NC DIVISION OF WATER RESOURCES (NCDWR) THIRD ROUND OF DAN RIVER FISH TISSUE METALS FOLLOWING THE EDEN COAL ASH SPILL (10 MONTH POST-SPILL ASSESSMENT), MAY 18, 2015.

Key Findings

- Results for the NCDWR's third round of fish tissue metals from the Dan River (Table 1) are similar to its baseline results (February-April, 2014) and also to its historic data from two Dan River sites in 2005. Collectively, all of the NCDWR Dan River fish tissue data reported to date show similar levels of heavy metals among alike species.
- Approximately ten months after the Duke Energy coal ash spill, there are very few signs of heavy metals being incorporated into fish tissues in the North Carolina portions of the Dan River downstream of the spill site (Table 1). Only two metals (Mg and Se) showed increasing trends at NC stations downstream of the spill site, whereas six metals (Mg, Mn, Al, Se, Fe and Ba) showed increasing trends at the Eden control station upstream of the spill site and low head dam near the Dan River Steam Station.
- **Mercury** was reported above the laboratory PQL (0.02 mg/kg) in 45 of 55 samples **(**82%) in the third round assessment (vs 100% in both rounds one and two). Only the two biggest Largemouth Bass collected from the Satterwhite Point State Recreation Area on Kerr Lake showed mercury concentrations in fillets above the 0.4 mg/kg NC mercury action level. All mercury observations were also in range of or above the generic wildlife reference screening values of 0.03 to 0.1 mg/kg. *North Carolina's statewide mercury advisory for Largemouth Bass has been in place since 2001 and a fish advisory for the North Carolina portions of the Dan River has been in place since February 17, 2015. The state of Virginia has also issued fish consumption advisories for mercury and PCBs in the Dan River.*
- **Arsenic** was reported above the laboratory PQL (0.10 mg/kg) in only one Redear Sunfish fillet sample (0.11 mg/kg) from the Satterwhite Point State Recreation Area of Kerr Lake. No measurements of total arsenic in NCDWR's third round reached the 0.27 mg/kg North Carolina Department of Public Health (NCDPH) fillet screening value or the 1.3 mg/kg generic wildlife screening value.
- **Selenium** was detected in all 55 fish samples in NCDWR's third round assessment (100%), but all were well below the NCDPH fish consumption advisory action level of 10.0 mg/kg. Concentrations ranged from 0.28 to 1.2 mg/kg and were similar to baseline data with no clear differences between fish species or trophic guilds. Fifteen percent of selenium values in fish tissues were at or above the generic wildlife screening value of 0.6 mg/kg.
- Much like the first two Dan River fish tissue assessments, the highest concentrations of heavy metals were often observed in whole-body samples, although the number of whole body samples was low (n=7, 13%). *The NCDPH uses only fillet concentrations to determine if fish consumption advisories will be recommended.*
- The NCDWR is currently conducting its fourth round fish tissue assessment of the Dan River. Monitoring efforts will continue through the fall of 2015 (and longer if necessary) in order to evaluate the potential bioaccumulation of coal-ash-associated heavy metals, in support the February, 2015 fish advisory.

Introduction

In mid-November and early December of 2014, the NCDWR collected its third round of fish samples from the Dan River for an approximate ten-month post-spill assessment of heavy metals following the February 2-6th coal ash spill in Eden, NC. The objectives of this third round of sampling were 1) to continue providing Dan River fish tissue data to the NCDPH for human risk assessment and 2) to evaluate any potential changes in fish tissue metals concentrations that may be associated with the February, 2014 coal ash spill at Eden, NC.

Methods

The four sampling stations from upstream of the Dan River Steam Station to the lower North Carolina portion of Kerr Reservoir at Satterwhite Point State Park Recreation Area (approximately 115 river miles) were sampled from 11/12 to 12/3/2014 using 7.5 and 2.5 generator powered pulsator (GPP) boat-mounted electrofishers (see map in Appendix 1). Fish tissue samples were then processed and analyzed at the NCDWR Water Sciences Section (WSS) laboratories in Raleigh, NC according to the NCDWR fish tissue contaminant SOP (http://portal.ncdenr.org/web/wq/ess/isu) and according to the United States Environmental Protection Agency (EPA) methods 245.6 (CVAA), 200.7 (ICP) and 200.8 (ICPMS).

The two previously assessed sites in Virginia (Danville, and Kerr Reservoir headwaters) were dropped from the second and third rounds of fish collections in order to eliminate duplicate sampling efforts between NCDWR and the Virginia Department of Environmental Quality (VADEQ). A total of ten previously sampled species were collected during the third round of fish metals assessments, including five species of suckers (including 3 redhorse species), three sunfish species, one minnow species and Largemouth Bass. The suite of 16 metals tested for in the 55 processed fish tissue samples included aluminum (Al), arsenic (As), barium (Ba), cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), lead (Pb), magnesium (Mg), manganese (Mn), mercury (Hg), nickel (Ni), selenium (Se), silver (Ag), thallium (Tl) and zinc (Zn).

