

Project No. 1464-01-2018

Certified Water Rights Examiner Analysis of Water Right No. 37-7842

Prepared for:

Idaho Water Resource Board
322 East Front Street
Boise, ID 83720

August 10, 2018



For information concerning this report, contact
G. Erick Powell, Ph.D., P.E.



CHARLES E. BROCKWAY, Ph.D., P.E.
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2016 WASHINGTON STREET NORTH
SUITE 4
TWIN FALLS, IDAHO 83301



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Certified Water Rights Examiner Analysis of Water Right No. 37-7842

Prepared by: G. Erick Powell, Ph.D., P.E.
Brockway Engineering, PLLC

Date: August 10, 2018

A. Introduction

This report is a summary review of water use for recharge under water right no. 37-7842 during the permit development period between 1982 and 1992. As a Certified Water Rights Examiner (personal credentials available in Appendix A), I was requested to review the documentation pertaining to the permit application, proof of beneficial use, license exams, and the IDWR issued license. In addition, I was asked to review all pertinent data associated with this water right. Using all of the data contained in the report's Tables, Figures, and Appendices, I have rendered an opinion of the beneficial use of water right permit no. 37-7842 during the development period from 1982 through 1992.

B. Development Period

Water right permit application no. 37-7842 was filed with IDWR in 1980 (Appendix B – original POU and POD shown in Figure 1) and approved by IDWR for development on June 2, 1982 with a proof of beneficial use due date of June 1, 1987 (Appendix C). A development period extension was filed for and approved by IDWR until June 1, 1992 (Appendix C). Therefore, water diverted for recharge between 1982 and 1992 was evaluated in this report.

C. Beneficial Use Evaluations

Two evaluations of the beneficial use of recharge water under water right no. 37-7842 have been previously generated. Each evaluation has strengths as they review historic data but fall short in

describing the full water use during the development period. Gerald Martens, the permit holders' representative, submitted a beneficial use field exam in 1993 (Appendix D). Later, IDWR staff reviewed the beneficial use field exam prepared by Mr. Martens and prepared a license review memorandum dated October 29, 2014 (Appendix E).

C.1. Gerald Martens' Field Report

Mr. Martens submitted a final beneficial use field report on November 24, 1993 for permit no. 37-7842. Mr. Martens' field report can be found in Appendix D. Mr. Martens focused his analysis on the Shoshone recharge site only and combined the beneficial use of water right no. 37-7842 with water right permit no. 1-7054. However, recharge water was diverted into the Richfield Canals and into the Dietrich site, which was not included in Mr. Martens' analysis. A copy of the map included with Mr. Martens' field report is shown in Figure 2, which shows measurement locations around Shoshone. A summary of the field report regarding water right no. 37-7842 is found in Table 1.

Table 1. Beneficial Use Field Exam Summary for Water Right no. 37-7842

Owner	Source	POD	POU	Flow Rate	Max Volume
LSARD	Big Wood River	SENE Sec. 22 T5S R17E	Sec. 22 T5S R17E	300 cfs	--

C.2. Michele Edl's Beneficial Use License Review

Michele Edl, IDWR staff member, reviewed the beneficial use field report submitted by Mr. Martens and determined that there was insufficient information to allow her to complete a license recommendation. She performed additional research, analyzed alternative data, made calculations and ultimately made recommendations based on this additional information (Appendix E). In Ms. Edl's materials, she includes a document titled "Lower Snake Aquifer Recharge District Ground Water Recharge Demonstration Proposal," in which the recharge district discusses using the Dietrich Site and the Shoshone sites as recharge locations. Ms. Edl's analysis focused on the diversion of recharge water to the Dietrich recharge site. But Ms. Edl's analysis did not consider the recharge water diverted into the Richfield Canal or the Shoshone site. Ms. Edl did not formally submit a field report, but the license that was issued on July 13, 2017 was a direct result

of her additional information, work and recommendations. A summary of the recommendations are found in Table 2.

Table 2. Additional information for Water Right no. 37-7842 provided by Michele Edl and used for license of water right no. 37-7842.

Owner	Source	POD	POU	Flow Rate	Max Volume
IWRB	Little Wood River	SWSE Sec. 25, T4S R19E	Sec. 35 T4S R19E Sec. 2 T5S R19E	250 cfs	13,900 acft

C.3. Need for Additional Beneficial Use Analysis

This analysis is required because neither of the two evaluations of the beneficial use of water right permit no. 37-7842 have considered the full use of the water right permit during the development period. This analysis evaluates the recharge use during the development period within the permitted place of use and conveyance system and does not limit the analysis to a single location as was done by Mr. Martens or Ms. Edl.

D. Available Data

Water measurement data are available from Big Wood Canal Company and Water District 37. All pertinent data is available in Appendices J and K.

E. Beneficial Use Field Report

The following section contains my evaluation of all data relating to the measured data between 1982 and 1992. A completed Beneficial Use Field Report with revised data is located in Appendix F.

E.1. Section A: General Information

Permit No.: 37-7842
Owner: Idaho Water Resource Board
Phone No.: 208-287-4800
Current Address: 322 East Front Street, P.O. Box 83720

	Boise, ID 83720
Examiner's Name:	G. Erick Powell, Ph.D., P.E.
Exam Date:	August 10, 2018
Accompanied by:	Ann Vonde (project scope and original data)
Email:	ann.vonde@ag.idaho.gov
Address:	322 East Front Street, P.O. Box 83720 Boise, ID 83720
Relationship to Permit Holder:	Representative
Phone No.:	208-334-4141
Source:	Big Wood River and/or Little Wood River
Tributary to:	Malad River

Section A is regarding general information for permit 37-7842. The water right permit was assigned to the Idaho Water Resource Board (IWRB) in 1999 (Appendix G). I was retained by the IWRB to complete an independent evaluation of the beneficial use of water right permit no. 37-7842 for purpose of licensing using the original data during the development period from 1982 through 1992. My contact with IWRB is Ann Vonde, who presented me with the original diversion data, however she did not visit the sites with me. I personally visited the diversion points from the Little Wood River on July 22, 2018.

The source of water listed on the permit application, permit advertisement, IDWR approved permit, and 1993 IDWR reinstatement order was the Big Wood River and the Little Wood River (Appendices B and C). Water was diverted from both rivers as evidence by the watermaster diversion records (Section E.4). Water recharged along the Richfield Canal is only Big Wood River water. However, Big Wood River water combines with Little Wood River water where the Jim Byrns Slough injects water into the Little Wood River (Near #11 on Figure 3). Once Big Wood River water combines with Little Wood River water at the point of injection, it is not practical to differentiate the source of water diverted into the Dietrich Canal or the Milner-Gooding Canal. It is a mixture of Big Wood and Little Wood River water. Therefore, it is reasonable to conclude that water from both sources were used for recharge in the Dietrich and Shoshone Sites.

E.2. Section B: Overlap Review

1. Other water rights with the same place of use: 1-7054
2. Other water rights with the same source and point of diversion: See Table 3.

Section B discusses the overlap review of water rights with the same point of diversion, distribution system, place of use or beneficial use (IDAPA 37.03.02.35.d). There is one water right permit no. 1-7054 with the same purpose of recharge that overlaps a portion of the place of use for water right permit no. 37-7842. The place of use that is in common between water right permit no. 37-7842 and water right permit no. 1-7054 is the Shoshone recharge site.

As will be discussed in Section E.3 below, I conclude that there should be several points of diversion, points of injection and points of re-diversion for this water right. Table 3 lists all water rights that share these points of diversion. An analysis of all water rights sharing the place of use was not completed due to the large size of the place of use listed in the permit application and permit.

Table 3. Water rights with the same source and point of diversion.

Point of Diversion	Source	PLSS Location	Lat/Long	Water Rights	
BWR 1	Big Wood River	SENE Sec. 30 T2S R18E	43° 13' 16" N 114° 21' 25" W	37-59A	37-10343
				37-59B	37-10399
				37-59C	37-10400
				37-59D	37-10426
				37-59G	37-10596
				37-59J	37-13115
				37-59K	37-13116
				37-59L	37-15143
				37-59M	37-20733
				37-867	37-21485
				37-870	37-21836
				37-895	37-21837
LWR 1	Little Wood River or Injected Big Wood River	SWSE Sec. 25 T4S R19E	43° 02' 36" N 114° 08' 30" W	37-14264	37-13115
				37-13111	37-867
				37-20733	37-13112
				37-21404	37-13113
				37-21405	37-13114
				37-13116	37-21401
				37-13043	37-21402
				37-895	37-21403
				37-870	
LWR 2	Little Wood River or Injected Big Wood River	SWNE Sec. 36 T5S R17E	42° 56' 55" N 114° 22' 56" W		

E.3. Section C: Diversion and Delivery System

The permit application and permit list the source of the water as the Big Wood River and Little Wood River (Appendices B and C). However, only a single point of diversion is listed on the permit application and permit, which is the SWSE of Section 24, T4S R19E (Appendices B and C). This point is not located on either the Big Wood or Little Wood River courses. There are several notes in the file about this point of diversion being incorrect, as seen in Appendix H. The original POD location was likely a clerical error, and the point of diversion was intended to be the SWSE of Section 25, T4S R19E (just one section off). Within this corrected quarter-quarter, the Jim Byrns Slough ends and water from the slough enters the Little Wood River and the Dietrich Canal is diverted from the Little Wood River. The Jim Byrns Slough water is water diverted from the Big Wood River into the Richfield Canal system. The quarter-quarter discussed above is the

location where Big Wood River water is injected into the Little Wood River. In 1980, the permit application only had a space for a single point of diversion, and I interpret this as an attempt to describe a location where water from two sources are brought together for beneficial use, based on the space provided in the application.

