Presentation
to
Water Policy Interim Committee
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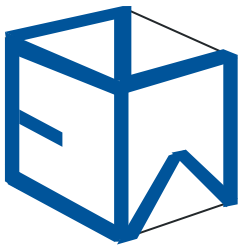
Update on Evaluations Significance of Exempt Wells Montana's Closed Basins

prepared by



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Update on Evaluations Significance of Exempt Wells Montana's Closed Basins

by

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The focus of my presentation today is to expand on the relative significance of exempt wells on stream flows from a water supply perspective. My first efforts on this issue were first defined in a study I completed in early 2007 (Nicklin Earth & Water, Inc., 2007). This presentation also uses information and interpretations that were developed by the Montana Department of Natural Resources and Conservation (DNRC) as set forth in its "Working Draft Memorandum entitled Effects of Exempt Wells on Existing Water Rights" [DNRC Memorandum]. The information presented in the DNRC Memorandum, if put in a proper perspective, actually further buttresses the conclusions that I had drawn in the Gallatin Valley study.

The original Gallatin Valley study was employed to develop a better understanding of the relative significance of ground-water extractions as they affect stream flows and also on ground-water levels. In that study, I used standard hydrologic evaluation methodology to conclude that the relative significance of exempt wells is inconsequential (de Minimus) in comparison to stream flows and irrigation demands on those stream flows. Although flow changes and below average flow in the streams of the Gallatin Valley have been observed in recent years, these changes are obviously due to climatic factors (drought).

Since the original effort, Nicklin Earth & Water, Inc. (NE&W) has conducted more detailed assessments including the following:

- Considering projected population growth using demographic projections by the Census Bureau and other means.
- Conducting preliminary ground-water model simulation efforts using a regional model that I have developed for the Gallatin Valley.
- Evaluating agricultural irrigation usage and agricultural commodity production over time in the Gallatin Valley.
- Analyzing drought implications/conditions on stream flows of the Gallatin Valley.

The focus of these efforts was to expand our previous work regarding concerns expressed by DNRC and others that the growth in the number of exempt wells will cause adverse impacts of existing water users (senior appropriators) in the valley. My preliminary assessment using the updated information leads to conclusions that are in conformance with conclusions set forth in the initial Gallatin Valley study. I also conclude that the potential for adverse impacts to existing appropriators (senior or junior) from the growth of exempt wells is highly unlikely to be a factor as far as one can

meaningfully project population growth in the future.

Some Observations and Commentary on DNRC Memorandum

Observation/Comment #1

Most of the exempt wells in the valley have tended to be clustered in the valley in areas that were historically irrigated with surface water. There are obviously some areas where exempt wells have been placed where land had not been historically irrigated. The key to properly evaluating the potential for adverse impacts in a study area is to conduct a thorough water budgeting effort. This includes addressing all the depletions (e.g., well pumping, stream diversions, etc.) and all accretions (recharge, runoff, etc.). This should be done before drawing conclusions and prior to developing water policies that may or may not be appropriate.

Observation/Comment #2

In the Gallatin Valley, the majority of exempt wells are located at significant distances from both the West Gallatin River or the East Gallatin River. The relative distance of a well from a stream is very important in quantifying the influence of a pumping well on a given stream. For example, if a given well is close and also hydraulically connected to a stream, pumping during the summer manifests its affects on flow more substantially during the irrigation season and less during the non-irrigation season. However, as the distance between a pumping well and stream increases, the interaction becomes more uniform or steady with time. The technical reasons for this are presented in a recent article in the publication Ground Water (Bredehoeft and Kendy, 2008).

In effect, pumping of a single exempt well substantially distant from a river will result in the consumed water being spread throughout the calendar year at a relatively steady rate. Hence, a well consumptively using 0.33 acre-ft of irrigation water during the irrigation season will result in about 0.14 acre-ft of water being abstracted from the stream during the irrigation season (May 1 through September 30) if the flow impacts are steady-state. In essence, an assertion that 0.34 acre-ft of water from a given well pumping in the Gallatin Valley would have been available for senior or junior surface water appropriators during the irrigation season is false.

For the Gallatin Valley, a ground-water model that I have developed addresses the distribution of the wells in the valley and aquifer system parameters. Preliminary simulations results from that effort reveal that it is appropriate to assume that a steady-state assumption for exempt well consumption effects on stream flow is a reasonable approximation in the valley. However, even this assumption probably yields results that are overly conservative simply because there are other water budget factors that need to be addressed as well.

In effect, it is inaccurate to characterize or extrapolate that the total seasonal consumptive use of irrigation water from exempt wells would have been available for surface water users during the season of irrigation.

Observation/Comment #3

In its Work Draft Memorandum, DNRC projects the potential growth of exempt wells to year 2060. Making projections of population growth and well development this far into the future is, at the very least, highly speculative. For purposes of the evaluation that follows, I will constrain the discussion to computations set forth by DNRC to the year ending 2030.

Let us examine the following statement by the DNRC:

> Depletions by exempt well use may not be discernible by basin-scale water balances or analysis of hydrographs of gross basin inflows and outflows, in part because these depletions are small relative to annual flows. In addition, records of consumption by exempt well use may be masked during periods of water shortage by curtailment of junior surface water uses.

The key word here is "may" be masked. Again, this is purely speculation on the part of DNRC as it has no definitive evidence to prove this.

In order to put DNRC's claims in another perspective I have done the following:

1) Quantified the existing number of domestic wells in the Gallatin Valley using the Montana Bureau of Mines and Geology Ground-water Information Center database. It should be noted that this database seems to provide current well number estimates that exceed the exempt well computations set forth in the DNRC memorandum.

2) Developed projected well exemption growth estimates based upon current well growth patterns and population growth estimates presented defined by the Census Bureau.

3) Utilized the relative consumptive use estimates provided by the DNRC in its memorandum.

