Additional Syngenta Comments Concerning the
Minnesota Department of Agriculture's
"Scoping an Interagency Review of Atrazine Use, Impacts,
and Registration in Minnesota"

Introduction

In September 2008, the Minnesota Department of Agriculture (MDA) published a scoping document[1] describing their proposed process for the reevaluation of use of the herbicide atrazine in the state. The MDA has indicated that they will review a select number of pesticides each year, beginning with atrazine. The described goal of this process is to "identify any unreasonable adverse effects on human health or the environment in Minnesota that might be addressed through state-specific registration and regulation". The primary components of the risk assessment process for this review include dietary exposure from drinking water, occupational (primarily dermal) exposure and ecological effect assessment of aquatic plants and animals in surface waters. In addition, this assessment will include a review of costs and benefits of atrazine use, portions of the existing label, opportunities for increased applicator awareness and whether the existing BMPs need revision.

MDA states in the scoping document that the intention is not to be redundant of the analyses and decision reached by the U.S. Environmental Protection Agency (USEPA). Throughout the scoping document a total of eleven recommended actions are proposed. In this submission, we will comment on specific items found in the document and provide additional information on several of the recommendations.

Figure 2 is not complete and we offer these additional key steps:

2000 June 27 to 29th USEPA SAP on Atrazine Carcinogenic Potential

2000 December 13th: USEPA CARC Cancer Classification: Not Likely to be a Human Carcinogen

2002 March 2, USEPA Common Mechanism Group for Chlorotriazines

2003 July 17th USEPA SAP on Atrazine Carcinogenic Potential in Prostate

2003 October 31st 2003 IRED Appendix

2006 April 6th USEPA Final RED for Atrazine and Cumulative Triazine Assessment

In addition the World Health Organization (WHO) completed a toxicology review in 2007. The Meeting agreed that atrazine

- *Is unlikely that atrazine is genotoxic*
- *That atrazine is not likely to pose a carcinogenic risk to humans*
- *That atrazine was not teratogenic*

[1] http://www.mda.state.mn.us/news/publications/chemfert/scopingatrazine.pdf

- *That the existing database on atrazine is adequate to characterize the potential hazards for fetuses, infants and children.*

Recommendation 1 (p. 18): MDA review of portions of the federal atrazine label and evaluation of need for a Minnesota supplemental label.

There have been numerous and extensive surface and groundwater atrazine monitoring projects conducted in the state of Minnesota. These monitoring projects have been performed by the MDA, Minnesota Department of Health (MDH), Dakota County, and the United States Geological Survey (USGS). These projects have generally focused on the areas believed to be most vulnerable, both in terms of geology and use patterns, to the presence of atrazine. Results of these intensive monitoring programs demonstrate that there have been no reported violations of state or federal criteria for the presence of atrazine in surface water (for the protection of human health or aquatic life), rural drinking water wells, or public drinking water. The MN scoping document acknowledges that even though MPCA surface water standards for atrazine are more stringent than current EPA guidelines atrazine detections have not violated the existing MPCA water quality criteria.

Summary details from a number of atrazine water monitoring projects are discussed below, primarily as excerpts from the technical report summarizing MN atrazine surface and groundwater monitoring results from 2000 through 2006[2]. Additional data, tables and figures are included in the full technical report (see attached). These data clearly show that, even with extensive monitoring programs in the most vulnerable regions of the state, atrazine concentrations in Minnesota ground and surface waters do not exceed levels of concern and in most cases, these already low levels are in further decline. These data support the fact that the current atrazine label, and the water protection measures therein, are protective for both aquatic life and human health uses for water in the state of Minnesota.

Existing Water Quality Criteria

Table 1 summarizes the currently applicable water quality standards for surface and groundwater (including drinking water) in the state of Minnesota. The scoping document indicates, for private wells used for drinking water, the HRL is 3 ppb inclusive of atrazine plus degradates. However, a rule change that provides for the inclusion of degradates in an MCL-based HRL is still under review and subject to revision. Syngenta has submitted comments on this proposed rule to indicate that is inappropriate and inconsistent with the US EPA risk assessment, to include atrazine degradates within the same value as the maximum contaminant limit (MCL) derived for parent alone. In the atrazine reregistration eligibility decision (RED), finalized in April 2006, the USEPA published a human health drinking water level of comparison of 12.5 ppb inclusive of atrazine and its chlorodegradates for the most sensitive population subgroup[3].

By MDH definition, a health risk limit (HRL) is the concentration of a groundwater contaminant, or a mixture of contaminants, that can be safely consumed daily for a lifetime. As instructed by statute the

[2] See attached "Atrazine Occurrence in Minnesota Ground and Surface Waters, 2000-2006", Tierney, D.P., Williams, R.W., Christensen, B.R. and Dando, C.L., Technical Report 1-2008, Syngenta Crop Protection, October 2008.

[3] See http://www.epa.gov/oppsrrd1/REDs/atrazine_combined_docs.pdf

MDH has proposed to utilize the federal MCL of 3 ppb, which was established for atrazine parent only as the MN HRL.

Table 1 Atrazine Drinking Water Human Health Standards and Aquatic Life Water Quality Criteria Applicable to Waters of Minnesota, 2008

Agency	Standard	Time Frame	Concentration
Minnesota Department of Health	Human Health - Rural Well Health Risk Limit (Groundwater)	Daily	3 ppb
US Environmental Protection Agency	Human Health Public Drinking Water Maximum Contaminant Level (Finished Water)	4-Quarter Running Average	3 ppb
Minnesota Pollution Control Agency	Human Health - Class 2A, 2Bb Waters (Ambient Water)	30-day Average (Twice in 3 years)	3.4 ppb
Minnesota Pollution Control Agency	Aquatic Life (Chronic) (Ambient Surface Water)	4-day Average (Twice in 3 years)	10 ppb
Minnesota Pollution Control Agency	Aquatic Life (Acute) (Ambient Surface Water)	1-hour	323 ppb

See attached "Atrazine Occurrence in Minnesota Ground and Surface Waters, 2000-2006", Tierney, D.P., Williams, R.W., Christensen, B.R. and Dando, C.L., Technical Report 1-2008, Syngenta Crop Protection, October 2008.

