Supporting Data for EPA's Effect Determinations for Atrazine Relative to Three Federally Listed Endangered Freshwater Mussels and Two Federally Listed Endangered Freshwater Fish: Report No T005015-07: Assessment (August 13, 2007)

VOLUME ___ OF___ OF SUBMISSION

Atrazine

Supporting Data for EPA's Effect Determinations for Atrazine Relative to Three Federally Listed Endangered Freshwater Mussels [Catspaw (*Epioblasma obliquata obliquata*), Fat pocketbook (*Potamilus capax*), Northern riffleshell (*Epioblasma torulosa rangiana*)] and Two Federally Listed Endangered Freshwater Fish [Pallid sturgeon (*Scaphirhynchus albus*), Topeka shiner (*Notropis topeka*)]

Assessment

DATA REQUIREMENT:	October 31, 2003 Amended Interim Registration Eligibility Decision for Atrazine Generic and Product-Specific Data Call-In for Atrazine, Addendum of March 18, 2005
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VOLUME 1 OF 1 OF STUDY

PAGE 1 OF 46

This report contains color pages.

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Company: Syngenta Crop Protection, Inc.

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Since this volume contains previously published information and results from non-laboratory-based studies, a Good Laboratory Practice Compliance Statement as defined by 40 CFR Part 160 is not appropriate.

Study Director: There is no GLP Study Director for this volume.

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TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY

Syngenta has conducted refined spatial and effects analyses to support EPA's assessments for atrazine relative to three endangered freshwater mussels [Catspaw (*Epioblasma obliquata obliquata*), Fat Pocketbook (*Potamilus capax*), and Northern Riffleshell (*Epioblasma torulosa rangiana*) mussels) and two endangered freshwater fishes [Pallid Sturgeon (*Scaphirhynchus albus*) and Topeka Shiner (*Notropis topeka*)].

As described herein, spatial analyses were only focused on current species locations within the 1172 vulnerable watersheds identified as part of the Atrazine Ecological Exposure Monitoring Program (AEEMP). These watersheds have moderate to higher atrazine use and fall in the upper 20th-centile of vulnerability for atrazine exposure. Since no current Catspaw mussel locations were within the 1172 vulnerable watersheds, spatial analysis alone supports a "no effect" determination for the Catspaw mussel. However, since the remaining four species contained current locations within the 1172 vulnerable watersheds, a refined analysis of potential exposure and effects was required to support reasonable effects determinations.

With the exception of the Topeka Shiner, sampled AEEMP subwatersheds exceeding the 5% screening LOC for more than one year (MO-01 and MO-02) have flow rates significantly less than flow rates for streams and rivers occupied by the Fat Pocketbook mussel, Northern Riffleshell mussel, and Pallid Sturgeon within the 1172 vulnerable watersheds. Dilution of atrazine will occur as residues move from headwater streams to larger streams and rivers, resulting in significantly lower atrazine concentrations within these occupied streams/rivers relative to AEEMP headwater streams. Therefore, a dilution term is appropriate for residues measured from AEEMP sites since flow rates for streams or rivers containing the Fat Pocketbook mussel, Northern Riffleshell mussel, and Pallid Sturgeon are higher than flow rates for AEEMP headwater streams. Overall, Syngenta's flow data analysis supports a "may affect, but not likely to adversely affect" determination for potential direct or indirect effects to the Fat Pocketbook mussel, Northern Riffleshell mussel, and Pallid Sturgeon.

The remaining listed species – the Topeka Shiner – inhabits small, low-flow headwater streams with good water quality and permanent-to-intermittent flow. As stream flows for Topeka Shiner habitats and some AEEMP sites can be similar, a dilution term for atrazine residue estimation based on flow data was not applicable. However, as detailed herein, further analysis of effects data, spatial data, and habitats supporting Topeka Shiner populations demonstrate that atrazine use on corn and sorghum will not adversely affect Topeka Shiner survival, growth, or reproduction. Therefore, a "may affect, but not likely to adversely affect" determination for the Topeka Shiner is a reasonable and conservative conclusion after considering additional spatial and effects data, as well as common habitat characteristics for the Topeka Shiner.

Syngenta believes that these refinements support a "no effect" and/or "may affect, but not likely to adversely affect" determination for potential direct and indirect effects to the five named species.

2.0 INTRODUCTION

This report provides "best available" data and information to support EPA's assessments for atrazine relative to three endangered freshwater mussels [Catspaw (*Epioblasma obliquata obliquata*), Fat Pocketbook (*Potamilus capax*), Northern Riffleshell (*Epioblasma torulosa rangiana*)] and two endangered freshwater fish [Pallid Sturgeon (*Scaphirhynchus albus*), Topeka Shiner (*Notropis topeka*)]. Syngenta is providing detailed species location information for the listed mussels and fishes; these data are also provided in a CD accompanying this submission. In addition, Syngenta is providing a brief overview of habitat characteristics for each above-mentioned species, and considers this information in the appropriate context of environmental exposure.

3.0 SPATIAL ANALYSIS OF MUSSEL AND FISH LOCATIONS

3.1 Available Species Location Data and Geospatial Analysis

For the five listed species, Syngenta's geospatial analysis utilized specific location information from the Federal Endangered Species Task Force (FESTF) multi-jurisdictional database (MJD), which is licensed from NatureServe's MJD. The FESTF MJD is a database developed and maintained by NatureServe, and is comprised of species location data and information/records ancillary to such location data (or "element occurrences"). The listed mussel and fish location maps were created using ArcGIS 9.2 (ESRI, 2006). Spatial data for Topeka Shiner critical habitat were only available from the USFWS critical habitat portal (http://criticalhabitat.fws.gov/). Therefore, the critical habitat stream maps were digitized based on the USFWS' 2004 designation of Topeka Shiner critical habitats (USFWS, 2004).

The status of individual element occurrences (EOs) (i.e., individual mussel and fish population observations) were considered in order to adequately assess the data quality. Data were considered "historic" if the metadata associated with each occurrence in the FESTF MJD indicated the record was "Extirpated", "Failed to find", "Historical", or the last observation date was during or before 1980. An observation date before 1980 was established based on EPA's previous effects determinations for mussels (USEPA, 2007; e.g., stirrupshell mussel considered extinct due to lack of observation since 1980.). Based on these criteria, spatial analyses of "historic" locations were not considered relevant to the assessments described within this report.

Syngenta is providing this refined spatial analysis here and in electronic format accompanying this submission (accompanying CD). Pursuant to the terms of the NATURESERVE AGREEMENT FOR LICENSE OF THREATENED AND ENDANGERED SPECIES DATA AND SUPPORT SERVICES (further described within an electronic copy of the confidentiality statement provided on the accompanying CD), documents generated from such files and revealing specific location data must include the note "Confidential and Proprietary -- For Internal Use Only."

As previously summarized (Hendley *et al.*, 2007), the watersheds monitored in the Atrazine Ecological Exposure Monitoring Program (AEEMP) are a pool of Hydrologic Unit Code

(HUC) 10-scale watersheds with moderate to higher atrazine use which fall in the upper 20th-centile of vulnerability for atrazine exposure when ranked using the United States Geological Survey's (USGS) Watershed Regression for Pesticides (WARP) model; these 1172 "vulnerable watersheds" represent approximately 70% of atrazine use in the United States. Forty of these HUC10-scale watersheds were selected for the AEEMP by spatially randomized identification from the 1172 watersheds. However, this selection approach ensured that 20 of the sampled watersheds were selected from the 80th- to 95th-centile and 20 from the 95th- to 100th-centile ranges of WARP-estimated vulnerability. Once these 40 HUC10-scale watersheds were identified, additional criteria were applied to select smaller headwater sampling subwatersheds from within each HUC10 that were of higher vulnerability than their parent watershed with respect to flow rates, cropping density, and other factors. Due to the underlying watershed selection methods and assumptions, the 1172 vulnerable watersheds are considered the most conservative estimates of atrazine exposure (i.e., represents 70% of atrazine use in the United States and upper 20th-centile of vulnerability). Thus, the spatial relationship of current species locations to the 1172 vulnerable watersheds were only considered within this report.

All current and historic EOs for the listed species within and outside the 1172 vulnerable watersheds are presented in Table 1. Overall, 126 out of 964 (13%) current locations were identified within the 1172 vulnerable watersheds. Out of these 126 locations, only four of the five listed species have current locations within the 1172 vulnerable watersheds: Fat Pocketbook mussel (54 current EOs), Northern Riffleshell mussel (46 current EOs), Pallid Sturgeon (17 current EOs), and Topeka Shiner (9 current EOs) (Tables 1 and 2). There are no current Catspaw mussel EOs within the 1172 vulnerable watersheds. Of the remaining four species, no current locations were identified within the 40 AEEMP subwatersheds (Figure 1) including those that EPA relied on (MO-01, MO-02, IN-11, NE-04, and NE-07) to make previous effects determinations (USEPA, 2007).

Based on Syngenta's evaluation of the species location data, the following conclusions can be made for the five species:

- ***Pallid Sturgeon:*** Twenty-one locations were identified within the 1172 vulnerable watersheds, with 17 locations considered current. Sixteen of these current occurrences are located in the main stem of the Mississippi River and one location in the Platte River. Since locations were identified within the vulnerable watersheds, further refinements based on flow rates for species locations, effects analysis, and additional spatial analysis are required prior to an effects determination.
- ***Topeka Shiner:*** Twenty-five locations were identified within the 1172 vulnerable watersheds. Sixteen and nine of these locations are considered historic and current occurrences respectively. Almost all of the designated Topeka Shiner critical habitat streams do not intersect with the 1172 vulnerable watersheds. Out of 86 total critical habitat stream segments comprising 836 total stream miles, only one stream segment with 6-stream miles in Madison County, NE intersects with the 1172 vulnerable watersheds. Since locations were identified within the vulnerable watersheds, further refinements based on flow rates for species locations, effects analysis, and additional spatial analysis are required prior to an effects determination.

- ***Catspaw Mussel:*** Only two historic locations were identified within the 1172 vulnerable watersheds. Therefore, since no locations are within the 1172 vulnerable watersheds, spatial analysis alone supports a “no effect” determination.
- ***Fat Pocketbook Mussel:*** Seventy locations were identified within the 1172 vulnerable watersheds. Sixteen and 54 of these locations are considered historic and current occurrences respectively. Since locations were identified within the vulnerable watersheds, further refinements based on flow rates for species locations, effects analysis, and additional spatial analysis are required prior to an effects determination.
- ***Northern Riffleshell Mussel:*** Fifty locations were identified within the 1172 vulnerable watersheds. Four and 46 of these locations are considered historic and current occurrences respectively. Since locations were identified within the vulnerable watersheds, further refinements based on flow rates for species locations, effects analysis, and additional spatial analysis are required prior to an effects determination.

