Slattery Aqua Engineering LLC

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To: Keith Vander Horst – Colorado Division of Water Resources

From: James E. Slattery
Randy L. Hendrix - Helton & Williamsen, P.C.

Date: February 25, 2008

Subject: Application for a Change of Type of Use of Rights to Designated Ground Water in the Northern High Plains Designated Ground Water Basin, Changes of Well Location, and a Change to Allow Wells to be Alternate Point of Diversions by the Republican River Water Conservation District, acting by and through its Water Activity Enterprise

Subsection III.B.1.k of the Final Settlement Stipulation filed in *Kansas v. Colorado and Nebraska*, No. 126, Original (U.S. Supreme Court), allows wells to be acquired or constructed for the sole purpose of offsetting stream depletions in order to comply with a State's Compact Allocations under the Republican River Compact. At the Ground Water Commission's meeting on February 15, 2008, the Commission adopted amendments to the Commission's Rules and Regulations for the Management and Control of Designated Ground Water to allow "Republican River Compact Compliance Wells" and to allow a permit to be issued to change an existing well to a Republican River Compact Compliance Well as part of an application for a change of rights to designated ground water pursuant to the Rules, so long as the well would be in compliance with (a) subsection III.B.1.k of the Final Settlement Stipulation and (b) Rules 7.7 of the Rules.

The Republican River Water Conservation District, acting by and through its Water Activity Enterprise ("RRWCD WAE"), is filing this application to change the use of existing wells in the Northern High Plains Designated Ground Water Basin to Republican River Compact Compliance Wells. The Republican River Compact Compliance Wells will be used for the sole purpose of offsetting stream depletions in order to comply with the State of Colorado's Compact Allocations. The withdrawals from the Republican River Compact Compliance Wells will be limited to the historical consumptive use of the rights to designated ground water that are being changed.

The RRWCD WAE proposes to build a compact compliance pipeline to deliver ground water from the Republican River Compact Compliance Wells to the North Fork of the Republican River to offset stream depletions to assist the State of Colorado to comply with its Compact Allocations. The compact compliance pipeline will deliver ground water that was historically consumed by irrigation of crops in the Northern High Plains Designated Ground Water Basin. This ground water will be delivered to the Colorado-Nebraska state line via a 36" pipeline. The pipeline will be approximately 12 miles in length and will be approximately one half mile west of and parallel to the state line. The RRWCD WAE is working with the State Engineer to develop an augmentation plan and related accounting procedures that will be

submitted for approval to the Republican River Compact Administration under subsection III.B.1.k of the Final Settlement Stipulation.

The rights to designated ground water that will be used as the source of the water for the pipeline historically irrigated approximately 10,000 acres of land with a consumptive use of approximately15,000 ac-ft/yr. This historical consumptive use was associated with 58 wells and 66 final permits as shown in Table 1 (8 of the wells have 2 associated final permits). The RRWCD WAE requests that the historical consumptive use associated with these permits be consolidated and transferred to 15 existing wells in the basin as shown in Figure 1 that will be Republican River Compact Compliance Wells. These 15 wells are listed in Table 2. This application involves the following:

1. An application to change the type of use of rights to designated ground water from irrigation to Republican River Compact Compliance Wells for 58 wells (66 final permits).
2. A variance request to change the location of the rights to designated ground water for the 66 final permits to the 15 well locations that will be Republican River Compact Compliance Wells. This variance is necessary since the 15 Republican River Compact Compliance Wells are generally in excess of 300 feet from the original permitted well location.
3. An application to make a total of 15 Republican River Compact Compliance Wells alternate points of diversions to one another.
4. A variance request to make the 15 wells alternate points of diversions to one another..

We are still in the process of collecting data on 11 of the wells, and we will provide this information as soon as it becomes available. Therefore, only the information for 47 of the 58 wells is included in this transmittal.

Ownership of Wells and Permits

The RRWCD WAE has entered into a Purchase and Sale Agreement with Cure Land, LLC, to purchase the rights to designated ground water shown in Figure 1. A copy of the Purchase and Sale Agreement is attached as Attachment A. Attachment B is a letter from Cure Land, LLC, authorizing the RRWCD WAE to file applications for a change of location and use of the rights to designated ground water in the name of the RRWCD WAE. In Article 2, paragraph 2 of the Purchase and Sale Agreement, Cure Land, LLC, agreed that it will not object to changes in location and use of the rights to designated ground water sold to the RRWCD WAE pursuant to the Agreement.

It also should be noted that Article 6, paragraph 1 of the Purchase and Sale Agreement includes terms and conditions that the existing wells will be alternate points of diversion for the rights to

designated ground water in 2008 for irrigation use and thereafter as required to comply with a Revegetation Requirement and further provides that any change shall not be effective until the rights are transferred to the RRWCD WAE unless Cure Land, LLC, expressly authorizes the RRWCD WAE in writing to use water prior to that time.

Alternate Point of Diversion Application

The RRWCD WAE requests that the 15 Republican River Compact Compliance Wells be made alternate points of diversions to one another. The application is shown in Attachment C. The 15 Republican River Compact Compliance Wells are shown in Table 2 and in Figure 1.

Variance for Alternate Point of Diversion and Change in Use

The RRWCD WAE requests a variance to make each of the 15 Republican River Compact Compliance Wells alternate points of diversions to one another. The variance application letter is shown in Attachment D.

Change in Type of Use

The RRWCD WAE requests a change in type of use from irrigation to Republican River Compact Compliance Wells for the 47 wells (55 permits) shown in Table 1. For each of the 47 wells a change of water right form (DB-005) was completed. We have included a hard copy of this application that is organized by the field numbers shown in Figure 1. We have also included a CD ROM that has the change of right to designated ground water application in PDF format. The attached CD-ROM has a complete copy of the 55 final permits in PDF format for references purposes.

The historical consumptive use analysis used the 10-year study period of 1998-2007. The historical consumptive use associated with each well and final permit was calculated using the spreadsheet format and procedure requested by the SEO staff. A summary of the consumptive associated with each well and final permits are shown in Table 1. The EXCEL spreadsheet for each of the wells is included on the attached CD-ROM.

The potential consumptive use was estimated using the Penman-Monteith equation and crop coefficients to be consistent with the procedure used in developing the RRCA Accounting Procedures that are used to determine Annual Computed Beneficial Consumptive Use and the Compact Allocations of each State under the Final Settlement Stipulation in the Republican River Compact litigation. A copy of the memorandum describing the consumptive use method is included as Attachment F. The spreadsheet to calculate the potential consumptive use for the various crop types is included on the attached CD-ROM. The effective precipitation was estimated using the procedure outlined by the Soil Conservation Service in TR-21. Table 3 presents the average annual crop irrigation requirement for the crops used in this study.

It should be noted that the consumptive use calculations that were made as part of the Republican River Compact litigation did not include sunflowers and potatoes. For this study, the consumptive use of sunflowers was estimated using Penman-Monteith reference evapotranspiration and the crop coefficients for sunflowers obtained from the High Plains Climate Center (HPCC). Only 35 acres of sunflowers were grown on one field for one year, so the sunflower consumptive use estimates have a minimal effect on the historical consumptive use estimates. The 1998-2007 average sunflower crop irrigation requirement was 16.7 in/yr (potential consumptive use minus effective precipitation).

The application of the crop coefficients for potatoes obtained from the HPCC resulted in a crop irrigation requirement of only 12.8 inches/year, which is not reasonable. Therefore, the potato crop irrigation requirement was estimated using modified Blaney-Criddle method, which resulted in a 1998-2007 average crop irrigation requirement of 22.3 inches/year.

It should be noted Final Permit No. 14122FP irrigates parcel 7-19 and the center pivot just south of pivot 7-19. The RRWCD WAE only purchased the portion of the permit that was historically used on Field Number 7-19. This consumptive use study pro-rated the pumping from the well permitted by Final Permit No. 14122FP between the two fields using the irrigated acreage, which resulted in 50% of the pumping being assigned to parcel 7-19. The Purchase and Sale Agreement contemplates that the historical consumptive use associated with Field Number 7-19 will be changed to a new location for the compact compliance pipeline and that Cure Land, LLC, will retain Permit No. 14222-FP, which will be modified consistent with the RRWCD WAE's right to the ground water associated with Field Number 7-19. See Article 3, paragraph 6 of the Purchase and Sale Agreement.

Summary

The RRWCD WAE is submitting:

1. Applications that requests the change of type of use of rights to designated ground water from agricultural irrigation to Republican River Compact Compliance Wells for 58 wells (66 permits) in the Northern High Plains Designated Basin. A variance request to change the location of the rights to designated ground water for the 66 final permits to the 15 well locations that will be Republican River Compact Compliance Wells. This variance is necessary since the 15 Republican River Compact Compliance Wells are generally in excess of 300 feet from the original permitted well location.
2. Application to make 15 Republican River Compact Compliance Wells alternate points of diversions to one another. A variance request to make the 15 wells alternate points of diversions to one another.

This application will be supplemented in the next few weeks with additional information for the 11 wells (11 permits) for which historical withdrawal and consumptive use data was not provided in this letter of transmittal. The attached applications state the use as irrigation and augmentation. The 47 applications were completed before the Ground Water Commission's meeting on February 15, 2008. At this meeting the Commission adopted amendments to the Commission's Rules and Regulations for the Management and Control of Designated Ground Water to allow "Republican River Compact Compliance Wells". We request that one of the new uses included in the change of use application be "Republican River Compact Compliance Wells".

This application involves a large amount of information, all of which is included on the attached CD-ROM and summarized in Table 4. If you have any questions, please give me a call.

Please find attached a check for $5,500 for the change in use and alternate point of diversion application. This check is for the 55 permits included with this transmittal. We understand that an additional check for $1,100 is due when we submit the information for the 11 permits whose information was not included in this transmittal.

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RRWCD WATER ACTIVITY ENTERPRISE
410 MAIN STREET SUITE 8
WRAY, CO 80758

Bank of Colorado
YUMA
(970) 848-5447
320 S. Main, P.O. Box 266, Yuma, Colorado 80759
Telebank 1-800-295-6879

82-244-1070

2/19/2008

PAY TO THE ORDER OF: Colorado Division of Water Resources $ **5,500.00

Five Thousand Five Hundred and 00/100********** DOLLARS

Colorado Division of Water Resources
1313 Sherman Street, Room 818
Denver, CO 80203

AUTHORIZED SIGNATURE

MEMO Water Change Applications

⑈00277⑈ ⑆107002448⑆ 200003255⑈

RRWCD WATER ACTIVITY ENTERPRISE 277

Colorado Division of Water Resources		2/19/2008	
	Water Change Applications		5,500.00

Bank of Colorado - Ch	Water Change Applications	5,500.00

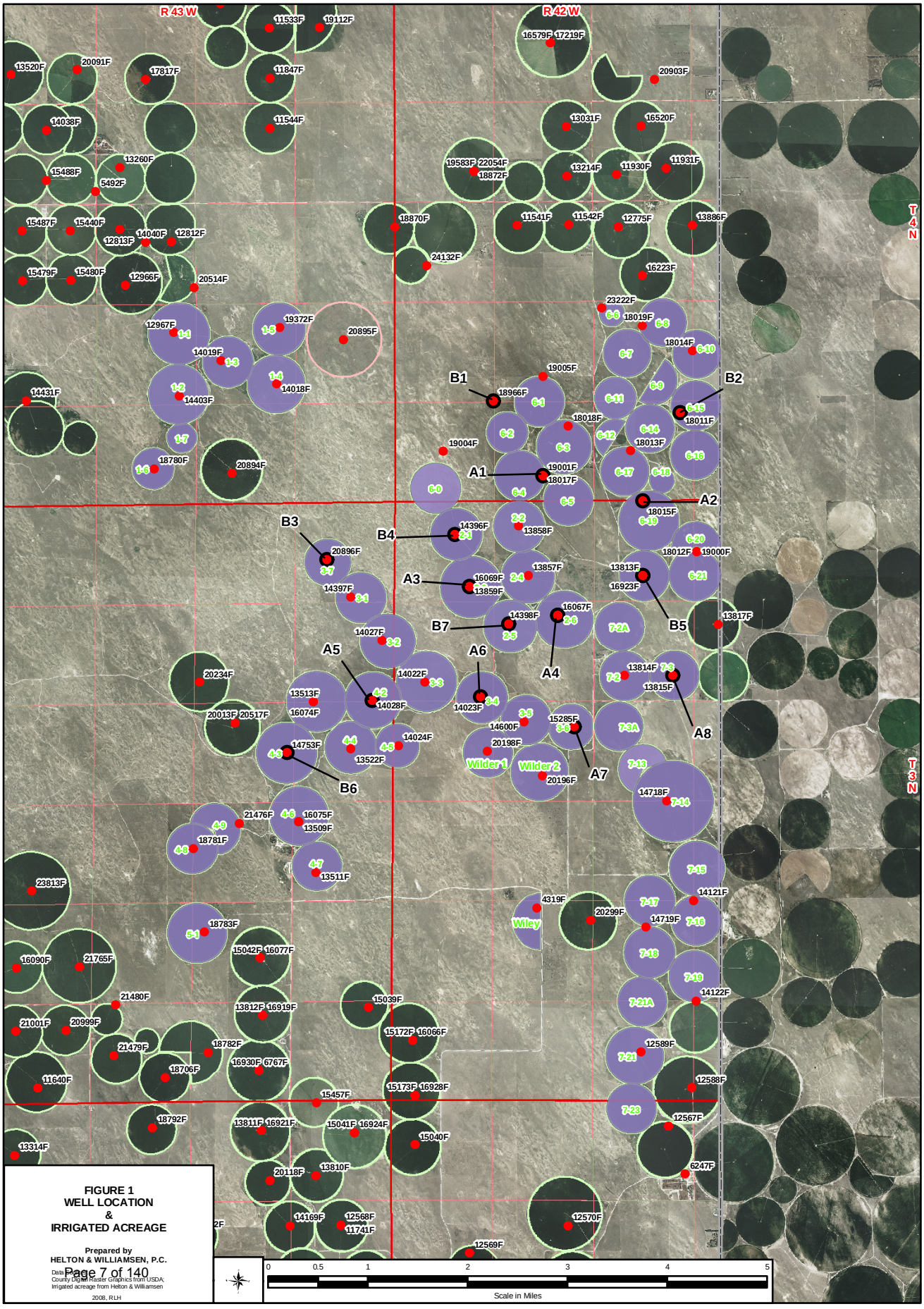
R 43 W
R 42 W
T 4 N
T 3 N
B1
B2
B3
B4
B5
B6
B7
A1
A2
A3
A4
A5
A6
A7
A8
Wilder 1
Wilder 2
Wiley
FIGURE 1
WELL LOCATION
&
IRRIGATED ACREAGE
Prepared by
HELTON & WILLIAMSEN, P.C.
Data Sources:
County Digital Raster Graphics from USDA;
Irrigated acreage from Helton & Williamsen
2008, RLH
0 0.5 1 2 3 4 5
Scale in Miles

Table 1
Rights to Designated Groundwater

Field Number (1)	Permit #1 (2)	Permit #2 (3)	Acreage in Change of Use Form (4)	Historical Consumptive Use (ac-ft/yr) (5)
1-1	12967-FP	16920-FP	194	345
1-3	14019-FP		133	217
1-4	14018-FP		164	252
1-5	19372-FP		136	218
1-6 and 1-7	18780-FP		127	192
Subtotal			**754**	**1,223**
2-1	14396-FP		130	192
2-2	13858-FP		133	228
2-3	13859-FP	16069-FP	188	270
2-4	13857-FP		147	229
2-5	14398-FP		144	240
2-6	13856-FP	16067-FP	164	249
Subtotal			**906**	**1,408**
3-1	14397-FP		127	192
3-2	14027-FP		153	251
3-3	14022-FP		180	289
3-4	14023-FP		133	219
3-5	14600-FP		124	197
3-6	15285-FP		98	161
3-7	20896-FP		107	169
Subtotal			**922**	**1,479**
4-1	13513-FP	16074-FP	186	302
4-2	14028-FP		146	218
4-3	14753-FP		185	310
4-4	13522-FP		135	204
4-5	14024-FP		93	141
4-6	13509-FP	16075-FP	179	284
4-7	13511-FP		123	192
4-8	18781-FP		128	216
4-9	21476-FP		88	144
5-1	18783-FP		173	273
Subtotal			**1,437**	**2,285**
6-1	19005-FP		124	178
6-2	18966-FP		94	172
6-3	18018-FP		148	230
6-4,6-5	18017-FP	19001-FP	245	361
6-8	18019-FP		107	173
6-9, 6-10	18014-FP		176	259
6-11,12,13,14	18013-FP		250	350
6-15, 6-16	18011-FP		244	431
6-17, 6-18, 6-19	18015-FP		329	549
6-20, 6-21	18012-FP	19000-FP	208	322
Subtotal			**1,925**	**3,026**

Table 1
Rights to Designated Groundwater

Field Number (1)	Permit #1 (2)	Permit #2 (3)	Acreage in Change of Use Form (4)	Historical Consumptive Use (ac-ft/yr) (5)
7-1	13813-FP	16923-FP	126	206
7-2, 7-2A	13814-FP		219	334
7-3, 7-3a	13815-FP		197	291
7-13, 7-14	14718-FP		358	526
7-15, 7-16	14121-FP		285	437
7-17, 7-18	14719-FP		263	455
7-19 [a)]	14122-FP		131	215
7-21, 7-21A	12589-FP		251	376
7-23	12567-FP		126	201
Subtotal			**1,957**	**3,041**
Total			**7,901**	**12,462**

The following wells are shown on Figure 1 but are not included in the information submitted with this application due to incomplete data. The information for these wells will be provided when it becomes available.

Field Number (1)	Permit #1 (2)	Permit #2 (3)	Acreage in Change of Use Form (4)	Historical Consumptive Use (ac-ft/yr) (5)
1-2	14403-FP			
6-0	19004-FP			
6-6, 6-7	23222-FP			
Wiley	4319-FP			
Wilder1	20198-FP			
Wilder2	20196-FP			

An additional 5 wells that are not shown on Figure 1. Data will be provided when it becomes available.

Footnotes

a) Permit allows for irrigation of parcels 7-19 and 7-20. Only the portion of permit historically used to irrigate parcel 7-19 is included in this table.

b) Under contract for purchase by Cure Land.

Explanation of Columns

(1) Field Number as shown on Attachment D

(2) Final permit for the Northern High Plains Designated Ground Water Basin. See permit for well location, priority

(3) Second permit associated with the permit shown in column 2. Typically, these are permits for additional acreage, but

(4) Average acreage reported in change of use form used to determine values in Column 9.

(5) Historical consumptive use determined from irrigated acreage, crop records and power records.

Table 2

Alternate Point of Diversion Wells

Republican River Water Conservation District Compact Compliance Pipeline

Well Id Shown on Figure 1	Field	Permit No.	Qtr	Qtr	Sec	Township	Range	Dist. NS	Dist EW
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A1	6-4, 6-5	18017-FP	NE	SW	32	4N	42W	1340 S	2600 W
		19001-FP							
A2	6-17, 6-18, 6-19	18015-FP	NW	NE	4	3N	42W	20 N	2635 E
A3	2-3	13859-FP	SE	SE	6	3N	42W	770 S	1210 E
		16069-FP							
A4	2-6	13856-FP	NW	NE	8	3N	42W	1340 S	1900 W
		16067-FP							
A5	4-2	14028-FP	SE	SE	12	3N	42W	30 S	1066 E
A6	3-4	14023-FP	SE	SE	7	3N	42W	200 S	600 E
A7	3-6	15285-FP	SE	NE	17	3N	42W	1400 N	950 E
A8	7-3, 7-3A	13815-FP	NE	SE	9	3N	42W	1330 S	1070 E
B1	6-2	18966-FP	SE	SE	30	4N	42W	20 S	50 E
B2	6-15, 6-16	18011-FP	NE	NE	33	4N	42W	660 N	660 E
B3	3-7	20896-FP	NE	SW	1	3N	43W	2250 S	1670 W
B4	2-1	14396-FP	SW	NE	6	3N	42W	1750 N	2030 E
B5	7-1	13813-FP	SE	SW	4	3N	42W	1320 S	2630 W
		16923-FP							
B6	4-3	14753-FP	NE	SE	14	#N	43W	2620 S	380 E
B7	2-5	14398-FP	NW	NW	8	3N	42W	1340 S	1900 W

Note:
Also includes all permits shown in Table 1 transferred to the above wells.

Table 3
Crop Irrigation Requirement
(values in inches)

Year	Corn (Grain)	Corn (Silage)	Wheat	Grass Hay	Alfalfa Hay	Sorghum	Dry Beans	Oats	Sugar Beets	Potato	Sunflower
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1998	18.15	17.32	18.93	22.65	31.19	10.03	8.79	18.70	24.56	21.54	17.10
1999	15.23	14.98	15.34	20.52	27.97	8.83	7.82	15.13	21.65	20.27	14.87
2000	20.67	20.67	17.69	23.36	33.85	10.63	8.96	18.39	27.34	24.83	17.85
2001	20.04	19.87	17.79	23.88	34.07	11.77	9.87	19.19	26.58	24.04	18.75
2002	20.40	20.40	19.39	24.33	33.51	11.46	10.08	19.39	26.21	26.69	19.13
2003	20.59	19.63	16.63	24.00	34.92	12.24	10.98	16.91	24.35	25.62	19.90
2004	16.57	15.36	16.75	20.90	27.29	8.55	7.79	16.96	22.62	18.99	15.55
2005	15.06	13.56	12.96	18.73	25.02	7.68	6.91	16.17	22.37	17.43	14.47
2006	18.62	18.62	17.19	21.84	30.54	10.71	9.23	17.96	23.30	25.57	17.05
2007	12.39	12.17	14.10	19.79	26.72	6.51	5.94	14.45	22.63	18.22	12.57
Average	17.77	17.26	16.68	22.00	30.51	9.84	8.64	17.32	24.16	22.32	16.72

Note:

a) All crop potential consumptive use calculated using a calibrated Hargreaves method except for potatoes which was calculated using Modified Blaney-Criddle

b) Effective precipitation calculated as outlined in Irrigation Water Requirements Technical Release No. 21.

c) Crop irrigation requirement = potential consumptive use minus effective precipitation.

Table 4
Summary of Information Included in this Application

Item	Location	Description
1	Figure 1	Map Showing General Location of Irrigated Fields and Location of 15 Compact Compliance Wells
2	Table 1	Summary of Consumptive Use in this Application for 55 permits
3	Table 2	Alternate Point of Diversion Wells
4	Table 3	Summary of Crop Irrigation Requirements
5	Table 4	Summary of Information Included in this Application
6	Attachment A	Contract between Cure Land, LLC and the RRWCD WAE
7	Attachment B	Letter from Cure Land, LLC allowing RRWCD WAE to make application for change of Use and alternate point of diversion
8	Attachment C	Alternate Point of Diversion Application
9	Attachment D	Variance for Alternate Point of Diversion
10	Attachment E	Consumptive Use Memorandum
11	CD ROM	Water Right Application in PDF format (organized by field group)
12	CD ROM	Permits in PDF format (organized by field group)
13	CD ROM	Spreadsheet used to calculate consumptive use for each well (organized by field group)
14	CD ROM	PDF format of this memorandum including tables, figures, and attachments in PDF format

Attachment A

Contract between Cure Land, LLC and the RRWCD WAE

PURCHASE AND SALE AGREEMENT

THIS PURCHASE AND SALE AGREEMENT ("Agreement") is made and entered this 10th day of January, 2008, by and between Cure Land, LLC ("Cure Land"), a Colorado Limited Liability company, whose address is 36977 Road CC, Bethune, Colorado 80805, and the Republican River Water Conservation District, acting by and through its Water Activity Enterprise ("RRWCD WAE"), whose legal address is 410 Main Street, Suite 8, Wray, Colorado 80758.

