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Part III People	
1. In the Adams and Fisheries Group Report, "First Report of the Fisheries Working Group for the Northern Plan (1976) referenced by MH in Part III of RCEA it was indicated that an over quota fish harvest was proposed for South Indian Lake to salvage the predicted fish kill associated with activities on South Indian Lake. Was any information found around this issue? Such details as: did the over quota harvest every take place? If it did what were the results? Was this a unique occurrence or was it used on other water bodies? Any details that can provide clarification would be helpful.	We are not aware of any fish salvage programs that were conducted on Southern Indian Lake. There were, however, salvage fisheries conducted on lakes on the Churchill River that were expected to be substantially affected by the reduced flows resulting from the Churchill River Diversion (this was predicted by Adams and Fisheries Group Report, "First Report of the Fisheries Working Group for the Northern Plan" (1976)). Pages 5.3-181 and 5.3-182 of the RCEA state: **PRE-CRD** The pre-CRD salvage fisheries conducted on Partridge Breast, Northern Indian, Fidler, and Billard Lakes in 1975, resulted in the highest catches ever recorded for Partridge Breast, Northern Indian Lake and Billard lakes, and potentially impacted future commercial production on each of these lakes. Manitoba Hydro and the Special Agriculture and Rural Development Act fund provided a subsidy for a salvage fishery by covering transportation costs and fishing equipment respectively to 20 fishers, most of whom were from Ilford. Northern Indian Lake production exceeded 215,000 kg of Lake Whitefish within eight weeks (Adams et al. 1976; Barnes 1990). Partridge Breast, Fidler and Billard were also salvage fished in the summer of 1975 producing a total of 17,115, 12,865 and 10,933 kg of fish, respectively (MDMNR c1975). **POST-CRD** Following the 1975 salvage fishery, a summer fishery on Partridge Breast Lake resumed in 1981 and continued until 1985. A winter fishery was then started up in the 1997–1998 season and has continued consistently up to the 2013–2014 winter season (Figure 5.3.8A-7). Post-CRD Lake Whitefish catches are variable, as were pre-CRD catches, but Walleye and Northern Pike catches have increased post-CRD (Figure 5.3.8A-7). The fisheries on Fidler and Billard lakes were discontinued following the 1975 salvage fishery due at least in part to CRD, but also as a result of being economically unviable. Records indicate that Lake Whitefish were harvested again on Fidler Lake in the summers of 1985 and 1986 (Barnes 1990), but no records for other fish species or recent production were found. Billard Lake was last fished in 1975 (Volume 3, Split Lake Cree-Manitoba Hydro Joint Study Group 1996). Northern Indian Lake continued

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	to produce after the salvage fishery into the mid-1980s (see Figure 5.3.8A-7), averaging an annual production of just over 18,600 kg of Lake Whitefish between 1976 and 1986 (Barnes 1990). No information was available on harvest of other species from 1976–1986 and on harvest of any species from 1987–1995. Based on available information, Northern Indian Lake was fished by residents of Ilford up to and including 1978, residents of both Ilford and South Indian Lake during 1979, and residents of South Indian Lake after 1979 (MFB, unpubl. data). The current quota is 25,000 kg of Lake Whitefish, Walleye and Lake Trout and only a small proportion of quota has been taken. From 1996 to 2013, the lake has averaged approximately 3,600 kg of Lake Whitefish, 3,200 kg of Walleye and 120 kg of Lake Trout for a total average quota production of 6,500 kg annually plus 3,300 kg of Northern Pike, a non-quota species. Lake Trout were last reported harvested in 2004.
2. Does Manitoba Hydro plan to continue its: waterways management program, debris management program and water level forecasting programs in perpetuity, or how far into the future is it predicted to go? Have any alternatives been considered to mitigate the problems or addressing them in a different way?	The Waterways Management Program, Debris Management Program and Water Level Notification Program will continue into perpetuity as long as there is a need for the programs and consistent with various settlement agreements. The programs are intended to enhance safety on affected waterways for local users, and thereby encourage continued access and use. The Debris Management Program continues to involve First Nations and impacted communities in determining priorities. With the support of Manitoba Hydro, local communities determine main travel routes, shoreline access, and priority sites for debris management activities. Residents of local communities are hired to manage and perform this work. The Waterways Management Program supports and promotes the safety of people travelling on waterways affected by Manitoba Hydro's operations. This includes boat patrol, debris management, and safe ice trails programs. Manitoba Hydro's Debris Management Program is acknowledged by our peers as one of the best of its kind in North America. Improvements to the Program are made on a continual basis with the emergence of new technology and information, and with the identification of new priorities at the community level. For example, over time we have gained an increasing appreciation of the role debris plays in shoreline stabilization and fish habitat, and this knowledge has been incorporated into debris management activities. Given the collaborative nature of the Waterway Management and Debris Management programs, and their overall effectiveness, alternatives to the program have not been considered.

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3. When did sturgeon studies begin? mitigation studies? and how long are they expected to carryon into the future?	The answer to this depends somewhat on the definition of “study”. The RCEA used isinglass data from the HBC archives as far back 1832 to look at historic populations in the Norway House/Cross Lake area. Several studies aimed at understanding Lake Sturgeon in the Nelson River in relation to the management of the commercial fishery were conducted circa 1955 – 1960. A Natural Resources Institute practicum documenting the views of the domestic fishers from the upper Nelson River, published in 1992 and relying on considerable historical and interview data was also used to provide some historical perspective. Focused studies on sturgeon in the Nelson River started around 1985 near the Long Spruce and Limestone Generating Stations and have continued to present. During this time, there have also been several long term research/enhancement studies/initiatives. These include Manitoba Hydro initiatives such as the corporate Lake Sturgeon Stewardship and Enhancement Program and the Grand Rapids hatchery which is now owned and funded by Manitoba Hydro as well as collaborative activities such as the Nelson River Sturgeon Board and the Kischis Sipi Namao Committee on the lower Nelson River with representatives from the First Nations harvesting in the area and study/work with sturgeon. Extensive assessment and pre-construction studies were conducted for the Keeyask Generating Station and post-construction monitoring is scheduled to continue until 2037 or until a self-sustaining population is established.
4. On page 3.4-32 it was indicated that Manitoba Hydro does not allow construction workers to possess firearms while in camp. When did Hydro begin restricting possession of firearms in camp; when did Hydro begin restricting hunting and fishing activities of construction workers.	Documentation could not be located to confirm the exact date or project these restrictions came into existence.
5. Manitoba Hydro’s construction program for its infrastructure in the RCEA ROI was extensive and involved many temporary facilities such as worker camps, construction areas and borrow pits. It appears that for the more recent projects such as Wuskwatim and Keeyask these projects have involved a commitment to fully restoring such temporary areas. Is that assumption correct? For projects earlier than Wuskwatim, does Manitoba Hydro possess an inventory of such areas? Has Manitoba Hydro reported any contaminated or impacted sites to the province? Are there plans to clean up and rehabilitate these temporary sites?	Manitoba Hydro has started on a process to move forward on rehabilitating disturbed past project sites that are no longer required by Manitoba Hydro. The Wuskwatim and Keeyask Projects had vegetation rehabilitation plans developed as part of their license. Temporary areas have been reseeded and/or replanted at Wuskwatim. At Keeyask some areas have been already been replanted, and addition rehabilitation will occur as temporary areas are no longer needed for construction. Manitoba Hydro’s potentially contaminated site program systematically identifies lands the Corporation has owned, operated or affected to assess the potential for contaminant conditions. Sites

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	are documented, investigated, prioritized, and remediated if required, in consultation with Manitoba Sustainable Development and in compliance with contaminated site regulations. The program provides assurance that impacted sites do not pose a threat to human health or the environment. Manitoba Hydro works with affected local Indigenous communities to incorporate their knowledge and concerns, and to provide employment opportunities.
Part IV Water	
6. For water elevation graphs shown in Part IV on the Water Regime there appear to only be averages, it would be helpful if the lake monthly elevation levels could also be provided showing the respective upper and lower quartiles and deciles pre and post development. Could this be provided for the following waterbodies: Little Playgreen; Playgreen south; Kiskittogisu; Cross; Sipiwesk; Split; Gull; Stephens; South Indian Lake; Churchill River below Fidler Lake Discharge; Churchill River above Red Head Rapids Discharge; Footprint Lake; and, Burntwood River near Thompson Discharge. (These could be provided electronically as part of the reference package)	Graphs showing upper and lower quartiles and deciles are included for Little Playgreen (Nelson River East Channel at Norway House), Kiskittogisu, Cross, Sipiwesk, Split, Southern Indian Lake, Churchill River below Fidler Lake Discharge, Churchill River above Red Head Rapids Discharge, Footprint, and Burntwood River near Thompson Discharge. Water levels on Little Playgreen can be used as a proxy for water levels on Playgreen south. “Water level records for the Southern basin of Playgreen Lake at WSC station 05UB005 prior to LWR are only available for parts of a few summers. For this reason, station 05UB001 (Nelson River east channel at Norway House) on Little Playgreen Lake is used as a proxy for Playgreen Lake levels as it has been in operation since 1913 and water levels at the two location have a strong correlation (Figure 4.3.2-8).” (Page 4.3-19 RCEA Phase II Report) A continuous water level record is not available for Gull or Stephens Lake before hydroelectric development so quartile and decile graphs cannot be prepared for these locations.

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7. Have any comparable reference locations/watersheds been identified with water quality data that might give more clues to what predevelopment water quality was like?	There are pre-Project water quality data for some sites (e.g., Southern Indian Lake) but the data are generally limited. Water quality at off-system sites has been monitored through the Coordinated Aquatic Monitoring Program since 2008. However, the off-system sites are not referred to as reference sites as they are not similar enough to the on-system sites to be called true reference sites. It is also difficult to find reference sites for some of the larger waterbodies such as the Nelson River as they are unique in the ROI. The information from the off-system sites does, however, assist in determining the effects of changes fthat may be ubiquitous across the area (e.g., climate change).
8. While the emphasis of the water quality analyses was to focus on statistically significant differences in the values of different parameters, both temporally and spatially; were there any trends in parameters over time/space that, while not significant, may warrant further attention – was this considered/examined?	Trends in water quality were evaluated and identified in the RCEA in several manners including synthesis and description of results from published literature and through analysis of raw data. The primary ways that trends were addressed is summarized below. • Published literature in which formal trend analyses was reported, was synthesized and the results described (e.g., Jones, G., and Armstrong, N. 2001. Long-term trends in total nitrogen and total phosphorus concentrations in Manitoba streams. Manitoba Conservation Rep. No. 2001-07, Water Branch, Water Quality Management Section, Manitoba Conservation, Winnipeg, MB. 173 pp.). See Section 5.2.2.3.1 (page 5.2-28), Section 5.2.5.3.1 (page 5.2-82), and Section 5.2.10.3.1 (pages 5.2-173 and 5.2-174), for examples. • Raw data were evaluated for indications of recent trends, notably for indications of upward trends in concentrations (i.e., indications of potential deterioration in water quality), through qualitative review of raw data plotted over time. For example, several water quality metrics (total phosphorus, hardness, specific conductance, and major ions) were noted to exhibit a recent upward trend at some sites in the upper Nelson River (Section 5.2.2.3.1, page 5.2-28; Section 5.2.2.3.4, page 5.2-32; Section 5.2.2.3.5, page 5.2-33; Section 5.2.3.3.4, page 5.2-51; Section 5.2.3.3.5, page 5.2-52; Section 5.2.4.3.1, page 5.2-63; Section 5.2.4.3.5, page 5.2-69); and; • Non-linear trends over time were also described for the post-development period based on qualitative review of the raw water quality data and in conjunction with hydrological information.

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	For example, water quality conditions were noted to oscillate over time in the lower Nelson River (i.e., oscillating trends) which were described and characterized as a result of the varying influence (i.e., relative discharge) of the two main tributaries (i.e., the upper Nelson and Burntwood rivers) to the region (see Section 5.5.2.4, page 5.2-93, for example).
9. In the review of the mercury section the Report would benefit from some kind of graphic that shows fish mercury concentrations spatially in areas affected by hydroelectric developments in the ROI. It is difficult to really understand how mercury levels in fish changed in areas affected by hydroelectric developments. To that end, it would be useful if maps with different coloured dots for different peak fish mercury concentrations for all of the ROI could be used. Different maps could be created for different time periods, showing where fish mercury increased/decreased at different times. This would assist in identifying any spatial insights into areas of higher concentrations or spatial trends along rivers. Such plots may also be helpful in visually assessing the likelihood of cumulative effects downstream. Is it possible to provide such an alternative presentation of data?	Due to the extensive databases on fish mercury levels, this would require a substantial amount of effort. It also may not provide information that is particularly accurate. There are a number of good data sets but the lakes were not sampled yearly. The exact date that fish mercury concentrations peaked in a specific waterbody is, therefore, unknown. The current graphs showing fish mercury increases and decreases over time for specific waterbodies provide a more accurate assessment.
10. A comparison of the abilities of models predicting peak fish mercury concentrations has been done and it was found that considering the effects of upstream flooding (multiple sites) performed better than standalone site models, in some cases. This suggests that there can be a cumulative downstream effect. Factors examined included when reservoirs were constructed (e.g. within a decade of each other), the water travel time between reservoirs on the same system, and whether downstream waters merged with other large rivers that could dilute the effects of upstream flooding. Has statistical analysis or modeling of the potential for cumulative downstream effects been done or considered?	This was not considered as there are empirical fish mercury data for downstream sites, which negates the need to model it. It would also be difficult to do as lakes often act as sinks, which may balance off inflows.
11. The Phase II Report acknowledges the limitations of the use of historical data alone for determination of the effects of hydro development on the water regime (Part IV, Section 4.3.1): "The amount of pre-hydroelectric development data is limited because other than longer term records at a few sites many gauging stations in Northern Manitoba were established in the 1950s and 1960s, sometimes only a few years before hydroelectric development. These earlier records contain data gaps and were	The in depth analysis, which consisted of simulating water levels and flows that would have occurred without hydroelectric development in the Region of Interest, is described in the following three RCEA Phase II Report Appendices: Appendix 4.3A: An Assessment of the Hydraulic Impacts of Lake Winnipeg Regulation and the Churchill River Diversion on the Nelson River Appendix 4.3B: An Assessment of the Hydraulic Impacts of the Churchill River Diversion on the Upper

