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Joe Kolman
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Mr. Kolman,

Attached are our comments on the report entitled *Water Resources Evaluation: Water Rights in Closed Basins* by Nicklin Earth & Water, Inc. (June 2008). These comments were prepared by staff from DNRC with the assistance of DEQ staff. Although the Nicklin report presents generalized annual water budgets for several areas of the state and includes much information on recent snowpack trends, it disregards seasonal water shortages or water short streams and stream reaches within a watershed. Nor does the report evaluate water rights in closed basins, as the title implies, and more specifically the effects that ground-water pumping may have on senior surface water users. For these reasons, we believe that the report does not provide any new information that would help the Committee in developing policy concerning exempt wells or permitting ground-water use in general.

We describe our major concerns with the report in the attached comments. If the Committee members have other questions concerning the report or our comments, please let me know and my staff and I will be happy to be of assistance.

Sincerely,

John Tubbs, Administrator
DNRC, Water Resources Division

Cc: Mary Sexton, Director, DNRC

Review of the Report: ***Water Resources Evaluation: Water Rights In Closed Basins*** **by Nicklin Earth & Water, Inc.**

Comments provided by DNRC and DEQ staff

Introduction

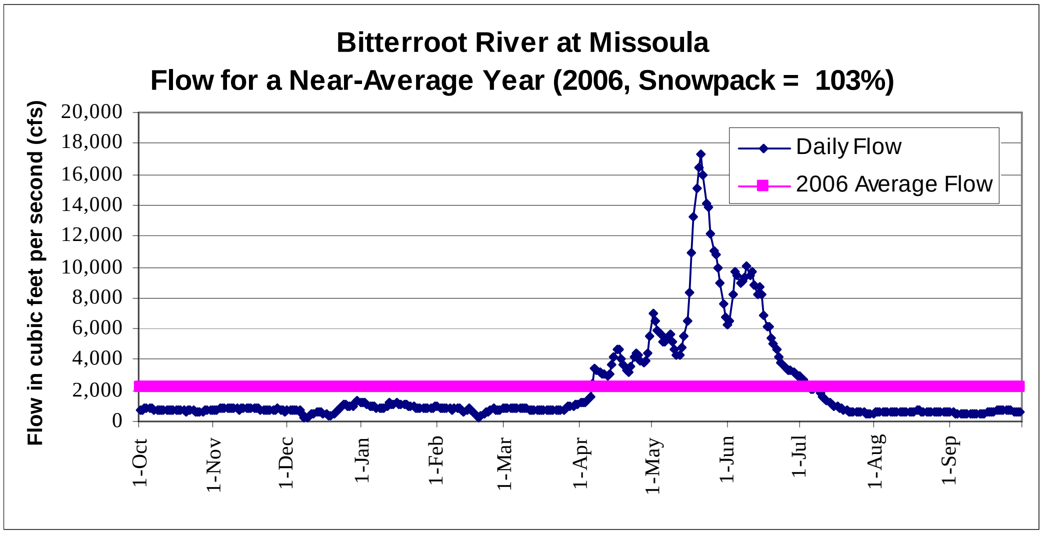
DNRC and DEQ were asked by the Water Policy Interim Committee to comment on the report entitled *Water Resources Evaluation: Water Rights in Closed Basins* by Nicklin Earth & Water, Inc. (June 2008), which was prepared for the Montana Association of Realtors. The Nicklin report discusses the relationship between precipitation and stream flows and considers whether subdivision development is causing increased consumption in closed basins. Unfortunately, the report relies on an evaluation of annual water budgets rather than a more rigorous analysis of the water supply during the late summer, when streamflows are low and water demands are high. Further, the report is not an evaluation of water rights in closed basins as the title implies; it does not assess the potential effects of ground water pumping on surface water flows or the difficulty of protecting senior water users from junior groundwater users under the priority system.

We certainly do not dispute that water budgets are useful and that stream flows are driven by precipitation, particular snow melt. However, we do not agree that, because the surface water runoff is a large number when compared to groundwater pumping in an annual water budget, there are or will be no effects of ground-water pumping on surface water users. The seasonal patterns of precipitation, snowmelt, runoff and water demand can result in water shortages within basins, both on main stem rivers and tributary streams. And these water shortages result in curtailment of surface water uses that can be made worse by ground water depletions, which generally occurs outside the priority system.

