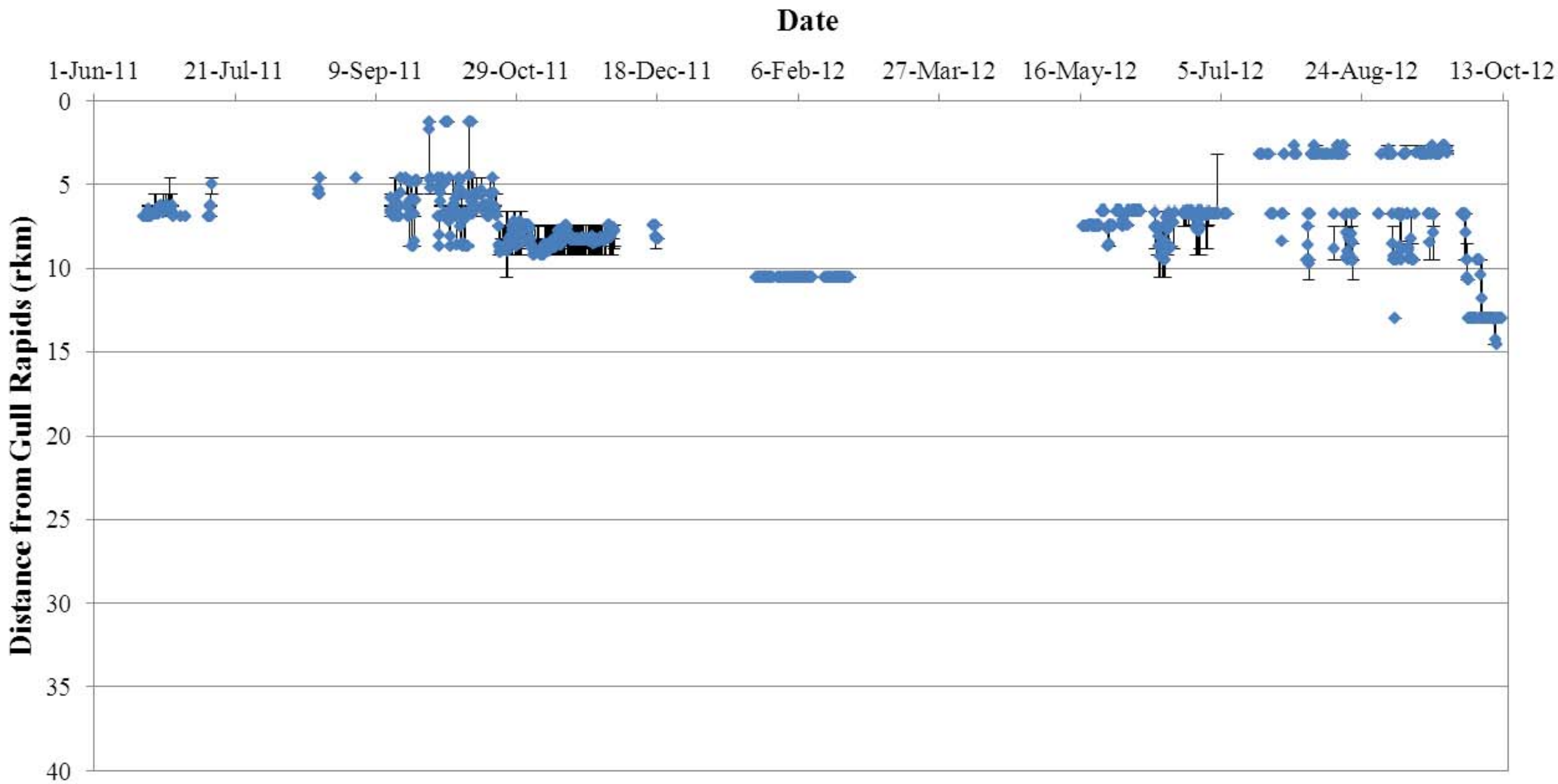
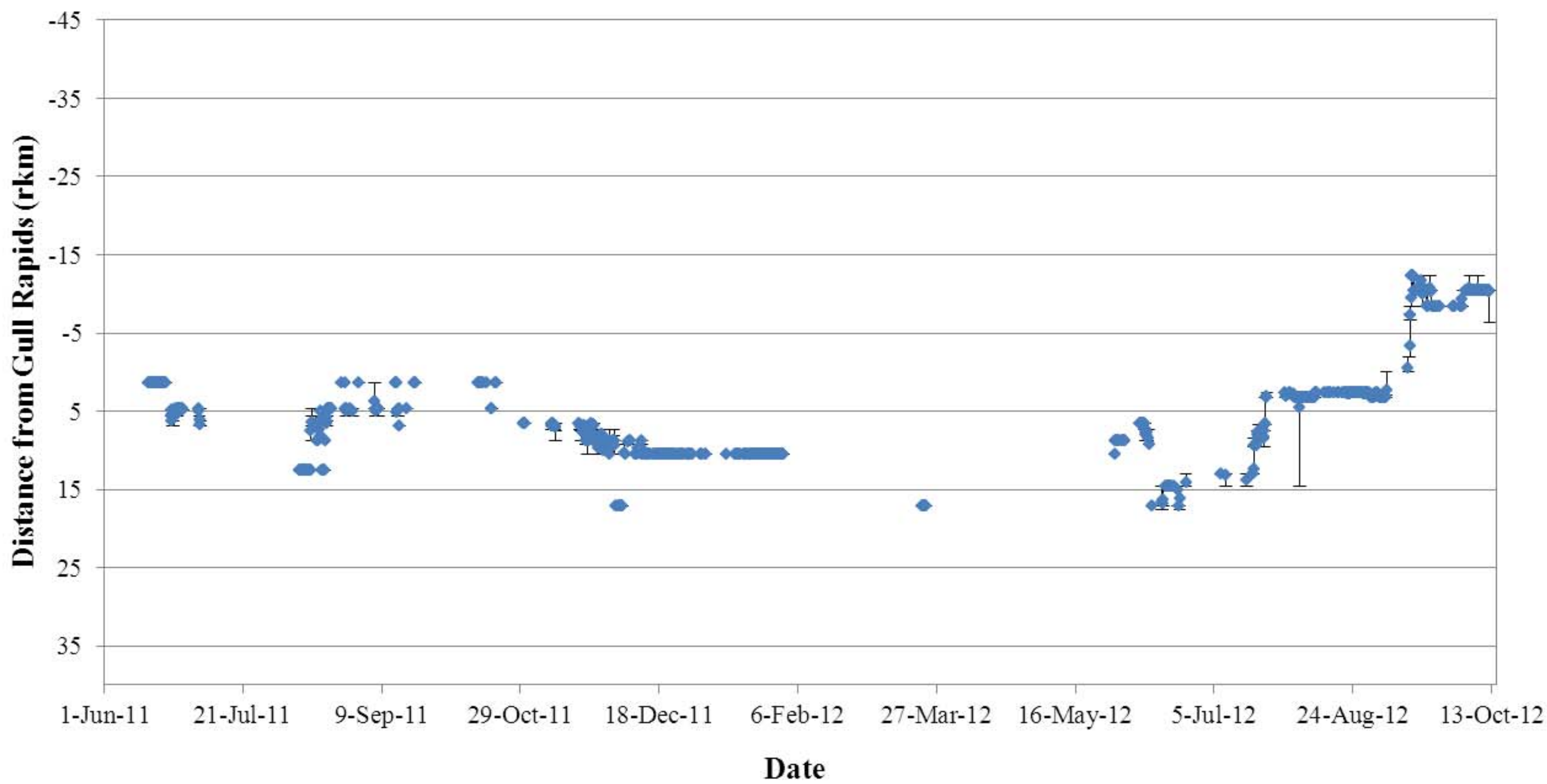
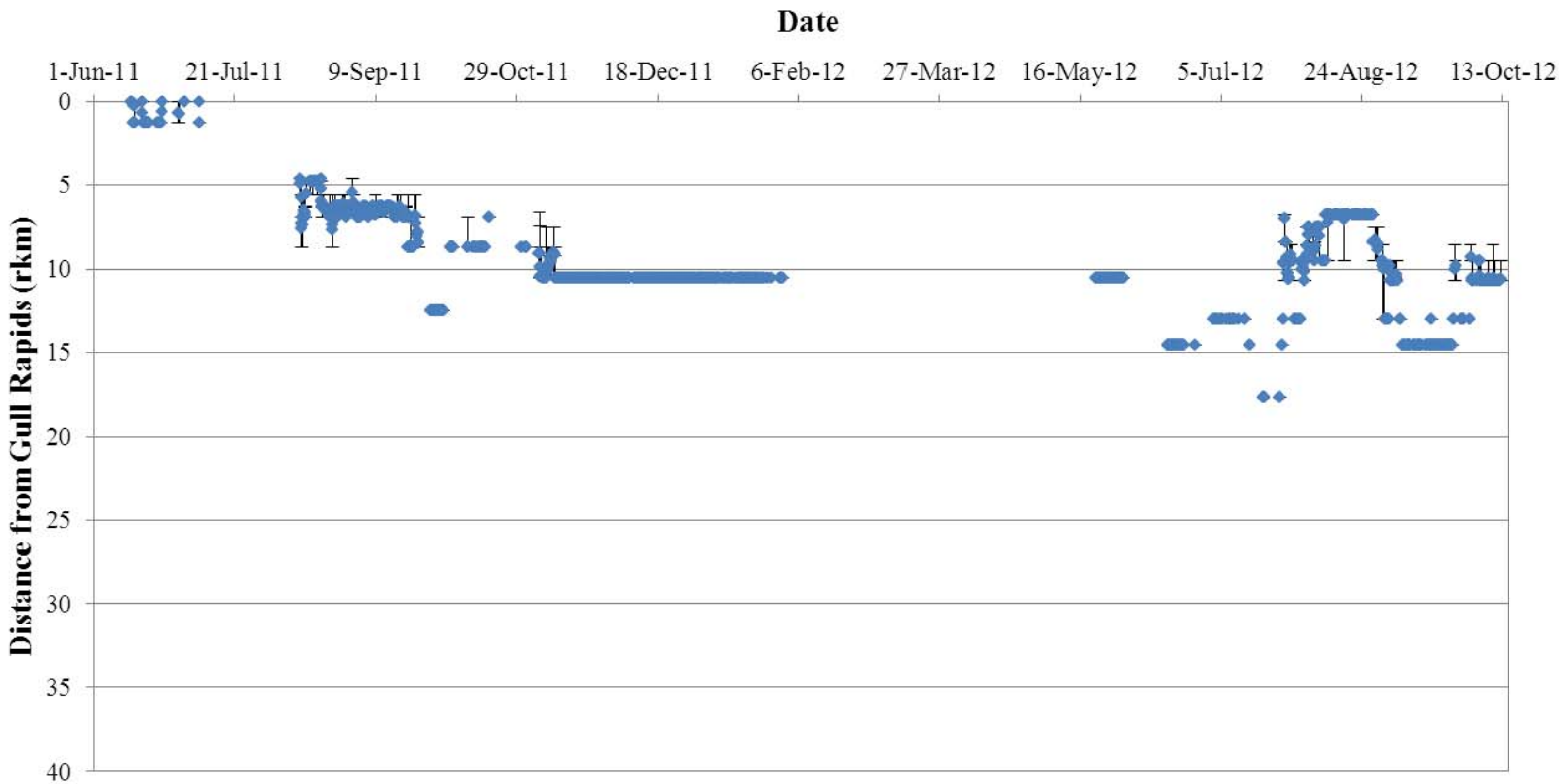


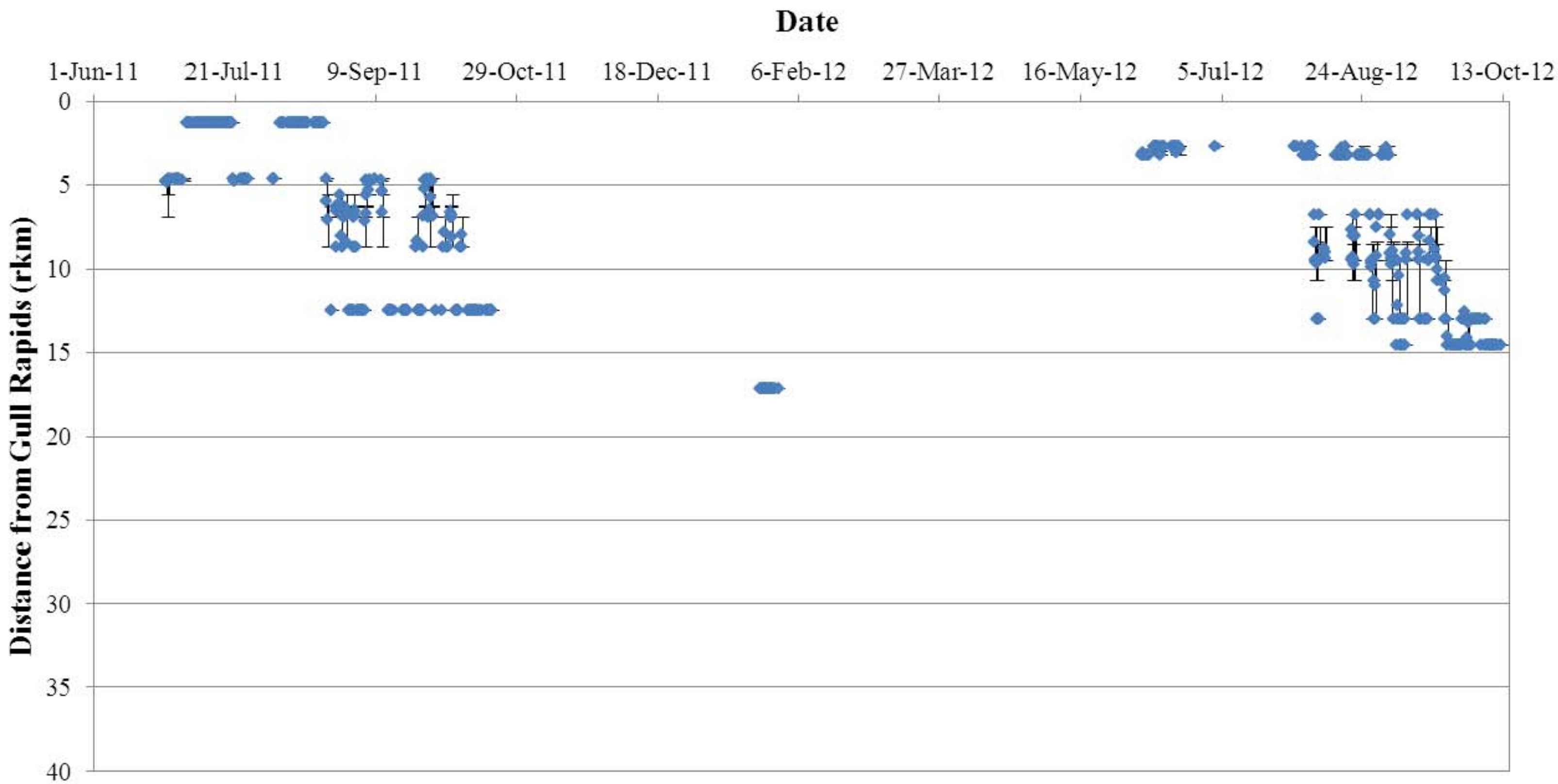
A3- 17. Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16037) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 15 October, 2012.



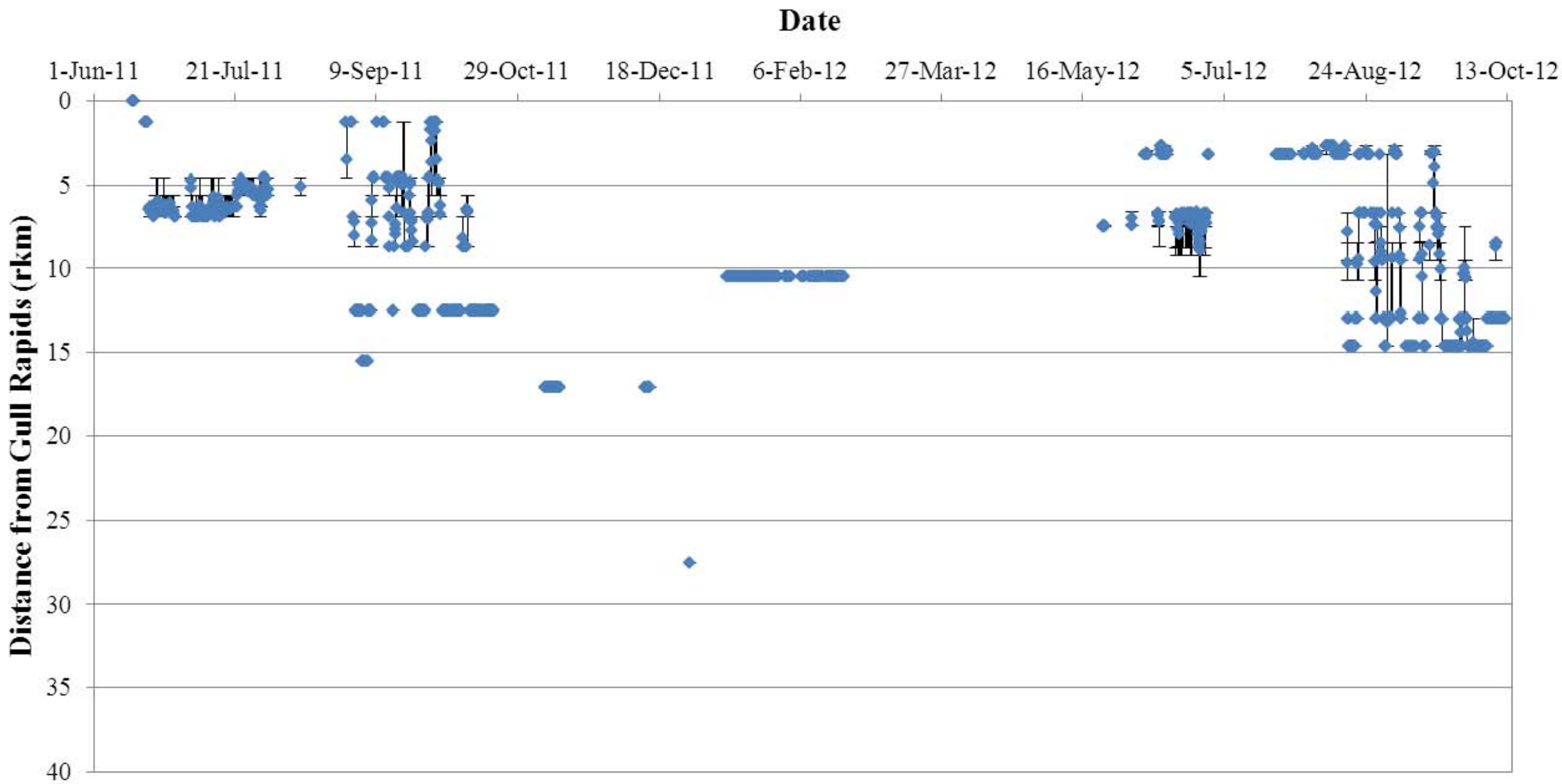
A3- 18. Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16038) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 15 October, 2012.



