MEMORANDUM

DATE: March 20, 2015

TO: Shelley Keen
Water Rights Section Manager

FROM: Ashley Newbry
Engineer Associate

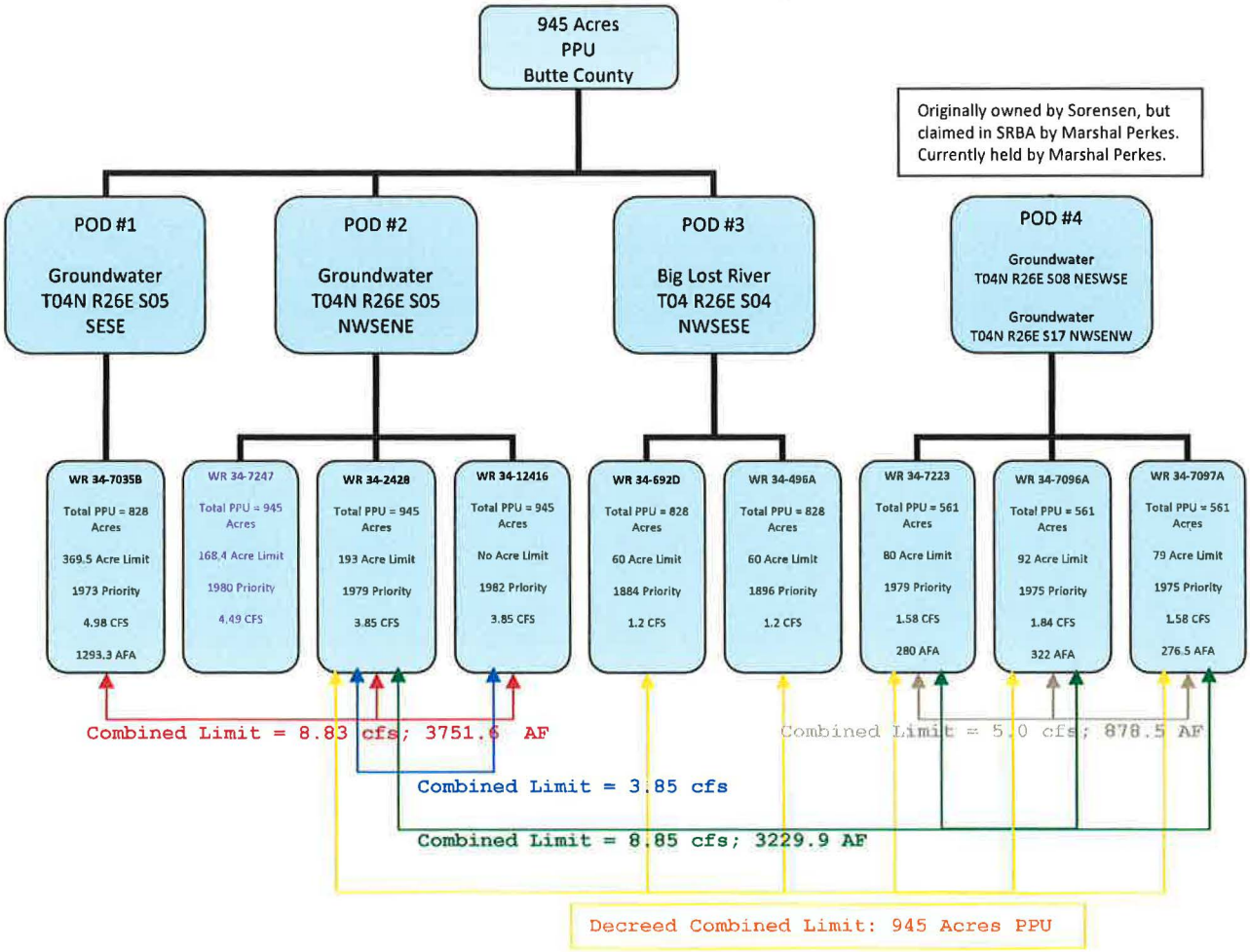
RE: Proposed Licensure of WR 34-07247

You tasked me with review of WR Permit 34-07247, held by Mitchell Sorensen. I have reviewed the file for facts pertinent to development of WR License 34-07247.

A list of tasks was noted on the front of the folder:

1. Review overlaps.
2. Has the annual volume been measured by the water district? Is it in WMIS?
3. Review volume – Is volume enough to cover conveyance losses?