Based on my personal conversation with Lynn Harmon, former manager of the Big Wood Canal Company, (Notes of Conversation found in Appendix I), it is my opinion that water from the Big Wood River can and was diverted for recharge use during the development period. Big Wood River water is diverted into the Richfield Canal at Station #4 (Figure 3), can be diverted into East and West Main Richfield Canals shown with call outs on Figure 3. Un-diverted Richfield Canal water flows into the Jim Byrns Slough and is measured at the head of the Jim Byrns Slough (station HJB) and at the mouth of the Jim Byrns Slough (Station MJB). The mouth of the Jim Byrns Slough is where the slough confluences with the Little Wood River.

The place of use identified in the permit application and permit included the entire service area of the Lower Snake Aquifer Recharge District and 5 sites outside the service area (Figure 1). The permit application/permit and permit advertisement clearly state that the recharge water was to use the Richfield and Dietrich Canal systems (Appendix B). Based on evidence of diversions, water was used in three recharge locations: (1) The Dietrich site located along the Dietrich Canal south of the Little Wood River, (2) The Shoshone site located along the Milner-Gooding Canal north of the Little Wood River, and (3) along the Richfield Canal before or after the irrigation season delivery occurred.

E.3.1 Dietrich Site Diversion and Delivery System

Water from the Little Wood River, which can be Little Wood River flow or injected Big Wood River water, can be diverted into the Dietrich Canal (Figure 4). A check structure exists across the Little Wood River to back water up and ensure adequate flow is diverted into the Dietrich Canal. I visited the Dietrich Canal diversion point in July 2018 and witnessed Big Wood River water being injected into the Little Wood River from the Jim Byrns Slough (Figure 8), the check structure on the Little Wood River (Figure 9) and a combination of Big Wood/Little Wood River water being diverted into the Dietrich Canal (Figure 10). I also witnessed water (from both the Little Wood and Big Wood Rivers) flowing past the check structure to continue down the Little

Wood River towards the bifurcation, where the Milner-Gooding Canal intersects with the Little Wood River.

E.3.2 Shoshone Site Diversion and Delivery System

The Milner-Gooding Canal and the Little Wood River intersects at a location called the bifurcation, located northeast of the city of Shoshone (Figure 5). The bifurcation is a hydraulic structure where Snake River water in the Milner-Gooding Canal can be split and either injected into the Little Wood River or through a siphon tube under the Little Wood River to the north section of the Milner-Gooding Canal (Figure 10). Lynn Harmon stated in a personal conversation to me that during high flows in the Little Wood River, when Snake River water is flowing only through the syphon, it is possible for Little Wood River water to flow up the bifurcation into the syphon.

I have not personally observed this backflow into the bifurcation, but Mr. Harmon has witnessed water flowing from the Little Wood River into the bifurcation. The water flow situation is obvious from the water measurement data. Figure 5 shows the measurement locations around the bifurcation. Measurement location #53 is a measurement on the Milner-Gooding Canal and measures the flow of Snake River water coming into the bifurcation. Measurement location #56 (also on the Milner-Gooding Canal) is measuring what water is flowing north away from the bifurcation (Figure 11). Occasionally, water measurements show an increase in flow from measurement location #53 to #56 (See discussion in Section E.4.2 below). An increase in flow between Stations #53 and #56 is concluded to come from the Big Wood/Little Wood Rivers.

E.3.3 Richfield Canal Diversion and Delivery System

Throughout the state of Idaho, recharge routinely occurs and is recognized as recharge within the canal systems during the non-irrigation season. Water from the Big Wood River was diverted into the Richfield canals during the non-irrigation season. Irrigation water rights diverted into the Richfield Canal have periods of use either from April 1st through October 31st or from March 15th through November 15th. However, the actual diversion of irrigation water occurs in a narrower window. In my personal conversation with Mr. Harmon, he said that the typical start of the irrigation season on the Richfield Canal is May 1st and the irrigation season usually ends in mid-

September. The watermaster records support a narrow irrigation season, with smaller diversions reported during April and no diversion records in October (Appendix J). Therefore, I concluded that the irrigation season for the Richfield Canal during the development period was from May 1st through September 30th. As described in more detail in Section E.4.3, diversions occurred to the Richfield Canal system outside of the irrigation season and the recharge flow rate within the Richfield Canal was calculated from Station #4 to HJB. Recharge was not calculated to the MJB due to seasonal gains in the slough, as discussed in Section E.4.3. However, the place of use for the Richfield Canal diversions includes the Richfield Canal from Station #4 to the MJB because, during the development period recharge water was not stopped at the HJB but continued to flow through to the MJB. Watermaster records confirm that seasonally water was recharged in the Jim Byrns Slough (HJB to MJB) during the development period.

E.3.4 Recommended Points of Diversion

Based on historical documents, watermaster delivery records, personal communication with Lynn Harmon and personal visit to the diversion sites, it is my opinion that the points of diversion for water right no. 37-7842 should be designated as shown in Tables 4 and 5. Figure 6 shows a map of the points of diversions and the conveyance system to arrive at the potential places of use.

Table 4. Proposed points of diversion based on review of the water delivery system for water diverted from the Big Wood River.

Ident. No.	¼	¼	Sec	Twp	Rge	County	Method of Determination/Remarks
BWR 1	SE	NE	30	2S	18E	Blaine County	Point of Diversion
LWR 1	SW	SE	25	4S	19E	Lincoln County	Point of Injection
LWR 1	SW	SE	25	4S	19E	Lincoln County	Point of Re-diversion
LWR 2	SW	NE	36	5S	17E	Lincoln County	Point of Re-diversion

Table 5. Proposed points of diversion based on review of the water delivery system for water diverted from the Little Wood River.

Ident. No.	¼	¼	Sec	Twp	Rge	County	Method of Determination/Remarks
LWR 1	SW	SE	25	4S	19E	Lincoln County	Point of Diversion
LWR 2	SW	NE	36	5S	17E	Lincoln County	Point of Diversion

E.3.5 Recommended Place of Use

Tables 6 through 8 lists the places of use for recharge and Figure 7 is a map of the recommended place of use.

Table 6. Place of use for the Dietrich recharge site.

			NE				NW				SW				SE			
Twp	Rge	Sec	NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE
4S	19E	35															E	E
5S	19E	2	E	E	E					E	E	E	E			E		
5S	19E	3															E	E
5S	19E	10	E			E												
5S	19E	11					E											

Table 7. Place of use for the Shoshone recharge site.

			NE				NW				SW				SE			
Twp	Rge	Sec	NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE
5S	17E	22			E	E				E	E		E	E	E	E		

Table 8. Place of use for the Richfield Canal.

Twp	Rge	Sec	NE				NW				SW				SE			
			NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE
2S	18E	29										E	E	E				
2S	18E	30													E			
S2	18E	32		E	E	E	E								E			
2S	18E	33			E				E	E		E			E	E		E
2S	18E	34											E	E				
3S	18E	2											E	E				
3S	18E	3		E	E		E				E					E	E	E
3S	18E	11			E		E			E						E	E	E
3S	18E	13						E	E									
3S	18E	14	E	E	E	E										E	E	
3S	18E	23		E	E	E									E			E
3S	18E	24											E	E	E		E	E
3S	19E	13										E	E					
3S	19E	14									E	E			E	E	E	
3S	19E	15			E	E					E	E	E			E		
3S	19E	16									E		E	E	E	E		E
3S	19E	17										E	E	E			E	E
3S	19E	18													E			E
3S	19E	19	E	E	E					E	E	E						
3S	19E	24						E	E	E	E	E				E	E	E
3S	19E	25	E															
3S	20E	30						E	E		E	E	E	E				
3S	20E	31					E	E		E	E						E	E
4S	19E	13													E			E
4S	19E	24	E	E	E		E				E			E				
4S	19E	25	E	E	E	E	E									E		
4S	20E	6		E	E						E			E		E	E	
4S	20E	7		E	E	E									E	E	E	E
4S	20E	18					E		E	E		E						

The points of diversion and place of use were identified by combination of aerial photography, GIS data, GPS coordinates and/or site inspection.

E.4. Section D: Flow Measurements

Flow measurements throughout the region were collected by the Big Wood Canal Company and provided to the Water District 37 watermaster. The watermaster would double check measurement data with spot measurements and adjust flows as necessary. The watermaster then reports daily diversion rates in an annual report to IDWR. Diversion data by the Water District 37 watermaster is available in Appendix J and the Big Wood Canal Company measurements are

available in Appendix K. I used the watermaster records as my primary data source and then supplemented the data with records from the Big Wood Canal Company, especially diversion data during the non-irrigation season which was outside of the watermaster's records. These are public records and can be obtained through public records request. Measurements were collected in accordance with IDWR policy in place at the time and are presumed to be accurate. The actual measurement devices used to obtain these measurements existed prior to the approval and development of this permit. If the measurement device is of interest, I would suggest that one contact the Water District 37 watermaster and/or the Big Wood Canal Company. These data are considered to be the best available data for this system.