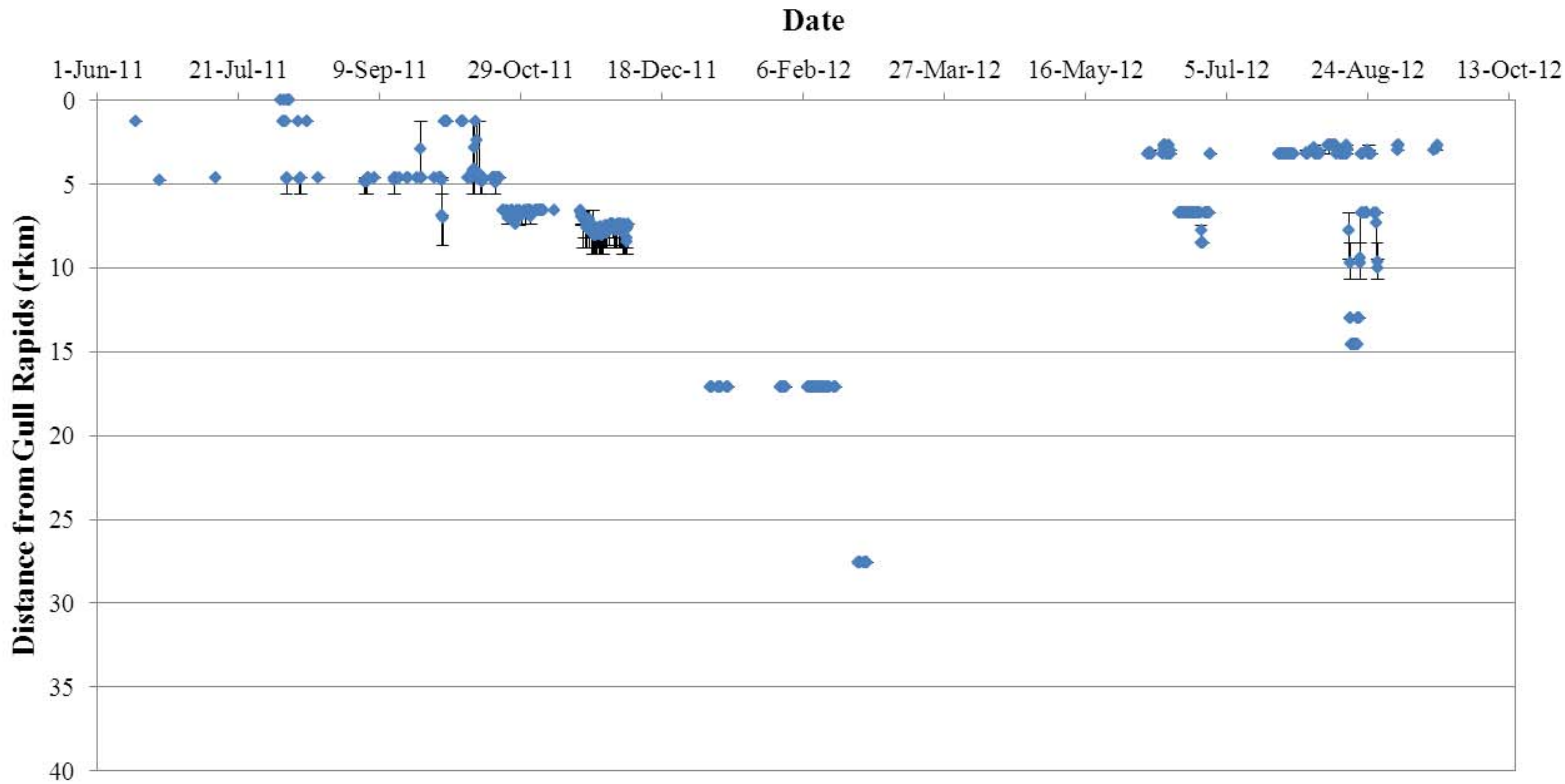
A3- 19. Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16040) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 15 October, 2012. This fish was identified as a male when tagged in 2011.



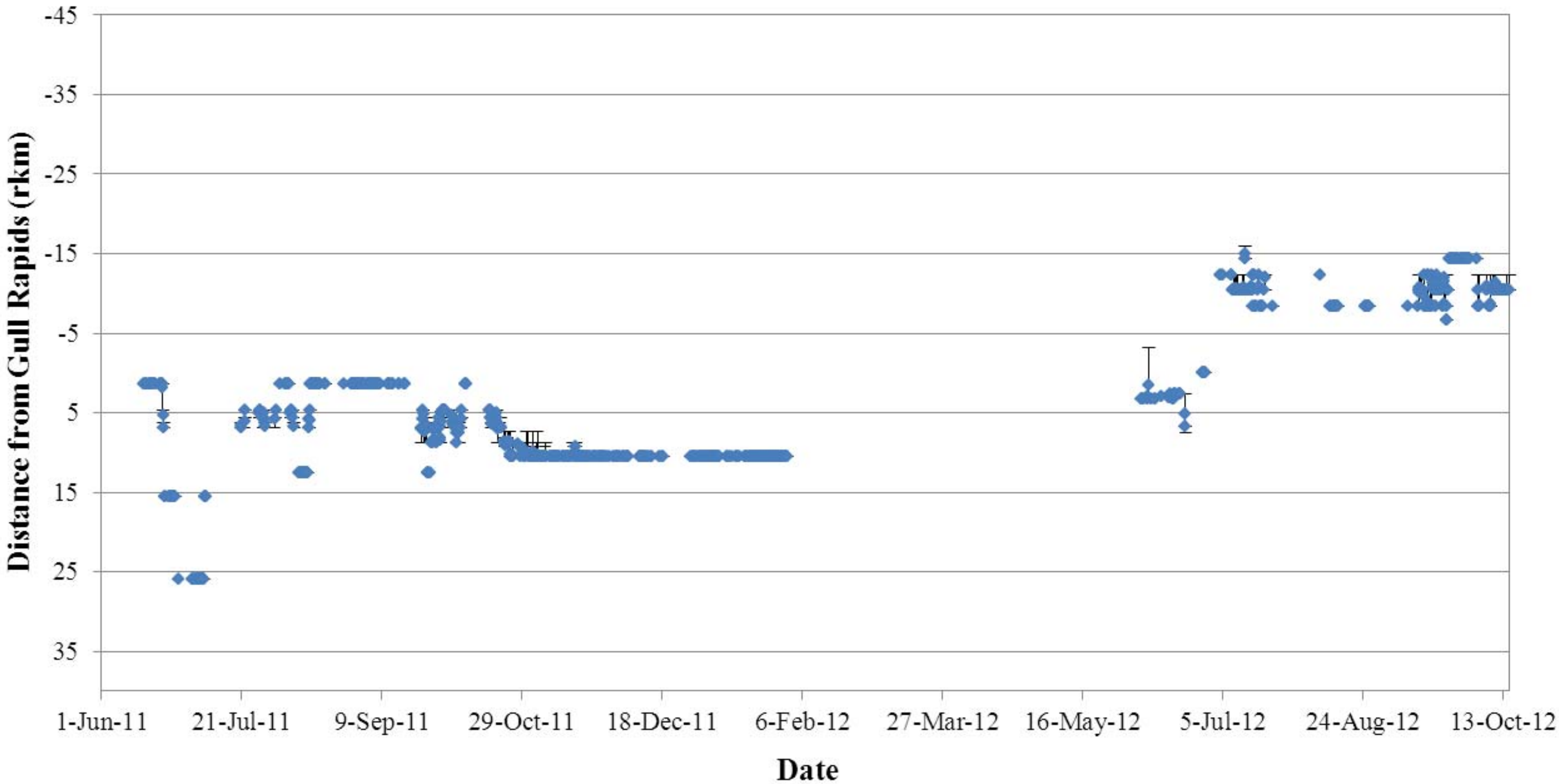
A3- 20. Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16041) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 15 October, 2012.



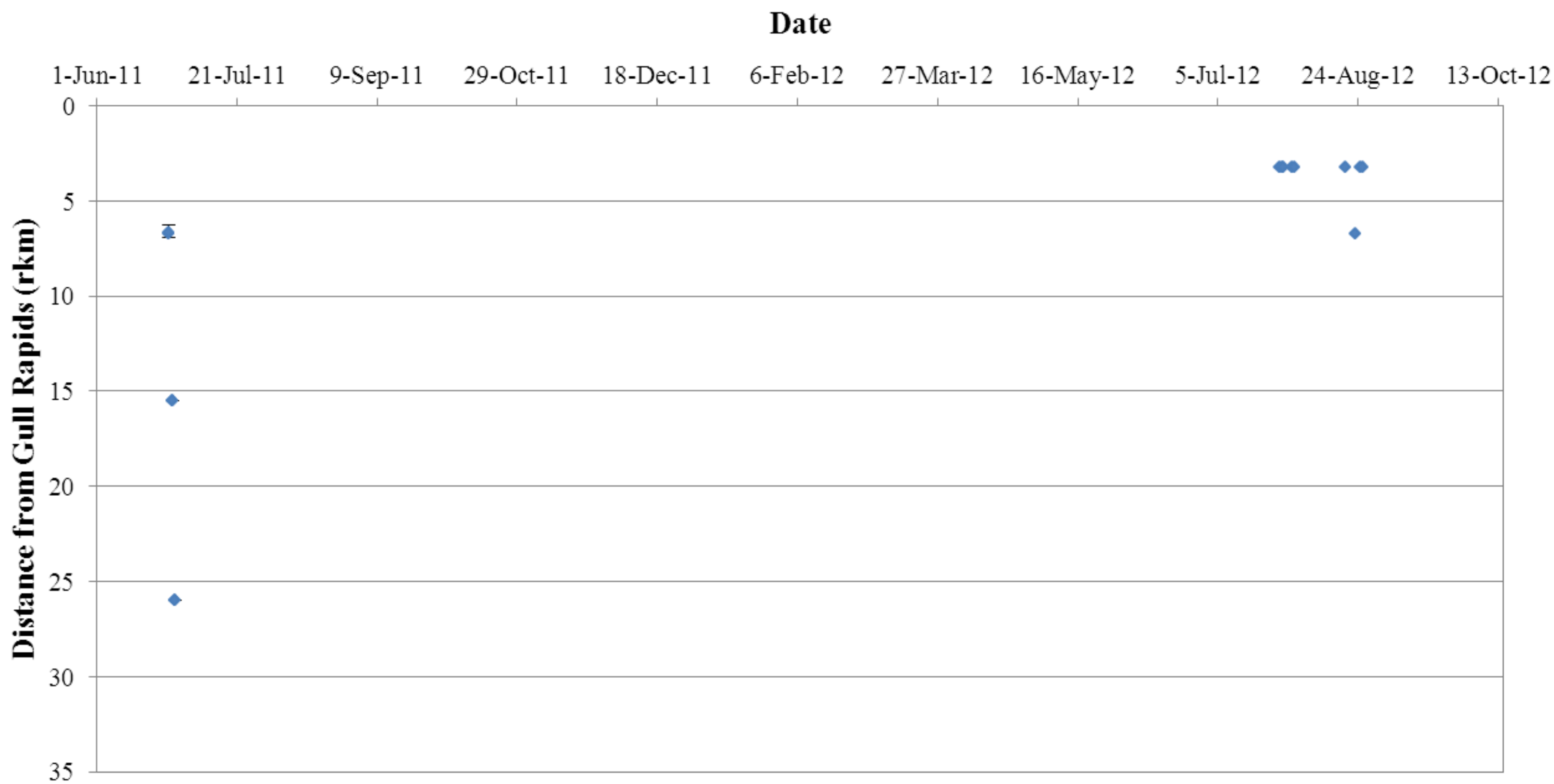
A3- 21. Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16043) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 15 October, 2012.



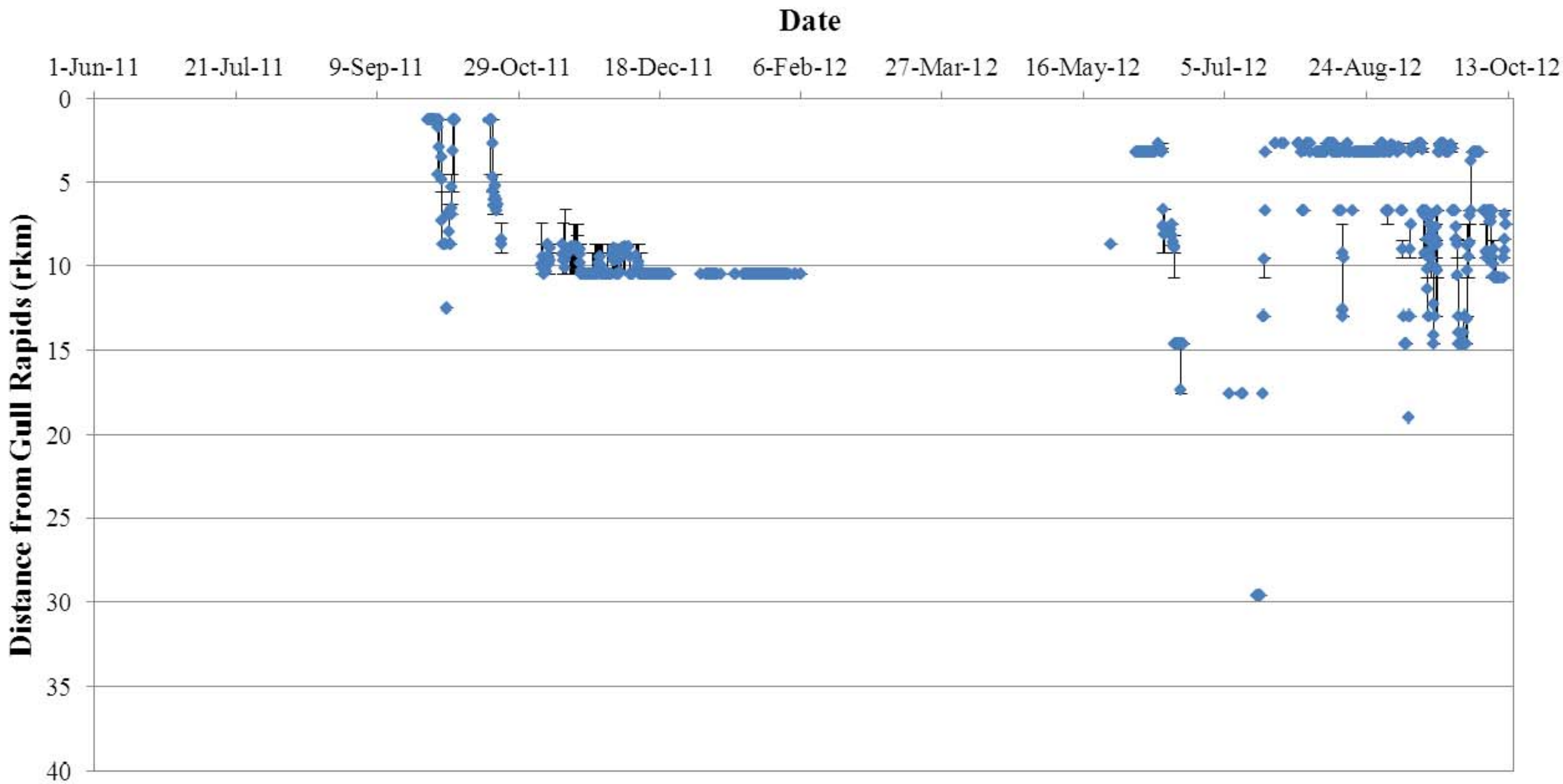
A3- 22. Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16044) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 15 October, 2012. This fish was identified as a male when tagged in 2011.



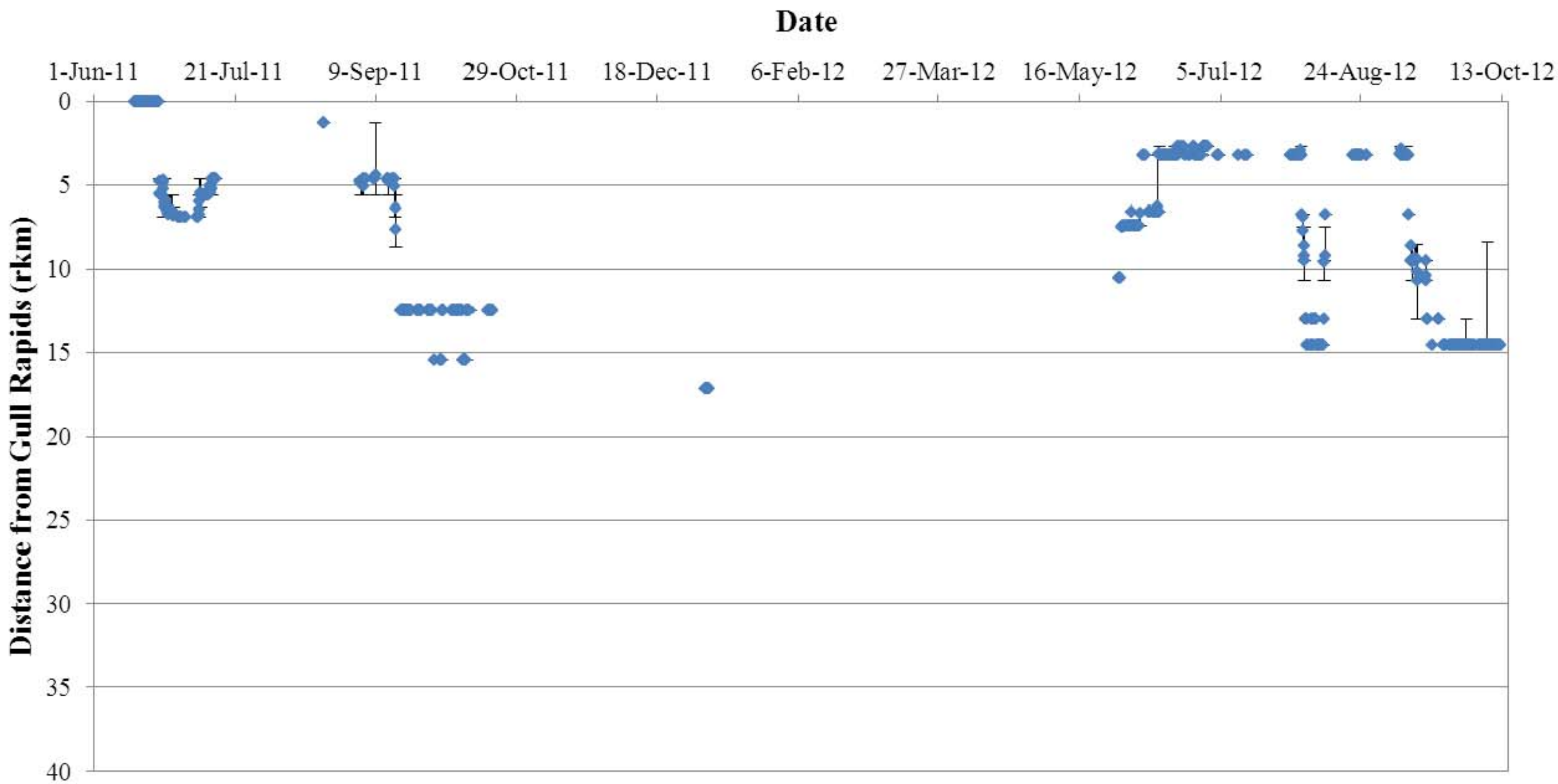
A3- 23. Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16046) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 15 October, 2012. This fish was identified as a male when tagged in 2011.



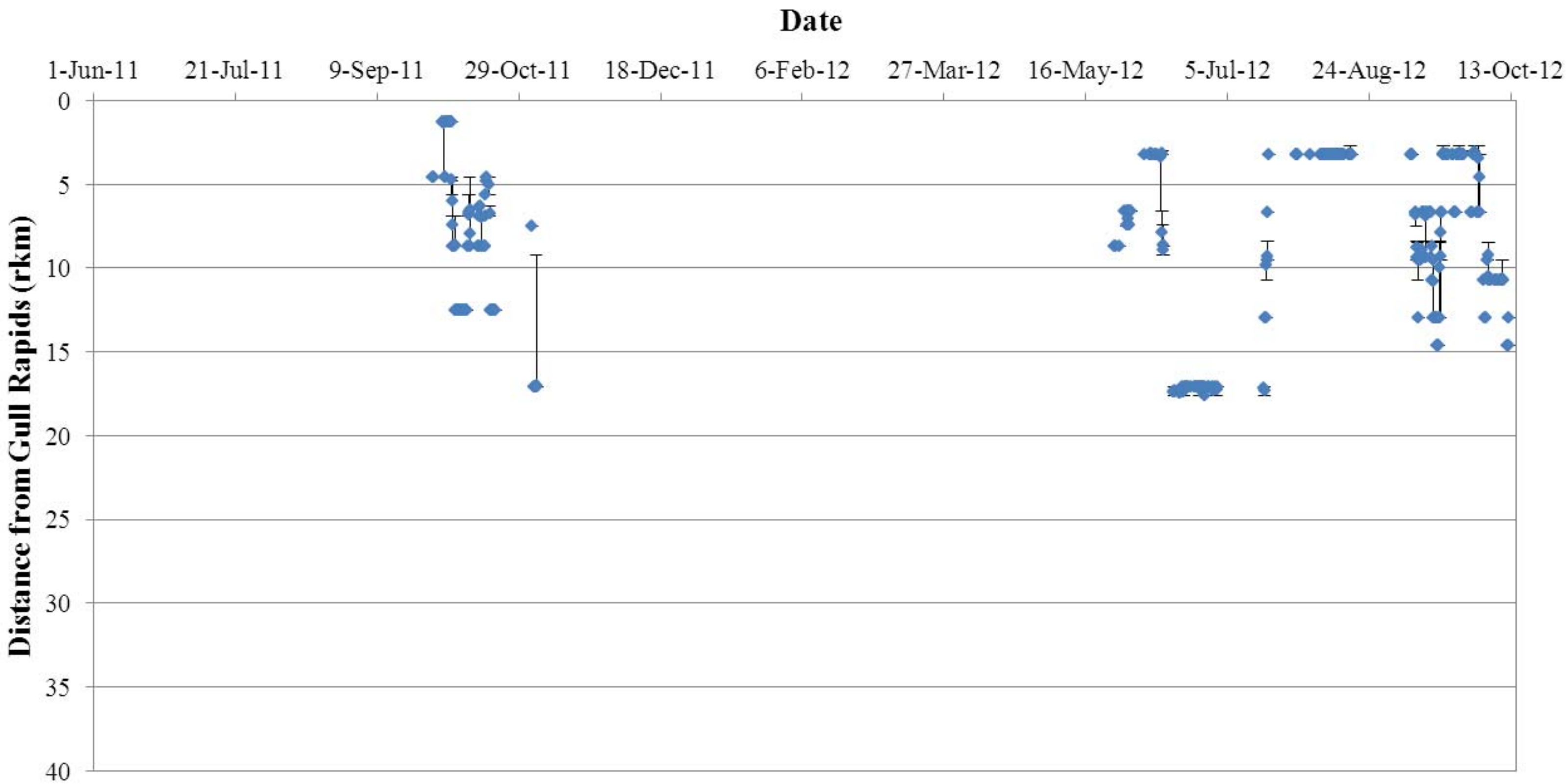
A3- 24. Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16047) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 15 October, 2012.



