



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 6

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Dan Eden, Deputy Director
Office of Permitting, Remediation & Registration (MC-122)
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, TX 78711-3087

Dear Mr. Eden:

The Environmental Protection Agency (EPA or Agency) has completed its review of site-specific selenium criteria for Dixon Creek (unclassified water body in segment 0101 of the Canadian River Basin). This change was adopted by the Texas Natural Resource Conservation Commission (TNRCC - now the Texas Commission on Environmental Quality (TCEQ)) on July 26, 2000, as part of the triennial revision of the Texas Surface Water Quality Standards (TX WQS). In this action, the selenium criteria for Dixon Creek were revised from 20 ug/L to 219 ug/L (acute criterion) and from 5 ug/L to 34.6 ug/L (chronic criterion). The submission included a study conducted by the Phillips 66 Company (now the ConocoPhillips Company) which includes water chemistry, sediment and tissue data, and assessment of the aquatic habitat and the fish community.

The Agency has conducted an extensive review of the submission package in order to understand whether the new criteria are scientifically-defensible and protective of the designated uses of Dixon Creek and the downstream water body, the Canadian River. In the case of selenium, EPA is in a unique situation, because although the existing, published §304(a)-recommended criteria are based on concentrations of selenium in the water column, EPA has issued, a new fish tissue-based criterion for selenium.¹ Accordingly, in reviewing the submission, we considered not only the data the TCEQ submitted to EPA but also data and information EPA has gathered on the aquatic risks of selenium as part of the process of revising the existing EPA-recommended criteria. However, at this time, the Agency has concluded that the available supporting documentation does not provide sufficient scientific support to demonstrate that the site-specific selenium criteria will protect the aquatic life uses designated by the state for Dixon Creek and the Canadian River. Thus, EPA is disapproving the proposed site-specific criteria for Dixon Creek.

In conducting its review, the Agency evaluated water column concentration data, fish tissue concentration data, biological assessment data for the habitat of interest, and Index of Biotic Integrity scores. EPA focused primarily on the extent to which selenium in Dixon Creek would bioaccumulate in fish tissue in Dixon Creek and the Canadian River. EPA used the chronic

¹ U.S. EPA. 2004. *Draft Aquatic Life Water Quality Criteria for Selenium - 2004*. Office of Water, Washington D.C. November 2004. 334 pp. EPA-822-D-04-001.

value, 34.6 ug/L, because for selenium, this lower value is more pertinent to the toxic effects of selenium and the derivation of permit limits and assessing of attainment of water quality standards. The chronic fish tissue criterion that EPA has developed represents the latest science regarding selenium concentrations that would be protective of aquatic life; accordingly, EPA views this criterion (7.9 ug/g dry weight) as an appropriate value for purposes of evaluating the adequacy of the Texas site-specific criteria to protect aquatic life uses.

For this evaluation, EPA assessed the fish tissue concentrations in Dixon Creek and the Canadian River, both upstream and downstream of the confluence of the discharge. The submitted data (from the ConocoPhillips study) show elevated water column levels of selenium in Dixon Creek downstream of the discharge for the ConocoPhillips refinery, with levels close to or exceeding EPA's currently recommended water column-based aquatic life criteria for selenium of 5 ug/L (concentrations ranged from 35.4 ug/L downstream of the discharge to 8.87 ug/L at a sampling point in Dixon Creek closest to the confluence with the Canadian River).

EPA then considered available fish tissue data and compared selenium levels in fish tissue from Dixon Creek to the 7.9 ug/g dry weight criterion (hereafter, the "reference value") that EPA has issued in draft form. The submitted data show that the fish tissue samples in Dixon Creek exceeded 7.9 ug/g dry weight in 13 of the 18 samples downstream of the discharge versus an upstream exceedence in one of the 11 samples.² Additionally, the tissue samples of fish species taken downstream from Dixon Creek's confluence with the Canadian River exceeded the reference value in seven of the nine samples as opposed to one exceedence in nine tissue samples collected at the upstream sites. In the reference stream, White Deer Creek, no samples exceeded the tissue criterion. Thus, the available data suggest that water column concentrations in Dixon Creek (levels that were close to or exceeded 5 ug/L when they were collected) may be associated with elevated (exceeding the reference value) fish tissue levels in Dixon Creek and the Canadian River.

