

**DEQ/DWR**  
**FACT SHEET FOR NPDES PERMIT DEVELOPMENT**  
 NPDES No. NC0024406

<b>Facility Information</b>			
Applicant/Facility Name:	Duke Energy Carolinas, LLC- Belews Creek Steam Station		
Applicant Address:	13339 Hagers Ferry Road; Huntersville, North Carolina 28078		
Facility Address:	3195 Pine Hall Road; Belews Creek, NC 27009		
Permitted Flow	N/A		
Type of Waste:	Industrial (~100%); Domestic (<1%) Prim.SIC Code: 4911		
Facility/Permit Status:	Class I /Active; Renewal		
County:	Stokes County		
<b>Miscellaneous</b>			
Receiving Stream:	Belews Lake (001, 005, 007), UT to Dan River (003, 003A) , Dan River (006)	Regional Office:	Winston-Salem (WSRO)
Stream Classification:	C (Belews Lake), WS-IV (Dan River and UT to Dan River)	State Grid / USGS Quad:	B18SE/Belews Lake
303(d) Listed?	No	Permit Writer:	Sergei Chernikov, Ph.D.
Subbasin:	03-02-01	Date:	10/29/2018
Drainage Area (mi <sup>2</sup> ):	501 (Dan River)	 <p>001: Lat. 36°16' 49.5" N Long. 80° 03' 39.8" W            003: Lat. 36°18' 22.0" N Long. 80° 04' 50.7" W            006: Lat. 36°18' 34.8" N Long. 80° 04' 36.1" W</p>	
Summer 7Q10 (cfs)	80 (Dan River)		
Winter 7Q10 (cfs):	160 (Dan River)		
30Q2 (cfs)	195 (Dan River)		
Average Flow (cfs):	576 (Dan River)		
IWC (%):	26.5		

**BACKGROUND**

Duke Energy's Belews Creek Steam Station is a coal fired steam electric plant in Stokes County. The facility is subject to the federal effluent guidelines 40 CFR Part 423.

In addition to NPDES Permit NC0024406, the facility also holds the following permits: 01983R12 (air permit), NCD000856591 (Hazardous wastes), and 85-03 (industrial landfill).

The Division revokes the Effluent Channel designation for Outfall 003 with this permit renewal.

The facility operates the following outfalls:

- Outfall 001: once through cooling water consisting of intake screen backwash, recirculating cooling water, station equipment cooling water and once-through cooling water, this Outfall discharges to Belews Lake.

- Outfall 003: ash basin discharge consisting of waste streams from the power house and yard holding sumps, ash sluice lines, chemical holding pond, coal yard sumps, stormwater, coal pile collection basins (collecting contact stormwater from coal piles), remediated groundwater, emergency release of anhydrous ammonia, seepage from coal ash basin, emergency overflow from the retention basin, emergency overflows from the existing effluent channels, and treated FGD wastewater from internal outfall 002. The wastewater from this outfall discharges to Unnamed Tributary (UT) to Dan River.
- Internal outfall 002: FGD wastewater (discharging to ash pond)
- Outfall 003A/006. Upon completion of construction, discharge from the new lined retention basin. Basin will accept wastes from holding basin, ash contact water, various sumps, coal pile runoff, stormwater runoff, cooling tower blowdown, FGD wastewater, and various low volume wastes such as boiler blowdown, oily waste treatment, wastes/backwash from the water treatment processes, coal pile collection basins (collecting contact stormwater from coal piles), plant area wash down water, cooling tower blowdown, equipment heat exchanger water, remediated groundwater, emergency overflow (rain in excess of designed storm event), toe drain (potential discharge to outfall 006 only), emergency release of anhydrous ammonia, release of ammonia during quarterly testing, and treated domestic wastewater. Outfall 003A discharges to UT to Dan River via the Outfall 003. Upon completion of construction all waste streams previously discharged to ash basin, will be re-routed to the new retention basin. During the transition period, wastewater from the ash pond can also be discharged from Outfall 003. New Outfall 006 will be constructed for the lined retention basin within 2 years to replace Outfall 003A. Outfall 006 will discharge to Dan River, this Outfall will be used for dewatering of the ash basin.
- Outfall 005. This is a former stormwater outfall SW002, consists of once through non-contact chiller water and stormwater. The wastewater from this outfall discharges to Belews Lake.
- Internal Outfall 006A-temporary internal outfall for dewatering of the ash basin, it discharges through Outfall 006.
- Outfall 007 (lat. - 36°16'51.604"; long. 80°03'52.995"). This is an emergency spillway for South Coal Basin. This outfall discharges to Belews Lake. The spillway is designed for a flood greater than 100-year event. Sampling of this spillway is waived due to unsafe conditions associated with sampling during overflow event.
- Internal outfall 009. Domestic wastewater plant. The wastewater from this outfall discharges to UT to Dan River via Outfall 003 or to Dan River via Outfall 006.
- Toe Drain Outfall 111 (lat. - 36°17'54.94"; long. - 80.04'32.57")- potentially contaminated toe drain. This outfall discharges to UT to Dan River.
- Internal Outfall 006A. Dewatering of the ash pond. This outfall discharges to Dan River via Outfall 006.