E.4.1 Dietrich Canal Site

Recharge diversions to the Dietrich site were estimated based on measured delivery to the Dietrich Canal at measurement location number #11. Water diverted into the Dietrich Canal is a combination of water from the Little Wood and Big Wood Rivers (Figure 9). Mr. Harmon said to me that the irrigation season in the Dietrich Canal usually begins on April 15th and from that date through May, the demand is between 100 cfs and 120 cfs. Ms. Edl (Appendix E) used a more conservative estimate of 150 cfs for early irrigation demand in her analysis. The likely irrigation demand in April is well below 100 cfs and by the end of May is likely close to 150 cfs, so I used an early irrigation flow rate of 120 cfs as an average irrigation demand during the dates of April 15 through May 31. I focused on the dates between April 15th and May 31st as the logical period when recharge would occur, because irrigation demands increases in June and peaks in July while spring runoff is less. If excess water exists in the Dietrich Canal, then excess water flows through the F-Waste gage and returns to the Little Wood River. Any diverted rate above the 120 cfs irrigation demand and not returned to the Little Wood River through the F-waste gage was diverted for another use and concluded to be used for recharge water.

Flow estimate to the Dietrich Canal recharge site was calculated based on the following logic:

1. Total flows into the Dietrich Canal are measured at Station #11.
2. Between April 15th and May 31st the average irrigation demand on the Dietrich Canal is 120 cfs. 120 cfs is subtracted from the total flow measurements.
3. Excess flow in the Dietrich Canal system flows through the F-Waste gage into the Little Wood River. Flows measured at the F-Waste are subtracted from the total flow measurements.

The maximum flow rate calculated for recharge use from the Dietrich Canal diversion data was 276 cfs which occurred in May 1984. Table 9 shows a sample spreadsheet of flow calculations for May 1984 when the maximum diversion rate for recharge was calculated. Complete spreadsheet calculations for all years during the development period can be found in Appendix L. The maximum annual flow rates calculated for recharge during the development period are shown in Table 10.

Table 9. Example recharge flow rate calculations to the Dietrich Site for May 1984. Highlighted row was the maximum diversion rate for recharge from the Big Wood/Little Wood Rivers during the development period.

Date	#11 Flow (cfs)	Demand (cfs)	F-Waste Flow (cfs)	Recharge (#11-Demand-F-waste) (cfs)	Date	#11 Flow (cfs)	Demand (cfs)	F-Waste Flow (cfs)	Recharge (#11-Demand-F-waste) (cfs)
5/1/84	291	120	0	171	5/16/84	390	120	0	270
5/2/84	309	120	0	189	5/17/84	396	120	0	276
5/3/84	321	120	0	201	5/18/84	387	120	0	267
5/4/84	321	120	0	201	5/19/84	390	120	0	270
5/5/84	319	120	0	199	5/20/84	387	120	0	267
5/6/84	309	120	0	189	5/21/84	375	120	0	255
5/7/84	306	120	0	186	5/22/84	247	120	0	127
5/8/84	300	120	0	180	5/23/84	209	120	0	89
5/9/84	251	120	0	131	5/24/84	210	120	0	90
5/10/84	183	120	0	63	5/25/84	207	120	0	87
5/11/84	184	120	0	64	5/26/84	207	120	0	87
5/12/84	204	120	0	84	5/27/84	206	120	0	86
5/13/84	213	120	0	93	5/28/84	219	120	0	99
5/14/84	219	120	0	99	5/29/84	226	120	0	106
5/15/84	294	120	0	174	5/30/84	227	120	0	107
					5/31/84	221	120	0	101

Table 10. Maximum flow estimates for recharge use in the Dietrich Canal in CFS for water delivery under permit no. 37-7842.

Year	Max Flow (cfs)
1982	256
1983	152
1984	276
1985	132
1986	129
1987	88
1988	129
1989	115
1990	100
1991	129
1992	144

E.4.2 Shoshone Recharge Site

Most of the recharge occurring at this location is from the Snake River delivered through the Milner-Gooding Canal. However, during high flows in the Little Wood River, water from the Big Wood/Little Wood Rivers could flow through the bifurcation and into the syphon. Diverted waters would flow through the Milner Gooding Canal to the Shoshone recharge site.

Measurements are collected as shown on Figure 5: Station #53 (Milner-Gooding Canal, before the Little Wood River), Station #56 (Milner-Gooding Canal, after the Little Wood River, before the recharge diversion) and Station #57 (Milner-Gooding Canal after the recharge diversion).

Big Wood/Little Wood River recharge at the Shoshone Site was calculated based on the following logic:

1. Total recharge from the Snake, Big Wood, and Little Wood Rivers at the Shoshone site is calculated by subtracting the flow measurements at Stations #56 and #57.
2. Comparison between Station #53 and Station #56.
 - a. If Station #56 is less than Station #53, then water is diverted from the Milner-Gooding Canal into the Little Wood River through the bifurcation.
 - b. If Station #56 is more than Station #53 then water must have come from the Big Wood/Little Wood Rivers into the bifurcation and into the Milner-Gooding Canal

because no other sources of the additional water exist during the time periods analyzed.

Table 11 shows sample calculations from April 1984 when the maximum diversion rate from the Big Wood/Little Wood Rivers was observed in the Milner-Gooding Canal. Complete calculations for all years of the development period for the Shoshone Site flows can be found in Appendix M. Table 12 shows the annual maximum flow rate of Big Wood/Little Wood River water flowing into the Shoshone Recharge Site.

The maximum flow rate diverted into the Shoshone Recharge Site from the Big Wood/Little Wood Rivers occurred in April 1984 and was calculated to be 295 cfs.

Table 11. Sample calculations for Shoshone Site Recharge from April 1984 data. Total recharge column includes water from all sources, including Snake, Big Wood, and Little Wood Rivers. Highlighted row was the maximum diverted flow rate from the Big Wood/Little Wood Rivers into the Milner-Gooding Canal for recharge.

Date	#53 Flow (cfs)	#56 Flow (cfs)	#57 Flow (cfs)	Total Recharge (#57-#56) (cfs)	BWR/ LWR Recharge (#56-#53) (cfs)	Date	#53 Flow (cfs)	#56 Flow (cfs)	#57 Flow (cfs)	Total Recharge (#57-#56) (cfs)	BWR/ LWR Recharge (#56-#53) (cfs)
4/1/84	0	0	0	0	0	4/16/84	222	507	213	294	285
4/2/84	0	0	0	0	0	4/17/84	222	517	217	300	295
4/3/84	0	0	0	0	0	4/18/84	521	545	229	316	24
4/4/84	0	0	0	0	0	4/19/84	540	560	235	325	20
4/5/84	0	0	0	0	0	4/20/84	552	584	245	339	32
4/6/84	0	0	0	0	0	4/21/84	572	568	239	329	0
4/7/84	0	0	0	0	0	4/22/84	560	560	235	325	0
4/8/84	0	0	0	0	0	4/23/84	536	543	228	315	7
4/9/84	0	0	0	0	0	4/24/84	542	549	231	318	7
4/10/84	106	0	0	0	0	4/25/84	546	540	227	313	0
4/11/84	128	0	0	0	0	4/26/84	574	582	244	338	8
4/12/84	205	205	127	78	0	4/27/84	572	576	242	334	4
4/13/84	202	201	84	117	0	4/28/84	567	572	240	332	5
4/14/84	194	353	148	205	159	4/29/84	564	568	239	329	4
4/15/84	222	438	184	254	216	4/30/84	568	574	241	333	6

Table 12. Maximum annual flow estimates for recharge use in the Shoshone Site in CFS for water delivery under permit no. 37-7842.

Year	Max Flow (cfs)
1982	152
1983	66
1984	295
1985	232
1986	27
1987	0
1988	0
1989	33
1990	0
1991	3
1992	6

E.4.3 Richfield Canal

Based on my experience with recharge projects throughout Idaho, water diverted into canal systems during the non-irrigation season is considered recharge. As discussed in Section E.3, Big Wood River water was diverted during the non-irrigation season (before May 1st or after September 30th with no East Main and/or West Main Canal diversions) into the Richfield Canal. Mr. Harmon told me that there are no stockwater diversions into the Richfield Canal during the non-irrigation season. Water measured and diverted into the Richfield Canal system should be considered recharge water during the development period.