Overlaps. A thorough review of Mr. Sorensen's suite of water rights reveals that many of them are related via the same permissible place of use, and an assortment of combined limits. This information is conveyed in the chart below.

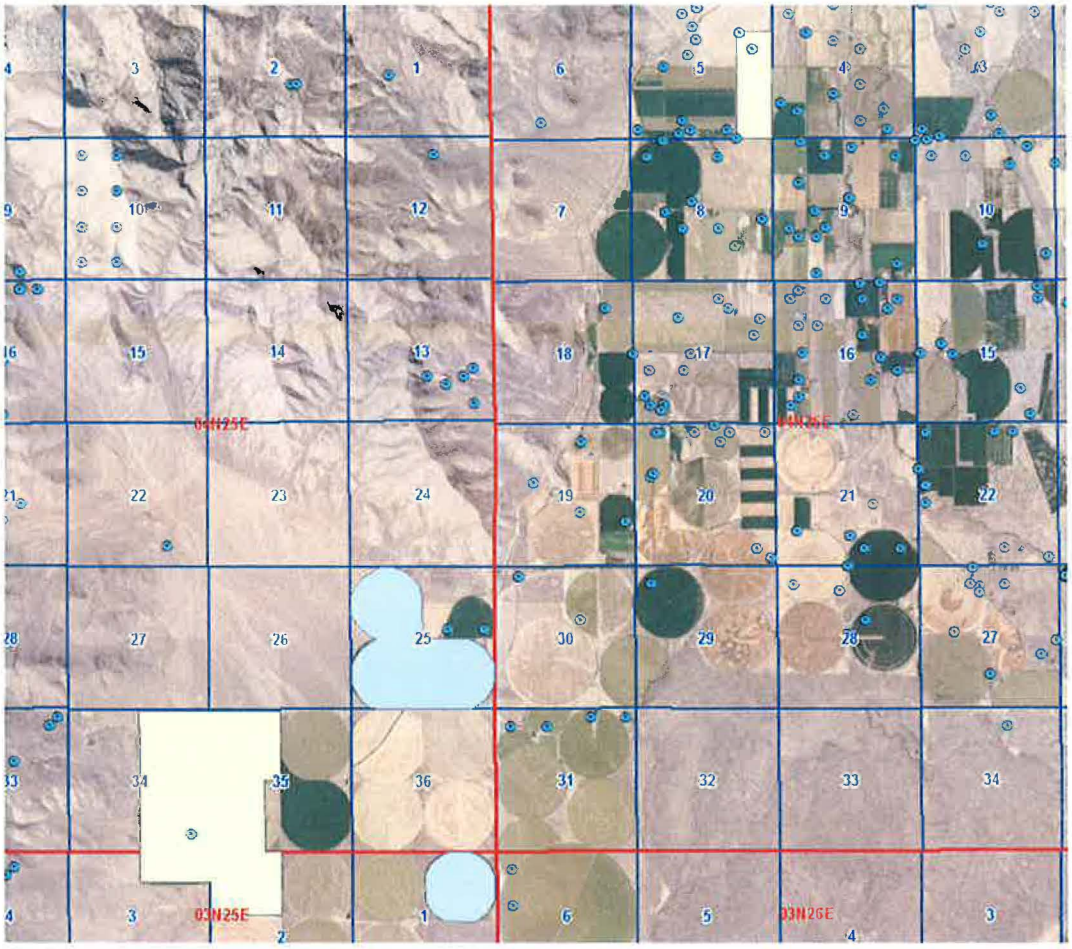


34-7247

My review revealed a great number of combined limits amongst eight related water rights and one permit awaiting licensure. One quandary was amongst multiple partial decrees. All of the water rights listed under POD's #1, #2, and #3 overlap the same 945 acre place of use. All of the water rights listed under POD #4 overlap the same 561 acre place of use. The 945 acre place of use and the 561 acre place of use do not overlap. It was surprising to see the following condition:

> "Use of this right with rights listed below is limited to the irrigation of a combined total of 945 acres within the place of use *described above* in a single irrigation season. Combined Right Nos.: 34-12416, 34-00496A, 34-00692D, 34-02428, 34-07096A, 34-07097A, 34-07223."

The place of use *described above* is the 945 acre place of use. In the map below, the 945 acre place of use is shown in yellow; the 561 acre place of use is shown in blue.