MDA Regional Groundwater Monitoring Network

A state-wide network of groundwater monitoring wells was established by the MDA in 2004. The network was divided into 10 pesticide monitoring regions (PMR). Regions 1, 4, 6, 7, 8 and 10 (urban wells) were monitored from 2004 – 2006. However, region 4, synonymous with "Central Sands", was also monitored prior to 2004. These wells were not sources of public or private drinking water but are considered representative of private drinking water wells finished in glacial outwash sand aquifers. A total of fifty five wells were monitored between 2004 and 2006.

The MDA groundwater monitoring program does not include private drinking water wells, but is meant to reflect private wells finished in the same glacial outwash sand aquifer region. Private well water quality is regulated by the MDH based upon drinking water HRLs (3 ppb for atrazine).

During the seven-year (2000-2006) interval, a total of 1,146 groundwater samples from 246 wells were collected and analyzed for a number of chemicals, including atrazine.

Atrazine concentrations from the six PMRs ranged from non-detection to 0.51 ppb or about one-sixth the 3 ppb atrazine drinking water HRL. The 95th percentile annual atrazine concentrations for PMR 4 during 2000 to 2006 ranged from 0.05 to 0.22 ppb with a clear yearly downward trend over the seven years. For samples with atrazine detections, the concentration distribution for wells in all regions and years was below the MDH drinking water HRL for atrazine in groundwater.

MDA Southeast Minnesota Springs Monitoring

The geology of southeastern Minnesota is dominated by the presence of limestone bedrock (karst). Karst topography is noted for being very porous and fractured. Because of the porosity of the limestone bedrock, and often shallow topsoil layer, groundwater is this region can be vulnerable to soil applied compounds, such as agricultural chemicals.

In 1993 MDA began collecting groundwater samples at two springs in Winona County (Crystal Springs 1 and 2). These two springs were monitored until 2005. In 2003, four additional springs were added to the monitoring program with two at Lanesboro and two at Peterson. Monitoring continued at these four Fillmore County springs plus the two original springs in Winona County through 2005. In 2006, monitoring began at eleven new southeast Minnesota springs.

The spring monitoring program is representative of private wells finished in karst bedrock aquifers. The atrazine results from the 17 spring network were compared to the drinking water Health Risk Limits developed by the MDH for private wells (3 ppb for atrazine).

During the 2000 – 2006 monitoring time frame, a total of 303 samples were collected for seventeen springs. The maximum individual atrazine concentration was 0.26 ppb which is less than one-tenth of the atrazine drinking water HRL of 3 ppb. The 95th percentile annual atrazine concentrations (2000-2006) ranged from 0.09 to 0.22 ppb and show a downward trend.

MDA, MDH and MCPA Random Survey of Drinking Water Wells

The MDA, in cooperation with the MDH and MPCA, surveyed public and private drinking water wells throughout the agricultural regions of Minnesota. A state-wide geographic grid was established to select locations for monitoring. At the confluence of each grid line a private or public well was identified and sampled once.

A total of 71 wells were sampled between January and March, 2004. Four wells had detectable concentrations of atrazine while 67 wells had no detectable levels of atrazine. Atrazine concentrations in the four wells, with detections, ranged from 0.06 to 1.52 ppb.

United States Geological Survey – National Water Quality Assessment Groundwater Monitoring

The USGS assesses ground water and streams in most of Minnesota through its studies in the Upper Mississippi River Basin and in the Red River of the North Basin.

The USGS groundwater monitoring network is reflective of ambient groundwater from rural wells. However, the network does not include either public or private drinking water wells. USGS collected a total of 120 groundwater samples from 81 wells between 2000 and 2006 in Minnesota. Atrazine was detected in 39 samples. The maximum detected atrazine concentration during the course of this study was 0.224 ppb in 2002. Annual maximum detections ranged from 0.013 ppb to 0.224 ppb. The 95th percentile concentration for the seven years of monitoring was 0.069 ppb. The maximum reported atrazine concentration is less than one-tenth the Minnesota HRL for rural drinking water wells.

Groundwater Monitoring in Dakota County, Minnesota

The Dakota County Environmental Management Department initiated an Ambient Groundwater Quality Study in 1999. The purpose of the study was to annually monitor the quality of water in a network of privately owned drinking water wells throughout Dakota County. Atrazine was monitored in 138 drinking water wells between 2001 and 2006.

Between 2001 and 2006, 301 groundwater samples (from 138 wells) were analyzed for atrazine and its metabolites. Atrazine was detected in 99 samples from the 138 wells. The atrazine concentrations in these wells ranged from 0.22 ppb to 0.60 ppb. The maximum detected concentration is only about one-fifth the Minnesota atrazine HRL for rural drinking water wells

MDA Surface Water Monitoring Network

The MDA developed a surface water monitoring network in 2001 to provide detailed monitoring of pesticide occurrence within select watersheds in the state and track changes in concentrations over time. The Surface Water Monitoring Network consisted of surface waters that were not utilized as public or private water supply sources and were protected only for aquatic life by the MPCA under the Clean Water Act. The Whitewater River Middle Branch and Seven Mile Creek #3 are designated trout streams and, by state rule, are also protected as drinking water sources. The rivers and streams represented in this network are subject to the atrazine aquatic life acute (daily) standard of 323 ppb and the 4-day average standard of 10 ppb. With their trout stream designations, the Whitewater River Middle Branch and Seven Mile Creek #3 are also subject to the state human health drinking water 30-day average standard of 3.4 ppb for atrazine.

Surface Water Grab Sampling

Under the MDA grab sampling scheme, water quality is determined by the collection of at least monthly samples during the months of May, June and July (highest predicted herbicide use and potential runoff window). During the six-year period (2001-2006) 1,094 grab samples were collected. Maximum atrazine concentrations ranged from 0.07 to 13.2 ppb. The mean detected concentration was 0.46 ppb and the 95th percentile concentration was 1.44 ppb.

Over the six-year monitoring period, the maximum detected atrazine concentration in surface water grab samples of 13.20 ppb was 25 times below the daily (acute) aquatic life protection standard of 323 ppb. Two individual daily samples (13.2 and 10.0 ppb) were equal to or greater than the 4-day chronic aquatic life criteria of 10 ppb. However, the 4-day averages for these sites did not exceed the chronic aquatic life criteria (10 ppb).