RECITALS

R.1 The Republican River Water Conservation District ("District") was created by Colorado statute in 2004 to assist the State of Colorado to carry out the State's duty to comply with the Republican River Compact ("Compact").

R.2 The District has established a water activity enterprise (the "RRWCD WAE") pursuant to Article 45.1 of Title 37 of the Colorado Revised Statutes.

R.3 The RRWCD WAE intends to construct a Compact Compliance Pipeline to deliver water to the North Fork of the Republican River to assist the State of Colorado to comply with the Compact.

R.4 Cure Land owns or will own certain rights to designated ground water and land that it desires to sell to the RRWCD WAE and that the RRWCD WAE desires to purchase from Cure Land for a Compact Compliance Pipeline to assist the State of Colorado to comply with the Compact.

JPC MIC ESC DC

NOW THEREFORE, for and in consideration of the mutual promises, warranties, and agreements set forth herein, Cure Land and the RRWCD WAE agree as follows:

ARTICLE 1
PURCHASE AND SALE AND PURCHASE PRICE

1. Purchase and Sale of Property. Cure Land agrees to sell to the RRWCD WAE, and the RRWCD WAE agrees to buy from Cure Land, the following property in Yuma County, Colorado: the rights to designated ground water listed on Attachment "A," the rights to designated ground water listed on Attachment "B," and the "Dryden" real property described on Attachment "C" (all of which are collectively referred to herein as "the Property"), subject to and on the terms and conditions stated in this Agreement.

2. Purchase Price. The total purchase price for the Property and the easements provided in Article 2 below is forty-nine million, one hundred eighty-one thousand, two hundred eighty dollars ($49,181,280.00). Cure Land shall have an option up until the Closing Date provided below to retain the right to designated ground water for field number 7-19 (Permit #14122-FP) as shown on Attachment "A." If Cure Land exercises this option, the Purchase Price shall be reduced by $675,444. If Cure Land does not exercise this option, the parties agree that Permit #14122 shall be amended to reflect that Cure Land has retained title to the portion of the right to designated ground water represented by Permit #14122 that is used on field number 7-20. The Purchase Price shall be payable by the RRWCD WAE to Cure Land as follows:

(a) Down Payment. Four million, nine hundred eighteen thousand, one hundred twenty-eight dollars ($4,918,128), payable by wire transfer, shall be payable to and held by Yuma County Abstract, in its trust account, on behalf of both Cure Land and the RRWCD WAE on or before January 11th, 2008, as part payment of the Purchase Price. Upon delivery of the

JPC MAC wire EJC DK

Water Rights Report provided for in Article 3, paragraph 1 of this Agreement, $250,000 shall be paid to Cure Land. One-half of the Down Payment, less $250,000 previously paid to Cure Land, together with one-half of the interest that has accrued on the Down Payment, shall be paid to Cure Land at the end of the period of title review, unless the RRWCD WAE gives notice of title defects, as provided in Article 3 below, in which case one-half of the Down Payment, less $250,000 previously paid to Cure Land, together with one-half of the accrued interest on the Down Payment, shall be paid to Cure Land if Cure Land cures said title defects, the RRWCD WAE waives said title defects, or the RRWCD WAE elects to partially terminate the Agreement as provided in Article 3 below. The parties authorize delivery of the remaining one-half of the Down Payment deposit ("Remaining Down Payment") to the company conducting the closing ("Closing Company"), if any, at or before the closing. Interest on the Remaining Down Payment shall be paid to Cure Land at closing, unless this Agreement is terminated as provided below. The parties shall each pay one-half of the fees of Yuma County Abstract and the Closing Company. If Cure Land does not cure said title defects and the RRWCD WAE does not (a) waive said title defects or (b) elect to partially terminate the Agreement as provided in Article 3 below, this Agreement shall terminate and the remainder of the Down Payment, together with the accrued interest, shall be paid to the RRWCD WAE.

(b) Upon the Closing Date provided below, the Remaining Down Payment will be paid to Cure Land and the remainder of the Purchase Price will be paid to Cure Land by wire transfer.

JPC MRC WSC EJC DC

ARTICLE 2
EASEMENTS, WELL PERMITTING, DISCONNECTION AND ABANDONMENT OF WELLS, AND DRY-UP COVENANT

1. At closing, Cure Land will provide easements on or across land owned by Cure Land in Yuma County, Colorado, that is north of the North Fork of the Republican River for well sites for new wells, a Compact Compliance Pipeline, connector pipelines, and related facilities, including but not limited to a systems control building, maintenance yard, one or more storage tanks, any utility lines necessary to provide power for the new wells and related facilities for a Compact Compliance Pipeline. The easements for well sites for new wells and the related facilities except utility lines shall be exclusive easements. The easements for the Compact Compliance Pipeline, connector pipelines, and utility lines shall be non-exclusive easements, but Cure Land shall not construct or place any new building, fence, (unless the fence is gated to allow access) or retaining wall, or plant any tree, shrub, woody plant, or nursery stock on any part of such easements without the RRWCD WAE's consent. The preliminary design for the Compact Compliance Pipeline project calls for 6-8 new well sites, although additional well sites may be necessary to pump the amounts approved by the Colorado Ground Water Commission pursuant to the applications described in Article 6, in which case consideration will be given to using one or more existing Cure Land wells in the project. The approximate location of the well sites, the Compact Compliance Pipeline, and related facilities is shown on Attachment "D." The dimensions of the easements are described on Attachment "E." The final number of well sites and their location, the location of the Compact Compliance Pipeline, and the related facilities and their location will be determined after the final design engineering and the changes of the rights to designated ground water have been approved, provided the well sites are located within the "well field boundary" shown on Attachment "D." The parties agree that the easements (a) will require restoration of the ground surface and replacement of fences, roads, and other structures

JPC MAC w/c EJC DG

following the RRWCD WAE's construction activities and that the RRWCD WAE will restore such land and replace such fences, roads, or other structures to the same or as good a condition as existed prior to the construction, and (b) will not encroach upon lands that will continue to be irrigated by Cure Land with rights to designated ground water that are not purchased by the RRWCD WAE in accordance with the Agreement without Cure Land's prior consent. The easements to be provided shall include the right to reasonable ingress and egress for maintenance and repair, and the easements for the well sites shall include the right to redrill wells within 300 feet of the location of the wells.

2. Cure Land agrees that it will not object to changes in location and use of the rights to designated ground water rights sold to the RRWCD WAE pursuant to this Agreement.

3. In the event the Colorado Ground Water Commission ("GWC") amends its rules and regulations for the management and control of designated ground water to allow new Republican River Compact Compliance Wells ("Compact Compliance Wells") to be constructed for the purpose of offsetting stream depletions to the Republican River and its tributaries in order to comply with Colorado's Compact allocations under the Republican River Compact, the RRWCD WAE shall have the right to drill new Compact Compliance Wells on lands owned by Cure Land in Yuma County, Colorado, and Cure Land will provide easements as provided in Article 2, paragraph 1 of this Agreement, on or across lands owned by Cure Land in Yuma County, Colorado, for up to 10 well sites for such Compact Compliance Wells, connector pipelines, utility lines, and related facilities to connect such Compact Compliance Wells to the Compact Compliance Pipeline, provided that (a) the total amount of future withdrawals under the rights to designated ground water listed on Attachment "A" and such Compact Compliance Wells shall not exceed the total permitted amounts of the rights to designated ground water listed

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on Attachment "A;" (b) such new wells are located at least 10 miles north of the North Fork of the Republican River and more that three miles from any well that is used to divert ground water under a right to designated ground water that is currently owned by Cure Land and that is not being sold to the RRWCD WAE pursuant to this Agreement; and (c) such easements are otherwise consistent with the provisions of Article 2, paragraph 1 of this Agreement.

4. Cure Land and the RRWCD WAE agree that the RRWCD WAE intends to construct new wells and a Compact Compliance Pipeline to deliver water available under the rights to designated ground water listed on Attachment "A" that are purchased by the RRWCD WAE in accordance with this Agreement to the North Fork of the Republican River via a Compact Compliance Pipeline. After the Closing Date provided below, if requested in writing by the RRWCD WAE, Cure Land, at its cost and expense, shall disconnect and abandon all wells currently used to withdraw ground water under the rights to designated ground water listed on Attachment "A" that are purchased by the RRWCD WAE in accordance with this Agreement, provided that Cure Land shall not be required to disconnect or abandon any such wells before the end of the 2008 growing season or so long as any of such wells are required to comply with the terms of a conservation plan for lands enrolled in the Republican River Conservation Reserve Enhancement Program ("Republican River CREP") that were historically irrigated by said rights to designated ground water or are required to comply with the terms of a valid law or regulation requiring such irrigated lands to be revegetated (collectively "Revegetation Requirement.") Notwithstanding the sale of the rights to designated ground water listed on Attachment "A" to the RRWCD WAE, Cure Land shall have the right to divert water under those rights from wells currently used to withdraw ground water under such rights in an amount not to exceed 6 inches per acre to comply with the terms of a Revegetation Requirement. Cure Land shall pay the costs

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for power and maintenance of pumps and motors to pump ground water to comply with the terms of a Revegetation Requirement, but shall not otherwise pay for the cost of the water for the Revegetation Requirement, including RRWCD use fees for 2009 and subsequent years.

5. After closing, except during 2008 and thereafter as necessary to comply with the terms of a Revegetation Requirement, Cure Land agrees that it will not irrigate the permitted or historically irrigated acreage associated with the rights to designated ground water listed on Attachment "A" that are purchased by the RRWCD WAE in accordance with this Agreement, unless irrigation of those lands is permitted by a change of a right to designated ground water approved by the GWC, and will comply with the terms of any Revegetation Requirement. The lands historically irrigated by the rights to designated ground water listed on Attachment "A" are shown on Attachment "D." This provision shall be a covenant running with the land and shall be binding on Cure Land and its successors and assigns.

ARTICLE 3
TITLE, DEED, TAXES AND DUE DILIGENCE

1. On or before March 10, 2008, Cure Land shall caused to be furnished to the RRWCD WAE, at Cure Land's expense, a written report, prepared under the supervision of Trout, Raley, Montaño, Witwer & Freeman, P.C., or another licensed Colorado attorney acceptable to RRWCD WAE (the "Water Rights Report"), that consists of the following: Based solely upon a) vesting deeds provided by Yuma County Abstract Company showing ownership, from the time well permit applications were filed through a date no earlier than two business days prior to the date of the report, of the land described as the permitted acreage on the well permits corresponding to each field number listed on Attachment "A" or Attachment "B" for which rights to designated ground water are being conveyed herein; b) well permit applicant and

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holder name information available from the files of the State Engineer's Office for such well permits; and c) a search of the grantor indexes in the office of the Yuma County Clerk and Recorder forward in time to a date no earlier than two business days prior to the date of the report, the Water Rights Report will disclose any recorded conveyance(s) of the rights to designated ground water listed on Attachment "A" and Attachment "B" during the searched period(s) to persons not shown, on the date of such conveyance(s), to be either the record owner(s) of the corresponding permitted acreage listed on such attachment(s) or the applicant or permit holder for the corresponding well permit(s). Cure Land shall also furnish any abstract or abstracts of title in the possession or control of Cure Land for the lands on which those rights to designated ground water have been used. The Water Rights Report shall state that it is being provided for the benefit of the RRWCD WAE and that it may be relied upon by the RRWCD WAE.

2. On or before March 3, 2008, Cure Land shall caused to be furnished to the RRWCD WAE, at Cure Land's expense, a current Title Commitment in the amount of $4,000,000 for the Dryden property described on Attachment "C" ("Dryden property"), and Cure Land shall cause the title insurance policy to be issued and delivered to the RRWCD WAE as soon as practicable at or after Closing. The RRWCD WAE shall have the right to review the Title Commitment.

3. On or before March 10, 2008, Cure Land, at Cure Land's expense, shall furnish the RRWCD WAE (1) copies of any plats, declarations, covenants, conditions and restrictions burdening the rights to designated ground water listed on Attachment "A" and Attachment "B" and copies of any documents listed in the schedule of exceptions to the Title Commitment.

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4. For a period of 30 days after the Water Rights Report and the Title Commitment are furnished to the RRWCD WAE, whichever is furnished later, the RRWCD WAE shall have the right to investigate the title to the Property. If there are any title defects discovered regarding the title to the Property, then the RRWCD WAE shall provide written notice to Cure Land of those defects within 30 days of the date of receipt of the Water Rights Report or the Title Commitment, whichever is later. If the RRWCD WAE gives notice of such title defects, it shall do so by giving notice in writing, identifying the specific title defect or defects. If such notice is given, then Cure Land shall have 30 days in which to cure said title defects. If Cure Land fails or is unable to cure said title defects, then Cure Land shall give notice in writing to the RRWCD WAE on or before the 30th day and the RRWCD WAE shall have 15 days from written notice that Cure Land is unable to cure the title defects to elect to terminate this Agreement or waive said title defects by giving notice in writing to Cure Land; provided, however, that if a title defect or defects affect(s) only some but not all of the rights to designated ground water listed on Attachment "A" and/or Attachment "B," the RRWCD WAE shall have the right to partially terminate this Agreement as to the rights to designated ground water listed on Attachment "A" or Attachment "B" for which there are title defects and to purchase the remainder of the rights to designated ground water listed on Attachment "A," Attachment "B," and/or the Dryden property. If the RRWCD WAE partially terminates this Agreement, the Purchase Price shall be reduced by $2,850 times the historical consumptive use in acre-feet per year shown in column (9) of Attachment "A" and/or Attachment "B" for the right or rights for which this Agreement has been terminated. Notice of this election shall be given in writing by the RRWCD WAE to Cure Land.

5. Title to the Property shall be marketable.

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6. On the Closing Date, Cure Land shall execute and deliver to the RRWCD WAE a good and sufficient special warranty deed conveying the rights to designated ground water on Attachments "A" and "B" free and clear of all liens and encumbrances, except those title defects which the RRWCD WAE may, but is not required to, have chosen to waive. On the Closing Date, Cure Land shall execute and deliver to the RRWCD WAE a good and sufficient assignment of final permits listed on Attachments "A" and "B", provided that Cure Land shall not be obligated to assign Permit No. 14122-FP as such permit may be modified consistent with RRWCD WAE's rights to designated groundwater associated with Field 7-19 under this Agreement. On the Closing Date, Cure Land shall execute and deliver to the RRWCD WAE a good and sufficient general warranty deed for the Dryden property described on Attachment "C" free and clear of all liens and encumbrances, except those title defects which the RRWCD WAE may, but is not required to, have chosen to waive. On the Closing Date, Cure Land shall execute and deliver to the RRWCD WAE good and sufficient easements as specified in Article 2, paragraphs 1 and 3, above. Title to such easements shall be subject to all easements of record.

7. On the Closing Date, the RRWCD WAE shall pay $44,263,152.00 in cash or equivalent funds to Cure Land, subject to the reduction as provided in Article 1, paragraph 2, above, if Cure Land exercises its option to retain the right to designated ground water for field number 7-19, and subject to any further reduction if the RRWCD WAE partially terminates this Agreement as provided in paragraph 4 of this Article 3.

8. Cure Land will be responsible for the payment of all taxes and RRWCD use fees attributable to the Property for 2007 and previous years. Notwithstanding the conveyance of the rights to designated ground water listed on Attachment "A" to the RRWCD WAE, Cure Land shall be responsible for the payment of all taxes on lands historically irrigated by those rights.

Taxes for 2008 on the Dryden property described on Attachment "C" shall be prorated to the closing based on the taxes for the calendar year immediately preceding the closing. RRWCD use fees for 2008, due in 2009, for diversions under the rights to designated ground water listed on Attachments "A" and "B" shall be paid by Cure Land.

9. For a period of 60 days after the date of this Agreement, Cure Land shall cooperate with the RRWCD WAE in its inspections and investigations of the condition and status of the Property, and will provide the RRWCD WAE reasonable access to its land and facilities for well testing, water level measurements, and other testing, provided the RRWCD WAE's testing does not interfere with Cure Land's operations. In addition, Cure Land will cooperate with and provide the RRWCD WAE reasonable access to its land in Yuma County, Colorado, north of the North Fork of the Republican River during 2008 for final design engineering for new wells, including drilling test wells for new wells, the Compact Compliance Pipeline, connector pipelines, and related facilities, provided the RRWCD WAE's operations do not interfere with Cure Land's operations.

ARTICLE 4
FINANCING

1. The RRWCD WAE has applied for a loan from the Colorado Water Conservation Board (CWCB) Construction Loan Fund for a minimum of $40 million at an interest rate of 2.25%. The loan is subject to approval by the CWCB and the Colorado General Assembly and will not be available before July 1, 2008. If the loan from the CWCB Construction Loan Fund has not been approved by July 1, 2008, and the RRWCD WAE is not able to secure another source of acceptable financing within 45 days thereafter, this Agreement shall terminate and, if Cure Land has not yet received a full one-half of the Down Payment under the provisions of

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Article 1, paragraph 2(a) of this Agreement, Cure Land shall receive one-half of the Down Payment and Yuma County Abstract shall pay the Remaining Down Payment to the RRWCD WAE. Any interest accrued on any portion of the Down Payment shall be paid to Cure Land.

ARTICLE 5
CLOSING

1. Closing Date. Cure Land and the RRWCD WAE agree that the Colorado Ground Water Commission ("GWC") must approve a change in location and use of the rights to designated ground water listed on Attachment "A" before those rights can be used in a Compact Compliance Pipeline and that the Sand Hills Ground Water Management District ("GWMD") must approve the export of ground water from the Sand Hills GWMD before water diverted under the rights to designated ground water listed on Attachment "A" can be delivered to the North Fork of the Republican River for Compact Compliance. The closing shall take place within 30 days after the CWCB loan has been approved and is available, provided that the approvals of the GWC and the Sand Hills GWMD and any appeals are final prior to closing. If the approvals by the GWC and the Sand Hills GWMD and any appeals are not final within 30 days after the CWCB loan has been approved and is available, the closing shall take place within 30 days after the approvals by the GWC and the Sand Hills GWMD and any appeals are final. If Cure Land or other entities approved by Cure Land have applied to enroll land irrigated by the rights to designated ground water listed on Attachment "A" in the Republican River CREP and the closing cannot take place until the CREP contracts have been signed, the closing will take place once the CREP contracts have been approved and signed by the FSA County Committee. The RRWCD WAE will provide normal and reasonable assistance to Cure Land or other entities approved by Cure Land that are eligible to enroll such irrigated lands in the Republican River CREP in reviewing information required for CREP contracts.

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2. At the closing Cure Land shall execute and deliver the deeds and easements, as provided above, to the RRWCD WAE, and Yuma County Abstract or the Closing Company shall deliver the Remaining Down Payment, including interest on the Remaining Down Payment, to Cure Land and the RRWCD WAE shall deliver the cash or equivalent funds for the remainder of the Purchase Price to Cure Land, as provided above.

ARTICLE 6
APPLICATIONS

1. Upon execution of this Agreement, Cure Land authorizes the RRWCD WAE to file applications with the GWC and the Sand Hills GWMD to change the location and use of the rights to designated ground water listed on Attachment "A" to new well locations and for Compact Compliance use and to allow the use of ground water diverted under such rights outside the boundaries of the Sand Hills GWMD, provided that Cure Land has acquired title to the rights at the time of the filing of the applications. The RRWCD WAE shall file such applications within 45 days of the execution of the Agreement and thereafter shall prosecute such applications with diligence until final decisions are made. Cure Land, represented by its counsel, may join the RRWCD WAE as a co-applicant in such applications and may participate in any proceedings held concerning such applications to ensure that the terms of this Agreement are complied with, provided, however, that the RRWCD WAE shall pay any fees and expenses for such applications, including the engineering and legal fees necessary to prepare, file, and prosecute such applications. Cure Land will pay its own legal fees or any other expenses to participate in any proceedings held concerning such applications. The applications shall include a term and condition that the existing wells will be alternate points of diversion for the rights to designated groundwater listed on Attachment "A" in 2008 for irrigation use and thereafter as required to comply with a Revegetation Requirement. The RRWCD WAE may file such applications with

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the GWC and the Sand Hills GWMD before the rights to designated ground water listed on Attachment "A" have been conveyed to the RRWCD WAE, but the applications shall state that any change shall not be effective until the rights are transferred to the RRWCD WAE unless Cure Land expressly authorizes the RRWCD WAE in writing to use water prior to that time.

2. Upon signing this Agreement, the RRWCD WAE will request the Colorado State Engineer to seek approval of Republican River Compact Administration for the Compact Compliance Pipeline project.

ARTICLE 7
LEASE OF RIGHTS TO DESIGNATED GROUND WATER

1. If the closing takes place prior to August 31, 2008, the RRWCD WAE agrees to lease the Property to Cure Land during the remainder of 2008 as follows: (a) for use of the rights to designated ground water listed on Attachment "A," the lease payment will be calculated by multiplying the number of days by which the Closing Date precedes August 31, 2008, by $3928; and b) for use of the rights to designated ground water listed on Attachment "B" and the Dryden property, the lease payment will be calculated by prorating an assumed annual lease payment of $100,000 for the remainder of 2008 following the Closing Date. After 2008, any use by Cure Land of rights to designated ground water conveyed herein to comply with the terms of any Revegetation Requirement consistent with the provisions of Article 2, paragraph 4 of this Agreement shall be at no cost to Cure Land.

ARTICLE 8
NOTICES

1. Notices, consents, approvals or other communications provided for herein or given in connection herewith shall be deemed given, made, delivered or served if made in

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writing and delivered personally or sent by registered or certified United States mail, return receipt requested and postage prepaid, to:

RRWCD WAE:
Stan Murphy
Republican River Water Conservation District
410 Main Street, Suite 8
Wray, CO 80758

With copy to:

David W. Robbins, Esq.
Hill & Robbins, P.C.
1441 18th Street, Suite 100
Denver, CO 80202

Cure Land, LLC:
36977 Road CC
Bethune, CO 80805

With copy to:
James S. Witwer, Esq.
Trout Raley Montaño Witwer & Freeman PC
1120 Lincoln Street, Suite 1600
Denver, CO 80203-2141

or to such other address as either party hereto may from time to time designate in writing and deliver in a like manner to the other party. Such notices or other communications shall be deemed given or made upon delivery, if delivered personally, or upon the date of the execution of the return receipt, if sent by registered or certified United States mail.

ARTICLE 9
DEFAULT, RIGHT TO CURE AND REMEDIES

1. In the event that either party believes that the other is in default of any obligation under this Agreement, the non-defaulting party shall give written notice of the default to the party it believes is in default. If a notice of default is provided, the party accused of the default shall either cure it or provide a written statement explaining why it is not in default. If the

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alleged default is not cured or otherwise resolved within 30 days, the parties may resort to their remedies.

2. Time is of the essence hereof and if any payment or condition hereof is not made, tendered or performed by either Cure Land or the RRWCD WAE as provided herein, and such default is not cured as provided above, the non-defaulting party may have any such remedies as provided by law, including the right to specific performance and damages. If any date or time period provided for in this Agreement is or ends on a Saturday, Sunday or federal or Colorado state holiday, then such date shall automatically be extended to the next day which is not a Saturday, Sunday or federal or Colorado state holiday. In no event shall either party hereto be liable to the other for lost profits or punitive, exemplary or consequential damages.

