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RE: Public Comment on Recommendations by the International Red River Board on proposed nutrient concentration objectives and nutrient load targets for the Red River at the boundary between the United States and Canada

To Whom It May Concern:

Thank you for the opportunity to comment on the recommendations by the International Red River Board on proposed nutrient concentration objectives and nutrient load targets for the Red River at the boundary between the United States and Canada (Proposed Nutrient Objectives Report – PNOR) (International Red River Board – Water Quality Committee, 2019.) Our organization represents the soybean farmers of North Dakota who grow millions of acres of soybeans within the Red River Basin.

Our comments below focus on what we like about the PNOR, the proposed approach to developing recommendations for nutrient loads, and conclude with a historical context of the Red River Basin (RRB) and our concerns that the scientific community needs to consider its work in historical context. History may inform science and vice versa.

What We Like about the Proposed Nutrient Objectives Report (PNOR)

A lot of effort has gone into the PNOR and several "guiding principles" should be highlighted:

- Effort will continue to be based on scientifically defensible research.
- Decisions will use an integrated watershed perspective and recognize synergies between sub-basins.
- Jurisdictional independence will be maintained, and jurisdictional participation is voluntary, but collaboration is desirable and information exchange between jurisdictions will be coordinated.
- Objectives will be outcome-based with focus on protection and restoration of the ecosystem.
- Efforts should strive to benefit Lake Winnipeg and local water quality.
- Decisions will be consensus-based, that is, by unanimous agreement of all "parties." (However, the definition of parties is not provided.)

Proposed Approach to Developing Recommendations for Nutrient Loads

Multiple technical approaches were reviewed by RESPEC (RESPEC 2013), a consulting firm in Roseville, Minnesota. One approach category uses "reference condition" and involves using paleolimnological techniques to reconstruct the reference condition through historical data. Another approach uses stressor-

response relationships where data analysis is used to understand the system and empirical data are used to model stressor-response relationships. Ultimately, the following two integrated approaches were recommended by RESPEC (2013) to develop recommendations for RR nutrient loading targets:

- Stressor-response modeling approach
- Downstream approach based on nutrient targets for Lake Winnipeg

The reference condition approach was rejected because of a lack of reference watersheds comparable to the RRB. We agree! There probably are no basins similar to the RRB. However, to propose to develop modern nutrient standards for the RRB in the absence of its historic context may lead to impractical nutrient targets and uninformed scientific inquiries.

Historical Context of the Red River Basin

The journal of Alexander Henry (the Younger) was compiled by Elliott Coues (1897). Henry was a fur trader with Northwest Company who lived in the RRB, at least partially, from 1799 to 1808. Our comments below refer to his time at the Park River Post (or "fort"), which was in what is now North Dakota, about 36 miles (58 km) south of the Canadian Border.

Henry was enthralled with the abundance of wildlife in the RRB (Coues, 1897, with pages numbers in parentheses at the end of each quote):

- September 11, 1800. "I climbed up a tall oak, which I had trimmed for that purpose, at the entrance of the plain, from the top of which I had an extensive view of the country. Buffalo and red deer were everywhere in sight (94)."
- September 18, 1800. "I took my usual morning view from the top of my oak and saw more buffaloes than ever. They formed one body, commencing about half a mile from camp, whence the plain was covered on the W. side of the river as far as the eye could reach (99)."
- October 13, 1800: "At one o'clock we stopped at this island to rest our horses and then proceeded to the foot of the Panbian (Pembina) river traverse. . . Here I climbed a high tree, and, as far as the eye could reach, the plains were covered with buffalo in every direction (117-118)."
- January 1, 1801: "Buffalo in great abundance; some within gunshot of the fort. The plains were entirely covered; all were moving in a body from N. to S. (162)."
- January 14, 1801: "At daybreak I was awakened by the bellowing of buffaloes. I got up, and was astonished when I climbed into the S. W. bastion. On my right the plains were black, and appeared as if in motion, S. to N. Opposite the fort the ice was covered; and on my left, to the utmost extent of the reach below us, the river was covered with buffalo moving northward. . . I had seen almost incredible numbers of buffalo in the fall, but nothing in comparison to what I now beheld. The ground was covered at every point of the compass, as far as the eye could reach, and every animal was in motion (167)."
- January 15, 1801: "The plains were still covered with buffalo moving slowly northward (167)."
- January 19, 1801: "Indians go hunting on the E. side of the river, where the buffalo are as numerous as on the W. (168-169)."

While Henry was enthralled with the abundance of wildlife – particularly "buffalo," he was astonished with their environmental toll (Coues, 1897):

- September 6, 1800: "The ground along the river is worn down by the buffalo, especially at every bend of the river westward, where the plains run down to the water, and where the herds come day and night to drink, returning to the plains to feed (88)."
- September 18, 1800: "This afternoon I rode a few miles up Park river. The few spots of woods along it have been ravaged by buffaloes; none but the large trees are standing, the bark of which is rubbed perfectly smooth, and heaps of wool and hair lie at the foot of the trees. The small wood and brush are entirely destroyed, and even the grass is not permitted to grow in the points of wood. The bare ground is more trampled by these cattle than the gate of a farm-yard (99)."