Surface Water Composite Sampling

Composite (intensive storm-event based) sampling of surface water was conducted each year by the MDA during four month periods (May to August) for six years (2001 to 2006). Over this six-year period, 453 storm-event based samples were collected. Atrazine detections, equal to or greater than the MRL, were found in 359 samples with a maximum concentration of 33.2 ppb. The highest annual 95th percentile atrazine concentration was 22.00 ppb. The maximum atrazine concentration (33.2 ppb) over the six-year period was approximately one-tenth of the 1-day acute aquatic life criteria of 323 ppb.

Seventeen individual composite samples had atrazine concentrations greater than the MPCA chronic aquatic life 4-day average standard of 10 ppb. These samples were collected from two watersheds.

Sixteen samples were from the Whitewater River and one sample from Chaska Creek. All other monitored water bodies had atrazine sample concentrations equal to or less than 10 ppb and did not exceed the chronic 4-day aquatic life criteria.

Chaska Creek had a single composite sample with an atrazine concentration greater than 10 ppb in 2002. An atrazine concentration of 33.2 ppb was detected on June 20 and, averaged with the other 2 sample concentrations over a 4-day window around June 20, resulted in a 4-day mean of 18.9 ppb which exceeded the chronic aquatic life criteria of 10 ppb. Atrazine concentrations did not exceed 10 ppb any other time during the monitoring period (2001-2006). By Minnesota rule a water body is considered to be "impaired" when the aquatic life criteria is exceeded twice in a three year period. Since atrazine concentrations in Chaska Creek exceeded the atrazine chronic aquatic life criteria just once in a three year period, it was not considered "impaired" under the Clean Water Act and MPCA regulations.

Over the 2001-2006 time period, 4-day average atrazine concentrations in the Whitewater River (Middle Branch) were greater than 10 ppb in one storm event in 2004. During a six-day interval from June 13 to June 18, 4-day running average atrazine concentrations were 14.50, 20.10 and 20.46 ppb. These concentrations were higher than the 4-day aquatic life standard of 10 ppb. Sample concentrations in the remainder of the 2001-2006 were below 10 ppb. By Minnesota rule, the aquatic life criteria are exceeded when concentrations over the criteria value occur twice in a three-year period. Atrazine concentrations in the Whitewater River exceeded the atrazine chronic aquatic life criteria concentration just once in the three year period.

The MPCA atrazine 30-day average human health standard of 3.4 ppb applies to waters designated as protected for drinking water use. The Root River, Seven Mile Creek #3 and the Middle Branch of the Whitewater River were designated trout streams and therefore protected as drinking water sources by the MPCA (Water Class 2A) under the Clean Water Act. The Root River, Seven Mile Creek #3 and the Whitewater River presently are not used as a raw water source for a Community Water System.

Using state methodology, MPCA determined the 30-day human-health standard of 3.4 ppb was exceeded (5.0 ppb) for the 30 day period beginning June 15, 2004 on the middle branch of the Whitewater River. This was the only 30-day increment in seven years (2000-2006) where the atrazine 30-day average concentration exceeded 3.4 ppb. A human health criteria violation in Class 2A waters is defined as the criteria being exceeded twice in a three-year period. Atrazine concentrations in the Whitewater River did not exceed the atrazine 30-day human health criteria concentration more than once in a three year period.

<u>USGS – Surface Water Monitoring In MN</u>

Since 1991, the USGS NAWQA program has been collecting and analyzing pesticide data and information in more than 50 major river basins and aquifers across the nation. The USGS assesses streams in most of Minnesota through its studies in the Upper Mississippi River Basin and in the Red River of the North Basin. The USGS surface water monitoring network was reflective of ambient surface water. The network does not contain public or private drinking water sources.

The USGS collected 160 surface water samples in Minnesota between 2000 and 2006. The maximum atrazine concentration detected was 0.960 ppb. For the five year period, the 95th percentile concentration was 0.468 ppb. The maximum individual atrazine concentration was 336 times below the daily and 10 times below the 4-day average Minnesota aquatic life criteria.

MDH Community Water System Safe Drinking Water Act Compliance Monitoring

CWS in the United States are required by the federal SDWA to monitor for synthetic organic contaminants (including atrazine) in finished drinking water. In Minnesota, the frequency of monitoring is defined by rules of the MDH and EPA under 40 CFR 141. Surface water source CWS were initially required to monitor quarterly and after four consecutive quarters of monitoring and no detections, sample frequency could be reduced to annually. If a compound was detected, sampling frequency was increased to quarterly. The initial round of four quarterly samples was conducted by each CWS in the early to mid-1990s. Finished water samples were collected for each well for CWS on groundwater and at the entry point of the distribution system for CWS on surface water.

Groundwater Source CWS: As of December 2006 there were 965 CWS in Minnesota with 919 CWS on groundwater sources, 25 CWS on surface water sources and 21 CWS with a combination of ground and surface water. Four hundred and ninety-five (495) CWS were monitored between 2000 and 2006. All CWS drawing from surface water or combination surface and ground water were required to be monitored at least annually.

The SDWA compliance monitoring database contains data from each CWS. The analytical results were compared to the federal atrazine MCL for public drinking water. The current federal MCL for atrazine is a running annual average, based on 4 quarterly means, of 3 ppb. Annual means were calculated using one or more samples for groundwater CWS and three or more samples for surface or combination CWS.

Using SDWA compliance monitoring data from 2000-2006, 53.9% of the Minnesota CWS on ground water sampled for atrazine. Atrazine was detected in only 24 of 1,957 samples and only 8 of 495 CWS. The maximum atrazine concentration for CWS on groundwater was 1.2 ppb at Goodhue CWS (MN1250005) in 2000.

Surface Water and Combined Source Water CWS: Twenty-five Minnesota CWS rely on surface water as the raw water source. An additional 21 CWS rely upon a combination of ground water and surface water.

During the seven-year period 2000-2006, 100% of the CWS on surface and combination water sources monitored for atrazine in finished water. Atrazine was detected in 11 of 147 samples and 3 of 46 CWS on raw water from a surface water or combination source. The maximum concentration was 0.50 ppb at both Mankato (MN1070009) and Fairmont (MN1460003) in 2000. The maximum atrazine annual mean concentration was 0.50 ppb at Fairmont in 2000. This annual mean was 1/6 of the atrazine MCL of 3 ppb.

Since the inception of the SDWA compliance monitoring program in 1993, there have been no Minnesota CWS on surface water, groundwater, or combination thereof that has reported a violation of the atrazine MCL.