Finally, EPA considered whether modeling could be used to estimate an approximate water column value for Dixon Creek that would result in a fish tissue concentration of 7.9 ug/g. The ambient water column data and fish tissue data submitted by ConocoPhillips were collected during one sampling event (May 1999). The single sampling event does not provide sufficient data to develop a bioaccumulation factor for selenium. Bioaccumulation is not constant over a range of concentrations and data collected over a longer period of time would be needed to estimate the bioaccumulation factor. The available data do not support the site-specific numeric water column-based criteria for selenium. We recommend that any future studies include data collected over a longer period of time for water concentrations and fish tissue in the Dixon Creek and the Canadian River. EPA would welcome the opportunity to work with you in a collaborative manner to help design study parameters or monitoring schemes which if

² Sample results submitted in ConocoPhillips study were based on wet weight of fish. A moisture content of 75% was assumed to convert wet weight measurements to dry weight measurements for comparison results (see Enclosure 2).

implemented would produce the type of data that would be needed in order to determine if a site-specific selenium criterion is appropriate for Dixon Creek.

The Agency also considered the biological assessment data provided in the ConocoPhillips study. Using TCEQ's Habitat Quality Index, the scores indicate that Dixon Creek could support a high aquatic life use, while the scores for the Canadian River indicate that an intermediate aquatic life use could be supported. Additionally, the fish community was assessed with TCEQ's Index of Biotic Integrity (IBI) scores. These IBI scores use metrics describing the species richness and diversity to assess the biological condition of a site. However, the IBI scoring does not directly address effects such as decreased reproduction, teratogenic defects, and impacts on growth. For example, to detect teratogenic effects or reduced growth effects from selenium exposure, evaluation of the physical condition of individual fish to report disease or other anomalies present would be needed. Age-class distribution would also serve as an indicator of reproductive success within the fish community.

Use of the statewide IBI indicated that limited to intermediate fish communities occur in Dixon Creek and the Canadian River. The fish community was also assessed with the IBIs developed for Texas ecoregions, which indicated that intermediate to exceptional fish communities were present in Dixon Creek. The ecoregion IBI scores for the Canadian River were similar with an exceptional score at one of the two upstream sites and limited to intermediate aquatic life uses at the other upstream site and two downstream sites. While these IBI scores are positive indicators of the quality of the biological communities, the scores were based on a single sampling event which provides only a snapshot of the biological community at a single point in time. Since the biological sampling is limited to a single sampling event, there is uncertainty as to how well this sampling event represents the quality of the biological communities present in these waters. Because the metrics used in IBI scoring do not cover the spectrum of potential endpoints of concern and because the biological sampling was limited to a single sampling event, this information is not viewed as sufficient scientifically to support an aquatic life criteria of 34.6 ug/L.

SUMMARY:

Given that the reference value (EPA's chronic fish tissue criterion) is based on the most recent and peer-reviewed studies, EPA considered the frequency and degree to which fish tissue concentrations in the relevant waters would exceed the reference value when water column concentrations are 34.6 ug/L. Using the evidence provided, EPA finds that the revised selenium criteria in Dixon Creek will not adequately protect the designated aquatic life uses in this water body or in the Canadian River. We will continue to provide assistance to TCEQ staff if the state wishes to pursue other options for site-specific criteria.

Under 40 CFR §131.21(c), new and revised standards do not go into effect for CWA purposes until approved by EPA. Therefore, the statewide selenium criteria in Table 3 of the TX WQS will continue to apply to Dixon Creek. The selenium criteria in Table 3 were not changed

in the 2000 TX WQS. The site-specific criteria in Appendix E of the TX WQS should be removed at the time of the next interim or triennial revision.

I would like to commend the TCEQ staff for its commitment in completing the task of reviewing and revising the state's water quality standards. EPA will take separate action on the remaining new and revised parts of the TX WQS. If you have any questions or concerns, please contact me at (214) 665-7101, or have your staff contact Diane Evans at (214) 665-6677.