Screening Values

There are currently two North Carolina fish consumption action levels established by the NCDPH for the protection of individuals who consume fish; mercury (0.4 mg/kg) and selenium (10.0 mg/kg). Fish tissue screening values have also been developed by NCDPH for 18 other metals since the Dan River coal ash spill (Appendix 2). Generic wildlife screening values are also available for mercury, selenium and arsenic for comparison to these data (Appendix 3). However, concentrations of metals in fish fillets or whole-body samples may not be representative of the specific diets of predatory fish and aquatic-dependent wildlife, and therefore may not be ideal for wildlife risk assessments. The values in Appendix 3 are provided for a general wildlife screen of fish tissue metals data, but have not been formally adopted by NCDWR or any other agency.

General Observations and Results

Due to the unique nature of the February 2014 coal ash spill into the Dan River, it is still unclear if any of the heavy metals associated with coal ash are being incorporated into fish tissues. At approximately 14 months after the Eden coal ash spill, the NCDWR is currently conducting its fourth round of Dan River fish tissue collections at the four NC sampling locations. The samples produced in this spring 2015 assessment will provide additional fish tissue metals data for the continued evaluation of potential bio-accumulative impacts from the coal ash spill.

Results for each of the 16 individual heavy metals measured in the NCDWR's third round fish tissue assessment of the Dan River are discussed here:

Aluminum (Al) – Twenty-nine of the 55 aluminum concentrations (53%) were equal to or above the laboratory practical quantitation limit (PQL) of 1.0 mg/kg. Values ranged from 1.0 to 54 mg/kg, with the highest occurring in a Redbreast Sunfish fillet composite from the Berry Hill site (D1). The next highest concentration (32 mg/kg) was observed in an individual V-lip Redhorse, also collected from the Berry Hill location. Similar to results from rounds one and two, all concentrations of aluminum were well below the NCDPH screening value of 410 mg/kg.

Arsenic (As) – One concentration (2%) of total arsenic was reported above the laboratory PQL (0.10 mg/kg) in a single Redear Sunfish fillet from the Kerr Lake site with a value of 0.11 mg/kg. In comparison, 12.5% and 37% of total arsenic measurements were reported above the lab PQL during the first and second rounds, respectively. The NCDPH screening value for total arsenic is 0.27 mg/kg and the generic wildlife reference screening value is 1.3 mg/kg.

Barium (Ba) – Eighteen of the 55 barium concentrations (33%) were reported above the laboratory PQL of 0.20 mg/kg. Values ranged from 0.21 to 7.7 mg/kg, with the highest occurring in an individual Bull Chub whole-body sample from the Milton site (F1). Similar to the results from rounds one and two, all concentrations were well below the NCDPH screening value of 82.0 mg/kg and all of the data were qualified J2 because there is no available standard method reference material for barium in fish tissues.

Cadmium (Cd) – Similar to the second round assessment results for cadmium, all of the concentrations in Dan River fish tissues (100%) were reported below the laboratory PQL of 0.10 mg/kg. The NCDPH screening value for cadmium in fish tissues is 0.41 mg/kg.

Chromium (Cr) – Chromium was reported above the laboratory PQL in only four of the 55 processed samples (7%), with concentrations ranging from 0.23 to 0.28 mg/kg. All detections of chromium occurred at either the upstream site near Eden (J1, n=1) or at the Berry Hill site (D1, n=4). Similar to the NCDWR baseline results (rounds one and two), none of the round three concentrations for chromium met or exceeded the NCDPH screening value of 1.2 mg/kg.

Copper (Cu) – All 55 concentrations (100%) were detected above the laboratory PQL of 0.10 mg/kg, with a range of 0.13 to 0.80 mg/kg. The highest two concentrations were observed in Bull Chub whole-body samples from the Milton site (F1). All observations of copper in Dan River fish continue to be well below the NCDPH screening value of 16.0 mg/kg.

Iron (Fe) – Iron was reported at or above the laboratory PQL of 1.0 mg/kg in all but one sample (98%), with a range of 1.0 to 53.0 mg/kg. Consistent with NCDWR's baseline observations, the highest iron concentrations were observed in whole-body sample types of multiple fish species. All observations were well below the NC screening value of 290 mg/kg.

Lead (Pb) – No concentrations of lead in fish tissues were reported above the laboratory PQL of 0.10 mg/kg. By comparison, 6% and 1% of the lead concentrations in the first two rounds were reported above the laboratory PQL, respectively. There is no screening value available for the evaluation of lead in fish tissues in North Carolina.

Magnesium (Mg) – Much like the two baseline assessments, all concentrations of magnesium in fish tissues (100%) were detected well above the laboratory PQL of 2.0 mg/kg. Values ranged from 220 to 530 mg/kg, with the highest concentrations in whole-body sample types of suckers, sunfish and minnows. No screening value is available in NC for the comparison of magnesium in fish tissues.

Manganese (Mn) – Thirty-seven of the 55 manganese concentrations (67%) were reported at or above the laboratory PQL of 0.20 mg/kg. Values were similar to baseline results and ranged from 0.24 to 34.0 mg/kg, with the highest values in whole-body samples of redhorse, minnows and sunfish. All concentrations were well below the NCDPH screening value of 58.0 mg/kg.

