



Keeyask Generation Project Aquatic Effects Monitoring Plan

Walleye Movement Monitoring Report

AEMP-2015-04



KEEYASK GENERATION PROJECT

AQUATIC EFFECTS MONITORING REPORT

Report # AEMP-2015-04

Walleye Movement Monitoring in the Nelson River between Clark Lake and the Long Spruce generating station, October 2013 to October 2014: Year 1 Construction

Prepared for

Manitoba Hydro

By

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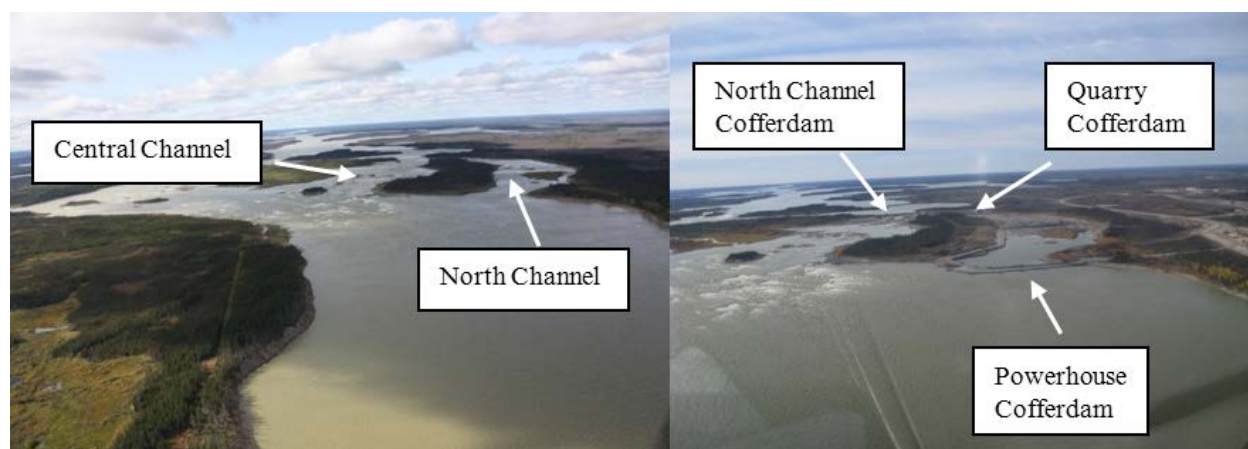
SUMMARY

BACKGROUND

Construction of the Keeyask Generating Station (GS) at Gull Rapids began in July 2014. Before the government issued a licence to construct the generating station, the Keeyask Hydropower Limited Partnership (KHLP) was required to prepare a plan to monitor the effects of construction and operation of the generating station on the aquatic environment. Monitoring results will help the KHLP, government regulators, members of local First Nation communities, and the general public understand how construction and operation of the generating station will affect the environment, and whether or not more needs to be done to reduce harmful effects.

Monitoring fish movements is an important component of the overall plan to monitor the impacts of construction and operation of the Keeyask GS on fish. Fish species such as Walleye and Lake Whitefish are important sources of food to local people and construction and operation of the generating station will alter or destroy habitat and alter fish movement patterns. In addition, results will be used to better understand fish movements in the study area and to address the possible need for a fish passage structure at the GS. Walleye were selected as one of the target species for the study as it is a species of commercial and domestic importance, abundant in the Keeyask Area, known to pass through Gull Rapids in either direction, and readily survives acoustic tag implantation.

This report provides one-year of results (October 2013 to October 2014) of a multi-year Walleye movement monitoring program initiated in June 2013. From mid-July to October 2014, flow in the north and central channels of Gull Rapids was blocked by the construction of cofferdams, which are temporary dams that create dry conditions where the powerhouse and permanent dams will be built. Both movements observed before construction (*i.e.*, from June 2013 to 14 July, 2014) and during construction (*i.e.*, from 15 July to 12 October, 2014) are discussed in this report.



Gull Rapids before (left) and after (right) construction of cofferdams blocked the north and central channels.

WHY IS THE STUDY BEING DONE?

The study is being done to address several questions:

How many of the Walleye that are near Gull Rapids move through the rapids each year and when are they moving?

Movement studies will help regulators and the KHLP determine the importance of movements through Gull Rapids for Walleye in Gull and Stephens lakes. Once the dam is built fish will not be able to move upstream past the dam unless a fish passage structure is built. Walleye moving downstream after the generating station is built would need to go over either the spillway or through the powerhouse and by the turbines (see photo), both of which may injure or kill them. Movement studies are also important to help determine how many fish are injured or killed moving downstream and if additional measures are needed to address effects to fish. This study will tell us how many move over Gull Rapids now. It will also tell us when the fish move over in case more are moving at a certain time of year.

Do Walleye move up and down over Gull Rapids to reach habitat that they need to complete their life cycle?

This question is important because if Walleye can't reach spawning sites because their movements are blocked by the dam, then it would harm the overall population. This study will help determine whether or not fish need to cross Gull Rapids to spawn.

Do Walleye stay near or move away from the construction area and, if so, how far?

This is important because if Walleye are in the river right where a cofferdam is being built, they could be harmed by higher than normal concentrations of mud in the water or trapped inside an area that will be drained. Another possibility is that Walleye could move away from the construction site and be lost from the population.



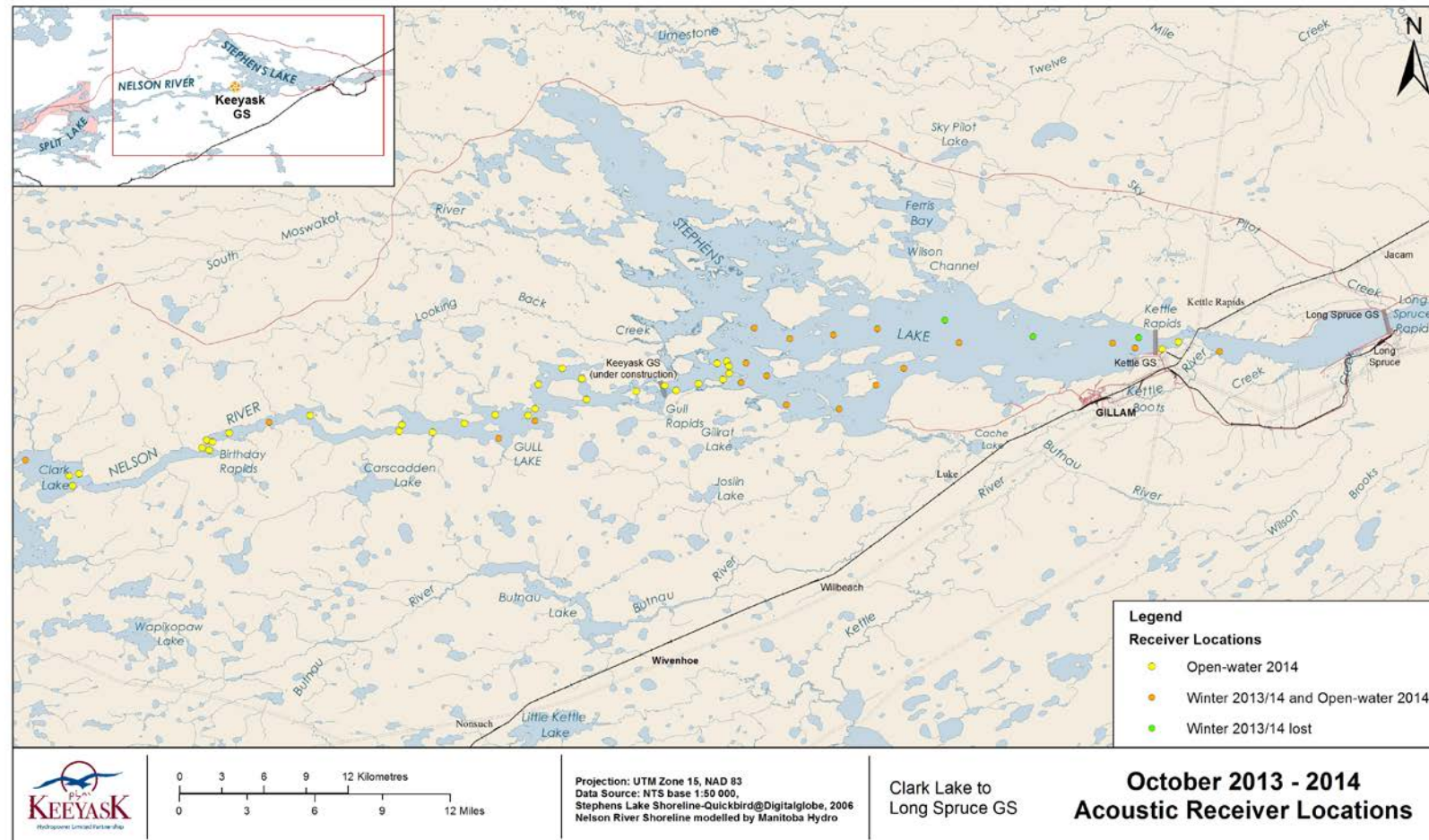
Generating station showing powerhouse and spillway. Water passing through the powerhouse turns turbines (example turbine on right).

WHAT WAS DONE?

The movements of Walleye were tracked using acoustic telemetry. This is a technique in which an acoustic tag is surgically implanted inside a fish (see below photo). Eighty Walleye were tagged, forty upstream and 40 downstream of Gull Rapids. Each tag emits a sound signal (called a “ping”) that is picked up by receivers placed along the Nelson River between Clark Lake and the Long Spruce Generating Station. Each fish is given a transmitter that sends out a unique ping, and the pings can be detected up to 1 km away from a receiver. By looking at the pings recorded by different receivers, the movement of each fish can be tracked. The transmitters are powered by batteries. The transmitters implanted into Walleye have a three year battery life.



Walleye ready for acoustic tag implanting.



Map of the study area. The dots represent the locations of receivers in the river. The different colours represent receivers that were in the river at different times of the year.

WHAT WAS FOUND?

How far and where Walleye moved depended on the individual fish, whether they lived upstream of Gull Rapids (in Gull Lake) or downstream of Gull Rapids (in Stephens Lake), and the season.

Walleye tagged upstream of Gull Rapids tended to stay in wider lake areas as opposed to being found in the more fast flowing environments of the Nelson River. Most of the Walleye remained close to the area in Gull Lake where they were tagged. A smaller number moved upstream through Birthday Rapids into Clark Lake. One of these was recaptured as far upstream as the Odei River, 100 km from where it was tagged. So far, two of the fish have moved downstream through Gull Rapids.



Birthday Rapids is 10 km upstream of Gull Lake.



Stephens Lake

Downstream of Gull Rapids, the majority of the tagged fish have remained in Stephens Lake. One moved upstream over Gull Rapids in late August/early September and continued upstream

through Gull Lake into Clark Lake. Another moved downstream through the Kettle GS and is known to have survived passage past the generating station. Walleye are frequently detected by the receivers immediately downstream of Gull Rapids and in the upper 6 km of Stephens Lake.



Gull Rapids

WHAT DOES IT MEAN?

The information collected so far is considered preliminary and it is too early to know whether or not Walleye movements or habitat use have been affected by construction of the GS, or if a fish passage structure will be needed. After 1.5 years of study, we have seen that few Walleye have moved past the place where the Keeyask GS will be built. Movements of Walleye may change after the GS is built because Gull Lake will become part of a reservoir and suitable areas for Walleye to spawn might only be found where the river is still fast flowing.

WHAT WILL BE DONE NEXT?

The tags that were implanted in 2013 will last until 2016 while those implanted in 2014 will last until 2017. New transmitters will be applied in 2016 and 2017 providing three more years of movement monitoring data during the construction phase and the first couple of years after the reservoir is created. Tracking individual fish over this period of time will give us a better idea of what kinds of habitats these fish need to use over many years, including times when they are spawning and times when they are feeding. This information will help government regulators and the KHLP decide if fish passage structures or additional mitigation measures are needed after the GS is built. Tracking will also let us continue to know whether fish may be exposed to harm at the construction site.

ACKNOWLEDGEMENTS

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The collection of biological samples described in this report was authorized by Manitoba Conservation and Water Stewardship, Fisheries Branch, under terms of the Scientific Collection Permit # 18-14.

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1.0 INTRODUCTION

Construction of the Keeyask Generation Project (the Project), a 695 megawatt hydroelectric generating station and associated facilities, began in July 2014. The Project is located at Gull Rapids on the lower Nelson River in northern Manitoba where Gull Lake flows into Stephens Lake, 35 km upstream of the existing Kettle Generating Station (Figure 1).

The *Keeyask Generation Project: Response to EIS Guidelines*, completed in June 2012, provides a summary of predicted effects and planned mitigation for the Project. Technical supporting information for the aquatic environment, including a description of the environmental setting, effects and mitigation, and a summary of proposed monitoring and follow-up programs is provided in the *Keeyask Generation Project Environmental Impact Statement: Aquatic Environment Supporting Volume* (AE SV). As part of the licencing process for the Project, an Aquatic Effects Monitoring Plan (AEMP) was developed detailing the monitoring activities of various components of the aquatic environment including the focus of this report, fish community, specifically Walleye movement, for the construction and operation phases of the Project.

The study area for the fish community component of the AEMP includes the reach of the Nelson River from the Kelsey Generating Station (GS) to the Kettle GS, as well as waterbodies immediately adjacent to the Nelson River (Figure 1).

Fish movement assessment or baseline studies have been conducted in the Keeyask Study Area since 2001. Studies focused on Lake Sturgeon, Walleye, Northern Pike and Lake Whitefish, species considered Valued Ecosystem Components for the Keeyask Environmental Assessment, were presented in the AE SV. Results indicated that each of these species move upstream and downstream over Gull Rapids; however, with the possible exception of Lake Sturgeon, the proportion of the population that moved through Gull Rapids is small.

Movement monitoring during the construction phase is being conducted to i) determine if disturbances associated with construction alter habitat use and coarse-scale movement patterns upstream and/or downstream of the Project; and ii) to better understand fish movements in the existing environment, and the potential need for, and the approach to, fish passage. Results will assist in identifying the use of key habitats (e.g., spawning, rearing, and foraging) during construction, the potential vulnerability of fish to activities at the construction site (i.e., if fish use the area in the immediate vicinity of the construction site they may be vulnerable to stranding during dewatering), and the potential for increased emigration or avoidance of the construction site due to disturbance (e.g., blasting, suspended sediment inputs, etc.). Further, movement data collected during the construction period, in conjunction with baseline data collected prior to construction, will contribute to the assessment of the need for: (i) upstream fish passage; and (ii) additional mitigation to address effects to fish moving downstream after the GS is completed.

Walleye were selected as one of the target species for fish movement/habitat use monitoring during construction and operation of the Keeyask Project, as it is a species of commercial and domestic importance, it is abundant in the Keeyask area, and is known to pass through Gull Rapids in either direction.

As presented in the AEMP, the key questions for Walleye movement monitoring, during construction are:

- To quantify the number (or the proportion) of tagged Walleye that move past the construction site; and
- To determine if fish are utilizing habitat in the vicinity of construction activities (particularly during spawning).

Movements and habitat use of Walleye may be affected by operation of the Project, as a result of changes in the water regime (e.g., flooding, reduction in water velocity). As described in the AEMP, acoustic transmitters will be applied to Walleye at three year intervals to extend the Walleye movement monitoring program into the operation phase of the Project. Specific objectives of monitoring during operation are as follows:

- To determine what types of habitat Walleye are utilizing in the Keeyask reservoir (i.e., are fish using the upper, middle or lower end of the reservoir);
- To identify what proportion of the fish population moves from the Keeyask reservoir upstream past Birthday and/or Long rapids;
- To assess the frequency of downstream movement through the Keeyask GS, which species/size classes are moving downstream, when are the movements occurring, and to determine mortality; and
- To determine where and what sizes of fish congregate in the fast water environment immediately below the Keeyask GS, and whether the species composition/size classes of fish vary by season.

To address these key questions/objectives during the construction phase of the project, 80 Walleye (measuring greater than 350 mm fork length) were tagged with acoustic transmitters (3-year battery life) in June/July 2013, one-year prior to the start of construction of the Keeyask GS. Forty fish captured upstream of Gull Rapids, and 40 fish captured downstream of Gull Rapids were tagged. By the end of the open-water period in 2013, it appeared that 11 tags had been lost either due to mortality, malfunction, or individuals permanently leaving the study area. Additionally, four fish tagged in Gull Lake moved upstream into Clark Lake and one tagged in Stephens Lake moved upstream through Gull Rapids as far upstream as Clark Lake (Hrenchuk and Barth 2014).

In June 2014, 11 additional tags were implanted to restore the sample size to 80. Nine of these tags were applied upstream of Gull Rapids and two were applied downstream.

Construction of the Keeyask GS began in mid-July 2014, and flows were altered in the north and, later, central channels of Gull Rapids, diverting them into the south channel (Figure 2).

Between 22 July and 4 August, 2014, flow in the north channel was cut off by construction of the Quarry Cofferdam. As construction continued, flow in the central channel was gradually cut off (construction of the North Channel Cofferdam began on 10 September and dewatering continued to the end of October, 2014). The Powerhouse Cofferdam was constructed at the base of the north channel of Gull Rapids, and dewatered the remainder of the north channel between 2 and 26 October, 2014. Blasting occurred in quarries situated in the north channel intermittently from July – October 2014.

Hrenchuk and Barth (2014) provided results of this movement monitoring study from June 2013 – October 2013. This report provides results from October 2013 – October 2014.

2.0 THE KEEYASK STUDY SETTING

The study area encompasses an approximately 95 km long reach of the Nelson River from Clark Lake to the upstream end of the Long Spruce GS forebay. This section of river offers a diversity of physical habitat conditions, including a variety of substrate types, and variable water depths (ranging from 0 to 30 m) and velocities.

Clark Lake is located immediately downstream of Split Lake, and approximately 42 km upstream of Gull Rapids (Figure 1). Current is restricted to the main section of the lake, with off-current bays outside the main channel. The Assean River is the only major tributary to Clark Lake, and flows into the north side. Downstream from the outlet of Clark Lake, the Nelson River narrows and water velocity increases for a 3 km stretch, known as Long Rapids. For the next 7 km, the river widens, and water velocity decreases.

Birthday Rapids is located approximately 10 km downstream of Clark Lake and 30 km upstream of Gull Rapids (Figure 1). The drop in elevation from the upstream to downstream side of Birthday Rapids is approximately 2 m. The 14 km reach of the Nelson River between Birthday Rapids and Gull Lake is characterized as a large somewhat uniform channel with medium to high water velocities. There are a few large bays with reduced water velocity and a number of small tributaries that drain into the Nelson River.

Gull Lake is a section of the Nelson River where the river widens, with moderate to low water velocity. Gull Lake is herein defined as the reach of the Nelson River beginning approximately 17 km upstream of Gull Rapids and 14 km downstream of Birthday Rapids, where the river widens to the north into a bay around a large point of land (Figure 1), and extending to the downstream end of Caribou Island, approximately 3 km upstream of Gull Rapids. Gull Lake has three distinct basins, the first extending from the upstream end of the lake downstream approximately 6 km to a large island; the second extending from the large island to Morris Point (a constriction in the river immediately upstream of Caribou Island); and the third extending from Morris Point to the downstream end of Caribou Island (Figure 4).

Gull Rapids is located approximately 3 km downstream of Caribou Island on the Nelson River (Figure 1). Two large islands and several small islands occur within the rapids, prior to the river narrowing. The rapids are approximately 2 km in length, and the river elevation drops approximately 11 m along its 2 km length.

Just below Gull Rapids, the Nelson River enters Stephens Lake. Stephens Lake was formed in 1971 by construction of the Kettle GS. Between Gull Rapids and Stephens Lake there is an approximately 6 km long reach of the Nelson River that, although affected by water regulation at the Kettle GS, remains riverine habitat with moderate velocity. Construction of the Kettle GS flooded Moose Nose Lake (north arm) and several other small lakes that previously drained into the Nelson River, as well as the old channels of the Nelson River that now lie within the southern portion of the lake. Major tributaries of Stephens Lake include the North and South Moswakot rivers that enter the north arm of the lake. Looking Back Creek is a second order

stream that drains into the north arm of Stephens Lake (Figure 1). Kettle GS is located approximately 40 km downstream of Gull Rapids.

Long Spruce Forebay was formed in 1979 by the construction of the Long Spruce GS. It is a 16 km reach of the Nelson River extending from Long Spruce GS upstream to Kettle GS (Manitoba Hydro Public Affairs 1999). Kettle River and Boots Creek are the only major tributaries flowing into Long Spruce Forebay, with both tributaries entering the Forebay on the south shore.

3.0 METHODS

3.1 ACOUSTIC TELEMETRY

Acoustic telemetry involves tracking movements of fish surgically implanted with internal acoustic transmitters (tags). Each transmitter emits a unique signal, recognizable by stationary receivers. When tagged fish come into range of a receiver (generally within 500 m to 1 km, depending on conditions), the transmitter code number, as well as the date and time is stored in the receiver.

3.1.1 ACOUSTIC TRANSMITTER APPLICATION

Acoustic transmitters (Vemco V13-1x, estimated 1141 day battery life) were first applied to 80 Walleye in 2013: 40 upstream, and 40 downstream of Gull Rapids (Table 1). By fall 2013 it was suspected that 11 fish either shed their tags, suffered mortality, or had been captured by local resource users and the tags not returned or reported captured.

In order to return the number of tagged fish to original sample sizes, additional transmitters were applied to Walleye upstream of Gull Rapids ($n = 9$) and in Stephens Lake ($n = 2$). At both locations, Walleye were captured in June, 2014, using 75 yd (68.7 m) long gill net gangs. Gangs were composed of a mix of three panels of 3, 3¾, 4¼, or 5" (76, 95, 108, or 127 mm) twisted nylon mesh set for short (*i.e.*, < 1 hr) durations. Individual gillnet panels measured 25 yds (22.9 m) long and 2.7 yds (2.5 m) deep. Following capture, Walleye were placed in a 76 L fish tub fitted with an aquarium aerator for transport. All tagging was conducted on shore near the site of capture. Prior to transmitter implantation, Walleye were anaesthetized in a solution of clove oil and ethanol, adapted from Anderson et al. (1997). When the Walleye became immobile, they were placed in a surgery cradle ventral side up. Because the anaesthetic renders a fish unable to ventilate on its own, freshwater was continuously pumped over the gills. A small incision, approximately 2 cm in length, was made through the ventral body wall using a sterilized scalpel. An acoustic transmitter was inserted into the body cavity and the incision was closed. Walleye were monitored in a recovery tank until they were able to maintain equilibrium and had regained their strength. They were released in off-current areas near the original capture site (Figure 3).

3.1.2 ACOUSTIC RECEIVERS AND DEPLOYMENT

During the 2014 open-water season, receivers were deployed in calm water with a flat bottom free of large debris to maximize detection range, and spaced along the main river channel throughout the study area to maximize spatial coverage. In Stephens Lake, receivers were placed at locations within pre-flood river channels, based on the observation that fish tend to

stay within channels, even in flooded environments. At constrictions within the river channel, a series of receivers were deployed to create “gates” with the intent of recording any fish that passed by.

The retrieval of receivers deployed during winter has proven challenging and several were lost in previous winters that were believed to have been moved by ice (Hrenchuk and Barth 2013). Because it appears that receivers will only remain safe from ice if deployed at depths > 10 m, the number of possible receiver locations during winter, especially in Gull Lake, is limited.

3.1.2.1 WINTER 2013/2014

Twenty-two stationary acoustic receivers (VEMCO model VR2 and VR2W, Shad Bay, Nova Scotia) were placed between Clark Lake and the Long Spruce GS during the winter 2013/2014 period (16 October, 2013, to 30 April, 2014) (figures 4, 5, and 6). Four were set upstream of Gull Rapids, 16 throughout Stephens Lake, and two in the Long Spruce Forebay. One receiver in Gull Lake (#122862; river kilometer [rkm] -12.9), and one in Stephens Lake (#114233; rkm 32) were not set previously.

3.1.2.2 OPEN-WATER 2014

An array of 50 stationary receivers was used during the 2014 open-water period (1 May to 12 October, 2014). Twenty-four were set between Clark Lake and Gull Rapids, one in Gull Rapids proper, and 22 in Stephens Lake (figures 7 and 8). Three additional receivers were placed in the Long Spruce Reservoir. No receivers were set in new deployment locations (Figure 9).

Receiver “gates” were deployed in several key areas: four between Clark Lake and Gull Rapids (44, 34, 19, and 10 rkms upstream of Gull Rapids), and two in Stephens Lake (4.5 and 40 rkms downstream of Gull Rapids) (figures 7 and 8). Receiver “gates” consisted of two or more acoustic receivers set parallel to flow to provide complete signal a river cross-section. Areas between the “gates” were referred to as river zones. The area upstream of Gull Rapids was divided into five zones (Figure 7), while Stephens Lake was divided into two zones (Figure 8). Gate locations were consistent with the 2013 open-water study period, and divided the river into the same zones. On 12 October 2014, the majority of receivers were removed and a subset (n = 22) were redeployed to monitor movements during winter 2014/2015.

3.1.3 DATA ANALYSIS

To filter out false detections, a Walleye was required to be detected at least two times within a 30 minute interval at a given stationary receiver for the detections to be deemed valid. Single detections were filtered and not used in analyses.

Movements were described in terms of rkm distance, with the base of Gull Rapids representing a distance of 0 rkm. Detections in the area downstream of Gull Rapids (*i.e.*, Stephens Lake,

Long Spruce Forebay) were given positive (+) distance values from Gull Rapids, while detections made in the area upstream (*i.e.*, Gull and Clark lakes) were given negative (-) distance values (figures 10 and 11). The average rkm distance from Gull Rapids was calculated over a 4-hour interval and plotted versus time for each fish. Total relocation ranges were calculated by subtracting the furthest downstream detection location from the location of the furthest upstream detection. Proportion of time all fish spent within each river zone was calculated and plotted.

4.0 RESULTS

The numbers of tags applied by year upstream and downstream of the GS are summarized in Table 1. Tables 2 and 3 provide tag and biological information associated with each tagged Walleye. Maps of receiver locations are provided in figures 3 to 9. Seasonal movement summaries, and proportional distribution analyses, by tagging location, are provided in figures 12 to 19. A detection summary by season and year, including farthest upstream and downstream detection location for each fish are provided in appendices A1-1 and A1-2. Individual movement summaries, in relation to Gull Rapids are provided for each tagged fish upstream of Gull Rapids in appendices A2-1 through A2-49, and downstream of Gull Rapids in A3-1 through A3-42.

4.1 UPSTREAM OF GULL RAPIDS

4.1.1 2013 RESULTS SUMMARY

In 2013, 40 Walleye were tagged upstream of Gull Rapids. As reported in Hrenchuk and Barth (2014) nine tags were considered missing prior to winter 2013/2014:

- Seven of these were tagged at the upstream end of Gull Lake (rkm -18.2) on 1 July, 2013. These were considered tagging mortalities.
 - Tag numbers included: #32865, #32866, #32867, #32870, #32871, #32876 and #32880 (appendices A2-15, A2-16, A2-17, A2-20, A2-21, A2-26, and A2-30).
- One (#32864) was not detected after being tagged (Appendix A2-14).
- One (#32884) was tagged at the mouth of Rabbit Creek in Gull Lake (rkm -17.1) on 30 August, 2013. It was last detected at rkm -9.9 two days after being tagged on 1 September, 2013 (Appendix A2-34).

These nine fish were not included in data analyses and are not discussed for the remainder of the report.

One fish tagged in Stephens Lake moved upstream through Gull Rapids into Clark Lake in 2013:

- #32843 was tagged in Stephens Lake on 27 June, 2013, and moved upstream through Gull Rapids between 28 August, 2013 (detected at rkm 0.5) and 12 September, 2013 (detected at rkm -5.8). It continued to move upstream and was relocated at the inlet to Clark Lake (rkm -48.2) in September (Appendix A3-31).

Four fish (#32851, #32868, #32873, and #32882) tagged in Gull Lake moved into Clark Lake (appendices A2-5, A2-18, A2-23, and A2-32).

Therefore, accounting for the 40 Walleye originally tagged, the nine missing tags, and the addition of one that moved upstream from Stephens Lake, 32 fish were available to be detected upstream of Gull Rapids during winter 2013/2014. Of these, 5 were last relocated in Clark Lake and 27 were last located in Gull Lake.

4.1.2 WINTER 2013/2014

All four stationary acoustic receivers deployed upstream of Gull Rapids during winter 2013/2014 were retrieved during spring 2014 (Figure 4). A total of 9,157 detections from 9 fish were logged, ranging from 3 – 5,796 detections per individual (Appendix A1-1). The average movement range was 1.0 rkm (StDev = 1.50; range: 0.0 – 3.0) (Figure 12). Relocated Walleye were detected at receivers for an average of 14.2 days (7.3% of the days) of the 196 day winter period (StDev = 21.8 days; range: 1 – 56 days) (Appendix A1-1).

- Two (#32873 and #32882) Walleye that had moved into Clark Lake during the open-water period in 2013 were relocated only at the upstream end of Clark Lake (rkm -48.2) for two and 49 days, respectively (appendices A2-23 and A2-32);
- Four (#32862, #32869, #32883, and #32887) Walleye were relocated only briefly in Gull Lake at rkm -12.9 for one to six days (appendices A2-12, A2-19, A2-33, and A2-37); and
- Three (#32861, #32888, and #32889) were relocated at both receivers in Gull Lake (rkms -12.9 and -9.9) for three, 56, and four days, respectively (appendices A2-11, A2-38, and A2-39).

4.1.3 OPEN-WATER 2014

4.1.3.1 ACOUSTIC TAGGING

As previously discussed, 9 additional tags were applied to Walleye upstream of Gull Rapids between 17 and 21 June, 2014. These fish had a mean fork length of 498 mm (range: 364 – 559 mm) and a mean weight of 1,651 g (range: 560 – 2,250 g) (Table 2). The majority of fish were released on either the north or south shore at the upstream end of Gull Lake (rkm -19.5); one fish was released on the south shore at the mouth of Rabbit Creek (rkm -17.3).

4.1.3.2 ACOUSTIC RECEIVER RETRIEVAL

All 24 stationary acoustic receivers deployed upstream of Gull Rapids were successfully retrieved at the end of the open-water period (Figure 7).

4.1.3.3 WALLEYE MOVEMENTS

In total, 42 fish were available to be detected upstream of Gull Rapids during open-water 2014. This includes the nine fish tagged in Gull Lake in 2014 (Section 4.1.3.1), the 32 fish thought to be in this area at the end of the open-water period in 2013 (section 4.1.1) and the relocation of one fish classified as missing in 2013 (#32880) (Hrenchuk and Barth 2014). Five of these fish were last relocated in Clark Lake and 37 were last relocated in Gull Lake.

Of the 42 fish available to be detected, 34 fish were relocated. From these, 436,775 detections were logged, ranging from 28 – 58,854 detections per individual (Appendix A1-1). Fish were detected for an average of 84 days of the 165 day open-water season (51%; StDev = 34.7 days; range: 5 – 130 days). The mean total movement range was 16.4 rkm (range: 0.0 – 53.1 rkm) (Figure 14).

4.1.3.3.1 CLARK LAKE

Of the five fish last relocated in Clark Lake:

- Two (#32843 and #32868) were relocated exclusively within Clark Lake for short periods of time (appendices A3-31 and A2-18, respectively).
- Walleye #32851 moved downstream from Clark Lake to Gull Lake in the spring (between 5 and 26 June, 2014) (Appendix A2-5).
- Walleye #32873 moved downstream from Clark Lake to Gull Lake in the spring and returned upstream to Clark Lake in the fall (between 11 and 26 September, 2014) (Appendix A2-23).
- Walleye #32882 was detected frequently in Clark Lake during winter 2013/2014 and early spring until 28 May, 2014. It was next detected at the receiver gate upstream of Gull Rapids (rkm -9.9) on 12 August, 2014, and subsequently by the gate in Stephens Lake (rkm 4.9) 4 hours later. It was relocated between rkms 4.3 and 4.9 in Stephens Lake for the remainder of that day, but was not relocated after this date (Appendix A2-32).

4.1.3.3.2 GULL LAKE

Of the 37 fish last relocated in Gull Lake, 29 were relocated. Eight fish (#32846, #32853, #32856, #32863, #32875, #32885, #32887, and #32889) were not detected in 2014 (appendices A2-3, A2-7, A2-8, A2-13, A2-21, A2-35, A2-37, and A2-39).

Twenty-two were relocated primarily in Zone 4, the upstream end of Gull Lake:

- Thirteen (#32847, #32857, #32861, #32872, #32883, #32886, #32890, #6418, #6421, #6422, #6423, #6425, and #6426) were only relocated in Zone 4 between rkms -19.5 and -9.9) (appendices A2-4, A2-9, A2-11, A2-33, A2-36, A2-40, A2-42, A2-45, A2-46, A2-47, A2-48, and A2-49).
- Three (#32833, #32858, and #32874) made brief downstream movements into lower Gull Lake (Zone 5) but moved back upstream into Zone 4 (appendices A2-2, A2-10, and A2-24).

- Six (#32813, #32852, #32879, #32878, #32881, and #6419) remained primarily in Zone 4 but moved briefly into the adjacent upstream riverine section (Zone 3) (appendices A2-1, A2-6, A2-28, A2-29, A2-31, and A2-43).
 - #32852, #32879, and #6419 were relocated briefly in Zone 3 during spring.
 - #32813, #32878, and #32881 moved upstream into Zone 3 during fall.

Six Walleye moved upstream into Clark Lake in 2014:

- Three (#32869, #6417, and #6420) were detected exclusively in Gull Lake between June and August, 2014. They then moved upstream into Clark Lake during late summer/fall and were last relocated by the receiver at the inlet of Clark Lake (rkm -48.2) (appendices A2-19, A2-41, and A2-44).
 - One of these (#6417) was captured and released by a recreational fisher on 15 September, 2014 in the Odei River. The fish moved upstream through Clark Lake, Split Lake, and the Burntwood River, a distance of approximately 100 km from its original release location (Appendix A2-41).
- Two Walleye (#32862, 32877 and 32888) moved into Clark Lake during spring and subsequently moved back downstream into Gull Lake in July, 2014 (appendices A2-12 and A2-27).
- One (#32888) moved upstream into Clark Lake during spring, back down to Gull Lake during summer and back upstream into Clark Lake during fall (Appendix A2-38).

One Walleye (#32880) moved from Gull Lake downstream through Gull Rapids into Stephens Lake:

- #32880 had previously been classified as missing in the 2013 analysis (Hrenchuk and Barth 2014). It was last detected in Gull Lake at rkm -5.8 on 5 July, 2013. However, it was relocated at rkm 4.9 in Stephens Lake on 14 June, 2014. It was relocated multiple times at this location until 1 September, 2014. Due to the gap between detections, the date this fish moved downstream through Gull Rapids is unknown (Appendix A2-30).

Proportional distribution analysis for the open-water period of 2014, based on the relocation data from the 34 Walleye relocated upstream of Gull Rapids, indicates that the upper basin of Gull Lake (Zone 4), was used most frequently (fish relocated for 80.7% of the time in this zone) (StDev = 25%; range: 0 – 100%). Walleye spent 9.5% of their time in Zone 1 (StDev = 25%; range: 0 – 100%), almost exclusively in June and September. Zones 2 and 3 were used less frequently 1.1% (StDev = 3%; range: 0 – 17%) and 4.5% (StDev = 9%; range: 0 -45%) of the time, respectively. Fish generally remain within these zones, and relocations here were often associated with upstream movements into Zone 1. Fish spent 4.1% of their time in Zone 5 (StDev = 10%; range: 0 – 31%), however, relocations in this area were generally brief (figures 15 and 16).

4.2 DOWNSTREAM OF GULL RAPIDS

4.2.1 2013 RESULTS SUMMARY

Forty fish were originally tagged downstream of Gull Rapids in 2013 (at rkm 1.7), however, two (#32820 and #32842) displayed rapid downstream movements following tagging and were considered mortalities (Hrenchuk and Barth 2014) (appendices A3-9 and A3-30, respectively). Further, as previously discussed in Section 4.1.1, one Walleye (#32843) moved upstream into Clark Lake (Appendix A3-31). Therefore, accounting for the 40 fish originally tagged, the two considered missing, and the one that moved upstream into Clark Lake in 2013, there were 37 fish available to be detected in Stephens Lake during winter 2013/2014.

4.2.2 WINTER 2013/2014

Thirteen of 16 receivers deployed in Stephens Lake during winter 2013/2014 were retrieved. Three receivers, located at rkms 26.0, 32.0, and 40.8 could not be retrieved due to the buildup of large woody debris (Figure 5). The single receiver set in the Long Spruce Reservoir was retrieved (Figure 6).

In total, 120,541 detections were logged by the 26 relocated fish, ranging from 17 – 27,452 detections per individual (Appendix A1-2). The average movement range was 4.6 rkm (StDev = 3.1; range: 0.0 – 11.0) (Figure 13; Appendix A1-2). Fish were detected for an average of 34.3 days during the 196 day winter period (17.5 % of the days; StDev = 33.6; range: 2 – 124 days) (Appendix A1-2).

Eighteen Walleye were located within 10.5 rkms of the base of Gull Rapids for the majority of the winter:

- Seven (#32811, #32824, #32836, #32837, #32840, #32844, and #32859) remained exclusively in the former Moosenose River channel between receivers #114227 (rkm 7.9) and #7778 (rkm 10.5) (Figure 5; appendices A3-1, A3-13, A3-24, A3-25, A3-28, A3-32, and A3-39).
- Nine (#32812, #32817, #32821, #32826, #32827, #32830, #32834, #32838, and #32848) remained in the southern portion of Stephens Lake and moved between receivers #107998 (rkm 6.1) and #107995 (rkm 10.2) (Figure 5; appendices A3-2, A3-6, A3-10, A3-15, A3-16, A3-19, A3-22, A3-26, and A3-34).
- Two (#32850 and #32855) moved between the former Moosenose River channel and the southern portion of Stephens Lake (appendices A3-36 and A3-38).

Three Walleye were relocated exclusively downstream of rkm 10.5:

- #32845 was relocated between rkms 14.9 and 21.0 for 142 days (Appendix A3-33);

- #32854 was relocated exclusively at rkm 14.9 for 3 days (Appendix A3-37); and
- #32860 was detected at rkm 16.8 for 2 days (Appendix A3-40).

Five Walleye exhibited some degree of movement between upper and lower Stephens Lake (rkms 6.1 to 18.7):

- #32822 was relocated between rkms 6.1 and 16.8 (Appendix A3-11).
- #32825 was relocated periodically from 1 and 24 November, 2013, between rkms 7.9 and 13.4 (Appendix A3-14).
- #32829 remained in lower Stephens Lake (rkms 14.8 and 16.8) from 17 October, 2013 to 1 February, 2014, after which it was relocated exclusively between rkms 7.7 and 10.2 (Appendix A3-18).
- #32832 was relocated between rkm 6.3 and 13.4 periodically (on 19 days) between 16 October, 2013, and 29 January, 2014 (Appendix A3-21).
- #32841 was relocated at rkm 14.1 for the majority of the study period (3 November, 2013, to 11 February, 2014), but was relocated as far upstream as rkm 6.1 and the beginning of the study period and rkm 10.2 at the end (Appendix A3-29).

4.2.3 OPEN-WATER 2014

4.2.3.1 ACOUSTIC TAGGING

As previously discussed, two Walleye were implanted with acoustic transmitters in Stephens Lake on 11 June, 2014. The fish had fork lengths of 443 and 455 mm and their respective weights were 1015 and 1100 g (Table 3). Both fish were released 1.5 rkm downstream of Gull Rapids on the north shore.

4.2.3.2 ACOUSTIC RECEIVER RETRIEVAL

All 22 and three stationary acoustic receivers were successfully retrieved from Stephens Lake and the Long Spruce Reservoir at the end of the open-water study period, respectively (figures 7, 8, and 9). One receiver set within Gull Rapids was lost (Figure 8).

4.2.3.3 WALLEYE MOVEMENTS

With the addition of the two fish tagged in 2014 to the 37 that were last relocated in this area (section 4.2.1), 39 fish were available to be detected in Stephens Lake during the open-water period in 2014. Thirty-three of these were relocated between 2 and 22,064 times (total of 135,072 detections), for 1 – 112 days of the 167 day study period (Appendix A1-2). The mean movement range was 9.9 rkm (StDev = 7.7 rkm; range: 0.2 – 43.0 rkm) (Figure 17).

Six fish went undetected during the 2014 open-water period:

- Two (#32832 and #32836) were last relocated during winter 2013/2014 (appendices A3-21 and A3-24).
- Four (#32823, #32831, #32835, and #32839) have not been relocated since open-water 2013 (appendices A3-12, A3-20, A3-23, and A3-27).

Twenty-two fish were detected exclusively within the upper 10.5 rkms of Stephens Lake:

- Eight (#32814, #32815, #32816, #32817, #32819, #32825, #32837, and #32850) were relocated infrequently (between 1 and 13 days) (appendices A3-3, A3-4, A3-5, A3-6, A3-8, A3-14, A3-25, and A3-36).
- Seven Walleye moved throughout the upper 10.5 rkms of Stephens Lake and had total movement ranges between 9.7 and 10.0 rkm #32812, #32822, #32824, #32834, #32848, #32855, and #32859 (appendices A3-2, A3-11, A3-13, A3-22, A3-34, A3-38, and A3-39).
- The remaining seven (#32821, #32826, #32827, #32828, #32840, #32849, and #6424) moved over a smaller extent within the upper portion of Stephens Lake (movement ranges of 3.2 to 7.2 rkms) and were relocated between 17 and 112 days (appendices A3-10, A3-15, A3-16, A3-17, A3-28, A3-35, and A3-41).

Ten fish were detected throughout Stephens Lake:

- Three fish were relocated for short periods of time (2 to 12 days):
 - #32818 was relocated only on July 28 and 29, 2014. It moved into the upper reaches of Stephens Lake in the former channel of the Moosenose River (rkm 7.9 to 13.4) from upper Stephens Lake (rkm 4.3 to 5.8) (Appendix A3-7).
 - #32844 moved upstream and downstream between rkms 2.9 and 13.4 between 13 June and 5 July, 2014 (Appendix A3-32).
 - #32860 was relocated moving between rkm 2.9 and 16.8 between 23 June and 23 August, 2014 (Appendix A3-40).
- A single fish (#32829) was relocated in the upstream portion of Stephens Lake at the beginning of the period and moved downstream as the season progressed. It was relocated between rkm 0.5 and 10.2 from 13 May to 12 September, 2014. After this date it was relocated exclusively in lower Stephens Lake between rkms 10.2 and 18.7 (Appendix A3-18);
- Six made regular upstream and downstream movements.
 - Four (#32830, #32838, #32841, and #6427) moved as far downstream as rkm 14.9 and were relocated between 17 and 106 days (appendices A3-19, A3-26, A3-29, and A3-42).
 - One (#32845) moved as far downstream as rkm 21.0 and was relocated for 59 days (Appendix A3-33).

- One (#32854) moved as far downstream as rkm 18.7 and was relocated for 47 days (Appendix A3-37).

One fish moved downstream through the Kettle GS. Walleye #32811 was relocated in upper Stephens Lake (rkms 0.5 to 10.2) from 13 to 30 June, 2014. It then moved downstream and was relocated at rkm 13.5 on 3 July, 2014. The next relocation of this fish occurred in the Long Spruce Reservoir (rkm 42.7) on 11 July, 2014. It moved between receivers in the upstream portion of the reach (rkm 42.7 to 43.5) until 24 July, 2014, indicating that it survived passage past the Kettle GS (Appendix A3-1).

Overall, Walleye were found to use Zone 1 more than Zone 2, spending 60% (StDev = 35%; range: 1 – 100%) and 40% (StDev = 35%; range: 0 – 99%) of the study period in each zone, respectively (figures 18 and 19). It should be noted that although the time spent in Zone 1 overall was higher than in Zone 2, Figure 18 clearly shows a steady increase in time spent in Zone 2, the zone near Gull Rapids, as the open-water season progressed.

5.0 DISCUSSION

This report presents one year of results (October 2013 to October 2014), of a three-year Walleye movement monitoring study initiated in June 2013. Given that the transmitters will last at least until June 2016 for fish tagged in 2013 and until June 2017 for fish tagged in 2014, data are considered preliminary, and analysis will be not be conducted until the study is completed.

Acoustic telemetry has proven effective for monitoring movements of Walleye, however, relative to similar studies on adult and juvenile Lake Sturgeon in this study area (Hrenchuk et al. 2015 and Lacho et al. 2015), the results are more difficult to interpret. This is because unlike Lake Sturgeon, Walleye do not always remain within the thalweg of the Nelson River and may utilize tributaries, habitat in off-current embayments or use areas such as the north arm of Stephens Lake, where there is no receiver coverage. Furthermore, Walleye may also move through shallow water habitats, where acoustic signal attenuation is relatively poor, more frequently than Lake Sturgeon. For these reasons, a greater number of tagged Walleye are either not detected, or go undetected for extended periods, relative to Lake Sturgeon. A considerable proportion of the Walleye tagged upstream of Gull Rapids (6 of 42; 14%) and downstream of Gull Rapids (6 of 39; 15%) were not detected in 2014. Although this complicates data interpretation, this is a common problem for the analysis of telemetry data, and is a reason why it is difficult to perform quantitative/statistical analyses on these types of data.

Despite the finding that a considerable proportion of Walleye were undetected during the open-water period of 2014, a considerable quantity of data was collected relevant to the key questions presented in the AEMP. Upstream of Gull Rapids, essentially two movement patterns have become apparent. First, a considerable proportion (22 of 29 Walleye detected during the open-water period of 2014) of Walleye move very little and have remained year-round in Zone 4, the upstream end of Gull Lake. Fish in that exhibit this movement pattern rarely move outside of Zone 4. The second pattern, observed by five individuals in 2013 and six individuals in 2014 (approximately 25% of the tagged fish), is the upstream movement into Clark Lake. These movements tend to be complex. One fish continued moving upstream as far as the Odei River; another fish moving into Clark Lake in 2013 and downstream into Stephens Lake in 2014; one fish moving to Clark Lake in spring, back to Gull Lake during summer, and upstream again into Clark during fall (in 2014). Importantly, results have shown that the proportion of fish that moved downstream through the rapids, or even downstream into the lower basin of Gull Lake is small (2 of 41 tags, approximately 5% in two years of study). This suggests that Walleye upstream of Gull Rapids are unlikely to be affected by construction of the GS until impoundment occurs.

Most of the Walleye tagged in Stephens Lake have remained in the lake. In two years of study, a small proportion of the tagged population has moved out of the lake; one of 40 fish (2.5%) has moved upstream through Gull Rapids and the same proportion has moved downstream through the Kettle GS. Although recognizable movement “patterns” in Stephens Lake are difficult to identify, it is apparent that a considerable proportion of the population utilize upper Stephens Lake during the open-water period with use of the channel immediately downstream of Gull

Rapids being more frequent during fall. Because Stephens Lake fish frequent the base of Gull Rapids and frequently utilize the channel immediately downstream of the rapids, they may be influenced by construction related activities such as noise, blasting, increased TSS levels, etc.

In the discussion below, the key questions for Walleye movement monitoring during construction, as described in the AEMP, and presented in the introduction of this report, are addressed:

- *To quantify the number (or the proportion) of tagged Walleye that move past the construction site.*

Although preliminary, results of this study suggest that a small proportion of the Walleye population from either Gull or Stephens lakes, moves through Gull Rapids. This finding is consistent with baseline movement studies. Since construction began in July 2014, no tagged Walleye have moved upstream through Gull Rapids, while at least one has moved downstream. Further, in the 1.5 years since the study began, one (1 of 40; 2.5% of tagged individuals) tagged Walleye in Stephens Lake has moved upstream, and two (2 of 41; approximately 5%) Walleye tagged in Gull Lake have moved downstream over Gull Rapids. The one fish that moved upstream over Gull Rapids did so between August 28 and September 12, 2013. In terms of downstream movement, one fish moved through Gull Rapids on August 12, 2014. The timing of the downstream movement for the other fish is less certain, and could have occurred anytime over an 11 month period.

- *To determine if fish are utilizing habitat in the vicinity of construction activities (particularly during spawning).*

This question cannot be answered, as the spring of 2015 will be the first spawning season that tagged Walleye will be monitored since construction of the GS began. However, since the onset of the study, Walleye tagged in Stephens Lake are frequently relocated at the base of Gull Rapids and in the upper 6 km of Stephens Lake during the open-water period. Further, baseline data would suggest that Walleye frequently use this area. In 2014, nine tagged Walleye were relocated for at least one day by the receiver immediately downstream of the rapids after construction of the cofferdams began.

6.0 REFERENCES

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TABLES

Table 1: Number of acoustic tags applied to Walleye in the Keeyask Study Area (upstream of Gull Rapids and in Stephens Lake) between June 2013 and October 2014.

Year	Upstream GR	Stephens Lake	Total
2013	40	40	80
2014	9	2	11

Table 2: Tag and biological information for each Walleye acoustically tagged upstream of Gull Rapids in 2013 and 2014.

Tag ID	Date tagged	Tag Life (days)	Expiry date	Fork Length (mm)	Weight (g)
32813	29-Jun-13	1141	13-Aug-16	410	750
32833	1-Jul-13	1141	15-Aug-16	532	2000
32846	30-Jun-13	1141	14-Aug-16	510	1600
32847	30-Jun-13	1141	14-Aug-16	412	900
32851	30-Jun-13	1141	14-Aug-16	530	1975
32852	29-Jun-13	1141	13-Aug-16	526	1675
32853	30-Jun-13	1141	14-Aug-16	375	575
32856	29-Jun-13	1141	13-Aug-16	580	2675
32857	30-Jun-13	1141	14-Aug-16	560	2225
32858	29-Jun-13	1141	13-Aug-16	495	1550
32861	1-Jul-13	1141	15-Aug-16	530	1975
32862	1-Jul-13	1141	15-Aug-16	500	1850
32863	1-Jul-13	1141	15-Aug-16	460	1200
32864	27-Aug-13	1141	11-Oct-16	420	960
32865	1-Jul-13	1141	15-Aug-16	551	2000
32866	1-Jul-13	1141	15-Aug-16	552	1950
32867	1-Jul-13	1141	15-Aug-16	525	2225
32868	30-Aug-13	1141	14-Oct-16	396	850
32869	30-Aug-13	1141	14-Oct-16	365	600
32870	1-Jul-13	1141	15-Aug-16	567	2200
32871	1-Jul-13	1141	15-Aug-16	550	2000
32872	27-Aug-13	1141	11-Oct-16	566	2300
32873	30-Aug-13	1141	14-Oct-16	385	750
32874	30-Aug-13	1141	14-Oct-16	443	1000
32875	1-Jul-13	1141	15-Aug-16	412	1000
32876	1-Jul-13	1141	15-Aug-16	566	2150
32877	27-Aug-13	1141	11-Oct-16	476	1310
32878	30-Aug-13	1141	14-Oct-16	446	1150
32879	30-Aug-13	1141	14-Oct-16	437	1070
32880	1-Jul-13	1141	15-Aug-16	600	2700
32881	30-Aug-13	1141	14-Oct-16	405	900
32882	29-Aug-13	1141	13-Oct-16	450	1000
32883	30-Aug-13	1141	14-Oct-16	535	2200
32884	30-Aug-13	1141	14-Oct-16	400	900
32885	30-Aug-13	1141	14-Oct-16	395	825

Table 2: Tag and biological information for each Walleye acoustically tagged upstream of Gull Rapids in 2013 and 2014.

Tag ID	Date tagged	Tag Life (days)	Expiry date	Fork Length (mm)	Weight (g)
32886	30-Aug-13	1141	14-Oct-16	578	2425
32887	30-Aug-13	1141	14-Oct-16	451	1125
32888	30-Aug-13	1141	14-Oct-16	444	1300
32889	30-Aug-13	1141	14-Oct-16	418	940
32890	30-Aug-13	1141	14-Oct-16	390	850
6417	21-Jun-14	1141	5-Aug-17	559	2250
6418	17-Jun-14	1141	1-Aug-17	529	1950
6419	18-Jun-14	1141	2-Aug-17	490	1550
6420	18-Jun-14	1141	2-Aug-17	467	1250
6421	18-Jun-14	1141	2-Aug-17	514	1800
6422	19-Jun-14	1141	3-Aug-17	514	1750
6423	18-Jun-14	1141	2-Aug-17	503	1800
6425	19-Jun-14	1141	3-Aug-17	364	560
6426	18-Jun-14	1141	2-Aug-17	541	1950

Table 3. Tag and biological information for each Walleye acoustically tagged downstream of Gull Rapids in 2013 and 2014.

Tag ID	Date tagged	Tag Life (days)	Expiry date	Fork Length (mm)	Weight (g)
32811	26-Jun-13	1141	10-Aug-16	524	1750
32812	28-Jun-13	1141	12-Aug-16	464	1250
32814	26-Jun-13	1141	10-Aug-16	470	1350
32815	26-Jun-13	1141	10-Aug-16	610	2525
32816	26-Jun-13	1141	10-Aug-16	533	1675
32817	26-Jun-13	1141	10-Aug-16	444	1150
32818	26-Jun-13	1141	10-Aug-16	591	2800
32819	26-Jun-13	1141	10-Aug-16	492	1500
32820	26-Jun-13	1142	11-Aug-16	430	900
32821	27-Jun-13	1141	11-Aug-16	474	1250
32822	27-Jun-13	1141	11-Aug-16	530	1750
32823	28-Jun-13	1141	12-Aug-16	438	975
32824	27-Jun-13	1141	11-Aug-16	510	1800
32825	27-Jun-13	1141	11-Aug-16	600	2800
32826	27-Jun-13	1141	11-Aug-16	480	1600
32827	27-Jun-13	1141	11-Aug-16	515	2000
32828	27-Jun-13	1141	11-Aug-16	406	900
32829	27-Jun-13	1141	11-Aug-16	395	700
32830	27-Jun-13	1141	11-Aug-16	432	950
32831	27-Jun-13	1141	11-Aug-16	441	1150
32832	27-Jun-13	1141	11-Aug-16	476	1450
32834	27-Jun-13	1141	11-Aug-16	525	1900
32835	27-Jun-13	1141	11-Aug-16	554	2000
32836	26-Jun-13	1141	10-Aug-16	463	1350
32837	27-Jun-13	1141	11-Aug-16	451	1250
32838	27-Jun-13	1141	11-Aug-16	445	1100
32839	27-Jun-13	1141	11-Aug-16	477	1350
32840	27-Jun-13	1141	11-Aug-16	480	1700
32841	26-Jun-13	1141	10-Aug-16	530	1700
32842	27-Jun-13	1141	11-Aug-16	561	2200
32843	27-Jun-13	1141	11-Aug-16	390	800
32844	27-Jun-13	1141	11-Aug-16	492	1400
32845	21-Sep-13	1141	5-Nov-16	474	1400
32848	28-Jun-13	1141	12-Aug-16	500	1500
32849	28-Jun-13	1141	12-Aug-16	472	1525
32850	27-Jun-13	1141	11-Aug-16	460	1225

Table 3. Tag and biological information for each Walleye acoustically tagged downstream of Gull Rapids in 2013 and 2014.

Tag ID	Date tagged	Tag Life (days)	Expiry date	Fork Length (mm)	Weight (g)
32854	28-Jun-13	1141	12-Aug-16	475	1425
32855	28-Jun-13	1141	12-Aug-16	496	1400
32859	28-Jun-13	1141	12-Aug-16	516	1600
32860	28-Jun-13	1141	12-Aug-16	450	1175
6424	11-Jun-14	1141	26-Jul-17	443	1015
6427	11-Jun-14	1141	26-Jul-17	455	1100

FIGURES

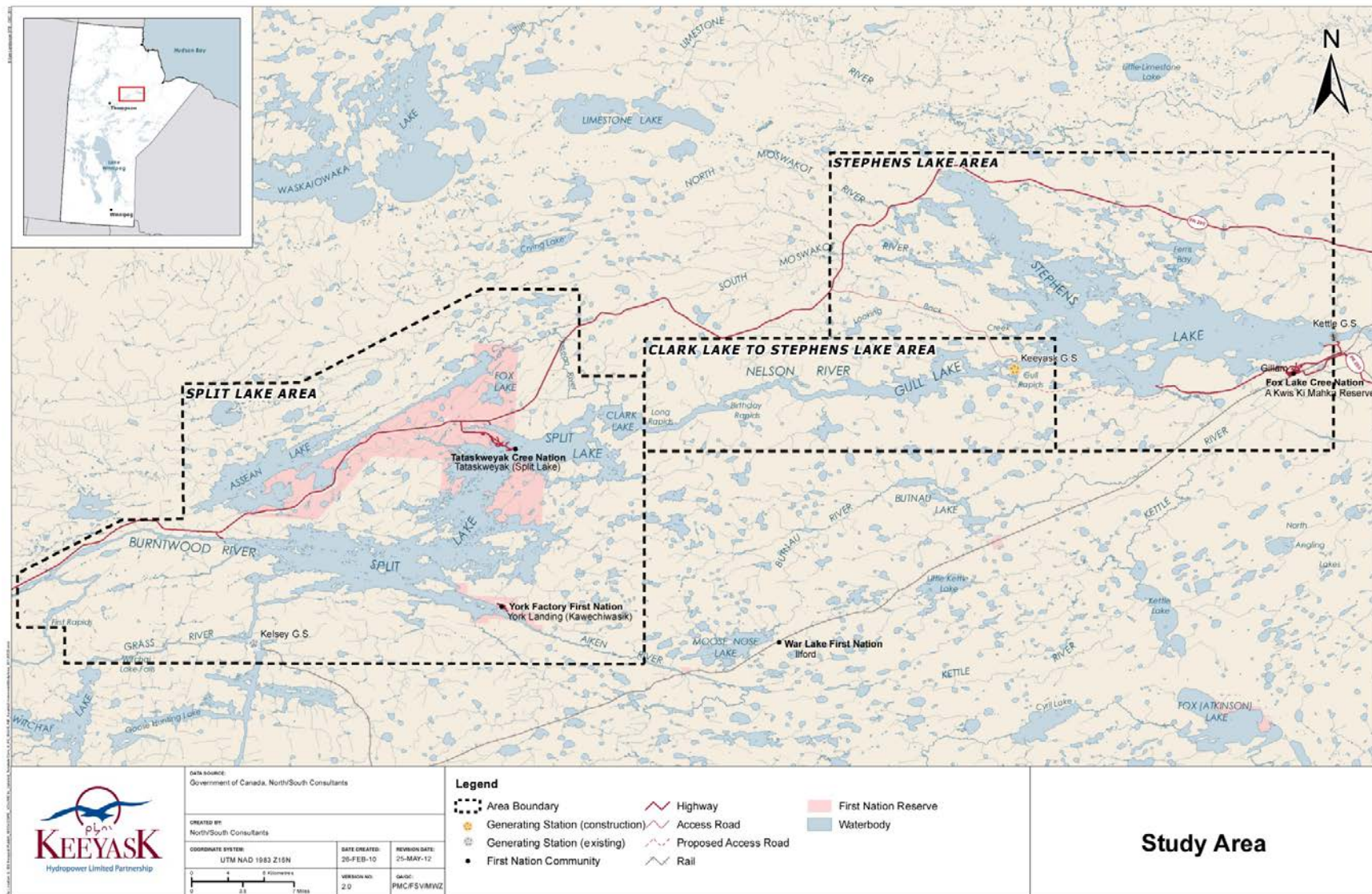


Figure 1: Map of the Keeyask Study Area showing hydroelectric development.