Big Wood River diversions into the Richfield Canal is measured at Station #4 (Figure 3). A measurement at the end of the Richfield Canal system occurs at the mouth of the Jim Byrns Slough (MJB) where the slough water combines with the Little Wood River. My original calculations for recharge within the Richfield Canal system was the difference between Station #4 and the MJB. However, sometimes, but not always, the MJB measurement was higher (more flow) than the HJB measurement, leading me to conclude that water from unknown sources were entering the slough. In order to eliminate unknown gains to the system, I calculated recharge as the difference between Station #4 and the HJB. This is a conservative approach, as there are many days within the non-irrigation season where the MJB measurement is lower than the HJB

measurement and would have resulted in higher recharge flows. But given the uncertainty of water sources within the Jim Byrns Slough, I concluded that the most defensible course was to end recharge calculations at the HJB. As previously discussed, Mr. Harmon told me that diversions into the Richfield Canal during the non-irrigation season were kept in the Richfield Canal or the Jim Byrns Slough, if water was diverted into the East or West Main Canals off of the Richfield Canal, then that water was being used for irrigation.

The flow rate diverted for recharge in the Richfield Canal was calculated based on the following logic:

1. Recharge only was considered outside of the irrigation season, April 1 through April 30 or after September 30 when water was not being not diverted into the East or West Canals.
2. Stockwater and/or irrigation diversions do not occur in the Richfield Canal system during the non-irrigation season.
3. Recharge rate was calculated as the difference between Station #4 and the HJB.

Table 13 shows a sample spreadsheet with calculations to determine the maximum flow rates for recharge along the Richfield Canal for portions of April and October/November 1987. Complete spreadsheet calculations of Richfield Canal flows for recharge for all development period years can be found in Appendix N. The maximum recharge rate for the Richfield Canal was calculated to be 300 cfs in 1987 and Table 14 shows the annual maximum rates.

Table 13. Sample calculations of Richfield Canal Recharge from portions of April and October/November 1987 data. The maximum flow rate calculated during the development period is highlighted.

Date	#4 Flow (cfs)	East Canal (cfs)	West Canal (cfs)	HJB Flow (cfs)	Recharge (#4-HJB) (cfs)		Date	#4 Flow (cfs)	East Canal (cfs)	West Canal (cfs)	HJB Flow (cfs)	Recharge (#4-HJB) (cfs)
4/15/87	0	0	0	0	0		10/18/87	0	0	0	0	0
4/16/87	0	0	0	0	0		10/19/87	0	0	0	0	0
4/17/87	0	0	0	0	0		10/20/87	0	0	0	0	0
4/18/87	0	0	0	0	0		10/21/87	0	0	0	0	0
4/19/87	0	0	0	0	0		10/22/87	0	0	0	0	0
4/20/87	0	0	0	0	0		10/23/87	0	0	0	0	0
4/21/87	122	0	0	0	122		10/24/87	0	0	0	0	0
4/22/87	168	0	0	172	0		10/25/87	0	0	0	0	0
4/23/87	170	0	0	182	0		10/26/87	0	0	0	0	0
4/24/87	172	0	0	86	86		10/27/87	0	0	0	0	0
4/25/87	186	0	0	93	93		10/28/87	0	0	0	0	0
4/26/87	206	0	0	101	105		10/29/87	0	0	0	0	0
4/27/87	318	0	0	132	186		10/30/87	0	0	0	0	0
4/28/87	327	0	0	136	191		10/31/87	0	0	0	0	0
4/29/87	382	0	0	141	241		11/1/87	300	0	0	0	300
4/30/87	443	0	0	152	291		11/2/87	316	231	73	90	0

Table 14. Maximum flow estimates for recharge use in the Richfield Canal in CFS for water delivery under permit no. 37-7842.

Year	Max Flow (cfs)
1982	110
1983	84
1984	63
1985	71
1986	234
1987	300
1988	0
1989	140
1990	0
1991	0
1992	0

E.4.4 Flow Estimates

Recharge flow rates were described above. Table 15 shows the total recharge diversion rates for water right no. 37-7842 during the development period.

Table 15. Maximum flow estimates in CFS for water delivery under permit no. 37-7842.

Year	Max Diversion Dietrich (cfs)	Max Diversion Shoshone (cfs)	Max Diversion Richfield (cfs)	Total Diversion Rate (cfs)
1982	256	152	110	518
1983	152	66	84	302
1984	276	295	63	634
1985	132	232	71	435
1986	129	27	234	390
1987	88	0	300	388
1988	129	0	0	129
1989	115	33	140	288
1990	100	0	0	100
1991	129	3	0	132
1992	144	6	0	150

Based on the flow data, and the evaluation of water diverted for recharge use, I conclude that a maximum diversion rate during a single year of the period of development was 634 cfs in 1984. The original permit application requested a total of 800 cfs, so the total recommendation diversion rate would be limited to 634 cfs.

E.5. Section E: Narrative/Remarks/Comments

I consider this entire report part of the narrative, remarks and comments section. The other part of this section is to certify that all conditions of the permit approval have been met. It is my understanding that these conditions were evaluated by Ms. Edl in her review of the permit for IDWR (Appendix E) and IDWR issued a license. I conclude that the conditions were met with sufficient evidence for IDWR.

E.6. Section F: Flow Calculations

All flow calculations made were presented in Section E.4.

E.7. Section G: Volume Calculations

Water right volume amounts are required by IDAPA 37.03.02.35.j for most beneficial use field exams. IDAPA 37.03.02.35.j.i-viii also allows for certain water rights to be issued without a volume limitation, but groundwater recharge is not listed as an exemption to the volume. The instructions in the Code state, “The annual diversion volume shall account for seasonal variations in factors affecting water use, including seasonal variations in water availability (IDAPA 37.03.02.35.j).”

Water volumes available for groundwater recharge are highly sensitive to the seasonal variations in water availability. It is the practice of most groundwater recharge water rights to divert runoff during early spring or late fall when there is no longer other demands. Placing a volume limitation on a groundwater recharge water right based on a 10-year development period where excess flow may have been limited would artificially limit the volume authorized for recharge during the high runoff events.

I examined the measured peak flows data of the USGS Big Wood River Gage below Magic Dam near Richfield, Idaho for the development period compared to the period of record for the gage (1915-2017) to illustrate the variability in water availability in these mountain basins. The peak recharge occurred in 1984 (Table 15), and the peak flow in 1984 correspond to a 17-year recurrence interval (RI) flow event. Recently, we have had larger water years in 2006 (21-year RI event) and 2017 (54-year RI event). Limiting the volume of water right no. 37-7842 to only the volume available during the development period (1982 – 1992) that included 6 out of 10 years with a recurrence interval of 1.5-year or less severely limits the opportunity to maximize water use during the above average years when groundwater recharge could be available.

The variability of recharge availability is evident by looking at the table of recharge flow rates by year in Table 15 with the total recharge flow ranging from 0 cfs to 634 cfs. This also does not take into account the duration of time that recharge water might be available. Volume calculations are sensitive to the assumptions of when recharge can occur and the duration recharge availability.

If a recharge volume must be established for groundwater recharge licenses, there are multiple approaches to estimate the recharge volume. One approach was suggested by Ms. Edl (Appendix

E) and I have used another approach. Both methods are subject to the availability of water during the development period only, which appears to be in conflict with the IDAPA rules, when recharge water rights are to capture high flows during less-frequent water years.

1. Michele Edl (Appendix E) calculated a volume based on an estimated flow rate and the number of days that this flow rate may have been available. It is unknown how Ms. Edl established the number of days that the flow rate may be available. In 2006 or 2017, this flow rate may have been available for much longer. The number of days used in Ms. Edl's analysis is arbitrary and would vary substantially in different water years.
2. I calculated a daily volume based on the flow rates diverted for recharge as discussed in Section E.4. Annual volumes can then be calculated by summing the daily recharge volumes. This method is more defensible, but highly restrictive to water availability during the development period and specific years in question. A summary of the recharge volume diverted during the development period was performed and available in Appendix O.

It is my personal opinion that the volume limit on groundwater recharge rights hinders the opportunity to recharge the aquifer during less-frequent abundant water years when more water is available for recharge. In most years, water availability for recharge will be curtailed because of priority cuts, before volume limitations are reached. However, during years of large snow pack or precipitation that did not occur during the development period, when more recharge water is available, a volume limit could prevent additional recharge from occurring. Under these conditions, no priority cut would prevent the water right holder from diverting water for recharge, but the water right would be in violation of the volume limit, because the volume limit was based on only the water available during a "normal" water year, and not a less-frequent abundant water year. Therefore, I recommend that no volume limit be included on the water right license.