Measurements. I found data entries in WMIS for POD #2, shared by 34-7247, 34-2428, and 34-12416 from 2000 to 2013. These records have been printed and attached to this memo. The majority are PCC readings in gallons per minute.

Volume. Theoretically, one could calculate the volume of water needed to irrigate Sorensen's 945 acres each year. Using IDWR standard methods, the calculation would be the following:

Field Headgate Requirement: (3.5 AFA) x (945 AC PPU) = **3,307.5 AF**

This methodology is recommended in the Field Exam Report by Certified Water Right Examiner David Shaw at ERO Resources. IDWR Water Resource Agent, Sandy Hemenway, performed a supplementary review of overlapping

water rights for the licensure of permit 34-07247. Her calculations (shown below) are in line with those performed by David Shaw.

WR's held by Sorensen: 1.2 CFS (34-692D) + 1.2 CFS (34-496A) + 4.98 CFS (34-7035B) + 3.85 CFS (34-12416) + 3.85 CFS (34-2428) + 4.49 CFS (Permit 34-7247) = **15.7 CFS** (considering combined limits)

Flow Rate Needed by Sorensen: 945 AC PPU x 0.02 CFS = **18.9 CFS**
Volume Needed by Sorensen: (3.5 AFA) x (945 AC PPU) = **3,307.5 AF** (recommended combined limit for 34-2428, 34-7035B, 34-12416, and 34-7247)

Craig Saxton, Water Rights Supervisor, provides the following line of reasoning for irrigated acres proposed for licensure.

Acres requested in original permit: 200 Acres
Acres actually irrigated within permit POU: 188.4 Acres
Acres already covered by WR 34-13841 POU: 20 Acres
Recommend Acre Limit to be licensed: **168.4 Acres**

Saxton also recommends that the volume limit should be defined in a combined use limit for the groundwater rights. He notes that WR 34-7035B contains a combined use limit that limits WR 34-7035B, 34-2428, and 34-12416 to 3,751.6 AF (SRBA partial decree), which is more than what would be allowed per the field headgate requirement. He recommends a combined use limit of 3,751.6 AF for all groundwater rights: 34-7035B, 34-2428, 34-12416, and 34-7247.

Saxton noticed an occurrence worthy of further analysis: In the SRBA, Sorensen was allowed greater volume at the point of diversion than what would be considered standard practice. This region is anecdotally known for significant conveyance losses. The extra volume of 444.1 AF was likely allowed because of the distance between the point of diversion and the field headgate—approximately 6.3 miles. The water is transported via the Timberdome Canal.

Location	Earthen Canal Distance (FT.)	(MI.)
04N 26E Sec 5	5,325.91	1.01
04N 26E Sec 7	5,995.87	1.14
04N 26E Sec 18	5,875.87	1.11
04N 26E Sec 19	6,067.88	1.15
04N 26E Sec 30	1,192.37	0.23
04N 25E Sec 25	6,037.51	1.14
04N 25E Sec 36	3,004.89	0.57
Total	*33,500.3*	*6.34*

The additional volume may have been based upon measured seepage rates in the Timberdome Canal or for the regional soil type. One can begin with a simplistic approach to seepage loss via conveyance efficiency. Some fraction of conveyance efficiency can be apportioned to arrive at the 3751.6 AF value.

$$E_{Conveyance} = \frac{volume\ at\ place\ of\ use}{volume\ at\ headgate}$$

By allowing a diversion of 3751.6 AF, but assuming that only 3307.5 AFA reach the place of use, we can calculate a conveyance efficiency of approximately 88%.

$$E_{Conveyance} = \frac{3{,}307.5\ AFA}{3{,}751.6\ AFA} = \mathbf{0.88}16238\ldots$$

A brief literary review (see "Sources Consulted") reveals that earthen irrigation canal conveyance efficiency for loams is about 70%. No research was found on conveyance using highly gravelly soils. By reason, the addition of gravel and cobbles would increase soil permeability and reduce conveyance efficiency.

Due to the distance between Sorensen's diversion and place of use, it would not be unreasonable to expect that approximately 70% or less of the water measured at the point of diversion would ever reach the place of use. Using the E_c equation above, we can estimate how much water should be diverted.

$$0.70 = \frac{3{,}307.5\ AFA}{volume\ at\ headgate}$$

$$volume\ at\ headgate = \frac{3{,}307.5\ AFA}{0.70} = 4725.0\ AFA$$

Based upon this simple calculation, one could potentially recommend an annual diversion limit of **4,725.0 AFA** due to estimated conveyance losses during transport down the Timberdome Canal.