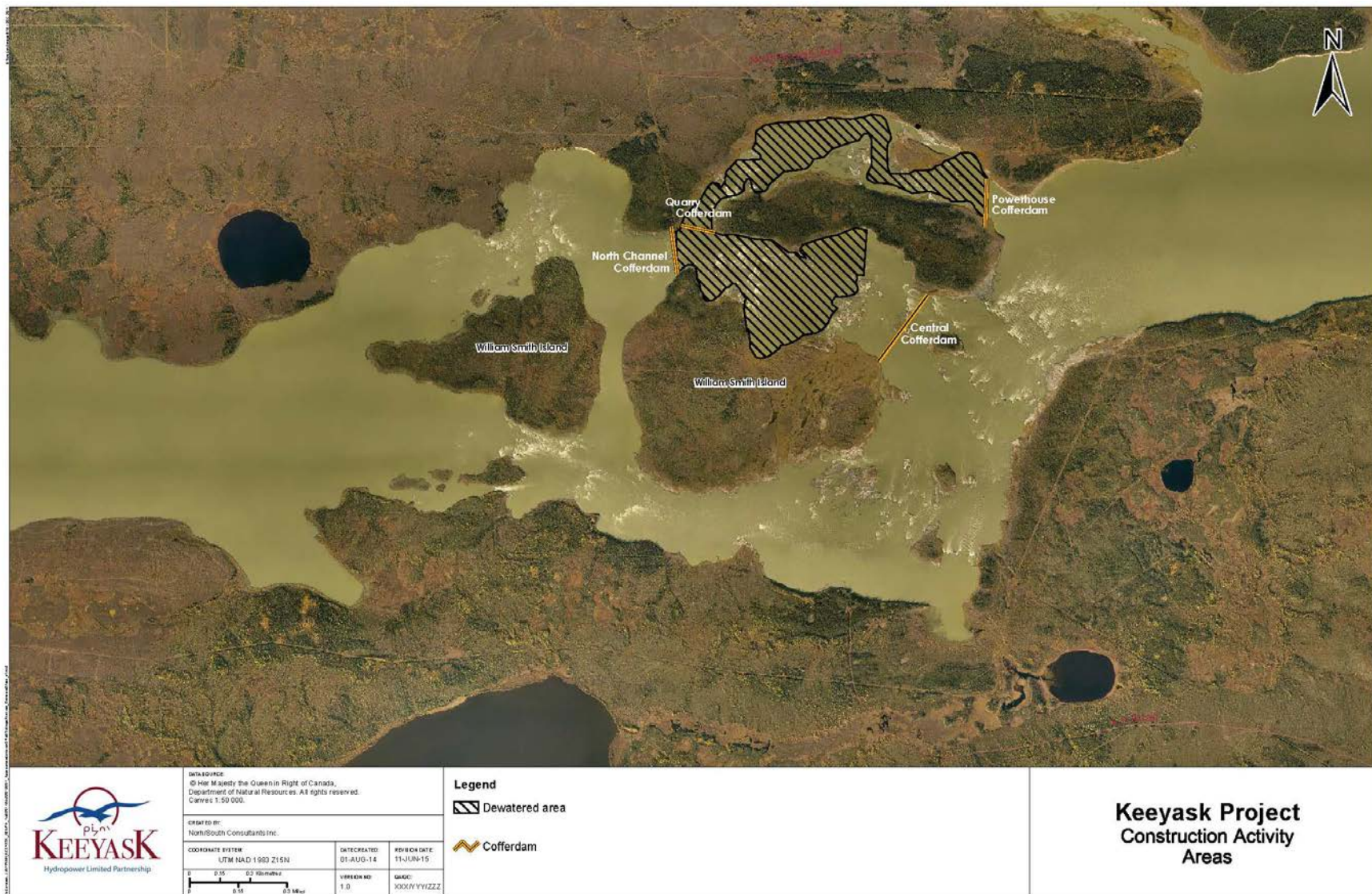


Figure 2: Locations of construction activities within the north and central channels of Gull Lake, July to October, 2014.



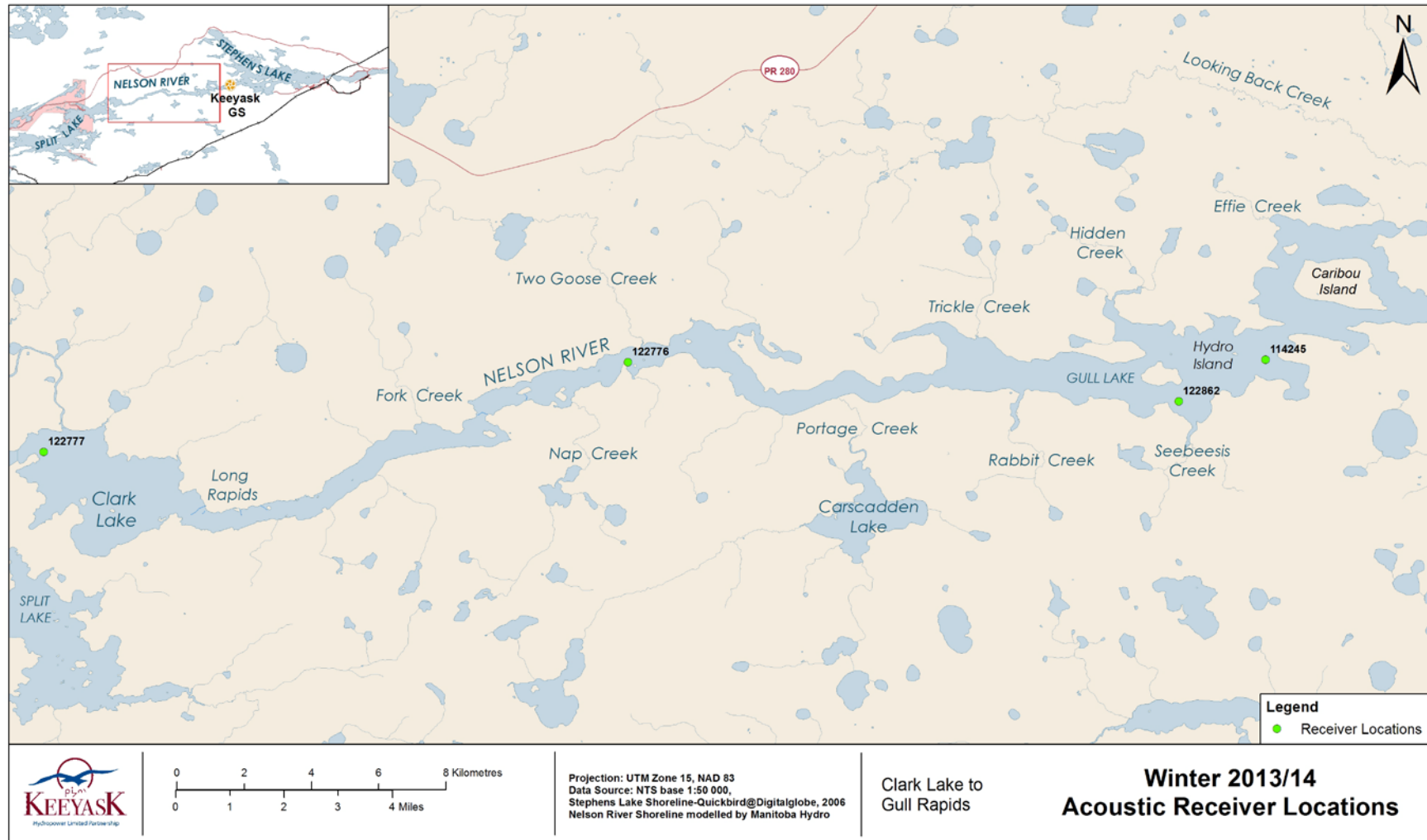


Figure 4: Stationary receiver locations set in the Nelson River from Clark Lake to Gull Rapids between October, 2013, and June, 2014.

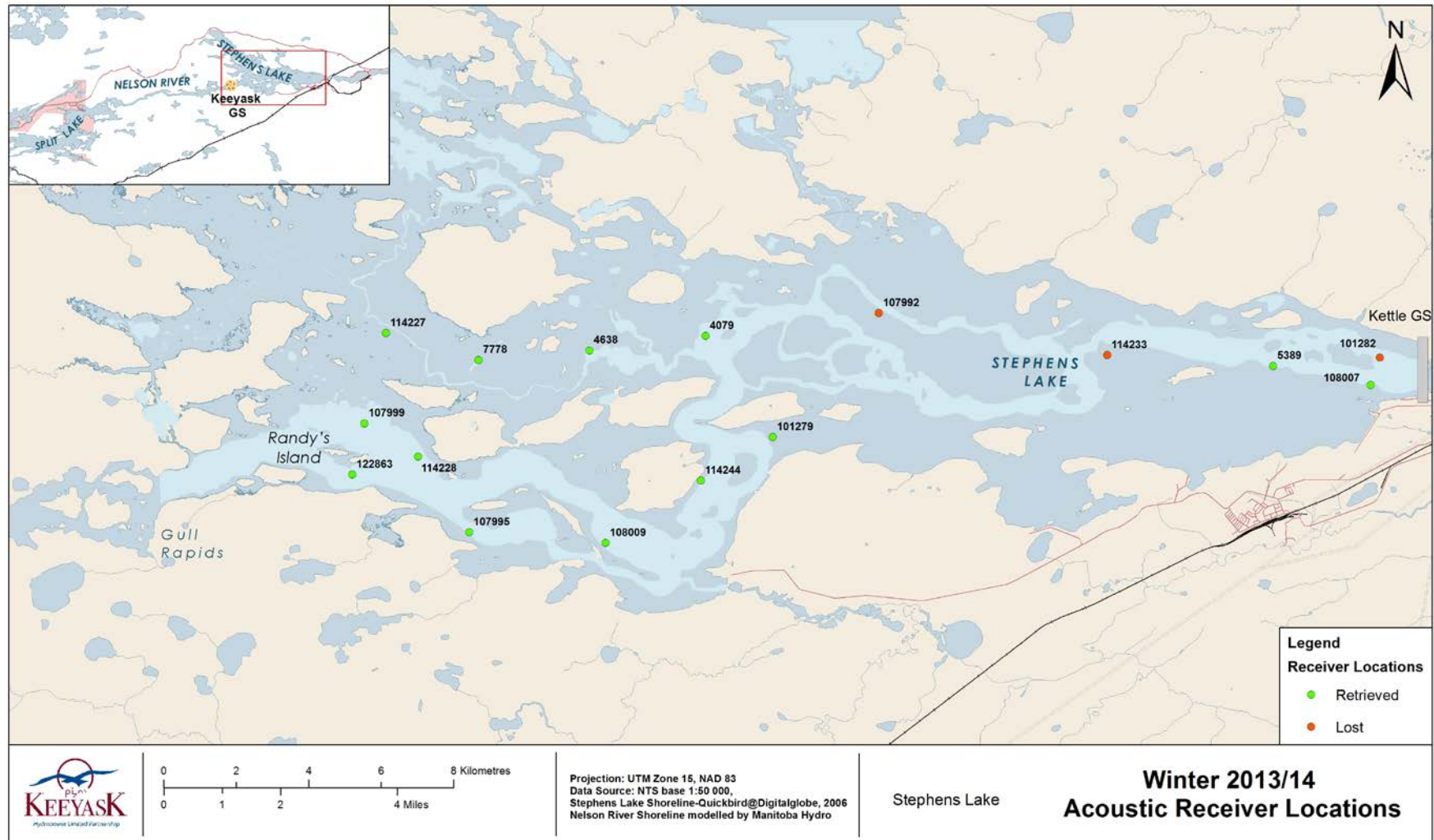


Figure 5: Locations of stationary receivers set in Stephens Lake from Gull Rapids to Kettle GS between October, 2013, and June, 2014. The former (pre-impoundment) river channel is shown in light blue.

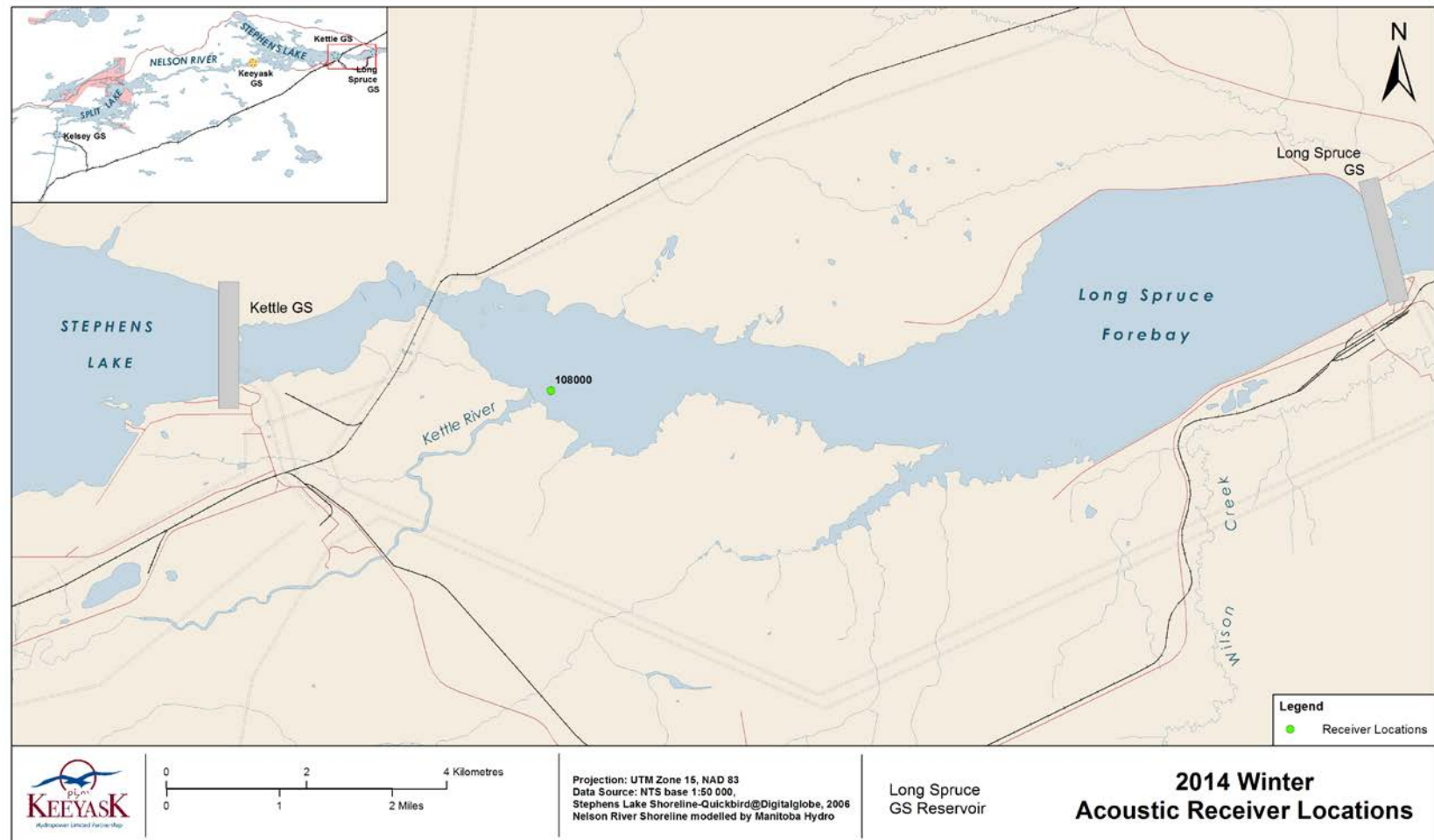


Figure 6: Locations of stationary receivers set in the Long Spruce Forebay between October, 2013, and June, 2014.

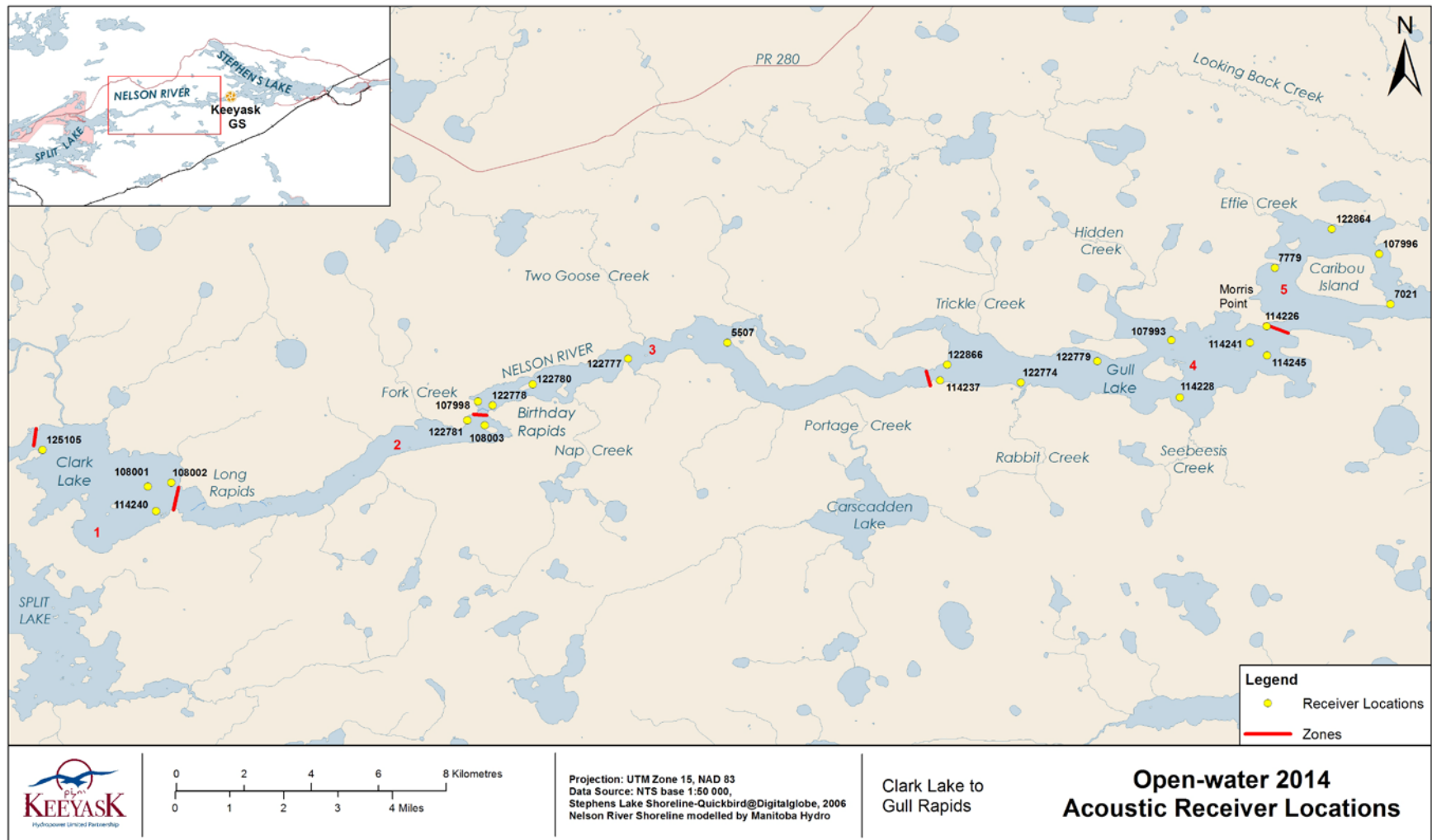


Figure 7: Locations of stationary receivers set in the Nelson River from Clark Lake to Gull Rapids between June and October, 2014. The river is divided into five “zones” based on placement of receiver “gates”.

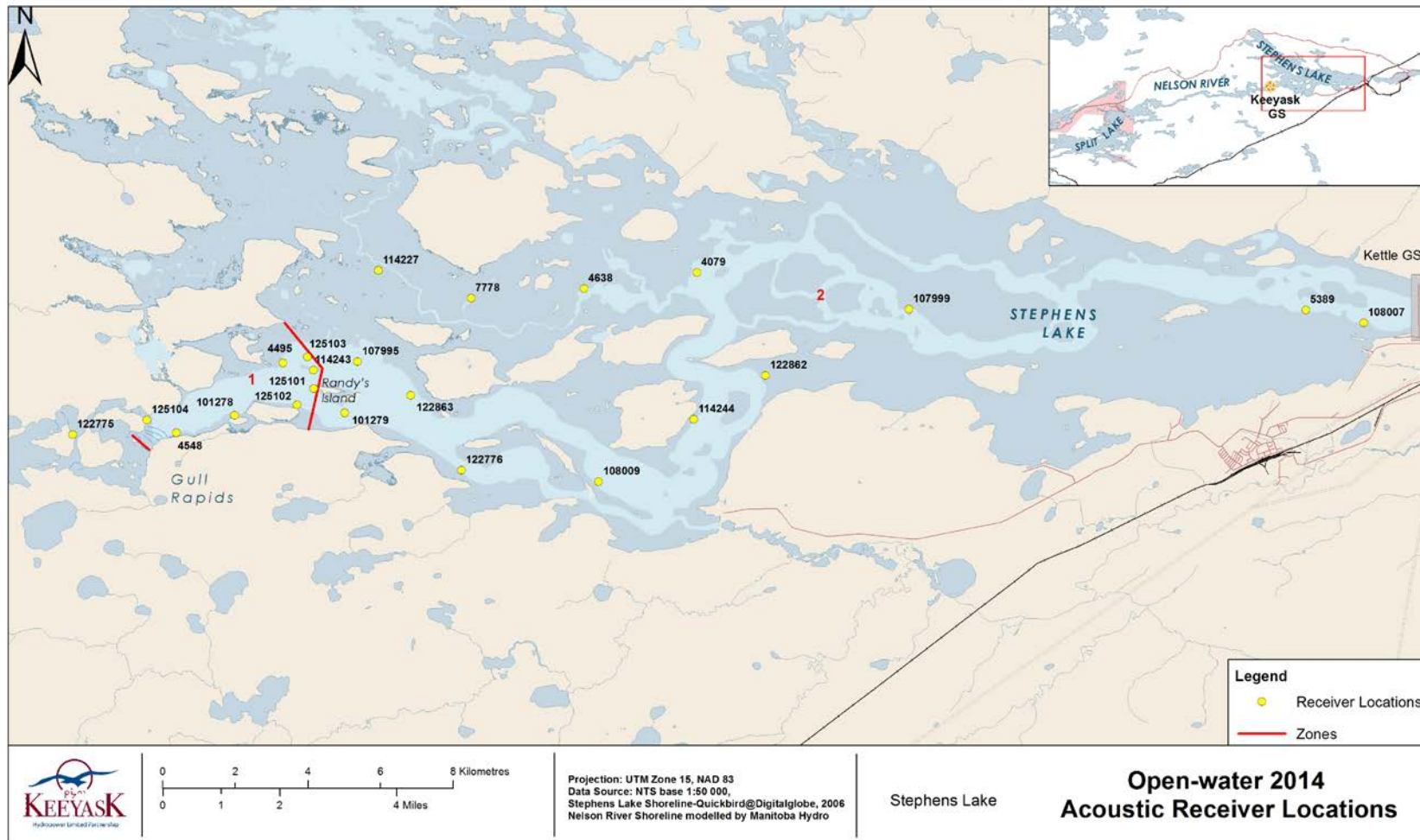


Figure 8: Locations of stationary receivers set in Stephens Lake from Gull Rapids to Kettle GS between June and October, 2014. The river is divided into two “zones” based on placement of receiver “gates”. Pre-impoundment river channel is shown in light blue.

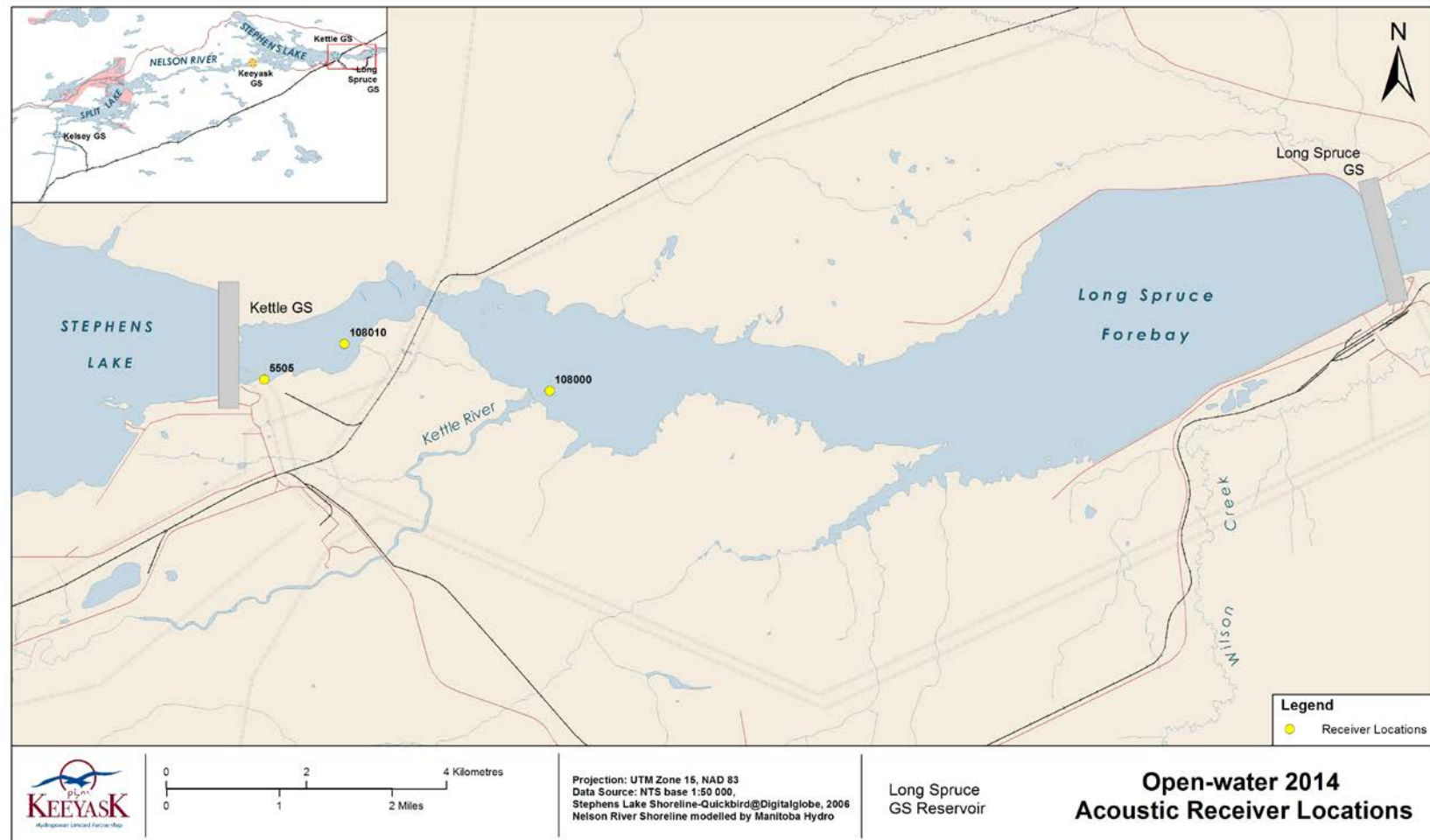


Figure 9: Locations of stationary receivers set in the Long Spruce Forebay between June and October, 2014

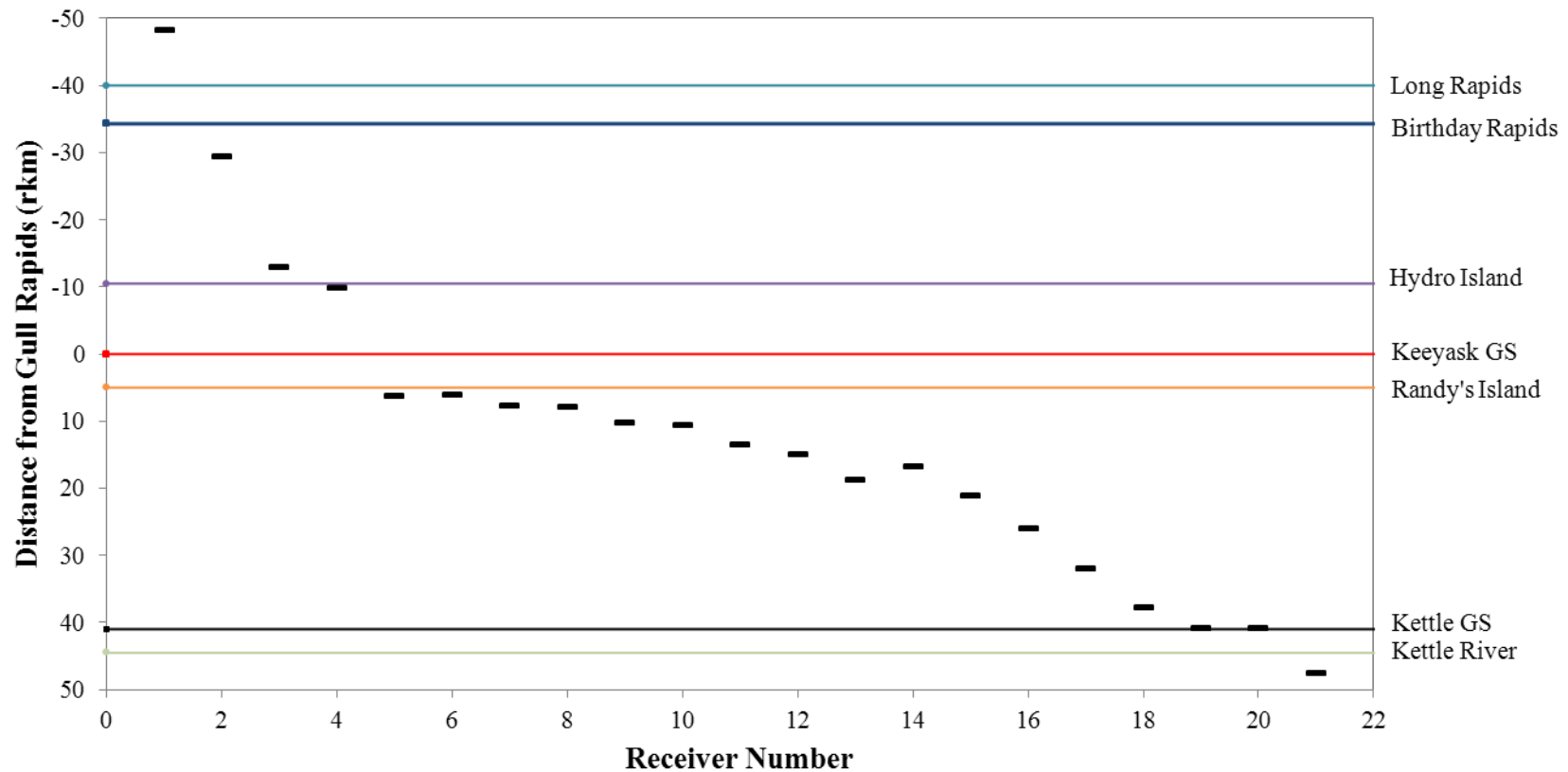


Figure 10: Locations of stationary acoustic receivers in relation to the base of Gull Rapids (rkm 0) and other major landmarks in the Nelson River between Clark Lake and the Long Spruce GS between October, 2013 and June, 2014

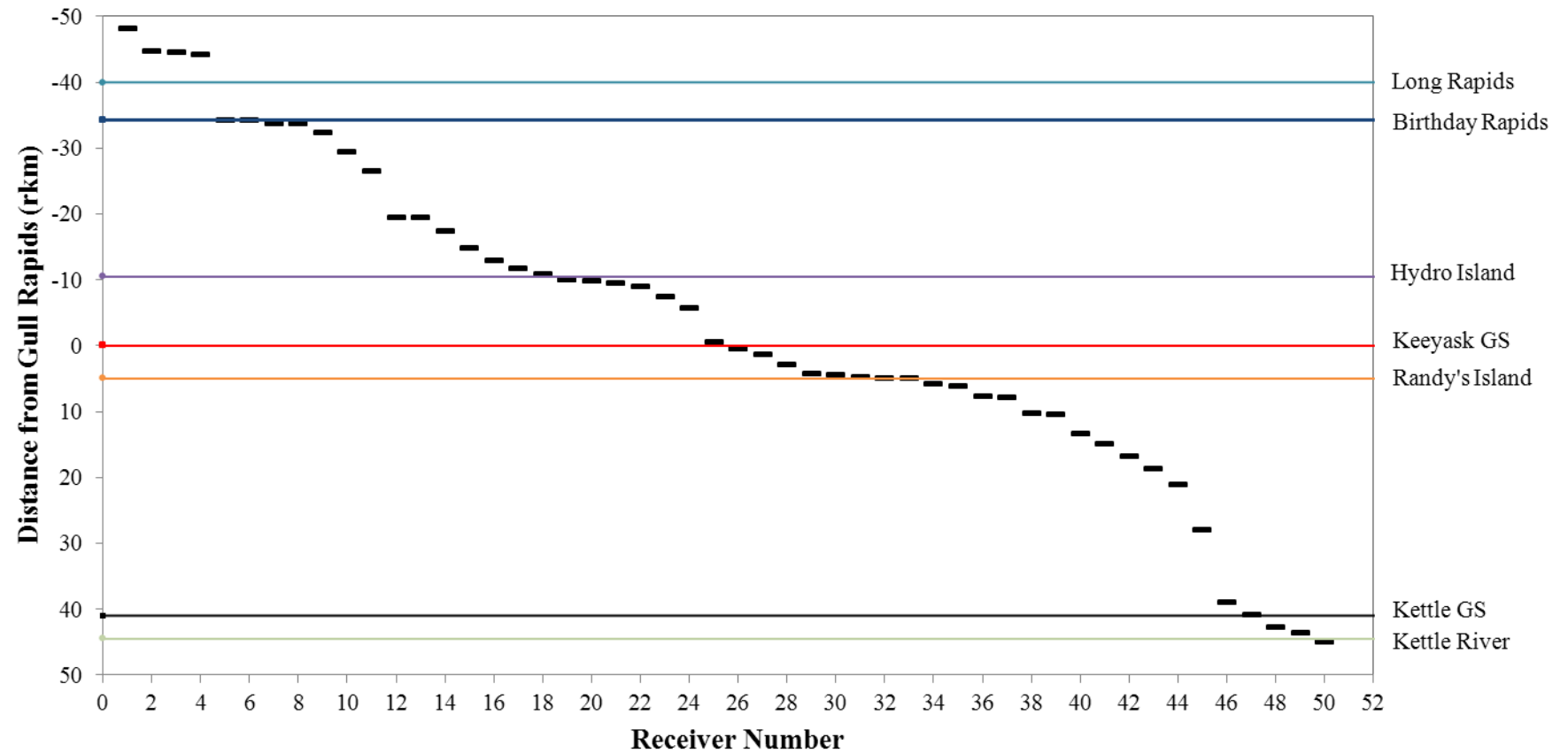


Figure 11: Locations of stationary acoustic receivers in relation to the base of Gull Rapids (rkm 0) and other major landmarks in the Nelson River between Clark Lake and the Long Spruce GS between June and October, 2014

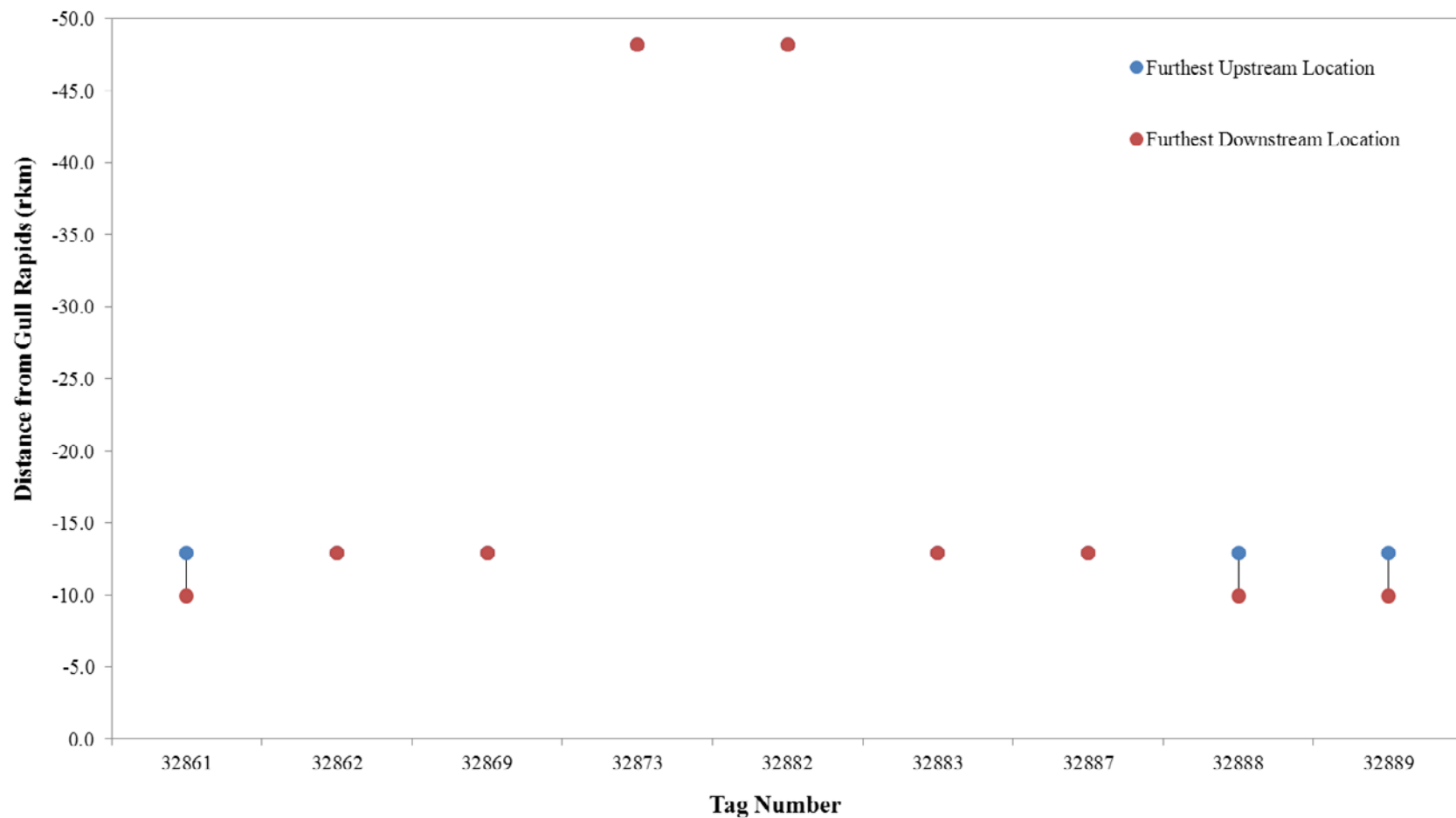


Figure 12: Detection ranges for individual Walleye tagged with acoustic transmitters upstream of Gull Rapids during the winter 2013/2014 period (16 October, 2013 to 30 April, 2014)

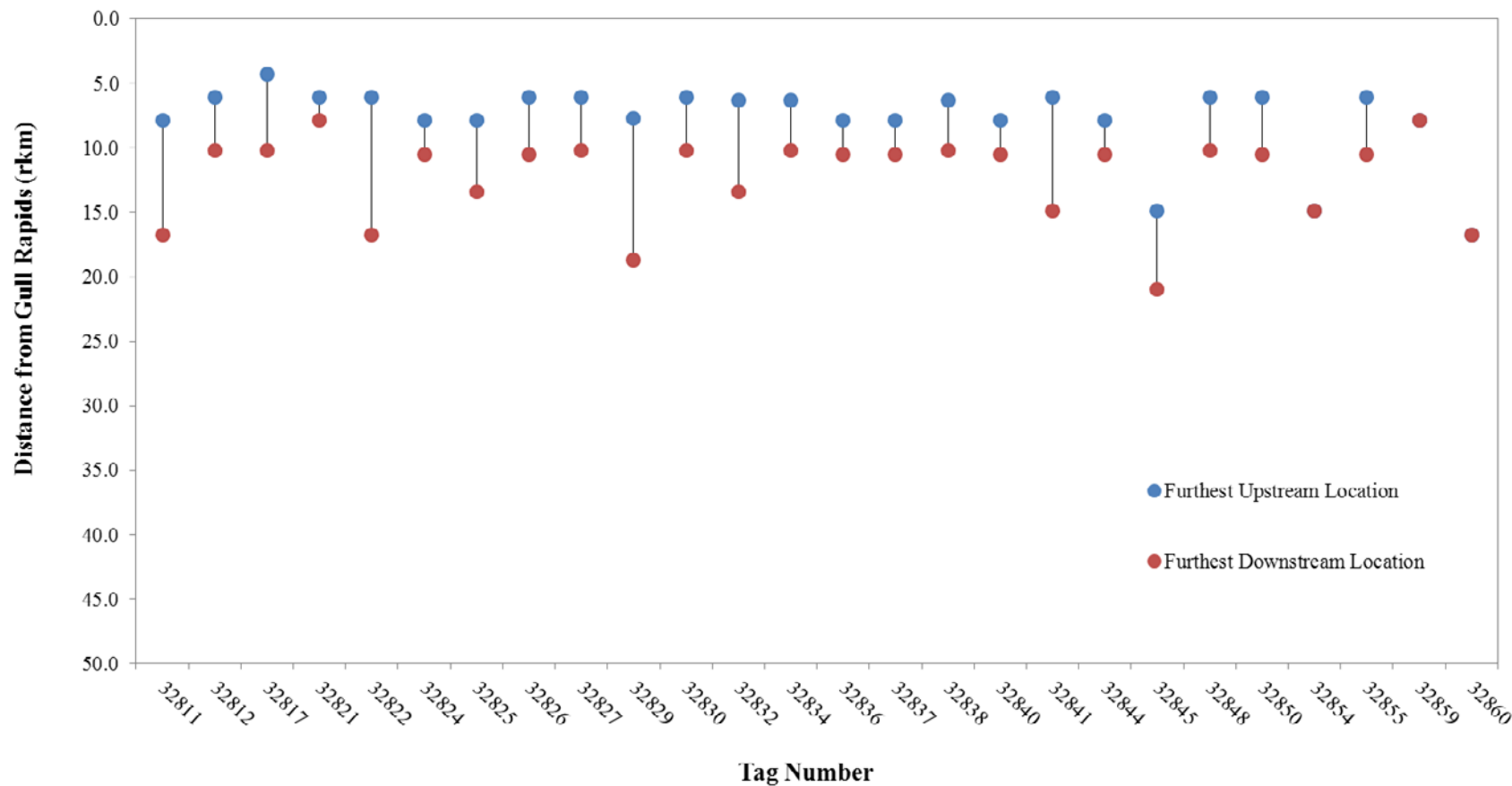


Figure 13: Detection ranges for individual Walleye tagged with acoustic transmitters in Stephens Lake during the winter 2013/2014 period (16 October, 2013 to 30 April, 2014)

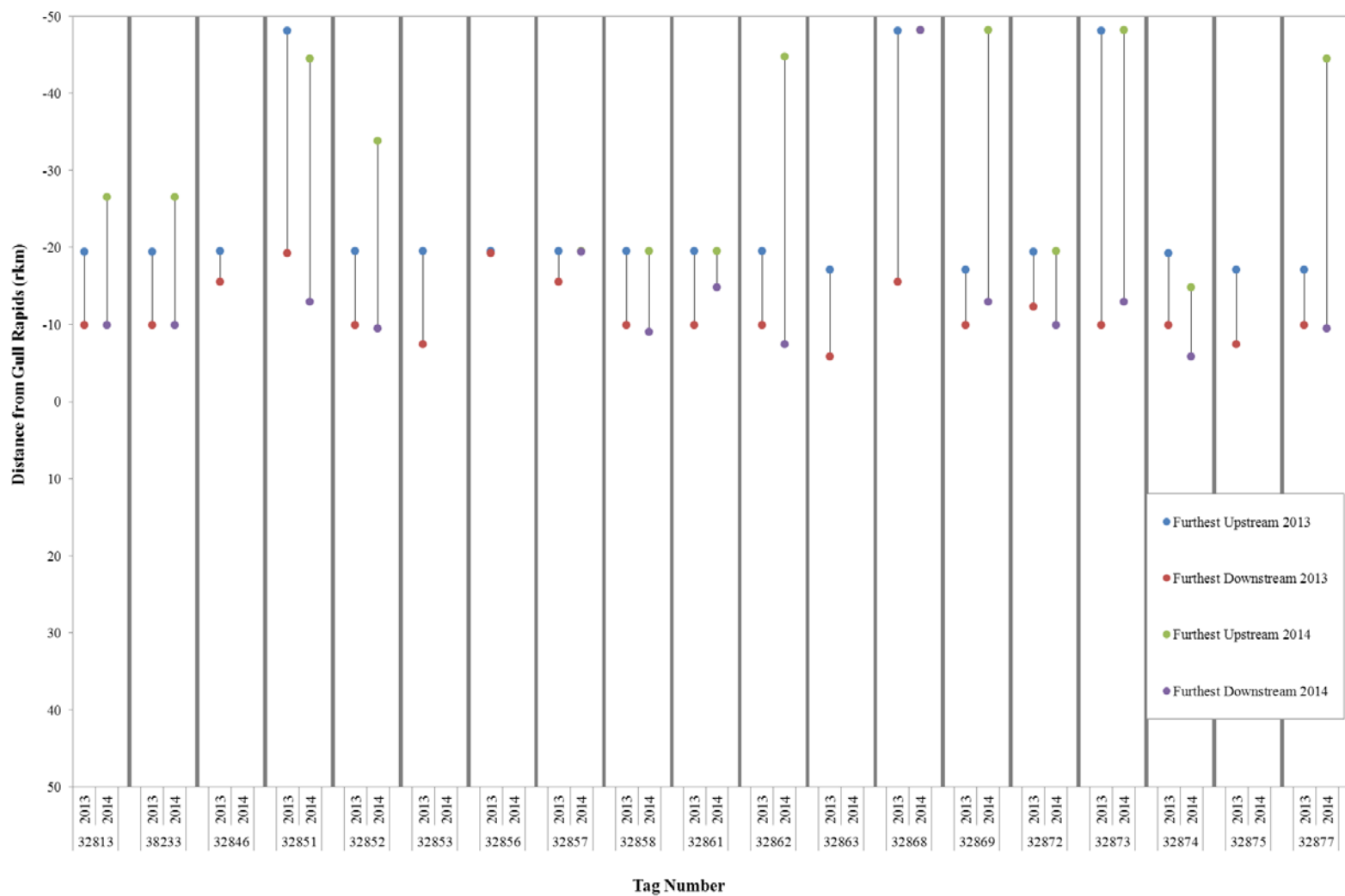


Figure 14: Detection ranges for individual Walleye tagged with acoustic transmitters upstream of Gull Rapids during the 2014 open-water period (4 June, 2014 to 3 October, 2014).

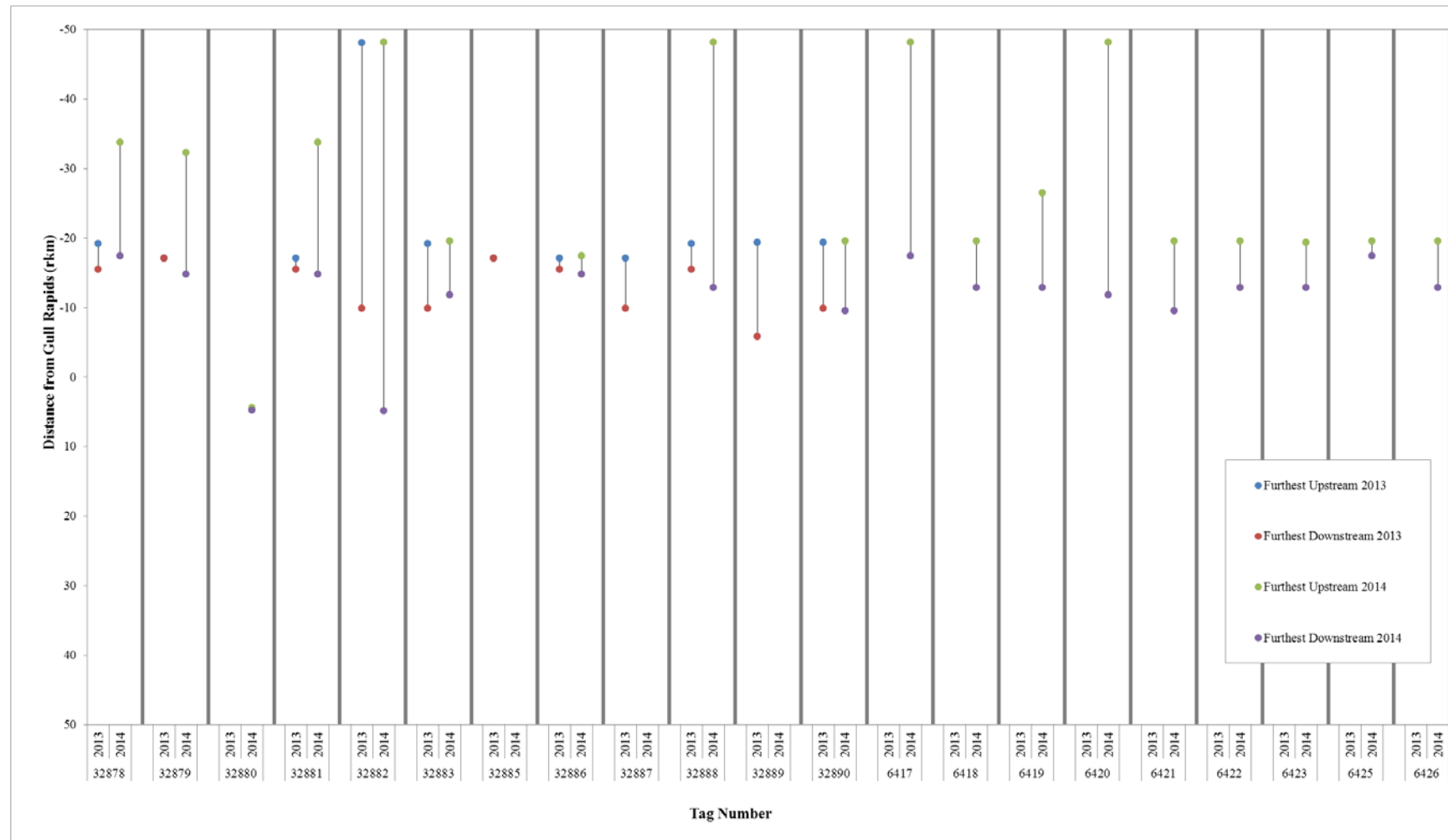


Figure 14: Continued.

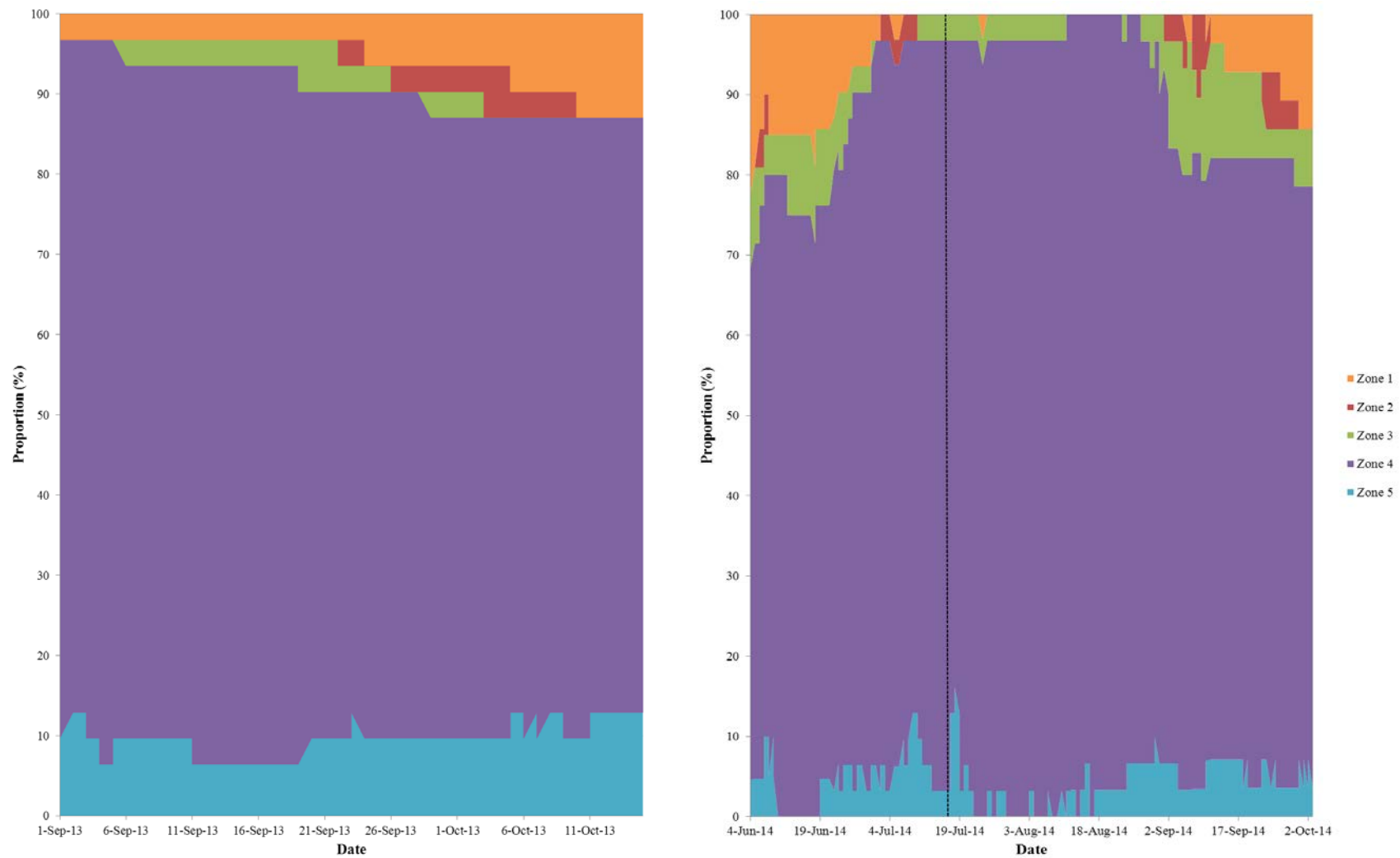


Figure 15: Proportional distribution of acoustic tagged Walleye within five river zones between Clark Lake and Gull Rapids in the 2013 (4 June to 15 October) and 2014 (4 June to 3 October) open-water periods. Dotted line indicates start of Keeyask construction.

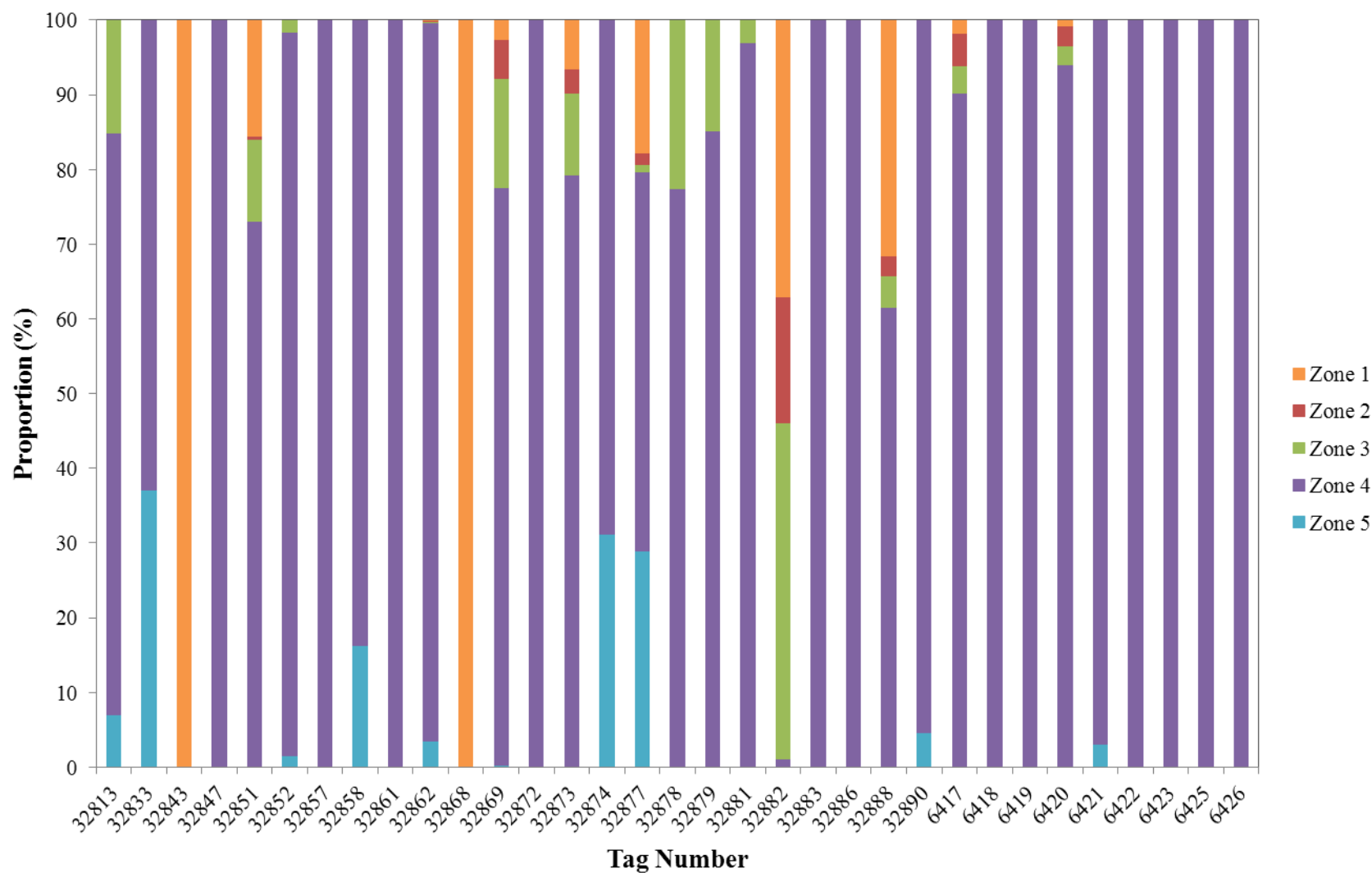


Figure 16: Proportion of time spent within five river zones between Clark Lake and Gull Rapids by individual acoustic tagged Walleye between 4 June and 3 October, 2014.