Figure 1 **Spatial Distribution of Occupied Locations for the Catspaw Mussel, Fat Pocketbook Mussel, Northern Riffleshell Mussel, Pallid Sturgeon, and Topeka Shiner**

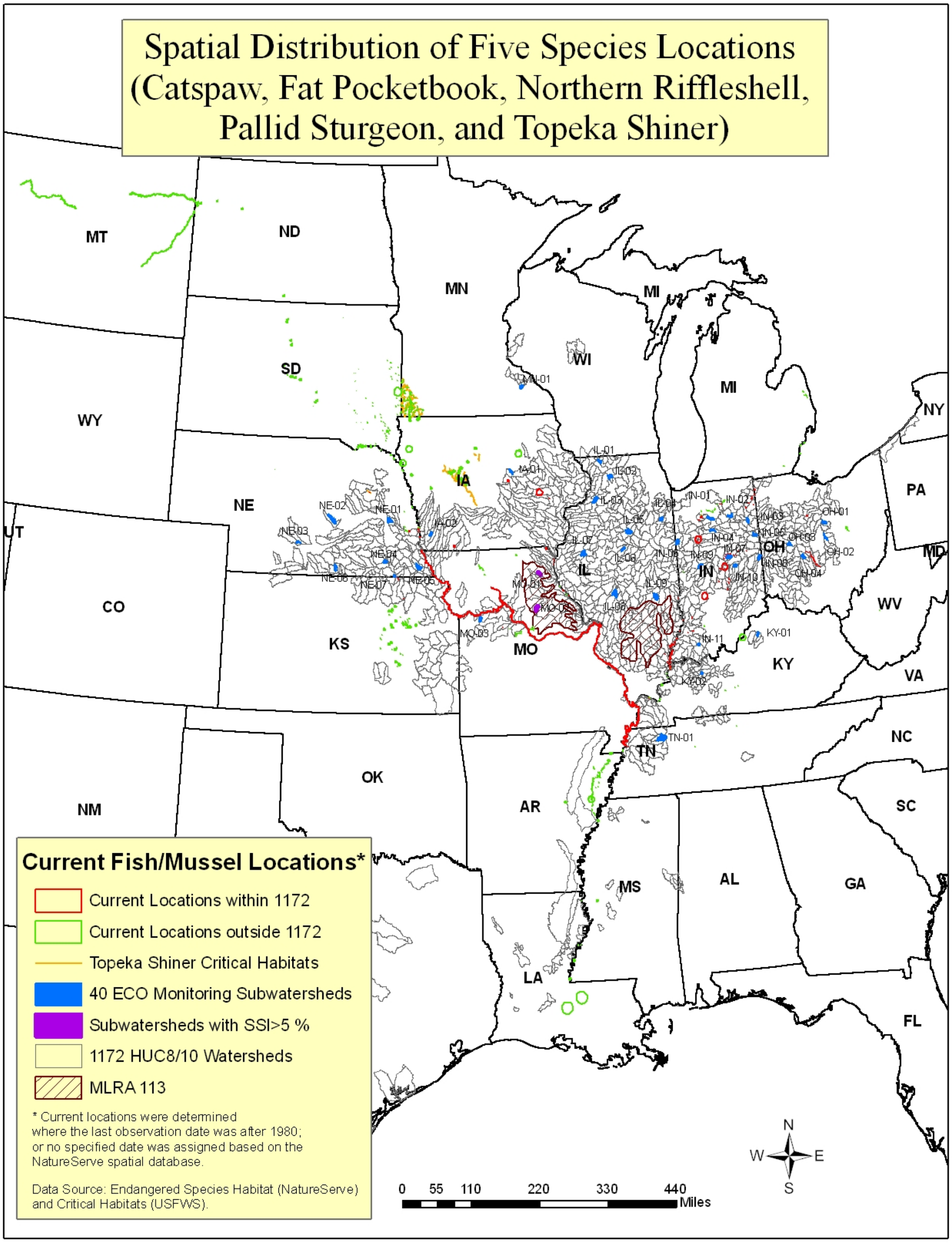


Table 1 Summary of Current and Historic Species Locations by State

State	Common Name	Within 1172		Outside 1172		Total # locations
		Current	Historic	Current	Historic	
AR	Pallid Sturgeon	0	0	2	0	2
	Fat Pocketbook	0	0	173	3	176
IL	Pallid Sturgeon	2	0	0	2	4
	Fat Pocketbook	20	3	2	0	25
IN	Fat Pocketbook	23	7	1	0	31
	Catspaw	0	0	1	0	1
	Northern Riffleshell	38	0	19	0	57
IA	Topeka Shiner	3	1	26	18	48
	Pallid Sturgeon	0	0	0	1	1
	Fat Pocketbook	1	0	0	1	2
KS	Topeka Shiner	3	3	54	34	94
	Pallid Sturgeon	4	1	0	2	7
KY	Pallid Sturgeon	0	1	3	0	4
	Fat Pocketbook	4	6	15	6	31
	Catspaw	0	2	7	7	16
	Northern Riffleshell	0	0	6	33	39
LA	Pallid Sturgeon	0	1	3	5	9
	Fat Pocketbook	0	0	1	0	1
MI	Northern Riffleshell	0	0	12	3	15
MN	Topeka Shiner	0	0	72	4	76
MS	Pallid Sturgeon	0	1	1	1	3
	Fat Pocketbook	0	0	4	0	4
MO	Topeka Shiner	2	9	28	42	81
	Pallid Sturgeon	2	0	0	0	2
	Fat Pocketbook	6	0	5	0	11
MT	Pallid Sturgeon	0	0	2	0	2
NE	Topeka Shiner	1	3	1	4	9
	Pallid Sturgeon	8	0	28	5	41
ND	Pallid Sturgeon	0	0	7	18	25
OH	Catspaw	0	0	3	0	3
	Northern Riffleshell	8	4	0	5	17
SD	Topeka Shiner	0	0	64	7	71
	Pallid Sturgeon	0	0	30	20	50
TN	Pallid Sturgeon	1	0	1	0	2
	Catspaw	0	0	1	1	2
WV	Northern Riffleshell	0	0	1	1	2
	Total Locations	126	42	573	223	964
	Percent Total Locations	13	4	59	23	

Table 2 Summary of Species Locations Within the 1172 Vulnerable Watersheds

Species Common Name	Status	Element Occurrence IDs	Total number of locations
Catspaw	Current	None	0
	Historical	445715, 443131	2
Fat Pocketbook	Current	101173, 101352, 101942, 102014, 102398, 103651, 103743, 103793, 103941, 103942, 104107, 104108, 104287, 165820, 166664, 168205, 169004, 169040, 169095, 170204, 170946, 171551, 171886, 172248, 173961, 175783, 175784, 177021, 177045, 179509, 179520, 300691, 305279, 316110, 336809, 345292, 439665, 446797, 449057, 449113, 629681, 629682, 629683, 629684, 654680, 670779, 737598, 737607, 737632, 739069, 739070, 739071, 739072, 739073	54
	Historical	101821, 102335, 165684, 167166, 167834, 169094, 171661, 174206, 179966, 439632, 442354, 445477, 446016, 448624, 449072, 737602	16
Northern Riffleshell	Current	166491, 166516, 166889, 167700, 167722, 168988, 169082, 169526, 169648, 169941, 169942, 170620, 170723, 172324, 172745, 173566, 175064, 176260, 176261, 176461, 179024, 179428, 179685, 180721, 181182, 181204, 181320, 259853, 261664, 261879, 263179, 263180, 264567, 265958, 267399, 739790, 739791, 739792, 739793, 739794, 739795, 739796, 739797, 739798, 739799, 739800	46
	Historical	259667, 264346, 268833, 270620	4
Pallid Sturgeon	Current	101845, 101918, 110162, 110263, 111157, 115255, 292065, 342945, 487894, 490480, 491716, 493118, 493726, 498032, 498270, 498479, 746018	17
	Historical	115253, 121393, 440701, 465603	4
Topeka Shiner	Current	114662, 115443, 120288, 137274, 137328, 308967, 329319, 493323, 653227	9
	Historical	109430, 115501, 118726, 137432, 283196, 290561, 309270, 309271, 311728, 314667, 320903, 336223, 337432, 487851, 489615, 498094	16

4.0 RELEVANCE OF ATRAZINE MONITORING SITES TO SPECIES LOCATIONS

4.1 Overview of AAEMP Data Interpretation

Interpretation of the AEEMP data has been previously reported to EPA (Hendley *et al.*, 2007). These same data are summarized below to provide the appropriate context of potential exposure of the five listed species to atrazine. As part of the AEEMP, each of the 40 sampled subwatersheds were monitored for at least two consecutive seasons. Three headwater subwatersheds (NE-04, NE-05, and NE-07) experienced complete dry down during significant portions of the monitoring season, precluding surface water sampling, atrazine analysis, and chemograph generation throughout the monitoring season. Since the listed mussels and fish cannot survive in such streams, these three sites are not considered representative of streams or rivers where the mussels and fish occur. The remaining 80 site-years and nearly 3500 samples analyzed for atrazine were evaluated against an ecological assessment endpoint based on the Comprehensive Aquatic Systems Model for Atrazine (CASM_Atrazine) Midwest stream model predictions for the percent Steinhaus Similarity Index (SSI) average deviation. A screening (no-effect) level-of-concern (LOC) of a 5% SSI deviation was established by EPA as the trigger for further evaluation (with a 15% SSI deviation requiring mitigation). From 2004 to 2006, six out of 80 site-years (7.5% of total) exceeded the 5% screening LOC – IN-11 in 2005; MO-01 in 2004, 2005, and 2006; and MO-02 in 2004 and 2006. However, as described below, IN-11 does not exceed the CASM_Atrazine screening LOC when the autosampler data are considered. Maximum rolling average atrazine concentrations from these sites were previously used for EPA's effects determinations for mussels (USEPA, 2007).

As previously described and reported to EPA (Wall *et al.*, 2007; Hampton *et al.*, 2007; Hendley *et al.*, 2007; Miller *et al.*, 2007), Syngenta believes that data from IN-11, MO-01, and MO-02 should not be extrapolated to all 1172 WARP-predicted upper 20th-centile watersheds in the Midwest corn/sorghum growing regions. A brief summary of Syngenta's reasons and conclusions for these sites are provided below.

1. MO-01 and MO-02 (Figures 2 and 3 respectively) are small streams with sand (MO-01) or sand/gravel (MO-02) bed material (substrate) and slightly murky to murky water. During the summer, water levels can be significantly lower than normal and, in some cases, may dry down with only small pools of water remaining (Figures 2 and 3). Both sites are located in the Missouri portion of the Central Claypan Major Land Resource Area (MLRA 113) – a unique region where a combination of hydrogeological, pedological, and cropping factors can combine with higher rainfall in some vulnerable small headwater watersheds within the MLRA to generate higher levels of atrazine runoff and prolonged chemograph durations. As dictated by hydrology, non-point source residues in small streams in the headwaters of small subwatersheds in MLRA 113 (such as MO-01 and MO-02) would tend to be higher than at the pour points of larger watersheds (see Wall *et al.*, 2007). The runoff-inducing factors which dominate in the Missouri portion of MLRA 113 do not co-

occur in small headwater subwatersheds elsewhere in the corn and sorghum cropping regions of the US. Therefore, streams within MLRA 113 do not readily apply to streams outside of MLRA 113.