Setbacks for Standpipes in Terraced and Non-terraced Tile-Outletted Fields

Use labels for some atrazine containing products contain setback restrictions that differ for tile-outletted standpipes located in terraced fields versus standpipes located in fields that are not terraced. This difference is due to the fact that some product labels did not make this distinction when originally approved. The reason why setbacks should apply in terraced fields and not in non-terraced fields is due to the fact that the two systems are fundamentally different in function and the type of water that is removed

from the field[4]. Tile outlets in terraced fields drain primarily surface water whereas tile outlets in non-terraced fields drain intercept large amounts of subsurface flow and may in fact flow year round. Since tile outlets in non-terraced fields drain a substantial amount of subsurface flow, the concentration of surface applied herbicides, such as atrazine is very low. Furthermore, herbicide concentrations in surface water that enters the tile outlet are significantly diluted by the subsurface water in the system. As the Fawcett (2004) study shows, differences in atrazine concentration can be two orders of magnitude lower in non-terraced outlets versus terraced outlets. Therefore, atrazine label setbacks from standpipes in non-terraced fields are not necessary to protect surface water quality at the tile outlet.

Recommendation 3 (p. 22): MDA consideration of revisions to voluntary atrazine BMPs.

As evidenced by the ground and surface water monitoring data discussed above, current atrazine label restrictions, use practices and BMPs are effective in minimizing off-site movement. No violations of state or federal atrazine water criteria for protection of aquatic life or human health have been reported. The existing federal atrazine label contains several provisions and set-back requirements designed to protect surface water and groundwater. In many instances, concentrations of atrazine found in ground and surface waters are already on the decline.

Continued label education efforts targeted to certified applicators serve to reinforce these protective label provisions. These voluntary atrazine BMPs have been proven to be effective, therefore no Minnesota specific label changes are needed.

Recommendation 4 (p. 24): MDA and MDH evaluation of dietary exposure from Minnesota drinking water, including from private drinking water wells.

Private well groundwater and SDWA compliance monitoring data for finished water from community (public) water systems show that atrazine levels in drinking water are below the existing and conservative thresholds for human health. The scoping document indicates that MDH is also interested in evaluating exposure and potential human health effects from atrazine plus its chloro degradates and consideration for vulnerable subpopulations. Such an assessment was conducted by the USEPA during the atrazine reregistration process and published in the atrazine RED.

As part of the reregistration review of atrazine, the EPA calculated Drinking Water Levels of Comparison (DWLOCs) to capture risk associated with exposure to atrazine and its chloro degradates in drinking water. These DWLOCs account for atrazine plus its three chloro degradates (deethylatrazine, deisopropylatrazine and diaminochlorotriazine). The EPA defines the DWLOC as the maximum concentration in drinking water that, when considered together with dietary (food) exposure, does not exceed a level of concern. As shown below, the EPA calculated DWLOCs for various durations of exposure and numerous population subgroups (Table 2). The most sensitive population subgroup was identified as infants less than 1 year old with a resulting intermediate (seasonal) exposure DWLOC of 12.5 ppb. For acute (one day) exposure, the calculated DWLOC is 298 ppb for the population subgroup females aged 13 to 50.

[4] Fawcett, R.S., "Impact of Surface Intakes on Atrazine Concentrations in Outflow from Tile-Outlet Terraces and Subsurface Drainage Tile Systems", technical report, November 5, 2004.

Table 2: Summary of Lowest DWLOC Values for Atrazine and Its Chlorinated Degradates (Atrazine RED, April 2006)

Population Subgroup	DWLOC (ppb)[5]	
	Acute (One Day) Exposure	Intermediate (Seasonal) and Chronic (Annual) Exposure
General Population	Not available	68
Infants <1 year old	Not available	12.5
Children 1 to 6	Not available	23
Children 7 to 12	Not available	53
Females 13 to 50	298	60
Males 13 to 19	Not available	68
Males 20 and over	Not available	68
Seniors	Not available	68

An HRL for rural/domestic drinking water wells of 12.5 ppb (intermediate/chronic) and 298 ppb (acute) for atrazine and its chloro degradates would be protective of human health for the most vulnerable population subgroups. This value is conservative, incorporating a 1000-fold safety factor. Monitoring data show that the levels found in Minnesota's ground water are well below this value. We support the most current EPA risk assessment that reports a drinking water level of comparison of 12.5 ppb for atrazine plus its three chlorinated degradates as protective of human health for chronic drinking water consumption for all population subgroups.

Recommendation 5 (p. 26): MDH evaluation of occupational exposure risks that may occur in Minnesota.

EPA (2006 RED) concluded that all risks associated with occupational exposure due to atrazine uses on the current label are acceptable for atrazine.

Recommendation 6 (p. 28): MPCA evaluation of state surface water standards relative to new information on toxicity to aquatic plant and animal communities.

CASM_Atrazine

The "Comprehensive Aquatic Systems Model for Atrazine" (CASM_Atrazine) ecosystem model simulates complex ecological production dynamics of a generic 2nd-to-3rd-order Midwestern stream with or without atrazine exposure. CASM_Atrazine predicts daily biomass (carbon) production of modeled populations of aquatic plants and animals as complex, nonlinear functions of fluctuating environmental conditions (e.g., light, temperature, nutrients), time-varying ecological conditions (e.g., competition within trophic guilds, grazing, predator-prey interactions), and producer- and consumer-specific sensitivities to atrazine exposure. Using atrazine monitoring data from the Atrazine Ecological

[5] The screening level DWLOC of 12.5 ppb is based on an endpoint of 1.8 mg/kg/day and a 1000-fold uncertainty factor. The 1000-fold uncertainty factor includes a 10-fold factor for interspecies variation, a 10-fold factor for intraspecies variability, and a 10-fold FQPA safety factor. (EPA-OPP, Atrazine: Addendum to Revised Human Health Risk Assessment for the Reregistration Eligibility Decision (RED) dated April 16, 2002. PC Code: 080803. DP Barcode: D287740, January 31, 2003).

Monitoring Program conducted in Midwestern streams, the primary objective of this model is to predict the potential for realistic time-varying atrazine concentrations to influence total biomass production of primary producer and consumer populations.