E.8. Section H: Recommendations

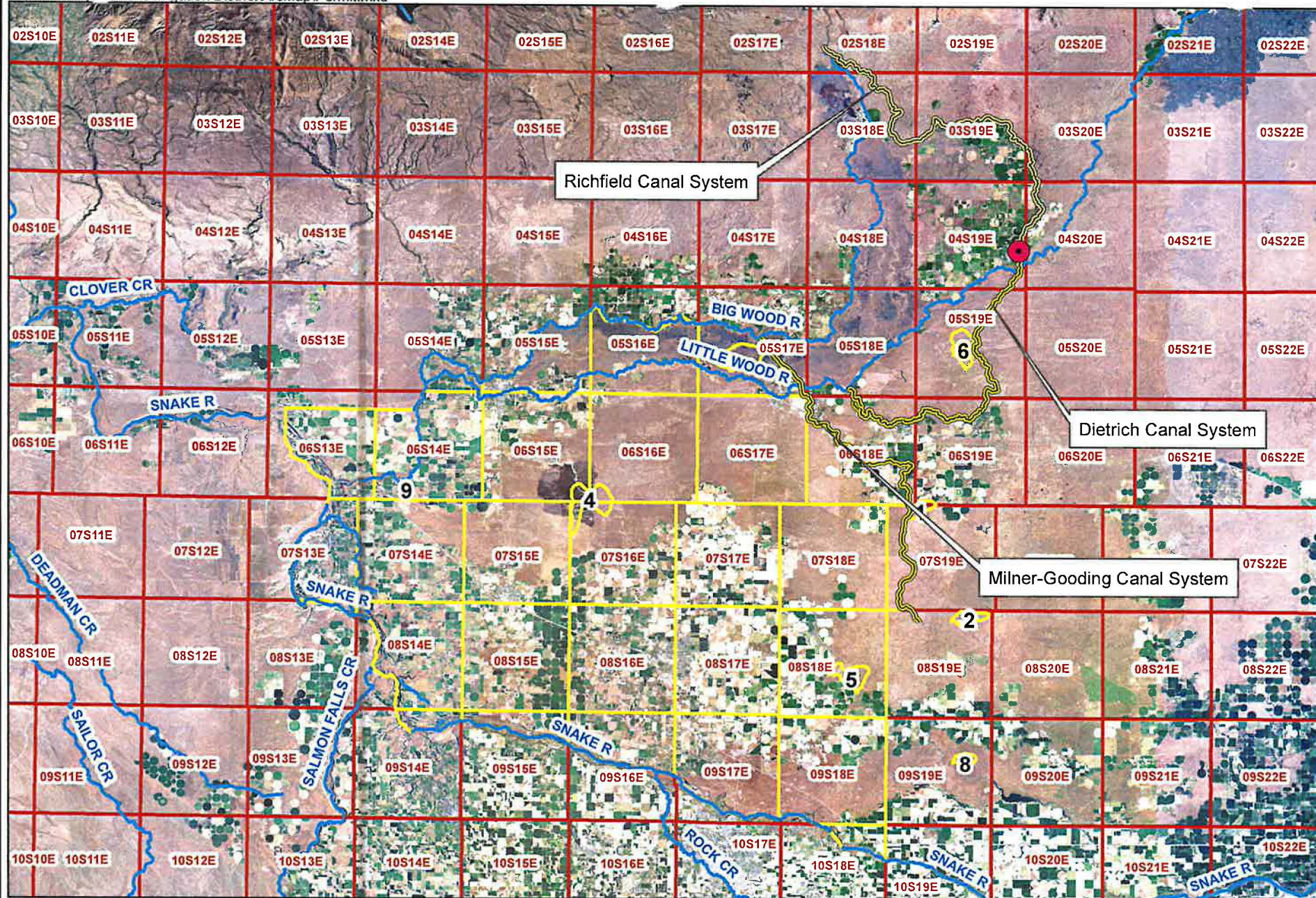
The following section is my recommendation based on the available data for this permit.

1. Recommended Amounts

Beneficial Use	Period of Use		Rate of Diversion Q (cfs)	Annual Volume V (afa)
	From	To		
Groundwater Recharge	1/1	12/31	634 cfs	NA

2. Recommended Amendments

- Change P.D. as reflected on page 1
- Change P.U. as reflected on page 1



N 1 inch = 38,000 feet

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FIGURE 1: PERMIT APPLICATION POU AND POD

WATER RIGHT NO. 37-7842
NAIP 2017 AERIAL PHOTOGRAPH

Legend

- POU
- Permit POD

IDWR B00063062

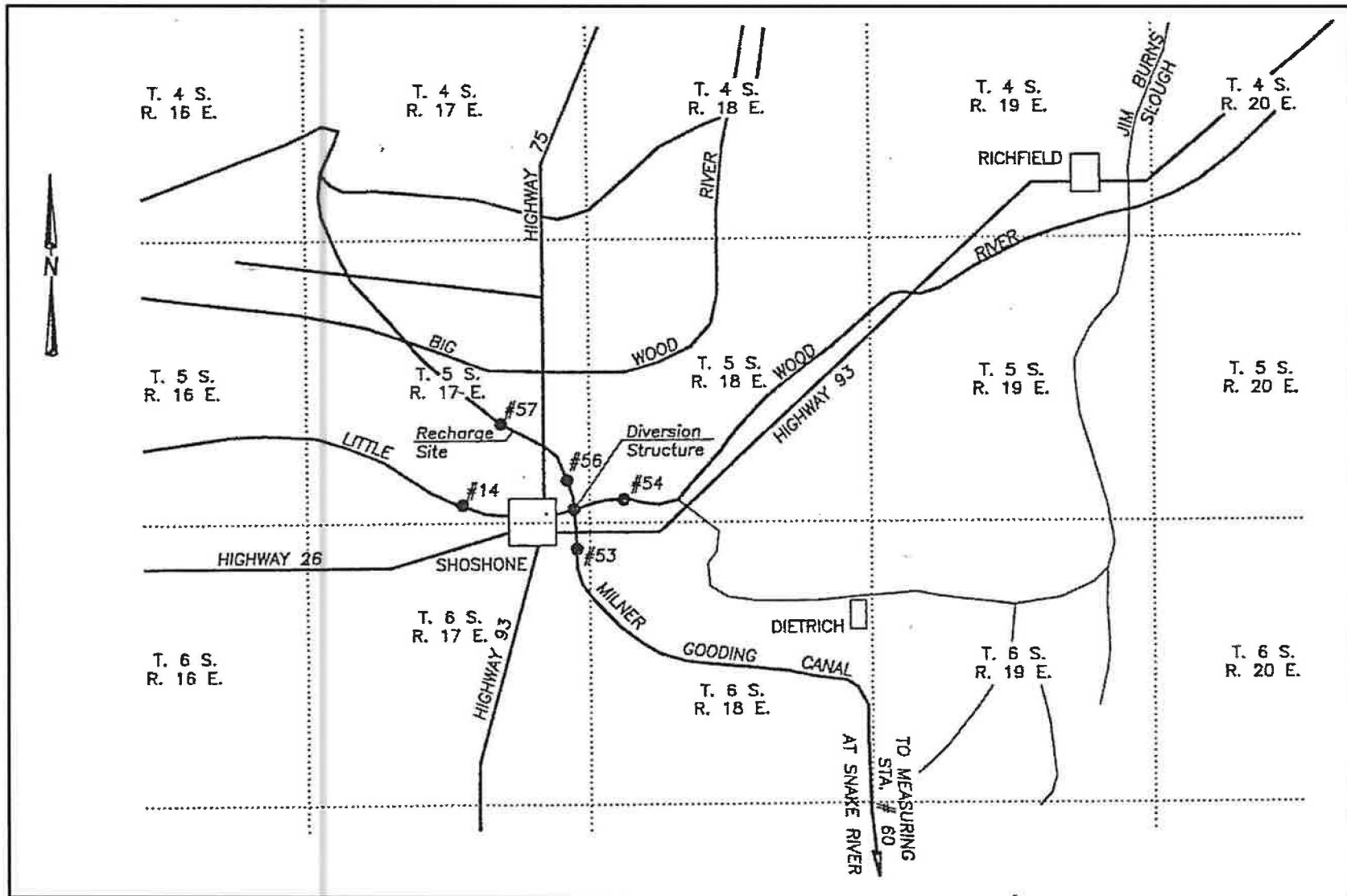
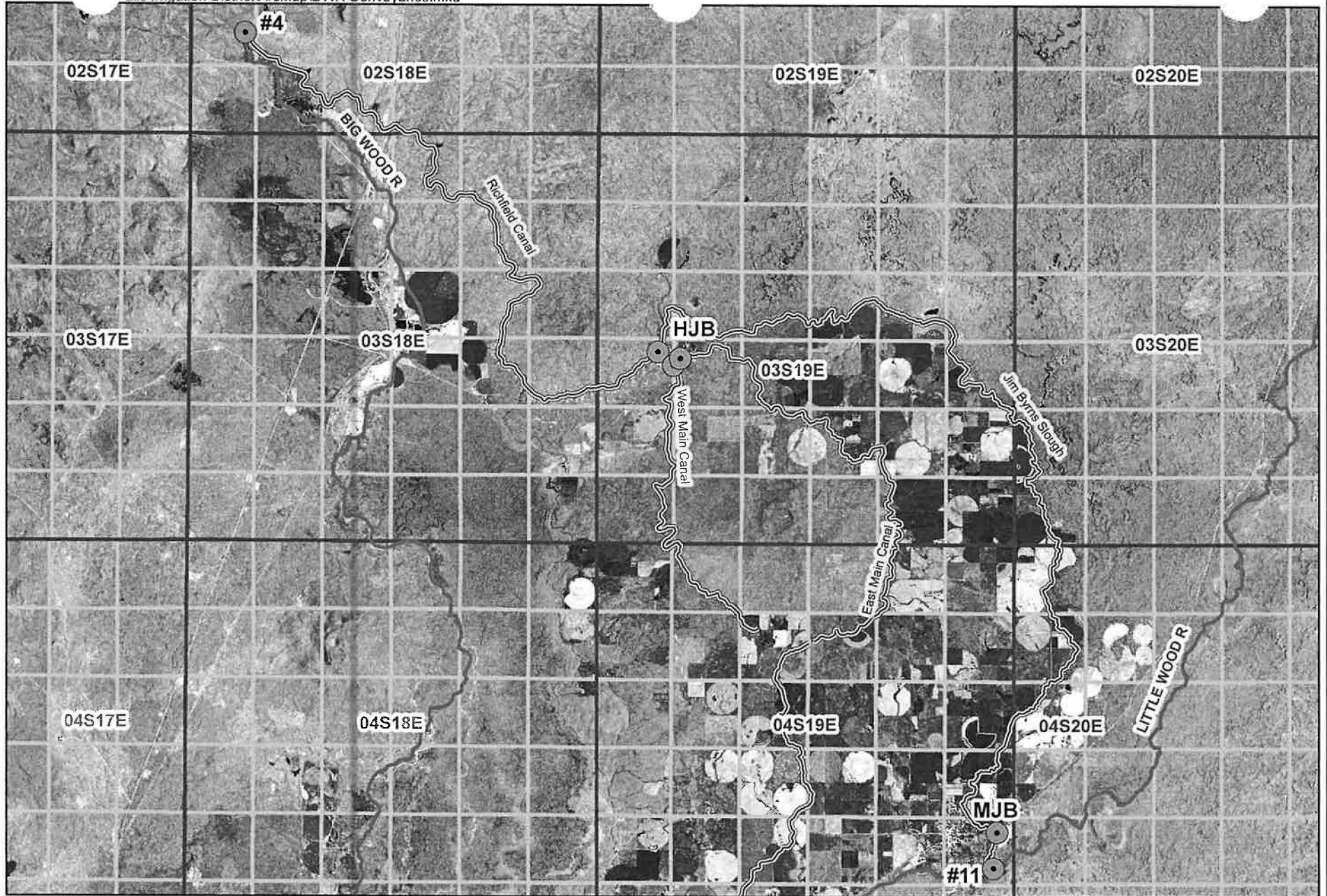


