

Memorandum

To: Don Shaff
From: Marci Pape, P.E.
Date: 10/6/06
Re: Diversion Rate Analysis for Simpson Right No. 73-12041

I have completed the diversion rate analysis for Water Right 73-12041. The claim is for 4.0 cfs and 80 acres of irrigation, plus 0.05 cfs for stockwater, although the claimant is requesting that the irrigation portion of the claim be amended to 5.64 cfs. Below are a summary of the information on which I based my analysis, any assumptions that were made, and the results of my analysis. For the recommended 46.3 acres, the total on-farm irrigation requirement was found to be 3.03 cfs, with an additional conveyance loss of 0.79 cfs for a total irrigation diversion rate requirement of **3.82 cfs**.

CALCULATIONS

For the place of use, I used a POU shapefile supplied by IDWR, consisting of three fields covering a total of 46.3 acres. The fields are flood irrigated, based on the questionnaire received from the claimant, and no information was provided as to other historical irrigation methods for these fields. The Department generally considers wild flooding to be an unacceptable irrigation practice due to the lack of control on the water and the very low field application efficiencies. The standard method of analysis adopted by IDWR is based on using existing slopes, appropriate intake family and design application, and corrugations with reasonable corrugation spacing (2 ft. for pasture).

All of the fields were analyzed using pasture, based on the information provided in the questionnaire. The rooting depth and percent available moisture I used were those suggested in Figure A-6 of the "Guidelines for the Evaluation of Irrigation Diversion Rates", prepared in October of 1991 by Hubble Engineering, Inc. and Associated Earth Sciences, Inc.

Furrow slope was found using 1:24000 digital topographic maps in ArcView. It was assumed that the corrugations would run in the same general direction as the water currently runs with the flood irrigation system, approximately northwest-southeast toward Morgan Creek. The range of slopes was measured to be between 2.3% and 8.2%. In their questionnaire, the Simpsons listed a field slope of 4 to 8%. Since the slopes I measured were somewhat consistent with those given in the questionnaire, I used the values I measured for each individual field.

The weather station nearest to this site is the May station. The 80th percentile monthly ET values from that weather station were used for my analysis.

The soil types were determined using the soils information from the USDA, NRCS for the Custer-Lemhi area, Soil Survey Area 752. The three dominant soils on the property are Bartonflat very gravelly sandy loam, Dawtonia gravelly loam, and Klug-Gaciba-Dacont complex.

Soil intake family must be determined for each soil within the analysis area. Soil intake family relates the cumulative depth of water infiltration to the time water is in contact with the soil surface. The intake family for a soil is found by looking at the texture of the soil's surface layer. There are two tables in the Hubble Report that may be used in this process, Appendixes A-2 and A-3, with Appendix A-3 being preferred since it contains further refinements. The large amounts of gravel present in several of these soils made it difficult to determine an appropriate intake family. For those soils, Figure A-2 in the Hubble Report was used, and the intake family was adjusted by one level. For instance, if a soil was described as "very gravelly loam" or "extremely gravelly loam", it was assigned a furrow intake family of 0.70 instead of the value of 0.55, which is the value recommended for gravelly loam. Appendix A-3 was not useful for gravelly soils, since that table does not address gravelly soils when recommending intake families based on soil textures.

One of the fields, Field C, was divided into two separate fields for the purpose of the analysis. When analyzed using furrows, that field has very short furrow lengths on the western two-thirds of the field, but much longer furrows on the eastern one-third. Therefore, the field was split into Fields C1 and C2.

Conveyance loss was calculated for this water right claim using the delivery information provided in the questionnaire. I attempted to correctly interpret the locations of the delivery ditches using the claimant's map. With that information, I calculated a conveyance loss of 0.02 cfs for Field B and 0.77 cfs for the combination of Fields A, C1, and C2. Field B required a separate conveyance loss calculation because it is irrigated using a different point of diversion and delivery ditch than the other three fields. The claimant did not describe specific irrigation rotations, so I assumed that the shared ditch would carry all the water necessary for Fields A, C1, and C2 at once.

RESULTS

The following table summarizes the field application efficiency, management allowed deficit (MAD), equivalent to the net irrigation application, resulting flow rate per acre, and total flow rate for each of the fields included in this claim.

Field ID	Field Efficiency	MAD (in.)	Flow Rate/Acre (cfs/ac)	Total Flow Rate (cfs)
A	15%	0.85	0.078	1.27
B	20%	1.37	0.058	0.83
C1	15%	1.60	0.077	0.53
C2	26%	1.37	0.045	0.40

The total on-farm irrigation requirement for A73-12041 was determined to be **3.03 cfs for 46.3 acres**. With the additional conveyance loss of **0.79 cfs**, the **Total Irrigation Diversion Rate Requirement** becomes **3.82 cfs**.

