TOTAL MAXIMUM DAILY LOAD (TMDL) DEVELOPMENT

- CHLORIDES -

for

NEWCOMBE CREEK

(ELLIOTT COUNTY, KENTUCKY)

Natural Resources and Environmental Protection Cabinet

Kentucky Division of Water

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KENTUCKY DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION OF WATER

Frankfort, Kentucky

This report has been approved for release:

Jack A. Wilson, Director
Division of Water

Dec. 8, 2000
Date

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Contributor

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TMDL FACT SHEET

NEWCOMBE CREEK

Project Name:	Newcombe Creek: Chlorides/TDS/Salinity
Location:	Elliott County, Kentucky
Scope/Size:	Newcombe Creek: River mile 0.0 to 11.9
TMDL Issues:	Point and Nonpoint Sources
Data Sources:	Kentucky Department for Environmental Protection, Division of Water (KDEP-DOW), SMC Martin Inc.
Control Measures:	KPDES Regulations, Kentucky Non-point Source TMDL Implementation Plan, Kentucky Watershed Framework
Summary:	Newcombe Creek, a tributary to the Little Sandy River was determined not to be supporting the designated use of aquatic life. Therefore, the stream was listed on the 303(d) list for Total Maximum Daily Load (TMDL) development. The stream segment is impacted by chlorides (in conjunction with total dissolved solids [TDS] and salinity), the result of brine discharges to surface streams from oil production activities (stripper wells). The period of greatest impact is during low base-flow conditions.

TMDL Development: Total maximum daily loads in pounds per day (lbs/day) were computed based on the allowable maximum concentration for chloride (the standard for chronic exposure is 600 milligrams per liter [mg/l] for warm water aquatic habitat) and the estimated 7-day, 10-year low-flow value (0.01 ft^3/sec). The TMDL was done for chloride because numerical criteria are available for chloride but not for TDS or salinity. Because these parameters are so closely related to chloride, the TMDL for chloride will also account for impairments resulting from TDS and salinity.

Summary of Total Maximum Daily Load Allocations for Chloride for Newcombe Creek (in pounds per day)

Source:	Chloride Load At River Mile 0.0
All Sources	31
Background	1
Waste Load Allocations (WLAs)	
Existing permits	14
New permits (no offset)	8
Maximum of (with offset)	13
Load Allocation (LAs)	
If no offset for WLAs	8
Minimum of (with offset)	3

Background loads are based on an in-stream concentration of 11 mg/l (from Ruin Creek). After background and permitted discharge loads were subtracted from the Total Maximum

Daily Load from all sources, the Remaining Allowable Load (16 lbs/day at river mile 0.0) will be allocated as follows:

(1) 50% of the Remaining Allowable Load, 8 lbs/day at river mile 0.0, will be made available for future permitted point source discharges (WLAs);

(2) 50% of the Remaining Allowable Load, 8 lbs/day at river mile 0.0, will be allocated for nonpoint source discharges (LAs).

In addition, if point discharge permit requests should exceed the above criteria (50% of the Remaining Allowable Load), then the KDEP-DOW will allow a permittee to remove an existing nonpoint source (such as an abandoned well, holding pond, or [holding] tank) such that the 50% value of the Remaining Allowable Load allocated for point discharges (WLAs) could be increased (referred to as an offset) based on an estimate in the reduction of the load contributed by the source(s), to the nonpoint source load to the stream (LA). However, the total amount of the Remaining Allowable Load allocated for permitted point source discharges (WLAs) shall not exceed 80%, 13 lbs/day at river mile 0.0. This will allow for a potential nonpoint source (LA) contribution of 3 lbs/day at river mile 0.0, and constitutes an explicit margin of safety. The allocations were made in this manner because of the uncertainty of the impact of abandoned ponds and failing separator tanks.

Implementation Controls: Discharge permits were required from oil producers starting in 1987. Many of these permits were not renewed by the producers because production has ceased or has significantly decreased. Production in Kentucky has dropped from 17,700 barrels in 1986 to 9,400 barrels in 1996. Correspondingly, production has decreased in the Newcombe Creek basin. The drop in production is the result of a drop in crude oil prices worldwide, making production less economical, particularly for smaller producers. Chloride levels from nonpoint sources should decrease over time as dilution lowers concentration levels in existing ponds. The stream was initially monitored for chloride in 1985 and a concentration value of 2,020 mg/l was obtained, which is greater than the water quality standard for Warm Water Aquatic Habitat of 600 mg/l. In 1991, the stream was monitored again and a chloride concentration of 181 mg/l was determined, which is lower than the chloride standard. Kentucky is currently conducting stream monitoring on a watershed basis. Sampling to determine levels of chloride, TDS, and salinity will be conducted during the period of April 2002 to March 2003 in this watershed. If chloride concentrations are determined to be below 600 mg/l, then a request will be made to remove the site from the list of impaired waters.