TOE DRAIN – OUTFALL 111

The facility identified 1 unpermitted toe drain from the ash settling basin.

The location of the toe drain is identified below and are depicted on the map attached to the permit.

Table 1. Discharge Coordinates and Assigned Outfall Numbers

Discharge ID	Latitude	Longitude	Outfall number
S-11	36°17'54.94"	80.04'32.57"	111

## ASH POND DAMS

Seepage through earthen dams is common and is an expected consequence of impounding water with an earthen embankment. Even the tightest, best-compacted clays cannot prevent some water from seeping through them. Seepage is not necessarily an indication that a dam has structural problems, but should be kept in check through various engineering controls and regularly monitored for changes in quantity or quality which, over time, may result in dam failure.

## FGD TREATMENT

Currently the facility uses the following treatment train for FGD wastewater

- 1) addition of lime, ferric chloride, and polymer in the multiple reaction tanks
- 2) 2 clarifiers
- 3) 3 filters
- 4) 8 first stage bioreactors
- 5) 8 second-stage bioreactors

However, this treatment is insufficient to consistently meet the new FGD limits for selenium. For example, on 01/29/2015 and on 02/25/2015 the selenium concentration in the wastewater discharged from Outfall 002 was 32.2 µg/L and 37.9 µg/L, respectively. This is substantially higher than the 23 µg/L, which is a selenium limit in a newly promulgated effluent guideline. Therefore, Duke is proposing to install an additional membrane ultrafiltration treatment. Installation and optimization of this system would require time, it has been determined that November 1, 2020 is an appropriate effective date for complying with the new FGD limits.

It is important to emphasize that Duke Energy's proposed combination of treatment technology (adding membrane ultrafiltration to the existing chemical precipitation and biological treatment system) is more advanced treatment than the BAT technology basis for the ELGs (chemical precipitation and biological treatment). This treatment has the potential to remove significant amounts of the arsenic, mercury and selenium that remains following BAT-level treatment. Such would not be the case if a facility were to propose adding less effective technology (such as sand filtration, which is already part of the BAT technology basis) to the BAT technology. Furthermore, this facility will be the first full-scale implementation of membrane ultrafiltration for treating FGD wastewater.

## REASONABLE POTENTIAL ANALYSIS(RPA)-ASH POND AND TOE DRAIN

The Division conducted EPA-recommended analyses to determine the reasonable potential for toxicants to be discharged at levels exceeding water quality standards/EPA criteria by this facility. For the purposes of the RPA, the background concentrations for all parameters were assumed to be below detections level. The RPA uses 95% probability level and 95% confidence basis in accordance with the EPA Guidance entitled "Technical Support Document for Water Quality-based Toxics Control." The RPA included evaluation of dissolved metals' standards, utilizing a default hardness value of 25 mg/L CaCO<sub>3</sub> for hardness-dependent metals. The RPA spreadsheets are attached to this Fact Sheet.

- a) RPA for the Lined Retention Basin (Outfall 006).  
The RPA was conducted for decanting of Ash Pond, the calculations included: As, Cd, Chlorides, Cr, Cu, F, Pb, Hg, Mo, Ni, Se, Zn, Ba, Sb, Sulfates, Al, and Tl (please see attached). The design flow of 10.9 MGD was used for the analysis. The discharge data on the EPA Form 2C, and DMR reports were used for the RPA,

the data was supplemented by the analysis of the free standing water in the ash pond. The analysis indicates reasonable potential to violate the surface water quality standards or EPA criteria for the following parameters: Pb. The appropriate limits were added to the permit.