The driller's remarks on Sorensen's well log (POD #2) indicate that the soils nearby are largely made up of gravel and cobbles. A NRCS soils map, Soil Survey Geographic Data Base (SSURGO), shows that much of the regional soils (including the Timberdome Canal) are composed of the "Techick-Soelberg-Lesbut Complex, 0 to 4 percent slopes" (Butte Soil Survey, symbol 126). This alluvial soil type is known for being well-drained; the permeability ranges from 0.56 to 1.99 inches per hour.

Techick-Soelberg-Lesbut Complex, 0 to 4 percent Slopes		
Techick	Soelberg	Lesbut
40 % of complex	35 % of complex	15 % of complex
Loamy	Gravelly Loam	Gravelly Loam
USCS Classification (40-60"): GP; poorly graded gravels and sandy gravel mixtures with little or no fines		

IDWR most commonly uses the Worstell method seepage loss estimation procedure from the Guidelines for the Evaluation of Irrigation Diversion Rates (Hubble 1991).

$$S = 0.0667\ x\ i\ x\ W$$

Where

S is seepage loss in cfs per mile
i is seepage rate in feet per day
W is top width of the water surface in feet
0.0667 is the factor to estimate the wetted perimeter as a function of W and to convert units.

The estimated seepage loss is multiplied by the canal length (miles) to determine the canal's total conveyance loss. Let's input the values for the Timberdome Canal.

From the NRCS Soil Survey Geographic (SSURGO) Data Base, the median seepage rate for Techick-Soelberg-Lesbut Complex is 1.275 inches per hour. By converting to the necessary units, *i* = 2.55 feet per day.

By measuring multiple widths of the Timberdome Canal using GIS software and aerial photography, I found that the Canal measures approximately 15 feet across (assumed at steady state flows).

Therefore,

$$S = (0.0667)x\left(2.55\frac{ft}{day}\right)x(15\,ft) = 2.55\frac{cfs}{mile}$$

In this region, the irrigation season is 214 days in length (4/1-10/31). Therefore,

$$\left(2.55\frac{cfs}{mile}\right)x\left(60\frac{sec}{\text{min}}\right)x\left(60\frac{min}{hour}\right)x\left(24\frac{hour}{day}\right)x\,(214\,days)x(6.34\,miles) \div \left(43{,}560\frac{ft^3}{AF}\right) = 6{,}870.87\,AFY$$

This calculation is an estimation of the total conveyance loss in the 6.34 miles of the Timberdome Canal utilized by Sorensen, for all of the water transported. Unfortunately, one cannot assume that the total 6,870.87 AFY should be attributed solely to the transport of Sorensen's water.

Unfortunately, there is very little flow data available to IDWR about the Timberdome Canal. Per some exchange with Nick Miller (Water Distribution Section Mgr.), "The Timberdome Canal is basically a lateral canal off of the Moore Canal, so neither the irrigation district, the Water District, nor IDWR get much information about what goes on past our respective points of delivery." Because of the lack of data available, it was necessary for me to make some assumptions about the geometry of the Canal.

Any further analysis calculations become nearly impossible without at least an estimate of how much water flows down the Timberdome Canal each irrigation season. The District 34 Watermaster, M. Todd Perkes reassured me that there is no flow measurement of the canal except the diversions. He directed me to Mitchel Sorensen himself, President of Timberdome Canal Company.

A short conversation with Mr. Sorensen revealed that he had a meeting with Tim Luke (Water Compliance Bureau Chief) about this very issue on the same day that I called (October 22, 2014). IDWR and Timberdome Canal Company are similarly concerned about conveyance losses and lack of flow measurement in the Canal. Timberdome Canal Company would like to explore options for reduce their conveyance losses. He explained that Water District 34 – Big Lost Irrigation District has not yet "come to terms" with the regional conveyance loss problems, even though they struggle to make all of their deliveries.

While commuting to his meeting, Sorensen explained that the Canal is approximately 10 miles long in total (with some portions which are now lined). At the beginning of irrigation season, they see conveyance losses of approximately 30-40%, but losses are about 20% once the system reaches steady state. The flows in the canal vary between 3,000 to 5,500 miner's inches (75-140 cfs) during irrigation season. He reassured me that he makes sure that all parties using the Canal are compliant with the conjunctive management regulations. After this, I questioned Sorensen about what he could remember regarding conveyance losses allowed during the SRBA. He recalled that Basin 34 was one of the first test basins, and he felt that because of the unfamiliarity of the claimants, the Director, and the Court, the conveyance loss allowances lacked consistency from claimant to claimant. He regretfully explained that even though he was allowed some additional volume for conveyance losses, he would leap for joy if he had enough water to place 1 inch on each acre of his place of use.