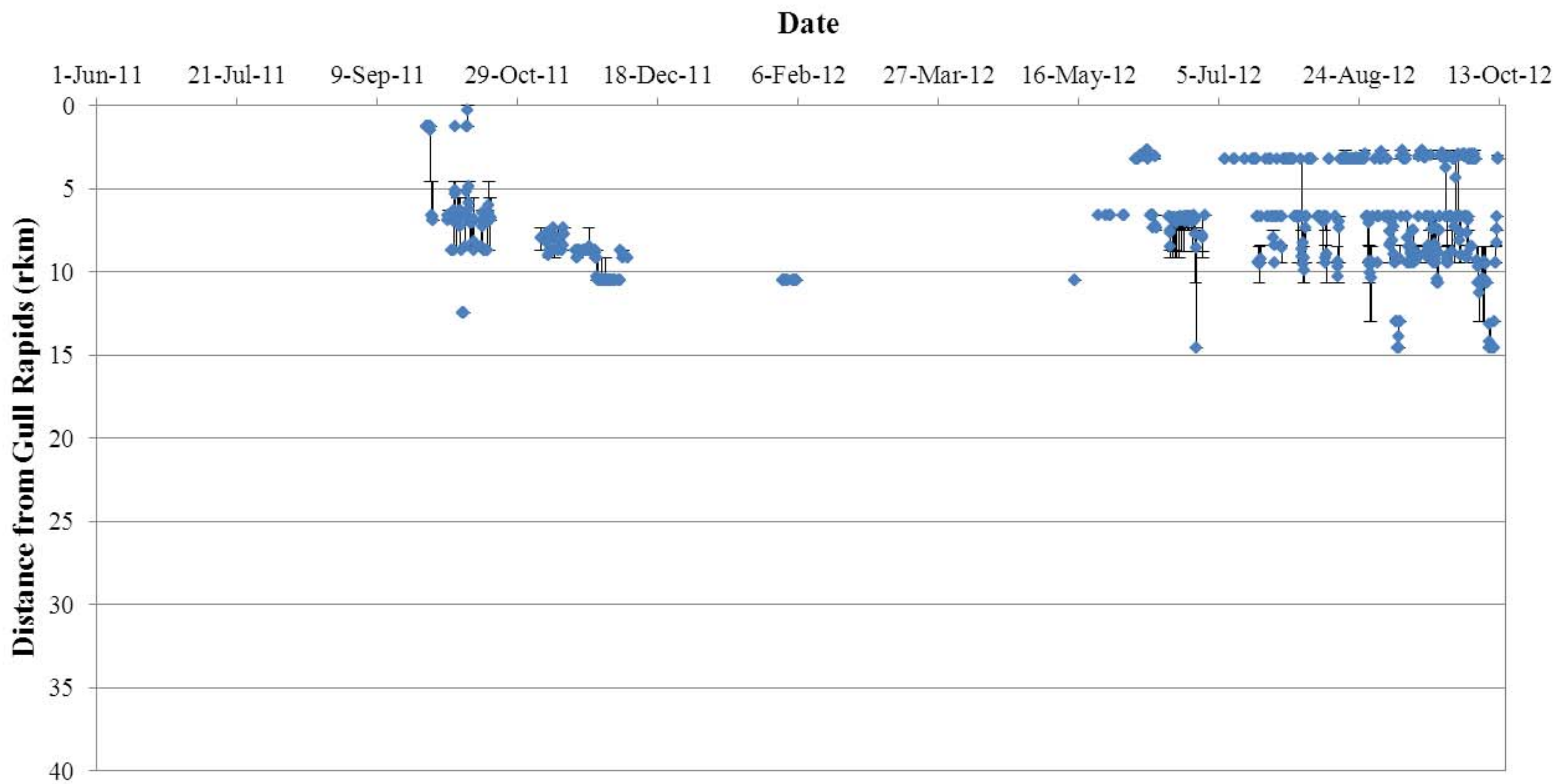
A3- 25. Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16049) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 15 October, 2012.



A3- 26. Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16050) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 15 October, 2012.



A3- 27. Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16052) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 15 October, 2012.



A3- 28. Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16053) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 15 October, 2012.

APPENDIX 4. Acoustic tagging and biological information for Lake Sturgeon tagged in the Nelson River in spring, 2012.

Page

A4- 1. Tag and biological information for Lake Sturgeon tagged with acoustic transmitters in the Nelson River between Clark Lake and Gull Rapids during spring 2011 and 2012.

Tagging Location	Date Tagged	ID Code	Floy-tag number	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity
Nelson River	5-Jun-11	16036	NSC 74400	1313	1414	20185	-	-
Nelson River	5-Jun-11	16039	NSC 48596	1425	1530	27216	F	2
Nelson River	5-Jun-11	16042	NSC 74399	956	1060	8165	M	7
Nelson River	6-Jun-11	16055	NSC 74396	872	974	6350	M	7
Nelson River	6-Jun-11	16054	NSC 74398	816	915	5023	-	-
Nelson River	7-Jun-11	16048	NSC 94396	967	1103	9299	-	-
Nelson River	9-Jun-11	16058	NSC 82631	867	953	6124	-	-
Nelson River	10-Jun-11	16075	NSC 50888	1610	1700	43092	F	2
Nelson River	10-Jun-11	16051	NSC 74394	1386	1510	24494	-	-
Nelson River	10-Jun-11	16045	NSC 77516	1379	1533	21773	M	9
Nelson River	10-Jun-11	16077	NSC 80265	1143	1245	12247	M	7
Nelson River	10-Jun-11	16056	NSC 77515	1020	1120	9526	M	8
Nelson River	11-Jun-11	16063	NSC 77514	1124	1229	10660	M	7
Nelson River	12-Jun-11	16073	NSC 77512	1169	1284	15422	M	8
Nelson River	12-Jun-11	16064	NSC 80370	1066	1148	9072	M	8
Nelson River	12-Jun-11	16065	NSC 77511	958	1058	7484	-	-
Nelson River	12-Jun-11	16062	NSC 77510	1176	1284	12247	-	-
Nelson River	13-Jun-11	16074	NSC 94030	915	1016	6804	M	7
Nelson River	16-Jun-11	16059	NSC 64718	1260	1385	16783	F	4
Nelson River	16-Jun-11	16076	NSC 50808	1260	1375	19958	-	-
Nelson River	16-Jun-11	16057	NSC 77509	900	1024	7711	-	-
Nelson River	16-Jun-11	16070	NSC 77508	1072	1195	10886	M	7
Nelson River	16-Jun-11	16071	NSC 76484	1026	1133	7711	M	8
Nelson River	17-Jun-11	16069	NSC 48909	1400	1570	32659	-	-
Nelson River	19-Jun-11	16067	NSC 50826	1090	1210	11340	-	-
Nelson River	19-Jun-11	16068	NSC 80368	1140	1254	11794	-	-
Nelson River	20-Jun-11	16066	NSC 77507	1310	1405	25855	F	4
Nelson River	21-Jun-11	16060	NSC 80118	1060	1170	10433	-	-
Nelson River	21-Jun-11	16072	NSC 77506	850	967	6350	-	-
Nelson River	21-Jun-11	16061	NSC 77504	805	901	3175	-	-
Nelson River	19-Jun-12	16026	NSC 100450	955	1070	7711.1	-	-

A4- 2. Tag and biological information for Lake Sturgeon tagged with acoustic transmitters in Stephens Lake, during spring and fall, 2011, and spring, 2012.

Tagging Location	Date Tagged	ID Code	Floy-tag number	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity
Stephens Lake	8-Jun-11	16037	-	826	911	-	-	-
Stephens Lake	9-Jun-11	16040	NSC 74411	1006	1105	8391	M	7
Stephens Lake	9-Jun-11	16044	NSC 56208	1161	1296	14969	M	-
Stephens Lake	10-Jun-11	16043	NSC 88788	790	885	4536	-	-
Stephens Lake	11-Jun-11	16032	NSC 46892	1064	1159	11340	M	-
Stephens Lake	11-Jun-11	16046	NSC 74413	1085	1209	9979	M	-
Stephens Lake	12-Jun-11	16030	NSC 56152	1004	1103	7711	-	-
Stephens Lake	12-Jun-11	16038	NSC 74415	1116	1239	11793	-	-
Stephens Lake	13-Jun-11	16050	NSC 74416	922	1041	6577	-	-
Stephens Lake	18-Jun-11	16033	NSC 74419	881	974	5443	-	-
Stephens Lake	18-Jun-11	16034	NSC 74418	796	904	4082	-	-
Stephens Lake	21-Jun-11	16029	NSC 56202	1208	1316	16556	F	5
Stephens Lake	26-Jun-11	16041	NSC 74421	903	1001	7257	-	-
Stephens Lake	26-Jun-11	16047	NSC 88789	920	1020	6577	-	-
Stephens Lake	24-Sep-11	16049	NSC 91174	1070	1182	10886	-	-
Stephens Lake	26-Sep-11	16035	NSC 69868	941	1040	8165	-	-
Stephens Lake	26-Sep-11	16052	NSC 69865	1190	1337	16329	-	-
Stephens Lake	26-Sep-11	16053	NSC 69867	919	1021	8218	-	-
Stephens Lake	28-Sep-11	16021	NSC 91715	880	977	6804	-	-
Stephens Lake	8-Jun-12	16020	NSC 55557	992	1100	-	M	7
Stephens Lake	13-Jun-12	16022	NSC 93924	884	976	5216.3	M	7
Stephens Lake	15-Jun-12	16027	NSC 80374	1120	2350	10432.6	M	-
Stephens Lake	16-Jun-12	16025	NSC 88776	1176	2956	14968.5	M	-
Stephens Lake	13-Jun-12	16028	NSC 93923	1024	1145	8618.3	M	8
Stephens Lake	13-Jun-12	16018	NSC 93922	850	951	6577.1	M	7
Stephens Lake	13-Jun-12	16019	NSC 93921	894	991	6803.9	-	-
Stephens Lake	13-Jun-12	16023	NSC 74416	960	1081	8391.5	-	-
Stephens Lake	13-Jun-12	16024	NSC 92925	906	1011	6803.9	-	-
Stephens Lake	13-Jun-12	16031	NSC 81628	810	900	5443.1	-	-

APPENDIX 5. Stationary receiver deployment and manual tracking information.

A5- 1. Detections of acoustically tagged Lake Sturgeon during manual tracking conducted at 38 sites in the Nelson River between Birthday Rapids and Gull Rapids, July 2012.

Site[1]	Date	Time Start[2]	Time End[2]	ID Code 1[3]	Detection Time 1	ID Code 2[3]	Detection Time 2	ID Code 3[3]	Detection Time 3
1	5-Aug-12	17:00	17:10						
2	5-Aug-12	16:19	16:29						
3	5-Aug-12	16:07	16:17	16074	16:08:22				
4	5-Aug-12	15:46	15:56	16069	15:47:54				
5	5-Aug-12	15:35	15:45						
6	5-Aug-12	16:32	16:42						
7	5-Aug-12	16:44	16:54						
8	5-Aug-12	15:24	15:34						
9	5-Aug-12	15:13	15:23						
10	5-Aug-12	14:53	15:03						
11	5-Aug-12	13:58	14:08						
12	5-Aug-12	13:45	13:55						
13	5-Aug-12	13:18	13:28						
14	5-Aug-12	13:31	13:41						
15	5-Aug-12	13:03	13:13	16051	13:06:54				
16	5-Aug-12	12:32	12:42						
17	5-Aug-12	12:18	12:28						
18	5-Aug-12	12:03	12:13						
19	5-Aug-12	11:30	11:40						
20	5-Aug-12	11:16	11:26						
21	5-Aug-12	11:04	11:14						
22	5-Aug-12	10:48	10:58	16046	10:52:11	16066	10:52:44		
23	4-Aug-12	16:32	16:42						
24	4-Aug-12	16:19	16:29	16071	16:19:31	16063	16:21:22		

A5- 1. Continued.

Site[1]	Date	Time Start[2]	Time End[2]	ID Code 1[3]	Detection Time 1	ID Code 2[3]	Detection Time 2	ID Code 3[3]	Detection Time 3
25	4-Aug-12	16:07	16:17	16060	16:07:07	16071	16:08:44	16063	16:09:32
26	4-Aug-12	15:40	15:50						
27	4-Aug-12	15:55	16:05	16076	15:56:28	16055	16:00:32	16059	16:03:59
28	3-Aug-12	16:22	16:32						
29	3-Aug-12	16:10	16:20						
30	3-Aug-12	15:30	15:40						
31	3-Aug-12	15:44	15:54						
32	3-Aug-12	15:58	16:08	16075	16:02:10				
33	3-Aug-12	16:35	16:45						
34	4-Aug-12	14:26	14:36						
35	4-Aug-12	14:40	14:50						
36	4-Aug-12	14:56	15:06						
37	4-Aug-12	15:13	15:23						
38	4-Aug-12	15:28	15:38						

1 – Refer to Figure 19 for sample site locations
2 – Indicates time at which acoustic monitoring began and ended
3 – Indicates acoustic ID of tagged fish detected at each sampling site

REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.4.2.2.2. Habitat; Page No.: 6-37

TAC Public Rd 3 DFO-0043

ROUND 1 PREAMBLE AND QUESTION:

"The majority of the lake sturgeon captured in the Long Spruce and Limestone reservoirs are taken in the upper end of the reservoirs where conditions are more characteristic of riverine habitat (NSC 2012). These observations suggest that, while the amount of usable foraging habitat (i.e., WUA) upstream of the Keeyask GS will be higher in the post-Project environment, not all this habitat may be selected by either sub-adult or adult fish."

This suggests that post the project environment WUA for these life stages may need to be modified using this system specific observations. Please consider these changes in the WUA tables and discuss this in the EIS.

ROUND 2 PREAMBLE AND QUESTION:

WUA, in practice, is the combination of suitabilities.

FOLLOW-UP QUESTION:

Please see DFO-0001.

RESPONSE:

Please see the response to TAC Public Rd 3 DFO-0001.

REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.4.2.3.1 Habitat; Page No.: 6-40

TAC Public Rd 3 DFO-0044

ROUND 1 PREAMBLE AND QUESTION:

"To compensate for the loss of spawning habitat, several areas will be developed to provide suitable spawning habit"

All proposed compensation works should have relevant suitability curves applied and commensurate WUA and HU's calculated.

ROUND 2 PREAMBLE AND QUESTION:

DFO will require confirmation that methods/analysis for delineation of HADD's are commensurate with the proposed compensation (i.e. HSI or area based descriptions).

FOLLOW-UP QUESTION:

Please see DFO-0001.

RESPONSE:

Please see the response to TAC Public Rd 3 DFO-0001.

REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.4.2.3.1 Habitat; Page No.: 6-41

TAC Public Rd 3 DFO-0045

ROUND 1 PREAMBLE AND QUESTION:

"Lake sturgeon could also use habitat in the river below the spillway in years when the spillway is operating at sufficient discharges during the spawning and egg incubation period"

Please provide details on performance/success of lake sturgeon spawning habitat use and successful hatch from similar structures developed at the Grand Rapids and Limestone GS's.

ROUND 2 PREAMBLE AND QUESTION:

Experimental spawning habitat has been developed at Point du Bois generating station. Please provide the results.

FOLLOW-UP QUESTION:

Please see DFO-0001.

RESPONSE:

Please see the response to TAC Public Rd 3 DFO-0001. Information on spawning structures constructed at Pointe du Bois and elsewhere is used to address the certainty of proposed compensation measures provided in the table with this response.

REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.4.2.3.1 Habitat; Page No.: 6-41

TAC Public Rd 3 DFO-0047

ROUND 1 PREAMBLE AND QUESTION:

"Because the number of lake sturgeon residing downstream of Gull Rapids is considerably reduced compared to historic levels, a stocking program will be implemented to avoid possible effects of a temporary reduction in rearing habitat should it occur"

Given the loss of known high quality YOY habitat north of Caribou Island (future forebay), the known YOY rearing habitat below Gull Rapids must be protected. What measures will be taken to ensure that this habitat will not change, both during construction and operation?

ROUND 2 PREAMBLE AND QUESTION:

The EIS describes, at best an expected small change in habitat composition at this location. At worst, predictions may be wrong and this critical habitat is lost.

FOLLOW-UP QUESTION:

Please see DFO-0001.

RESPONSE:

Please see the response to TAC Public Rd 3 DFO-0001. Uncertainty with respect to proposed mitigation and compensation measures are addressed in the table associated with this response.

REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.4.2.3.2 Movements; Page No.: 6-43

TAC Public Rd 3 DFO-0048

ROUND 1 PREAMBLE AND QUESTION:

"The phased approach to fish passage…..will permit trial implementation of fish passage for lake sturgeon with minimal risk to the Stephens Lake population."

The stated risk to the Stephens Lake sturgeon population is not identified. Note, the proponent has been requested to investigate the cost/benefits of various fish passage designs, including cost, environmental cost/benefit, etc. The proponent has retained a consultant for this investigation, which has produced a preliminary report on this comparison. The detailed results of this report should be made available in the EIS for review.

ROUND 2 PREAMBLE AND QUESTION:

A detailed report on options and/or an agreement on post-project fish movement/behaviour have not been provided and/or concluded.

FOLLOW-UP QUESTION:

Please see DFO-0033.

RESPONSE:

Please see the response to TAC Public Rd 3 DFO-0033.

REFERENCE: Volume: N/A; Section: N/A; Page No.: N/A

TAC Public Rd 3 DFO-0049

ROUND 1 PREAMBLE AND QUESTION:

"The phased approach to fish passage…..will permit trial implementation of fish passage for lake sturgeon with minimal risk to the Stephens Lake population."

Trap and truck was identified as the fish passage option for Keeyask, this method has traditionally been used at high head dams and information behind the rationale for the selection of this option is required. What criteria will be used to determine if and when trap and truck should be implemented?

ROUND 2 PREAMBLE AND QUESTION:

While DFO has been provided a summary report on November 29th, 2012, this report has not (to DFO's knowledge) been made available to the federal review team or the public. Moreover, release of the full report on fish passage options at Keeyask would be ideal.

FOLLOW-UP QUESTION:

Please see DFO-0033.

RESPONSE:

Please see the response to TAC Public Rd 3 DFO-0033.

REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 6.4.2.3.2 Movements; Page No.: 6-43

TAC Public Rd 3 DFO-0051

ROUND 1 PREAMBLE AND QUESTION:

"There is no information available on turbine mortality rates for sturgeon."

Mortality rate for sturgeon should be based on:

1. known mortality for species of a similar size (e.g. pike) for both spillway and turbine and
2. the number of individuals passing the turbines can be calculated based on fish passage studies (e.g. Missi Falls) and a commensurate relative abundance estimates. Please provide detailed reports which describe this.