To illustrate the shortcomings associated with using annual average flows, Figure 1 compares flows for each day to the annual average for the Bitterroot River near Missoula during a near-average snowpack water year. The daily flow was below the average about 75 percent of the time. In fact, half of the average annual flow was contributed in the month and one-half period from May 1 to June 15. During late July and through much of August, when irrigation demands generally peak, flows were only about 25 percent of the annual average.

Nicklin also contends that overall water consumption in closed basins is declining and that water use for residential development is only consuming water that was previously consumed by retired agricultural irrigation. Some housing development does occur on land that previously was irrigated as the author argues; however, data presented in the report do not support the conclusion that irrigated acreage and overall water consumption is declining, with perhaps the exception of the Missoula Valley. Considerable development is occurring on land that previously was not irrigated and declines in irrigated acreage do not directly translate into decreased consumption. Furthermore, irrigation water that is released when subdivisions are developed on land that was previously irrigated is not necessarily returned to the source stream.

Figure 1. Bitterroot River near Missoula flows for the 2006 water year.



An Example Water Budget Analysis for the Late Summer During a Dry Year

By including peak runoff times and comparing water that is flowing in the rivers year round to the water needed during only the irrigation months, average annual water budgets can mask seasonal and localized water shortages. Figure ES-4 from the executive summary of the Nicklin report (reproduced as Figure 2 here) compares dry-year annual flows in the Bitterroot River for 2001 to water consumption for various uses. One could conclude that there are no water shortages by looking at this graph. However, you get a different impression from the graph in Figure 3 which presents a comparison of flows during the month of August for the same year to water needs (August use is estimated to be about 25% of the annual use based on the irrigation need for grasses pursuant to DNRC website information). It shows that about 92% of the water in the Bitterroot River during August of 2001 was used by Agriculture and domestic/public water supplies.

Figure 2. Comparison between annual Bitterroot River flow and water use for a dry year as presented by Nicklin.

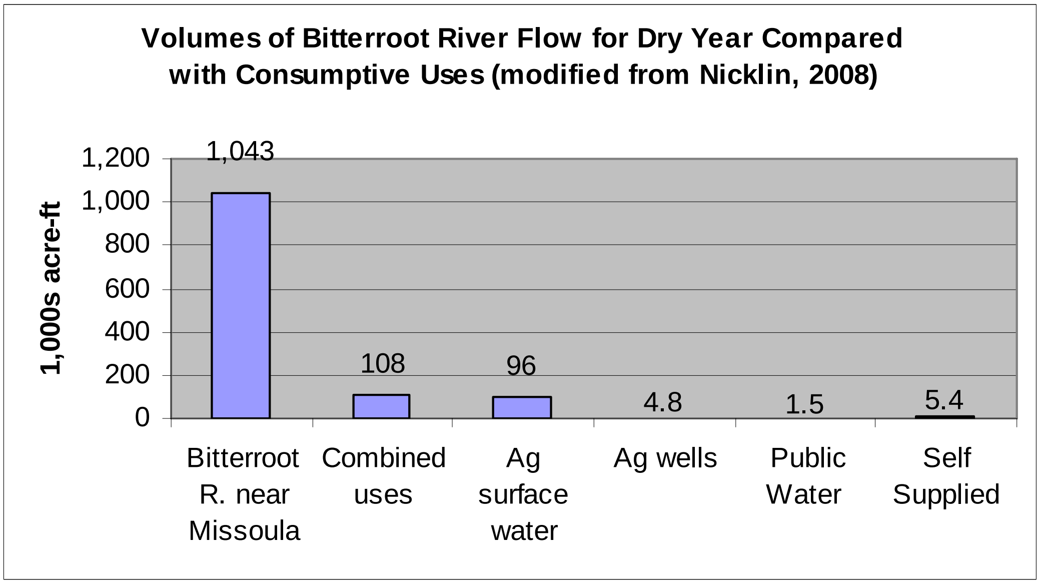
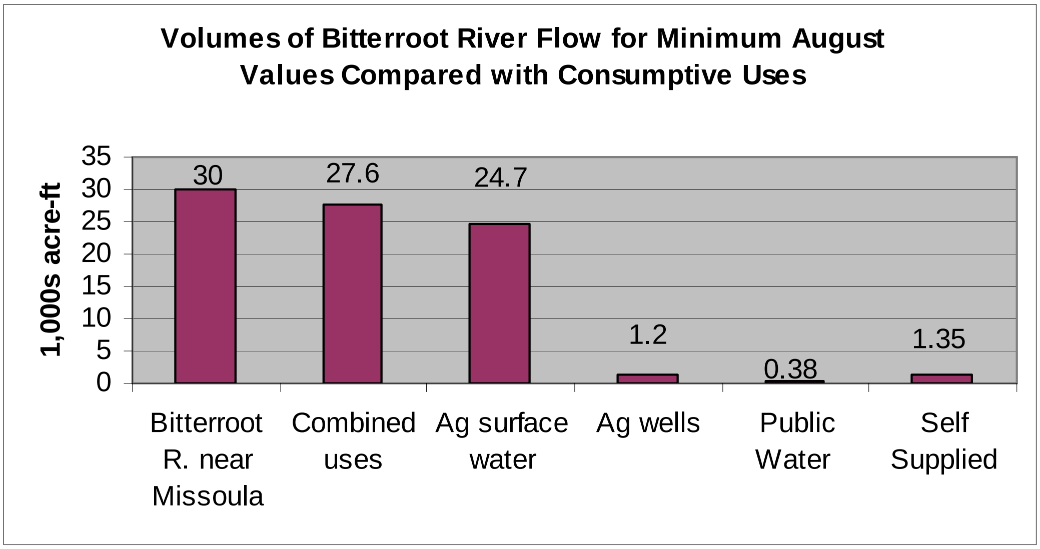