Mercury (Hg) – Forty-five of the 55 concentrations of total mercury (82%) were reported at or above the 0.02 mg/kg laboratory PQL, with a range of 0.02 to 0.76 mg/kg. By contrast, 100% of concentrations in both of the baseline assessments were reported above the lab PQL. Only two samples in round three (4%) exceeded the NC fish consumption action level of 0.4 mg/kg, both of which occurred in the biggest Largemouth Bass from the Kerr Lake site (19 and 20 inch fish). All mercury observations were also in range of or greater than the generic wildlife reference screening values of 0.03 to 0.1 mg/kg.

Nickel (Ni) – Thirteen concentrations of nickel (24%) were reported above the laboratory PQL of 0.10 mg/kg in fillet and whole-body samples of suckers, sunfish and minnow species. Much like the nickel results from NCDWR's two baseline assessments, concentrations ranged from 0.11 to 0.49 mg/kg; all well below the NCDPH screening value of 8.2 mg/kg.

Selenium (Se) – All 55 selenium observations (100%) were reported at concentrations above the laboratory PQL of 0.10 mg/kg. Concentrations ranged from 0.28 to 1.2 mg/kg, all well below the 10.0 mg/kg NCDPH action level. Eight of these values were equal to or greater than the generic wildlife reference screening value of 0.6 mg/kg (15%), the highest of which occurred in a single Redbreast Sunfish fillet sample from the Berry Hill site (D1). Similar to the baseline data, all selenium observations were above the lab PQL and one third (33%) of them had J2 qualifiers because they failed to meet established quality control criteria.

Silver (Ag) – All 55 concentrations of silver in fish tissues from the Dan River (100%) were reported below the laboratory PQL of 0.10 mg/kg. To date, no observations of silver in Dan River fish (NCDWR rounds one through three) have been reported above laboratory PQL. The NCDPH screening value for silver in fish tissue is 2.1 mg/kg.

Thallium (Tl) – Consistent with the first two assessments, all concentrations of thallium (100%) were reported below the laboratory PQL of 0.10 mg/kg and were qualified (J2) because there is no available standard reference material for the analytical method used in determining this element. Values with J2 qualifiers may be higher or lower than reported. The NCDPH screening value for thallium in fish tissue is 0.00412 mg/kg.

Zinc (Zn) – Zinc was reported above the laboratory PQL in all of the round three Dan River fish samples (100%) with a range of 3.0 to 30.0 mg/kg. Much like rounds one and two, the highest zinc concentrations were observed in whole-body samples of sunfish, minnows and suckers. All concentrations were well below the NCDPH screening value of 120 mg/kg.

Statistical Analysis of 16 Fish Tissue Metals since the Coal Ash Spill

The NCDWR has sampled three of its Dan River fish tissue monitoring sites [Eden (J1), Berry Hill (D1) and Milton (F1), see Appendix 1] on three occasions since the February 2014 coal ash spill. The following four fish species have been collected at these repeat sampling locations during one or both of the NCDWR baseline assessments (rounds 1 and 2, February through April, 2014) and also during the November/December assessment (round 3). These data have been evaluated for changes in concentrations of 16 heavy metals in fillets over time using JMP statistical software:

- Golden Redhorse (Eden and Berry Hill)
- V-lip Redhorse (Eden and Berry Hill)
- Redbreast Sunfish (Eden and Berry Hill)
- Notchlip Redhorse (Milton)

Results of regression analyses of the 16 heavy metals in the fillets of these four recurring species are summarized in Table 2 for the purpose of evaluating the potential impacts of coal ash on fish tissues at the approximate ten-month post-spill period. The NCDWR will evaluate all subsequent rounds of fish tissue metals data from the Dan River using this statistical method.

At the ten-month post-spill juncture, there are very few signs of heavy metal bioaccumulation into fish tissues downstream of the Dan River Steam Station in the NC portions of the river. Only two metals (Mg and Se) showed increasing trends at the NCDWR fish tissue stations downstream of the power-plant. Moreover, six metals (Mg, Mn, Al, Se, Fe and Ba) showed increasing trends at the Eden control site located just upstream of the low-head dam at Duke Energy's Dan River Steam Station.

Table 1. NCDWR Third Round Dan River Fish Tissue Metals Analysis Ten Months following Eden, NC Coal Ash Spill (February, 2014).

Analyte (mg/kg wet weight).

Bold data indicates detection above the laboratory practical quantitation limit (PQL) and does not represent concentrations above NCDPH screening levels or wildlife screening levels.