ROUND 2 PREAMBLE AND QUESTION:

Unclear as to why northern pike cannot be used as a surrogate for lake sturgeon - please clarify. Are mortality rates available for white sturgeon for comparable turbine designs?

FOLLOW-UP QUESTION:

Would the Proponent please summarize its present information on expected sources and estimates of fish mortality from passage of fish through the Keeyask turbines and spillway? DFO needs a clear understanding of expected sources and estimates of fish mortality.

DFO notes that Table 2 on page 1A-81 AE SV does not include anticipated physical and hydraulic characteristics for the proposed Keeyask turbines - can this be provided?

The turbine design description gives an anticipated survival rate for fish up to 500 mm as over 90%. However, Table 1 on page 1A-101 indicates that pike, walleye, and sturgeon larger than 500 mm could pass the trash racks and go through the turbines. What are the survival rates anticipated for fish greater than 500 mm up to the maximum expected sizes estimated to be? Can survival estimates be made for whitefish?

Although a population model for sturgeon, estimating the population trajectory, is given with anticipated effects for general changes in survival, this is not related to the estimated additional mortality the population might experience from turbine passage. Given the proponent's knowledge of sturgeon population structure and movements through the rapids can this information be provided?

Keeyask Hydropower Limited Partnership

Information is only provided for sturgeon - can it be provided for other VEC species. Can it be assumed that eggs, larvae, smaller life stages, and small bodied forage species passing downstream will not be significantly affected?

Little or no information has been provided for spillway characteristics and potential impacts - can the proponent describe anticipated impacts for downstream passage at the spillway?

In addition, an Aquatic Effects Monitoring Plan (AEMP) - referred to by the proponent as providing additional information, is presently under discussion and is scheduled for public release by the Proponent in the second quarter of 2013.

RESPONSE:

Each of the questions or groups of similar questions are addressed below:

1. *"Would the Proponent please summarize its present information on expected sources and estimates of fish mortality from passage of fish through the Keeyask turbines and spillway? DFO needs a clear understanding of expected sources and estimates of fish mortality."*

The following information was extracted from CEC Rd 2 CEC-0100:

As discussed in the AE SV, the estimated survival rate of fish up to 500 mm in length during passage through turbines with design specifications for the proposed Keeyask turbines is greater than 90%. This estimate is based on the Franke formula, which addresses injury due to blade strikes; mechanical damage is the primary cause for fish injury/mortality passing through low head (<30 m) hydro facilities similar to the Keeyask GS (18 m head).

With respect to adverse effects related to pressure changes during passage through the turbines, tests with surface acclimated fish have shown little effect of pressure changes during turbine passage:

> "*Although thousands of HI-Z tagged fish have been passed through turbines with a wide range of nadirs very few (<1%) of the recaptured fish have displayed injuries that could be attributed to sudden decompression trauma. Because the HI-Z tagged fish are held in water less than 40 cm deep prior to turbine passage these test fish are not acclimated to depths that a portion of naturally entrained fish would be. However, it has been very obvious from the HI-Z tag tests that there is little evidence that a sudden increase or decrease in pressure has any substantial negative effects on near surface acclimated fish...... Based on the parameters of the selected turbine design, it is anticipated that fish passing through the Keeyask GS turbines will be not be exposed to sudden increases or*

> *decreases in pressure that would have substantial negative effects on the fish.*" (AE SV Appendix 1A Attachment 1).

Mortality during passage over the spillway is not expected to be substantial at the Keeyask GS. As stated in the AE SV (Section 5.4.2.3.7, p. 5-63):

> "*Passage through the spillway is not expected to result in greater mortality or injury than currently occurs for fish moving downstream past Gull Rapids because the spillway channel will follow the old riverbed and not have any sudden drops, plunge pools, or barriers. Fish could become stranded in isolated pools that may form in portions of the south channel of Gull Rapids after the spillway ceases operation (Section 3.4.2.3). To mitigate this effect, channels will be excavated to connect the pools to Stephens Lake to prevent fish stranding when water is not passed through the spillway (Appendix 1A).*"

Pressure changes experienced by fish during passage by the spillway are not expected to cause injury/mortality to a substantial portion of the fish moving downstream for the following reasons:

- At Full Supply Level, the depth of water at the spillway entrance will be 14.5 m. Most of the fish in the study area (with the exception of Lake Sturgeon) will be distributed throughout the water column and so few will be acclimated to the higher pressure at the bottom.
- Spillway flow will quickly carry fish from the spillway gate, over the steep portion of the river channel (present day Gull Rapids) to deeper waters in the Nelson River channel (4-8 m depth and rapidly increasing to 8-12 metres) providing fish with deeper water in close proximity to the spillway.
- Physoclistous fish are typically affected to a greater degree than physostomous fish. Of the four VEC fish species, only walleye are physoclistous.

In addition to the above-stated points, it should be noted that no evidence of barotrauma following spillway passage has been reported at any Manitoba Hydro facility.

2. "*DFO notes that Table 2 on page 1A-81 AE SV does not include anticipated physical and hydraulic characteristics for the proposed Keeyask turbines - can this be provided?*"

The anticipated physical and hydraulic characteristics for the proposed Keeyask turbines are proprietary and cannot be provided.

Additional information on the method used to apply the Franke formula to estimate survival based on the design specifications for the Keeyask turbines is provided in the attachment.

3. “*The turbine design description gives an anticipated survival rate for fish up to 500 mm as over 90%. However, Table 1 on page 1A-101 indicates that pike, walleye, and sturgeon larger than 500 mm could pass the trash racks and go through the turbines. What are the survival rates anticipated for fish greater than 500 mm up to the maximum expected sizes estimated to be? Can survival estimates be made for whitefish?*”

The Franke Formula (used to estimate survival of fish passing through the Keeyask turbines) was developed using a large set of reference field survival data. As most of those studies were conducted with small fish (> 200 mm), and few survival data exist on large fish, Franke et al. (1997) conclude that considerations for turbine design modifications for large fish cannot be fully concluded. As a result, estimating survival for fish larger than 500 mm is a significant extrapolation from any existing reference data or the capabilities of the Franke formula, and cannot be done with confidence. However, the following discusses trends that were observed in the 2006 and 2008 studies conducted at the Kelsey GS (NSC and Normandeau Associates 2007, 2009). The study evaluated injury and mortality of Northern Pike (n=88 in 2006, 116 in 2008) and Walleye (n=99 in 2006, 91 in 2008) that were experimentally introduced into two different turbine units (unit 2 in 2006, re-runnered unit 5 in 2008) at the Kelsey GS.

Mortality (assessed 48 h post-passage) was not statistically related to fish length for each species by Normandeau in 2006. However, NSC and Normandeau (2007) indicate that survival decreased with increasing length (i.e., 50 mm length classes) for each species, almost linearly for Walleye and stepwise for pike. For the latter species, the 10 fish of <550 mm length had 100% survival, whereas survival in all larger fish ranged from 64-81%, with an overall mean of approximately 73%. For Walleye, there was an almost continuous decline in survival rate from 100% for the three fish of 300-350 mm length to approximately 61% for the five fish in the >550 mm length class. Normandeau also concluded that the overall lower survival rate (i.e., calculated probability) of pike (66%) in 2006 was most likely related to their larger size (455-1085 mm total length, mean 660mm) compared to the Walleye (314-651 mm, mean 446 mm).

In 2008 size related differences in survival rate were less pronounced than in 2006. Northern Pike showed a tendency for decreasing survival in the larger length classes (total length range 156-769 mm, mean 553 mm), whereas Walleye of all size classes (total length range 332-653 mm, mean 428 mm) had survival rates of between 86 and 100% without showing a clear trend over the size range covered. In agreement with these conclusions, an analysis by Normandeau indicated, that the mean length of pike and Walleye that survived turbine passage were similar to those that did not survive, respectively (NSC and Normandeau 2009).

In addition to survival, Normandeau also considered the relationship between injury rate and fish length in the two studies. In 2006, the observed lower frequency of injuries in the smaller length classes of Walleye was statistically significant (p=0.001), whereas no such trend could be discerned for pike (NSC and Normandeau 2007). Although injury rates were also related to fish length in 2008, there was a species reversal compared to 2006. The mean length (497 mm) of the injury-free pike in was significant (p<0.05) lower than the mean length (556 mm) of the injured pike in 2008 (NSC and Normandeau 2009). Uninjured Walleye were also on average smaller (406 mm) than their conspecifics with injuries (412 mm length), but the difference in the mean lengths was not significant.

In conclusion, the Kelsey turbine mortality studies indicated that mortality and injury rates can increase with fish size over a considerable length range for Northern Pike and Walleye, thus confirming results from many other studies and supporting the underpinnings of mathematical models to estimate fish turbine mortality (e.g., the Franke formula). However the results of the Kelsey studies were inconsistent, showing sometimes considerable interactions between the two species and the study year in the relationship of fish size and fish mortality/injury.

As discussed in TAC and Public Round 1 DFO-0051, Table 2 in the Aquatic Environment Supporting Volume Appendix 1A, Attachment 1 contains a list of measured mortality rates from many species, sizes and types of turbines and provides an indication of the range in mortality rates that have been observed. Information from Table 2 for larger fish and a few key turbine parameters is attached[4]. Survival estimates range from 65-93% and tend to be greater for turbines with a larger diameter and slower rotational speed. As described in DFO-0102, the turbines at the Keeyask GS will have a larger diameter (8.35 m) and slower rotational rate (75 rpm) than any of the GS listed in the attached table; these properties are expected to reduce the incidence of fish injury and mortality.

Summary of information extracted from Aquatic Environment Supporting Volume Appendix 1A, Part 1, Attachment 1 Table 2

[4] Note that the turbine diameter of the Kelsey GS has been corrected to 5.84 m here and was erroneously presented as 7.92 m in Table 2 in the Aquatic Environment Supporting Volume.

Station	Species	Size (mm)	Turbine	Blades	Runner Speed (rpm)	Diam. (m)	48 d Survival
Safe Harbor	shad	425	Mixed Flow	7	76.6	6.10	0.843
Kelsey	walleye	431	Propeller	5	102.9	5.84	0.877
Kelsey	walleye	447	Propeller	6	102.9	5.84	0.804
Kelsey	pike	595	Propeller	5	102.9	5.84	0.756
Kelsey	pike	661	Propeller	6	102.9	5.84	0.659
Beaucaire	eel	690	Bulb	4	94	6.24	0.93
Fessenheim	eel	704	Kaplan	4	88	6.67	0.924
Ottmarsheim	eel	750	Kaplan	5	94	6.25	0.799
Robert Moses	eel	1020	Propeller	6	99	6.10	73.5 (88h)

4. "Although a population model for sturgeon, estimating the population trajectory, is given with anticipated effects for general changes in survival, this is not related to the estimated additional mortality the population might experience from turbine passage. Given the proponent's knowledge of sturgeon population structure and movements through the rapids can this information be provided? Information is only provided for sturgeon - can it be provided for other VEC species."

As previously described in TAC Public Rd2 DFO-106, the program used to estimate Lake Sturgeon population size also calculates lambda, the probability that the population trajectory is stable (lambda=1), increasing (>1) or decreasing (<1). The current population model has a survival rate of 84% and an 11% chance that the population is in decline. If it is assumed that approximately 1% of the Lake Sturgeon in Gull Lake move downstream and are lost to the population each year (based on the number of sturgeon leaving Gull Lake at present and assuming 100% turbine mortality), then the probability that the population is decreasing increases to 15%. The highest recorded rate of downstream movement of adult sturgeon was at the Slave Falls GS – based on an annual downstream loss of 3%, the probability that the Gull Lake population is in decline increases to 32%.

As discussed with DFO, this model only address the population trajectory based on survival; a more robust estimate of the long term persistence of the population could be obtained if a population model similar to that used in DFO's Recovery Potential Assessment was applied. The Partnership will work with DFO to develop such a model using site-specific parameters (e.g., survival, mortality rates).

Population trajectories are not available for other species; however, as noted previously, the other VEC species maintain populations in reservoirs upstream and downstream of generating stations on systems such as the Winnipeg River and the Nelson River were several GSs are developed in sequence, suggesting that the cumulative loss of fish moving downstream is not sufficient to have a marked effect on fish populations.

5. "Can it be assumed that eggs, larvae, smaller life stages, and small bodied forage species passing downstream will not be significantly affected?"

Based primarily on a literature review by Cada (1990) on non-migratory fish species and propeller-type turbines at low-head dams (i.e., <30 m), it is expected that young life-stages of fish (i.e., eggs and larvae) will be less affected by turbine passage than larger fish. Cada (1990) estimated that "less than 5% of entrained ichthyoplankton will be affected". The main reason for this low percentage is that these small life-stages are less susceptible to mechanical injury during turbine passage. Theoretically, cavitation and high turbulence should affect fish larvae more than larger fish, but Cada (1990) found no clear evidence for this. Increases in larval mortality can be expected, as for larger fish, if larvae are entrained from depth that result in decompression within the turbine to <40% of acclimation pressure.

We are not aware of studies to address turbine mortality/injury of small-bodied forage fish species typical for northern Manitoba. However many studies have experimentally measured turbine mortality of smolts of Pacific salmon (*Oncorhynchus* spec.) in the Snake/Columbia River system. These fish measure between 90-180 mm on average. Mortality rates at well-operating power stations have been measured in the range of 1-15%, and commonly are 3-7% (Cada 2001).

6. "Little or no information has been provided for spillway characteristics and potential impacts - can the proponent describe anticipated impacts for downstream passage at the spillway?"

See text under question 1 above.

7. " In addition, an Aquatic Effects Monitoring Plan (AEMP) - referred to by the proponent as providing additional information, is presently under discussion and is scheduled for public release by the Proponent in the second quarter of 2013".

The draft AEMP is available on the Partnership's website.

Information on monitoring movements and turbine effects was provided in CEC Rd1 CAC -0036 and is reproduced below. As discussed, monitoring will include both movements of tagged fish and experimental introduction of fish into the turbines.

Monitoring of Lake Sturgeon movements during construction will be conducted based on acoustic tags (Vemco V16 transmitters with a 10 year battery life) that were implanted in 2011. It is anticipated that the number of tags (31 initially applied upstream of the generating station) will be maintained through the initial years of operation. A 50+ receiver VR2W array, currently being used to monitor movements of Lake Sturgeon, will be supplemented in 2013 with receiver "gates" deployed in several key areas (upstream and downstream of Gull Rapids, upstream and downstream of Birthday Rapids, upstream of Kettle GS). For reference, "gates" refer to simultaneous use of two or more acoustic receivers oriented perpendicular to the primary flow axis to provide complete coverage for a cross section of river. Theoretically, this should result in 100% detection of passing fish and allow for directionality of movements to be ascertained. The number and location of receivers may be modified post-impoundment to continue to provide maximum possible coverage of the mainstem of the Nelson River. Movements of tagged fish will be monitored throughout the open-water season and, to a lesser extent, during the ice covered season (depending on ice conditions). The methodologies employed will achieve a high level temporal resolution associated with large scale movements between or through key locations (i.e. Gull Rapids and, post-Project, the generating station). In addition to addressing movements past the generating station, the data collected post-impoundment will increase understanding of Lake Sturgeon movement patterns (i.e., typical distances and spatial patterns associated with spawning and foraging) and relative utilization of the different reaches of the Nelson River.

Movements of other species such as Walleye, and potentially Northern Pike and Lake Whitefish, will also be monitored with acoustic telemetry; however, the largest fish in the population will likely not be targeted due to increased susceptibility to mortality due to tagging.

Turbine effects may also be assessed based on the experimental introduction of fish into the turbines (i.e., not passing by the trashracks). Based on currently available information, this aspect of monitoring will be modelled after studies conducted at the Kelsey Generating Station in 2006 and 2008 (North/South Consultants Inc. [NSC] and Normandeau Associates Inc. 2007, 2009). While the approach outlined in the sections below is based on the Kelsey studies, alternate approaches to estimating turbine and spillway mortality at the Keeyask Generating Station will be evaluated in consultation with MCWS and DFO before such a study is conducted, and the most effective approach will be selected.

To estimate the rates of injury and mortality of fish during passage through the Keeyask Generating Station, Walleye, Northern Pike, and Lake Whitefish (if adequate numbers can be captured) would be experimentally passed through one turbine and the spillway in sufficient numbers to make statistically valid predictions of 48-hour survival. Control fish would be released immediately downstream of the GS and the spillway. All study fish will be captured in the area, marked with HI-Z (balloon) and radio tags, and released into the turbine intake or spillway. Fish would be recaptured downstream of the generating station, injuries assessed, and survival calculated after a 48-hour holding period.

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Cada, G. F. 1990. A review of studies relating to the effects of propeller-type turbine passage on fish early life stages. N. Am. J. Fish. Manage. 10:418-426

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North/South Consultants Inc. and Normandeau Associates Inc. 2007. Fish movements and turbine passage at selected Manitoba Hydro generating stations 2005-2006 interim report. North/South Consultants Inc., Winnipeg, MB.

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ATTACHMENT – METHOD TO CALCULATE EXPECTED TURBINE MORTALITY

INTRODUCTION

Mitigating the risk of injury or mortality to fish passing downstream via the turbines of the Keeyask Generating Station (GS) was identified early on in the planning of the project as a key design component. The inclusion of Environmentally Enhanced Design Features was therefore incorporated as a requirement of the tendering process for the Keeyask turbines.

A number of variables were considered in the selection and development of turbines for the Keeyask GS to minimize the risk of injury and mortality of fish as they pass downstream. These variables include the number, alignment, and shape of stay vanes and wicket gates, clearance at the wicket gates and runners, wicket gate overhang, number of blades, blade leading edge thickness, blade trailing edge (related to turbulence), rotation rate, runner diameter, blade speed, and absolute lowest pressure.

At present the design of the Keeyask turbines has not been finalized; however many of the key factors relating to fish mortality have been determined through preliminary design studies. This has allowed Manitoba Hydro (MH) on behalf of the Keeyask Hydropower Limited Partnership) KHLP to develop preliminary estimates of fish mortality in an effort to confirm the industry leading "fish friendly" features that have been incorporated into their design.

To facilitate this analysis MH retained the services of Normandeau Associates (Normandeau). The analysis of Normandeau was also reviewed and expanded upon by R2 Resource Consultants (R2) as part of a broader fish passage study. The analysis of both consultants make use of the Franke Formula (Franke et al. 1997) to estimate strike related mortality of fish passed through propeller type turbines. The intent of this document is to summarize the key findings of Normandeau and R2's analysis. The referenced documents are not provided as they contain proprietary information relating to the preliminary design of the Keeyask turbines which cannot be released under the terms of MH's contract with the supplier.

FRANKE FORMULA

An analysis of turbine parameters can be used to estimate survival using a formula developed by Franke et al. (1997). The formula grew out of efforts by the Department of Energy (DOE) to design more "fish-friendly" turbines, and was developed in conjunction with the U.S. Department of Energy's Advanced Hydro Turbine System Program (AHTSP). The results of hundreds of turbine mortality studies were compiled to develop predictive equations of turbine mortality based on specific turbine characteristics (Franke et al. 1997). Propeller turbines were considered separately in the AHTSP study, since these are different turbine designs and understandably result in very different impacts on fish passing through them. A thorough discussion of the derivation and application of the formulas is provided in Franke et al. (1997).

The Franke predictive equation uses turbine size, rotational speed, number of turbine blades, flow, and the length of the fish entrained to estimate the probability that a fish of a given size will come near to or in contact with a structural element as it passes through the turbine. The predictive equation also adjusts the results for head and mechanical efficiency. The equation is used to estimate the probability that a fish passing through the turbine will experience significant negative impacts. Strike, shear, grinding and cavitation (if it occurs) all are most pronounced very near to or in contact with the turbine blades or other physical components of the turbine, and pressure changes and turbulence are accounted for by the adjustments made for head and efficiency. Fish length and available passage space are the principal drivers of the output.

Use of the Franke predictive equation involves development of a blade strike correlation factor (lambda, λ) to translate field mortality measurements at other projects throughout North America to the calculated probability estimate for the Keeyask Generating Station. Obviously, this factor will vary by species of fish, as some species fare better than others when passing through turbines. One significant factor affecting turbine survival is the anatomy of the air bladder. In some species of fish (physostomatous species) the air bladder is connected via a duct to the mouth and the fish are able to rapidly discharge excess air from the bladder upon rapid pressure drops. Among the target species at the Keeyask site, these species include lake sturgeon and lake whitefish. Physoclistous species, including walleye, northern pike and burbot, do not have this duct. The air bladder pressure is controlled by special tissues or glands at a much slower pace making them more susceptible to injury upon exposure to large, rapid pressure decreases. In developing correlation factors for the estimates of mortality for the Keeyask turbines, we conservatively limited our review to physoclistous species. The survival of lake sturgeon and lake whitefish may be toward the higher end of our survival estimate ranges.