- b) RPA for ash pond decanting/normal operations was conducted based on the assumption of the discharge to a zero-flow stream (current situation for Outfall 003 and Outfall 003A). The calculations included: As, Cd, Chlorides, Cr, Cu, F, Pb, Hg, Mo, Ni, Se, Zn, Ba, Sb, Sulfates, Al, and Tl (please see attached). The flow of 18.6 MGD was used for the analysis. The discharge data on the EPA Form 2C, and DMR reports were used for the RPA, the data was supplemented by the analysis of the free standing water in the ash pond. The analysis indicates reasonable potential to violate the surface water quality standards or EPA criteria for the following parameters: Sulfates, Chlorides, Al, Cd, Se, Pb, and Tl. The appropriate limits were added to the permit.
- c) RPA for Dewatering of Ash pond (Outfall 006).  
To meet the requirements of the Coal Ash Management Act of 2014, the facility needs to dewater ash ponds by removing the interstitial water. The facility's highest discharge rate from the dewatering process will be 2.0 MGD. The facility submitted data for the standing surface water in the ash ponds, interstitial water in the ash, and interstitial ash water that was treated by filters of various sizes. To evaluate the impact of the dewatering on the receiving stream the RPA was conducted for the wastewater that will be generated by the dewatering process. To introduce a margin of safety, the highest measured concentration for a particular parameter was used. The RPA was conducted for As, Cd, Chlorides, Cr, Cu, F, Pb, Hg, Mo, Ni, Se, Zn, Ba, Sb, Al, and Sulfates. The analysis indicates reasonable potential to violate the surface water quality standards or EPA criteria for the following parameters: Cu, Se, Mo, Al, and Pb. The appropriate limits were added to the permit.
- d) RPA for Toe Drain (Outfall 111).  
The RPA calculations was conducted for Toe Drain, the calculations included: As, Cd, Chlorides, Cr, Cu, F, Pb, Hg, Mo, Ni, Se, Zn, Ba, Sb, and Sulfates. The flow volume for all seeps was measured at 0.2 MGD. However, the flow of 2.0 MGD was used for RPA calculations to incorporate a safety factor, account for potential new seeps that might emerge in the future or increase in flow volume at the existing seeps. The analysis indicates reasonable potential to violate the surface water quality standards or EPA criteria for the following parameters: As, Se, Cd, Sulfates, Hg, and TDS. The appropriate limits were added to the permit.
- e) RPA for Outfall 005.  
The RPA was conducted for Outfall 005, the calculations included: As, Cd, Cr, Cu, Pb, Hg, Mo, Ni, Se, Zn, Ba, Sb, and Tl (please see attached). The flow of 2.59 MGD was used for the analysis. The discharge data on the EPA Form 2C were used for the RPA. The analysis indicates no reasonable potential to violate the surface water quality standards or EPA criteria.

The proposed permit requires that EPA methods 200.7 or 200.8 (or the most current versions) shall be used for analyses of all metals except for total mercury.

#### MERCURY EVALUATION-OUTFALL 003 (ASH POND)

The State of North Carolina has a state-wide mercury impairment. A TMDL has been developed to address this issue in 2012. The TMDL included the implementation

strategy, both documents were approved by EPA in 2012. The mercury evaluation was conducted in accordance with the Permitting Guidelines for Statewide Mercury TMDL.

Year	2011	2012	2013	2014	2015	2016
Annual average concentration (ng/L)	1.83	2.15	1.47	1.57	2.97	2.6
Maximum sampling result (ng/L)	2.98	2.69	1.59	1.76	5.0	2.94
Number of samples	2	4	4	6	9	2

The allowable mercury concentration for this facility is 45.3 ng/L. All annual average mercury concentrations are below the allowable level. All maximum sampling results are below the TBEL of 47.0 ng/L. Based on the Permitting Guidelines for Statewide Mercury TMDL, the limits are not required.

#### TEMPERATURE VARIANCE – OUTFALL 001

State of North Carolina (NC Board of Water and Air Resources) granted the facility a temperature variance in 1970, which was prior to the 316(a) requirement of the CWA. However, based on the biological study submitted in 2016, the Water Sciences Section of the DWR concluded that the information provided in the latest report is insufficient to determine existence of the Balanced and Indigenous population of fish and macroinvertebrates in the receiving stream.

The facility will be provided a compliance schedule to develop and conduct a comprehensive study of the Belews Lake and obtain a 316(a) Variance in accordance with the 40 CFR 125 Subpart H and the EPA’s Draft 316(a) Guidance Manual, dated 1977, and the Region 4 letter to NC DENR, dated June 3, 2010.

#### CWA SECTION 316(b)

The permittee shall comply with the Cooling Water Intake Structure Rule per 40 CFR 125.95. The Division approved the facility request for an alternative schedule in accordance with 40 CFR 125.95(a)(2). The permittee shall submit all the materials required by the Rule 3.5 years from the effective date of the permit. This is an accelerated schedule that includes: 6 months for the development of the sampling plan and obtaining approval from the Division, 2 years of sampling to adequately characterize seasonal variation, and 1 year for the report development. Based on the results of the studies, the Division may require an implementation of the additional measures to reduce impingement and entrainment of the aquatic organisms.

