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Department of Water Resources
Eastern Region

BEFORE THE DEPARTMENT OF WATER RESOURCES

OF THE STATE OF IDAHO

IN THE MATTER OF APPLICATION FOR
TRANSFER NOS. 84488 AND 84490 IN THE
NAME OF LCSC ENTERPRISES LLC

**IDAHO POWER COMPANY'S
DISCLOSURE OF EXPERT REPORT
AND SUPPORTING INFORMATION**

Pursuant to the Hearing Officer's April 26, 2021, *Notice of Hearing and Scheduling Order*, Protestant Idaho Power Company hereby submits its expert report and supporting information. The Expert Report on LCSC Transfers T84488 and T84990 submitted herewith, authored by Willem Schreuder and David Blew, is attached hereto as Exhibit A. Attached hereto as Exhibit B is the curriculum vitae of Willem Schreuder. Attached hereto as Exhibit C is the curriculum vitae of David Blew.

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DATED this 15th day of July, 2021.

BARKER ROSHOLT & SIMPSON LLP

/s/ John K. Simpson

John K. Simpson

Attorneys for Idaho Power Company

CERTIFICATE OF SERVICE

I hereby certify that on this 15th day of July, 2021, I served the original of the foregoing **IDAHO POWER COMPANY'S DISCLOSURE OF EXPERT REPORT AND SUPPORTING INFORMATION**, by hand-delivering or depositing same in the U.S. Mail, postage prepaid, as indicated, addressed to the following:

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EXHIBIT A

Expert Report on LCSC Transfers T84488 and T84990

Willem Schreuder, PhD, Principia Mathematica

and

David Blew, Idaho Power

Background

Applicant, LCSC Enterprises LLC, has filed two transfers of four ground water rights in Basin 35 in the Eastern Snake River Plain. The two transfer applications, T84488 and T84490, have the potential to impact Idaho Power water rights in the Milner to Swan Falls reach of the Snake River and associated springs. At issue, is the magnitude of depletion that may occur downstream of Milner Dam and if those depletions constitute injury to Idaho Power. Despite significant depletions, neither transfer required mitigation downstream of Milner Dam. Idaho Power has protested each of the applications.

This report presents the expert opinions of Willem Schreuder and David Blew. These opinions may be updated as new information comes to light.

Opinion 1. The transfers will negatively impact water rights held by Idaho Power downstream of Milner Dam and other surface water rights.

Basis: The impacts of the transfers were analyzed by the applicant using the version of the Transfer Tool that is based on the East Snake Plain Aquifer Model (ESPAM) version 2.1 using annualized steady pumping rates. The analysis is flawed in that the regional ESPAM 2.1 model performs poorly at the specific “from”, and “to” locations proposed in the transfer applications. An improved ESPAM 2.2 model is available that performs significantly better and represents the best available science to analyze the impacts of the transfers, both in terms of the spatial and temporal distributions of these impacts.

The analysis performed by the applicant simulates pumping year-round instead of seasonally as specified on the permit. Seasonal differences in stream depletions are critical to existing water rights and an annualized average impact underestimates the seasonal impacts to these rights. This is particularly true in the LCSC transfers given the juxtaposition of the new PODs to the Snake River.

The IDWR memorandum that gives guidance regarding mitigation requirements as a result of a transfer on the ESPA is flawed because mitigation is only required when all criteria of a three-tailed test are met. Additionally, the memorandum disaggregates the application of the criteria into reaches instead of accumulating impacts upstream of existing water rights. The disaggregation can result in depletions to existing water rights that are significantly in excess of the memorandum criteria without requiring appropriate mitigation.

Opinion 2. The ETRAN 3.3 transfer tool does not represent the best available science for determining the impacts from the proposed transfer.

The transfer tool relies on the use of the Enhanced Snake Plain Aquifer Model (ESPAM). The development of the model is done through a collaborative process involving representatives from a number of government agencies and NGOs representing a variety of interests. Those representatives are part of the Eastern Snake Hydrologic Modeling Committee (ESHMC). The version of the model used in the current transfer tool is 2.1, which was first released in 2009. In 2020, the ESHMC approved the adoption of a new version of the model, ESPAM 2.2.

The transfer tool uses the ESPAM model to calculate the change in stream gains and losses for five stream reaches above Milner. Figure 1 shows the ESPAM 2.1 model domain, the stream reaches and the “from” and “to” locations of Transfer 84490.¹ The stream reaches were selected during the calibration of the model as reaches for which stream gains and losses could be calculated and compared against model predictions. The “from” location is within cell 66,128 in the model, approximately 16 miles from the Snake River. The “to” location is within cell 96,83 which is co-located with the Snake River in the model because it is a fraction of a mile from the river.²

The transfer tool evaluates stream depletions due to historical pumping at the “from” location and the hypothetical depletions that would have occurred if the transfer did not take place. Figure 2 shows the modeled stream depletion for the wells in this transfer to the Near Blackfoot-Neeley reach as a dark blue line. The depletions start with the commencement of pumping in the spring of 1975 and is projected out until 2124.

The transfer tool then computes the stream depletions due to the historical pumping at the “from” location followed by hypothetical depletions at the “to” location. This second simulation represents the post-pumping depletions due to historical pumping at the “from” location and the depletions after the transfer. In Figure 2, this is represented as a light blue dashed line. From 1975 to 2008, the light and dark blue lines match because the pumping is the same in both simulations. However, from 2008 to 2021, the second simulation represents the fact that no pumping occurred at the “from” location, resulting in a decline in stream depletions. Then in 2021, pumping resumes at the new “to” location, leading to an increase in stream depletions.

The transfer tool evaluates the net impact of the transfer as the difference between these two simulations. In Figure 2, this is represented as a red line. The red line is negative because the depletions to this reach resulting from pumping at the “to” location is less than the impact of pumping at the “from” location. The benefit to this reach peaks in 2021 as a result of not pumping the well for 13 years and reaches a steady state within a few decades thereafter.

Figure 3 shows the same information as Figure 1, but applied to the Neeley to Minidoka reach. At first glance this result makes sense because the stream depletions to this reach resulting from the “from” location should be small while depletions from the “to” location should be larger given its proximity to the reach. However, on closer inspection, the results show that depletions to the Near Blackfoot to-Neeley reach many miles away remains twice as large as depletions to the reach a fraction of a mile away.

Figure 4 summarizes the steady state results for all the stream reaches, again using dark blue for depletions at the “from” location and light blue for the “to” locations, and red for the difference.

This surprising result is explained by the stream bed conductance shown in Figure 5. The stream bed conductance represents the volume of water leaking from the stream per foot of head difference

¹Transfer 84488 and 84490 have the same “from” location but different “to” locations. For purposes of this discussion only Transfer 84490 are shown, but the results are not materially different.

²Model Cells in the ESPAM model are one mile on a side, limiting the spatial resolution of the model to 1 mile.

between the stream stage and the aquifer head.³ Generally, the greater the stream bed conductance, the easier pumping can deplete the stream.

At the “to” location, the stream bed conductance in ESPAM 2.1 is 1,626 ft²/day. At the 11 modeled river cells immediately upstream of American Falls reservoir, the stream bed conductance is 100,000,000 ft²/day. Therefore, although the cells above American Falls Reservoir are 40 miles away from the “to” location, the stream depletions caused by pumping at the “to” location is twice as much in this reach as depletions in the reach located a fraction of a mile away.

The ESPAM 2.1 model similarly predicts increased stream depletions to the Lower Snake reaches approximately equal to the Neeley-Minidoka reach, even though those reaches are, on-average, some 100 miles away.

Our understanding of the hydrology of the Snake Plain Aquifer suggests that this behavior is incorrect. To evaluate the progress made during the last decade in modeling the ESPA, we updated the transfer tool with the recently completed data from the ESPAM 2.2 model. IDWR prepared a superposition model for ESPAM 2.2 that provided the necessary files to refresh ETRAN 3.3. Appendix 1 describes the procedure we followed to create ETRAN NEW, which is what we anticipate an updated ETRAN 3.3 will be when IDWR updates the tool.

Figure 6 shows the Near Blackfoot-Neeley reach depletions using ESPAM 2.2. Comparing Figures 6 and 2 shows that the “from” depletions are essentially the same for both versions of the model, but the “to” depletions predicted to this reach is significantly less.

Similarly, Figure 7 shows the Neeley-Minidoka reach. In this instance, the depletions at the “to” location is are about three times greater in the new model than what is shown in Figure 3.

A summary of the steady state depletions for all the reaches using the new model is shown in Figure 8. The results shown in Figure 8 are more in keeping with our understanding of the ESPA hydrology. In the new model, about two-thirds of the depletions at the “to” location occurs to the reach closest to the well, and an additional 19% occurs to the upstream reach.

Figure 9 shows the stream bed conductance from the ESPAM 2.2 model. Near the “to” location, the stream bed conductance is 5,965 ft²/day, while above American Falls, the stream bed conductance varies but is about 300,000 ft²/day on average.

It is important to note that the ESPAM is a regional model. Any version of ESPAM is evaluated by comparing model predictions to observations over the entire plain and numerous springs and stream reaches. The model performance is also evaluated using some curtailment and sensitivity analyses, but these analyses are again evaluated on a regional scale. Based on such evaluations the ESHMC recommended adoption of each version of the model as the best available science.

Whenever such a regional model is applied to a site-specific question such as this transfer and its close proximity to the Snake River, it is not surprising that it sometimes reveals a flaw in the model not

³This relationship changes when the stream stage and aquifer head is sufficiently large for unsaturated flow conditions to developed. The stream is said to have “broken connection” at this point and results in “perched” conditions, limiting the rate of stream leakage.

revealed by the regional analysis. For example, when the model was used to evaluate recharge at Milepost 31, it was clear that the model did not perform well at such a local scale, and a refinement was needed before the model would reasonably replicate the observed aquifer behavior.

The LCSC Transfers specifically revealed that while ESPAM 2.1 performed *reasonably* at a regional scale, the predictions for the “to” and “from” locations associated with this transfer are not reasonable.

While the ESPAM 2.2 model is still a regional model, its predictions for the “to” and “from” locations better match the general understanding of the hydrogeologic behavior of the ESPA. It is therefore our professional opinion that the ESPAM 2.1 model is not reliable for purposes of evaluating this transfer, and that the ESPAM 2.2 model provides a more reasonable estimate of the impacts to various stream reaches.

Any new version of the ESPAM will typically yield different values compared to a previous model. These differences would typically represent refinements to our understanding of the hydrology, and at a regional scale would not represent a major departure from previous results.

However, as demonstrated here, it is important that a regional model should not be blindly applied to site specific problems such as a transfer. The application needs to be critically reviewed and professional judgment should be applied to the specific application of the model to ensure that the predictions are reliable.

As demonstrated above, the ETRAN 3.3 tool using the ESPAM 2.1 results are not reliable and does not yield a reasonable result. The ESPAM 2.2 model results are more reasonable and while it may be refined by future studies, it currently presents the best available science.

Opinion 3: The transfer does not properly consider seasonal variations in impacts.

Water rights, especially direct flow rights, typically have a seasonal demand curve. Hydropower water needs and irrigation water demands peak during the summer months. Storage, for example, in American Falls reservoir can to some extent offset seasonal variations in demands, unless depletions occur below where storage can occur, or the water right does not include the right to store water.

Demands in the transfer tool can be assigned using a seasonal pattern. The transfer tool uses a unit response function generated by running the ESPAM model to simulate pumping for a four-month period and then computes the depletions for that period, as well a sequence of the following four-month periods.

This sequence of depletions yields a Unit Response Function (URF). In essence, pumping eventually translates into stream depletions, so that the depletions, over time, sum to the net pumping.

Figure 10 shows the URFs for the “from” and “to” locations calculated by the ESPAM 2.1 model. Colors represent the depletions to individual reaches stacked upon each other. The four-month periods are evident from the steps in the graphs. Figure 11 shows the corresponding cumulative URFs, indicating that the sum of net depletions approaches 100% after a few decades.

Figures 12 and 13 show the URFs calculated by ESPAM 2.2. What is particularly evident in Figure 12 is how much faster the response at the “to” location is compared to ESPAM 2.1. In particular, for the

Neeley-Minidoka reach, depletions during the first four months are significantly greater than in subsequent months.

When pumping is during the summer and spring, the URF indicates that depletions during the spring and summer will be greater than during the winter. Figure 14 shows the predicted depletions to the Neeley-Minidoka reach using ESPAM 2.1 when pumping is applied only to the spring and summer. Figure 15 shows the predicted depletions using the ESPAM 2.2 model. The effect of seasonal pumping on the magnitude and timing of the depletions are readily seen in these figures.

Figure 16 shows the measured and modeled reach gains for the Neeley to Minidoka reach from the ESPAM 2.2 calibration. The ESPAM 2.2 model underestimates the seasonal fluctuation in this reach, as does other versions of the ESPAM. The ESHMC has not been able to determine why the model consistently predicts less fluctuation in the reach gains for this reach than estimated from observations.

The seasonal fluctuation in the URF derived from the ESPAM is therefore likely to underestimate depletions as well. We, therefore, applied the Glover equation to provide a conservative estimate of the stream depletions. The Glover equation assumes a fully penetrating river, that is, a river that is fully in connection with the aquifer. The aquifer properties in the “to” cell for the ESPAM 2.2 model has a transmissivity of 245,270 ft²/day (1,834,747 gpd/ft) and specific yield of 7.77%. Between the “from” cell and the river the average transmissivity is about 7,700,000 ft²/day (58,000,000 gpd/ft) and the specific yield is about 8.5%.

Using a distance to the stream of 275 feet at the “to” location and 16 miles at the “from” location, the results of calculating a URF using the Glover equation is shown in Figure 17. The prediction for the “from” location is similar to that shown in Figure 12, but at the “to” location the Glover prediction is an order of magnitude different. Using the Glover equation at the “to” location, 98.4% of the pumped amount will translate into stream depletions in the first four months, 0.9% in the next four months, and 0.15% in the third four months, so that 99.5% of the net pumping translates to stream depletions within a year.

The Glover modeling implies that seasonal pumping could translate into much faster stream depletions, and that stream depletions to the Neeley-Minidoka reach could be as much as 1100 acre-feet during the spring and summer months.

Opinion 4: The Idaho Department of Water Resources Transfer memorandum of December 21, 2009, does not provide adequate protection of existing water rights.

On December 21, 2009, the Idaho Department of Water Resources (IDWR) issued a memorandum entitled *Transfer Processing Policies and Procedures*. The purpose of the memo was “to provide policy guidance for processing applications for transfers of water rights pursuant to Section 42-222, Idaho Code, and other applicable law.” The memorandum was issued as a guidance document and is not considered as law but is “an agency interpretation of existing law.”⁴ The memorandum states that “Section 42-222, *Idaho Code*, requires that the department evaluate whether there would be injury to other water rights....” Idaho Code indicates that a transfer can be approved if it does not injure other water rights.

⁴ Idaho Department of Water Resources, Administrator’s Memorandum, Transfer Processing No. 24, Transfer Processing Policies and Procedures. December 21, 2009

Idaho Code Section 42-222 contains the following language: “The director of the department of water resources shall examine all the evidence and available information and shall approve the change in whole, or in part, or upon conditions, provided no other water rights are injured thereby....”

Section 5c of the memorandum specifically addresses injury to other water rights. The memorandum provides guidance for what mitigation is considered acceptable when injury to existing water rights would occur. Section 5c(5) of the memorandum states:

Unless agreed to in writing by the holder of an existing right, the only mitigation that can be considered acceptable by the department is the provision of replacement water in the full amount of the injury, at the same time injury would otherwise occur, and of acceptable water quality at the point of diversion for the existing right.

However, for transfer on the Eastern Snake Plain Aquifer (ESPA), the December 21, 2009 memorandum provides special guidance to determine if mitigation is required. It does not address whether injury will occur to existing water rights, only whether mitigation is required. The guidance provides for a three-tailed test before mitigation is required. The memorandum states:

For applications that propose to move the point of diversion for a water right to divert and use ground water from one location to another within the ESPA, including any modeled tributary aquifers, mitigation is required for transfer approval when all of the following conditions occur: (a) the transfer would result in increased depletions (transient or steady state) greater than 10%, to any hydraulically-connected reach of the Snake River; (b) the increased depletion (transient or steady state) to the reach is greater than 2 acre-feet per trimester; and (c) the depletion, at steady-state conditions, to the reach is greater than 10% of the total depletion to all reaches resulting from the diversion under the proposed transfer.

Mitigation is not required unless all three conditions are met or exceeded by a proposed transfer. These criteria set a high standard for the requirement of mitigation, particularly in the stream reaches below Milner Dam and effectively assigns the risk of injury to other water rights holders. These standards appear to evaluate specific reaches of the Snake River and do not address the impacts to surface water rights downstream of Milner Dam, especially rights that rely on the combined discharge from springs below Milner Dam.