Site Location	Date Coll.	DWR # [1]	Species	Sample Type [2]	TL (mm)	Wt (g)	Hg	As	Cd	Cr	Cu	Ni	Pb	Zn	Se	Al	Tl	Fe	Mg	Ba	Mn	Ag
J1	11/12/14	14-305	Golden Redhorse	F	319	304	**0.10**	<0.10	<0.10	<0.20	**0.38**	<0.10	<0.10	**5.10**	**0.33***	<1.00	<0.10*	**4.30**	**290.00**	**0.22***	**1.10**	<0.10*
Eden	"	14-306	Golden Redhorse	F	353	425	**0.21**	<0.10	<0.10	<0.20	**0.32**	<0.10	<0.10	**4.80**	**0.33***	**1.10**	<0.10*	**4.30**	**290.00**	**0.26***	**1.30**	<0.10
NC	"	14-307	Golden Redhorse	F	325	337	**0.21**	<0.10	<0.10	<0.20	**0.28**	<0.10	<0.10	**4.40**	**0.36***	**1.00**	<0.10*	**4.20**	**290.00**	**0.22***	**1.30**	<0.10
"	"	14-308	Golden Redhorse	F	346	426	**0.22**	<0.10	<0.10	<0.20	**0.39**	<0.10	<0.10	**4.80**	**0.35***	<1.00	<0.10*	**4.40**	**300.00**	<0.20*	**0.70**	<0.10
"	"	14-310	Golden Redhorse	F	277	218	**0.14**	<0.10	<0.10	<0.20	**0.36**	<0.10	<0.10	**4.70**	**0.47***	**1.20**	<0.10*	**2.50**	**300.00**	<0.20*	**0.69**	<0.10
"	"	14-311	Golden Redhorse	F	293	250	**0.13**	<0.10	<0.10	<0.20	**0.39**	<0.10	<0.10	**4.70**	**0.45***	**1.20**	<0.10*	**2.50**	**300.00**	<0.20*	**0.59**	<0.10
"	"	14-312	V-lip Redhorse	F	270	161	**0.11**	<0.10	<0.10	<0.20	**0.22**	<0.10	<0.10	**3.00**	**0.52***	<1.00	<0.10*	**1.50**	**270.00**	<0.20*	**0.51**	<0.10
"	"	14-313	V-lip Redhorse	F	296	223	**0.13**	<0.10	<0.10	<0.20	**0.30**	<0.10	<0.10	**3.80**	**0.37***	<1.00	<0.10*	**2.10**	**250.00**	**0.32***	**0.59**	<0.10
"	"	14-314	V-lip Redhorse	F	310	220	<0.02	<0.10	<0.10	<0.20	**0.30**	<0.10	<0.10	**3.90**	**0.49***	**1.30**	<0.10*	**3.30**	**220.00**	**0.38***	**0.86**	<0.10
"	"	14-315	Redbreast Sunfish	F	177	106	**0.10**	<0.10	<0.10	<0.20	**0.32**	<0.10	<0.10	**4.50**	**0.45***	**1.50**	<0.10*	**2.00**	**280.00**	<0.20*	**0.29**	<0.10
"	"	14-316	Redbreast Sunfish	F	170	100	**0.06**	<0.10	<0.10	<0.20	**0.22**	<0.10	<0.10	**5.10**	**0.44***	**2.50**	<0.10*	**1.70**	**270.00**	<0.20*	**0.52**	<0.10
	"	14-317	Redbreast Sunfish	FC4	150	58	**0.02**	<0.10	<0.10	<0.20	**0.39**	<0.10	<0.10	**5.90**	**0.72***	**2.40**	<0.10*	**1.90**	**290.00**	<0.20*	**0.24**	<0.10
"	"	14-318	Redbreast Sunfish	WC4	134	43	<0.02	<0.10	<0.10	**0.26**	**0.57**	**0.39**	<0.10	**17.00**	**0.72***	**17.00**	<0.10*	**27.00**	**530.00**	**2.10***	**7.80**	<0.10
D1	12/3/14	14-319	Quillback	F	352	457	<0.02	<0.10	<0.10	<0.20	**0.43**	<0.10	<0.10	**4.90**	**0.83***	<1.00	<0.10*	**6.20**	**230.00**	**0.28***	**0.92**	<0.10
Berry	"	14-321	White Sucker	F	315	317	**0.03**	<0.10	<0.10	<0.20	**0.36**	<0.10	<0.10	**3.80**	**0.30***	<1.00	<0.10*	**3.10**	**250.00**	<0.20*	**0.68**	<0.10