4) Compared the increased demands using Gallatin River flow data cited in the DNRC memorandum.

5) Assessed the likelihood or lack thereof that surface water irrigators in the valley could be adversely impacted with the increase in exempt wells (from present to 2030).

6) Provided a visual perspective of the significance of the projected increase in consumptive developed DNRC with exempt well growth using graphical procedures.

Figure 1 provides a location map.

Figure 2 provides a plot showing current well growth trends (most wells are domestic - exempt). This plot provides two projections, the upper plot uses current well growth trends, the lower plot uses census-based projections.

Using DNRC consumptive values and MBMG GWIC data, the maximum impact on surface water flows as it affects irrigators during the irrigation season associated with projected exempt well growth in the Gallatin Valley by year 2030 is projected to be 1.69 cfs (68 miners inches).

Figures 3 - 7 provide self-explanatory plots using an overly simplistic assumption that the net water balance is limited to stream flows and well pumping. Again, there are obviously other water budget issues as well which further mitigate the significance of exempt wells.

All the plots show that the influence of exempt wells is de Minimus. Even if we discount other water budget factors, 68 miners inches, is not a very substantial amount of surface water for irrigation use, especially if that flow is spread throughout the valley. This 68 miners inches of flow would not be concentrated to the I-15 bridge on the West Gallatin as seems to be inferred by DNRC. This affect of the abstraction would be distributed throughout the valley (East Gallatin, West Gallatin, Gallatin, Sourdough Creek, etc.). Furthermore, there are other water budget factors at stake as well which should be accounted for including: contributions to surface water and ground-water recharge associated with runoff from impervious surfaces; reduction in plant transpiration associated with presence of impervious surfaces; reduced surface water irrigation; etc.. These factors are not accounted for in DNRC methods.

Hence, it is concluded DNRC's claim of "masking" has no basis.

In a nutshell, definitive adverse impacts from exempt wells to prior appropriators is difficult to reconcile when the facts and data are properly accounted for in the Gallatin Valley.

Additional Comparisons

The DNRC also projects/claims that there "may" be an increase of about 10,000 acre-ft of consumptive use in association with exempt wells by the year 2030 in Montana closed basins. It even goes so far as to speculate to the amount of exempt well water use by

the year 2060. This cannot be meaningfully done.

Let us put this DNRC projection of 10,000 acre-ft additional use by the year 2030 in perspective as follows:

- Not all the 10,000 acre-ft of water would have been available for irrigation use during the irrigation season simply because abstractions from exempt well pumping are spread throughout the year. If other watersheds/well conditions are reasonably comparable to those of the Gallatin Valley, this would leave about 5,000 acre-ft (as opposed to 10,000 acre-ft) of water feasibly available for the irrigation season (assumes methods defined by Bredehoeft and Kendy, 2008 are appropriate).

- The 5,000 acre-ft of "impact" to senior appropriators is spread over the entire area of all the closed basins in Montana. Furthermore, this 5,000 acre-ft would be distributed between numerous if not several hundred different streams within these closed basins.

- From an irrigator's perspective this is equivalent to dividing about 552 miners inches of flow between all the streams in the closed basins of Montana which has an area of about 23,900 square miles. The net significance on a stream by stream basis is inconsequential when considered on a practical basis. As an illustration of this point, 5,000 acre-ft of consumption equates to approximately 3,500 acre-ft of alfalfa irrigation for this entire region (see Figure 8). Again, this is a worst case scenario simply because DNRC does not take into account other water budget factors which are indeed relevant.

- Again, using DNRC's own projections, I conclude that any consequences on stream flow associated with exempt wells are de Minimus.

Summary

In summary, it is my conclusion that when the overall projected effects of exempt wells are properly accounted for using water budget methods that everyone in the profession of hydrology should employ, it is difficult to conceive that there would be any practical circumstance in any closed basin in Montana where future growth in exempt wells would result in any discernable, detectable, or measurable adverse impact to any prior surface water appropriator. If any such circumstance does exist it would be anomalous. It would be highly questionable to establish water policy for the entire state of Montana on the basis of an anomalous condition.

In my review of work products that have been prepared by the Montana Bureau of Mines and Geology from their efforts involving the North Helena Valley (Madison 2006), the Bitterroot River Basin, and in their evaluations of well hydrographs statewide, it is clear that my interpretative results are by no means unique.

References

Bredehoeft J., and E. Kendy. Strategies for Offsetting Seasonal Impacts of Pumping on a Nearby Stream. Ground Water. Volume 46, No. 1. 2008.

Madison, J. Hydrology of the North Hills, Helena, MT. Montana Bureau of Mines and Geology Open-File Report 544. 2006.