If oil production in the basins appreciably increases (which would most likely result from increasing oil prices or an oil supply shortage), permit compliance will be pursued and periodic monitoring of stream water quality including chloride, TDS, and salinity levels will be conducted as deemed appropriate.

CHLORIDES TMDL DEVELOPMENT

Newcombe Creek
Elliott County, Kentucky

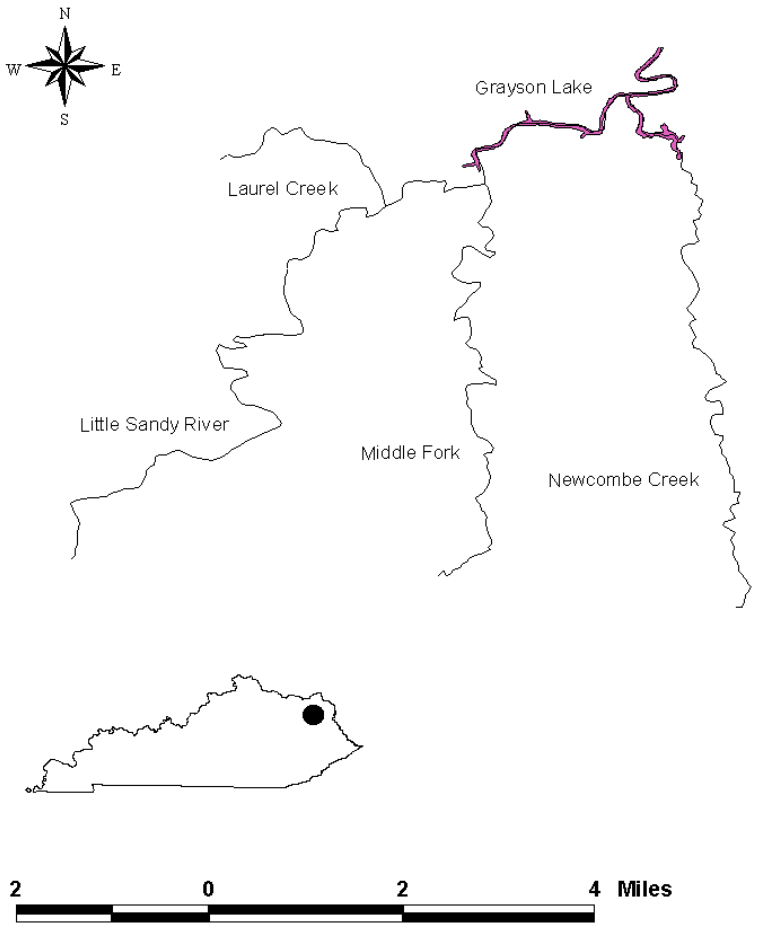
Introduction

Section 303(d) of the Clean Water Act and the Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop total maximum daily loads (TMDLs) for water bodies that are not meeting designated uses under technology-based controls for pollution. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a water body based on the relation between pollution sources and in-stream water quality conditions. States can then establish water-quality based controls to reduce pollution from both point and nonpoint sources and restore the quality of their water resources.

Problem Definition

Newcombe Creek (Fig. 1) was determined not to be supporting the designated use of aquatic life based on information collected during a 1985 intensive survey (KDEP-DOW, 1991). It was listed in the 1986 and subsequent 305(b) reports as being in nonsupport. Therefore, the stream was listed on the 1990 and subsequent 303(d) lists for Total Maximum Daily Load (TMDL) development. The stream segment is impacted by chlorides (in conjunction with total dissolved solids [TDS] and salinity) as a result of brine discharges to surface streams from oil production activities (stripper wells). The period of greatest impact is during low-flow (SCM Martin, Inc., 1983; Evaldi and Kipp, 1991).

Figure 1. Map of the Upper Little Sandy River Basin



2

In the early 1800s, oil was discovered during salt well drilling (SMC Martin Inc., 1983). At that time, oil was considered an unwanted by-product of the process, but in the 1850s, the oil became a desired commodity. Production was high throughout the early 1900s, but yields, and subsequently production, have declined over time. For the past several decades, most wells in Eastern Kentucky have yielded less than about 10 gallons of oil per day. These are termed 'stripper wells.' Almost half of the producers own only one (1) well, and eight (8) out of ten producers own six (6) wells or fewer. Brine is also extracted during the process, and for each barrel of oil, approximately ten barrels of brine are produced (SMC Martin Inc., 1983). The oil and brine are separated, and the brine is stored in a large tank or discharged to a holding pond. Brine is sometimes disposed of by injection into wells and is also used to force oil in the well to the surface. Before 1987, brine was also discharged directly to the surface stream. The discharge of brine to the receiving stream adversely affects aquatic life in the stream.