Within Figure 1 of the MDA's Scoping document, the MDA states that the "Chronic Aquatic Life Value" is "10 to 20 ppb over approx. 2 weeks to 3 months [pg. 8]." The EPA Office of Water draft document for ambient aquatic life water quality criteria for atrazine[6] concludes that "[t]he procedures described in the Guidelines indicate that, except possibly where a locally important species is very sensitive, freshwater aquatic life and their uses should not be directly affected unacceptably if the Average Primary Producer Steinhaus Similarity deviation for a site is less than 5% (as determined using Comprehensive Aquatic Systems Model (CASM) or other appropriate model and index) and is not exceeded more than once every three years (or other appropriate return frequency sufficient to allow system recovery) [pg. 58]" and that "[t]he 5% index for the protection of aquatic plant community should also be protective of most freshwater animals [pg. 58]." Numeric triggers and durations are expected to be finalized in 2009 following EPA's final review of CASM_Atrazine.

CASM_Atrazine was first reviewed by a FIFRA Scientific Advisory Panel (SAP) in December 2007, and minutes from the December SAP meeting were published on March 5, 2008[7]. While the SAP provided recommendations for improving the parameterization and validation of CASM_Atrazine, the SAP strongly supported the selection of CASM, the incorporation of food web analysis and bioenergetics modeling within atrazine risk assessments, as well as the approach used by EPA for selection of the LOC (correlation of model output to effect scores for the micro/mesocosm studies). Therefore, based on this intensive independent peer-review, the Panel concluded that CASM_Atrazine is a useful ecological model for processing atrazine-specific exposure time series and relating those exposure data to effects observed within micro/mesocosm studies.

To address the 2007 Panel's comments regarding model parameterization and validation, CASM_Atrazine is being reviewed and will be the subject of an EPA SAP in 2009. CASM_Atrazine is then expected to be released in late summer or early fall of 2009.

Developmental Effects of Atrazine on Amphibians (p. 27)

Syngenta disagrees with the statement "The properties of atrazine as an endocrine disruptor have been documented from a wide array of terrestrial and aquatic animals." The weight of evidence does not support the document's statement.

The USEPA has completed a comprehensive review of the question of the potential for atrazine to effect development of amphibians as have two Scientific Advisory Panels (SAP) in 2003 and 2007. The 2003 SAP recommended that a laboratory study be conducted using *Xenopus laevis* as the surrogate species using flow-through exposure systems, under standardized procedures for husbandry and meeting

[6] U.S. EPA. (2003). Ambient Aquatic Life Water Quality Criteria for Atrazine – Revised Draft. Office of Water, U.S. Environmental Protection Agency, Washington, D.C. EPA-822-R-03-023. 178 pp.

[7] http://www.epa.gov/oscpmont/sap/meetings/2007/120407_mtg.htm#materials

American Society for Testing and Materials (ASTM) water quality criterion. The SAP also recommended that 1) atrazine dosing concentrations should span previously reported effect concentrations, 2) differences in gonadal terminology be resolved and 3) a positive control be employed to validate the system and sensitivity of the species tested (FIFRA SAP 2003). (http://www.epa.gov/scipoly/sap/meetings/2003/061703_mtg.htm)

Syngenta has conducted the required studies as directed by the EPA and the 2003 SAP to investigate the possible effects of atrazine on amphibian development. The Data-Call-In (DCI) studies were unprecedented with respect to:

- range of doses
- number of replicates and individual frogs
- chemical analysis
- biometrics included in the studies
- exhaustive histological evaluation
- compliance with Good Laboratory Practices
- governmental inspection and oversight
- repeatability between two laboratories
- data transparency and external review by EPA and SAP scientists

The 2007 SAP acknowledged "the DCI studies as being well designed and executed" (p 6 of FIFRA SAP 2007), and that the SAP "was not aware of any studies that would call into question the design of the DCI study" (p 22). The 2007 SAP agreed "that the open literature studies suffer from various deficiencies due to design limitations, poor study conduct and lack of access to raw data for confirmation of results and conclusions" (p 6). The 2007 SAP also stated that "study endpoints that are more likely to impact reproductive fitness (sex ratio, intersex condition) were unaffected in animals exposed in 100 µg/L atrazine" (p 19) and "there is currently no available proof for the hypothesis regarding the purported action of atrazine on the induction of aromatase" (p 19) . The SAP "concluded that the DCI study is sufficient to test and refute the hypothesis that atrazine by itself can adversely affect *X. laevis* gonadal development under the conditions tested" (p 26), (FIFRA SAP 2007). http://www.epa.gov/scipoly/sap/meetings/2007/100907_mtg.htm

Subsequent to the 2007 SAP, key amphibian publications warrant inclusion in the MN Review. These are:

LaFiandra, Emily May, Babbitt, Kimberly J. and Sower, Stacia A.(2008) 'Effects of Atrazine on Anuran Development are Altered by the Presence of a Nonlethal Predator', *Journal of Toxicology and Environmental Health*, Part A, 71:8, 505 – 511. DOI: 10.1080/15287390801907442

Oka, T., Tooi, O., Mitsui, N., Miyahara, M., Ohnishi, Y., Takase, M., Kashiwagi, A., Santo, N., Iguchi, T. (2007) Effect of atrazine on metamorphosis and sexual differentiation in *Xenopus laevis*, *Aquatic Toxicology*,doi:10.1016/j.aquatox.2008.02.009

Storrs, S.I., Semlitsch, R.D. (2008) Variation in somatic and ovarian development: Predicting susceptibility of amphibians to estrogenic contaminants. *Gen. Comp. Endocrinol*. doi:10.1016/j.ygcen.2008.03.001

Solomon K., Carr, J., du Preez, L., Giesy, J., Kendall, R., Smith, E., Van Der Kraak, G. (2008) Effects of atrazine on fish, amphibians and aquatic reptiles: A critical review. *Critical Reviews in Toxicology.* (Accepted)

Text References

FIFRA SAP (2003) Report No 2003-01. FIFRA Scientific Advisory Panel Meeting, June 17-20, 2003 Arlington VA. A Set of Scientific Issues Being Considered by the Environmental Protection Agency Regarding: Potential Developmental Effects of Atrazine on Amphibians.

FIFRA SAP (2007) Report No 2007-08. FIFRA Scientific Advisory Panel Meeting, October 9-11, 2007 Arlington VA. A Set of Scientific Issues Being Considered by the Environmental Protection Agency Regarding: The Potential for Atrazine to Affect Amphibian Gonadal Development.

Recommendation Number 7 (p 25.) MDA evaluation of the potential costs of mitigation measures needed to protect human health and the environment from the impacts of atrazine use.