The State of Idaho policy for a zero flow at Milner Dam dictates that surface water rights in Basin 2 are solely dependent upon reach gains to the Snake River. The majority of gains to the Snake River from Milner Dam to the state line are from discharge from the ESPA. Basin 2 water rights are dependent on flow, not from an individual spring or stream reach, but on the entirety of gains from all reaches below Milner Dam to their respective points of diversion. By requiring the three-tailed test and by analyzing each reach individually, injury to downstream water rights could occur without the requirement of mitigation. Injury to a Basin 2 right may occur through two pathways. First, simply a decline in flow may deprive a junior water right holder from the ability to divert water during times of shortage. Second, depletions in multiple springs could reduce flow resulting in a water right call based on the Swan Falls minimum stream flows. This would deprive junior Basin 2 water right holders of the ability to divert and could result in depriving hydropower owners of their full right and trust-water to produce power.

The depletion criteria for the steady state condition is also flawed in that it only addresses the percent of the total depletion of pumping at the new location, and not a minimum amount above which mitigation would be required. The LCSC transfer is an example that demonstrates this problem. The steady state criterion requires that the impact to any reach be at least 10% of the total impact of the pumping at a steady state before mitigation is required. The amount of water being transferred does not weigh into the equation of determining injury to existing water rights. For example, a transfer of 100 ac-ft./trimester might create a total depletion at steady state of 7% or a 7 ac-ft./trimester impact. However, because the impact fails the 10% threshold test, no mitigation is required. If that same transfer instead proposed to move 1000 ac-ft./trimester, the impact would be 70 ac-ft./trimester, but due to the linear nature of ESPAM, no mitigation would be required as the percent of impact is still just 7% of the total. In this case, a water right owner could transfer as much as they wanted, and no mitigation would be required despite the magnitude of the impact. In the case of LCSC, the transfer tool predicts large percentage changes in the stream reaches below Milner Dam for both the steady state and transient conditions. However, no mitigation is required because the depletion, at steady-state conditions, to those reaches is less than 10% of the total depletion to all reaches resulting from the diversion under the proposed transfers. The total impact to below Milner reach gains is about 80 ac-ft./trimester or about 240 ac-ft./yr. However, because ESPAM is essentially linear, under this scenario, an applicant could transfer as much as they wanted and would never have to provide any mitigation below Milner because the 10% threshold would never be exceeded.

The 10% criteria also creates disparity between transfers requiring mitigation and those that do not require mitigation. Consider the LCSC transfers 84488 and 84490. Based on the criteria in the transfer memo, no mitigation is required for either transfer. This is because neither result in greater than 10% depletion to any reach at steady-state condition, of the total diversion after the transfers. This despite the fact the decline below Milner dam is 80 ac-ft./trimester.

In 2019, an applicant made application for two transfers, 83505 and 83597. Each transfer would impact the Devils Washbowl to Buhl Reach by 17.3% and the Buhl to Thousand Springs reach by 21.6% of the total impact at steady state. However, individually, the transfers would not require mitigation as the impact to any individual reach was less than 2 ac-ft./trimester. Idaho Power protested the transfers, arguing that because both transfers were for essentially the same purpose, they should be considered as one transfer.⁵ When considered as a single transfer, mitigation would be required and the total impact below Milner Dam was 9.9 ac-ft./trimester.

In terms of injury to existing water rights, the LCSC transfer has nearly 10 times the impact of transfers 83505 and 83597, yet the smaller transfer would have been required to mitigate the injury, while the LCSC is not. The difference between the two scenarios is the 10% criteria described in the transfer memorandum. Transfers 83505 and 83597, both individually and cumulatively, meet the 10% criteria despite a much smaller impact to reaches below Milner. The LCSC transfers could theoretically transfer an unlimited amount of water and never be required to mitigate for depletions below Milner Dam regardless how large the impacts. The 10% criteria fails to protect existing water rights and is a poor discriminator for determining potential injury of proposed transfers.

Had the memorandum stated the three tests as an “or” condition instead of an “and” condition, mitigation would be required whenever the injury exceed 2 acre-feet. However, since it is an “and”

⁵ To resolve the Idaho Power protest, the applicant withdrew transfer application 83597.

condition, the injury can be up to 10% of the amount transferred, and therefore the larger the transfer, the larger the injury could be without mitigation being required.

Idaho Code § 42-222 requires that the approval for any transfer not injure other existing water rights. The three-tailed test described in the memorandum does not adequately address surface water rights located in Basin 2, nor natural flow rights in Basin 1. By requiring adherence to the three-tailed test and limiting the analysis to individual spring reaches when evaluating transfers, Basin 2 water users could find themselves deprived of water or subject to water calls. The memo as currently written does not adequately protect Basin 2 water right holders from the potential injury from a transfer.

Opinion 5: The guidance provided in the IDWR transfer memo would allow for depletions to existing water rights that would be greater than the 10% depletion at steady state.

The transfer memorandum issued by IDWR on December 21, 2009, provides the guidance to be followed when determining if an individual transfer will be required to mitigate, and the amount of mitigation required before it can be approved. The memorandum provided special instructions for the evaluation of transfers on the ESPA, particularly if the point of diversion (POD) will be changing. The evaluation includes modeling to determine the long-term impact of a transfer on individual reaches of the Snake River. Part of the three-tailed analysis for mitigation includes an analysis to determine if the increased depletions are greater than 10%. The memorandum states: "Increased depletions greater than 10 percent for any reach are presumed to cause injury and must be fully mitigated such that there are no increases in depletion to those reaches except as described below."

The intent of the guidance appears to tie mitigation requirements to potential streamflow gage error. The footnote attached to this statement says: "This 10% threshold for mitigation reflects overall model uncertainty, of which one factor is the inherent error associated with measuring flows of water used as input to the model."

The 10% threshold also applies to impact to any single reach at steady state pumping. The memorandum states: ".....the depletion, at steady-state conditions, to the reach is greater than 10% of the total depletion to all reaches resulting from the diversion under the proposed transfer."

The intent of this condition appears to establish a minimum level of impact to existing water rights before mitigation is required. This 10% threshold also seems to be tied to perceived error associated with measuring water flows. The 10% criteria was established in response to water calls by the owners of water rights sourced by individual springs and not for water rights sourced from the Snake River. The application of the criteria outlined in the transfer memorandum also provides the transfer applicant with the benefit of the model error and potentially allows injury to existing water rights. On June 28, 2021, IDWR issued a curtailment order in Basin 37, based in part on a ground water model for the area. That model has an uncertainty of $\pm 22\%$. Ground water appropriators in this area facing possible curtailment argued that the model uncertainty of $\pm 22\%$ should be taken into consideration in any curtailment scenario.⁶ The Director of IDWR, in his Final Order In the Matter of Basin 37 Administrative Proceeding⁷, addressed the concerns over model uncertainty stating:

⁶ [South Valley GWD and Galena GWD District's Post-Hearing Memorandum](#) - June 21, 2021

⁷ Docket No. AA-WRA-2021-001, IN THE MATTER OF BASIN 37 ADMINISTRATIVE PROCEEDING, FINAL ORDER

The ground water users also relied on evidence that WRVI.1 Model has a predictive uncertainty of $\pm 22\%$ over a ten-month span, and the predictive uncertainty may increase over shorter time periods, such as Sukow's curtailment simulations. SVGWD-GGWD Brief at 29. All ground water models are simplifications with inherent predictive uncertainty, however, Tr. p. 82, and it is undisputed that the WRVI.1 Model is the best scientifically-based tool currently available for predicting Silver Creek's hydraulic responses to ground water curtailment in the Bellevue Triangle. Tr. pp. 156-57, 231, 1299-1300, 1320, 1452.

Further, the Model's predictive uncertainty does not mean the Model is overestimating Silver Creek's hydraulic responses to ground water curtailment. It means that it is equally possible that the Model is underestimating Silver Creek's hydraulic responses to ground water curtailment. Id. The risk of any uncertainty in this regard must be allocated to the ground water users. "Equality in sharing the risk does not adequately protect the senior priority surface water right holder from injury." Memorandum Decision and Order on Petition/or Judicial Review, *Rangen, Inc. v. IDWR*, p. 13 (5th Jud. Dist. Case No. CV 2014-2446) (Dec. 3, 2014) (Rangen Dec.).

In the Basin 37 order, the Director allocated the risk of uncertainty to the ground water user. In our opinion the uncertainty of ESPAM 2.1 or 2.2 should be allocated to the transfer applicant because the current employed methodology "does not adequately protect" existing water rights.

Within ESPAM 2.1, reaches of the Snake River above Milner Dam are considered "river reaches" indicating that the aquifer is in contact with the river. Design documentation for the ESPAM 2.1 describes how the Snake River above Milner Dam was divided into individual reaches. The design document states:

Most of the Snake River above Milner Dam, including American Falls Reservoir, is represented by two hundred-forty-one river cells (Figure 19). Since riverbed conductance is a lumped parameter (i.e., it represents multiple physical attributes) and impossible to measure, it was estimated during model calibration. River cells were aggregated into five reaches for calibration.....

Below Milner Dam, the bulk of reach gains are modeled as "drain cells". The Snake River in this area is generally considered to be not in contact with the aquifer. The design documentation for this portion of the river states:

For ESPAM1.1, the ESHMC agreed that drain cells should be aggregated into reaches. This was accomplished based on an analysis of: a) discharge of individual groups of springs, and b) cumulative discharge of springs along the entire Thousand Springs reach. A significant part of the effort in developing ESPAM 2.1 involved explicitly representing individual springs or small groups of springs located within one or two model cells. To provide additional calibration targets for ESPAM 2.1, the drain cells were also aggregated into three "spring" reaches (Kimberly to Buhl, Buhl to Lower Salmon Falls, and Lower Salmon Falls to King Hill) based on the existence of gages on the Snake River.

The stream reaches below Milner Dam described in the design document appear to be those reaches that were used for calibration purposes based on gages located on the Snake River. The three original

reaches designated in the ESPAM 2.1 design documentation were disaggregated into six reaches for the purpose of evaluating transfer for mitigation requirements. This disaggregation complicates the application of the 10% threshold to account for “inherent error associated with measuring flows.” The disaggregation of the Snake River below Milner Dam and the manner in which the transfer memorandum calculates potential injury to water rights, underestimates potential injury to water rights, particularly those located in Basin 2.

The memorandum establishes the 10% threshold for both the total increase in depletions and the percent of depletion at steady state. These criteria are applied at the reach level and not to a particular water right. In previous water calls, the application of the 10% depletion (trim line) was applied to specific water rights at specific springs or spring complexes. Basin 2 water rights are those water rights which are diverted from the Snake River from Milner Dam to the Oregon state line. The largest source of water for Basin 2 water rights is discharge from the ESPA below Milner Dam and these rights are not dependent upon any specific spring source. The application of the 10% depletion standard, for both the increased depletion and the steady state condition, should be applied not at individual spring sources but on the total depletionary impacts of a transfer to the Snake River below Milner Dam.

The reason that transfers look at individual reaches appears to be a “hold-over” from previous water calls by spring users. The argument stems from the fact that only certain stream reaches (model drain cells or river cells) impact the flow to specific water users. There appears to have been no consideration of the cumulative impacts to the reaches above American Falls or the Milner to King Hill reach. In the Clear Springs and Blue Lakes delivery calls, Clear Springs argued that all junior ground water rights should be curtailed to satisfy their water delivery call. In their brief, IDWR responded to Clear Springs assertions and stated:

Clear Springs’ argument demonstrates a fundamental misunderstanding of the ESPA Model and the complex factors associated with conjunctive administration. The Model divides the Thousand Springs area into six adjacent groupings of spring complexes, or spring reaches, based on the relative magnitude of spring discharge. R. Vol. 1 at 48, ¶ 14. Blue Lakes is located in the Devil’s Washbowl to Buhl Gage spring reach and Clear Springs is located in the Buhl Gage to Thousand Springs reach. R. Vol. 1 at 48, ¶ 15; R. Vol. 3 at 491, ¶15. Therefore, only two of the six sub-reaches in the Thousand Springs area were at issue in the Clear Springs and Blue Lakes delivery calls.⁸

The approach of the department was to focus only on those reaches that only impacted Clear Springs and Blue Lakes water diversions. The result is to limit the number of ground water appropriators who may be subject to curtailment. This approach made sense during a water call where a specific spring user is claiming injury and the response in that specific reach is of particular concern. However, in the case of transfers, and the duty to not harm any water right, the effect at specific reaches and, the cumulative impact to downstream water rights should be taken into consideration.

In the case of Transfer 79560, Rangen argued that the transfer could impact downstream users including the minimum flows at Swan Falls. At issue was the potential impact of 10 cfs being consumptively used after the transfer from Magic Springs to Billingsley Creek. The Director, when assessing the impacts of IGWA activities on reach gains for the purposes of evaluating mitigation, aggregated the increases in reach gains from three separate springs represented in the model. The Director aggregated the reach

⁸ Case No. CV-2008-0000444 Respondents’ Brief, Page 12

gains predicted by ESPAM 2.1 at Box Canyon, The Devil's Washbowl and Devil's Corral. These sites were selected because there are no consumptive uses at these springs and all reach gains are expected to accrue to the Snake River.

The approach IDWR took in calculating the benefit of mitigation activities was to aggregate reach gains from several distinct springs and spring complexes. It is clear from their analysis, IDWR recognizes the cumulative impact of ground water mitigation practices on the Snake River. Even the LCSC transfers have aggregated stream reaches for the purposes of satisfying mitigation requirements. It would make sense then that if modeled spring cells from separate reaches can be aggregated to calculate mitigation for downstream water users on the Snake River, it should also make sense to aggregate the cumulative impact of a transfer. Analysis of individual springs cells or reaches would still be necessary to assess the impacts to individual spring owners, however, an aggregated total must be used to understand the impacts to surface water users downstream of Milner Dam.

The transfer memorandum does not provide adequate protection to existing water rights by allowing a 10% perceived model error to favor the transfer applicant. The transfer memorandum appears to limit its assessment of injury to water rights associated with springs or spring reaches. It appears to not consider those rights sourced from the Snake River which is in large part dependent upon the discharge from the ESPA. The depletionary impacts from a transfer would likely manifest during drought and periods of low flow in the Snake River from Milner to King Hill or as the result of a water call.

Opinion 6: The proposed transfers will reduce the amount of water available for diversion and use at Idaho Power generation facilities located downstream of Milner Dam.

The LCSC transfers were modeled using the transfer tool which currently employs the use of ESPAM 2.1. Based on modeling using the current transfer tool, total new depletions to the Snake River resulting from this transfer are approximately 505 ac-ft./yr. The total new depletions below Milner Dam total approximately 243 ac-ft./yr. Based on the current modeling, nearly 50% of the new impacts of this transfer would be realized in the Snake River reaches downgradient of Milner Dam. This would impact flows at eight downstream hydropower plants, including the Hells Canyon Complex and four spring supplied power plants. Those plants where flows would be impacted are:

- Twin Falls
- Shoshone Falls
- Clear Lake
- Thousand Springs
- Upper Salmon Falls B
- Upper Salmon Falls A
- Lower Salmon Falls
- Upper Malad
- Lower Malad
- Bliss
- C. J. Strike
- Swan Falls
- Hells Canyon Complex

An assessment of the impact of the LCSC transfers was performed to determine potential impact to Idaho Power's hydropower production. The assessment was conducted using the results of the transfer tool using ESPAM 2.1, as that is the version of the tool used by the Applicant. Impact to each power plant was determined using the calculations in Table X and the resulting acre-foot impact at each plant can be found in Table Y. The Clear Lakes and Thousand Springs plants were not included in this analysis.

Calculation of Response at Idaho Power Facilities Based on the Results of ESPAM 2.1	
Plant	Plant Impacts Based on Reach Results from ESPAM
Twin Falls	30% of Devils Washbowl to Buhl
Shoshone Falls	40% of Devils Washbowl to Buhl
Upper Salmon B	Devils Washbowl to Buhl + Buhl to Thousand Springs + Thousand Springs Reach + (70% Thousand Springs to Malad)
Upper Salmon A	Devils Washbowl to Buhl + Buhl to Thousand Springs + Thousand Springs Reach + (70% Thousand Springs to Malad)
Upper Mald	Malad Reach
Lower Malad	Malad Reach
Lower Salmon Falls	Devils Washbowl to Buhl + Buhl to Thousand Springs + Thousand Springs Reach + Thousand Springs to Malad
Bliss	Devils Washbowl to Buhl + Buhl to Thousand Springs + Thousand Springs Reach + Thousand Springs to Malad + Malad Reach + (50% of Malad to Bankcroft)
C.J. Strike	Devils Washbowl to Buhl + Buhl to Thousand Springs + Thousand Springs Reach + Thousand Springs to Malad + Malad Reach + Malad to Bankcroft
Swan Falls	Devils Washbowl to Buhl + Buhl to Thousand Springs + Thousand Springs Reach + Thousand Springs to Malad + Malad Reach + Malad to Bankcroft
Hells Canyon Complex	Devils Washbowl to Buhl + Buhl to Thousand Springs + Thousand Springs Reach + Thousand Springs to Malad + Malad Reach + Malad to Bankcroft

Plant	Trimester Impacts (acft)	Yearly Impacts (acft)
Twin Falls	7.47	22.41
Shoshone Falls	9.96	29.88
Upper Salmon B	70.38	211.14
Upper Salmon A	70.38	211.14
Upper Mald	72.6	217.8
Lower Malad	7.2	21.6
Lower Salmon Falls	7.2	21.6
Bliss	80.2	240.6
C.J. Strike	80.2	240.6
Swan Falls	80.2	240.6
Hells Canyon Complex	80.2	240.6

Impacts to generation were calculated based on a K factor for each plant or complex. If the total annual acre-foot impact is used to calculate impacts to generation, the decline in generation is approximately 200 MWh/yr. The K factors used assume a full pool condition for reservoirs and convert acre-feet to MWh for each facility and the Hells Canyon Complex. It is difficult to establish a monetary value as energy prices can vary from day to day and such an analysis is beyond the expertise of the authors.