Based on 40 CFR 125.92 (c) the Director has determined that operating and maintaining the existing closed-cycle recirculating system meets the requirements for a provisional BTA. The final determination will be made upon review of the materials submitted by the permittee. This determination is consistent with the Region IV decision regarding Robinson station and the Region III decision regarding North Anna station.

Belews lake has a supplemental pumping station that provides water from the Dan River during the drought years to maintain an operational level of water. During the life of the station the pumping has been carried out 4 times, in 2002, 2008, 2009, and 2010. The Dan River intake minimizes impingement and entrainment by having an

approach velocity of  $\leq 0.5$  feet/second at the inlet, it also equipped with a 2 mm fine mesh travelling screen with a fish return system.

#### INSTREAM MONITORING

In 2014, the facility provided instream sampling data for Oil & Grease, COD, Chlorides, Fluoride, Sulfate, Mercury, Aluminum, Barium, Boron, Calcium, Hardness, Iron, Magnesium, Manganese, Zinc, Antimony, Arsenic, Cadmium, Chromium, Copper, Lead, Molybdenum, Nickel, Selenium, Thallium, TDS, TSS, pH, Temperature, and Specific Conductance. The upstream monitoring station was located approximately 6,000 ft. upstream of Outfall 003 and the downstream monitoring station was located approximately 21,000 ft. downstream of the Outfall 003.

The following parameters were below detection level at both monitoring stations: Oil & Grease, COD, Fluoride, Mercury, Zinc, Antimony, Arsenic, Cadmium, Chromium, Copper, Lead, Molybdenum, Nickel, Selenium, and Thallium. All parameters were well below water quality standards/EPA criteria.

The proposed permit will require a monthly monitoring for total arsenic, total selenium, total mercury, total chromium, dissolved lead, dissolved cadmium, dissolved copper, dissolved zinc, total bromide, total hardness (as  $\text{CaCO}_3$ ), temperature, turbidity, and total dissolved solids (TDS).

#### FISH TISSUE MONITORING-NEAR OUTFALL 003/003A/006

The permit required fish tissue monitoring for As, Se, and Hg near the ash pond discharge once every 5 years. This frequency is consistent with EPA guidance. Golden Redhorse and Redbreast Sunfish tissues were analyzed for these trace elements. The data was collected from one locations upstream of the discharge and two locations downstream of the discharge. The results were below NC human consumption advisory levels for Se and Hg ( $10.0 \mu\text{g/g}$  – Se,  $0.40 \mu\text{g/g}$  – Hg, NC) and screening value for As ( $1.20 \mu\text{g/g}$ , EPA). Only one Golden Redhorse from one downstream location had a mercury concentration of  $0.40 \mu\text{g/g}$ , which is equal to NC human consumption advisory level for Hg.

#### TOXICITY TESTING

Type of Toxicity Test:	Chronic P/F
Existing Limit:	003: Chronic P/F @ 19% ( <i>Ceriodaphnia dubia</i> )
Recommended Limit:	003/003A: Chronic P/F @ 90% ( <i>Ceriodaphnia dubia</i> )
Recommended Limit:	006A dewatering: Chronic P/F @ 3.7% ( <i>Ceriodaphnia dubia</i> )
Recommended Limit:	006: Chronic P/F @ 17.4% ( <i>Ceriodaphnia dubia</i> )

This facility has passed all toxicity tests (22 out of 22) during the previous permit cycle, please see attached.

The Division will increase the Instream Waste Concentration from 19% to 90% for Outfalls 003/003A due to the reconsideration of the effluent channel status. For the purposes of the permitting, the highest monthly average flow reported during the last 3 years in conjunction with the 7Q10 summer flow was used to calculate the percent effluent concentration to be used for WET.

#### COMPLIANCE SUMMARY

During the last 5 years, the facility had 1 violations of the Copper limit (Outfall 003), please see attached.