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often more limited because of access and recording equipment issues. In cases where the data is more limited, the effects of hydroelectric development on the water regime are described where possible but are more qualitative. In addition, direct comparisons of data can sometimes lead to incorrect conclusions regarding the effects of hydroelectric development. This is because differences in hydrological conditions in the periods of record pre- and post-hydroelectric development can affect flows and water levels regardless of whether hydroelectric development took place. In these cases, a more in depth analysis is conducted including simulating water levels and flows that would have occurred without hydroelectric development." Was the in-depth analysis described above performed using the spreadsheet models developed for determination of effects of Lake Winnipeg Regulation (LWR) on flows and lake levels in the Nelson River downstream of Jenpeg Generating Station,[1] referenced in Section 4.3.2 of Part IV of the Phase II Report?	and Lower Churchill Rivers Appendix 4.3C: An Assessment of the Hydraulic Impacts of the Churchill River Diversion on the Rat and Burntwood Rivers
12. In Part IV, Physical Environment, analyses are conducted by Hydraulic Zones but, unlike other major analytical areas, there is no summary roll-up that would speak to aggregate impacts across the ROI. Such summaries were provided in other Parts of the RCEA. Would the Working Group please comment on the different approach taken in Part IV in this regard and what it might contribute to the RCEA?	Physical Environment analyses were conducted in this manner because the physical environment in each of the 12 Hydraulic Zones is affected by hydroelectric development in a unique way. As referenced in section 4.1.1.1 "…However in order to assess information in a more meaningful fashion, these four reaches have been subdivided into 12 hydraulic zones (Map 4.1.1-1). In general, these zones run between control structures or generating stations, reflecting logical steps along the regulated system encompassed by the ROI, and representing reaches where similar conditions and effects would be expected." We will also discuss this more in detail at the Workshop.
13. The methods used to evaluate the magnitude of erosion and sedimentation, on cursory observation by the panel, would appear to underestimate these impacts. Could you provide further clarification of the choice of methods, available data and how the outcome may be influenced?	Because little historical information existed, the erosion assessment used satellite and air photo imagery to identify to the extent possible the erosion before development and between the time of development and present day. Analyses were performed to a level that could be executed within the time frames of the study. A significant limitation on the work was the resolution of the imagery, which

[1] Manitoba Hydro (March 9, 2015). *Lake Winnipeg Regulation Report in Support of a Request for a Final Licence under the Water Power Act*. Winnipeg, Manitoba Canada

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	determines the lower limit of erosion that can be detected (e.g., 90m or more for satellite images). More detailed air photo analyses may be possible in some areas, including consideration of more intervening time periods, which would help elucidate temporal changes. The assessment may appear to under-represent the total amount of erosion because ‘small’ erosion is not identifiable. However, the study broadly describes where the greatest extents of erosion have occurred and may be ongoing. It has significantly added to the understanding of past and current erosion conditions, which has never been studied to this extent over the Nelson, Churchill and Burntwood river systems. Because historical data were available with respect to sedimentation, this component of the work was more retrospective in nature. Historical information (studies, journal articles, etc.) was summarized along with data from more contemporary and ongoing studies such as environmental impact studies and monitoring for recent generation projects. This review and synthesis describes effects of past hydro developments and the current conditions in areas affected by Manitoba Hydro developments, providing a comparison with pre-development information to the extent it might be available. This approach was consistent with the RCEA Terms of Reference.
14. Fish Community Summary A “table of effects” summary that identifies key changes to the fish habitat, fish community and populations of key species by area and waterbody/reach would be helpful to assess if any broadly-based trends are apparent that could be the result of individual or cumulative effects. The summaries at the end of each section would serve as a beginning for this table. A possible qualitative approach to such a summary table is provided below. There may be additional relevant habitat changes or changes to fish communities or populations that it would be desirable to include. Changes could be characterized as yes/no (i.e. seasonal flow reversal) or increase/decrease/ no change/insufficient data (i.e. changes in abundance) or more specific (i.e. fish community shift from whitefish to walleye/suckers). Colour coding of cells would aid in interpretation. Would it be possible to produce such a summary table? (see attached)	To produce the table discussed above, would require a considerable amount of work even for a single component such as the fish community because of the number of waterbodies in the ROI combined with the number of species of interest and metrics. More importantly, producing a summary table such as the one appended to the question would over-simplify the results of the assessment, and would even obfuscate the interpretation of the results in some cases. Producing the table by the four areas would be difficult as waterbodies are affected differently within some area (e.g., Kiskitto Lake dammed and water levels stabilized, but Kiskittogisu was converted to a flow through system). This, would result in many effects being described as both + and –, which would not improve the readers understanding of the effects of hydroelectric developments in the area. Whereas, producing the table by waterbodies would result in a large number of rows of data, with many of the columns stating “insufficient information”, as there is very little data for many of the waterbodies in the ROI. The repetition of “insufficient information” could erroneously imply that there is a lack of understanding about the effects of hydroelectric development in the ROI, and minimize the substantial number of scientific studies that have been conducted. Such a table could also erroneously imply that all of the effects described are the direct result of hydroelectric development. For example, in the case of Lake Sturgeon, abundance has decreased in

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	many areas, but this effect is primarily attributable to commercial fishing. In another case, the decreased catches in gill nets observed in Playgreen Lake in more recent surveys compared to those conducted in the 1980s are likely the result of differences in the sampling strategy between studies, with the earlier surveys targeting two species rather than conducting whole-lake sampling. These important details would be lost in a summary table reducing effects to a simple word or symbol.
15. Change in Habitat Area and Type Is it possible to include quantification of fish habitat and change in fish habitat as a metric for fish community and Lake Sturgeon and provide, in tabular form, the area of habitat (and for riverine habitats, also the length) that was present pre- and post-development, broken down by habitat types, as well as the number, pre- and post-development, of key habitat features such as rapids and barriers to upstream fish migration. This information could be broken down geographically in a manner that maximizes its relevance to the fish community and Lake Sturgeon RSCs. Overall totals could also be provided. At a minimum, the habitat breakdown should distinguish between lacustrine (lake) and riverine habitat, with further subdivisions with respect to depth, substrate and velocity to the extent that is feasible/practical.	As discussed in the documents prepared for RCEA, there are very limited pre-project data of any kind for many of the hydroelectric developments due to their age. Even post-project, quantifiable data on fish habitat is limited for many reaches simply due to the size of the ROI, which includes a distance of approximately 1,500 km (940 miles) from the outlet of Lake Winnipeg to the Nelson and Churchill River estuaries. In particular, quantitative data for substrate and velocity is lacking. Table 4.3.1-1 on Page 4.3-2 (Section 4.3.1) of the RCEA Phase II Report includes the flooded and dewatered area for each hydroelectric development in the ROI. However, this information would not account for other effects hydroelectric development has had on fish and their habitat such as seasonal changes in flow patterns and increased fluctuations in water levels.
16. von Bertalanffy Growth Curves: It is important to be clear that the coefficients of the von Von Bertalanffy growth curves are derived from the input data and that differences in the size/age distributions of fish in the input data set affect those coefficients. The effect of the age/size distribution of the fish that are used to construct von Bertalanffy growth curves on the coefficients that describe the shape of the curves is acknowledged in some sections of the report. Some examples include: • Section 5.3.6.3.2 (page 5.3-124) states *Although fish* [lake whitefish] *from Area 1 currently show a faster growth rate before reaching maturity, the von Bertalanffy curves predict that they attain a smaller maximum size than they did historically (Figure 5.3.6A-13). The difference in the curves in SIL Area 1 may be a factor of fewer large fish (> 500 mm/2000 g) being captured in more recent surveys than were in the 1980s.*	While the sample size and range data of the von Bertalanffy growth curves could be tabulated as requested, because of the number of years, focal species, and waterbodies in the ROI, this task would take a considerable amount of time to complete. Although both of these factors are important with regards to derivation and interpretation of a growth curve, they are unlikely to clarify interpretation of the curves beyond what has been outlined in the text. Since there is little added value in compiling this information, we would not recommend providing this additional information. It should be noted that the coefficients for the growth curves are tabulated and the growth curves are presented graphically for each species by Area in appendices 5.3.2A, 5.3.3A, 5.3.4A, 5.3.5A, 5.3.6A, 5.3.7A, and 5.3.8A. A number of potential pathways of effect for the fish community are outlined in the RCEA. Fish growth (as measured using the von Bertalanffy growth model or VBGM metric) was selected as an indicator to assess the effects of these potential pathways on fish over time and among waterbodies. There are many ways fish growth can be quantified, the VBGM (and its coefficients - t_0, $L\infty$, k) was selected as it is widely used and possibly the simplest method to employ and interpret. As mentioned, there are also a

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• Section 5.3.7.3.3 (page 5.3-159) states *There was considerable difference in the growth of Walleye in several of the lakes from the 1980s to 2010s (Figure 5.3.7A-14). Walleye from Rat, Notigi, and Apussigamasi lakes now have a more rapid rate of growth during the early years (i.e., k has increased), followed by a slower rate for mature fish compared to the early post-CRD period, and the maximal size attained in Notigi and Apussigamasi lakes has decreased. The difference in the curves between sampling periods reflects differences in the age/size structure of the catch. There were few larger, older Walleye captured in the recent period compared the 1980s. Walleye as old as 31 years and 642 mm were captured in the 1980s, compared to recently, when the oldest fish was 18 years and 545 mm.* • In section 5.3.8.3.3 (Page 5.3-183) states *In comparison, Lake Whitefish from Billard Lake, on average, appeared to be larger at each successive age compared to Lake Whitefish from the other waterbodies, although k calculated for Lake Whitefish from Billard Lake was identical to those calculated for the other waterbodies. The growth curve fit (and its associated parameter values) to the 1981 Lake Whitefish data from Northern Indian Lake is slightly skewed, caused in part, by a lack of older fish (i.e., >14-years-of-age). This resulted in a very low estimated k value (k = 0.09) and a very high estimated theoretical maximum length (L∞ = 624).* • Section 5.3.3.3.3 (page 5.3-52) states *Growth curves were calculated only for decades in which Walleye were aged using otoliths. There was little difference in the growth of Walleye from the west basin of Cross Lake from the 1980s to 2010s, but there were considerable differences in the growth of Walleye from Sipiwesk Lake over this period (Figure 5.3.3A-17). The difference in the curves between decades could be a function of the small sample size of Walleye captured in 2011, or a function of differences in the age structure of the catch. In 2011, none of the Walleye captured were older than eight years; whereas, in the 1980s Walleye as old as 29 years were captured, with approximately 10% of the catch older than 15 years.* This last statement alludes to the potential inaccuracy of von Von Bertalanffy	number of drawbacks to utilizing the VBGM (i.e., see Enberg et al. 2008; Pardo et al. 2013).

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growth curves that are derived from sparse data. The Phase II report does not provide plots of the data from which the von Von Bertalanffy growth curves were derived nor does it provide samples sizes or length ranges or age ranges. In Appendix 5.3.1B (page 5.3.1B-5) where the methods for developing the von Von Bertalanffy growth curves are provided it is stated "To increase the sample size, fish were pooled from all years sampled within a given period for each waterbody." Can information be provided with respect to the sample sizes and data ranges used to derive the von Von Bertalanffy growth curves? Can some clarification be provide regarding the utility of the von Von Bertalanffy growth curves and their coefficients for assessing whether or not there have been effects on fish growth due to hydroelectric development (or other factors).	
17. Analysis of fish relative abundance: The relative abundance of fish species was expressed as the percentage of the catch which each species accounted for. An average relative abundance was calculated by summing the catches from all nets set over a given period of time (a decade in many cases) and dividing by the total catch during that same period. The average relative abundances are presented in bar charts. Ordination of the catch data using a measure of similarity (or dissimilarity) could provide additional insights into the changes that have occurred in the fish communities and how the past and current fish communities in areas affected by hydroelectric development and the offline lakes compare. Was ordination considered? What was the outcome?	Ordination for these types of biological community data (e.g., principal coordinates analysis) were considered, but were not conducted due to the differences in gear, season, and sampling intervals among the various historic studies. Because the data were not directly comparable in terms of method, effort, and periodicity it was decided pooling the data for an ordination was not an appropriate approach for the waterbodies in the ROI.
Part VI – Terrestrial	
18. Can further rationale be provided as to how shoreline effects along the Churchill, Burntwood, and Nelson river systems and associated waterbodies can be considered *local* effects (p. 6.1-7) rather than *regional effects*, given they encompass approximately 25,000 km of shoreline and represent the two largest river systems in northern Manitoba?	In responding, we have assumed that the page referenced in the question was intended to be 6.1-17 rather than 6.1-7. Effects on the Churchill, Burntwood, and Nelson river systems and associated waterbodies are referred to as "local" for an ecological reason and to address First Nations concerns. Both reasons seek to avoid having important effects masked by the regional context. • From the ecological perspective, hydroelectric development effects on shorelines were low in most of the terrestrial regions (<10% of shoreline length in 11 regions and <5% of shoreline length in 7 regions). However, it was important to include a focus on the large river systems even if shoreline

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	effects at the regional level were low or spatially concentrated. The ecological characteristics and functions of large river systems differ in some ways from smaller river systems. Also, hydroelectric development has had considerable effects on three of the four largest river systems that flow through the ROI. On this basis, the RCEA devoted a major mapping effort and report subsection (Section 6.3.8) to effects on the large river systems. • For First Nation concerns, the First Nation communities were originally situated on or near the large rivers and lakes. A report that only focused on the regional condition (which was the appropriate level for evaluating regional cumulative effects) would mask the direct (flooding) or indirect (loss of access) effects on the local areas harvested by the First Nations. In summary, the word “local” was not intended to minimize the importance of effects on the large river systems. Rather it provided a rationale for highlighting effects that were regionally low or spatially concentrated but were still of concern from the ecological or First Nations perspectives.
19. Would displacement/loss of the Gull Rapids gull colony not be a “high” impact since it represents more than 10% of the breeding population in that Terrestrial Ecoregion (and more if using Hydraulic Zones)?	Without mitigation, the displacement/loss of the Gull Rapids gull habitat may be considered a “high” impact. However, the Keeyask Hydropower Limited Partnership committed to developing alternate gull and tern nesting habitat during the construction of the Keeyask Generation Project, to mitigate the loss of the nesting habitat in Gull Rapids. An island and floating platform nesting habitats are currently available to waterbirds and are being monitored. A commitment was also made to develop a permanent waterbird nesting island near the future generating station to replace the loss of nesting habitat for gulls. Finally, other islands in the future reservoir will be formed during flooding. It is highly likely that some of these islands will be used by colonial waterbirds for future nesting. As a result of mitigation and the formation of other islands in the future reservoir, the loss of Gull Rapids gull nesting habitat is not expected to substantially affect the future regional gull population.
20. Does the reduced suitability of beaver habitat on-system represent a permanent loss in productivity for this species, and if so, how important is it with respect to the overall regional/ROI population?	The reduced suitability of beaver habitat on-system does not represent a permanent loss in productivity for beaver at the RCEA ROI scale. Permanent reduction in the suitability of beaver habitat (on-system) has occurred in some areas, such as on the larger river and lake systems where the combination of water regime (fluctuation and flow) and shoreline habitat loss (debris and erosion) resulted in a reduction of habitat quality. However, in respect to the overall RCEA ROI beaver population, some additional on-system habitat was created as a result of inland flooding, and the regional/off-system area containing the majority of beaver habitat in the RCEA ROI was largely not affected. Other factors, as described in Section 6.6.8, supporting conclusions regarding the overall

