April 23, 2015

The Redwillow Watershed Restoration Project Team has received a variety of input, comments and suggestions regarding fish passage at the Beaverlodge weir, as has our consultant Matrix Solutions Inc. Through the Town Hall meeting held on March 17 at the Beaverlodge Ag Plex, email submission and conversations the public has provided some very useful and constructive ideas.

Here is an overview of the two design approaches discussed and their evaluation.

	Fish Ladder	Natural Design
Pros	• Less expensive construction • Easier construction	• Suitable for passing wide range of fish species over a longer duration • Low maintenance; easily passes wood and sediment
Cons	• Difficult to pass Grayling • Location not ideal for attracting fish • Sensitive to maintenance	• More expensive to construct • More difficult to construct

We appreciate all the different comments and the large number of people who pointed out the advantages of the different design approaches. There were a few particular concerns raised about the design options and Matrix Solutions has reviewed these concerns and responded to them in the attached letter. If there are any questions please contact Adam Norris at 780-324-3355 or 780-552-4354.

Sincerely,

The Redwillow Watershed Restoration Project Team

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Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

April 20, 2015 Matrix 2199-510

Adam Norris, Watershed Coordinator
REDWILLOW WATERSHED RESTORATION PROJECT
MIGHTY PEACE WATERSHED ALLIANCE

RE: Stakeholder Comments on the Proposed Design of Fish Passage at the Beaverlodge Weir

Dear Adam,

Please accept this letter as a summary of the written comments that have been received and our corresponding responses. To date, most of the comments that have been received on the natural fish passage approach have been very favourable with the exception of the comments we received from Beaverlodge Arctic Grayling Renewal (BAGR) in their email dated March 20, 2015.

The list of general concerns has been summarized below and is followed by our corresponding responses.

Statement of Concerns

1. The fish ladder provides more "control" than the natural rocky ramp design.

2. The fish ladder, as it more controllable would enable grayling hatchlings to move downstream during low flow conditions, whereas the low flow conditions would be too low to enable the hatchlings to use the natural rock ramp.

3. As noted from BAGR, a concern is 'water speed'; specifically as stated in their email…. "Pool and Weir fish ladder has complete control by using the baffles boards in each pool for depth control. Speed rate estimated at 2.5 miles per hour with a 1 foot deep flow. This pool is 54 inches wide and 56 inches long, but can be used as 2 pools in low water or 8 pools if there is 8 feet of water. The rock ramp ladder requires a flow of not less than 1 foot of water and a width of approx 4 - 5 meters width to accommodate leakage to sustain a flow over the rock bed of the first ladder compared to water used as described above."

4. The proposed rocky ramp will be susceptible to leakage, resulting in more flow to pass fish. Furthermore, the 2nd proposed rocky ramp would also dry up creating a new barrier.

5. There is no erosion within the Pool and Weir fish ladder.

6. The fish ladder could be repaired for much lower cost than the construction of the natural rock ramp approach, as it more controllable would enable grayling hatchlings to move downstream during low flow conditions, whereas the low flow conditions would be too low to enable the hatchlings to use the natural rock ramp.

Our Responses

1. *We concur that the fish ladder does provide more 'control'. Maintaining this necessary control will require direct, human management - an approach that is considered both feasible and desirable by BAGR in the foreseeable future. We have found through our experience, however, that this approach can prove challenging over longer time periods, when time and resources to actively manage the fish ladder are provided solely on a volunteer basis. This approach also does not take into consideration the operations and maintenance costs, as well as the structural liability, which the municipality will have to incur to maintain the fish ladder over time. With these challenges in mind, we have presented a natural, self-maintaining solution that will minimize both the maintenance requirements and potential liabilities that the maintenance of a fish ladder may have in the future.*

2. *We appreciate the expressed uncertainty with respect to seasonal flows, and the availability of adequate water levels when Grayling fry emerge from their spawning grounds. While this is a tangible risk, this risk is a constant in any future fish passage mitigation scenario due to the natural uncertainty in the river's flow regime from year to year*

   We are also uncertain that the baffle board design of the fish ladder would be effective in moving fish downstream, as the fish ladder would face the same challenge of diminishing flows when the Grayling fry may be moving. It was noted during the stakeholders meeting that the upstream entrance of the fish ladder intends to be lower than the weir crest, enabling a longer period for moving fish. If this were possible and permitted by the Town, it would help movement during low flows; however, our primary design constraint is to maintain the weir elevation to sustain and protect the municipal

water supply. It has been determined that the overall risk to the municipal water supply would be too great to contemplate a lower draw, even if it was a temporary condition.