Figure 3. Comparison between minimum August Bitterroot River flow to water use for a dry year.



Potential Effects of Groundwater Use on Senior Surface Water Users

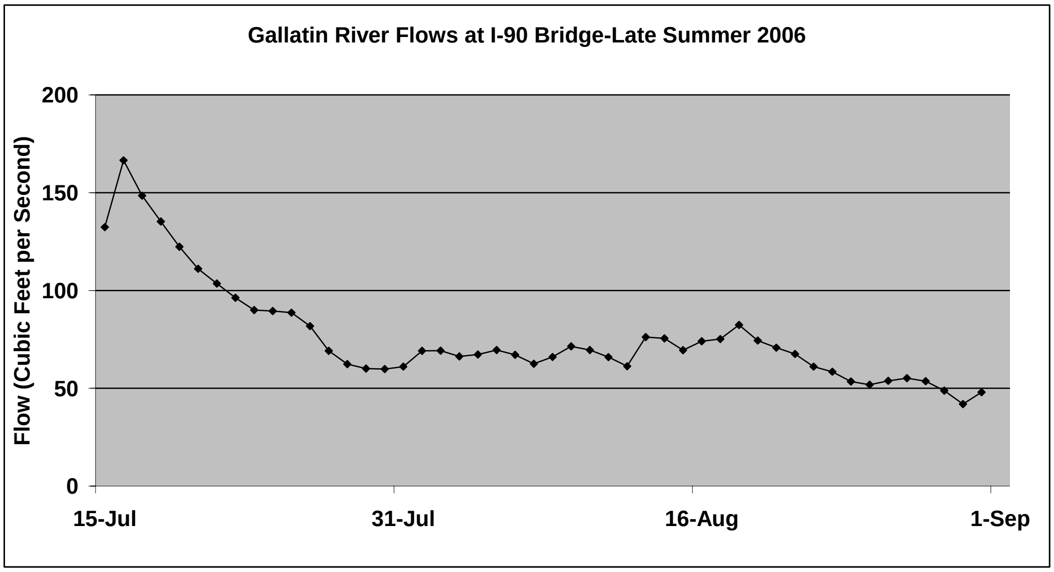
Nicklin states that ground water withdrawals are very small when compared to stream flow diversions for agriculture. We do not dispute this statement, but when the surface water in a basin is over-appropriated and agricultural needs use up almost all of the available stream flow, every percent taken via another use, including ground water for subdivisions, will be missed.