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	regional/ROI beaver population are provided below. • "Other factors may have affected beaver populations in addition to hydroelectric or other developments on the landscape, which makes it difficult to define the causes of apparent population trends. These include the price of beaver pelts, and changes in human consumption of beaver meat; both factors have likely lowered harvest pressure on beaver populations in recent years. • It is likely that the overall beaver populations in the RCEA ROI have not been substantially affected by hydroelectric development. • Beaver are extremely adaptable and have high reproductive potential. • Based on the current understanding of beaver populations in Manitoba, including the RCEA ROI, beaver populations are considered sustainable and capable of increased harvest in most areas. • There are no population data to directly support this conclusion. However, the availability of primary beaver habitat provides strong indirect support to this conclusion." It should be noted that although overall regional/ROI beaver populations have likely not been substantially affected, localized reduction of on-system beaver habitat in some areas has affected beaver abundance as well as trapping and resource user access. Factors include water fluctuation and increased flow resulting in poor ice conditions, erosion and accumulation of shoreline debris.
21. In the summary of effects for beaver (p. 6.6-79), when referring to populations not being "*substantially*" affected, how does that relate to established the benchmarks of <%, 1-10% and >10 used elsewhere in the RCEA?	The benchmarks described were utilized in the terrestrial habitat analysis and applied to determine a low (less than 1%), moderate (1-10%), or high (>10%) magnitude effect. As described in Section 6.6.1.3 (Benchmarks), "*There are no established benchmarks in the literature for assessing changes to beaver habitat. Regional habitat modeling for beaver was completed for each of the RCEA terrestrial regions to determine regional habitat availability in* km^2*. In addition, finer scale beaver habitat modeling was completed for the regulated, on-system areas to determine on-system habitat availability, in km where available data exist. All modeling was conducted for both the pre- and post-hydroelectric development periods.* *There are no established benchmarks in the literature for assessing changes to beaver populations. For this assessment, post-hydroelectric development population densities are only available for two terrestrial regions; therefore, data for these areas were used to assess relative change in populations due to hydroelectric development.*" The application of benchmarks used in the Terrestrial Habitat section would not be appropriate in

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	determining the magnitude of effect on beaver. Additionally, data on beaver populations and habitat utilization are extremely limited, and cannot be extrapolated across the RCEA ROI. As indicated in Section 6.6.8 (Effects of Hydroelectric Development in the Region of Interest on Aquatic Furbearers), it is likely that overall beaver populations have not been substantially affected based on the availability of primary habitat in the ROI. It should be noted however, that although overall regional/ROI beaver populations have likely not been substantially affected, localized reduction of on-system beaver habitat in some areas has affected beaver abundance as well as trapping and resource user access. Factors include water fluctuation and increased flow resulting in poor ice conditions, shoreline erosion and accumulation of shoreline debris.
22. Has hydroelectric development had an impact on moose populations in the ROI as a whole, and if so what magnitude?	Hydroelectric development impacts are detailed by terrestrial region because there is a large variation among each region. As such, it is extremely difficult to look at all of the terrestrial regions simultaneously, over time, and across such a large area, and provide a single response for the complex differences among all moose populations in the RCEA ROI as a whole. As demonstrated in RCEA Phase II, Section 6.10.8, Tables 6.10.8-2 and 6.10.8-3, the magnitude of impacts for the RCEA ROI range from mostly low, to some Terrestrial Regions having magnitudes at the low end of the moderate magnitude scale.
Chapter 6.2 – Intactness	
23. On Page 6.2-27, the RCEA states, "Regional cumulative effects on intactness have been low primarily because the human infrastructure footprint remains low. <u>Additionally, many features were situated near other existing human features or near or on the large rivers that already naturally fragmented the region</u>."	There are circumstances where impacts from the original structures are altered by the addition of new features. As noted on page 6.1-15, the combined effects of the features can be additive. An example of an additive effect on intactness occurs when vegetation clearing for a generating station near an existing road reduces the size of a core area or even eliminates it.
a. Locating features near existing human features is an important means of reducing fragmentation. However, are there circumstances where impacts from the original structures are altered by the addition of new features?	In some cases, the combined effects of the features can be subtractive. For example, the Wuskwatim Generation Project has reduced water level fluctuations on Wuskwatim Lake that were caused by the Churchill River Diversion.
b. The idea that large rivers naturally "fragment" the region seems at odds with the concept of intactness. Are large rivers not part of a contiguous mosaic of naturally occurring ecosystems and, therefore, part of an intact landscape if essentially undisturbed by human influence?	Fragmentation was taken to refer to any feature or process that either breaks habitat into smaller blocks or substantially reduces, or even deters, ecological flows. Fragmentation arises from natural as well as human features and processes (Forman 1995). This source of fragmentation was not discussed in the RCEA as this document's primary focus was on human impacts that caused fragmentation, and

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	reduced intactness. *Reference* Forman, R.T. 1995. Land mosaics: the ecology of landscapes and regions. Cambridge University Press, Cambridge, United Kingdom. 632 pp.
Chapter 6.3 – Terrestrial Habitats	
24. Is it possible to provide more detailed species descriptions in the Broad Habitat Types? For example, what shrub species commonly occur in the habitat type "tall shrub on riparian peatland"?	There is substantial variability in the species composition of the broad habitat types when viewed across all 17 terrestrial regions, primarily due to the wide range of climatic and surface material conditions. Only a few of the terrestrial regions have sufficient available data to characterize which are the commonly occurring understorey species. Additionally, it would take a considerable amount of effort to produce a characterization for each habitat type given there are over 90 broad habitat types and 17 terrestrial regions. Coarse habitat type descriptions completed for past project environmental impact statements are relevant for selected terrestrial regions. These descriptions would be representative for the terrestrial region they fall within, and also generally for the terrestrial ecozone. Please see bullet list below for reports that include such habitat descriptions. While the habitat classifications in these reports are not identical to that used in the RCEA, they would give a good sense of the common understory species. Smith et al. (1998) provides more general Ecodistrict level vegetation descriptions. • Wuskwatim and Paint terrestrial regions: ECOSTEM Ltd. and Calyx Consulting (2003) - Section 5.3.1.2.5. • Keeyask terrestrial region: ECOSTEM Ltd. (2016) - Section 7.3.2.2.6 and Section 7.3.4. • Limestone Rapids and Deer Island terrestrial regions: ECOSTEM Ltd. (2016) - Section 3.4.5. and Appendix B Section 7.4. *References* ECOSTEM Ltd. and Calyx Consulting. 2003. Wuskwatim Generation Project. Environmental impact statement. Terrestrial habitat. Volume 6, Section 5. April 2003. Prepared for Manitoba Hydro and Nisichawayasihk Cree Nation. ECOSTEM Ltd. 2012. Terrestrial habitats and ecosystems in the lower Nelson River region: Keeyask

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	regional study area. Keeyask Project Environmental Studies Program, Prepared for Manitoba Hydro. Report # 12-02. ECOSTEM Ltd. 2016. Terrestrial habitat and ecosystems in the Conawapa regional study area. Consolidated technical memo. Prepared for Manitoba Hydro. Smith, R.E., H. Veldhuis, G.F. Mills, R.G. Eilers, W.R. Fraser, and G.W. Lelyk. 1998. Terrestrial Ecozones, Ecoregions, and Ecodistricts of Manitoba: An Ecological Stratification of Manitoba's Natural Landscapes. Land Resource Unit, Brandon Research Centre, Research Branch, Agriculture and Agri-Food Canada. Research Branch. Technical Bulletin 1998-9E.
Chapter 6.5 – Colonial Waterbird Population – Coastal Hudson's Bay Ecozone	
25. Will any process for continued monitoring and reporting on the state of the environment into the future take into consideration impacts on the Important Bird Areas in the region? It is notable that the Important Bird Area established at Churchill and adjacent areas is one of two places in Canada where Ross's Gull breeds. This species is listed as "threatened" under Canada's *Species at Risk Act*, SC 2002, c29.	Manitoba Hydro has no current plans for continued monitoring and reporting on Important Bird Areas in the RCEA ROI, including Churchill where Ross's Gull breeds. Ross's Gull, which is listed as "threatened", breeds in the Akudlik area near Churchill. This site contains a viewing area, interpretative signage and a board, which posts daily sightings of rare birds.
General Questions	
26. Could the Working Group elaborate on the definition used for a Regional Cumulative Effects Assessment, and the underlying methodology employed? Are there broad over arching conclusions as a result of this analysis?	The CEC's Bipole III report indicated, "*During the Bipole III hearings, it became apparent that past hydro-electric developments in northern Manitoba have had a profound impact on communities in the area of these projects, as well as on the environment upstream and downstream…A regional cumulative effects assessment is needed for all Manitoba Hydro projects and associated infrastructure in the Nelson River sub-watershed…The regional assessment must include, but not be limited to, Jenpeg, Kettle, Long Spruce, Limestone, Bipole I, II and III and all associated transmission lines and infrastructure.*" This recommendation was accepted by the then Minister of Conservation and Water Stewardship and a MH/MB RCEA Terms of Reference was developed indicating the MB and MH undertake a retrospective assessment that describes environmental change over time as a result of previous hydro development, including impacts, mitigation measures, community issues, compensation and the current quality of the environment in areas affected by Lake Winnipeg Regulation, Churchill River Diversion and associated infrastructure. The region of study is greater than that identified in the CEC report which included the Nelson River sub-watershed.

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	Overall conclusions can be found in the summary sections for each RSC, as well as in the RCEA Integrated Summary Report. A few of the key conclusions in regards to the assessment were: a) that assessing the effects of hydroelectric development in the absence of other effects (e.g., commercial sturgeon fishing) would not have provided an accurate picture of what occurred; b) that it was important to provide some historical context, particularly in regards to the affected communities, to get a better understanding of the area prior to hydro development; and c) that looking at the terrestrial component without differentiating between areas accessible to, and primarily used by, the resource harvesters would have substantially underestimated the effects of Hydro's activities on the communities.
27. Were there or have there been any environmental studies of the effects of Kelsey Generating station?	As part of Phase I of RCEA, an extensive search of the available literature was conducted to identify all possible sources of material pertaining to the ROI. The results of these searches were compiled in a document entitled "Regional Cumulative Effects Assessment for hydroelectric developments on the Churchill, Burntwood and Nelson River system: Phase I Reports. This document is available online at https://www.hydro.mb.ca/regulatory_affairs/rcea/ Information located regarding the effects of the Kelsey GS was included in this document (see Section 5.0 Water and Land). Some key studies identified in Phase I include: • the Lake Winnipeg, Churchill and Nelson River Study Board reports (1973 survey of Sipiwesk Lake); • the Canada-Manitoba Agreement on the Study and Monitoring of Mercury in the Churchill River Diversion (1983 survey of Sipiwesk Lake); • a Post-Project Environmental Review conducted by McKay, Davies, and Westdal that looked at the effects of LWR and Kelsey on Wabowden (1990); • a study funded by Manitoba Hydro in response to claims for domestic and commercial sturgeon fishing losses by the Cross Lake Band of Indians looked at the effects of LWR/Kelsey on sturgeon McCart 1992); • a joint assessment by Manitoba Hydro and the Split Lake Cree of hydroelectric development in the Split Lake Resource Management Area (1996); • the work by Manitoba Hydro for the re-runnering/turbine work at Kelsey (2006-2013); • some sturgeon genetic studies done as part of Manitoba Hydro's Lake Sturgeon Stewardship and

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	Enhancement Program (2008-ongoing); and • monitoring of Sipiwesk Lake as part of CAMP (2008-ongoing) Where possible, the data from some of these studies were included in the quantitative assessment of the effects of hydroelectric development as part of the RCEA Phase II. In other cases, information presented in these sources was used qualitatively as part of the Phase II assessment.

Graphs showing upper and lower quartiles and deciles are included below for Little Playgreen (Nelson River East Channel at Norway House), Kiskittogisu, Cross, Sipiwesk, Split, Southern Indian Lake, Churchill River below Fidler Lake Discharge, Churchill River above Red Head Rapids Discharge, Footprint, and Burntwood River near Thompson Discharge.

