REVIEWER #1

Location	Comment	Response
General	I suggest rejecting this manuscript. I have some conceptual objections which, of course, could be discussed. The main problem here is that the manuscript is too confused, key points are unclear. Due to this, at the end of two readings, I was not able to form an opinion on the main typical points of such a research project.	We respectfully disagree with the comment. The manuscript makes important points regarding topics of global interest and presents in detail current methodologies and approaches with suggested improvements and considerations of factors that are presently considered. The authors will take this comment into consideration and make further improvements to respond to the reviewer request for more clarity in the paper.
General	How robustly do the chosen variables represent the economic/social/… impacts of a flood they are intended to represent?	The robustness of the chosen variables is demonstrated according to their stakeholder-derived weightings, with consistency ratios < 0.1, described in **Lines 408-409** as well as a comprehensive literature review of all economic/social/environmental impacts from the Hurricane Harvey flooding (**Section 2.1.3**). When combining qualitative and quantitative factors, it is not feasible to do a traditional sensitivity analysis, and this method is intended to assist decision-makers in thinking more holistically and encouraging iterative discussions about all of the factors involved in such decision-making, beyond cost-benefits. As described in **Section 2.1.2**, the current USACE approach to including environmental and social variables is extremely qualitative, using thresholds from "low" to "high" and not based on spatially-derived, empirical evidence of such factors locally.
General	How robust are results (preferences among mitigation solutions) with respect to all uncertainties in the intermediate steps of the procedure?	See response directly above.
General	The fact that a MCA provides a wider view with respect to a CBA within evaluation of flood mitigation solutions is well established. Which is the (methodological?) innovation with respect to other MCA in flood mitigation problems?	This is not well-established *in practice* within U.S.-based reservoir planning, as documented by references in **Line 55** and throughout manuscript.
Line 384	Definition of R is not clear to me. Symbol of intersection in eq. (7) means a product? If yes, please notice that Rk is either equal to 0 (if Ak=A1) or equal to Ik (if A1=1, Ak=0). In a few cases it could be equal to -Ik, if the mitigation strategy generates a larger flooded area than the baseline.	Symbol of intersection is not a product but a zonally-aggregated summation of the *spatial* intersection of two polygons or rasters in GIS. However, yes, risk can be 0 if the alternative's spatial bounds (Ak) are the same as whatever the baseline-scenario demonstrates (A1), which would mean that alternative does not present any *additional* risk than the do-nothing strategy. The other point mentioned here (like having a negative impact, Ik) is valid, meaning the overall impact (and thus risk) is less in the alternative strategy than the baseline. This is preferred and is demonstrated by negative values in **Figure 6**. If the outcome is 0, then the alterative provides the same level of environmental or social risk when compared to the baseline strategy (see A5 and A6 on the right-