3. *With respect to function of the fish ladder, the values provided in our design have been generated to permit the passage of grayling. The velocity in the proposed fish ladder is 1.11m/s (2.5 miles/hour) with a depth of 0.30m (12 in) and a width of 1.37m (54 in) resulting in a flow of 0.46 m3/s – a value that falls within the design low flow (0.45 – 0.5 m3/s) that was used in the rocky ramp alternative. A missing element in the fish ladder design, however, is the ability for grayling to swim for a sufficient duration to navigate through the fish ladder. This will need to be determined based on the grayling's burst speed and swim endurance to maintain the necessary level of effort to navigate through the structure. Based on the presented information, it is unclear how the overall velocity in the fish ladder was derived in the absence of gradient information. It is also noted that the fish ladder calculations have also assumed that all low flows will be diverted through the fish ladder. This assumption is not feasible due to the size of the river and the proposed location of the fish ladder. Therefore, it is unknown how much flow will pass the weir if the fish ladder is designed to pass a flow of 0.46m3/s.*

4. *The comments with respect to the rocky ramp and leakage were recognized and discussed at the stakeholder meeting, as this potential issue was acknowledged as a risk in our study. The implementation of our design will be founded upon our past experience in building similar ramp features in other rivers, ensuring that flows remain on the surface of the feature, and limited from passing through the stone. While the exact approach to filling the voids will be determined during the detailed design process, we will remain cognizant of the potential issues that may arise and solutions that are available to minimize these issues.*

   The advantage of a rocky ramp feature is that it can be built into a parabolic form which focuses flows into the centre of the feature such that passage can be extended for as long as possible while discharge slowly diminishes. A variety of hydraulic tests were completed in our study to ensure the slope, shape and resulting velocity (for a range of flows) permit passage of grayling based on published targets for grayling swimming performance. The proposed design has accounted for a slight increase in the amount of stone to be placed above the weir to help focus and attract grayling, and the 2nd rocky ramp (riffle) is intended to diversify aquatic habitat and provide a deeper resting pool for adult grayling. While we acknowledge that the second rocky ramp will dry up under severe low flow conditions, it is noted that this is a natural process and an artifact of the existing flow regime of the river.

5. *The rocky ramp will naturally collect and re-distribute sediment on an upstream to downstream gradient. Sediment (typically in a suspended load) currently passes the weir and has been observed under higher, channel-formative flows. The proposed solution will ultimately draw more fine sediment downstream. While the coarser fraction (bed load) will be trapped in behind the weir, it is recognized that the maintenance would overall be lower with the rocky ramp alternative. This alternative will also permit the free passage of logs and other debris that is conveyed by the river. In our preliminary design work, we have aimed to size the stone to be stable under very large flow and flood events. The final stone sizing will be checked against the known high flows for the river to demonstrate the overall stability of the design.*

6. *We believe that we have adequately disclosed the anticipated costs of the proposed rocky ramp approach. Based on our experience, we believe that the costs presented by BAGR may not account for the extent of instream work that will be required to construct the fish ladder. These costs are also recognized to be capital expenditures, and do not provide consideration for the long-term maintenance costs associated with the management and operation of the fish ladder.*

   As a part of this study, the option to repair of the fish ladder was thoroughly assessed. It was determined that the benefits that may be realized were not sufficient to overcome the potential disadvantages that may result from its construction, such as:
   - *the lack of attraction of grayling to the fish ladder;*
   - *the extent of channel work that would be required to retrofit the existing ladder;*
   - *the 'management' nature of the structure; and,*
   - *the ongoing necessary adjustments to ensure adequate hydraulics for fish movement under the broad range of flow conditions.*

We trust that you will find this letter and our responses to be beneficial to you and the committee in determining the next steps. We are available to your convenience if you wish to discuss any of the items in the letter, or any other issues. We look forward to moving ahead in the design process.

Yours truly,

MATRIX SOLUTIONS INC.

Kreg Alde, EP, ATT Ag.	Darrell Jobson	John Parish
Principal	Senior Fisheries Biologist	Principal, Geomorphologist