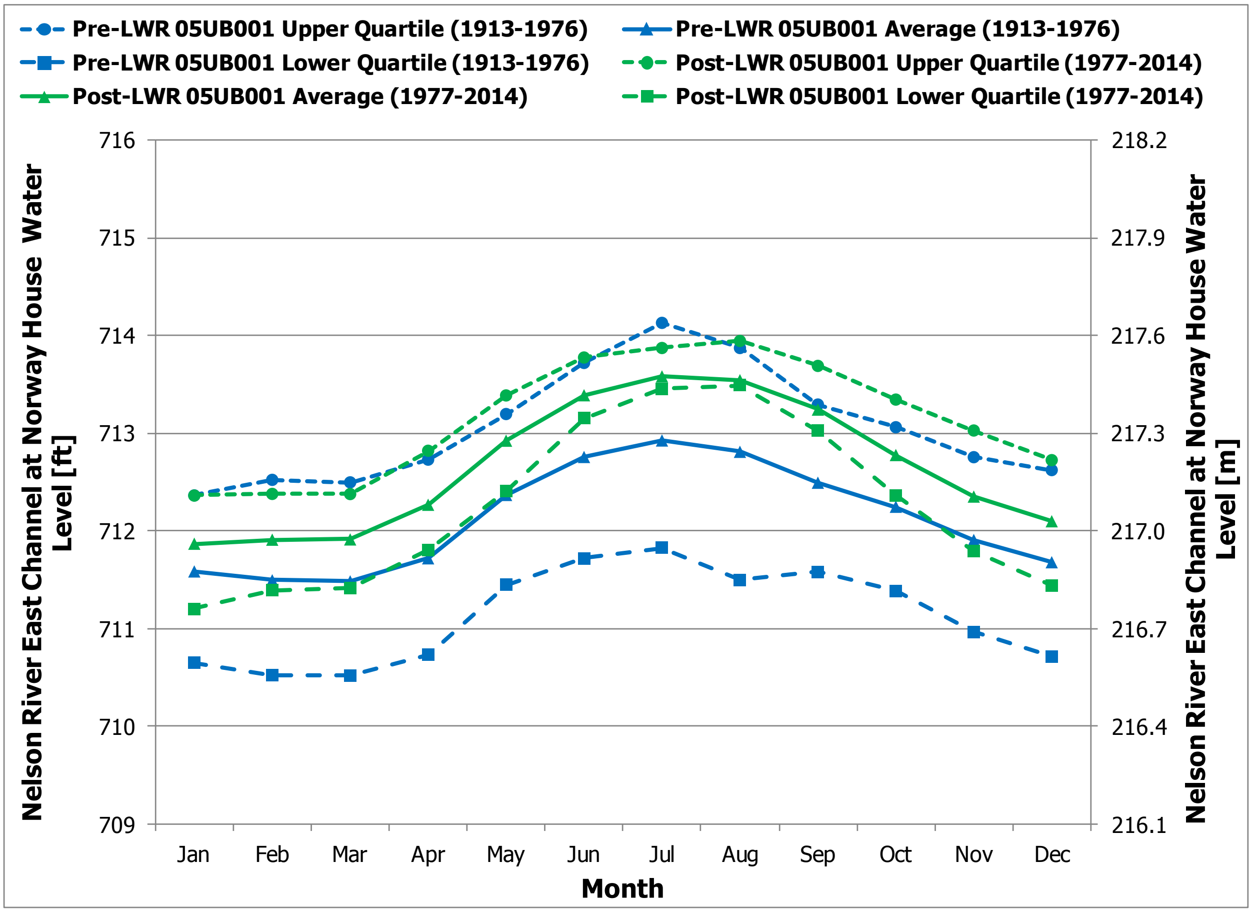

Figure 1: **Monthly Average Nelson River East Channel at Norway House Water Levels with Upper and Lower Quartiles**

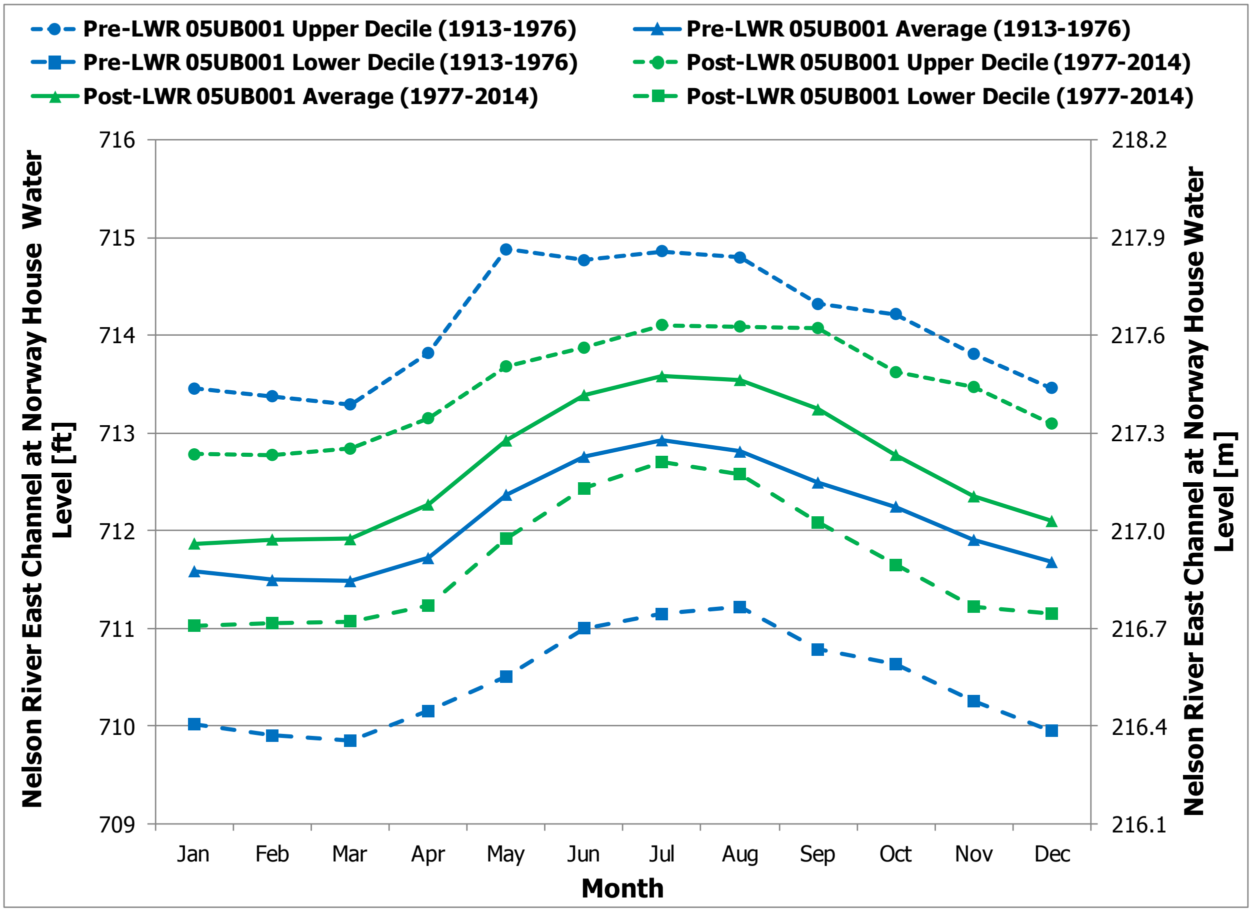

Figure 2: **Monthly Average Nelson River East Channel at Norway House Water Levels with Upper and Lower Deciles**

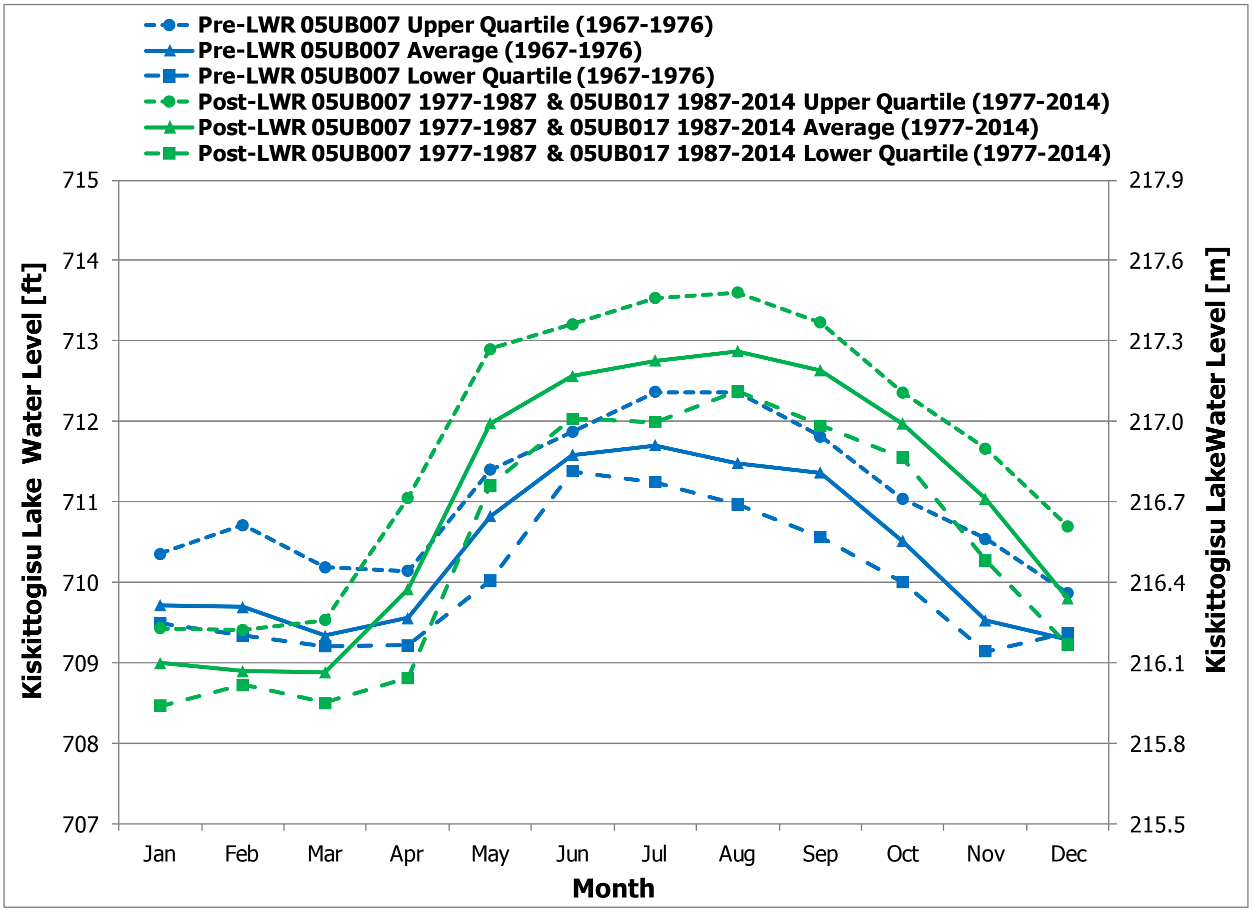

Figure 3: **Monthly Average Kiskittogisu Lake Water Levels with Upper and Lower Quartiles**

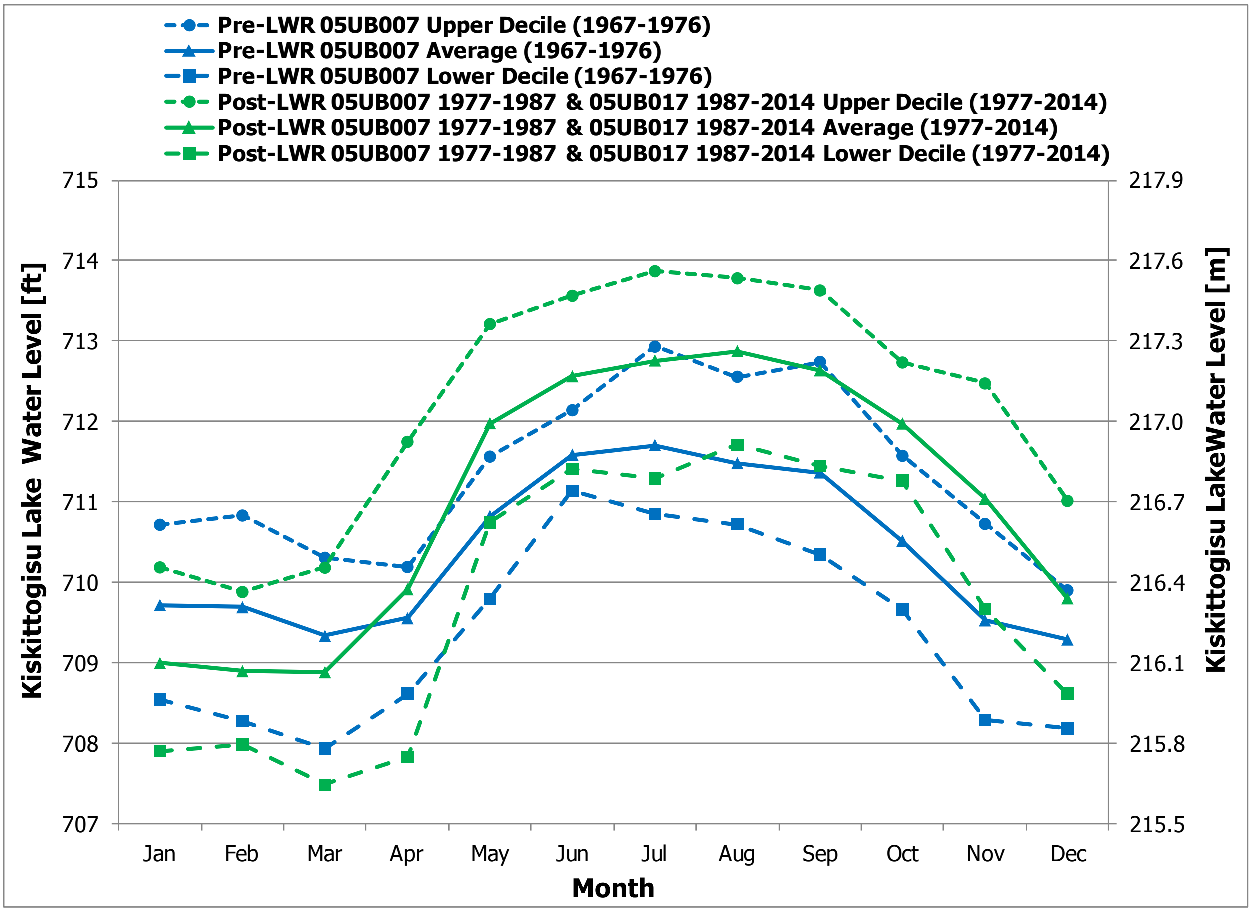

Figure 4: **Monthly Average Kiskittogisu Lake Water Levels with Upper and Lower Deciles**