IRRIGATION DIVERSION RATE ANALYSIS

CLAIM NO(S):	73-12041
FIELD ID NO:	A
TOTAL ACRES:	16.2 AC
FIELD SLOPE:	7.0 %
FURROW LENGTH:	350 FT

ANALYSIS COMPLETED BY:	MARCI PAPE
DATE OF ANALYSIS:	09/29/06
Qmax PER FURROW:	Qmin PER FURROW:
For corrugates: 5.7 gpm	For both: 3.0 gpm
For furrows: 1.4 gpm	

[illegible]

TOTAL AC	TOTAL %	CFS/AC FOR
16.2	100	EACH CROP: 0.078

TOTAL CFS FOR FIELD: 1.27

FIELD ID NO:	B
TOTAL ACRES:	14.3 AC
FIELD SLOPE:	8.2 %
FURROW LENGTH:	250 FT

DATE OF ANALYSIS:	09/29/06
Qmax PER FURROW:	Qmin PER FURROW:
For corrugates: 4.9 gpm	For both: 3.0 gpm
For furrows: 1.2 gpm	

[illegible]

TOTAL AC	TOTAL %	CFS/AC FOR EACH CROP:
14.3	100	0.058

TOTAL CFS FOR FIELD: 0.83

FIELD ID NO: C1
 TOTAL ACRES: 6.9 AC
 FIELD SLOPE: 5.2 %
 FURROW LENGTH: 150 FT

DATE OF ANALYSIS: 9/29/06
 Qmax PER FURROW: 7.7 gpm
 For corrugates: 1.9 gpm
 Qmin PER FURROW: 3.0 gpm
 For both: 3.0 gpm

SOIL TYPE	ACRES	% OF TOTAL AC	INTAKE FAMILY	CROP = MAD	pasture EFFICIENCY	CROP = MAD	EFFICIENCY	CROP = MAD	EFFICIENCY	CROP = MAD	EFFICIENCY	CROP = MAD	EFFICIENCY
48	6.3	91	0.7	1.6	TH ₂ O → use 15%!								
241	0.6	9			***		***		***		***		***

TOTAL AC 6.9 TOTAL % 100

CFS/AC FOR EACH CROP: 0.077

TOTAL CFS FOR FIELD : 0.53

FIELD ID NO: C2
 TOTAL ACRES: 8.9 AC
 FIELD SLOPE: 2.3 %
 FURROW LENGTH: 500 FT

DATE OF ANALYSIS: 9/29/06
 Qmax PER FURROW: 10.0 gpm
 For corrugates: 4.3 gpm
 Qmin PER FURROW: 3.0 gpm
 For both: 3.0 gpm

SOIL TYPE	ACRES	% OF TOTAL AC	INTAKE FAMILY	CROP = MAD	EFFICIENCY	CROP = MAD	EFFICIENCY	CROP = MAD	EFFICIENCY	CROP = MAD	EFFICIENCY	CROP = MAD	EFFICIENCY
105	0.9	10	0.7	1.37	21%								
48	7.8	88	0.7	1.6	31%								
241	0.2	2			***		***		***		***		***

TOTAL AC 8.9 TOTAL % 100

CFS/AC FOR EACH CROP: 0.045

TOTAL CFS FOR FIELD : 0.40

CONVEYANCE LOSS - WORSTELL

NAME OF DITCH: Delivery ditch-Flds A,C1,C2 BY: MP DATE: 10/6/06

REACH	LENGTH (FT)	AVE WIDTH (FT)	SEEPAGE (FT/DAY)	WORSTELL LOSS (CFS)	DELIVERY (CFS)	DELIVERY LEFT (CFS)	LOSS FACTOR	DELIVERY LOSS (CFS)	FLOW (CFS)
1	400	3.0	4.00	0.06	0.00	2.20	0.0276	0.00	2.97
2	300	3.0	4.50	0.05	0.00	2.20	0.0233	0.00	2.91
3	300	3.0	2.20	0.03	0.40	2.20	0.0114	0.02	2.85
4	600	3.0	2.20	0.05	0.53	1.80	0.0278	0.05	2.43
5	1600	3.0	4.50	0.27	0.00	1.27	0.2149	0.00	1.85
6	1800	3.0	4.50	0.31	1.27	1.27	0.2417	0.69	1.58
7				0.00		0.00	0.0000	0.00	0.00
8				0.00		0.00	0.0000	0.00	0.00
9				0.00		0.00	0.0000	0.00	0.00
10				0.00		0.00	0.0000	0.00	0.00
11				0.00		0.00	0.0000	0.00	0.00
12				0.00		0.00	0.0000	0.00	0.00
13				0.00		0.00	0.0000	0.00	0.00
14				0.00		0.00	0.0000	0.00	0.00
15				0.00		0.00	0.0000	0.00	0.00
16				0.00		0.00	0.0000	0.00	0.00
17				0.00		0.00	0.0000	0.00	0.00
18				0.00		0.00	0.0000	0.00	0.00
19				0.00		0.00	0.0000	0.00	0.00
20				0.00		0.00	0.0000	0.00	0.00
TOTALS	5000			0.77	2.20			0.77	

REACH = SECTION OF CHANNEL

LENGTH = LENGTH OF REACH, THE CHANNEL CAN BE DIVIDED INTO EQUAL LENGTH REACHES
OR ACTUAL LENGTHS BETWEEN DELIVERY POINTS

AVE WIDTH = AVERAGE TOP WIDTH OF WATER SURFACE IN REACH

SEEPAGE = SOIL SEEPAGE RATE OF REACH

WORSTELL LOSS = CONVEYANCE LOSS IN REACH BASED ON WORSTELL METHOD

DELIVERY = TOTAL DELIVERIES IN REACH

DELIVERY LEFT = SUM(DELIVERIES OF CURRENT AND REMAINING REACHES)