ARTICLE 10
BINDING EFFECT AND ASSIGNMENT

1. This Agreement shall be binding upon and inure to the benefit of the parties and their respective successors.

2. There shall be no assignment of any interest under this Agreement without the prior written consent of the other party. Upon an authorized assignment, all the provisions hereof shall inure to the benefit and be binding upon the successors and assigns of Cure Land and the RRWCD WAE.

ARTICLE 11
WAIVER

1. No delay in exercising any remedy shall constitute a waiver thereof, and no waiver by Cure Land or the RRWCD WAE of the breach of any covenant or condition of this

JPC MMC WEC ESC DC

Agreement shall be construed as a waiver of any preceding or succeeding breach of the same, or any other covenant or condition of this Agreement.

ARTICLE 12
CAPTIONS

1. The captions of the articles of this Agreement are for convenience only and shall not govern or influence the interpretation hereof.

ARTICLE 13
COLORADO LAW, PLACE OF PERFORMANCE AND VENUE

1. This Agreement shall be governed by the laws of the State of Colorado.

2. The parties agree that this Agreement is performable in the County of Yuma, Colorado, and that venue for any disputes over any issue resulting from this Agreement shall be in Yuma County District Court.

ARTICLE 14
FURTHER DOCUMENTS, ETC.

1. Each party shall execute and deliver all such documents and perform all such acts as reasonably requested by the other party from time to time at and after the closing to carry out the matters contemplated by this Agreement.

ARTICLE 15
ENTIRE AGREEMENT AND CHANGES

1. This Agreement constitutes the entire agreement between the parties pertaining to the subject matter hereof. All prior and contemporaneous agreements, representations and understanding of the parties, oral or written, are hereby superseded and merged herein. No change or addition may be made to this Agreement, except by a written agreement executed by the parties.

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ARTICLE 16
COMMISSIONS

1. Each party represents to the other that no commissions are due to any other person or entity as a result of the execution of this Agreement or the sale and transfer of the rights to designated ground water and the real property interests pursuant thereto.

ARTICLE 17
SURVIVAL OF CLOSING

1. All terms and conditions of this Agreement shall survive the closing and shall not merge into the deeds.

ARTICLE 18
COUNTERPARTS

1. This Agreement may be executed in duplicate counterparts and the counterparts shall together constitute this Agreement.

ARTICLE 19
DATE OF THIS AGREEMENT

1. The date of this Agreement shall be the date of the execution of this Agreement by Cure Land and the RRWCD WAE, if executed on the same date. If the Agreement is not executed by Cure Land and the RRWCD WAE on the same date, then the date of this Agreement shall be the latest date on which Cure Land or the RRWCD WAE executed this Agreement.

ARTICLE 20
ADDITIONAL WARRANTIES

1. The RRWCD WAE makes the following representations, warranties and covenants to Cure Land:

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(a) The execution and performance of this Agreement has been duly approved by the board of directors of the District, which is the Governing Body of the RRWCD WAE, in accordance with applicable law.

(b) The RRWCD WAE has the right, power and authority to enter into this Agreement and to perform its obligations hereunder, and the person executing this Agreement on behalf of the RRWCD WAE has the right, power and authority to do so.

(c) This Agreement constitutes the legal, valid and binding obligation of the RRWCD WAE enforceable against the RRWCD WAE in accordance with its terms. Neither this Agreement nor the consummation of any of the transactions contemplated hereby violates or shall violate any provision of any agreement or documents to which the RRWCD WAE is a party or to which the RRWCD WAE is bound.

(d) There is no suit, action or arbitration, or legal, administrative, or other proceeding, formal or informal, pending or threatened, which affects the RRWCD WAE's ability to perform this Agreement.

(e) The execution, delivery and performance of this Agreement shall not breach or constitute a default, or grounds for the acceleration of the maturity of, any agreement, indenture, undertaking or other instrument, to which the RRWCD WAE is a party or by which the RRWCD WAE or any of its property may be bound or affected.

2. Cure Land makes the following representations, warranties and covenants to the RRWCD WAE:

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(a) The execution and performance of this Agreement has been duly approved Cure Land in accordance with applicable law.

(b) Cure Land has the right, power and authority to enter into this Agreement and to perform its obligations hereunder, and the person executing this Agreement on behalf of Cure Land has the right, power and authority to do so.

(c) This Agreement constitutes the legal, valid and binding obligation of Cure Land enforceable against Cure Land in accordance with its terms. Neither this Agreement nor the consummation of any of the transactions contemplated hereby violates or shall violate any provision of any agreement or documents to which Cure Land is a party or to which Cure Land is bound.

(d) There is no suit, action or arbitration, or legal, administrative, or other proceeding, formal or informal, pending or threatened, which affects Cure Land' ability to perform this Agreement.

(e) The execution, delivery and performance of this Agreement shall not breach or constitute a default, or grounds for the acceleration of the maturity of, any agreement, indenture, undertaking or other instrument, to which Cure Land is a party or by which Cure Land or any of its property may be bound or affected.

REPUBLICAN RIVER WATER CONSERVATION DISTRICT, Acting by and through THE REPUBLICAN RIVER WATER CONSERVATION DISTRICT WATER ACTIVITY ENTERPRISE

By: _____
Dennis Coryell
President
RRWCD Board of Directors

ATTEST:

By: _____
TIMOTHY ~~Tim~~ Pautler
TP Secretary

CURE LAND, LLC

By: _____
William E. Cure
Manager

By: _____
Edward J. Cure
Manager

By: _____
John R. Cure
Manager

By: _____
Michael R. Cure
Manager

ESC DC

STATE OF COLORADO)
) ss.
COUNTY OF Kit Carson)

Subscribed and sworn to before me this 10th day of January, 2008 by Dennis Coryell as President and ~~Tim~~ Timothy Pautler Dawn Meurisse as Secretary of the Republican River Water Conservation District, acting by and through its Water Activity Enterprise.

Witness my hand and seal.
My commission expires: 6-23-2011

DARVIN MEURISSE
Notary Public
State of Colorado

Dawn Meurisse
Notary Public
Darvin Meurisse
390 18th St
Burlington, CO 80807

STATE OF COLORADO)
) ss.
COUNTY OF Kit Carson)

Subscribed and sworn to before me this 10th day of January, 2008 by William E. Cure, as Manager of Cure Land, LLC.

Witness my hand and seal.
My commission expires: 6-23-2011

DARVIN MEURISSE
Notary Public
State of Colorado

Dawn Meurisse
Notary Public
Darvin Meurisse
390 18th St
Burlington, CO 80807

JPC MLC WBC DC

STATE OF COLORADO)
) ss.
COUNTY OF Kit Carson)

Subscribed and sworn to before me this 10th day of January, 2008 by Edward J. Cure, as Manager of Cure Land, LLC.

Witness my hand and seal.
My commission expires: 6-23-2011

DARVIN MEURISSE
Notary Public
State of Colorado

Notary Public
Darvin Meurisse
390 18th St
Burlington, CO 80807

STATE OF COLORADO)
) ss.
COUNTY OF Kit Carson)

Subscribed and sworn to before me this 10th day of January, 2008 by John P. Cure, as Manager of Cure Land, LLC.

Witness my hand and seal.
My commission expires: 6-23-2011

DARVIN MEURISSE
Notary Public
State of Colorado

Notary Public
Darvin Meurisse
390 18th St
Burlington, CO
80807

JPC MJC WSC ESC DC

STATE OF COLORADO)
) ss.
COUNTY OF Kit Carson)

Subscribed and sworn to before me this 10th day of January, 2008 by Michael R. Cure, as Manager of Cure Land, LLC.

Witness my hand and seal.
My commission expires: 6-23-2011

DARVIN MEURISSE
Notary Public
State of Colorado

Notary Public
Darvin Meurisse
390 18th St
Burlington, CO 80807

JPC MMC WSC ESC DC

Attachment A - Rights to Designated Groundwater

(note values shown in bold red indicate incomplete data and values are estimated for the purposes of this table)

Field Number (1)	Permit #1 (2)	Permit #2 (3)	Average Acreage to be Reported in Change of Use Form (4)	Irrigated Acreage from Satellite Photos (5)	Permitted Acreage (6)	Permitted ac-ft/yr (7)	GPM from Pump Test (8)	Historical Consumptive Use (ac-ft/yr) (9)
1-1	12967-FP	16920-FP	194	191	197	493	1,469	345
1-2	14403-FP		181	180	183	458	1,280	306
1-3	14019-FP		133	130	135	380	825	217
1-4	14018-FP		164	167	168	418	1,057	252
1-5	19372-FP		136	139	136	340	962	218
1-6 and 1-7	18780-FP		127	131	138	345	898	192
Subtotal			**935**	**938**	**957**	**2,434**	**6,491**	**1,530**
2-1	14396-FP		130	135	130	325	791	192
2-2	13858-FP		133	133	133	333	823	228
2-3	13859-FP	16069-FP	188	187	189	473	1,106	270
2-4	13857-FP		147	141	146	365	1,153	229
2-5	14398-FP		144	142	144	360	1,059	240
2-6	13856-FP	16067-FP	164	168	165	413	1,159	249
Subtotal			**906**	**906**	**907**	**2,269**	**6,091**	**1,408**
3-1	14397-FP		127	127	126	315	890	192
3-2	14027-FP		153	153	154	385	1,191	251
3-3	14022-FP		180	181	180	450	1,236	289
3-4	14023-FP		133	133	133	333	989	219
3-5	14600-FP		124	125	126	315	832	197
3-6	15285-FP		98	101	97	243	747	161
3-7	20896-FP		107	108	106	265	814	169
Subtotal			**922**	**928**	**922**	**2,306**	**6,699**	**1,479**
4-1	13513-FP	16074-FP	186	182	187	468	1,283	303
4-2	14028-FP		146	159	146	365	1,147	218
4-3	14753-FP		185	186	185	463	1,230	310
4-4	13522-FP		135	134	137	343	1,073	204
4-5	14024-FP		93	96	94	235	699	141
4-6	13509-FP	16075-FP	179	174	179	448	1,223	284
4-7	13511-FP		123	124	124	310	927	192
4-8	18781-FP		128	130	128	320	873	216
4-9	21476-FP		88	91	88	220	589	143
5-1	18783-FP		173	180	180	400	938	273
Subtotal			**1,437**	**1,456**	**1,448**	**3,572**	**9,982**	**2,284**
6-0	19004-FP		82	127	328	700	**1,000**	129
6-1	19005-FP		124	125	180	335	798	178
6-2	18966-FP		94	87	408	900	769	172
6-3	18018-FP		148	151	204	400	995	230
6-4,6-5	18017-FP	19001-FP	245	251	336	800	1,699	359
6-6, 6-7	23222-FP		148	148	194	267	**1,000**	171
6-8	18019-FP		108	115	194	400	707	174
6-9, 6-10	18014-FP		176	179	251	400	988	259
6-11,12,13,14	18013-FP		250	260	228	400	1,812	350
6-15, 6-16	18011-FP		244	248	428	900	2,254	431
6-17, 6-18, 6-19	18015-FP		329	333	280	900	2,371	543
6-20, 6-21	18012-FP	19000-FP	208	208	262	582	1,436	322
Subtotal			**2,156**	**2,232**	**3,293**	**6,984**	**15,829**	**3,319**

JPC MMC ESC D.C.

Attachment A - Rights to Designated Groundwater

(note values shown in bold red indicate incomplete data and values are estimated for the purposes of this table)

Field Number (1)	Permit #1 (2)	Permit #2 (3)	Average Acreage to be Reported in Change of Use Form (4)	Irrigated Acreage from Satellite Photos (5)	Permitted Acreage (6)	Permitted ac-ft/yr (7)	GPM from Pump Test (8)	Historical Consumptive Use (ac-ft/yr) (9)
7-1	13813-FP	16923-FP	126	128	160	400	941	206
7-2, 7-2A	13814-FP		219	246	240	480	1,405	334
7-3, 7-3a	13815-FP		197	243	240	480	1,291	291
7-13, 7-14	14718-FP		358	406	480	800	1,990	535
7-15, 7-16	14121-FP		284	279	320	800	1,618	436
7-17, 7-18	14719-FP		263	262	320	800	2,018	455
7-19 [a]	14122-FP		131	132	160	400	918	215
7-21, 7-21a	12589-FP		251	291	200	560	1,640	376
7-23	12567-FP		126	125	126	315	1,002	201
Wiley	4319-FP		62	78	50	125	374	75
Wilder/Cure [b]	20198-FP		**124**	124	**124**	**310**	**1,000**	**170**
Wilder/Cure [b]	20196-FP		**165**	165	**165**	**413**	**1,000**	**230**
Subtotal			**2,308**	**2,479**	**2,585**	**5,883**	**15,196**	**3,523**
Total			**8,663**	**8,939**	**10,112**	**23,448**	**60,287**	**13,543**
Total with Dryden wells in Attachment B			**9,330**	**9,604**	**10,932**	**25,498**	**62,504**	**14,536**

Footnotes

a) Permit allows for irrigation of parcels 7-19 and 7-20. Only the portion of permit historically used to irrigate parcel 7-19 is included in this table.

b) Under contract for purchase by Cure Land.

Explanation of Columns

(1) Field Number as shown on Attachment D

(2) Final permit for the Northern High Plains Designated Ground Water Basin. See permit for well location, priority date, and other information, including any allowable commingling with other permits.

(3) Second permit associated with the permit shown in column 2. Typically, these are permits for additional acreage, but see permit for details.

(4) Average acreage reported in change of use form used to determine values in Column 9.

(5) Irrigated acreage as determined from 2004 and 2005 Satellite photography.

(6) Reported permitted acreage.

(7) Reported permitted amount.

(8) Reported gallons per minute for the well from the power coefficient pumping test.

(9) Historical consumptive use determined from irrigated acreage, crop records and power records.

Attachment B - Dryden Rights to Designated Groundwater

(note values shown in bold red indicate incomplete data and values are estimated for the purposes of this table)

Field Number (1)	Permit #1 (2)	Permit #2 (3)	Average Acreage to be Reported in Change of Use Form (4)	Irrigated Acreage from Satellite Photos (5)	Permitted Acreage (6)	Permitted ac-ft/yr (7)	GPM from Pump Test (8)	Historical Consumptive Use (ac-ft/yr) (9)
W-1	13353-FP	16931-FP	157	158	180	450		236
W-2	13316-FP		135	133	160	400	1,157	211
W-3	13317-FP		117	121	160	400	1,060	140
W-4	19910-FP		127	123	160	400		183
W-5	14422-FP		131	130	160	400		223
Subtotal			**667**	**665**	**820**	**2,050**	**2,217**	**993**

See Attachment A for explanation of columns.

JJC MMC EJC D.C.

ATTACHMENT C

Township 2 North, Range 44 West of the 6th P.M., Yuma County, Colorado:

Section 1: E/2NW/4, W2NE/4, SW/4, W/2SE/4, SE/4SE/4

Section 12: That part of said Section 12, more particularly described as follows:

Beginning at the Northwest corner of said Section 12; thence South 89°40'30" East and along the North line of said Section 12 a distance of 3974.4 feet; thence South 15°06'30" East a distance of 721.7 feet; thence South 27°53'00" East a distance of 695.4 feet; thence South 17°55'30" West a distance of 268.5 feet; thence South 57°44'30" East a distance of 401.4 feet; thence South 46°47'30" East a distance of 338.5 feet; thence South 26°43'30" East a distance of 682.3 feet to a point on the East line of said Section 12; thence South 00°01'00" West and along the East line of said Section 12 a distance of 126.0 feet; thence South 10°18'30" West a distance of 579.8 feet; thence South 37°29'30" West a distance of 837.1 feet; thence South 65°24'00" West a distance of 488.4 feet; thence South 76°07'30" West a distance of 371.6 feet; thence North 71°37'00" West a distance of 670.3 feet; thence North 52°51'30" West a distance of 334.3 feet; thence South 89°33'00" West a distance of 301.5 feet; thence North 10°58'30" West a distance of 545.0 feet: thence South 84°26'00" West a distance of 1029.4 feet; thence North 80°03'30" \Vest a distance of 811.4 feet: thence North 89`40'00" West a distance of 755.7 feet to a point on the West line of said Section 12; thence North 0°07'00" East and along the West line of said Section 12,a distance of 3307.4 feet to the point of beginning and containing 399.54 acres, more or less, subject to U.S. Highway N. 385 Right-of-Way, Except a 40.1 acre tract described in Book 510 at Page 390 described as follows:

A tract of land in the NE/4 of Section 12, Township 2 North. Range 44 West of the 6" P.M., Yuma County, Colorado, said tract being more particularly described as follows:

Commencing at the Northeast corner of said Section 12; thence North 89°40'30" \Vest and along the North line of said Section 12 a distance of 1324.8 feet to the true point of beginning; thence South 15°06'30" East a distance of 721.7 feet; thence South 27°53'00" East a distance of 695.4 feet; thence South 17°55'30" West a distance of 268.5 feet; thence North 57°54'00" West a distance of 266.4 feet; thence North 84°09'00" West a distance of 260.3 feet; thence South 73°50'30" West a distance of 763.0 feet; thence South 44°51'00" West a distance of 175.9 feet; thence North 0°09'30" \Vest a distance of 1740.4 feet to a point on the North line of said Section 12; thence South 89°40'30" East and along the North line of said Section 12 a distance of 914.9 feet to the point of beginning, and containing 40.1 acres, more or less.

Reserving, however, to Grantor all of the remaining oil, gas, and minerals, of every kind and nature, after the grants or reservations of record in the Yuma County Clerk and Recorder's records, lying in, on, and under, and that may be produced from all of the Property, together with rights to reduce the same to possession, of ingress and egress and use of so much of the surface

WSC
JYC MK C ESC DC

as may be necessary for the full enjoyment of the mineral estate herein saved and reserved, including rights incident to the development, production, conservation, and transportation thereof.

And further subject, however, to a life estate reserved to Gleason E. Dryden for the entire use and possession of a tract of approximately 35 acres, more or less, located in Section 12, Township 2 North, Range 44 West of the 6th P.M., Yuma County, Colorado, which is part of the Property described herein, including the residence, out buildings, corrals, and pasture.

JPC MMC Wife ESC DC.


ATTACHMENT D
COLORADO
REPUBLICAN RIVER BASIN
NORTHEAST OF WRAY, COLORADO
Prepared by
HELTON & WILLIAMSEN, P.C.
Legend
Pipeline
Cure Farms
Cure Farms - Dryden Property
Well Field Boundary
0 0.5 1 2 3 4 5
Scale in Miles

Attachment E- Easements

The exact location of the Compact Compliance Pipeline system (CCPS) has not been determined. The general layout and alignment of the CCPS, based on the preliminary design, is shown in Attachment D. At the northern end of the main conveyance pipeline there will be a storage tank, a maintenance yard, and a control building. The rights to designated ground water listed on Attachments "A" and "B" will be transferred to approximately 6 to 15 wells that will be connected to the storage tank by collector pipelines. The dimensions of the easements for the CCPS are described below.

Well Sites

There will be exclusive easements for up to 15 well sites. The final location of the wells has not been determined, but the wells will be located within the well field boundary line shown on Attachment D. It is anticipated that one or more existing irrigation wells owned by Cure Land could be used for purposes of pumping groundwater for the Compact Compliance Pipeline, thereby reducing the need to construct a similar number of new wells. However, easements will be required for existing wells if used in this manner. The individual well site easements will consist of three components: 1) a nonexclusive access easement that will allow for access to the well sites through land owned by Cure Land along agreed upon farm roads from county roads; 2) a well site easement consisting of a square that is six hundred feet on a side with the well located at its center to allow for maintenance and repair on the well and to allow for the well to be re-drilled within 300 feet of the original well location in any direction; and 3) a sufficient nonexclusive easement to allow for construction and maintenance of electric power lines from the well to the closest REA lines capable of providing service. It is understood that the actual well facility within the easement may be fenced to protect its integrity.

Well Connector Pipelines

There will be non-exclusive easements for approximately 8 to 16 miles of 12" to 24" pipe to connect the wells to the storage tank, depending on the

number of wells and the required spacing of the wells. These collector pipe easements will require a 70-foot construction easement and a 50-foot permanent easement. The permanent easements will be centered along the center line of the connector pipe. The crown of the pipe will be buried a minimum of 3 feet below ground surface. In addition, the easements will allow for access manholes, air release valves, and drain values at appropriate locations along the pipeline.

Storage Tank, Maintenance Storage Yard, and Control Structure.

There will be an exclusive easement for a storage tank of approximately a 1 million gallons, a maintenance storage yard, and a control building. Located adjacent to the storage tank will be a maintenance storage yard and a building with controls for the pipeline operations. The total easement area for these three structures will be up to 5 acres. The area will be fenced to prevent cattle from crossing onto the grounds and to protect the integrity of the structures.

In addition, there will be a temporary 10-acre construction easement along a county road to serve as a pipe yard.

Main Conveyance Pipeline

There will be a non-exclusive easement on the Cure Land for approximately 9 to 15 miles of 36" pipe to deliver the water from the storage tank south toward the North Fork of the Republican River. The approximate location of the conveyance pipeline is shown on Attachment D. The conveyance pipe easement will require a 100-foot construction easement and a 50-foot permanent easement. The permanent easement will be centered along the center line of the pipe. The crown of the pipe will be buried at least 3 feet below ground surface. In addition the easement will allow for access manholes, air release valves, and drain values at appropriate locations along the pipeline.

JK MJC wife EJC DC

Attachment B

Letter from Cure Land, LLC allowing RRWCD WAE to make application for change of Use and alternate point of diversion

Attachment C

Alternate Point of Diversion Application

DBB-010 (6/2006)

APPLICATION FOR ALTERNATE POINTS OF DIVERSION
COLORADO GROUND WATER COMMISSION
Room 818 Centennial Building, 1313 Sherman Street
Denver, CO 80203

Application must be complete where applicable. Type or print in BLACK INK. No overstrikes or erasures unless initialed.

NOTE: This application can only be used for wells located within a Designated Ground Water Basin. Additional information, including estimates of historic withdrawal for the wells, will be required for areas where water is not available for new appropriations.

I am the owner of the wells referenced below and I hereby apply to obtain approval to use the subject wells as alternate points of diversion for each other. I understand that I am not allowed to use these wells as such without first obtaining approval from the Commission.

See Attached Table 1,Table 2, and Figure 1

Permit No.	Well Location	Permitted Number of Acres	Permitted Average Annual Appropriation (acre-feet)
_____	_____	_____	_____
_____	_____1/4 of the_____1/4, Sec_____, T____N/S, R____W	_____	_____
_____	_____1/4 of the_____1/4, Sec_____, T____N/S, R____W	_____	_____
_____	_____1/4 of the_____1/4, Sec_____, T____N/S, R____W	_____	_____
_____	_____1/4 of the_____1/4, Sec_____, T____N/S, R____W	_____	_____
_____	_____1/4 of the_____1/4, Sec_____, T____N/S, R____W	_____	_____
_____	_____1/4 of the_____1/4, Sec_____, T____N/S, R____W	_____	_____
NOTE:	COMPLETE DIAGRAM ON BACK OF APPLICATION	Total	_____

The land to be irrigated by these wells, without duplication of acres, totals _____ acres and is described as follows:_____

_____

_____

_____

Enclosed herewith is the nonrefundable application fee of $_____ (The fee required is $100 per well involved.) I understand that this request will be published in the local newspaper(s) as may be required by law and that I will pay the actual publication cost to the Commission when the same is billed to me.

I have read the statements made herein and know the contents thereof, and that they are true to my knowledge.

Signed and dated this 22 day of February, 20 08.

