State-based Exempt Well Water Consumption Estimations
Across the Flathead Indian Reservation

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Summary and Results:
We estimated total annual water diversion and consumption volumes associated with Montana state-based exempt groundwater certificates (henceforth "exempt wells") across the Flathead Reservation. Current state standards limit exempt wells to 35 gallons per minute and 10 acre-feet per year. The State of Montana does not review or issue public notice before certifying exempt wells.

We present results by dates relevant to the Ciotti line of cases, which resulted in 2000 in a suspension of DNRC water right application processing on the Flathead Reservation (Table 1). These calculations offer a quantification estimate and context concerning exempt wells for the purposes of Confederated Salish and Kootenai Tribe-Reserved Water Rights Compact Commission negotiations. These calculations intentionally over-estimate the amount of water diverted and consumed, thus applying a precautionary principle with respect to water allocation and resource impacts.

Table 1. Estimated water diversion and net consumption for Montana state-based exempt wells on the Flathead Indian Reservation

		Number of Exempt Wells	Acre-Feet Per Year: Household Use		Irrigation Requirement		Average Acreage		Total Use
Single Home	Diverted	1	0.21	+	(2.39	x	0.54)	=	1.51
	Consumed	1	0.01	+	(1.67	x	0.54)	=	0.92
Pre-Ciotti (1973-1999)	Diverted	2319	0.21	+	(2.39	x	0.54)	=	3496.04
	Consumed	2319	0.01	+	(1.67	x	0.54)	=	2125.75
Post-Ciotti (2000-2008)	Diverted	730	0.21	+	(2.39	x	0.54)	=	1100.52
	Consumed	730	0.01	+	(1.67	x	0.54)	=	669.17
Total DNRC Wells	Diverted	3049	0.21	+	(2.39	x	0.54)	=	4596.56
	Consumed	3049	0.01	+	(1.67	x	0.54)	=	2794.91
Total GWIC[1] Wells	Diverted	5610	0.21	+	(2.39	x	0.54)	=	8457.42
	Consumed	5610	0.01	+	(1.67	x	0.54)	=	5142.49

[1] GWIC stands for the "Ground Water Information Center" maintained by the Montana Bureau of Mines and Geology in Butte.

Methods:
We used four data sets for the calculation: annual use for irrigation; annual use for household; average acreage for each well's place of use; and counts of exempt wells.

1) We estimated annual water use, diverted and consumed, including per-acre irrigation requirements for exempt wells. Total consumption of water used indoors and during wastewater treatment is estimated at 5 percent of the water used indoors. Russ Levens, DNRC hydrogeologist approximated this number by choosing an intermediate value between an estimate by Kimsey and Flood (1987) of 2 percent for households served by municipal wastewater treatment plants and an estimate by Vanslyke and Simpson (1974) of 10 percent for households with individual septic systems (Levens et al, 2008). Irrigation requirements were calculated using the USDA Irrigation Water Requirement Program (Table 2) (Dalton, 2003). We chose the Polson Weather Station for climate adjustments. The program output recommended 20 inches or 1.67 acre-feet per year for an alfalfa crop during a normal year (Appendix 1). We estimated irrigation efficiency at 70% as per Levens' report.

Table 2. Calculated water diversion and net consumption per household (Levens, DNRC WMB 2008), adjusted to 20" Irrigation Water Requirement for Polson Weather Station.

		Acre-Feet Per Year		
		Household	Irrigation	Total
Household with 1/4 acre lawn	Diversions	0.21	0.6	0.81
	Consumption	0.01	0.42	0.43
Household with 1/2 acre lawn	Diversions	0.21	1.19	1.4
	Consumption	0.01	0.84	0.85
Household with 1 acre lawn	Diversions	0.21	2.39	2.6
	Consumption	0.01	1.67	1.68

2) We estimated the average place of use acreage for exempt wells (Table 3). First, we selected unique exempt wells that listed domestic, lawn/garden, or irrigation as their purpose. We then linked Point of Diversion data with Montana Cadastral Database ownership lots (GIS Bureau, 2008) to delineate the location of the exempt wells. Every 3rd exempt well location was evaluated for appropriateness. Wells lacking confident ownership matching or those masked with dense timber were excluded. An overlay of National Agriculture Imaging Program (NAIP) color infrared air photos from July and August of 2005 (USDA NAIP, 2005) were visually interpreted to determine irrigated lands around each well location; irrigated perimeters were digitized based on associated legal lands description, and perimeter areas were calculated. The effort resulted in 100 stratified random samples, tending to be dominated by grass/forb plant communities; each area estimate constituted a subset of the total lot ownership area (Sadak, 2008).

Table 3. Summary statistics for average acre calculation of place of use (Lot Size) for State-based exempt wells on the Flathead Indian Reservation (N=100)

Summary Statistic	Value (Acres)	Summary Statistic	Value (Acres)
Mean	0.54	Sample Variance	0.17
Standard Error	0.04	Range	1.87
Median	0.42	Minimum	0.03
Standard Deviation	0.42	Maximum	1.90

3) We then estimated the number of exempt wells within the Flathead Reservation. Data was extracted from four sources (DNRC 2008a, 2008b, 2008c, 2008d). There are a total of 3049 unique groundwater certifications, consisting of 2319 pre-Ciotti and 730 post-Ciotti certificates (Table 1).