2. For the IN-11 site, there was a single high detection (208.76 µg/L) on one day in grab samples monitored over two years of monitoring. This high detection in 2005 was due to measurement of unmixed edge-of-field runoff coming from a ditch immediately adjacent to the sampler. At this site, autosampler residues greater than 25 µg/L, and the grab sample of 208.76 µg/L, all occurred on a single day, and no other residue greater than 25 µg/L was measured over two years of monitoring. The 14- and 30-day rolling average LOC exceedances are driven by this single sample and use of a stair-step calculation method within CASM_Atrazine. As such, the value of 208.76 µg/L is a considerable overestimate since the autosampler data during this same day (May 14, 2005) generated a daily mean of approximately 136 µg/L (equal time weighting of the 4 six-hour composite samples). When all data are considered, there is no LOC exceedance for IN-11 in 2005; 2006 CASM_Atrazine data (0% SSI deviation) and preliminary data for 2007 support this conclusion. Therefore, the erroneous IN-11 exceedance in 2005 is not applicable for assessment of exposure and effects to the five listed species.

Overall, the AEEMP data show that two groups of watersheds should be considered when interpreting the AEEMP findings. The first group is associated with the Illinois and Missouri portions of MLRA 113. The second remaining group of vulnerable watersheds are represented by the results from at least 35 sampling subwatersheds from the first two monitoring seasons; none of these subwatersheds exceeded the CASM_Atrazine screening LOC.

Within the first group, the available data suggest that results obtained in the MO-01 and MO-02 subwatersheds may be representative of small headwater subwatersheds elsewhere in the Missouri portion of MLRA 113. However, preliminary analysis of 2007 data from two additional monitoring sites within MLRA 113 – MO-04 and MO-05 – suggest that these subwatersheds will not exceed the CASM_Atrazine screening LOC. Since AEEMP data are not available from subwatersheds within the Illinois portion of MLRA 113, potential vulnerability to atrazine runoff within this region is not as well defined. Previous soil analyses demonstrated that claypan soils in the Missouri portion of MLRA 113 are more shallow (7 to 18 inches below the surface) than claypan soils in the Illinois portion of MLRA 113 (18 to 30 inches) (Miller *et al.*, 2007). Consequently, following a rainfall event, the Missouri portion of MLRA 113 is saturated more rapidly than the Illinois portion of MLRA 113. Combined with decreased land slopes relative to the Missouri portion of MLRA 113, the Illinois portion of MLRA 113 is likely less vulnerable to atrazine runoff than the Missouri portion of MLRA 113. Given these claypan differences, data from MO-01 and MO-02 should only be extrapolated to the Missouri portion of MLRA 113. However, as a conservative assessment, potential atrazine effects on the five listed species should be considered relative to the proximity of species locations to both the Illinois and Missouri portions of MLRA 113.

Figure 2 Photograph of MO-01 Directly Upstream of Sampling Point

Photograph taken on 27 July 2007, looking upstream from sampling bridge. Note significant dry-down conditions, sand/silt substrate, and murky pools within the immediate sampling area.

Figure 3 Photograph of MO-02 Directly Upstream of Sampling Point

Photograph taken on 27 July 2007, looking upstream from sampling bridge. Note livestock, low water levels, sand/gravel substrate, and slightly murky water within the immediate sampling area.

4.2 Overview of Mussel and Fish Habitat Characteristics

4.2.1 Freshwater Mussels

4.2.1.1 Catspaw Mussel (*Epioblasma obliquata obliquata*)

The Catspaw mussel is a medium-sized (up to 2 inches in length) riverine subspecies that inhabits medium to large rivers with high flow and sand/gravel substrates (NatureServe, 2007). No critical habitat has been designated for this species (USFWS, 2007a). The specific food habits for the Catspaw mussel are unknown but are likely similar to other filter-feeding freshwater mussels. As such, this species likely feeds predominantly on detritus, diatoms, phytoplankton, and zooplankton (USFWS, 1992).

4.2.1.2 Fat Pocketbook Mussel (*Potamilus capax*)

The Fat Pocketbook mussel is a large (up to 5 inches long) riverine species typically found in medium to large rivers (NatureServe, 2007). This species' food habits are unknown but are likely similar to other filter-feeding freshwater mussels. As such, this species likely feeds predominantly on detritus, diatoms, phytoplankton, and zooplankton (NatureServe, 2007). Substrate preferences include sand, mud, fine gravel, silt, and clay (USFWS, 1989). This species buries in these substrates in water ranging from a few inches to 8 feet deep, with only the edge of its shell and feeding siphons exposed (USFWS, 2007b). No critical habitat has been designated for this species.

4.2.1.3 Northern Riffleshell Mussel (*Epioblasma torulosa rangiana*)

The Northern Riffleshell mussel is a small to medium sized (up to 3 inches long) freshwater mussel that inhabits streams and medium-sized rivers, preferring runs and riffles comprised of packed sand and fine to coarse gravel substrates. The specific food habits for this species are unknown but are likely similar to other filter-feeding freshwater mussels. As such, this species likely feeds predominantly on detritus, diatoms, phytoplankton, and zooplankton (USFWS, 2007c). This species requires swift-moving, well-oxygenated water for survival (NatureServe, 2007). No critical habitat has been designated for this species.

4.2.2 Freshwater Fish

4.2.2.1 Pallid Sturgeon (*Scaphirhynchus albus*)

The Pallid Sturgeon is a large (reaching almost 2 meters long) freshwater fish (NatureServe, 2007; USFWS, 1993). These fish spawn during the summer (between June and August), reach sexual maturity within 10 to 20 years, and can live more than 40 years. The Pallid Sturgeon is an invertivore and piscivore, feeding on aquatic insects, crustaceans, mollusks, annelids, eggs of other fishes, and small fish (NatureServe, 2007). This bottom-dwelling fish is found in large rivers with swift currents, preferring a turbid, free-flowing riverine habitat comprised of firm gravel and sandy substrates (NatureServe, 2007; USFWS, 1993). These fish can also inhabit reservoirs, deep waters at the downstream end of chutes and sandbars where currents converge, and in slower currents of near-shore areas (NatureServe, 2007; USFWS, 1993). No critical habitat has been designated for this species (USFWS, 2007d).

4.2.2.2 Topeka shiner (*Notropis topeka*)

The Topeka shiner is a small (up to 2 inches long) cyprinid freshwater fish (NatureServe, 2007; USFWS, 2004). These fish spawn during the summer (between May and August), mature after 12-14 months post-hatch, and live up to 3 years. Topeka Shiners inhabit small, low-flow streams with good water quality, permanent or intermittent flow, and moderate amounts of woody debris, overhanging terrestrial vegetation, and aquatic plants (USFWS, 2004). During the summer or periods of drought, these fish are found within clear pools maintained by groundwater percolation or small springs. Stream substrates required for Topkea Shiner habitats include a mixture of sand, gravel, cobble, and silt. In general, good water quality (e.g, low suspended solids, high dissolved oxygen, etc.) and an adequate food base are required for growth and reproduction (USFWS, 2004). Topeka Shiners have a diverse food base, including zooplankton, immature stages of aquatic insects, and fish eggs or larvae (USFWS, 2004). However, the principal component of the Topeka Shiner diet are zooplankton and aquatic insects.

As shown in Figure 1, critical habitats for the Topeka shiner were designated in a total of 83 stream segments (836 miles of stream) within the States of Iowa, Minnesota, and Nebraska (USFWS, 2004). Missouri was excluded from critical habitat designation since adequate management plans and protections implemented through the Missouri Action Plan (MDC, 1999) were already established (USFWS, 2004). Kansas and South Dakota were excluded from critical habitat designation since the benefits of excluding critical habitat outweighed the benefits of designating critical habitat (USFWS, 2004).

4.3 Comparison of Stream Flows from MO-01 and MO-02 with Stream/River Flows from Mussel and Fish Locations

Syngenta evaluated (1) flow rates for streams containing current occurrences of all species within the 1172 vulnerable watersheds and (2) flow rates for MO-01 and MO-02. The Catspaw mussel is not discussed in this section since no current locations exist within the 1172 vulnerable watersheds and, therefore, AEEMP data are not relevant to this species. If available, measured mean daily flow rates from the nearest USGS gauging station to individual EOs were utilized. Estimated mean flow rates for individual reaches containing EOs were also obtained using the NHDPlus flowline attribute table. USGS-measured and NHDPlus-estimated flow data for all current EOs within the 1172 vulnerable watersheds are provided in Appendix 1. For all EOs, differences between USGS-measured and NHDPlus-estimated flow data were minimal (Appendix 1). In some cases, there were no relevant USGS gauging stations near the EOs. Therefore, in the absence of EO-specific USGS flow data, NHDPlus-estimated flow data were used to “fill in” these data gaps. Based on the final flow rates (measured and estimated) for all current species locations within the 1172 vulnerable watersheds, species-specific EOs were summarized as mean, 5^{th}-centile, 50^{th}-

centile, and 95th-centile flow rates across all locations. These summarized data were then compared to summarized flow data from MO-01 and MO-02.

As shown in Table 3, there is a wide range of flow rates across different locations for each species. With the exception of the Topeka Shiner, MO-01 and MO-02 have upper 95th-centile flow rates less than the lower 5th-centile flow rates for streams and rivers occupied by the Fat Pocketbook mussel, Northern Riffleshell mussel, and Pallid Sturgeon within the 1172 vulnerable watersheds (Table 3). Dilution of atrazine will occur as residues move from headwater streams to larger streams and rivers, resulting in significantly lower atrazine concentrations within these occupied streams/rivers relative to AEEMP headwater streams. As previously described (Wall *et al.*, 2007), a dilution term ranging from ~23- to 1515-fold should be applied to residues measured from AEEMP sites since flow rates for streams or rivers containing the Fat Pocketbook mussel, Northern Riffleshell mussel, and Pallid Sturgeon are higher than flow rates for AEEMP headwater streams. Since atrazine exposure will be significantly less than worst-case AEEMP headwater streams (MO-01 and MO-02), and no current locations for these species are within the Missouri or Illinois portion of MLRA 113 (Figure 1), a “may affect, but not likely to adversely affect” determination via direct or indirect effects is a conservative effects conclusion for the Fat Pocketbook mussel, Northern Riffleshell mussel, and Pallid Sturgeon.

Table 3 Comparison of Flow Rates for Current Species Locations Within the 1172 Vulnerable Watersheds to AEEMP Sites Exceeding the CASM_Atrazine LOC

	Daily Flow Rate[a] (ft^3/sec)			
Species Common Name (No. of Element Occurrences)	Mean	5th-centile	50th-centile	95th-centile
Fat Pocketbook (53[b])	54798.3	2232.0	29196.8	224548.4
Northern Riffleshell (46)	1186.1	93.4	573.1	3013.8
Pallid Sturgeon (17)	52975.7	6152.7	37882.2	186886.3
Topeka Shiner (9)	326.1	2.1	6.6	1512.6

	Daily Flow Rate[c] (ft^3/sec)			
Ecological Monitoring Site ID	Mean	5th-centile	50th-centile	95th-centile
MO-1	2.7	1.0	2.3	4.9
MO-2	27.9	16.5	25.4	41.8

[a] For each EO, mean daily flow rates were based on USGS-measured data or, in the absence of measured data, on NHDPlus-estimated data for the individual EO stream reach using Unit Runoff Model (NHDPlus User Guide, 2006). Summary statistics for each species are based on mean daily flow rates from all EOs with the 1172 watershed boundary.

[b] No flow rate data available for reachcode #7110004000756 associated with one location (EOID: 305279).

[c] Summary statistics based on all site-years of monitoring data.