Signature of Applicant: _____

Applicant's Name: Republican River Water Conservation District - Water Activity Enterprise
(Please Print)

Address: 410 Main Street

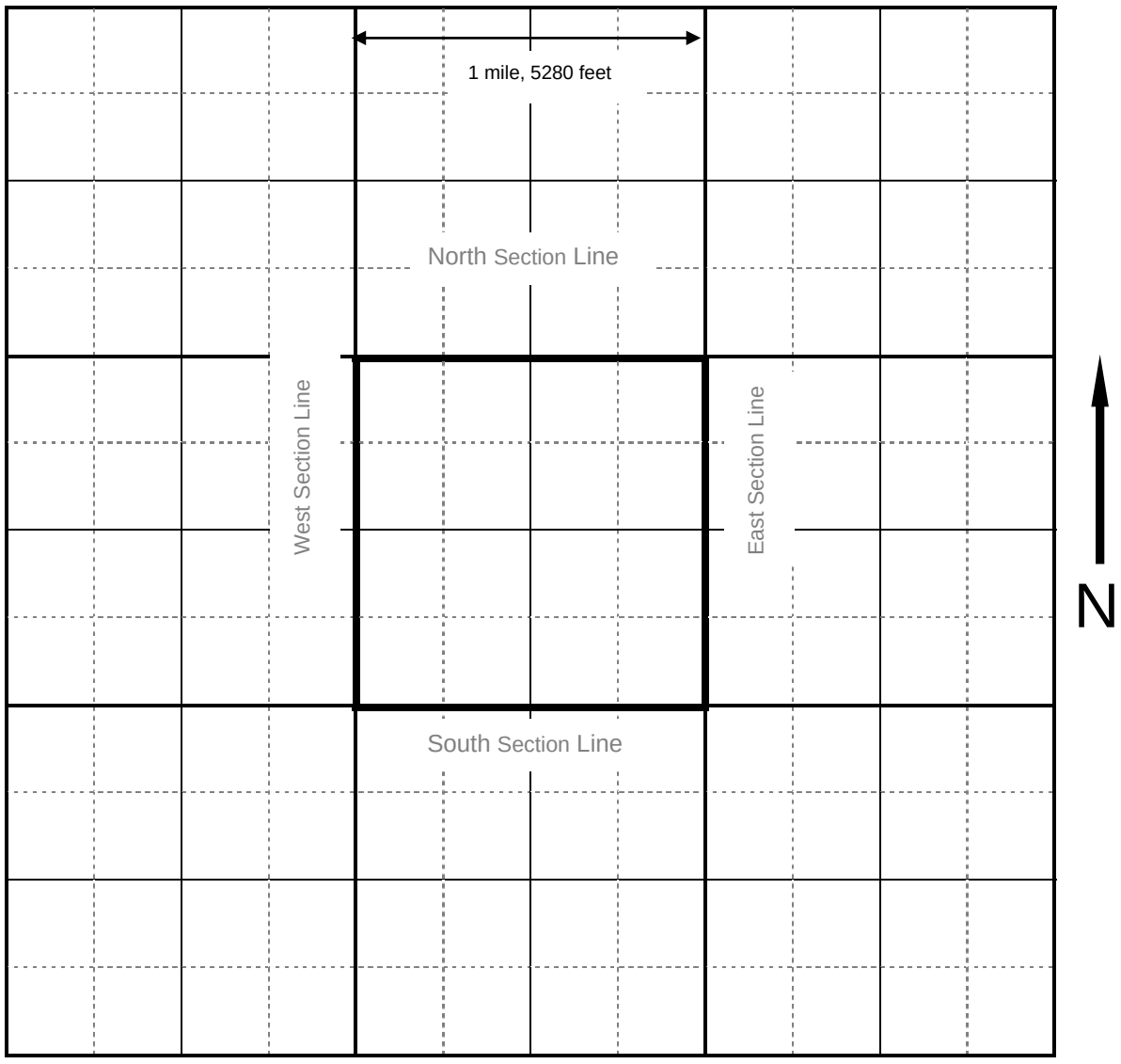
City, State & Zip: Wray, CO 80758

FOR OFFICE USE ONLY
Div._____ Co._____ WD_____ Basin_____ MD_____ Use_____ Receipt No._____

Telephone No.: (970) 332-3552

APPLICATION FOR ALTERNATE POINTS OF DIVERSION
COLORADO GROUND WATER COMMISSION

Diagram of Irrigated Acres and Well Locations.
This diagram must be completed. Label all wells with permit numbers.



The scale of this diagram is 2 inches = 1 mile.
Each small square represents 40 acres.

Incomplete applications will be returned to applicant

See Attached Figure 1

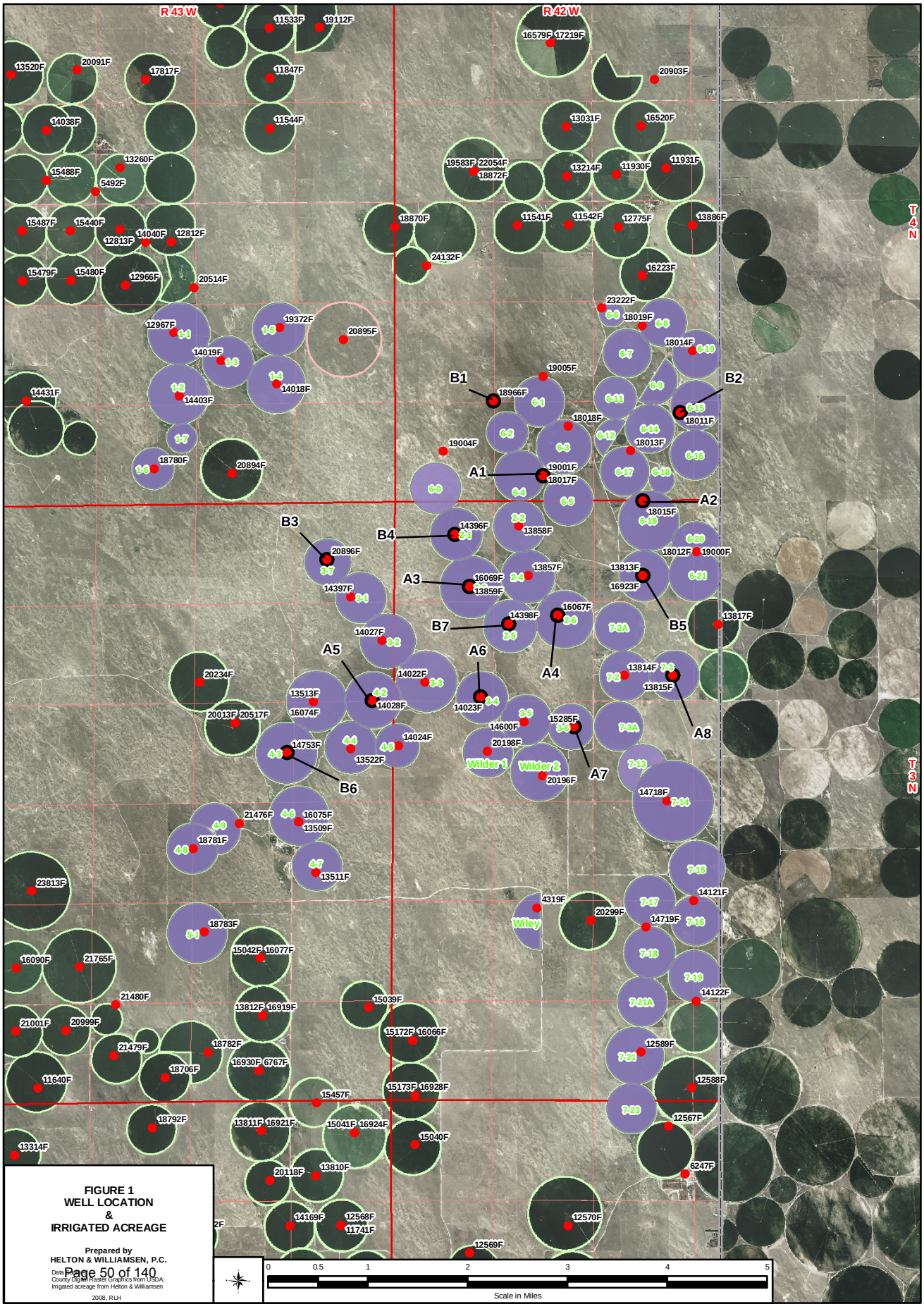

R 43 W
R 42 W
T 4 N
T 3 N
B1
B2
B3
B4
B5
B6
B7
A1
A2
A3
A4
A5
A6
A7
A8
Wilder 1
Wilder 2
Wiley
FIGURE 1
WELL LOCATION
&
IRRIGATED ACREAGE
Prepared by
HELTON & WILLIAMSEN, P.C.
Data Sources:
County Digital Raster Graphics from USDA;
Irrigated acreage from Helton & Williamsen
2008, RLH
0 0.5 1 2 3 4 5
Scale in Miles

Table 1
Rights to Designated Groundwater

Field Number (1)	Permit #1 (2)	Permit #2 (3)	Acreage in Change of Use Form (4)	Historical Consumptive Use (ac-ft/yr) (5)
1-1	12967-FP	16920-FP	194	345
1-3	14019-FP		133	217
1-4	14018-FP		164	252
1-5	19372-FP		136	218
1-6 and 1-7	18780-FP		127	192
Subtotal			**754**	**1,223**
2-1	14396-FP		130	192
2-2	13858-FP		133	228
2-3	13859-FP	16069-FP	188	270
2-4	13857-FP		147	229
2-5	14398-FP		144	240
2-6	13856-FP	16067-FP	164	249
Subtotal			**906**	**1,408**
3-1	14397-FP		127	192
3-2	14027-FP		153	251
3-3	14022-FP		180	289
3-4	14023-FP		133	219
3-5	14600-FP		124	197
3-6	15285-FP		98	161
3-7	20896-FP		107	169
Subtotal			**922**	**1,479**
4-1	13513-FP	16074-FP	186	302
4-2	14028-FP		146	218
4-3	14753-FP		185	310
4-4	13522-FP		135	204
4-5	14024-FP		93	141
4-6	13509-FP	16075-FP	179	284
4-7	13511-FP		123	192
4-8	18781-FP		128	216
4-9	21476-FP		88	144
5-1	18783-FP		173	273
Subtotal			**1,437**	**2,285**
6-1	19005-FP		124	178
6-2	18966-FP		94	172
6-3	18018-FP		148	230
6-4,6-5	18017-FP	19001-FP	245	361
6-8	18019-FP		107	173
6-9, 6-10	18014-FP		176	259
6-11,12,13,14	18013-FP		250	350
6-15, 6-16	18011-FP		244	431
6-17, 6-18, 6-19	18015-FP		329	549
6-20, 6-21	18012-FP	19000-FP	208	322
Subtotal			**1,925**	**3,026**

Table 1
Rights to Designated Groundwater

Field Number (1)	Permit #1 (2)	Permit #2 (3)	Acreage in Change of Use Form (4)	Historical Consumptive Use (ac-ft/yr) (5)
7-1	13813-FP	16923-FP	126	206
7-2, 7-2A	13814-FP		219	334
7-3, 7-3a	13815-FP		197	291
7-13, 7-14	14718-FP		358	526
7-15, 7-16	14121-FP		285	437
7-17, 7-18	14719-FP		263	455
7-19 [a)]	14122-FP		131	215
7-21, 7-21A	12589-FP		251	376
7-23	12567-FP		126	201
Subtotal			**1,957**	**3,041**
Total			**7,901**	**12,462**

The following wells are shown on Figure 1 but are not included in the information submitted with this application due to incomplete data. The information for these wells will be provided when it becomes available.

Field Number (1)	Permit #1 (2)	Permit #2 (3)	Acreage in Change of Use Form (4)	Historical Consumptive Use (ac-ft/yr) (5)
1-2	14403-FP			
6-0	19004-FP			
6-6, 6-7	23222-FP			
Wiley	4319-FP			
Wilder1	20198-FP			
Wilder2	20196-FP			

An additional 5 wells that are not shown on Figure 1. Data will be provided when it becomes available.

Footnotes

a) Permit allows for irrigation of parcels 7-19 and 7-20. Only the portion of permit historically used to irrigate parcel 7-19 is included in this table.

b) Under contract for purchase by Cure Land.

Explanation of Columns

(1) Field Number as shown on Attachment D

(2) Final permit for the Northern High Plains Designated Ground Water Basin. See permit for well location, priority

(3) Second permit associated with the permit shown in column 2. Typically, these are permits for additional acreage, but

(4) Average acreage reported in change of use form used to determine values in Column 9.

(5) Historical consumptive use determined from irrigated acreage, crop records and power records.

Table 2

Alternate Point of Diversion Wells

Republican River Water Conservation District Compact Compliance Pipeline

Well Id Shown on Figure 1	Field	Permit No.	Qtr	Qtr	Sec	Township	Range	Dist. NS	Dist EW
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A1	6-4, 6-5	18017-FP	NE	SW	32	4N	42W	1340 S	2600 W
		19001-FP							
A2	6-17, 6-18, 6-19	18015-FP	NW	NE	4	3N	42W	20 N	2635 E
A3	2-3	13859-FP	SE	SE	6	3N	42W	770 S	1210 E
		16069-FP							
A4	2-6	13856-FP	NW	NE	8	3N	42W	1340 S	1900 W
		16067-FP							
A5	4-2	14028-FP	SE	SE	12	3N	42W	30 S	1066 E
A6	3-4	14023-FP	SE	SE	7	3N	42W	200 S	600 E
A7	3-6	15285-FP	SE	NE	17	3N	42W	1400 N	950 E
A8	7-3, 7-3A	13815-FP	NE	SE	9	3N	42W	1330 S	1070 E
B1	6-2	18966-FP	SE	SE	30	4N	42W	20 S	50 E
B2	6-15, 6-16	18011-FP	NE	NE	33	4N	42W	660 N	660 E
B3	3-7	20896-FP	NE	SW	1	3N	43W	2250 S	1670 W
B4	2-1	14396-FP	SW	NE	6	3N	42W	1750 N	2030 E
B5	7-1	13813-FP	SE	SW	4	3N	42W	1320 S	2630 W
		16923-FP							
B6	4-3	14753-FP	NE	SE	14	#N	43W	2620 S	380 E
B7	2-5	14398-FP	NW	NW	8	3N	42W	1340 S	1900 W

Note:
Also includes all permits shown in Table 1 transferred to the above wells.

Attachment D

Request for Variance for Alternate Point of Diversion and Change of Use

Republican River Water Conservation District
Water Activity Enterprise

410 Main Street, Suite 8, Wray, Colorado 80758
email: rrwcd@centurytel.net
Phone: 970-332-3552 Fax: 970-332-3553

February 11, 2008

Colorado Ground Water Commission
Office of the State Engineer
1313 Sherman Street, 8th Floor
Denver, CO 80203

Attn: Keith Vander Horst

Re: **Request for Variance**

Dear Mr. Vander Horst:

Pursuant to Rule 11 of the Ground Water Commission's Rules and Regulations for the Management and Control of Designated Ground Water, the Republican River Water Conservation District, acting by and through its Water Activity Enterprise (RRWCD WAE), requests a variance from Rule 7.3.4 of the Commission's Rules to allow a change of well location in excess of 300 feet from the original permitted site of 55 final permits to 8 existing well sites to be used as Republican River Compact Compliance Wells pursuant to Rule 7.1.2.H. The 8 existing well sites are described in applications filed by the RRWCD WAE.

Second, the RRWCD WAE requests a variance from Rule 7.3.4 of the Commission's Rules to allow these 8 wells and 7 additional wells to be used as alternate points of diversion as necessary to withdraw the historic consumptive use under the permits that are changed to Republican River Compact Compliance Wells. The 15 well sites are described in applications filed by the RRWCD WAE.

The RRWCD WAE agrees to pay all publication costs associated with these variance requests pursuant to Commission Rule 11.2.5.

Sincerely,

Dennis Coryell
President
Board of Directors
Republican River Water Conservation District

cc: Stan Murphy, General Manager
Dennis M. Montgomery, Esq.
James S. Witwer, Esq.
James E. Slattery, P.E.

Attachment E

Consumptive Use Memorandum

HELTON & WILLIAMSEN, P.C.
CONSULTING ENGINEERS IN WATER RESOURCES
384 INVERNESS DRIVE SOUTH, SUITE 144
ENGLEWOOD, COLORADO 80112-5822
PHONE (303) 792-2161
FAX (303) 792-2165

November 19, 2002

CONFIDENTIAL –
PREPARED FOR SETTLEMENT DISCUSSIONS

M E M O R A N D U M

TO: Ken Knox – Colorado Division of Water Resources

FROM: Jim Slattery, Tom Williamsen, and Randy Hendrix

SUBJECT: Crop Consumptive Use Requirements – Republican River Basin in Colorado

This memorandum presents our results and our methods of calculating the consumptive irrigation requirements for crops grown in the area covered by the U.S. Geological Survey's ground water model in Colorado. The model area includes the Republican River basin and a portion of the Smoky Hill River basin. It includes all of Kit Carson, Phillips, and Yuma counties and portions of Elbert, Cheyenne, Lincoln, Logan, Sedgwick, and Washington counties. There is no irrigated land in Elbert County within the Republican River basin portion, so consumptive irrigation requirements were not calculated for Elbert County. Figure 1 shows the boundaries of the ground water model study area and the Republican River basin in Colorado.

PROCEDURE

The procedure used to estimate consumptive irrigation requirements in Colorado is similar to that adopted by the Kansas experts and is outlined below.

1. Compiled daily climate records for stations reported by the National Oceanic and Atmospheric Administration (NOAA), the Automated Weather Data Network (AWDN) operated by the High Plains Climate Center (HPCC), and the Colorado Agricultural Meteorological Network (COAGMET).

2. Checked the integrity and suitability of the AWDN and COAGMET climate data for estimation of reference crop ET; estimated data for days with missing records; adjusted or replaced certain data; adjusted maximum, minimum, and dew point temperatures for aridity; and limited daily wind run. Estimated data for missing days for the NOAA stations.

3. Assigned NOAA weather stations, AWDN and COAGMET stations to the eight counties.

4. Calculated daily reference crop (alfalfa) evapotranspiration, ET_r, using the Penman-Monteith formula for one AWDN and five COAGMET stations with the available records.

5. Calculated daily reference crop (grass) evapotranspiration, ET_o, using the Hargreaves formula with the NOAA weather station records for periods corresponding to Penman-Monteith estimates.

6. Compared monthly sums of reference crop ET_r from the Penman-Monteith and Et_o from the Hargreaves calculations and calculated monthly ratios of ET_r/ET_o. These monthly ratios were multiplied by the calculated Hargreaves ET_o, to estimate daily ET_r. The ratios calibrated the Hargreaves ET_o to an alfalfa-based ET_r.

7. Summarized irrigated crop acreage from National Agricultural Statistics Service (NASS) for each county. The primary crops were tabulated annually as a percentage of total irrigated acreage.

8. Gathered information about crop growing seasons and other growth parameters. The crop coefficients, K_c, developed by HPCC and adjusted by the Kansas experts, were further adjusted to correspond to the growing seasons for each county.

9. Calculated potential crop consumptive use daily, $Et_r \times K_c$, for each crop and county, for 1940 through 2000 and summarized the results monthly.

10. Calculated crop irrigation requirements, CIR, for each crop as the difference between monthly potential crop consumptive use and monthly effective precipitation.

11. Calculated the potential crop consumptive use by the modified Blaney-Criddle method and compared the results to the results from the procedure described above.

Following are details of this process.

CLIMATE DATA

Five NOAA weather stations with records that exceed or closely match the study period, 1940 through 2000, were selected. Based on the location of the NOAA stations, each was assigned to particular counties. Two AWDN and ten COAGMET electronic stations were identified within the study area and site visits were conducted. Attachment A is Dr. Thomas W. Ley's assessment of the weather station sites. Dr. Ley concluded that none of the weather stations are located in ideal environments and that the measured data are affected by aridity of the local and regional environment to varying degrees. Dr. Ley discarded the data from three stations due to aridity and adjusted some of the data for other stations. Attachment B is Dr. Ley's report concerning the integrity of the climate data and calculation of reference crop ET using the Penman-Monteith method. On 1) Dr. Ley's recommendation, 2) review of the site conditions and 3) available period of record, the following NOAA and electronic weather stations were used in this analysis.

County	Electronic Weather Station	Primary NOAA Weather Station	Coinciding Period
Cheyenne	Idalia COAGMET	Cheyenne Wells	Jun 91-Dec 01
Kit Carson	Idalia COAGMET	Burlington 4S	Jun 91-Dec 01
Lincoln	Idalia COAGMET	Burlington 4S	Jun 91-Dec 01
Logan	Haxtun COAGMET	Holyoke	Apr 97-Dec 01
Phillips	Holyoke COAGMET	Holyoke	May 91-Dec 96 Jul 97-Dec 01
Sedgwick	Haxtun COAGMET	Holyoke	Apr 97-Dec 01
Washington	Akron AWDN	Akron 4E	Jun 86-Dec 01
Yuma	Yuma02 COAGMET (50%) Wray COAGMET (50%)	Wray 2E	Jan 97-Dec 01

Missing daily NOAA weather station data were estimated by Dr. Jon K. Eisheid, Cooperative Institute for Research in Environmental Sciences at the University of Colorado in Boulder. Dr. Eisheid used a multi-step approach to process observed daily precipitation amounts and mean daily, maximum and minimum temperatures and to prepare complete data sets (Eischeid, 2000).

The period of record for the Holyoke climate station is January 1948 to present. We estimated the data for 1940 through 1947 using a linear regression relationship with the nearest weather station, Wray 2 E. Figure 1 shows the location of the climate stations used for this analysis.

ESTIMATE OF REFERENCE ET

"Reference ET" is the evapotranspiration rate from a reference surface, not short of water (Allen, 1998). The reference crop may be a short crop having an approximate height of 0.12 meter (similar to grass) or a tall crop having an approximate height of 0.50 meter (similar to alfalfa). The reference ET is denoted as ET_o or Et_r when referencing short or tall crops, respectively (ASCE, 2000).

The Hargreaves equation is a temperature-based method of estimating daily grass reference ET_o (Hargreaves, 1985). Data requirements include daily maximum, minimum, and average temperatures, extraterrestrial radiation, and the latent heat of vaporization. The daily climate data required in the Hargreaves equation were obtained from the selected NOAA climate stations. Extraterrestrial radiation is calculated based on the climate station's latitude and the latent heat of vaporization is calculated based on the average temperature.

The Penman-Monteith equation calculates an alfalfa-based reference ET_r. Data requirements include temperature, wind speed, relative humidity, and solar radiation. The data required to utilize the Penman-Monteith equation were obtained from the COAGMET and AWDN climate stations. Table 1 shows the monthly reference ET_r for each of the electronic climate stations during a common period of March 1998 to December 2001. ET_r was calculated by Dr. Ley. Attachment B describes Dr. Ley's procedures.

CALIBRATION OF HARGREAVES TO PENMAN-MONTEITH

The Penman-Monteith ET_r estimates were developed from data collected at the electronic weather station(s) for each county and the data collected at the NOAA station for each county were used to develop Hargreaves ET_o estimates. The ratio of the Penman-Monteith ET_r to the Hargreaves ET_o, ET_r/ET_o, was calculated monthly for corresponding periods of climate records. Table 2 shows the monthly ratios for each county. The Hargreaves ET_o, for the historical period of 1940-2000, was multiplied by these monthly ratios to develop daily calibrated Hargreaves ET_r values. Table 3 shows the May-through-September calibrated Hargreaves ET_r for each county.

