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Interactive comment on "Mass imbalances in EPANET water-quality simulations" *by* Michael J. Davis et al.

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The authors have presented both empirical and conceptual evidence to support the claim that EPANET 2.x can exhibit mass imbalance during water quality simulations. For that work the community should be grateful. For my part, the authors will know that the following comments are meant to be constructive; my desire is to help improve the material for more widespread comprehension and collaboration.

The outline of an event-driven algorithm (begin pg. 14/L29), while carefully worded, has a logical inconsistency: (p15/L12) "Nodes are processed in an arbitrary order as long as all inflow paths to a node have water parcels with a known constituent concentration", and then later (p15/L19) "situations can occur in which there are nodes for

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which constituent concentrations have not yet been determined for all inflow links. In these cases, an incomplete parcel is created". The second statement would seem to render the first as misleading, or incomplete. Further, is the first statement to be taken literally? That is to say, if all inflow paths to a node do NOT have parcels with known concentration, then would it be true that the nodes are processed in NON-arbitrary order? If this passage is to be an overview of an algorithm, it should be reviewed for logical consistency.

Appendices B-C are extremely illustrative for those readers patient enough to wade through the diagrams and realistic numbers presented (speaking especially of App. B). I would submit that the same concepts communicated in Appendix B could be more concisely framed with a much more pared-down example. A very simple straight-pipe configuration with carefully chosen round-number initial conditions can be made to exhibit the mass imbalance problem, and would have the added benefit of being both intuitively obvious to the hurried, and being "hand-workable" for the more careful reader.

The Recommendations (p20), while well-intentioned, cannot all be supported by the paper's discussion. In particular, the suggestion that "(1) The default water-quality time step [...] should be 60 s" is both jarring and incorrect. The paper delves into great detail about the causes and nature of the mass imbalance phenomenon. It can be clearly understood well before section 6 that mass generation/removal occurs when: 1) the volume carried through a link during a timestep exceeds its geometric volume, and 2) the water quality segments through the transported volume vary spatially.

Both of these conditions are absolutely linked to the particular network being analyzed - in particular the relationship between each link and its volume transported over each timestep. If it is the authors' belief that the current "default" water quality timestep (which may be acceptable for network "A") is worse than a 60-second timestep (which may be not small enough for network "B"), then the recommendation is at worst lacking in nuance. In any case, the guidance of a default 60-second timestep and a do-not-

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exceed of 300-seconds simply cannot be rationalized. Recommendation (1) should be changed to something similar to: - EPANET's current water quality engine should be made to issue a warning/error statement when conditions exist that could lead to mass generation/loss, or when such occurence is detected.

Furthermore, the Recommendations do not coherently describe their urgency or expose any relevant interdependencies. For instance, if (4 - replacement of algorithm) is carried out, then items (1-3) relating to selection of timestep and reporting on mass balance are rendered moot: "The method actually does not require an independent water-quality time step: the simulation is event driven as long as the hydraulic conditions do not change. Because by construction the method accounts for every individual water parcel, its resulting MBR will always be 1.0" (p15/L26). To improve this section, it should be separated into two tiers of recommendations: those that can be accomplished in short order to verify good quality results, and those that can be developed to perfection on a longer timescale.

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