## PERMIT LIMITS DEVELOPMENT

- The temperature limit in the permit (Outfall 001) is based on the North Carolina water quality standards (15A NCAC 2B .0200).
- The limits for Oil and Grease and Total Suspended Solids (Outfall 003, Outfall 003A, Outfall 006, Outfall 006A, and Outfall 111) were established in accordance with the 40 CFR 423.
- The limits for BOD and Total Suspended Solids (Internal Outfall 009) were established in accordance with the 40 CFR 133.102.
- The limit for Fecal Coliform (Internal Outfall 009) is based on the North Carolina water quality standards (15A NCAC 2B .0200).
- The pH limits (Outfall 003, Outfall 003A, Outfall 006, Outfall 006A, and Outfall 111) in the permit are based on the North Carolina water quality standards (15A NCAC 2B .0200).
- The turbidity limit in the permit (Outfall 003 and Outfall 006A-dewatering) is based on the North Carolina water quality standards (15A NCAC 2B .0200).
- The Whole Effluent Toxicity limit (Outfall 003, Outfall 003A, Outfall 006A, and Outfall 006) is based on the requirements of 15A NCAC 2B .0500.
- The Technology Based Effluent Limits for Total Arsenic, Total Mercury, Total Selenium, Nitrate/nitrite as N, Oil and Grease and Total Suspended Solids (Internal Outfall 002) are based on the requirements of 40 CFR 423.
- The Technology Based Effluent Limits for Total Iron and Total Copper (Outfall 003, Outfall 003A, and Outfall 006) are based on the requirements of 40 CFR 423.
- The Water Quality Based Effluent Limits for Chlorides, Sulfates, Total Aluminum, Total Arsenic, Total Cadmium, Total Selenium, Total Lead, and Total Thallium in the permit (Outfall 003 – normal operations/decanting) are based on the North Carolina water quality standards (15A NCAC 2B .0200) and EPA water quality criteria.
- The Water Quality Based Effluent Limits for Total Copper, Total Molybdenum, Total Selenium, Total Aluminum, Total Lead, in the permit (Outfall 006A) are based on the North Carolina water quality standards (15A NCAC 2B .0200) and EPA water quality criteria.
- The Water Quality Based Effluent Limits for Total Selenium, Chlorides, Sulfates, Total Cadmium, Total Arsenic, Total Lead, Total Aluminum, and Total Thallium in the permit (Outfall 003A) are based on the North Carolina water quality standards (15A NCAC 2B .0200) and EPA water quality criteria.
- The Water Quality Based Effluent Limits for Total Lead in the permit (Outfall 006) are based on the North Carolina water quality standards (15A NCAC 2B .0200) and EPA water quality criteria.
- The Water Quality Based Effluent Limits for Total Mercury, Total Arsenic, Total Cadmium, Total Selenium, TDS, and Chlorides (Outfall 111) are based on the North Carolina water quality standards (15A NCAC 2B .0200) and EPA water quality criteria.
- Ammonia limits in the permit (Outfall 003, Outfall 003A, and Outfall 006) are based on the ammonia criteria (monthly average limit). The Division uses ammonia criteria that were developed by EPA: 1 mg/L - summer; 1.8 mg/L – winter.

## PROPOSED CHANGES

- The following monitoring parameters were eliminated (Internal Outfall 002) to be consistent with the latest update to 40 CFR 423: Chlorides and TSS.
- The Technology Based Effluent Limits for Total Arsenic, Total Mercury, Total Selenium, and Nitrate/nitrite as N were added to the permit (Internal Outfall 002) based on the requirements in 40 CFR 423.

- The Decanting Special Conditions were added to Outfall 003, please see A. (3.).
- Monitoring frequency for all parameters that were previously monitored Quarterly were increased to Monthly with an exception of Toxicity (Outfall 003 – normal operations/decanting), please see A. (3.).
- Instream Waste Concentration for Outfall 003 (normal operations/decanting) was increased to 90% from 19% based on the re-consideration of the effluent channel status.
- The compliance dates for fly ash transport water (November 1, 2018) and bottom ash transport water (May 31, 2021) were added to Outfall 003 in accordance with 40 CFR 423.
- The compliance date of November 1, 2020 for Technology Based Effluent Limits was added to Internal Outfall 002 in accordance with 40 CFR 423.
- The Water Quality Based Effluent Limits for Chlorides, Sulfates, Total Aluminum, Total Cadmium, Total Selenium, Total Arsenic, Total Lead, Ammonia, and Total Thallium were added to the permit based on the results of Reasonable Potential Analysis (Outfall 003 – normal operations/decanting).
- A new internal Outfall 006A for the dewatering of the ash pond was added to the permit. Please see Condition A. (4.).
- A separate effluent page for the new Retention Basin (Outfall 003A) was added to the permit. Please see Condition A. (5.).
- A new Outfall for the new Retention Basin (Outfall 006) was added to the permit. Please see Condition A. (7.).
- The Instream Monitoring Special Condition was added to the permit to monitor the impact of the facility on the receiving stream. Please see Special Condition A. (22.).
- A new Outfall for the Toe Drain discharge (Outfall 111) was added to the permit. Please see Condition A. (10.).
- Federal regulations require electronic submittal of all discharge monitoring reports (DMRs) and program reports. The final NPDES Electronic Reporting Rule was adopted and became effective on December 21, 2015. The requirement to begin reporting discharge monitoring data electronically using the NC DWR's Electronic Discharge Monitoring Report (eDMR) internet application has been added to your final NPDES permit. [See Special Condition A. (23.)]