CROP COEFFICIENTS

A crop coefficient, K_c, is the ratio of the ET for a specific crop and stage of growth to the reference ET at a particular time (Jensen, 1990). The crop coefficient integrates four primary effects that a crop distinguishes itself from a reference crop. They are crop height, reflectance of the crop-soil surface, the crop canopy resistance to vapor transfer, and evaporation of exposed soil (Allen, 1998). The HPCC provides crop coefficients for various crops. The crop coefficients relate the growth of the crop at each stage to accumulated growing degree day units from planting date to crop maturity and for three different lengths of growing seasons: short, medium and long. A growing degree day unit is the difference between the average daily temperature and the base temperature for a given crop. One unit accumulates for each degree above the base temperature. Average temperatures below the base temperature accumulate zero units. Maximum threshold temperatures for each crop limit the number of units for a particular day.

The HPCC crop coefficients were modified by the Kansas experts based upon the advice of Dr. Richard G. Allen to limit the crop coefficient per stage to a maximum of 1.0 except for corn, which was limited to a maximum of 0.95 per growth stage. Dr. Ley reviewed the crop coefficients supplied by Kansas and concluded that the coefficients were reasonable for use in this study. Table 4 summarizes the crop coefficients for each crop in this analysis along with the growing degree day threshold temperatures. The HPCC provided the crop coefficients for short, medium, and long growing seasons.

CROPS AND GROWING SEASONS

After reviewing the Colorado Department of Agriculture and NASS data for the study period, nine major crops were identified in the study area: corn (grain), corn (silage), winter wheat, grass hay, alfalfa hay, sorghum, dry beans, oats, and sugar beets. Barley was also a significant crop during the early part of the study period and was included as winter wheat due to similar planting and harvest dates.

NASS, an agency of the U.S. Department of Agriculture (USDA), in cooperation with the Colorado Department of Agriculture, prepares estimates of crop acreage by county. Annually, they produce “Colorado Agricultural Statistics” which is a compilation of information about farms, crops, and livestock. Every five years, NASS produces the Census of Agriculture which is a detailed counting of farms, crops and livestock. During the intervening four years, the estimates are prepared using smaller samples than the census. Periodically, NASS presents revisions to the annual estimates based on the results of the most recent census. The reports have been

prepared annually for Colorado since 1919. For 1944 through 1947, the data were collected and summarized statewide but not broken down by county.

The annual NASS reports list the irrigated and non-irrigated acreage for some crops. NASS reports total acreage harvested every year and irrigated acreage periodically for crops such as alfalfa, grass hay, and corn silage. Our estimate of the irrigated acres for these crops is based on the ratio of reported irrigated acreage and total acreage harvested in other years. Sugar beets were also reported by NASS as total acreage harvested, and it was assumed that all acreage harvested was irrigated. The crop distribution for each county prior to 1948 was estimated using the average crop distribution for 1950 to 1960.

The planting and harvest dates for each crop were determined by review of literature from the Colorado State University Cooperative Extension office and NASS annual reports. Local residents were contacted to discuss planting and harvest dates of the major crops to refine dates to common practices (Charles, 2002 and Rebis, 2002). The same planting and harvest dates were assigned to every county within the study area. The length of the growing season was determined using the average accumulated growing degree days over the study period for each crop based on the planting and harvest dates. The results were compared to the accumulated growing degree days provided with the HPCC crop coefficients to determine the season length. Table 5 summarizes the planting date, harvest date, and season length for each crop. Tables 6 through 13 summarize the historical crop distribution per county.

POTENTIAL CROP CONSUMPTIVE USE

Potential crop consumptive use is the amount of water required to fully satisfy a crop's water demand. The daily values are calculated by multiplying the reference crop, ET_r, by a crop coefficient, K_c. The daily growing degree day units (GDD) are calculated based on the threshold temperatures provided by the HPCC during the crops' growing season. The average of the current day's GDD (cumulative) and the previous day's GDD (cumulative) determine the crop coefficient, which is interpolated between known GDDs with corresponding crop coefficients. This interpolated crop coefficient is then multiplied by the calibrated reference ET_r to determine the daily potential consumptive use. Potential crop consumptive use is summarized annually by crop and by county in Tables 14 through 21. Table 22 shows the annual weighted (by crop distribution) potential crop consumptive use for each county. A comparison of potential crop consumptive use as calculated by the modified Blaney Criddle method and the calibrated Hargreaves method is shown in Table 23 for 1940 through 2000. This comparison is shown because the modified Blaney Criddle method has been used in previous investigations within the study area. Figure 2 presents the average annual potential consumptive use by crop weighted by county acreage.

EFFECTIVE PRECIPITATION

Effective precipitation is that portion of total rainfall during the growing period of a crop that infiltrates the soil and is available to the crop for transpiration. Since effective precipitation is not measured at the climate stations, it must be estimated from total rainfall. The method selected for this analysis was developed by the Soil Conservation Service (SCS) (USDA, 1970). The procedure is based on the SCS's analysis of 22 climate stations dispersed throughout the continental United States. The SCS performed daily soil water balances for 50 years of record at each station and the results were used to develop the equation shown below. The effective

precipitation is a function of potential crop consumptive use which varies by crop. This method estimates the effective precipitation based on monthly rainfall, monthly potential crop consumptive use and the depth of application using the following equation:

$$r_e = \left(0.70917 * r_t^{\,0.82416} - 0.11556\right) * \left(10^{0.02426 * u}\right) * (f)$$

Where:

r_e = monthly effective precipitation in inches
r_t = monthly rainfall in inches
u = potential crop consumptive use
f = soil water storage factor.

$$f = 0.531747 + 0.29164 * D - 0.057697 * D^2 + 0.003804 * D^3$$

Where:

D = depth of application in inches

The depth of application for all crops was estimated at 3 inches except alfalfa, which was estimated at 4 inches. Thus, the soil water storage factor for all crops is 1.00 except for alfalfa, which is 1.03. Table 24 shows the average precipitation, average effective precipitation, and average percentage of total precipitation that is effective for each crop during its growing season from 1940 to 2000 by county.

This method accounts for precipitation during the growing season of each crop and does not consider or account for precipitation accumulations during the fall, winter, and spring. Monthly precipitation in the fall and winter average less than one inch per month and soil evaporation probably depletes most of this water. The spring showers, in March, April, and May, however, do contribute to soil moisture storage. This stored water is available to the crop later in the growing season. We have not quantified the effectiveness herein, but it is a factor considered in the well pumpage estimates.

CROP IRRIGATION REQUIREMENT

Crop irrigation requirement (CIR) is the monthly difference between the potential crop consumptive use and effective precipitation. This term, CIR, also has been called “potential consumptive use of irrigation water”. If the effective precipitation is greater than the potential crop consumptive use, then the CIR for that crop is zero. The crops’ potential consumptive use is first met by the effective precipitation and second by irrigation applications. Tables 25 through 33 provide the summary of the CIR for each county with a weighted CIR based on the annual crop distribution from the NASS statistics.

CONCLUSIONS

1. The AWDN and COAGMET stations in the Republican River basin in Colorado are located in non-ideal environments for the collection of the climatic data necessary to calculate reference crop ET. Various data for the stations were adjusted for aridity effects. Without these necessary data adjustments, the calculated reference crop ET would be overstated.

2. The necessary climate data to calculate the reference crop ET by the Penman-Monteith equation is available for COAGMET and AWDN stations for a small portion of the study

period. The Hargreaves formula is a temperature based procedure and can be applied to the long-term records of the NOAA stations. The ET_o from the Hargreaves calculations was calibrated to the ET_r results of the Penman-Monteith by the ratio of ET_r/ET_o for each county. During the growing season, May through September, the calibration ratios are smallest (1.11 to 1.40) in July and largest (1.34 to 1.65) in September.

3. Daily reference crop ET by the calibrated Hargreaves method was calculated for 1940 through 2000 for each of the 8 counties in the model area. The average May-through-September totals ranged from 42.06 inches for Yuma County to 46.51 inches for Logan and Sedgwick Counties

4. The daily potential crop consumptive use was calculated by multiplying the calibrated Hargreaves ET_r for each county by the crop coefficient for each crop. The results were weighted by the crop distribution and accumulated to develop monthly values of potential crop consumptive use. The average annual values ranged from 26.53 inches in Yuma County to 29.55 inches in Logan County.

5. Effective precipitation for each crop was calculated as a function of the monthly precipitation and the potential crop consumptive use. The results were subtracted from the monthly potential crop consumptive use to determine the crop irrigation requirement for each crop. The average annual crop irrigation requirement ranged from 18.36 inches for Yuma County to 20.90 inches for Logan County. Weighted by actual irrigated acreage, the crop irrigation requirement averaged 19.47 inches basin-wide in Colorado. The effective precipitation calculation does not consider precipitation stored in the soil for use by the crops in subsequent months, so the calculated crop irrigation requirements are overstated.

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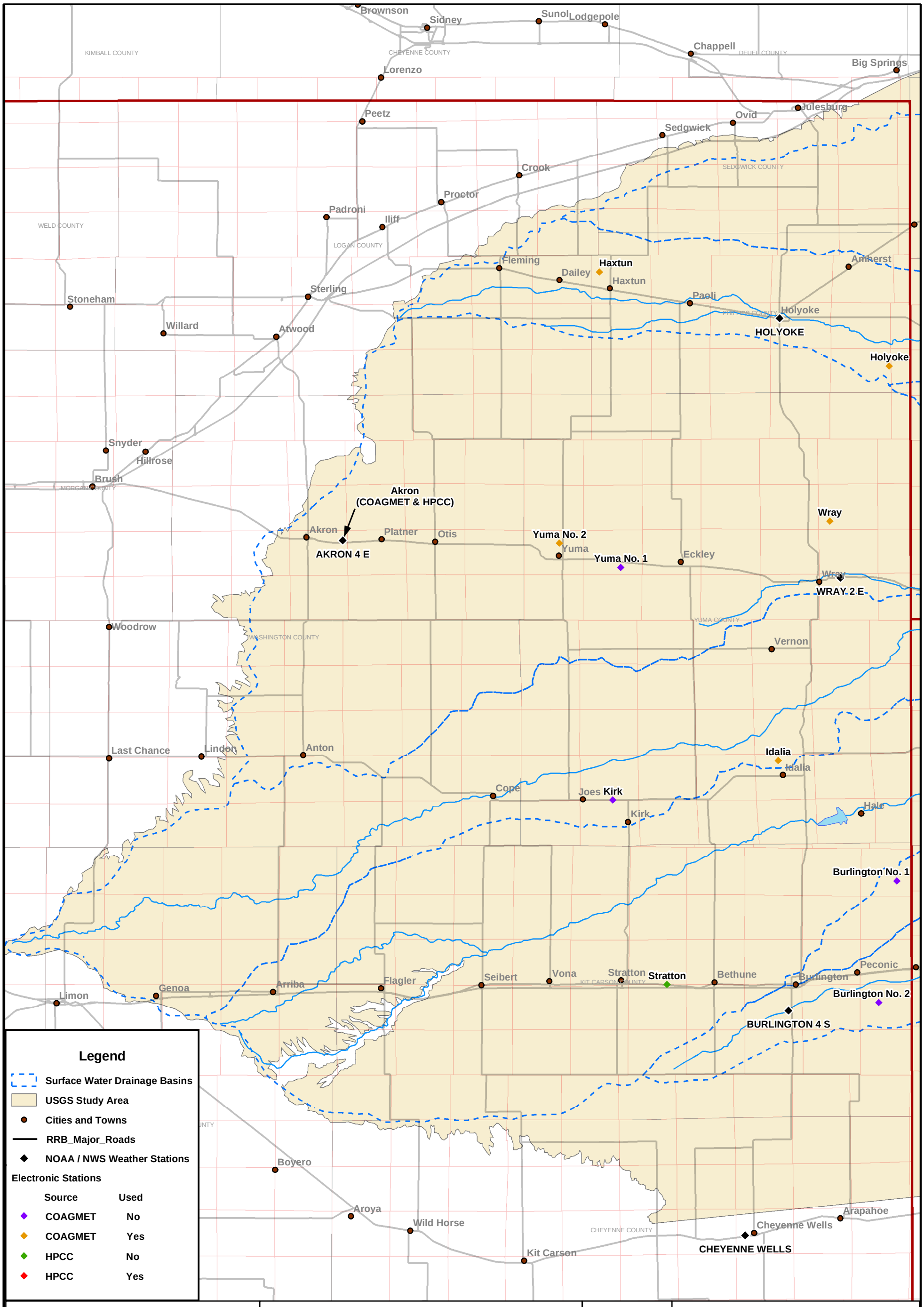


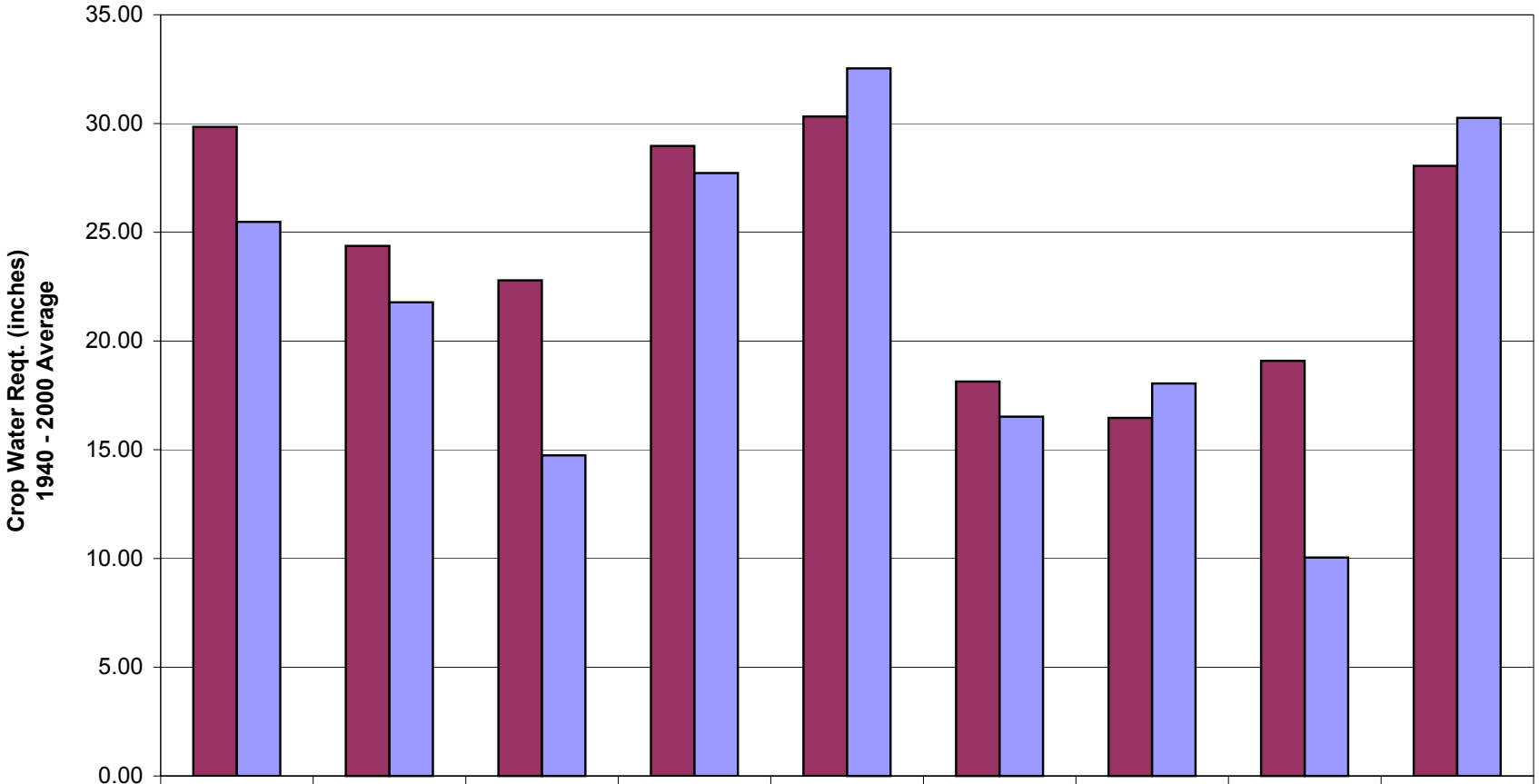
Figure 1

LOCATION OF CLIMATE STATIONS
REPUBLICAN RIVER BASIN
IN COLORADO

Job No.	C102
Created By:	Randy Hendrix
Checked by:	Randy Hendrix
Date:	October 11, 2002
Rev. Date:	

Helton & Williamsen, P.C.

FIGURE 2
Average Calibrated Hargreaves vs. Modified Blaney Criddle
Potential Consumptive Use in the Study Area



	Corn (Grain)	Corn (Silage)	Wheat	Grass Hay	Alfalfa Hay	Sorghum	Dry Beans	Oats	Sugar Beets
Hargreaves	29.84	24.37	22.79	28.97	30.32	18.14	16.46	19.09	28.05
Blaney Criddle	25.48	21.78	14.74	27.72	32.53	16.52	18.05	10.04	30.26

Crops

Note: Values are based on the 1940 through 2000 average crop water requirement weighted by the average acres per county derived in the memorandum entitled "Irrigated acreage estimate - Republican River Basin in Colorado" dated October 8, 2002.

TABLE 1
PENMAN-MONTEITH REFERENCE EVAPOTRANSPIRATION
(values in inches)

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	May - Sept
Arkon AWDN	1998			3.84	5.56	8.23	9.45	9.30	9.61	9.68	4.28	3.53	2.62		46.28
Arkon AWDN	1999	2.70	4.45	4.99	4.05	6.78	8.72	10.94	8.22	6.44	6.67	5.60	2.34	71.91	41.11
Arkon AWDN	2000	2.34	3.83	3.65	6.71	8.40	10.55	11.57	11.16	8.67	4.78	1.77	2.02	75.45	50.34
Arkon AWDN	2001	2.27	1.71	3.00	5.59	6.64	10.24	10.46	9.64	7.44	5.45	3.02	2.28	67.75	44.43
Average		**2.44**	**3.33**	**3.87**	**5.48**	**7.52**	**9.74**	**10.57**	**9.66**	**8.06**	**5.29**	**3.48**	**2.31**	**71.70**	**45.54**

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	May - Sept
Idalia Coagmet	1998			4.23	5.85	8.59	10.74	10.16	9.62	9.06	5.14	3.68	3.03		48.18
Idalia Coagmet	1999	3.24	4.77	5.20	4.90	7.43	9.44	11.27	8.83	6.20	6.57	5.54	3.05	76.42	43.16
Idalia Coagmet	2000	2.32	4.13	4.17	7.63	9.63	10.81	11.29	10.93	9.35	5.39	2.13	2.31	80.10	52.02
Idalia Coagmet	2001	2.47	1.89	4.02	6.93	7.73	11.40	10.83	10.68	7.94	5.92	3.55	2.94	76.31	48.59
Average		**2.68**	**3.59**	**4.40**	**6.33**	**8.34**	**10.60**	**10.89**	**10.02**	**8.14**	**5.76**	**3.73**	**2.83**	**77.61**	**47.99**

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	May - Sept
Haxtun Coagmet	1998			3.65	6.14	8.40	9.12	9.07	8.58	9.12	4.14	3.51	2.74		44.30
Haxtun Coagmet	1999	2.75	4.43	5.27	4.17	7.28	9.11	10.20	8.43	6.44	6.86	5.51	3.02	73.47	41.45
Haxtun Coagmet	2000	2.32	3.46	3.83	7.13	8.59	10.98	11.20	10.61	8.70	4.80	2.10	2.21	75.94	50.09
Haxtun Coagmet	2001	2.57	1.86	3.43	5.89	7.40	10.82	10.90	9.81	7.47	6.04	3.59	2.11	71.89	46.40
Average		**2.55**	**3.25**	**4.04**	**5.83**	**7.92**	**10.01**	**10.34**	**9.36**	**7.93**	**5.46**	**3.68**	**2.52**	**73.77**	**45.56**

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	May - Sept
Holyoke Coagmet	1998			3.77	6.36	8.62	9.34	8.77	8.51	8.62	4.35	3.68	2.95		43.86
Holyoke Coagmet	1999	3.00	4.71	5.36	4.34	7.22	8.70	9.78	7.78	5.63	6.23	4.81	3.02	70.58	39.11
Holyoke Coagmet	2000	2.22	3.51	3.97	7.27	8.70	10.89	11.24	10.82	8.40	5.09	2.15	2.13	76.40	50.05
Holyoke Coagmet	2001	2.64	1.92	3.94	6.47	7.29	10.29	9.83	9.90	7.66	5.86	4.01	2.13	71.94	44.97
Average		**2.62**	**3.38**	**4.26**	**6.11**	**7.96**	**9.80**	**9.91**	**9.25**	**7.58**	**5.38**	**3.66**	**2.56**	**72.97**	**44.50**

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	May - Sept
Yuma 02 Coagmet	1998			4.12	6.26	8.61	9.25	8.09	8.89	7.89	4.38	4.11	2.68		42.74
Yuma 02 Coagmet	1999	3.25	4.63	5.36	4.31	7.61	9.23	10.03	8.79	6.02	6.72	5.31	2.71	73.98	41.68
Yuma 02 Coagmet	2000	2.49	3.74	6.43	10.96	9.09	10.74	10.57	9.52	8.52	4.32	2.03	2.24	80.65	48.44
Yuma 02 Coagmet	2001	2.54	1.87	3.45	6.21	7.94	11.33	10.27	9.00	7.22	6.04	3.56	2.24	71.66	45.76
Average		**2.76**	**3.41**	**4.84**	**6.94**	**8.31**	**10.14**	**9.74**	**9.05**	**7.41**	**5.37**	**3.75**	**2.47**	**75.43**	**44.65**

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	May - Sept
Wray Coagmet	1998			3.89	6.16	8.94	9.24	8.09	7.54	7.70	4.44	3.34	2.67		41.51
Wray Coagmet	1999	3.26	4.51	4.03	4.37	7.12	8.72	8.08	6.50	4.84	5.19	3.28	2.49	62.39	35.27
Wray Coagmet	2000	1.95	3.09	4.18	7.73	9.14	10.05	9.94	9.52	8.05	5.35	2.17	2.12	73.29	46.70
Wray Coagmet	2001	2.64	2.05	3.99	6.97	7.91	10.34	9.39	8.69	6.81	5.59	3.32	2.07	69.78	43.15
Average		**2.62**	**3.22**	**4.02**	**6.31**	**8.28**	**9.59**	**8.88**	**8.06**	**6.85**	**5.14**	**3.03**	**2.34**	**68.49**	**41.66**

Source:
Values provided by Dr. Thomas W. Ley from results of climate assessment and data integrity analysis.