The MDH has stated that it intends to review the cancer and noncancer effects of atrazine and its degradates/metabolites (page 25). This would represent "redundant of analyses and decisions reached by the US EPA", as well as the World Health Organization and the JMPR and would be extremely resource intensive.

Syngenta has previously commented on the current 1994 HRL Rule (attached). The Minnesota scoping document is correct in concluding that "food-related exposures and risks appear to be negligible." We reiterate that Minnesota should revisit whether it is appropriate to continue using the default Relative Source Contribution of 20% for atrazine.

Epidemiology

The Scoping Document includes few studies and has not proposed a weight of evidence approach for assessing epidemiological evidence.

Reviewers of the epidemiological evidence at EPA (Blondell et al., 2003), IARC (1999) and independent experts (Delzell et al., 2004 and Mandel, 2004) have all failed to find any valid evidence of a causal association between atrazine exposure and human cancer.

This conclusion is reinforced by the 2004 publication on cancer incidence data for atrazine applicators in the Agricultural Health Study (Rusiecki, et al., 2004). The Agricultural Health Study is a government sponsored study being conducted by the National Institute of Health, the National Cancer Institute, the National Institute of Environmental Health Science and the Environmental Protection Agency. The authors of this most recent study state that "We found no association between cancer incidence and

atrazine exposure, whether atrazine was analyzed as a cumulative measure (lifetime days of exposure) or as an intensity-weighted cumulative measure(intensity-weighted lifetime days of exposure)."

Alavanja et al., (2003) under the Agricultural Health Study examined a cohort of 55,332 male pesticide applicators from Iowa and North Carolina and found no evidence of an increased risk of prostate cancer among pesticide applicators that reported exposure to atrazine in this study.

Rusiecki et al., (2004) also reported Under the Agricultural Health Study that relative risk ratios for prostate cancer ranged from 0.75 to 0.88 and 0.86 to 1.03, respectively, for lifetime days of atrazine exposure or intensity-weighted days atrazine exposure. These new data confirm the previous publication (Alavanja et al., 2003) that found no association between prostate cancer incidence and atrazine exposure.

USEPA (Blondell, 2004) recently reviewed the nested case-control study (published by Hessel et al., 2004), of prostate cancer in the Syngenta atrazine production facility located in St. Gabriel, LA. He concluded that the results "did not support a finding of association between prostate cancer and atrazine exposure" … nor was atrazine "a likely cause of prostate cancer".

Additionally, under the Agricultural Health Study, Engel, et al., conducted research on a large number of pesticides to assess the potential for any association of exposure to these chemicals with breast cancer. There was no association of exposure to atrazine with breast cancer.

In the citation of Swan et al., (2003) the Minnesota scoping document is correct in pointing out limitations of epidemiological studies on atrazine. The major limitation of the Swan et al., 2003 study are as follows:

1) The number of men in each cohort was limited to 50 men (25 cases, 25 controls) evaluated in Missouri and 36 men (9 cases, 25 controls) in Minnesota. The small numbers of men in each subgroup allow for variables, other than the presence of pesticide in urine to potentially confound the interpretation. For example, in the Missouri cohort, there are six non-white men in the controls and none in the cases, a difference that is highly statistically significant. There also tended to be more smokers among the controls than among the cases and the mean abstinence time tended to be less for cases than for the controls. There were also age differences between the men recruited in Minnesota cohort compared to those recruited in Missouri.

2) The procedure of assigning men to cases (low sperm quality) and controls (higher sperm quality) after the data has been collected rather than assigning men to those categories based upon pesticide exposure metrics taken prior to data analysis is a hypothesis generating, rather than a hypothesis testing strategy. The ability to reach conclusions about causation using this type of ad hoc approach is limited.

3) Even among the pesticides evaluated in this study, there was co-variation such that differences between cases and controls existed for several of the chemicals found in urine in these men. Thus it is not possible to make any causal inference about a single chemical given that the presence of the covariate, - exposure to other chemicals, was not controlled in this study.

4) The question of biological plausibility has to be considered. The authors report that the mercapturate of atrazine, a toxicologically inert metabolite was near the limit of detection in a highly sensitive assay

(0.1 ug metabolite/g creatinine). It is not possible to accurately reconstruct the magnitude of actual exposure to atrazine from the data reported by Swan et al. 2003a, because details of the volume of urine collected, time of day of sample collection (1st void, 24 hour void etc.), month of the year and residence and occupation of the subjects (i.e. urban dwelling vs. agricultural worker) was not provided.

Assuming normal values for these men (Body weight = 70kg, age = 30 years, 24 hour urine volume = 1.5 liter, serum creatinine concentration = 1.05 mg/dl, urinary creatinine concentration = 98.18 mg/dl), it was estimated that average urinary concentration of the atrazine mercapturate metabolite ranged from 0.07 to 0.17 µg atrazine mercapturate/L urine (ppb); the limit of detection of the assay was approximately 0.1 ppb. These estimates may be slightly in error because, the Center for Disease Control and Prevention (CDC) which apparently analyzed the samples for Swan et al., 2003b, reported average detection limits of 0.047 ppb in the Second National Report on Exposure to Environmental Chemicals. It should be noted in the CDC study that there were no detects of atrazine mercapturate in any of the 1878 samples analyzed. However, Swan et al., 2003 report that 18% (9) out of the 50 men sampled in Missouri, had atrazine mercapturate in their urine at levels above the detection limit while only 6% (2 out of 36 men) had values above the LOD in Minnesota.

In addition to the EPA classification of atrazine as not likely to be a human carcinogen the World Health Organizaton (WHO) completed a toxicology review in 2007 and determined that atrazine is not likely to pose a carcinogenic risk to humans. Other regulatory authorities around the world have come to the similar favorable conclusions as outlines in the table below:

	EU-UK (2000)	**Australia (2004)**	**IARC (1999)**	**USEPA (2000, 2003, 2006)**
Genotoxicity	Not Genotoxic	Not Genotoxic	Not Genotoxic	Not Genotoxic
Animal Evidence	Mammary – Female SD Rat	Mammary – Female SD Rat	Mammary – Female SD Rat	Mammary - Female SD Rat
Mode of Action (MOA)	Adequately Explained MOA confined to Female SD Rate	MOA Unique to Female SD Rat	MOA Unique to Female SD Rat	MOA Unique to Female SD Rat
Relevance	Not Relevant to Humans	Not Relevant to Humans	Not Relevant to Humans	Not Relevant to Humans
Epidemiology	Not Evaluated	Data Support the Absence of Any Carcinogenic Potential	Inadequate Evidence in Humans for Carcinogenicity	Human Cancer Risk Not Likely
Classification	Carcinogen classification not appropriate	Absence of Any Carcinogenic Potential	Not classifiable Group 3	Not Likely to be Carcinogenic in Humans

Recommendation 8 (p. 31) MDA evaluation of the benefits of atrazine as a tool for mitigating weed resistance in corn fields.