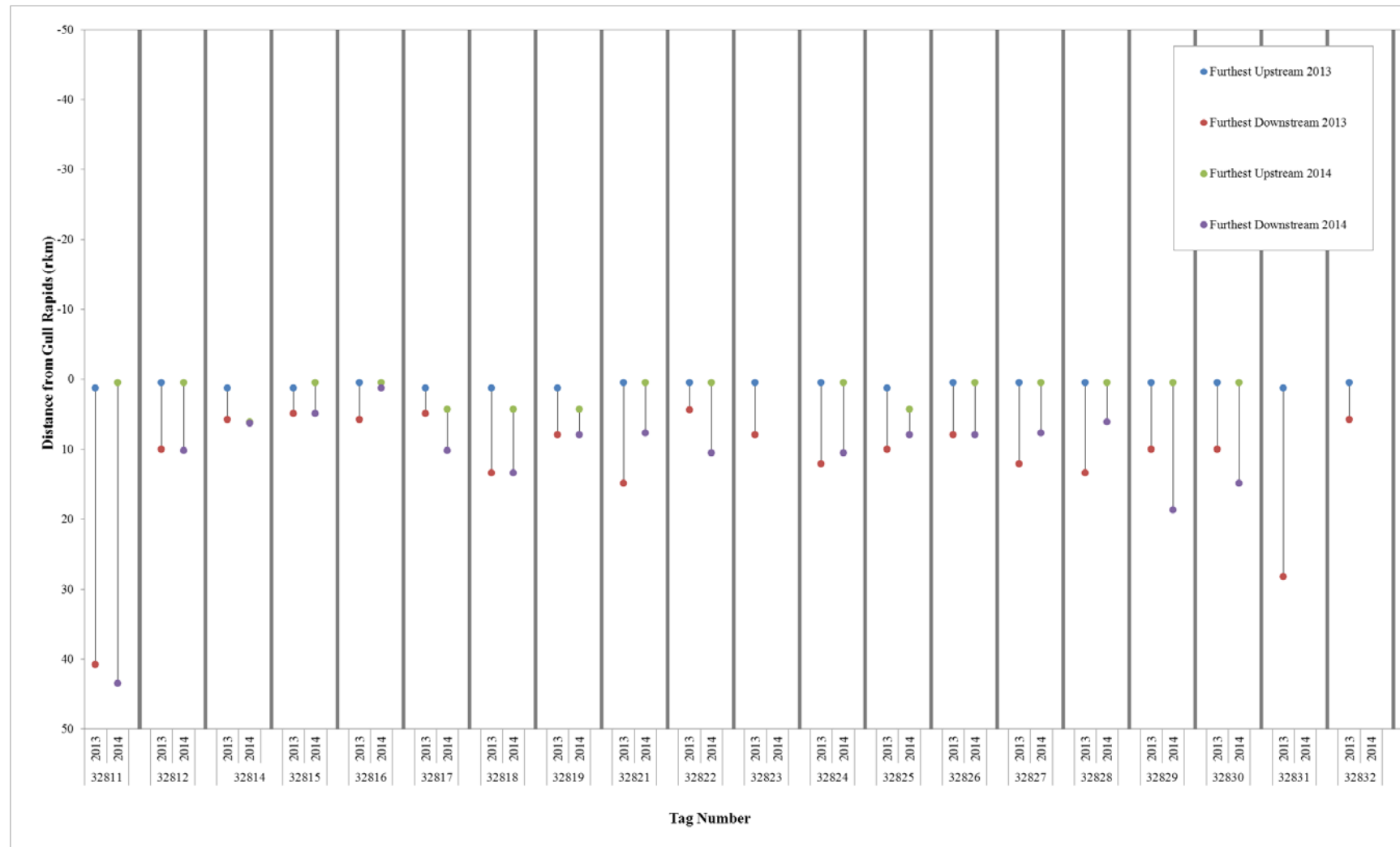


Figure 17: Detection ranges for individual Walleye tagged with acoustic transmitters downstream of Gull Rapids during the 2014 open-water period (14 June, 2014 to 3 October, 2014).

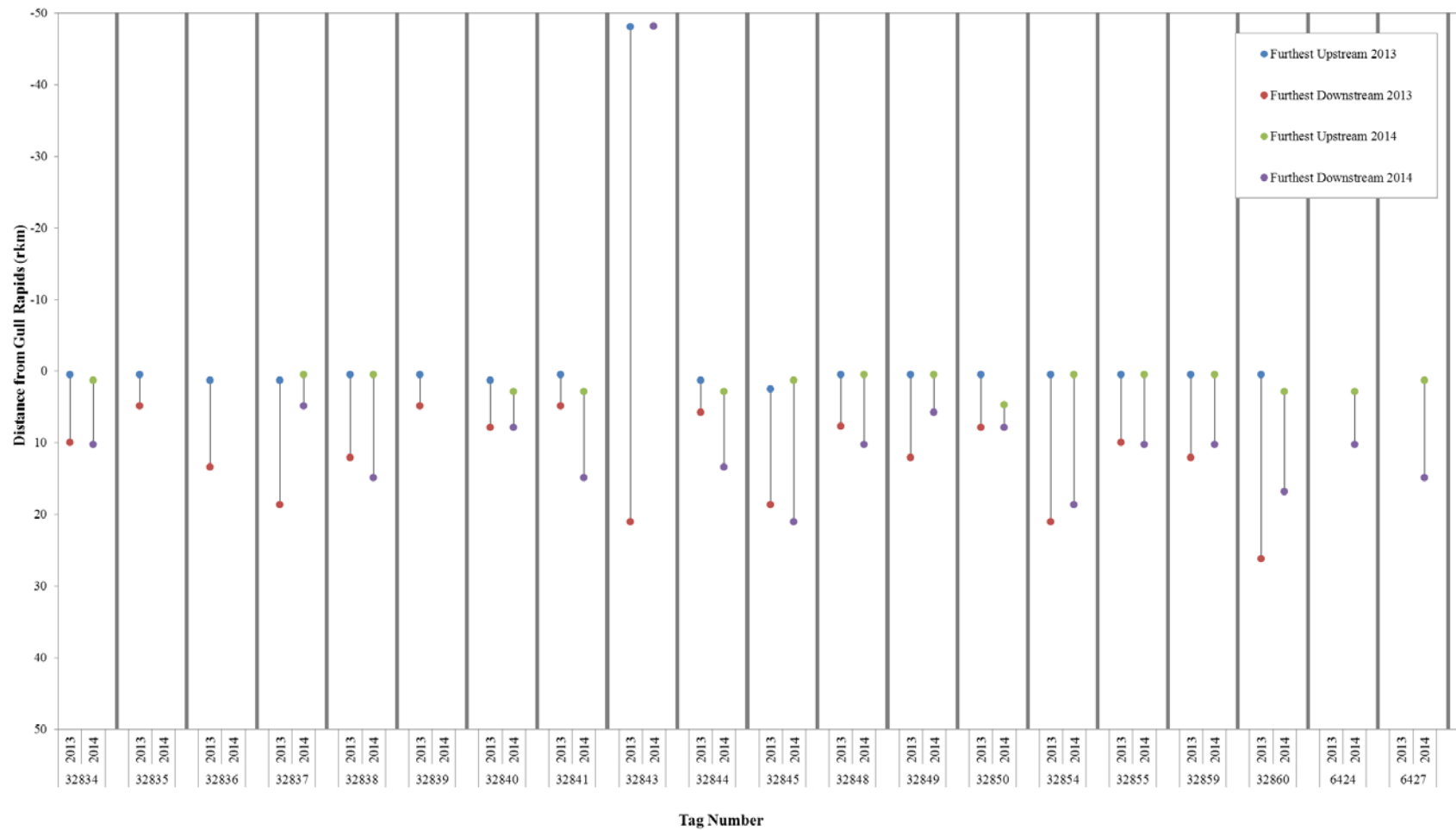


Figure 17: Continued.

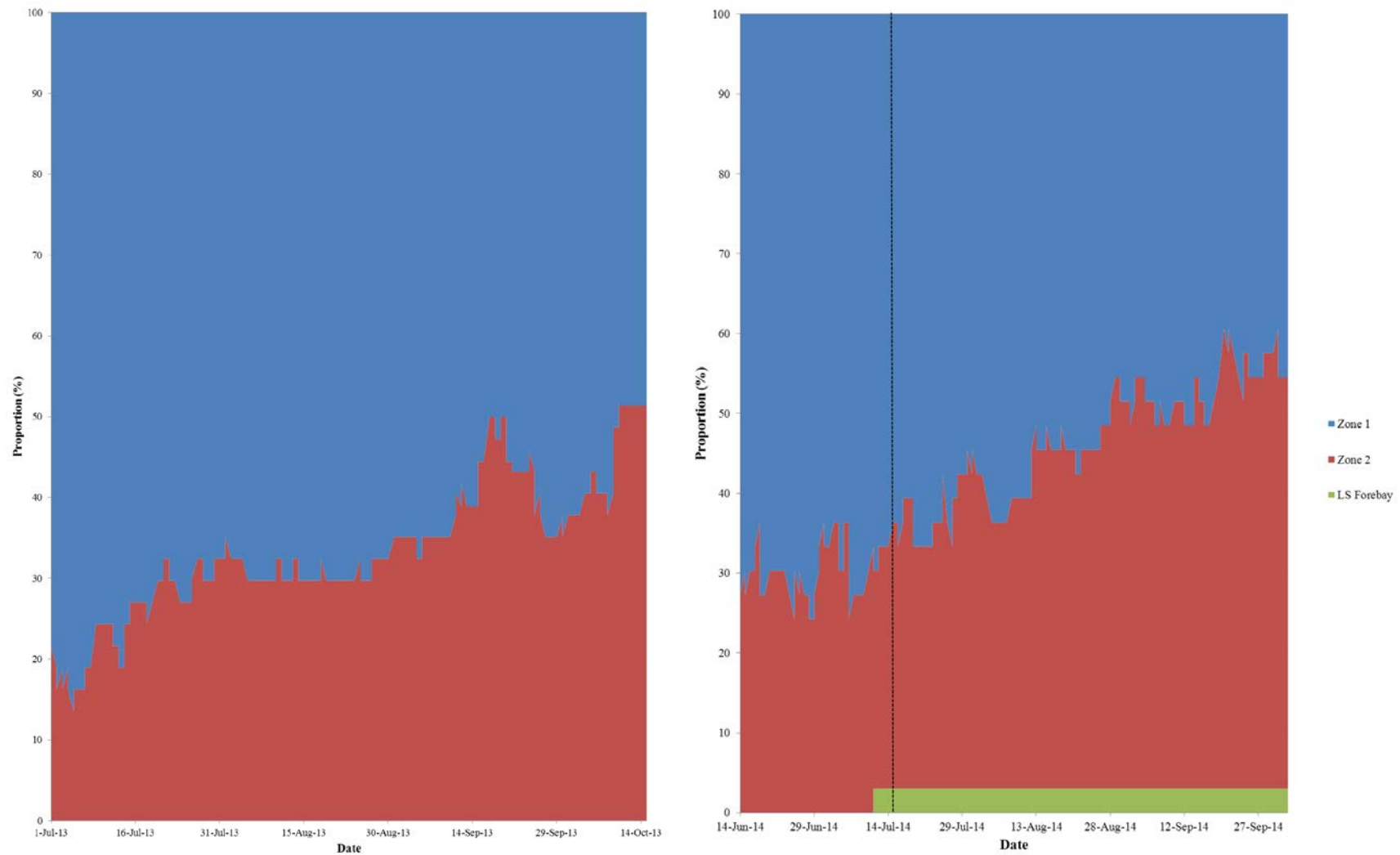


Figure 18: Proportional distribution of acoustic tagged Walleye within two zones between Gull Rapids and Kettle GS in the 2013 (4 June to 15 October) and 2014 (4 June to 3 October) open-water periods. Dotted line indicates start of Keeyask construction

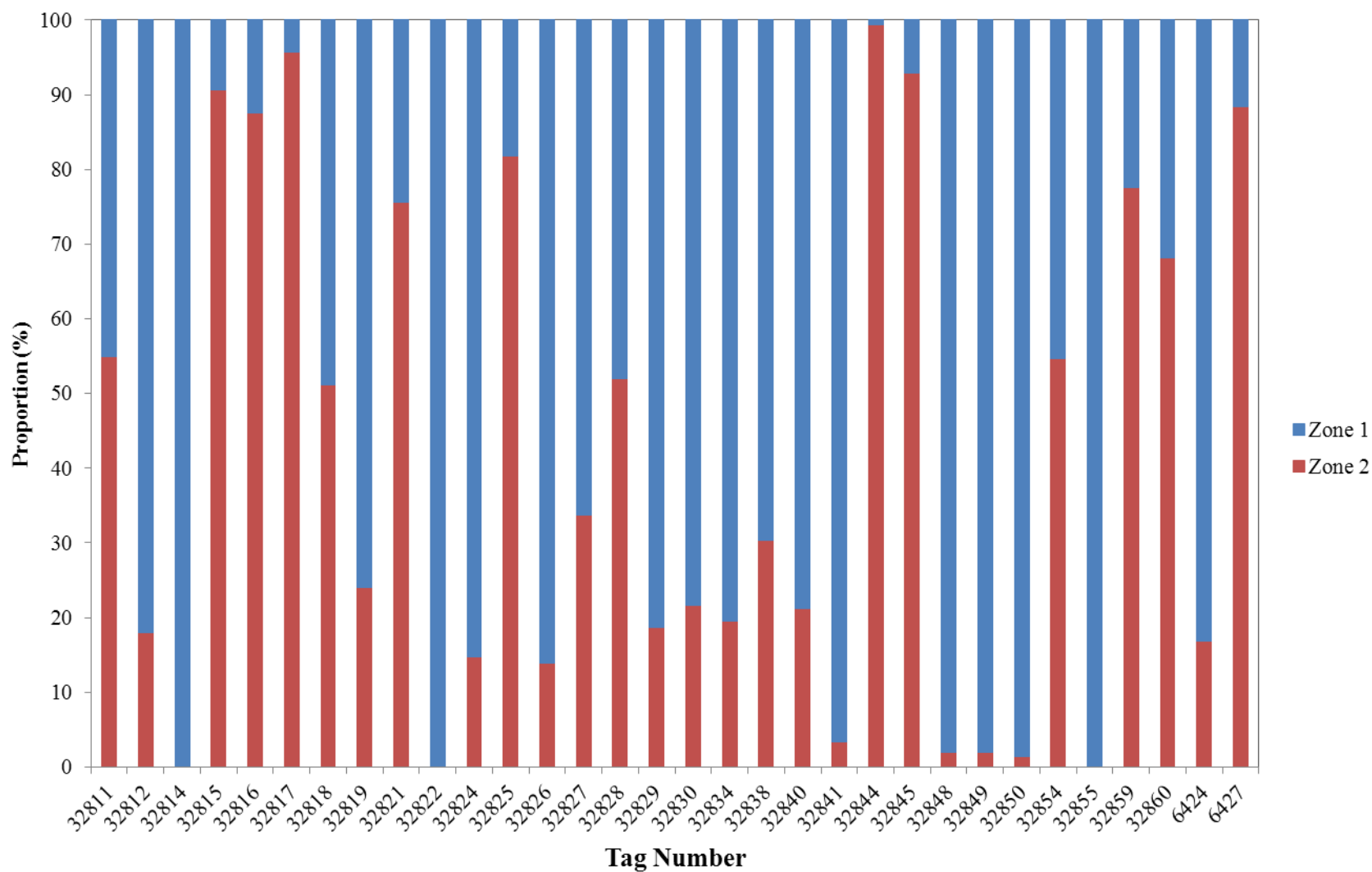


Figure 19: Proportion of time spent within two river zones between Gull Rapids and Kettle GS by individual acoustic tagged Walleye between 14 June and 3 October, 2014

APPENDICES

APPENDIX 1: DETECTION SUMMARIES FOR WALLEYE TAGGED AND MONITORED IN THE KEEYASK STUDY AREA BETWEEN 2013 AND 2014.

Table A1-1:	Detection summary for Walleye tagged upstream of the GS from June, 2013 to October 2014. Movements of fish not detected since being tagged are highlighted in yellow, those not detected in open-water 2014 in red, and those that moved upstream over Gull Rapids in blue.	50
Table A1-2:	Detection summary for Walleye tagged downstream of the GS from June, 2013 to October 2014. Movements of fish not detected since being tagged are highlighted in yellow, those not detected in open-water 2014 in red, those that moved downstream over Kettle GS in green, and those that moved upstream over Gull Rapids in blue.....	53

Table A1-1: Detection summary for Walleye tagged upstream of the GS from June, 2013 to October 2014. Movements of fish not detected since being tagged are highlighted in yellow, those not detected in open-water 2014 in red, and those that moved upstream over Gull Rapids in blue.

Tag ID	Open-water 2013					Winter 2013/2014					Open-water 2014				
	# of detections	Furthest U/S rkm	Furthest D/S rkm	Movement Range (rkm)	# Detection Days	# of detections	Furthest U/S rkm	Furthest D/S rkm	Movement Range (rkm)	# Detection Days	# of detections	Furthest U/S rkm	Furthest D/S rkm	Movement Range (rkm)	# Detection Days
32813	4894	-19.4	-9.9	9.5	122	0	-	-	-	0	1130	-26.5	-9.9	16.6	35
32833	23015	-19.5	-15.5	4.0	104	0	-	-	-	0	5458	-19.5	-7.4	12.1	87
32846	21867	-19.5	-15.5	4.0	89	0	-	-	-	0	0	-	-	-	0
32847	48687	-17.1	-17.1	0.0	99	0	-	-	-	0	56438	-17.4	-17.4	0.0	130
32851	11797	-48.1	-19.2	28.9	91	0	-	-	-	0	6405	-44.5	-12.9	31.6	104
32852	12797	-19.5	-9.9	9.6	90	0	-	-	-	0	5620	-33.8	-9.5	24.3	95
32853	5475	-19.5	-7.4	12.1	61	0	-	-	-	0	0	-	-	-	0
32856	28306	-19.5	-19.2	0.3	85	0	-	-	-	0	0	-	-	-	0
32857	25904	-19.5	-15.5	4.0	87	0	-	-	-	0	11327	-19.5	-19.4	0.1	74
32858	17890	-19.5	-9.9	9.6	103	0	-	-	-	0	7307	-19.5	-9.0	10.5	115
32861	14577	-19.5	-9.9	9.6	90	20	-12.9	-9.9	3.0	3	9424	-19.5	-14.8	4.7	118
32862	4284	-19.5	-9.9	9.6	61	3	-12.9	-12.9	0.0	1	7216	-44.7	-7.4	37.3	84
32863	1081	-17.1	-5.8	11.3	8	0	-	-	-	0	0	-	-	-	0
32864	0	-	-	-	-	0	-	-	-	0	0	-	-	-	0
32865	191	-17.1	4.9	22.0	3	0	-	-	-	0	0	-	-	-	0
32866	230	-17.1	10.0	27.1	3	0	-	-	-	0	0	-	-	-	0
32867	63	-15.5	-9.9	5.6	2	0	-	-	-	0	0	-	-	-	0
32868	3318	-48.1	-15.5	32.6	24	0	-	-	-	0	156	-48.2	-48.2	0.0	9
32869	1312	-17.1	-9.9	7.2	9	48	-12.9	-12.9	0.0	4	8500	-48.2	-12.9	35.3	103
32870	273	-17.1	-9.9	7.2	4	0	-	-	-	0	0	-	-	-	0
32871	78	-17.1	-5.8	11.3	1	0	-	-	-	0	0	-	-	-	0
32872	8740	-19.4	-12.3	7.1	46	0	-	-	-	0	26481	-19.5	-9.9	9.6	124

Table A1-1: Detection summary for Walleye tagged upstream of the GS from June, 2013 to October 2014. Movements of fish not detected since being tagged are highlighted in yellow, those not detected in open-water 2014 in red, and those that moved upstream over Gull Rapids in blue.

Tag ID	Open-water 2013					Winter 2013/2014					Open-water 2014				
	# of detections	Furthest U/S rkm	Furthest D/S rkm	Movement Range (rkm)	# Detection Days	# of detections	Furthest U/S rkm	Furthest D/S rkm	Movement Range (rkm)	# Detection Days	# of detections	Furthest U/S rkm	Furthest D/S rkm	Movement Range (rkm)	# Detection Days
32873	3275	-48.1	-9.9	38.2	27	52	-48.2	-48.2	0.0	2	2570	-48.2	-12.9	35.3	70
32874	1678	-19.2	-9.9	9.3	30	0	-	-	-	0	4414	-14.8	-5.8	9.0	77
32875	357	-17.1	-7.4	9.7	3	0	-	-	-	0	0	-	-	-	0
32876	150	-17.1	-5.8	11.3	2	0	-	-	-	0	0	-	-	-	0
32877	4876	-17.1	-9.9	7.2	35	0	-	-	-	0	3647	-44.5	-9.5	35.0	68
32878	10313	-19.2	-15.5	3.7	42	0	-	-	-	0	6883	-33.8	-17.4	16.4	84
32879	10523	-17.1	-17.1	0.0	42	0	-	-	-	0	27102	-32.3	-14.8	17.5	105
32880	223	-17.1	-5.8	11.3	2	0	-	-	-	0	158	4.4	4.8	0.4	8
32881	12893	-17.1	-15.5	1.6	44	0	-	-	-	0	14741	-33.8	-14.8	19.0	96
32882	3806	-48.1	-9.9	38.2	24	3047	-48.2	-48.2	0.0	49	512	-48.2	4.9	53.1	6
32883	4491	-19.2	-9.9	9.3	40	47	-12.9	-12.9	0.0	6	18889	-19.5	-11.8	7.7	122
32884	79	-17.1	-9.9	7.2	3	0	-	-	-	0	0	-	-	-	0
32885	151	-17.1	-17.1	0.0	5	0	-	-	-	0	0	-	-	-	0
32886	11127	-17.1	-15.5	1.6	46	0	-	-	-	0	37512	-17.4	-14.8	2.6	127
32887	6256	-17.1	-9.9	7.2	28	68	-12.9	-12.9	0.0	3	0	-	-	-	0
32888	542	-19.2	-15.5	3.7	24	5796	-12.9	-9.9	3.0	56	1896	-48.2	-12.9	35.3	45
32889	6145	-19.4	-5.8	13.6	42	76	-12.9	-9.9	3.0	4	0	-	-	-	0
32890	581	-19.4	-9.9	9.5	17	0	-	-	-	0	2794	-19.5	-9.5	10.0	57
6417	-	-	-	-	-	-	-	-	-	-	9504	-48.2	-17.4	30.8	71
6418	-	-	-	-	-	-	-	-	-	-	20683	-19.5	-12.9	6.6	114
6419	-	-	-	-	-	-	-	-	-	-	11490	-26.5	-12.9	13.6	82
6420	-	-	-	-	-	-	-	-	-	-	8224	-48.2	-11.8	36.4	66

Table A1-1: Detection summary for Walleye tagged upstream of the GS from June, 2013 to October 2014. Movements of fish not detected since being tagged are highlighted in yellow, those not detected in open-water 2014 in red, and those that moved upstream over Gull Rapids in blue.

Tag ID	Open-water 2013					Winter 2013/2014					Open-water 2014				
	# of detections	Furthest U/S rkm	Furthest D/S rkm	Movement Range (rkm)	# Detection Days	# of detections	Furthest U/S rkm	Furthest D/S rkm	Movement Range (rkm)	# Detection Days	# of detections	Furthest U/S rkm	Furthest D/S rkm	Movement Range (rkm)	# Detection Days
6421	-	-	-	-	-	-	-	-	-	-	15291	-19.5	-9.5	10.0	111
6422	-	-	-	-	-	-	-	-	-	-	20831	-19.5	-12.9	6.6	111
6423	-	-	-	-	-	-	-	-	-	-	3044	-19.4	-12.9	6.5	62
6425	-	-	-	-	-	-	-	-	-	-	58854	-19.5	-17.4	2.1	110
6426	-	-	-	-	-	-	-	-	-	-	22404	-19.5	-12.9	6.6	109

Table A1-2: Detection summary for Walleye tagged downstream of the GS from June, 2013 to October 2014. Movements of fish not detected since being tagged are highlighted in yellow, those not detected in open-water 2014 in red, those that moved downstream over Kettle GS in green, and those that moved upstream over Gull Rapids in blue.

Tag ID	Open-water 2013					Winter 2013/2014					Open-water 2014				
	# of detections	Furthest U/S rkm	Furthest D/S rkm	Movement Range (rkm)	# Detection Days	# of detections	Furthest U/S rkm	Furthest D/S rkm	Movement Range (rkm)	# Detection Days	# of detections	Furthest U/S rkm	Furthest D/S rkm	Movement Range (rkm)	# Detection Days
32811	3101	1.3	40.8	39.5	15	2223	7.9	16.8	8.9	34	4201	0.5	43.5	43.0	29
32812	23567	0.5	10.0	9.5	99	9630	6.1	10.2	4.1	86	6015	0.5	10.2	9.7	79
32814	4291	1.3	5.8	4.5	29	0	-	-	-	0	2	6.1	6.3	0.2	1
32815	2024	1.3	4.9	3.6	11	0	-	-	-	0	33	0.5	4.9	4.4	2
32816	524	0.5	5.8	5.3	8	0	-	-	-	0	230	0.5	1.3	0.8	7
32817	9533	1.3	4.9	3.6	71	4313	4.3	10.2	5.9	16	863	4.3	10.2	5.9	13
32818	2734	1.3	13.4	12.1	16	0	-	-	-	0	77	4.3	13.4	9.1	2
32819	1597	1.3	7.9	6.6	20	0	-	-	-	0	29	4.3	7.9	3.6	3
32821	6300	0.5	14.9	14.4	62	17	6.1	7.9	1.8	2	1516	0.5	7.7	7.2	17
32820	526	1.3	26.2	24.9	7	0	-	-	-	0	0	-	-	-	0
32822	3366	0.5	4.4	3.9	24	157	6.1	16.8	10.7	2	402	0.5	10.5	10.0	13
32823	1740	0.5	7.9	7.4	26	0	-	-	-	0	0	-	-	-	0
32824	1851	0.5	12.1	11.6	38	6984	7.9	10.5	2.6	64	3052	0.5	10.5	10.0	33
32825	2477	1.3	10.0	8.7	29	196	7.9	13.4	5.5	6	91	4.3	7.9	3.6	4
32826	21084	0.5	7.9	7.4	66	3219	6.1	10.5	4.4	19	3175	0.5	7.9	7.4	28
32827	11028	0.5	12.1	11.6	101	13769	6.1	10.2	4.1	86	15945	0.5	7.7	7.2	112
32828	1676	0.5	13.4	12.9	14	0	-	-	-	0	1729	0.5	6.1	5.6	25
32829	3237	0.5	10.0	9.5	35	1239	7.7	18.7	11.0	32	8433	0.5	18.7	18.2	83
32830	15475	0.5	10.0	9.5	83	3029	6.1	10.2	4.1	25	22064	0.5	14.9	14.4	106
32831	8716	1.3	28.2	26.9	46	0	-	-	-	0	0	-	-	-	0
32832	11783	0.5	5.8	5.3	102	1881	6.3	13.4	7.1	19	0	-	-	-	0

Table A1-2: Detection summary for Walleye tagged downstream of the GS from June, 2013 to October 2014. Movements of fish not detected since being tagged are highlighted in yellow, those not detected in open-water 2014 in red, those that moved downstream over Kettle GS in green, and those that moved upstream over Gull Rapids in blue.

Tag ID	Open-water 2013					Winter 2013/2014					Open-water 2014				
	# of detections	Furthest U/S rkm	Furthest D/S rkm	Movement Range (rkm)	# Detection Days	# of detections	Furthest U/S rkm	Furthest D/S rkm	Movement Range (rkm)	# Detection Days	# of detections	Furthest U/S rkm	Furthest D/S rkm	Movement Range (rkm)	# Detection Days
32834	5591	0.5	10.0	9.5	44	3617	6.3	10.2	3.9	28	4633	1.3	10.2	8.9	35
32835	7249	0.5	4.9	4.4	39	0	-	-	-	0	0	-	-	-	0
32836	7946	1.3	13.4	12.1	59	343	7.9	10.5	2.6	6	0	-	-	-	0
32837	6998	1.3	18.7	17.4	62	1240	7.9	10.5	2.6	15	20	0.5	4.9	4.4	1
32838	24259	0.5	12.1	11.6	101	6796	6.3	10.2	3.9	51	14365	0.5	14.9	14.4	97
32839	9101	0.5	4.9	4.4	50	0	-	-	-	0	0	-	-	-	0
32840	1470	1.3	7.9	6.6	35	180	7.9	10.5	2.6	13	669	2.9	7.9	5.0	22
32841	7626	0.5	4.9	4.4	88	5180	6.1	14.9	8.8	44	1284	2.9	14.9	12.0	17
32842	100	1.3	28.2	26.9	4	0	-	-	-	0	0	-	-	-	0
32843	2242	-48.1	21.0	69.1	21	0	-	-	-	0	28	-48.2	-48.2	0.0	5
32844	3359	1.3	5.8	4.5	28	4669	7.9	10.5	2.6	48	631	2.9	13.4	10.5	8
32845	3441	2.5	18.7	16.2	21	27452	14.9	21.0	6.1	142	4509	1.3	21.0	19.7	59
32848	4342	0.5	7.7	7.2	36	9944	6.1	10.2	4.1	64	2297	0.5	10.2	9.7	30
32849	3753	0.5	12.1	11.6	22	0	-	-	-	0	15784	0.5	5.8	5.3	89
32850	33539	0.5	7.9	7.4	87	1017	6.1	10.5	4.4	21	284	4.7	7.9	3.2	2
32854	11244	0.5	21.0	20.5	57	17	14.9	14.9	0.0	3	5003	0.5	18.7	18.2	47
32855	4044	0.5	10.0	9.5	49	13200	6.1	10.5	4.4	57	5724	0.5	10.2	9.7	33
32859	4456	0.5	12.1	11.6	31	187	7.9	7.9	0.0	7	5184	0.5	10.2	9.7	88
32860	4879	0.5	26.2	25.7	37	42	16.8	16.8	0.0	2	180	2.9	16.8	13.9	12
6424	-	-	-	-	-	-	-	-	-	-	4389	2.9	10.2	7.3	46
6427	-	-	-	-	-	-	-	-	-	-	2259	1.3	14.9	13.6	21

APPENDIX 2:

LOCATION SUMMARY FOR INDIVIDUAL ACOUSTIC TAGGED WALLEYE, CLARK LAKE TO GULL RAPIDS, JUNE 2013 TO OCTOBER 2014.

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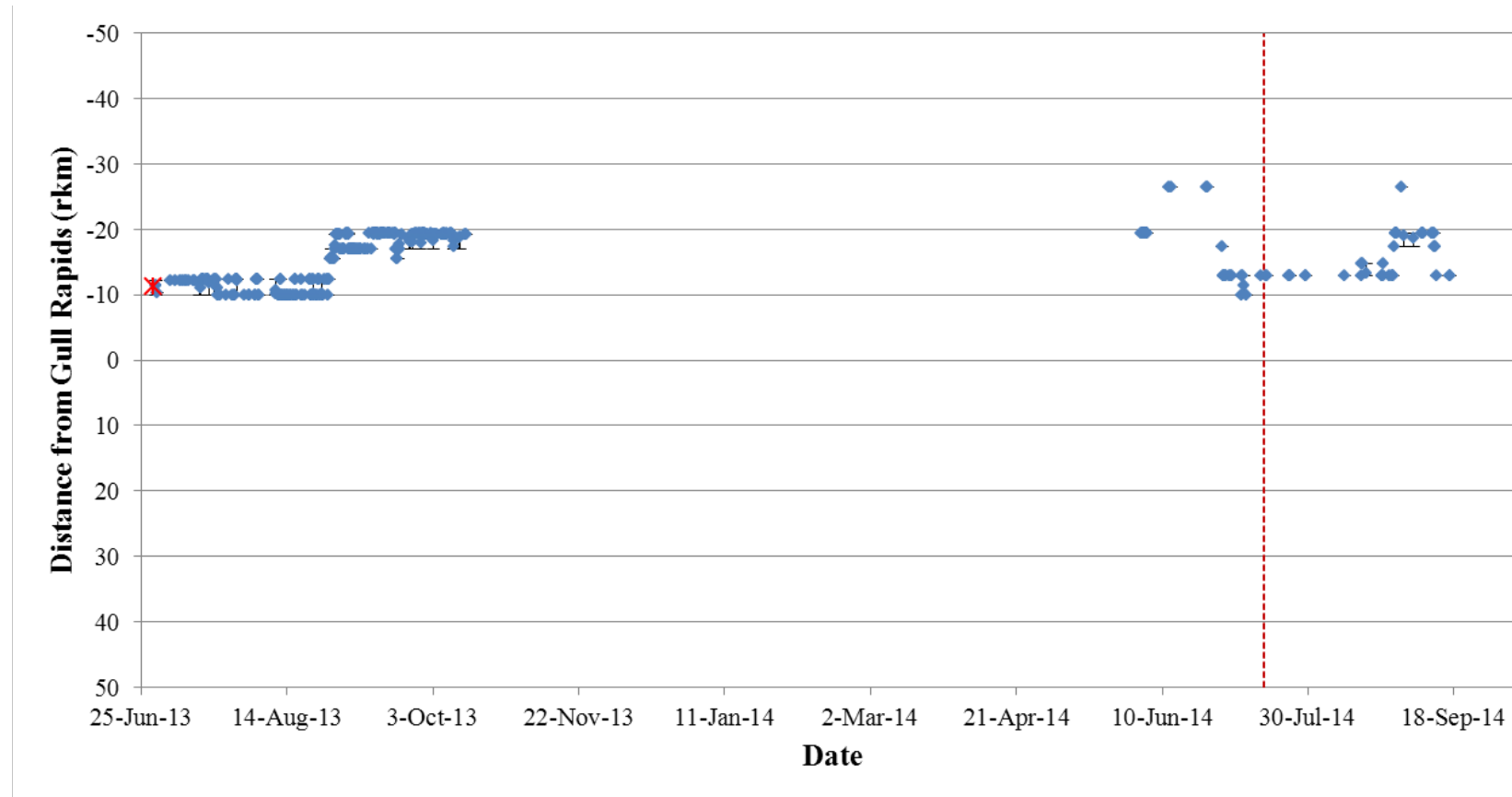


Figure A2- 1: Position of a Walleye tagged with an acoustic transmitter (code #32813) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

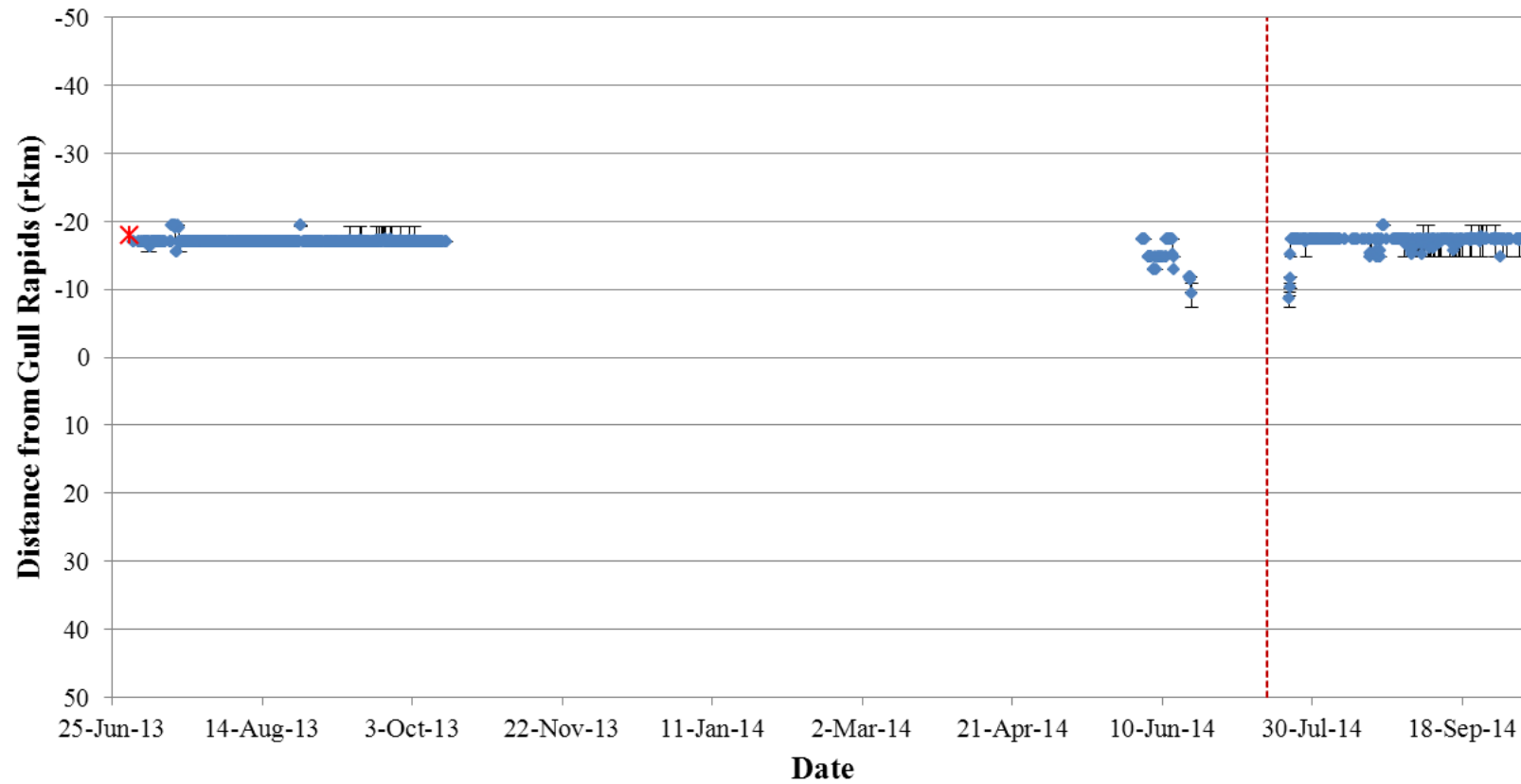


Figure A2- 2: Position of a Walleye tagged with an acoustic transmitter (code #32833) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

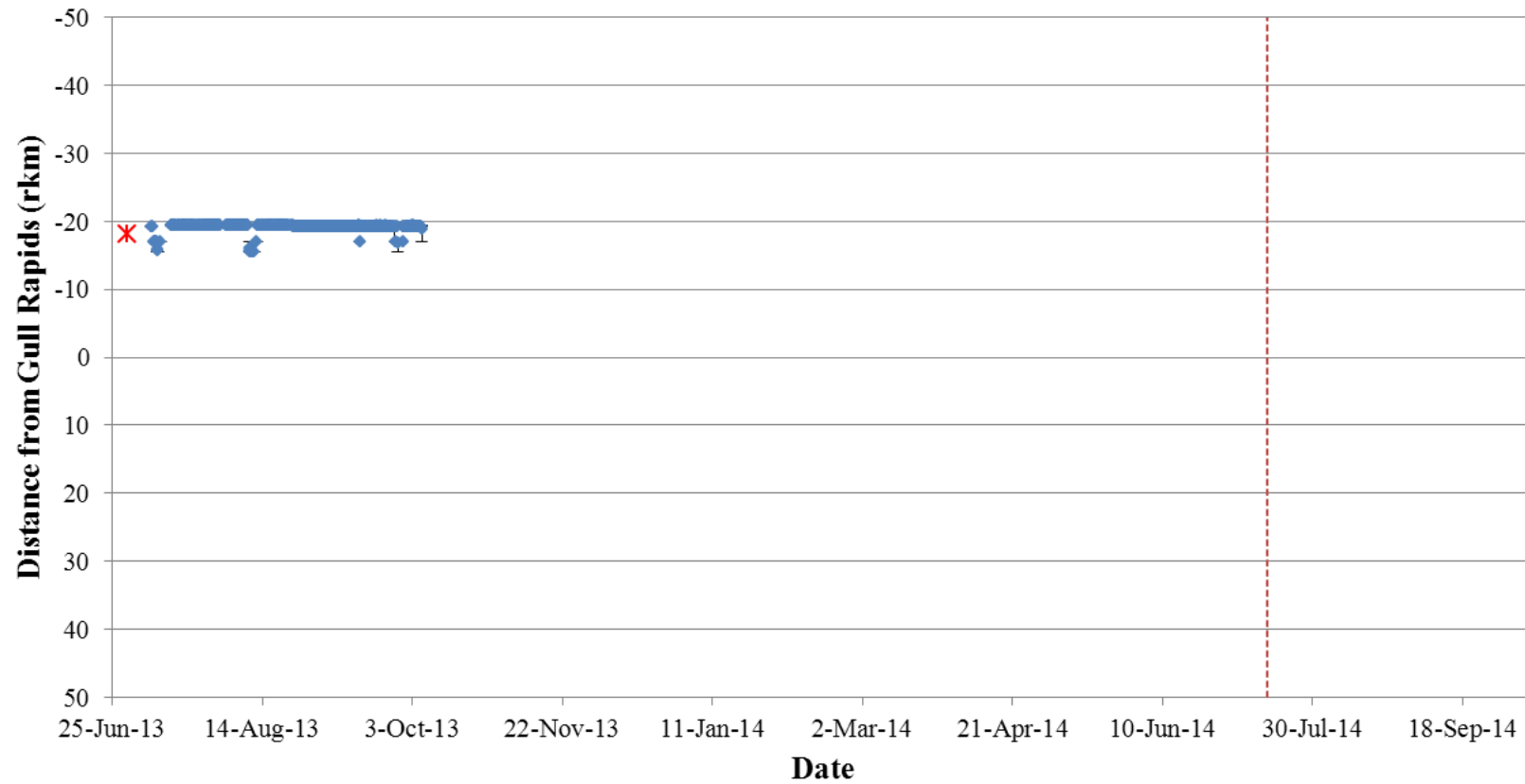


Figure A2- 3: Position of a Walleye tagged with an acoustic transmitter (code #32846) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

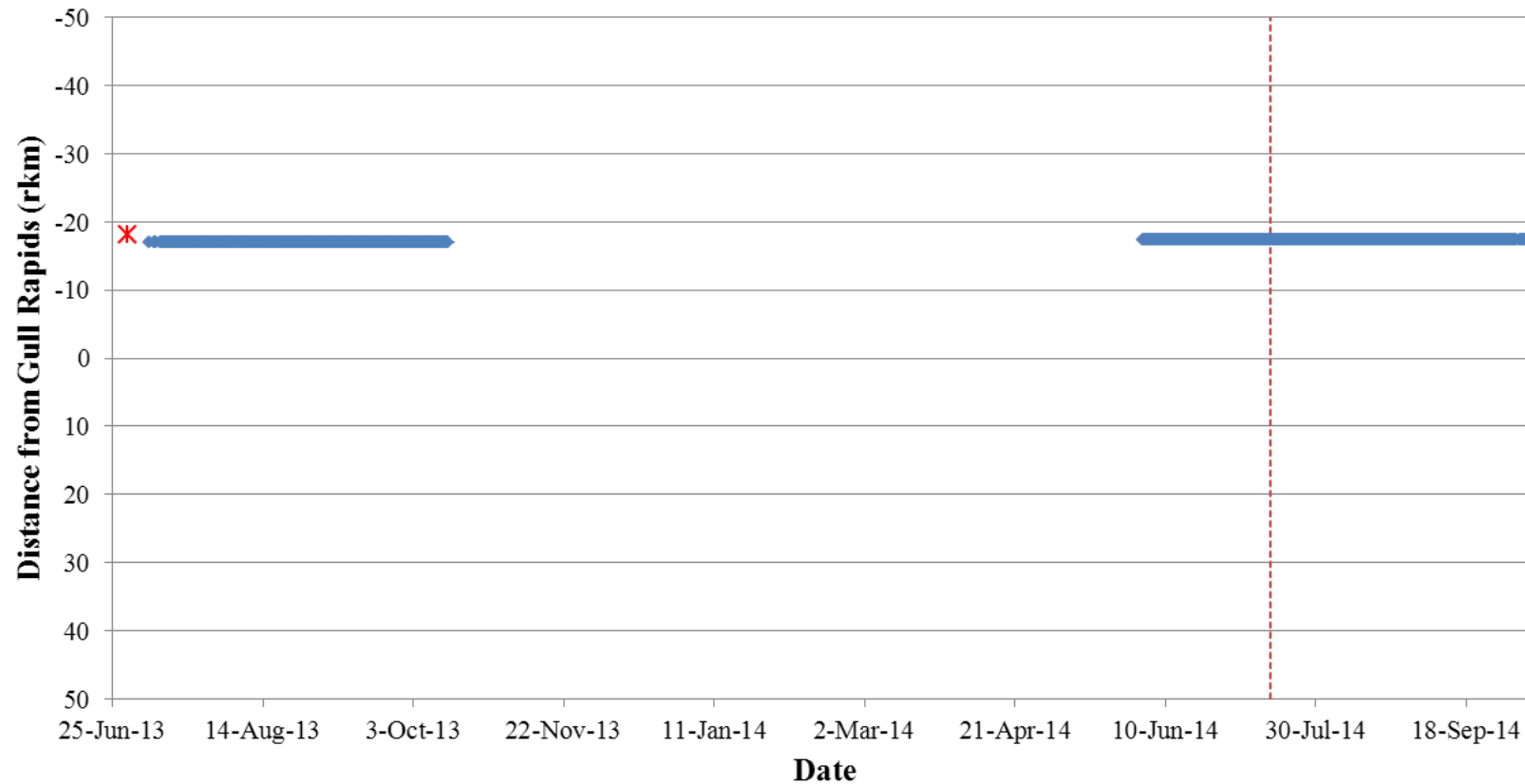
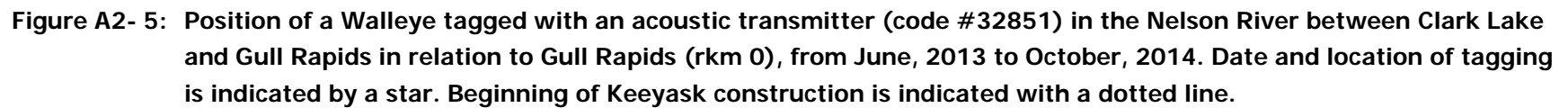


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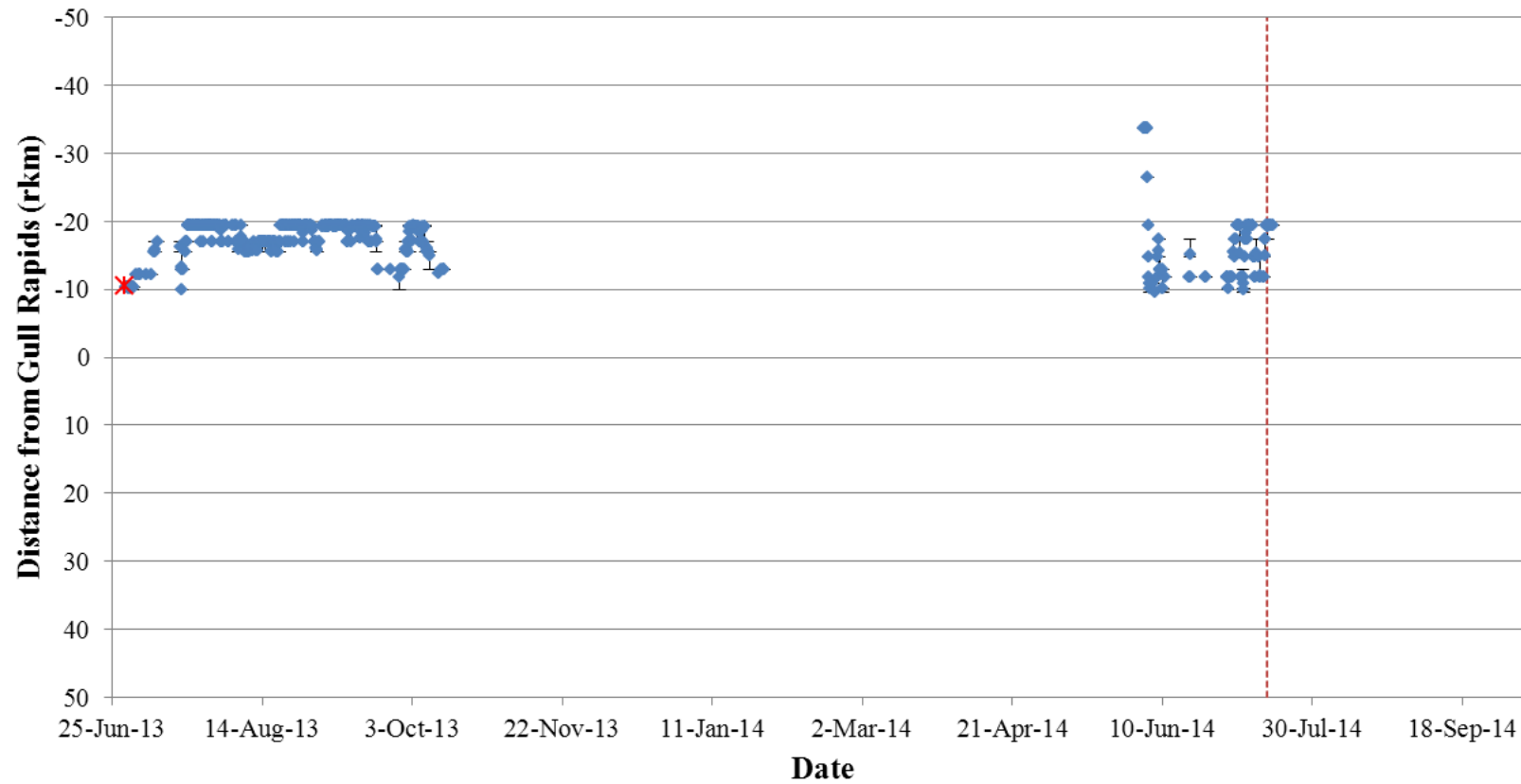
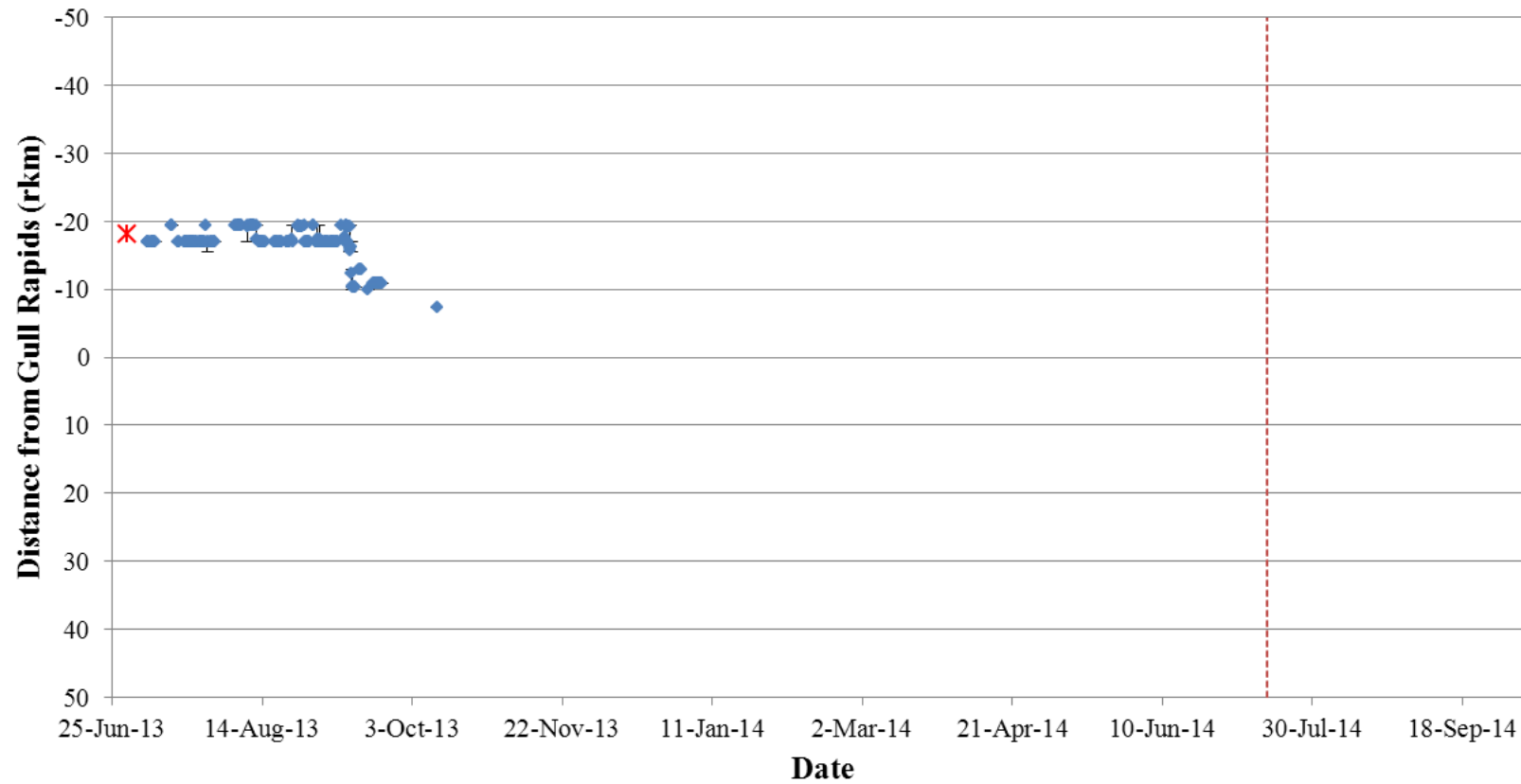


Figure A2- 6: Position of a Walleye tagged with an acoustic transmitter (code #32852) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.