During runoff events, contaminants such as chloride will typically move rapidly through the stream system and become diluted. However, during low-flow conditions, there may be only a minor contribution to streamflow through groundwater discharge for many streams (SCM Martin, Inc., 1983). Therefore, only limited dilution of the chlorides that are present in the stream or that are discharged to the stream occurs. In addition, some of the flow that may exist in the stream may be from discharges of the brine solution from the separator tanks (discharges or failing separator tanks) or discharges and possibly seepage from holding ponds. Low flow, therefore, represents the critical condition when adverse stream impacts due to chlorides exist in the stream.

Target Identification

The endpoint or goal of the TMDL is to achieve a chloride concentration (and associated load in lbs/day) that allows for the sustainability of aquatic life in the stream. The chronic chloride criterion to protect Warm Water Aquatic Habitat Use in Kentucky is 600 mg/l (Title 401, Kentucky Administrative Regulations, Chapter 5:031). This criterion was developed from a study conducted in 1985 by the University of Kentucky (Birge et al, 1985) through the KDEP-DOW. Because the critical period of the effect of chlorides on water quality occurs during low-flow conditions (as previously discussed), the 7-day, 10-year low-flow value ($7Q_{10}$) was selected as the design flow. The $7Q_{10}$ is also used as the permitted flow value.

The $7Q_{10}$ flow at the mouth of Newcombe Creek was estimated to be 0.01 cubic feet per second (ft^3/s). The $7Q_{10}$ flow at river mile 5.8 (the sampling location for the October 30, 1985, intensive survey) of Newcombe Creek was also estimated to be about 0.01 cubic feet per second (ft^3/s). The estimates are based on a combination of: (1) techniques described by Ruhl and Martin (1991); (2) comparison of drainage area to flow at sites in the Little Sandy River watershed during low-flow conditions (USGS, 1986); and (3) information obtained during the October 30, 1985, synoptic sampling survey of Newcombe Creek (KDEP-DOW, 1991). There have been several permits issued to dischargers in the Newcombe Creek watershed, but many of these permits are listed as ‘inactive.’ The permitted flow at the active sites in the watershed totals 2754 gallons per day, which is 0.004 ft^3/s.

Based on the $7Q_{10}$ flow of 0.01 ft^3/s and chloride concentration of 600 mg/l, the permissible load of chloride (in lbs/day) at the mouth of Newcombe Creek is 31 lbs/day. Newcombe Creek flows into the headwater area of Grayson Lake, and there are no water supply withdrawal locations immediately downstream of the confluence of Newcombe Creek and the Little Sandy River. Therefore, the use of a chloride concentration value of 250 mg/l, which is the state's criteria for drinking water sources, is not necessary.

Source Assessment

Brine was previously discharged directly to the streams, but permit limits based on the chloride criterion developed in 1985 were required after 1987. However, there are a number of abandoned wells, separator tanks, and holding ponds that exist throughout the upper part of the Newcombe Creek basin. The separator tanks and holding ponds deteriorate over time and are potential contributors of chloride to the streams. The abandoned wells and holding ponds are also potential sources of chloride during even small runoff events.

Linkage Between Numeric Targets and Sources - Model Development

Data on chloride, total dissolved solids, and salinity were collected at several locations throughout the upper Little Sandy River watershed but at only one (1) location in the Newcombe Creek watershed (Fig. 1). These data are included in a report by the KDEP-DOW (1991) for the October 30, 1985, intensive survey and in the KDEP-DOW files for the August 8, 1991 intensive survey. On October 30, 1985, Newcombe Creek had a chloride concentration of 2020 mg/l. On August 8, 1991, Newcombe Creek had a chloride concentration of 181 mg/l. The sampling location for both surveys was at river mile 5.8 and most of the oil wells are located upstream of the sampling location. Therefore, the chloride concentration is considered indicative of that which would occur throughout the lower reach. For the 1985 survey, streamflow values from nearby sites (USGS, 1986) indicate that the intensive survey was conducted during a period of low base-flow but that values were not close to $7Q_{10}$ levels. If streamflow had been lower, closer to $7Q_{10}$ levels, chloride levels would probably have been higher (because of limited dilution potential), but the extent of this increase is unknown. The August 8, 1991, intensive survey was made when flows were much lower, close to $7Q_{10}$ levels.