Figure 2: Map generated by Mr. Marten as part of the beneficial use exam for water right permit no. 37-7842.



N 1 inch = 10,000 feet

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FIGURE 3: RICHFIELD CANAL CONVEYANCE

WATER RIGHT NO. 37-7842
NAIP 2017 AERIAL PHOTOGRAPH

Legend

- Measuring Stations
 - Richfield_Canal_System
- IWRB00003064



N 1 inch = 7,500 feet

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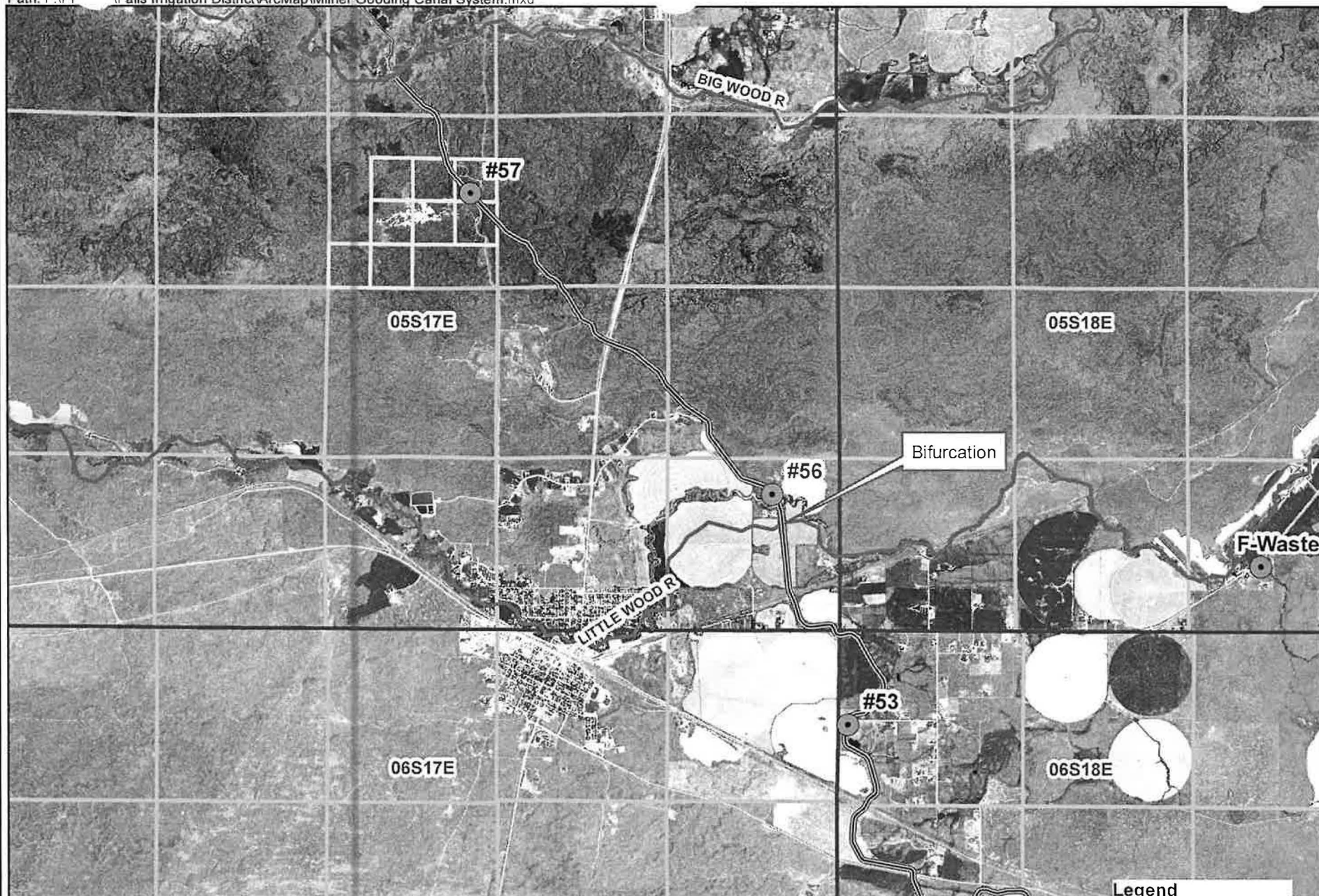
FIGURE 4: DIETRICH CANAL CONVEYANCE

WATER RIGHT NO. 37-7842
NAIP 2017 AERIAL PHOTOGRAPH

Legend

- Measuring Stations
- Dietrich_Canal_System
- Dietrich_Site_POU

IWRB00003065



N 1 inch = 4,000 feet



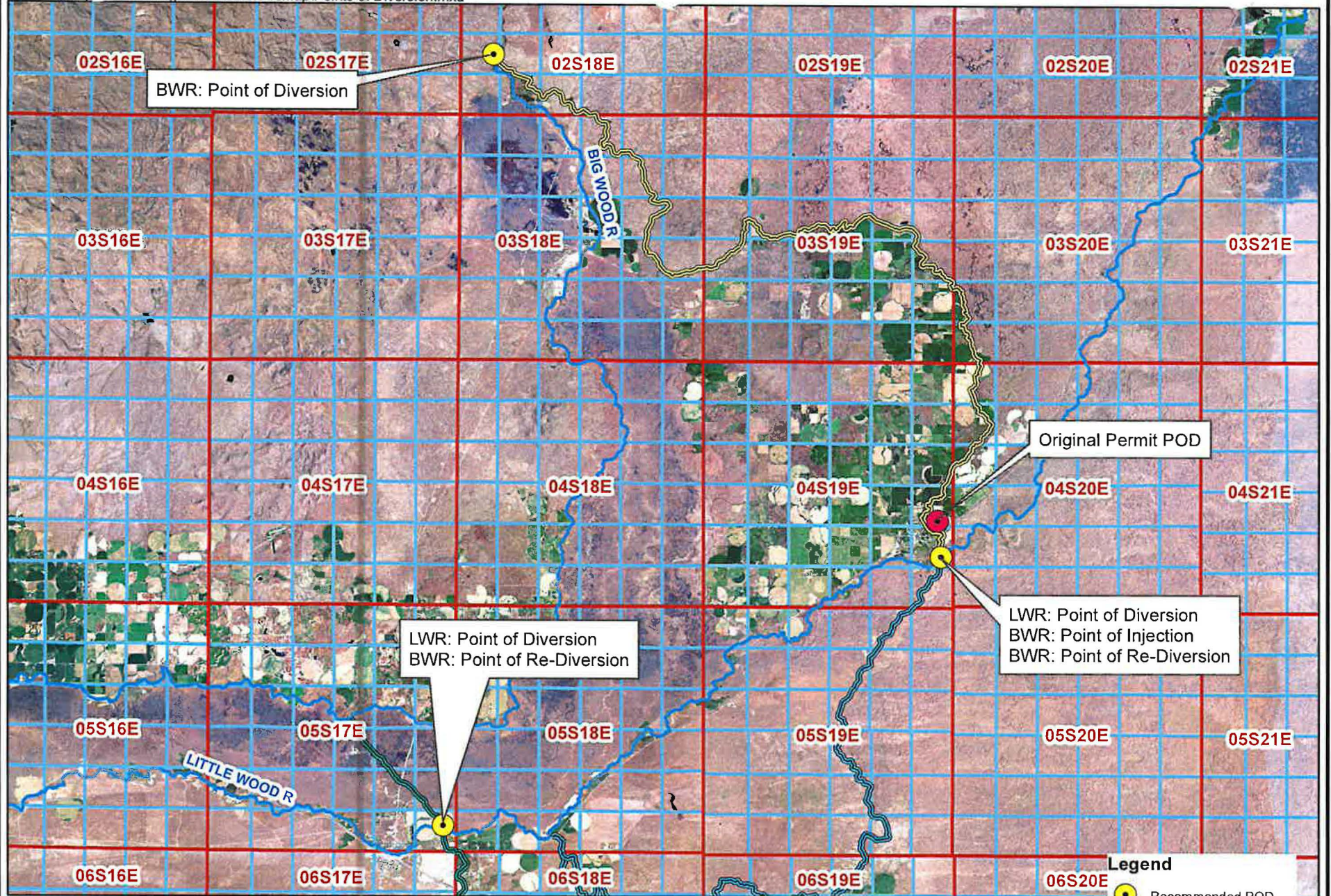
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FIGURE 5: MILNER-GOODING CANAL CONVEYANCE