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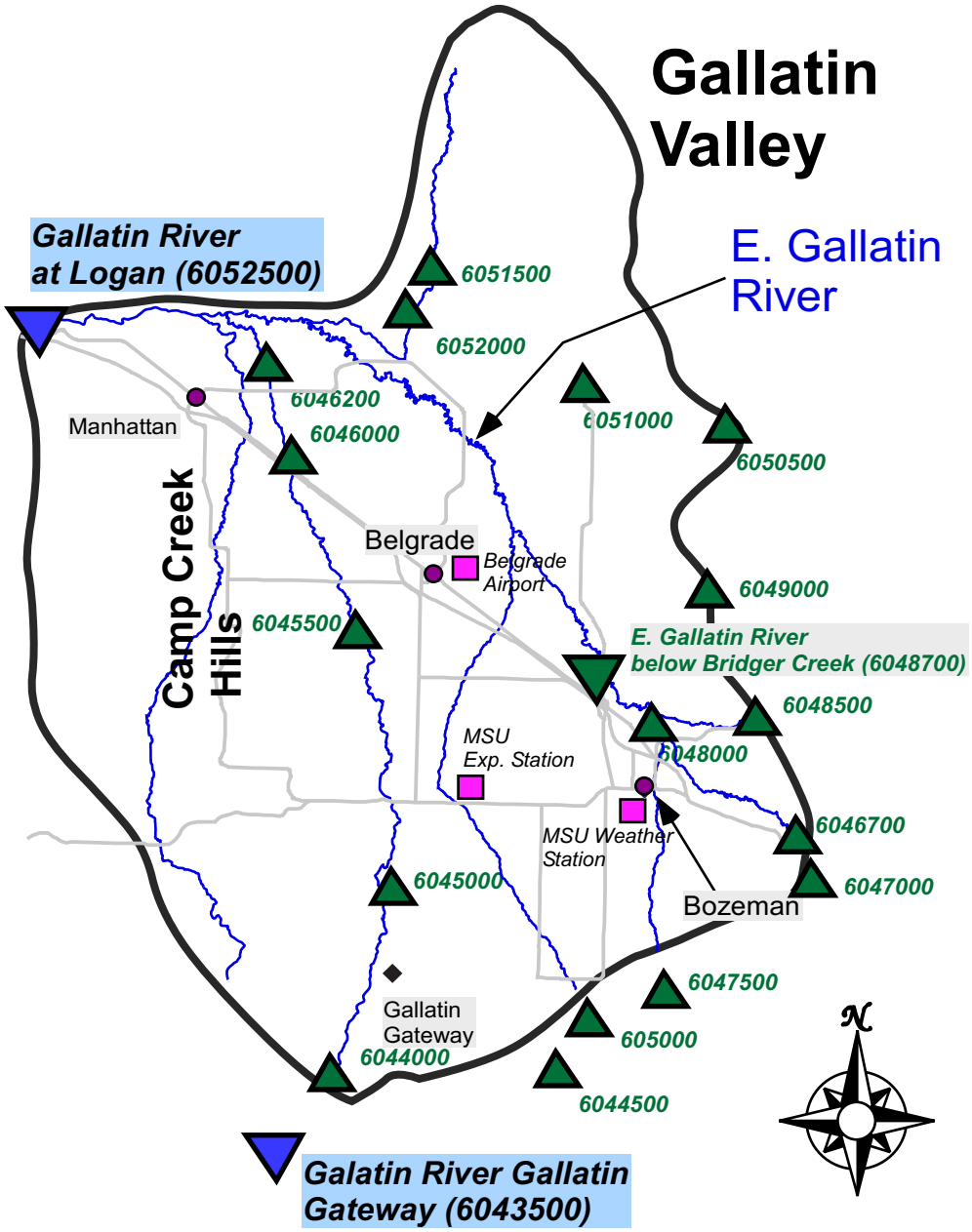

Figure 1 - Measurement Stations Gallatin Valley

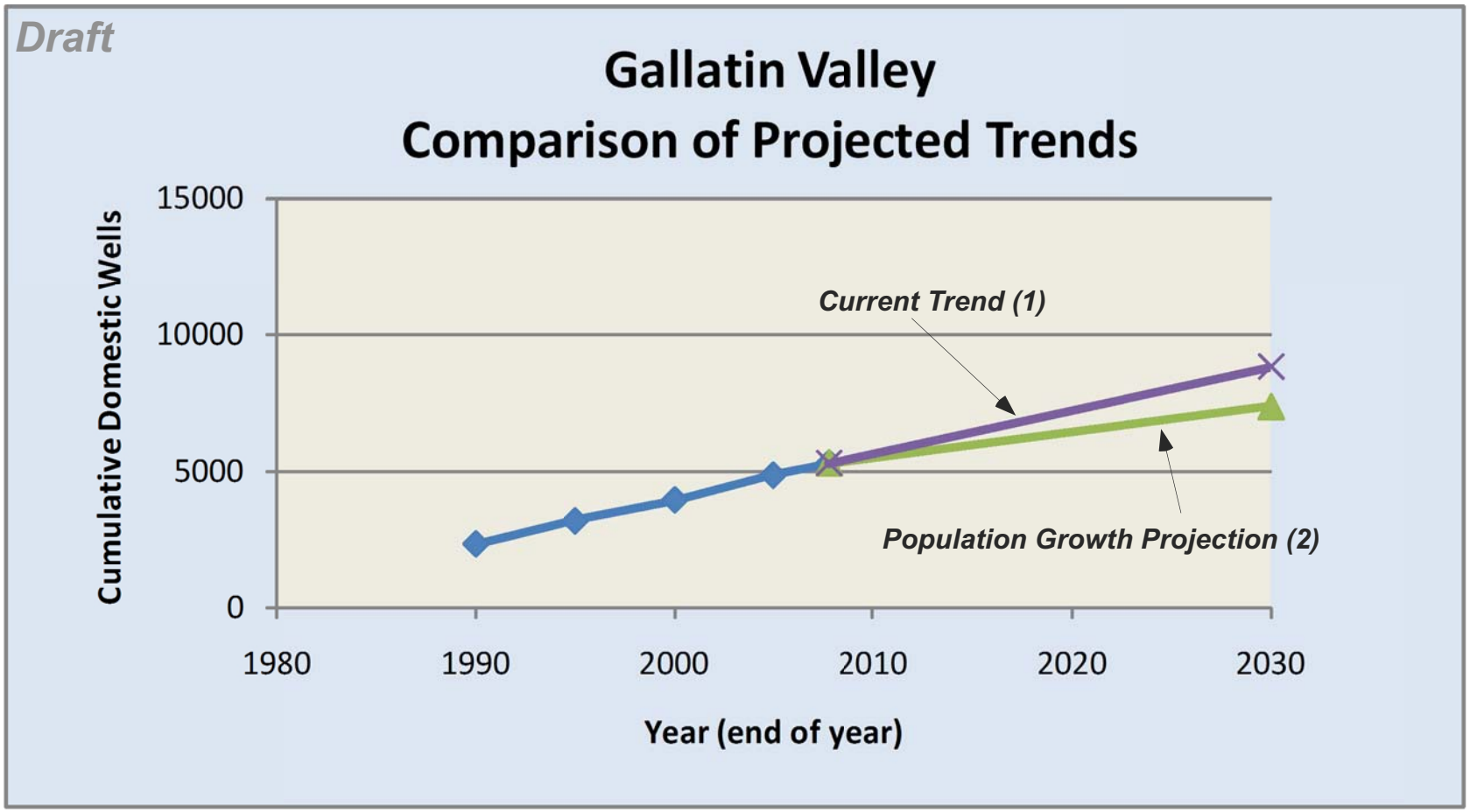

Figure 2 - Domestic well addition trends and population growth projections for Gallatin Valley.