LOSS FACTOR = WORSTELL LOSS/DELIVERY LEFT

DELIVERY LOSS = SUM(LOSS FACTORS OF CURRENT AND PREVIOUS REACHES) X DELIVERY;
REPRESENTS THE LOSSES ASSIGNED TO THE DELIVERIES IN THE REACH;
IF MULTIPLE RIGHTS WITHIN REACH, DELIVERY LOSSES SHOULD BE
PRORATED BASED ON SIZE OF DELIVERY FOR EACH RIGHT WITHIN REACH

FLOW = TOTAL FLOW AT BEGINNING OF EACH REACH

CONVEYANCE LOSS - WORSTELL

NAME OF DITCH: Delivery ditch - Field B BY: MP DATE: 9/29/06

REACH	LENGTH (FT)	AVE WIDTH (FT)	SEEPAGE (FT/DAY)	WORSTELL LOSS (CFS)	DELIVERY (CFS)	DELIVERY LEFT (CFS)	LOSS FACTOR	DELIVERY LOSS (CFS)	FLOW (CFS)
1	150	3.0	4.00	0.02	0.83	0.83	0.0274	0.02	0.85
2				0.00		0.00	0.0000	0.00	0.00
3				0.00		0.00	0.0000	0.00	0.00
4				0.00		0.00	0.0000	0.00	0.00
5				0.00		0.00	0.0000	0.00	0.00
6				0.00		0.00	0.0000	0.00	0.00
7				0.00		0.00	0.0000	0.00	0.00
8				0.00		0.00	0.0000	0.00	0.00
9				0.00		0.00	0.0000	0.00	0.00
10				0.00		0.00	0.0000	0.00	0.00
11				0.00		0.00	0.0000	0.00	0.00
12				0.00		0.00	0.0000	0.00	0.00
13				0.00		0.00	0.0000	0.00	0.00
14				0.00		0.00	0.0000	0.00	0.00
15				0.00		0.00	0.0000	0.00	0.00
16				0.00		0.00	0.0000	0.00	0.00
17				0.00		0.00	0.0000	0.00	0.00
18				0.00		0.00	0.0000	0.00	0.00
19				0.00		0.00	0.0000	0.00	0.00
20				0.00		0.00	0.0000	0.00	0.00
TOTALS	150			0.02	0.83			0.02	

REACH = SECTION OF CHANNEL

LENGTH = LENGTH OF REACH, THE CHANNEL CAN BE DIVIDED INTO EQUAL LENGTH REACHES
OR ACTUAL LENGTHS BETWEEN DELIVERY POINTS

AVE WIDTH = AVERAGE TOP WIDTH OF WATER SURFACE IN REACH

SEEPAGE = SOIL SEEPAGE RATE OF REACH

WORSTELL LOSS = CONVEYANCE LOSS IN REACH BASED ON WORSTELL METHOD

DELIVERY = TOTAL DELIVERIES IN REACH

DELIVERY LEFT = SUM(DELIVERIES OF CURRENT AND REMAINING REACHES)

LOSS FACTOR = WORSTELL LOSS/DELIVERY LEFT

DELIVERY LOSS = SUM(LOSS FACTORS OF CURRENT AND PREVIOUS REACHES) X DELIVERY;
REPRESENTS THE LOSSES ASSIGNED TO THE DELIVERIES IN THE REACH;
IF MULTIPLE RIGHTS WITHIN REACH, DELIVERY LOSSES SHOULD BE
PRORATED BASED ON SIZE OF DELIVERY FOR EACH RIGHT WITHIN REACH

FLOW = TOTAL FLOW AT BEGINNING OF EACH REACH

FIELD IRRIGATION REQUIREMENT

initials: MP Claimant = Simpson - Field A
 date: 09/29/06 Weather Station = May

crop	acres	irrig. system	eff. (%)	Monthly ET (mm/day)												net irrig. app. (in)	AVE IR season (mm/yr)	ET ratio	irrig. freq. (days)	Gross Irrigation Application (peak period Et/eff. in mm/day)						season (mm/yr)
				mar	apr	may	jun	jul	aug	sep	oct	mar	apr	may	jun					jul	aug	sep	oct			
past	16.2	cor	15	1.54	4.22	5.81	6.23	5.04	3.76	2.35						0.71	1.14	2.5	11.70	32.07	44.16	47.35	38.30	28.58	17.86	
Summary	16.2																		11.70	32.07	44.16	47.35	38.30	28.58	17.86	

Summary 16.2

Peak Gross Irrigation Application (mm/day) = 47.35
 On-Farm Irrigation Requirement (cfs/acre) = 0.078
 Total On-Farm Irrigation Requirement (cfs) = 1.27
 Irrigation Diversion Volume (ft/yr) = 0.00
 Total Irrigation Diversion Volume (ac-ft/yr) = 0

11.70 32.07 44.16 47.35 38.30 28.58 17.86

FIELD IRRIGATION REQUIREMENT

initials: MP

Claimant = Simpson

Field B

date: 09/29/06

Weather Station = May

crop	past	acres	irrig. system	eff. (%)	Monthly ET (mm/day)					AVE IR season (mm/yr)		net irrig. app. (in)	ET ratio	irrig. freq. (days)	Gross Irrigation Application (peak period ET/eff. in mm/day)					season (mm/yr)		
					mar	apr	may	jun	jul	aug	sep				oct	mar	apr	may	jun		jul	aug
						1.54	4.22	5.81	6.23	5.04	3.76	2.35	1.37	1.13	4.9	8.70	23.84	32.83	35.20	28.48	21.24	13.28