For information on eDMR, registering for eDMR and obtaining an eDMR user account, please visit the following web page:

<http://deq.nc.gov/about/divisions/water-resources/edmr>.

For more information on EPA's final NPDES Electronic Reporting Rule, please visit the following web site:

<https://www.federalregister.gov/documents/2015/10/22/2015-24954/national-pollutant-discharge-elimination-system-npdes-electronic-reporting-rule>

- The turbidity limit was added to the permit (Outfall 003) to meet the state turbidity standard per 15A NCAC 2B .0211(3) (k).
- Clean Water Act Section 316(b) special condition was updated. Please see Sprcial Condition A. (16.).
- A new outfall was added to the permit (Outfall 005). This is a former stormwater outfall SW002, it consists of once through non-contact chiller water and stormwater. Please see Condition A. (6.).
- A new internal outfall was added to the permit (Outfall 009) for the discharge of domestic wastewater. Please see Condition A. (9.).
- A new outfall was added to the permit (Outfall 007) for the emergency spillway discharge from the South Coal Basin. Please see Condition A. (8.).

- The Compliance Boundary special condition was added to the permit. Please see Special Condition A. (25.). This special condition replaces Groundwater Well Construction and Sampling special condition.
- An Applicable State Law special condition was added to the permit. Please see Special Condition A. (26.).

PROPOSED SCHEDULE

Draft Permit to Public Notice:

November 21, 2018

Permit Scheduled to Issue:

January 19, 2019

STATE CONTACT

If you have any questions on any of the above information or on the attached permit, please contact Sergei Chernikov at (919) 707-3606 or [sergei.chernikov@ncdenr.gov](mailto:sergei.chernikov@ncdenr.gov).

**NPDES Implementation of Instream Dissolved Metals Standards – Freshwater Standards**

The NC 2007-2015 Water Quality Standard (WQS) Triennial Review was approved by the NC Environmental Management Commission (EMC) on November 13, 2014. The US EPA subsequently approved the WQS revisions on April 6, 2016, with some exceptions. Therefore, metal limits in draft permits out to public notice after April 6, 2016 must be calculated to protect the new standards - as approved.

**Table 1. NC Dissolved Metals Water Quality Standards/Aquatic Life Protection**

Parameter	Acute FW, µg/l (Dissolved)	Chronic FW, µg/l (Dissolved)	Acute SW, µg/l (Dissolved)	Chronic SW, µg/l (Dissolved)
Arsenic	340	150	69	36
Beryllium	65	6.5	---	---
Cadmium	Calculation	Calculation	40	8.8
Chromium III	Calculation	Calculation	---	---
Chromium VI	16	11	1100	50
Copper	Calculation	Calculation	4.8	3.1
Lead	Calculation	Calculation	210	8.1
Nickel	Calculation	Calculation	74	8.2
Silver	Calculation	0.06	1.9	0.1
Zinc	Calculation	Calculation	90	81

Table 1 Notes:

1. FW= Freshwater, SW= Saltwater
2. Calculation = Hardness dependent standard
3. Only the aquatic life standards listed above are expressed in dissolved form. Aquatic life standards for Mercury and selenium are still expressed as Total Recoverable Metals due to bioaccumulative concerns (as are all human health standards for all metals). It is still necessary to evaluate total recoverable aquatic life and human health standards listed in 15A NCAC 2B.0200 (e.g., arsenic at 10 µg/l for human health protection; cyanide at 5 µg/L and fluoride at 1.8 mg/L for aquatic life protection).

**Table 2. Dissolved Freshwater Standards for Hardness-Dependent Metals**

The Water Effects Ratio (WER) is equal to one unless determined otherwise under 15A NCAC 02B .0211 Subparagraph (11)(d)

Metal	NC Dissolved Standard, µg/l
Cadmium, Acute	$WER * \{1.136672 - [\ln \text{hardness}](0.041838)\} \cdot e^{\{0.9151 [\ln \text{hardness}] - 3.1485\}}$
Cadmium, Acute Trout waters	$WER * \{1.136672 - [\ln \text{hardness}](0.041838)\} \cdot e^{\{0.9151 [\ln \text{hardness}] - 3.6236\}}$
Cadmium, Chronic	$WER * \{1.101672 - [\ln \text{hardness}](0.041838)\} \cdot e^{\{0.7998 [\ln \text{hardness}] - 4.4451\}}$
Chromium III, Acute	$WER * 0.316 \cdot e^{\{0.8190 [\ln \text{hardness}] + 3.7256\}}$
Chromium III, Chronic	$WER * 0.860 \cdot e^{\{0.8190 [\ln \text{hardness}] + 0.6848\}}$