Hill	"	14-322	V-lip Redhorse	F	346	402	<0.02	<0.10	<0.10	<0.20	**0.19**	<0.10	<0.10	**3.40**	**0.60***	<1.00	<0.10*	**1.20**	**280.00**	**0.21***	**0.57**	<0.10
NC	"	14-323	V-lip Redhorse	FC2	301	239	**0.02**	<0.10	<0.10	<0.20	**0.27**	<0.10	<0.10	**4.30**	**0.74***	<1.00	<0.10*	**2.30**	**280.00**	**0.22***	**0.66**	<0.10
"	"	14-324	V-lip Redhorse	W	213	91	**0.10**	<0.10	<0.10	**0.25**	**0.69**	**0.28**	<0.10	**16.00**	**0.44***	**32.00**	<0.10*	**36.00**	**480.00**	**3.80***	**14.00**	<0.10
"	"	14-325	Golden Redhorse	F	331	363	**0.10**	<0.10	<0.10	<0.20	**0.34**	<0.10	<0.10	**4.60**	**0.34**	**1.10**	<0.10*	**2.70**	**300.00**	<0.20*	**0.77**	<0.10
"	"	14-326	Golden Redhorse	F	334	403	<0.02	<0.10	<0.10	<0.20	**0.27**	<0.10	<0.10	**4.60**	**0.40**	<1.00	<0.10*	**3.10**	**290.00**	<0.20*	**0.71**	<0.10
"	"	14-327	Golden Redhorse	F	335	389	<0.02	<0.10	<0.10	<0.20	**0.28**	<0.10	<0.10	**5.40**	**0.39**	<1.00	<0.10*	**4.10**	**290.00**	<0.20*	**0.60**	<0.10
"	"	14-328	Golden Redhorse	F	257	170	<0.02	<0.10	<0.10	<0.20	**0.21**	<0.10	<0.10	**4.40**	**0.38**	<1.00	<0.10*	**1.90**	**320.00**	**0.24***	**1.10**	<0.10
"	"	14-329	Golden Redhorse	W	160	42	<0.02	<0.10	<0.10	<0.20	**0.36**	**0.28**	<0.10	**14.00**	**0.34**	**14.00**	<0.10*	**17.00**	**480.00**	**2.70***	**34.00**	<0.10
"	"	14-330	Redbreast Sunfish	F	169	74	<0.02	<0.10	<0.10	<0.20	**0.24**	**0.12**	<0.10	**5.80**	**0.54**	**1.20**	<0.10*	**2.00**	**260.00**	<0.20*	<0.20	<0.10
"	"	14-332	Redbreast Sunfish	F	158	65	**0.03**	<0.10	<0.10	<0.20	**0.28**	<0.10	<0.10	**5.70**	**0.67**	**15.00**	<0.10*	**1.50**	**250.00**	<0.20*	**0.29**	<0.10
"	"	14-333	Redbreast Sunfish	F	150	54	**0.06**	<0.10	<0.10	<0.20	**0.29**	<0.10	<0.10	**6.30**	**1.20**	**1.00**	<0.10*	**1.30**	**250.00**	<0.20*	<0.20	<0.10
"	"	14-334	Redbreast Sunfish	F	151	57	<0.02	<0.10	<0.10	<0.20	**0.18**	**0.11**	<0.10	**4.60**	**0.74**	<1.00	<0.10*	**1.70**	**270.00**	<0.20*	<0.20	<0.10
"	"	14-335	Redbreast Sunfish	F	144	49	**0.07**	<0.10	<0.10	<0.20	**0.35**	**0.11**	<0.10	**4.70**	**0.45**	<1.00	<0.10*	**1.60**	**260.00**	<0.20*	<0.20	<0.10
"	"	14-336	Redbreast Sunfish	FC4	129	42	**0.06**	<0.10	<0.10	**0.28**	**0.67**	**0.49**	<0.10	**19.00**	**0.52**	**54.00**	<0.10*	**53.00**	**510.00**	**3.20***	**9.50**	<0.10
"	"	14-337	Redbreast Sunfish	WC4	99	14	**0.06**	<0.10	<0.10	**0.23**	**0.50**	**0.39**	<0.10	**24.00**	**0.56**	**8.10**	<0.10*	**19.00**	**530.00**	**3.00***	**7.20**	<0.10