Sincerely yours,


Miguel I. Flores
Director
Water Quality Protection Division (6WQ)

Enclosures

cc: Jim Davenport, TCEQ - Water Quality Assessment Section (MC-150)
Allen White, USFWS - Austin Ecological Services Office

Record of Decision for EPA Review of Site-specific Selenium Criteria for Dixon Creek

The Environmental Protection Agency (EPA or Agency) has completed its review of site-specific selenium criteria for Dixon Creek (unclassified water body in segment 0101 of the Canadian River Basin). This change was adopted by the Texas Natural Resource Conservation Commission (TNRCC - now the Texas Commission on Environmental Quality (TCEQ)) on July 26, 2000, as part of the triennial revision of the Texas Surface Water Quality Standards (TX WQS). The acute selenium criterion for Dixon Creek was revised from 20 ug/L to 219 ug/L and the chronic selenium criterion was revised from 5 ug/L to 34.6 ug/L. A study conducted by the Phillip66 Company (now the ConocoPhillips Company) was also submitted to EPA which includes water chemistry, sediment and tissue data, and assessment of the aquatic habitat and the fish community in Dixon Creek and a portion of the Canadian River.

The revised site-specific standards for Dixon Creek became effective as state law on August 17, 2000, and were submitted to EPA on September 27, 2000, as required under federal regulation 40 CFR §131.5. Clean Water Act (CWA) §303(c) requires EPA to approve or disapprove new or revised water quality standards in order for the standard to become effective for purposes of the CWA (see 40 CFR §131.21(b)). States may adopt site-specific criteria if the State demonstrates that the site-specific criteria support the designated use(s) (see §40 CFR §131.11). The Agency has concluded that the supporting documentation does not provide sufficient justification to demonstrate that the site-specific selenium criteria will protect the aquatic life uses designated by the State for Dixon Creek and the Canadian River. Thus, EPA is disapproving the site-specific selenium criteria for Dixon Creek.

Aquatic organisms may be affected by toxic concentrations of selenium in water or by bioaccumulation of selenium in food sources. Aquatic-dependent species, such as birds, may also be affected by bioaccumulation of selenium in fish and invertebrates. Thus, as discussed below, EPA found it relevant to consider the fish tissue concentrations in the water bodies where the site-specific criteria would apply. Because the State did not submit site-specific fish tissue criteria, but rather, ambient water column criteria, EPA thought that it was relevant to consider the ambient water column concentrations in the waters along with the fish tissue concentrations associated with those waters. The data in the ConocoPhillips report documents selenium at elevated levels in Dixon Creek downstream of the discharge. Total selenium in the water column was measured at 35.4 ug/L at the site downstream of the facility's discharge and decreased to 8.87 ug/L at the site closest to the confluence with the Canadian River. These data show that Dixon Creek has selenium concentrations above the statewide chronic criteria of 5 ug/L, but near the proposed chronic site-specific criteria of 34.6 ug/L. Selenium concentrations in the Canadian River did not exceed the statewide chronic criterion of 5 ug/L according to data in the ConocoPhillips report. However, this was based on a single sampling event. Monitoring conducted by the TCEQ has measured selenium above 5 ug/L below the confluence of Dixon Creek and the Canadian River, also in a single sampling event. Additional data submitted by ConocoPhillips in August 2005 does not confirm that the chronic criterion of 5 ug/L for the

Canadian River is maintained. Thus, the data submitted to EPA show that the waters where the site-specific criteria would apply, have ambient water column concentrations near the chronic site-specific criteria submitted by the State.