1) *Based upon Montana Bureau of Mines and Geology GWIC data (through 2007)*

2) *Projections made based upon "Montana's Growth Policy Resource Book - Montana Department of Commerce Community Development Division January, 2007."*

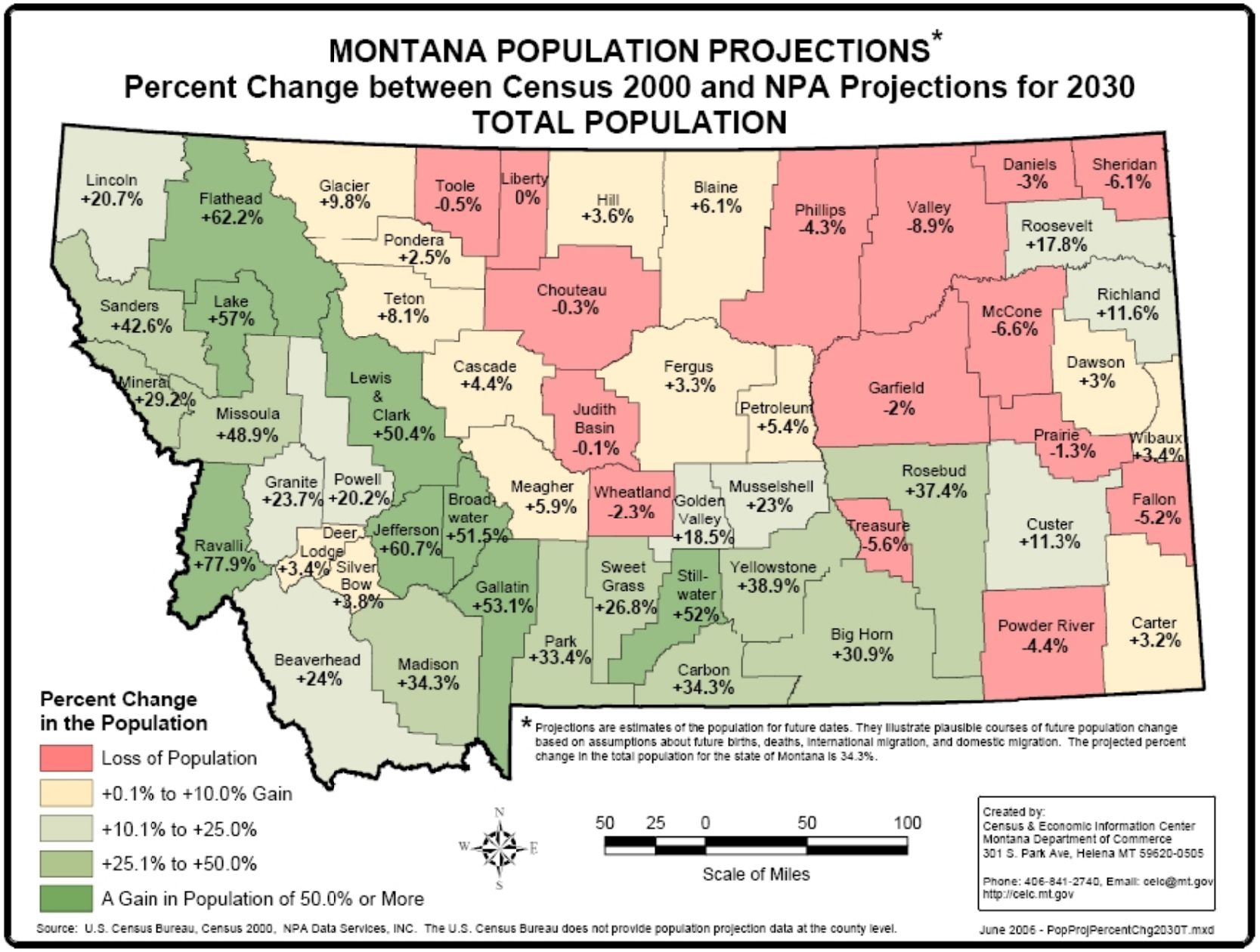

Figure 3 - Montana Growth Projections from Montana's Growth Policy Resource Book Montana Department of Commerce Community Development Division January, 2007.