Table 1 continued.

Analyte (mg/kg wet weight).

Bold data indicates detection above the laboratory practical quantitation limit (PQL) and does not represent concentrations above NCDPH screening levels or wildlife screening levels.

Site Location	Date Coll.	DWR # [1]	Species	Sample Type [2]	TL (mm)	Wt (g)	Hg	As	Cd	Cr	Cu	Ni	Pb	Zn	Se	Al	Tl	Fe	Mg	Ba	Mn	Ag
F1	11/20/14	14-338	Notchlip Redhorse	F	470	1201	**0.12**	<0.10	<0.10	<0.20	**0.28**	<0.10	<0.10	**4.60**	**0.38**	<1.00	<0.10*	**4.30**	**270.00**	<0.20*	**0.69**	<0.10
Milton	"	14-339	Golden Redhorse	F	320	384	**0.06**	<0.10	<0.10	<0.20	**0.32**	<0.10	<0.10	**6.20**	**0.33**	<1.00	<0.10*	**2.90**	**310.00**	**0.26***	**1.20**	<0.10
NC	"	14-340	White Sucker	F	310	326	**0.09**	<0.10	<0.10	<0.20	**0.29**	<0.10	<0.10	**3.80**	**0.43**	<1.00	<0.10*	**2.70**	**290.00**	<0.20*	**0.61**	<0.10
"	"	14-341	White Sucker	F	310	329	**0.15**	<0.10	<0.10	<0.20	**0.41**	**0.16**	<0.10	**4.30**	**0.35**	<1.00	<0.10*	**3.70**	**280.00**	<0.20*	**0.38**	<0.10
"	"	14-343	White Sucker	F	330	392	**0.05**	<0.10	<0.10	<0.20	**0.35**	<0.10	<0.10	**4.80**	**0.35**	<1.00	<0.10*	**4.20**	**290.00**	<0.20*	**0.65**	<0.10
"	"	14-344	White Sucker	F	310	324	**0.20**	<0.10	<0.10	<0.20	**0.39**	<0.10	<0.10	**4.00**	**0.44**	<1.00	<0.10*	**4.00**	**270.00**	<0.20*	**0.45**	<0.10
"	"	14-345	Bluegill Sunfish	F	170	87	**0.08**	<0.10	<0.10	<0.20	**0.40**	<0.10	<0.10	**6.10**	**0.41**	**1.30**	<0.10*	**1.90**	**280.00**	<0.20*	**0.31**	<0.10
"	"	14-346	Bluegill Sunfish	WC2	115	27	**0.04**	<0.10	<0.10	<0.20	**0.47**	**0.30**	<0.10	**19.00**	**0.40**	**12.00**	<0.10*	**15.00**	**450.00**	**2.90***	**20.00**	<0.10
"	"	14-347	Redbreast Sunfish	F	150	56	**0.09**	<0.10	<0.10	<0.20	**0.29**	<0.10	<0.10	**9.90**	**0.41**	**1.70**	<0.10*	**1.60**	**280.00**	<0.20*	**0.49**	<0.10
"	"	14-348	Bull Chub	W	250	182	**0.05**	<0.10	<0.10	<0.20	**0.80**	**0.33**	<0.10	**30.00**	**0.32**	**18.00**	<0.10*	**20.00**	**470.00**	**7.70***	**30.00**	<0.10
"	"	14-349	Bull Chub	WC2	225	135	**0.06**	<0.10	<0.10	<0.20	**0.78**	**0.18**	<0.10	**21.00**	**0.38**	**31.00**	<0.10*	**44.00**	**360.00**	**6.20***	**11.00**	<0.10
Kerr Res.	11/13/14	14-350	Largemouth Bass	F	370	687	**0.25**	<0.10	<0.10	<0.20	**0.23**	<0.10	<0.10	**5.10**	**0.35**	**1.70**	<0.10*	**2.10**	**300.00**	<0.20*	<0.20	<0.10
Satterwhite	"	14-351	Largemouth Bass	F	480	1479	**0.56**	<0.10	<0.10	<0.20	**0.18**	<0.10	<0.10	**4.10**	**0.36**	**1.80**	<0.10*	**1.30**	**300.00**	<0.20*	<0.20	<0.10
Point	"	14-352	Largemouth Bass	F	520	2068	**0.76**	<0.10	<0.10	<0.20	**0.24**	<0.10	<0.10	**4.10**	**0.36**	**1.40**	<0.10*	**1.90**	**270.00**	<0.20*	<0.20	<0.10
State	"	14-354	Largemouth Bass	F	360	611	**0.18**	<0.10	<0.10	<0.20	**0.28**	<0.10	<0.10	**4.90**	**0.31**	<1.00	<0.10*	**1.90**	**290.00**	<0.20*	<0.20	<0.10
Rec.	"	14-355	Largemouth Bass	F	290	309	**0.13**	<0.10	<0.10	<0.20	**0.28**	<0.10	<0.10	**5.30**	**0.28**	**1.10**	<0.10*	**1.80**	**300.00**	<0.20*	<0.20	<0.10
Area	"	14-356	Redear Sunfish	F	290	453	**0.16**	<0.10	<0.10	<0.20	**0.13**	<0.10	<0.10	**6.50**	**0.40**	<1.00	<0.10*	**1.40**	**280.00**	<0.20*	<0.20	<0.10
NC	"	14-357	Redear Sunfish	F	240	221	**0.09**	<0.10	<0.10	<0.20	**0.16**	<0.10	<0.10	**5.60**	**0.31**	<1.00	<0.10*	**1.40**	**260.00**	<0.20*	<0.20	<0.10
"	"	14-358	Redear Sunfish	F	250	303	**0.06**	<0.10	<0.10	<0.20	**0.15**	<0.10	<0.10	**7.40**	**0.40**	<1.00	<0.10*	<1.00	**290.00**	<0.20*	<0.20	<0.10
"	"	14-359	Redear Sunfish	F	270	342	**0.09**	<0.10	<0.10	<0.20	**0.15**	**0.37**	<0.10	**6.60**	**0.41**	<1.00	<0.10*	**2.10**	**260.00**	<0.20*	<0.20	<0.10
"	"	14-360	Redear Sunfish	F	260	268	**0.13**	<0.10	<0.10	<0.20	**0.13**	<0.10	<0.10	**5.30**	**0.31**	<1.00	<0.10*	**1.60**	**260.00**	<0.20*	<0.20	<0.10
"	"	14-361	Redear Sunfish	F	230	217	**0.09**	<0.10	<0.10	<0.20	**0.15**	<0.10	<0.10	**6.30**	**0.49**	<1.00	<0.10*	**1.00**	**290.00**	<0.20*	<0.20	<0.10
"	"	14-362	Redear Sunfish	F	220	170	**0.08**	**0.11**	<0.10	<0.20	**0.20**	<0.10	<0.10	**7.00**	**0.37**	**1.30**	<0.10*	**1.00**	**270.00**	<0.20*	<0.20	<0.10
"	"	14-363	Redear Sunfish	F	280	334	**0.14**	<0.10	<0.10	<0.20	**0.13**	<0.10	<0.10	**6.80**	**0.40**	**1.60**	<0.10*	**2.00**	**260.00**	<0.20*	<0.20	<0.10
"	"	14-365	Redear Sunfish	F	240	243	**0.07**	<0.10	<0.10	<0.20	**0.13**	<0.10	<0.10	**5.90**	**0.48**	**1.00**	<0.10*	**1.00**	**290.00**	<0.20*	<0.20	<0.10

[1] DWR # - The following blind duplicate samples intended for laboratory quality control were removed (14-309, 14-320, 14-331, 14-342, 14-353, 14-364).