How much conveyance loss should be allowed to Sorensen? His volume allowance for conveyance losses should be proportional to the total conveyance losses. In our conversation, he explained that this is the precise manner which the Canal operates. Consider a slice of pizza or pie, for example. Each piece will have a portion of crust that is proportional to the total amount of crust in the dish. Choose a large piece, and receive more crust; choose a smaller piece, and receive less crust. Whichever selection, the ratio of the crust to the whole dish should remain constant.

$$\frac{Canal\ Conveyance\ Loss}{Canal\ Volume} = \frac{Sorensen's\ Conveyance\ Loss}{Sorensen\ Diversion\ Volume}$$

I was able to obtain a copy of a ditch rider's log from Nick Miller; it is a portion of the 2011 irrigation season on the Timberdome canal. It displays the same operating conditions which Sorenson described to me on the telephone; each user equally shares his portion of the conveyance loss. A summary of the log is shown below.

Date: 5/22/2011

User	Input Inches	Inches After Loss	Delivered Inches	% Conv. Loss	% Efficiency
Todd	407	240	200	41	59
P.U.	212	125	125	41	59
Sorensen	287	169	249	41	59
Telford	274	161	120	41	59

Date: 5/25/2011

User	Input Inches	Inches After Loss	Delivered Inches	% Conv. Loss	% Efficiency
Todd	396	240	240	39	61
P.U.	206	125	125	39	61
Sorensen	935	566	564	39	61
Telford	681	412	414	40	60

Date: 5/28/2011

User	Input Inches	Inches After Loss	Delivered Inches	% Conv. Loss	% Efficiency
Todd	458	307	302	33	67
P.U.	238	160	0	33	67
Sorensen	143	96	243	33	67
Telford	308	207	225	33	67

Date: 5/30/2011

User	Input Inches	Inches After Loss	Delivered Inches	% Conv. Loss	% Efficiency
Todd	374	256	100	32	68
Gary	411	281	333	32	68
P.U.	195	133	0	32	68
Sorensen	117	80	213	32	68
Telford	252	172	220	32	68

Date: 6/2/2011

User	Input Inches	Inches After Loss	Delivered Inches	% Conv. Loss	% Efficiency
Todd	336	207	300	38	62
Gary	381	235	400	38	62
Seth	444	273	0	39	61
P.U.	175	108	0	38	62
Sorensen	437	269	553	38	62
Telford	619	381	220	38	62

Date: 6/5/2011

User	Input Inches	Inches After Loss	Delivered Inches	% Conv. Loss	% Efficiency
Todd	269	182	200	32	68
Gary	381	257	300	33	67
Seth	444	300	300	32	68
P.U.	140	95	0	32	68
Sorensen	416	281	390	32	68
Telford	977	659	587	33	67

Date: 6/7/2011

User	Input Inches	Inches After Loss	Delivered Inches	% Conv. Loss	% Efficiency
Todd	350	228	200	35	65
Gary	381	248	430	35	65
Seth	444	289	300	35	65

P.U.	182	119	0	35	65
Sorensen	441	288	306	35	65
Telford	1031	672	608	35	65

Date: 6/9/2011

User	Input Inches	Inches After Loss	Delivered Inches	% Conv. Loss	% Efficiency
Todd	291	175	200	40	60
P.U.	152	91	0	40	60
Sorensen	91	55	124	40	60
Telford	196	117	120	40	60

Date: 6/11/2011

User	Input Inches	Inches After Loss	Delivered Inches	% Conv. Loss	% Efficiency
Todd	269	157	170	42	58
P.U.	140	82	0	41	59
Sorensen	84	49	124	42	58
Telford	181	106	100	41	59

Date: 6/23/2011

User	Input Inches	Inches After Loss	Delivered Inches	% Conv. Loss	% Efficiency
Todd	269	202	140	25	75
Seth	436	327	360	25	75
P.U.	140	105	0	25	75
Sorensen	742	557	678	25	75
Telford	889	667	680	25	75