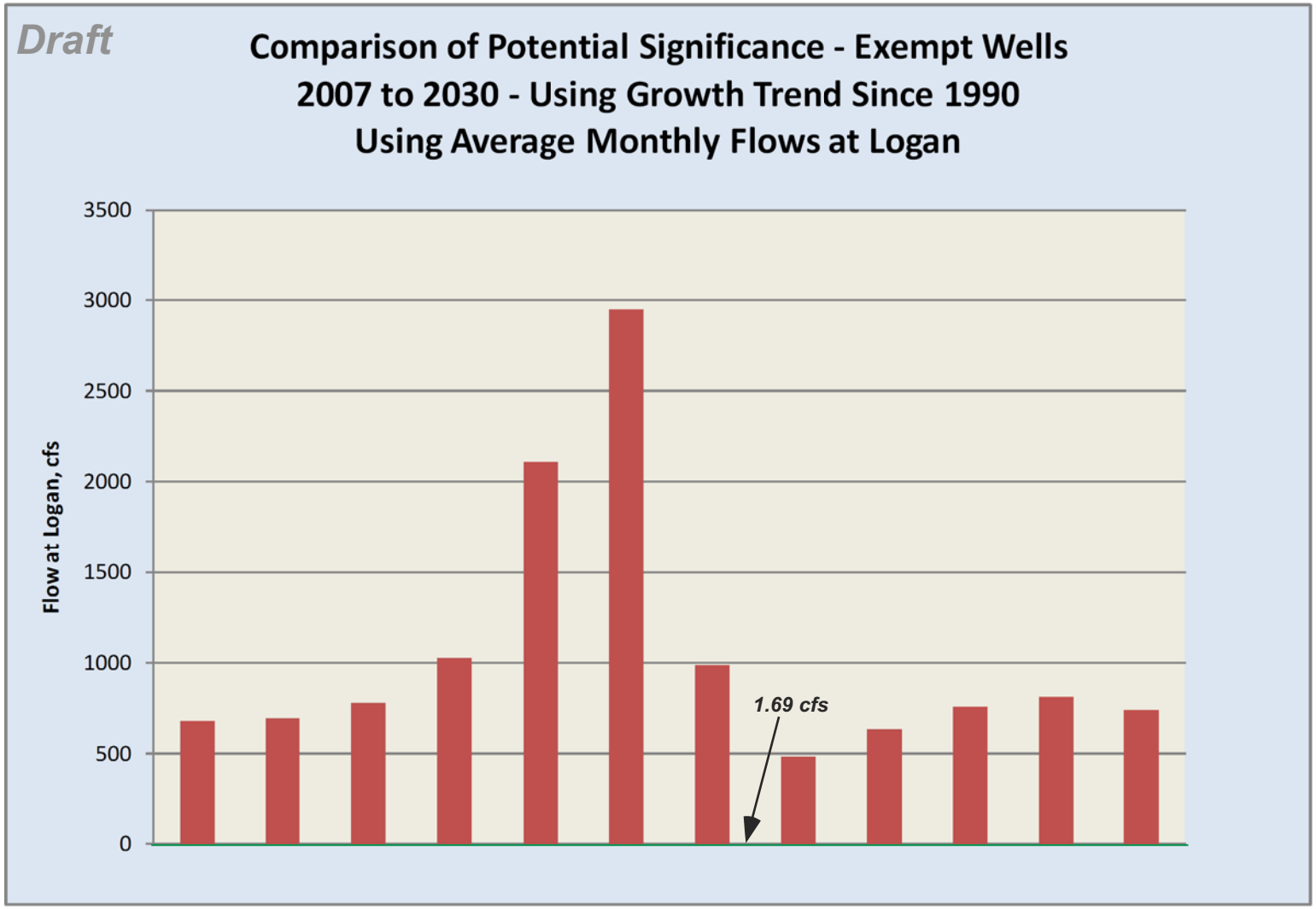

Figure 4. The 1.69 cfs shown is the calculated consumptive use associated with the growth of exempt wells from 2007 to 2030 in the Gallatin Valley. It is highly conservative as it does not include other water budget factors which would reduce the net flow rate substantially.