[2] Sample Type - F = individual fillet, W = individual whole body, FC2 = fillet composite of 2, FC3 = fillet composite of 3, WC2 = whole body composite of 2, etc.

Bold data indicates analyte detection above the laboratory practical quantitation limit (PQL).

< indicates that the analyte was not detected above the reported PQL.

*** indicates J2 Qualifier - estimated value - failed to meet established quality control criteria.**

PQL's for analytes with all detections above the laboratory PQL

Cu = 0.10

Zn = 0.20

Se = 0.10

Mg = 2.00

Method Reference

U.S. EPA - 245.6 - Hg

U.S. EPA - 200.3 - sample prep. for spectrochemical determination of total recoverable elements in biological tissues (precedes 200.7 and 200.8).

U.S. EPA - 200.7 - Al, Ba, Cr, Fe, Mg, Mn, Zn

U.S. EPA - 200.8 - Ag, As, Cd, Cu, Pb, Ni, Se, Tl

Table 2. NCDWR Regression Analysis Summary for 16 Heavy Metals in Fish Fillets from Three Repeat Dan River Collection Stations *

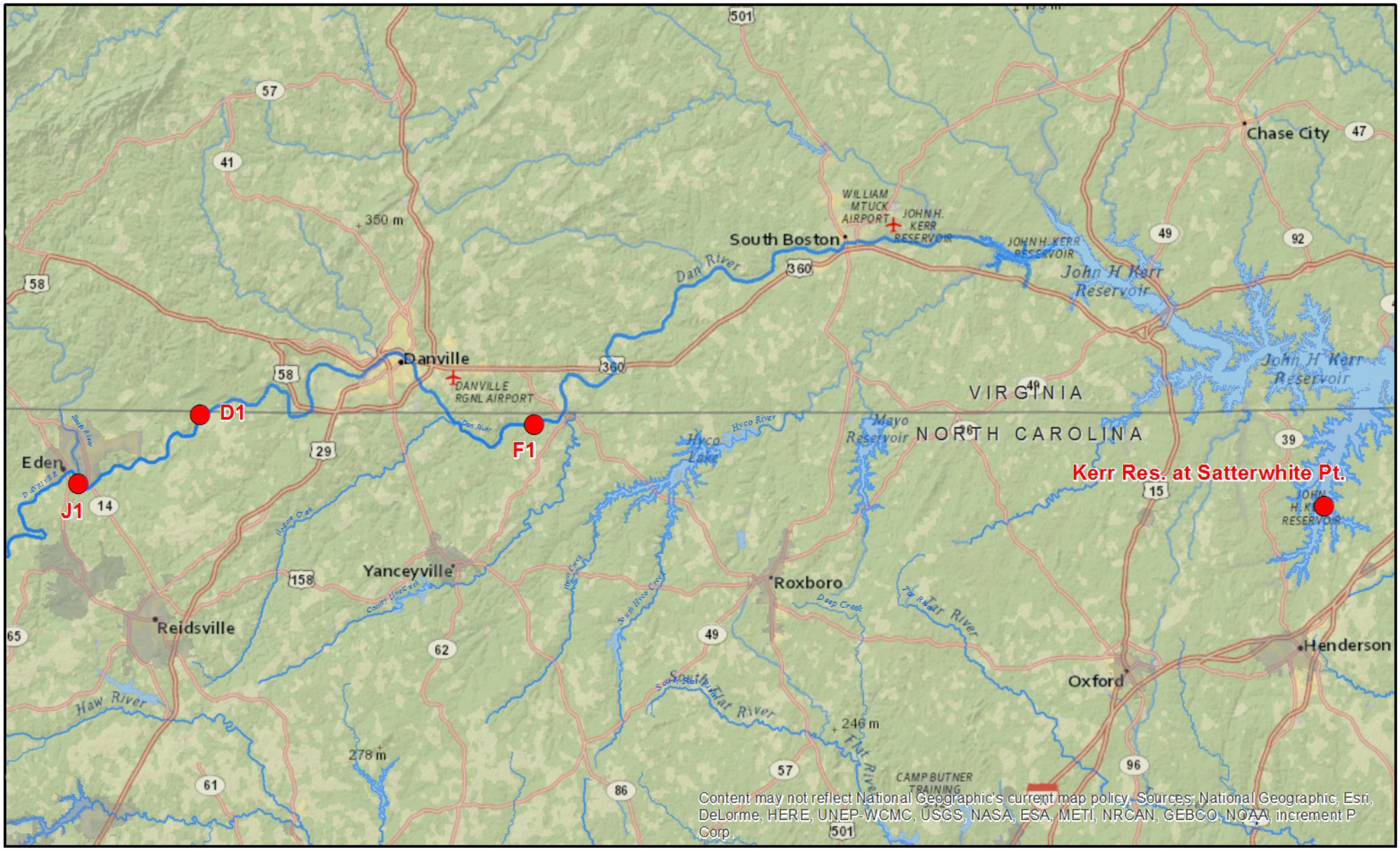
Station	Species	Total N	Significant Increase (p<0.05)	Non-significant upward trend (p>0.05)	Significant decrease (p<0.05)	Non-significant downward trend (p>0.05)
Eden (control)	Golden Redhorse	16	**Mg**	**Se**	none	**Fe**
Eden (control)	Redbreast Sunfish	14	**Al**, **Mg** and **Mn**	**Se**	none	**Hg**, **Cu**, **Zn** and **Fe**
Eden (control)	V-lip Redhorse **	5	**Mn**	**Se (near SIG), Al**, **Fe and Ba**	none	**Zn** and **Mg**
Berry Hill	Golden Redhorse	12	**Mg**	none	**Hg** and **Zn**	**Cu**, **Pb**, **Fe**, **Ba** and **Mn**
Berry Hill	Redbreast Sunfish	13	none	**Se**	**Hg**	Most other metals
Berry Hill	V-lip Redhorse **	6	none	none	**Hg**	**Cu**, **Zn**, **Al**, **Fe**, **Ba** and **Mn**
Milton	Notchlip Redhorse	11	none	none	none	Most metals