ConocoPhillips analyzed selenium concentrations in whole fish for several species including minnows, livebearers, and sunfish. For each of the six species collected at both upstream and downstream sites, the average concentrations in whole body samples were higher at downstream sites when compared to samples from upstream sites or the reference site on White Deer Creek. Because toxic effects from selenium may occur through bioaccumulation, EPA compared selenium concentrations in fish tissue collected from Dixon Creek, the Canadian River, and White Deer Creek (a reference stream) to EPA's chronic selenium aquatic life criterion value of 7.9 ug/g.¹ EPA believes that fish tissue concentration, as opposed to water column concentration is an appropriate indicator of adequate protection from chronic effects. Dietary intake and resulting bioaccumulation is the most important route of exposure for chronic selenium toxicity. Besides being a direct link to chronic endpoints, a tissue-based criterion has the positive attributes of integrating many site-specific factors, such as chemical speciation and rates of transformation, large variations in temporal concentrations in water, types of organisms constituting the food chain, and rates of exchange between water, sediment and organisms.

The criteria document for selenium identifies a tissue-based value of 7.9 ug/g (dry weight) as the chronic criterion value protective of aquatic life. While the draft criteria have not been published as recommended criteria under CWA §304(a), they represent the Agency's best available science. In addition, EPA conducted a peer review of the draft criteria with a panel of outside experts concluding that the criteria were scientifically-sound. The chronic criterion is expressed as a fish tissue concentration and is based on recent data that includes studies of reproductive effects and bioaccumulation of selenium. Therefore, as part of assessing the protectiveness of Texas' proposed site-specific water column criteria, EPA compared the chronic criterion to the fish tissue data provided from fish taken from Dixon Creek, the Canadian River, and White Deer Creek.

Data provided to the Agency indicate that the facility analyzed fish tissue samples as wet weight using TCEQ's monitoring procedures. A moisture content of 75% was assumed to convert wet weight measurements in the Phillips study to dry weight measurements for comparison with screening factors. In Dixon Creek, 13 of the 18 samples exceeded the recommended chronic criterion value of 7.9 ug/g. For the 11 fish samples collected in Dixon Creek upstream of the facility's discharge, one sample exceeded the screening level of 7.9 ug/g. Similar results were found for fish sampled in the Canadian River. Downstream of the confluence with Dixon Creek, seven of nine samples exceeded the screening level of 7.9 ug/g. Upstream of the confluence with Dixon Creek, only one of nine samples exceeded the screening level of 7.9 ug/g. In the reference stream, White Deer Creek, no samples exceeded the screening

¹ U.S. EPA. 2004. *Draft Aquatic Life Water Quality Criteria for Selenium - 2004*. Office of Water, Washington D.C. November 2004. 334 pp. EPA-822-D-04-001.

level of 7.9 ug/g. The fish tissue samples in Dixon Creek exceeded the recommended chronic criterion (7.9 $\mu\text{g/g}$) by almost three times the concentration, and the fish tissue samples in the Canadian River exceeded the chronic criterion by approximately two times.

The water concentration data showed that ambient selenium concentrations in the water column in Dixon Creek were near the proposed chronic site-specific criterion of 34.6 ug/L, but the fish tissue data provided show fish tissue concentrations that exceed the reference value for protection of aquatic life. In this case, using fish tissue concentration data to estimate exposure to selenium at levels of concern through the most important exposure route, there is evidence that the proposed water column site-specific criteria will not protect the designated use. Absent additional data showing that the biota are less sensitive to selenium at this individual site, the data provided do not demonstrate that the proposed site-specific criteria would protect the designated aquatic life use.

The facility included some biological assessment data to demonstrate the condition of the habitat and biota in the area where the site-specific criteria would apply. First, the facility assessed the aquatic habitat for Dixon Creek and a twelve-mile reach of the Canadian River using TCEQ's Habitat Quality Index. This type of study examines the physical features of the water body, such as buffer vegetation, substrate stability, and channel sinuosity, without examining pollutant concentrations in the water body. Scores for Dixon Creek indicate that the habitat should support a high aquatic life use. The scores for the Habitat Quality Index in the Canadian River indicate that an intermediate aquatic life use could be supported.

In addition, the fish community was assessed with TCEQ's Index of Biotic Integrity (IBI) scores. These IBI scores use metrics describing the species richness and the diversity in the water body to assess the biological condition of a site. Use of the statewide IBI indicated that limited to intermediate fish communities occur in Dixon Creek and this reach of the Canadian River. The assessment of the benthic macroinvertebrate community equated to a limited aquatic life use ranking for all sites in Dixon Creek (including sites above the discharge), and limited to intermediate rankings for the Canadian River sites. As the ConocoPhillips report notes, the benthic macroinvertebrate IBI was developed on a statewide basis.