4.4 Topeka Shiner Locations Relative to MLRA 113 Vulnerable Wateseds

Topeka Shiners inhabit small, low-flow headwater streams with good water quality and permanent-to-intermittent flow. As stream flows for Topeka Shiner habitats, MO-01, and MO-02 are similar (Table 3), a dilution term for atrazine residue estimation based on flow data was not applicable. Therefore, further analysis of exposure, effects, and refined spatial data were necessary for this species.

4.4.1 Effects Analysis

4.4.1.1 Direct Acute Effects

As discussed in Section 4.1, the use of 208.76 µg/L from IN-11 in 2005 as a peak concentration is a considerable overestimate since the autosampler data during this same day shows the daily mean was approximately 136 µg/L. The maximum peak concentration from all targeted monitoring data is 182.75 µg/L (MO-01 in 2005); importantly, this peak concentration was derived from a grab sample since autosampler data were not available for the same sampling day. Using these worst-case data, the peak atrazine concentration is below the lowest acute freshwater fish toxicity value (rainbow trout LC_{50} = 5300 µg/L) and acute endangered species LOC (=0.05) for fish (RQ = 0.03). Therefore, these data support a "no effect" determination for Topeka shiner via direct acute effects.

4.4.1.2 Direct Chronic Effects

The maximum 60-d rolling average concentration from all site-years of targeted monitoring data was 26 µg/L (MO-01 in 2006). Using these worst-case data, the peak atrazine concentration is below the lowest fish chronic toxicity value (brook trout NOEC = 65 µg/L) and chronic endangered species LOC (=1.0) for fish (RQ = 0.4). Therefore, these data support a "no effect" determination for Topeka shiner via direct chronic effects.

4.4.1.3 Indirect Effects

Primary Producers
As previously described (Wall *et al.*, 2007), indirect effects on consumer communities based on direct effects on primary producers were not exceeded for worst-case targeted monitoring sites using CASM_Atrazine. Moreover, the worst-case 14-day (78 µg/L), 30-day (43 µg/L), 60-day (26 µg/L) and 90-day (18 µg/L) rolling average concentrations from the AEEMP are below the approximate 21-to-63-day 90-µg/L no-effect threshold concentration for indirect effects on consumers based on experimental mesocosm/microcosm data. Therefore, indirect effects on Topeka Shiner populations are not expected via direct effects on invertebrate food items (phytoplankton) and, consequently, indirect effects on Topeka shiner food items (invertebrates). These data support a "may affect, but not likely to adversely affect" determination for Topeka shiner via direct effects on primary producers or aquatic habitat.

Aquatic Invertebrates
The principal food source for Topeka Shiners are zooplankton and immature stages of aquatic insects. Therefore, the most appropriate standard surrogate test species for Topeka Shiner diet are *Daphnia magna* (waterflea) and *Chironomus* spp. (midge). The lowest acute E/LC_{50} for *Daphnia* and *Chironomus* is 3500 µg/L (48-hr) and 720 µg/L (48-hr) respectively; the lowest chronic NOEC for *Daphnia* and *Chironomus* is 110 µg/L (21-day) and 140 µg/L (38-day) respectively. The most sensitive chronic NOEC (60 µg/L) for freshwater invertebrates is associated with the scud (*Gammarus fasciatus*), a species not applicable for an indirect effects assessment for Topeka Shiners since the scud is not a relevant food source. Using relevant data (*Daphnia* EC_{50} and NOEC), indirect effects on Topeka Shiner populations due to direct acute or chronic effects on zooplankton are not expected since RQs based on the maximum peak AEEMP EEC (182.75 µg/L) (RQ = 0.05) and 21-day EEC (62 µg/L) (RQ = 0.6) are at or below screening-level acute and chronic LOCs respectively. Using the same worst-case peak and 21-day EECs as above, the midge RQ exceeds the acute LOC (RQ = 0.3) but does not exceed the chronic LOC (RQ = 0.4). However, as previously noted by EPA (USEPA, 2007), “the available acute toxicity data for the midge shows high variability with the LC_{50} values, ranging from 720 to >33,000 µg/L (pg. 116).” This range represents five separate studies with reported LC_{50} values of 720 (48-hr exposure), 1000 (unknown exposure), >24000 (10-day exposure), >30000 (10-day exposure), and >33000 (10-day exposure) µg/L, with respective acute RQs of 0.3, 0.2, 0.008, 0.006, and 0.005. Therefore, based on the significant variability in effects, potential acute toxicity to midges is highly unlikely under environmentally realistic scenarios. Further, other relevant aquatic insect data (stonefly EC_{50} = 6700 µg/L) indicates the RQ (= 0.03) is below the acute LOC. Given that midges are not the primary food source for Topeka Shiners, indirect effects on Topeka Shiners due to potential direct acute effects on midges (if they occur at all) are also highly unlikely. Taken together, these data support a “may affect, but not likely to adversely affect” determination for Topeka shiner via direct effects on prey.

4.4.2 Spatial Analysis of Locations Near MLRA 113

Based on spatial analysis of all EOs, no current Topeka Shiner occurrences *within* the 1172 vulnerable watersheds are located *within* MLRA 113 in Illinois or Missouri – the MLRA that overlaps with MO-01 and MO-02 (Figures 4 and 5). However, two current occurrences *outside* the 1172 vulnerable watersheds are located *within* MLRA 113 (Figures 4 and 5). Importantly, these two occurrences are localized to the lower, southwest boundary of MLRA 113 within the Moreau/Loutre Ecological Drainage Unit (EDU) (east-central Missouri) and not within the Cuivre/Salt EDU (northeastern Missouri) (Figure 5). These two EDUs have distinct geologic, topographic, and soil properties that govern the biotic properties and, consequently, stream ecology within these EDUs (USGS, 2005). The Cuivre/Salt EDU is dominated by distinct flat plains underlain by claypan soils (i.e., MLRA 113 Central Claypan Area) with streams that are generally turbid and warm with sand/silt substrates, intermediate gradients, and fewer springs (USGS, 2005); Figures 2 and 3 (as well as many figures within Hampton *et al.*, 2007) illustrate these stream characteristics since MO-01 and MO-02 are located within the Cuivre/Salt EDU (Figures 4 and 5). In contrast, streams within the Moreau/Loutre EDU are generally clear and cool with coarse substrates, higher gradients, and a riffle-pool morphology (USGS, 2005).

Figure 4 **Spatial Distribution of Current Topeka Shiner Locations Within and Outside the 1172 Vulnerable Watersheds**

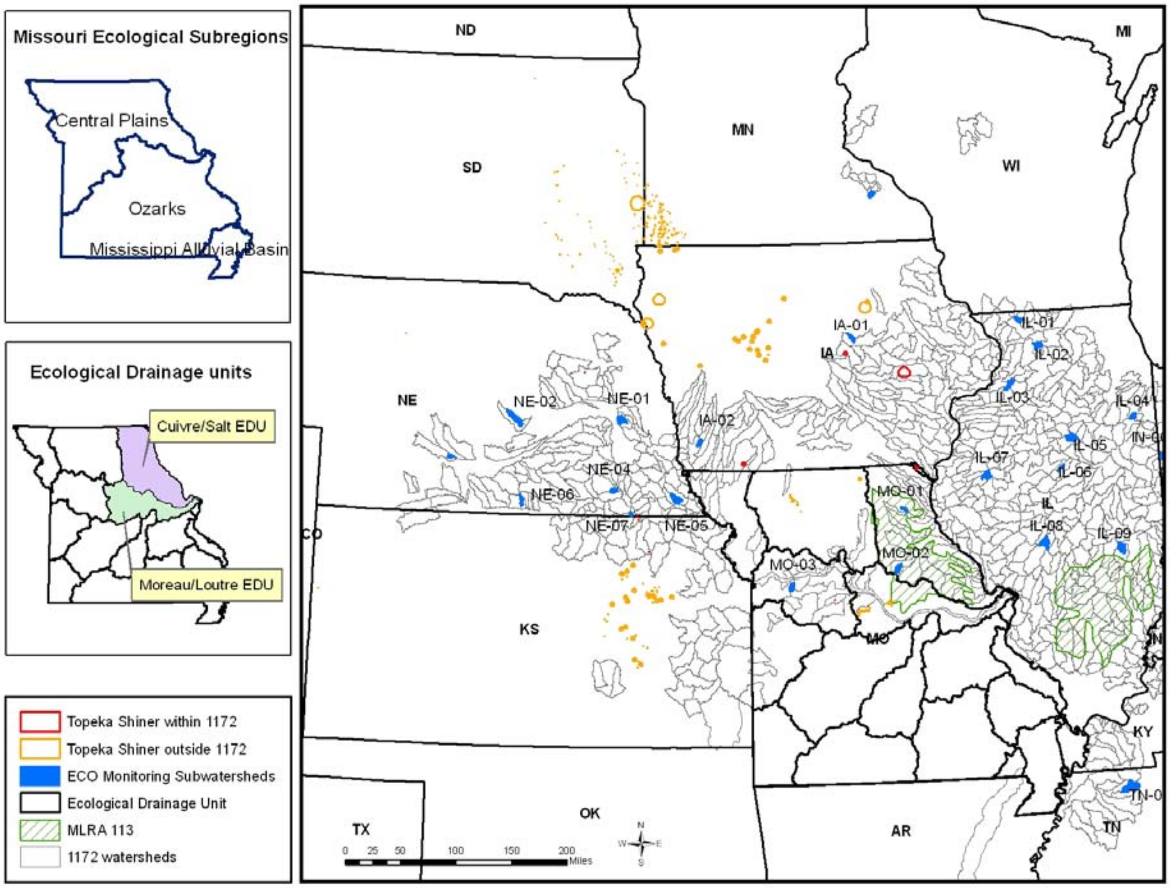
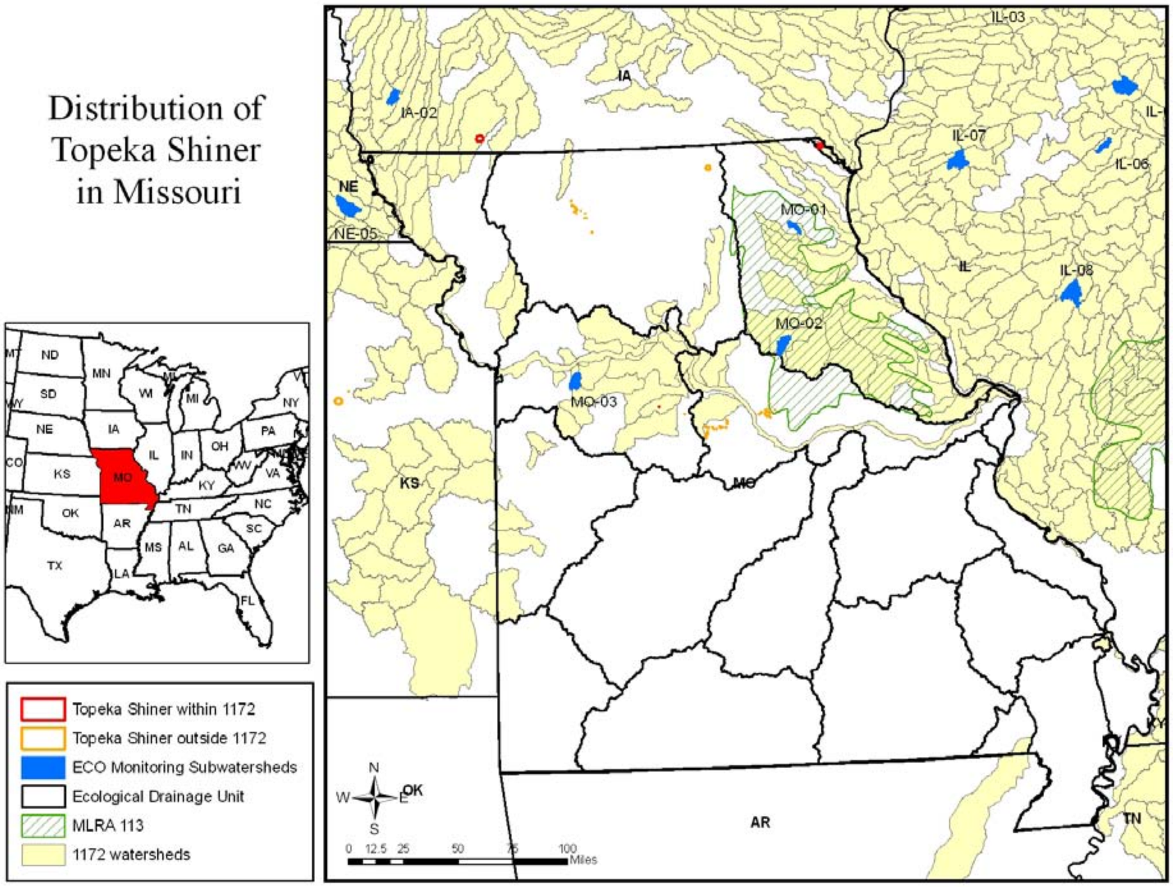