Opinion 7: The transfers will result in a reallocation of trust water.

Idaho Power devotes considerable resources towards evaluating impacts to the trust water from new water rights applications and transfers. The establishment of the trust allowed the rights at Swan Falls above the minimums to remain unsubordinated but subordinatable to future water rights which are subject to review under the public interest criteria⁹. IDWR issued a guidance document for using the transfer tool states "(s)urface water in the Snake River and many tributary springs are considered fully

⁹ Clive J. Strong & Michael C. Orr, *Understanding the 1984 Swan Falls Settlement*, 52 IDAHO L. REV. 223 (2016).

appropriated.”¹⁰ In our opinion, the establishment of the trust effectively means that all of the water tributary to the Snake River below Milner is fully allocated under the trust water provisions.

The water appropriation rules define trust water as “That portion of an unsubordinated water right used for hydropower generation purposes which is in excess of a minimum stream flow established by state action either with agreement of the holder of the hydropower right as provided by Section 42-203B(5), Idaho Code or without an agreement as provided by Section 42-203B(3), Idaho Code.” The unique nature of the trust allows the Snake River and tributary inflow from Milner Dam to the Murphy gage to be considered fully appropriated. As such, new depletions in this reach are considered a reallocation of the trust water.

In the review of applications, Idaho Power evaluates the potential for new water rights or transfers to impact the availability of water for hydropower generation below Milner Dam. Because the Snake River and tributary inflow below Milner Dam is considered trust water, the review conducted by Idaho Power of applications is in essence our opinion of the reallocation of trust water. The review of the LCSC transfers were conducted in the same manner as past applications for permit and transfers. The modeling provided with the applications indicated that the impact of the transfers would result in new depletions below Milner Dam, therefore impacting water availability in Basin 2. In our opinion, this would result in a new reallocation of the trustwater.

Appendix 1: ETRAN NEW update procedure

Update hcond2.ref and sy2.ref with files from superposition run
 Replace superTR.riv with super.riv from superposition run
 Replace super.ghb with superDRN.ghb from superposition run
 Expand zone 4 in respzon.inf to cover Portneuf River
 Add tucker.hfb from superposition run.
 Update .nam file to add HFB boundary.