METHODS

Estimates of survival through the Keeyask turbines were assessed by Normandeau Associates Inc. (2011), and then peer reviewed by R2 Resource Consultants, Inc. (2012) using the Franke Formula. Projected estimates of survival at Keeyask were calculated using four representative fish lengths (100, 205, 305 and 510mm), a single discharge condition (maximum), and the preliminary design parameters for the Keeyask turbines. As outlined earlier the Keeyask turbines are undergoing final design and optimization and as such, specific design features of the Keeyask turbines are currently proprietary information of the supplier and others are simply not known at present. Preliminary survival estimates were therefore developed based on reasonable assumptions of some parameters or a range of parameters.

The Normandeau report estimated exposure to hazardous conditions at three passage locations (near hub, mid blade and tip), and used two blade strike correlation factors (0.1 and 0.2, determined by Franke *et al.* (1997) from Kaplan survival tests). This approach mimics the methods used in the Kelsey Turbine Passage study, allowing comparison between those results and the expected outcomes of the Keeyask turbines. The approach taken by R2 estimated probability of exposure to hazardous conditions relative to the overall turbine flow, rather than isolating estimates relative to passage near the hub, mid-blade, and tip separately at a single passage location. This is appropriate because there is typically no basis for knowing what percentage of fish might pass by any of the three given routes, so an overall average passage survival estimate is typically more useful. For this approach, additional blade strike correlation factors were determined through back-calculating correlation factors for non-salmonids from the results of 23 survival studies at 5 projects with Kaplan turbines. This resulted in factors from slightly below 0.1 to slightly above 0.3, with values scattered fairly equally throughout the range. In some cases the factor might be near or below 0.1 for one test and as high as 0.3 for the same size and species of fish at the same project on a different day. This range of unpredictability was accounted for by increasing the range of correlation factors from 0.07 to 0.33, and using 0.20 as the average value and as a comparison value.

Although the formula calculates a probability, in the present context it is more conventionally used in the formula Survival (S) = 1 – P, with results expressed as a survival percentage.

Formula 1: Franke Formula for estimating strike related mortality of fish passed through propeller type turbines.

$$P = \lambda\left[\frac{N * L}{D}\right]\left[\frac{\cos\alpha_a}{8Q_{\omega d}} + \frac{\sin\alpha_a}{\pi\frac{r}{R}}\right] \textit{ and}$$

S = 1 – P *where,*

P = probability of strike,

l = strike mortality correlation factor,

N = number of turbine runner blades,

L = fish length,

D = maximum turbine runner diameter,

a_a = angle to axial of absolute flow upstream of turbine runner,

Q_{wd} = discharge coefficient (Q/wD^3),

w = rotational speed (rpm x 2p/60),

R = turbine runner radius,

r = turbine runner radius at point fish enters turbine, and

S = survival probability.

RESULTS

The assessments completed by Normandeau (2011) and R2 Resource Consultants (2012) had comparable results. Based on their results, the turbine design selected for Keeyask GS will have an estimated survival over 90% (Tables 1 and 2). This generalized estimate includes fish up to 510 mm, at a single discharge condition (maximum), three passage locations (near hub, mid blade and tip) and a single passage locations, and multiple blade strike correlation factors (0.07, 0.1, 0.2 and 0.33).

Table 1: Turbine Survival Estimates at three turbine locations (Hub, Mid-blade and Tip) for Keeyask Turbines using the Francke Formula (Formula 1)

Correlation Factor:	**0.1**			**0.2**		
Passage Location:	**Hub**	**Mid**	**Tip**	**Hub**	**Mid**	**Tip**
Fish Length (mm)						
100	99.5	99.4	98.4	99.0	98.9	96.8
205	99.0	98.9	96.8	97.9	97.7	93.7
305	98.4	98.3	95.2	96.9	96.6	90.5
510	97.4	97.4	92.1	94.8	94.3	84.2

Table 2: Turbine Survival Estimates relative to the entire Keeyask turbine flow using the Franke Formula (Formula 1).

Correlation Factor:	**0.07**	**0.2**	**0.33**	**Range**
Fish Length (mm)				
100	99.6	99.0	98.3	99.0 +/- 0.7
205	99.3	97.9	96.5	97.9 +/- 1.4
305	98.9	96.8	94.7	96.8 +/- 2.1
510	98.2	94.7	91.2	94.7 +/- 3.5

DISCUSSION

The use of a fixed blade vertical shaft turbine design for Keeyask GS results in several advantages for fish passage survivability compared to other turbine styles. The fixed blade pitch of the vertical shaft units allows for the gap between the runner blades and the discharge ring to be minimized, reducing the likelihood of fish impingement and injury. The low rotational speeds associated with large diameter vertical shaft turbines also result in greater fish survivability. To reduce the risk of striking or impingement injuries; runner blades incorporate a thicker rounder leading edge, the gaps between wicket gates and both the head ring and head cover were minimized, and the wicket gate overhang was also minimized. To reduce turbulence levels experienced by fish passing through the turbines, the runner blades incorporate a thinner trailing edge, and the shape of the draft tubes incorporate large sweeping radii. These are all known to improve the probability of a fish passing through a turbine without incurring significant injury or mortality.

This is the first time that Manitoba Hydro has included these variables relevant for fish survival as part of the evaluation in the initial turbine design selection process, and as a priority for further turbine design development. Although there are many variables to consider beyond those relevant for fish survival (particularly efficiency and cost), the objective for the Keeyask GS turbines is to achieve a minimum survival rate of 90% for fish as large as 500 mm.

REFERENCES

Franke, G.F., D.R. Webb, R.K. Fisher, Jr., D. Mathur, P.N. Hopping, P.A. March, M.R. Headrick, I.T. Laczo, Y. Ventikos, and F. Sotiropoulos. 1997. Development of environmentally advanced hydropower turbine system design concepts.

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R2 Resource Consultants Inc. February 2012. Technical Memorandum 1895.014, Keeyask Generating Station Fish Passage Study, R2 Evaluation of Turbine Passage Survival Estimates. Prepared for Manitoba Hydro. 9 pp.

REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 6B.1 Field Data Collection and Analysis; Page No.: 6B-1

TAC Public Rd 3 DFO-0054

ROUND 1 PREAMBLE AND QUESTION:

Appendix 6B Field Data Collection and Analysis

Details on mark recapture information is lacking in terms of annual movements. Raw data used for population estimates should be made available.

ROUND 2 PREAMBLE AND QUESTION:

Proponent plan still in production and not available for review.

FOLLOW-UP QUESTION:

Please see DFO-0033

RESPONSE:

Please see the response to TAC Public Rd 3 DFO-0033.

REFERENCE: Volume: Project Description Supporting Volume; Section: 3.10.2 Management Plans to be Developed; Page No.: 3-32

TAC Public Rd 3 DFO-0055

ROUND 1 PREAMBLE AND QUESTION:

Management Plans to be Developed

All cited management plans should be provided as part of the EIS submission.

ROUND 2 PREAMBLE AND QUESTION:

Proponent plans still in production and not available for review.

FOLLOW-UP QUESTION:

DFO would appreciate seeing reports in preparation such as the Physical Environment Monitoring Plan (PEMP) as this is frequently referred to as having information that will help answer DFO's questions.

RESPONSE:

The Partnership submitted a preliminary version of the PEMP to regulators on June 28, 2013. This preliminary version is also available on the Partnership’s website at www.keeyask.com.

REFERENCE: Volume: Response to EIS Guidelines; Section: Section: 4.3.3 Environmental Mitigation/Compensation; Page No.: 4-14

TAC Public Rd 3 DFO-0057

ROUND 1 PREAMBLE AND QUESTION:

Construction Mitigation - DFO notes that timing for the majority of in-stream work is scheduled between July 16 to September 15

Please provide detailed contingency plans for construction techniques proposed should a request to extend construction beyond proposed dates occur. DFO would appreciate the opportunity to review contingency plans in advance to ensure appropriate decisions with a timely response can be provided.

ROUND 2 PREAMBLE AND QUESTION:

Pre-emptive planning and design required for exemption to time restrictions

FOLLOW-UP QUESTION:

The question was about construction scheduling changes and the mitigation that could occur if the schedule changes - using construction suspended sediment inputs as one example. The Proponent's response focused on construction sediment which should now be captured in the Sediment Management Plan. However, other potential effects were not discussed. For example, contingency planning for prevention of fish kills in cofferdam dewatering. DFO needs a clear understanding of expected sources and estimates of fish mortality. DFO is aware of occasions when a construction schedule change from open water to winter prevented the capture and downstream release of fish isolated behind the cofferdam during dewatering. This was for staff safety and there was no option available to regulators to advise a delay in dewatering. DFO believes there is some risk of this potentially occurring at Keeyask. Can the proponent provide additional information about its action plan for assessment/prevention/mitigation of fish kills. To date, the proponent suggests that they will provide a risk assessment and ask for approval from regulators - as problems arise. Ideally, DFO would like to know that the potential fish kill for any given scenario is likely to be insignificant in relation to any serious harm that might be incurred by fish that support a fishery - significantly in advance of situations arising. Could the Proponent, for example, calculate the areas and other characteristics of cofferdam impoundments, compare this with any previous fish rescue information it may have, look at any possible mitigation, and assess the potential risk of not being able to carry out rescues?

RESPONSE:

Please see the response to TAC Public Rd 3 DFO-0086.

REFERENCE: Volume: Response to EIS Guidelines; Section: 8.0 Monitoring & Follow-up; Page No.: N/A

TAC Public Rd 3 DFO-0058

ROUND 1 PREAMBLE AND QUESTION:

Monitoring

DFO notes that there are no monitoring plans submitted within the EIS. We look forward to reviewing the following management and monitoring plans (as proposed to be developed in chapter 8 of the EIS):

- Sediment Management Plan
- Fish Habitat Compensation Plan
- Waterways Management Plan
- Aquatic Effects Monitoring Plan
- Physical Environment Monitoring Plan

ROUND 2 PREAMBLE AND QUESTION:

See DFO-0055

FOLLOW-UP QUESTION:

AEMP and Habitat Compensation Plan still under discussion. DFO would appreciate seeing the draft PEMP as soon as it is available

RESPONSE:

The Partnership submitted a preliminary version of the PEMP to regulators on June 28, 2013. This preliminary version is also available on the Partnership's website at www.keeyask.com.

REFERENCE: Volume: Response to EIS Guidelines; Section: 8.0 Monitoring & Follow-up; Page No.: N/A

TAC Public Rd 3 DFO-0059

ROUND 1 PREAMBLE AND QUESTION:

Monitoring

How will peat deposition be monitored? And assumptions in the EIS verified? (ex. Estimate only 1% of peat will be transported downstream)

ROUND 2 PREAMBLE AND QUESTION:

Proponent plan still in production and not available for review.

FOLLOW-UP QUESTION:

Please see DFO-0058

RESPONSE:

The Partnership submitted a preliminary version of the PEMP to regulators on June 28, 2013. This preliminary version is also available on the Partnership's website at www.keeyask.com.

REFERENCE: Volume: Physical Environment Supporting Volume; Section: Appendix 7C Field Maps (Open Water) and 7D Monitoring Locations (Winter); Page No.: N/A

TAC Public Rd 3 DFO-0060

ROUND 1 PREAMBLE AND QUESTION:

Monitoring

Please provide a detailed map of baseline sedimentation sampling sites and proposed monitoring sites? Ideally, future monitoring sites should be located near the baseline sampling sites for accurate comparisons.

ROUND 2 PREAMBLE AND QUESTION:

Proponent plan still in production and not available for review.

FOLLOW-UP QUESTION:

Please see DFO-0058

RESPONSE:

The Partnership submitted a preliminary version of the PEMP to regulators on June 28, 2013. This preliminary version is also available on the Partnership's website at www.keeyask.com.

REFERENCE: Volume: Physical Environment Supporting Volume; Section: Appendix 7B Detailed Description of the Environmental Setting for Mineral Sedimentation; Page No.: N/A

TAC Public Rd 3 DFO-0061

ROUND 1 PREAMBLE AND QUESTION:

Bed Load

Between 2005-2007, approximately 350 bedload samples were collected, but this yielded few measurable samples (Appendix 7B). The EIS reports an estimated an average bedload of 4 g/m/s. How reasonable is this estimate given the insufficient samples to estimate the annual bedload discharge? What method(s) will be used to monitor bedload?

ROUND 2 PREAMBLE AND QUESTION:

Proponent plan still in production and not available for review.

FOLLOW-UP QUESTION:

Please see DFO-0058

RESPONSE:

The Partnership submitted a preliminary version of the PEMP to regulators on June 28, 2013. This preliminary version is also available on the Partnership's website at www.keeyask.com.

REFERENCE: Volume: Physical Environment Supporting Volume; Section: 7.2.5.1 Mineral Sedimentation and Appendix 7A.2.2 Stephens Lake Sedimentation During Construction Model; Page No.: 7-11 and 7A-25

TAC Public Rd 3 DFO-0065

ROUND 1 PREAMBLE AND QUESTION:

Sedimentation - TSS

Assumption that 70% of all fine particles will remain in suspension past Kettle GS. How can they determine this? Has this been modelled? How will the model/assumptions be tested?

ROUND 2 PREAMBLE AND QUESTION:

Proponent plan still in production and not available for review.

FOLLOW-UP QUESTION:

Please see DFO-0058.

RESPONSE:

The Partnership submitted a preliminary version of the PEMP to regulators on June 28, 2013. This preliminary version is also available on the Partnership's website at www.keeyask.com.

REFERENCE: Volume: Physical Environment Supporting Volume; Section: 4.0 Surface Water and Ice Regimes; Page No.: N/A

TAC Public Rd 3 DFO-0070

ROUND 1 PREAMBLE AND QUESTION:

Sedimentation - TSS

Existing environment sedimentation models based on low, med and high flows (2059, 3032 and 4,327 cms). Do these relate to percentile flows? Post-project sedimentation modelling simulated under 50th percentile for year 1, 5, 15 and 30 years after impoundment, and under 5th and 95th percentile flow for 1 and 5 years after impoundment. Why different flow regimes for different time periods? The post-project sedimentation environment was also simulated under the 50th and 95th percentile flows using the eroded shore mineral volumes as estimated, considering peaking mode of operation for the time frames of 1 and 5 years after impoundment. Proposed monitoring to valid models?

ROUND 2 PREAMBLE AND QUESTION:

Proponent plan still in production and not available for review.

FOLLOW-UP QUESTION:

Please see DFO-0001 A proposed Physical Environment Monitoring Plan (PEMP) was not available for review. The Proponent notes that a draft may be available by end June 2013. The plan is to monitor "sedimentation during the construction and operation phases." The plan is required for review to determine if sediment deposition predictions can be validated, if it will be possible to determine if mitigation is successful, and to determine if it will be possible to adaptively manage unexpected sediment deposition impacts

RESPONSE:

The Partnership submitted a preliminary version of the PEMP to regulators on June 28, 2013. This preliminary version is also available on the Partnership's website at www.keeyask.com.

REFERENCE: Volume: Physical Environment Supporting Volume; Section: Appendix 7A, Model Descriptions; Page No.: N/A

TAC Public Rd 3 DFO-0071

ROUND 1 PREAMBLE AND QUESTION:

Peatland Erosion.

Did not look at peat downstream of the generating station, claiming that peat would not go past the GS (only 1% would get past the GS – is this reasonable?). What monitoring is proposed to confirm this?

ROUND 2 PREAMBLE AND QUESTION:

Would the proponent please extract those parts of the EIS referred to that provide an assessment of the risk to fish, fisheries, and fish habitat of peat deposition from peat passing through the GS?

FOLLOW-UP QUESTION:

Please see DFO-0001.

RESPONSE:

Please see the response to TAC Public Rd 3 DFO-0001. Effects of peat erosion and deposition are considered in the post-Project habitat described in the table provided with this response.

REFERENCE: Volume: Physical Environment Supporting Volume; Section: 7.4.2.3 Peat Sedimentation - Upstream of Projects; p. 7-35 Volume: Aquatic Environment Supporting Volume; Section: 3.4.2.2 Outlet of Clark Lake to the Keeyask Generating Station; Page No.: N/A

TAC Public Rd 3 DFO-0072

ROUND 1 PREAMBLE AND QUESTION:

Peatland Erosion.

Visual distribution (maps) of peatland deposition not presented in the EIS. How will peat deposition impact on known/suspected areas of fish habitat in the future forebay?

ROUND 2 PREAMBLE AND QUESTION:

Would the proponent please provide a GIS or similar analysis of peatland deposition in fish habitat in the future forebay? Would the proponent please provide an analysis, including a table of areas, of impact, given a biologically significant risk threshold, of impact area?

FOLLOW-UP QUESTION:

Please see DFO-0001.

RESPONSE:

Please see the response to TAC Public Rd 3 DFO-0001. Effects of peat on aquatic habitat are included in the description of post-Project habitat.

REFERENCE: Volume: Response to EIS Guidelines; Section: 6.3.8 Sedimentation; Page No.: 6-215

TAC Public Rd 3 DFO-0073

ROUND 1 PREAMBLE AND QUESTION:

Deposition - EIS states deposition loads will not change post project – about 3cm/year, based on about 30cm of sediment deposited in ten years since Kettle GS was built. "Based on extensive modelling (using Stephens Lake) and field verification", the majority of mineral sediments resulting from shoreline erosion are predicted to deposit in near shore areas…after year 1, rates predicted at 0-3 cm/y. Offshore = 0-1 cm/y after year 1. The south nearshore areas in gull lake predicted to experience highest deposition rate of 4-6 cm/y for year 1 under baseloaded conditions.

Do not provide sedimentation rates based on a range of flows. No detail on sampling conducted to establish baseline other than at Kettle GS. How will the sedimentation model be tested for accuracy? What monitoring will be conducted to validate model assumptions?

ROUND 2 PREAMBLE AND QUESTION:

Would the proponent now provide details from documents not provided with the EIS that were to follow (e.g., physical environment monitoring plan for second quarter 2013) that answer this question? Can the proponent provide information on thresholds for risk of sediment deposition (e.g., are 1-4 cm sediment thickness of concern or some other thickness)? Can the proponent carry out a GIS, or other, risk based assessment that delineates areas of pre-project sediment types of biological interest compared with post-project critical deposition thicknesses? Can the proponent provide a table of total areas by impact zone (e.g., upstream and downstream) of area affected by biologically significant deposition? Proponent plan still in production and not available for review.

FOLLOW-UP QUESTION:

Please see DFO-0001.

RESPONSE:

Please see TAC and Public Round 3 DFO-0001.

REFERENCE: Volume: Physical Environment Supporting Volume; Section: Appendix 7A.1.1.3 Post-Project Nearshore Sedimentation Model; Page No.: 7A-6

TAC Public Rd 3 DFO-0074

ROUND 1 PREAMBLE AND QUESTION:

Sedimentation

Given the variation in sedimentation rates over time and the challenges in estimating sedimentation level, does the sedimentation analysis include a sensitivity analysis to reflect possible ranges in sedimentation and the effects on fish and fish habitat both upstream and downstream?

ROUND 2 PREAMBLE AND QUESTION:

Sensitivity analysis not provided.

FOLLOW-UP QUESTION:

Please see DFO-0001.

RESPONSE:

Please see the response to TAC Public Rd 3 DFO-0001.

REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: 1A.2.1 Structures in Water - Construction Scheduling; Page No.: N/A

TAC Public Rd 3 DFO-0086

ROUND 1 PREAMBLE AND QUESTION:

"Keeyask Generation Project Environmental Impact Statement Supporting Volume Aquatic Environment June 2012" (disc 2), p1A-2ff… Restricted activity timing windows…DFO…In northern Manitoba, no in-water or shoreline work is allowed during the 15 April – 30 June, 15 May – 15 July, and 1 September -15 May periods where spring, summer, and fall spawning fish respectively are present, except under site- or project-specific review and with…implementation of protective measures…Based on data from Keeyask field investigations…proposed area-specific timing windows for restricted in-water construction activities are…15 May – 15 July for spring and summer spawning fish and 15 September – 15 May for fall spawning fish…scheduling of construction activities that require working in water have been developed and modified to the extent practicable to avoid or minimize the potential for disturbance to fish in the Keeyask area during spawning, and egg an fry development periods…Adjustments to scheduling…to restrict construction and removal of structures to times of …year when sensitive life stages of fish are least likely to be present are summarized in Table 1A-2…" A summary listing shows these are mostly for cofferdam construction and removal "To the extent possible, work in water has been scheduled to avoid interaction with fish and fish habitat during the spring and fall spawning periods…When avoidance of both spring and fall spawning periods was not possible due to critical construction sequences, avoidance of spring spawning periods was given priority over avoidance of the fall spawning period…Additional mitigation of potential disturbances to fish and fish habitat will be gained by constructing each cofferdam in a sequence that minimizes the exposure of readily-transported fines to flowing water…"

A key mitigation is timing of in-water activity to avoid impacts on VEC fish species. Can the Proponent describe its contingency plans for unavoidable changes in scheduling. E.g., if a TSS episode exceeding the CCME guidelines is relatively benign for adult whitefish migration to spawning areas, is the same episode when delayed due to schedule changes similarly benign for incubating whitefish eggs? What sort of information would be available to rapidly assess the potential risk of a schedule change? What criteria would the Proponent use to trade-off costs to the project and costs to a VEC fish species?

ROUND 2 PREAMBLE AND QUESTION:

The proponent's answer refers to action plans yet to be developed. Would the proponent provide details of action plans for unanticipated scheduling changes that are protective of fish, fisheries, and fish habitat?

FOLLOW-UP QUESTION:

The question was about construction scheduling changes and the mitigation that could occur if the schedule changes - using construction suspended sediment inputs as one example. The Proponent's response focused on construction sediment which should now be captured in the Sediment Management Plan. However, other potential effects were not discussed. For example, contingency planning for prevention of fish kills in cofferdam dewatering. DFO needs a clear understanding of expected sources and estimates of fish mortality. DFO is aware of occasions when a construction schedule change to winter prevented the capture and downstream release of fish isolated behind the cofferdam during dewatering. This was for staff safety and there was no option available to regulators to advise a delay in dewatering. DFO believes there is some risk of this potentially occurring at Keeyask. Can the proponent provide additional information about its action plan for assessment/prevention/mitigation of fish kills. To date, the proponent suggests that they will provide a risk assessment and ask for approval from regulators - as problems arise. Ideally, DFO would like to know that the potential fish kill for any given scenario is likely to be insignificant in relation to any serious harm that might be incurred by fish that support a fishery - significantly in advance of situations arising. Would the Proponent, for example, calculate the areas and other characteristics of cofferdam impoundments, compare this with any previous fish rescue information it may have, look at any possible mitigation, and assess the potential risk of not being able to carry out rescues.

RESPONSE:

The response is organized into the following topics:

- Summary of construction timing issues;
- Information available to assess effects; and
- Action plan for unanticipated changes in schedule.

Summary of Construction Timing Issues

Construction timing relating to fisheries issues is discussed in Section 3.4 of the Project Description Supporting Volume (PDSV). As discussed in Section 3.4.1 of the PDSV, the following avoidance windows were established to protect fish:

- May 15 to July 15, which corresponds to the spawning period for Lake Sturgeon and other spring spawning fish; and

- September 16 to May 15, which corresponds to the spawning period for Lake Whitefish.

During the planning phase the construction schedule was adjusted to avoid in-water work during these sensitive periods as much as practicable. A potential change in schedule could occur during the initial stages of construction (i.e., during stage I river management activities) if there is a delay in regulatory approvals, but could also occur if the timing of any in-river activity changes and encroaches on the sensitive windows listed above.

As described in Section 3.4 of the PDSV, the sequence for in-river construction/river management activities in the first year begins with the quarry cofferdam, currently scheduled for mid to late July 2014, and ends with the Stage I island cofferdam, currently scheduled for early to mid September 2014. At this point the entire river is passing along the south channel of Gull Rapids. In the following year of Stage I Diversion in-river construction/river management activities will include construction of the central dam cofferdam in last summer and fall and the spillway cofferdam in the south channel, scheduled for mid July to mid October 2015 which will permit construction of the spillway structure. The sequence for in stream construction/river management activities associated with Stage II Diversion will include the Stage II island cofferdam, currently scheduled for August 2017, and removal of portions of the Stage I spillway cofferdam upstream and downstream of the spillway, scheduled for early August to early September 2017, to facilitate diversion of the river flow through the spillway. The powerhouse summer level cofferdam will be constructed in summer 2018 and removed summer 2019.

Information Available to Assess Effects

Important information that will be available to assess effects includes the following:

- an understanding of the anticipated construction sequence including timing and duration for cofferdam construction and removal;
- maps showing the location of the in-river work;
- estimates of changes to water levels and river flows for in-river work; and
- any changes to the current estimated Total Suspended Solids (TSS) and sediment deposition.

The vulnerability of fish to construction of any of the cofferdams outside of the planned period would be evaluated based on aspects such as known timing of fish use, documented fish behavior, “real time” acoustic tagging study results, site specific conditions and sequence of dewatering, and experience from similar salvaging issues (i.e., Wuskwatim GS). These topics are discussed below.

Known Timing of Fish Use

For example, during the winter months ice conditions and increasing water velocity as ice dams form would make the rapids largely uninhabitable to fish; therefore, construction of a cofferdam in mid winter would be expected to trap a minimal number of fish.

Documented Fish Behavior

For example, it has been observed that Lake Sturgeon with acoustic tags typically move from the receivers immediately downstream of the rapids to the receivers immediately upstream of the rapids within a day or two. Therefore, apart from the spawning period, sturgeon do not appear to be staying in the rapids.

Real Time Acoustic Tagging Study Results

Site conditions permitting, it may be possible to determine whether any of the acoustically tagged fish are within the rapids at the time of construction. If all of the tagged fish leave the area in response to construction activity, then it may be surmised that other fish would have left as well.

Site Specific Conditions and Sequence of Dewatering

Much of the area where cofferdams will be constructed has a high gradient, and as planned when upstream cofferdams are constructed first, the water will gradually drain out of the area downstream of the cofferdam and it is expected that many fish will move downstream and out of the section of river that is draining. It is recognized, however, that some fish will remain in deeper pools. The location and number of pools will not be predictable given that bathymetry of the rapids cannot be obtained under existing conditions.

Experience from Wuskwatim Generating Station Fish Salvage

As requested by the reviewer, information is provided for the fish salvage conducted at the Wuskwatim GS.For this project, fish salvage was conducted within a cofferdam constructed upstream of Taskinigup Falls and a second cofferdam constructed downstream of the falls. A small section of Taskingup Falls separated from the main falls by an island was dewatered during winter. A salvage fishery could not be conducted due to access and safety concerns however this cofferdam did drain quickly because of the 14 metre drop in this location. Salvage at this location would have been challenging with respect to safety regardless of the timing of cofferdam construction.

The first fish salvage was conducted within the Phase I upstream cofferdam in August 2008 in an area of approximately 0.9 ha. A total of 1189 fish, representing 14 species, were captured during approximately 47 hours of fishing. The majority (60%) of fish captured were young-of-the-year sculpin, and only 59 of the fish captured exceeded 150 mm in length. Fish capture methods included gillnetting, dipnetting and backpack electrofishing.

The Stage II downstream cofferdam created a water impoundment with a surface area of roughly 4.4 ha. The salvage fishery was conducted in two phases during the fall of 2010. A total of 2505 fish, representing 14 species, were captured during approximately 138 hours of fishing. The majority (45%) of fish captured were Longnose Sucker, and 1285 of the fish captured were greater than or equal to 150 mm long. Fish capture methods employed included gillnetting, dipnetting and backpack electrofishing.

Based on a rough extrapolation, it may be anticipated that fish salvage for the Keeyask Project, conducted over all of the cofferdam stages encompassing a total area of approximately 120 ha, could yield 75,000 fish. The estimated number of fish depends on the number of fish in Gull Rapids as the cofferdams are constructed; at Wuskwatim, fish may have entered the area that was impounded by the downstream cofferdam as a low current refuge was formed when flows were diverted through the spillway. The number of fish in Gull Rapids may be lower if fish move downstream out of the rapids as the water gradually drains from the areas being dewatered.

Action Plans for Unanticipated Changes in Schedule

As indicated above, the majority of risks to fish would relate to the river management activities, such that work that is planned to be completed during the period July-October is completed some other time that infringes on the avoidance windows. However, delays in the construction schedule may occur such that work planned for the open water season occurs during the winter months, as noted by the reviewer, and that fish salvage to remove trapped fish during cofferdam dewatering is ineffective or impossible under ice conditions.

As indicated, the Partnership has developed detailed schedules that include environmental timing restrictions and the schedules are monitored on a regular basis. Any potential to extend construction into restriction periods will be communicated to regulators with as much advance notice as possible. Information will be provided on projected change, rationale, anticipated environmental effects and any planned management/mitigation to obtain regulatory feedback/approval.

Potential management/mitigation would be designed to reduce the number of fish that would be stranded in the cofferdam, in the event that dewatering will occur in late fall or winter, when fish salvage may be hindered by ice and/or freezing temperatures.

Specific methods would require input from the contractor, but could include the following:

- Constructing the cofferdam from the upstream to the downstream direction to allow fish to escape as water levels decline;
- Not sealing and dewatering the cofferdam until the open water season when a fish salvage can be conducted;
- If the area is allowed to drain gradually, creating channels to allow fish to escape downstream from pools; and
- Providing a means to allow transport of salvaged fish from isolated pools to the nearby river (e.g., creating a trail).

It should be noted that in recognition of the sensitivity of Lake Sturgeon, the Partnership is committed to not dewatering habitat where large numbers of adult Lake Sturgeon may have congregated (i.e., during spring spawning period in suitable habitat), to avoid risk to individuals of this species. In addition, as described in Section 5.4 of the Aquatic Effects Supporting Volume, the assessment considered the effects of several years of decreased recruitment during construction due to issues such as avoidance of Gull Rapids, disruption of spawning activity, and loss of eggs for fall spawning species such as Lake Whitefish during some construction periods. While this was predicted to result in a decrease in year class strength during some years of construction, an increase in habitat through reservoir creation would result in neutral long term adverse effects.

REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 1A, Part 2 Keeyask Lake Sturgeon Stocking Strategy; Page No.: N/A

TAC Public Rd 3 DFO-0093

ROUND 1 PREAMBLE AND QUESTION:

Appendix 1A - Part2

Should the original population be decimated, how will the population within the Gull Reach be maintained?

ROUND 2 PREAMBLE AND QUESTION:

Proponent's answer asks reader to re-read sections of the EIS. Would the proponent please extract the appropriate information from the EIS or provide additional information to answer the question?

FOLLOW-UP QUESTION:

Please see also DFO-0001. The Proponent notes that "genetic analyses presently being conducted...will be provided when available." When can the Proponent provide the second "Bernatchez" report on genetics to reduce uncertainty in decision making?

RESPONSE:

Preliminary results from the more detailed genetic analysis substantiate the distinctions among areas noted in the initial analysis (e.g., Birthday Rapids is different from Burntwood River). Analysis to determine relationships among individuals (e.g., families) is currently being undertaken. A final report is expected in fall 2013 and will be provided to DFO and MCWS when it is available.

REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 1A, Part 2 Keeyask Lake Sturgeon Stocking Strategy; Page No.: N/A

TAC Public Rd 3 DFO-0098

ROUND 1 PREAMBLE AND QUESTION:

Appendix 1A - Part2

Given predictions of accumulated sedimentation/peat accumulation and subsequent influences in water chemistry (including decreasing oxygen and increasing mercury levels) is stocking the forebay with sturgeon a rational option?

ROUND 2 PREAMBLE AND QUESTION:

DFO is interested in knowing more detail about the amount of change in the reservoir. The Proponent's answer talks about the post-project but does not compare it to the pre-project. Would the proponent please provide a pre- versus post-project comparison? "Stocking lake sturgeon into the Keeyask Reservoir is a rational option to recover populations"

Please provide publications in support for this conclusion, given mercury in fish tissue significantly elevate post project.

FOLLOW-UP QUESTION:

Please see DFO-0001. In addition, the proponent acknowledges that it may take up to 30 years for mercury levels to return to pre-project levels. DFO notes that models applied after the EIS to estimate mean mercury concentrations in sturgeon "are only based on 13 fish from one location (Gull Lake)" (Human Health Risk Assessment...April 2013..." in Supplemental Filing #1).

Mercury levels in sturgeon are less than the 0.5 ppm limit for commercial sale and are not expected to increase significantly - but no commercial sturgeon fisheries can be considered in any case due to the small populations. Human health advisories that are still under development could affect subsistence (ceremonial) fishing. Further, the proponent acknowledges that no known studies exist that specifically address the effects of mercury on Lake Sturgeon health. DFO is not aware of any information that may have been provided on mercury in sturgeon dietary items and the potential effect on sturgeon health. Can the Proponent provide additional information on the effects of methylmercury on sturgeon health?

RESPONSE:

It should be noted that, although only 14 measurements of Lake Sturgeon mercury concentrations are available from Gull Lake for 2002-2006, a summary of all existing Lake Sturgeon mercury concentrations from Manitoba waters indicates that the Gull Lake data fall well within the Manitoba range (Table 1 of TAC Public Rd 2 DFO-0098). The Manitoba data indicate that Lake Sturgeon mercury concentrations rarely exceed 0.2 ppm, and if they do, only in large, old individuals. Fish at the length of first reproduction (approximately 880 mm as stated in the AE SV) can be assumed to have mercury concentrations of less than 0.2 ppm.

To the best of our knowledge, Haxton and Findlay (2008; cited in TAC Public Rd 2 DFO-0098, but not used in a "health" context) represents the only study on Lake Sturgeon that has attempted to correlate muscle (or any other tissue) mercury concentrations with fish health. These authors found no correlation between mercury muscle concentration (range 0.06-0.68 ppm) and growth or condition of 48 Lake Sturgeon from impounded and free-flowing sections of the Ottawa River. These results are in agreement with those of three laboratory studies (Gharei et al 2008, 2011; Lee et al. 2011; all cited in initial response) on juveniles of other sturgeon species (Green Sturgeon, Beluga) that found lowest observed adverse effects levels of dietary methylmercury of >2 ppm. The only field study on sturgeon that has documented effects of muscle tissue concentrations on reproductive parameters is Webb et al. (2006; cited in original response, but results not presented in detail). These authors found a negative correlation between gonad mercury concentration (mean of 49 fish = 0.027 ppm) and the gonado-somatic index of White Sturgeon. However, the relationship was weak ($r2=0.26$), and was only significant in immature fish and only for males. Webb et al. (2006) also found significant but weak ($r2=0.16-0.26$) negative correlations between either muscle or liver mercury concentrations and those of plasma sex steroids, including testosterone and estradiol.

The much lower mercury concentration reported to affect reproductive and biochemical endpoints in Depew et al. (2012) on which the arguments for a threshold concentration of <0.04 ppm for "assessment of effects of methylmercury for fish in the Keeyask impoundment" by Environment Canada are based) comes from laboratory studies on dietary exposure on a total of 4-7 species, none of which are sturgeon (we are not aware of any laboratory studies on the effects of dietary mercury on Lake Sturgeon). Depew et al. (2012) stress that "species differences in sensitivity to methylmercury exposure are considerable". They conclude that "chronic dietary exposure to low concentrations of methylmercury may have significant adverse effects on wild fish populations but remain little studied". Indeed, currently no studies exist that demonstrate population level effects of "elevated" mercury concentrations in fish (discussions at the 11th ICMGP conference, Edinburgh, 28 July - 2 August, 2013). In contrast to Depew et al. (2012), studies on ecological risk assessment of mercury to fish use a threshold tissue (NOT dietary) concentration value of 0.3 ppm in the whole body (or 0.5 ppm in the muscle; e.g. Sandheinrich et al. 2011).

The reviewer is correct to note that no information exists on mercury concentrations of Lake Sturgeon dietary items from Gull Lake (or any other Keeyask waterbody). Site specific diet information was not collected as part of the Keeyask studies, although diet information was collected on dead-sampled individuals. The stomach analysis of four juvenile sturgeon (550-700 mm), two each from Gull Lake and the Winnipeg River near Pointe du Bois, indicate a diet of northern crayfish, pisiid clams, and mayfly larvae of the genus *Hexagenia*. No mercury concentrations have been measured for these organisms, but literature data indicate mercury levels of slightly less than 0.1 ppm for the crayfish (Allard and Stokes 1989; Pennuto 2005), and even lower for the other two invertebrate taxa (Mathers and Johansen 1985; Jansen et al,., unpublished). Mercury concentrations do not exist for any of these taxa for the existing environment of Keeyask, and potential Project related changes in concentrations would be difficult to assess. Furthermore, the most relevant and more commonly used indicator of potential health risk in fish is tissue concentration, not concentrations in diet items (Sandheinrich et al. 2011), because concentrations in blood and organ cells determine biochemical or other physiological responses to mercury exposure. Therefore, measurement of tissue(muscle) mercury concentrations are more important to assess health effects than diet concentrations.

Monitoring of mercury concentrations in lower trophic organisms is planned under the Aquatic Effects Monitoring Plan by sampling 1-year old yellow perch (*Perca flavescens*). These fish will likely show a similar response to Project related increases in environmental mercury concentrations as other common forage species such as shiner (*Notropis* spec.) species.

REFERENCES:

Allard, M., and P. M. Stokes. 1989. Mercury in crayfish species from thirteen Ontario lakes in relation to water chemistry and smallmouth bass (Micropterus dolomieui) mercury. Can. Fish. Aquat. Sci. 46: 1040-1046.

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Haxton, T. J., and C. S. Findlay. 2008. Variation in lake sturgeon (Acipenser fulvescens) abundance and growth among river reaches in a large regulated river. Can. J. Fish. Aquat. Sci. 65: 645-657.

Lee, J.-W., N.D. Riu, S. Lee, S.C. Bai, G. Moniello, S.S.O. Hung. 2011. Effects of dietary methylmercury on growth performance and tissue burden in juvenile green (Acipenser medirostris) and white sturgeon (A. transmontanus). Aquat Toxicol 105: 227-234.

Mathers, R. A. and P. H. Johansen. 1985. The effects of feeding ecology on mercury accumulation in walleye (Stizostedion vitreum) and pike (Esox lucius) in Lake Simcoe. Can. J. Zool. 63:2006 2012.

Pennuto C. M, O. P. Lane, D. C. Evers, R. J. Taylor, and Jeff Loukmas. 2005. Mercury in the Northern Crayfish, Orconectes virilis (Hagen), in New England, USA. Ecotoxicology, 14, 149-162.

Sandheinrich, M. B., S. P. Bhavsar, R. A. Bodaly, P. E. Drevnick, E. A. Paul 2011. Ecological risk of methylmercury to piscivorous fish of the Great Lakes region. Ecotoxicology (2011) 20:1577–1587

Webb, M. A. H., G. W. Feist, M. S. Fitzpatrick, E. P. Foster, C. B. Schreck, M. Plumlee, C. Wong, D. T. Gundersen 2006. Mercury Concentrations in Gonad, Liver, and Muscle of White Sturgeon Acipenser transmontanus in the Lower Columbia River. Arch. Environ. Contam. Toxicol. 50: 443-451

REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Appendix 1A, Part 2 Keeyask Lake Sturgeon Stocking Strategy; Page No.: N/A

TAC Public Rd 3 DFO-0100

ROUND 1 PREAMBLE AND QUESTION:

Appendix 1A - Part2

Given the challenges of detecting changes in sturgeon (growth, age, etc.) over the short term, how will success/failure be determined?

ROUND 2 PREAMBLE AND QUESTION:

To date, sample sizes for lake sturgeon in the study area has been challenging due to population size. Will sample sizes be sufficient to detect statistical change in life history parameters post project?

FOLLOW-UP QUESTION:

Please see also DFO-0001. DFO notes that additional discussions with the Proponent on sturgeon stocking as an offsetting measure have been suggested. In addition, the Proponent notes that "genetic analyses presently being conducted...will be provided when available." When can the Proponent provide the second "Bernatchez" report on genetics to reduce uncertainty in decision making?

RESPONSE:

Preliminary results from the more detailed genetic analysis substantiate the distinctions among areas noted in the initial analysis (e.g., Birthday Rapids is different from Burntwood River). Analysis to determine relationships among individuals (e.g., families) is currently being undertaken. A final report is expected in fall 2013 and will be provided to DFO and MCWS when it is available.