Figure 5 Spatial Distribution of Current Topeka Shiner Locations Relative to the Missouri Portion of MLRA 113



As mentioned above, current Topeka Shiner occurrences are within streams more typical of the Moreau/Loutre EDU. Based on Missouri Aquatic Gap Analysis (MAGA) (USGS, 2005), current and future predicted Topeka Shiner habitats are not located within the Cuivre/Salt EDU but are predominantly located within the Moreau/Loutre EDU and Blackwater/Lamine EDU (westcentral Missouri) (Figure 6). The MAGA was conducted by USGS to classify valley segments as high, moderate, or low potential for presence of current and future Topeka Shiner populations using multi-layered spatial data. Spatial layers included: stream size; flow regime; gradient; ground water potential; surface geology; size discrepancy; floodplain interaction; and connectivity to a lake. In Missouri, Topeka Shiner habitats tend to occur in belts of hilly topography where higher gradients flush silt efficiently to maintain clear water quality within streams and pools (e.g., Moreau/Loutre EDU) (Pflieger, 1997). In contrast, USGS' spatial analysis of all potential Topeka Shiner occurrences within Missouri (using known habitat preferences) found that streams within the Cuivre/Salt EDU/MLRA 113 region do not support current or future Topeka Shiner habitats. In other words, since MO-01 and MO-02 are localized within the Cuivre/Salt EDU/MLRA 113 region and this region does not represent current or future habitats, MO-01 and MO-02 data are not directly relevant to streams supporting Topeka Shiner populations. This conclusion is further supported by monitoring data from MO-03, an AEEMP site that is not within the Cuivre/Salt EDU/MLRA 113 region, and has not exceeded the CASM_Atrazine screening LOC across all three years of monitoring. Interestingly, MO-03 is located within the Blackwater/Lamine EDU, an EDU which supports Topeka Shiner habitat (Figures 5 and 6). Taken together, these data support a "may affect, but not likely to adversely affect" determination via potential direct or indirect effects on prey or aquatic habitat since streams vulnerable to atrazine exposure (i.e., headwater streams within MLRA 113) are not characteristic of, and do not support, current or potential Topeka Shiner populations.

4.4.3 Summary of Effects Determination for the Topeka Shiner

In summary, refined analyses of effects data, spatial data, and habitat characteristics that support Topeka Shiner populations demonstrate that atrazine use on corn and sorghum throughout the Midwest – including the vulnerable MLRA 113 region – will not adversely affect Topeka Shiner survival, growth, or reproduction. Based on relevant toxicity data and maximum peak or rolling average concentrations derived from MO-01, direct acute or chronic effects on the Topeka Shiner are not expected and indirect effects based on direct effects on primary producers and/or aquatic invertebrates are highly unlikely. Moreover, a comparison of Topeka Shiner habitats to streams vulnerable to atrazine exposure (i.e., headwater streams within MLRA 113) demonstrates that current or future Topeka Shiner populations will not be adversely affected via direct and/or indirect effects. Therefore, a "may affect, but not likely to adversely affect" determination via potential direct or indirect effects on prey or aquatic habitat for the Topeka Shiner is a reasonable and conservative conclusion after considering all "best available" data and information.

Figure 6 **Current and Future Predicted Topeka Shiner Locations Based on Missouri Aquatic Gap Analysis (USGS, 2005)**

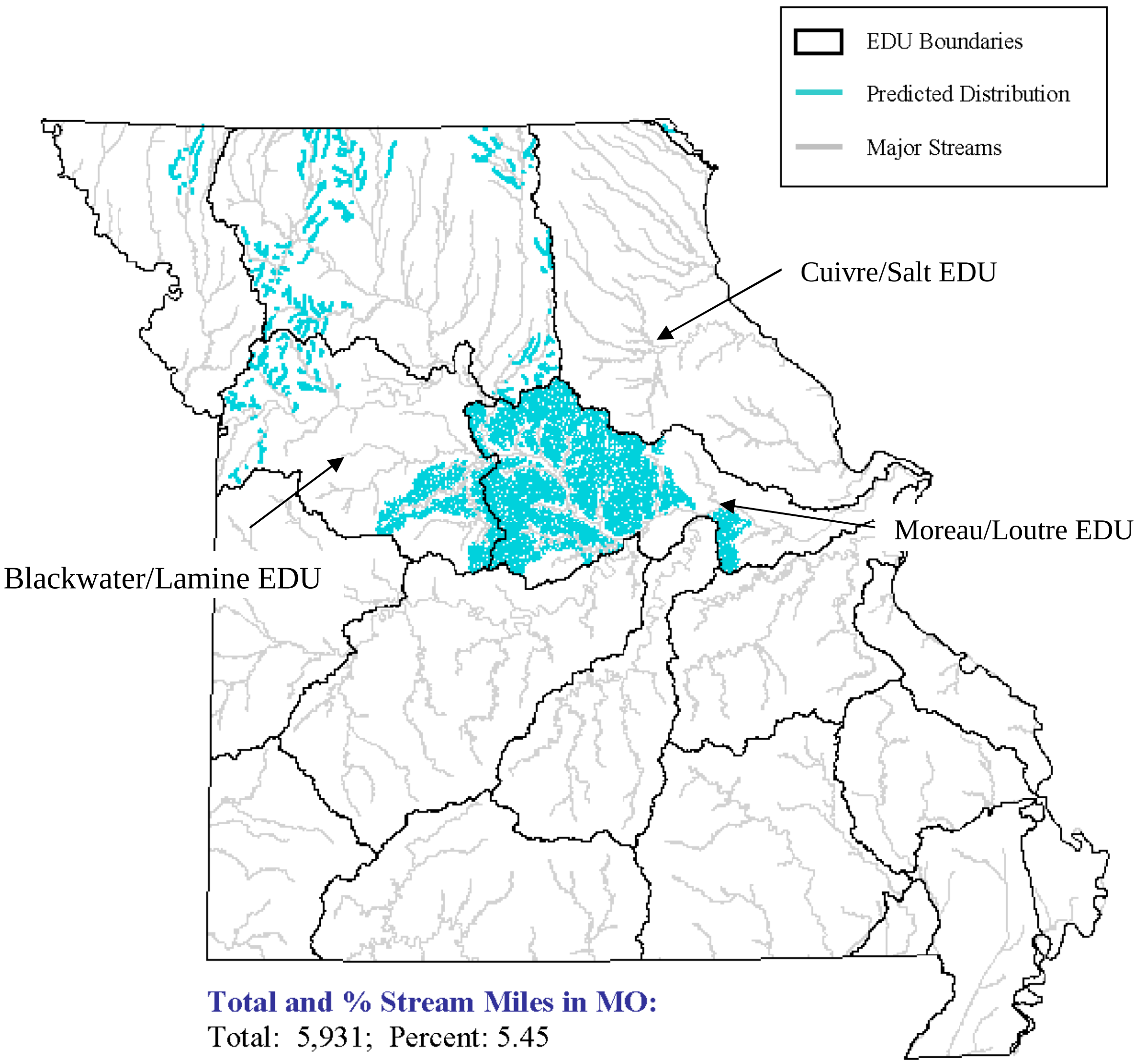


*Figure reproduced from "Fish of Missouri" document available at: http://www.cerc.usgs.gov/morap/projects.asp?project_id=1.

5.0 RIPARIAN VEGETATION

Syngenta has previously described in detail that additional data need to be considered for indirect effect determinations for listed species based on potential impacts on herbaceous/grassy riparian areas (Wall *et al.*, 2007). This includes refinement of the terrestrial plant screening-level model; consideration of recovery; use of available literature which indicates minimal impact in riparian areas; use of technical experts who have studied the effectiveness of riparian buffer zones (see supporting letters in Appendix 2); and use of available spatial data. Consideration of these refinements will support a "may affect, but not likely to adversely affect" determination for potential indirect effects on the listed mussels and fish via potential direct effects on riparian habitat.

6.0 CRITICAL HABITAT

No critical habitat has been designated for the Catspaw mussel, Fat Pocketbook mussel, Northern Riffleshell mussel, and Pallid Sturgeon. As described in Section 4.2, critical habitats for the Topeka shiner were designated in a total of 83 stream segments (836 miles of stream) within the States of Iowa, Minnesota, and Nebraska (Figure 1) (USFWS, 2004). From these total stream segments, only one stream segment with 6-stream miles in Madison County, NE intersects with the 1172 vulnerable watersheds. Given the limited intersection of Topeka Shiner critical habitat with the 1172 vulnerable watersheds, as well the "best available" information provided in Section 4.4, a "may affect, but not likely to adversely affect" determination via potential direct or indirect effects on Topeka Shiner critical habitat is a reasonable and conservative conclusion.

7.0 CONCLUSIONS

Syngenta has provided additional scientific information important to EPA's assessments for atrazine relative to three endangered freshwater mussels [Catspaw (*Epioblasma obliquata obliquata*), Fat Pocketbook (*Potamilus capax*), and Northern Riffleshell (*Epioblasma torulosa rangiana*) mussels) and two endangered freshwater fishes [Pallid Sturgeon (*Scaphirhynchus albus*) and Topeka Shiner (*Notropis topeka*)]. Overall, spatial analysis of species locations, appropriate representation of AEEMP data, differences in flow rate, consideration of effects data, and a more detailed evaluation of the potential impact of atrazine on grassy/herbaceous and woody riparian areas supports "no effect" and/or "may affect, but not likely to adversely affect" determinations for potential direct and indirect effects to all named species.