¹⁰IDWR, Quick Guide to the ESPA Modeling Tools



ESPAM Model Domain and Stream Reaches

ETRAN 3.3: LCSC Transfer T84490

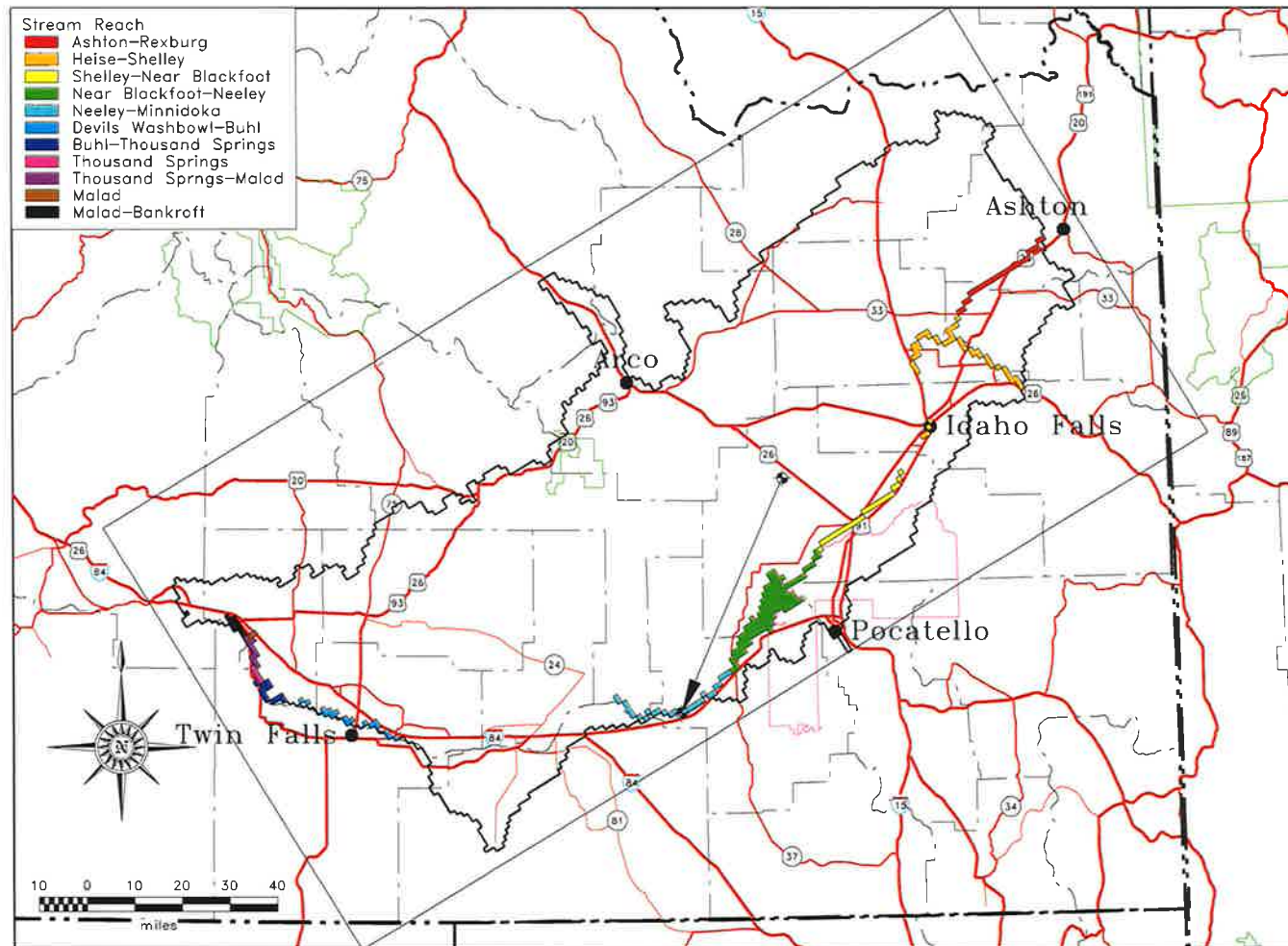


Figure 1



Transient Impact: Near Blackfoot–Neeley

ETRAN 3.3: LCSC Transfer T84490

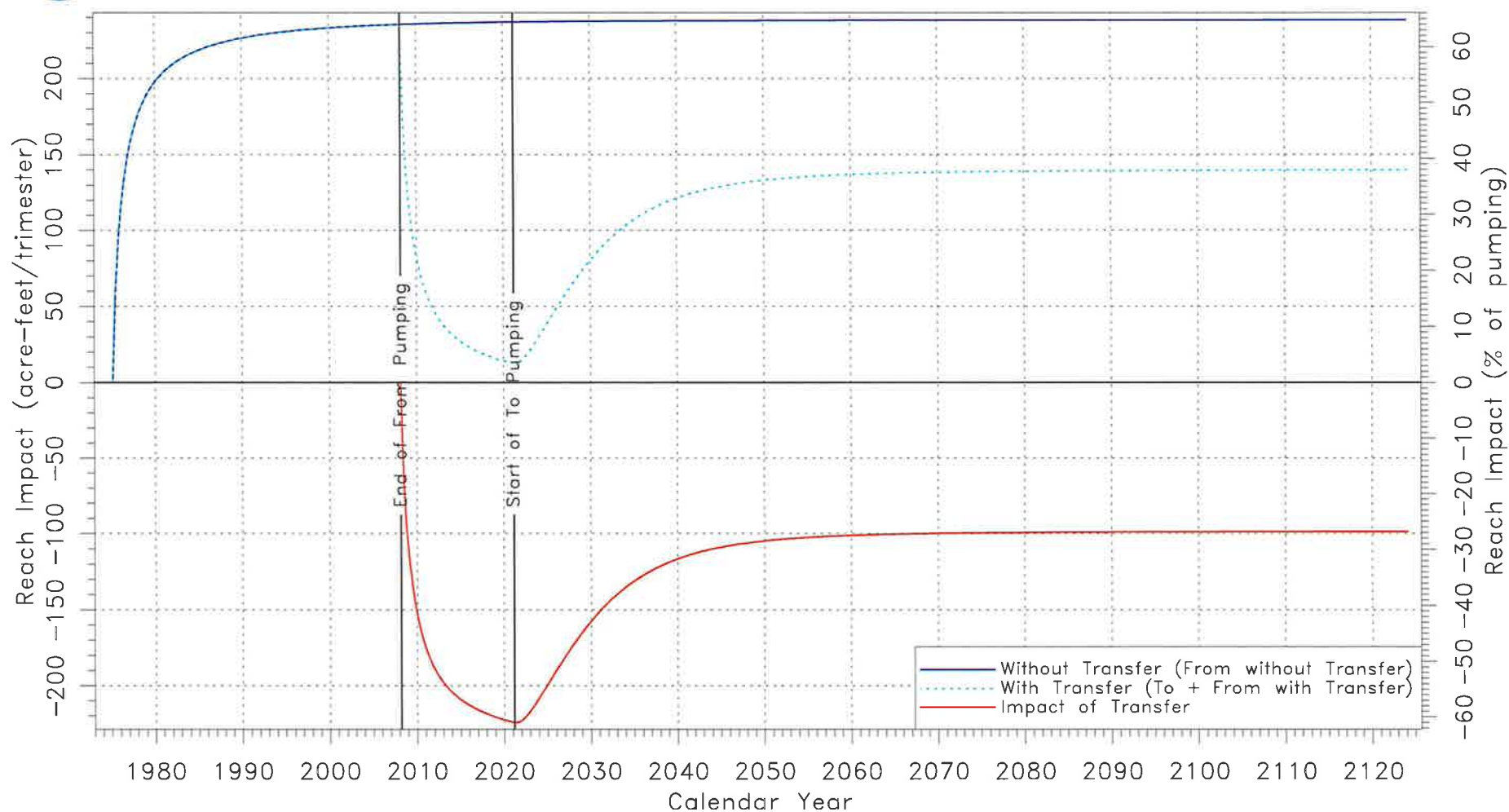


Figure 2



Transient Impact: Neeley-Minnidoka

ETRAN 3.3: LCSC Transfer T84490

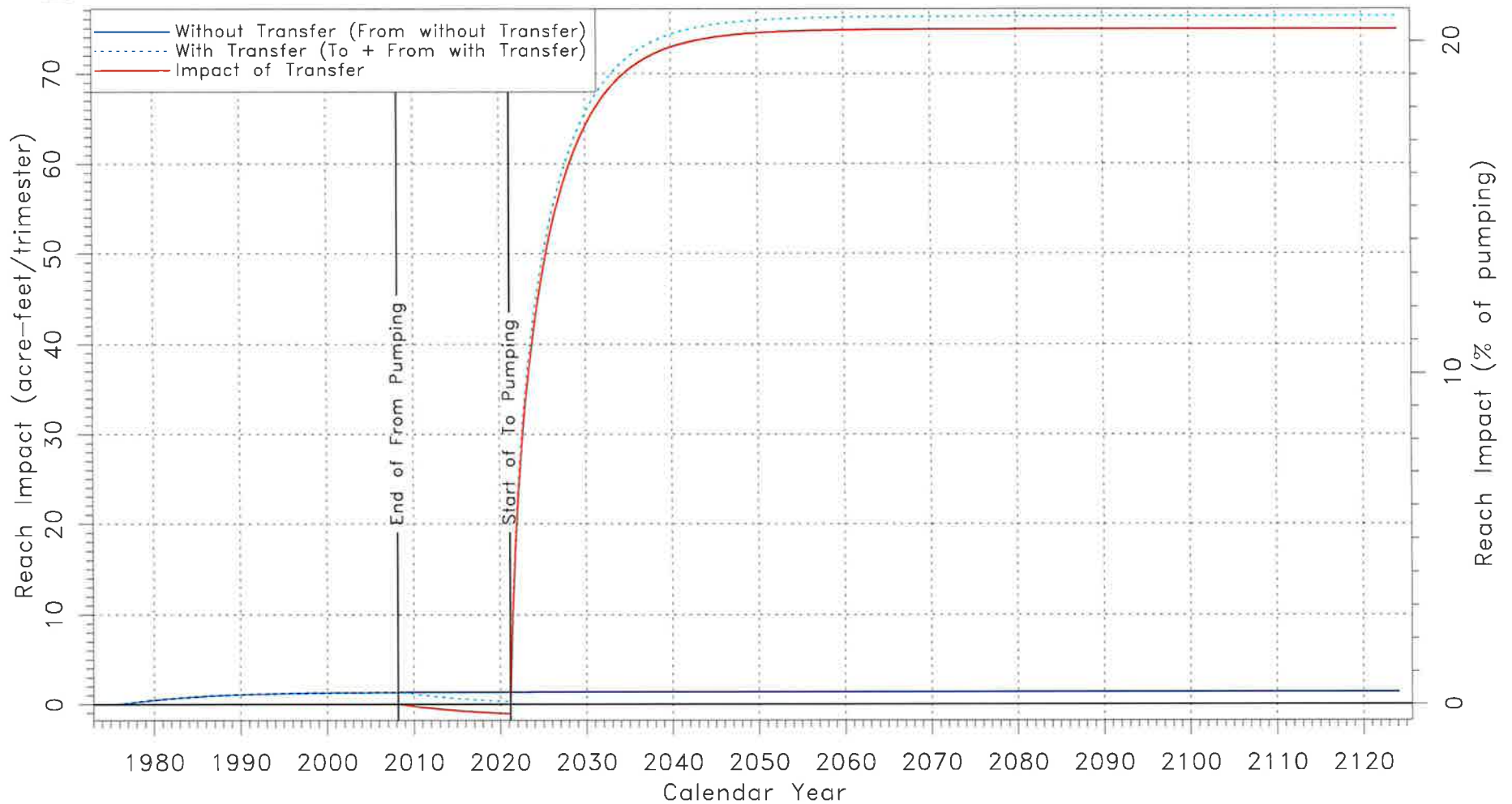


Figure 3



Steady State Impact by Reach

ETRAN 3.3: LCSC Transfer T84490

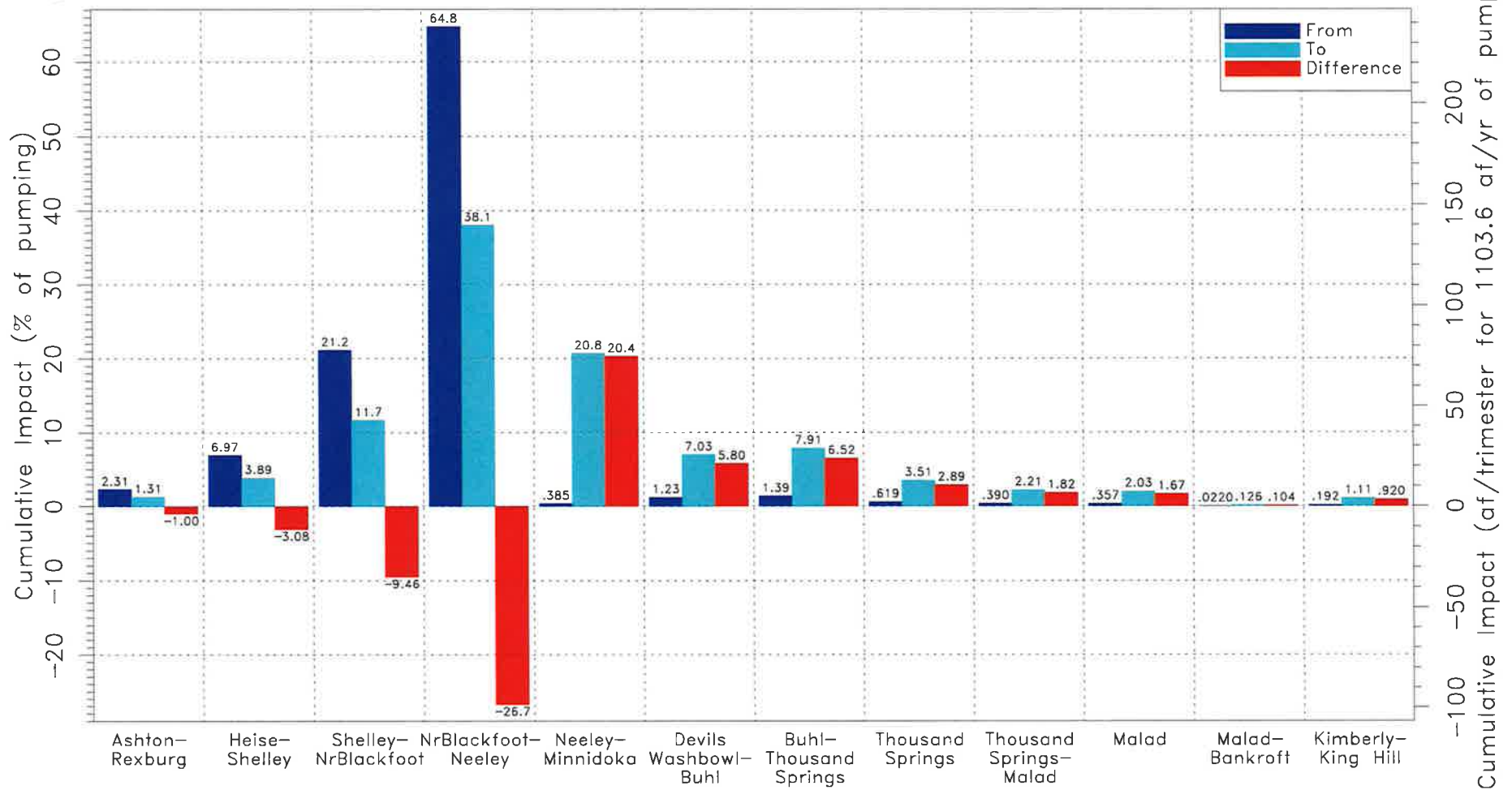


Figure 4



Stream Bed Conductance

ETRAN 3.3: LCSC Transfer T84490

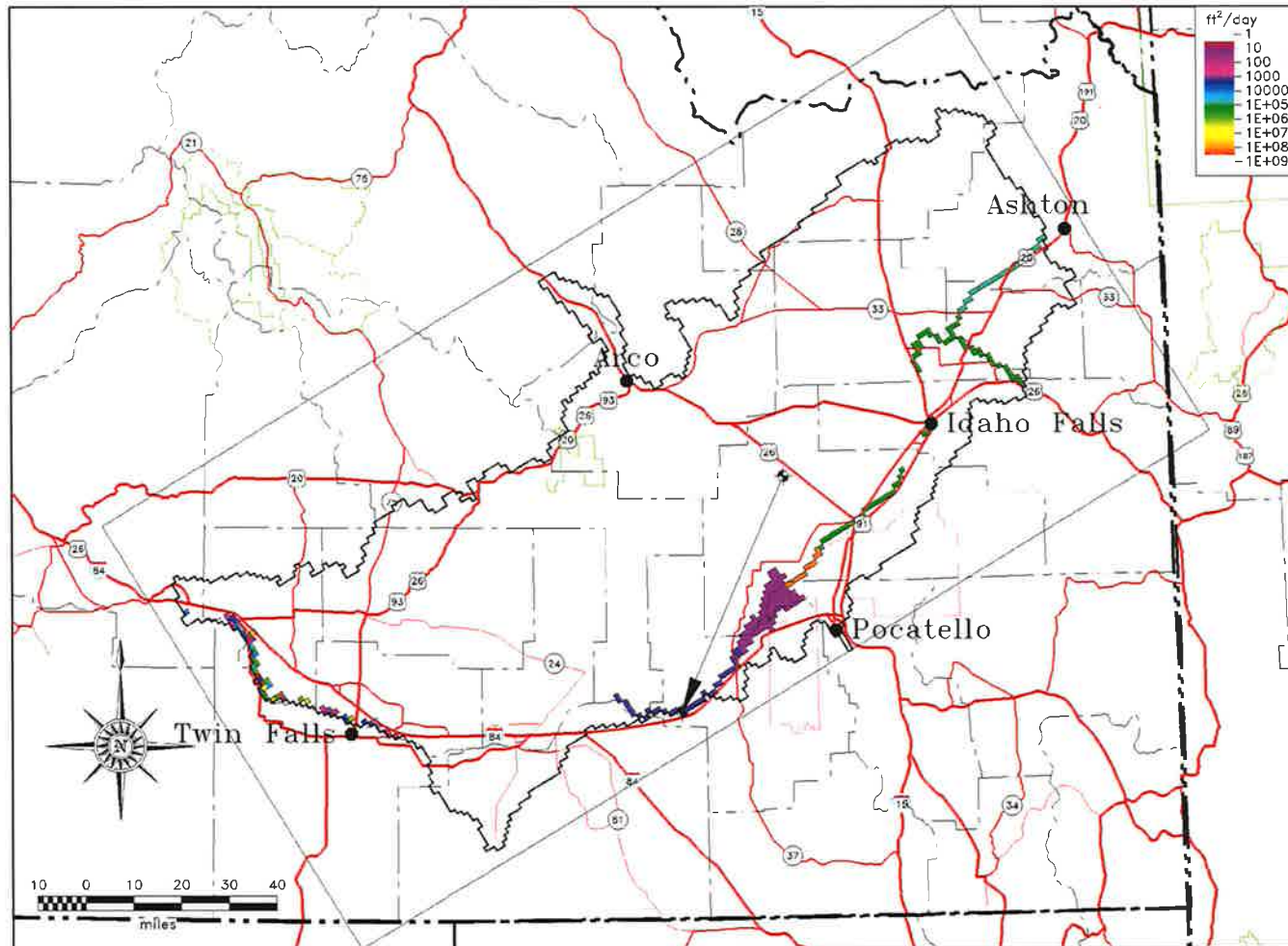


Figure 5