Summary 14.3

Peak Gross Irrigation Application (mm/day) = 35.20
 On-Farm Irrigation Requirement (cfs/acre) = 0.058
 Total On-Farm Irrigation Requirement (cfs) = 0.83
 Irrigation Diversion Volume (ft/yr) = 0.00
 Total Irrigation Diversion Volume (ac-ft/yr) = 0

8.70 23.84 32.83 35.20 28.48 21.24 13.28

FIELD IRRIGATION REQUIREMENT

initials: MP Claimant = Simpson - Field CI
 date: 09/29/06 Weather Station = May

crop	acres	irrig. system	eff. (%)	Monthly ET (mm/day)												Gross Irrigation Application (peak period ET/eff. in mm/day)												season (mm/yr)
				mar	apr	may	jun	jul	aug	sep	oct	AVE IR season (mm/yr)	net irrig. app. (in)	ET ratio	irrig. freq. (days)	mar	apr	may	jun	jul	aug	sep	oct					
past	6.9	cor	15		1.54	4.22	5.81	6.23	5.04	3.76	2.35		1.60	1.12	5.8		11.50	31.51	43.38	46.52	37.63	28.07	17.55					
Summary		6.9															11.50	31.51	43.38	46.52	37.63	28.07	17.55					

Peak Gross Irrigation Application (mm/day) = 46.52
 On-Farm Irrigation Requirement (cfs/acre) = 0.077
 Total On-Farm Irrigation Requirement (cfs) = 0.53
 Irrigation Diversion Volume (ft/yr) = 0.00
 Total Irrigation Diversion Volume (ac-ft/yr) = 0

FIELD IRRIGATION REQUIREMENT

initials: MF Claimant = Simpson, Field C2
 date: 09/29/06 Weather Station = May

	crop	acres	irrig. system	eff. (%)	Monthly ET (mm/day)							AVE IR season (mm/yr)		net irrig. app. (in)	ET ratio	irrig. freq. (days)	Gross Irrigation Application (peak period ET/eff. in mm/day)										season
					mar	apr	may	jun	jul	aug	sep	oct	apr				may	jun	jul	aug	sep	oct					
				26	1.54	4.22	5.81	6.23	5.04	3.76	2.35	1.37	1.13	4.9	6.69	18.34	25.25	27.08	21.90	16.34	10.21						

Summary 8.9

Peak Gross Irrigation Application (mm/day) = 27.08
 On-Farm Irrigation Requirement (cfs/acre) = 0.045
 Total On-Farm Irrigation Requirement (cfs) = 0.40
 Irrigation Diversion Volume (ft/yr) = 0.00
 Total Irrigation Diversion Volume (ac-Ft/yr) = 0

6.69 18.34 25.25 27.08 21.90 16.34 10.21

Field A: Soil 7, pasture, corrugations

FURROW

Auto

INTAKE FAMILY <If> = 0.85
 DESIGN APPLICATION <Fn> = 0.71 INCHES
 FURROW SLOPE <S> = 0.070 FEET/FOOT
 FURROW SPACING <W> = 2.00 FEET
 FURROW LENGTH <L> = 350 FEET
 INFLOW RATE <Q> = 3.5 GPM/FURROW
 APPLICATION TIME <Ti> = 12 HOURS

 ADVANCE TIME <Tt> = 24.4 MINUTES; OR 0.4 HOURS
 GROSS APPLICATION <Fg> = 5.77 INCHES
 NET APPLICATION <F< = 5.51 INCHES
 RUNOFF <Ro> = 0.18 INCHES
 DEEP PERCOLATION <Dp> = 4.89 INCHES
 EFFICIENCY <E> = 12.29 %

TO CHANGE: PRESS (EXISTING)
 Design Application <1> 0.71 in
 Furrow Slope <2> 0.070 ft/ft
 Furrow Spacing <3> 2.00 ft
 Furrow Length <4> 350 ft
 Furrow Intake Family <5> 0.85
 Inflow Rate <6> 3.5 gpm/furrow
 Inflow Time <7> 12 hours <ANALYSIS MODE>

TO PRINT: DATA/WITH HEADING PRESS:<8/9>
 NEW DESIGN PRESS <10>, NEW ANALYSIS PRESS <11>, QUIT PRESS <12>? *

Field A: Soil 48, pasture, corrugations

FURROW

Auto

INTAKE FAMILY <If> = 0.70
 DESIGN APPLICATION <Fn> = 1.60 INCHES
 FURROW SLOPE <S> = 0.070 FEET/FOOT
 FURROW SPACING <W> = 2.00 FEET
 FURROW LENGTH <L> = 350 FEET
 INFLOW RATE <Q> = 3.0 GPM/FURROW
 APPLICATION TIME <Ti> = 12 HOURS

 ADVANCE TIME <Tt> = 25.4 MINUTES; OR 0.4 HOURS
 GROSS APPLICATION <Fg> = 4.95 INCHES
 NET APPLICATION <F< = 4.52 INCHES
 RUNOFF <Ro> = 0.35 INCHES
 DEEP PERCOLATION <Dp> = 3.00 INCHES
 EFFICIENCY <E> = 32.32 %