TABLE 2
RATIO OF HARGREAVES ET_o TO PENMAN-MONTEITH ET_r
(calibration ratios)

County	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cheyenne	2.13	1.81	1.57	1.39	1.25	1.33	1.30	1.34	1.54	1.79	2.06	2.36
Kit Carson	2.36	1.97	1.65	1.45	1.30	1.37	1.34	1.39	1.60	1.87	2.23	2.58
Lincoln	2.36	1.97	1.65	1.45	1.30	1.37	1.34	1.39	1.60	1.87	2.23	2.58
Logan	2.26	1.92	1.56	1.42	1.37	1.46	1.40	1.38	1.65	1.89	2.28	2.45
Phillips	2.22	2.05	1.64	1.55	1.39	1.43	1.32	1.34	1.61	1.88	2.19	2.44
Sedgwick	2.26	1.92	1.56	1.42	1.37	1.46	1.40	1.38	1.65	1.89	2.28	2.45
Washington	2.40	1.95	1.66	1.42	1.22	1.30	1.33	1.38	1.61	1.91	2.25	2.52
Yuma	2.24	1.75	1.63	1.47	1.30	1.31	1.11	1.14	1.34	1.64	1.98	2.20
Average	2.28	1.92	1.62	1.45	1.31	1.38	1.32	1.34	1.58	1.84	2.19	2.45

County	Electronic Station	NOAA Station	Coinciding Period
Cheyenne	Idalia 01 COAGMET	Cheyenne Wells	Jun 91 - Dec 01
Kit Carson	Idalia 01 COAGMET	Burlington 4 S	Jun 91 - Dec 01
Lincoln	Idalia 01 COAGMET	Burlington 4 S	Jun 91 - Dec 01
Logan	Haxtun 01 COAGMET	Holyoke	Apr 97 - Dec 01
Phillips	Holyoke 02 COAGMET	Holyoke	May 91 - Dec 96 Jul 97 - Dec 01
Sedgwick	Haxtun 01 COAGMET	Holyoke	Apr 97 - Dec 01
Washington	Akron AWDN	Akron 4 E	Jun 86 - Dec 01
Yuma	Yuma 02 COAGMET (50%) Wray 01 COAGMET (50%)	Wray 2 E	Jan 97 - Dec 01

Note:
Monthly calibration ratios are calculated using common time periods for both methods as follows: (Average Monthly Penman-Monteith ET_r / Average Monthly Hargreaves ET_o)

TABLE 3
MAY THROUGH SEPTEMBER CALIBRATED HARGREAVES REFERENCE ET
(values in inches)

	County							
Year	Cheyenne	Kit Carson	Lincoln	Logan	Phillips	Sedgwick	Wash-ington	Yuma
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1940	46.08	46.52	46.52	47.57	46.34	47.57	43.14	43.12
1941	42.26	44.33	44.33	42.76	41.68	42.76	43.09	38.89
1942	43.03	45.53	45.53	43.23	42.09	43.23	43.09	39.10
1943	46.31	46.79	46.79	45.64	44.39	45.64	43.09	41.05
1944	45.99	47.21	47.21	45.13	44.02	45.13	43.14	40.97
1945	43.40	45.00	45.00	43.09	41.99	43.09	43.09	38.90
1946	46.17	46.07	46.07	45.30	44.11	45.30	43.09	40.97
1947	46.28	46.10	46.10	44.90	43.73	44.90	43.09	40.57
1948	47.26	45.73	45.73	48.72	47.50	48.72	43.14	41.00
1949	44.45	44.29	44.29	46.58	45.39	46.58	41.34	40.32
1950	43.58	42.99	42.99	45.55	44.40	45.55	40.09	40.45
1951	43.69	41.82	41.82	43.63	42.52	43.63	40.76	38.67
1952	49.32	49.18	49.18	51.06	49.71	51.06	45.90	44.43
1953	47.37	45.47	45.47	49.00	47.75	49.00	44.26	43.30
1954	48.88	50.02	50.02	51.66	50.29	51.66	46.35	46.40
1955	46.59	47.37	47.37	49.61	48.31	49.61	43.72	42.43
1956	50.03	51.28	51.28	52.12	50.84	52.12	45.52	44.60
1957	46.04	44.76	44.76	48.81	47.50	48.81	41.86	39.95
1958	45.67	44.79	44.79	47.72	46.55	47.72	43.13	41.76
1959	47.03	49.06	49.06	49.36	48.08	49.36	44.43	43.12
1960	48.37	47.48	47.48	49.18	47.91	49.18	44.18	42.46
1961	46.33	46.23	46.23	46.82	45.60	46.82	41.96	40.68
1962	46.47	47.68	47.68	47.15	46.00	47.15	43.63	42.14
1963	48.41	49.90	49.90	50.33	49.05	50.33	44.85	43.86
1964	48.45	46.59	46.59	50.00	48.74	50.00	44.70	44.53
1965	43.46	42.01	42.01	44.43	43.33	44.43	39.90	39.41
1966	45.94	44.54	44.54	49.06	47.89	49.06	43.23	42.83
1967	42.98	42.82	42.82	45.44	44.29	45.44	40.13	39.86
1968	44.90	45.17	45.17	48.98	47.70	48.98	42.13	42.09
1969	43.67	44.97	44.97	48.23	47.01	48.23	42.32	41.89
1970	46.37	47.19	47.19	52.03	50.73	52.03	45.23	44.92
1971	44.94	45.60	45.60	47.50	46.27	47.50	43.09	42.60
1972	43.72	43.84	43.84	47.04	45.87	47.04	42.69	41.03
1973	43.78	43.68	43.68	47.83	46.61	47.83	42.50	41.31
1974	46.42	46.38	46.38	49.97	48.70	49.97	45.36	45.03
1975	46.10	45.23	45.23	48.01	46.78	48.01	42.65	42.93
1976	45.41	45.11	45.11	49.27	48.01	49.27	44.26	44.00
1977	46.84	46.01	46.01	48.36	47.14	48.36	45.32	44.95
1978	45.48	45.35	45.35	50.39	49.09	50.39	44.80	46.04
1979	45.21	44.03	44.03	46.90	45.72	46.90	42.24	43.57
1980	46.82	46.86	46.86	49.83	48.54	49.83	45.60	46.57
1981	43.99	43.94	43.94	46.64	45.41	46.64	42.79	43.25
1982	43.54	43.51	43.51	45.21	44.06	45.21	41.59	40.99
1983	46.70	46.07	46.07	48.08	46.82	48.08	42.96	45.38
1984	46.31	45.76	45.76	48.02	46.79	48.02	43.33	45.03
1985	45.13	43.92	43.92	47.04	45.87	47.04	43.08	43.67
1986	45.03	44.47	44.47	45.13	44.02	45.13	43.94	43.10
1987	45.37	44.12	44.12	43.35	42.24	43.35	42.69	42.14
1988	45.97	45.06	45.06	45.24	44.10	45.24	45.30	45.85
1989	43.12	42.64	42.64	41.66	40.61	41.66	42.46	38.25
1990	45.85	45.01	45.01	43.44	42.34	43.44	43.16	40.61
1991	45.11	44.55	44.55	41.99	40.94	41.99	43.55	39.00
1992	44.42	43.20	43.20	40.69	39.72	40.69	41.59	37.98
1993	44.78	42.44	42.44	39.46	38.50	39.46	41.46	37.87
1994	48.26	47.36	47.36	45.46	44.36	45.46	47.11	42.32
1995	44.61	43.17	43.17	41.59	40.45	41.59	42.15	39.13
1996	43.80	43.39	43.39	39.42	38.41	39.42	41.79	38.78
1997	43.93	45.25	45.25	42.55	41.46	42.55	43.94	40.93
1998	45.61	46.74	46.74	43.85	42.76	43.85	45.65	42.91
1999	44.60	45.22	45.22	42.11	41.04	42.11	42.42	40.59
2000	49.22	50.16	50.16	48.26	47.04	48.26	47.27	45.00
Avg	45.65	45.52	45.52	46.51	45.33	46.51	43.35	42.06
50-64 Avg	47.08	46.97	46.97	48.80	47.55	48.80	43.69	42.58
86-00 Avg	45.31	44.85	44.85	42.95	41.87	42.95	43.63	40.96
Min	42.26	41.82	41.82	39.42	38.41	39.42	39.90	37.87
Max	50.03	51.28	51.28	52.12	50.84	52.12	47.27	46.57

Column Explanations:

1) Year

2 - 9) May through September calibrated reference evapotranspiration.

TABLE 4
CROP COEFFICIENTS FOR ALFALFA BASED REFERENCE CROP ET

Corn (Grain)

Growing Degree Limits
Upper 86 **Lower** 50

Stage (1)	Kc (2)	Season Short GDD (3)	Season Medium GDD (4)	Season Long GDD (5)
2leaves 0.5	0.100	0	0	0
4leaves 1	0.180	220	240	294
6leaves 1.5	0.350	329	360	440
8leaves 2	0.510	440	480	588
10leaves 2.5	0.690	549	600	735
12leaves 3	0.880	658	720	882
14leaves 3.5	0.950	768	840	1029
16leaves 4	0.950	878	960	1175
Silks--HMAX	0.950	1097	1200	1470
Blister 6	0.950	1316	1440	1763
Dough 7	0.950	1536	1680	2057
beg Dent 8	0.950	1755	1920	2351
fullDent 9	0.930	1975	2160	2645
BlackLay 10	0.600	2194	2400	2939
Full Mat 11	0.100	2240	2450	3000
Max	0.100	9999	9999	9999

Corn (Silage)

Growing Degree Limits
Upper 86 **Lower** 50

Stage (1)	Kc (2)	Season Short GDD (3)	Season Medium GDD (4)	Season Long GDD (5)
2leaves 0.5	0.100	0	0	0
4leaves 1	0.180	220	240	294
6leaves 1.5	0.350	329	360	440
8leaves 2	0.510	440	480	588
10leaves 2.5	0.690	549	600	735
12leaves 3	0.880	658	720	882
14leaves 3.5	0.950	768	840	1029
16leaves 4	0.950	878	960	1175
Silks--HMAX	0.950	1097	1200	1470
Blister 6	0.950	1316	1440	1763
Dough 7	0.950	1536	1680	2057
beg Dent 8	0.950	1755	1920	2351
fullDent 9	0.930	1975	2160	2645
BlackLay 10	0.600	2194	2400	2939
Full Mat 11	0.100	2240	2450	3000
Max	0.100	9999	9999	9999

Wheat (Fall)

Growing Degree Limits
Upper 77 **Lower** 40

Stage (1)	Kc (2)	Season Short GDD (3)	Season Medium GDD (4)	Season Long GDD (5)
Emergence	0.100	0	0	0
Vis. Crown	0.100	100	115	190
Leaf Elong.	0.350	200	230	300
	0.400	450	518	600
	0.350	585	673	750
	0.100	710	817	900
Max	0.100	9999	9999	9999

Note: For Winter Wheat you apply the wheat (fall) coefficients durin September through October and the wheat (spring) coefficients from March through harvest.

Wheat (Spring)

Growing Degree Limits
Upper 77 **Lower** 40

Stage (1)	Short Kc (2)	Season Short GDD (3)	Season Medium GDD (4)	Season Long GDD (5)
Break Dor	0.100	0	0	0
Vis. Crown	0.500	100	115	190
Leaf Elong.	0.900	200	230	300
Jointing	0.950	450	518	600
Boot	1.000	585	673	750
Heading	1.000	710	817	900
Flowering	1.000	795	914	1050
Grain Fill	1.000	1000	1150	1300
Stiff Dough	0.980	1225	1409	1600
Ripening	0.500	1450	1668	1850
Mature	0.100	1600	1840	2000
Max	0.100	9999	9999	9999

Grass (Hay)

Growing Degree Limits
Upper 77 **Lower** 40

Stage (1)	Short Kc (2)	Season Short GDD (3)	Season Medium GDD (4)	Season Long GDD (5)
Green-up	0.100	0	0	0
Regrowth	0.480	400	525	800
Nr Full Cov	0.650	990	1140	1400
Full Cover	0.680	2425	2600	2800
Dormant	0.460	5000	5000	5000
Max	0.460	9999	9999	9999

Alfalfa (Hay)

Growing Degree Limits
Upper 77 **Lower** 40

Stage (1)	Short Kc (2)	Season Short GDD (3)	Season Medium GDD (4)	Season Long GDD (5)
Stage 1	0.100	0	0	0
Stage 2	0.180	90	100	110
Stage 3	0.350	225	250	280
Stage 4	0.510	270	300	330
Maturity	0.690	360	400	440
Full Cov	0.880	630	700	750
Full Cov	1.000	4800	4900	5000
Max	1.000	9999	9999	9999

TABLE 4 (cont'd)
CROP COEFFICIENTS FOR ALFALFA BASED REFERENCE CROP ET

Sorghum				
Growing Degree Limits				
Upper 86		Lower 50		
		Season		
Stage (1)	Short Kc (2)	Short GDD (3)	Medium GDD (4)	Long GDD (5)
Emergence	0.100	0	0	0
3 leaves	0.150	192	200	216
5 leaves	0.310	468	484	527
8lv-GrPtdif	0.560	723	748	790
Final leaf	0.870	956	990	1053
Boot	1.000	1190	1232	1317
Half-bloom	1.000	1424	1528	1580
Soft dough	1.000	1658	1716	1843
Hard dough	0.840	1891	1958	2106
Mature	0.100	2125	2200	2369
Max	0.100	9999	9999	9999

Dry Beans				
Growing Degree Limits				
Upper 86		Lower 50		
		Season		
Stage (1)	Short Kc (2)	Short GDD (3)	Medium GDD (4)	Long GDD (5)
Emerg-10%	0.060	0	0	0
Cover 10-50%	0.060	170	191	200
Cover 50-80%	0.480	520	599	660
Cover 80-Full	0.810	720	823	900
Full Cover	1.000	900	1020	1100
Pod Elong	1.000	1100	1239	1350
Pod Fill	0.830	1300	1438	1600
Dry Down	0.590	1400	1656	1800
Senescens	0.300	1700	1876	2050
Mature	0.090	1800	2023	2200
Max	0.090	9999	9999	9999

Oats				
Growing Degree Limits				
Upper 77		Lower 40		
		Season		
Stage (1)	Short Kc (2)	Short GDD (3)	Medium GDD (4)	Long GDD (5)
Emergence	0.100	0	0	0
Vis. Crown	0.500	100	115	190
Leaf Elong.	0.900	200	230	300
Jointing	0.950	450	518	600
Boot	1.000	585	673	750
Heading	1.000	710	817	900
Flowering	1.000	795	914	1050
Grain Fill	1.000	1000	1150	1300
Stiff Dough	0.980	1225	1409	1600
Ripening	0.500	1450	1668	1850
Mature	0.100	1600	1840	2000
Max	0.100	9999	9999	9999

Sugar Beets				
Growing Degree Limits				
Upper 86		Lower 50		
		Season		
Stage (1)	Short Kc (2)	Short GDD (3)	Medium GDD (4)	Long GDD (5)
Emergence	0.100	0	0	0
Cover20-30%	0.140	220	247	275
Cover30-50%	0.210	400	438	495
Cover50-70%	0.340	570	637	700
Cover70-80%	0.480	760	846	920
Cover80-90%	0.600	900	1070	1200
Cover90-Full	0.730	1050	1267	1400
Full Cover	0.830	1300	1486	1630
Max LAI	0.910	1500	1685	1850
Root Stg	0.910	2000	2300	2400
After Frost	0.900	2600	2700	2800
Max	0.900	9999	9999	9999

Column Explanations:

1) Crop growth stage as identified by the High Plains Climate Center.
2) Crop growth coefficient as identified by HPCC and modified by the Kansas experts upon the advice of Dr. Richard Allen.
3) Accumulated growing degree day units for a short growing season.
4) Accumulated growing degree day units for a medium growing season.
5) Accumulated growing degree day units for a long growing season.

GDD = Growing Degree day units which are calculated as the difference between the daily average temperature and the base temperature. One unit is accumulated for each degree Fahrenheit the average temperature is above the base temperature. Example: (75 - 50) = 25 GDD for corn.

Upper = the maximum average daily temperature threshold. If average daily temperature is greater than the threshold then the upper value is used instead of the average daily temperature in calculation of GDD. Example: Avg Temp = 87 then (86-50) = 36 GDD for corn.

Lower = the minimum average daily temperature threshold or base temperature. If average daily temperature is less than the threshold then GDD = 0.

Source:

High Plains Climate Center

Spronk Water Engineers memorandum "Calculation of Consumptive Use of Irrigation Water by Crops in the Republican River Basin in Kansas", August 2, 2002.

TABLE 5
GROWING SEASON FOR REPUBLICAN RIVER BASIN IN COLORADO

Crop	Beginning Growth Date	Ending Growth Date	Total No. of Days	HPCC Season
Corn (Grain)	May-1	Sep-30	152	**Long**
Corn (Silage)	May-1	Aug-31	122	**Medium**
Wheat (Fall)	Sep-10	Oct-30	50	**Long**
Wheat (Spring)	Mar-22	Jun-30	100	**Medium**
Grass Hay	Apr-1	Oct-31	213	**Long**
Alfalfa Hay	Apr-25	Oct-10	168	**Long**
Sorghum	Jun-1	Sep-15	106	**Short**
Dry Beans	Jun-1	Sep-30	121	**Long**
Oats	Apr-1	Jun-30	90	**Medium**
Sugar Beets	Apr-20	Oct-12	175	**Long**

Sources:

Colorado Agricultural Statistics (Years: 1972, 1981, 1985, 1990, 1995, and 2000)

Arkansas River Basin Study - Boyle Engineering (December 1990)

Fact Sheet No. 103. "Planting Guide for Field Crops", Colorado State University Cooperative Extension

Irrigation Water Requirements, Technical Release No 21. USDA Soil Conservation Service

Personal communications with Don Higbee, Farmer, September 27, 2002.

Personal communications with Allen Charles, Agricultural Teacher - Arickaree High School, October 1, 2002.

Personal communications with David Rebis, Water Commissioner - Dist. 49 & 65, October 7, 2002.

TABLE 6
IRRIGATED CROP MIX

CHEYENNE COUNTY
(values in percentage)

Year	Corn-Grain	Corn-Silage	Wheat	Other Hay	Alfalfa	Sorghum	Dry Beans	Oats	Sugar Beets	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(11)	(13)
1940	6.0	2.6	3.2	28.9	30.1	28.6	0.4	0.2	0.0	100.0
1941	6.0	2.6	3.2	28.9	30.1	28.6	0.4	0.2	0.0	100.0
1942	6.0	2.6	3.2	28.9	30.1	28.6	0.4	0.2	0.0	100.0
1943	6.0	2.6	3.2	28.9	30.1	28.6	0.4	0.2	0.0	100.0
1944	6.0	2.6	3.2	28.9	30.1	28.6	0.4	0.2	0.0	100.0
1945	6.0	2.6	3.2	28.9	30.1	28.6	0.4	0.2	0.0	100.0
1946	6.0	2.6	3.2	28.9	30.1	28.6	0.4	0.2	0.0	100.0
1947	6.0	2.6	3.2	28.9	30.1	28.6	0.4	0.2	0.0	100.0
1948	0.0	0.0	0.0	**15.4**	**2.0**	**82.6**	0.0	0.0	0.0	100.0
1949	0.0	0.0	0.0	**16.7**	**3.0**	**80.3**	0.0	0.0	0.0	100.0
1950	**0.0**	**0.0**	0.0	**61.7**	**23.6**	**14.6**	0.0	0.0	0.0	100.0
1951	0.0	**0.0**	0.0	**82.2**	**7.0**	**10.8**	0.0	0.0	0.0	100.0
1952	0.0	**0.0**	0.0	**45.8**	**28.9**	**25.3**	0.0	0.0	0.0	100.0
1953	0.0	**0.0**	0.0	**30.5**	**32.0**	**37.4**	0.0	0.0	0.0	100.0
1954	0.0	**0.0**	0.0	**8.7**	**41.9**	**49.3**	0.0	0.0	0.0	100.0
1955	2.6	**2.7**	3.9	**7.2**	**49.5**	**34.0**	0.0	0.0	0.0	100.0
1956	12.2	**5.9**	8.4	**5.5**	**58.5**	**8.8**	0.0	**0.8**	0.0	100.0
1957	14.8	**6.0**	9.2	**23.0**	**32.3**	13.3	**0.4**	1.0	0.0	100.0
1958	12.0	**4.8**	5.8	**8.4**	**24.5**	43.8	**0.5**	0.0	0.0	100.0
1959	14.5	**5.7**	**3.1**	**10.9**	**31.6**	32.6	**1.7**	0.0	0.0	100.0
1960	6.8	**3.6**	**4.2**	**18.8**	**24.7**	38.5	**3.5**	0.0	0.0	100.0
1961	0.6	**13.6**	28.1	**11.0**	**20.0**	24.4	**2.4**	0.0	0.0	100.0
1962	6.4	**5.1**	21.4	**29.4**	**13.0**	21.4	**3.3**	0.0	0.0	100.0
1963	6.3	**7.2**	14.1	**47.7**	**11.4**	10.5	**2.9**	0.0	0.0	100.0
1964	10.9	**12.1**	10.9	**35.1**	**6.3**	21.8	**2.7**	0.0	0.0	100.0
1965	6.6	**8.5**	15.4	**30.4**	**6.4**	30.1	1.5	1.1	0.0	100.0
1966	23.0	**16.6**	6.5	**19.4**	**9.8**	16.0	1.4	**1.1**	6.2	100.0
1967	20.5	**23.7**	19.8	**18.1**	**5.1**	7.1	0.7	0.4	4.5	100.0
1968	27.4	**23.8**	11.6	**15.2**	**4.1**	4.7	5.2	0.0	7.9	100.0
1969	25.0	**17.0**	18.8	**2.2**	**26.6**	3.0	1.7	**0.2**	5.5	100.0
1970	33.9	**23.4**	23.9	**6.9**	**3.2**	1.9	1.3	**0.4**	5.2	100.0
1971	47.7	**0.0**	30.1	**8.5**	**5.3**	1.5	1.5	**0.6**	4.8	100.0
1972	39.8	**0.0**	19.9	**16.5**	**4.2**	8.7	**1.5**	**1.1**	8.3	100.0
1973	50.5	**0.0**	8.0	**14.0**	**8.7**	8.0	0.8	**1.1**	8.8	100.0
1974	43.7	**6.9**	24.8	5.3	5.3	4.7	0.0	**1.0**	8.3	100.0
1975	30.3	**11.0**	31.0	1.3	4.5	6.5	**0.0**	1.3	14.2	100.0
1976	30.5	**10.0**	38.0	3.5	3.5	5.2	**0.0**	**1.3**	8.1	100.0
1977	55.6	**8.7**	19.9	2.9	5.9	2.3	**0.0**	**1.4**	3.2	100.0
1978	63.9	**3.4**	18.1	0.4	9.7	1.3	0.0	**1.2**	2.1	100.0
1979	52.2	**6.1**	24.6	**2.2**	**6.1**	3.1	**2.9**	**1.1**	1.8	100.0
1980	48.0	**5.4**	23.2	**1.7**	**7.2**	4.3	6.4	**1.3**	2.5	100.0
1981	46.7	**2.9**	33.0	**1.3**	**5.2**	1.8	5.7	**1.2**	2.1	100.0
1982	53.6	**2.8**	21.6	**2.9**	**5.0**	4.1	6.4	**1.6**	2.0	100.0
1983	60.4	**0.0**	17.1	**7.7**	**7.1**	0.0	5.5	**2.3**	0.0	100.0
1984	50.3	**0.0**	26.6	2.5	5.5	3.0	7.5	**2.0**	2.5	100.0
1985	55.1	**0.0**	17.8	6.3	6.3	3.4	8.6	**2.4**	0.0	100.0
1986	49.9	**1.6**	26.6	5.4	6.0	2.7	5.4	**2.4**	0.0	100.0
1987	45.1	**2.3**	30.2	7.2	6.8	2.7	3.6	**2.1**	0.0	100.0
1988	49.0	**7.0**	17.5	7.0	7.0	5.6	3.5	**3.4**	0.0	100.0
1989	52.9	**5.9**	17.1	4.1	7.1	8.8	1.2	2.9	0.0	100.0
1990	40.7	**4.5**	33.9	6.8	5.6	4.5	2.8	1.1	0.0	100.0
1991	46.6	**3.2**	30.9	7.6	5.8	3.5	1.7	0.6	0.0	100.0
1992	51.1	**2.8**	32.0	5.8	6.4	1.3	0.6	0.0	0.0	100.0
1993	56.5	**2.7**	27.4	4.3	6.7	1.2	1.2	0.0	0.0	100.0
1994	51.8	**2.3**	31.6	4.0	7.5	0.0	2.9	0.0	0.0	100.0
1995	48.4	**1.8**	32.3	5.4	9.1	0.0	2.2	**0.8**	0.0	100.0
1996	48.0	**1.5**	28.8	3.8	12.0	2.4	**1.9**	1.4	0.0	100.0
1997	65.0	**3.3**	20.0	5.0	3.0	1.0	2.0	**0.8**	0.0	100.0
1998	63.4	**0.8**	26.0	2.9	2.9	0.0	**4.0**	0.0	0.0	100.0
1999	73.4	**0.6**	10.8	2.2	2.2	6.5	4.3	0.0	0.0	100.0
2000	66.7	**0.8**	15.7	2.0	2.0	9.8	2.4	0.8	0.0	100.0
Avg	29.6	4.9	15.8	15.3	14.5	15.6	2.0	0.7	1.6	100.0
50-64 Avg	5.8	4.4	7.3	28.4	27.0	25.8	1.2	0.1	0.0	100.0
86-00 Avg	53.9	2.7	25.4	4.9	6.0	3.3	2.7	1.1	0.0	100.0
Max	73.4	23.8	38.0	82.2	58.5	82.6	8.6	3.4	14.2	100.0
Min	0.0	0.0	0.0	0.4	2.0	0.0	0.0	0.0	0.0	100.0

Notes:

Data from NASS

Bold - data is estimated using various techniques based on available data. (See spreadsheet "Crop Production w-Estimates.xls")

Data for 1940-47 is estimated using the 1950-60 average

Percentage for column 4 includes wheat and barley.