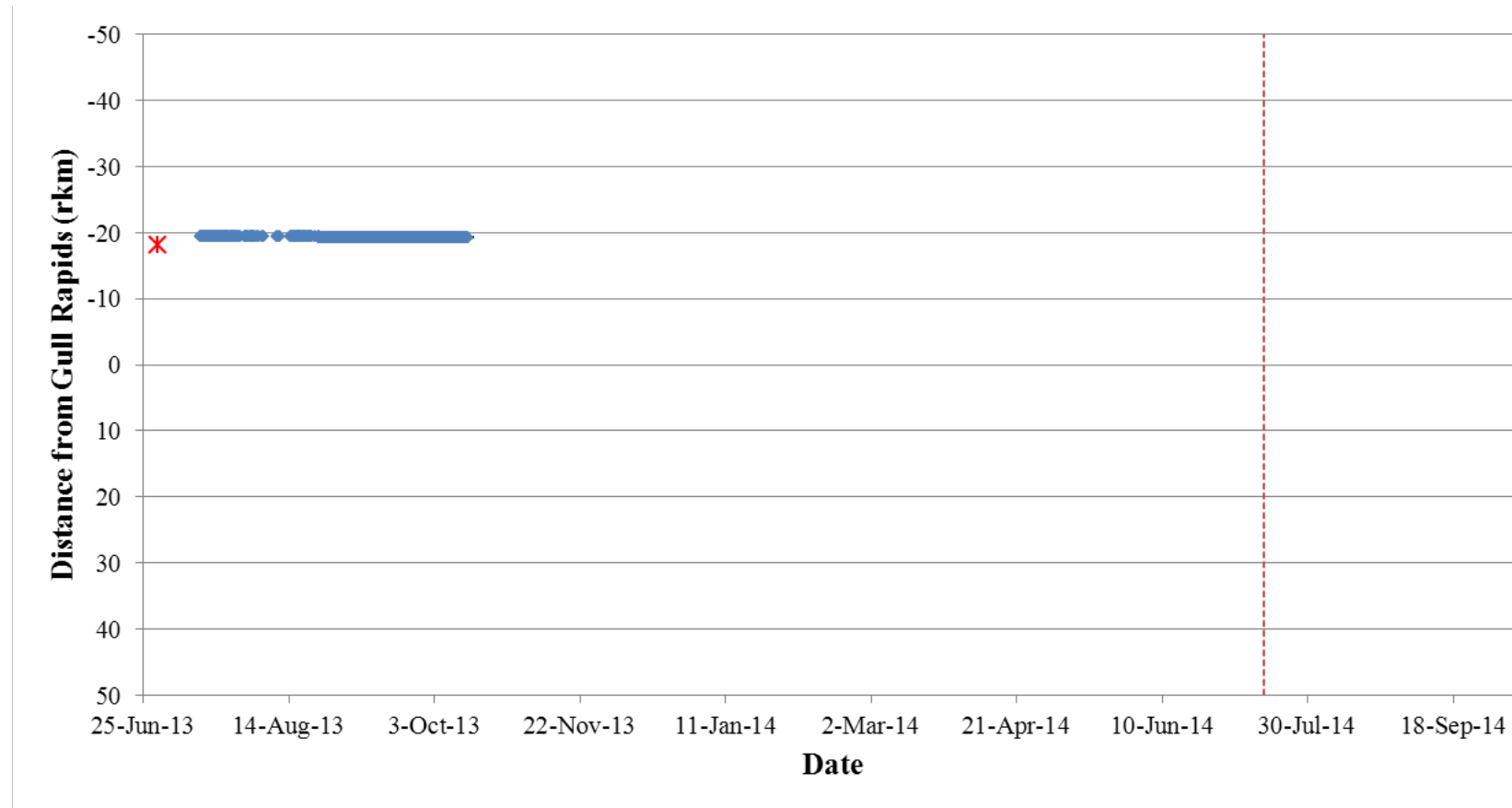


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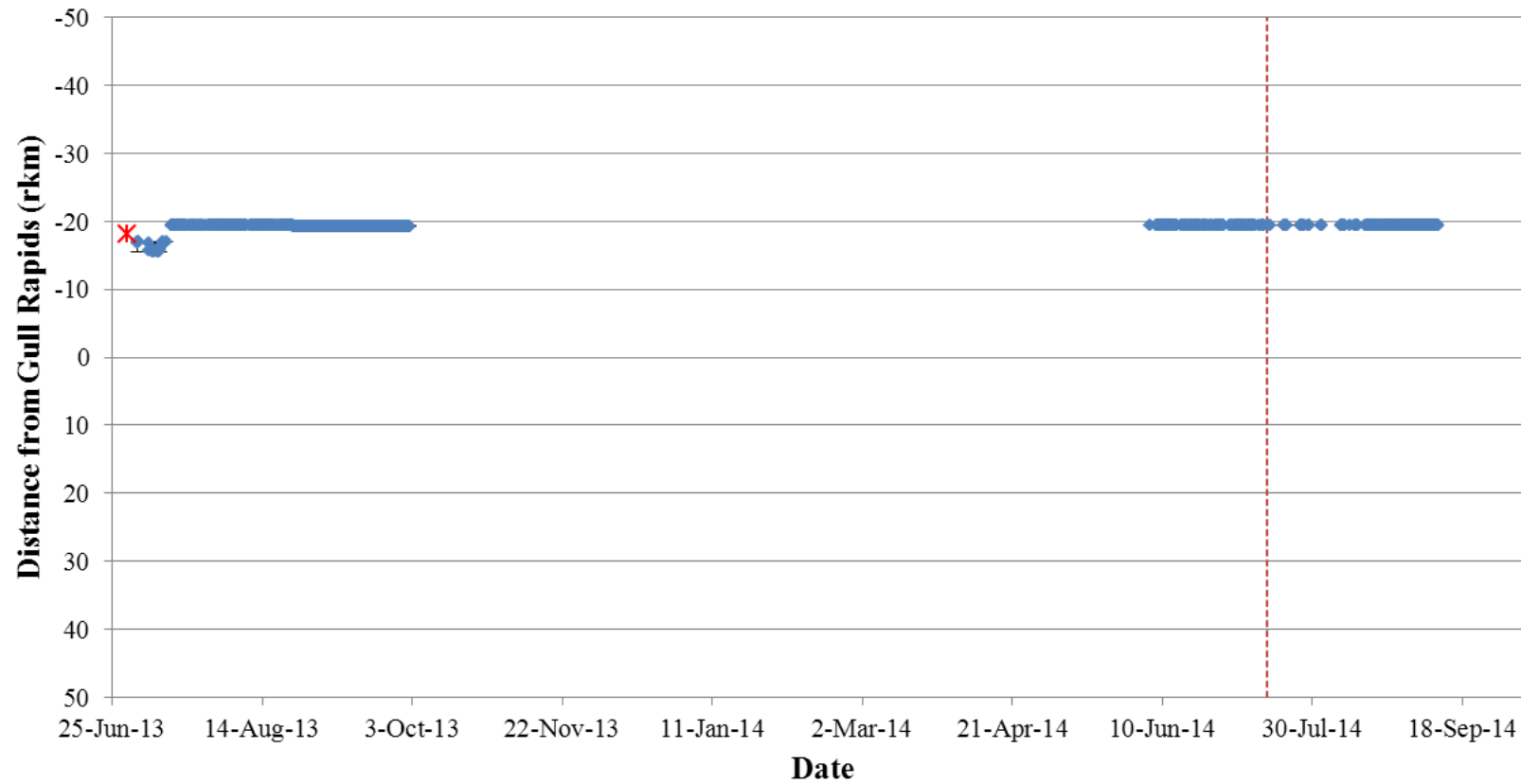


Figure A2- 9: Position of a Walleye tagged with an acoustic transmitter (code #32857) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

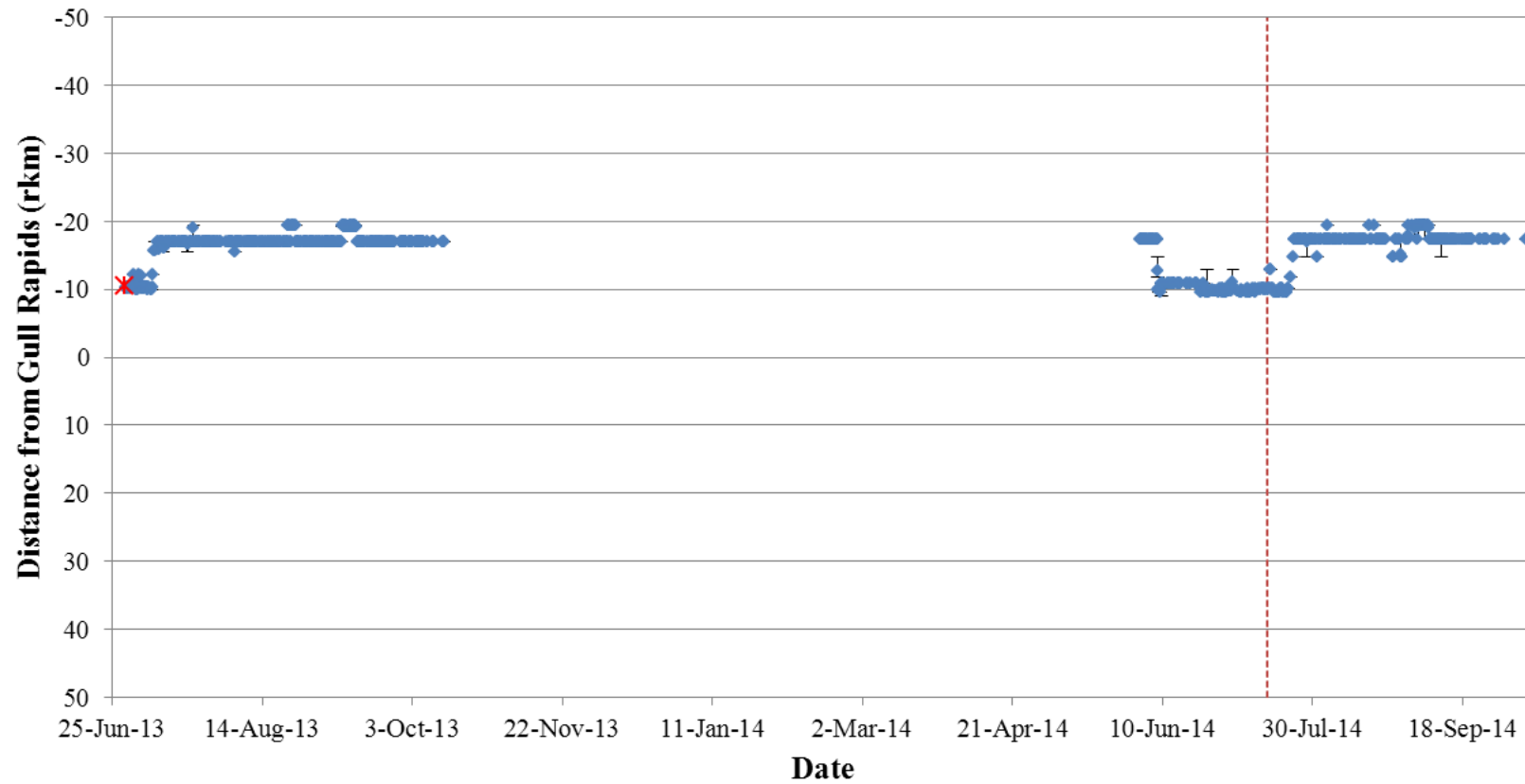


Figure A2- 10: Position of a Walleye tagged with an acoustic transmitter (code #32858) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

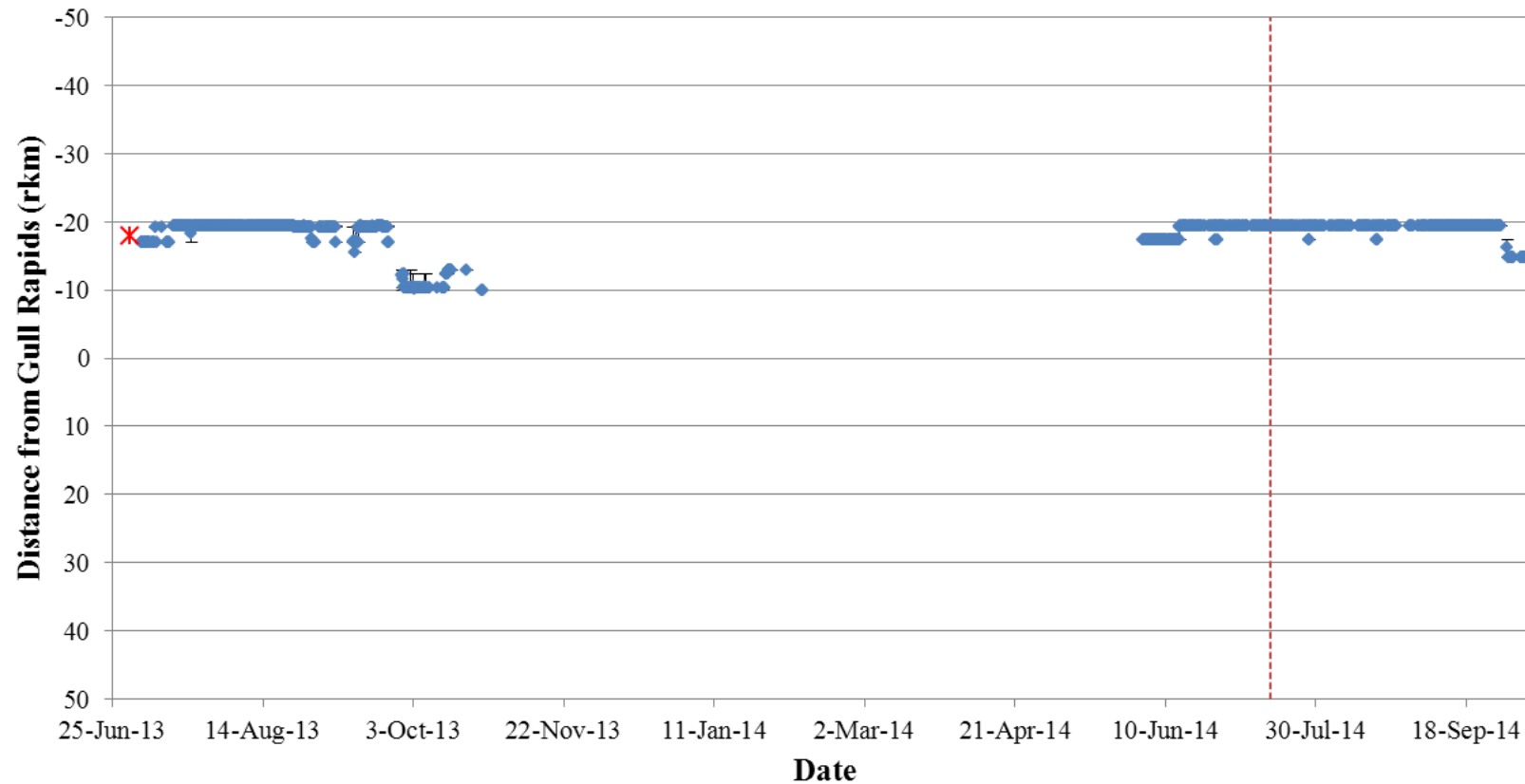


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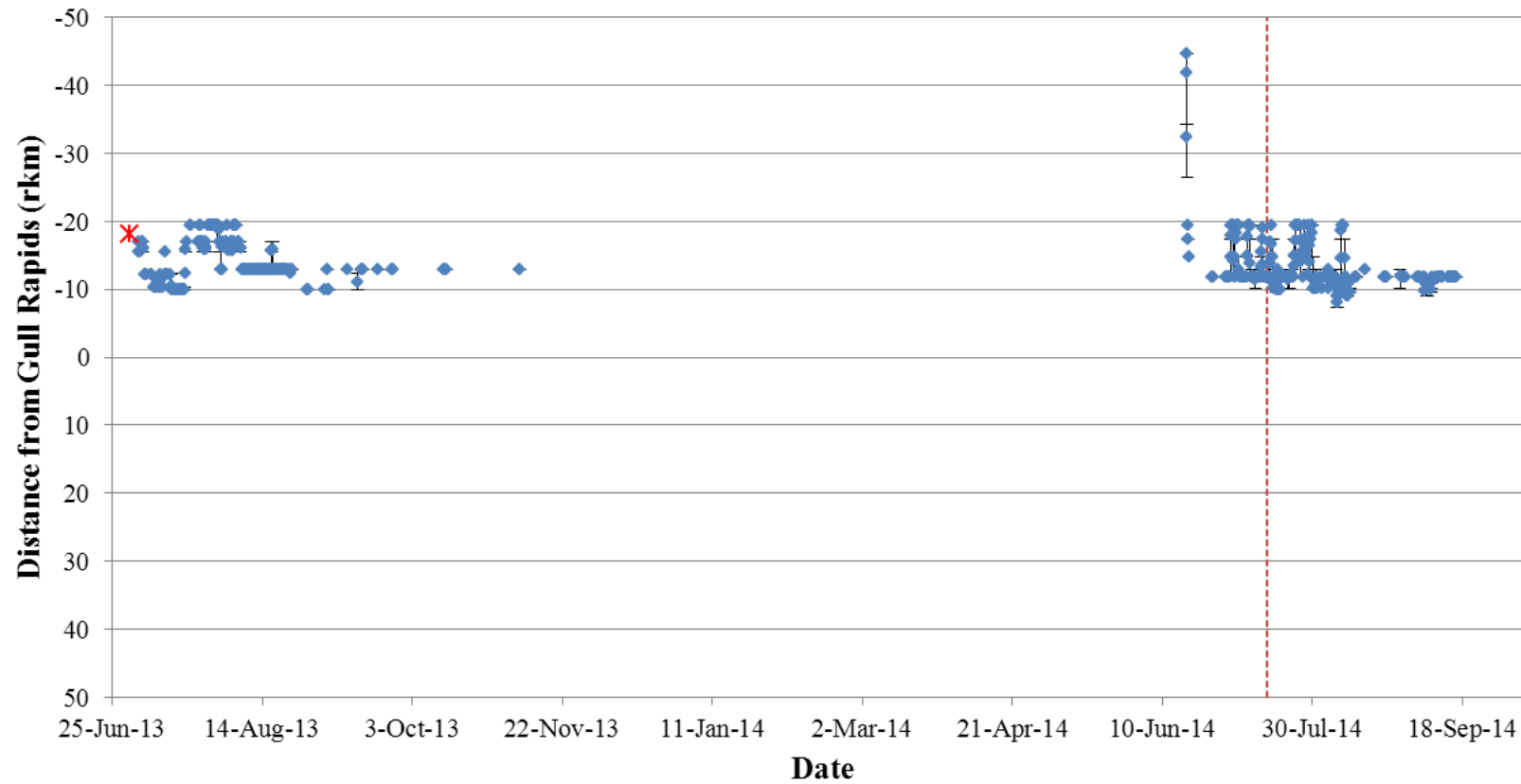
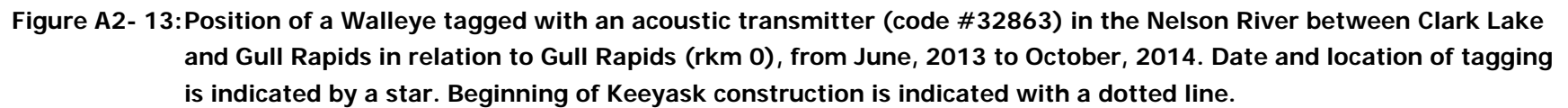


Figure A2- 12: Position of a Walleye tagged with an acoustic transmitter (code #32862) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.



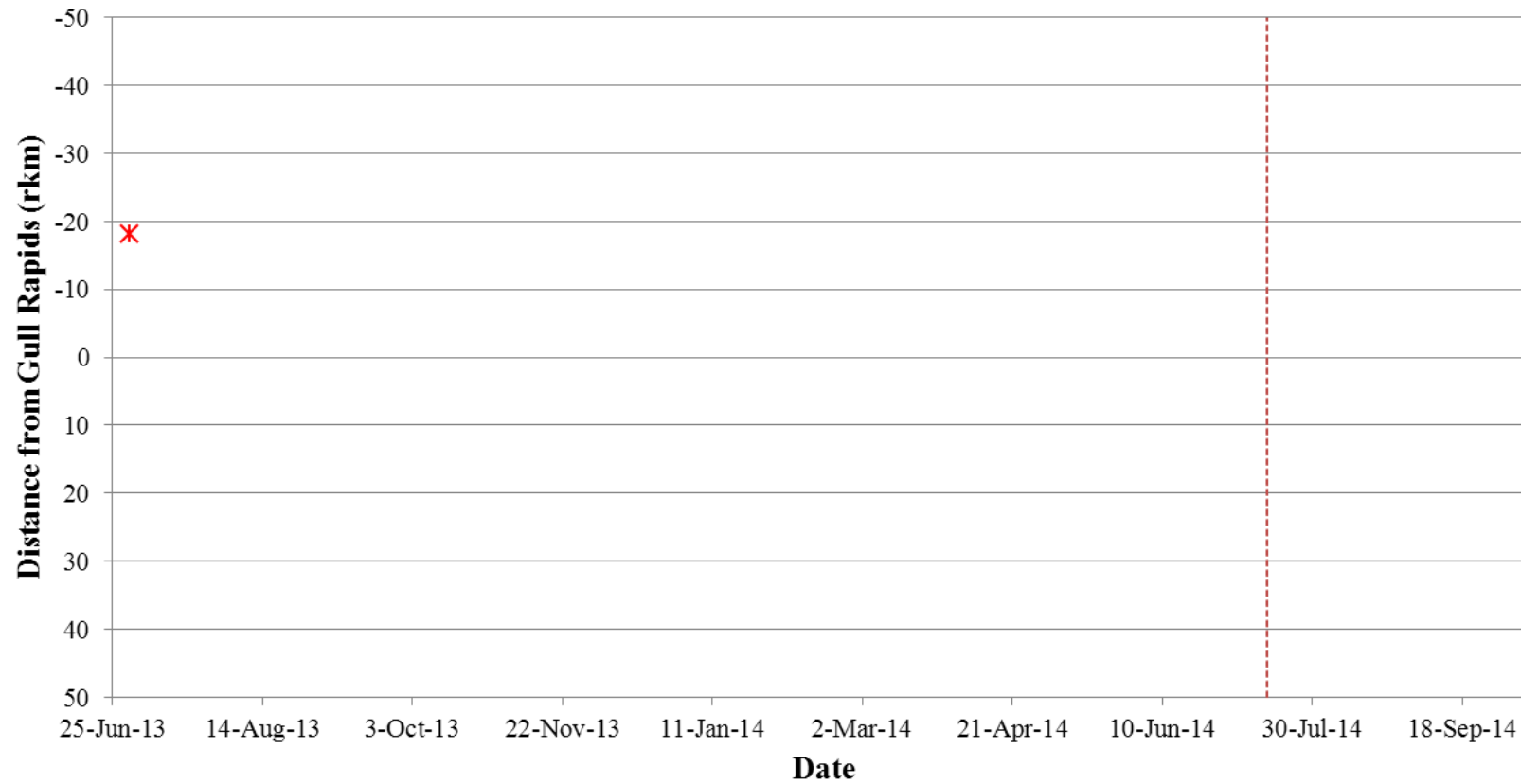
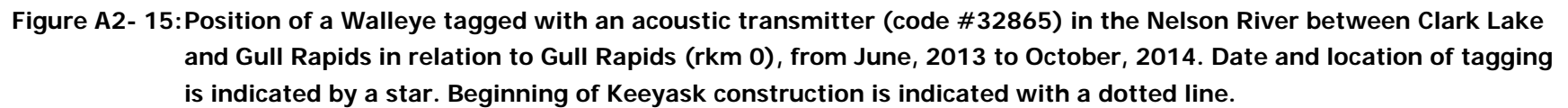


Figure A2- 14: Position of a Walleye tagged with an acoustic transmitter (code #32864) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.



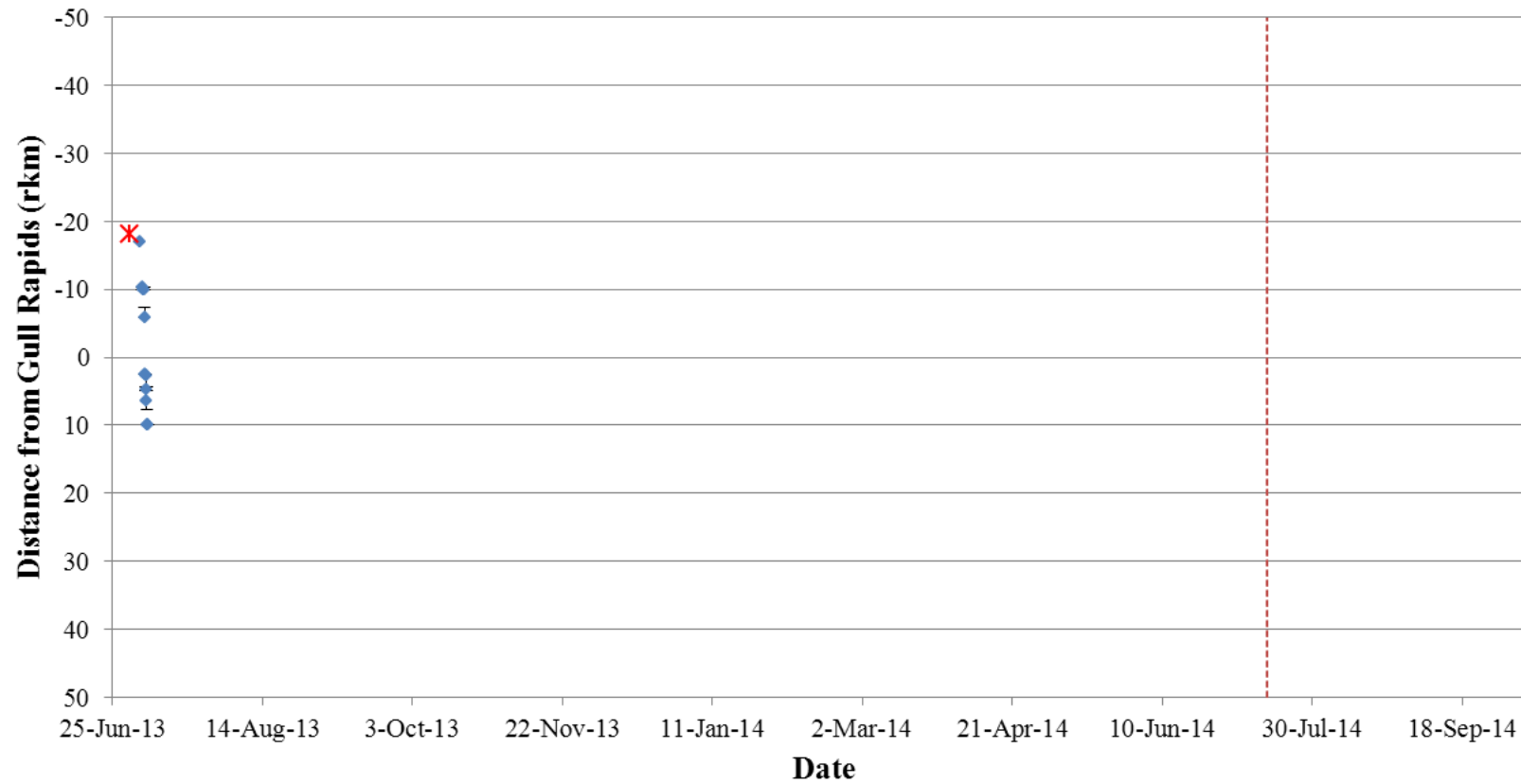


Figure A2- 16: Position of a Walleye tagged with an acoustic transmitter (code #32866) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

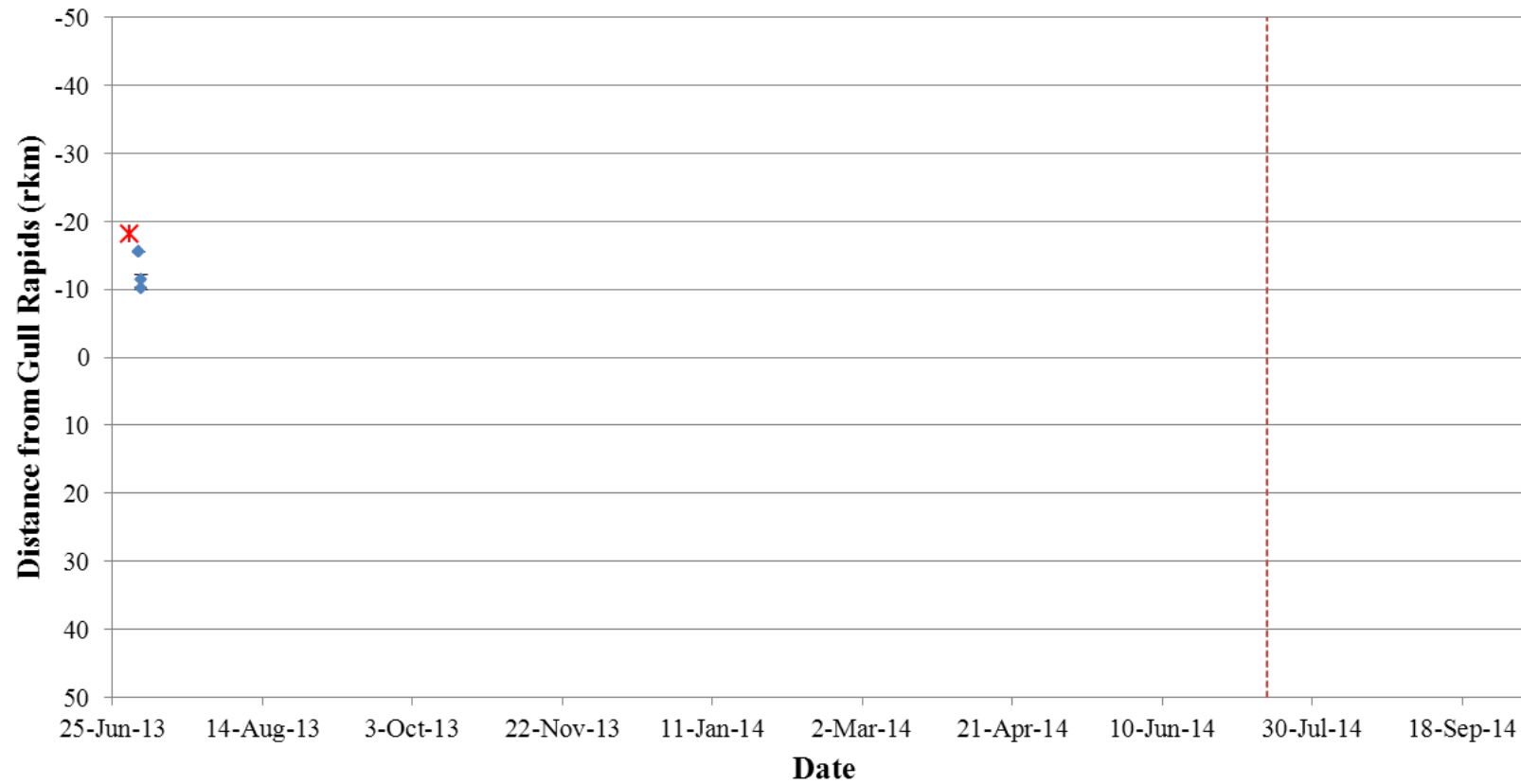
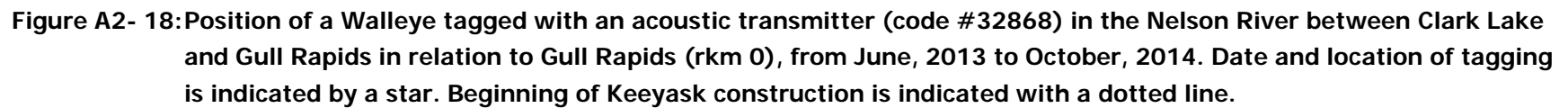


Figure A2- 17: Position of a Walleye tagged with an acoustic transmitter (code #32867) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.



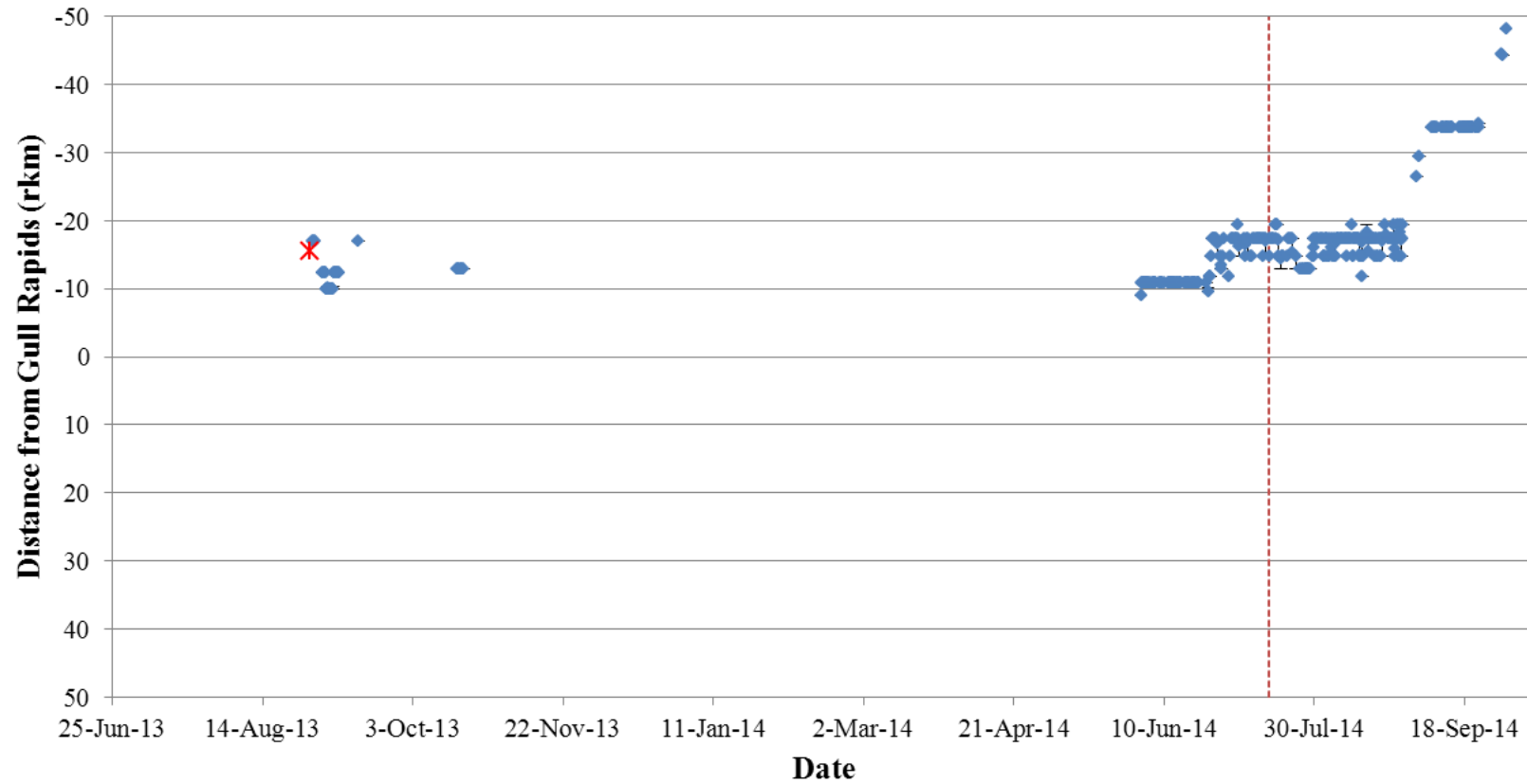


Figure A2- 19: Position of a Walleye tagged with an acoustic transmitter (code #32869) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

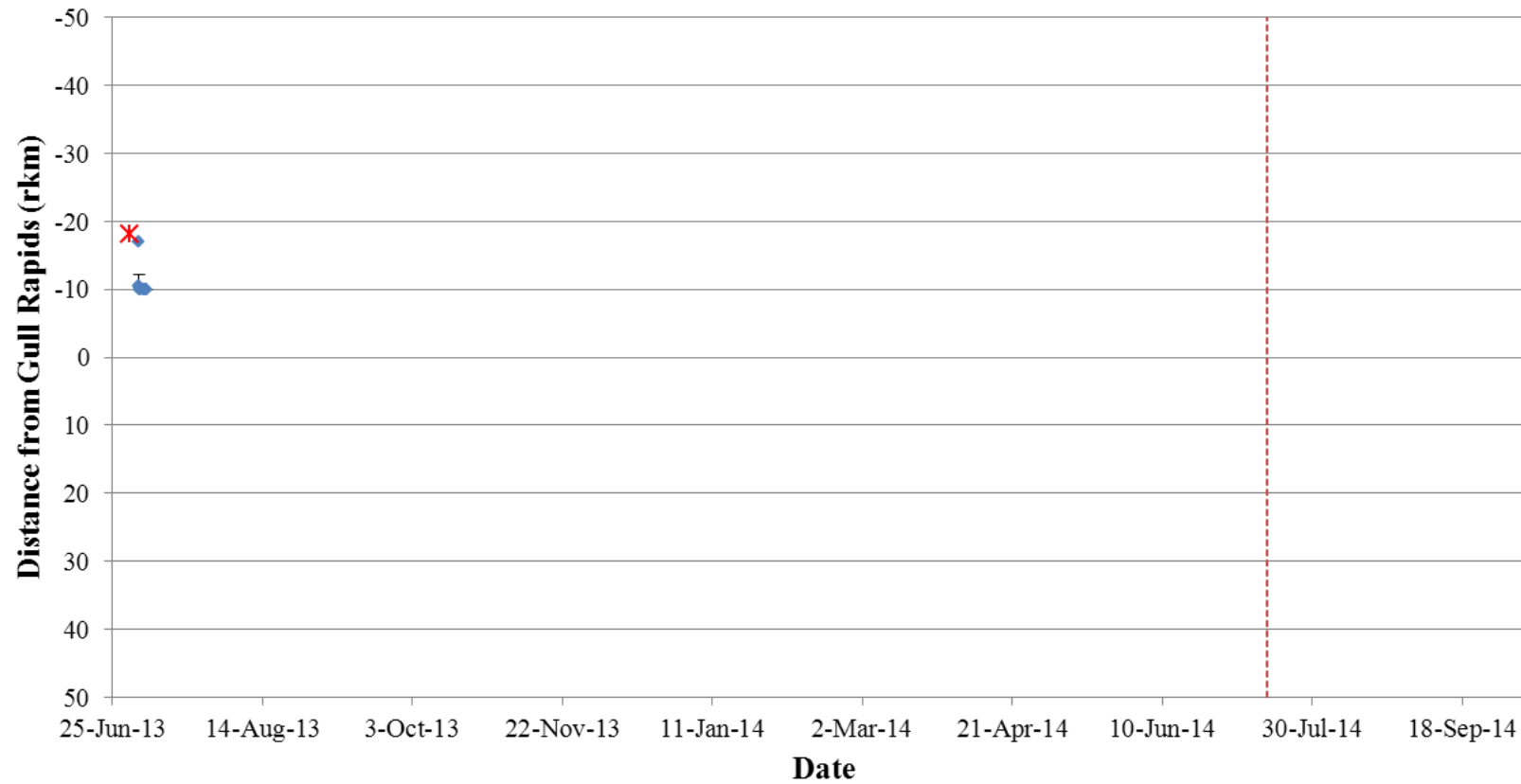


Figure A2- 20: Position of a Walleye tagged with an acoustic transmitter (code #32870) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

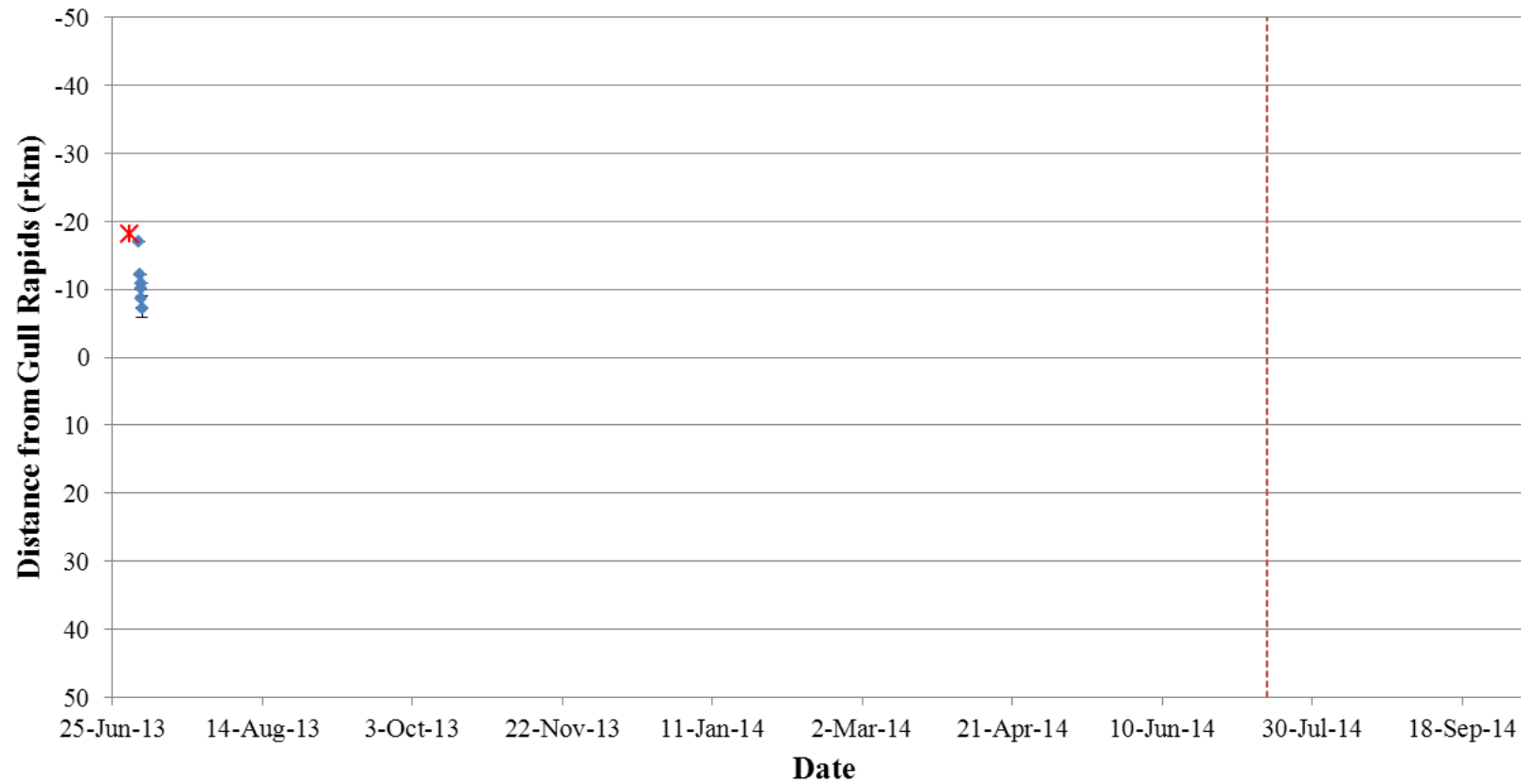


Figure A2- 21: Position of a Walleye tagged with an acoustic transmitter (code #32871) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

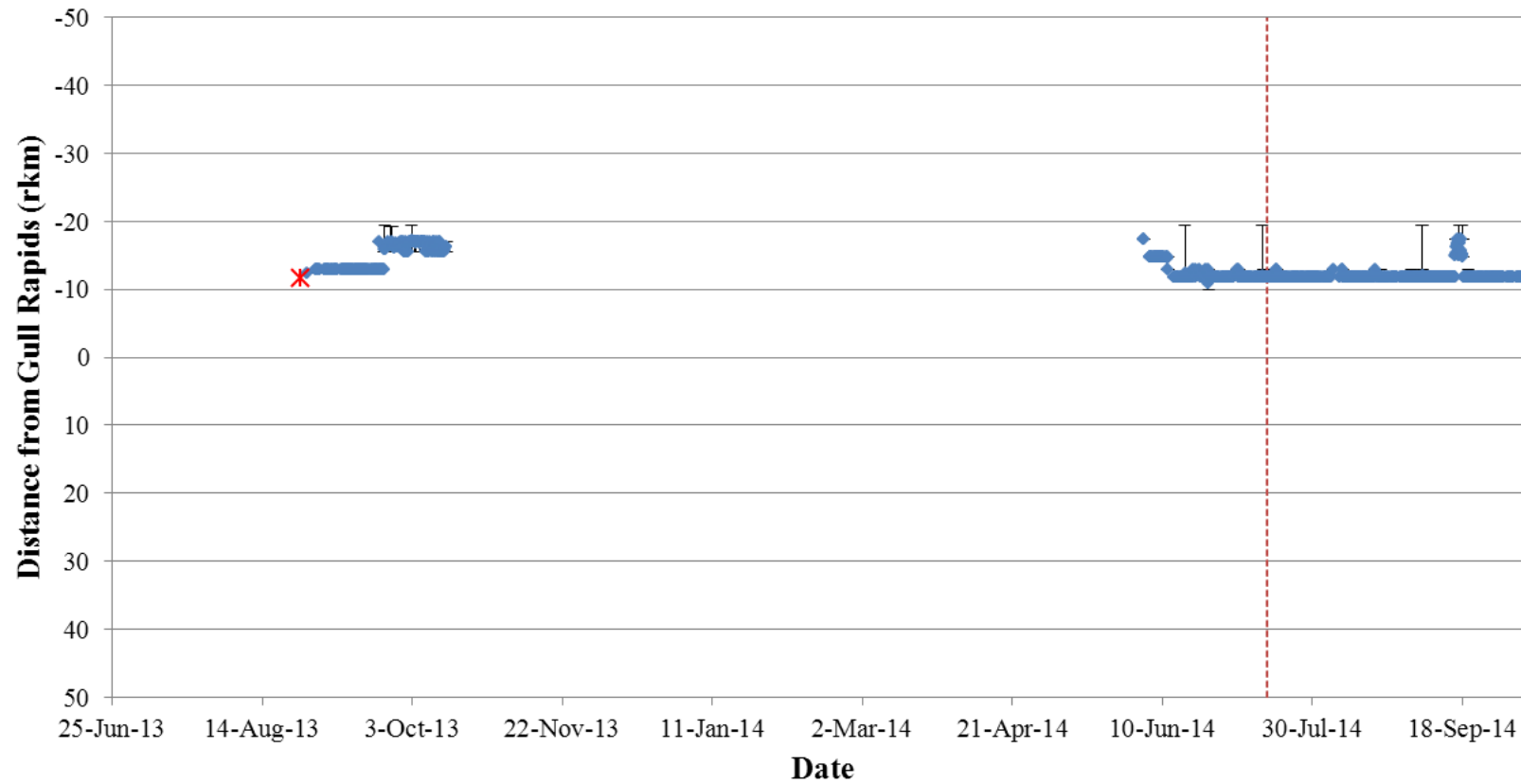
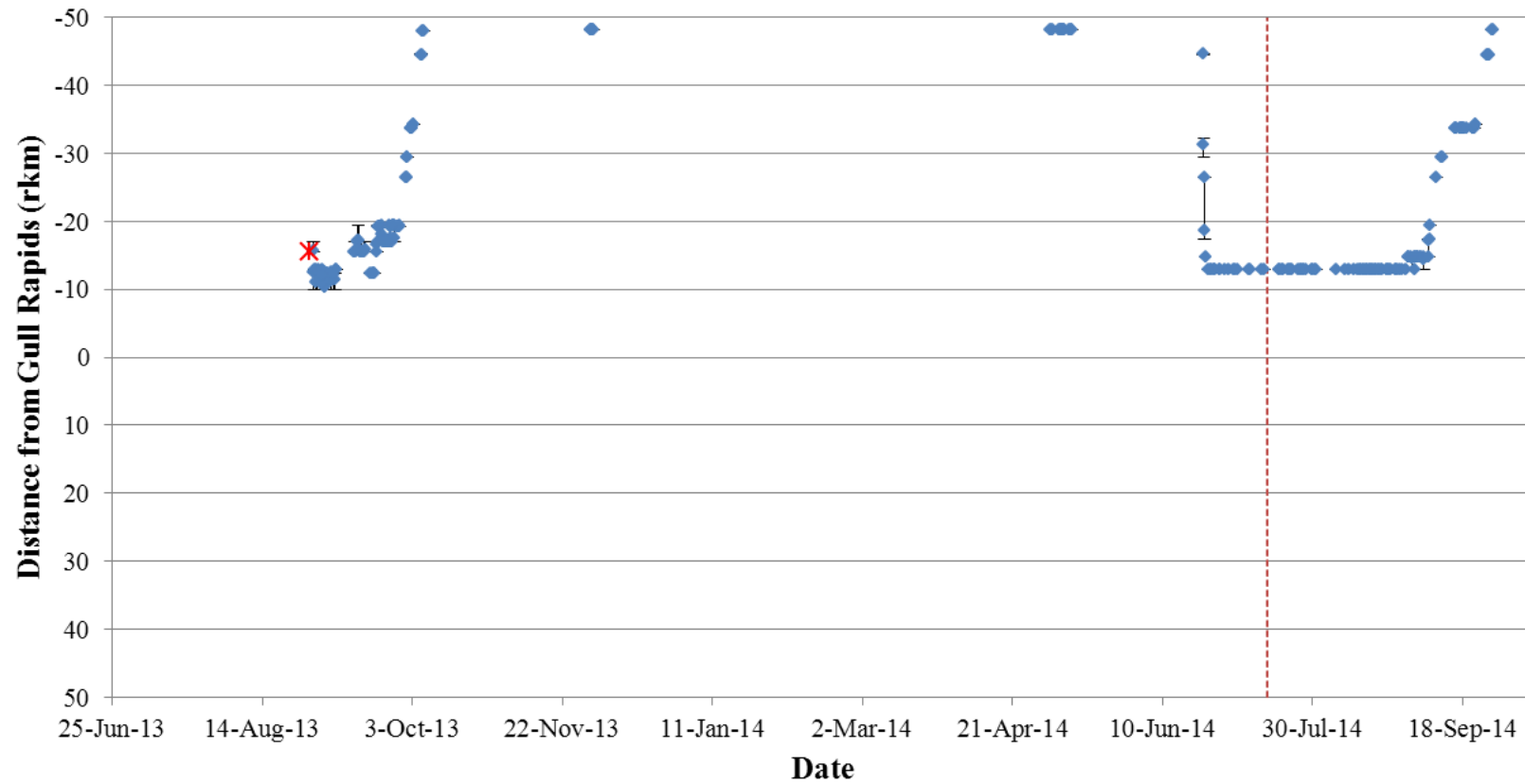


Figure A2- 22: Position of a Walleye tagged with an acoustic transmitter (code #32872) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.



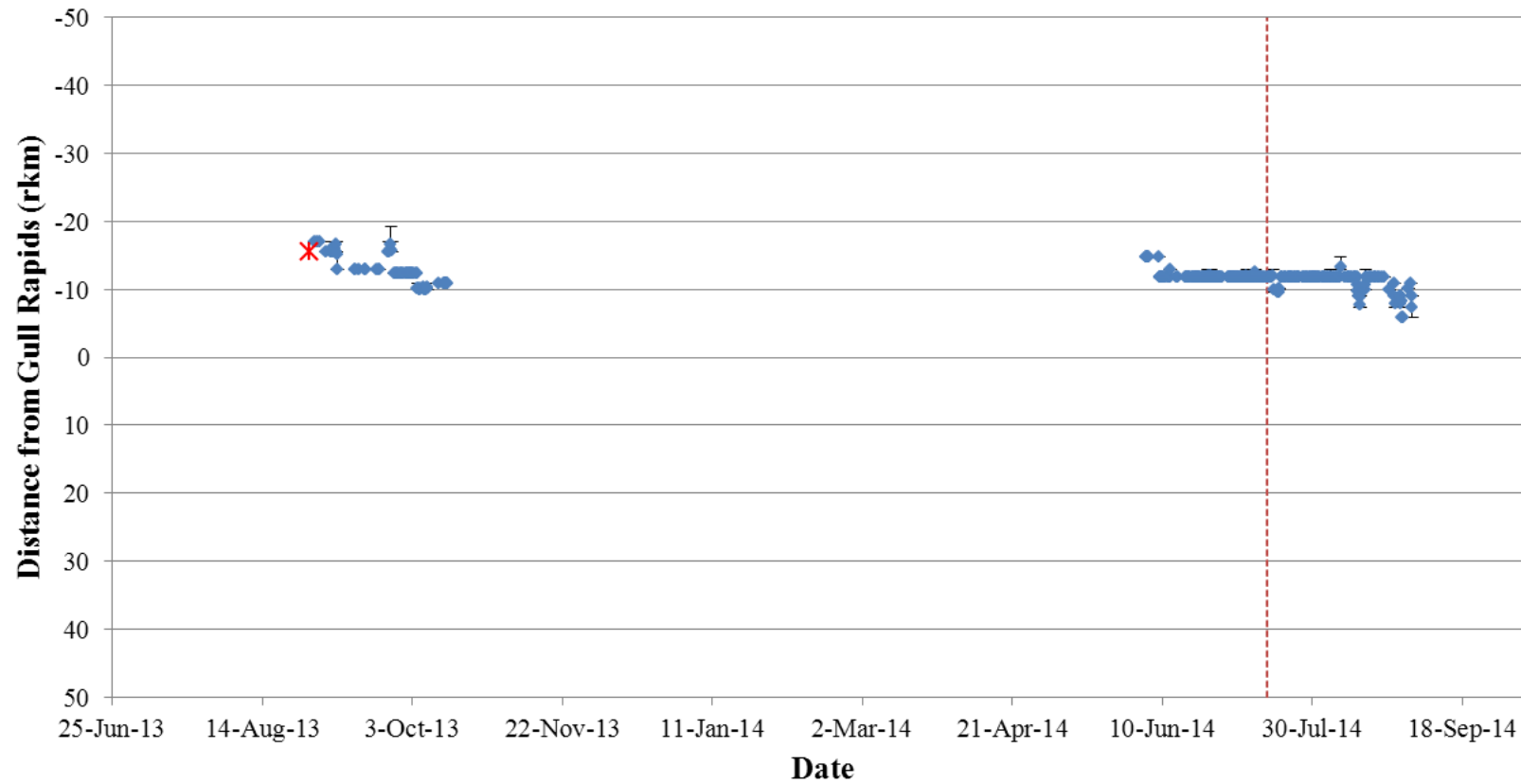


Figure A2- 24: Position of a Walleye tagged with an acoustic transmitter (code #32874) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

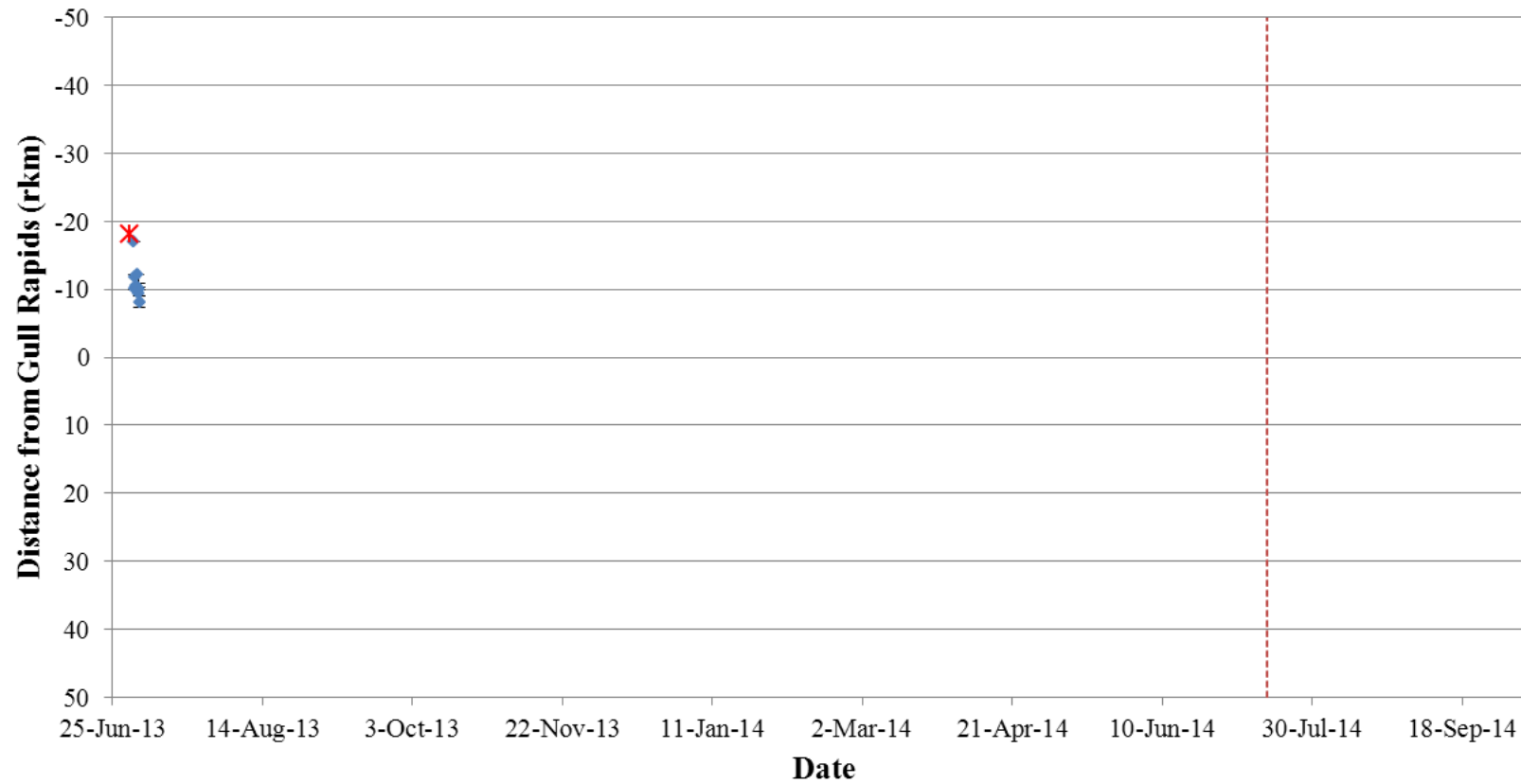


Figure A2- 25: Position of a Walleye tagged with an acoustic transmitter (code #32875) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

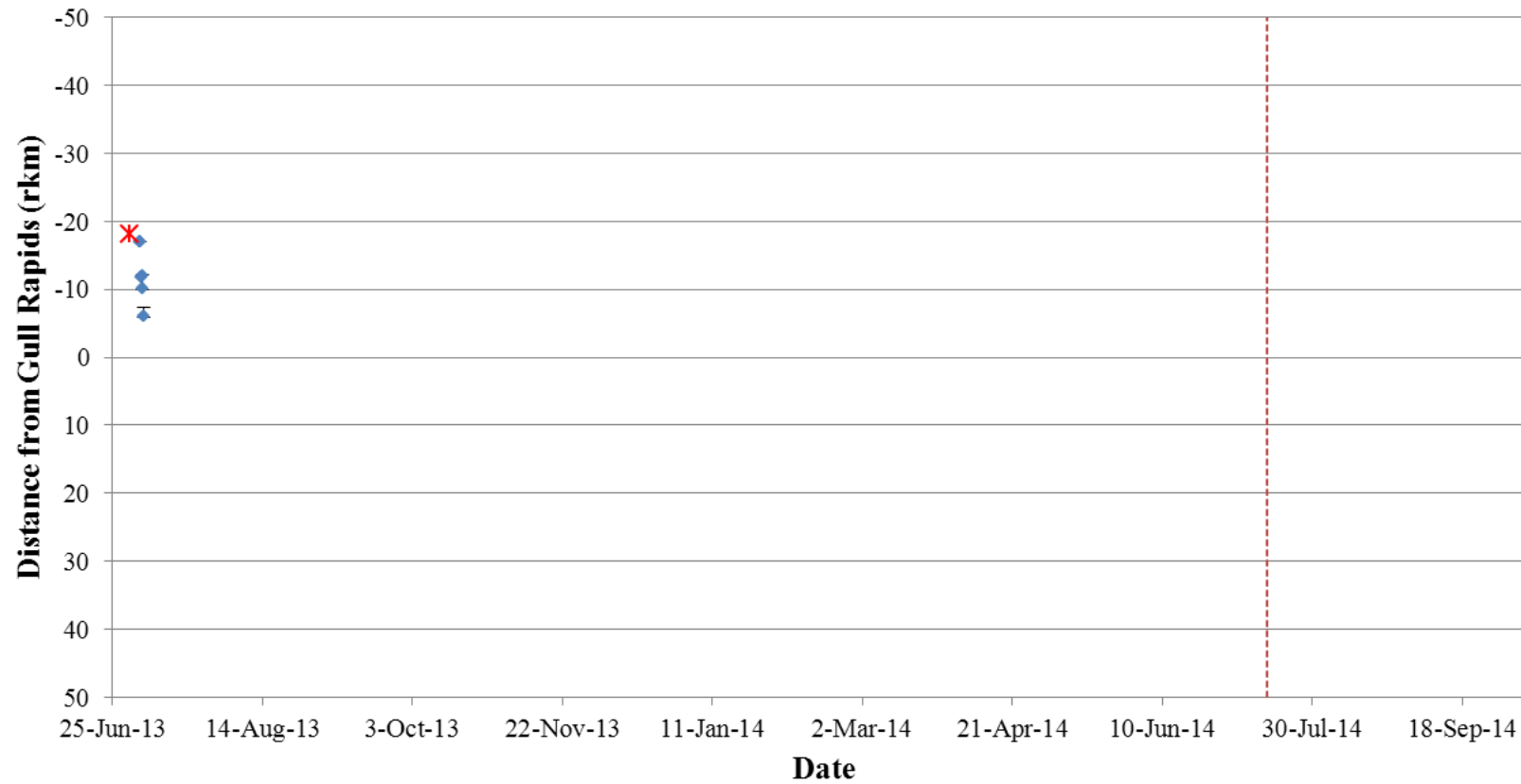


Figure A2- 26: Position of a Walleye tagged with an acoustic transmitter (code #32876) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