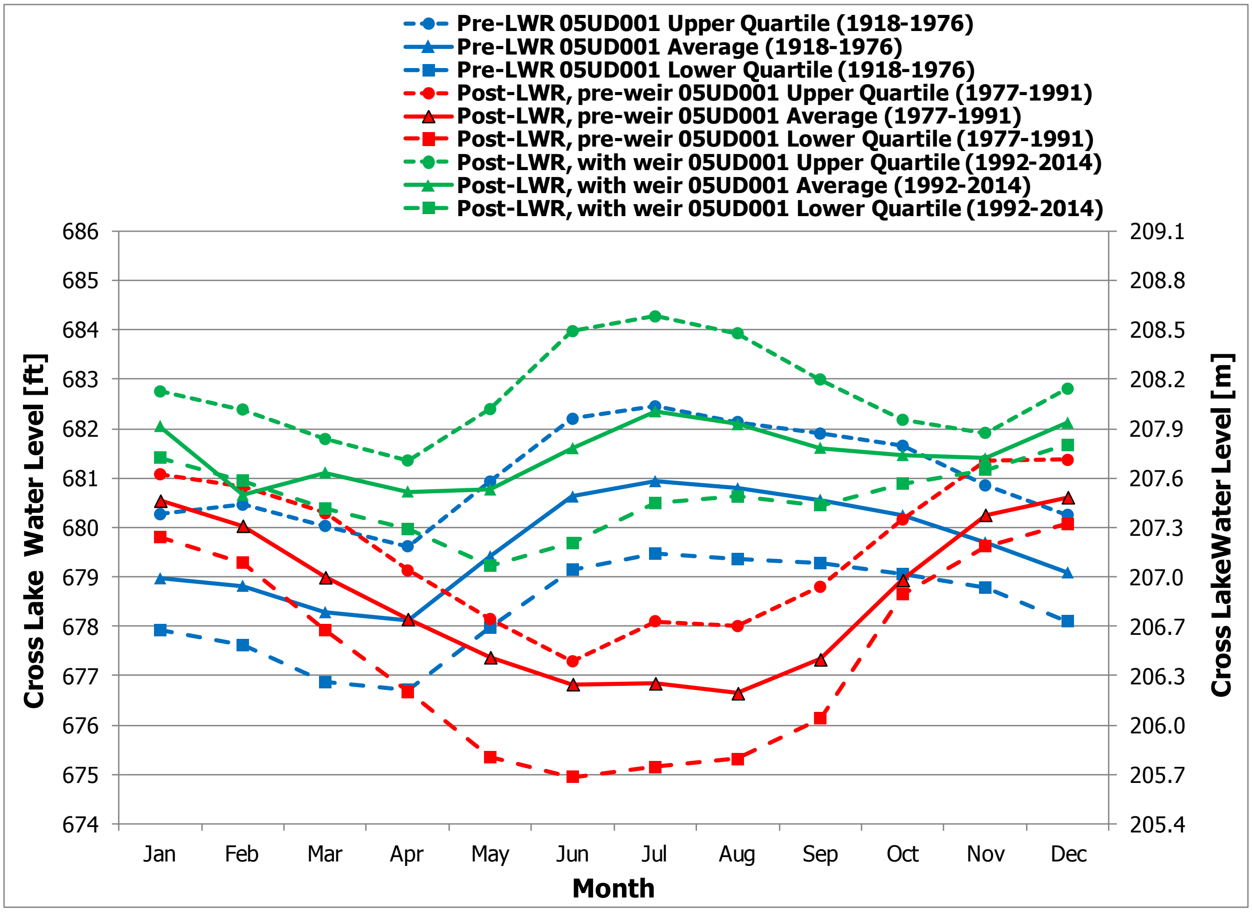

Figure 5: **Monthly Average Cross Lake Water Levels with Upper and Lower Quartiles**

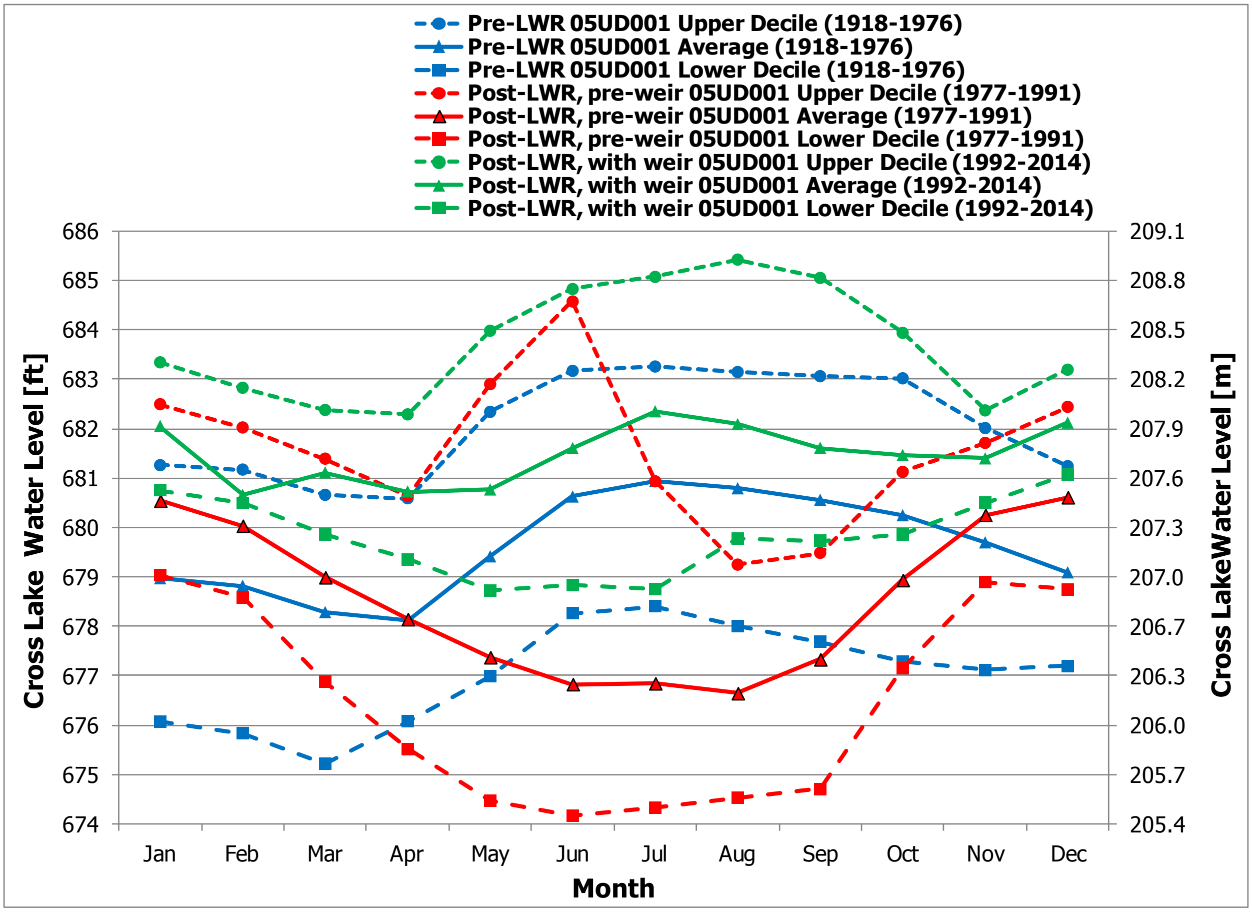

Figure 6: **Monthly Average Cross Lake Water Levels with Upper and Lower Deciles**

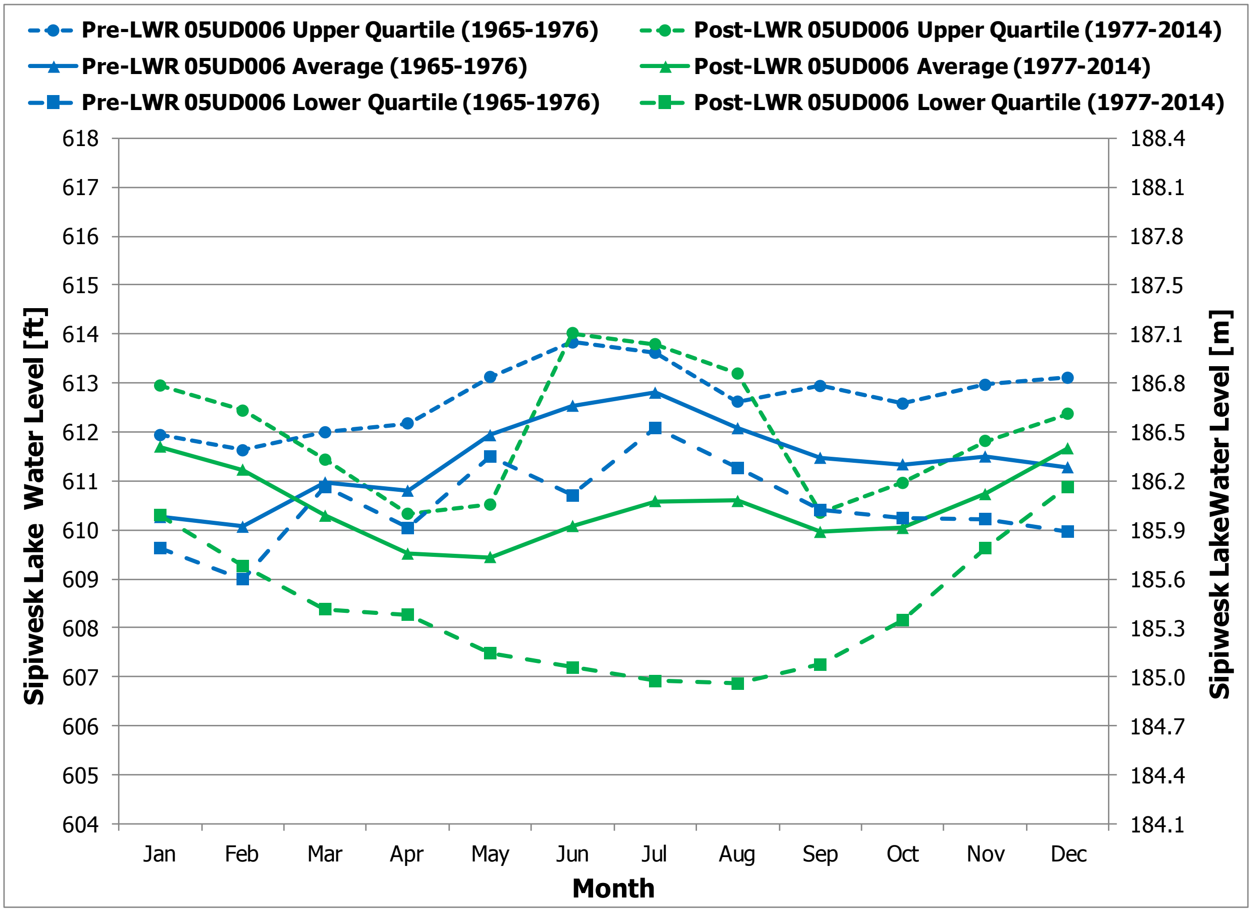

Figure 7: **Monthly Average Sipiwesk Lake Water Levels with Upper and Lower Quartiles**

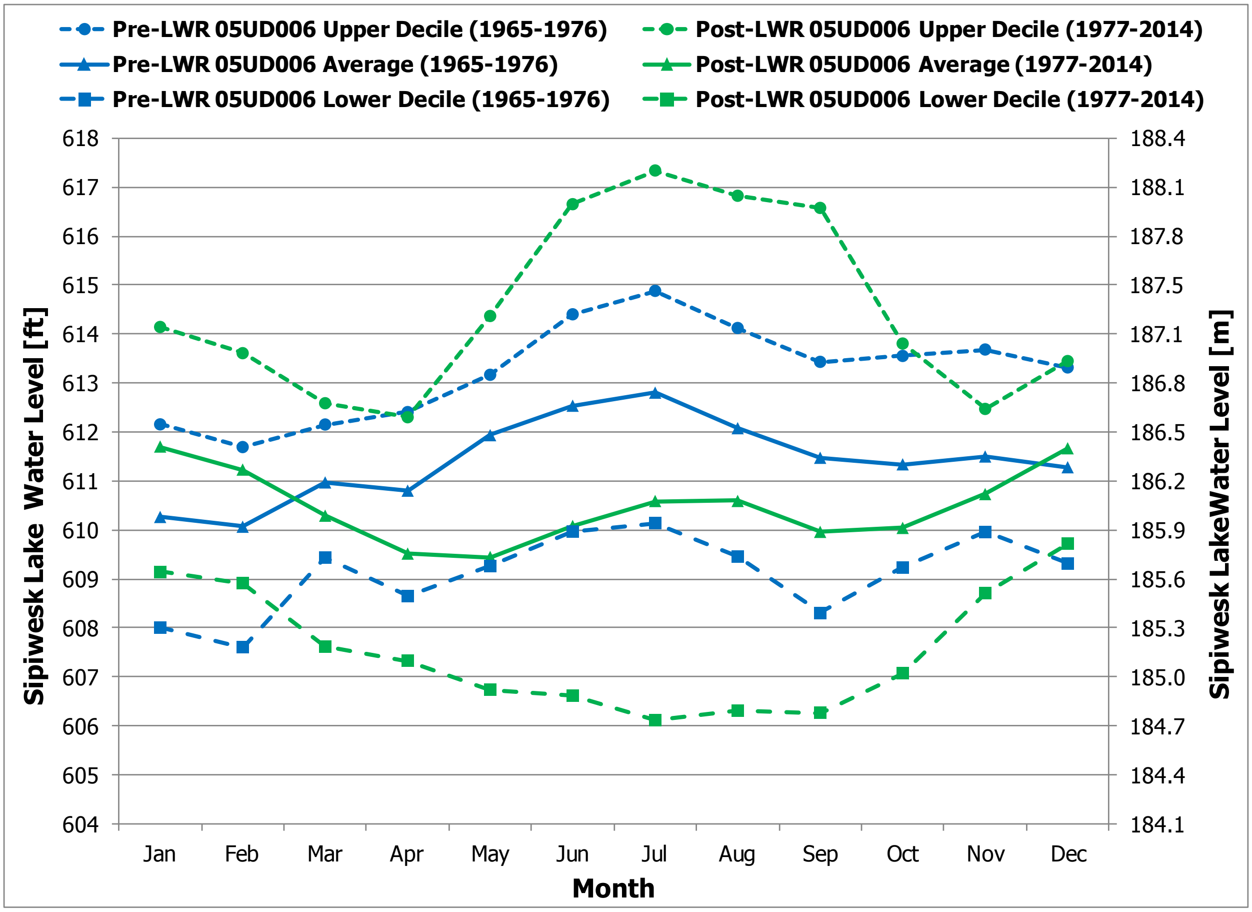

Figure 8: **Monthly Average Sipiwesk Lake Water Levels with Upper and Lower Deciles**