For the October 30, 1985, intensive survey, the flow at the mouth of Newcombe Creek was estimated as 4.5 ft^3/s. Using this flow value and the concentration value of 2020 mg/l, the load at the mouth of Newcombe Creek was 49,000 lbs/day. This estimate is probably higher than what actually occurred because the increased flow from the sampling location to the mouth probably diluted the chloride concentration. For the October 30, 1985, intensive survey, the flow at river mile

5.8 was estimated as 1.6 ft^3/s. Using this flow value and the concentration value of 2020 mg/l, the load at river mile 5.8 of Newcombe Creek was 17,400 lbs/day. The value of 17,400 lbs/day is probably more reasonable as the load which occurred throughout the Newcombe Creek reach because, as mentioned previously: (1) chloride concentration would decrease in the downstream direction as flow increased; and (2) the majority of oil wells are located above the sampling location (at river mile 5.8).

For the August 8, 1991, survey, the flow at the mouth of Newcombe Creek was estimated to be 0.01 cfs. The flow at river mile 5.8 was estimated to also be about 0.01 cfs. Using this flow value and a chloride concentration of 181 mg/l, the load at the mouth and at river mile 5.8 would be 10 lbs/day. This concentration value is below the water quality standard of 600 mg/l for Warm Water Aquatic Habitat. The watershed is scheduled to be sampled again in the summer or fall of 2002. If chloride concentrations are determined to be below 600 mg/l, then a request will be made to remove the stream from the list of impaired waters.

TMDL Development

Total maximum daily loads (TMDLs) are comprised of the sum of individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and natural background levels for a given watershed. The sum of these components must not result in the exceedance of water quality standards for that watershed. The TMDL is the total amount of pollutant that can be assimilated by the receiving stream without violating water quality standards. The TMDL document establishes the allowable stream loadings that are less than or equal to the TMDL and thereby provide the basis to establish water-quality based controls.

For Newcombe Creek at the mouth (river mile 0.00), the total allowable chloride load is 31 lbs/day. The currently active permitted dischargers can account for a chloride load of 14 lbs/day. These are direct point source discharges of brine to the stream (WLAs). This allows for a maximum remaining chloride load of 17 lbs/day for future permitted discharges (WLAs) and contributions from nonpoint sources and from natural background (LAs). Chloride concentrations at the control site (indicative of background conditions) were about 11 mg/l (1 lbs/day). This allows for future permitting and nonpoint contributions (most likely from failing separator tanks or holding ponds, or seepage from holding ponds) up to a maximum of about 16 lbs/day.

To accommodate future permittees for Newcombe Creek, 50 percent of this maximum load (8 lbs/day) will be allocated for point discharge permits. The remaining 50 percent of this maximum load (8 lbs/day) will be set aside as a factor of safety (implicit) to account for the unknown nonpoint sources (failing separator tanks or holding ponds, abandoned wells, seepage from holding ponds, or other sources). Permit applications exceeding 50 percent of the allowable total maximum daily load of 8 lbs/day would be approved by the KDEP-DOW provided that the applicant removed an equivalent amount from nonpoint sources in the watershed, such as separator tanks or abandoned holding ponds. At no time would permits be approved beyond 80 percent of the allowable TMDL of 16 lbs/day (13 lbs/day). This would provide at least a 20 percent margin of safety (explicit) to account for uncontrollable or unidentified nonpoint sources.

Table 1. Summary of Total Maximum Daily Load Allocations for Chloride for Newcombe Creek (in pounds per day) for 7Q10 = 0.01 ft^3/sec

Source:	Chloride Load At River Mile 0.0
All Sources	31
Background	1
Waste Load Allocations (WLAs)	
Existing permits	14
New permits (no offset)	8
Maximum of (with offset)	13
Load Allocation (LAs)	
If no offset for WLAs	8
Minimum of (with offset)	3

Currently, there is little oil production taking place within the watershed because the price of oil has recently been low (less than $15 per barrel). Production in Kentucky dropped from 17,700 barrels in 1986 to 9400 barrels in 1996 (Environmental Quality Commission, 1997). As a result, direct discharges are small, and chloride loads from the failing separator tanks and holding ponds should decrease over time as the separator tanks empty and as dilution occurs in the holding ponds. As mentioned previously, the August 8, 1991, survey indicated that chloride concentration values in Newcombe Creek were lower than the water quality standard for Warm Water Aquatic Habitat. Sampling in the basin will occur between April 2002 and March 2003. If chloride concentrations are determined to be below 600 mg/l, then a request will be made to remove the stream from the list of impaired waters.