		hand-side of **Figure 6**). These outcomes are expected and operate as the formula was intended.
Eq. 7	Is R a cell-defined variable or it is a sum over the whole domain? At line 480 I read about "impacts per spatial unit". I R an extensive or intensive variable?	R is a function of total inundated area, **Lines 478-479** and **Fig. 5**, and emphasized in **Lines 480-481**. It is unclear to me where the confusion lies.
Fig. 6	What is exactly the variable on the x-axis of fig. 6? R? some percentage of R?	This is simply a percent-change calculation from R1 versus Rk, which is demonstrated in the **axis title** and discussed throughout **Section 3.3**. When comparing qualitative and quantitative factors, there is no other way of combining such variables except through risk change as a unitless percentage. This method was adapted from **Rincon et al., (2018)**, **Line 387**, and was demonstrated in other literature sources I am happy to provide if helpful.
Eq. 7	Based on my understanding of eq. 7 a value of R larger than 0 means that the mitigation strategy is less impacting than the baseline. But this is exactly the opposite of what I read. This means that I could not understand the definition of R.	No, positive values indicate greater risk than baseline. Negative values indicate lesser risk than baseline. I think familiarity with the ArcGIS "Zonal Statistics" toolset would help with this confusion. We tried to reference this in the manuscript (**Line 377**), but I am happy to provide more information about its operation in the revised manuscript or SI.
General	I cannot understand how most of mitigation strategies produce larger impacts than the to-do-nothing option. Authors write that "this is likely due to the areal approach used to quantify risk change from the baseline scenario," But this does not explain much to me.	That is the point of our results – that even when thinking a strategy is better, based solely on costs and area of inundation, they, in fact, can produce *more* risk when viewed holistically as a function of social, environmental, and hydrologic considerations. We can further expound on this point in the revised text.
Fig. 7	At the end, having all these doubts, fig. 7 is simply not understandable to me.	Fig. 7 is simply a demonstration of comparing the *relative* degree of CBA versus MCDA outputs. When combining them, we can start to visualize general differences across mitigation alternatives.
General	AHP weights depend on the scenario. This appears inconsistent to me. If I want to compare different scenarios all variables should be weighted, even if not relevant for that scenario, so that weights remain constant. The fact that medical facility are more or less important with respect to amenity disruption is an absolute evaluation, which cannot depend on the presence of either one or the other. Otherwise, I should have different weights for each cell, not only for each scenario.	No, as each scenario has different sets of factors involved, depending on what infrastructural or non-infrastructural measure is chosen. For example, changing the Katy Prairie lands is only necessary in one of the Alternatives, thus, the *relative* percentage of weightings (to add to 100) will change. The same environmental/social considerations do not, and should not, apply to all mitigation alternatives considered; otherwise, the MCDA approach would not be as helpful. Since they are all different spatially, the AHP weights must also differ to be true to the real-world case study.
Fig. 5	What are the Social Vulnerability circles in fig. 5b?	These are CDC SoVI rasters simply symbolized on a relative scale by size of the circle for each sub-catchment area. Without such symbolization, we would have too many rasters overlying each other, and the figures would not be legible. This is a common approach in GIS mapping.
General	Presentation is confused. The case is complex, I understand this. Authors try to present it from different perspectives and through a variety of alternatives. This is nice, but, at the end, the picture is not clear.	We agree that the case study is complex, and hence, the presentation is equally involved. We will strive to simplify and clarify further to describe the two different methodological frameworks, calculations, results, and implications.
General	Use of terms hazard, vulnerability, exposure is not standard. I do not like to be rigid on terminology, but	The term 'hazard' was presented initially to follow USACE's standard conventions, discussed in **Lines**

	authors should discuss and justify their unconventional choice.	**36-38** with references to the industry material. Vulnerability describes the degree of susceptibility a given region is to the flooded area (described here as 'exposure'), see **Line 115**. We will explain this further and adopt standard conventions. Due to the potential for understanding such terms differently depending on the reader's context, we described early on in **Section 2** what *was* meant by these terms, generalized in **Eq. 1**, and referenced by Kron (2005) and Cabrera and Lee (2020). We tried to detail and justify this further in **Lines 116-117, 120-124, 240, 269**, etc. for overall reader clarity.
General	Many minor details should be polished (examples: ABRS is first used and then defined; Fig. 1B contains quantities that are discussed much later – no clear how "language" and "disability" can be a flood impact; fig 1a is totally useless; SAW is not defined; some information is repeated; fig. 5 and 6 are inverted in the discussion; …)	We will address requested edits, however, we note that some of the comments refer to items already addressed in the manuscript. For example: - ABRS and SAW are defined in Appendix C but can also be spelled-out in the earlier text - Language barriers were described as a flood impact by literature studies on Harvey – Ratnapradia et al., 2018, Line 265 - Disabilities were proven to be flood impacts in Harvey by Chakraborty et al., 2019, Line 260. - Fig. 1B contents are mentioned in the Abstract and can reference here general vulnerabilities and hazards, depending on the reader's applicable case study. - We found through conference presentations that Fig. 1A was useful as a visualization tool for those unfamiliar with MCDA and spatial overlay techniques. - Agree, the numbers for Fig. 5 and 6 need to be switched in the text.