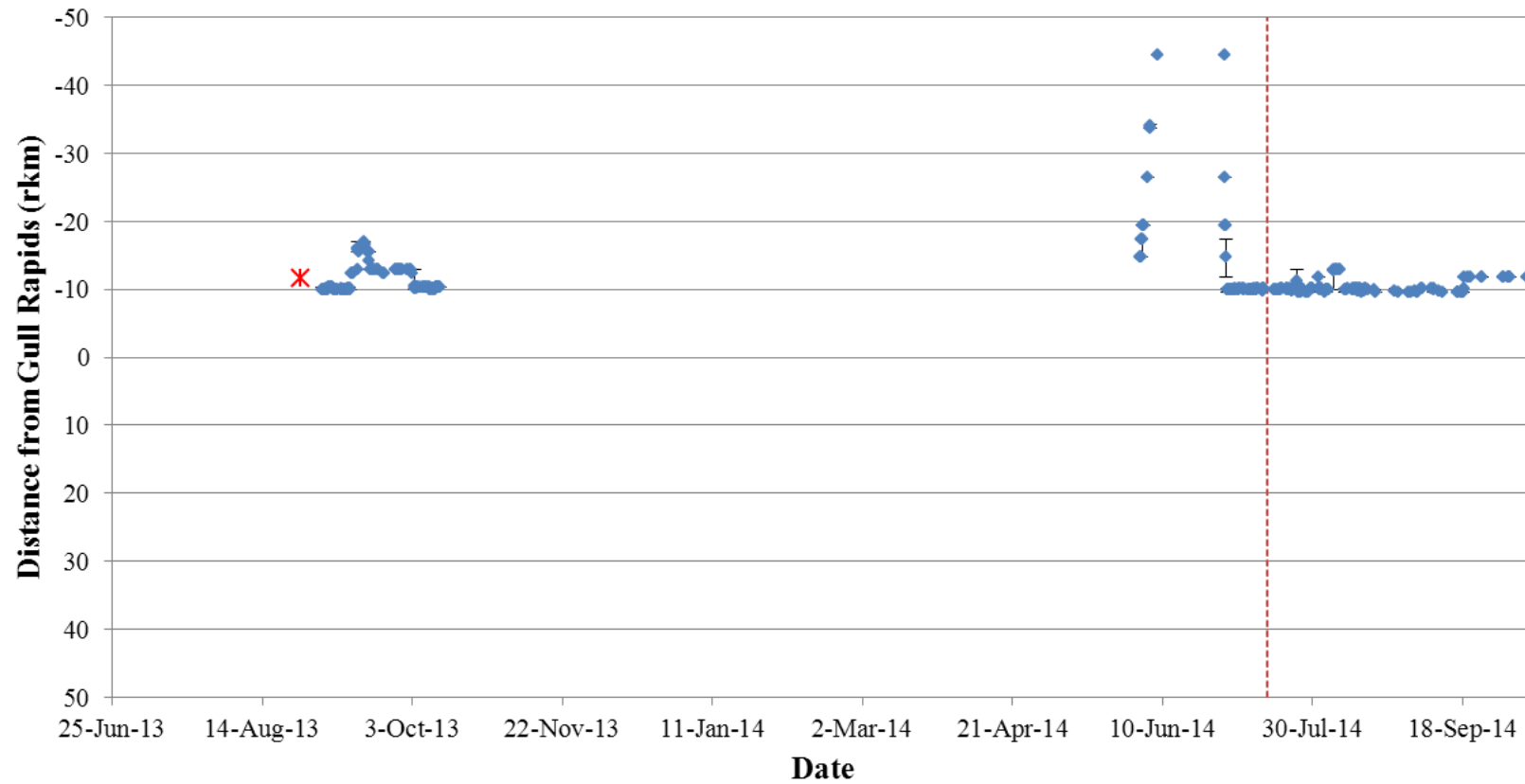


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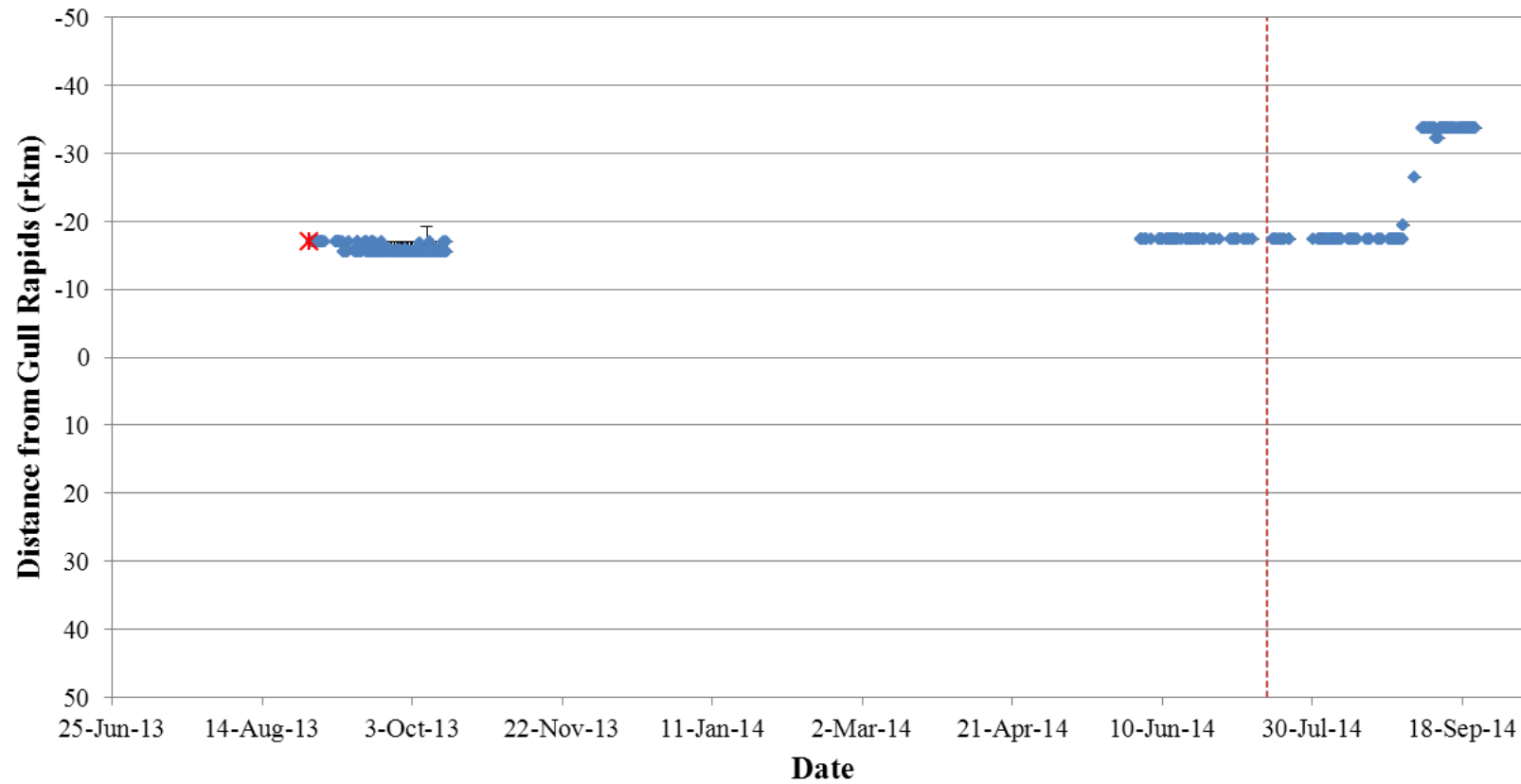


Figure A2- 28: Position of a Walleye tagged with an acoustic transmitter (code #32878) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

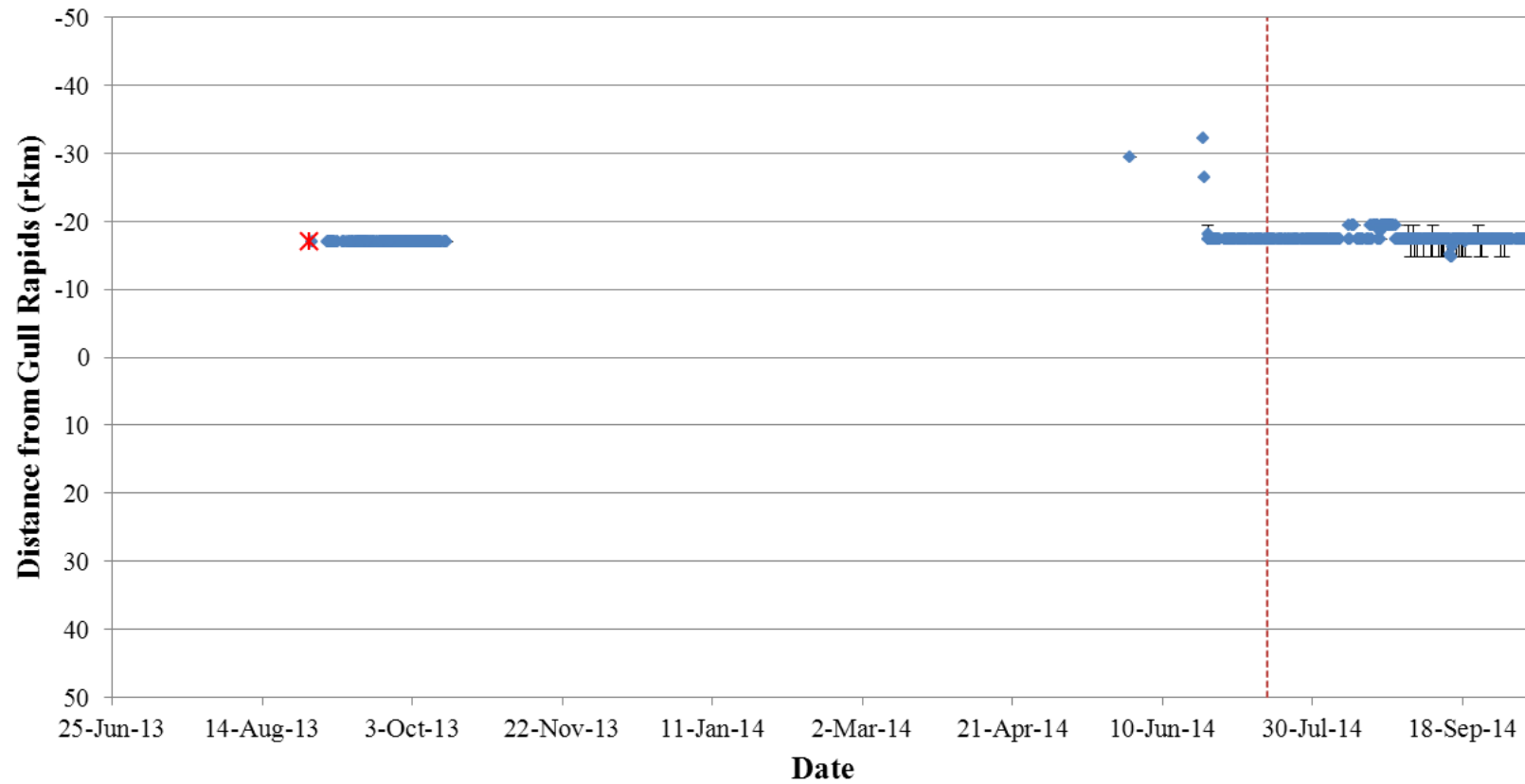


Figure A2- 29: Position of a Walleye tagged with an acoustic transmitter (code #32879) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

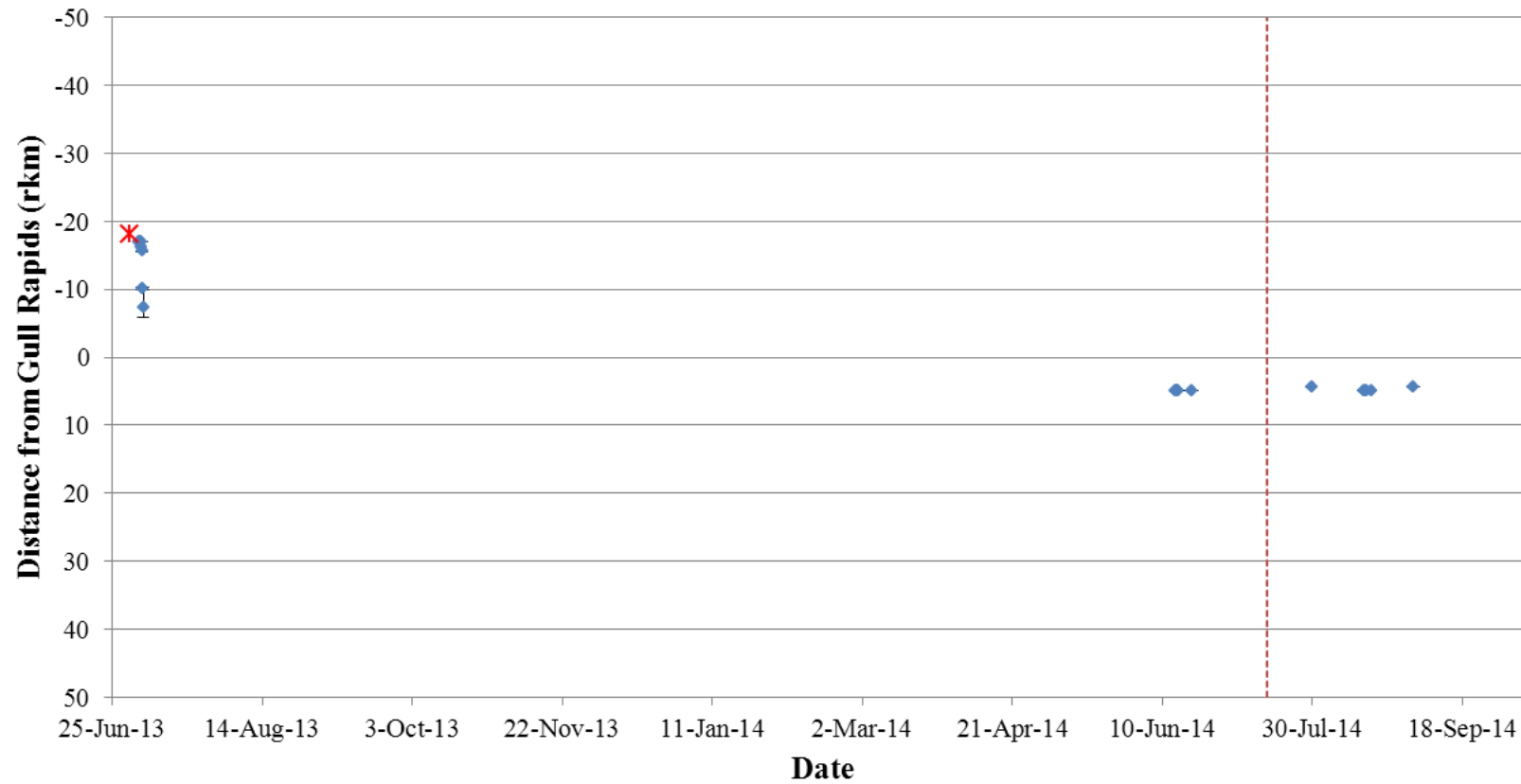


Figure A2- 30: Position of a Walleye tagged with an acoustic transmitter (code #32880) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

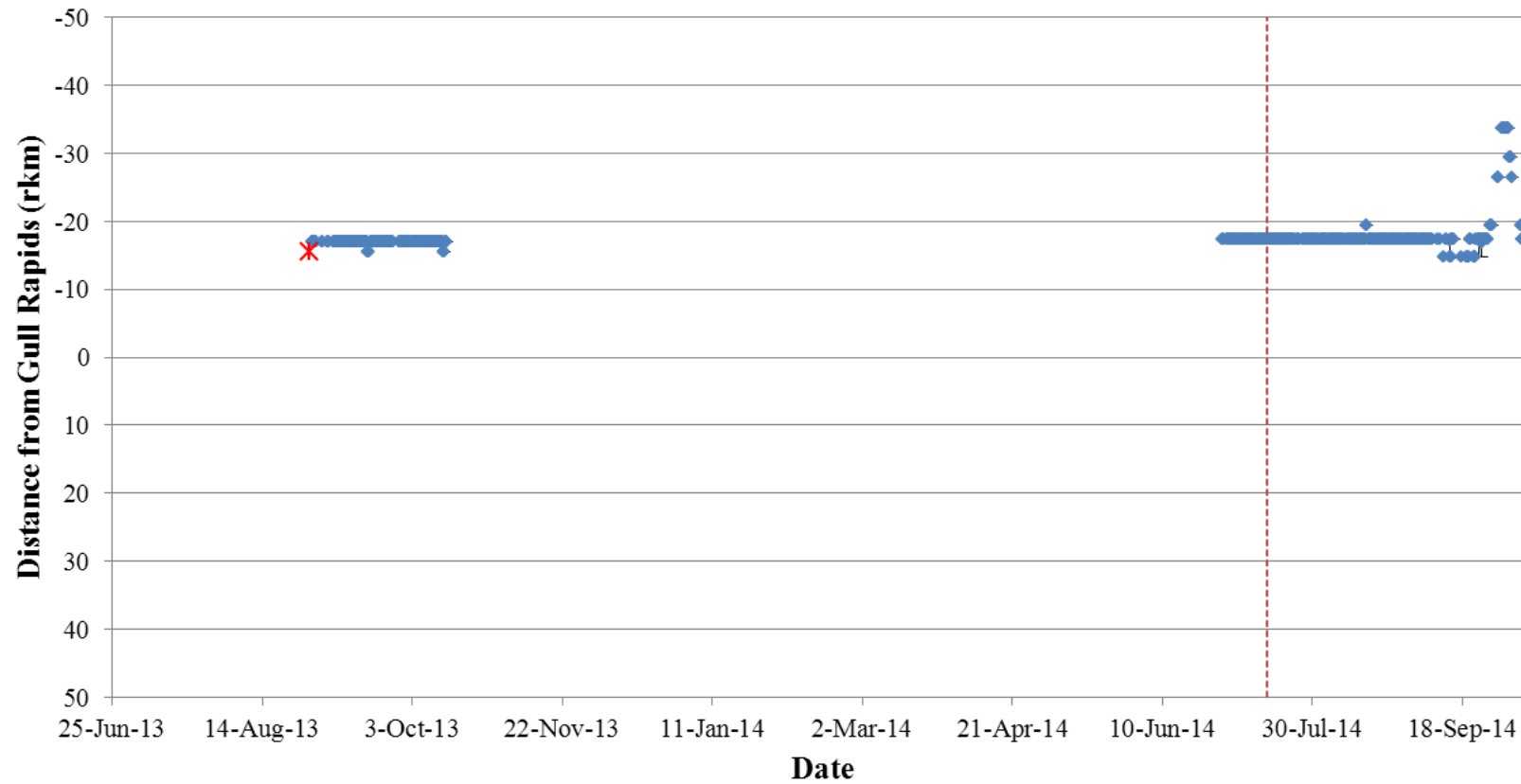


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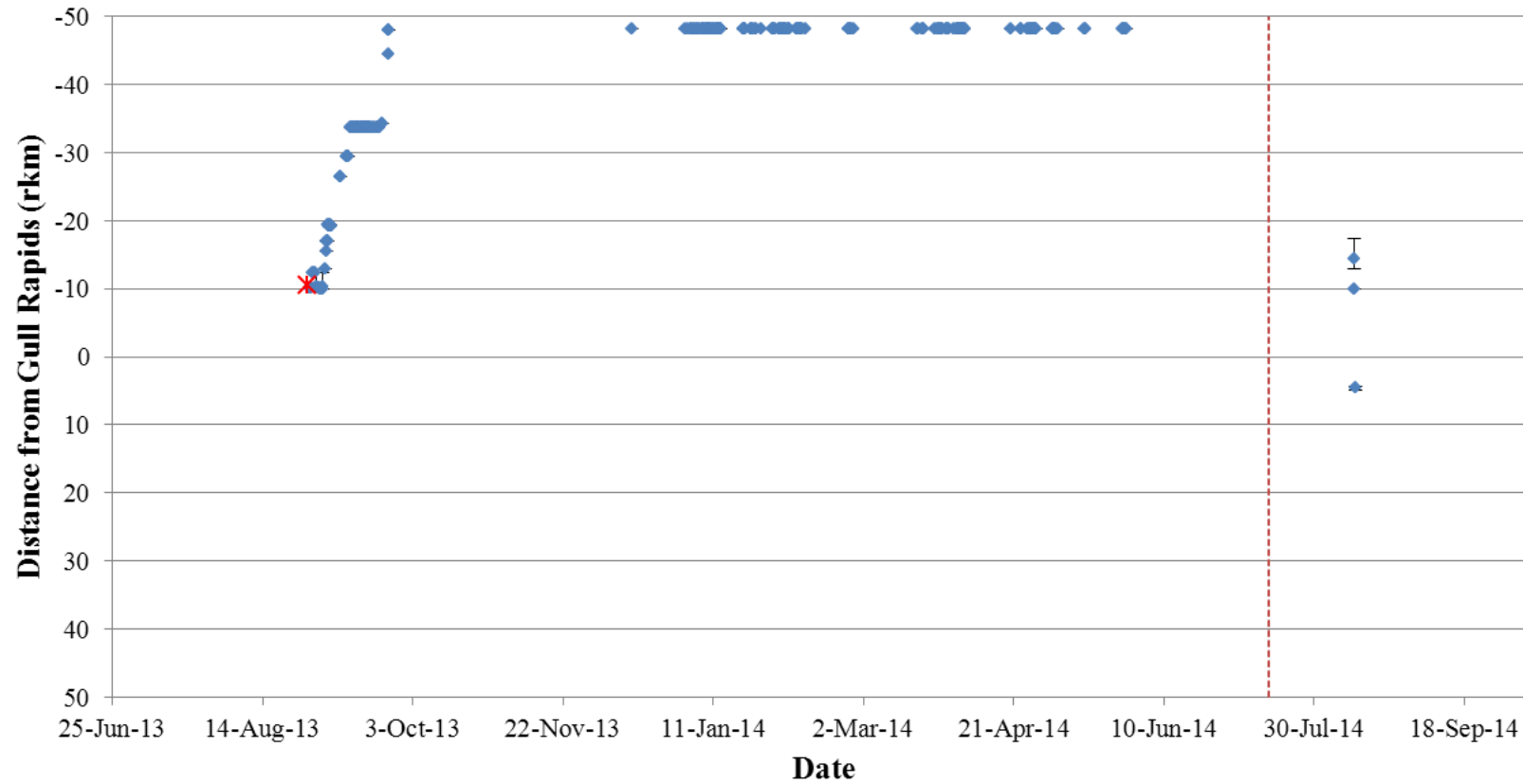


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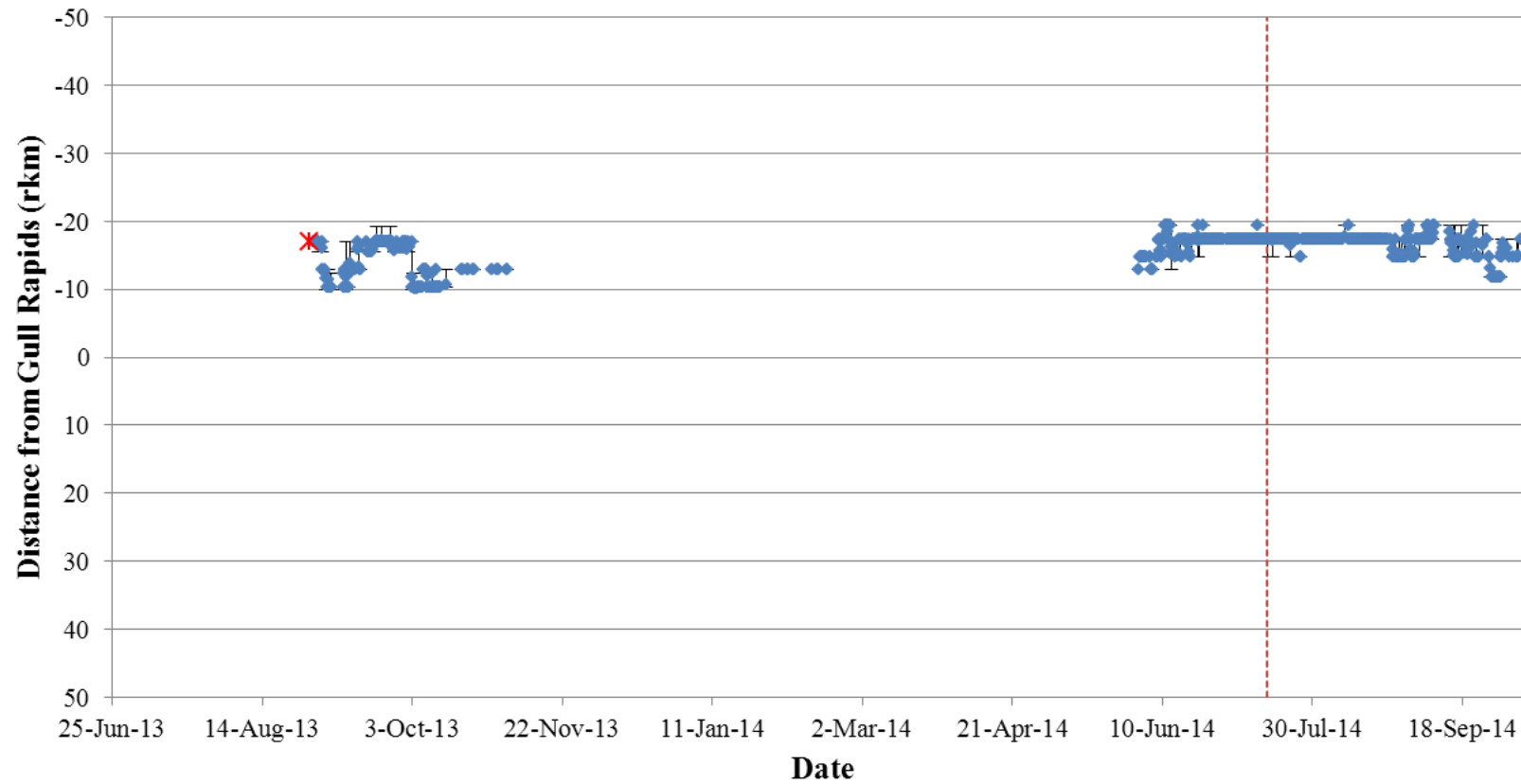


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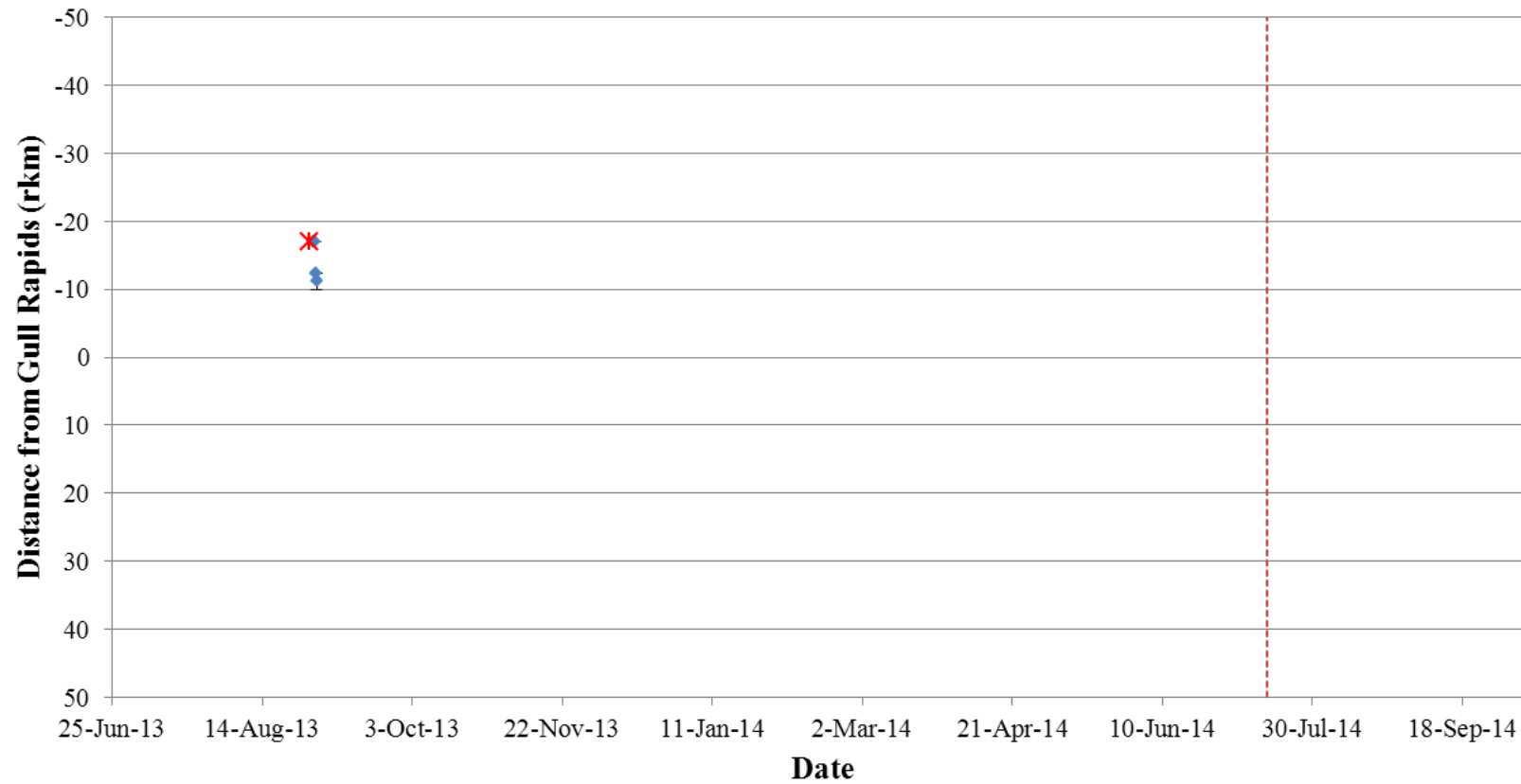


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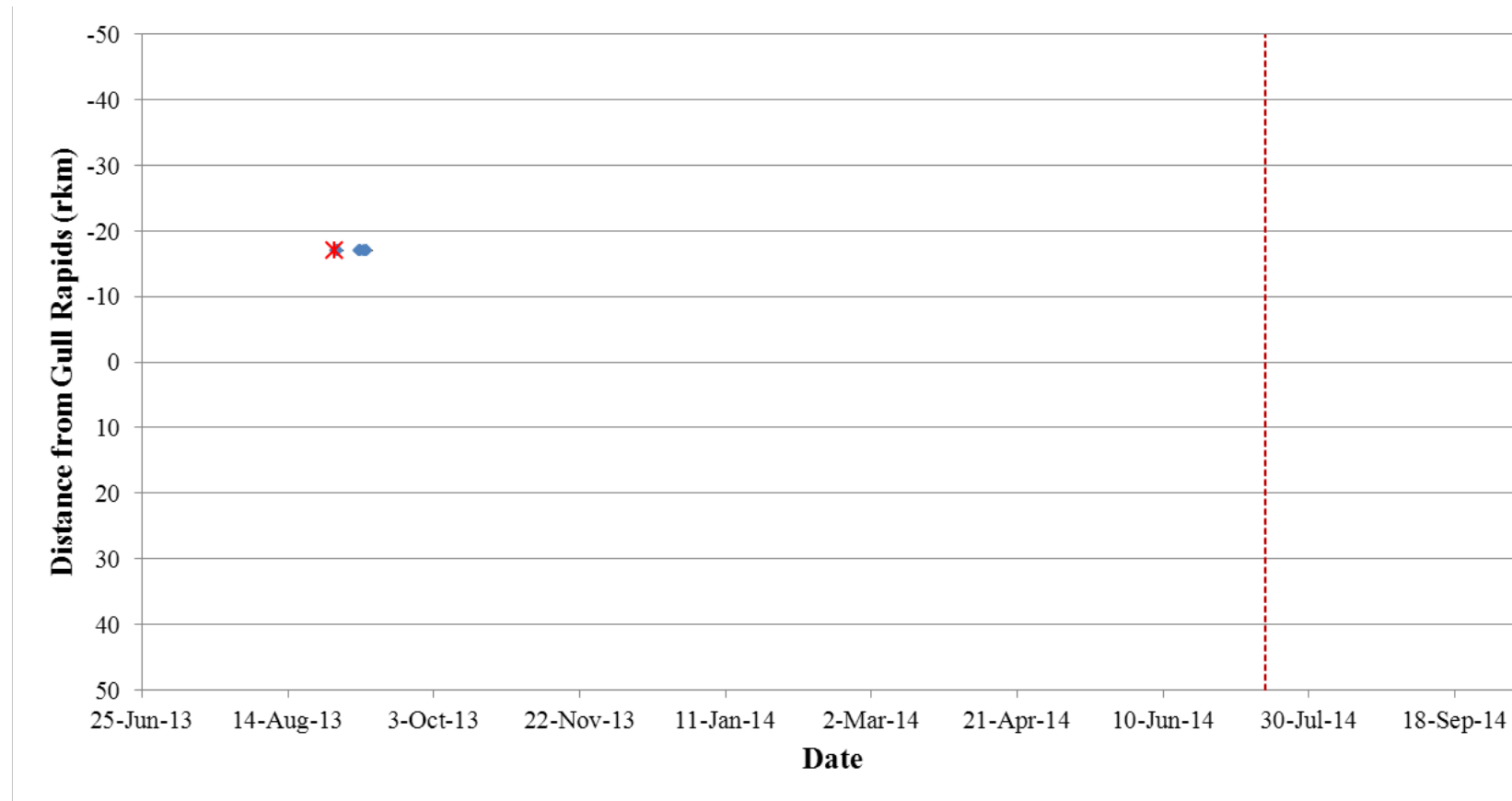


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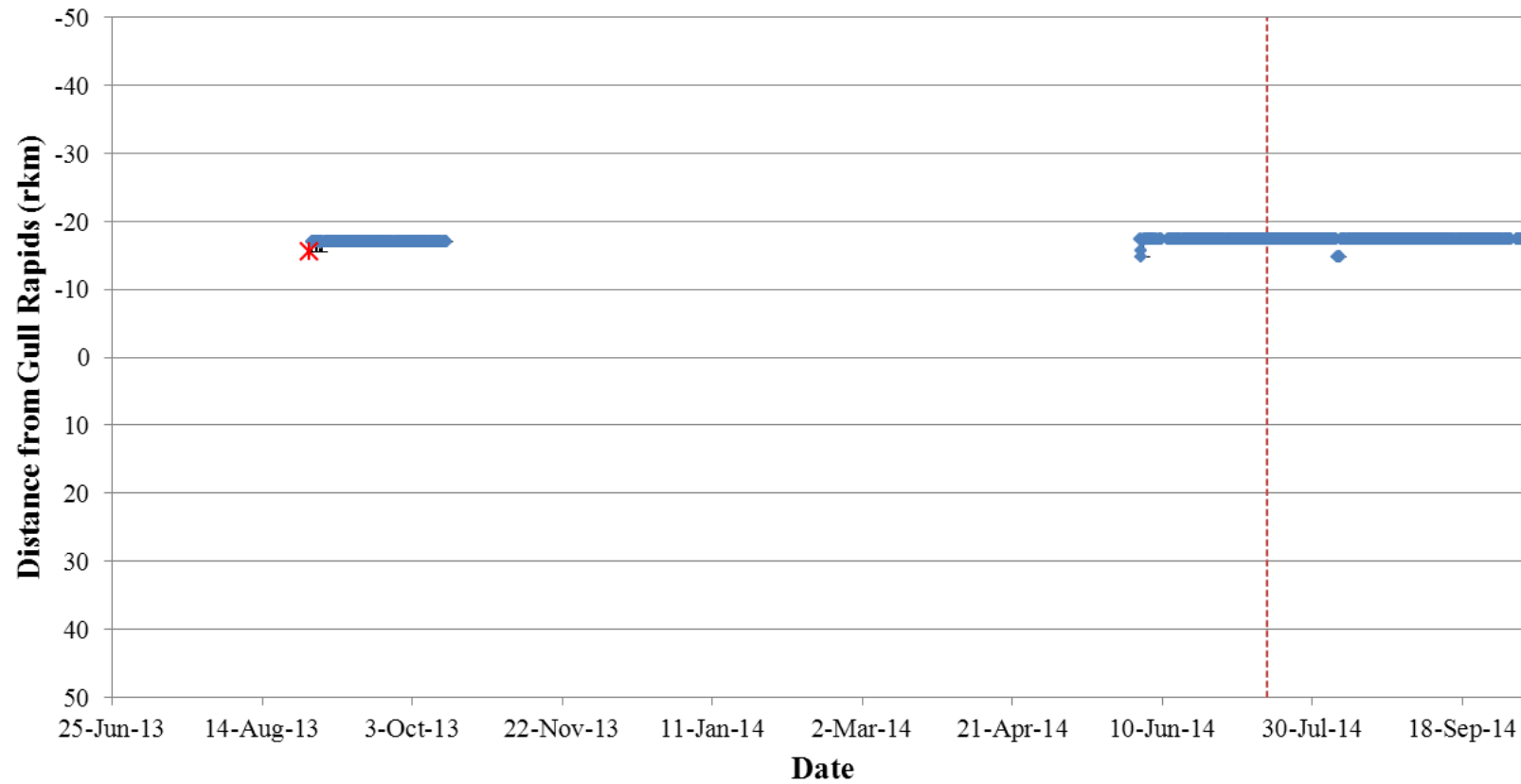


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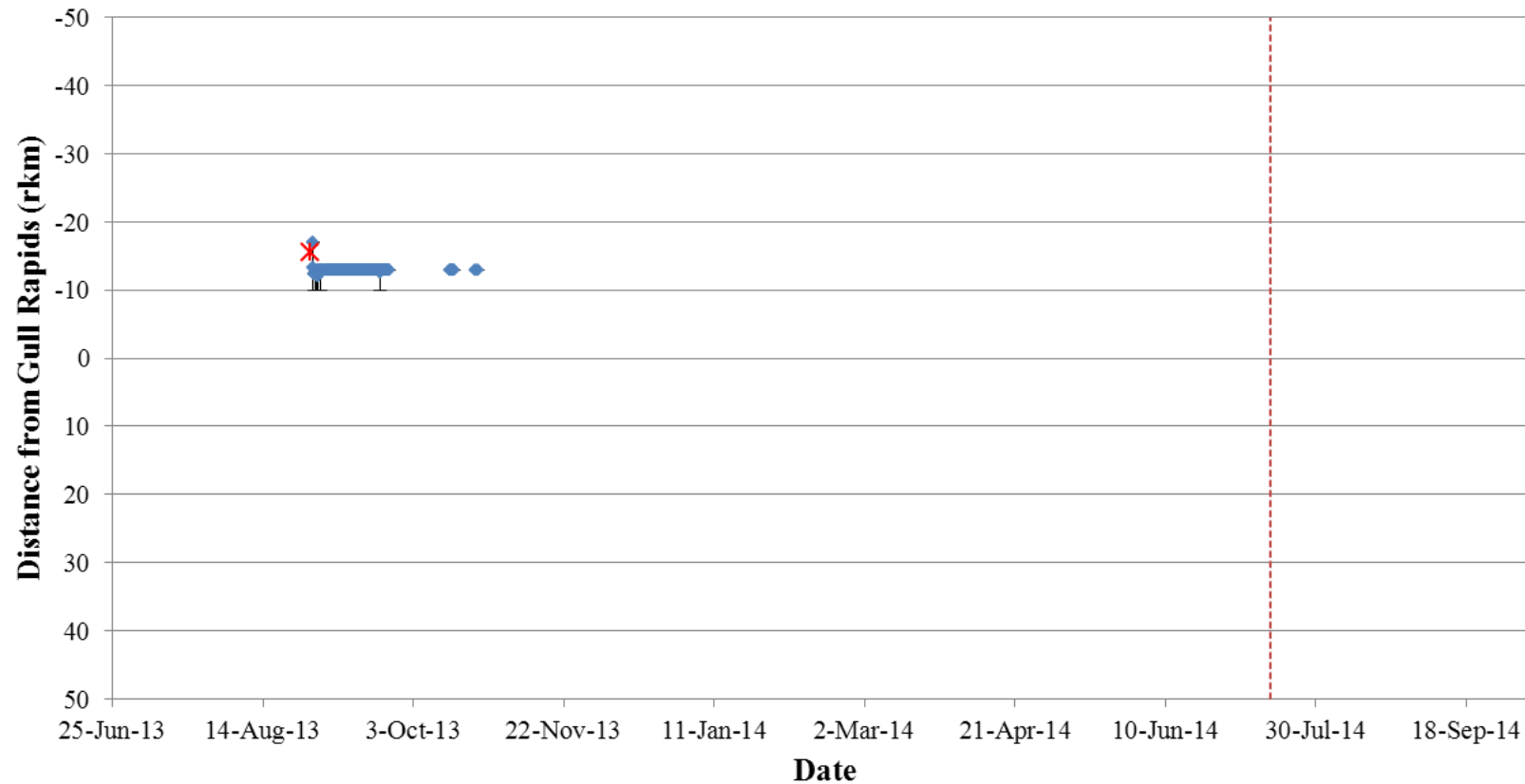
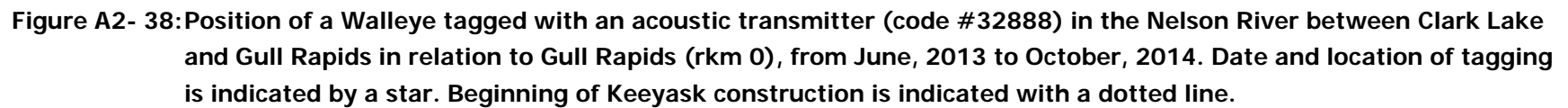
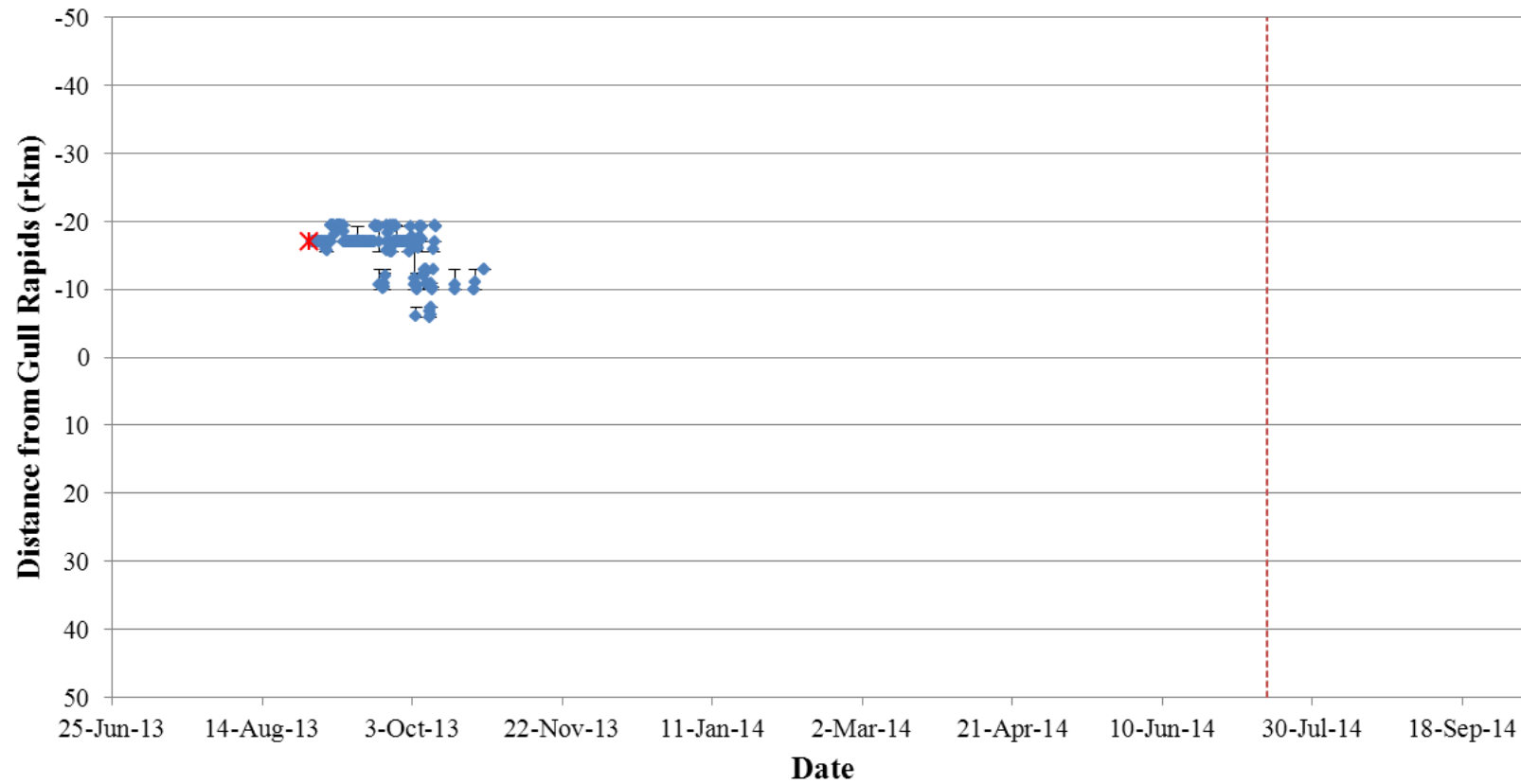


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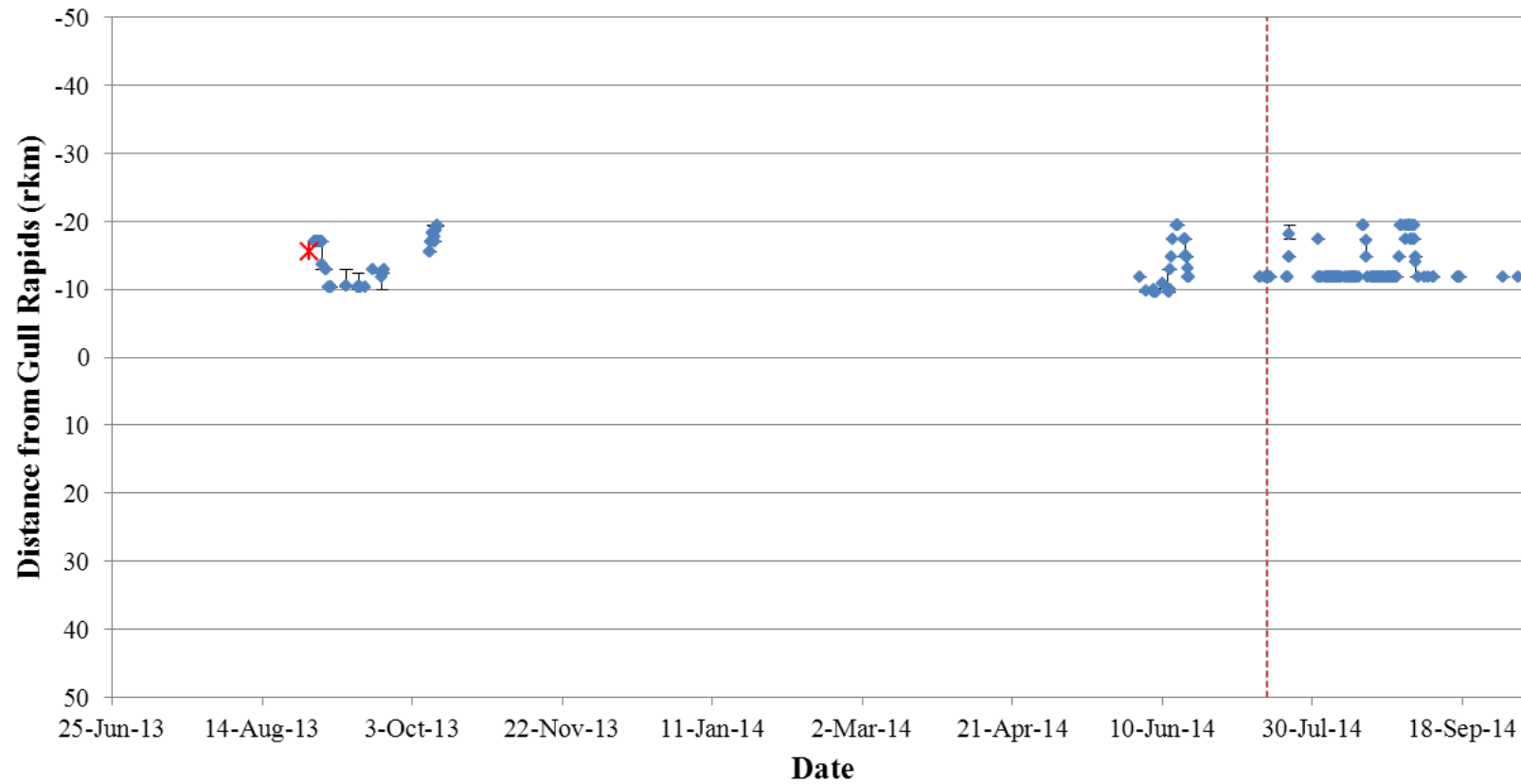


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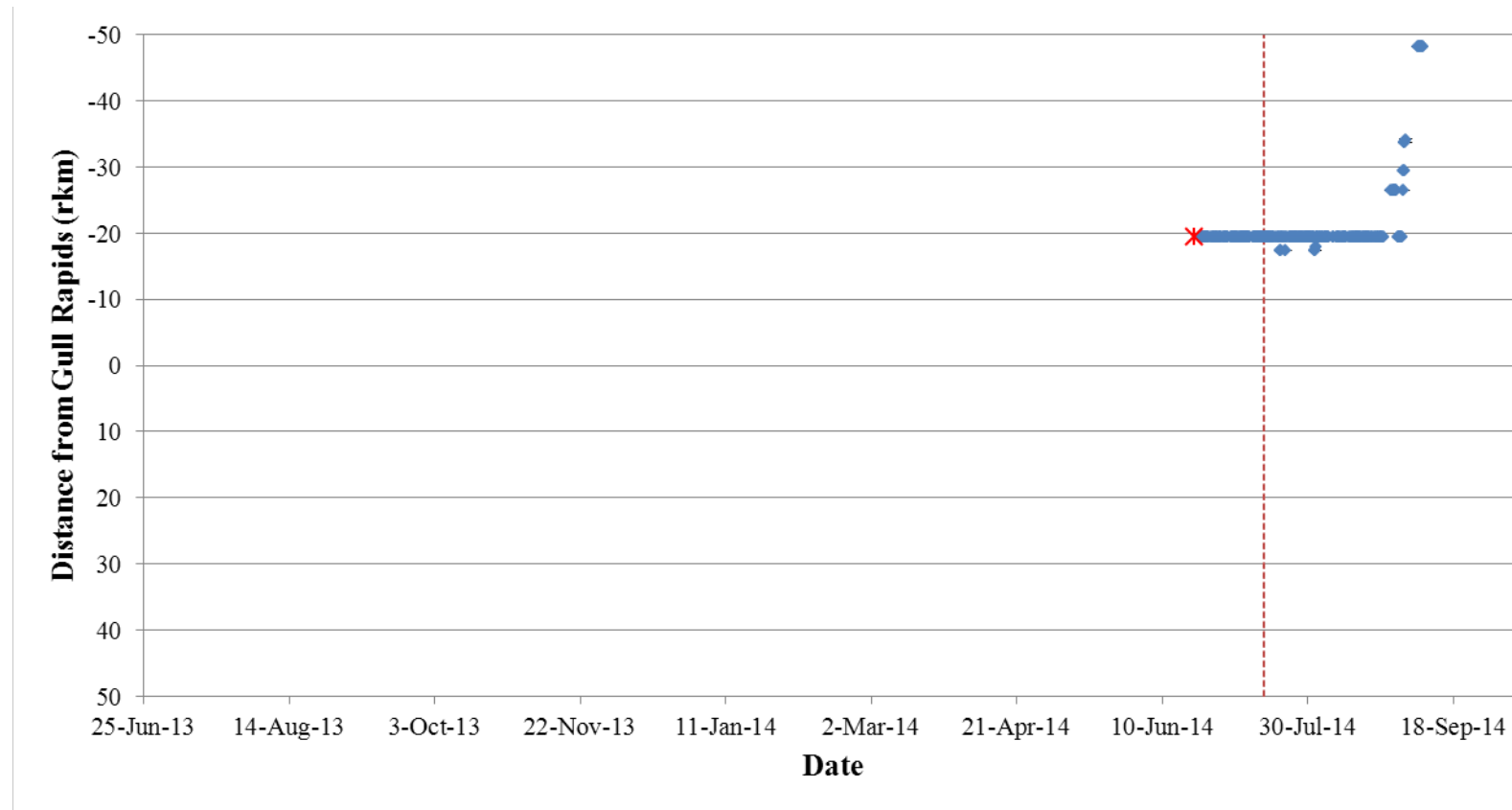


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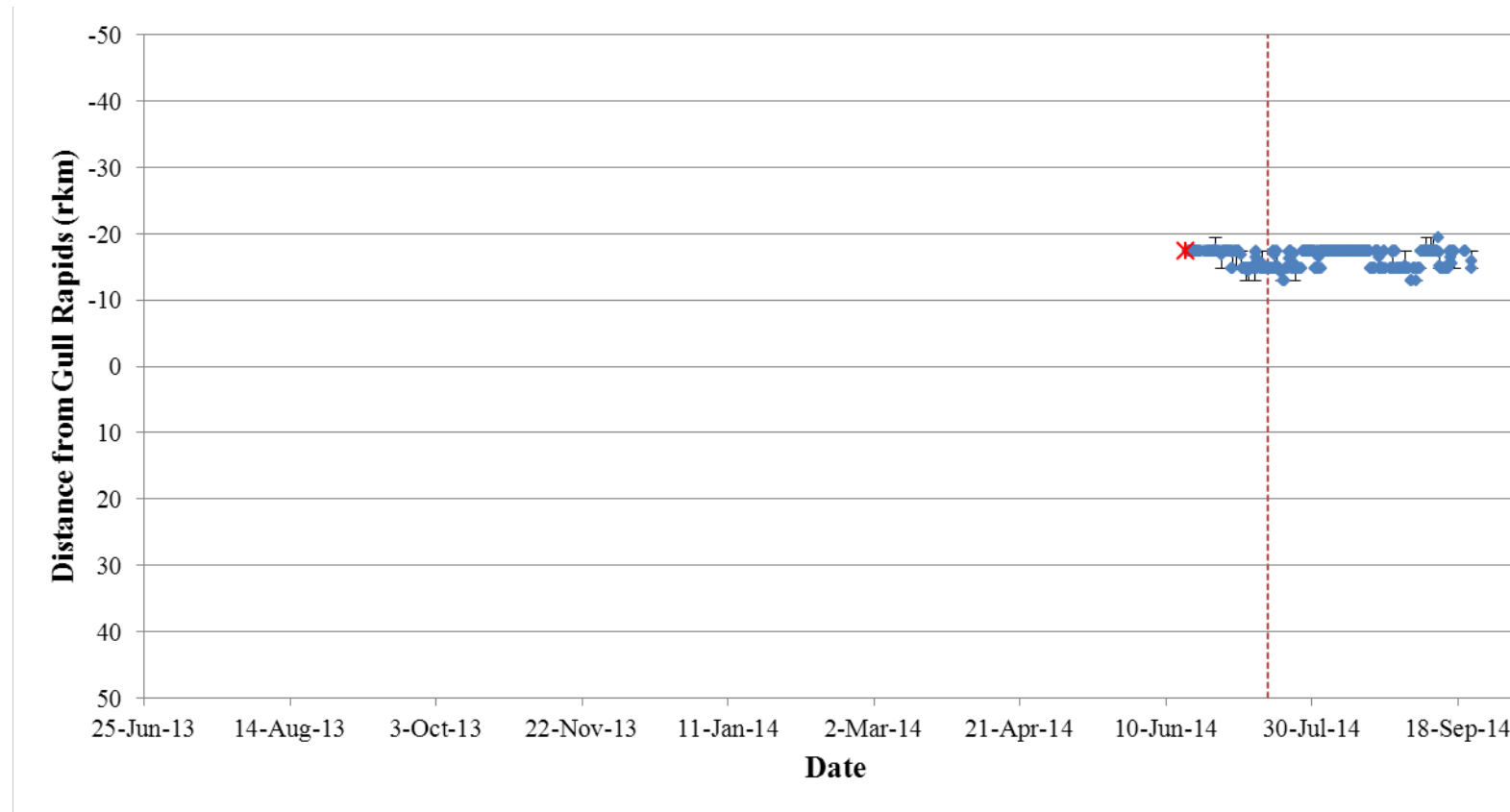


