Actual stuff from the BHHRA (sect 5.2.5 & meths section) (modified) below

DETAILED HUMAN HEALTH RISK ASSESSMENT

Northern Impoundments

The health risk assessment was prepared by Integral Consulting Inc. and Anchor QEA, LLC. (2013). Human health risks in the area of investigation north of I-10 (northern impoundments) were characterized for three hypothetical receptor groups: recreational fishers, subsistence fishers, and recreational visitors. Exposure scenarios are presented in Table 5-1 from the BHHRA, and exposure parameters are presented in Tables 5-6 and 5-7 from the BHHRA). The exposure media evaluated were sediments in four individual beach areas, soils throughout the entire area of the northern impoundments and edible fish and shellfish (see Conceptual site model, Figure 1-1 from BHHRA). For each receptor group, the potential for long-term exposure to $COPC_{H}$s was evaluated under baseline conditions (i.e., immediately prior to the TCRA). The evaluation was completed for a series of different hypothetical scenarios that address direct contact in different areas or ingestion of different types of tissue. Incremental risks from background, and reductions in risk resulting from completion of the TCRA, were also evaluated.

The parameters used for evaluating potential exposures and estimating risks and hazards relied on multiple conservative assumptions, which enhance the likelihood that potential assumed exposures and estimated risks are overestimated. The key findings of this BHHRA and conclusions about the potential health risks are summarized below.

Insert some of the key methods stuff... (highlighting different than usual)
Determininistic… then sometimes Probabilistic
Basics on dioxin cancer hazard assmt, rather than old EPA cancer slope factor
Bioavailability... 0.5, rather than 100%

Toxicological criteria (tables 4-1 & 4-2)
Exposure assumptions (tables 5-1 and 6-2)
Chemical specific exp parameters, like RBA (table 5-7

Figure 1-4 (flow chart of risk analyses)

Refer to sensitivity analyses if want to show Cancer Hazard approach ok (even more sensitive... found more risk)

Of the $COPC_{H}$s identified for evaluation in this BHHRA (see Table 1-1 from the BHHRA) for the area north of I-10 and the aquatic environment, dioxins and furans were identified as a risk driver in all media evaluated for the area north of I-10 and the aquatic environment. PCBs in fish and shellfish tissue, and methylmercury in catfish tissue were additionally identified as $COPC_{H}$s that contributed substantially to potential risks associated with the area under study.

The results of this BHHRA generally indicate that hypothetical fishing and recreational exposure scenarios that assume direct contact with sediment within the original 1966 perimeter of the northern impoundments (i.e., termed “Beach Area E”) under baseline conditions (i.e., immediately prior to the TCRA) would result in higher potential exposures to risk driving $COPC_{HS}$, than fishing and recreational scenarios elsewhere within the area under study.

To aid in the presentation of results in a manner useful for risk management, the results of the risk assessment are summarized in two sections below. First, the results for scenarios that assumed exposure to sediments at Beach Area E, together with consumption of fish or shellfish from the adjacent FCA, or soils from north of I-10 are summarized. Second, a summary of results for scenarios that assumed exposure to sediments at other areas (i.e., outside of the 1966 impoundment perimeter (termed "Beach Area A", "Beach Area B/C", and "Beach Area D") in combination with consumption of fish or shellfish from adjacent FCAs or soils is presented (see Figure 5-1 and 5-2 from BHHRA).

Hypothetical Scenarios with Exposure at Beach Area E

Three types of hypothetical receptors—recreational fishers, subsistence fishers, and recreational visitors—with potential exposure to sediments at Beach Area E were evaluated. These scenarios assumed that recreational and subsistence fishers exposed via direct contact with beach sediments also ingested fish or shellfish from the adjacent FCA. Hypothetical recreational visitors who contacted sediments in this area were assumed to also contact soils throughout the study area.

Noncancer Hazards

RME noncancer HIs greater than 1 were estimated for hypothetical fishing and recreational scenarios that assume direct contact with sediments at Beach Area E (see Table 5-11 from BHHRA). For all three potential receptor groups, regardless of the other media to which they were exposed, assumed direct contact to sediments in Beach Area E accounted for over 98 percent of the RME hazard for reproductive/developmental endpoints.[31] Although the HIs exceeded 1, these results do not necessarily indicate that adverse health effects would have occurred under baseline conditions. The CTE noncancer HIs for all potential receptors in this area were less than 1 (see Table 5-12 from BHHRA).