* stats available upon request

** small sample size and results not statistically powerful for this species.

Appendix 1.

Duke Power Eden Coal Ash Spill - Fish Tissue Monitoring Locations for Dan River, NC



Fish Tissue Monitoring Stations

0 2.5 5 10 15 20 Miles

N

DWR
Division of Water Resources

Appendix 2. NCDPH Fish Tissue Screening Levels

North Carolina Divison of Public Health Fish Tissue Screening Levels (ALs) for Human Ingestion Exposures for the Dan River Coal Ash Spill		
Metal	**Screening Levels (µg/kg)**	**Screening Levels (mg/kg)**
Aluminum	410,000	410
Antimony	160	0.16
Arsenic (as inorganic As)	27	0.027
Arsenic (as total As)	270	0.27
Barium	82,000	82
Beryllium	1600	1.6
Boron	82,000	82
Cadmium	410	0.41
Calcium	Not Available	Not Available
Chromium (VI)	1200	1.2
Cobalt	120	0.12
Copper	16,000	16
Iron	290,000	290
Lead	Not Available	Not Available
Lithium	820	0.82
Magnesium	Not Available	Not Available
Manganese	58,000	58
Nickel	8200	8.2
Silver	2100	2.1
Sodium	Not Available	Not Available
Thallium	4.1	0.00412
Vanadium	2,100	2.1
Zinc	120,000	120

Mercury (mg/kg)	Women of Childbearing Age (15 to 44 years) and Children (< 15 years)	Others
<0.4	2 meals per week	4 meals per week
0.4 to 1.0	Do not eat	1 meal per week
>1.0 to 3.0	Do not eat	1 meal per month
>3.0	Do not eat	Do not eat

Selenium (mg/kg)	Advisory
<10.0	No advisory
10 to 20	1 meal per week
>20 to 50	1 meal per month
>50	Do not eat

Notes:

1. SVs based on fish ingestion rate of 170 g/day, Acceptable Cancer Risk Level of 1E-04, a 70 kg adult, and daily life-time exposure.
2. All values as wet weight fillet tissue.

prepared September 16, 2014

Appendix 3. Generic Wildlife Screening Values

Mercury – 0.03 to 0.1 mg/kg wet weight (EPA 1997, Shore et al. 2011)[1,2]

Selenium – 3.0 mg/kg dry weight – (about 0.6 mg/kg wet weight) (Ohlendorf and Heinze, 2011)[3]

Arsenic – 1.3 mg/kg wet weight (muscle tissue) (from Table 28.7 in Eisler 2000)[4]

[1] U.S. Environmental Protection Agency. 1997. Mercury report to Congress. Volume VII: Characterization of human health and wildlife risks from mercury exposure in the United States. Office of Air Quality Planning and Standards and Office of Research and Development. EPA-452-R-97-009.

[2] Shore RF, Pereira MG, Woshner V, Thompson DR. 2011. Mercury in Nonmarine Birds and Mammals. Pages 609-624 In: WN Beyer, JP Meador (Eds). Environmental Contaminants in Biota: Interpreting Tissue Concentrations, Second Edition. CRC Press, Boca Raton, FL.

[3] Ohlendorf HM, Heinz GH. 2011. Selenium in Birds. Pages 669-701 In: WN Beyer, JP Meador (Eds). Environmental Contaminants in Biota: Interpreting Tissue Concentrations, Second Edition. CRC Press, Boca Raton, FL.

[4] Eisler R. 2000. Handbook of Chemical Risk Assessment: Health Hazards to Humans, Plants, and Animals, Vol. 3. Lewis Publishers, Boca Raton, FL.