- September 22, 1800: "Bears make prodigious ravages in the brush and willows; the plum trees are torn to pieces, and every tree that bears fruit has shared the same fate. The tops of the oaks are also very roughly handled and torn down to get the acorns. The havoc they commit is astonishing; their dung lies about in the woods as plentiful as that of the buffalo in the meadow (101-102)."
- Sunday, February 28, 1801: "Wolves and crows are very numerous, feeding on the buffalo carcasses that lie in every direction (171)."
- March 30, 1801: "Many trunks of trees and much mud are carried down on the ice. It continued to drift on the 31st, bearing great numbers of dead buffalo from above, which must have been drowned in attempting to cross while the ice was weak (174)."
- Wednesday, April 1, 1801: "The river is clear of ice, but drowned buffalo continue to drift by entire herds. . . It is really astonishing what vast numbers have perished; they formed one continuous line in the current for two days and nights." (At this point, Coues added the following footnote: "This account is not exaggerated. John McDonnell's Journal of May 18th, 1795, when he was descending Qu'Appelle r., states: 'Observing a good many carcasses of buffaloes in the river and along its banks. I was taken up the whole day with counting them, and, to my surprise, found I had numbered when we put up at night, 7,360, drowned and mired along the river and in it. It is true, in one or two places, I went on shore and walked from one carcass to the other, where they lay from three to five files deep.') (174)."
- April 18, 1801: "Rain; drowned buffalo still drifting down the river, but not in such vast numbers as before, many having lodged on the banks and along the beach (175)."
- April 25, 1801: "Drowned buffalo drift down river day and night (176)."
- April 30, 1801: "Drowned buffalo drift as usual (177)."
- May 1, 1801: "The stench from the vast numbers of drowned buffalo along the river was intolerable. . . Two hunters arrived in a skin canoe from Grandes Fourches (Grand Forks) with 30 beaver and 7 bear skins. They tell me the number of buffalo lying along the beach and on the banks above passes all imagination; they form one continuous line and emit a horrid stench. I am informed that every spring it is about the same (177)." (Our note: The linear distance [not river length] from the confluence at Grand Forks to the confluence of the Park and Red Rivers is about 38.5 miles [62 km].

The reader is likely aware that settlers in the late 1800s collected bison bones on the Great Plains. The bones and teeth, both of which have high concentrations of apatite (a phosphorus-rich mineral), were processed into charcoal filters and phosphate fertilizer (Barnett, 1972). The PNOR total phosphorus (TP) target for the RRB at the international border is 1,400 tonnes per year. Some simple back-of-the-envelope calculations suggest that this TP load was likely exceeded as a result of the buffalo carcasses recorded by Henry to be in the river and on the shore. And these calculations do not include any additional dissolved P in the water for the rest of the year, and these concentrations would certainly be high at times because of the dung on the plains and meadows. Nor do they include P contributed by sediment; sediment derived from shales in the RRB in North Dakota (Korom and Quinlan, 2019) have relatively high concentrations of P (Schultz et al., 1980). Are Henry's observations consistent with sediment cores in Lake Winnipeg?

Bunting et al. (2016) studied three sediment cores collected along a 35-km transect within the south basin of Lake Winnipeg in 2006 and presented the analytical results from 1800 to 2006 in graphical form. They reported, that the sediments were "phosphorus-rich." Furthermore, they stated, "In all three cores, concentrations of TP and chemical fractions showed few pronounced changes in sediment deposited during the past two centuries (Fig 4). For example, TP content was almost constant throughout the 19th century and increased only 10-15% by present day (Fig. 4a) (page 2096)." Not discussed by the authors is an anomalous spike in non-apatite P in one of the cores at approximately 1820-1830 (Reported errors were ~20 years for basal sediments.). The spike is likely a result of severe flooding in the RRB; phosphorus loads to Lake Winnipeg tend to increase with increased average annual flows (Manitoba Sustainable Development (2019). Early Winnipeg records indicate that major flooding occurred in 1824, 1825, and 1826 (LeFever et al., 1999), with the worst flood on record in 1826 (James and Korom, 2001). That the peak is non-apatite P suggests

that the P may be from sources other than bones and teeth, perhaps from dung left by bison herds that could cover the basin "as far as the eye could reach."

With respect to nutrients, the RRB is recognized as a cold-climate basin that is dominated by high flows caused by melting snow and ice (Red River Basin/Cold Climate Agricultural Nutrients BMP April 16-17, 2019). We also know that it was a bison-dominated basin in the days of Henry, and probably for thousands of years before him. Being bison-dominated, the RRB was also phosphorus-fertilized long before fertilizer was applied to crops on any significant agricultural scale. What are the natural P loads to Lake Winnipeg – both historical and modern? Without this information, setting P objectives will likely lead to targets that are both impractical to reach and unpopular with some jurisdictions.

Bunting et al. (2016) continued, "We infer that livestock wastes may contribute strongly to the eutrophication of Lake Winnipeg, either as direct runoff or via their use as fertilizers (page 2102)." "Contribute strongly," is this true? Is the mass of mammals in the RRB greater than it was in 1800? Inferences like this may be uninformed without the historical context that the RRB was a bison-dominated basin. Eutrophication in Lake Winnipeg accelerated from 1900-1990 (Bunting et al., 2016), not in the early 1800s when buffalo herds stretched "as far as the eye could reach." What specifically about the livestock waste in the 20th century caused the problems in Lake Winnipeg?

Our comments on Bunting et al. (2016), however, are not all negative – quite the contrary. The core data they provided are of great value. P, nitrogen (N), and carbon (C) concentrations were stable in the 1900s. Afterward, P concentrations increased only 10-15%, but N and C concentrations increased gradually by 50%, then rose rapidly in sediments deposited in 2006. Perhaps N and C loads are more of an issue than P loads with respect to diminishing water quality and increasing harmful algal blooms in Lake Winnipeg. What are the nutrient-loading ratios and interactions that caused the problems? We encourage more scientific investigation on this, and related, topics.

Should you have any questions or need additional clarification, please contact Scott Korom, our educational science advisor on water quality at SKorom@barr.com. Thanks again for the opportunity to comment.

Sincerely,

Joe Ericson

President, NDSGA

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