WATER RIGHT NO. 37-7842
NAIP 2017 AERIAL PHOTOGRAPH

Legend

- Measuring Stations
 - Milner_Gooding_Canal
 - Shoshone_Site_POU
- IWRB00003066



N 1 inch = 16,667 feet

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FIGURE 6: RECOMMENDED POINTS OF DIVERSION

WATER RIGHT NO. 37-7842
NAIP 2017 AERIAL PHOTOGRAPH

Legend

- Recommended POD
- Milner_Gooding_Canal
- Dietrich_Canal_System
- Richfield_Canal_System

EDWB
IWRB 0000 3067

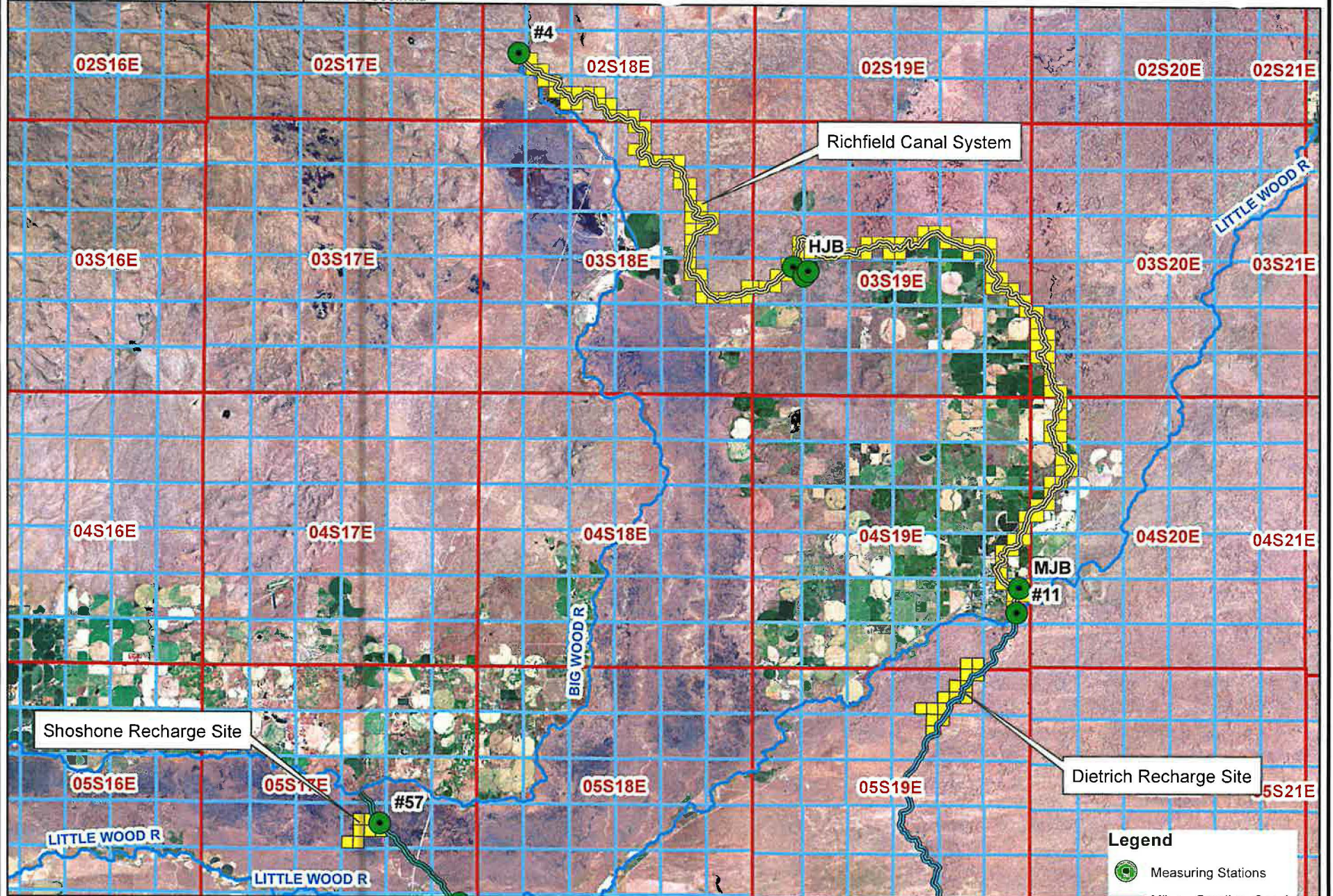


FIGURE 7: RECOMMENDED PLACE OF USE

WATER RIGHT NO. 37-7842
NAIP 2017 AERIAL PHOTOGRAPH

N 1 inch = 15,000 feet

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Legend

- Measuring Stations
- Milner_Gooding_Canal
- Dietrich_Canal_System
- Richfield_Canal_System
- Recommended POU

TWRB 00003068

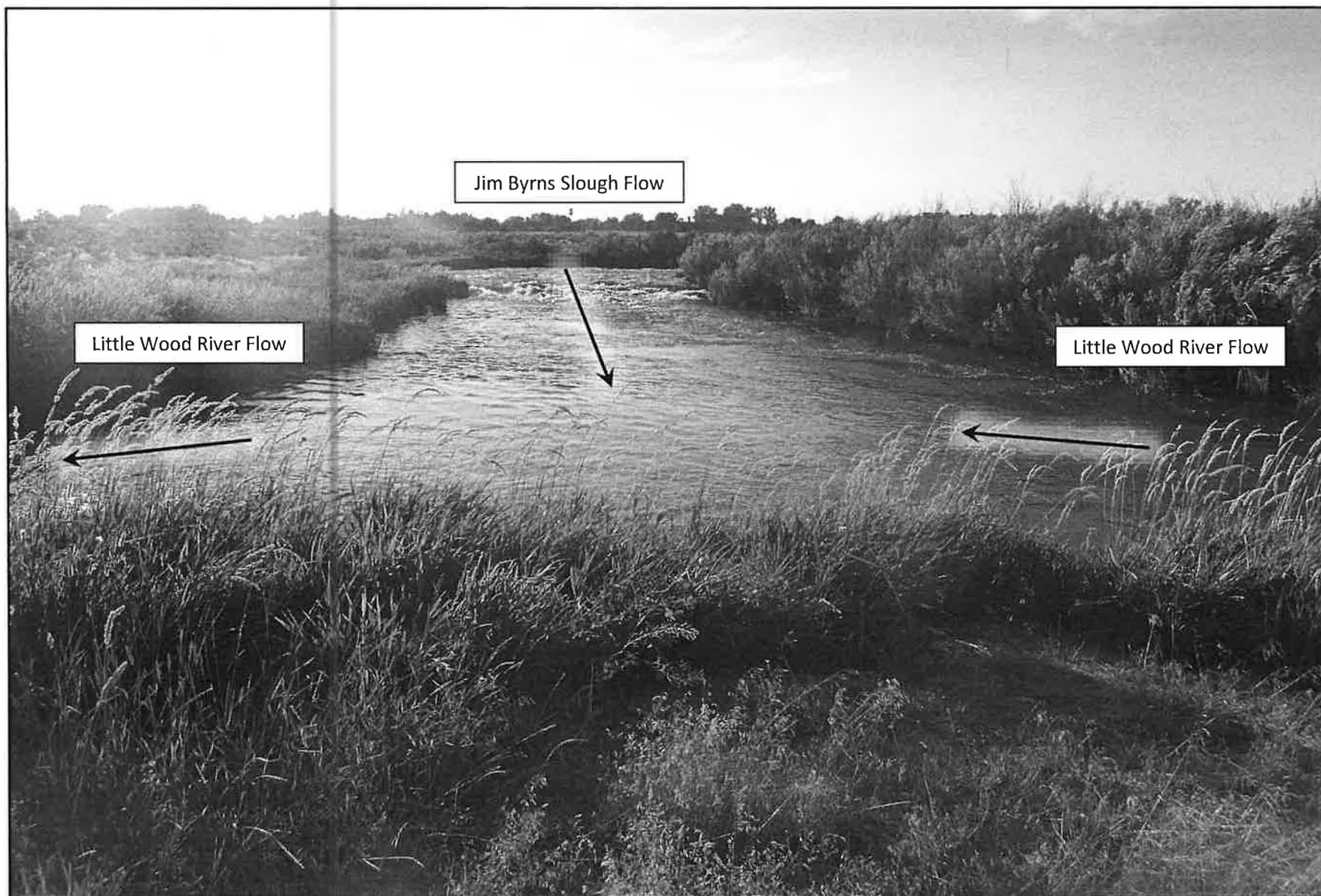


Figure 8: Photograph taken on July 22nd of the Jim Byrns Slough, water from the Big Wood River, injecting into the Little Wood River.