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APPENDICES SECTION

APPENDIX 1 FLOW RATES FOR OCCUPIED MUSSEL AND FISH LOCATIONS WITHIN THE 1172 VULNERABLE WATERSHEDS

EO ID	Species Common Name	Gauge Station ID	Flow Direction	Distance from EO (stream miles)	Number of Days of Streamflow Data Records	Mean Daily Flow Rate (ft^3/sec)	Standard Deviation (ft^3/sec)^2	Minimum Flow Rate (ft^3/sec)	5th Centile Flow Rate (ft^3/sec)	50th Centile Flow Rate (ft^3/sec)	95th Centile Flow Rate (ft^3/sec)	Maximum Flow Rate (ft^3/sec)	NHDplus Estimated Mean Flow Rate* (ft^3/sec)	Reachcode
166491	Northern Riffleshell	03361850	Upstream	5.6	13149	93.405	204.527	0.6	3.9	33	376.5	3570	243.26	5120204000083
166516	Northern Riffleshell	03361850	Upstream	7.2	13149	93.405	204.527	0.6	3.9	33	376.5	3570	248.46	5120204000083
166889	Northern Riffleshell	03329500	Upstream	0.89	11518	3352.633	5632.052	158	320	1380	13500	82100	3823.45	5120105000058
167700	Northern Riffleshell	03333050	Upstream	11.15	6209	1997.283	1846.048	131	394	1430	5575	18400	6073.47	5120105000352
167722	Northern Riffleshell	03352500	Upstream	0	27028	294.493	518.762	7.8	40	130	1080	10600	243.34	5120201000051
168988	Northern Riffleshell	04178500	Upstream	8.8	1461	647.242	934.703	22	45	266	2814	7030	558.52	4100003000029
169082	Northern Riffleshell	04180000	Upstream	5.3	20790	255.771	418.481	13	27	115	996.45	5220	256.89	4100003000168
169526	Northern Riffleshell	NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	261.29	5120106002206
169648	Northern Riffleshell	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	236.68	5120106000124
169941	Northern Riffleshell	03362500	Upstream	0.96	22098	506.705	966.062	9.2	35	212	1960	19200	484.46	5120204000078
169942	Northern Riffleshell	03347000	Downstream	11	26481	218.655	488.812	1.1	7.2	76	886	11600	173.88	5120201000100
170620	Northern Riffleshell	03348000	Upstream	13.5	22828	395.807	743.314	9.1	48	182	1435.5	16700	348.27	5120201000092
170723	Northern Riffleshell	04178000	Downstream	2.2	17116	536.913	798.174	14	35	230	2120	9450	485.84	4100003000040
172324	Northern Riffleshell	03332000	Upstream	4.47	1278	1178.663	1291.564	232	248	669	4250	7410	1004.94	5120106001784
172745	Northern Riffleshell	03332000	Downstream	4.27	1278	1178.663	1291.564	232	248	669	4250	7410	1088.76	5120106000030
173566	Northern Riffleshell	03362500	Upstream	2.46	22098	506.705	966.062	9.2	35	212	1960	19200	483.37	5120204000078
175064	Northern Riffleshell	03343000	Upstream	9	24097	12360.589	13232.917	770	1810	7450	38500	184000	12535.62	5120111000975
176260	Northern Riffleshell	04179000	Upstream	0	10206	625.562	927.589	1.6	47	258	2536.5	9780	610.04	4100003000014

EO ID	Species Common Name	Gauge Station ID	Flow Direction	Distance from EO (stream miles)	Number of Days of Streamflow Data Records	Mean Daily Flow Rate (ft^3/sec)	Standard Deviation (ft^3/sec)^2	Minimum Flow Rate (ft^3/sec)	5th Centile Flow Rate (ft^3/sec)	50th Centile Flow Rate (ft^3/sec)	95th Centile Flow Rate (ft^3/sec)	Maximum Flow Rate (ft^3/sec)	NHDplus Estimated Mean Flow Rate* (ft^3/sec)	Reachcode
176261	Northern Riffleshell	04178500	Upstream	6.3	1461	647.242	934.703	22	45	266	2814	7030	565.79	4100003000026
176461	Northern Riffleshell	04183500	Upstream	15	20832	1712.367	2662.688	26	118	639	7280	25800	1700.62	4100005000033
179024	Northern Riffleshell	04178500	Upstream	11	1461	647.242	934.703	22	45	266	2814	7030	533.98	4100003000031
179428	Northern Riffleshell	03361850	Upstream	12.28	13149	93.405	204.527	0.6	3.9	33	376.5	3570	294.40	5120204000082
179685	Northern Riffleshell	03333050	Upstream	1.87	6209	1997.283	1846.048	131	394	1430	5575	18400	1827.30	5120106001796
180721	Northern Riffleshell	03341500	Upstream	23	27759	11165.012	12771.962	701	1570	6450	36500	186000	11799.26	5120111000070
181182	Northern Riffleshell	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1984.25	5120201000031
181204	Northern Riffleshell	04180500	Downstream	8.3	12472	1013.211	1431.327	27	87.65	450	4000	13100	907.36	4100003000873
181320	Northern Riffleshell	03332000	Upstream	2.12	1278	1178.663	1291.564	232	248	669	4250	7410	1009.48	5120106001803
259853	Northern Riffleshell	03230500	Upstream	7	29220	472.437	979.094	1.4	18	162	1970	38400	379.30	5060001000528
261664	Northern Riffleshell	03230500	Upstream	0	29220	472.437	979.094	1.4	18	162	1970	38400	456.48	5060001000499
261879	Northern Riffleshell	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	200.84	5060001000541
263179	Northern Riffleshell	04177810	Upstream	3.5	2002	84.578	138.671	3.6	6.4	33	355	1360	65.41	4100003000149
263180	Northern Riffleshell	03230310	Downstream	9.6	4383	172.981	313.253	0	5.82	70	730.8	4910	124.60	5060001000609
264567	Northern Riffleshell	03230310	Downstream	3.6	4383	172.981	313.253	0	5.82	70	730.8	4910	138.65	5060001000603
265958	Northern Riffleshell	04196200	Downstream	5.8	2096	98.844	253.593	0.15	1.6	20	569.15	2610	177.17	4100011000172
267399	Northern Riffleshell	03230500	Upstream	9.5	29220	472.437	979.094	1.4	18	162	1970	38400	468.01	5060001000496
739790	Northern Riffleshell	03351000	Upstream	9.33	27028	1153.954	1936.94	49	139	529	4300	31500	1245.83	5120201000071
739791	Northern Riffleshell	03348500	Upstream	6.97	20819	797.22	1419.393	39	95	348	2980	21800	558.80	5120201000084
739792	Northern Riffleshell	03348500	Upstream	1.9	20819	797.22	1419.393	39	95	348	2980	21800	712.72	5120201000083

EO ID	Species Common Name	Gauge Station ID	Flow Direction	Distance from EO (stream miles)	Number of Days of Streamflow Data Records	Mean Daily Flow Rate (ft^3/sec)	Standard Deviation (ft^3/sec)^2	Minimum Flow Rate (ft^3/sec)	5th Centile Flow Rate (ft^3/sec)	50th Centile Flow Rate (ft^3/sec)	95th Centile Flow Rate (ft^3/sec)	Maximum Flow Rate (ft^3/sec)	NHDplus Estimated Mean Flow Rate* (ft^3/sec)	Reachcode
739793	Northern Riffleshell	03348130	Upstream	0	1461	609.19	1110.187	74	89	296	2080	13500	530.52	5120201000089
739794	Northern Riffleshell	03348000	Upstream	3.82	22828	395.807	743.314	9.1	48	182	1435.5	16700	400.37	5120201000090
739795	Northern Riffleshell	03348130	Upstream	5.57	1461	609.19	1110.187	74	89	296	2080	13500	555.29	5120201000088
739796	Northern Riffleshell	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	161.45	5120202000136
739797	Northern Riffleshell	03361850	Upstream	15.66	13149	93.405	204.527	0.6	3.9	33	376.5	3570	329.03	5120204000081
739798	Northern Riffleshell	03349000	Upstream	5.01	20819	871.959	1438.879	44	115	410	3290	25400	841.50	5120201000689
739799	Northern Riffleshell	03349000	Upstream	8.78	20819	871.959	1438.879	44	115	410	3290	25400	1152.88	5120201000073
739800	Northern Riffleshell	03349000	Upstream	5.07	20819	871.959	1438.879	44	115	410	3290	25400	830.85	5120201000078
101845	Pallid Sturgeon	07020500	Upstream	0	22738	206269.549	135785.191	37600	68200	166000	484000	1000000	182438.29	7140105000123
101918	Pallid Sturgeon	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	97507.89	7110009000723
110162	Pallid Sturgeon	06818000	Upstream	16.7	27759	42853.735	25944.524	2300	12200	38100	90700	380000	61142.25	10240011000070
110263	Pallid Sturgeon	06818000	Upstream	10.7	27759	42853.735	25944.524	2300	12200	38100	90700	380000	61109.73	10240011000077
111157	Pallid Sturgeon	06893000	Upstream	38	27759	51958.209	35525.476	1500	14200	43000	118000	558000	61223.49	10240011000881
115255	Pallid Sturgeon	06893000	Upstream	30	27759	51958.209	35525.476	1500	14200	43000	118000	558000	61284.33	10240011000015
292065	Pallid Sturgeon	06818000	Upstream	0	27759	42853.735	25944.524	2300	12200	38100	90700	380000	58963.88	10240001000528
342945	Pallid Sturgeon	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	182040.49	7140105000124
487894	Pallid Sturgeon	06805500	Upstream	17	18750	6977.172	7047.946	131	1480	5230	18200	138000	58765.93	10240001000116
490480	Pallid Sturgeon	06807000	Upstream	29	27445	37882.165	21676.032	1800	11500	35100	74600	390000	59548.67	10240005000179
491716	Pallid Sturgeon	06805500	Upstream	21	18750	6977.172	7047.946	131	1480	5230	18200	138000	58768.08	10240001000116
493118	Pallid Sturgeon	06807000	Upstream	36	27445	37882.165	21676.032	1800	11500	35100	74600	390000	59813.86	10240005000176
493726	Pallid Sturgeon	06807000	Upstream	14	27445	37882.165	21676.032	1800	11500	35100	74600	390000	58961.08	10240001000002
498032	Pallid Sturgeon	06805500	Upstream	16	18750	6977.172	7047.946	131	1480	5230	18200	138000	11655.95	10200202000717
498270	Pallid Sturgeon	06805500	Upstream	0	18750	6977.172	7047.946	131	1480	5230	18200	138000	11630.78	10200202000724
498479	Pallid Sturgeon	06807000	Downstream	17	27445	37882.165	21676.032	1800	11500	35100	74600	390000	58836.21	10240001000027
746018	Pallid Sturgeon	07026300	Upstream	5.8	10915	2854.839	4164.091	104	429	1130	11200	47000	2973.90	8010202000026