Date: 6/26/2011

User	Input Inches	Inches After Loss	Delivered Inches	% Conv. Loss	% Efficiency
Todd	269	206	187	33	77
Seth	558	427	440	33	77
P.U.	140	107	0	34	76
Sorensen	436	333	462	34	76
Telford	876	669	650	34	76

Date: 6/29/2011

User	Input Inches	Inches After Loss	Delivered Inches	% Conv. Loss	% Efficiency
Todd	498	402	210	19	81
Gary	129	104	100	19	81
Seth	436	352	440	19	81
P.U.	259	209	0	19	81
Sorensen	508	410	618	19	81
Telford	1030	831	939	19	81

Based on this log, 2011 appears to be relatively representative of the annual conveyance losses seen in the Timberdome canal. Conveyance losses range from approximately 20% to 40%. Because of this, an average conveyance loss of 30% would not be unreasonable. From these inferences, one could recommend an annual diversion limit of **4,725.0 AFA** for Sorensen, due to estimated conveyance losses during transport down the Timberdome Canal.

Sources Consulted.

Bhawan, S., & Puram, R. K. (2014). Guideline for Computing the Water Use Efficiency of Irrigation Projects. Performance Overview & Management Improvement Organization – Central Water Commission – Ministry of Water Resources. Retrieved from http://www.cwc.gov.in/main/downloads/Modified%20WUE%20guidelines%20merged%20document.pdf.

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Natural Resource conservation Service. (2009). *Soil Survey of Butte County Area, Idaho, Parts of Butte and Bingham Counties*. United States Department of Agriculture. Retrieved from http://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/idaho/ID763/0/ButteID.pdf

Natural Resources Management and Environment Department. *Annex I: Irrigation Efficiencies.* Irrigation Water Management: Irrigation Scheduling, I. Retrieved from www.fao.org/docrep/t7202e/t7202e08.htm.

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34-7247

Idaho Department of Water Resources

WMIS
Water Management Information System

Quick Search:

For assistance, email WMIS Info

Search Method:	Reporting District
Reporting District:	Water District 34
WMIS Number:	40
Legal Description:	04N 26E 5 00 SE NE
Metal Tag Number:	A0018657

You are logged in as Guest

Point Of Diversion

You are viewing 40; A0018657

WMIS Number	40	**Network Well**	No
Reporting District	Water District 34	**Access Power**	Yes
Measurement Option	Flowmeter (1)	**Water District**	34
Metal Tag Number	A0018657	**Tag Location**	
Followup Date		**Comments**	
Diversion Name	44		

Search Water Rights

Contacts PLSS Spatial Data Water Source Water Rights

Water Right Number	Owner Type	Owner Name	Address	Phone	City/State/ Zip	Email
34-2428	Current Owner	SORENSEN, MITCHELL D	3871 W 2500 N	(208) 527-3271	MOORE, ID 83255	soremd@ida.net
34-7247	Current Owner	SORENSEN, MITCHELL D	3871 W 2500 N	(208) 527-3271	MOORE, ID 83255	soremd@ida.net
34-12416	Current Owner	SORENSEN, MITCHELL D	3871 W 2500 N	(208) 527-3271	MOORE, ID 83255	soremd@ida.net

34-7247

Idaho Department of Water Resources

WMIS
Water Management Information System

Quick Search:

For assistance, email WMIS Info

Search Method:	Reporting District
Reporting District:	Water District 34
WMIS Number:	40
Legal Description:	04N 26E 5 00 SE NE
Metal Tag Number:	A0018657

You are logged in as Guest

Data Summary

You are viewing 40; A0018657

AF gpm.

Report Year	Alternate FM	PCC	Time Clock
2014			
2013	1392.9		
2012		904.49	
2011		358.00	
2010		432.00	
2009		548.00	
2008		921.86	
2007		845.01	
2006		401.30	
2005		388.60	
2004		1038.10	
2003		769.02	
2002		1542.70	
2001		1225.60	
2000		1278.81	

Saxton, Craig

From: Harris, Lori
Sent: Tuesday, February 05, 2013 7:01 AM
To: Saxton, Craig
Subject: Permits to be Licensed

Craig per our conversation, here is a list of rights that were recommended as Permits and were decreed as Permits, but still need to be Licensed and we need to NCAP to the Court once Licensed. Hopefully it isn't too much trouble to notify me when they have been Licensed and I can proceed as needed.

Thanks,

Lori

31-7113
31-7567
34-7247
34-7430
36-7881
41-7058
45-7373
51-7292
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