Transient Impact: Near Blackfoot–Neeley

ETRAN NEW: LCSC Transfer T84490

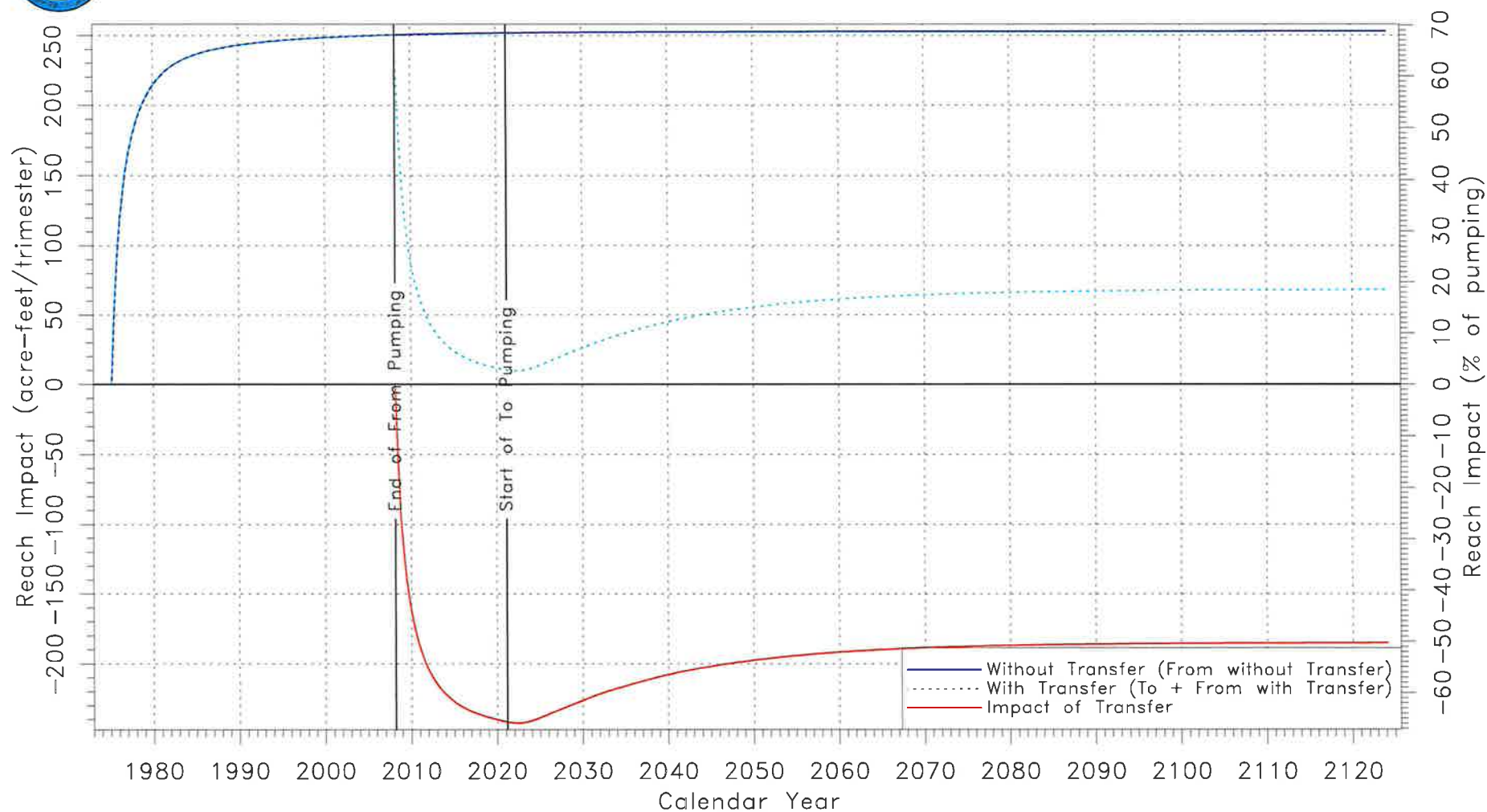


Figure 6



Transient Impact: Neeley-Minnidoka

ETRAN NEW: LCSC Transfer T84490

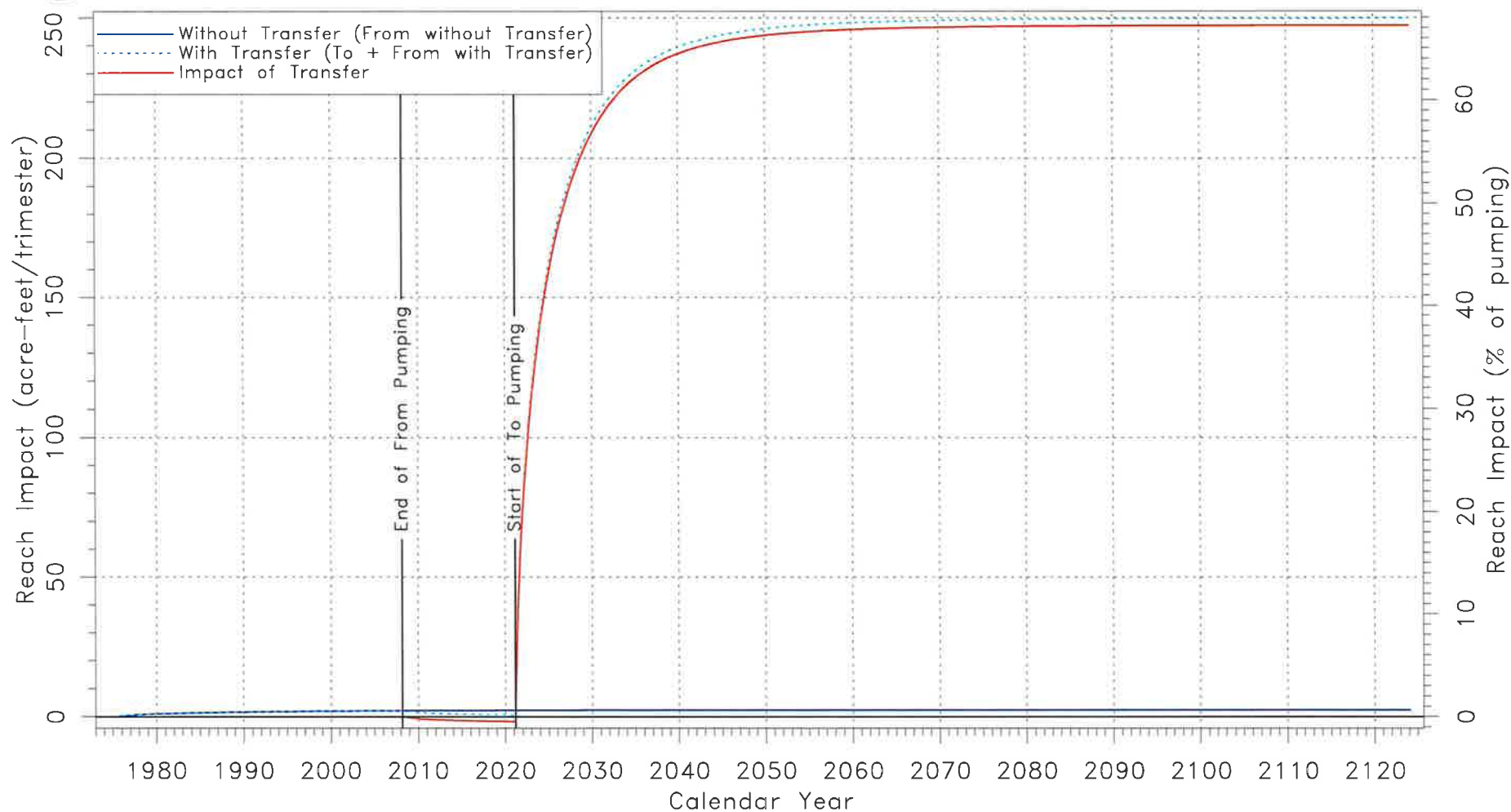


Figure 7



Steady State Impact by Reach

ETRAN NEW: LCSC Transfer T84490

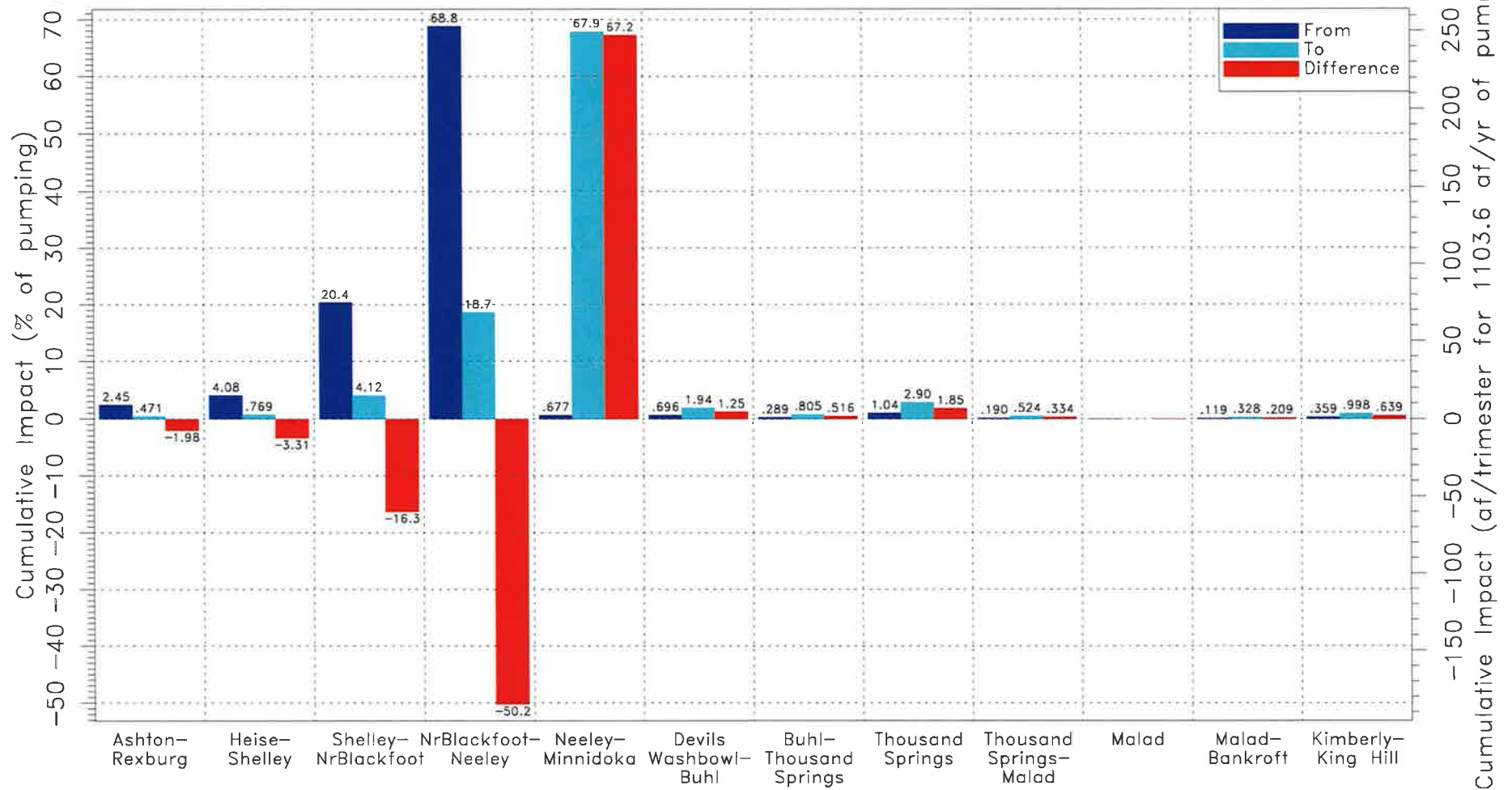


Figure 8



Stream Bed Conductance

ETRAN NEW: LCSC Transfer T84490

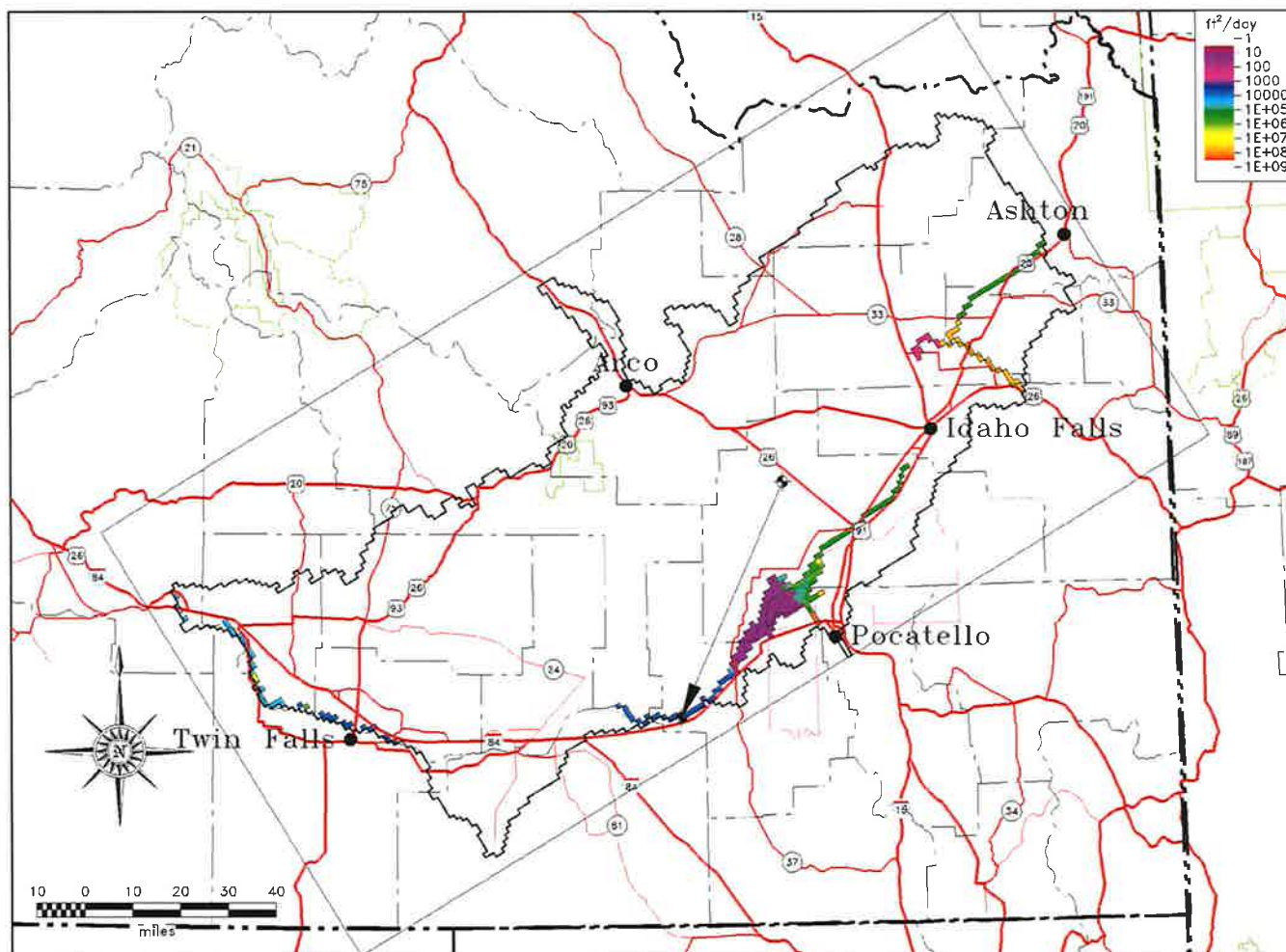
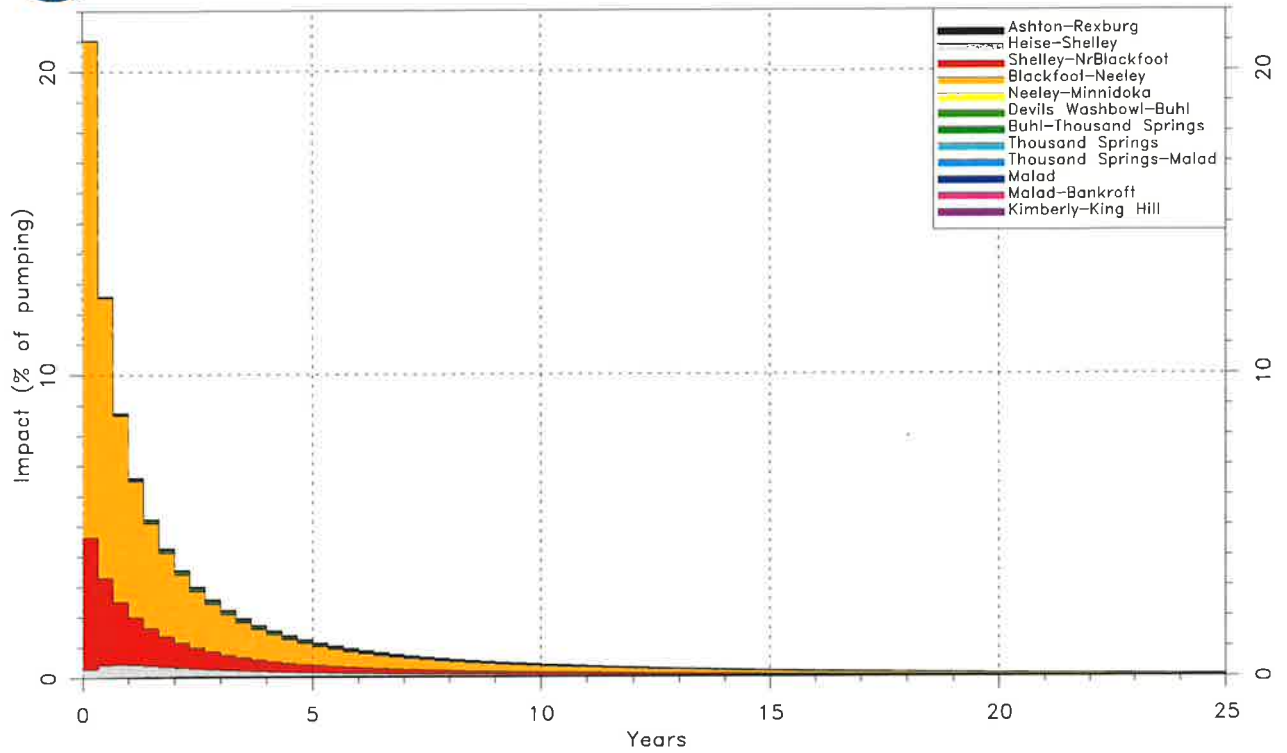


Figure 9



From URF

ETRAN 3.3: LCSC Transfer T84490



To URF

ETRAN 3.3: LCSC Transfer T84490

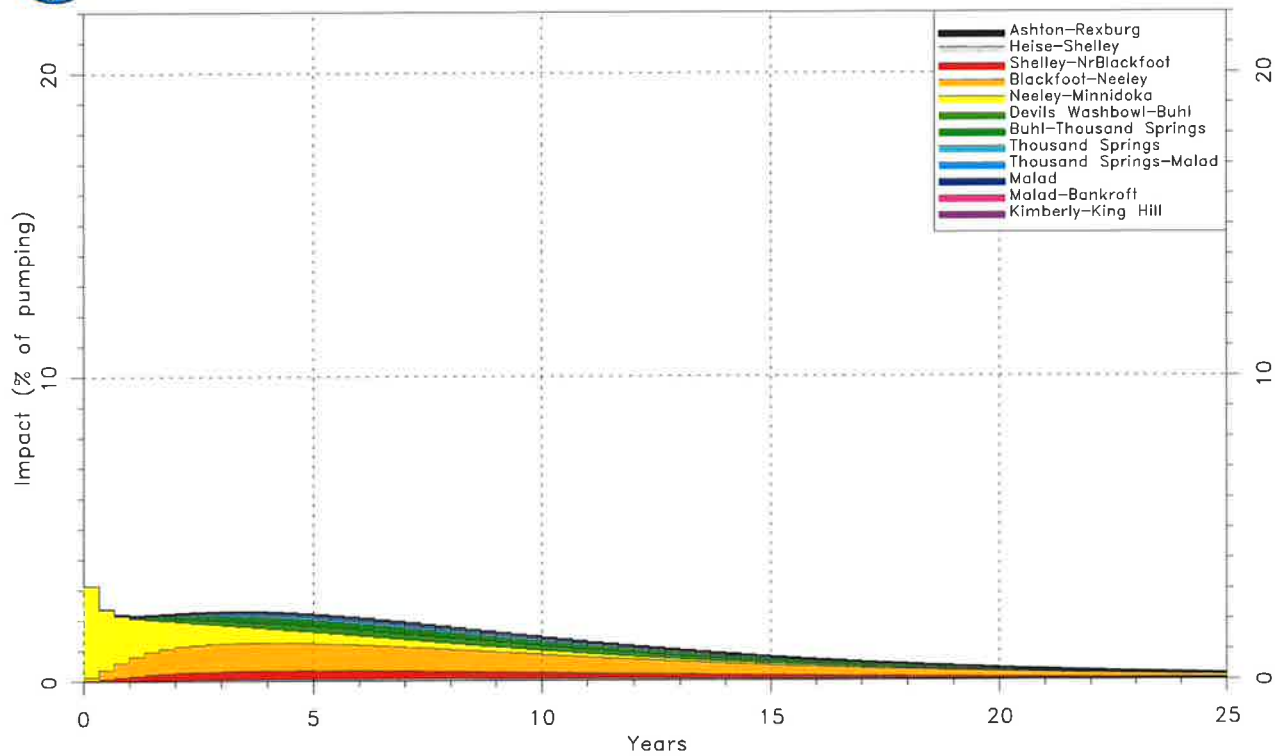
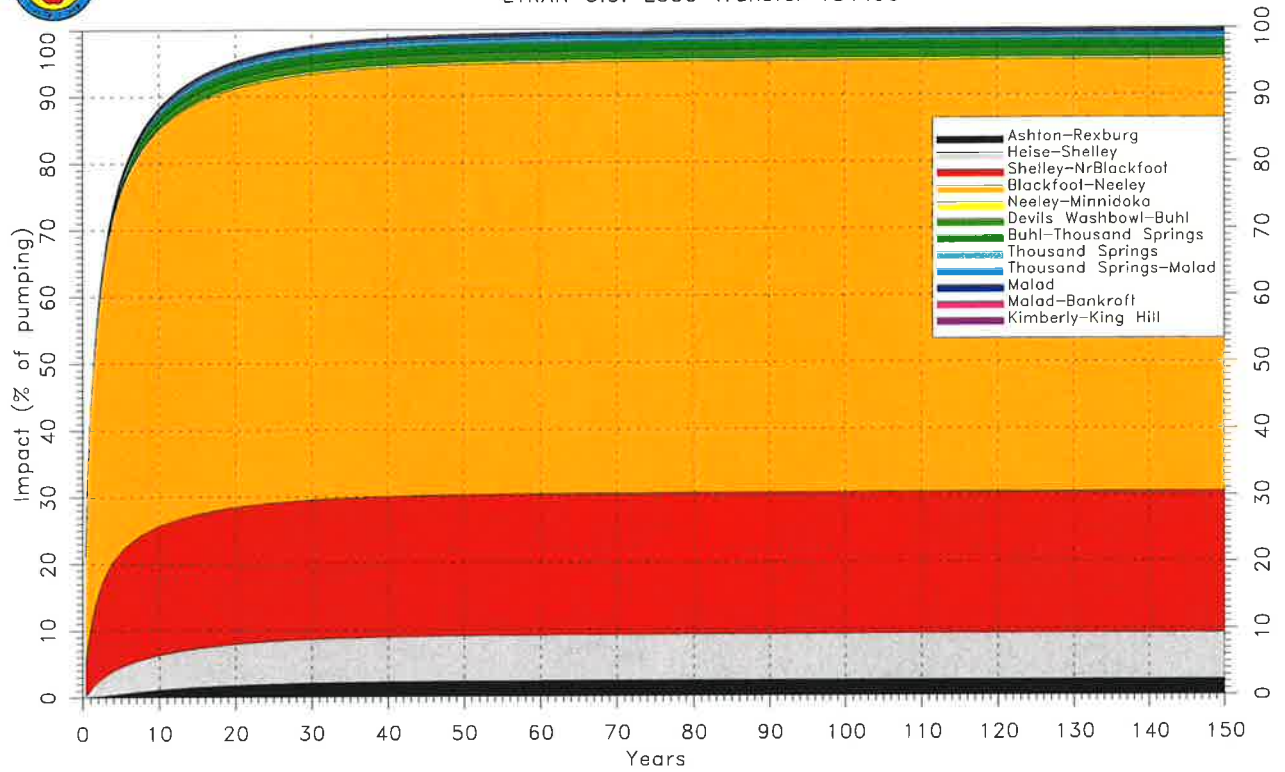