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114662	Topeka Shiner	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.94	10270205000200
115443	Topeka Shiner	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.58	10270205000199
120288	Topeka Shiner	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.24	10270205000023
137274	Topeka Shiner	05451500	Upstream	0	31411	881.934	1407.774	4.7	51	395	3300	39400	751.45	7080208000273
137328	Topeka Shiner	05453100	Upstream	13.176	17532	1933.029	2680.049	24	146.65	981.5	7190	35600	1455.15	7080208000025
308967	Topeka Shiner	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.27	10300103000424
329319	Topeka Shiner	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.55	7100009000838
493323	Topeka Shiner	06799230	Upstream	2.74	5479	45.427	196.872	2	8.8	20	93	7590	0.54	10220003000467
653227	Topeka Shiner	06819185	Upstream	0	7671	57.794	229.175	0	0.22	6.7	219.4	7600	11.91	10240013000054
101173	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	32075.90	5120113000600
101352	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2481.30	5120114002197
101942	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	29479.18	5120113000006
102014	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	29239.80	5120113000044
102398	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	29229.43	5120113000046
103651	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	29252.12	5120113000593
103743	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	32075.90	5120113000600
103793	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	32094.40	5120113000595
103941	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	29486.20	5120113000594
103942	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	29196.83	5120113000588
104107	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	32094.40	5120113000595
104108	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	28823.39	5120113000068
104287	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2571.29	5120114000002
165820	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	29055.82	5120113000607
166664	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	28805.96	5120113000925
168205	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	28780.02	5120113000924
169004	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	206.03	5120113000010
169040	Fat Pocketbook	03381700	Upstream	10	975	224548.41	142278.197	10800	34440	192000	495200	615000	32122.36	5120113000001
169095	Fat Pocketbook	03335500	Upstream	7	29220	6699.913	8376.458	399	910	3650	23200	129000	6040.95	5120105000367
170204	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	29225.89	5120113000047

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170946	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	29238.87	5120113000044
171551	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	81.89	5120113000051
171886	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	29196.83	5120113000588
172248	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	32075.90	5120113000600
173961	Fat Pocketbook	03377500	Upstream	0.3	27759	28426.253	31813.019	1650	3460	16700	91900	302000	28702.02	5120113000077
175783	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	29499.31	5120113000601
175784	Fat Pocketbook	03357000	Upstream	0	16801	2960.906	4575.929	135	330	1400	11400	55900	2996.36	5120202000099
177021	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	28823.39	5120113000068
177045	Fat Pocketbook	03377500	Downstream	1	27759	28426.253	31813.019	1650	3460	16700	91900	302000	27492.13	5120113000583
179509	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	29486.20	5120113000594
179520	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	32075.90	5120113000600
300691	Fat Pocketbook	05474500	Upstream	11	46294	66454.86	47545.988	5000	19700	51100	163000	434000	72121.08	7110001002342
305279	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No Data	7110004000756
316110	Fat Pocketbook	05501600	Upstream	9.1	0	0	0	0	0	0	0	0	74224.23	7110004000191
336809	Fat Pocketbook	05474500	Upstream	15	46294	66454.86	47545.988	5000	19700	51100	163000	434000	72122.45	7110001002376
345292	Fat Pocketbook	05474500	Upstream	7.9	46294	66454.86	47545.988	5000	19700	51100	163000	434000	71818.27	7110001002377
439665	Fat Pocketbook	03611500	Upstream	1.5	27942	278413.507	234631.68	15000	54200	193000	770850	1850000	287058.33	5140206000050
446797	Fat Pocketbook	03381700	Upstream	6	975	224548.41	142278.197	10800	34440	192000	495200	615000	179146.63	5140203000128
449057	Fat Pocketbook	03381700	Upstream	9	975	224548.41	142278.197	10800	34440	192000	495200	615000	179113.05	5140203001216
449113	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	572845.43	8010100000817
629681	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	14616.49	5120113000086
629682	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	29102.83	5120113000596
629683	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	29225.89	5120113000047
629684	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	28805.96	5120113000925
654680	Fat Pocketbook	05454500	Upstream	0	37013	1857.949	2408.435	29	134	983	6380	40500	1674.66	7080209000057
670779	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	74228.64	7110004002875
737598	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	29055.82	5120113000607
737607	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	28828.96	5120113000068
737632	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	28823.39	5120113000068

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739069	Fat Pocketbook	03374000	Upstream	9	27576	12210.092	15398.205	573	1170	6600	42500	182000	12476.68	5120202000442
739070	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	29062.05	5120113000598
739071	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	28823.39	5120113000068
739072	Fat Pocketbook	03373980	Upstream	2.75	3422	11250.446	14650.246	870	1110	6045	38400	123000	6796.02	5120208000522
739073	Fat Pocketbook	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	28759.77	5120113000071

* Mean annual mean flow rate is estimated using Unit Runoff Model (NHDPlus User Guide, 2006)

** NA: No relevant USGS gauging stations available near species locations.

APPENDIX 2 LETTERS SUPPORTING EFFECTIVENESS OF RIPARIAN BUFFER ZONES

Note: While these letters were specifically written in response to EPA's assessment for mussels (USEPA, 2007), they remain applicable and should be considered for EPA's assessments for atrazine relative to three endangered freshwater mussels [Catspaw (*Epioblasma obliquata obliquata*), Fat Pocketbook (*Potamilus capax*), and Northern Riffleshell (*Epioblasma torulosa rangiana*) mussels) and two endangered freshwater fishes [Pallid Sturgeon (*Scaphirhynchus albus*) and Topeka Shiner (*Notropis topeka*)].

To: Dr. Arthur -Jean B. Williams, Associate Director
Environmental Fate and Effects Division
EPA- Office of Pesticide Programs
1200 Pennsylvania Ave N.W.
Washington, D.C. 20460

Dear Dr. Williams:

This is a comment on the conclusion of EPA document: Risk of Atrazine Use to Eight Federally Listed Endangered Fresh Water Mussels, Pesticide Effects Determination, Environmental Fate and Effects Division, Office of Pesticide Programs, Feb. 28, 2007. I strongly disagree with the conclusion that drifts and runoff of atrazine have significant negative impacts on riparian buffers, thus allowing greater sedimentation of waters in mussel habitat. Below, I provide the major reasons for my disagreement with the above conclusion.

I have a Ph.D. from Virginia Tech in Plant Physiology/Weed Science and my dissertation was on the fate of herbicides in soil. After graduation, I continued to work on herbicide degradation first at University of Florida and in the last 18 years here at Virginia State University (VSU). Since I joined VSU, my primary duty has been to develop and promote Best Management Practices (BMPs) to abate the transport of pesticides from runoff. The results of my research have been published in several journals many of them dealing on the effectiveness of switchgrass (*Panicum virgatum* L.) in removing atrazine and other pesticides from runoff.

In one of these published papers (Mersie et al., 1999), we found that switchgrass filter strips reduce the mass of dissolved atrazine by 52%. Switchgrass helped to remove the herbicides by slowing runoff velocity and increasing their retention by soil. Switchgrass filter strips also accelerated the degradation of atrazine when compared to bare soil. The research was done using aluminum titled beds filled with soil that simulate actual field conditions and allow planting of switchgrass, control of slope, runoff volume and flow rate (Mersie and Seybold, 1997). Atrazine concentration in the simulated runoff was 6.2 mg L^{-1} and the switchgrass was few weeks old (tillering stage) at the time of runoff application. There was no herbicide injury to switchgrass at this relatively high atrazine concentration.

Switchgrass was used in all of our runoff studies because it is recommended by USDA's Natural Resources Conservation Service (NRCS) for this purpose and it is the most widely used filter strip grass. It is a warm season grass adapted to most of the U.S. and has robust growth that could withstand inundation by runoff and sediment. It is also promoted as a sustainable biofuel crop because of its large biomass production.

Unlike switchgrass, none of the species except ryegrass mentioned on the EPA's document (corn, oats, onion, ryegrass, carrot, soybean, lettuce, cabbage, tomato and cucumber) are recommended for use in filter strips down slope of atrazine treated fields. They lack important features of a filter strip species such as being a perennial, ability to form dense stand, low water and nutrient requirement, and a deep root system to hold soil in place (McLaughin, 1993). To the contrary most of the species in the list are high maintenance crops that will require application of pesticides and fertilizers which are not recommended practices for riparian zones.

So, the assertion that atrazine in runoff could be phytotoxic to filter strip seedling such as corn, oats, onion, carrot, soybean, lettuce, cabbage, tomato and cucumber during establishment should not be a concern because these species of plants are not recommended or used for this purpose. The vegetation in natural or established filter strips is mostly composed of perennial species that can tolerate atrazine concentrations usually found in runoff.

For field applied atrazine, it was estimated that between 1 and 5% of the amount applied can be transported out of the field with runoff (Wu, 1980; Glotfelty et al., 1984). For ryegrass, the relatively low concentrations of atrazine detected in runoff are unlikely to cause injury. Perennial ryegrass is used after it is established in the second and subsequent years when it can tolerate the relatively low concentration of atrazine in runoff or in a drift.

In conclusion, vegetative filter strips or natural riparian zones down slope of treated fields can abate the transport of herbicide to non-target sites. They are most effective when used in combination with other BMPs that reduce the availability of the herbicide for transport with runoff. As shown on NRCS publication, Plants for Conservation Buffers, the majority of the 34 plant species recommended for buffers are perennial grasses. These grasses make thick stands that change the flow hydrology of runoff to increase infiltration, enhance herbicide adsorption, degradation and are low maintenance. All are tolerant to levels of atrazine usually found in runoff and drift. So, there should not be a concern about drift and runoff of atrazine having a significant negative impact on riparian buffers.

Sincerely,

Wondi Mersie
Associate Professor

Literature Cited

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May 3, 2007

Arthur -Jean B. Williams, Associate Director
Environmental Fate and Effects Division
EPA - Office of Pesticide Programs
1200 Pennsylvania Ave N.W.
Washington, D.C. 20460

Dear Ms. Williams:

I am writing this letter with respect to the issue of the conclusion that atrazine concentrations in field runoff water kill riparian buffers. I currently work part-time for the Iowa Department of Agriculture and Land Stewardship on water quality issues, having retired as a University Professor from the Department of Agricultural and Biosystems Engineering at Iowa State University. From December1971 to my retirement in July 2004, I was on a post-doctorate and then faculty appointments with the Agricultural Experiment Station performing water quality research with respect to sediment, pesticides, and nutrients. I was named a Fellow in the American Society of Agronomy and in the American Society of Agricultural and Biological Engineers.

In my research career, I studied the effects of infield (e.g., rate, method, and timing of pesticide application; cropping; and tillage) and off-site (vegetated buffer strips) management practices to reduce pesticide transport and losses. Most relevant to the issue at hand are several studies we performed near Ames at Iowa State University in the 1990's.

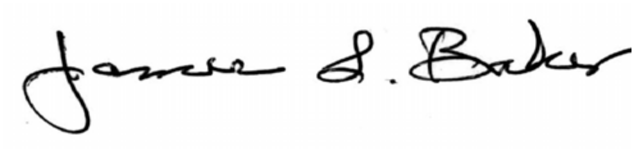
In those studies we utilized natural rainfall to create runoff from an atrazine-treated field and also used simulated rainfall and created simulated runoff with addition of sediment and low levels of atrazine to runoff water. These runoff waters were then added to the upper ends of 30 or 66 foot long vegetated buffer strips. We situated the studies in an area with well-established grass waterways consisting of vegetation commonly used for waterways. For the most used area, analysis and quantification showed that the vegetation was composed of mostly bromegrass (81%) and bluegrasses (17%); there were about 8.8 M tillers per hectare (Arora et al., 1996).