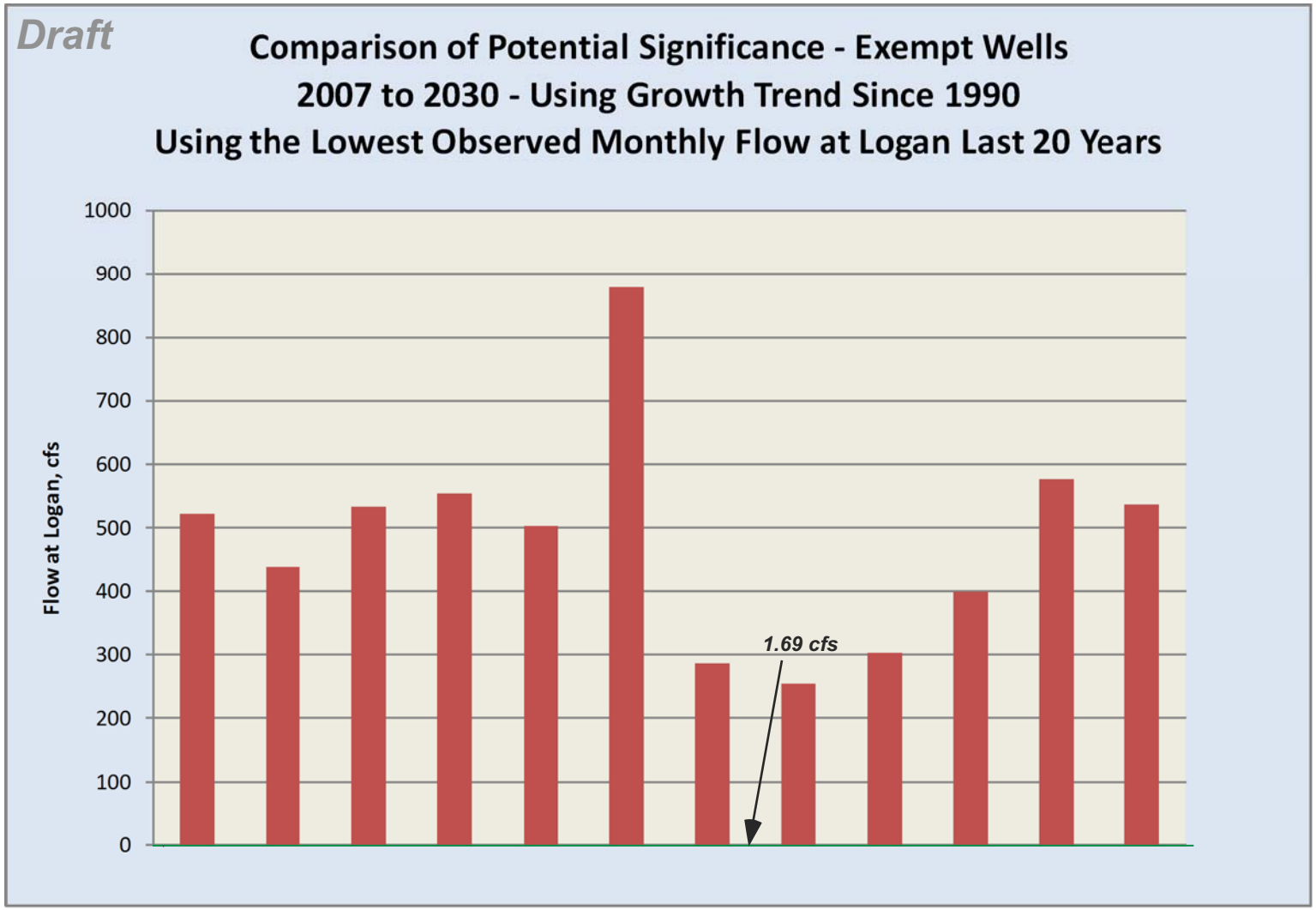

Figure 5. The 1.69 cfs shown is the calculated consumptive use associated with the growth of exempt wells from 2007 to 2030 in the Gallatin Valley. It is highly conservative as it does not include other water budget factors which would reduce the net flow rate substantially.

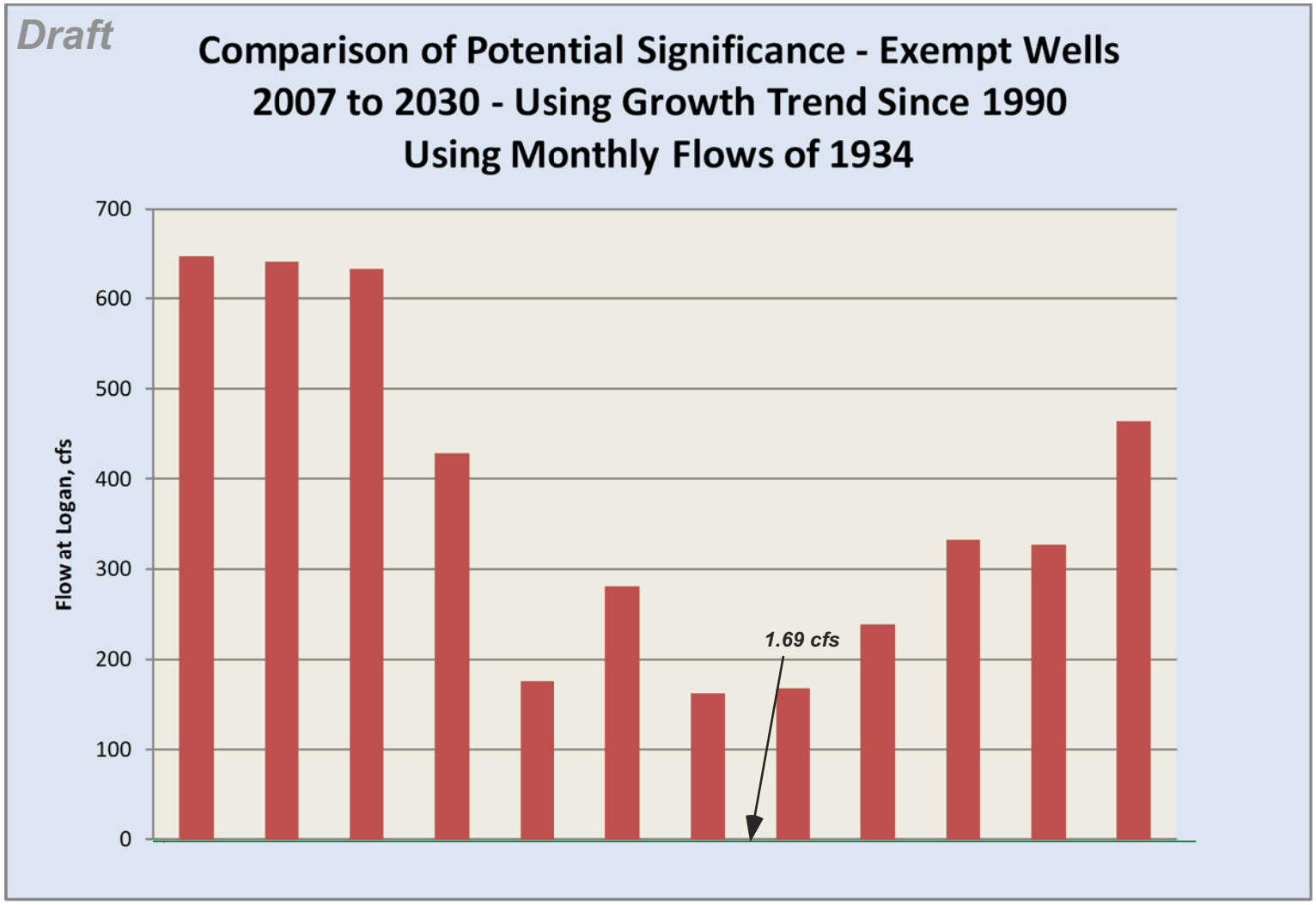

Figure 6. The 1.69 cfs shown is the calculated consumptive use associated with the growth of exempt wells from 2007 to 2030 in the Gallatin Valley. It is highly conservative as it does not include other water budget factors which would reduce the net flow rate substantially.

