# RTC Attachment 2. Results of additional MAGtool runs for atrazine BE

In this attachment, results are presented for additional MAGtool runs conducted with the updated version of the MAGtool (version 2.3.1) and include exploration of predicted impacts under different input parameters. These changes include incorporation of spray drift parameters based on a spray drift study (MRID 50683101) that was given additional review between the draft and final BE and classified as acceptable. Other parameters investigated were the impact of considering other endpoints for certain taxa, different assumption for prey, pollination, habitat, and dispersal vectors (PPHD) relationships for a species, and the influence of utilizing different usage scenarios on output.

The species selected for this analysis were those considered most likely to rise to the level of potential jeopardy in consultation. This was based on consideration of factors such as the number of individuals impacted (converted to the predicted magnitude of the population impacted) from the draft BE output, species with impacts based more on direct effects to the species versus low impacts based only on PPHD, and vulnerability of the species. These analyses were run deterministically in order to allow for faster processing, except for the noted examples that were run probabilistically. Only impacts to the species were considered; critical habitat runs were not conducted, but these types of analyses could be similarly applied to critical habitat.

The MAGtool and detailed output files for the runs discussed below are included in **Attachment 3**.

## Plants analysis

Of the 466 plant species identified as LAA in the draft BE, 321 were identified as potentially rising to a concern for jeopardy. Ninety of these species were selected for further analyses with the MAGtool.

*Run 1*: This analysis was done to investigate the impact of some of the basic updates made from the draft BE analysis. This included error correction in the MAGtool as well as the update of the Action Area, excluding the conservation reserve program (CRP) or Right of Way use data layers (UDLs).

*Run 2:* This analysis was done to investigate the impact of including spray drift parameters developed from the submitted atrazine spray drift study.

*Results of analyses:* The results of Run 1 did not change any of the LAA determinations from those in the draft BE. With the inclusion of new spray drift parameters in Run 2, drift impacts were significantly reduced, down to 0% contribution to impacts for many species. However, none of the species analyzed in Run 2 had a change in the effects determinations. Across all species analyzed, there was an average 86% reduction (range of 28 – 99%) in number of individuals impacted (based both on direct effects and effects to PPHD. Additional characterization of the likelihood of plant species to be on the use sites where impacts are still predicted, particularly for the Open Space Developed UDL layer, could reduce expected impacts further.

## Birds, Reptiles and Terrestrial-phase amphibian analyses

Of the 97 birds, reptiles and terrestrial-phase amphibian species identified as LAA in the draft BE, 63 were identified as potentially rising to a concern for jeopardy and were considered for additional analyses.

*Run 1*: This reanalysis was not conducted for this group as the impact of the new MAGtool and Action Area changes was already demonstrated with plant analysis.

*Run 2:* This analysis was done to investigate the impact of including spray drift parameters developed from the submitted atrazine spray drift study.

*Run 3:* This analysis was done to summarize the impact of assuming the average uniform distribution instead of maximum upper for usage data assumptions.

*Run 4:* In addition to parameters from Run 3, this analysis assessed the impact of using a toxicity endpoint of 225 mg a.i./kg-diet (21 mg a.i./kg-bw) for sublethal effects to birds, reptiles and terrestrial-phase amphibian, in place of the 75 mg a.i./kg-diet (7 mg a.i./kg-bw) endpoint. As discussed in **Attachment 1**, the magnitude of effect on hatchling weight was greater at 225 mg a.i./kg-diet and there were additional reproductive parameters impacted at this level.

*Results of analyses:* Similar to the results for the plant analyses, with the inclusion of new spray drift parameters in Run 2, drift impacts were significantly reduced, down to 0% contribution to impacts for many species. It was notable that for the individual outputs there were large differences between the predicted impacts under the maximum upper usage data assumptions versus the average uniform assumptions. The results of Run 3 demonstrated a large impact on the number of individuals impacted for each species where the average uniform overlap was used in place of the maximum upper. Across all species analyzed, there was an average 74% reduction (range of 24 % – 100%) in the number of individuals impacted (based both on direct effects and effects to PPHD), with some species having less than one individual impacted (this results in automated NLAA calls in these output sheets). For Run 4 where different toxicity endpoints were considered, a subset of nine species were analyzed, representing those that still had greater than 5% of the population predicted to be impacted after applying the assumptions of Runs 2 and 3. Results of this analysis did not change the number of individuals impacted based on the dose-based endpoints, but did reduce the number of individuals impacted for some species when based on dietary endpoints.

## Fish and Aquatic-phase amphibian analyses

Of the 207 fish and aquatic-phase amphibian species identified as LAA in the draft BE, 122 were identified as potentially rising to a concern for jeopardy and were considered for additional analyses.