Figure 10



Cumulative From URF

ETRAN 3.3: LCSC Transfer T84490



Cumulative To URF

ETRAN 3.3: LCSC Transfer T84490

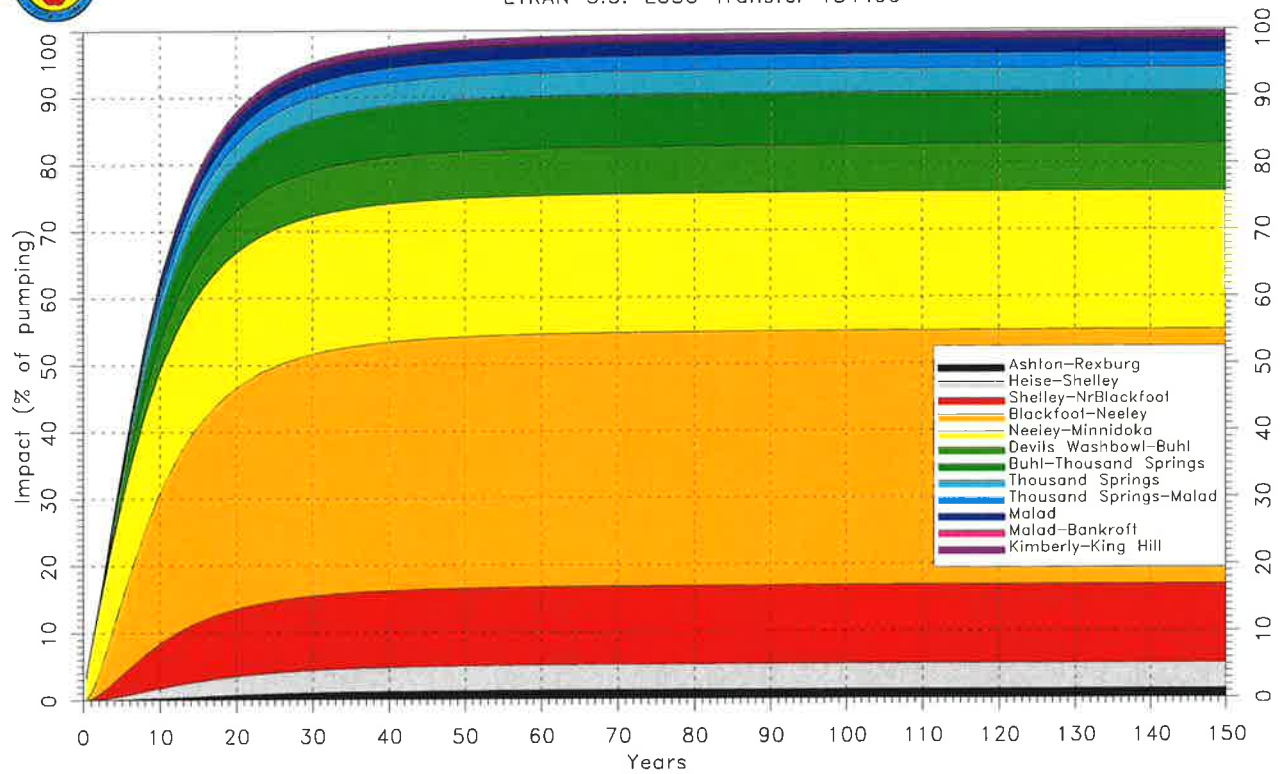
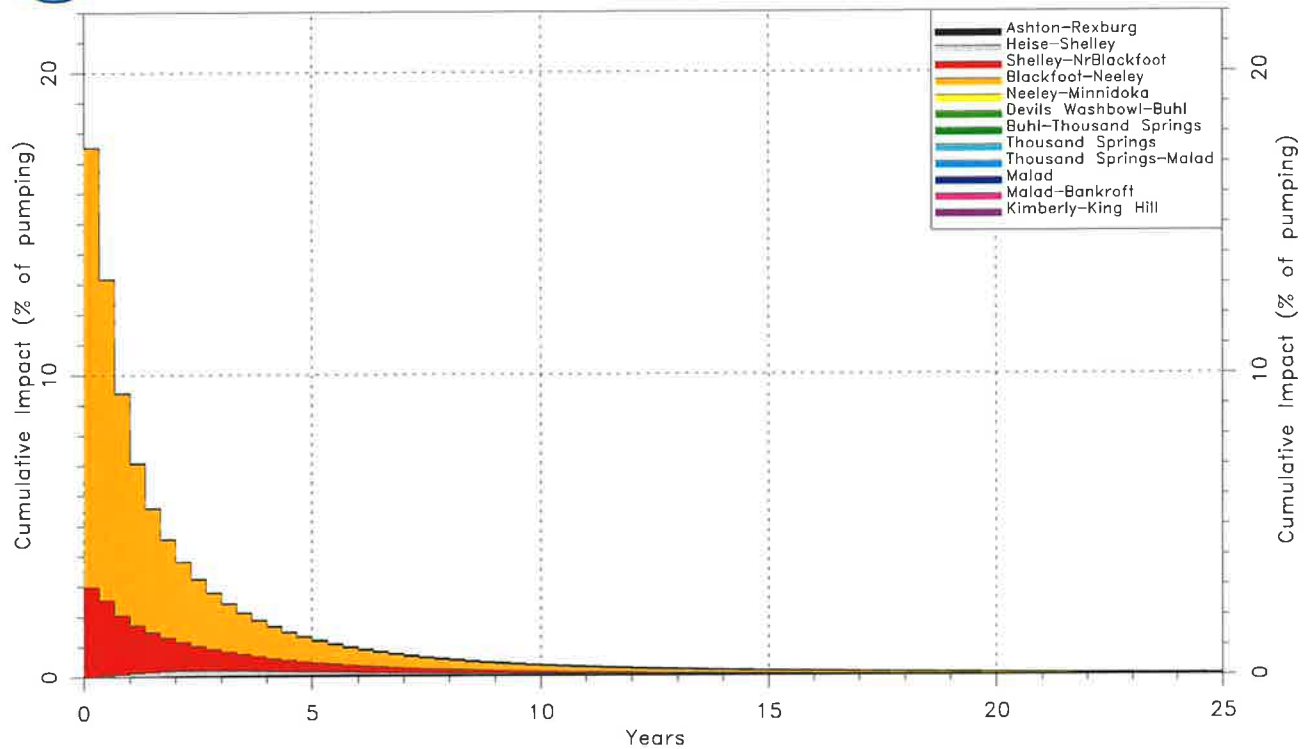


Figure 11



From URF

ETRAN NEW: LCSC Transfer T84490



To URF

ETRAN NEW: LCSC Transfer T84490

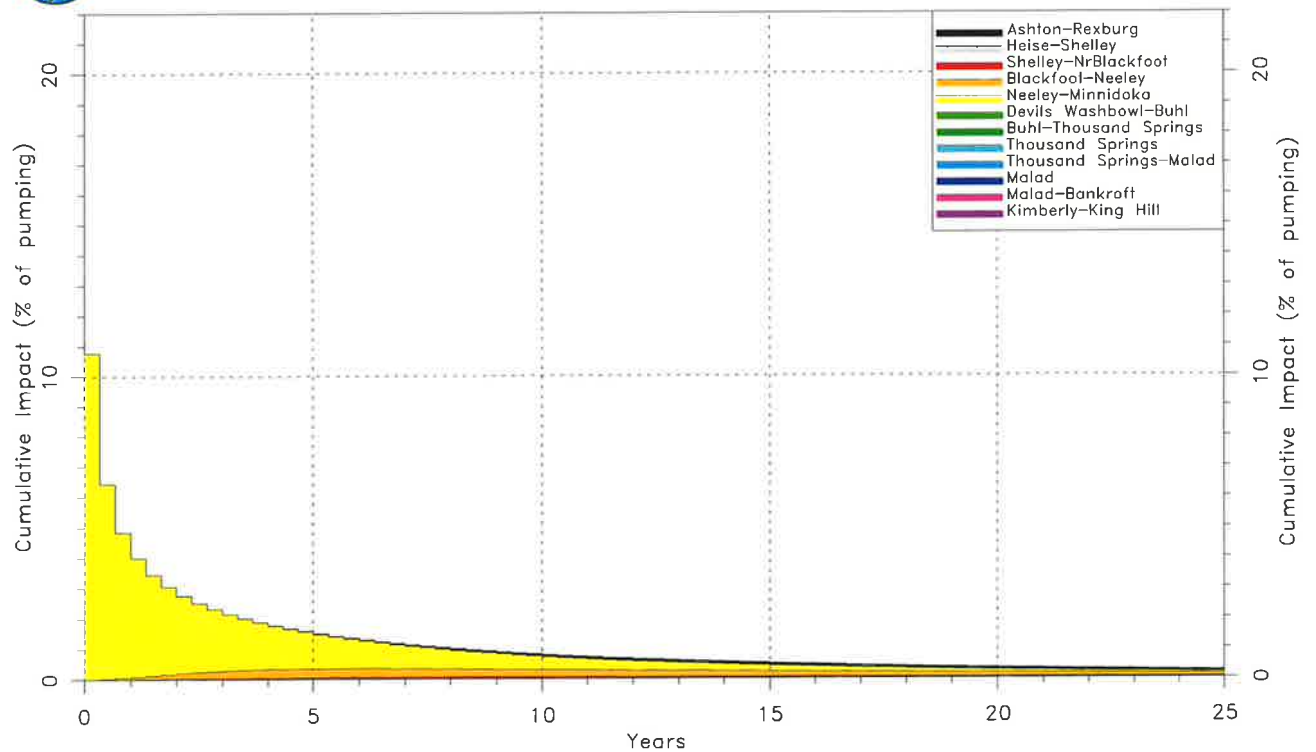
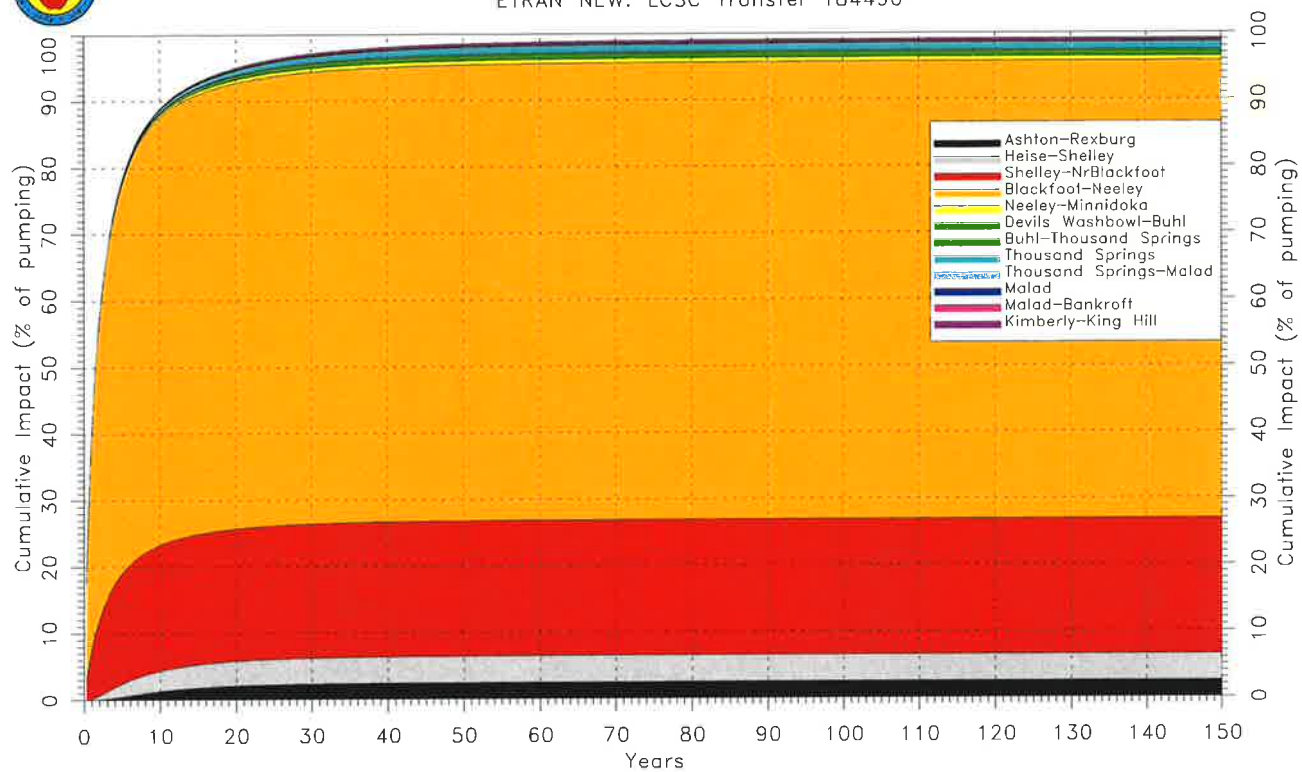