Figures adapted from DNRC Memorandum - Working Draft on Effects of Exempt Wells on Existing Water Rights

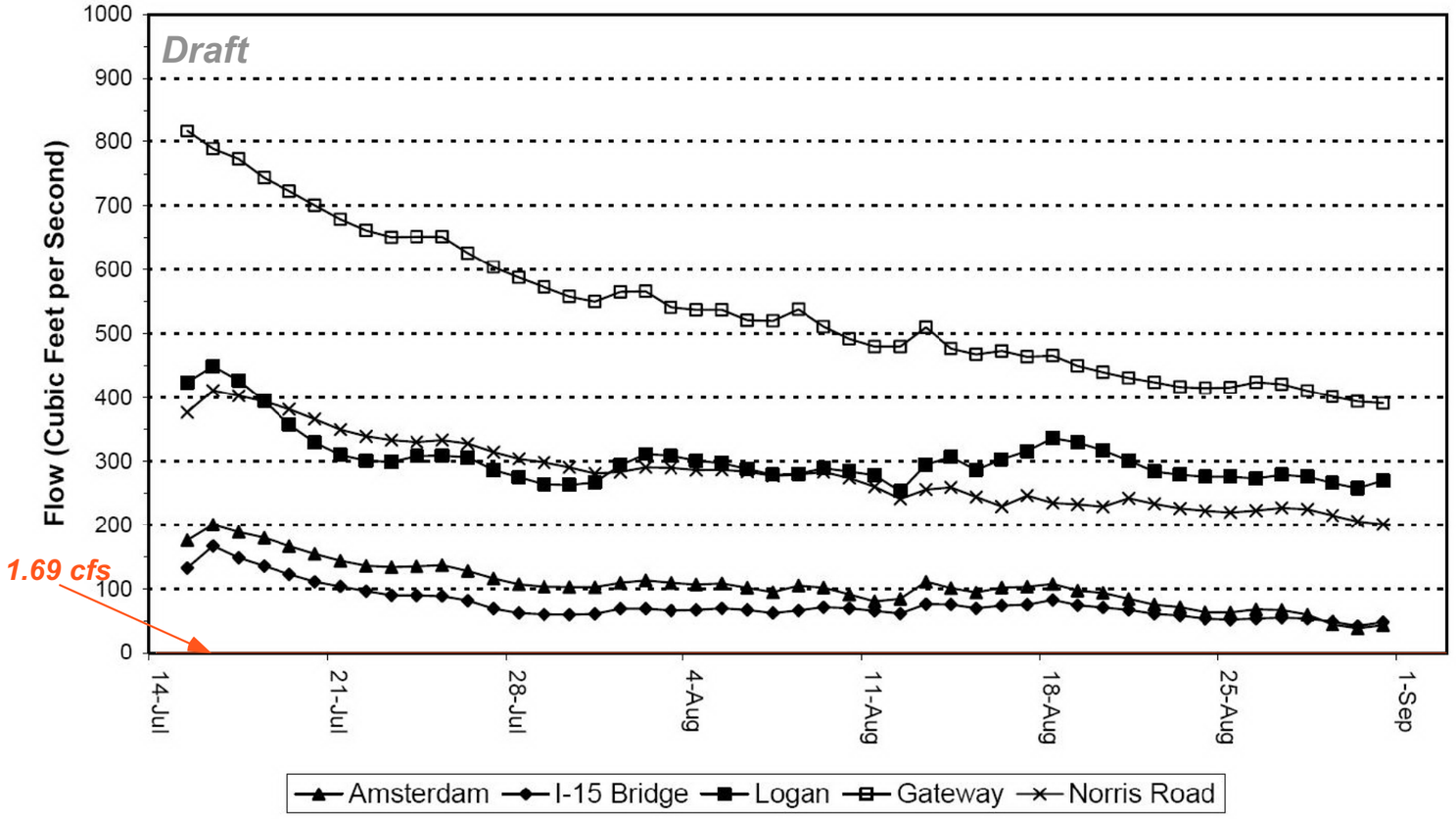

Figure 7. Figure adapted from DNRC memorandum. Note that there are other streams in the valley other than Gallatin River. Only a fraction of the exempt wells consumption in the Valley (something far less than 1.69 cfs) would be manifested at the Norris Road, I-15 Bridge, Logan and the I-15 Bridge on the West Gallatin River.