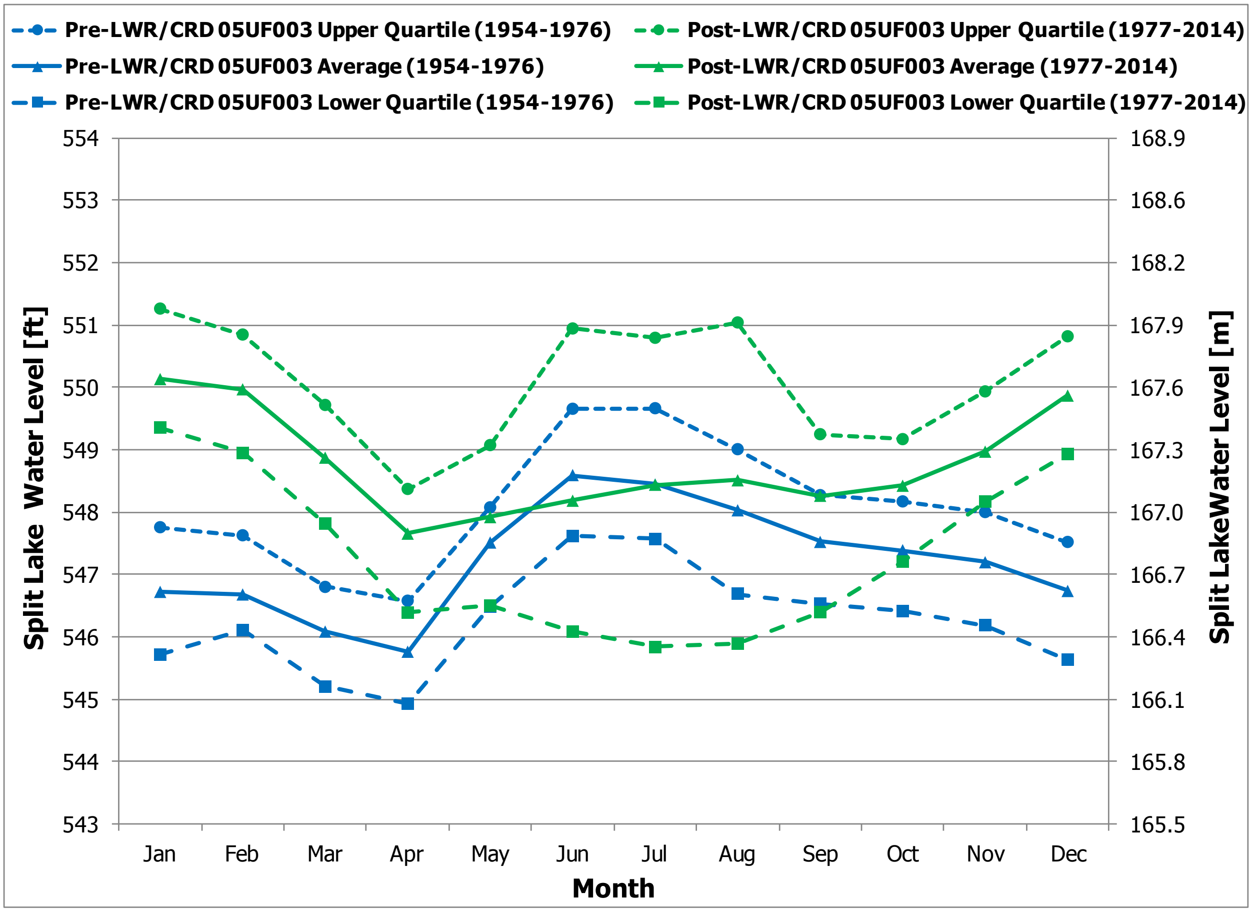

Figure 9: **Monthly Average Split Lake Water Levels with Upper and Lower Quartiles**

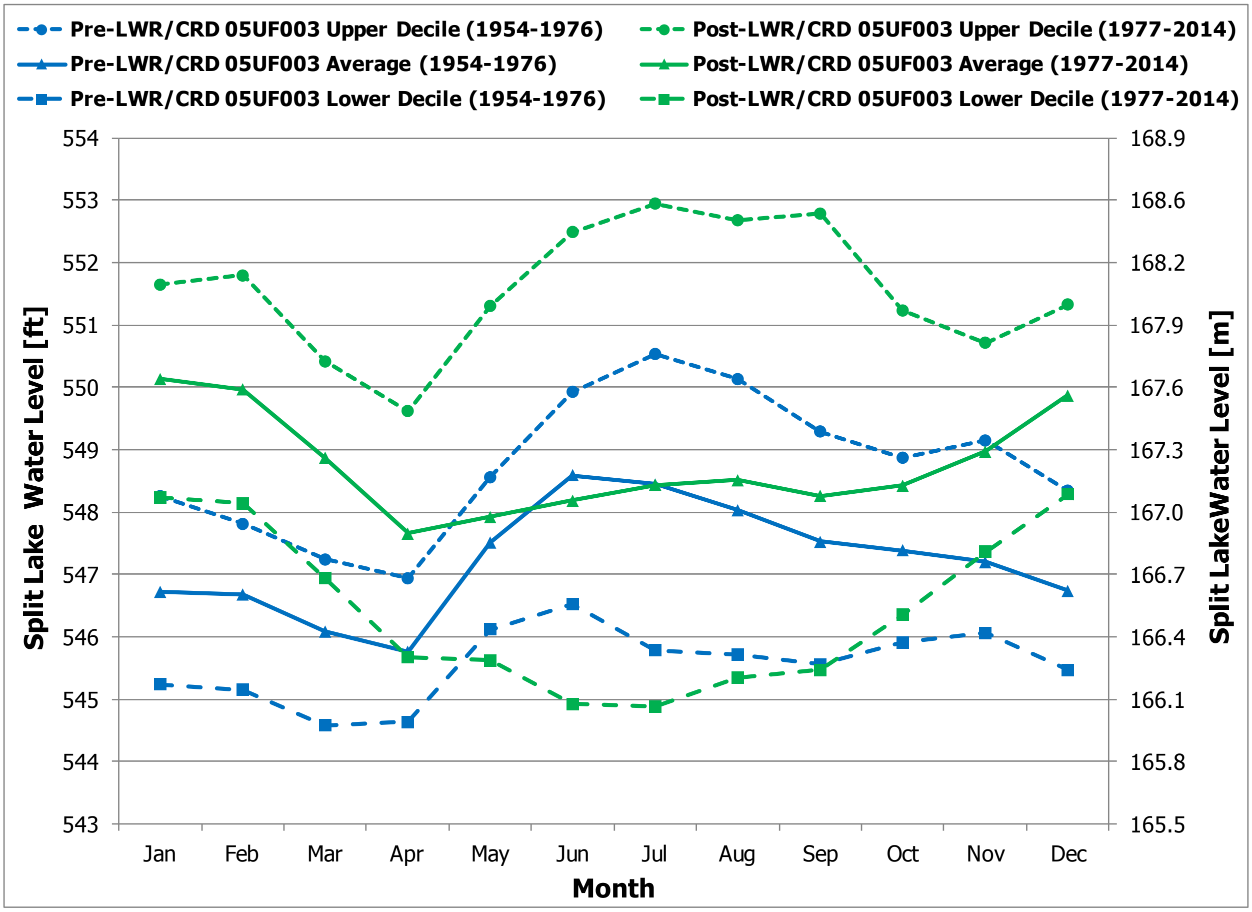

Figure 10: **Monthly Average Split Lake Water Levels with Upper and Lower Deciles**

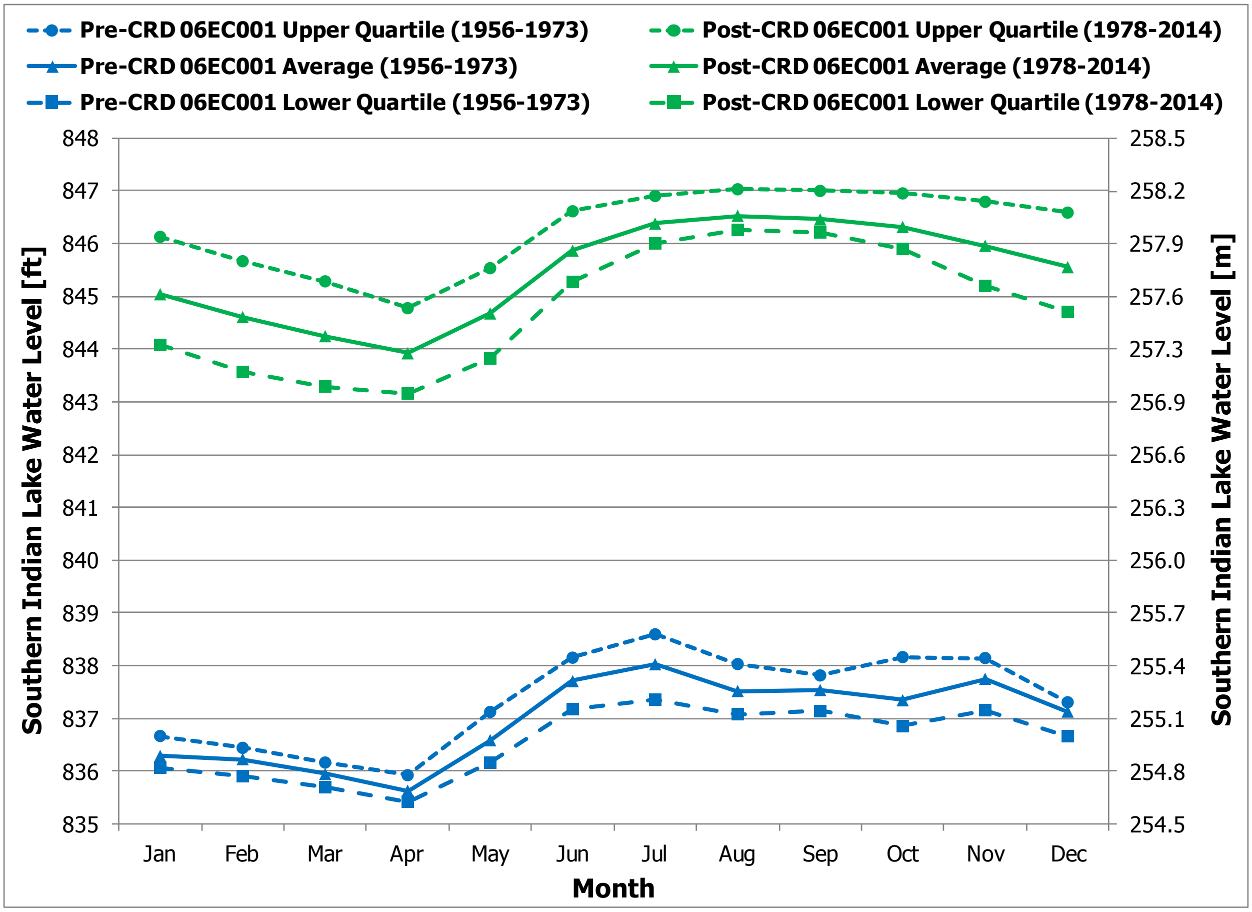

Figure 11: **Monthly Average Southern Indian Lake Water Levels with Upper and Lower Quartiles**

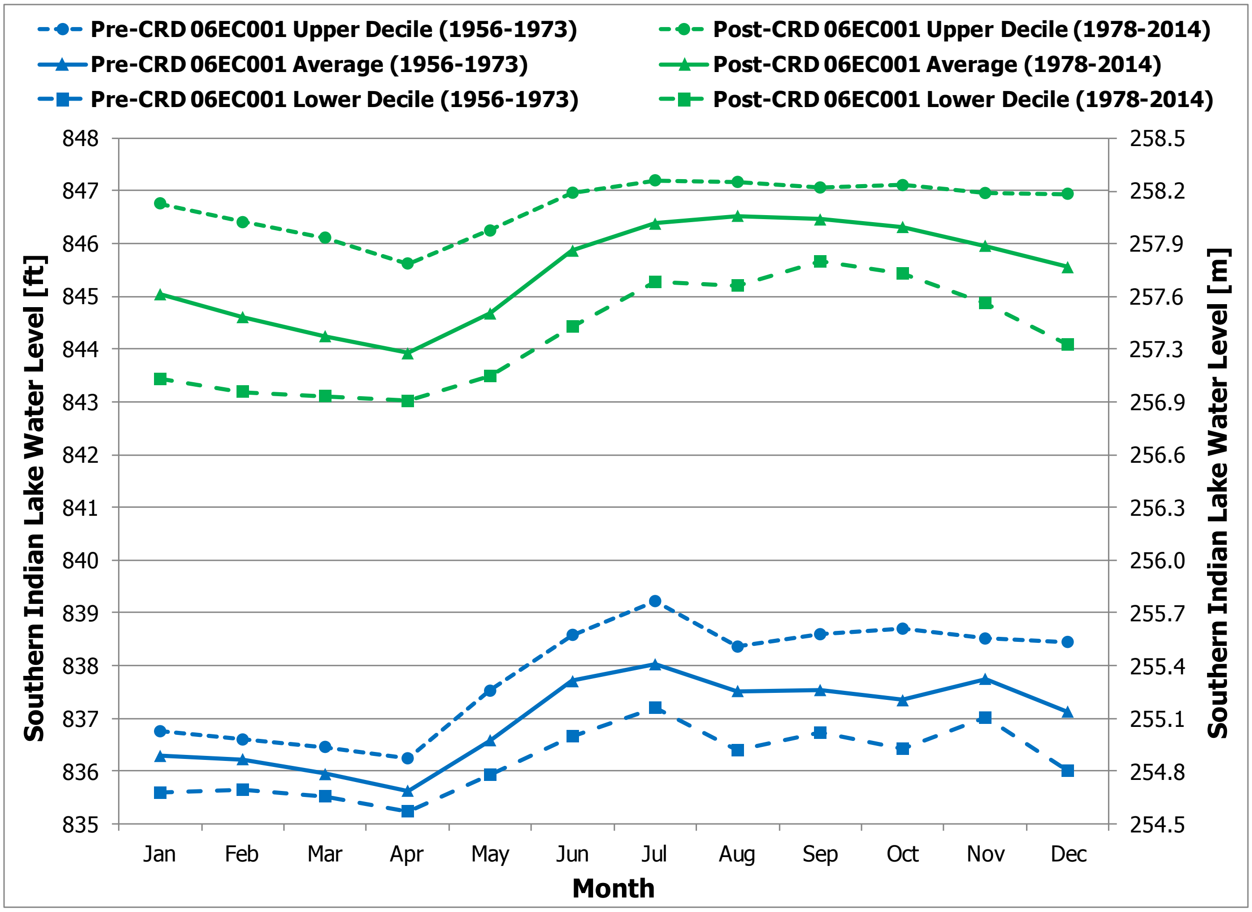

Figure 12: **Monthly Average Southern Indian Lake Water Levels with Upper and Lower Deciles**