Copper, Acute	$WER \cdot 0.960 \cdot e^{\{0.9422[\ln \text{ hardness}] - 1.700\}}$
Copper, Chronic	$WER \cdot 0.960 \cdot e^{\{0.8545[\ln \text{ hardness}] - 1.702\}}$
Lead, Acute	$WER \cdot \{1.46203 - [\ln \text{ hardness}](0.145712)\} \cdot e^{\{1.273[\ln \text{ hardness}] - 1.460\}}$
Lead, Chronic	$WER \cdot \{1.46203 - [\ln \text{ hardness}](0.145712)\} \cdot e^{\{1.273[\ln \text{ hardness}] - 4.705\}}$
Nickel, Acute	$WER \cdot 0.998 \cdot e^{\{0.8460[\ln \text{ hardness}] + 2.255\}}$
Nickel, Chronic	$WER \cdot 0.997 \cdot e^{\{0.8460[\ln \text{ hardness}] + 0.0584\}}$
Silver, Acute	$WER \cdot 0.85 \cdot e^{\{1.72[\ln \text{ hardness}] - 6.59\}}$
Silver, Chronic	Not applicable
Zinc, Acute	$WER \cdot 0.978 \cdot e^{\{0.8473[\ln \text{ hardness}] + 0.884\}}$
Zinc, Chronic	$WER \cdot 0.986 \cdot e^{\{0.8473[\ln \text{ hardness}] + 0.884\}}$

### **General Information on the Reasonable Potential Analysis (RPA)**

The RPA process itself did not change as the result of the new metals standards. However, application of the dissolved and hardness-dependent standards requires additional consideration in order to establish the numeric standard for each metal of concern of each individual discharge.

The hardness-based standards require some knowledge of the effluent and instream (upstream) hardness and so must be calculated case-by-case for each discharge.

Metals limits must be expressed as ‘total recoverable’ metals in accordance with 40 CFR 122.45(c). The discharge-specific standards must be converted to the equivalent total values for use in the RPA calculations. We will generally rely on default translator values developed for each metal (more on that below), but it is also possible to consider case-specific translators developed in accordance with established methodology.

### **RPA Permitting Guidance/WQBELs for Hardness-Dependent Metals - Freshwater**

The RPA is designed to predict the maximum likely effluent concentrations for each metal of concern, based on recent effluent data, and calculate the allowable effluent concentrations, based on applicable standards and the critical low-flow values for the receiving stream.

If the maximum predicted value is greater than the maximum allowed value (chronic or acute), the discharge has reasonable potential to exceed the standard, which warrants a permit limit in most cases. If monitoring for a particular pollutant indicates that the pollutant is not present (i.e. consistently below detection level), then the Division may remove the monitoring requirement in the reissued permit.

- To perform a RPA on the Freshwater hardness-dependent metals the Permit Writer compiles the following information:
  - Critical low flow of the receiving stream, 7Q10 (the spreadsheet automatically calculates the 1Q10 using the formula  $1Q10 = 0.843 (s7Q10, cfs)^{0.993}$ )
  - Effluent hardness and upstream hardness, site-specific data is preferred
  - Permitted flow
  - Receiving stream classification

2. In order to establish the numeric standard for each hardness-dependent metal of concern and for each individual discharge, the Permit Writer must first determine what effluent and instream (upstream) hardness values to use in the equations.

The permit writer reviews DMR's, Effluent Pollutant Scans, and Toxicity Test results for any hardness data and contacts the Permittee to see if any additional data is available for instream hardness values, upstream of the discharge.

If no hardness data is available, the permit writer may choose to do an initial evaluation using a default hardness of 25 mg/L (CaCO<sub>3</sub> or (Ca + Mg)). Minimum and maximum limits on the hardness value used for water quality calculations are 25 mg/L and 400 mg/L, respectively.

If the use of a default hardness value results in a hardness-dependent metal showing reasonable potential, the permit writer contacts the Permittee and requests 5 site-specific effluent and upstream hardness samples over a period of one week. The RPA is rerun using the new data.

The overall hardness value used in the water quality calculations is calculated as follows:

Combined Hardness (chronic)

$$= \frac{(\text{Permitted Flow, cfs} * \text{Avg. Effluent Hardness, mg/L}) + (s7Q10, \text{ cfs} * \text{Avg. Upstream Hardness, mg/L})}{(\text{Permitted Flow, cfs} + s7Q10, \text{ cfs})}$$

The Combined Hardness for acute is the same but the calculation uses the 1Q10 flow.

