mocksville WTP NC0089290
Town of Mooresville	Rocky River WWTP	NC0046728	Iredell	753		Mooresville Rocky R WWTP NC0046728
Town of Mount Gilead	Mount Gilead WWTP	NC0021105	Montgomery	733		Mt Gilead WWTP NC0021105
Town of North Wilkesboro	Thurman Street WWTP	NC0020761	Wilkes		35.05	North Wilkesboro WWTP NC0020761
Town of Norwood	Norwood WWTP	NC0021628	Stanly		715.896	Norwood WWTP NC0021628
Town of Parkton	Parkton WWTP	NC0026921	Robeson	1403		Parkton WWTP NC0026921
Town of Pembroke	Pembroke WWTP	NC0027103	Robeson	1123		Pembroke WWTP NC0027103

Owner Organization Name/Entity	Facility Name	Permit Number	County	OASIS Node #	OASIS Arc #	OASIS Node/Arc Name
Town of Pilot Mountain	Pilot Mountain WWTP	NC0026646	Surry		205.206	Pilot Mt WWTP NC0026646
Town of Pilot Mountain	Pilot Mountain WTP	NC0068365	Surry		205.19	Pilot Mt WTP NC0068365
Town of Red Springs	Red Springs WWTP	NC0025577	Robeson	1143		Red Springs WWTP NC0025577
Town of Rowland	Rowland WWTP	NC0069612	Robeson	1243		Rowland WWTP NC0069612
Town of Southern Pines	Southern Pines WTP	NC0049778	Moore		1025.102	Southern Pines WTP WW NC0049778
Town of St Pauls	St. Pauls WWTP	NC0020095	Robeson	1413		St Pauls WWTP NC0020095
Town of Tabor City	Tabor City WWTP	NC0026000	Columbus	1763		Tabor City WWTP NC0026000
Town of Troy	Troy WWTP	NC0028916	Montgomery	903		Troy WWTP NC0028916
Town of Wilkesboro	Cub Creek WWTP	NC0021717	Wilkes		25.05	Wilkesboro WWTP NC0021717
Town of Wilkesboro	Wilkesboro WTP	NC0055590	Wilkes			Not included - inactive
Town of Yadkinville	Yadkinville WWTP	NC0020338	Yadkin		355.36	Yadkinville WWTP NC0020338
Tyson Farms Inc	Tyson Farms, Inc.	NC0005126	Iredell	273		Tyson Farms WW NC0005126
Union County	Crooked Creek WWTP #2	NC0069841	Union	863		Union Co. Crooked Ck WWTP NC0069841
Union County	Hunley Creek WWTP	NC0072508	Union			Not included - inactive
United Technologies Auto Inc	United Technologies Auto,Inc.	NC0006238	Surry			Not included - inactive
WSACC	Rocky River WWTP	NC0036269	Cabarrus	793		WSACC Rocky R WWTP NC0036269
Wayne Farms LLC	Dobson Plant	NC0006548	Surry	143		Wayne Farms WWTP NC0006548
Yadkin Valley Sewer Authority	Yadkin Valley Sewer Authority WWTP	NC0020567	Surry	113		YVSA WWTP NC0020567
Yadkin Valley Sewer Authority	Jonesville WWTP	NC0021580	Surry			Not included - inactive