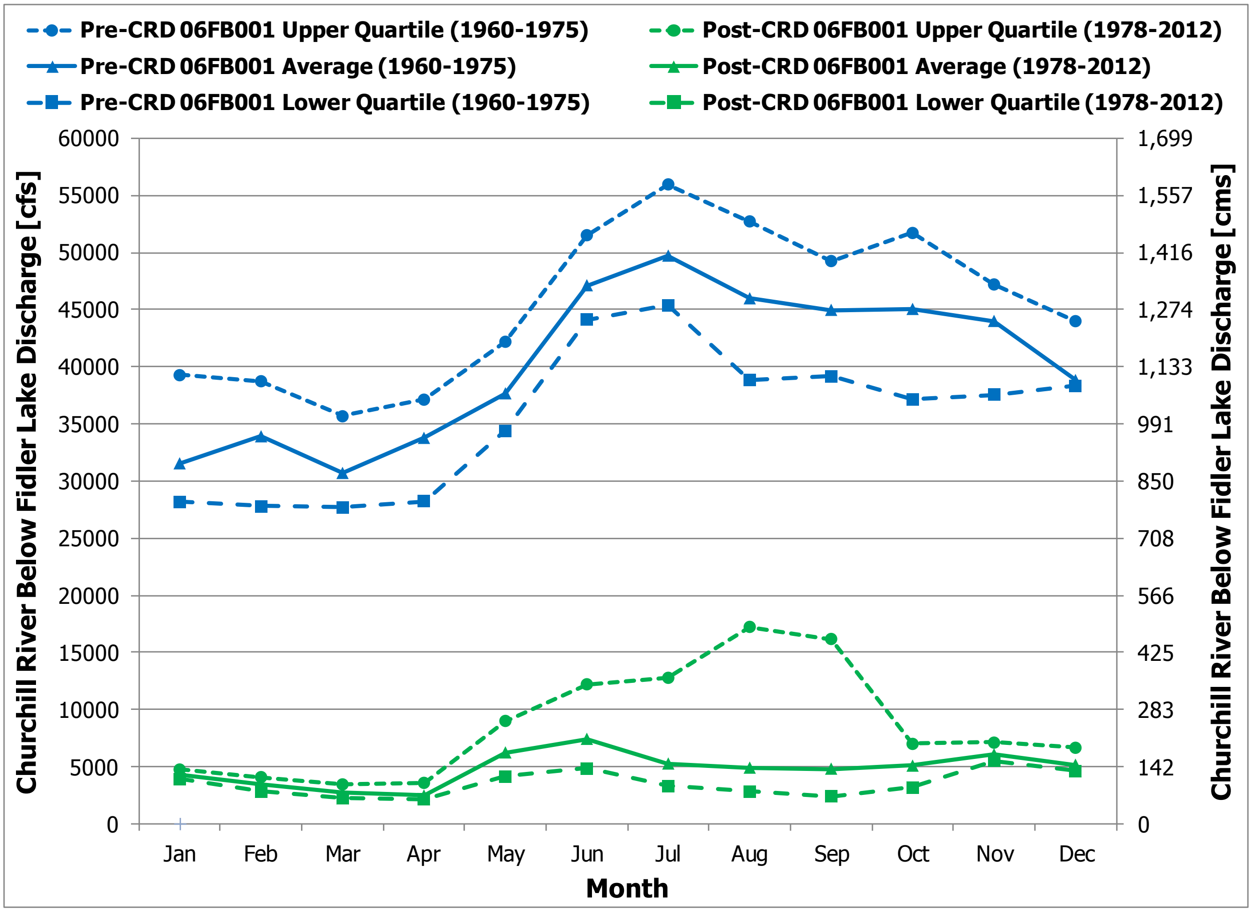

Figure 13: **Monthly Average Churchill River below Fidler Discharge with Upper and Lower Quartiles**

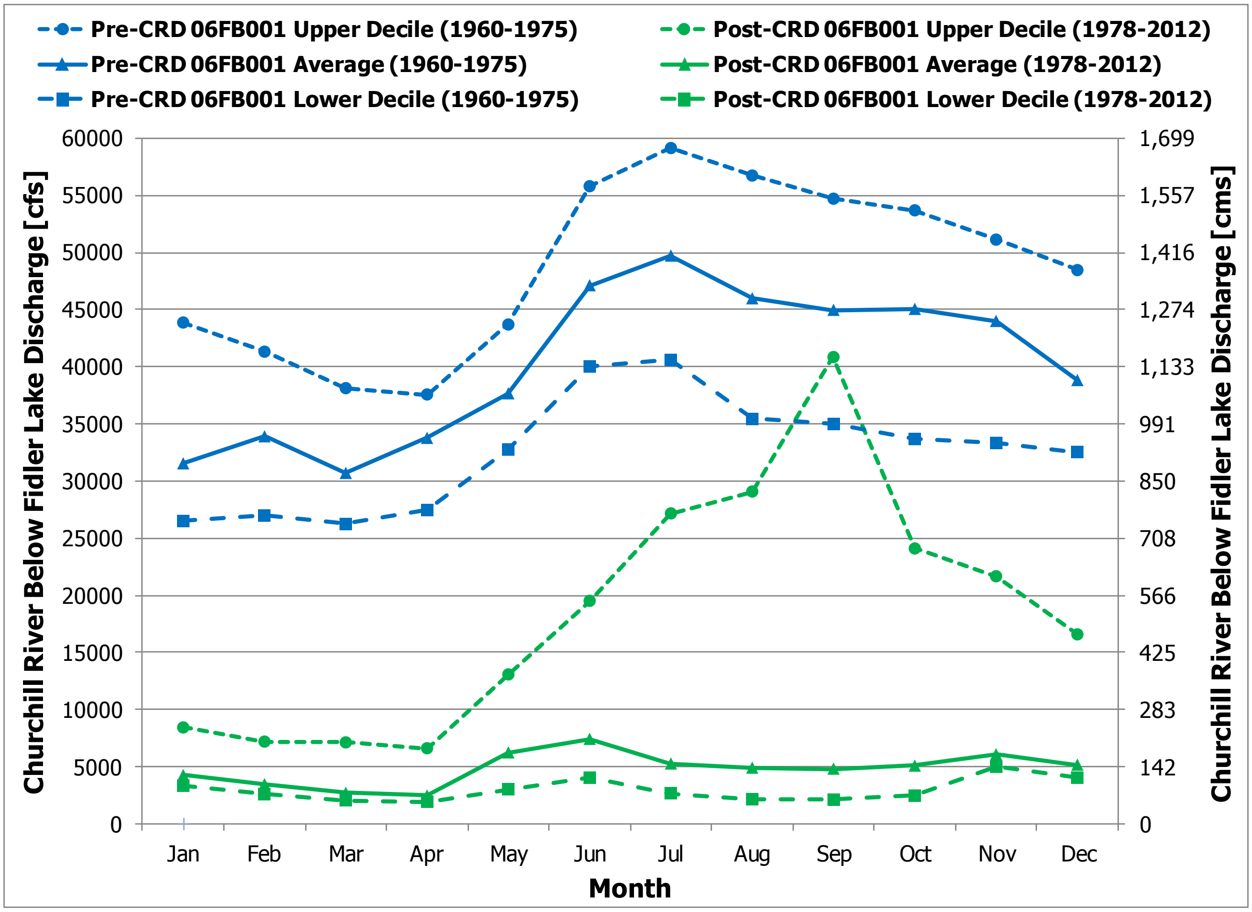

Figure 14: **Monthly Average Churchill River below Fidler Discharge with Upper and Lower Deciles**

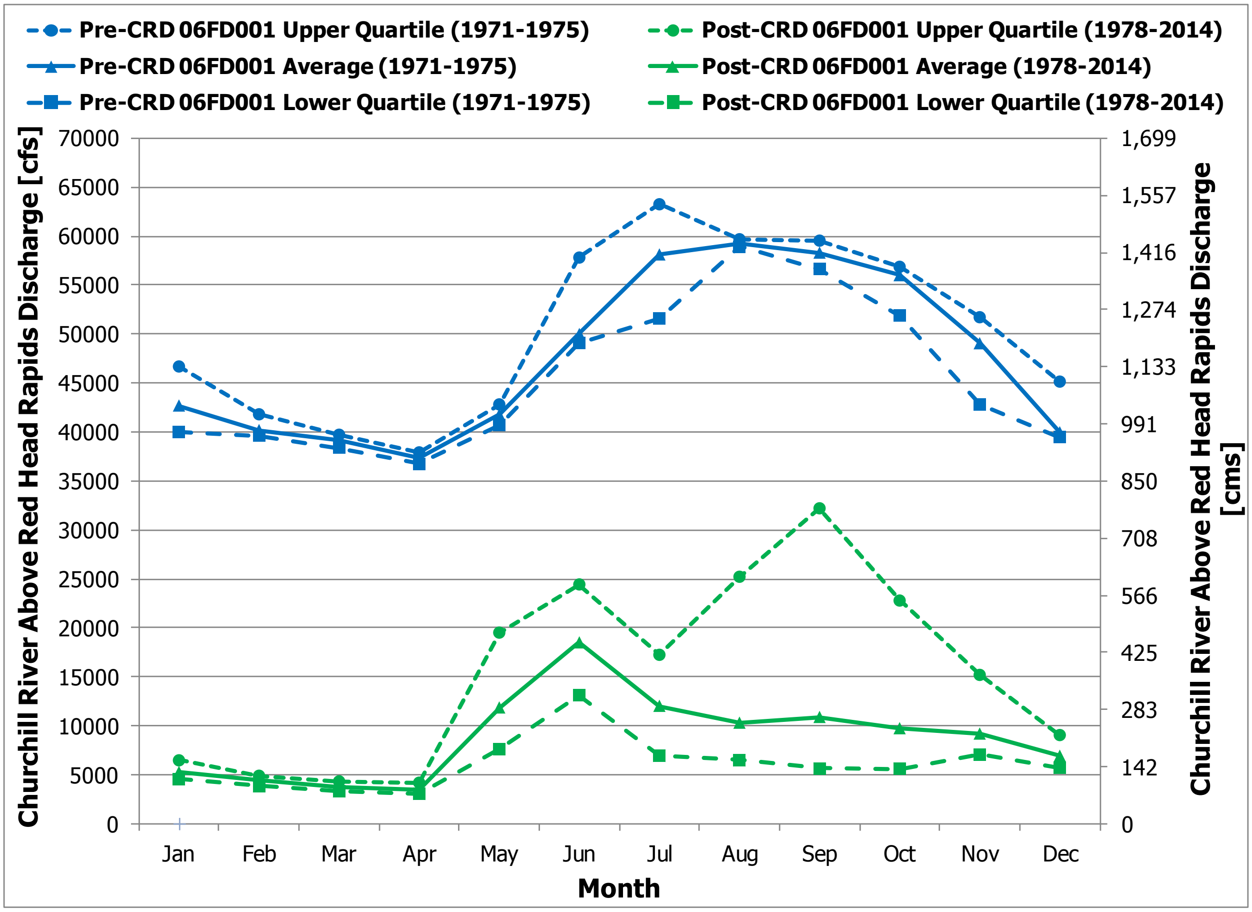

Figure 15: **Monthly Average Churchill River above Red Head Rapids Discharge with Upper and Lower Quartiles**

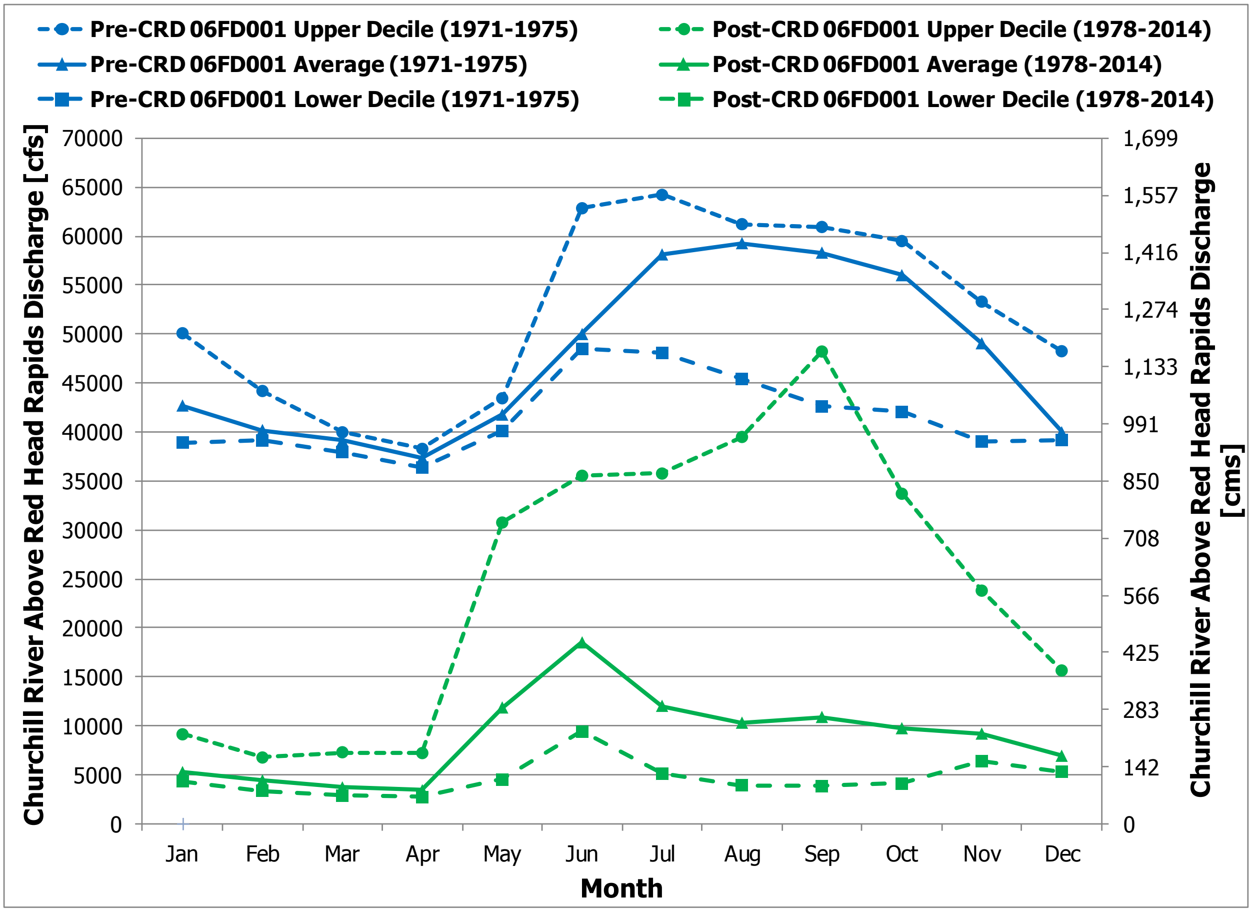

Figure 16: **Monthly Average Churchill River above Red Head Rapids Discharge with Upper and Lower Deciles**