Water commissioners' records and streamflow measurements during the lower flow months of the irrigation season from July to September demonstrate that water shortages occur in closed basins nearly every year. During times of shortage, junior surface water use typically is curtailed by court-appointed commissioners, or total water use is reduced through informal voluntary sharing among water users. Table 1 provides a small sample of curtailments for late July of 2008, which has started out as a relatively wet year. Surface water users with priority dates back to the 1890s are curtailed in the Gallatin during most years and, if not for voluntary reductions, the Gallatin River at the I-90 Bridge would go dry (Compton, 2007) (Figure 4). Depletion of surface water by wells which, if not mitigated, continue during these periods of shortages will add to shortages and the need to curtail junior surface water rights or the need for more voluntary reductions. The effects of ground-water pumping may not show up in records of annual basin water outflow because they can be offset by curtailed use by junior surface water users within the basin.

Table 2. Priority Dates at which junior water users have been shut off during late July of 2008 by stream.

	2008 July Shut-Offs	
Stream	Water Commissioner	Priority Date
West Gallatin River	Alberda	1890
Musselshell River	Marchi	1892
Tenmile Creek nr Helena	Tordale	1870
Big Lake, Rock Creeks (Big Hole)	Boetticher	1886
North Fork of Smith River	Horchstradt	1878

Figure 4. Gallatin River flows in dewatered reach during late summer.



Irrigated Acreage Trends

Nicklin concludes that irrigated acreage and water consumption is generally decreasing in the basins he assessed. We find that the Agricultural statistics do not support this conclusion. One of Nicklin's mistakes is that he relies on simple linear regressions, with no consideration of outliers or events that may skew results. He also does not discuss the low statistical significance of his regression coefficients. Irrigated acreage for Ravalli County provides a good example of the weaknesses of Nicklin's analysis. The declining trend identified in the Nicklin report for Ravalli County is not due to an incremental decrease in irrigated acreage related to subdivision growth, but by isolated events unrelated to housing development including: (1) six high irrigation years in the 1960's, and (2) one unusually low year in 2006 (Figure 5). The decline in acreage on the graph from the late 1960s to the early 1970s does not correspond to a period of rapid subdivision development. And because irrigated acreage rebounded in 2007, the dip in 2006 appears to be an anomaly unrelated to development. Elimination of data for these anomaly years reveals a visual flat to possibly increasing trend between 1970 and 2005 (Figure 6). Similarly, data for total irrigated acreage for Gallatin County also do not show a declining trend (Figure 7). Only for Missoula County, where irrigated acreage is relatively small and significant developments have occurred outside irrigated lands is a trend apparent.

Figure 5. Irrigated acreage trends for Ravalli County 1964-2007 (Nicklin Figure 3-16).