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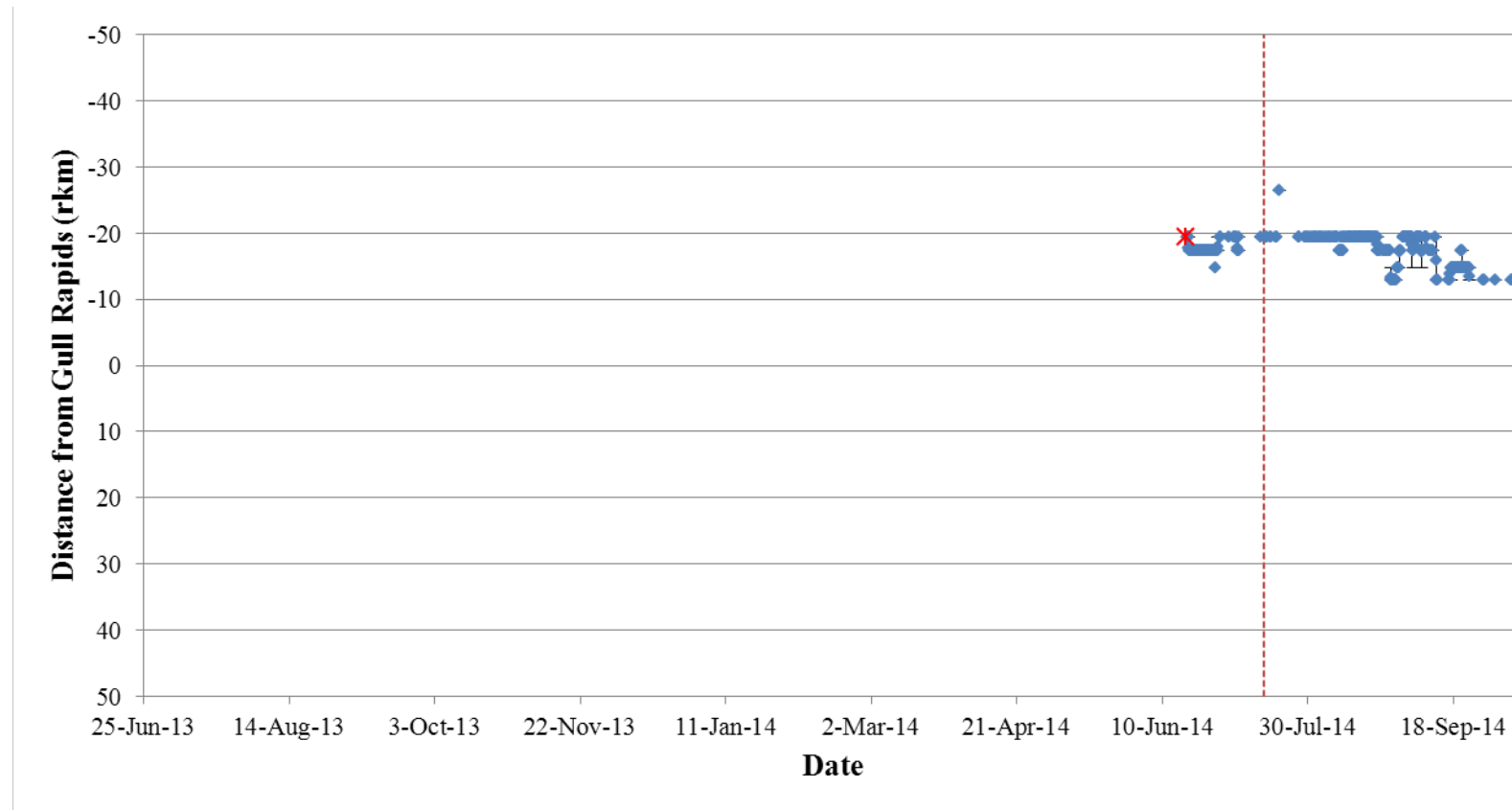


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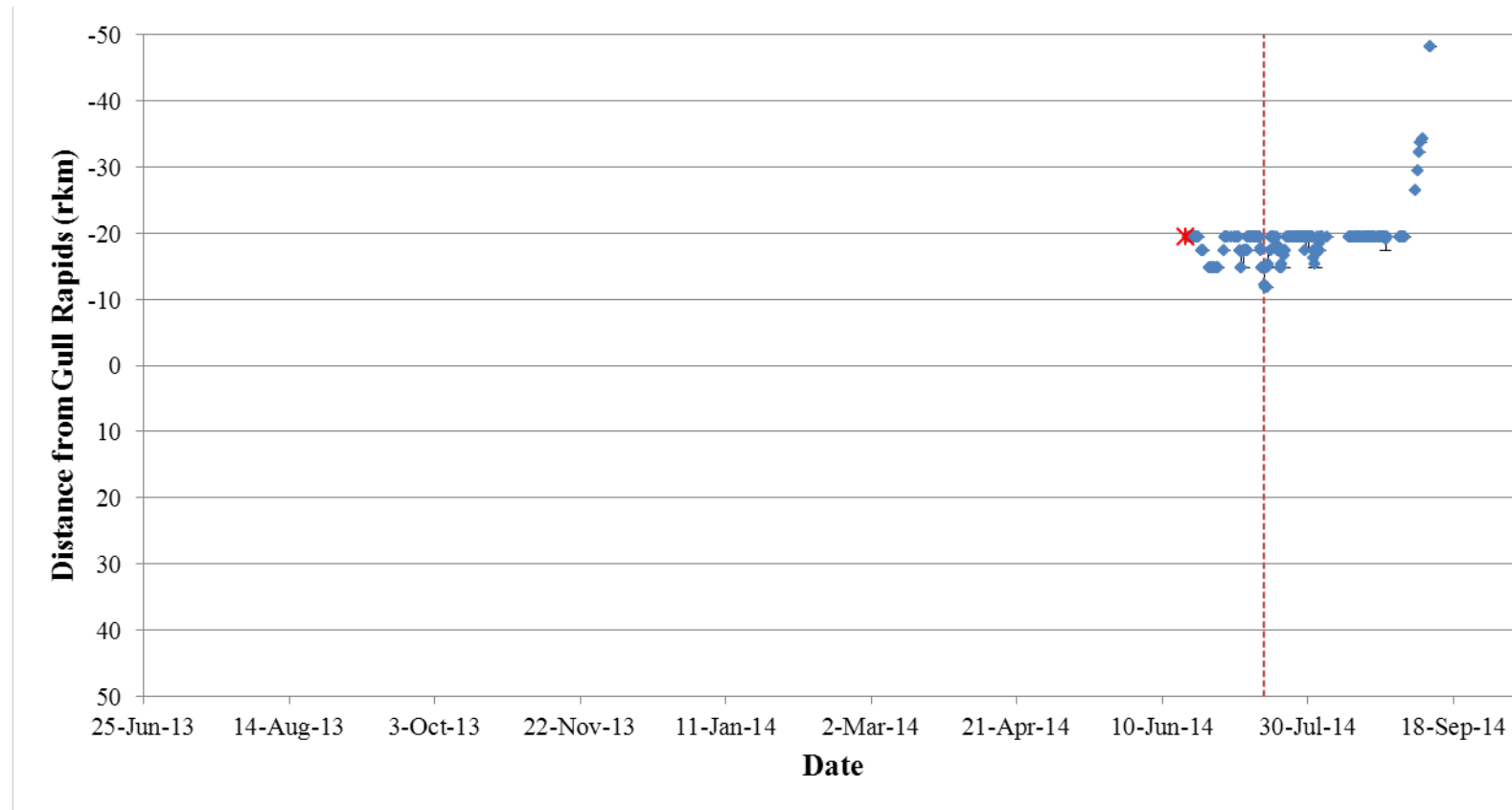


Figure A2- 44: Position of a Walleye tagged with an acoustic transmitter (code #6420) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2014 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

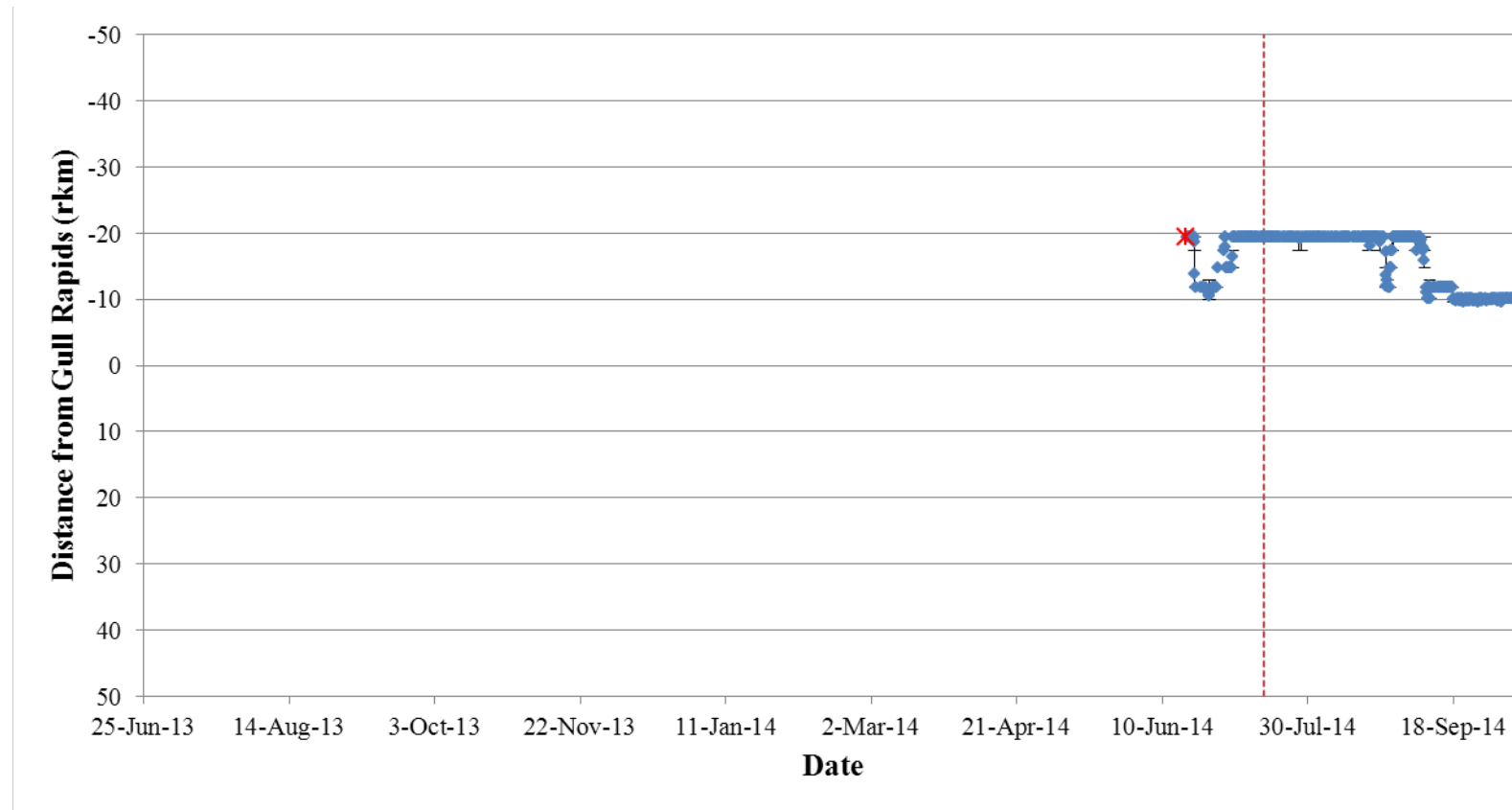


Figure A2- 45: Position of a Walleye tagged with an acoustic transmitter (code #6421) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2014 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

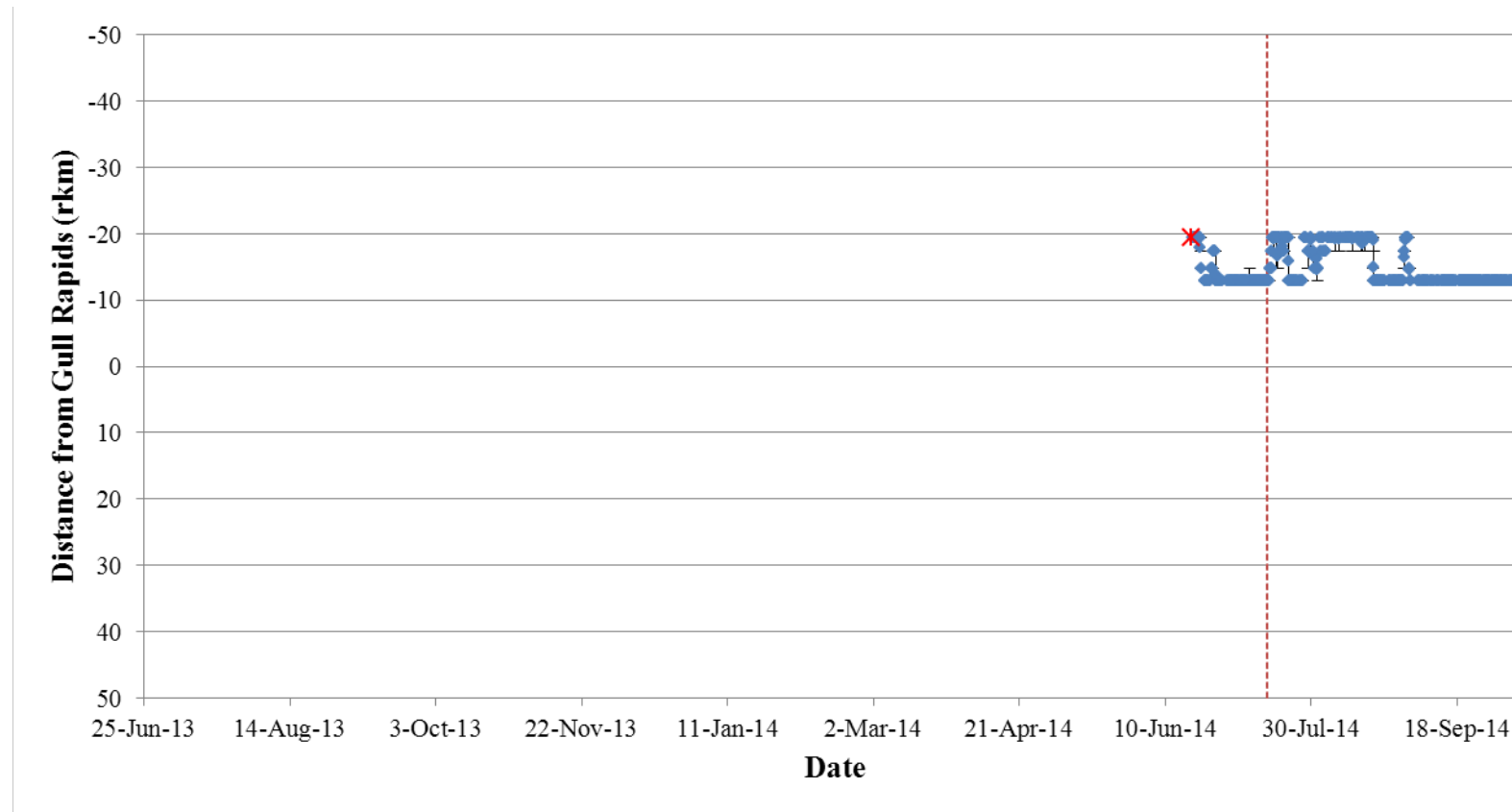


Figure A2- 46: Position of a Walleye tagged with an acoustic transmitter (code #6422) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2014 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

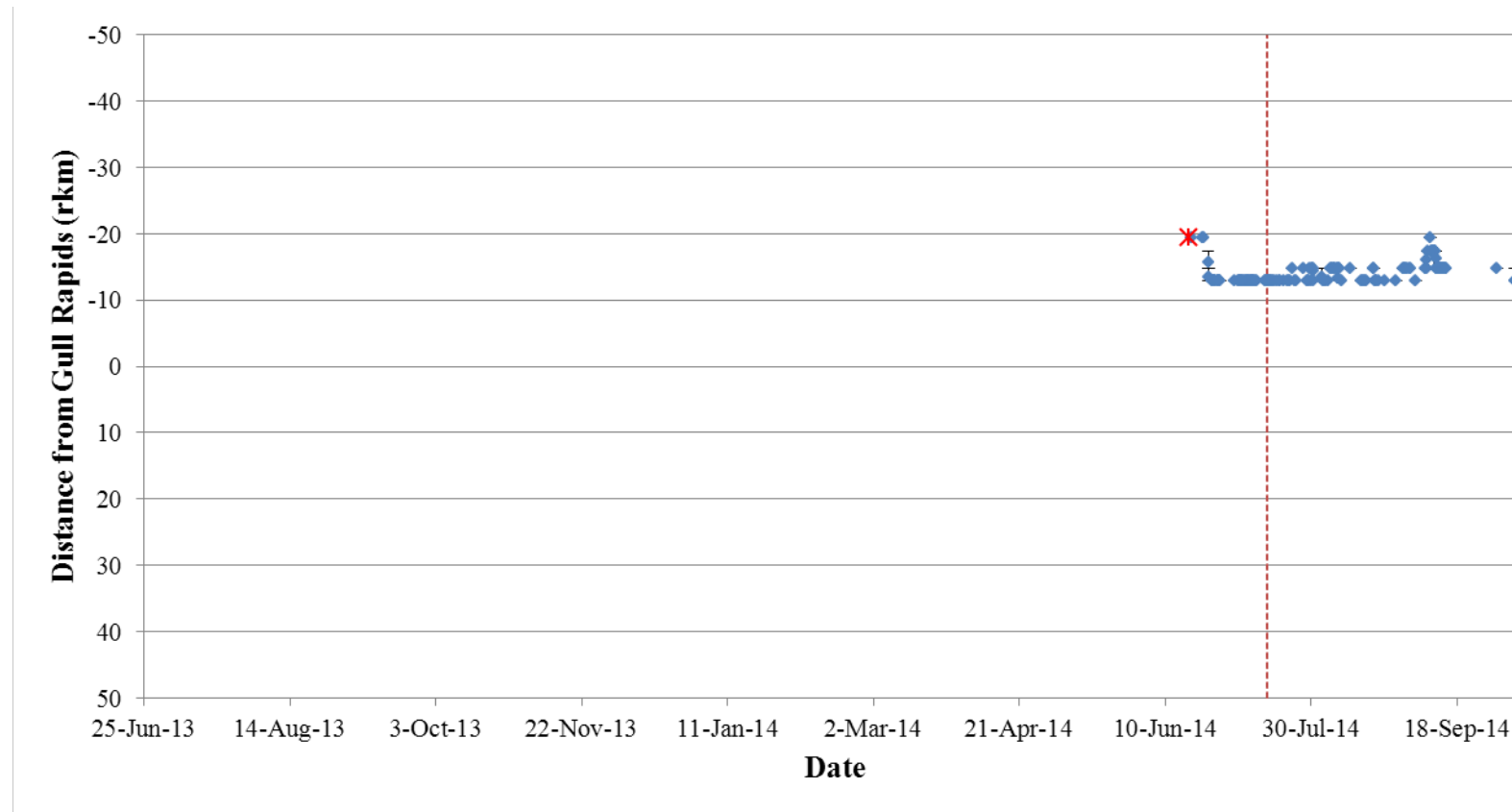


Figure A2- 47: Position of a Walleye tagged with an acoustic transmitter (code #6423) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2014 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

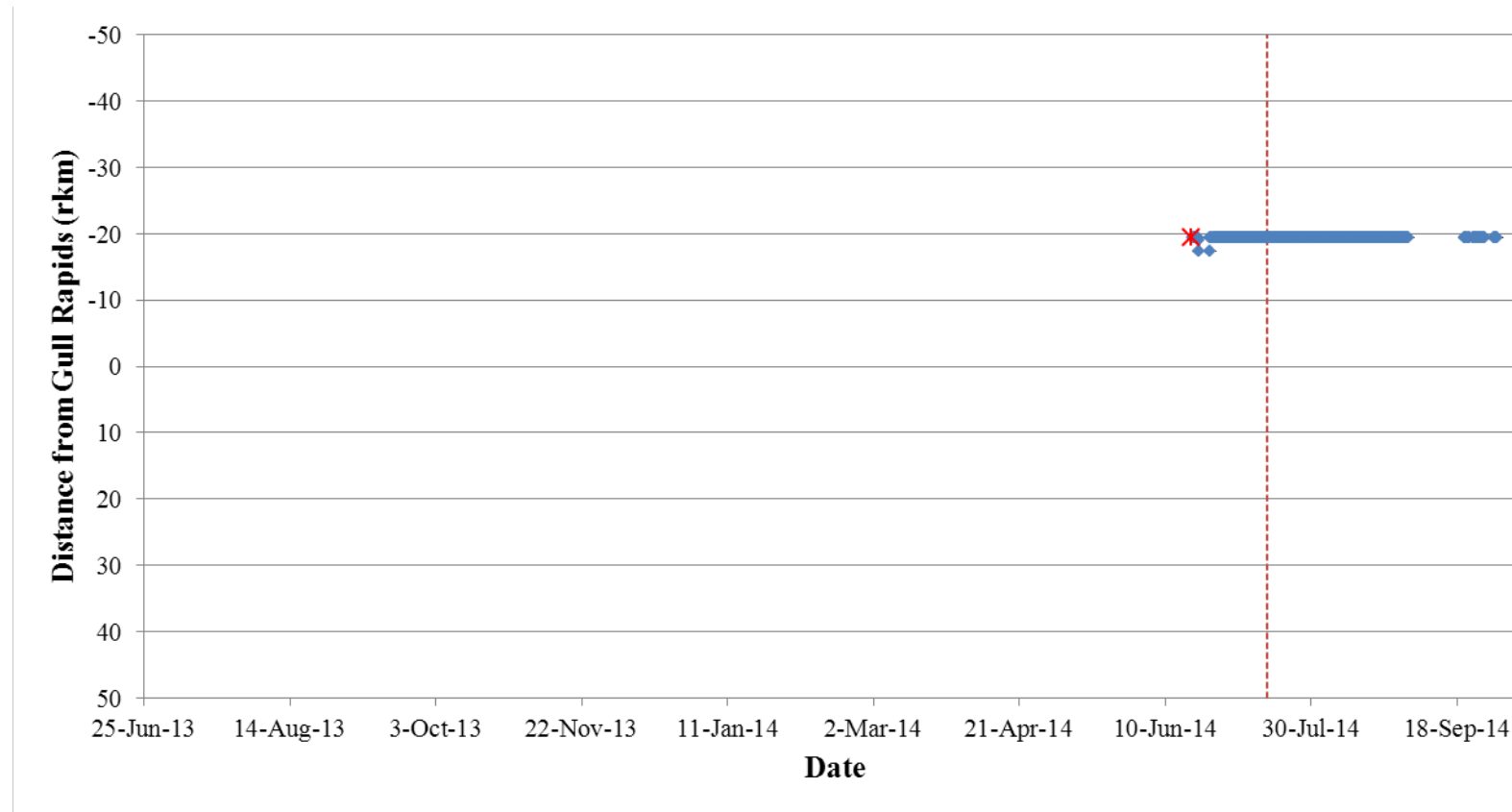


Figure A2- 48: Position of a Walleye tagged with an acoustic transmitter (code #6425) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2014 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

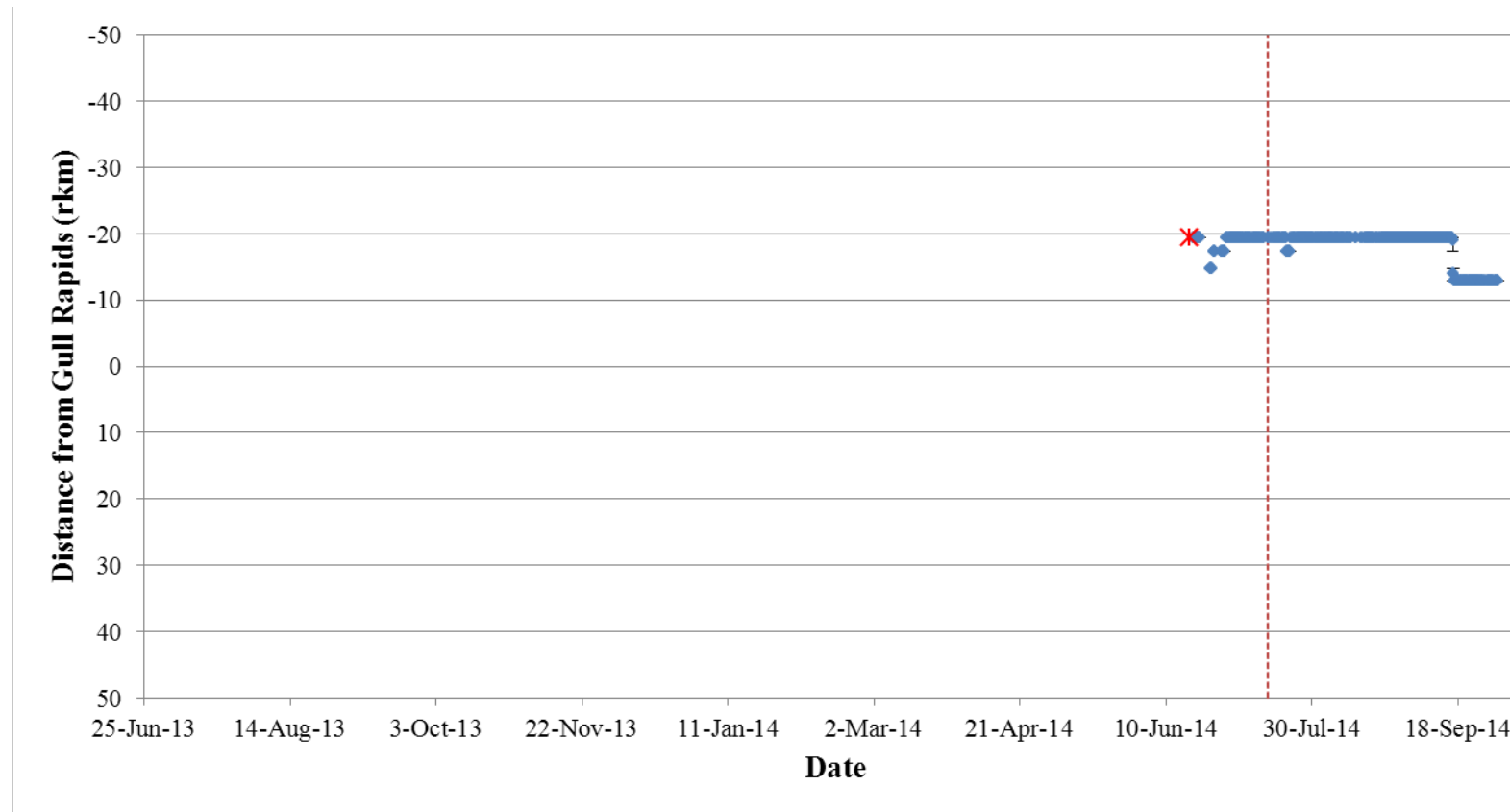


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LOCATION SUMMARY FOR INDIVIDUAL ACOUSTIC TAGGED WALLEYE IN STEPHENS LAKE, JUNE 2013 TO OCTOBER 2014

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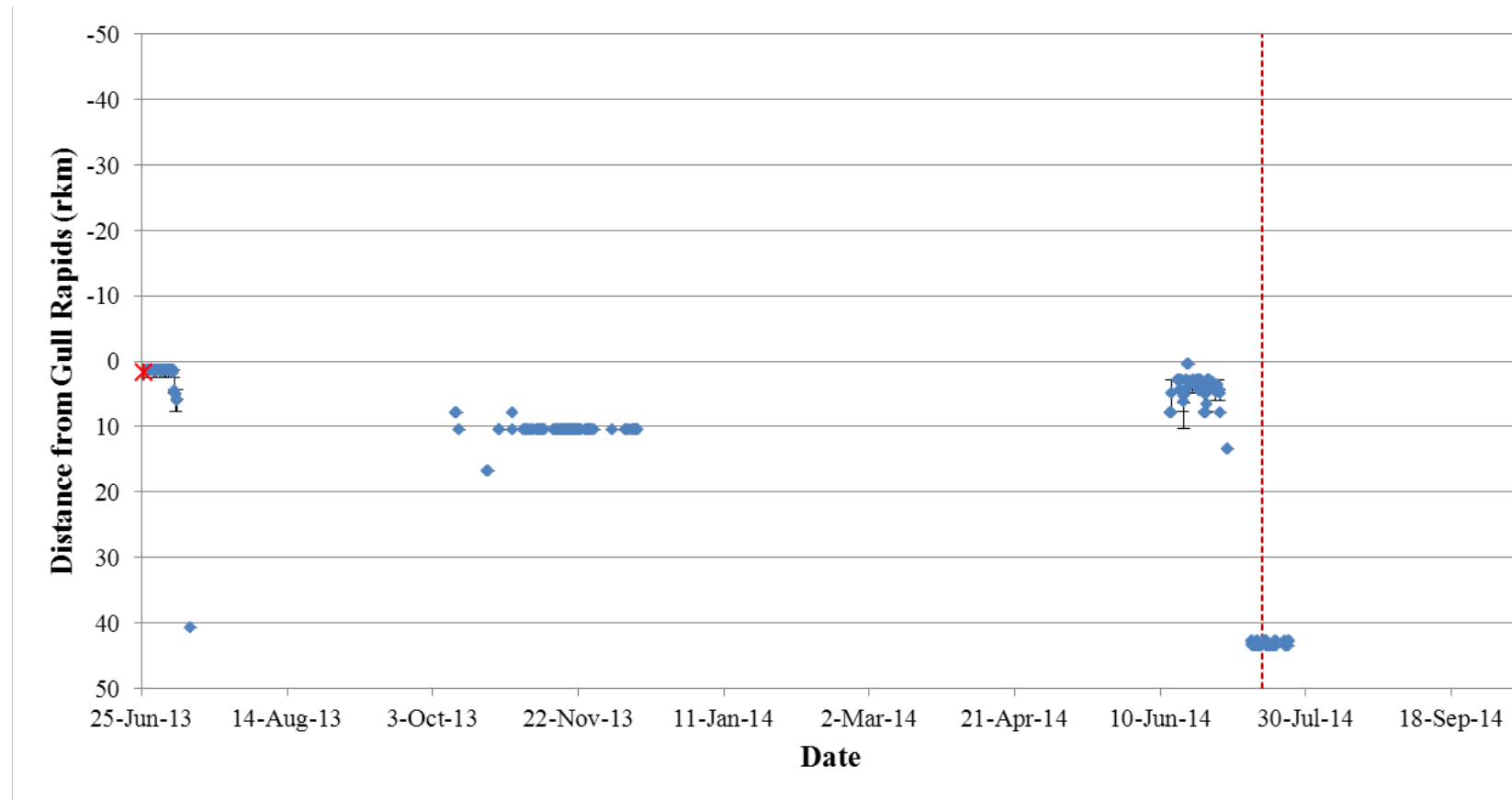
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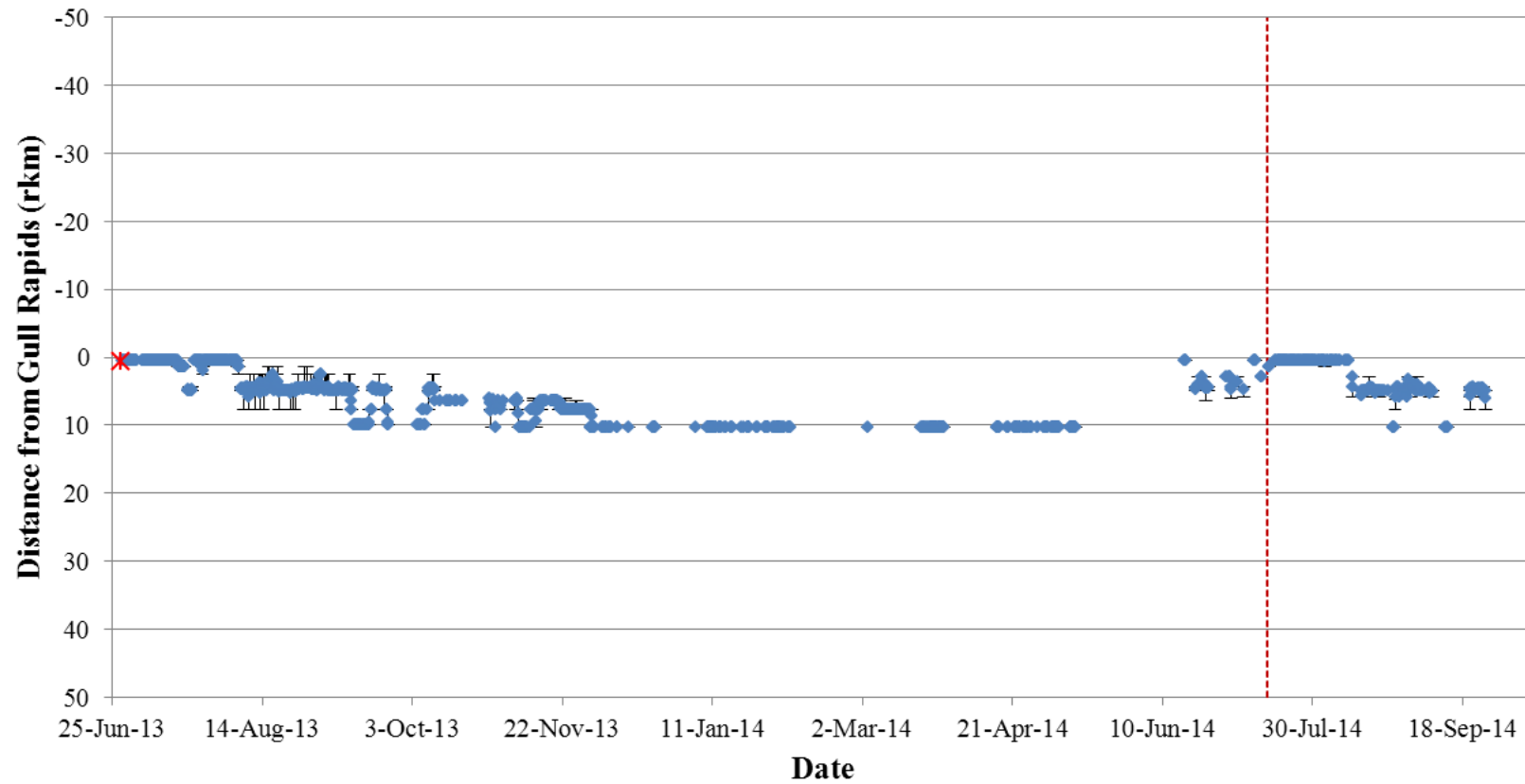
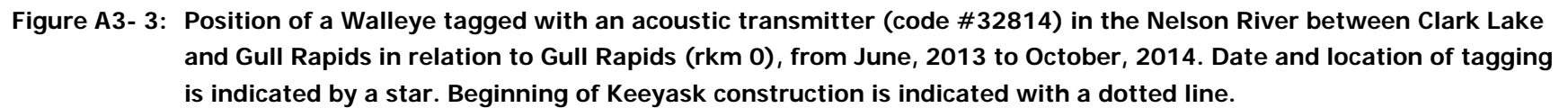
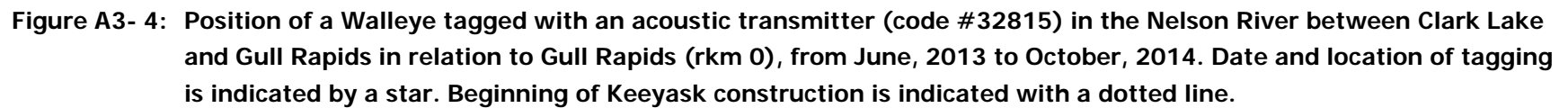


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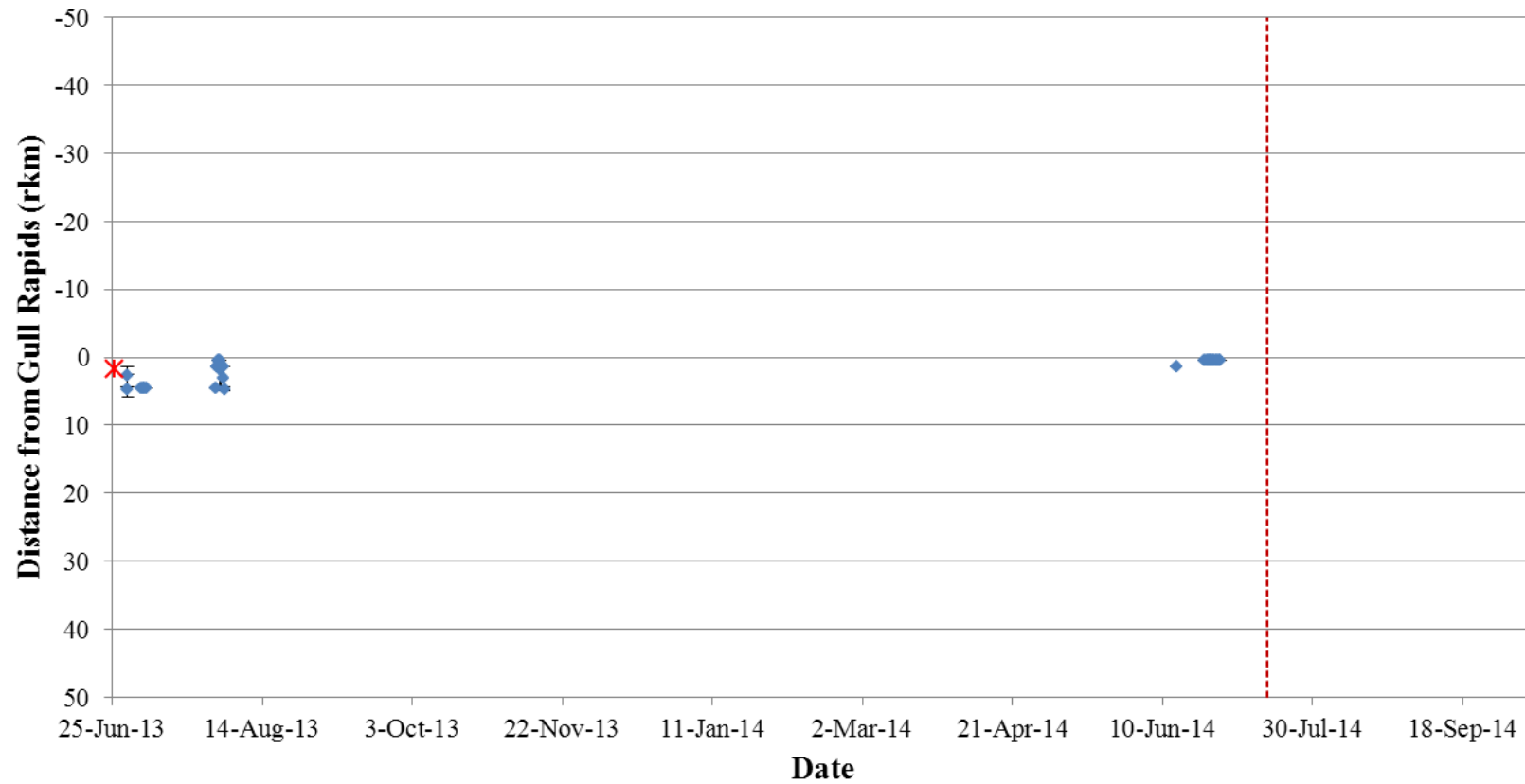


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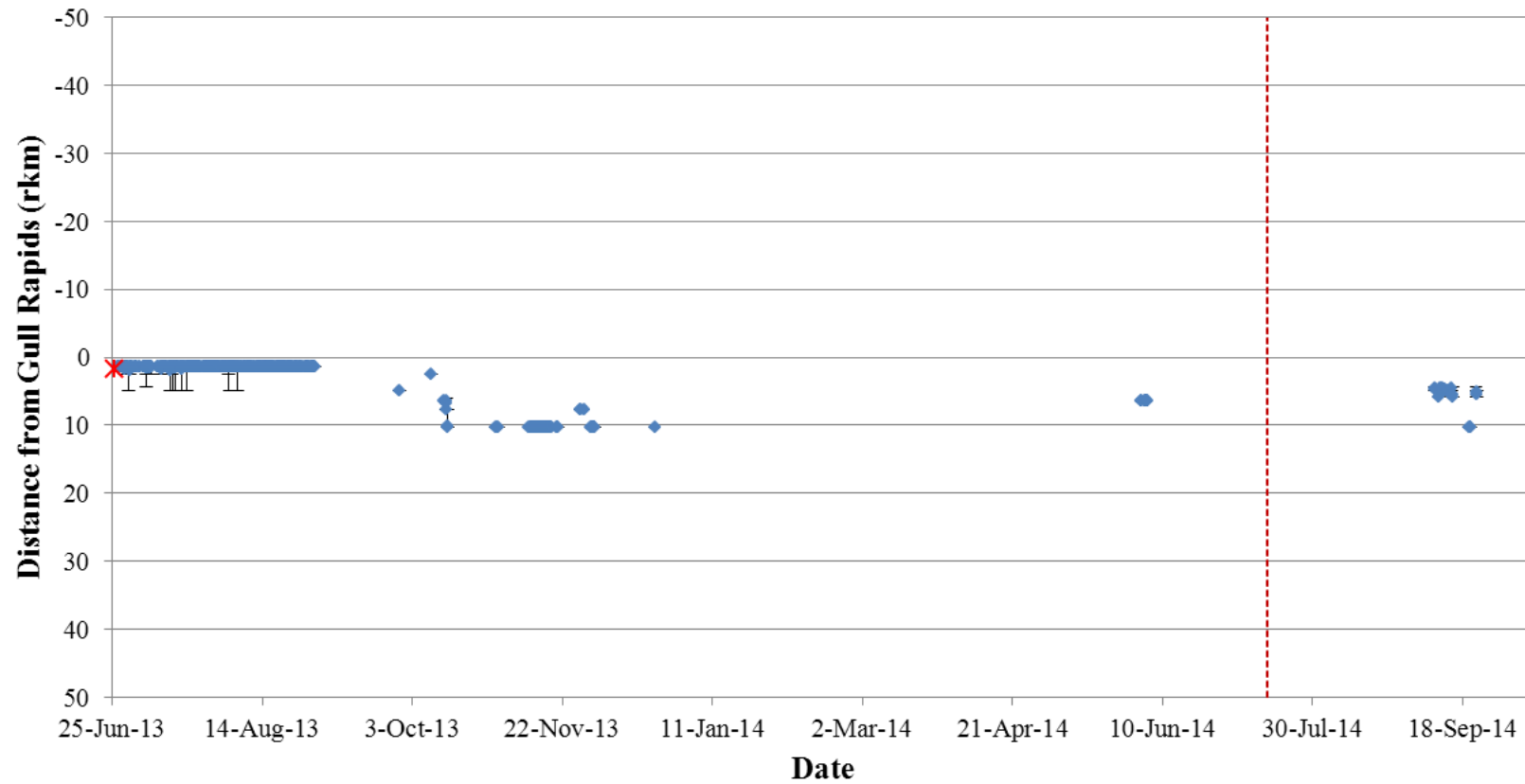
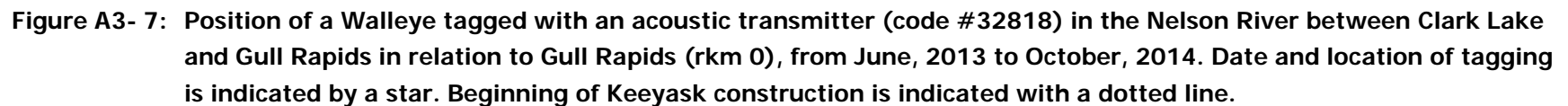


Figure A3- 6: Position of a Walleye tagged with an acoustic transmitter (code #32817) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.



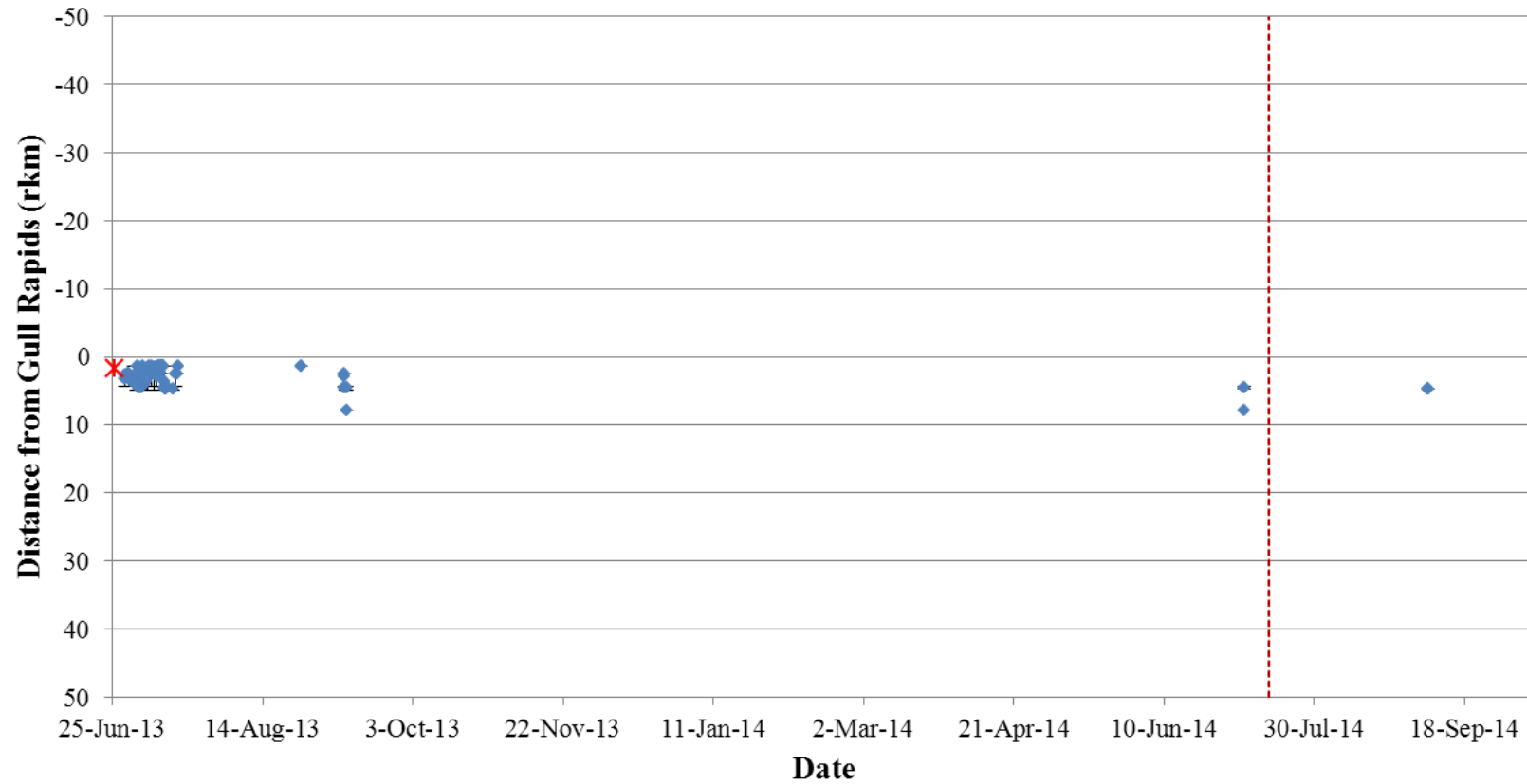


Figure A3- 8: Position of a Walleye tagged with an acoustic transmitter (code #32819) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

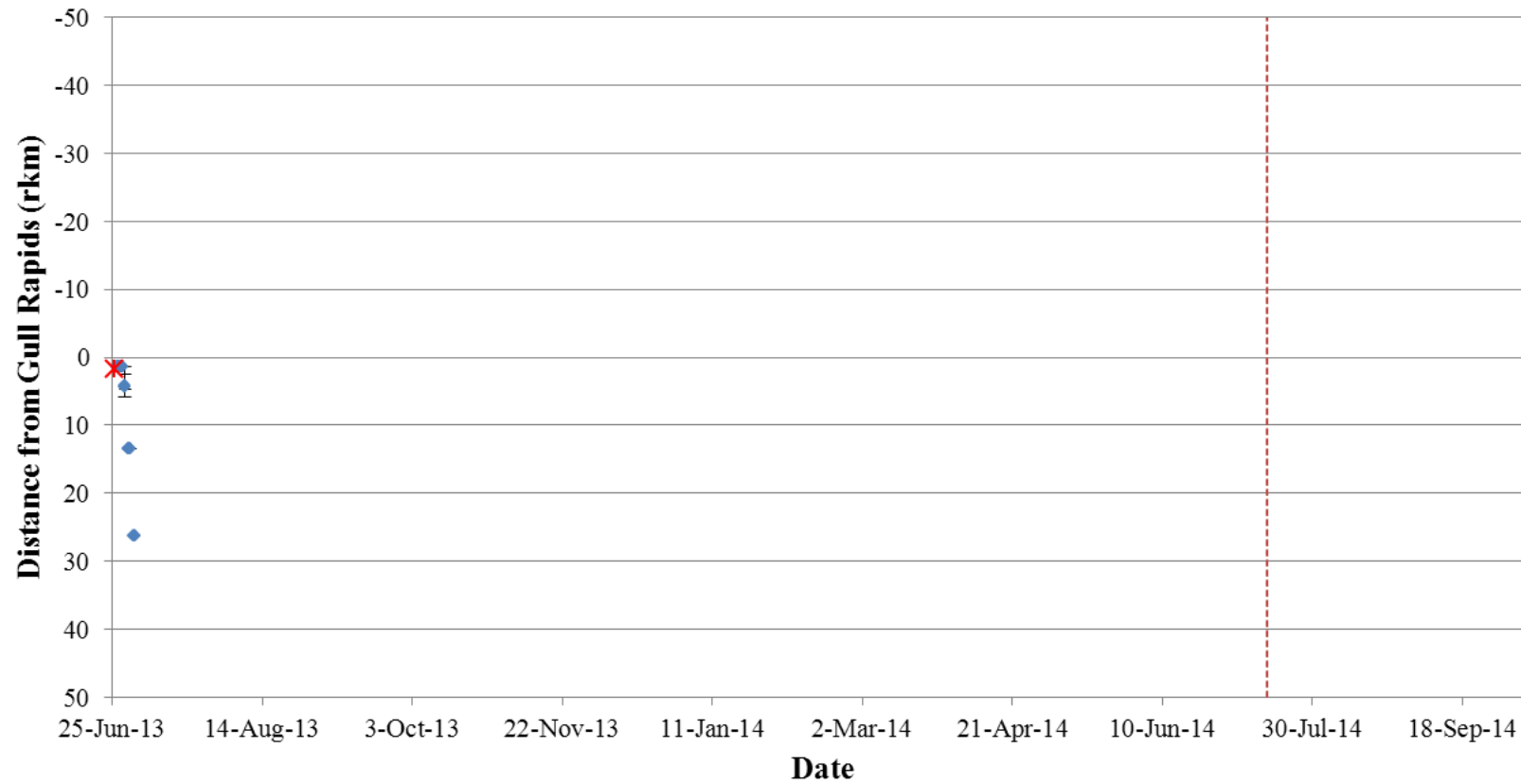
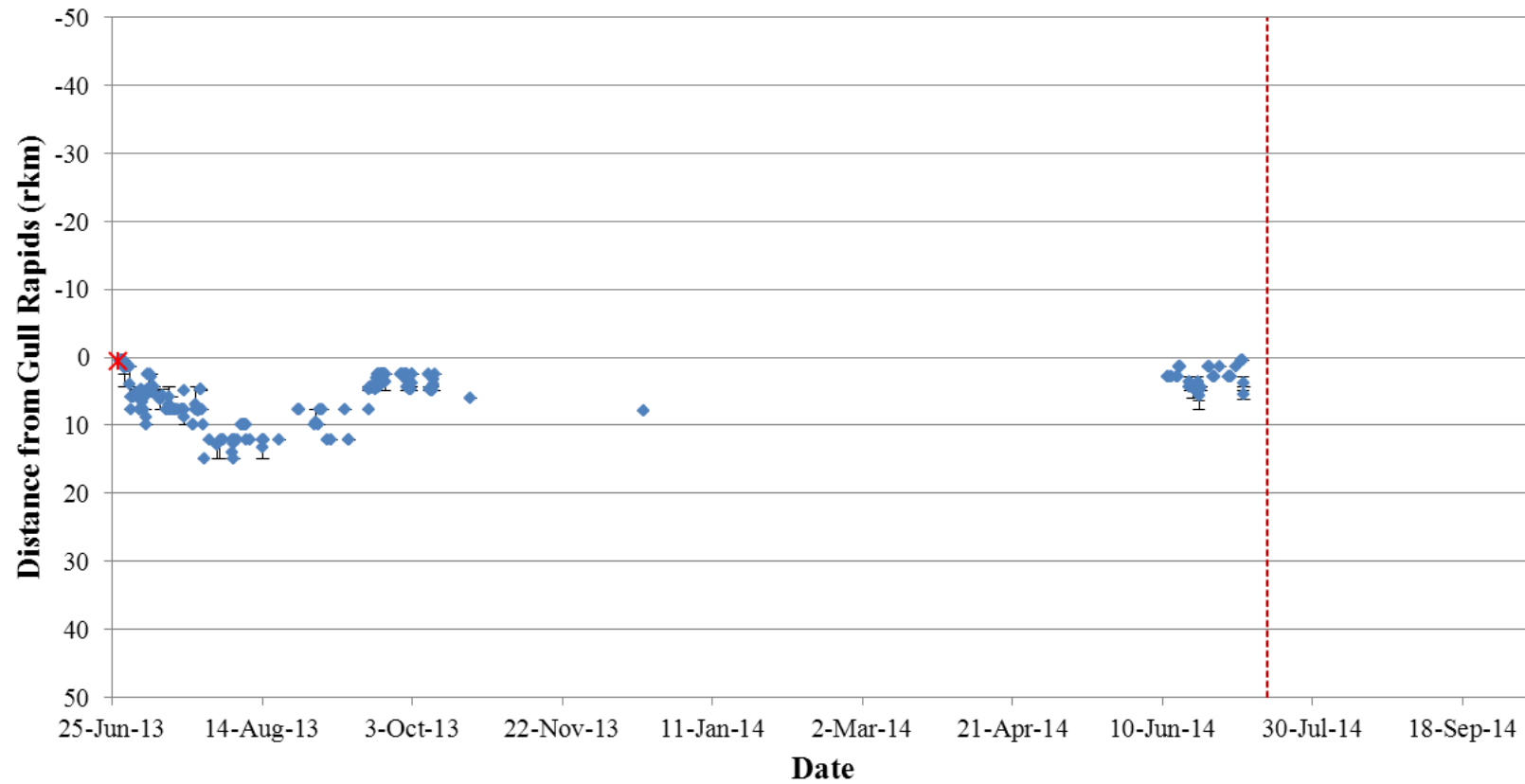


Figure A3- 9: Position of a Walleye tagged with an acoustic transmitter (code #32820) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.