Figure 12



Cumulative From URF

ETRAN NEW: LCSC Transfer T84490



Cumulative To URF

ETRAN NEW: LCSC Transfer T84490

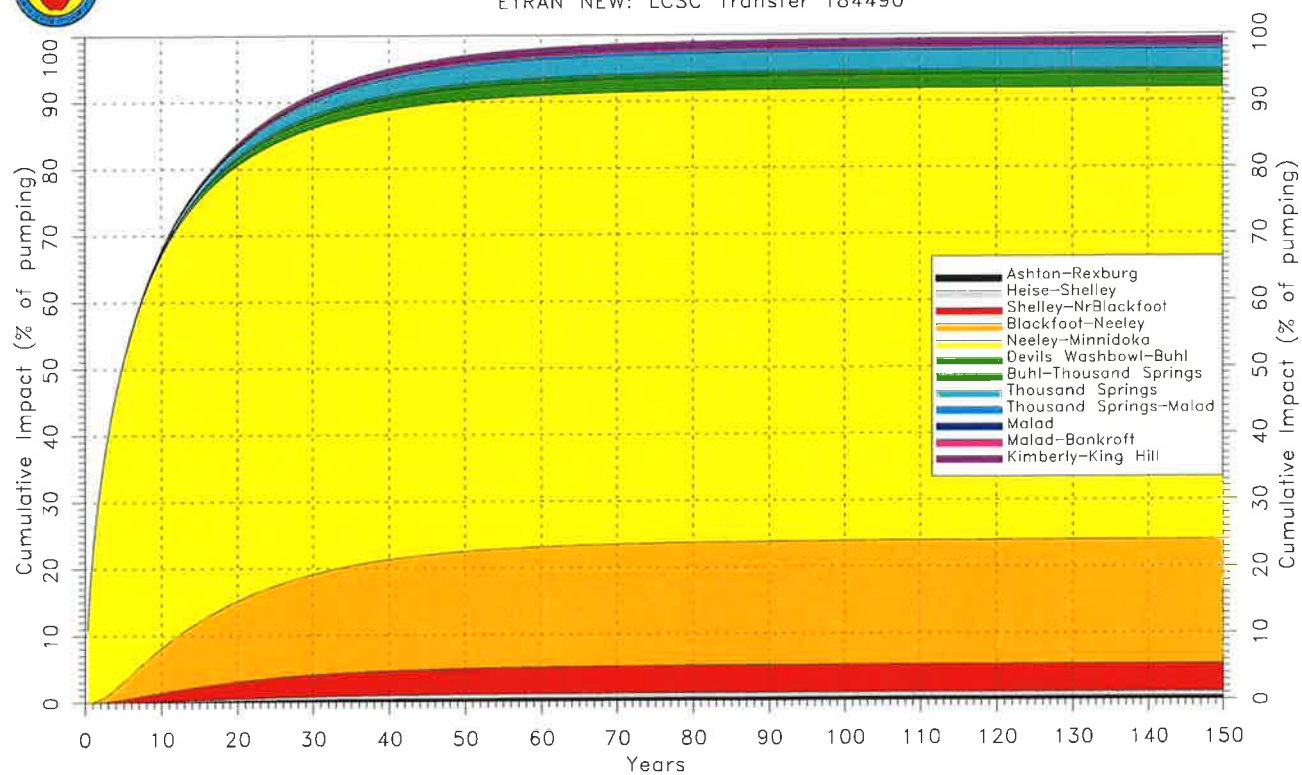


Figure 13



Transient Impact: Neeley-Minnidoka

ETRAN 3.3: LCSC Transfer T84490

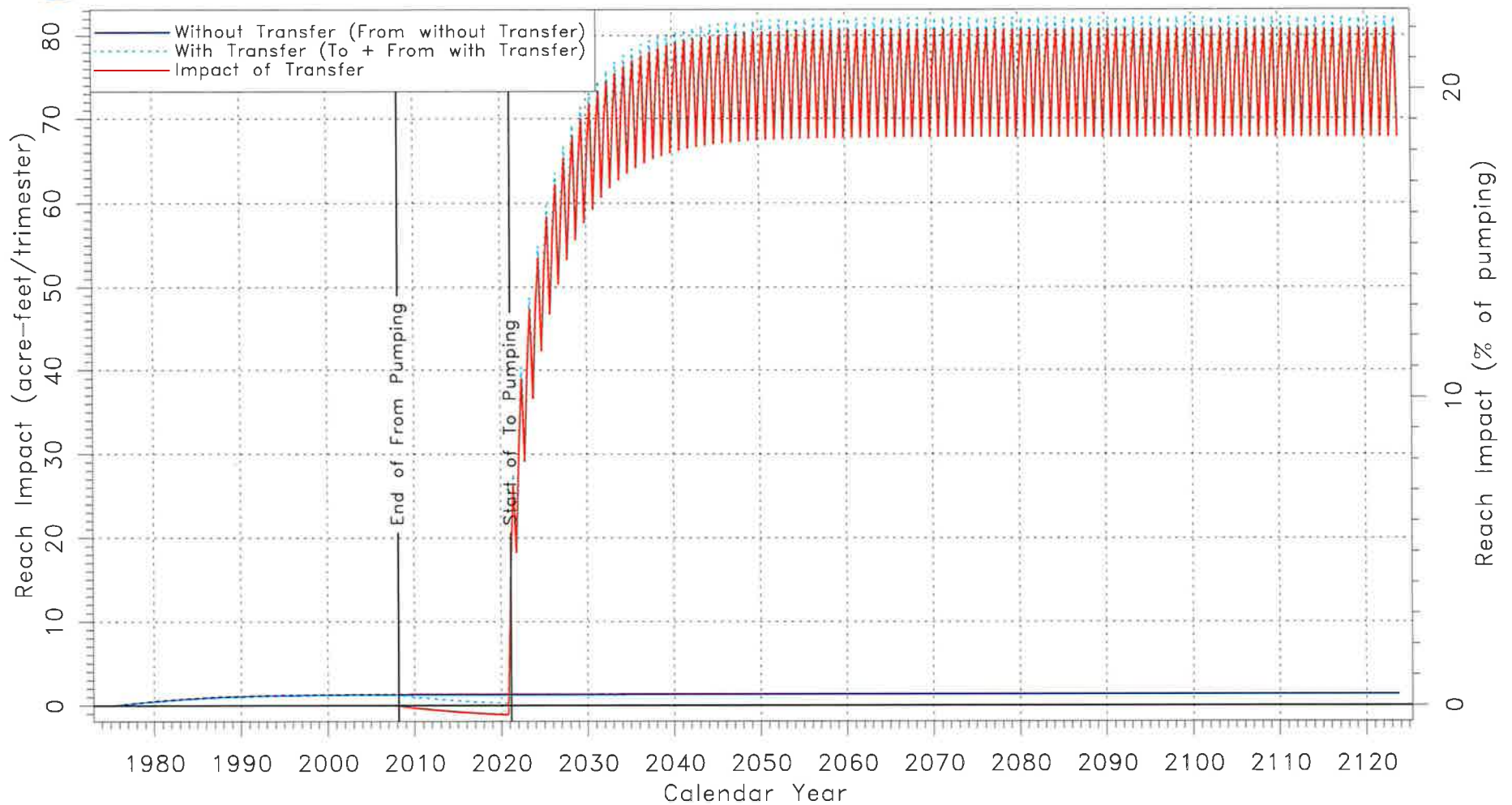


Figure 14



Transient Impact: Neeley-Minnidoka

ETRAN NEW: LCSC Transfer T84490

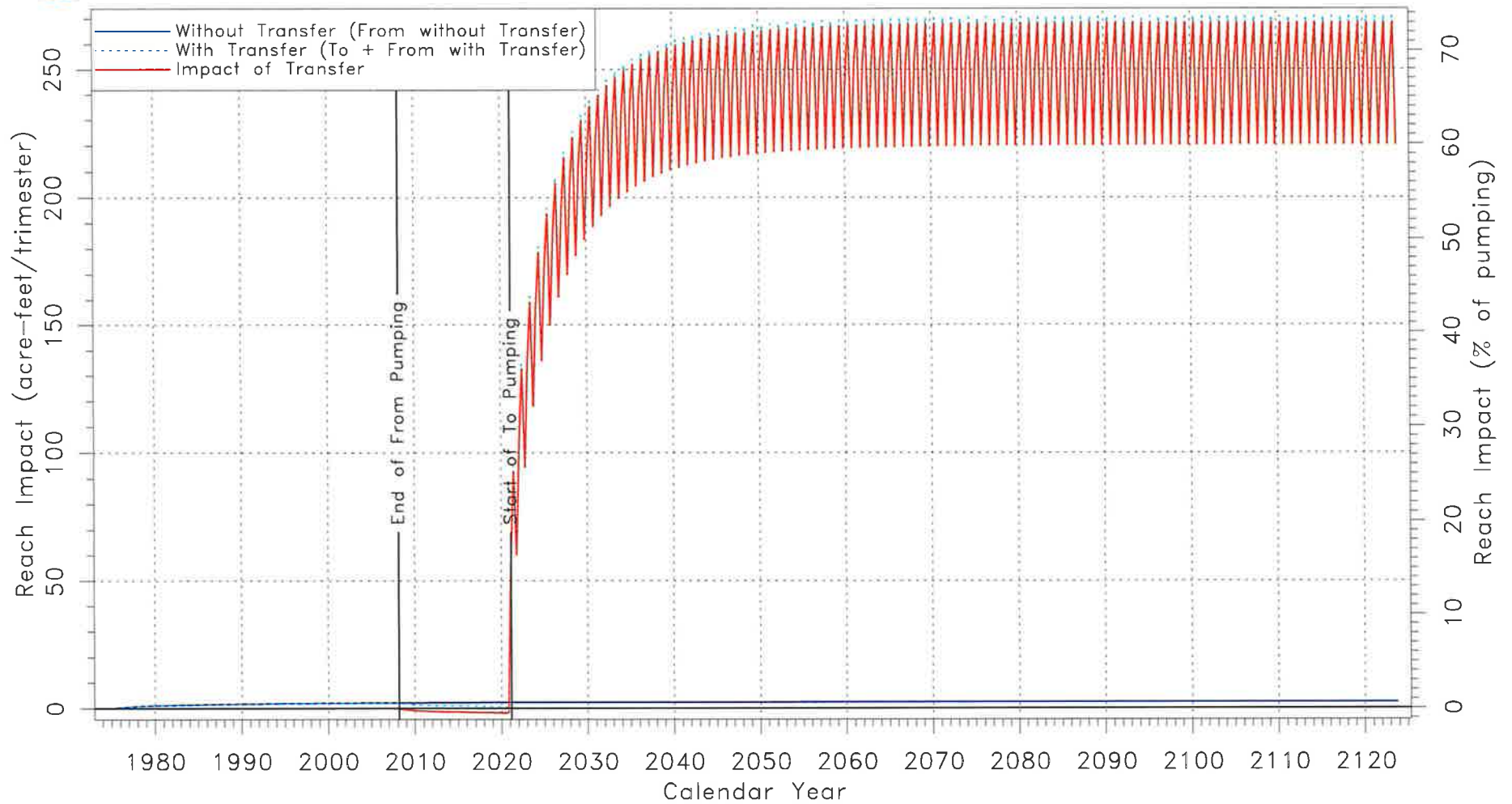
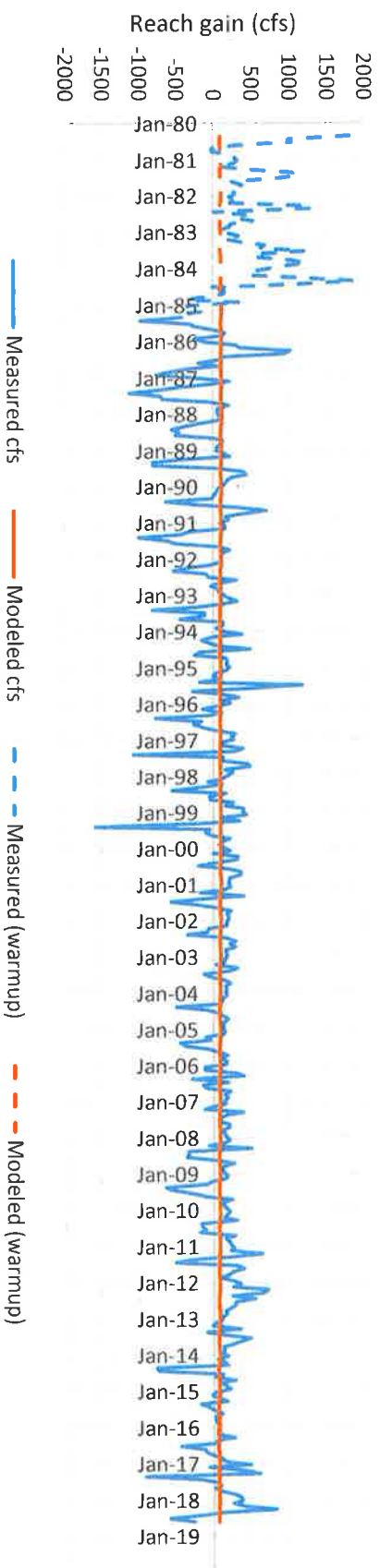


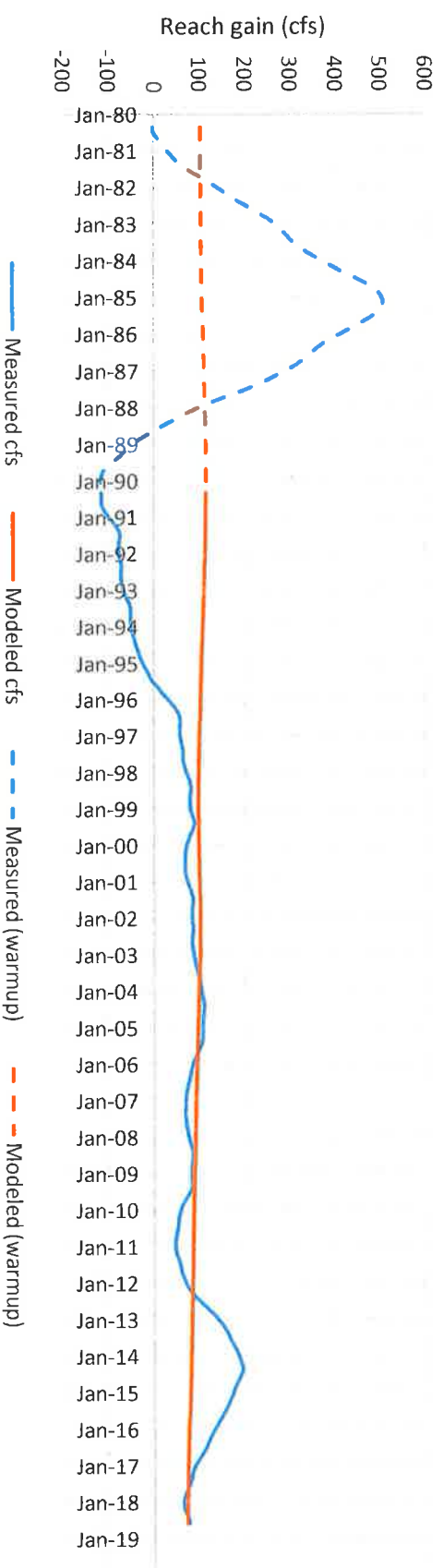
Figure 15

Snake River, Neeley to Minidoka

Neeley to Minidoka



Neeley to Minidoka filtered





Glover URF

ESPAM 2.2 Glover: LCSC Transfer T84490

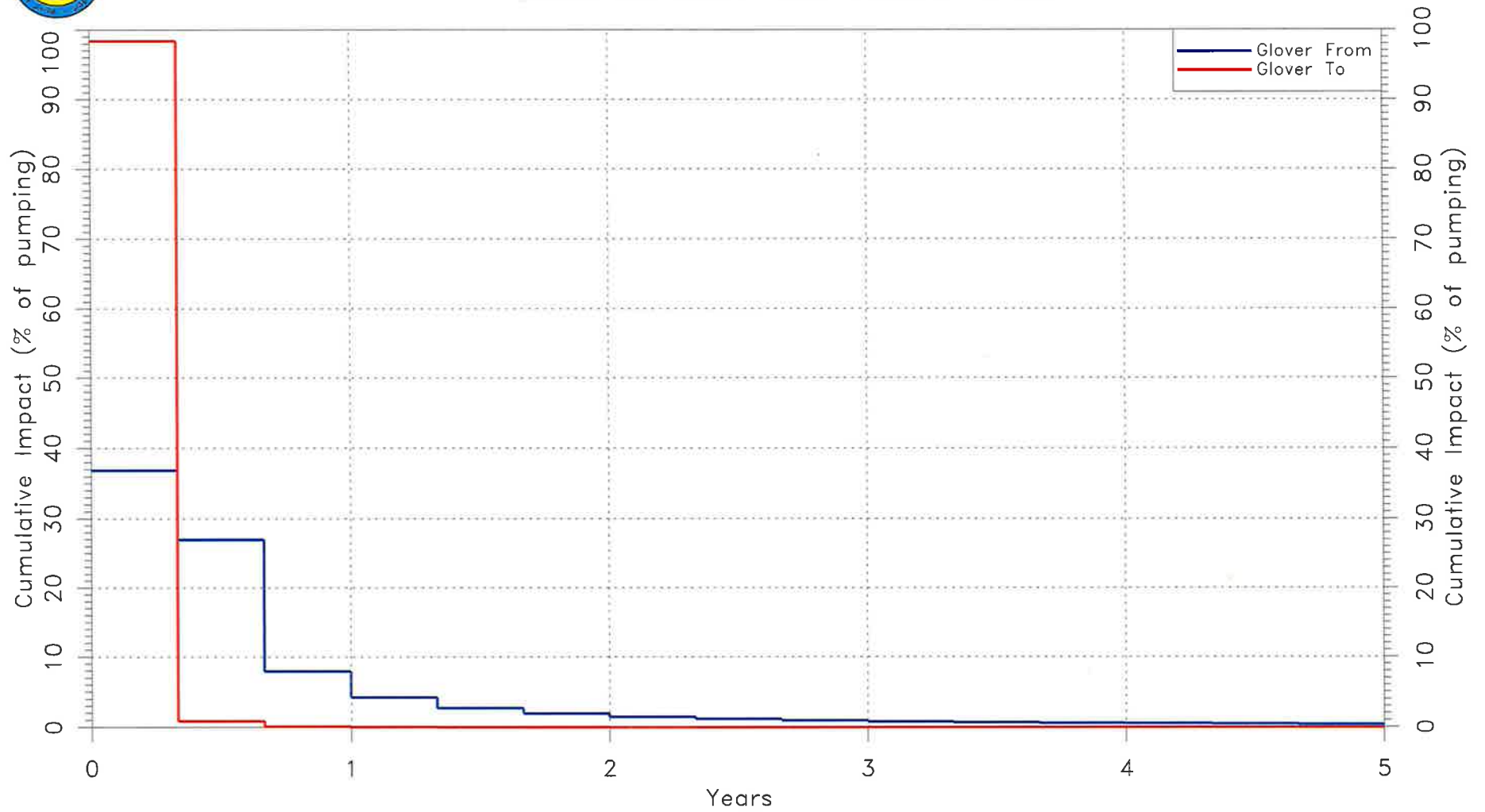


Figure 17

EXHIBIT B

Willem A. Schreüder, Ph.D

President and Principal Scientist, Principia Mathematica Inc.

Specialist in Applied Research and Development Activities in Mathematical Modeling and Computational Fluid Dynamics, including Groundwater Modeling.

Expertise: Mathematical Modeling; Advanced Data Analysis; Numerical Analysis; Computational Fluid Dynamics; Ground and Surface Water Hydrology; Water Rights Analysis; Contaminant Transport; Turbulence Modeling; Heat and Mass Transport; Software Development for Data Analysis, Mathematical Modeling, Computer Graphics and Geographical Information Systems (GIS); Solution of Differential Equations; Operations Research; Graphical Presentation of Information; Litigation Support and Expert Witness Testimony.

Billing Rate: \$200/hour

ACADEMIC BACKGROUND

B.Sc (1981), University of Stellenbosch. Physics III, Chemistry III, Mathematics III, Applied Mathematics III and Computer Science III.

Hons. B.Sc (1982), University of Stellenbosch. Applied Mathematics.

M.Sc (cum laude) (1984), University of Stellenbosch. Applied Mathematics.

Ph.D (1986), University of Stellenbosch. Applied Mathematics, Computational Fluid Dynamics.

Visiting Assistant Professor of Mathematical Sciences (1986-1987), Rensselaer Polytechnic Institute.

Assistant Professor of Mathematics (1987-1989), West Virginia University.

MS (1998), University of Colorado at Boulder. Computer Science.

Ph.D (2005), University of Colorado at Boulder. Computer Science, Parallel Systems.

Instructor (2006-2008), University of Colorado at Boulder, Computer Science.

Assistant Professor Adjunct (2008-2016), University of Colorado at Boulder, Computer Science.

Associate Professor Adjunct (2016-present), University of Colorado at Boulder, Computer Science.

PROFESSIONAL ASSOCIATION MEMBERSHIP

American Academy of Forensic Sciences (Fellow)

National Groundwater Association

EXPERT WITNESS TESTIMONY¹

1. Rio Grande Silvery Minnow, et al. vs. John W. Keys, III et al. Case No. CIV 99-1320 JP/RLP-ACE
2. Concerning the Application for Water Rights of Park County Sportsmen's Ranch LLP in Park County, Colorado Case No. 96CW014
3. Rules Governing New Withdrawals of Groundwater in Water Division 3 Affecting the Rate or Direction of Movement of Water in the Confined Aquifer, Case No. 04CW024.
- 4* ECCV Northern Project Case No. 02CW403
- 5 Republican River Compact Arbitration before Mr. Karl Dreher Pursuant to Section VII, Final Settlement Stipulation (2009)
- 6 Cherokee Metropolitan District Upper Black Squirrel Creek Designated Basin Alluvial Aquifer Replacement Plan, Case No. 08GW71.
- 7 Concerning the Office of the State Engineer's Approval of the Plan of Water Management for Special Improvement District No. 1 of the Rio Grande Water Conservation District, Case No. 2007CW52.
8. In the Matter of Rules and Regulations for the Determination of the Nontributary Nature of Ground Water Produces through Wells in Conjunction with the Mining of Minerals, 2 CCR 402-17
9. Colorado Ground Water Commission hearing on amendment of Rule 5.2.5.2 – Closing Hay Gulch subbasin of Lost Creek Designated Groundwater Basin 09-GW-12.
10. Republican River Compact Arbitration before Ms. Martha O. Pagel Pursuant to Section VII, Final Settlement Stipulation (2010).
11. California State Water Resources Control Board hearing regarding United States Bureau of Reclamation Water Rights Applications 31487 and 31488 and Petition to change Licenses 3723, 4196, 11605 and 10180.
12. Application for Water Rights of the United Water and Sanitation District, the East Cherry Creek Valley Water and Sanitation District and the Farmers Reservoir and Irrigation Company, Case Nos. 02CW404 and 03CW442.
13. Theodore Schroeder et. al. v. Pacific Gas and Electric, Case No. BC406019.
14. Crow Creek Designated Groundwater Basin - Petition for De-designation, Case No. 03GW06.
15. Kansas v. Nebraska and Colorado, Case No. 126 original (2012 & 2013).
16. Montana v. Wyoming and North Dakota, Case No. 137 original.
17. Application for Approval of Additional User in the Plans for Augmentation and Recharge Projects Decreed in Case No. 02CW403, 02CW404 and 03CW442, Case No. 10CW306.
- 18* Republican River Compact Arbitration - Rock Creek before Mr. Jeff Fereday (2013).
19. Republican River Compact Arbitration - CCP/Bonny before Ms. Martha O. Pagel (2013).
- 20* Republican River Compact Arbitration - NCORPE Creek before Mr. Jeff Fereday (2013).
21. Gallegos Family Properties v. Colorado Ground Water Commission, Case No. 2003CV1335.
- 22* Front Range Resource Replacement Plan, Case No. 13GW07.
23. Timbro Ranch Application for Water Rights, Case No. 2013CW3144.
- 24* Front Range Resource Replacement Plan, Case No. 15CV30493.
- 25* Raton CBM Plan for Augmentation, Case No. 10CW02.
- 26* United States v. Truckee-Carson Irrigation District, Case No. CV-N-95-757-HDM
27. In the Matter of the Rules Governing the Withdrawal of Groundwater in Water Division 3 (the Rio Grande Basin), Case No. 2015CW3024.
- 28* Central Walker Project, Case No. 2016CW3202.
- 29* Mile High Lakes, Case No. 2019CW3024.
- 30* Central Rural Lands Recharge Pond, Case No. 2017CW3165.
- 31* Republican River Compact Rules, Case No. 2019CW3002.