The study also included the assessment of the fish community based on the ecoregion IBIs developed by the Texas Parks and Wildlife Department. Dixon Creek and this part of the Canadian River are part of ecoregion 26 - Southwestern Tablelands. At the time that the ConocoPhillips study was conducted, the ecoregion IBIs were considered to be in draft form, but have since been published as a final document. The IBI scores for Dixon Creek resulted in exceptional aquatic life use rankings at four of the six sites and intermediate aquatic life use rankings at the other two sites. Assessment of the furthest upstream site in the Canadian River indicated an exceptional aquatic life use ranking and the remaining three sites resulted in limited to intermediate aquatic life use rankings. EPA agrees with the State that the ecoregion IBIs are a better indicator of the unique environment in the Texas panhandle than the statewide IBIs. Although the study indicated that a diverse fishery is present in Dixon Creek and the structure of

the fish communities is generally representative of the physical habitat in both Dixon Creek and this reach of the Canadian River, the study was based on a single sampling event. EPA has some concerns that relatively high flows (at time of sampling) could have influenced the results of the IBI sampling (e.g., more species washed downstream).

While the ecoregion-based IBI scores may be representative of a diverse fish community in Dixon Creek, a measure such as an IBI does not necessarily account for chronic effects in aquatic organisms or bioaccumulation. Bioassessment analyses such as IBI scores can reveal changes in the aquatic community as a result of chronic or acute effects. However, depending on the metrics selected, the IBI assessments conducted in support of these criteria may not be sensitive to the effects associated with selenium toxicity, such as decreased reproduction or growth. The metrics included in the IBI assessment measured total numbers of fish species, the trophic structure, and determined whether those species were considered "tolerant" of degraded habitats or pollution. Moderate pollution may produce changes in taxa so that diversity remains similar, but species composition has shifted. In response to increasing stressors, species richness can decline abruptly and the numbers of tolerant species can increase dramatically.

Given the frequency and degree to which the reference values for fish tissue concentrations are exceeded in the relevant waters, and that the reference value is based on recently collected data and peer-reviewed studies, the IBI scores based on very limited sampling events and the associated uncertainty with regard to the sensitivity of the IBI metrics to selenium toxicity do not justify a conclusion that the site-specific criteria will protect the designated aquatic life uses in Dixon Creek and the Canadian River.

In an effort to conduct a thorough evaluation, EPA attempted to model for Dixon Creek and the Canadian River the approximate ambient water column concentrations that would result in fish tissue concentrations approximating 7.9 ug/g. The fish tissue and ambient water column data submitted by ConocoPhillips were collected during one sampling event (May 1999). EPA concluded that more ambient water column concentration data would be needed to estimate the relationship between water column and fish tissue concentrations in Dixon Creek and the Canadian River, as bioaccumulation occurs over a period of time under varying environmental conditions. The rate at which selenium accumulates in fish tissue is also a function of dietary uptake. While tissue concentrations of selenium likely remain relatively stable over time, water concentrations may vary on a daily or weekly basis. Therefore, calculation of the rate of accumulation of selenium in fish tissue would require a long-term average water concentration.

Given that the reference value (EPA's draft chronic fish tissue criterion) is based on the most recent and peer-reviewed studies, EPA considered the frequency and degree to which fish tissue concentrations in the relevant waters would exceed the reference value when water column concentrations are 34.6 ug/L. Using the evidence provided, EPA finds that the revised selenium criteria in Dixon Creek will not adequately protect the designated aquatic life uses in this water body or in the Canadian River.