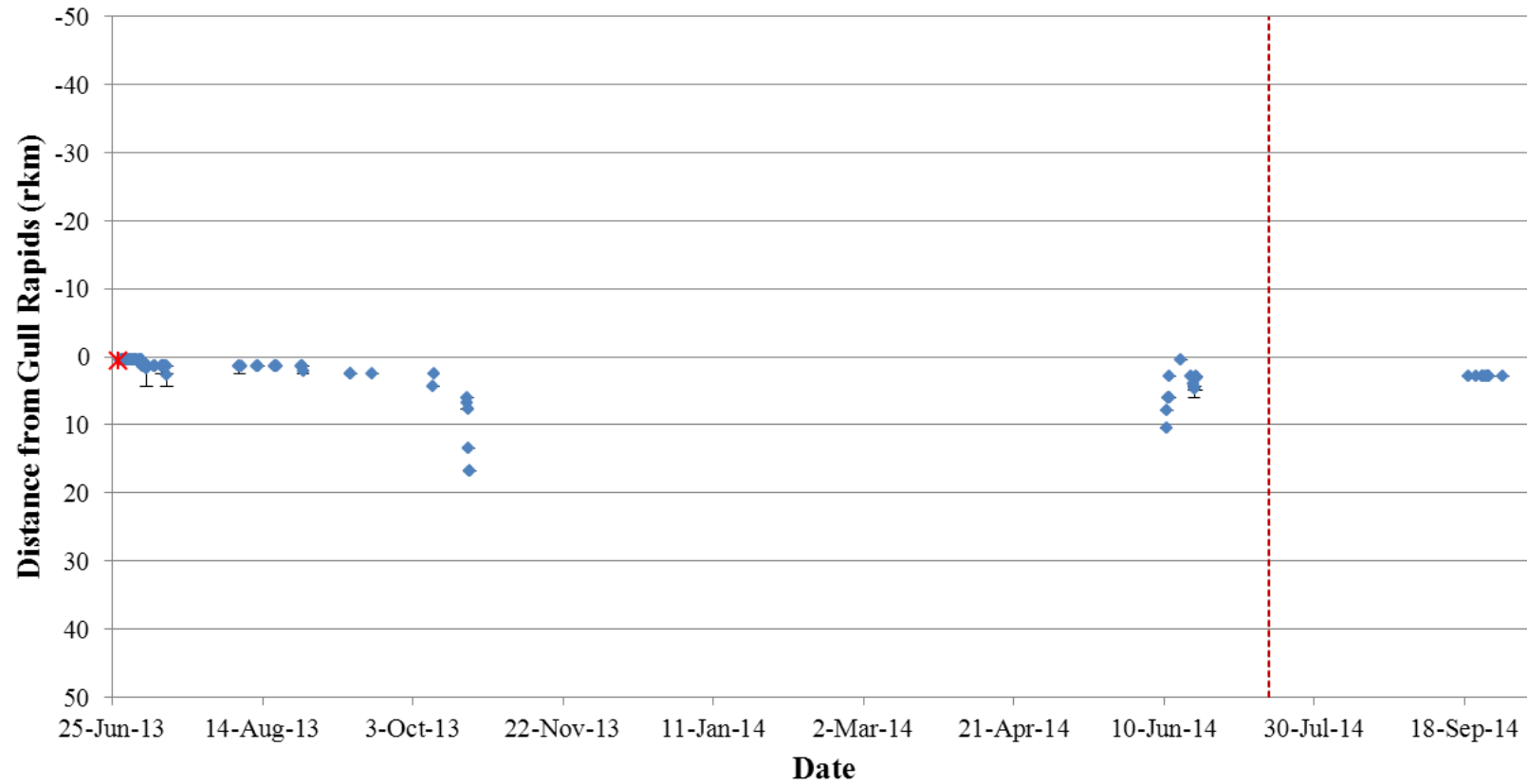


Figure A3- 11: Position of a Walleye tagged with an acoustic transmitter (code #32822) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

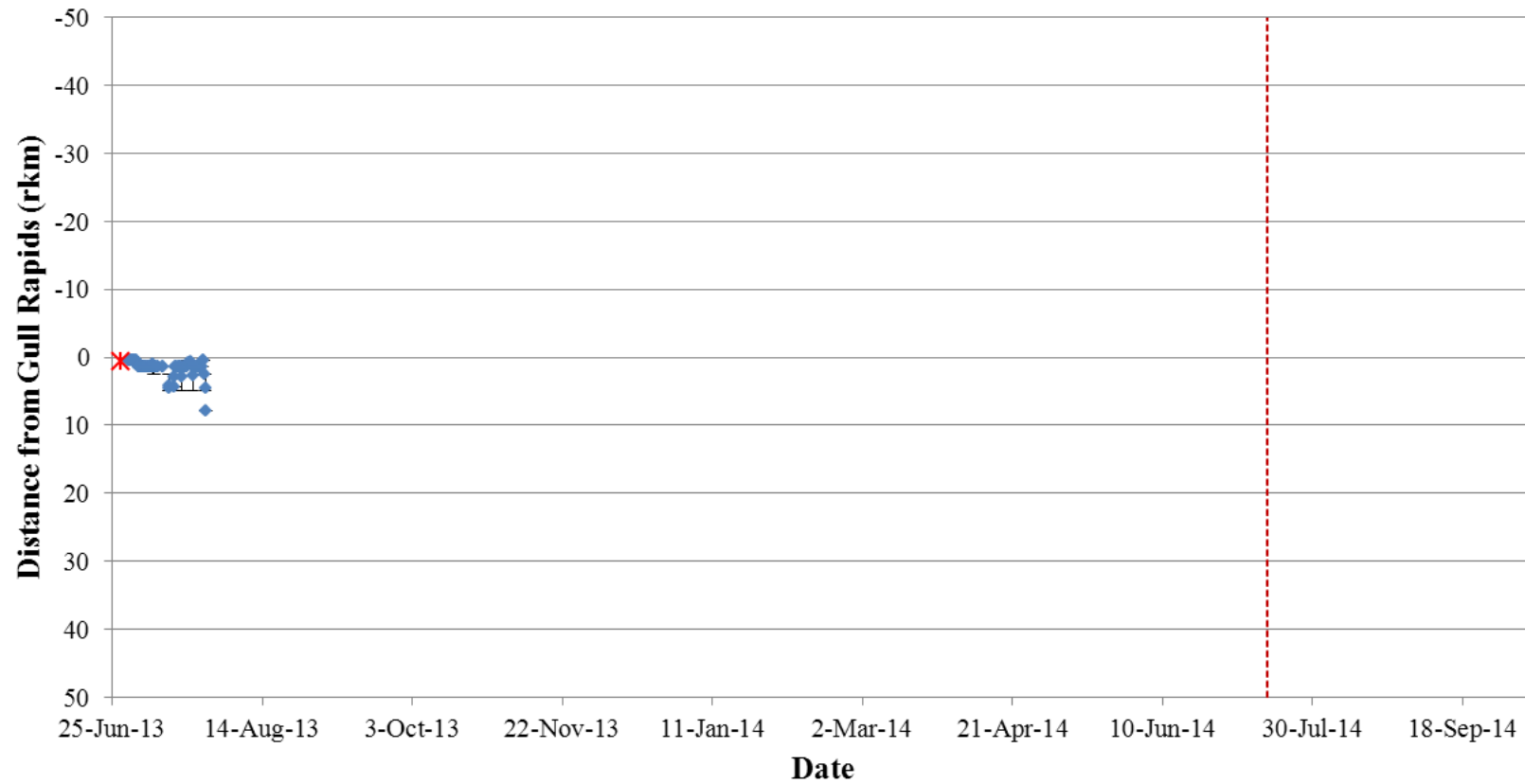


Figure A3- 12: Position of a Walleye tagged with an acoustic transmitter (code #32823) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

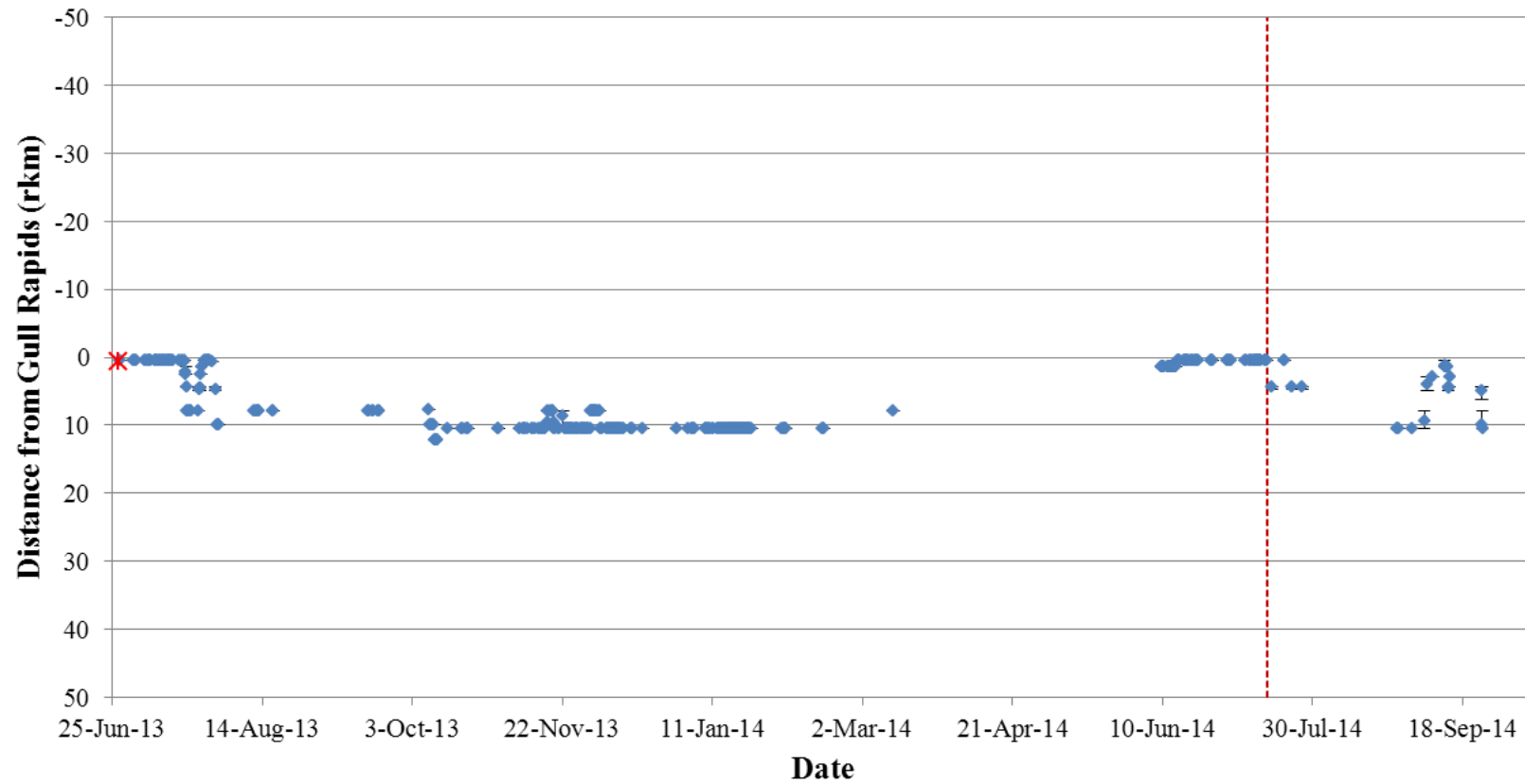


Figure A3- 13: Position of a Walleye tagged with an acoustic transmitter (code #32824) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

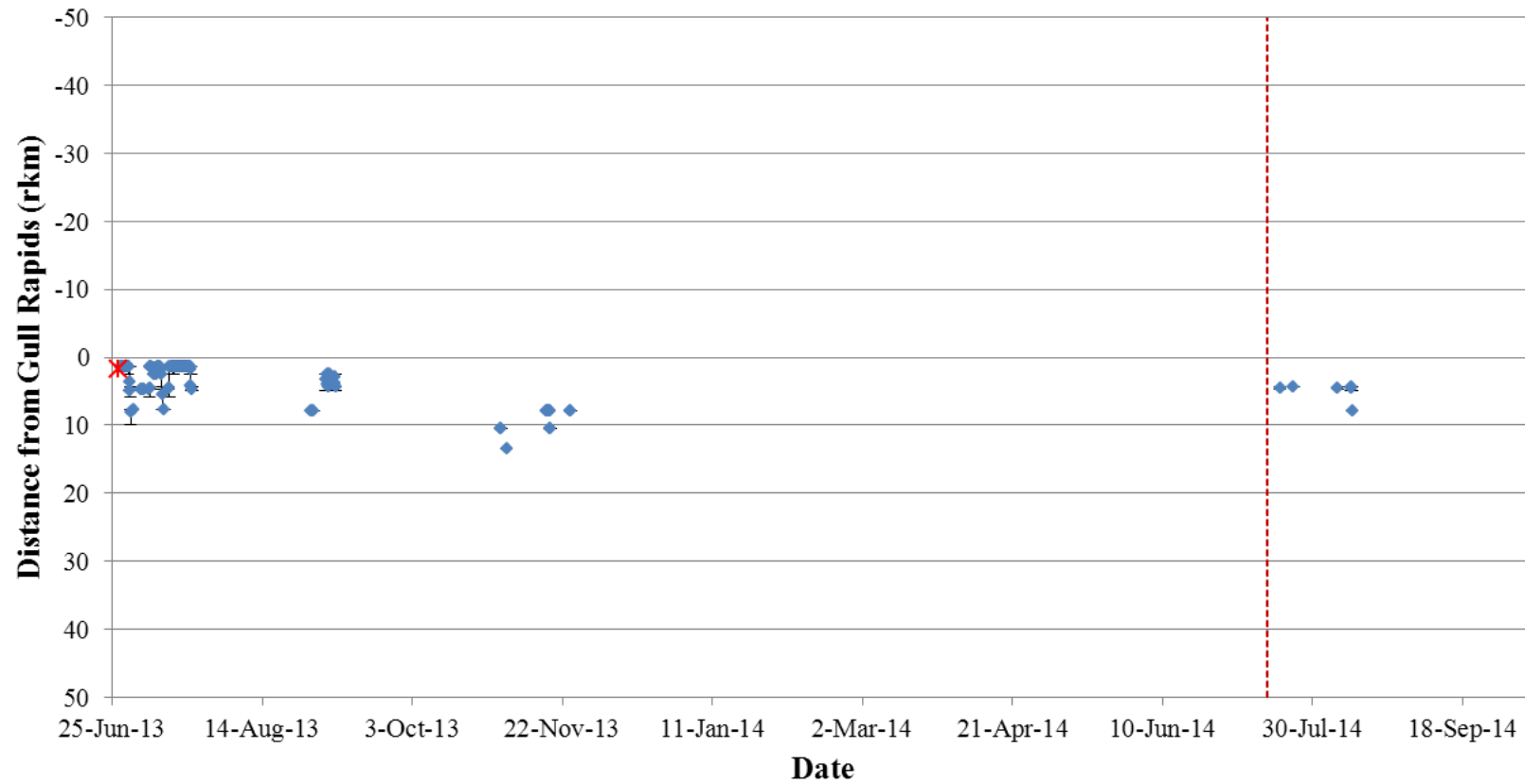


Figure A3- 14: Position of a Walleye tagged with an acoustic transmitter (code #32825) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

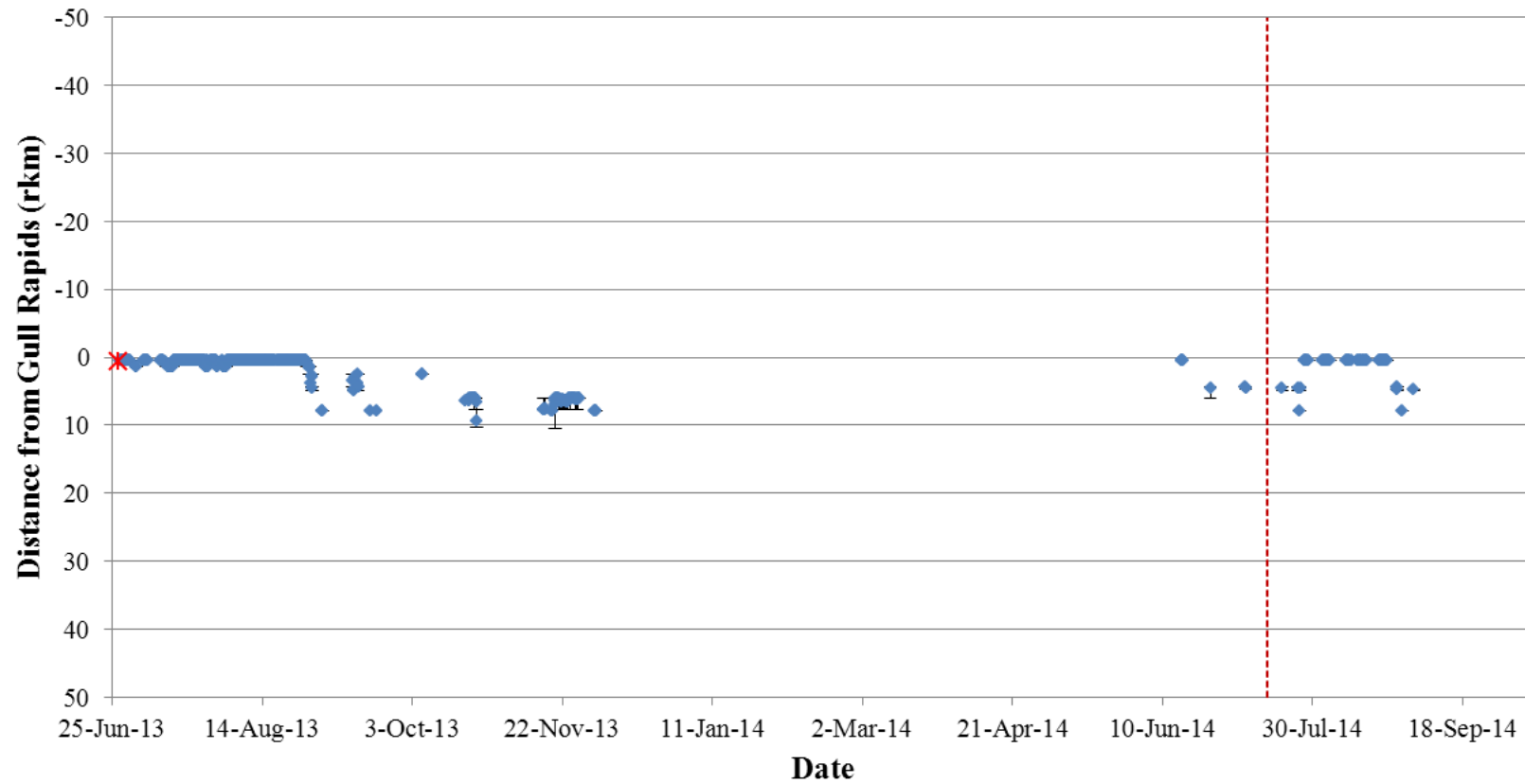


Figure A3- 15: Position of a Walleye tagged with an acoustic transmitter (code #32826) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

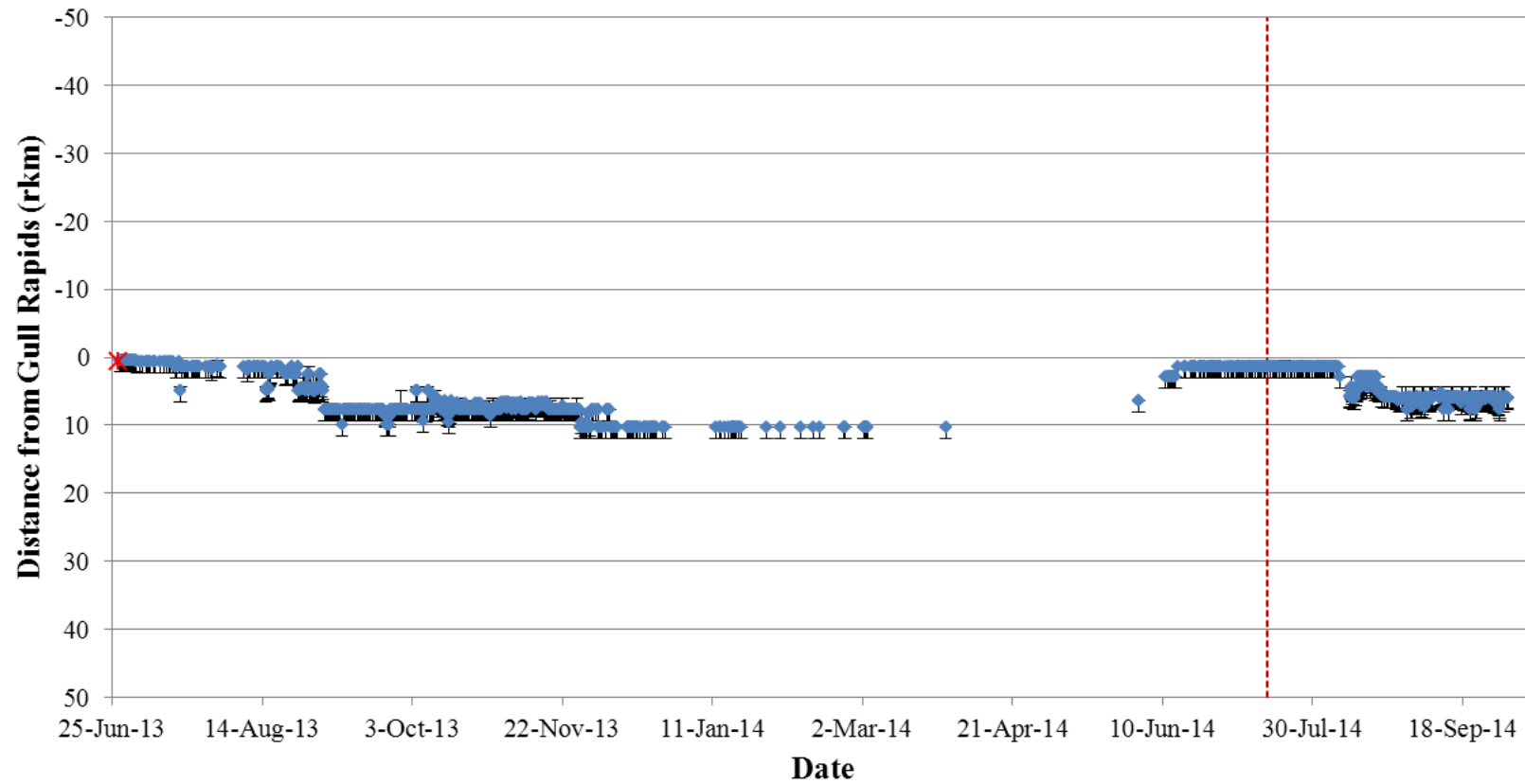


Figure A3- 16: Position of a Walleye tagged with an acoustic transmitter (code #32827) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

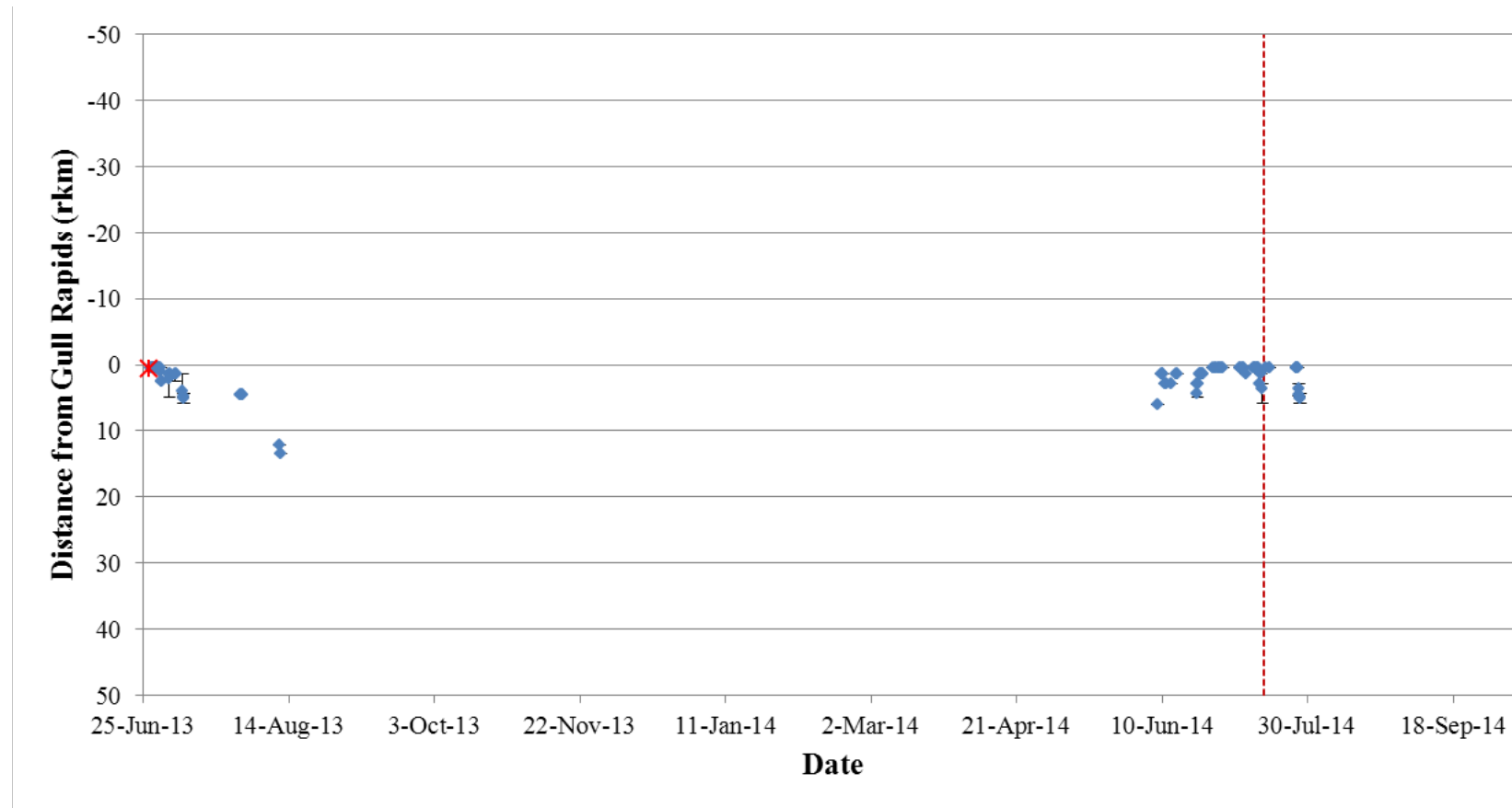


Figure A3- 17: Position of a Walleye tagged with an acoustic transmitter (code #32828) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

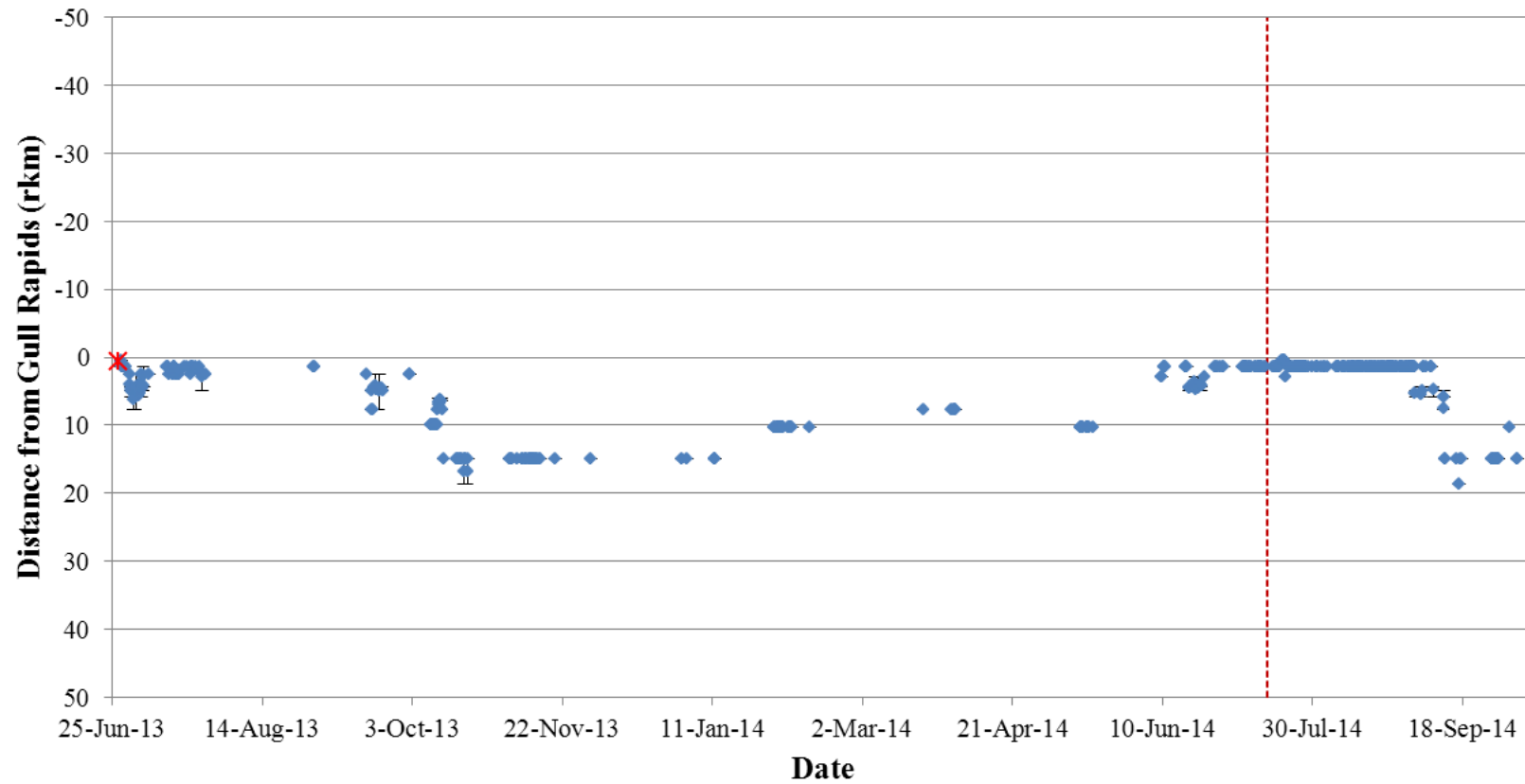


Figure A3- 18: Position of a Walleye tagged with an acoustic transmitter (code #32829) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

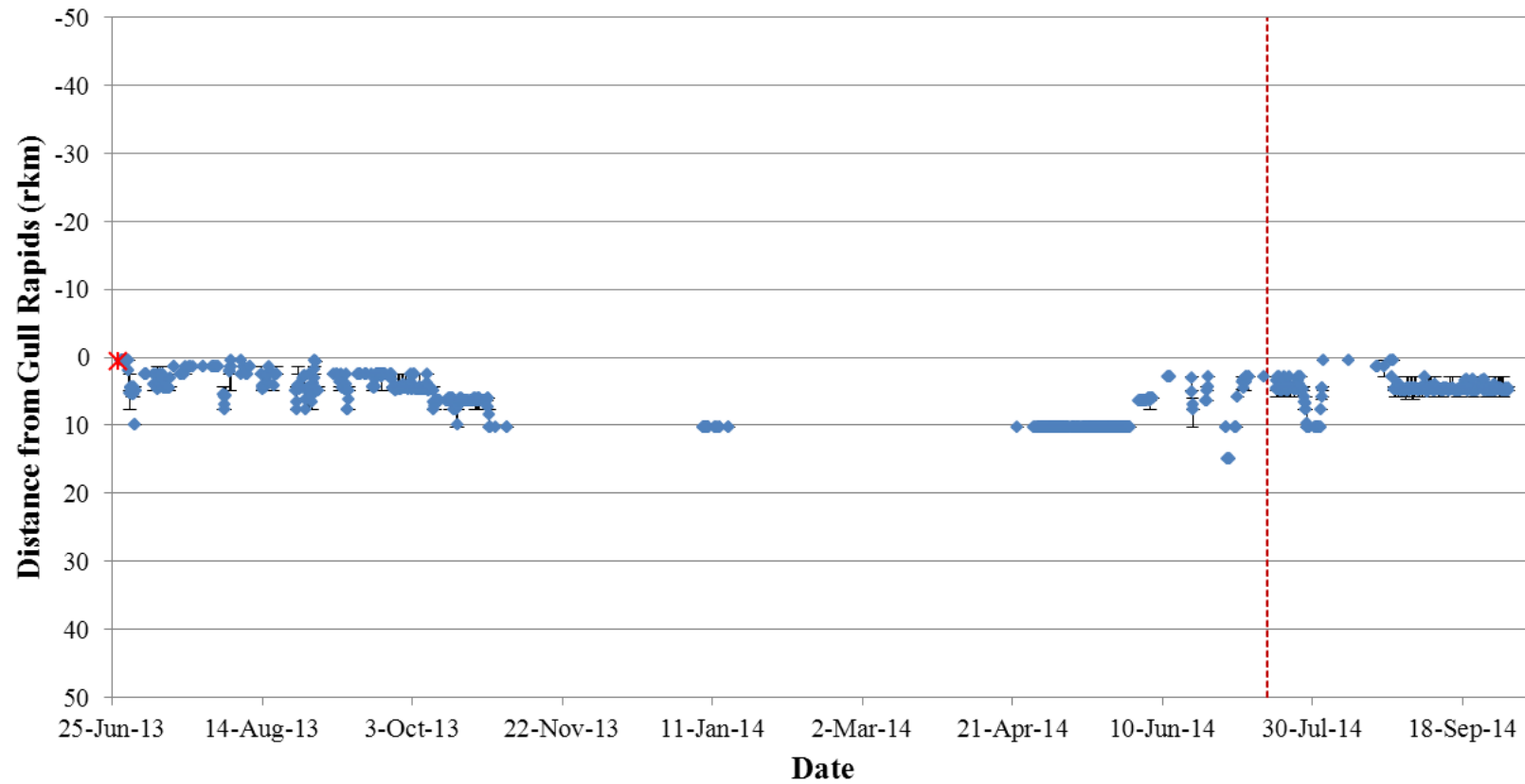


Figure A3- 19: Position of a Walleye tagged with an acoustic transmitter (code #32830) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

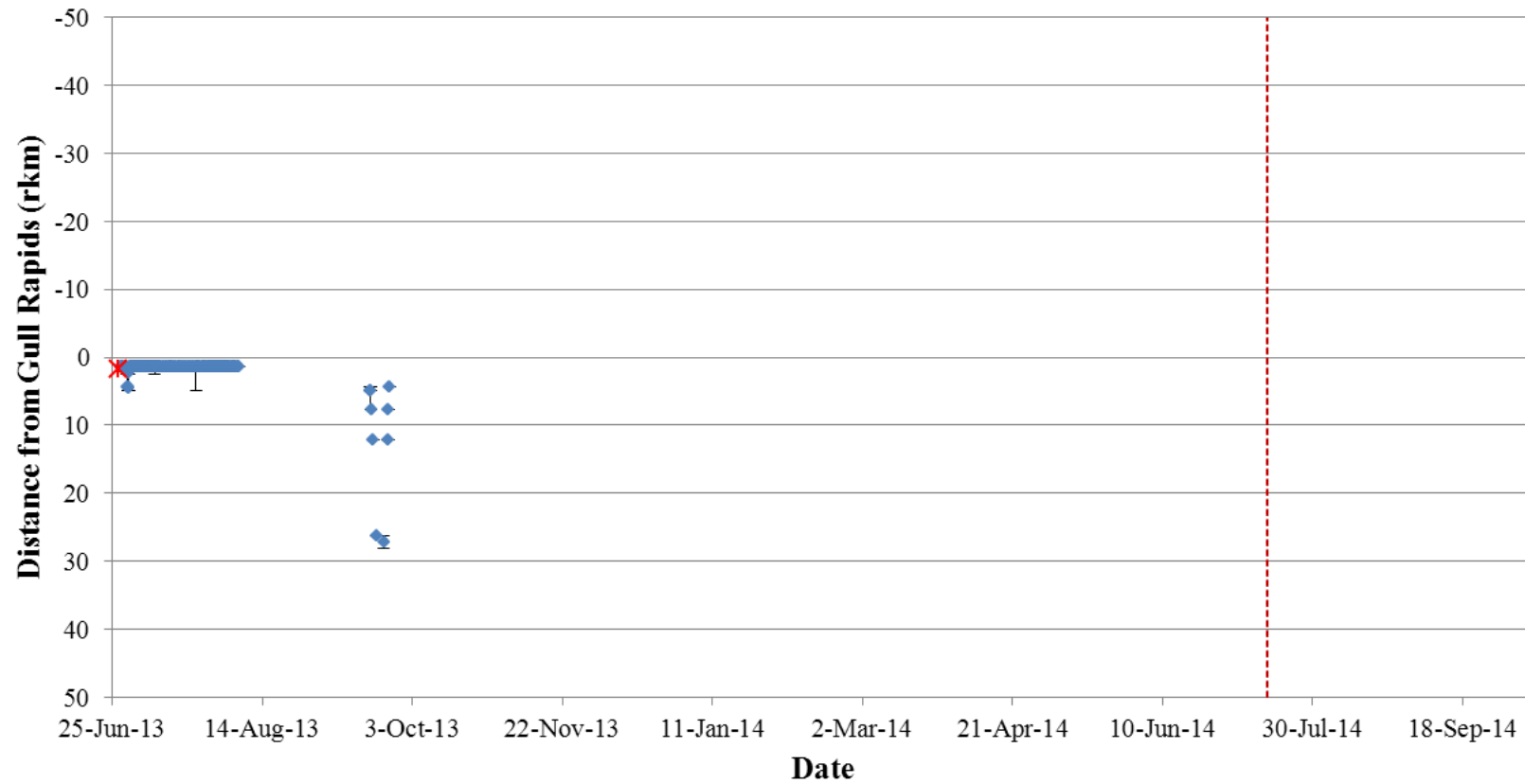


Figure A3- 20: Position of a Walleye tagged with an acoustic transmitter (code #32831) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

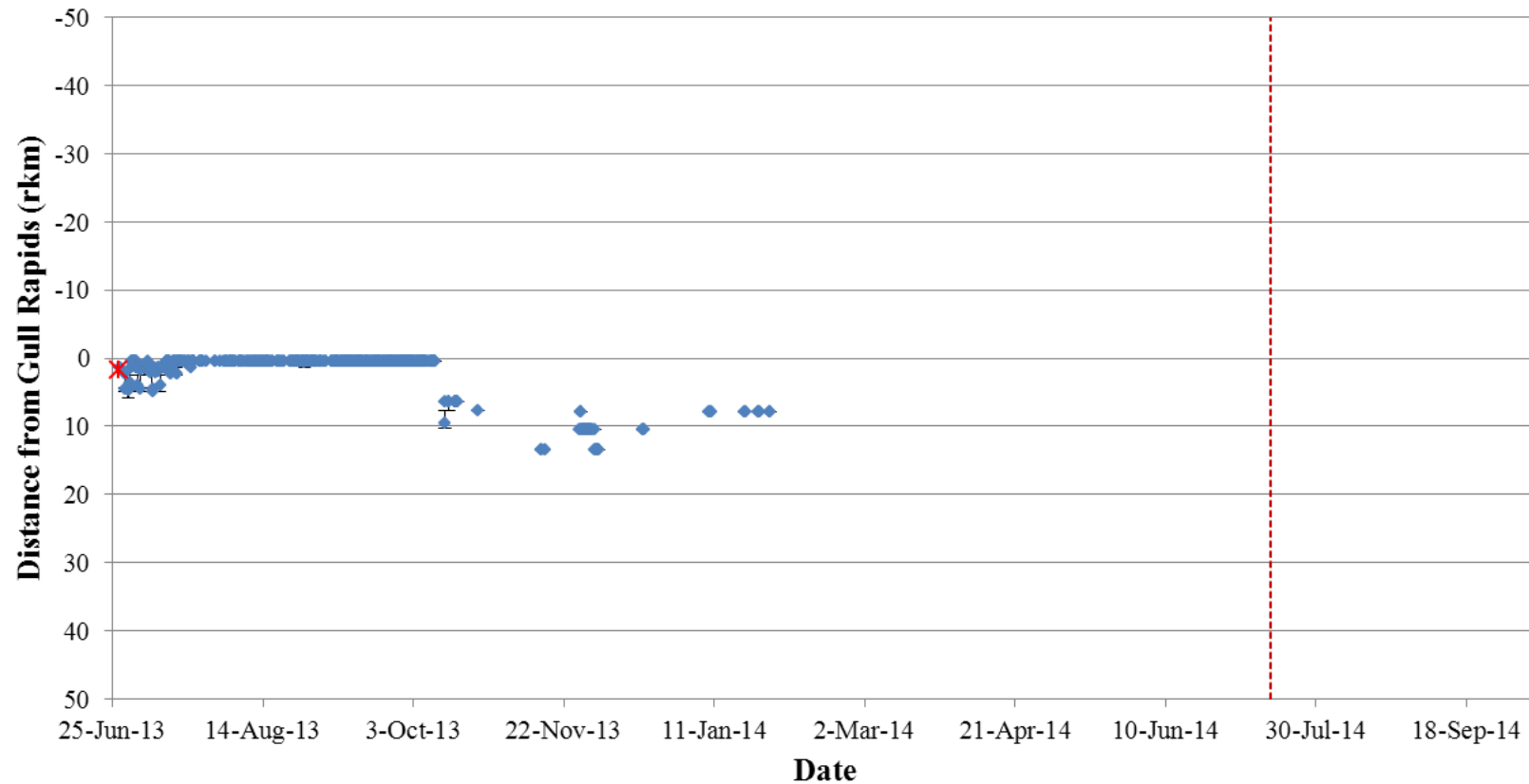


Figure A3- 21: Position of a Walleye tagged with an acoustic transmitter (code #32832) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

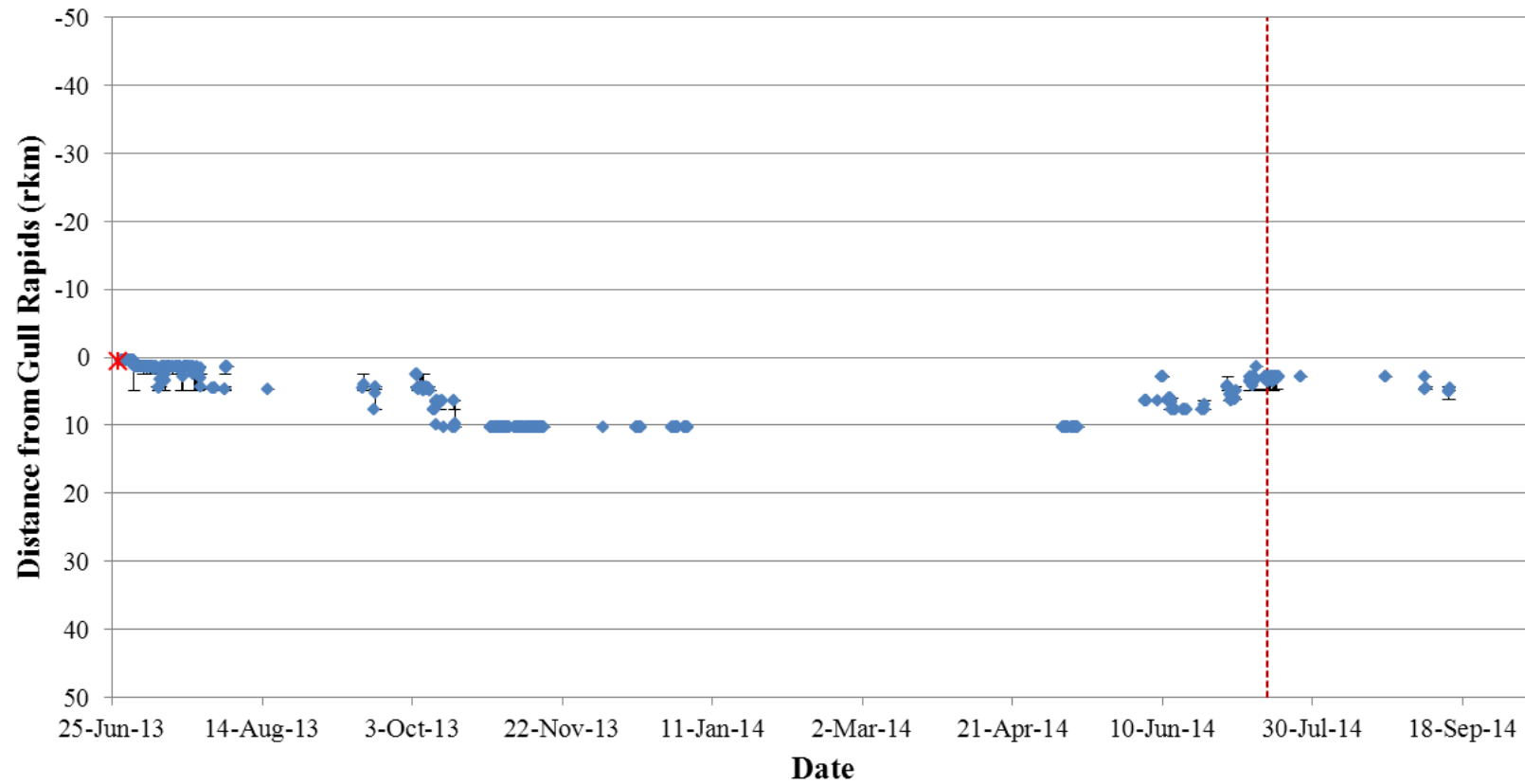


Figure A3- 22: Position of a Walleye tagged with an acoustic transmitter (code #32834) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

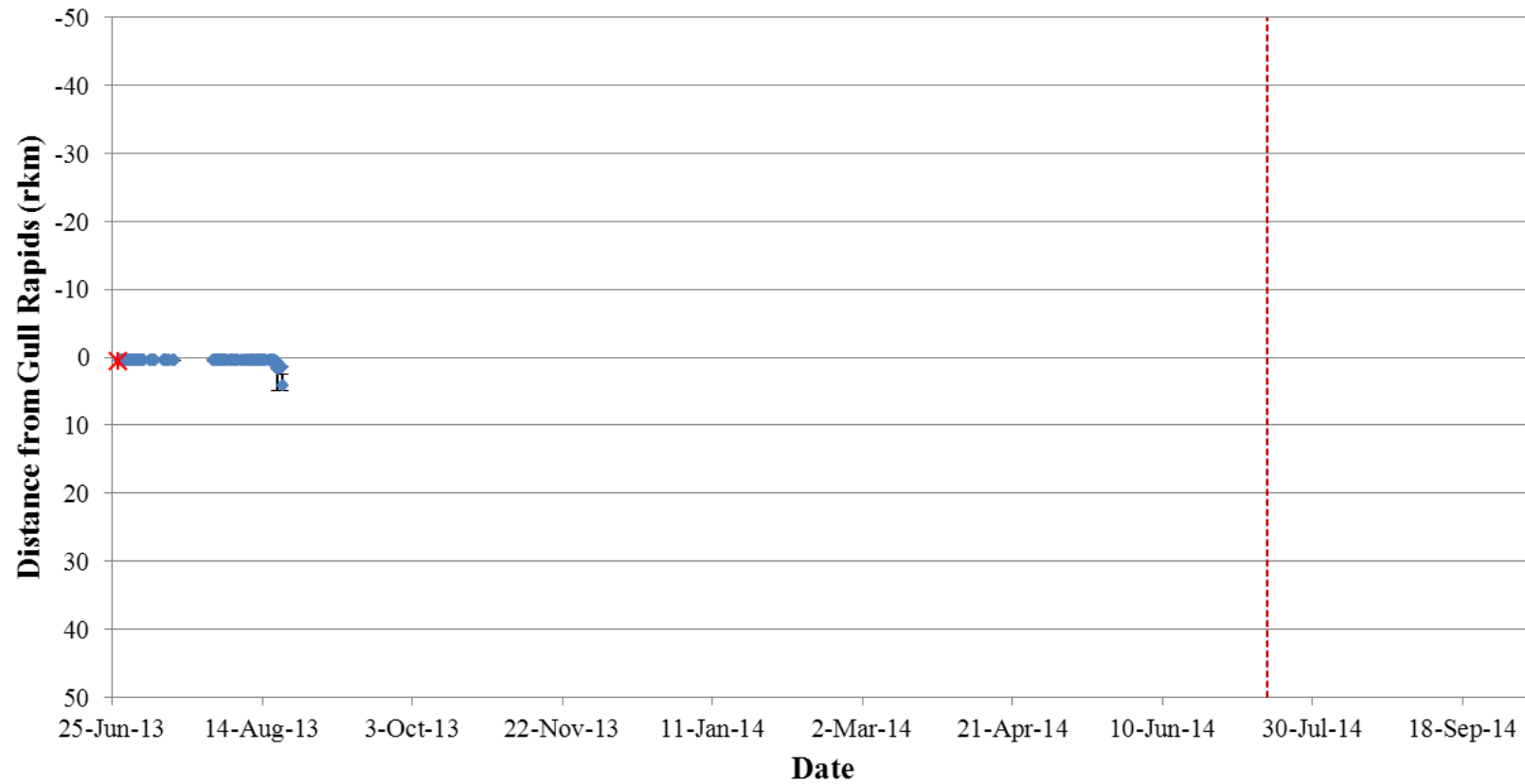


Figure A3- 23: Position of a Walleye tagged with an acoustic transmitter (code #32835) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

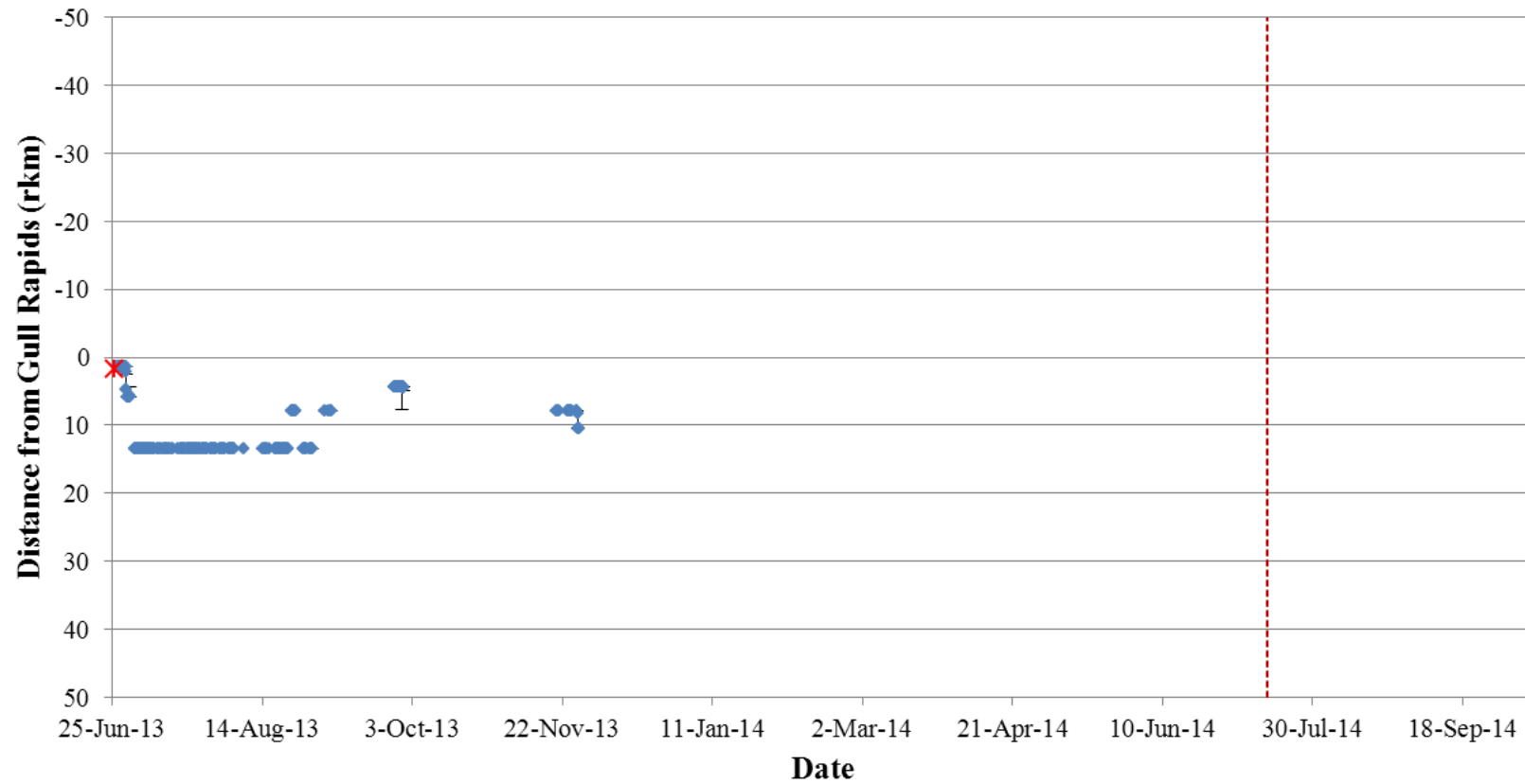


Figure A3- 24: Position of a Walleye tagged with an acoustic transmitter (code #32836) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

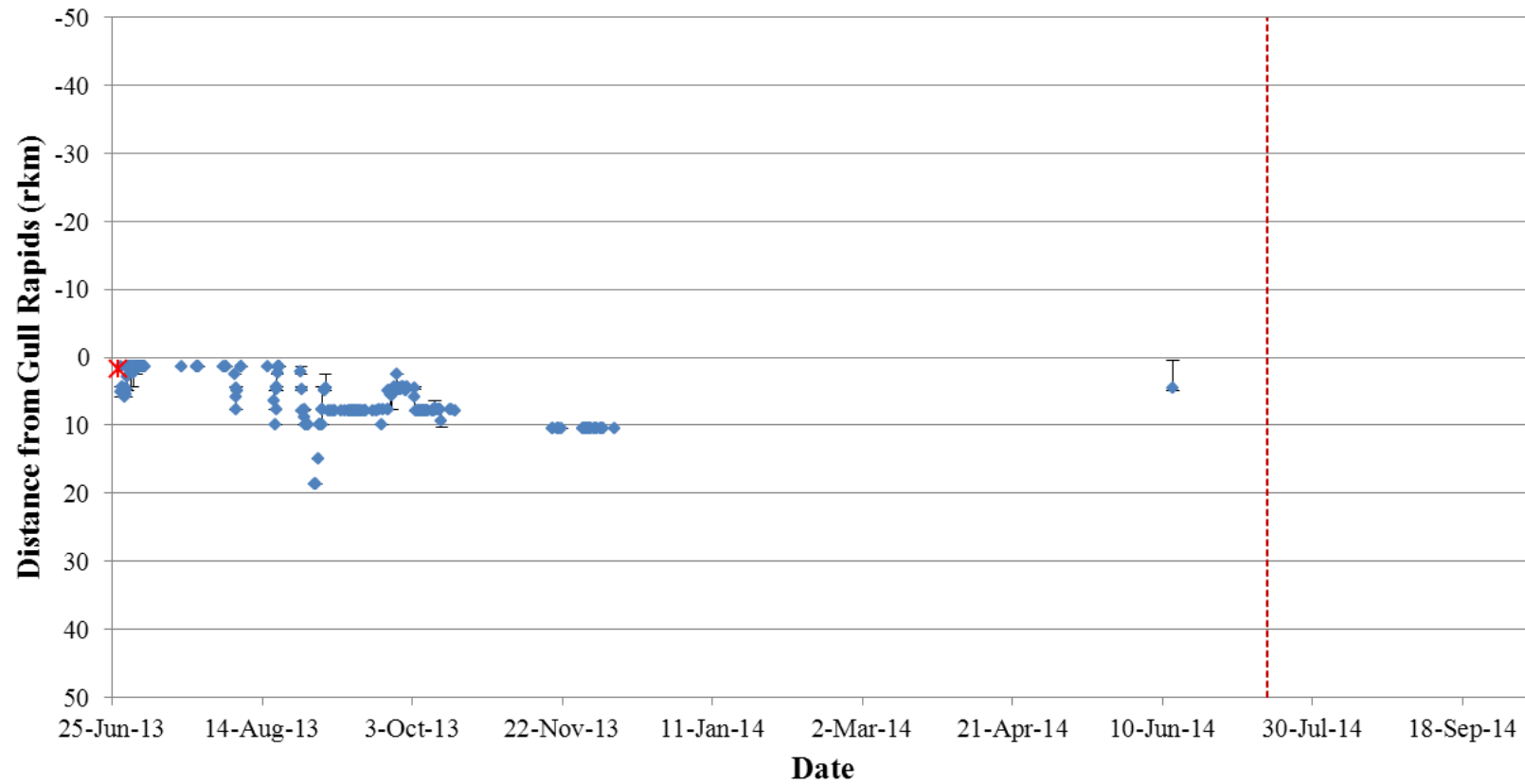


Figure A3- 25: Position of a Walleye tagged with an acoustic transmitter (code #32837) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

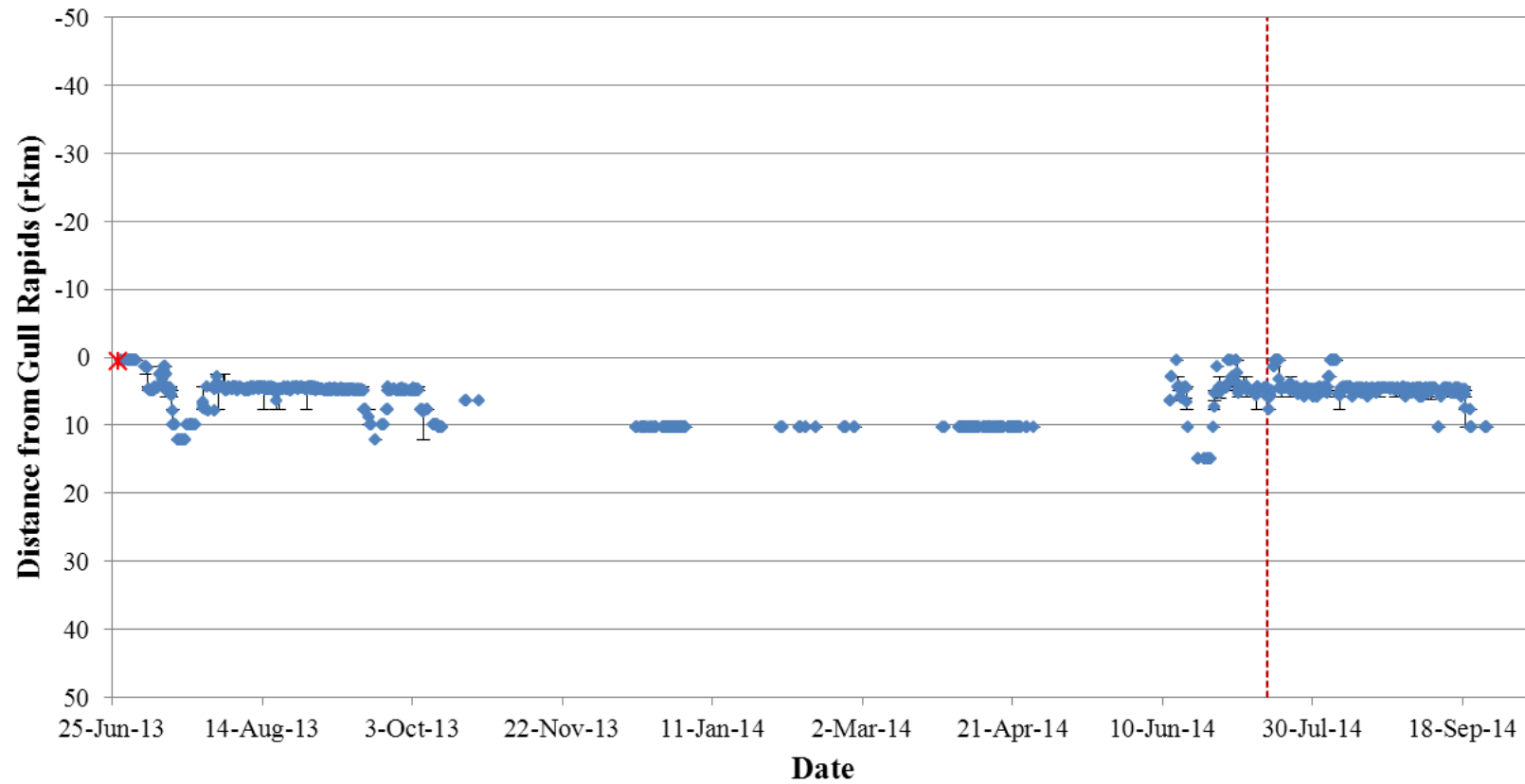


Figure A3- 26: Position of a Walleye tagged with an acoustic transmitter (code #32838) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