If oil production in the basins appreciably increases (which would most likely result from increasing oil prices or an oil supply shortage), permit compliance would be pursued and periodic monitoring of stream water quality, including chloride, TDS, and salinity levels, will be conducted as deemed appropriate.

References

Birge, W. J., J. A. Black, A. G. Westerman, T. M. Short, S. B. Taylor, and D. M. Bruser. 1985. Recommendations on numerical values for regulating iron and chloride concentrations for the purpose of protecting warmwater species of aquatic life in the Commonwealth of Kentucky. University of Kentucky. Lexington, KY.

(EQC) Environmental Quality Commission. 1997. 1996-97 State of Kentucky's Environment. Resource Extraction. Environmental Quality Commission, Frankfort, KY.

Evaldi, R. D. and J. A. Kipp. 1991. Effects of oil production on water resources in the Kentucky River basin, Kentucky. U.S. Dept. of Interior, Geological Survey, Water-Resources Investigations Report 90-4191.

(KDEP-DOW) Kentucky Department for Environmental Protection - Division of Water. 1991. Upper Little Sandy River system biological and water quality investigation. Technical Report No. 31. Department for Environmental Protection. Ky. Natural Resources and Environmental Protection Cabinet, Frankfort, KY.

Ruhl, K. J. and G. R. Martin. 1991. Low-flow characteristics of Kentucky stream. U.S. Dept. of Interior, Geological Survey, Water-Resources Investigations Report 91-4097.

S. M. C. Martin, Incorporated. 1983. The stripper wells of east-central Kentucky: an environmental assessment. S. M. C. Martin Inc. Valley Forge, PA. Ref. #8412-040-94005.

(USGS) United States Geological Survey. 1986. Water resources data for Kentucky, water year 1985. U.S. Dept. of Interior, Geological Survey, Water Data Report KY-85-1.

INDEX OF TMDL SUBMITTAL DOCUMENTATION

303(d) LIST INFORMATION

State	Kentucky
Name of 303(d) listed waterbody	Newcombe Creek
Segment as identified from 303(d) list	River Mile 0.0 to 11.9
City/County	Elliott County
Watershed(s)/8-digit cataloging unit code	05090104
3-digit EPA reach file number	032
Length (mi) or area (acres) of impairment	11.9 miles
Water quality standards being violated	Chloride Concentration > 600 mg/l
Water use classification	Aquatic Life (Warm Water Aquatic Habitat)
Pollutant of concern	Chlorides from oil brines
Location description of waterbody	40 miles southwest of Ashland, KY
Sources(s) of impairment	Oil production activities

PUBLIC NOTIFICATION INFORMATION

Form of public notification	Press release and letters to a mailing list to request comments on the draft report. Report will be available on the Internet.	
Beginning/ending dates of public notice	* /	
Notice mentioned TMDL proposal	* yes	no
Comments received from public	* yes	no
Responsiveness summary prepared	* yes	no

* Will provide public notification after having received the informal review comments back from EPA Region IV and having incorporated those changes into the report.

INDEX OF TMDL SUBMITTAL DOCUMENTATION (cont.)

TMDL INFORMATION

Critical Conditions		___ high flow _X_ low flow ___other_____
Seasonality		_X_Annual ___Summer/Winter ___Monthly
TMDL development tool(s)		_____Water quality model(s) _____ Mass balance equations __X___ Other Intensive Synoptic Survey
Supporting Models/Documents		Kentucky Department for Environmental Protection, Technical Report No.26 Birge, W.J., Report on Chlorides and Warm-water Species Protection SCM Martin Inc., Report on Eastern KY Stripper Wells
TOTAL MAXIMUM DAILY LOADS (Notes, such as: TMDL's for intermediate flows can be interpolated between those given). Can be in table format if necessary, but this may require only a single value. In that case continue on with the previous format		31 lbs/day for Newcombe Creek at river mile 0.00 based on an allowable chloride concentration of 600 mg/l and a 7-day 10-year low flow value of 0.01 cubic feet per second (cfs).
Loadings	Wasteload Allocation (Point Sources)	At river mile 0.00: 8 lbs/day to a maximum (offset) of 13 lbs/day – excludes 14 lbs/day currently permitted
	Load Allocation (Nonpoint Sources)	At river mile 0.00: 8 lbs/day to a minimum (offset) of 3 lbs/day - excludes background load of 1 lbs/day
	Margin of Safety _X_ Explicit	At river mile 0.00: 3 lbs/day (if maximum allowable load is permitted)
	_X_ Implicit	Allowable chloride concentration based on findings by Birge (conservative assumptions used)