Corn grain data in 1970 had a typographical error. Actual irrigated acres calculated as irrigated production divided by yield per acre.

TABLE 7
IRRIGATED CROP MIX

KIT CARSON COUNTY
(values in percentage)

Year	Corn-Grain	Corn-Silage	Wheat	Other Hay	Alfalfa	Sorghum	Dry Beans	Oats	Sugar Beets	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1940	33.8	12.3	5.4	10.9	12.5	22.2	0.4	0.9	1.5	100.0
1941	33.8	12.3	5.4	10.9	12.5	22.2	0.4	0.9	1.5	100.0
1942	33.8	12.3	5.4	10.9	12.5	22.2	0.4	0.9	1.5	100.0
1943	33.8	12.3	5.4	10.9	12.5	22.2	0.4	0.9	1.5	100.0
1944	33.8	12.3	5.4	10.9	12.5	22.2	0.4	0.9	1.5	100.0
1945	33.8	12.3	5.4	10.9	12.5	22.2	0.4	0.9	1.5	100.0
1946	33.8	12.3	5.4	10.9	12.5	22.2	0.4	0.9	1.5	100.0
1947	33.8	12.3	5.4	10.9	12.5	22.2	0.4	0.9	1.5	100.0
1948	0.0	**0.0**	3.0	**22.7**	**4.1**	**68.6**	1.5	0.0	0.0	100.0
1949	0.0	**0.0**	1.0	**27.3**	**8.2**	**61.5**	1.3	0.6	0.0	100.0
1950	0.0	**0.0**	0.0	**65.5**	**19.7**	**12.9**	0.9	1.1	0.0	100.0
1951	3.2	**1.0**	1.2	**15.0**	**28.3**	**49.6**	0.0	1.7	0.0	100.0
1952	2.2	**0.8**	0.7	**19.7**	**27.3**	**37.9**	0.0	11.5	0.0	100.0
1953	4.1	**1.3**	1.7	**14.4**	**30.9**	**45.4**	0.0	2.1	0.0	100.0
1954	15.2	**7.9**	2.1	**18.6**	**21.5**	**34.7**	0.0	0.0	0.0	100.0
1955	16.5	**9.6**	3.7	**10.7**	**10.3**	**48.6**	0.3	0.3	0.0	100.0
1956	34.4	**11.8**	12.5	**9.4**	**15.0**	**15.8**	0.3	0.8	0.0	100.0
1957	42.9	**13.8**	10.7	**6.8**	**5.5**	16.7	0.4	0.9	2.1	100.0
1958	55.6	**17.1**	2.6	**4.6**	**8.9**	6.9	1.1	0.3	3.1	100.0
1959	53.9	**15.9**	2.2	**3.9**	**8.6**	12.2	0.3	0.2	2.8	100.0
1960	37.3	**18.5**	9.1	**8.0**	**9.4**	14.4	0.3	0.3	2.6	100.0
1961	32.4	**15.7**	5.1	**6.2**	**10.5**	21.3	1.9	0.0	6.9	100.0
1962	18.7	**11.4**	10.1	**7.4**	**8.1**	28.4	5.1	0.2	10.8	100.0
1963	16.0	**12.8**	10.6	**8.5**	**4.4**	29.4	2.3	0.4	15.5	100.0
1964	17.0	**14.6**	13.3	**7.2**	**3.2**	27.2	1.2	0.1	16.1	100.0
1965	24.0	**9.1**	9.7	**5.2**	**4.2**	32.8	1.6	0.5	12.8	100.0
1966	38.0	**8.4**	6.7	**3.4**	**5.8**	16.8	2.0	0.1	18.7	100.0
1967	37.7	**12.6**	12.8	**4.5**	**6.6**	6.3	2.2	0.3	17.0	100.0
1968	27.4	**14.7**	6.5	**8.6**	**8.7**	2.5	3.4	0.3	27.9	100.0
1969	35.8	**13.8**	2.9	**7.5**	**8.3**	1.0	5.0	0.2	25.4	100.0
1970	34.9	**11.8**	5.7	**6.1**	**6.5**	1.6	6.9	0.6	25.9	100.0
1971	44.7	**13.1**	5.3	**3.7**	**5.3**	2.5	6.0	0.1	19.3	100.0
1972	43.6	**16.1**	6.8	**5.3**	**6.0**	1.3	4.7	0.1	16.1	100.0
1973	47.1	**13.3**	9.8	**3.4**	**6.2**	1.3	4.0	0.0	14.8	100.0
1974	51.2	**12.4**	7.8	3.7	4.3	1.9	5.1	0.1	13.5	100.0
1975	49.5	**12.8**	8.5	1.2	3.9	1.9	7.9	0.2	14.1	100.0
1976	52.0	**11.2**	14.3	1.6	3.8	1.7	6.1	0.5	8.9	100.0
1977	55.9	**12.3**	13.1	2.1	4.1	2.3	4.3	0.2	5.6	100.0
1978	47.6	**14.4**	17.2	2.0	5.6	3.5	4.2	0.1	5.4	100.0
1979	47.9	**8.5**	20.6	**5.7**	**5.8**	1.8	5.3	0.2	4.1	100.0
1980	43.8	**8.1**	24.6	**2.5**	**5.7**	3.4	6.3	0.2	5.4	100.0
1981	44.7	**5.2**	29.3	**1.3**	**4.5**	4.1	6.0	0.0	4.8	100.0
1982	43.5	**7.0**	27.2	**1.9**	**5.4**	5.7	6.3	0.1	2.9	100.0
1983	25.0	**6.0**	52.2	**3.4**	**5.2**	3.3	4.2	0.1	0.5	100.0
1984	30.8	**5.4**	42.7	1.1	6.2	6.4	6.4	0.1	0.8	100.0
1985	38.5	**3.4**	34.7	1.8	6.9	5.9	8.6	0.2	0.0	100.0
1986	40.9	**4.7**	33.8	1.7	6.8	3.4	8.6	0.1	0.0	100.0
1987	39.3	**5.3**	36.1	3.4	4.3	2.2	9.2	0.1	0.0	100.0
1988	46.8	**4.6**	25.7	4.5	4.4	2.8	10.9	0.2	0.0	100.0
1989	48.8	**4.3**	23.2	2.0	3.3	6.3	11.6	0.5	0.0	100.0
1990	46.9	**4.0**	24.9	2.8	3.2	3.1	14.9	0.1	0.0	100.0
1991	52.8	**4.6**	20.6	2.9	3.5	2.2	13.3	0.1	0.0	100.0
1992	54.5	**4.1**	24.9	2.4	4.3	0.8	9.0	0.1	0.0	100.0
1993	56.6	**4.4**	20.7	1.5	4.5	0.6	11.5	0.2	0.0	100.0
1994	55.6	**4.5**	21.1	1.0	4.4	0.5	12.8	0.2	0.0	100.0
1995	52.1	**4.6**	24.9	2.0	3.9	0.3	11.7	0.5	0.0	100.0
1996	54.9	**4.1**	25.0	2.1	3.4	0.3	9.8	0.3	0.0	100.0
1997	57.4	**4.9**	22.6	1.7	4.1	0.3	9.0	0.1	0.0	100.0
1998	66.6	**1.9**	17.5	1.4	2.9	0.2	9.3	0.1	0.0	100.0
1999	69.1	**1.3**	17.4	1.6	3.2	0.1	7.0	0.2	0.0	100.0
2000	65.6	**1.3**	22.5	0.8	5.2	0.4	3.6	0.1	0.4	100.0
Avg	37.6	8.7	14.0	7.4	8.3	13.8	4.6	0.6	5.2	100.0
50-64 Avg	23.3	10.2	5.7	13.7	14.1	26.8	0.9	1.3	4.0	100.0
86-00 Avg	53.9	3.9	24.1	2.1	4.1	1.6	10.1	0.2	0.0	100.0
Max	69.1	18.5	52.2	65.5	30.9	68.6	14.9	11.5	27.9	100.0
Min	0.0	0.0	0.0	0.8	2.9	0.1	0.0	0.0	0.0	100.0

Notes:
Data from NASS
Bold - data is estimated using various techniques based on available data. (See spreadsheet "Crop Production w-Estimates.xls")
Data for 1940-47 is estimated using the 1950-60 average
Percentage for column 4 includes wheat and barley.

TABLE 8
IRRIGATED CROP MIX

LINCOLN COUNTY
(values in percentage)

Year	Corn-Grain	Corn-Silage	Wheat	Other Hay	Alfalfa	Sorghum	Dry Beans	Oats	Sugar Beets	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1940	13.4	6.2	4.6	21.1	43.3	7.2	3.2	0.9	0.0	100.0
1941	13.4	6.2	4.6	21.1	43.3	7.2	3.2	0.9	0.0	100.0
1942	13.4	6.2	4.6	21.1	43.3	7.2	3.2	0.9	0.0	100.0
1943	13.4	6.2	4.6	21.1	43.3	7.2	3.2	0.9	0.0	100.0
1944	13.4	6.2	4.6	21.1	43.3	7.2	3.2	0.9	0.0	100.0
1945	13.4	6.2	4.6	21.1	43.3	7.2	3.2	0.9	0.0	100.0
1946	13.4	6.2	4.6	21.1	43.3	7.2	3.2	0.9	0.0	100.0
1947	13.4	6.2	4.6	21.1	43.3	7.2	3.2	0.9	0.0	100.0
1948	0.0	**0.0**	7.0	**62.7**	**10.6**	**12.7**	7.0	0.0	0.0	100.0
1949	0.0	**0.0**	0.0	**45.1**	**26.6**	**21.2**	7.0	0.0	0.0	100.0
1950	0.0	**0.0**	7.1	**39.2**	**45.1**	**4.0**	4.7	0.0	0.0	100.0
1951	0.0	**0.0**	3.3	**41.1**	**48.8**	**5.6**	1.1	0.0	0.0	100.0
1952	0.0	**0.0**	2.3	**37.1**	**47.2**	**12.6**	0.8	0.0	0.0	100.0
1953	0.0	**0.0**	8.3	**36.8**	**40.7**	**9.8**	0.0	4.4	0.0	100.0
1954	0.0	**0.0**	4.5	**26.0**	**51.1**	**18.3**	0.0	0.0	0.0	100.0
1955	10.1	**5.3**	0.9	**23.2**	**47.9**	**8.4**	3.3	0.9	0.0	100.0
1956	19.5	**9.2**	3.3	**13.3**	**42.1**	**9.3**	2.1	1.2	0.0	100.0
1957	15.7	**6.4**	3.9	**19.0**	**46.6**	3.1	3.9	1.3	0.0	100.0
1958	25.6	**9.9**	5.9	**14.1**	**38.0**	2.5	3.4	0.6	0.0	100.0
1959	32.2	**12.8**	3.0	**10.2**	**36.2**	2.7	2.5	0.5	0.0	100.0
1960	7.8	**8.5**	9.6	**12.7**	**41.5**	9.0	9.9	0.9	0.0	100.0
1961	9.6	**14.1**	2.6	**12.9**	**40.3**	14.6	5.8	0.0	0.0	100.0
1962	6.4	**5.1**	11.5	**20.2**	**36.8**	13.3	2.9	0.0	3.7	100.0
1963	4.1	**3.2**	9.5	**22.6**	**49.3**	9.0	2.3	0.0	0.0	100.0
1964	4.5	**4.0**	6.7	**21.7**	**42.9**	17.9	2.2	0.0	0.0	100.0
1965	2.8	**0.3**	5.6	**32.3**	**43.8**	13.9	1.4	**0.0**	0.0	100.0
1966	1.7	**6.9**	6.9	**26.6**	**54.2**	2.1	1.7	**0.0**	0.0	100.0
1967	3.0	**16.8**	5.0	**28.2**	**38.1**	4.0	5.0	**0.0**	0.0	100.0
1968	3.4	**21.9**	5.3	**32.1**	**32.6**	4.7	0.0	0.0	0.0	100.0
1969	9.1	**25.8**	3.4	**25.5**	**30.6**	4.5	1.1	0.0	0.0	100.0
1970	16.2	**20.3**	6.1	**23.8**	**28.5**	5.1	0.0	0.0	0.0	100.0
1971	8.0	**36.7**	6.4	**14.1**	**26.9**	8.0	0.0	0.0	0.0	100.0
1972	6.9	**13.8**	32.7	**19.2**	**19.4**	2.3	5.7	**0.0**	0.0	100.0
1973	5.5	**9.7**	46.0	**14.6**	**18.7**	0.0	5.5	**0.0**	0.0	100.0
1974	3.0	**19.4**	29.9	0.0	38.8	6.0	3.0	**0.0**	0.0	100.0
1975	7.1	**23.2**	8.9	17.9	35.7	3.6	3.6	0.0	0.0	100.0
1976	3.2	**4.8**	35.5	6.5	40.3	3.2	6.5	0.0	0.0	100.0
1977	3.0	**6.0**	47.8	10.4	23.9	4.5	4.5	0.0	0.0	100.0
1978	18.3	**18.3**	16.7	5.0	38.3	1.7	1.7	0.0	0.0	100.0
1979	1.5	**8.2**	16.4	**25.4**	**20.2**	26.8	1.5	**0.0**	0.0	100.0
1980	5.7	**11.3**	11.3	**25.9**	**23.1**	21.2	1.4	**0.0**	0.0	100.0
1981	0.0	**3.6**	36.2	**10.3**	**31.8**	9.0	9.0	**0.0**	0.0	100.0
1982	0.0	**5.0**	35.2	**20.4**	**29.3**	8.4	1.7	**0.0**	0.0	100.0
1983	2.0	**4.0**	30.2	**31.9**	**31.8**	0.0	0.0	**0.0**	0.0	100.0
1984	0.0	**9.1**	21.2	9.1	45.5	15.2	0.0	**0.0**	0.0	100.0
1985	0.0	**7.1**	25.0	7.1	46.4	14.3	0.0	**0.0**	0.0	100.0
1986	7.1	**10.7**	17.9	7.1	46.4	0.0	10.7	**0.0**	0.0	100.0
1987	3.3	**0.0**	19.0	44.6	27.9	2.2	**3.0**	0.0	0.0	100.0
1988	5.9	**0.0**	12.9	51.6	23.4	3.5	**2.7**	0.0	0.0	100.0
1989	7.8	**0.0**	10.9	39.1	28.1	10.9	3.1	0.0	0.0	100.0
1990	7.6	**0.0**	24.0	33.5	24.3	9.1	**1.5**	0.0	0.0	100.0
1991	8.5	**1.7**	21.4	17.1	34.2	17.1	0.0	0.0	0.0	100.0
1992	13.5	**1.8**	17.3	13.5	45.5	6.7	1.7	0.0	0.0	100.0
1993	18.6	**3.1**	18.6	9.9	36.0	11.2	2.5	0.0	0.0	100.0
1994	14.2	**1.9**	18.5	11.4	35.5	11.4	7.1	0.0	0.0	100.0
1995	12.2	**3.7**	20.1	17.1	28.0	15.9	**3.0**	**0.0**	0.0	100.0
1996	11.5	**1.8**	23.1	25.4	28.9	9.2	0.0	**0.0**	0.0	100.0
1997	22.7	**0.0**	7.6	30.3	19.7	15.2	4.5	**0.0**	0.0	100.0
1998	25.6	**0.0**	19.2	25.6	19.2	7.7	**2.9**	**0.0**	0.0	100.0
1999	57.6	**0.0**	14.4	14.4	8.6	2.9	**2.2**	**0.0**	0.0	100.0
2000	41.8	**0.0**	13.9	8.4	20.9	13.9	**1.0**	0.0	0.0	100.0
Avg	9.9	7.0	13.4	22.3	35.5	8.6	3.0	0.3	0.1	100.0
50-64 Avg	9.0	5.2	5.5	23.3	43.6	9.4	3.0	0.6	0.2	100.0
86-00 Avg	17.2	1.6	17.2	23.3	28.5	9.1	3.1	0.0	0.0	100.0
Max	57.6	36.7	47.8	62.7	54.2	26.8	10.7	4.4	3.7	100.0
Min	0.0	0.0	0.0	0.0	8.6	0.0	0.0	0.0	0.0	100.0

Notes:
Data from NASS
Bold - data is estimated using various techniques based on available data. (See spreadsheet "Crop Production w-Estimates.xls")
Data for 1940-47 is estimated using the 1950-60 average
Percentage for column 4 includes wheat and barley.

TABLE 9
IRRIGATED CROP MIX

LOGAN COUNTY
(values in percentage)

Year	Corn-Grain	Corn-Silage	Wheat	Other Hay	Alfalfa	Sorghum	Dry Beans	Oats	Sugar Beets	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1940	25.7	10.2	13.9	5.9	27.5	1.5	3.1	2.3	9.9	100.0
1941	25.7	10.2	13.9	5.9	27.5	1.5	3.1	2.3	9.9	100.0
1942	25.7	10.2	13.9	5.9	27.5	1.5	3.1	2.3	9.9	100.0
1943	25.7	10.2	13.9	5.9	27.5	1.5	3.1	2.3	9.9	100.0
1944	25.7	10.2	13.9	5.9	27.5	1.5	3.1	2.3	9.9	100.0
1945	25.7	10.2	13.9	5.9	27.5	1.5	3.1	2.3	9.9	100.0
1946	25.7	10.2	13.9	5.9	27.5	1.5	3.1	2.3	9.9	100.0
1947	25.7	10.2	13.9	5.9	27.5	1.5	3.1	2.3	9.9	100.0
1948	23.1	**12.7**	24.7	**4.0**	**18.4**	**0.9**	5.1	2.3	8.6	100.0
1949	25.4	**13.3**	23.3	**4.4**	**17.4**	**0.6**	4.8	2.8	8.0	100.0
1950	26.2	**10.0**	18.7	**4.8**	**21.2**	**0.2**	4.0	1.9	13.0	100.0
1951	19.4	**7.3**	21.7	**5.7**	**25.6**	**0.5**	4.8	2.6	12.3	100.0
1952	21.0	**8.1**	20.4	**6.7**	**26.9**	**0.3**	2.7	3.6	10.4	100.0
1953	19.7	**7.4**	19.4	**6.9**	**28.7**	**0.3**	3.4	3.4	10.7	100.0
1954	21.5	**8.6**	15.3	**6.0**	**28.9**	**1.5**	3.7	1.9	12.6	100.0
1955	26.2	**9.7**	11.3	**5.6**	**26.9**	**7.0**	2.9	2.2	8.2	100.0
1956	26.7	**10.5**	11.6	**5.0**	**29.9**	**2.1**	2.6	2.5	9.1	100.0
1957	28.7	**10.9**	9.8	**5.8**	**28.4**	1.6	2.5	1.6	10.6	100.0
1958	29.5	**11.0**	11.1	**5.0**	**26.7**	0.5	3.1	1.7	11.4	100.0
1959	31.8	**12.0**	8.8	**5.5**	**27.3**	0.6	2.4	1.3	10.3	100.0
1960	28.5	**15.8**	8.9	**7.6**	**32.4**	1.1	2.5	3.2	0.0	100.0
1961	19.9	**12.0**	6.1	**9.2**	**30.5**	0.5	3.4	2.4	15.9	100.0
1962	17.6	**11.2**	5.0	**11.9**	**33.1**	0.8	3.3	2.0	15.2	100.0
1963	18.1	**9.7**	4.4	**12.1**	**35.1**	0.3	2.9	1.8	15.5	100.0
1964	17.0	**12.7**	4.4	**8.6**	**38.3**	0.3	2.3	1.3	15.1	100.0
1965	17.2	**14.1**	5.3	**10.1**	**35.9**	1.0	3.9	2.5	9.9	100.0
1966	23.2	**10.8**	5.5	**6.1**	**37.6**	0.5	4.1	1.9	10.4	100.0
1967	20.8	**16.5**	5.1	**6.2**	**37.7**	0.3	2.8	1.8	8.9	100.0
1968	21.6	**10.4**	3.0	**7.5**	**37.5**	0.3	5.1	2.3	12.3	100.0
1969	18.6	**13.9**	3.0	**7.6**	**37.1**	0.2	4.7	1.7	13.1	100.0
1970	21.8	**14.0**	2.3	**8.0**	**35.1**	0.1	5.3	2.0	11.3	100.0
1971	31.7	**14.3**	1.8	**6.5**	**28.9**	0.1	3.9	1.1	11.7	100.0
1972	25.0	**17.9**	1.3	**6.8**	**31.6**	0.3	4.4	0.9	11.7	100.0
1973	26.6	**14.5**	3.9	**6.6**	**34.3**	0.6	3.6	0.6	9.3	100.0
1974	31.2	**18.0**	3.4	5.4	24.6	**0.7**	3.6	0.5	12.8	100.0
1975	33.1	**13.3**	2.1	5.0	26.5	0.6	4.4	0.8	14.3	100.0
1976	36.1	**14.6**	2.1	4.9	26.1	0.2	4.4	0.9	10.7	100.0
1977	38.4	**13.8**	2.1	8.3	26.5	0.7	4.2	0.8	5.3	100.0
1978	39.3	**14.2**	2.7	5.3	27.2	0.3	4.5	0.3	6.2	100.0
1979	36.6	**14.9**	3.6	**5.8**	**27.3**	0.8	4.3	1.3	5.5	100.0
1980	39.9	**10.5**	2.1	**3.8**	**28.5**	0.2	6.8	0.5	7.7	100.0
1981	40.4	**9.8**	2.9	**4.6**	**26.2**	0.7	8.0	0.8	6.7	100.0
1982	47.3	**8.6**	5.0	**3.8**	**23.6**	0.5	6.3	0.6	4.2	100.0
1983	35.6	**9.8**	5.2	**7.1**	**30.5**	**0.7**	3.1	0.8	7.2	100.0
1984	44.5	**7.6**	4.1	5.3	26.5	**0.7**	4.8	0.7	5.8	100.0
1985	46.0	**6.1**	7.5	2.6	30.3	**0.7**	5.9	0.9	0.0	100.0
1986	47.3	**3.8**	10.1	3.1	25.4	0.7	4.6	0.9	4.1	100.0
1987	40.7	**1.0**	8.2	7.4	29.6	0.5	7.7	0.5	4.3	100.0
1988	47.5	**2.5**	5.7	5.9	24.8	0.3	8.3	0.5	4.4	100.0
1989	46.5	**3.4**	9.5	3.7	23.7	0.5	8.1	0.8	3.9	100.0
1990	42.3	**4.6**	8.6	3.9	25.6	0.1	9.3	1.0	4.6	100.0
1991	45.1	**5.6**	5.9	3.5	26.6	0.1	7.8	0.4	4.8	100.0
1992	50.2	**4.1**	5.3	3.1	26.8	0.1	6.4	0.2	3.9	100.0
1993	45.6	**4.6**	5.1	4.1	29.4	**0.1**	6.8	0.2	4.0	100.0
1994	46.1	**5.4**	3.7	4.0	27.6	**0.1**	8.0	0.3	4.7	100.0
1995	43.4	**4.3**	4.0	7.1	30.4	**0.1**	5.6	0.5	4.8	100.0
1996	43.2	**3.0**	6.2	4.8	33.4	**0.1**	3.3	0.4	5.7	100.0
1997	46.3	**3.2**	8.4	3.7	28.7	0.1	2.6	0.2	7.0	100.0
1998	48.9	**3.8**	4.4	3.8	30.0	0.1	2.9	0.3	5.9	100.0
1999	51.7	**3.0**	5.8	5.3	25.0	0.1	2.6	0.2	6.3	100.0
2000	53.5	**2.1**	6.3	3.1	25.4	0.2	2.1	0.5	6.7	100.0
Avg	32.4	9.6	8.3	5.8	28.7	0.7	4.4	1.4	8.6	100.0
50-64 Avg	23.4	10.5	11.8	7.1	29.3	1.2	3.1	2.2	11.4	100.0
86-00 Avg	46.5	3.6	6.5	4.4	27.5	0.2	5.7	0.5	5.0	100.0
Max	53.5	18.0	24.7	12.1	38.3	7.0	9.3	3.6	15.9	100.0
Min	17.0	1.0	1.3	2.6	17.4	0.1	2.1	0.2	0.0	100.0

Notes:
Data from NASS
Bold - data is estimated using various techniques based on available data. (See spreadsheet "Crop Production w-Estimates.xls")
Data for 1940-47 is estimated using the 1950-60 average
Percentage for column 4 includes wheat and barley.