Many exempt wells list multiple purposes, which is allowed under Montana water law. Among the pre-2000 dataset, 115 (9.5%) of the 1210 stock purpose exempt wells were exclusively stock wells (i.e. with stock watering being their only designated purpose). 42 (32.0%) of the 131 commercial purpose certificates were dedicated solely for commercial purposes. Because of their low relative weight of influence and data manipulation complexities, the total counts were not stratified by purpose; all unique exempt wells were simply added to the total count, regardless of purpose. Purposes include: domestic, irrigation, lawn/garden, commercial, institutional, fire prevention, fish and wildlife, fishery, wildlife/waterfowl, stock, recreation, multiple domestic, geothermal heating, industrial, and the catch-all category of "other."

Exempt well categories of maximum flow rate were considered as a stratification parameter, but ultimately ignored. From 1973 to 1991, Montana law allowed exempt well certifications to be issued for wells producing up to 99 gallons per minute with no acre-foot restrictions. We assume the majority of those wells do not draw the full amount listed and that full development is unlikely to occur. This assumption, coupled with the lower relative representation of high flow rate exempt wells (Table 4), eliminated maximum flow rate as a category of stratification.

Table 4. Flathead Indian Reservation State-based Exempt Wells: Maximum Flow Rate Distributions of all known wells.

Maximum Flow Rate (gallons per minute)	Ground Water Certificates (total count)	Percent of Total
All Values	3049	100.00%
Less than 35	2575	84.45%
More than 35	446	14.63%
No Value Listed	28	0.92%

Additional exempt wells and future needs

To this point, we have presented data for exempt wells of which the DNRC has records; but we are aware of additional wells within the boundaries of the Flathead Reservation. These include Tribal wells, non-Tribal wells for which the landowner never applied for a

water right, and some are pre-1973 wells. Between 1962 and 1973, wells were governed by a GW-2 process, in which it was optional to submit well forms to the county; some of these are in the DNRC database, some are not. In addition, there is a category of wells whose priority date predates 1973 that were exempt from the filing requirements of Montana's general stream adjudication. Claimants could voluntarily file claims for these wells, and some did, but others did not. There are 5,610 well logs, excluding monitoring wells, filed with the Montana GWIC (MBMG, 2008). Assuming that every well has a corresponding well log in GWIC, there is a difference of 2561 wells, none of which are included in the present calculations (Table 1). If it is deemed necessary to develop a more complete estimation of groundwater use as these water right negotiations proceed, additional wells can be added to this methodology.

References

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Appendix 1:

Irrigation Water Requirements

Crop Data Summary

Job: **Exempt Wells**
Location: **MRO**
By: **Mace**
Weather Station: **POLSON**
Latitude: **4741** Longitude: **11410**
Computation Method: **Blaney Criddle (TR21)**
Crop Curve: **Blaney Criddle Perennial Crop**
Begin Growth: **5/10** End Growth: **9/22**

Crop: **Alfalfa Hay**
County: **Lake, MT**
Date: **05/13/08**
Sta No: **MT6635**
Elevation: **2990** feet above sea level

Net irrigation application: **1** inches
Estimated carryover moisture used at season:
Begin: **0.5** inches End: **0.5** inches

Month	Total Monthly ET (3) inches	Dry Year 80% Chance (1)		Normal Year 50% Chance (1)		Average Daily ETc inches	Peak Daily ETPk inches
		Effective Precipitation inches	Net Irrigation Reqirements inches (2)	Effective Precipitation inches	Net Irrigation Reqirements inches (2)		
January	0.00	0.00	0.00	0.00	0.00	0.00	
February	0.00	0.00	0.00	0.00	0.00	0.00	
March	0.00	0.00	0.00	0.00	0.00	0.00	
April	0.00	0.00	0.00	0.00	0.00	0.00	
May	2.49	0.60	1.39	0.78	1.21	0.11	
June	5.93	0.97	4.96	1.26	4.67	0.20	0.24
July	7.53	0.62	6.91	0.81	6.73	0.24	0.31
August	6.55	0.64	5.91	0.83	5.72	0.21	0.26
September	2.72	0.41	1.81	0.53	1.69	0.12	
October	0.00	0.00	0.00	0.00	0.00	0.00	
November	0.00	0.00	0.00	0.00	0.00	0.00	
December	0.00	0.00	0.00	0.00	0.00	0.00	
TOTAL	**25.23**	**3.24**	**20.99**	**4.21**	**20.02**		

(1) For 80 percent occurrence, growing season effective precipitation will be equaled or exceeded 8 out of 10 years. For 50 percent chance occurrence, effective precipitation will be equaled or exceeded 1 out of 2 years.

(2) Net irrigation requirements is adjusted for carryover moisture used at the beginning of the season and carryover moiature used at the end of the growing season.

(3) ET Evapotranspiration) is adjusted upwards 10% per 1000 meters above sea level.

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