For nearly 50 years, atrazine has been the industry standard for broadleaf weed control in corn because it has a flexible use pattern, is inexpensive and is highly effective (http://www.epa.gov/pesticides/reregistration/atrazine/). Atrazine is critically important to Minnesota farmers. They value it for its effectiveness against some of the toughest weeds in corn -- like lambsquarters, morningglory, nightshade, pigweed, cocklebur, velvetleaf and foxtails -- that make it the most popular herbicide in pre-mix combination products. It is a valuable tool for fighting weed resistance to herbicides with a different mode of action. Atrazine is especially useful on herbicide-tolerant corn hybrids, where it controls herbicide-resistant biotypes and helps to prevent future increases in herbicide-resistant biotypes.

Recommendation 9 (p.31) MDA evaluation of the role of atrazine in lowering overall herbicide use due to synergies with herbicides that have different mechanisms of action.

Although the actual pounds of Atrazine applied to corn across the USA over the last ten years has been relatively constant, there has been a sustained downward trend in US surface water Atrazine residues across the last 12 – 15 years. Syngenta believes this is most probably the result of several generally complementary factors, including:

1. the ongoing successful efforts of US farmers, USDA, and the agricultural industry to improve environmental stewardship with Best Management Practices to reduce off-target transport of agricultural inputs,
2. the introduction of new herbicide mixtures that allow for lower atrazine rates on a per acre basis,
3. increased no-till or reduced till corn acres,
4. lower label use rates and label mitigation requirements.

The relative contribution of these factors is believed to have been changing since the early 1990's. In the period between 1994 and 1998, the key factor was the voluntary introduction and gradual adoption of a series of atrazine label rate reductions and mitigation requirements. Subsequently, continuously improving environmental stewardship, no-till and conservation tillage farming practices and the introduction of low-rate atrazine mixtures have continued to cause further reductions in atrazine concentrations found in US surface waters.

Syngenta made significant reductions in atrazine use via voluntary label changes during the 1990's (Table 3), but the US Environmental Protection Agency (USEPA) did not mandate that these changes should be included on the labels of all Atrazine registrants until 2003.

Table 3. Mitigation measures that have been implemented for all Syngenta Atrazine formulations.

No.	Yr.	CROP	BEFORE	MITIGATION	CHANGE
1	1990	Corn	4 lb ai/A	Change to 3 lb ai/A	Rate reduction of 1 lb ai/A

2	1990	Sorghum	4 lb ai/A	Change to 3 lb ai/A	Rate reduction of 1 lb ai/A
3	1990	Non-Crop (Industrial Weed Control)	40 lb ai/A	Change to 10 lb ai/A	Rate reduction of 30 lb ai/A
4	1990	Rangeland	max 2 lb ai/A	Deleted use	Rate reduction of 2 lb ai/A
5	1990	Proso Millet	max 2 lb ai/A	Deleted use	Rate reduction of 2 lb ai/A
6	1990	Pineapple	max 30 lb ai/cycle	Deleted use	Rate reduction of 30 lb ai/cycle
7	1990	All	Chemigation	Deleted use	Reduced potential environmental exposure
8	1990	All	No buffers	50-foot buffer for wellhead protection	No storage, mixing, loading,or use within buffer
9	1990	All	No recommendation	Recommendation to floor/dike bulk storage	Reduced potential environmental exposure
10	1990	All	General Use	Restricted Use - all atrazine-products	Reduced potential groundwater exposure
11	1992	Corn	3 lb ai/A - pre+post	Change to 2.5 lb ai/A	Rate reduction of 0.5 lb ai/A
12	1992	Sorghum	3 lb ai/A - pre+post	Change to 2.5 lb ai/A	Rate reduction of 0.5 lb ai/A
13	1992	Corn	3 lb ai/A - pre only	Change to 1.6-2 lb ai/A	Rate reduction of 1-1.4 lb ai/A
14	1992	Sorghum	3 lb ai/A - pre only	Change to 1.6-2 lb ai/A	Rate reduction of 1-1.4 lb ai/A
15	1992	Corn	3 lb ai/A - post only	Change to 2 lb ai/A	Rate reduction of 1 lb ai/A
16	1992	Sorghum	3 lb ai/A - post only	Change to 2 lb ai/A	Rate reduction of 1 lb ai/A
17	1992	Non-Crop (Industrial Weed Control)	10 lb ai/A	Deleted use	Rate reduction of 10 lb ai/A
18	1992	All	Restricted Use	Expanded criteria to include surface water	Reduced potential surface water exposure

18a	1992	All	Buffers for wellheads only	included abandoned wells, drainage wells, and sink holes	Reduced potential ground water exposure
19	1992	All	Buffers for wellheads only	Addition of 50 ft mix/load buffers for surface water	Reduced exposure to streams, rivers, lakes, reservoirs
20	1992	All	Buffers for wellheads only	Addition of 66 ft application buffers	Reduced exposure to streams, rivers
21	1992	All	Buffers for wellheads only	Addition of 200 ft application buffers	Reduced exposure to lakes, reservoirs
22	1992	All	Buffers for wellheads only	Seeded 66 ft buffer on highly erodible land	Reduced exposure to streams, rivers
23	1992	All	Buffers for wellheads only	More restrictive setbacks, etc.	Required stricter measures where state or local need
24	1996	All	No Terrace Recommendations	Optional 66 ft application buffers for standpipes	Reduced runoff in tile-outletted terraced fields
25	1996	All	No Terrace Recommendations	Immediate incorporation to 2-3 inches	Reduced runoff in tile-outletted terraced fields
26	1996	All	No Terrace Recommendations	No-till only where high crop residue management	Reduced runoff in tile-outletted terraced fields

Atrazine is a premix partner with over 50 other herbicides to provide improved weed control in corn. Mixtures with other herbicides has allowed for use of reduced rates of atrazine. Table 4 shows that the percentage of total corn acres treated with Atrazine in 1998 and 2005 was very similar but the average rate per acre in 2005 was systematically lower across all tillage systems than in 1998. This probably reflects the increasing use of mixtures with substantially lower rates of atrazine in recent years, especially on highly productive corn land. The atrazine rate applied to no-till acres is higher than that applied to conservation and conventional acres.