¹ In cases marked with a *, only a report was written. In all other cases both an expert report and testimony were provided.

PROFESSIONAL EXPERIENCE

9/2001 - Present: President, Principia Mathematica Inc.

11/1997 – 8/2001: Senior Engineer/Scientist, Principia Mathematica Inc.

Responsible for data analysis and mathematical modeling related to groundwater flow and transport. Projects include:

1. Peer review and development of the Rio Grande Decision Support System (RGDSS) Groundwater Model;
2. Development and maintenance of the Republican River Compact Administration Groundwater Model, resulting from litigation before the U.S. Supreme Court between the States of Colorado, Kansas and Nebraska;
3. Evaluation of the Park County Sportsman's Ranch application which involved groundwater modeling to support an underground storage project;
4. Lockheed-Redlands project which involved basin-scale groundwater fate and transport modeling and data analysis.
5. Peer review and development of the East Snake Plane Hydrologic Model

Responsible for data analysis and mathematical modeling related to surface water. Projects include:

1. Evaluation of the Truckee River Operations Model (TROM) in California and Nevada;
2. Evaluation of the Upper Rio Grande Water Operations Model (URGWOM) as part of the Silvery Minnow litigation.

Responsible for data analysis and mathematical modeling related to atmospheric modeling. Projects include:

1. Evaluation of plume condensation at BASF facility, Port Arthur, TX;
2. Atmospheric dispersion modeling to evaluate the impacts of the Ingram Barge incident, Baton Rouge, LA;
3. Evaluation of hexavalent chromium exposure from cooling towers at the PG&E Hinkley and Kettleman facilities.

Responsible for mathematical modeling, model evaluations and data analysis in several projects involving complex soils and ground water contamination. Projects include:

1. Houston Research Tract;
2. Long Beach Terminal.

Responsible for development and maintenance of mathematical model software and software for data analysis and graphics.

2/1995 – 10/1997: Senior Engineer, Principia Mathematica Division of Terranext.

Responsible for development of advanced methods of site characterization, evaluation of soil and groundwater contamination, design and optimization of remediation options, atmospheric and groundwater modeling and data analysis. Specific issues addressed included interfacing with laboratories, data validation, integration of GIS and GPS technology into the database and field campaigns, interpretation and modeling of free product contamination, and bioremediation.

Responsible for data analysis and modeling in projects related to soil and groundwater contamination. Projects included:

1. Eugene Rail Yard in Eugene, Oregon;
2. Taylor Rail Yard in Los Angeles, California;
3. Los Angeles Transportation Center in Los Angeles, California;
4. Former Northeast Petroleum Terminal in Tiverton, Rhode Island.

Responsible for air quality data analysis and mathematical modeling related to atmospheric transport at several sites. Projects included:

1. Data analysis and modeling of hexavalent chromium releases from the Gas Compressor Station located at Hinkley, California. This project was dramatized in the motion picture *Erin Brockovich*.

2. Data analysis and modeling of formaldehyde and particulate matter releases from the Willamette plant near Gifford, Arkansas
3. Data analysis and mathematical modeling of air quality at an aircraft manufacturing facility located in Burbank, California;
4. Data analysis, modeling and operational analysis of plume condensation at a geothermal power plant in Kakkonda, Japan.

Responsible for development and maintenance of mathematical model software and software for data analysis and graphics.

1/1990 – 2/1995: Project Engineer, Principia Mathematica Inc.

7/1989-12/1989: Staff Engineer, Principia Mathematica Inc.

Responsible for data analysis and mathematical modeling related to groundwater flow and transport. Projects include:

1. Development of a groundwater model of the Lowry Landfill Site. The model included complex three-dimensional flow and transport of ten different compounds, including simultaneous simulation of five reacting compounds.
2. Development of a groundwater model in the Arkansas River Basin resulting from litigation before the U.S. Supreme Court Litigation between Colorado and Kansas.
3. Development of a groundwater model and evaluation of other groundwater models in the San Luis Valley, Colorado for the AWDI litigation, which involved an application for water rights.
4. Evaluation of groundwater flow and transport models in the Honey Lake Valley in California and Nevada as part of an EIS.
5. Development of a groundwater flow and transport model for the Remedial Action Plan at the Anoka Landfill Superfund Site in Minnesota. A Decision Support System (DSS) was developed and successfully defended before State regulatory agencies.
6. Forensic data analysis and modeling of groundwater and water chemistry to evaluate flooding at the IMC Esterhazy Mine.
7. Data analysis, model development and evaluation for a water rights dispute in Nevada.
8. Senior consultant to Waste Management of North America Inc. on data analysis and mathematical modeling. Specific projects included data analysis and model development for at the Cortese Landfill in New York, the WDI Landfill in New Jersey and the Durham Road landfill in California.

Responsible for the development and maintenance of software for mathematical modeling, data analysis and graphics. Specific items include:

1. Enhancement and maintenance of the PM-TARGET series of ground water flow and heat and mass transport model programs for saturated and unsaturated flow flow and transport in one, two and three dimensions;
2. Enhancements to the USGS MODFLOW groundwater flow program;
3. Development and maintenance of the PM-MODTAR program that permits simultaneous multi-compound reactive transport to be simulated;
4. Enhancement and maintenance of PM-DIAMOND, an advanced systems for the analysis of multi-dimensional models and data, and production of device-independent graphics.

Primary responsibility for analysis and evaluations of large volumes of complex precipitation, surface topography, hydrologic and geologic data, and developing new techniques specifically for this purpose.

Presented and led several scientific workshops on advanced data analyses, numerical modeling of ground water flow, contamination transport and remediation using the MODFLOW and PM-TARGET series of programs as well as the complete suite of Principia graphics packages.

8/1987-5/1989: Assistant Professor of Mathematics, West Virginia University.

Teaching undergraduate and graduate courses in Calculus, Differential Equations and Numerical Analysis. Research on the numerical prediction of highly non-linear diffusion processes, and numerical prediction of atmospheric flows. As part of both of the above research projects, fundamental research

was conducted on automatic grid refinement in parabolic and elliptic problems.

9/1986-6/1987: Visiting Assistant Professor of Mathematical Sciences, Rensselaer Polytechnic Institute.

Teaching Numerical Analysis. Research in conjunction with Prof. Georges Belfort of Chemical Engineering and Prof. Donald Drew of Mathematical Sciences Department on the numerical prediction of pulsating flow in ultra-filtration membrane systems.

1/1986-7/1986: Scientific Computing Specialist, Bureau of Mechanical Engineering, University of Stellenbosch.

Responsible for development of data acquisition system on towing tank; enhancement of ADINA finite element package, including development of graphical pre- and post-processing packages; development of VT 100/Tektronix 4010 terminal emulation software; supervising operation of VAX minicomputers; development of a routing and scheduling program for a fleet of containerized cargo vehicles; supervising development of software for a 4 axis flight simulator.

1/1985-12/1985: Captain Pilot, Wellington Air Services.

Flying charters in southern Africa. Command pilot on AC 112, PA 28-200R and PA 28-260, co-pilot on BE 54 and BE 58 aircraft.

SELECTED PUBLICATIONS:

- Schreüder, W.A. (1984) **Numerical Prediction of Laminar Cross-Stream Jet Flow**. M.Sc. thesis, University of Stellenbosch.
- du Plessis, J.P., W.A. Schreüder and M.R. Collins (1985) **Numerical Prediction of Dry Air Flow at Cooling Installations**. Report TW 85-2, Department of Applied Mathematics.
- Schreüder, W.A. (1986) **Air Flow About a Directly Air-Cooled Heat Exchanger**. Ph.D. thesis, University of Stellenbosch.
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- Schreüder, W.A. (2001) **Accessing Files on Unmounted File Systems**. *Proceedings, Large Installation System Administration Conference*, San Diego, CA, December 2-7, pp. 163--167.
- Schreüder, W.A. (2002) **Quantitative Uncertainty Analysis**. *Engineering Sciences Section, American Academy of Forensic Sciences, Annual Meeting*, Atlanta, Georgia, February 14-15.
- Schreüder, W.A. and Leslie Eng (2003) **Fitting Calibration Data**. *Engineering Sciences Section, American Academy of Forensic Sciences, Annual Meeting*, Chicago, Illinois, February 20-21.
- Schreüder, W.A. (2003) **The Five Minute Guide to Perl**. Principia Mathematica Technial Note PM-TN-2003-1.

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Schreüder, W.A. (2018) **What confidence do we have in confidence intervals?** *Engineering Sciences Section, American Academy of Forensic Sciences, Annual Meeting, Seattle Washington, February 24, 2018*.

Schreüder, W.A. (2019) **An analytical Solution for Water Table Rise from Managed Recharge**. *Proceeding of Modflow and More 2019* Golden CO, June 2019.

Schreüder, W.A. (2020) **Complex vs. Uncertainty in Models**. *Engineering Sciences Section, American Academy of Forensic Sciences, Annual Meeting, Anaheim California, February 20, 2020*.

EXHIBIT C

David Blew
12144 Goodson Road
Middleton, ID 83644

Education

B.S. Wildlife Biology, Emporia State University, Emporia, Kansas, 1983

M.S. Environmental Biology, Emporia State University, Emporia, Kansas, 1988

General Profile

Water resources professional with over 30 years of experience in wide variety of water management activities.

Work Experience

HYDROLOGIST II, IDAHO POWER COMPANY 2007 – present

Conduct studies and monitoring of ground water resources on the Eastern Snake River Plain. Provide general expertise in the use of ground water monitoring equipment. Develop reports and presentations on results of ground water studies. Provide expertise on water rights and other administrative actions related to water rights. Review applications for permits and transfer applications and assess the potential to impact water supplies for hydropower production. Provide water supply modeling for planning purpose including company's integrated resource plan. Coordinate the communication of flows below Hells Canyon Dam to agencies and the general public. Assist in the development of annual budgets and quarterly accounting. Provide representation on the Ada/Elmore Local Area Group for the Employee Community Fund.

WATER RESOURCES SPECIAL PROJECTS COORDINATOR, IDAHO DEPARTMENT OF WATER RESOURCES 2001 – 2007

Provide leadership for the development of managed recharge projects in Idaho. Advise the department and Idaho Water Resource Board on aquifer recharge projects. Make presentations and provide expertise on recharge issues and other water related issues to the Idaho Legislature, state and federal agencies and other interested parties.

Provide project oversight for the use of state and federal funds used for aquifer recharge projects. Develop and manage contracts and agreements to facilitate aquifer recharge projects. Develop financial and progress reports on managed recharge projects.

Evaluate existing and proposed projects involving aquifer recharge, using knowledge of irrigation system operation, economics, requirements of state and federal water law, and other applicable federal statutes including the National Environmental Policy Act and the Endangered Species Act. Develop cost estimates for recharge projects. Develop reports and evaluations of recharge projects considering hydrology, geology, soils and water quality impacts. Evaluate water rights and water availability for aquifer recharge projects using current and historic data.

Coordinate with a wide variety of water interest groups such as Water Districts, Idaho Water User Association, Idaho Water Alliance, state and federal water management agencies, irrigation district, canal companies and the Idaho Water Resource Board for the implementation of managed recharge projects. Coordinate project permitting with appropriate state and federal agencies. Negotiate agreements, facilitate meetings, and serve as a department liaison on

committees, panels and work groups. Make presentations to interested groups concerning managed recharge.

Provide leadership and technical expertise on special projects such as the Conservation Reserve Enhancement Program.

AQUATIC BIOLOGIST, IDAHO DEPARTMENT OF WATER RESOURCES 1999- 2001

Conduct research and resource evaluations on ecologically related issues for comprehensive basin planning. Evaluate the impacts of water use and development on biological communities and ecological systems. Evaluate streams for protected statutes for the Idaho Water Resource Board. Assisted with the minimum stream flow program. Provide expertise for the Endangered Species Act. Assist in the economic evaluation for comprehensive basin planning. Participate as a team member for comprehensive basin planning. Participate in public meetings for comprehensive basin planning. Developed reports and made presentations to interest groups and other governmental agencies.

RANGE/RIPARIAN SPECIALIST, IDAHO SOIL CONSERVATION COMMISSION 1990 -1999

Provide agency leadership on range and riparian related issues. Develop riparian grazing standards for the Agricultural Pollution Abatement Plan. Administer the ISCC's Rangeland Conservation and Resource Development Program grants. Work with private landowners to develop grazing plans for streams and riparian areas. Develop and evaluate riparian management alternatives for watershed planning efforts. Develop cost estimates and cost/benefit ratios for riparian management alternatives.

Organized workshops on riparian management for agency personnel and private landowners. Served as a member of the Idaho Riparian Training Cadre and taught numerous courses on the Properly Functioning Condition Analysis.

Responsible for the stream and riparian evaluations for water quality planning projects throughout Idaho. Served as a team leader for large stream and riparian survey efforts. Participate in large-scale watershed planning projects. Assess stream hydrology, sediment loads, streambank vegetation and streambank stability. Conducted comparative watershed hydrology studies to assess potential impacts to stream and riparian areas.

WATER QUALITY RESOURCE CONSERVATIONIST, IDAHO SOIL CONSERVATION COMMISSION 1988-1990

Designed irrigation systems and best management practices for water quality including water control structures, low head underground pipe, concrete ditches, gate pipe and runoff control systems. Advised landowners on irrigation water management and sediment control. Developed farm plans for erosion control to improve water quality. Develop budgets for BMP implementation and water quality programs.

Reports and Formal Presentations

Blew, D. and Farmer, N., 2019. Water Quality Monitoring on the Eastern Snake Plain Aquifer, Insights from a Decade of Ground Water Tracer Studies. Proceedings of Annual Idaho Water Quality Workshop, March 2019.

Blew, D. and Farmer, N., 2015. Evidence of High Velocity Flow and Small Transverse Dispersion Using Dye Tracer in a Fractured Basalt Aquifer. Proceeding of Modflow and More 2015, Golden CO, May 2015.

Farmer, N., & Blew, D., 2014b. Open File Report Fluorescent Dye Tracer Test Near Clear Lakes From the 'Ashmead' Well. Idaho Department of Water Resources, Online Publication

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Blew, D. L., 2005. Phase II Evaluation of Managed Recharge on the ESRP, Development of Recharge Facilities. Idaho Department of Water Resources, Online Publication April 2005

Ingham, M. D. Blew and E. Cowley, 1996. Riparian Vegetation and Channel Response on Boulder Creek with Changes in Livestock Grazing, Proceedings from the Sixth Annual Nonpoint Source Monitoring Results Workshop "Closing the Feedback Loop". -January 9 - 11, 1996 (ABS)

Blew, David L., 1996. Concept Paper for the Office of the Governor of Idaho on the Dispensation of Little Salmon Mitigation Funds. Idaho Soil Conservation Commission.

Blew, D. L., F. J Fink and J A. Cornwell. 1995. Riparian Appraisal and Aquatic Habitat Evaluation, USDA Natural Resources Conservation Service, Boise, ID. Range Technical Note Number ID-67.

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Yellowstone Soil Conservation District, 1995. Henry's Lake State Agricultural Water Quality Project Final Report and Environmental Assessment. Published by the Yellowstone Soil Conservation District (contributing author).

Blew, D. L. and L. R. Fox. 1993. Hydrologic Differences Between the Current and Historic Watershed Conditions of Big Canyon Creek Using the TR-20. Unpublished Report. USDA Soil Conservation Service and the Idaho Soil Conservation Commission.

Blew, D. L. 1988. Key to Dorsal Guard Hairs of Kansas Mammals. Master Thesis, Emporia State University. Emporia Kansas

Horak, G. J and D. L. Blew, 1987. Kansas Shorebirds. Kansas Wildlife Magazine. March/April 1987, Published by Kansas Fish and Game