TO CHANGE: PRESS (EXISTING)
 Design Application <1> 1.60 in
 Furrow Slope <2> 0.070 ft/ft
 Furrow Spacing <3> 2.00 ft
 Furrow Length <4> 350 ft
 Furrow Intake Family <5> 0.70
 Inflow Rate <6> 3.0 gpm/furrow
 Inflow Time <7> 12 hours <ANALYSIS MODE>

TO PRINT: DATA/WITH HEADING PRESS:<8/9>
 NEW DESIGN PRESS <10>, NEW ANALYSIS PRESS <11>, QUIT PRESS <12>? *

Field B: Soil 105, pasture, corrugations

FURROW

Auto

INTAKE FAMILY <If> = 0.70
 DESIGN APPLICATION <Fn> = 1.37 INCHES
 FURROW SLOPE <S> = 0.082 FEET/FOOT
 FURROW SPACING <W> = 2.00 FEET
 FURROW LENGTH <L> = 250 FEET
 INFLOW RATE <Q> = 3.0 GPM/FURROW
 APPLICATION TIME <Ti> = 12 HOURS

 ADVANCE TIME <Tt> = 14.4 MINUTES; OR 0.2 HOURS
 GROSS APPLICATION <Fg> = 6.93 INCHES
 NET APPLICATION <F< = 4.53 INCHES
 RUNOFF <Ro> = 2.36 INCHES
 DEEP PERCOLATION <Dp> = 3.20 INCHES
 EFFICIENCY <E> = 19.77 %

TO CHANGE: PRESS (EXISTING)
 Design Application <1> 1.37 in
 Furrow Slope <2> 0.082 ft/ft
 Furrow Spacing <3> 2.00 ft
 Furrow Length <4> 250 ft
 Furrow Intake Family <5> 0.70
 Inflow Rate <6> 3.0 gpm/furrow
 Inflow Time <7> 12 hours <ANALYSIS MODE>

TO PRINT: DATA/WITH HEADING PRESS:<8/9>
 NEW DESIGN PRESS <10>, NEW ANALYSIS PRESS <11>, QUIT PRESS <12>? *

Field C1: Soil 48, pasture, corrugations

FURROW

Auto

INTAKE FAMILY <If> = 0.70
 DESIGN APPLICATION <Fn> = 1.60 INCHES
 FURROW SLOPE <S> = 0.052 FEET/FOOT
 FURROW SPACING <W> = 2.00 FEET
 FURROW LENGTH <L> = 150 FEET
 INFLOW RATE <Q> = 3.0 GPM/FURROW
 APPLICATION TIME <Ti> = 12 HOURS

 ADVANCE TIME <Tt> = 7.7 MINUTES; OR 0.1 HOURS
 GROSS APPLICATION <FG> = 11.55 INCHES
 NET APPLICATION <Fn> = 4.69 INCHES
 RUNOFF <RO> = 6.84 INCHES
 DEEP PERCOLATION <DP> = 3.11 INCHES
 EFFICIENCY <E> = 13.05 %

TO CHANGE: PRESS (EXISTING)
 Design Application <1> 1.60 in
 Furrow Slope <2> 0.052 ft/ft
 Furrow Spacing <3> 2.00 ft
 Furrow length <4> 150 ft
 Furrow Intake Family <5> 0.70
 Inflow Rate <6> 3.0 gpm/furrow
 Inflow Time <7> 12 hours <ANALYSIS MODE>

TO PRINT: DATA/WITH HEADING PRESS:<0/9>
 NEW DESIGN PRESS <10>, NEW ANALYSIS PRESS <11>, QUIT PRESS <12>? _

Field C2: Soil 105, pasture, corrugations

FURROW

Auto

INTAKE FAMILY <If> = 0.70
 DESIGN APPLICATION <Fn> = 1.37 INCHES
 FURROW SLOPE <S> = 0.023 FEET/FOOT
 FURROW SPACING <W> = 2.00 FEET
 FURROW LENGTH <L> = 500 FEET
 INFLOW RATE <Q> = 4.5 GPM/FURROW
 APPLICATION TIME <Ti> = 12 HOURS

 ADVANCE TIME <Tt> = 57.0 MINUTES; OR 0.9 HOURS
 GROSS APPLICATION <FG> = 5.20 INCHES
 NET APPLICATION <Fn> = 4.98 INCHES
 RUNOFF <RO> = 0.02 INCHES
 DEEP PERCOLATION <DP> = 3.81 INCHES
 EFFICIENCY <E> = 26.36 %

TO CHANGE: PRESS (EXISTING)
 Design Application <1> 1.37 in
 Furrow Slope <2> 0.023 ft/ft
 Furrow Spacing <3> 2.00 ft
 Furrow length <4> 500 ft
 Furrow Intake Family <5> 0.70
 Inflow Rate <6> 4.5 gpm/furrow
 Inflow Time <7> 12 hours <ANALYSIS MODE>

TO PRINT: DATA/WITH HEADING PRESS:<0/9>
 NEW DESIGN PRESS <10>, NEW ANALYSIS PRESS <11>, QUIT PRESS <12>?