The Partnership looks forward to further discussions with DFO and MCWS on the Lake Sturgeon stocking plan in discussions related to completing the Authorization required under the *Fisheries Act*. Please note that additional information on the stocking plan has been filed as part of the CEC process, as follows:

- CEC Rd 1 CEC-0031 provides rationale for stocking as mitigation for the Keeyask project, including a discussion of post-Project habitat availability, evidence of successful stocking programs in other areas, and vulnerability of existing sturgeon populations.

- CEC Rd 1 CAC- 0038, 0039, and 0041 and follow-up in CEC Rd 2 CAC-154 and 155 address technical aspects of marking stocked fish so that their survival and contribution to the population can be monitored.
- CEC Rd 1 CAC-0042 and CEC Rd 1 CAC-0156 address adaptive approaches in rearing techniques to address loss of sturgeon in the hatchery.

In a meeting to discuss this information request, DFO also asked for information related to how the number and age of fish to be stocked will be determined. The derivation of the initial numbers for the stocking strategy were explained in the AE SV Appendix 1A Section 2.2 and are reproduced for the convenience of the reviewer below.

Section 2.2 Number of Fish, Age at Release and Duration of Stocking Program

The following section provides a rationale for the proposed number of fish stocked, age at release and duration of the stocking program required to meet the DFO (2010) RPA objective for MU3 (Kelsey GS to Kettle GS). The actual number of fish stocked and locations for stocking within MU3 will depend on ongoing monitoring and assessment, the age at which fish are stocked, and the success of spawn collection and rearing.

Number of Fish to Stock

The determination of the number of fish to stock within MU3 was based on stocking rates for lake sturgeon at the fall fingerling life stage. Stocking plans for older (i.e., yearling) or younger life stages would be adjusted according to expected survival rates for those stages.

Two approaches were followed to estimate the appropriate fall fingerling stocking density: 1) lake sturgeon stocking guidelines developed in Wisconsin; and 2) a recruitment model targeting reaching a specific adult spawning female population over the course of the program.

Wisconsin Guidelines

The Wisconsin Guidelines were developed based on Wisconsin rivers, which are smaller than the Nelson River. These guidelines suggest that fall fingerlings should be stocked at a rate of 80 fish/river mile (50 fish/river km). The river length in MU3 is 213 km; this was calculated by measuring river length from Kelsey GS to Kettle GS, plus the river length from First Rapids to a mid-point in the upper portion of Split Lake, plus the distance from the apex of the north arm of Stephens Lake to a mid-point in Stephens Lake. Based on the estimated river length, the Wisconsin Guidelines prescribe an annual fall fingerling stocking rate of 10,650 fish. As noted above, these guidelines are based on smaller rivers than the Nelson River; therefore, these estimates may be low.

Lake Sturgeon Recruitment Model

The DFO (2010) RPA provides a target number of a minimum number of 413 spawning females to achieve healthy, viable populations of lake sturgeon in each MU. To obtain an upper estimate on the number of sturgeon that could be stocked, targets for the release of fall fingerlings into the combined three reaches (Upper Split Lake, Nelson River between Clark Lake and Gull Rapids, and Stephens Lake) were developed based on a recovery target of 500 Adult Spawning Females (ASF) per year (which equates to 2500

ASF in the population based on females spawning every five years) within three generations (90 years) over the three areas combined.

The number of fall fingerlings required for stocking each year to achieve the ASF objective was derived through construction of a lake sturgeon life table with age, survival at age, and fecundity. The stocked cohorts were propagated through time using a matrix. For surviving spawning fish at each age over 25 years, a fecundity value was calculated based on literature values and a fecundity with age function was applied. The eggs that hatched and survived to fingerling stage were added to the population each year and the cycle repeated. The contribution of the existing population of “wild” adult spawning females to meeting the Management Unit ASF objective was not included in the recruitment model. Consequently, recruitment model results represent an over-estimate of the number of stocked fish required to meet the recovery target.

Three potential scenarios were explored and compared to determine the potential impact that ongoing harvest would have on the time to achieve the ASF objective (Figure 2). The stocking rate chosen for this comparison was the minimum rate that would achieve the ASF objective with both natural and fishing mortality factored into the adult survival rate.

1. **Unexploited Population** – This scenario (Figure 2 - top-most graph) assumes that only natural mortality (6.7%) would determine adult survival rates (i.e., no lake sturgeon fishing). Under these conditions, annual stocking of 19,722 fall fingerlings (includes both sexes at assumed 1:1 gender ratio) for 25 years would achieve the 2500 ASF objective in 32 years. Survival rates used in the model were as follows:
    - 0.300 annual survival of fall fingerlings;
    - 0.6998 annual survival of one-year olds; and
    - 0.933 annual survival for lake sturgeon older than two years of age (juvenile through all adult year classes).

2. **Exploited Population** – This scenario (Figure 2 – middle graph) shows how fishing mortality (in addition to natural mortality) would affect attainment of the ASF objective under the same stocking plan as above. No direct estimate of fishing mortality is available for the area. Therefore, an estimate of 8.3% was derived from the difference between the estimated population survival in the Nelson River between Clark Lake and Gull Rapids (85%) and the average adult survival provided by DFO (2010) (93.3%). Use of this estimate may result in an over-estimate of the effects of fishing mortality on the population as it was applied to the entire Kelsey to Keeyask reach, and fishing mortality in the other parts of the reach may be lower than in the Clark to Gull Rapids reach. Survival rates used in this run of the model were as follows:

- 0.300 annual survival of fall fingerlings;
- 0.6998 annual survival of one-year-olds;
- 0.933 annual survival for year classes two through 24; and
- 0.8496 annual survival for fish older than 24 years.

The modelled results show that at the same stocking rate and duration (i.e., 25 years) as above, the 2500 ASF objective would be met at approximately year 45. However, within five years the ASF population would begin to decline, reaching 500 ASF by year 90 and continuing a slow decline thereafter.

3. **Exploited Population but with Enhanced Stocking to Maintain ASF Objective** – Survival rates at each life stage for this scenario (Figure 2 – bottom graph) are identical to those used in the middle graph. In this case, the ASF objective in the exploited population would be met the same as above (approximately 45 years). However, to sustain and grow the ASF population, stocking would be required for as long as annual fishing mortality remained at or above the estimated rate of 8.3%. In the example shown, continued stocking at a constant rate of 19,722 fall fingerlings would result in growth of the ASF population to approximately 3,900 fish by year 90. Stocking at this rate would meet and exceed the DFO RPA objective.

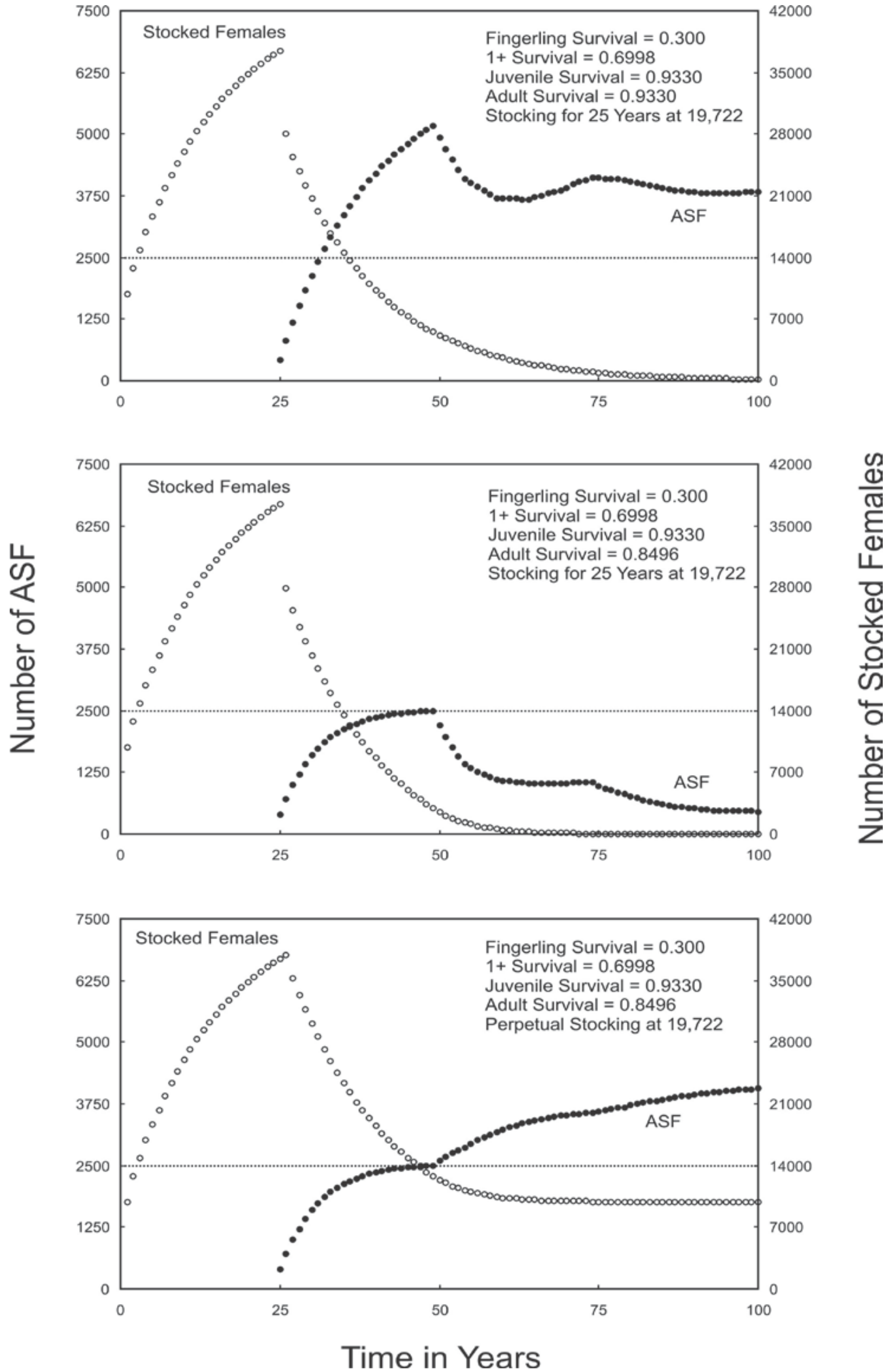

Figure 1. Adult spawning female (ASF) population response to fall fingerling stocking: Upper graph – stocking with no harvest; Middle graph – stocking with harvest (8.3% fishing mortality); Lower graph – stocking to compensate for harvest.

In the Exploited Scenario (i.e., assumes a constant annual 8.3% fishing mortality), to achieve the same objective in the same time frame as in the Unexploited Scenario, an annual stocking rate of 19,770 fall fingerlings would be required. However, to maintain the ASF population at or above the objective, ongoing stocking would be required in perpetuity providing fishing mortality remained at the current rate.

Of these three scenarios, it is recommended to use Scenario 3 as the basis for setting initial annual targets for stocking density. It is assumed that a sturgeon harvest on the Nelson River would continue since it is culturally important. It is important to note that lake sturgeon year-class strength and the proportion of the hatchery reared versus wild fish that comprise each year class will be monitored annually. Stocking rates would be modified based on monitoring results, to avoid either under or over-stocking.

Recommended Stocking Rate based on Fall Fingerling Stage

Using the Wisconsin Guidelines as a basis for determining the density of fish to be stocked, a fall fingerling stocking rate of 10,650 fish/year, annually over one generation or 25 years, would be recommended. However, stocking at this rate does not explicitly account for any assumed fishing mortality and may be too low considering the Wisconsin guideline was developed based on rivers smaller than the Nelson River.

Summary and Recommendation

The lake sturgeon recruitment model (Unexploited Scenario) indicates that, in the absence of fishing mortality, a stocking rate of 19,722/year for 25 years would achieve the ASF objective (DFO RPA) within 32 years. However, an analysis of how different rates of annual stocking affect the time (and cost) to achieve the long-term ASF objective indicates that stocking at a rate of 10,440/year for 25 years would attain the ASF objective in 45 years (Figure 3). This stocking rate appears to be the most cost-effective rate at which to stock fall fingerlings to achieve the DFO (2010) RPA objective within a reasonable period of time (i.e., within three generations). In the absence of fishing mortality, the ASF objective would be sustained over the long term at or above that level. This rate is essentially (and coincidentally) the same as the rate derived using the Wisconsin Guideline.

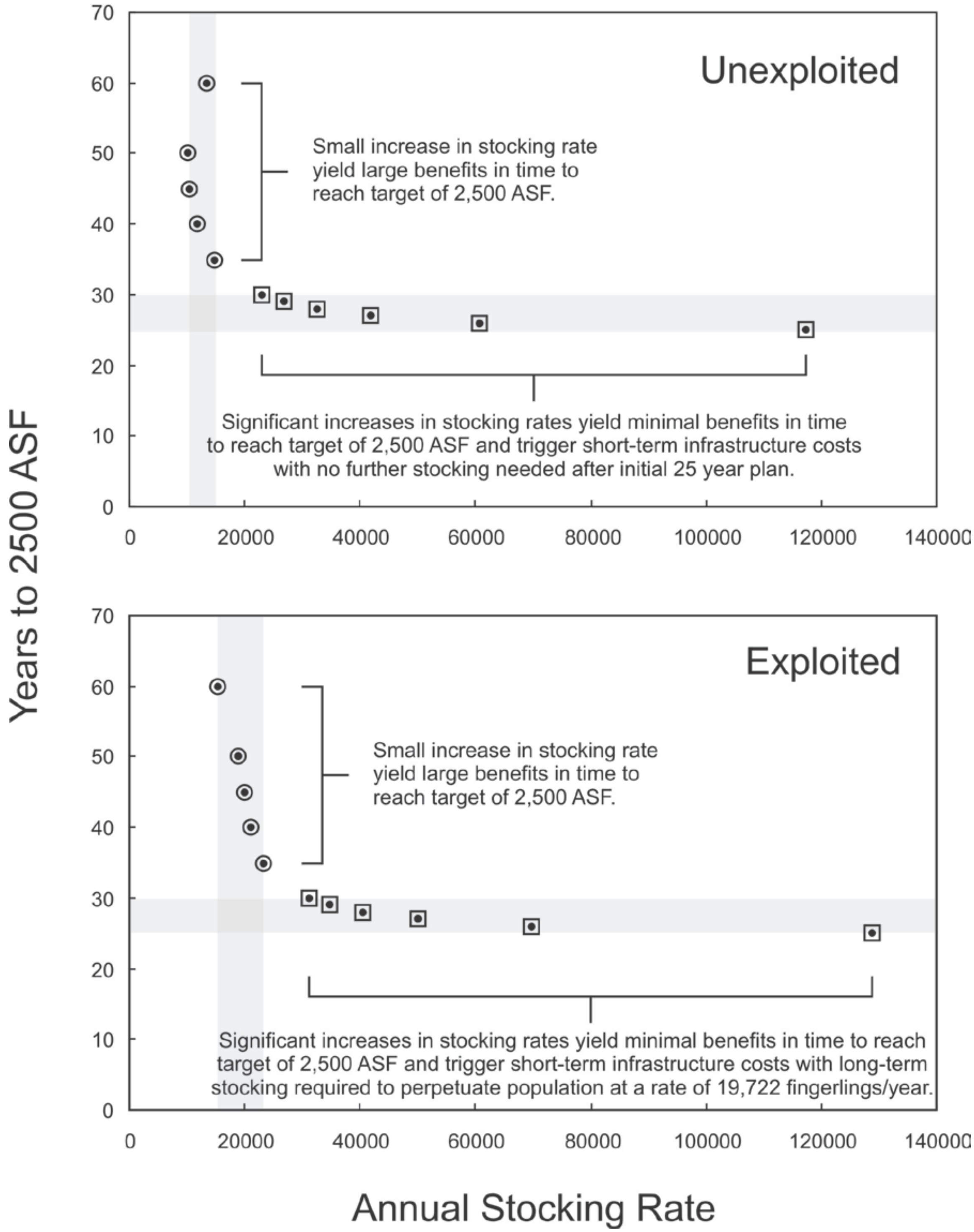

Figure 2. Relationship between number of lake sturgeon fall fingerlings (male and female) stocked and time to meeting the adult spawning female objective.

Age of Fish to Stock

Larvae (feeding stage; following yolk sac absorption), fall fingerlings (17 weeks old) and spring yearlings (1 year old) are the three life stages being considered for stocking. Advantages and disadvantages that are being considered in determining which life stages to stock are described below:

- Larval (feeding stage) fish have the advantage of lower rearing costs; however, mortality is considerably higher than older life stages due to starvation and predation once fish are released from the protective hatchery environment. Whether or not earlier life stage introduction to their receiving environment would result in higher future reproductive success is unknown, but it has been suggested that fish introduced at an early life stage would benefit in the long-term from effects of natural selection on maintaining desirable within-population genetic variation (Welsh *et al.* 2010). Habitat requirements of larval lake sturgeon are poorly understood, and further, uncertainties remain regarding the availability of this habitat following construction of the Keeyask GS. The number of larval sturgeon that are hatched in the hatchery may exceed the rearing requirement for fall fingerling and spring yearling release, as well as exceed the rearing capacity of the hatchery/rearing facility. Excess supply of larval lake sturgeon would be released into receiving reaches at locations in the same general area from which the gametes were sourced or where known YOY habitat is present.
- Fall fingerlings are the life stage released in many stocking programs as survival is higher relative to larval fish, and there are fewer uncertainties regarding the availability of suitable habitat. Crossman (2008) reported that recapture rates and dispersal distances were significantly higher for fish stocked at 17 weeks than for fish released at earlier ages. Additionally, given the uncertainty with the suitability of early young-of-the-year rearing habitat in the Keeyask reservoir, the release of fall fingerling may be more successful than the release of larvae. Although fall fingerlings cost more to raise than larvae/fry, the cost is significantly less than culturing the fingerlings over the winter. Literature sources suggest a first winter survival rate for fall released fingerlings of between 20 and 40% (Aloisi *et al.* 2006; Crossman *et al.* 2009).
- Spring yearlings would have the advantage of even higher survival relative to the earlier life stages and would be least likely to be limited by available foraging habitat in Stephens Lake and the newly created reservoir. Rearing costs would be the highest of the three life stages; however, the higher survival rate of one-year old lake sturgeon would also offset requirements to stock as many fall fingerlings to meet ASF recovery objectives. Other factors as noted by Welsh *et al.* (2010) (such as natural selection) need to be considered when making decisions on early versus later fish release.

The life stages proposed for stocking would depend on the availability of suitable habitat to support each life stage during and following construction of the Keeyask GS, the year-to-year variation in the supply of gametes, and consideration of survival rates versus rearing costs associated with each life stage. Population monitoring post-Project will play a key role in determining year-class strength and the relative contributions to each cohort from hatchery reared or wild fish. Monitoring will also be used to determine survival of each life stage of lake sturgeon released. These data will be used to fine-tune the stocking program by determining the optimal number, life stage and location to stock lake sturgeon.

Duration of Program

The Keeyask lake sturgeon stocking program is expected to be implemented for as long as required to achieve and maintain the stated DFO (2010) RPA objective for MU3. However, the focus and priorities attached to stocking program components are expected to change with time depending on Project phase (construction versus operation), habitat limitations, area-specific lake sturgeon population growth, and brood stock availability.

As discussed in Section 1.2, monitoring would be conducted during the pre-implementation and implementation phases of the stocking program to determine the effect on fish populations and avoid potential effects of overstocking. The duration of the program could vary depending on location and monitoring results as follows:

Short term – the aim of a short-term stocking program would be to prevent missing year classes in the sturgeon population in the Keeyask area during years of construction, as mitigation measures to support spawning and YOY rearing are refined. Therefore, stocking numbers and age at release would be modified once it is understood how the natural processes may have been affected by the project and how stocked lake sturgeon are surviving in the wild. A short-term stocking program would continue while the Keeyask GS is under construction.

Long term – the aim of a long-term stocking program would be to re-establish a sustainable population. Therefore, a long-term stocking program would continue through an entire generation (25 years). After 25 years, it is hoped that the number of naturally reproducing fish would be sufficient to sustain the population. For example, it is likely that the Stephens Lake area would be targeted with a 25-year program.

Permanent – as discussed in Section 2.2.1, the rates of exploitation in these areas may be sufficient to require stocking in perpetuity to support the populations. Monitoring would determine if densities are reaching levels that are too high; otherwise, stocking could continue for as long as mortality rates exceed a self-sustaining recruitment rate.