The RME estimates relied on a number of highly conservative parameters, including the use of the maximum detected concentration of TEQ_{DF} as the EPC for estimating exposure. As a result, a substantial margin of safety was built into the RME estimates for the baseline condition. Completion of the TCRA construction in July, 2011 rendered sediments at Beach Area E inaccessible for direct contact by humans, and is also likely to have led to reductions in tissue concentrations in catfish and clams obtained from this area (although this cannot be confirmed with existing data), substantially reducing any baseline risks in this area.

Cancer Risks

All estimated excess cancer risks for potential recreational fishers, subsistence fishers, and recreational visitors who were assumed to contact $COPC_{HS}$ (other than dioxins and furans) in sediments and soils, and ingest fish or shellfish from the waters within USEPA’s Preliminary

Site Perimeter were within or below USEPA's target cancer risk range of 1×10^{-6} to 1×10^{-4} (see Tables 5-11 and 5-12 [again] from BHHRA).

Cancer Hazards

RME dioxin cancer HIs greater than 1 were estimated for all hypothetical fisher and recreational visitor scenarios that assumed direct contact to sediments at Beach Area E (see Table 5-11 [again] from BHHRA). As was the case for noncancer hazards above, for these potential receptors assumed direct contact to sediment sediments in Beach Area E accounted for over 98 percent of the RME hazard. Although the cancer HIs exceeded 1, these results do not necessarily indicate that cancer effects to the hypothetical fishers and recreational visitors would have occurred under baseline conditions. The CTE cancer HIs for all hypothetical receptors in this area were less than 1 (see Table 5-12 [again] from BHHRA), and the RME estimates relied on a number of highly conservative parameters, including the use of the maximum detected concentration of TEQ_{DF} as the concentration term for estimating exposure. As a result, a substantial margin of safety was built into the RME estimates. Completion of the TCRA construction in July, 2011 rendered sediments at Beach Area E inaccessible for direct contact by humans, substantially reducing any baseline risks in this area.

Scenarios with Exposure at Beach Areas A, B/C, and D

Three types of potential receptors with exposure to sediments at Beach Areas A, B/C, and D were evaluated. Hypothetical recreational and subsistence fishers exposed via direct contact with sediments at one of the defined beach areas were assumed to also ingest fish or shellfish from the adjacent FCA. Recreational visitors who contact sediments in one of the defined beach areas were assumed to also contact soils throughout the area under study.

Noncancer Hazards

This analysis indicated that no adverse noncancer health effects would be expected for hypothetical recreational visitors and recreational fishers as a result of contact with $COPC_{H}$s in sediments at Beaches A, B/C, or D and soil throughout USEPA's Preliminary Site Perimeter, and consumption of fish or shellfish from the adjacent FCA. RME noncancer HIs for all $COPC_{H}$s combined for hypothetical recreational fishers were below 1 (see Table 5-11 [again] from BHHRA). For hypothetical recreational fishers, RME HIs grouped by toxicity endpoint, were all below 1 (see Table 5-14 from BHHRA).

Noncancer HIs greater than 1 occurred only for the hypothetical subsistence fisher under the following scenarios: direct contact to sediments at Beach Area A in combination with ingestion of catfish from the adjacent FCA 2/3; direct contact to sediments at Beach B/C in combination with consumption of either catfish from the adjacent FCA 2/3 or clams from the adjacent FCA 2; and direct contact to sediments at Beach D in combination with consumption of catfish from FCA 1 (see Tables 5-11 and 5-12 [again] from BHHRA).

For each of these scenarios the predominant pathway of estimated exposure was the consumption of tissue; direct contact with sediments accounted for less than 5 percent of exposure. Potential risk driving $COPC_{H}$s in tissue were dioxins and furans and PCBs in catfish and clams, and methylmercury in catfish.

Although the noncancer HIs exceeded 1 in these scenarios, these results do not indicate that adverse health effects would have occurred in the hypothetical receptor group under baseline conditions. The RME estimates relied on a number of highly conservative parameters including upper bound consumption rates, the assumption that an individual would obtain 100 percent of the fish or shellfish consumed from the area under study over the entire assumed exposure duration, and the assumption that the concentration of lipophilic compounds would not be reduced through preparation or cooking.

As indicated by the probabilistic risk assessment (PRA) completed for this BHHRA, the influence of variability in estimated consumption rates and the portion of an individual's total consumption obtained from the area under study have large impacts on estimated exposures and resulting hazards for the hypothetical fisher population (see Table 5-22 from the BHHRA).

Cancer Risks

All estimated excess cancer risks for scenarios that assumed exposures to Beach Areas A, B/C, and D were within or below USEPA's target cancer risk range of 1×10-6 to 1×10-4. These included both RME and CTE cancer risks for the hypothetical recreational fisher, subsistence fisher and recreational visitor scenarios (see Tables 5-11 and 5-12 [again] from BHHRA).