3. The permit writer converts the numeric standard for each metal of concern to a total recoverable metal, using the EPA Default Partition Coefficients (DPCs) or site-specific translators, if any have been developed using federally approved methodology.

EPA default partition coefficients or the "Fraction Dissolved" converts the value for dissolved metal at laboratory conditions to total recoverable metal at in-stream ambient conditions. This factor is calculated using the linear partition coefficients found in *The Metals Translator: Guidance for Calculating a Total Recoverable Permit Limit from a Dissolved Criterion* (EPA 823-B-96-007, June 1996) and the equation:

$$\frac{C_{\text{diss}}}{C_{\text{total}}} = \frac{1}{1 + \{ [K_{\text{po}}] [ss^{(1+a)}] [10^{-6}] \}}$$

Where:

4. The ss = in-stream suspended solids concentration [mg/l], minimum of 10 mg/L used, and

K<sub>po</sub> and a = constants that express the equilibrium relationship between dissolved and adsorbed forms of metals. A list of constants used for each hardness-dependent metal can also be found in the RPA program under a

numeric standard for each metal of concern is divided by the default partition coefficient (or site-specific translator) to obtain a Total Recoverable Metal at ambient conditions.

In some cases, where an EPA default partition coefficient translator does not exist (ie. silver), the dissolved numeric standard for each metal of concern is divided by the EPA conversion factor to obtain a Total Recoverable Metal at ambient conditions. This method presumes that the metal is dissolved to the same extent as it was during EPA's criteria

development for metals. For more information on conversion factors see the June, 1996 EPA Translator Guidance Document.

- The RPA spreadsheet uses a mass balance equation to determine the total allowable concentration (permit limits) for each pollutant using the following equation:

$$Ca = \frac{(s7Q10 + Qw) (Cwqs) - (s7Q10) (Cb)}{Qw}$$

Where: Ca = allowable effluent concentration (µg/L or mg/L)

Cwqs = NC Water Quality Standard or federal criteria (µg/L or mg/L)

Cb = background concentration: assume zero for all toxicants except NH<sub>3</sub>\* (µg/L or mg/L)

Qw = permitted effluent flow (cfs, match s7Q10)

s7Q10 = summer low flow used to protect aquatic life from chronic toxicity and human health through the consumption of water, fish, and shellfish from noncarcinogens (cfs)

\* Discussions are on-going with EPA on how best to address background concentrations

Flows other than s7Q10 may be incorporated as applicable:

1Q10 = used in the equation to protect aquatic life from acute toxicity

QA = used in the equation to protect human health through the consumption of water, fish, and shellfish from carcinogens

30Q2 = used in the equation to protect aesthetic quality

- The permit writer enters the most recent 2-3 years of effluent data for each pollutant of concern. Data entered must have been taken within four and one-half years prior to the date of the permit application (40 CFR 122.21). The RPA spreadsheet estimates the 95th percentile upper concentration of each pollutant. The Predicted Max concentrations are compared to the Total allowable concentrations to determine if a permit limit is necessary. If the predicted max exceeds the acute or chronic Total allowable concentrations, the discharge is considered to show reasonable potential to violate the water quality standard, and a permit limit (Total allowable concentration) is included in the permit in accordance with the U.S. EPA Technical Support Document for Water Quality-Based Toxics Control published in 1991.
- When appropriate, permit writers develop facility specific compliance schedules in accordance with the EPA Headquarters Memo dated May 10, 2007 from James Hanlon to Alexis Strauss on 40 CFR 122.47 Compliance Schedule Requirements.
- The Total Chromium NC WQS was removed and replaced with trivalent chromium and hexavalent chromium Water Quality Standards. As a cost savings measure, total chromium data results may be used as a conservative surrogate in cases where there are no analytical results based on chromium III or VI. In these cases, the projected maximum concentration (95th %) for total chromium will be compared against water quality standards for chromium III and chromium VI.
- Effluent hardness sampling and instream hardness sampling, upstream of the discharge, are inserted into all permits with facilities monitoring for hardness-dependent metals to ensure the accuracy of the permit limits and to build a more robust hardness dataset.
- Hardness and flow values used in the Reasonable Potential Analysis for this permit included:

Parameter	Value	Comments (Data Source)
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Average Effluent Hardness (mg/L) [Total as, CaCO <sub>3</sub> or (Ca+Mg)]	25.0	Default value
Average Upstream Hardness (mg/L) [Total as, CaCO <sub>3</sub> or (Ca+Mg)]	25.0	Default value
7Q10 summer (cfs)	0	Lake or Tidal
1Q10 (cfs)	0	Lake or Tidal
Permitted Flow (MGD)	2.1	For dewatering