Figure 9: Photograph taken on July 22nd of the Little Wood River check structure. Structure is immediately downstream of the confluence of the Jim Byrns Slough and the Little Wood River, and the diversion to the Dietrich Canal.

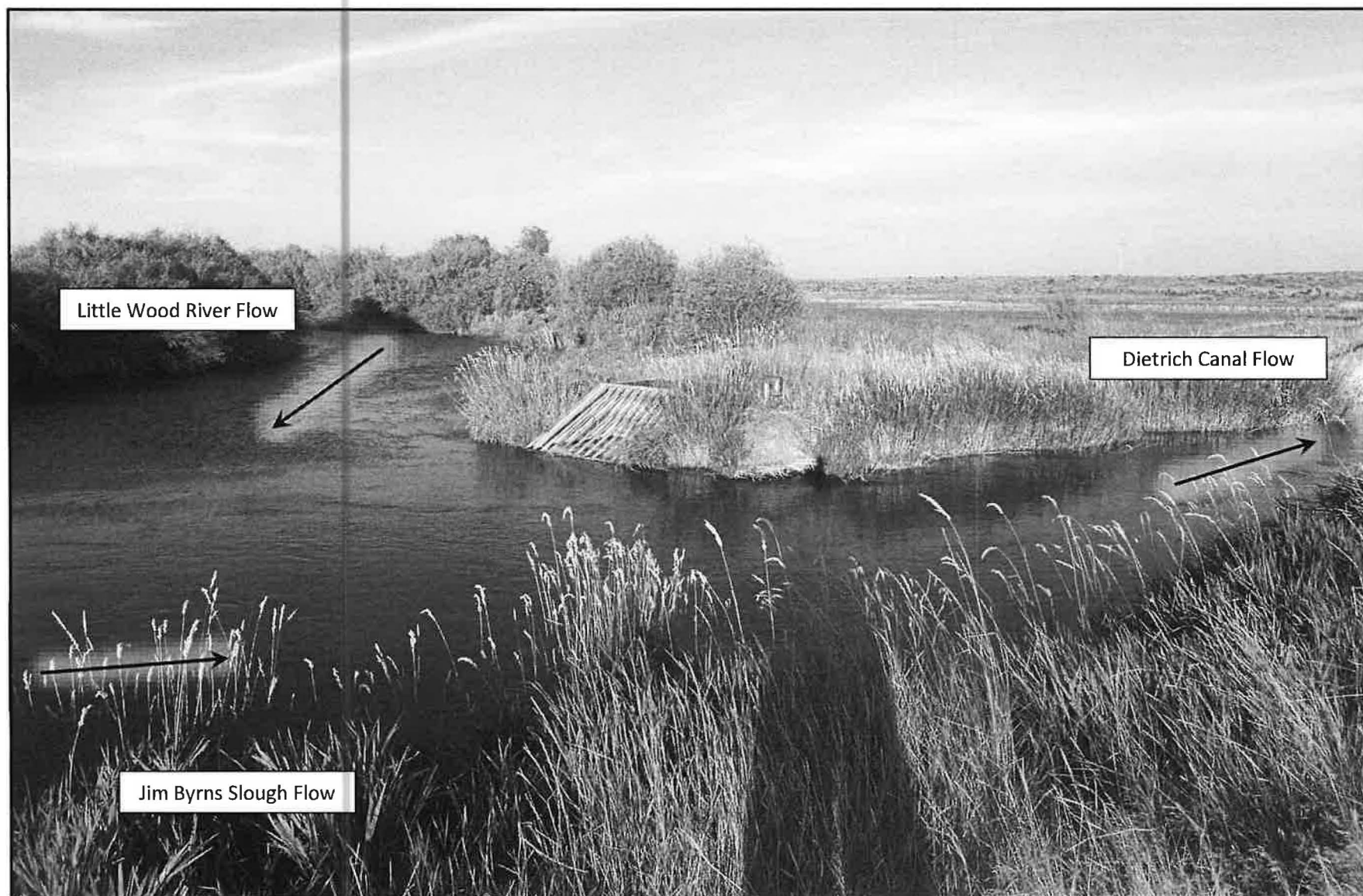


Figure 10: Photograph taken on July 22nd of the Dietrich Canal diversion, which includes water from the Little Wood River and Jim Byrns Slough, which is water from the Big Wood River.

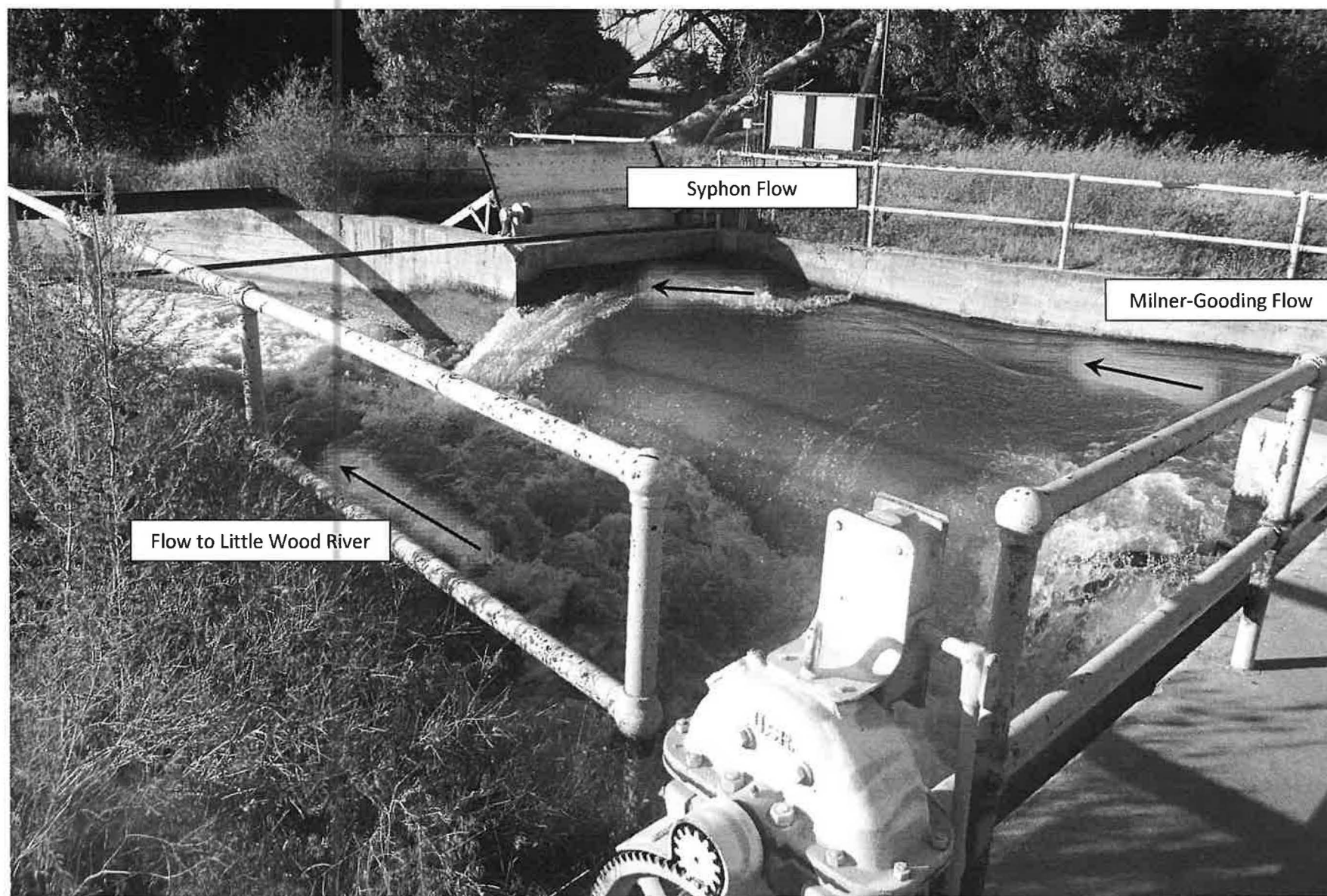


Figure 11: Photograph taken on July 22nd of the bifurcation, where the Milner-Gooding Canal can inject water into the Little Wood River or flow through a syphon tube under the Little Wood River.



Figure 12: Photograph taken on July 22nd of the Milner-Gooding Canal immediately downstream of the syphon tube. Measurement location #56 is visible.