*Run 1*: Similar to plants, this analysis was done to investigate the impact of some of the basic updates made from the draft BE analysis. This included updates in the MAGtool as well as the update of the Action Area to not include the CRP or Right of Way UDL layers.

*Run 2:* This analysis was done to investigate the impact of including spray drift parameters developed from the submitted atrazine spray drift study. This analysis only included drift only EECs and not the incorporation of these spray drift parameters into the PWC runs, which could result in lower EECs.

*Run 3*: This analysis was done to consider other toxicity endpoints for aquatic species, as discussed below.

Aquatic vertebrate (Aquatic amphibians, FW fish and E/M fish) sublethal endpoint - Both of the studies used for setting endpoints in the draft BE used the MATC (~30 µg/L) in the Step 2 analysis. In these studies, effects were actually observed at concentrations of 100 µg/L. In addition, studies on both amphibians and fish have been conducted where no effects have been observed at concentrations up to 100 µg/L. Therefore, in these runs, the direct endpoint was increased to 100 µg/L for sublethal effects to aquatic vertebrate species.

E/M fish mortality endpoint – The endpoint was changed to 13,000 µg/L. The original endpoint (2,100 µg/L) utilized in draft BE is lower than most other endpoints in the literature and there was some uncertainty around this endpoint based on the study. This lower endpoint for E/M fish was likely driving mortality impacts triggered for fish located in both FW and E/M environments.

E/M invertebrate mortality endpoint – The endpoint was changed to 5,400 µg/L based on a study in mysid shrimp. Some uncertainty exists around the original endpoint of 48 µg/L and this endpoint was suggested as the best available endpoint in public comments. However, all species that rely on E/M invertebrates also rely on F/W invertebrates, which has an LC50 of 720 µg/L. This FW endpoint would then represent the most sensitive endpoint for mortality impacts to aquatic invertebrates across both FW and E/M environments.

E/M invertebrate sublethal endpoint – The endpoint was changed to be equivalent to FW endpoint (MATC = 92 µg/L). Uncertainty exists around the original endpoint and may skew indirect impacts due to the low E/M endpoint used in analysis, which may drive the PPHD impacts for species in the FW and E/M environments.

*Run 4:* This set of analyses was used to assess the impact of habitat as the driver for PPHD. As plant endpoints are the most sensitive for atrazine in the aquatic environment, they will often drive impacts predicted to PPHD based on the assumption that all species rely on plants in the environment. This analysis allowed the differentiation of excluding plants if they were only part of the habitat in PPHD and the species did not rely on plants for prey, pollination or dispersal. This was done through an option in the MAGtool.

*Results of analyses:*

Similar to plants, the modifications made for Run 1 still resulted in LAA determinations to the species that were analyzed with the corrections to the MAGtool and changes to the Action Area. With the inclusion of new spray drift parameters in Run 2, impacts from drift-only EECs were significantly reduced, down to 0% contribution to impacts for many species. In Runs 3 and 4, the changes to endpoints and exclusion of plant habitat reduced the number of individuals impacted, but was most evident when considering both the minimum and maximum predictions for each species in the deterministic analysis.

Based on these results, it was apparent that the probabilistic analysis could further refine the aquatic analysis, as the magnitude of individuals impacted ranged greatly between the minimum and maximum predictions, which is highly dependent on the EECs. As a proof of concept, four fish species were analyzed using the probabilistic option in the MAGtool under the assumptions applied in Step 4 (a limited number of species was analyzed due to the time required for each run.) Across the four species analyzed, there was a 71-96% reduction in number of individuals impacted (based both on direct effects and effects to PPHD) for three of the species. For one species that relied on aquatic plants as a dietary item, a 37% reduction in predicted impacts to PPHD was observed.

## Further considerations for additional analyses

Although not all taxa were analyzed herein, other taxa could benefit from similar refined analyses. For aquatic invertebrate species, additional toxicity data available in the literature could allow for refinement of species analyses using toxicity data for the same order or family of the listed species. For mammals, further analysis could involve considering other endpoints associated with greater magnitude of effects or different types of effects (*e.g.,* reproductive effects). For all species, as was shown in the Run 3 with birds, reptiles and terrestrial-phase amphibians, consideration of the average uniform usage assumptions provides further valuable characterization. In addition, other qualitative factors regarding species life history may have an impact on the analysis, particularly as the more focused analyses highlight areas of greatest concern for the species.

As discussed in the body of the RTC document, there are additional data refinements based on public comments that may be incorporated into the analysis, including consideration of typical rate data for some crops and the impact to EECs, refinement of non-agricultural uses, further consideration of monitoring data, application of additional usage data, or updated species range data. These represent additional data refinements that may be useful when considering the likelihood of impacts rising to the level of jeopardy for a species or adverse modification of critical habitat, and extent of necessary mitigation.