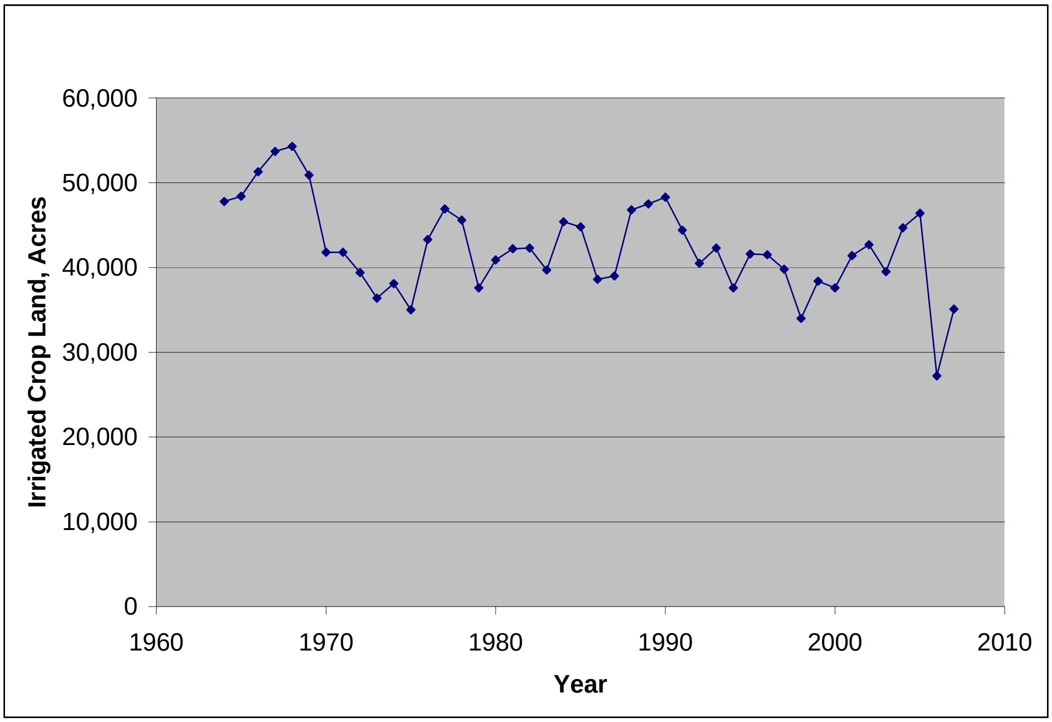


Figure 6. Irrigated acreage trends for Ravalli County 1970-2005.

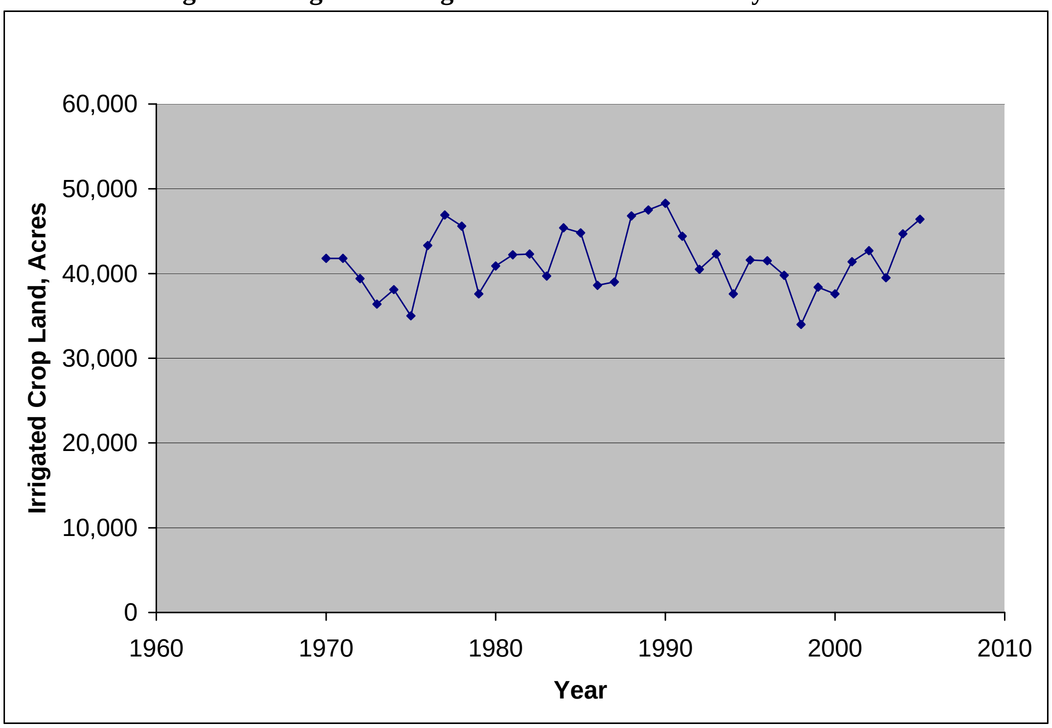
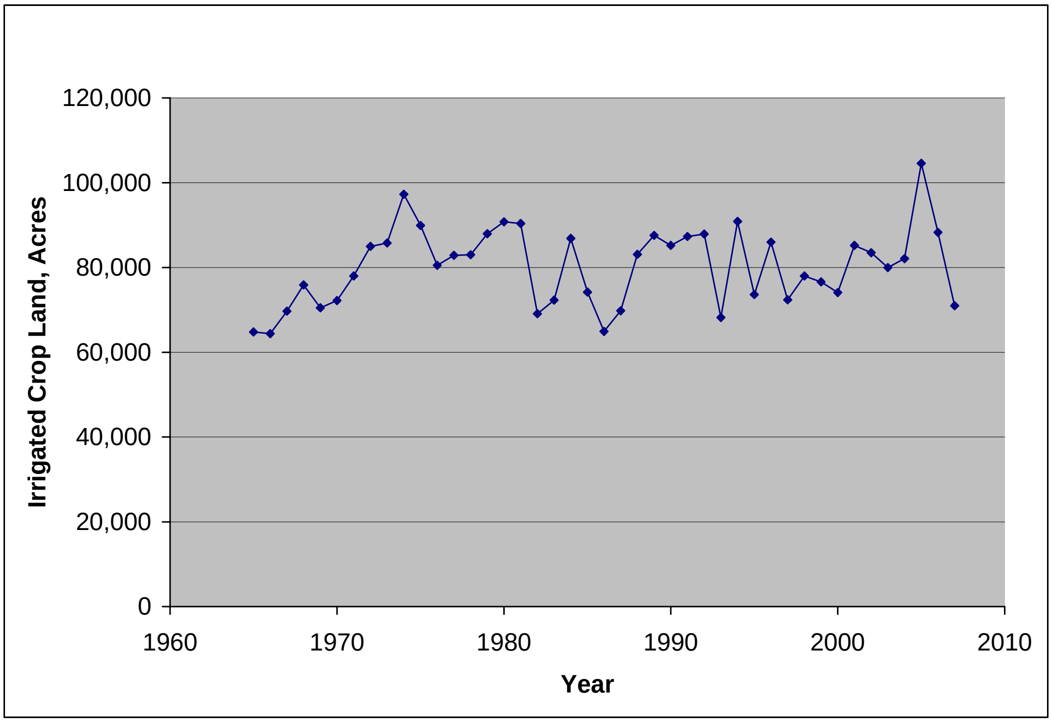