REFERENCE: Volume: Project Description Supporting Volume; Section: 6.7 Powerhouse; Page No.: 6-13

TAC Public Rd 3 DFO-0103

ROUND 1 PREAMBLE AND QUESTION:

The EIS indicates 90 % survival for fish up to 500mm. Can this be further broken down into species, sex, maturity and length for the VEC fish species within the Keeyask Study area. An analysis/graphs of survival rates and injury rates should be provided.

ROUND 2 PREAMBLE AND QUESTION:

A failure of the Franke analysis is the lack of size and age specific mortality rates, which are crucial for assessing impacts to populations and predicting change.

FOLLOW-UP QUESTION:

Please see DFO-0051

RESPONSE:

Please see the response to TAC Public Rd 3 DFO-0051.

REFERENCE: Volume: Project Description Supporting Volume; Section: 6.7 Powerhouse; Page No.: 6-13

TAC Public Rd 3 DFO-0104

ROUND 1 PREAMBLE AND QUESTION:

Several recommendations to minimize mortality that can be incorporated into hydro facilities include: using trashracks with reduced bar spacing while preventing further impingement, using temporary overlays with the existing trashracks to reduce clear spacing during migration periods, use of partial depth curtain wall over existing trash rack, installation of an inclined or skewed bar rack system upstream of the intake, barrier or stop nets set upstream in the forebay, and use of partial depth guide walls or an angled louver system upstream of the intakes coupled with a bypass system. Will the powerhouse be designed to incorporate some of these features if monitoring indicates that fish mortality is higher than predicted? Additional biological data and studies will be required post construction to better assess the requirements and potential mitigation for both potential downstream passage and protection. Also, these studies should determine the overall number of fish expected to pass through the turbines.

ROUND 2 PREAMBLE AND QUESTION:

DFO should be provided with an operating regime and an estimate of mortality under various flow/seasonal conditions. Mortality rates for fish over 500mm required.

FOLLOW-UP QUESTION:

Please see DFO-0051

RESPONSE:

Please see the response to TAC Public Rd 3 DFO-0051.

REFERENCE: Volume: Project Description Supporting Volume; Section: 6.7 Powerhouse; Page No.: 6-13

TAC Public Rd 3 DFO-0105

ROUND 1 PREAMBLE AND QUESTION:

Survival rates can be maximized for entrained fish if operation of the turbines is at maximum efficiency. How will Keeyask be operated to minimize mortality?

ROUND 2 PREAMBLE AND QUESTION:

Elaboration required. Could turbine operation mitigate impacts to fish during critical life stages (e.g. -Y-O-Y drift)?

FOLLOW-UP QUESTION:

Please see DFO-0051

RESPONSE:

Please see the response to TAC Public Rd 3 DFO-0051.

REFERENCE: Volume: Project Description Supporting Volume; Section: 6.7 Powerhouse; Page No.: 6-13

TAC Public Rd 3 DFO-0106

ROUND 1 PREAMBLE AND QUESTION:

What are acceptable mortality rates based on the fish community and population in the Keeyask study area?

ROUND 2 PREAMBLE AND QUESTION:

Information on acceptable mortality rates not provided (e.g. literature).

FOLLOW-UP QUESTION:

Please see DFO-0051

RESPONSE:

Please see the response to TAC Public Rd 3 DFO-0051.

REFERENCE: Volume: Project Description Supporting Volume; Section: 6.7 Powerhouse; Page No.: 6-13

TAC Public Rd 3 DFO-0107

ROUND 1 PREAMBLE AND QUESTION:

A detailed monitoring plan should be developed to assess mortality of fish passing through the station and spillway. How will this impact the fish community?

ROUND 2 PREAMBLE AND QUESTION:

See DFO-0015

FOLLOW-UP QUESTION:

Please see also DFO-0051. In addition, an Aquatic Effects Monitoring Plan (AEMP) is presently under discussion and is scheduled for public release by the Proponent in the second quarter of 2013. DFO would like to ensure that the potential for injury and death of fish passing downstream through the station has been estimated, mitigated to the extent practical, that residual impacts are known, and that monitoring will clarify uncertainty for adaptive management. Would the Proponent describe the monitoring that will be provided to address concerns about monitoring for downstream fish passage mortality?

RESPONSE:

Please see TAC Public Rd 3 DFO-0051 for a discussion of monitoring for downstream fish passage mortality and other issues related to downstream passage.

REFERENCE: Volume: Response to EIS Guidelines; Section: 6.5 Effects and Mitigation Terrestrial Environment; 6.5.7 Birds; 6.5.7.7 Other Priority Birds; 6.5.7.7.3 Colonial Water birds; Page No.: 6-362

TAC Public Rd 3 EC-0019

ROUND 1 PREAMBLE AND QUESTION:

In this section the Proponent has proposed the following mitigation in response to the loss of gull and tern breeding habitat: “Deployment of artificial gull and tern nesting platforms (e.g., reef rafts), breeding habitat enhancements to existing islands (e.g., predator fencing or placement of suitable surface substrate), and/or development of an artificial island, or a combination of these measures, will be implemented to off-set the loss of gull and tern nesting habitat at Gull Rapids and areas upstream.”

EC requests that the Proponent provide additional information regarding each mitigation measure (i.e., for artificial nesting platforms, island enhancements, or development of artificial islands), including information regarding the design, placement, development and implementation of each measure. EC also requests that the Proponent identify the decision-making process by and situations in which they would choose to a) deploy an artificial nesting platform, b) enhance an existing island, c) develop an artificial island, or d) implement a combination of these measures.

ROUND 2 PREAMBLE AND QUESTION:

As the proponent has indicated in their response, details about the mitigation measures to offset the loss of gull and tern nesting habitat at Gull Rapids and areas upstream are limited at this time.

EC requests the opportunity to review detailed plans (complete with design, placement, development, and implementation information for each proposed mitigation measure) as they are developed. With respect to the Artificial Nesting Platforms, EC recommends that the developed plan

1. address the recommendations in the studies cited, and their implementation for this project; and
2. include plans to maintain the rafts and make any necessary repairs to the platforms prior to each breeding season. To the extent possible, EC recommends constructing platforms such that the total available area for nesting waterbirds is equivalent to the area of the natural islands that will be lost, such that equivalent breeding populations might be maintained.

With respect to the Nesting Island (or Peninsula) Enhancements downstream, EC recommends that the developed plan address the expected variability of the water level below the Generation Station, and provide the rationale behind enhancing nesting sites downstream if the variation in water level will be greater than which would occur naturally during the breeding season.

Terns and other waterbirds often nest at sites that are only a few inches to a couple of feet above water and frequent changes to the water level during the breeding season may render this mitigation option futile.

EC also recommends that the plan address the feasibility of fencing off portions of land to limit predator access, and describe any plans to monitor and maintain the fencing. Colonial nesting birds have an innate preference for sites that mammalian predators cannot access and it would be preferential to work with islands. Moreover, maintaining the fencing and ensuring that it did not become a hazard to breeding colonial species or other wildlife would require frequent monitoring and maintenance throughout the year. With respect to the proponent's response regarding the development of Artificial Nesting Islands, EC questions how monitoring annually during the first 3 years of operations will confirm the necessity and feasibility of these nesting islands. More specifically, EC is unsure how the construction could take place prior to filling the reservoir considering monitoring will only occur after operation has commenced. EC requests that the proponent provide clarification.

FOLLOW-UP QUESTION:

EC's questions regarding the decision-making process by which, and situations in which, the proponent would choose to

a. deploy an artificial nesting platform,
b. enhance an existing island,
c. develop an artificial island, or
d. implement a combination of these measures, are still outstanding.

These questions may be addressed within the Terrestrial Mitigation Implementation Plan, however the proponent indicates that this "will be developed once construction is underway". EC notes that in the referenced section of the Terrestrial Environment Supporting Volume (Section 6.4.2.3) and the proponent's current response, it remains unclear if each of the proposed mitigation measures will be employed, and under which circumstances each may or may not be used (e.g., "The preferred time to build an artificial island is prior to filling the reservoir and this is the current plan if such an island is built" and "This Plan will include detailed design, placement, development, and implementation information for the gull and tern-nest habitat creation and/or enhancement.") EC requests clarification. EC also requests the opportunity to review both the Terrestrial Mitigation Implementation Plan and the Terrestrial Effects Monitoring Plan, prior to project approval.

RESPONSE:

The Terrestrial Environmental Monitoring Plan (TEMP) is currently available online at keeyask.com for review. The Partnership has received some of EC's initial comments on the proposed bird monitoring program and is revising the TEMP accordingly.

The Terrestrial Mitigation Implementation Plan (TMIP) is still preliminary and not yet available for review. The Partnership is committed to implementing a long-term solution to off-set the loss of gull and tern habitat. Options being considered by the Partnership have been provided in round one and two responses to EC-0019 and include: artificial nesting platforms, enhancement of areas below the generating station and artificial nesting islands. The decision making process as to which option(s) will be implemented will be a multi-stage process with input from engineers, biologists and Environment Canada. Feasibility and preliminary design studies undertaken by engineers are required for the decision making process. As the plan is further developed, the Partnership intends to share the preliminary designs and locations for alternate nesting habitat with EC and welcomes feedback on the proposed measures.

To expand on previous round one and two answers, see PD SV Map 2-22 and Table 6-4 for more information on the potential locations of some of the potential colonial waterbird nesting habitat mitigation measures.

Potential mitigation measures will include the use of use of floating platforms for common terns. Platforms or rafts could be created and installed in suitable areas of Gull Lake, Stephens Lake, the Keeyask Reservoir and/or inland lakes located within 9 km (tern foraging distance) of traditional nesting and foraging habitat at Gull Rapids. Exact locations would depend upon a number of factors including shoreline access (for seasonal deployment and retrieval of platforms), distance to Gull Rapids/GS site, water depth, and flow velocity.

Island enhancement and/or island creation are measures currently being investigated for off-setting losses of gull nesting habitat specifically at Gull Rapids. Erosion rates, water depths, flow velocity, water level fluctuations, effects of ice, constructability and distance to Gull Rapids/GS site are some of the factors considered in the planning of where and how alternate nesting habitat could be developed. The Partnership is aware that water level fluctuations in Stephens Lake can negatively affect nesting waterbirds. As such, water level fluctuation is a consideration in the design of nesting habitat.

REFERENCE: Volume: Aquatic Environment Supporting Volume; Section: Section 7.2.4 Project Effects: Mitigation and Monitoring; Page No.: 7-16 to 7-22

TAC Public Rd 3 HC-0007

ROUND 1 PREAMBLE AND QUESTION:

Project Effects, Mitigation and Monitoring: HC understands that the proponent has proposed to monitor mercury in fish tissue on an annual basis until maximum concentrations are reached, and every 3 years thereafter until concentrations are stable. HC does not have any objections to this approach; however, the EIS does not provided a clear determinant of what constitutes “maximum concentration” and “stable”. Mercury levels in fish are expected to steadily increase over a number of years, reach a maximum, and decline steadily thereafter but may fluctuate slightly over the course of this time. The number of years in which a decrease in mercury levels is observed to conclude that a maximum concentration has been reached, does not appear to have been determined.

The EIS includes an outline of monitoring planned for the mercury in fish tissue. However, the detailed monitoring program that will be provided in the Aquatic Effects Monitoring Plan (AEMP) is not yet provided and is related to regulatory licensing with DFO and Manitoba Conservation.

HC advises that the proponent provide a clear determinant in the EIS of what will constitute a “maximum concentration” and “stable” condition at which point fish tissue monitoring will be reduced to a frequency of every third year.

When the AEMP is available for review, HC is able to provide advice regarding potential effects and review of additional HHRAs to ensure fish consumption advisories remain protective of human health.

ROUND 2 PREAMBLE AND QUESTION:

HC is satisfied with the explanation of “maximum concentration” and “stable” for post-project monitoring of mercury concentrations in fish. Draft Aquatic Effects Monitoring Plan HC was provided with a copy of the draft Aquatic Effects Monitoring Plan on October 29, 2012. HC has the following comments:

Section 6.1.2.1.3 Parameters In the core monitoring of lake sturgeon, methyl mercury is not listed as a parameter that will be measured. Because draft risk communication products advise consuming lake sturgeon, please confirm that methyl mercury is included in the monitoring plan.

Section 7.0 Mercury in Fish Flesh In Section 7.2 Monitoring During Operation, HC advises that lake sturgeon be added to the large-bodied fish species that will sampled for mercury concentrations. HC advises that all fish species that will be consumed be included in the monitoring plan (including lake sturgeon, cisco, rainbow smelt, lake trout, etc.).

HC is available to review results of the AEMP, upon request.

FOLLOW-UP QUESTION:

It would appear from the proponent's SIR response (for DFO), that supplementary field studies for lake sturgeon [File Name: 11-02 Lake Sturgeon population estimates Keeyask 1995-2011.pdf] include long term monitoring of mercury levels in lake sturgeon. If this is the case, HC advises that data originating from this monitoring may also be used to support the development of the Environmental Management Plan and the conclusions of the HHRA.

RESPONSE:

File 11-02 Lake Sturgeon population estimates Keeyask 1995-2011.pdf does not include any reference to mercury concentrations. As indicated in TAC Public Rd 2 HC-0007 there is no intention to systematically measure Lake Sturgeon mercury concentrations in Keeyask waterbodies post-Project (only incidental sturgeon mortalities will be analyzed for mercury). Consequently, mercury monitoring of Lake Sturgeon is not included in the AEMP, which is available in its entirety on the Partnership website.

REFERENCE: Volume: Response to EIS Guidelines; Section: 6.2.3.2.9 Groundwater; Page No.: 6-50

TAC Public Rd 3 NRCan-0005

ROUND 1 PREAMBLE AND QUESTION:

The proponent discusses baseline groundwater quality based on reference to the literature. They also mention that on-site groundwater analyses confirm this and discuss elevated zinc concentrations. However, there is no information provided with respect to on-site sampling. It is unclear how many on-site samples were collected and what parameters they were analyzed for. The analytical results are not presented. The absence of this information makes it impossible to assess if baseline conditions of groundwater quality have been adequately determined.

Provide the location of on-site groundwater monitoring well sampling sites. Provide information on the frequency of groundwater sampling from these sites. Provide information on sampling and laboratory methodologies, including a discussion of quality assurance and quality control. Present the analytical results of all field-derived and laboratory analyses. Provide a direct comparison, by means of a table, of groundwater quality determined from on-site measurements versus groundwater quality gleaned from the literature. It is recommended the following physical and chemical parameters be tested for in groundwater: alkalinity, temperature, pH, Eh, electrical conductivity (EC), major ions, nutrients, minor and trace constituents, and metals (including methyl mercury).

ROUND 2 PREAMBLE AND QUESTION:

The proponent mentions that two groundwater sampling trips were conducted- one for the camp well investigation and one for the groundwater investigation. Are the results presented in the Keeyask Response to IR's just for the groundwater investigation? Please clarify. If camp well data has not been presented, please do so. Also, on Map 8.2-2 of the Physical Environment Supporting Volume Groundwater, there are 5 other wells (G-0556, G-5086, G-0561, 03-042, 03-045). Please clarify if these wells were sampled and provide any data for these wells.

FOLLOW-UP QUESTION:

NRCan is generally satisfied with the proponent's response to IR-0005. However, NRCan would like to request a further clarification. In the November 2012 IR responses provided by the proponent, the proponent mentions that the camp well investigation and groundwater investigation include testing of water quality for metals, and they specify that this would include testing for mercury. In the updated response to IR-0095, there are results for other metals, but not for mercury. Could the proponent confirm if groundwater in the vicinity of the camp site was analyzed for mercury, and if not, justification for the omission is requested.

RESPONSE:

In January 2013, additional water quality samples were obtained from the two groundwater wells that will supply water to the Keeyask construction camp. Test results are summarized in the following table. Water quality tests on groundwater samples from the camp wells included routine test parameters for a water supply well, which in Manitoba does not include mercury. Accordingly, the tests completed did not include mercury.

Health Canada's Guidelines for Canadian Drinking Water Quality Summary Table[5], prepared by the Federal-Provincial-Territorial Committee on Drinking Water, notes the following with respect to mercury in water: the common sources of the parameter in water are "Releases or spills from industrial effluents; waste disposal; irrigation or drainage of areas where agricultural pesticides are used", and further notes that "mercury is generally not found in drinking water, as it binds to sediments and soil".

The Groundwater Management Section of Manitoba Conservation and Water Stewardship indicated that mercury has not been identified as a likely contaminant of concern for groundwater in the Province, and that mercury is not typically tested unless there is a reason to suspect potential contamination from an external source (e.g., a nearby industrial development)[6].

For the groundwater samples where mercury was tested (see response to TAC Public Rd 1 NRCan-0005), the results showed mercury was below the test detection limit (0.00005 mg/L). Thus, concentrations were more than 20 times lower than the guideline for drinking water (0.001 mg/L, Health Canada[1]). Both the camp wells and these test wells are screened into the till aquifer suggesting that these results would be representative as well for the camp well.

Given that the Keeyask camp wells are located in an undeveloped area, considering the information from Health Canada and the province, and results of mercury tests for other wells in vicinity, the groundwater at the camp well site would not be considered at risk for elevated mercury. For these reasons the water samples collected from the camp wells was not tested for mercury.

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[5] Health Canada, August 2012, Guidelines for Canadian Drinking Water Quality Summary Table, viewed at http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/2012-sum_guide-res_recom/index-eng.php

[6] pers. comm., L. Frost (Manitoba Conservation and Water Stewardship), telephone conversation Jul 10, 2013.

Parameter	PW 13-01	PW 13-02	CCME Guidelines	
			Aquatic Life	Community Water
pH	8.25	8.12	6.5-9	*6.5-8.5*
Alkalinity, Total (as $CaCO_3$)	197	197	-	-
Bicarbonate (HCO_3)	240	241	-	-
Ammonia (NH_3)	<0.010	<0.010	4.4-6.7	-
Chloride (Cl)	0.53	0.58	-	*250*
Fluoride (F)	0.13	0.15	-	1.5
Nitrate+Nitrite-N	0.381	0.366	60	45
Sulphate	4.98	4.67	-	*500*
Mercury (Hg)			0.0001	0.001
Silver (Ag)	<0.00010	<0.00010	0.0001	-
Aluminum (Al)	0.0186	0.0195	0.005-0.1	-
Arsenic (As)	<0.00020	<0.00020	0.005	0.025
Boron (B)	<0.010	<0.010	-	-
Barium (Ba)	0.0269	0.0296	-	1
Beryllium (Be)	<0.00020	<0.00020	-	-
Bismuth (Bi)	<0.00020	<0.00020	-	-
Calcium (Ca)	56.0	56.2	-	-
Cadmium (Cd)	<0.000010	<0.000010	0.00017	0.005
Cobalt (Co)	<0.00020	<0.00020	-	-
Chromium (Cr)	<0.0010	<0.0010	0.01	0.05
Cesium (Cs)	<0.00010	<0.00010	-	-
Copper (Cu)	0.00125	0.00055	0.002-0.004	1
Iron (Fe)	<0.10	<0.10	0.3	*0.3*
Potassium (K)	1.51	1.56	-	-
Magnesium (Mg)	13.6	13.6	-	-

Parameter	PW 13-01	PW 13-02	CCME Guidelines	
			Aquatic Life	Community Water
Manganese (Mn)	0.00475	0.00294	-	*0.05*
Molybdenum (Mo)	0.00060	0.00072	0.073	-
Sodium (Na)	1.60	1.67	-	*200*
Nickel (Ni)	<0.0020	<0.0020	0.025	-
Phosphorus (P)	<0.20	<0.20	-	-
Lead (Pb)	<0.000090	<0.000090	0.001	0.01
Rubidium (Rb)	0.00021	0.00035	-	-
Antimony (Sb)	<0.00020	<0.00020	-	0.006
Selenium (Se)	<0.0010	<0.0010	0.001	0.01
Silicon (Si)	4.01	4.30	-	-
Tin (Sn)	<0.00020	<0.00020	-	-
Strontium (Sr)	0.0518	0.0548	-	-
Tellurium (Te)	<0.00020	<0.00020	-	-
Titanium (Ti)	0.00083	0.00084	-	-
Thallium (Tl)	<0.00010	<0.00010	0.0008	-
Uranium (U)	0.00079	0.00089	0.02	-
Vanadium (V)	0.00025	0.00024	-	-
Tungsten (W)	<0.0010	<0.0010	-	-
Zinc (Zn)	<0.0050	<0.0050	0.03	5

Notes: CCME aesthetic objective for drinking water shown in italics; "-" = no guideline established; ***bold*** *text denotes an exceedance of a guideline(s).*

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