Field C2: Soil 48, pasture, corrugations

FURROW

Auto

INTAKE FAMILY <If> = 0.70
 DESIGN APPLICATION <Fn> = 1.60 INCHES
 FURROW SLOPE <S> = 0.023 FEET/FOOT
 FURROW SPACING <W> = 2.00 FEET
 FURROW LENGTH <L> = 500 FEET
 INFLOW RATE <Q> = 4.5 GPM/FURROW
 APPLICATION TIME <Ti> = 12 HOURS

 ADVANCE TIME <Tt> = 57.0 MINUTES; OR 0.9 HOURS
 GROSS APPLICATION <FG> = 5.20 INCHES
 NET APPLICATION <Fn> = 4.98 INCHES
 RUNOFF <RO> = 0.02 INCHES
 DEEP PERCOLATION <DP> = 3.58 INCHES
 EFFICIENCY <E> = 30.79 %

TO CHANGE: PRESS (EXISTING)
 Design Application <1> 1.60 in
 Furrow Slope <2> 0.023 ft/ft
 Furrow Spacing <3> 2.00 ft
 Furrow length <4> 500 ft
 Furrow Intake Family <5> 0.70
 Inflow Rate <6> 4.5 gpm/furrow
 Inflow Time <7> 12 hours <ANALYSIS MODE>

TO PRINT: DATA/WITH HEADING PRESS:<0/9>
 NEW DESIGN PRESS <10>, NEW ANALYSIS PRESS <11>, QUIT PRESS <12>?

SOIL CHARACTERISTICS

initials: mp date: 09/29/06

Soil Type = Bartonflat (7)
Source of Soils Data = NRCS website

soil depth (inches)		AWC (in/in)		PH		organic (%)		soil depth (ft)		AWC (inches)		intake family	
lower	upper	lower	upper	lower	upper	lower	upper	lower	upper			flood	furrow
0	5	0.05	0.08	7.4	8.4	1	2	1	2	0.57		4	0.85
5	9	0.02	0.05					2		0.99			
9	60	0.02	0.05					3		1.41			
								4		1.83			alternate
								5		2.25			method

#N/A #N/A

Management Allowed Deficit (MAD)

crop	root		stress point	MAD	
	depth (ft)			depth (ft)	(inches)
alfalfa (hay or seed)	5		0.5	1.13	
corn (field or silage)	4		0.5	0.91	
grain (winter or spring)	4		0.5	0.91	
pasture (or grass hay)	3		0.5	0.71	
other (enter below)					

SOIL CHARACTERISTICS

initials: mp date: 09/29/06

Soil Type = Dawtonia (48)
Source of Soils Data = NRCS website

soil depth (inches)		AWC (in/in)		PH		organic (%)		soil depth (ft)		AWC (inches)		intake family	
lower	upper	lower	upper	lower	upper	lower	upper					flood	furrow
0	4	0.06	0.12	6.6	7.8	1	2	1		1.16		3	0.7
4	12	0.09	0.11					2		2.36			
12	24	0.09	0.11					3		3.20			
24	60	0.06	0.08					4		4.04			alternate
								5		4.88			method

#N/A #N/A

Management Allowed Deficit (MAD)

crop	root depth (ft)	stress point	MAD (inches)
alfalfa (hay or seed)	5	0.5	2.44
corn (field or silage)	4	0.5	2.02
grain (winter or spring)	4	0.5	2.02
pasture (or grass hay)	3	0.5	1.60
other (enter below)			

SOIL CHARACTERISTICS

initials: mp date: 09/29/06

Soil Type = Klug (105)
Source of Soils Data = NRCS website

soil depth (inches)		AWC (in/in)		PH		organic (%)		soil depth (ft)		AWC (inches)		intake family	
lower	upper	lower	upper	lower	upper	lower	upper					flood	furrow
0	4	0.11	0.14	6.6	7.3	2	3	1	1.18			3	0.7
4	20	0.06	0.11					2	2.08				
20	60	0.03	0.08					3	2.74				
								4	3.40				alternate
								5	4.06				method

#N/A #N/A

Management Allowed Deficit (MAD)

crop	root depth (ft)		stress point		MAD (inches)	
alfalfa (hay or seed)	5		0.5		2.03	
corn (field or silage)	4		0.5		1.70	
grain (winter or spring)	4		0.5		1.70	
pasture (or grass hay)	3		0.5		1.37	
other (enter below)						