Figure 7. Irrigated acreage trends for Gallatin County 1964-2007.



Another factor not considered by Nicklin is that the Agricultural statistics show steadily increasing crop yields over the period of record and this has likely resulted in increased water consumption per acre irrigated. There is a linear relationship between alfalfa hay yield and water consumption by the crop; it takes about 5-to-6 inches of water to produce a ton of hay (Smith et al., 1998; Bauder; Irmak, 2007; Hill, 2002; Hanson and Putnam, 2000). As hay yields increase--due to improvements such as sprinklers system, more use of fertilizer, and enhanced alfalfa varieties—a corresponding increase in crop water consumption can be expected. In other words, crop water consumption in a basin could increase, even as the amount of irrigated land remains constant or even decreases.

Other Factors Concerning Land Use Changes

Nicklin implies that most development is occurring on previously irrigated land, even though considerable development is occurring on land that was not previously irrigated. Even on previously irrigated land, without formal mitigation, there is no assurance that the water no longer used for crop irrigation will be left in the source or go to senior users by priority. Water that is diverted by a ditch company but no longer used on land within the ditch service area due to development might simply be diverted by other users on that ditch to increase their service and yields. In addition, the report does not consider the following questions concerning water rights on previously irrigated agricultural lands:

- Were the water rights for the irrigation transferred to another parcel?
- How much of the water might be used on the same ditch by another user who was historically short on water?
- Were the historic water rights subject to being shut down early and historically not used during the later part of the summer?

- What is the change in timing of use and return flow patterns due to the change from crop irrigation to residential use?

Nicklin assumes that residential development of irrigated agricultural land reduces overall water use, but the evidence does not support this. The water used by homeowners to irrigate lawns and garden is estimated to be similar to that used for full-service sprinkler irrigation of alfalfa (DNRC, 2008 "Effects of Exempt Wells on Existing Water Rights"). We agree that all the land in a housing development is not irrigated. On the other hand, much of the agricultural irrigation does not receive a full water supply during times of shortage. Residential ground-water use might increase during periods of drought (due to increased lawn irrigation during dry weather) at the same time surface-water irrigators might be curtailed.

Provisions of HB 831 codified at §85-2-360 MCA through §85-2-364 MCA provide mechanisms in addition to basic permitting criteria in §85-2-311 MCA whereby an applicant for a provisional permit for a well in a basin closed to new surface water use can pump and use ground water if effects to senior water users are mitigated. Most often, mitigation or aquifer recharge plans will involve retiring an existing surface water use and changing the water right to mitigate the impacts of the new use. A ground water applicant under HB 831, in conjunction with the change statute of §85-2-402 MCA, is required to demonstrate that the historic period of use and consumptive use of the right being retired will provide adequate water in priority generally during the time needed to mitigate any adverse effects of the new use. The change process ensures that the historic water right will not be expanded or used in a way that adversely affects other water users. These protections are not in place for subdivisions that are developed with exempt wells.