Selenium concentrations in fish tissue (converted to dry weight) from ConocoPhillips study

species	tissue	site	selenium in tissue ug/g (wet wt.)	conversion factor for assumed 75% moisture	selenium in tissue * ug/g (dry wt.)
red shiner	whole	DC-upstream	0.561	4	2.244
red shiner	whole	DC-upstream	1.589	4	6.276
bullhead minnow	whole	DC-upstream	5.302	4	21.208
mosquitofish	whole	DC-upstream	0.415	4	1.66
bluegill	whole	DC-upstream	0.415	4	1.66
green sunfish	whole	DC-upstream	0.624	4	2.496
bluegill	whole	DC-upstream	0.475	4	1.9
bluegill	whole	DC-upstream	0.429	4	1.716
orangespotted sunfish	whole	DC-upstream	0.643	4	2.572
mosquitofish	whole	DC-upstream	0.316	4	1.264
mosquitofish	whole	DC-upstream	0.496	4	1.984
red shiner	whole	DC-downstream	1.59	4	6.36
red shiner	whole	DC-downstream	3.712	4	14.848
sand shiner	whole	DC-downstream	4.223	4	16.892
bullhead minnow	whole	DC-downstream	1.758	4	7.032
mosquitofish	whole	DC-downstream	2.047	4	8.188
mosquitofish	whole	DC-downstream	2.693	4	10.772
orangespotted sunfish	whole	DC-downstream	1.165	4	4.66
bluegill	whole	DC-downstream	1.722	4	6.888
red shiner	whole	DC-downstream	5.673	4	22.692
bullhead minnow	whole	DC-downstream	6.362	4	25.448
mosquitofish	whole	DC-downstream	5.887	4	23.548
sand shiner	whole	DC-downstream	4.18	4	16.72
bullhead minnow	whole	DC-downstream	4.472	4	17.888
mosquitofish	whole	DC-downstream	4.333	4	17.332
bluegill	whole	DC-downstream	2.88	4	11.52
sand shiner	whole	DC-downstream	3.861	4	15.444
bullhead minnow	whole	DC-downstream	1.533	4	6.132
bluegill	whole	DC-downstream	2.535	4	10.14

species	tissue	site	selenium in tissue ug/g (wet wt.)	conversion factor for assumed 75% moisture	selenium in tissue * ug/g (dry wt.)
red shiner	whole	CR-upstream	0.698	4	2.792
red shiner	whole	CR-upstream	0.57	4	2.28
sand shiner	whole	CR-upstream	0.584	4	2.336
sand shiner	whole	CR-upstream	0.394	4	1.576
bullhead minnow	whole	CR-upstream	0.51	4	2.04
bullhead minnow	whole	CR-upstream	0.643	4	2.572
mosquito fish	whole	CR-upstream	0.485	4	1.94
red shiner	whole	CR-upstream	1.945	4	7.78
sand shiner	whole	CR-upstream	3.655	4	14.62
red shiner	whole	CR-downstream	1.837	4	7.348
red shiner	whole	CR-downstream	2.988	4	11.952
sand shiner	whole	CR-downstream	2.103	4	8.412
bullhead minnow	whole	CR-downstream	3.085	4	12.34
mosquitofish	whole	CR-downstream	0.966	4	3.864
red shiner	whole	CR-downstream	2.021	4	8.084
red shiner	whole	CR-downstream	2.98	4	11.92
sand shiner	whole	CR-downstream	3.647	4	14.588
mosquito fish	whole	CR-downstream	2.534	4	10.136
red shiner	whole	White Deer Creek	0.765	4	3.06
red shiner	whole	White Deer Creek	1.074	4	4.296
sand shiner	whole	White Deer Creek	0.612	4	2.448
mosquitofish	whole	White Deer Creek	0.365	4	1.46
mosquitofish	whole	White Deer Creek	0.42	4	1.68
green sunfish	whole	White Deer Creek	0.338	4	1.352
green sunfish	whole	White Deer Creek	0.609	4	2.436
green sunfish	whole	White Deer Creek	0.499	4	1.996
bluegill	whole	White Deer Creek	0.783	4	3.132
bluegill	whole	White Deer Creek	0.709	4	2.836
longear sunfish	whole	White Deer Creek	0.52	4	2.08
longear sunfish	whole	White Deer Creek	0.531	4	2.124

* shading indicates measurements that exceed the EPA's draft chronic criterion for selenium of 7.9 ug/g (dry weight)