Physical Soil Properties

Custer-Lemhi Area, Idaho, Parts of Blaine, Custer, and Lemhi Counties

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi- bility	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/in	Pct	Pct					
7: Bartonflat	0-5	---	---	4-12	1.45-1.60	14.11-42.34	0.05-0.08	0.0-2.9	1.0-2.0	.10	.28	5	5	56
	5-9	---	---	5-12	1.45-1.60	42.00-141.14	0.02-0.05	0.0-2.9	0.5-2.0	.05	.20			
	9-60	---	---	1-5	1.45-1.60	141. 00-141.14	0.02-0.05	0.0-2.9	0.0-0.5	.05	.15			
48: Dawtonia	0-4	---	---	15-25	1.40-1.55	4.00-14.11	0.06-0.12	0.0-2.9	1.0-2.0	.10	.37	5	7	38
	4-12	---	---	25-33	1.40-1.55	1.41-4.23	0.09-0.11	3.0-5.9	0.5-1.0	.10	.43			
	12-24	---	---	22-27	1.40-1.55	4.00-14.11	0.09-0.11	0.0-2.9	0.5-1.0	.10	.43			
	24-60	---	---	8-12	1.45-1.60	4.00-14.11	0.06-0.08	0.0-2.9	0.0-0.5	.05	.32			
105: Klug	0-4	---	---	12-20	1.20-1.35	4.00-14.11	0.11-0.14	0.0-2.9	2.0-3.0	.15	.32	5	6	48
	4-20	---	---	12-20	1.35-1.50	4.00-42.34	0.06-0.11	0.0-2.9	1.0-2.0	.10	.37			
	20-60	---	---	12-20	1.40-1.55	4.00-42.34	0.03-0.08	0.0-2.9	0.5-1.0	.05	.43			
Gaciba	0-3	---	---	12-18	1.20-1.35	4.00-14.11	0.11-0.14	0.0-2.9	1.0-2.0	.24	.37	1	6	48
	3-18	---	---	16-24	1.50-1.60	4.00-14.11	0.09-0.11	0.0-2.9	0.5-2.0	.15	.37			
	18-28	---	---	---	---	---	---	---	---	---	---			
Dacont	0-3	---	---	15-20	1.35-1.45	4.00-14.11	0.11-0.14	0.0-2.9	1.0-2.0	.17	.37	5	6	48
	3-28	---	---	20-32	1.35-1.45	4.00-14.11	0.08-0.11	3.0-5.9	0.5-2.0	.15	.37			
	28-41	---	---	16-22	1.35-1.45	4.00-14.11	0.07-0.08	0.0-2.9	0.0-0.5	.10	.32			
	41-60	---	---	15-22	1.40-1.50	4.00-14.11	0.02-0.05	0.0-2.9	0.0-0.5	.10	.32			

Physical Soil Properties

Custer-Lemhi Area, Idaho, Parts of Blaine, Custer, and Lemhi Counties

Map symbol and soil name	Depth <i>In</i>	Sand <i>Pct</i>	Silt <i>Pct</i>	Clay <i>Pct</i>	Moist bulk density <i>g/cc</i>	Saturated hydraulic conductivity <i>micro m/sec</i>	Available water capacity <i>In/In</i>	Linear extensi- bility <i>Pct</i>	Organic matter <i>Pct</i>	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
										Kw	Kf	T		
241: Yearian	0-2	---	---	12-20	1.10-1.20	4.00-14.11	0.11-0.14	0.0-2.9	3.0-4.0	.15	.43	5	8	0
	2-12	---	---	18-25	1.15-1.35	4.00-14.11	0.07-0.11	0.0-2.9	1.0-3.0	.10	.32			
	12-60	---	---	10-20	1.20-1.40	4.00-14.11	0.06-0.11	0.0-2.9	0.5-1.0	.10	.32			

Chemical Soil Properties

Custer-Lemhi Area, Idaho, Parts of Blaine, Custer, and Lemhi Counties

Map symbol and soil name	Depth	Cation- exchange capacity	Effective cation- exchange capacity	Soil reaction	Calcium carbon- ate	Gypsum	Salinity	Sodium adsorption ratio
	<i>In</i>	<i>meq/100 g</i>	<i>meq/100 g</i>	<i>pH</i>	<i>Pct</i>	<i>Pct</i>	<i>mmhos/cm</i>	
7:								
Bartonflat	0-5	5.0-12	---	7.4-8.4	0	0	0.0	0
	5-9	3.0-10	---	7.4-8.4	5-15	0	0.0	0
	9-60	0.0-3.0	---	7.4-8.4	5-15	0	0.0	0
48:								
Dawtonia	0-4	11-20	---	6.6-7.8	0	0	0.0-2.0	0
	4-12	15-25	---	7.4-7.8	15-25	0	0.0-2.0	0
	12-24	15-20	---	7.4-8.4	15-30	0	0.0-2.0	0
	24-60	6.0-10	---	7.4-8.4	15-20	0	0.0-2.0	0
105:								
Klug	0-4	12-20	---	6.6-7.3	0	0	0.0	0
	4-20	10-15	---	6.6-7.8	0	0	0.0	0
	20-60	10-15	---	6.6-7.8	0	0	0.0	0
Gaciba	0-3	11-20	---	7.4-7.8	0	0	0.0	0
	3-18	12-20	---	6.6-7.8	0-5	0	0.0	0
	18-28	---	---	---	---	---	---	---
Dacont	0-3	12-20	---	6.6-7.3	0	0	0.0	0
	3-28	15-30	---	7.4-8.4	0-30	0	0.0	0-5
	28-41	10-25	---	7.4-8.4	15-30	0	0.0-2.0	0-5
	41-60	10-25	---	7.4-8.4	5-15	0	0.0-2.0	0-5
241:								
Yearian	0-2	14-25	---	6.6-7.3	0	0	0.0	0
	2-12	10-20	---	6.6-7.8	0	0	0.0	0
	12-60	2.0-15	---	6.6-7.8	0	0	0.0	0