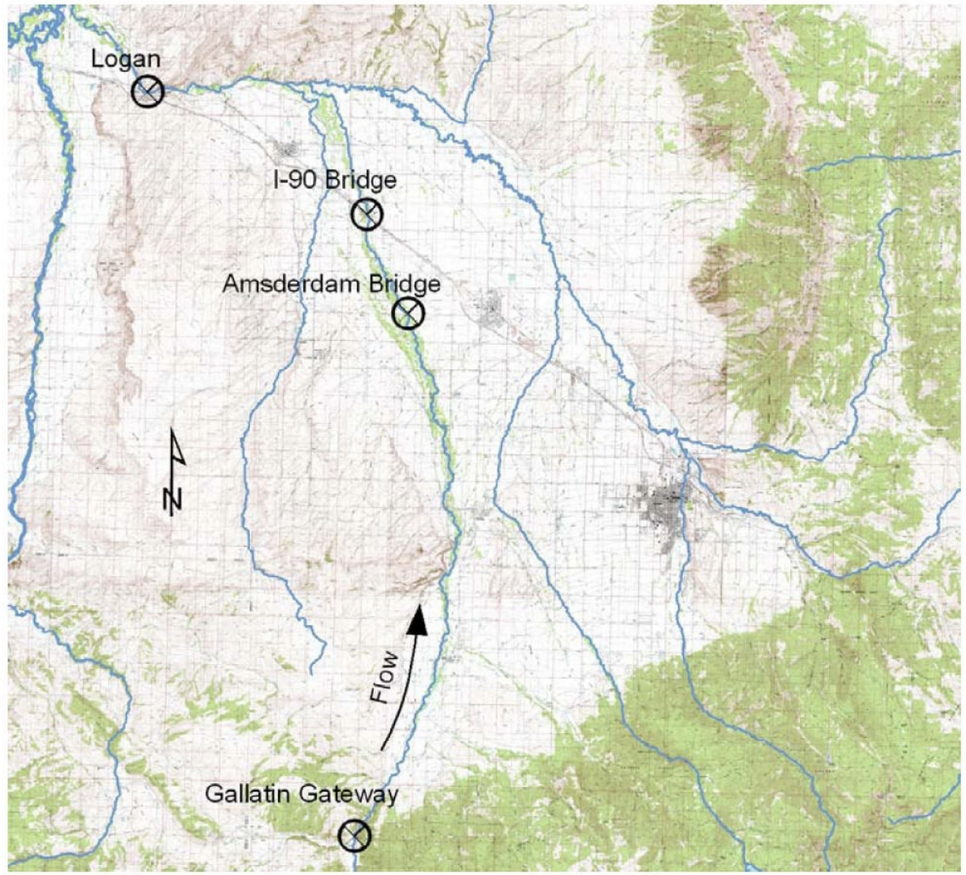

Figure 2. Locations of gauging stations on Gallatin River.

Note that the barely visible line on the horizontal axis represents the combined average flow of the increase in the number of exempt wells in the Gallatin Valley from 2007 to 2030 based upon current well development trends. Furthermore, many of the wells have been placed in areas that had been historically irrigated.

The maximum reduction in flow of 1.69 (68 miners inches) is before conducting a water budget analysis addressing all water budget factors. If all the addition and subtraction is conducted, the flow of 1.69 cfs would be further reduced.

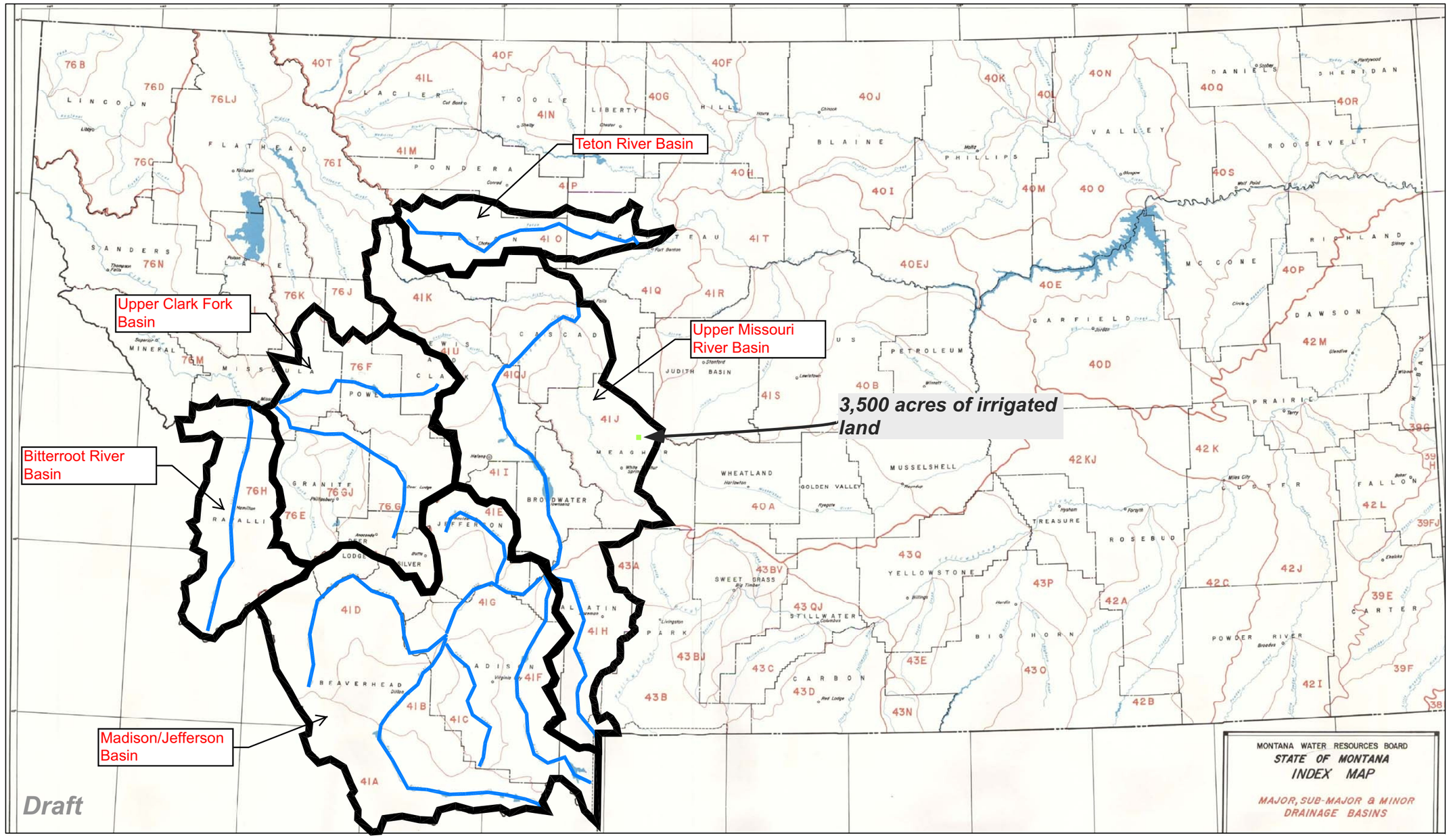

Figure 8. The illustration above presents the relative significance of growth in exempt wells using calculations performed by DNRC to 2030 and adjusting for seasonal availability of water in accordance with principles set forth in Bredehoeft and Kendy (2008). If all the water budgeting factors are carefully considered this irrigated acreage equivalent would be reduced significantly.