Table 4: Comparison of Atrazine applied rate per acre for different Tillage systems in 1998 and 2005 (Doanes Survey).

		1998 Data	2005 Data	
Corn treated (%)	All uses	69.10	65.81	%
Atrazine/treated acre	All uses	1.24	1.19	lbs ai/acre
Atrazine/treated acre	Conventional	1.20	1.15	lbs ai/acre
Atrazine/treated acre	Conservation	1.22	1.16	lbs ai/acre
Atrazine/treated acre	No-Till	1.32	1.27	lbs ai/acre

Recommendation 10 (p.31) MDA evaluation of the range of yield benefits and losses associated with the use of atrazine.

Based on two decades of publications in the north central weed science society proceedings, results from 59 Minnesota field trials conducted by university researchers show an average 5.45 bushel advantage for treatments containing atrazine in corn. (R. Fawcett, Two Decades of Atrazine Yield Benefits Research, Submission to the Special Review Division, U.S. EPA)

Numerous studies comparing the crop yields for fields treated by atrazine versus alternative treatments show that atrazine-treated fields produce consistently higher yields–from 4.3 bushels an acre to as much as 10.8 bushels per acre. Field trials show sorghum yields are also improved–by an average 11.3 bushels per acre.

Behnken et al., (2007) evaluated the impacts of BMP rates of atrazine on weed control and yield in corn. The report concluded that there was little difference in weed control for both of the pre emerge programs. However, for post emerge programs the study found a significant difference in both weed control and yield per acre. The report concludes that on average the addition of .5 lbs of atrazine to the studied pre emerge weed control programs increase yield on average by 30.3 bushels per acre (Behnken, Lisa M., Fritz R. Breitenbach, Ryan P. Miller, Jeffrey L. Gunsolus, Krista Sheehan and Matthew White, Evaluation of the impact of BMP rates of atrazine tank mixed with several broadleaf herbicides in field corn at Rochester, MN, in 2007).

Further, unlike many other herbicides, atrazine can be applied prior to, during or after planting the crop, or after crop emergence. This application flexibility makes atrazine very popular for use in conservation tillage or no-till systems—farming methods that eliminate plowing and/or reduce tillage. Atrazine is the most widely-used conservation tillage herbicide in corn and is a critical rotation product to manage weed resistance.

Conservation tillage makes cropland much less vulnerable to soil erosion, which is reduced by as much as 90 percent when compared to intensive tillage. And when erosion is prevented, so is the runoff of sediment to nearby waterways, helping to protect aquatic ecosystems and the quality of drinking water. EPA ranks sediment in runoff as the number one pollutant in our nation's waterways.

Conservation tillage also cuts the amount of fuel used by farmers, reducing their production costs, lowering exhaust emissions and decreasing consumption of non-renewable fossil fuels ("Benefits of Triazine Herbicides in Reducing Erosion and Fuel Use in U.S. Corn Production," Richard S.Fawcett, Ph.D., Proceedings of the North Central Weed Science Society, 2006.).

Farmers currently use conservation tillage or no-tillage on almost 44 million acres of corn in the United States. Atrazine is the preferred herbicide in these systems, and its loss would have a significant adverse effect on these soil conservation practices.

MDA cites an article on the economics of atrazine by Frank Ackerman (2007). Syngenta would like to make MDA aware of numerous documented flaws and inconsistencies in this study and to emphasize that the study by Don Coursey (2007) is a thorough assessment and validation of the benefits of atrazine use. The Coursey report shows a 5 to 11% increase in yield, demonstrated through the use of economic variables such as choices corn growers will face, anticipated yield losses, additional direct costs to growers, new indirect costs for growers, and the environmental impacts states will suffer. Additionally, the Fawcett (2005) analysis of university weed control studies for the period 1996-2005 shows a corn yield advantage for treatments including atrazine of 5.4 bushels per acre compared to non-atrazine treatments. This yield benefit is similar to a yield benefit of 6.3 bushels per acre calculated for the previous ten years of study. Ackerman (2007) relies on incorrect assumptions to draw erroneous conclusions about yield. He does not account for the fact that even though atrazine is not used in Italy or Germany, growers in those countries rely on a similar triazine herbicide, terbuthylazine. Additionally while mesotrione (Callisto) controls broadleaf weeds, using it with atrazine (in products such as Lumax) allows farmers to achieve broader spectrum weed control including better control of grassy species. Ackerman (2007) also uses an outdated model (Comprehensive Environmental Economic Policy Evaluation System or CEEPES) which predicts inaccurate results using inadequate data.

Recommendation 11 (p.33) MDA review of the advantages and disadvantages of atrazine alternatives available to corn growers in Minnesota.

In comparisons with competitive products, atrazine is consistently proven to be more reliable, effective against a broader spectrum of weeds than any other available approach to weed management and is cost effective. Competitor's products are typically less effective and often require either higher volumes and/or multiple applications. According to EPA, farmers who use atrazine save as much as $28 per acre in herbicide costs and increased yields (http://www.epa.gov/pesticides/reregistration/atrazine/).

Atrazine competitive products used in 2007 in MN Corn and Sorghum:

Active Ingredient	%Base in MN
Atrazine	34.9
2,4-D	0.3

Bromoxynil	1.0
Carfentrazone	0.1
Clopyralid	2.0
Dicamba	9.0
Flumetsulam	2.2
Flumiclorac	0.0
Flumioxazin	0.0
Fluroxypyr	0.0
Foramsulfuron	0.2
Glyphosate	69.5
Halosulfuron	0.0
Imazapyr	0.1
Imazethapyr	0.1
Iodosulfuron	0.0
Isoxaflutole	0.0
Mesotrione	16.1
Metribuzin	0.0
Pendimethalin	0.4
Primisulfuron	1.0
Prosulfuron	0.0
Rimsulfuron	5.6
Simazine	0.0
Thifensulfuron	0.6
Topramezone	1.6