Engineering Properties

Custer-Lemhi Area, Idaho, Parts of Blaine, Custer, and Lemhi Counties

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percent passing sieve number--					Liquid limit	Plasticity index
			Unified	AASHTO	>10 Inches	3-10 Inches	4	10	40	200			
<i>In</i> <i>Pct</i>													
7: Bartonflat	0-5	Very gravelly sandy loam	GM	A-1, A-2	0	0-10	30-55	25-50	20-45	10-30	17-28	1-7	
	5-9	Extremely gravelly sandy loam	GM, GP-GM	A-1	0	5-25	15-35	5-25	5-20	0-15	17-28	2-7	
	9-60	Extremely gravelly loamy coarse sand, Stratified extremely gravelly loamy coarse sand to extremely gravelly loamy sand	GP	A-1	0	15-65	25-45	20-40	10-30	0-5	0-19	NP-2	
48: Dawtonia	0-4	Very gravelly loam	GC	A-2, A-4	0-5	0-25	30-55	25-50	20-50	15-40	27-39	9-17	
	4-12	Very gravelly clay loam, Very gravelly loam, Extremely gravelly clay loam	GC, GC-GM	A-2	0-10	0-15	25-50	20-45	15-45	10-40	36-45	17-23	
	12-24	Very gravelly loam	GC	A-2	0-10	0-10	25-50	20-45	15-45	10-40	32-39	15-19	
	24-60	Extremely gravelly loam, Extremely gravelly sandy loam	GC-GM	A-1	0-10	5-20	25-35	15-25	10-25	5-15	18-25	4-7	
105: Klug	0-4	Gravelly loam	GC	A-2, A-4	0-5	0-5	55-80	50-75	40-70	30-55	26-37	7-13	
	4-20	Very gravelly loam, Very gravelly sandy loam	GC	A-2	0	0-10	30-50	25-45	20-40	10-35	24-35	7-13	
	20-60	Extremely gravelly loam, Extremely gravelly sandy loam	GC	A-2	0-5	15-50	15-45	10-40	10-30	5-25	23-33	7-13	

Engineering Properties

Custer-Lemhi Area, Idaho, Parts of Blaine, Custer, and Lemhi Counties

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percent passing sieve number—				Liquid limit	Plasticity index
			Unified	AASHTO	>10 Inches	3-10 Inches	4	10	40	200		
<i>In</i>												
<i>Pct</i>												
105:												
Gaciba	0-3	Cobbly loam	CL-ML, GC-GM	A-4	0-10	25-35	70-95	70-90	45-75	45-75	24-33	7-12
	3-18	Very gravelly loam	GC-GM	A-2, A-4	0-10	0-15	30-55	25-50	20-45	15-40	26-38	10-16
	18-28	Unweathered bedrock	---	---	---	---	---	---	---	---	---	---
<i>Pct</i>												
Dacont	0-3	Gravelly loam	GC-GM, SC-SM	A-4	0-1	0-10	55-80	50-75	45-65	35-50	27-35	9-13
	3-28	Very gravelly clay loam, Very gravelly loam	GC	A-2	0-1	0-15	35-55	30-50	25-40	20-35	32-47	13-23
	28-41	Very gravelly loam, Very gravelly sandy loam, Extremely gravelly loam	GC-GM	A-2	0-1	10-40	25-50	20-45	15-35	10-30	25-33	10-15
	41-60	Extremely cobbly loam, Very gravelly sandy loam	GC-GM, GP-GC	A-2	0-1	45-60	15-30	10-25	10-25	5-20	24-33	9-15
<i>Pct</i>												
241:												
Yearian	0-2	Very stony loam	GC-GM, SC-SM	A-2, A-4	5-10	10-30	50-85	45-80	35-55	25-45	28-39	7-13
	2-12	Very cobbly loam	GC, GC-GM	A-2	0-5	10-50	50-80	45-75	40-60	30-50	29-41	12-17
	12-60	Stratified extremely gravelly sandy loam to very gravelly loam	GC-GM	A-2	0-10	0-25	20-55	15-50	5-40	0-35	20-30	5-10

80th Percentile Values of Monthly ET (mm/day)

Station: May

	ETR	ALFH	ALFS	BEANS	F CRN	SILGE	S CRN	PEAS	POTAT	SBEET	SGRAN	WGRAN	PAST	ORCHD	VEGES	ONION	HOPS
March	1.15		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
March	0.41		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
March	1.50	U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
April	4.14	S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.41	0.00	0.00	0.00	0.00
April	0.46	E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00
April	4.53		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.54	0.00	0.00	0.00	0.00
May	5.68	E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.94	0.00	0.00	0.00	0.00
May	0.47	T	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00
May	6.08	R	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.22	0.00	0.00	0.00	0.00
June	7.15	F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.50	0.00	0.00	0.00	0.00
June	0.48	O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00	0.00	0.00
June	7.55	R	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.81	0.00	0.00	0.00	0.00
July	7.81		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.02	0.00	0.00	0.00	0.00
July	0.32	A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00
July	8.08	L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.23	0.00	0.00	0.00	0.00
August	6.26	F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.82	0.00	0.00	0.00	0.00
August	0.34	A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.00	0.00	0.00	0.00
August	6.55	L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.04	0.00	0.00	0.00	0.00
September	4.54	F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.49	0.00	0.00	0.00	0.00
September	0.41	A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00
September	4.89	H	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.76	0.00	0.00	0.00	0.00
October	2.79	A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.15	0.00	0.00	0.00	0.00
October	0.31	Y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00
October	3.05		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.35	0.00	0.00	0.00	0.00

ET and standard deviation data (AVE ET and STDD ET) taken from Appendix E (unpublished) of Brockway, C.E., and R.G. Allen, 1983, Estimating Consumptive Irrigation Requirements for Crops in Idaho, Idaho Water and Energy Resources Research Institute.

80th Percentile ET values (80PCT ET) calculated based on Walpole, R.E., and R.H. Meyers, 1985, third edition, PROBABILITY AND STATISTICS FOR ENGINEERS AND SCIENTISTS, New York: Macmillan Publishing Company, pp. 132-144 and 574.