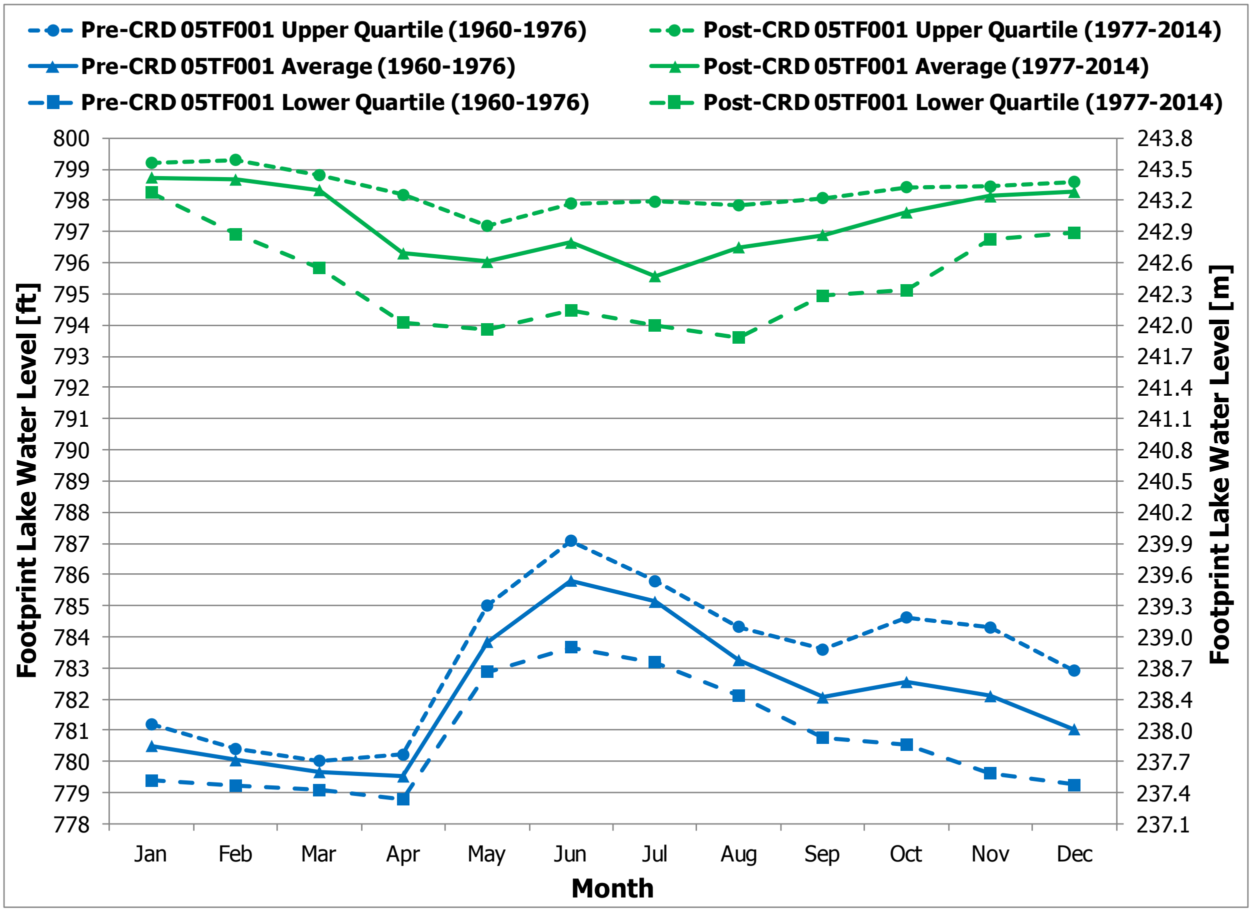

Figure 17: **Monthly Average Footprint Lake Water Levels with Upper and Lower Quartiles**

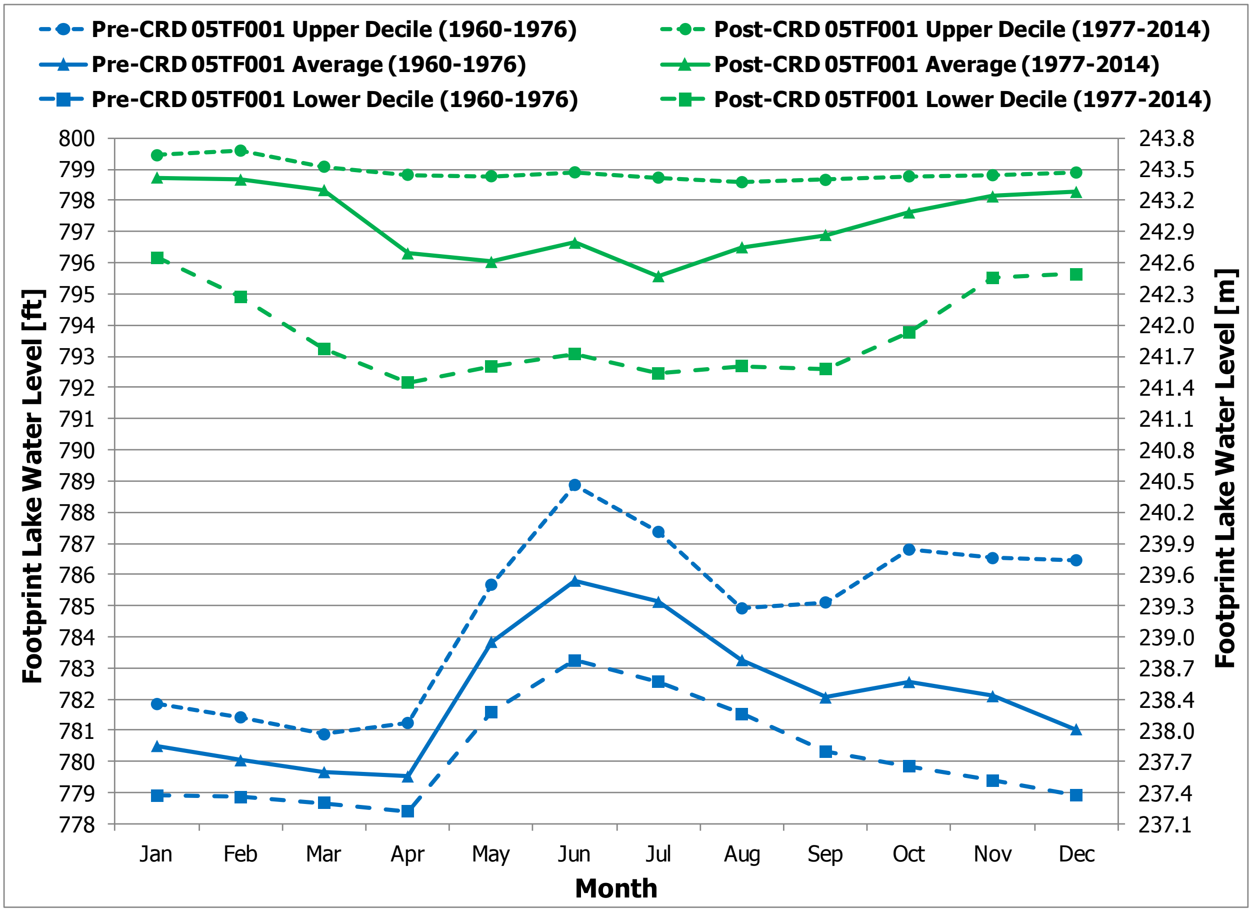

Figure 18: **Monthly Average Footprint Lake Water Levels with Upper and Lower Deciles**

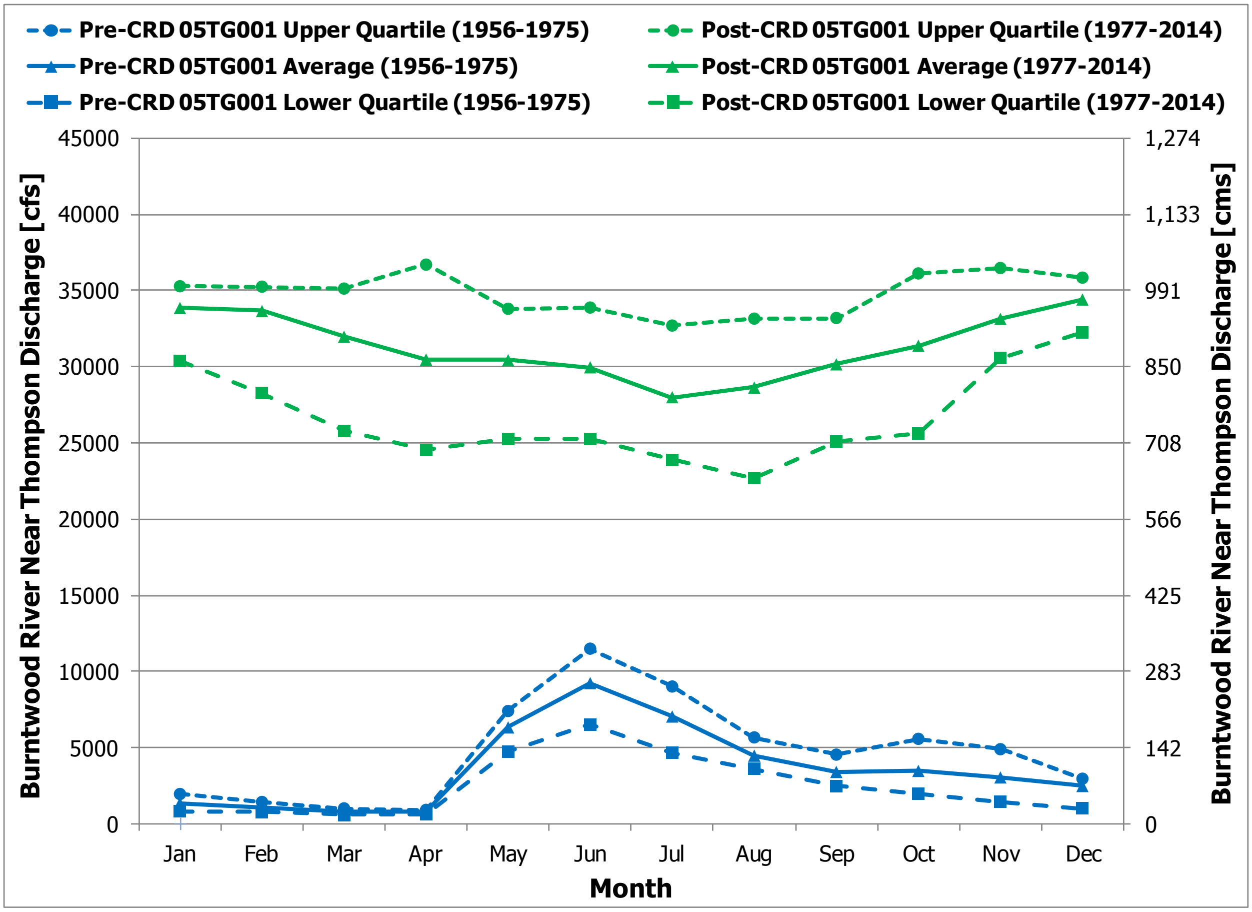

Figure 19: **Monthly Average Burntwood River near Thompson Discharge with Upper and Lower Quartiles**

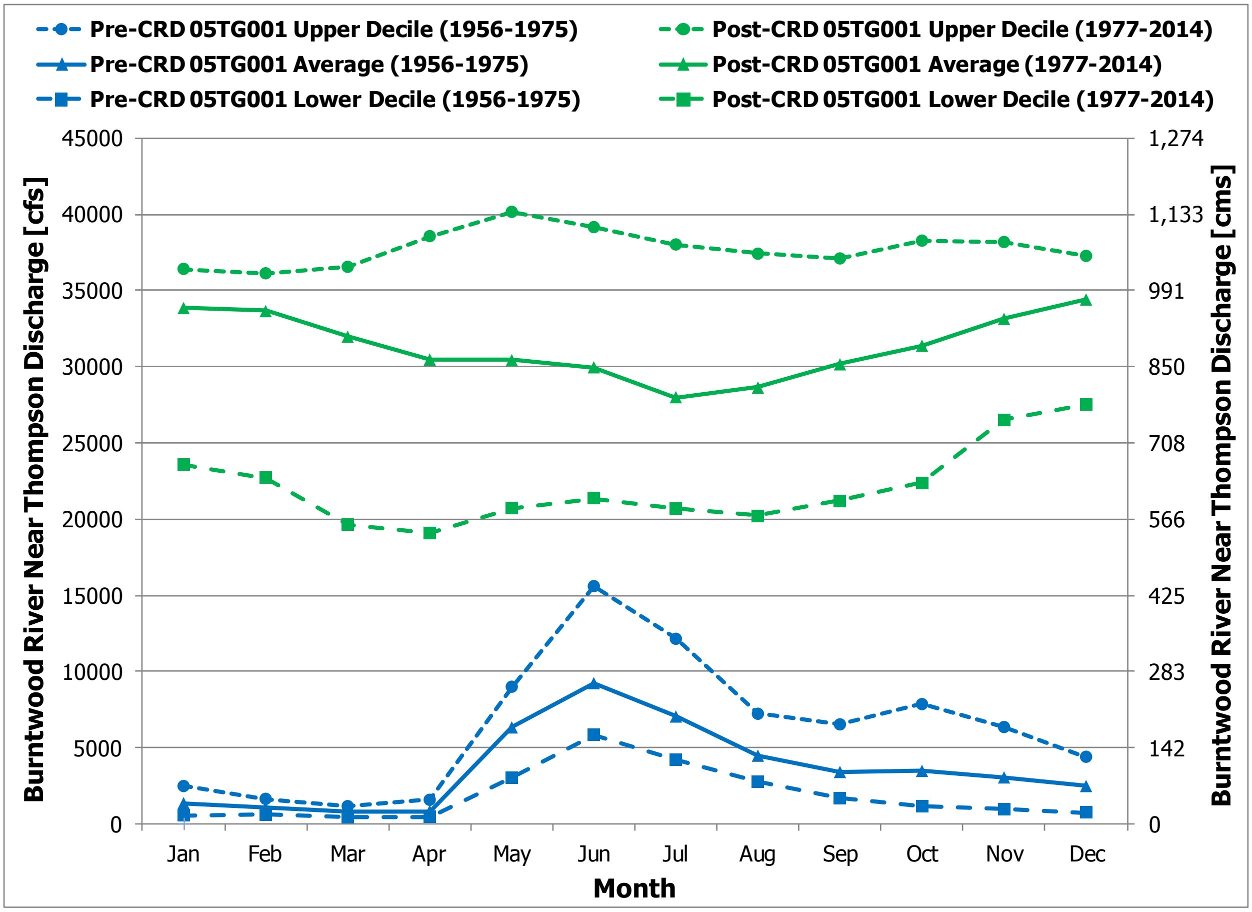

Figure 20: **Monthly Average Burntwood River near Thompson Discharge with Upper and Lower Deciles**