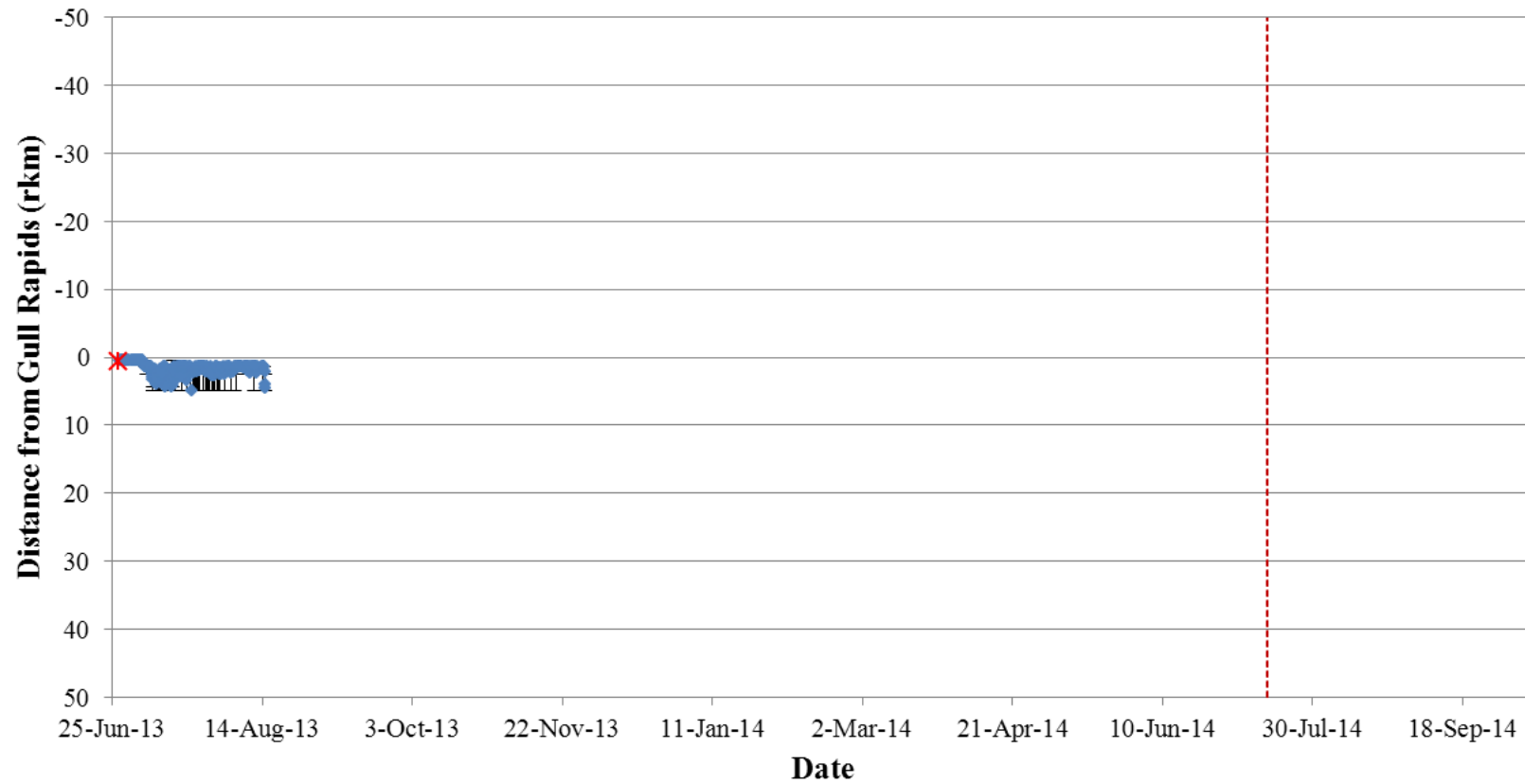


Figure A3- 27: Position of a Walleye tagged with an acoustic transmitter (code #32839) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

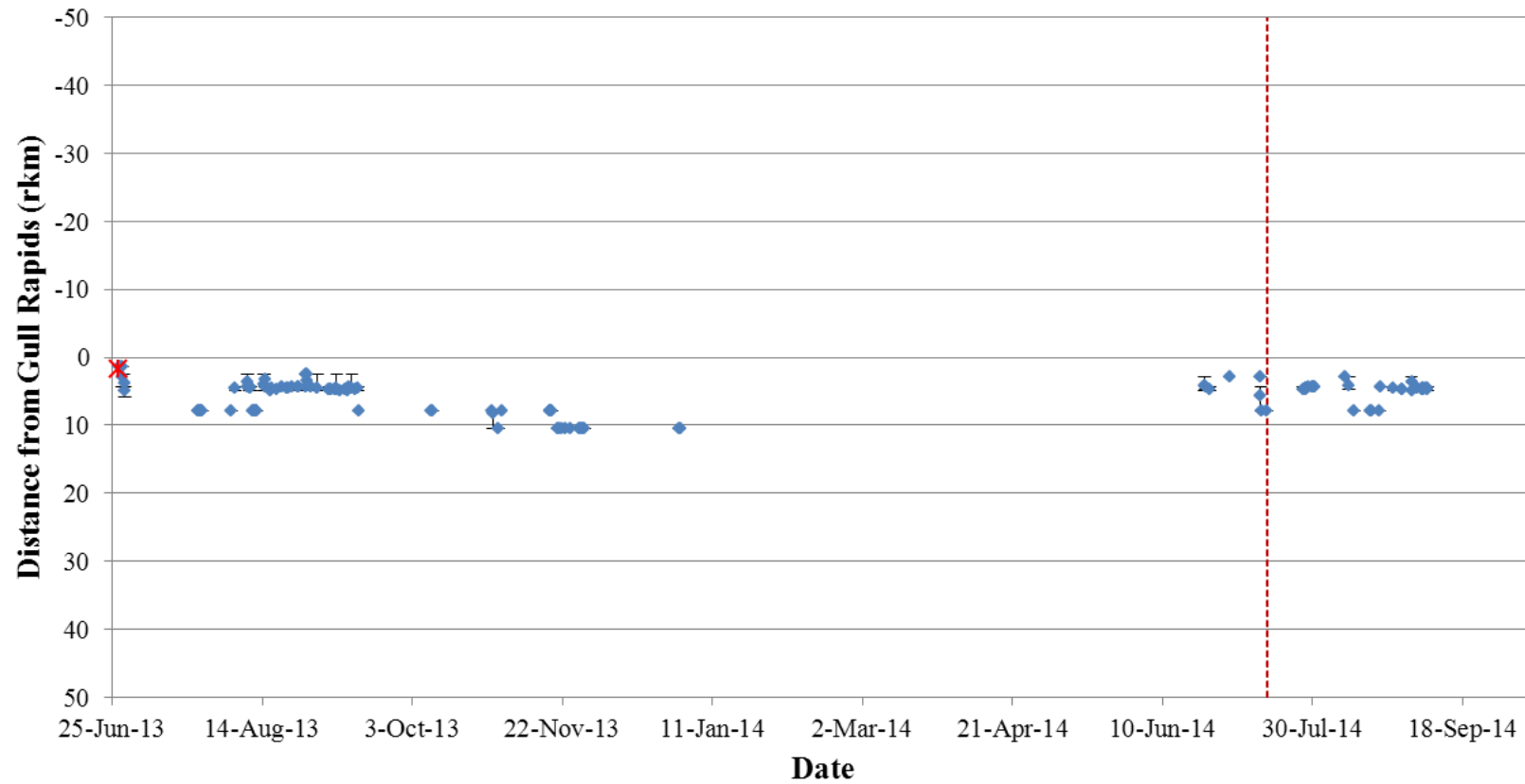


Figure A3- 28: Position of a Walleye tagged with an acoustic transmitter (code #32840) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

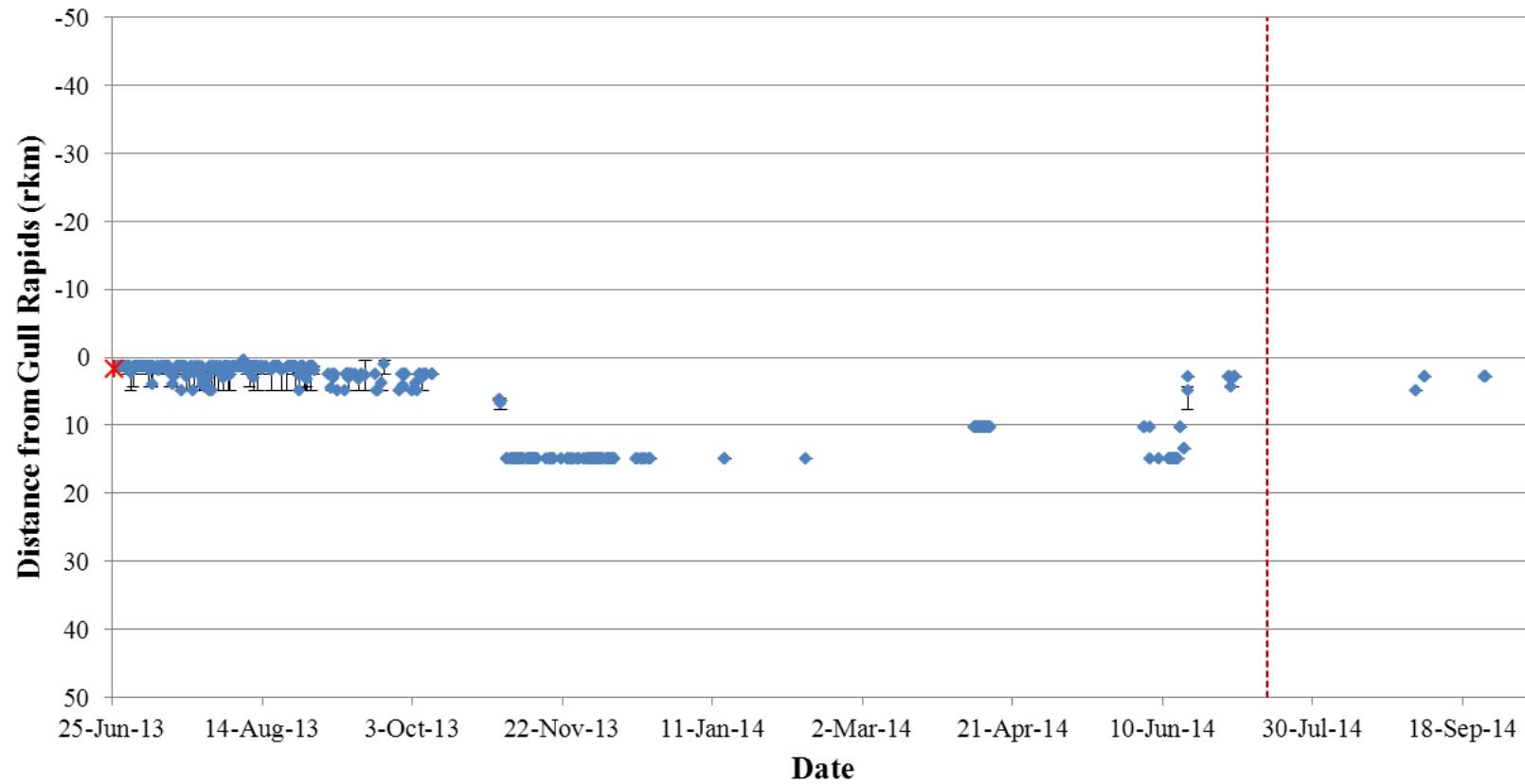


Figure A3- 29: Position of a Walleye tagged with an acoustic transmitter (code #32841) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

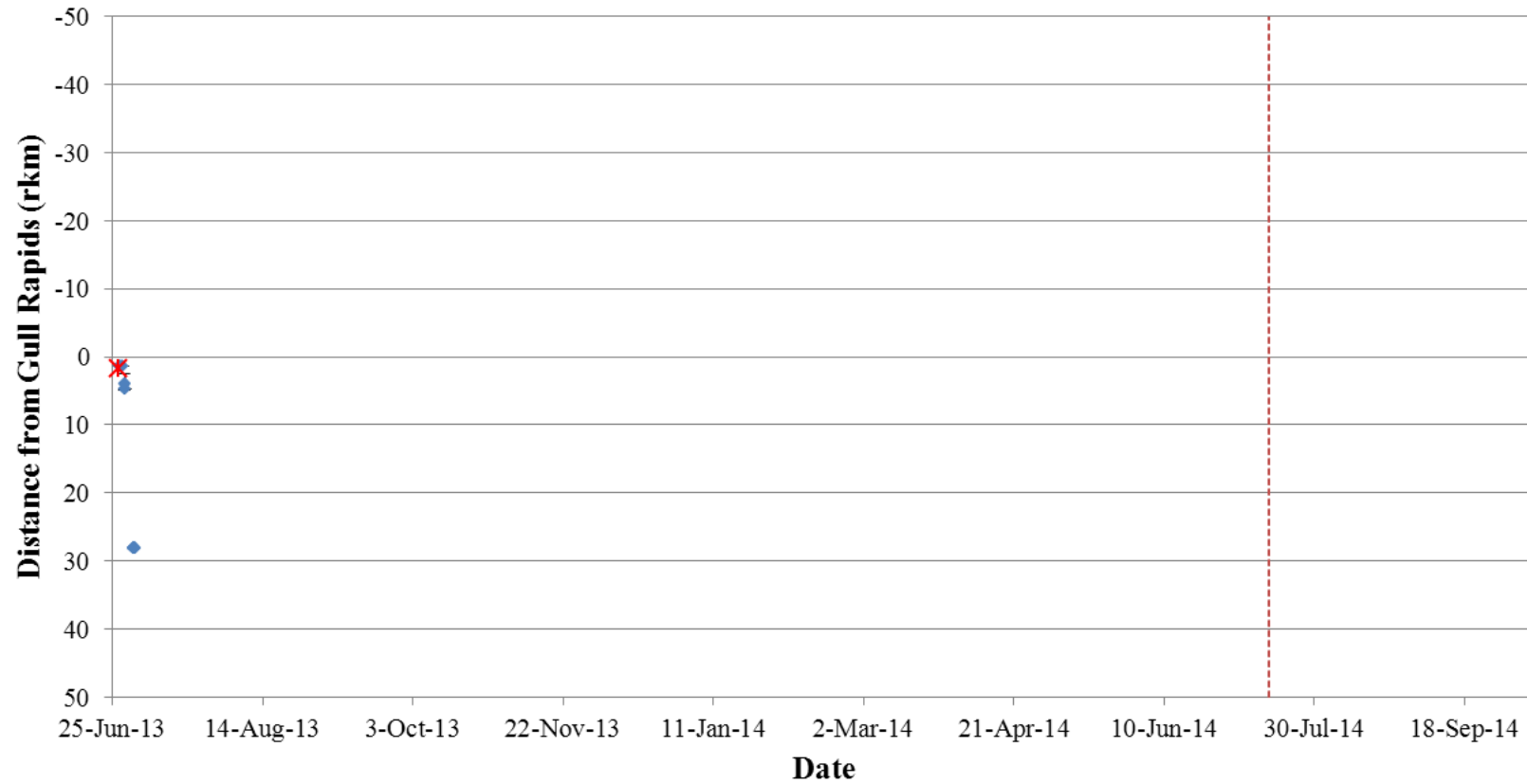


Figure A3- 30: Position of a Walleye tagged with an acoustic transmitter (code #32842) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

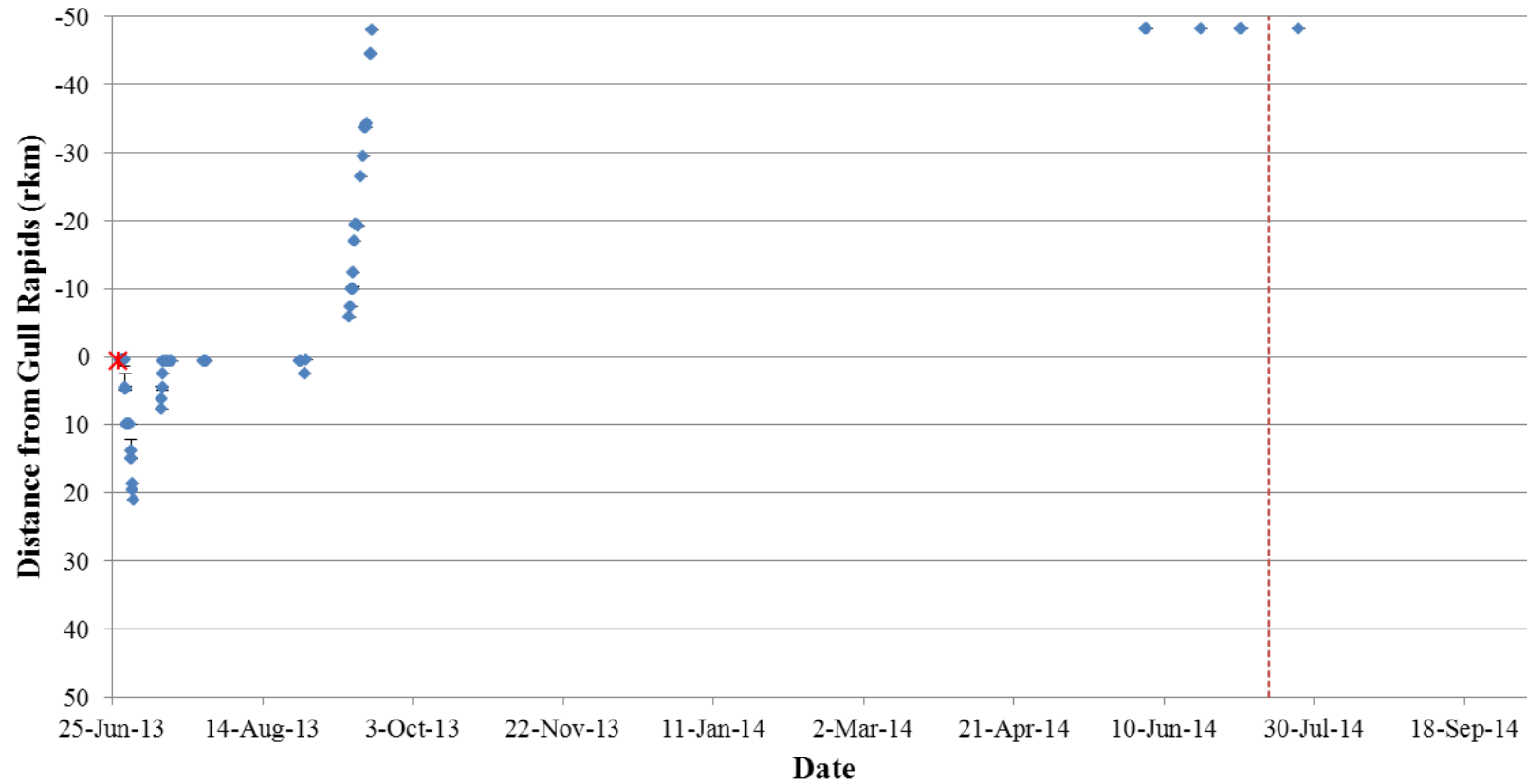
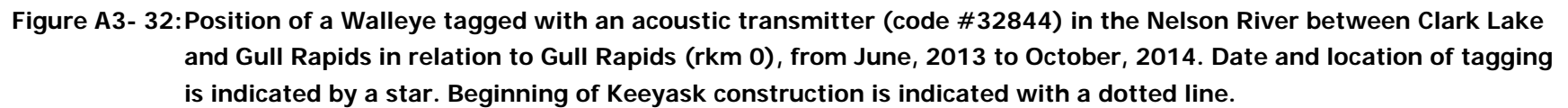


Figure A3- 31: Position of a Walleye tagged with an acoustic transmitter (code #32843) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.



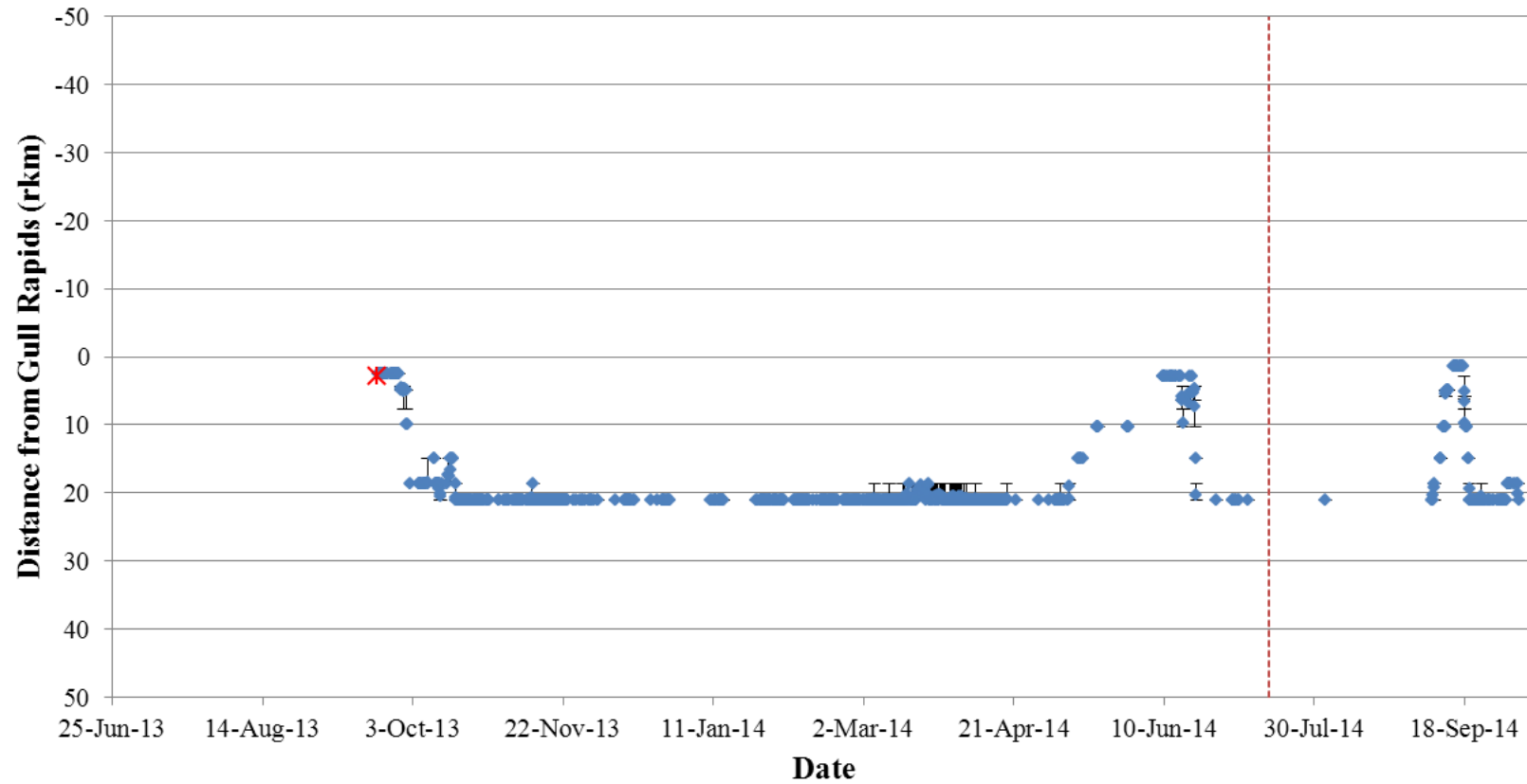


Figure A3- 33: Position of a Walleye tagged with an acoustic transmitter (code #32845) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

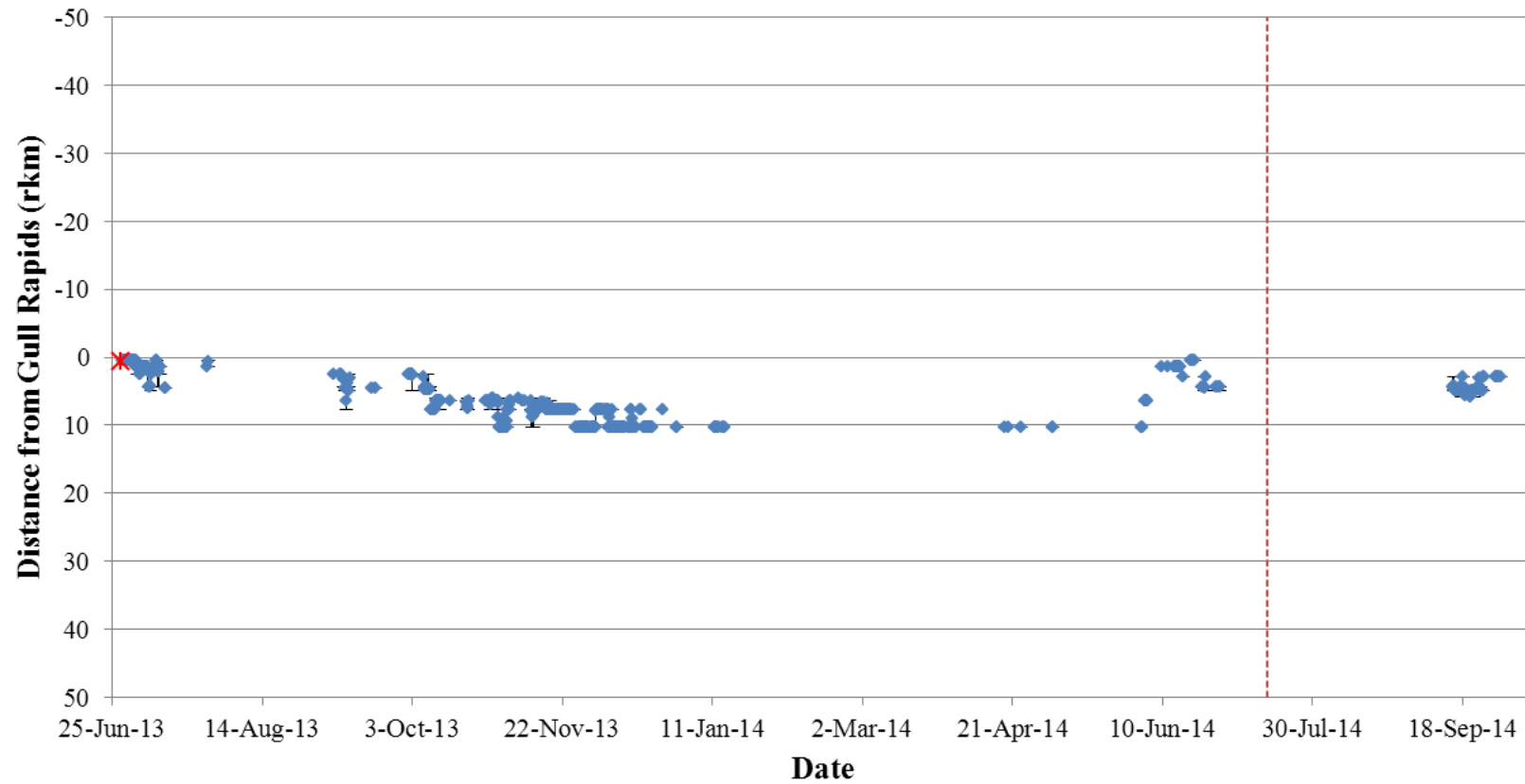


Figure A3- 34: Position of a Walleye tagged with an acoustic transmitter (code #32848) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

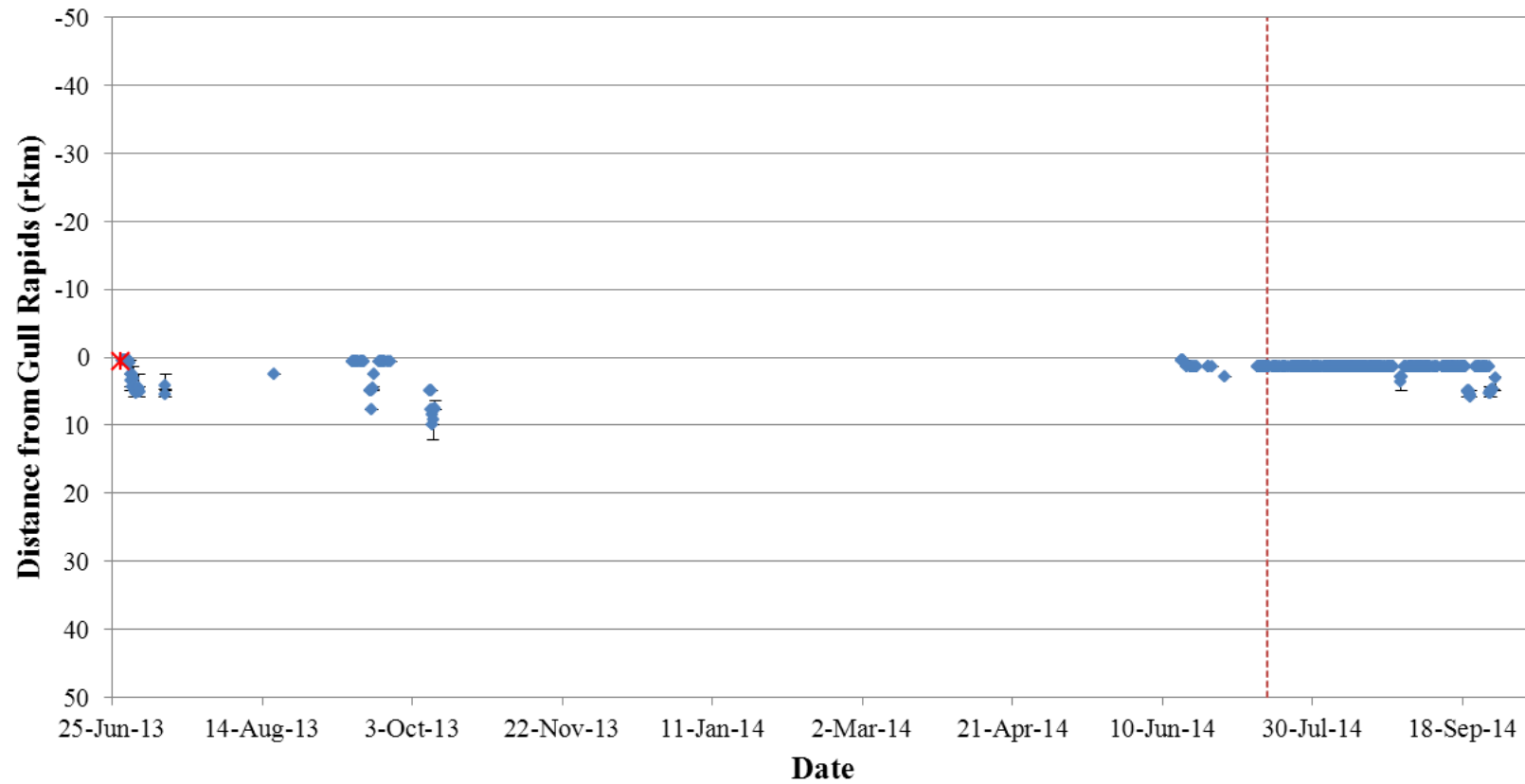


Figure A3- 35: Position of a Walleye tagged with an acoustic transmitter (code #32849) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

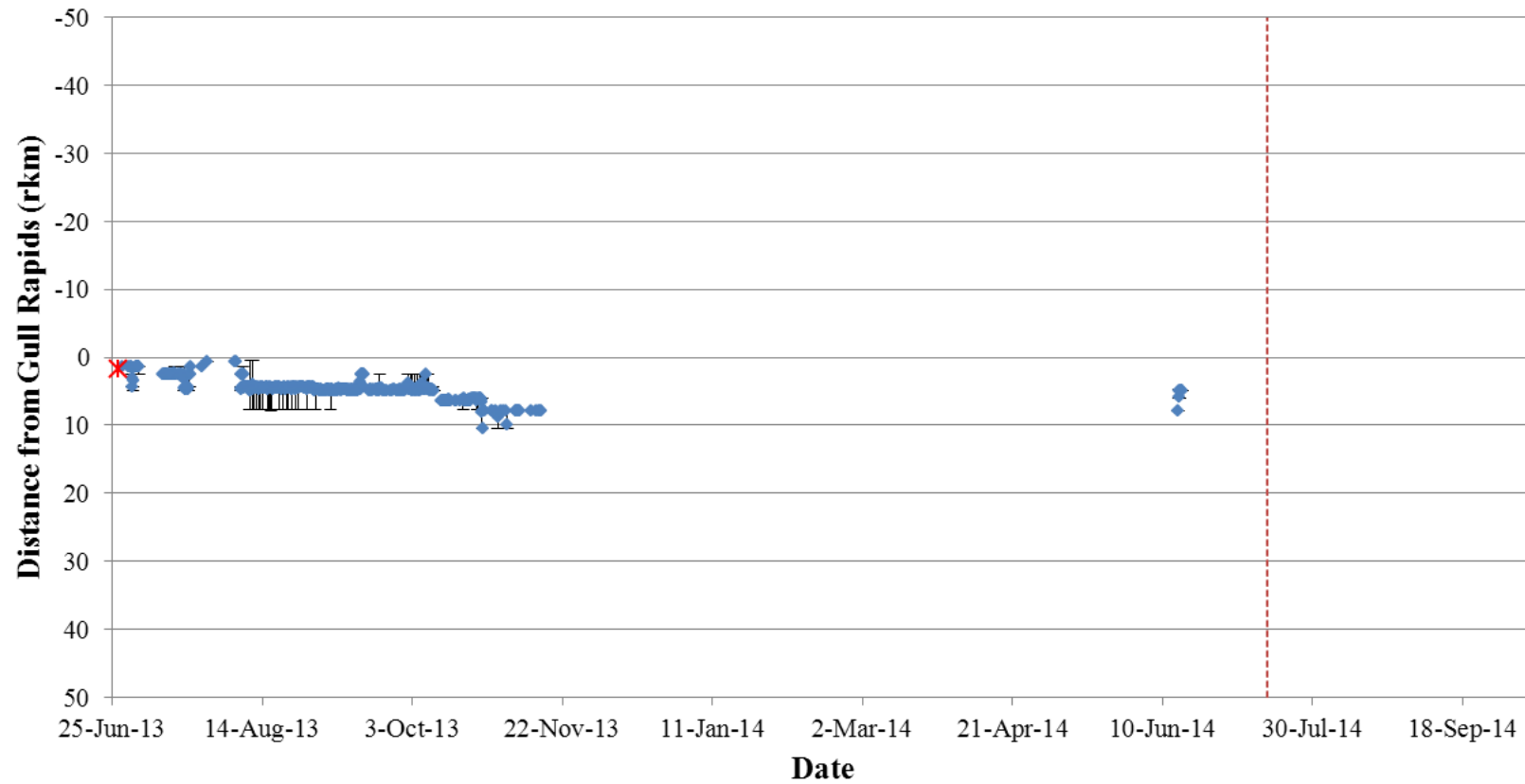
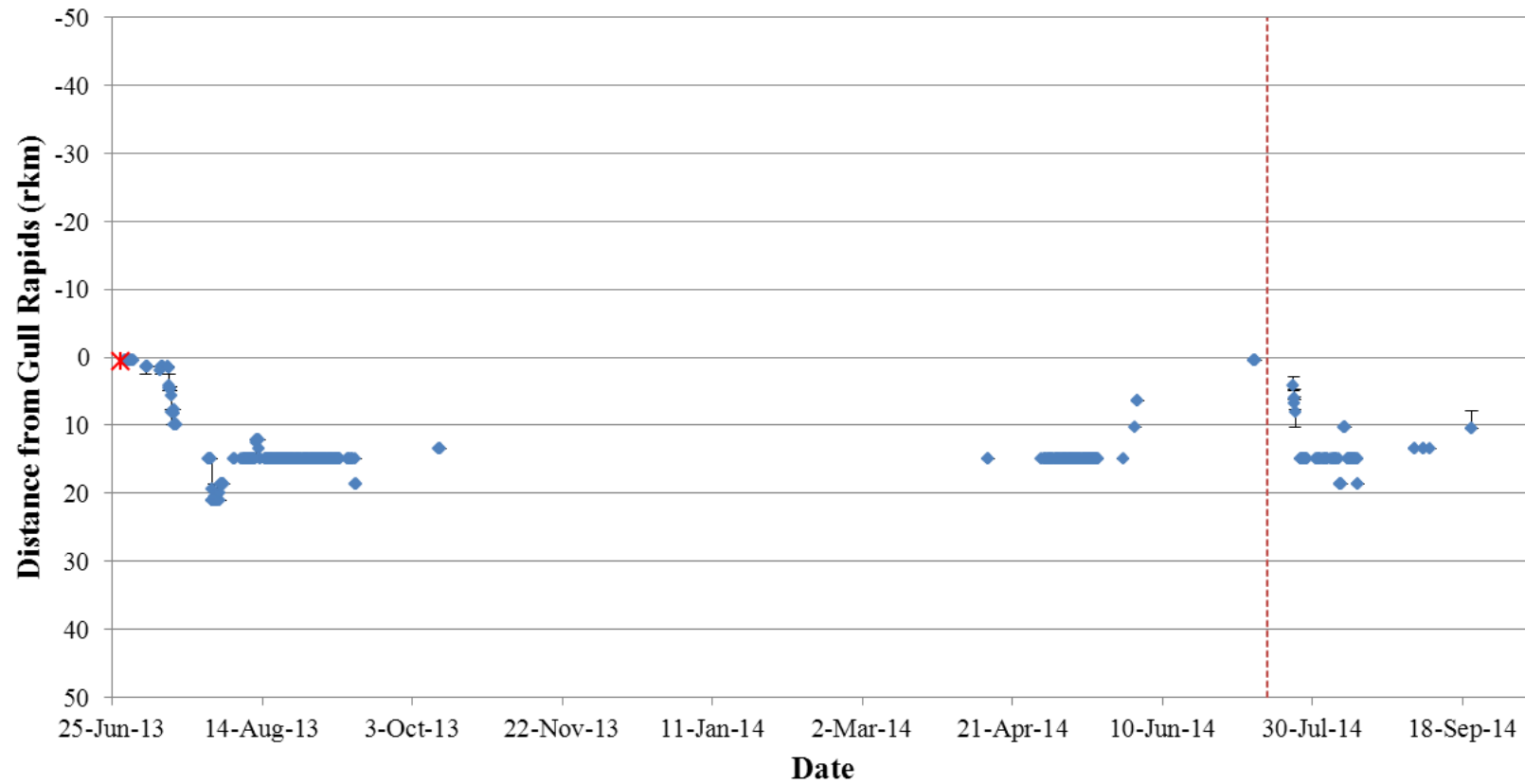


Figure A3- 36: Position of a Walleye tagged with an acoustic transmitter (code #32850) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.



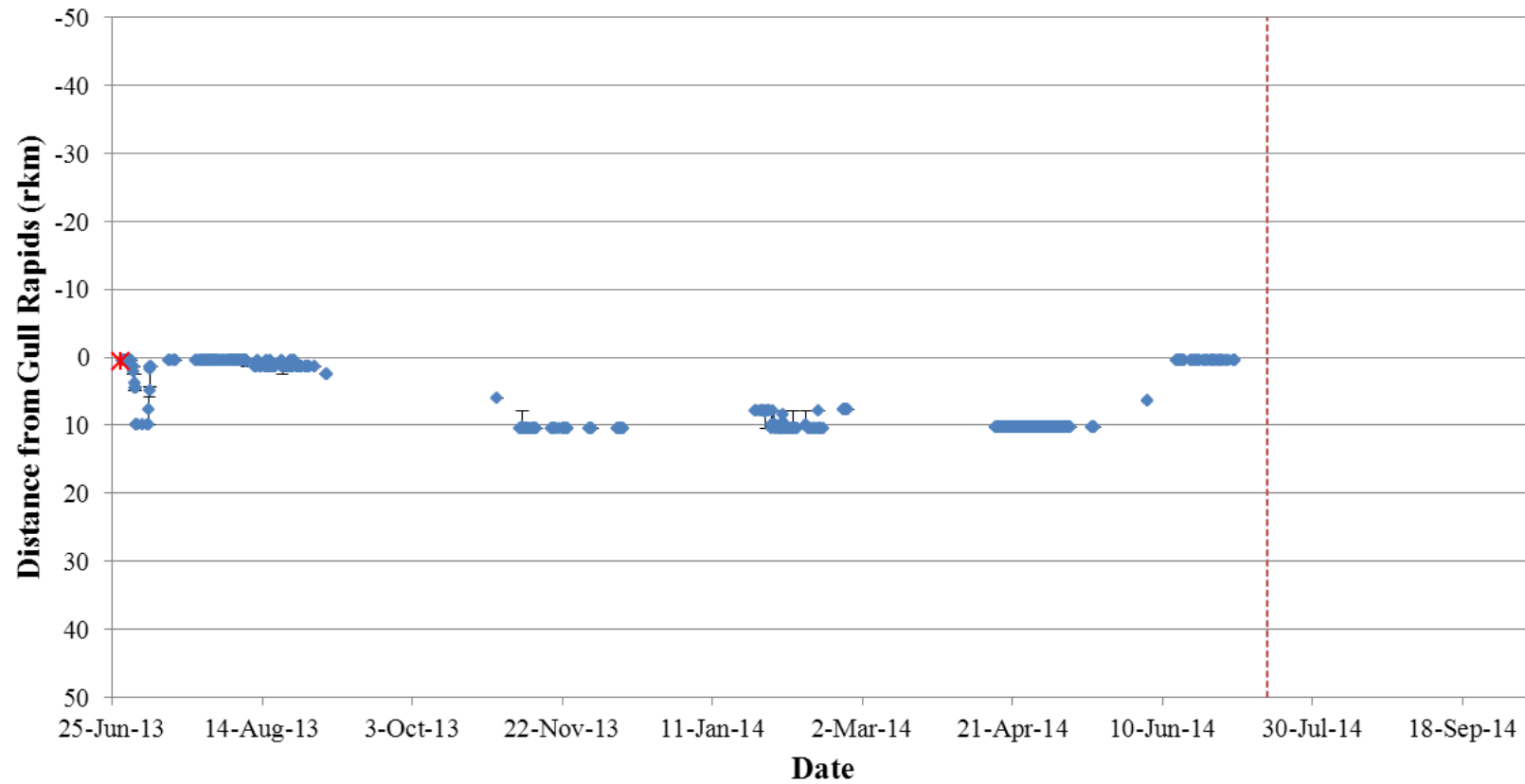


Figure A3- 38: Position of a Walleye tagged with an acoustic transmitter (code #32855) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

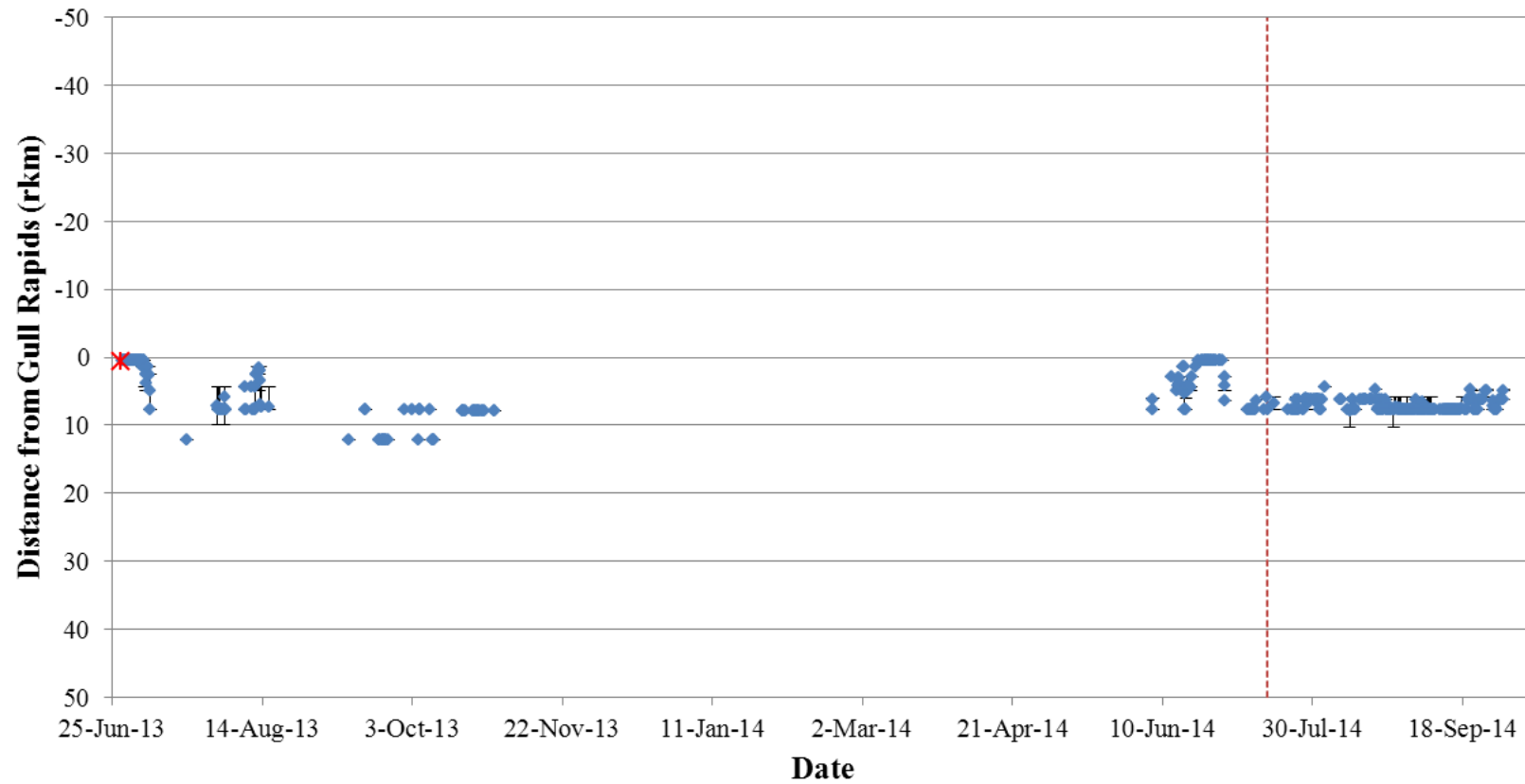


Figure A3- 39: Position of a Walleye tagged with an acoustic transmitter (code #32859) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

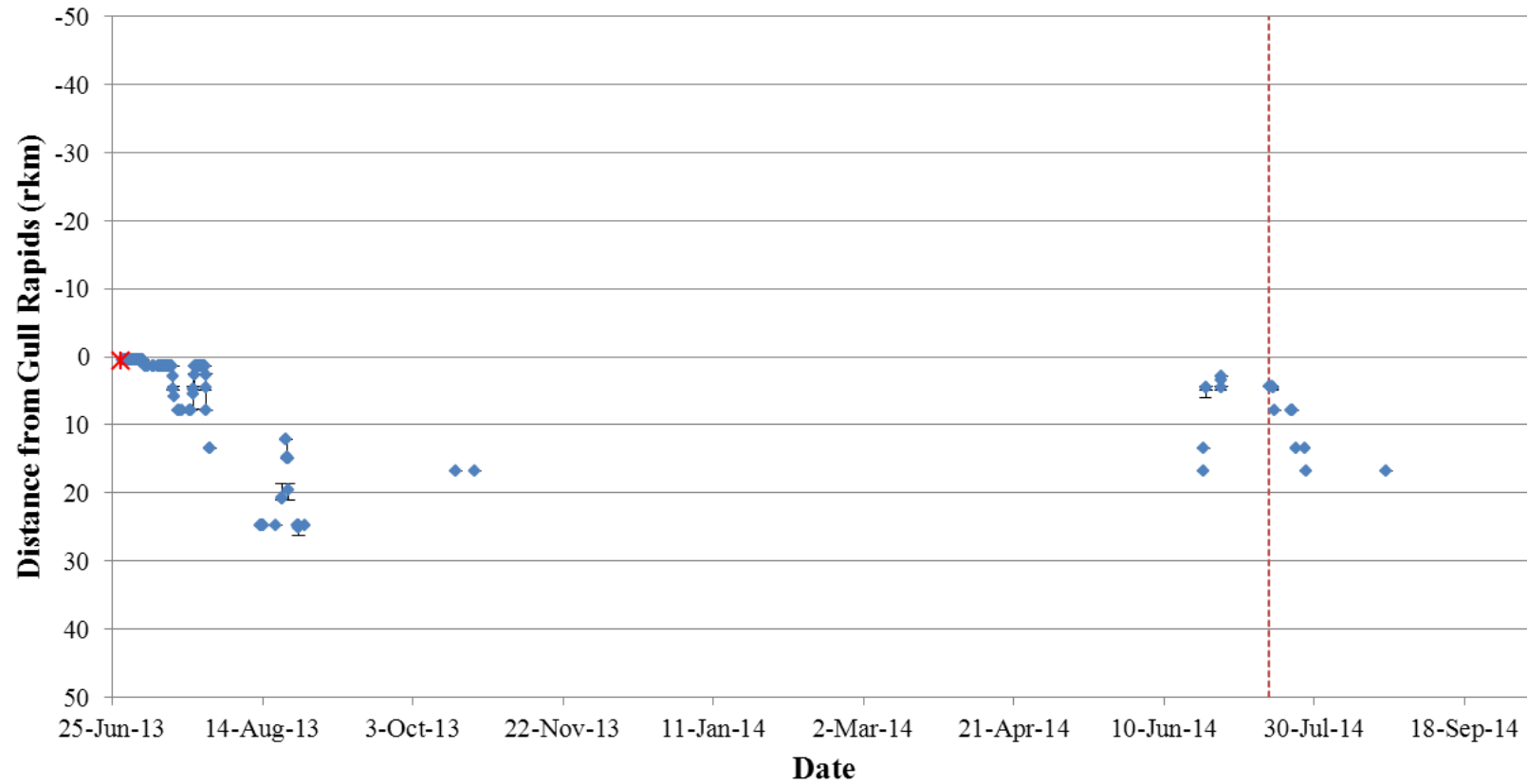


Figure A3- 40: Position of a Walleye tagged with an acoustic transmitter (code #32860) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2013 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

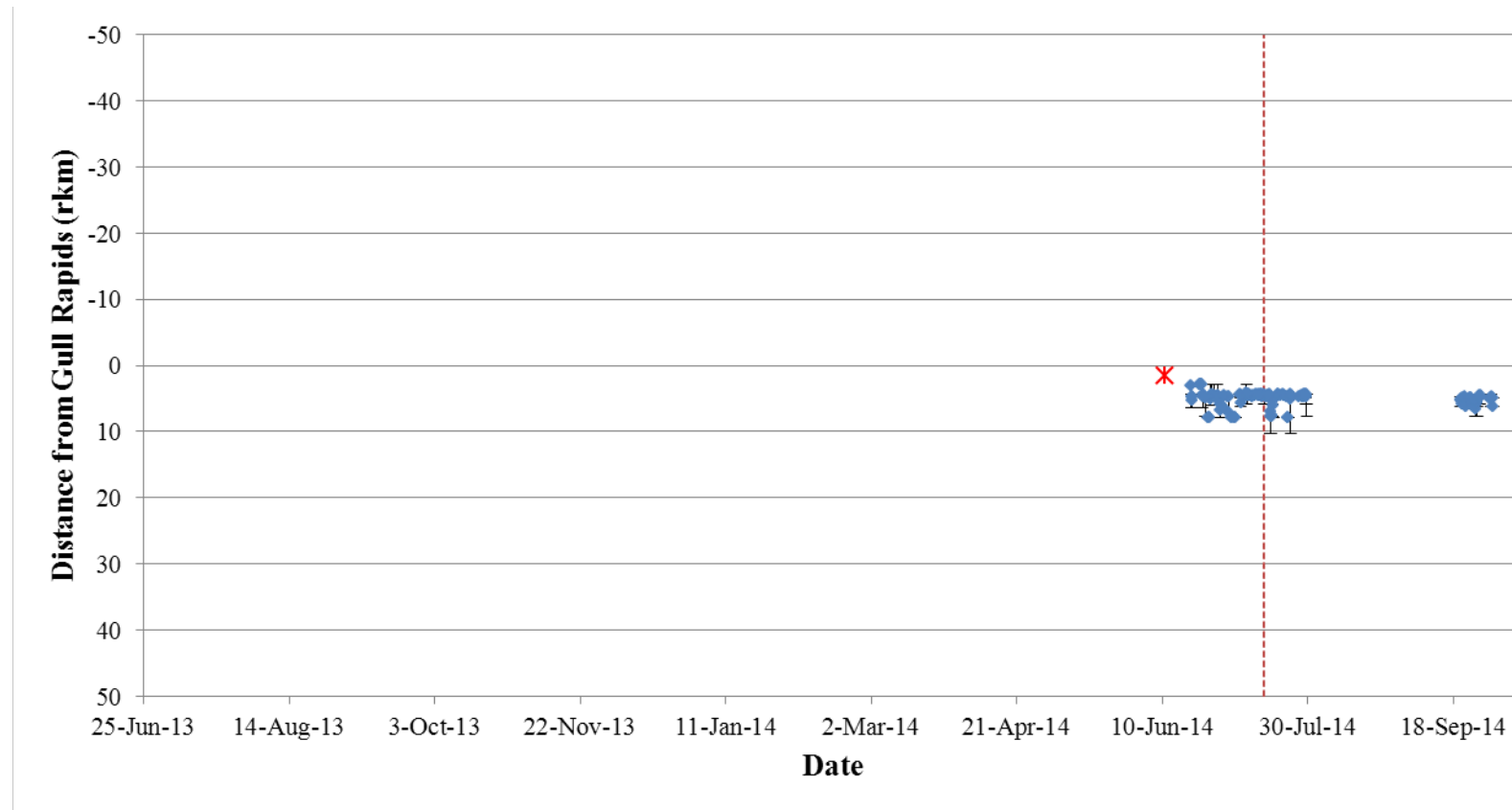


Figure A3- 41: Position of a Walleye tagged with an acoustic transmitter (code #6424) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2014 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

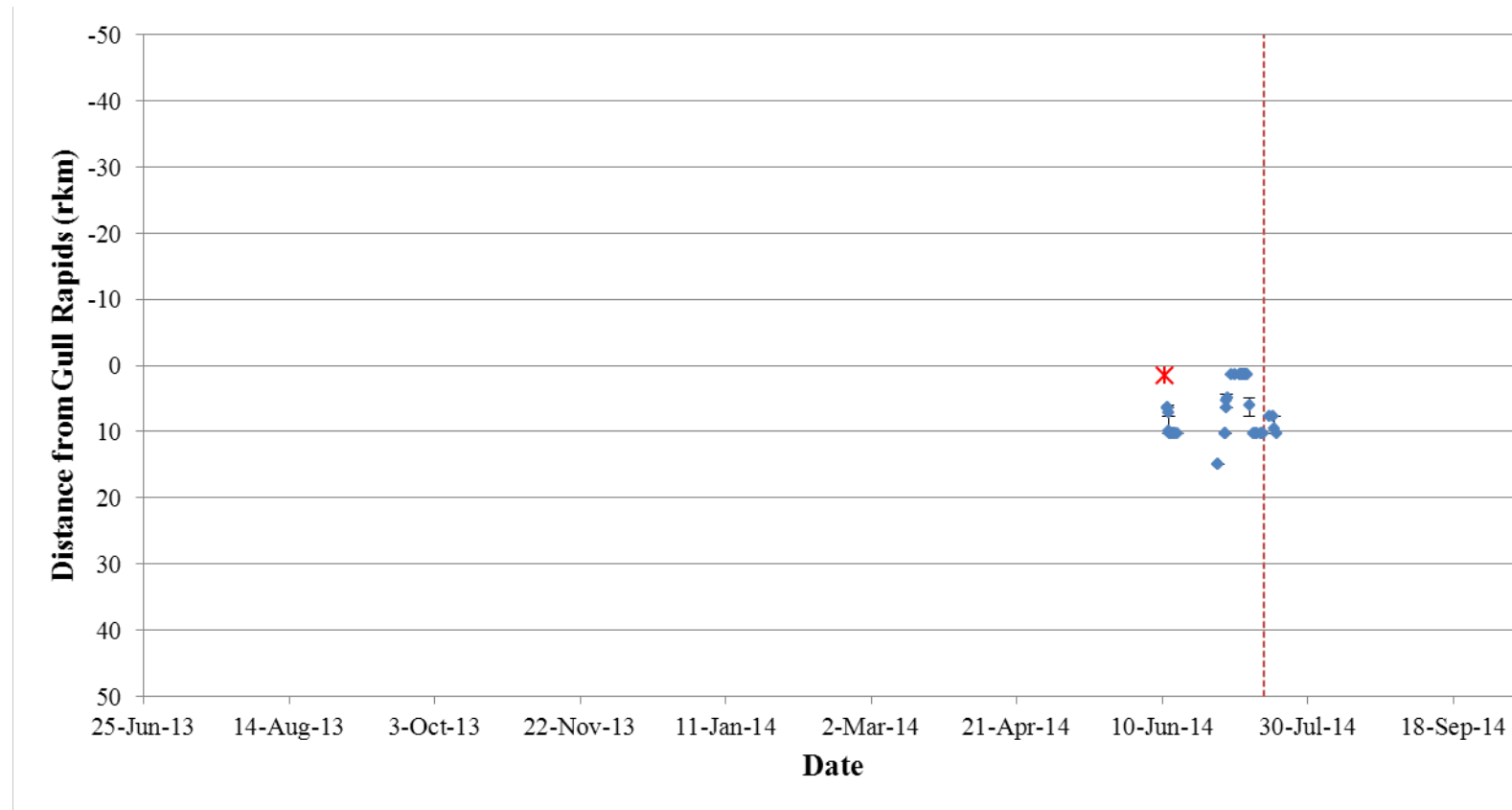


Figure A3- 42: Position of a Walleye tagged with an acoustic transmitter (code #6427) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from June, 2014 to October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.