Summary and DNRC Comments on the Key Findings of the Nicklin Report

Nicklin's report concludes the obvious: that annual water availability is primarily driven by precipitation. The report also finds that groundwater withdrawals are a small portion of annual basin water budgets. No one disagrees with these finding, but they do not help us to manage wells and insure that they are not taking water outside of the prior appropriations system. The author does not take into account that existing consumptive water uses, primarily agricultural irrigators, can be curtailed during times of shortage, by water commissioners or voluntary water sharing agreements. Nicklin does not consider that ground-water pumping can deplete streamflows and increases the need to curtail these senior water users.

The key findings from the summary of Nicklin's report are listed in italics followed by DNRC's comments.

Nicklin 1. ***Streamflows depend principally upon each given year's mountain snowpack in the subbasins that were evaluated. Snowpack as measured by water equivalent since the late 1990s has been below average. This has led to a period of lower than average streamflows.***

DNRC 1. DNRC does not dispute that precipitation, primarily mountain snowpack, is the principal factor that determines streamflows. However, the report does not acknowledge that the amount of water available to senior water users varies throughout the year and within basins depending on the timing of streamflows, water demands, and hydrogeologic conditions. Curtailment of surface water uses resulting from naturally occurring water shortages can be increased by depletion caused by ground water use.

Nicklin 2. ***By far the most significant human-related influence on streamflow in the watersheds examined are surface water diversions for irrigation. Reservoir evaporation was a significant factor for Lewis and Clark County in the Upper Missouri River basin. Ground water use is very small when compared to streamflow diversions.***

DNRC 2. DNRC does not disputes that surface-water diversions for irrigation are the most significant human-related influences on streamflow and that ground-water use is small relative to annual basin flows. However, depletion caused by ground-water pumping reduces the amount of water available for senior non-consumptive uses such as in-stream flows and hydropower, and leads to increased curtailment of surface water diversions for consumptive use on main stems and tributaries within basins.

Nicklin 3. ***Ground water levels and, hence, aquifer storage have remained relatively constant from year-to-year for all watersheds that were examined.***

DNRC 3. The report provides only a limited analysis of ground-water levels. However, relatively large ground water storage volumes and interaction with surface water moderates ground-water level fluctuations and mask any effects of relatively small ground water use.

Nicklin 4. ***There is no evidence that the overall consumptive water use has increased with the growth of subdivisions and their accompanying use of ground water. The primary reason for this is that many of these subdivisions have been placed in areas where agricultural irrigation activity has historically occurred.***

DNRC 4. Data presented in the report, with the exception of Missoula County, do not support the conclusion that irrigated acreage or overall consumptive water use has declined. Consumption depends on the crop irrigated, crop yield, the period of historic and new uses, availability of water for irrigation, and controls on water use imposed by the priority system or through voluntary actions. Ultimately, water consumption in water-short basins is controlled by water availability which is determined by snowpack, season of the year, the hydrogeologic conditions within each basin, and voluntary or enforced water management. Increased use of ground water that results in surface water depletion is offset by less surface water use on water-short streams.

Nicklin 5. ***It is concluded via water budgeting assessments that there is no measurable evidence of so-called "cumulative impacts" of exempt wells, public water supply wells, or even agricultural irrigation wells on streamflows in any of the watersheds evaluated. In effect, any net cumulative effect, if it exists, is simply too small to be discerned.***

DNRC 5. Annual water budgets are used in the report to support the presumption that, because groundwater use is small in comparison to basin water yields, there are no cumulative impacts from exempt wells. The occurrence of seasonal water shortages, historically low flows in the irrigation season or water supply problems on smaller tributary streams are not considered, nor are voluntary or enforced water reductions by surface water users.

Nicklin 6. ***Projections were made on future water demands on ground water. Based upon these projections, the impacts of ground water development by 2030 will not be measureable or observable in streams.***

DNRC 6. Very large additional use with significant impacts to senior water users could occur in the basins evaluated in the report and not be detected by the methods used in the report as long as senior surface water irrigators unknowingly and unwillingly absorb the increased depletions through reductions in their water use. The conclusion also assumes we can ignore localized impacts that might occur to smaller streams within a watershed.

References

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