Measurements made over the multiple-year natural rainfall study showed that the amounts of atrazine removed by the buffer strips, on a per area basis, would be less than the rate used in the source field, where the ratios of source area to buffer strip area were in the range of 15 to 1 to 45 to 1. Not having performed this type of research before, we were concerned that the atrazine retained by the buffer strip might kill the vegetation resulting in a denuded area that could enhance rather than deter erosion. Contrary to that possibility, it was observed that after the first year of the study, the grasses growing in the upper part of the vegetated buffer strip (roughly the top 10 feet) actually had enhanced growth (see the attached power-point slide with co-investigator Dr. Steve Mickelson standing near the upper end of the buffer strips). One possible explanation we had was that the sediment that was depositing there, although it contained atrazine, was more fertile than the in-place soil (the source area had been fertilized over the years, the waterway had not; in addition the selective erosion process transports soil that is generally more fertile because it is finer and less dense because of more organic matter.

In reviewing other research projects over the U.S., I do not recall that the plants used in creating vegetated buffer strips ever included species such soybean, onion, carrot, tomato, cabbage, and cucumbers; in fact I am reasonably sure they never would be. Nor are they among the plants recommended by the NRCS for buffers. Therefore, I would have to conclude that any predictions made on the basis of these atrazine-sensitive plants would not be useful in assessing the potential impacts of atrazine on vegetation in normal buffer strips. Furthermore, in my experience on plots and fields where the research objective was related to other issues such as fertility, but with atrazine used for weed control, there were no effects evident on grass borders over which runoff from the treated areas flowed.

If details or further information if needed, I can be contacted by phone (515-268-1797) or email (jlbaker@iastate.edu).

James L. Baker



University Professor Emeritus
Department of Agriculture and Biosystems Engineering
Iowa State University

cc: Steven Bradbury, Debbie Edwards, Allen L. Jennings, Jere White

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Dr. Richard S. Fawcett
Fawcett Consulting
30500 Doe Circle
Huxley, IA 50124
Phone/Fax: 515-597-2206

March 6, 2007

Dennis Tierney
Syngenta Crop Protection
P.O. Box 18300
Greensboro, NC 27419-8300

Dear Dr. Tierney:

I would like to respond to the conclusions of the EPA document: Risk of Atrazine Use to Eight Federally Listed Endangered Fresh Water Mussels, Pesticide Effects Determination, Environmental Fate and Effects Division, Office of Pesticide Programs, Feb. 28, 2007.

I have over 30 years experience in studying the impacts of pesticides on off-target species and have specifically worked with riparian buffers. I strongly disagree with the conclusion that drift and runoff of atrazine have significant negative impacts on riparian buffers, thus allowing greater sedimentation of waters in mussel habitat. Indeed the opposite is true. If atrazine were not available, conservation tillage systems relying on atrazine would be harmed, causing more tillage and more erosion. Atrazine is an essential tool for conservation tillage systems, such as no-till, as evidenced by the fact that it is used preferentially by conservation tillage farmers. In 2004, atrazine was used on 84.1% of conservation tillage corn, compared to 61.7% of conventional tillage corn. Reduced or mulch-till systems have reduced erosion by an average 69% in controlled studies (Fawcett et al. 1994). No-till reduces erosion by more than 90%. I have recently reported on the potential impact of the loss of atrazine availability and concurrent increase in tillage and erosion that would occur (Fawcett, R.S., 2006). Under one potential scenario, one half of no-till corn farmers would be expected to do one additional tillage operation, burying enough surface crop residue to place land into the reduced or mulch-tillage category (being less effective in reducing erosion). One half of mulch-tillage acres would receive extra tillage, placing these acres into the conventional tillage category. This modest increase in tillage would result in an increase in erosion of 68 million tons/year and increase fuel use by 43 million gallons per year.

As a university professor and later as an independent consultant, I have investigated hundreds of cases of herbicide drift throughout the United States. I have never investigated a case of atrazine drift. This is not to say that atrazine doesn't drift. Indeed it can when sprayed under windy conditions (it moves as spray particles only, not as a vapor). However, at rates found in drift it causes so little impact to established plants that economic or esthetic problems simply don't occur.

Table 5.9 Non-target Terrestrial Plant Vegetative Vigor Toxicity RQs, shows that using EPA's models, only soybean, cabbage, and cucumbers would be affected by predicted atrazine drift. Given my experience in observing a total lack of symptoms on millions of acres of soybeans planted immediately adjacent to atrazine-treated corn fields throughout the Corn Belt, the model must greatly exaggerate concentrations and effects.

EPA acknowledges that plants are most sensitive to atrazine in the seedling emergence stage. This begs the question: When would seedlings be emerging in a riparian area when atrazine might come in contact with them? <u>All</u> the species in Table 5.8 are <u>annual</u> species. Riparian buffers, either naturally occurring or planted by man, contain nearly exclusively perennial plants, not annuals. Perennial plants are far less sensitive to atrazine than seedlings. Most perennials would not be significantly affected by direct applications of atrazine. EPA acknowledges that woody species are not sensitive to atrazine, but fails to understand that perennial herbaceous species similarly are not affected.

Theoretically, a few seedling plants might be found in a buffer at some point in time and be sensitive to atrazine. Given the dense nature of perennial vegetation in a buffer, even if these seedlings were killed, it would have no effect on the sediment trapping ability of the buffer.

The USDA NRCS provides technical assistance to landowners planting conservation buffers. The NRCS publication, Plants for Conservation Buffers, lists 34 plant species recommended for buffers. All of these species are perennials, and would not be significantly affected by atrazine drift. Some popular species, such as switchgrass, indiangrass, and big bluestem (the top rated species in the publication) are resistant to atrazine, with direct applications having no impact. Some of the most common grasses found in riparian buffers, both natural and planted, are perennial grasses like smooth bromegrass, tall fescue, and reed canarygrass, species very tolerant to atrazine. Farmers trying to kill these grasses with direct applications of atrazine fail.

Buffers are a widely recommended practice to trap herbicides in runoff to protect surface water (Krutz, et al. 2005; NRCS 2000). The potential impact of trapped herbicides on buffer species has been studied with no detrimental effects found. In fact, in Iowa studies with atrazine, buffer vegetation was most vigorous at the top end of buffers adjacent to atrazine-treated corn fields (Arora et al. 1996). More vigorous growth was attributed to nutrients trapped by the buffer. However, the authors concluded that atrazine trapped by the buffers had no harmful effect on the buffer. Kurtx et al. (2005)

reviewed all published studies investigating buffer trapping of pesticides. No study reported problems with trapped herbicide (or drift of herbicides) causing any problem with buffer vegetation. In fact, several studies reported enhanced degradation of trapped herbicides, including atrazine (Mersie et al. 1999). I have examined hundreds of buffers across the Midwest and have never seen a buffer adversely affected by atrazine (or any other herbicide found in runoff). The NRCS publication, Conservation Buffers to Reduce Pesticide Losses (NRCS, 2000), similarly concludes that established buffers are usually not affected by herbicides in runoff. This publication points out that trapped sediment itself is the biggest problem in reducing the efficiency of buffers. Trapped sediment changes the shape of buffers and may lead to concentrated flow unless periodically removed.

Atrazine reaching buffers either as drift or in runoff simply is not a problem in the real world. Any atrazine reaching buffers is at a concentration far too low to kill perennial species found there. Effects, if any, would be slight symptoms, having no effect on buffer efficiency. Any rare annual seedling plants present would have no impact on buffer efficiency even if they were killed or injured.

The only possible real impact of atrazine off-target movement on buffers would be during the process of seeding new buffers. Even then the timing of runoff or drift would have to coincide with the exact time of seed germination and emergence to have significant impact. The NRCS Buffer publication acknowledges that "the greatest chance for harmful impact of herbicides in runoff would occur during buffer establishment." I have worked with farmers across the Midwest, helping them establish buffers and observing buffers. I can say that problems in buffer establishment due to drift or runoff are very rare. Farmers generally take extra care when seeding new buffers, as they recognize the greater sensitivity of seedlings.

In conclusion, it is my professional opinion that atrazine in runoff or drift would have no impact on sediment trapping efficiency of buffers, with the only exception being possibility of injury for a few weeks after seeding new buffers. I base this conclusion on my own research experience with buffers, 30 years of experience observing the impacts of atrazine and other herbicides on adjacent vegetation, and on my experience in installing buffers (on my own farm) and helping other landowners install buffers.

Sincerely,

Dr. Richard S. Fawcett

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April 30, 2007

Arthur-Jean B. Williams, Associate Director
Environmental Fate and Effects Division
EPA- Office of Pesticide Programs
1200 Pennsylvania Ave N.W.
Washington, D.C 20460

Dear Director:

I am responding to the conclusions made in the EPA document entitled "Risk of Atrazine Use to Eight Federally Listed Endangered Fresh Water Mussels, Pesticide Effects Determination, Environomental Fate and Effects Division, Office of Pesticide Programs, February 28, 2007". Our research group has had experience with riparian buffer strips by being involved with a long-term study in Temple, TX where atrazine was applied at a field rate on corn or sorghum and then collecting runoff through natural rain events. This project had been established prior to me coming to Texas A&M University by Dr. Dennis Hoffman at Temple. We were involved with the experiment for approximately five years. The concentrations of atrazine in the runoff water were ***never*** high enough to show phytotoxic effects to the bermudagrass (*Cynodon dactylon*). The highest concentrations that could have been achieved would have been collected during a rainfall event that occurred directly after application. In one of the years that we were monitoring runoff, a significant rainfall occurred about one hour after application. Concentrations were the highest (>500 ug/L) that we had seen but they were not enough to cause any phytotoxic effects to the grass filter strips.

In another study that was done on bermudagrass and buffalograss (*Buchloe dactyloides*) in another location at the Temple Blackland Research Station, we ran runoff concentrations of 100 ug/L atrazine, metolachlor, and atrazine+metolachlor across 1 by 3-m plot areas to see how much chemical the grass would remove. The runoff concentrations used were based on earlier findings from the previously mentioned study across filter strips. After the study was complete, we did not see any damage to the plot areas from these concentrations. Since we repeated the study for two years, we saw no problems the following season with the grass area that we had used the previous year.

A third study was done in the same buffalograss area as the previously mentioned experiment and was related to atrazine and metolachlor metabolites and the buffer strips ability to remove the parent and metabolites. Again, the concentrations were 100 ug/L of each of the analytes and no adverse effects were noted with the grass areas after the first or second year of studies.

Finally, I have asked our Extension Water Quality Specialist, Dr. Monty Dozier, who I have worked with during the past 12 years and who has also been involved with Best Management Practice implementation if he has seen any phytotoxic effects in filter strips from atrazine in our state. Dr. Dozier replied that he had not seen nor heard of any complaints regarding filter strip degradation from atrazine.

Therefore, based on my professional experience and the studies that we have done with the two grass species of buffalograss and bermudagrass, I am of the opinion that the conclusions that have been drawn from the EPA report are incorrect and that no phytotoxic effects should be expected on riparian buffer strips from typical runoff concentrations of atrazine, metolachlor, or their metabolites.

If you have questions regarding these statements, please feel free to contact me (Phone: 979-845-5375; e-mail: s-senseman@tamu.edu)

Sincerely,

Scott Senseman

Scott Senseman
Professor, Department of Soil and Crop Sciences

cc: Steven Bradbury
Debbie Edwards
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