Cancer Hazards

It is not expected that dioxin-related cancer effects would have occurred under the baseline hypothetical recreational visitor and recreational fisher scenarios as a result of assumed contact with dioxins and furans in sediments at Beach Area A, B/C, or D and soil, and consumption of fish or shellfish from within USEPA's Preliminary Site Perimeter. RME cancer TEQ_{DF} HIs for these potential receptor groups were all below 1 (see Table 5-11 [again] from BHHRA).

RME dioxin cancer HIs greater than 1 were limited to the hypothetical subsistence fisher receptor group under the following assumed scenarios: direct contact with sediments at Beach Area A in combination with ingestion of catfish from the adjacent FCA 2/3; direct contact with sediments at Beach Area B/C in combination with consumption of catfish from the adjacent FCA 2/3; and direct contact with sediments at Beach D in combination with consumption of catfish from FCA 1 (see Table 5-11 [again] from BHHRA).

For each of these hypothetical scenarios, consumption of tissue accounted for 95 percent or more of estimated $COPC_H$ exposure. Although the cancer HIs exceeded 1, these results do not indicate that cancer effects would have occurred in the hypothetical receptor group under baseline conditions. The RME estimates relied on a number of highly conservative parameters including upper-bound consumption rates, the assumption that an individual obtains 100 percent of the fish or shellfish consumed over the entire exposure duration from waters within USEPA's Preliminary Site Perimeter, and the assumption that concentrations of lipophilic compounds are not reduced during preparation or cooking.

Incremental Hazard

Exposure media that contributed the most to estimated human exposure to $COPC_H$s included sediments at Beach Area E, catfish fillet at FCA 2/3 and FCA 1, and clams from FCA 2. However, risk-driving $COPC_H$s present in catfish were also present at elevated concentrations in catfish harvested from background areas designated for this risk assessment. For example, in catfish fillet, 41 to 42 percent of the baseline hazard attributed to TEQ_{DF} exposures and 55 to 60 percent of baseline hazard associated with PCBs were also present under background conditions, suggesting that background conditions with respect to these $COPC_H$s contributed roughly one-half of the total potential risks under relevant scenarios. In addition, the hazards associated with background exposure to methylmercury in catfish fillets were similar to or higher, indicating that any exposures from the study area are not contributing additional risks due to methylmercury.

Baseline Versus Post-TCRA Hazards

[as discussed in Appendix F]... Post-TCRA noncancer TEQ_{DF} HIs for the hypothetical recreational fisher and recreational visitor scenarios are less than 1. For the hypothetical subsistence fisher, the exposure scenarios that assumed consumption of catfish in combination with direct contact to sediment (Scenarios 1A, 2A, and 3A) have post-TCRA RME TEQ_{DF} noncancer HIs of 6. These are lower than the baseline HIs, which ranged from 9 to 100, and higher than the background HIs of 4.

Post-TCRA cancer TEQ_{DF} HIs are less than 1 for all of the hypothetical recreational fisher and recreational visitor scenarios evaluated. Only the post-TCRA exposure scenarios for the hypothetical subsistence fisher that assumed consumption of catfish in combination with direct contact with sediment result in an RME cancer TEQ_{DF} HI of greater than 1 (HI=2). These are lower than baseline cancer TEQ_{DF} HIs, which ranged from 3 to 40, and only slightly higher than the background cancer TEQ_{DF} HIs of 1 for those scenarios.

The greatest hazard and risk reductions resulting from the TCRA are for baseline scenarios that assumed direct exposure to Beach Area E (Scenarios 3A, 3B, and 3C). This was because the majority of estimated TEQ_{DF} exposure and hazard for these scenarios was related to direct contact rather than to the ingestion of fish or shellfish, and because potential exposure to sediment in this area was completely restricted once the TCRA was implemented. For these scenarios, the hazard reductions resulting from TCRA implementation range from 84 to 100 percent. For hypothetical exposure scenarios that assumed direct contact with sediments at Beach Area A, B/C, or D and consumption of catfish or clam from the adjacent FCA, the hazard reductions resulting from the TCRA implementation range from 65 to 86 percent.

The post-TCRA evaluation indicated that the TCRA implementation has substantially reduced potential baseline risks for the area under study. Noncancer and cancer hazards calculated for the hypothetical recreational fisher and recreational visitor scenarios are all below the target HI of 1 under post-TCRA conditions. While potential noncancer and cancer hazards calculated for the hypothetical subsistence fisher scenario under post-TCRA conditions exceed the target HI of 1, these HIs exceed background levels only by factors of 2 or less.