TABLE 10
IRRIGATED CROP MIX

PHILLIPS COUNTY
(values in percentage)

Year	Corn-Grain	Corn-Silage	Wheat	Other Hay	Alfalfa	Sorghum	Dry Beans	Oats	Sugar Beets	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1940	19.5	1.6	1.1	17.6	49.4	9.7	0.0	1.0	0.0	100.0
1941	19.5	1.6	1.1	17.6	49.4	9.7	0.0	1.0	0.0	100.0
1942	19.5	1.6	1.1	17.6	49.4	9.7	0.0	1.0	0.0	100.0
1943	19.5	1.6	1.1	17.6	49.4	9.7	0.0	1.0	0.0	100.0
1944	19.5	1.6	1.1	17.6	49.4	9.7	0.0	1.0	0.0	100.0
1945	19.5	1.6	1.1	17.6	49.4	9.7	0.0	1.0	0.0	100.0
1946	19.5	1.6	1.1	17.6	49.4	9.7	0.0	1.0	0.0	100.0
1947	19.5	1.6	1.1	17.6	49.4	9.7	0.0	1.0	0.0	100.0
1948	0.0	**0.0**	0.0	**59.6**	**30.0**	**10.4**	0.0	0.0	0.0	100.0
1949	0.0	**0.0**	4.9	**44.0**	**45.3**	**5.8**	0.0	0.0	0.0	100.0
1950	**10.7**	**0.9**	3.0	**35.6**	**45.9**	**2.6**	0.0	1.3	0.0	100.0
1951	8.7	**0.8**	0.0	**27.8**	**59.5**	**1.5**	0.0	1.6	0.0	100.0
1952	8.4	**0.7**	0.8	**10.5**	**77.8**	**1.0**	0.0	0.8	0.0	100.0
1953	2.2	**0.2**	0.0	**17.6**	**76.1**	**3.8**	0.0	0.0	0.0	100.0
1954	2.3	**0.2**	0.7	**18.8**	**66.5**	**11.2**	0.0	0.3	0.0	100.0
1955	9.2	**0.8**	0.5	**14.7**	**49.1**	**24.7**	0.0	0.9	0.0	100.0
1956	31.8	**2.6**	0.0	**15.7**	**37.3**	**11.0**	0.0	1.4	0.0	100.0
1957	27.9	**2.3**	0.6	**22.0**	**38.3**	7.1	0.0	1.9	0.0	100.0
1958	42.1	**3.4**	0.6	**15.8**	**35.5**	1.9	0.0	0.6	0.0	100.0
1959	36.7	**3.0**	**1.6**	**10.0**	**38.1**	9.6	0.0	**0.9**	0.0	100.0
1960	11.2	**1.1**	**5.9**	**19.9**	**51.5**	8.6	0.0	1.7	0.0	100.0
1961	18.1	**1.8**	**8.0**	**15.1**	**45.9**	9.7	0.0	1.5	0.0	100.0
1962	15.2	**1.4**	**9.2**	**29.2**	**40.3**	2.0	1.3	1.3	0.0	100.0
1963	11.9	**1.1**	**6.0**	**31.5**	**38.7**	9.1	0.6	1.1	0.0	100.0
1964	17.6	**0.9**	7.0	**27.5**	**32.2**	9.8	0.6	0.5	3.9	100.0
1965	18.2	**3.7**	4.3	**23.2**	**32.5**	4.3	5.3	1.1	7.5	100.0
1966	32.9	**2.4**	5.9	**10.6**	**25.8**	3.6	7.8	0.8	10.0	100.0
1967	34.8	**4.1**	8.9	**5.6**	**21.0**	3.9	9.2	0.7	11.7	100.0
1968	39.6	**2.9**	2.5	**5.9**	**14.1**	0.6	9.0	0.9	24.5	100.0
1969	22.7	**2.7**	4.4	**4.7**	**10.6**	1.0	16.6	1.4	35.9	100.0
1970	29.9	**3.1**	5.3	**4.7**	**12.3**	0.7	19.9	0.7	23.6	100.0
1971	48.1	**3.1**	4.8	**3.4**	**11.3**	2.2	16.0	0.7	10.4	100.0
1972	52.8	**2.2**	6.0	**2.8**	**9.5**	0.8	10.9	0.3	14.7	100.0
1973	55.6	**2.3**	3.8	**2.8**	**10.8**	0.4	14.4	**0.3**	9.6	100.0
1974	63.3	**2.2**	3.6	0.0	7.3	0.5	14.2	0.2	8.8	100.0
1975	65.0	**2.1**	4.0	0.9	4.6	0.8	13.1	0.2	9.3	100.0
1976	71.3	**1.1**	3.3	0.4	5.5	0.4	8.2	0.7	9.2	100.0
1977	76.2	**2.7**	3.3	1.1	3.9	0.7	7.4	0.4	4.3	100.0
1978	76.6	**2.1**	2.7	1.0	3.5	1.2	6.4	0.1	6.4	100.0
1979	81.7	**2.2**	1.0	**1.8**	**3.1**	0.5	9.3	0.4	0.0	100.0
1980	74.8	**3.1**	2.4	**1.1**	**3.8**	1.4	12.8	0.6	0.0	100.0
1981	77.7	**1.5**	3.4	**0.7**	**3.2**	0.6	12.5	**0.5**	0.0	100.0
1982	74.2	**1.6**	7.6	**0.8**	**2.7**	0.2	12.5	0.5	0.0	100.0
1983	68.4	**2.1**	10.0	**2.1**	**3.6**	0.2	7.5	0.7	5.4	100.0
1984	66.5	**3.8**	7.2	2.9	3.4	0.3	9.1	1.1	5.7	100.0
1985	77.0	**1.0**	6.9	1.6	4.9	0.3	7.9	0.6	0.0	100.0
1986	75.0	**0.8**	9.8	1.4	3.9	0.7	8.1	0.3	0.0	100.0
1987	74.6	**0.9**	9.2	1.4	2.8	0.3	10.5	0.4	0.0	100.0
1988	78.4	**1.2**	5.5	1.0	2.4	0.4	10.6	0.5	0.0	100.0
1989	79.2	**2.2**	3.8	0.5	2.5	0.9	10.5	**0.5**	0.0	100.0
1990	75.2	**3.2**	3.6	0.4	3.3	0.6	13.3	**0.4**	0.0	100.0
1991	80.8	**2.5**	2.6	1.0	3.3	0.5	8.8	**0.4**	0.0	100.0
1992	83.6	**1.1**	2.7	0.7	3.2	0.1	8.2	**0.4**	0.0	100.0
1993	82.8	**1.0**	4.0	0.5	2.9	0.1	8.1	**0.3**	0.2	100.0
1994	84.0	**0.7**	2.8	0.4	2.9	**0.1**	8.9	**0.3**	0.0	100.0
1995	80.8	**0.6**	2.8	**0.5**	3.1	**0.1**	11.7	**0.2**	0.2	100.0
1996	77.1	**0.3**	3.2	**0.5**	3.4	**0.0**	12.8	**0.2**	2.4	100.0
1997	80.0	**0.8**	5.4	**0.4**	1.8	0.0	5.8	**0.1**	5.7	100.0
1998	73.1	**0.7**	4.2	**0.5**	2.1	**0.0**	13.7	**0.1**	5.5	100.0
1999	75.4	**1.0**	5.0	0.6	3.9	**0.0**	8.5	**0.1**	5.5	100.0
2000	75.1	**0.7**	7.6	0.4	3.4	**0.0**	6.6	**0.0**	6.1	100.0
Avg	45.8	1.7	3.8	10.6	23.7	3.9	6.2	0.7	3.7	100.0
50-64 Avg	16.9	1.4	2.9	20.8	48.9	7.6	0.2	1.1	0.3	100.0
86-00 Avg	78.3	1.2	4.8	0.7	3.0	0.3	9.7	0.3	1.7	100.0
Max	84.0	4.1	10.0	59.6	77.8	24.7	19.9	1.9	35.9	100.0
Min	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	100.0

Notes:
Data from NASS
Bold - data is estimated using various techniques based on available data. (See spreadsheet "Crop Production w-Estimates.xls")
Data for 1940-47 is estimated using the 1950-60 average
Percentage for column 4 includes wheat and barley.

TABLE 11
IRRIGATED CROP MIX

SEDGWICK COUNTY
(values in percentage)

Year	Corn-Grain	Corn-Silage	Wheat	Other Hay	Alfalfa	Sorghum	Dry Beans	Oats	Sugar Beets	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1940	25.8	6.7	8.5	12.2	17.0	0.8	11.3	2.4	15.4	100.0
1941	25.8	6.7	8.5	12.2	17.0	0.8	11.3	2.4	15.4	100.0
1942	25.8	6.7	8.5	12.2	17.0	0.8	11.3	2.4	15.4	100.0
1943	25.8	6.7	8.5	12.2	17.0	0.8	11.3	2.4	15.4	100.0
1944	25.8	6.7	8.5	12.2	17.0	0.8	11.3	2.4	15.4	100.0
1945	25.8	6.7	8.5	12.2	17.0	0.8	11.3	2.4	15.4	100.0
1946	25.8	6.7	8.5	12.2	17.0	0.8	11.3	2.4	15.4	100.0
1947	25.8	6.7	8.5	12.2	17.0	0.8	11.3	2.4	15.4	100.0
1948	**25.6**	**5.8**	9.6	**12.0**	**22.4**	**0.3**	7.2	5.2	11.8	100.0
1949	**27.7**	**6.3**	23.1	**11.6**	**17.2**	**0.3**	7.2	5.3	1.1	100.0
1950	**29.2**	**6.8**	14.1	**19.8**	**18.2**	**0.0**	6.7	3.3	1.8	100.0
1951	23.5	**7.4**	11.4	**10.9**	**17.0**	**0.1**	12.6	3.5	13.5	100.0
1952	21.5	**5.2**	12.0	**13.5**	**18.5**	**0.1**	9.9	5.8	13.6	100.0
1953	21.7	**5.1**	11.9	**11.3**	**20.0**	**0.0**	12.2	4.6	13.3	100.0
1954	23.0	**5.8**	9.0	**11.0**	**16.7**	**1.7**	12.7	2.2	17.9	100.0
1955	29.8	**6.9**	7.1	**12.7**	**16.1**	**2.2**	9.1	1.7	14.4	100.0
1956	29.4	**6.8**	6.1	**14.1**	**16.4**	**1.7**	9.4	0.4	15.8	100.0
1957	32.7	**7.6**	4.7	**13.0**	**13.1**	0.5	9.7	0.6	18.2	100.0
1958	2.9	**4.5**	9.0	**10.9**	**22.7**	0.2	18.0	1.9	29.8	100.0
1959	33.1	**8.0**	6.0	**8.9**	**15.9**	0.6	10.6	0.9	16.0	100.0
1960	25.8	**8.4**	4.6	**9.3**	**16.0**	1.0	14.9	1.7	18.3	100.0
1961	20.6	**6.5**	5.0	**11.8**	**16.1**	1.9	14.5	2.9	20.7	100.0
1962	23.2	**6.8**	1.6	**15.1**	**15.7**	0.9	14.2	1.2	21.3	100.0
1963	22.1	**8.9**	1.1	**9.1**	**17.0**	0.3	16.8	1.1	23.7	100.0
1964	23.9	**6.3**	0.6	**9.0**	**20.3**	0.4	16.6	0.1	22.7	100.0
1965	23.2	**8.1**	1.2	**12.2**	**17.5**	1.8	14.9	0.4	20.6	100.0
1966	25.4	**6.8**	1.4	**10.9**	**16.3**	0.6	15.0	6.6	17.0	100.0
1967	25.0	**10.2**	5.3	**9.8**	**16.5**	0.9	14.4	0.8	17.1	100.0
1968	23.2	**9.8**	5.8	**8.9**	**15.2**	1.2	18.8	0.7	16.3	100.0
1969	20.9	**12.8**	4.0	**9.2**	**16.3**	0.5	18.1	0.7	17.4	100.0
1970	23.1	**9.7**	3.6	**13.1**	**15.4**	0.5	20.2	1.5	12.9	100.0
1971	26.3	**21.8**	3.0	**8.0**	**17.5**	0.3	14.7	0.3	8.2	100.0
1972	30.9	**17.7**	3.4	**7.1**	**13.0**	0.3	18.2	0.3	9.1	100.0
1973	35.9	**10.8**	1.6	**7.6**	**13.7**	0.7	20.6	0.7	8.5	100.0
1974	40.5	**13.5**	3.4	6.2	10.0	0.5	18.1	0.9	6.9	100.0
1975	42.6	**10.6**	2.4	5.6	7.6	0.4	20.6	**1.2**	9.1	100.0
1976	43.2	**13.6**	8.6	2.6	9.1	0.2	15.6	0.6	6.5	100.0
1977	55.5	**11.7**	5.4	5.0	6.7	0.6	10.4	0.4	4.4	100.0
1978	57.2	**10.7**	3.4	3.6	7.0	0.6	12.1	**0.0**	5.5	100.0
1979	58.2	**10.3**	4.1	**4.7**	**5.5**	1.2	10.0	0.4	5.5	100.0
1980	62.7	**8.4**	3.0	**2.2**	**6.5**	0.2	11.0	1.0	5.0	100.0
1981	59.5	**7.4**	4.1	**2.9**	**6.2**	0.2	13.6	0.6	5.4	100.0
1982	61.2	**5.0**	10.2	**2.7**	**6.1**	0.4	11.3	0.4	2.8	100.0
1983	57.7	**9.4**	7.3	**3.8**	**6.1**	0.3	12.5	0.4	2.4	100.0
1984	58.6	**5.9**	11.3	2.9	5.3	0.2	11.5	0.2	4.2	100.0
1985	55.0	**2.4**	15.1	1.5	6.0	0.2	19.8	0.2	0.0	100.0
1986	58.4	**1.8**	13.3	2.2	6.0	0.2	17.7	0.4	0.0	100.0
1987	58.8	**3.0**	9.3	4.5	9.0	0.1	14.7	0.5	0.0	100.0
1988	64.6	**1.2**	9.0	3.4	9.0	0.1	11.6	1.0	0.0	100.0
1989	70.4	**1.8**	5.6	2.7	6.2	0.1	11.4	1.9	0.0	100.0
1990	67.5	**2.5**	6.1	2.9	6.3	0.0	13.7	1.0	0.0	100.0
1991	69.4	**3.6**	4.5	2.7	7.4	0.0	12.0	0.4	0.0	100.0
1992	72.8	**1.5**	4.5	2.1	8.6	0.0	10.3	0.2	0.0	100.0
1993	69.4	**1.2**	5.5	1.4	10.2	0.0	12.0	0.2	0.0	100.0
1994	69.4	**1.7**	3.4	1.2	11.4	**0.1**	12.4	0.0	0.3	100.0
1995	69.9	**1.2**	4.3	2.3	11.3	**0.1**	10.8	0.1	0.0	100.0
1996	73.6	**1.1**	4.7	2.2	11.0	**0.1**	7.0	0.2	0.1	100.0
1997	66.2	**1.8**	8.6	2.8	9.8	0.2	6.4	0.4	3.9	100.0
1998	67.4	**1.8**	7.1	2.0	8.7	0.2	8.2	0.5	4.2	100.0
1999	61.0	**2.2**	8.7	0.9	11.3	**0.2**	9.8	0.3	5.6	100.0
2000	64.1	**1.1**	8.8	1.2	11.0	0.0	9.6	0.5	3.8	100.0
Avg	41.2	6.7	6.8	7.6	13.1	0.5	12.8	1.4	9.8	100.0
50-64 Avg	24.2	6.7	6.9	12.0	17.3	0.8	12.5	2.1	17.4	100.0
86-00 Avg	66.9	1.8	6.9	2.3	9.1	0.1	11.2	0.5	1.2	100.0
Max	73.6	21.8	23.1	19.8	22.7	2.2	20.6	6.6	29.8	100.0
Min	2.9	1.1	0.6	0.9	5.3	0.0	6.4	0.0	0.0	100.0

Notes:
Data from NASS
Bold - data is estimated using various techniques based on available data. (See spreadsheet "Crop Production w-Estimates.xls")
Data for 1940-47 is estimated using the 1950-60 average
Percentage for column 4 includes wheat and barley.

TABLE 12
IRRIGATED CROP MIX

WASHINGTON COUNTY
(values in percentage)

Year	Corn-Grain	Corn-Silage	Wheat	Other Hay	Alfalfa	Sorghum	Dry Beans	Oats	Sugar Beets	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1940	23.6	4.1	10.4	15.1	30.5	1.8	6.6	2.8	5.1	100.0
1941	23.6	4.1	10.4	15.1	30.5	1.8	6.6	2.8	5.1	100.0
1942	23.6	4.1	10.4	15.1	30.5	1.8	6.6	2.8	5.1	100.0
1943	23.6	4.1	10.4	15.1	30.5	1.8	6.6	2.8	5.1	100.0
1944	23.6	4.1	10.4	15.1	30.5	1.8	6.6	2.8	5.1	100.0
1945	23.6	4.1	10.4	15.1	30.5	1.8	6.6	2.8	5.1	100.0
1946	23.6	4.1	10.4	15.1	30.5	1.8	6.6	2.8	5.1	100.0
1947	23.6	4.1	10.4	15.1	30.5	1.8	6.6	2.8	5.1	100.0
1948	**22.1**	**3.8**	26.3	**11.0**	**14.3**	**2.8**	9.6	2.6	7.5	100.0
1949	**27.4**	**4.3**	19.3	**10.7**	**16.0**	**2.3**	11.2	2.4	6.4	100.0
1950	**23.5**	**3.7**	13.5	**13.8**	**19.4**	**0.9**	9.9	6.7	8.6	100.0
1951	17.8	**3.2**	12.6	**19.6**	**23.3**	**0.7**	10.0	5.8	7.0	100.0
1952	20.2	**3.3**	14.7	**14.1**	**29.1**	**0.8**	9.9	3.5	4.3	100.0
1953	19.1	**3.2**	13.9	**13.4**	**31.6**	**0.7**	9.0	3.9	5.2	100.0
1954	19.5	**3.7**	8.8	**14.8**	**32.2**	**2.7**	9.3	2.7	6.4	100.0
1955	23.5	**4.4**	12.5	**13.4**	**24.9**	**9.2**	6.8	1.7	3.5	100.0
1956	34.0	**5.6**	11.7	**11.3**	**28.0**	**1.2**	2.6	1.5	4.2	100.0
1957	29.8	**4.9**	9.7	**13.5**	**30.5**	0.8	4.3	1.8	4.8	100.0
1958	29.3	**4.7**	8.1	**9.7**	**36.3**	0.6	5.0	1.8	4.4	100.0
1959	21.4	**3.6**	6.7	**26.6**	**31.5**	0.8	4.1	1.5	3.7	100.0
1960	17.2	**4.3**	6.5	**13.0**	**43.5**	1.4	6.0	2.4	5.7	100.0
1961	16.5	**3.6**	9.4	**13.5**	**40.6**	1.3	6.9	1.7	6.6	100.0
1962	12.4	**2.5**	7.4	**25.7**	**38.3**	2.0	5.1	1.1	5.7	100.0
1963	12.3	**2.5**	7.3	**29.6**	**35.8**	1.5	4.7	0.6	5.7	100.0
1964	12.2	**1.8**	7.5	**27.6**	**38.7**	1.9	4.6	0.7	5.0	100.0
1965	19.4	**6.6**	5.3	**15.7**	**37.8**	2.6	5.8	2.3	4.5	100.0
1966	23.6	**4.6**	11.2	**13.0**	**33.7**	0.8	7.2	1.7	4.2	100.0
1967	33.9	**4.5**	12.4	**11.1**	**29.0**	0.8	2.5	1.1	4.7	100.0
1968	20.7	**5.6**	20.5	**11.3**	**24.7**	1.4	2.8	0.9	12.2	100.0
1969	14.9	**10.0**	35.2	**8.7**	**18.4**	1.0	2.7	2.2	7.0	100.0
1970	17.4	**18.7**	26.5	**9.1**	**14.8**	0.6	4.4	2.5	5.9	100.0
1971	31.3	**6.8**	20.6	**9.9**	**14.4**	0.7	9.9	0.3	6.3	100.0
1972	23.1	**13.5**	12.7	**9.4**	**18.9**	0.6	14.6	0.2	7.0	100.0
1973	28.8	**12.4**	12.3	**9.2**	**20.9**	1.8	10.2	0.0	4.5	100.0
1974	45.7	**7.5**	7.5	6.8	16.3	0.7	7.5	0.7	7.5	100.0
1975	46.2	**7.9**	8.1	3.0	11.9	0.6	12.2	**0.4**	9.6	100.0
1976	42.1	**4.6**	14.4	2.4	13.0	0.5	15.5	0.3	7.1	100.0
1977	51.9	**3.5**	14.2	5.2	13.7	0.7	4.2	0.7	5.9	100.0
1978	41.5	**3.8**	36.5	2.2	8.8	0.4	2.6	**1.0**	3.3	100.0
1979	57.7	**3.4**	12.1	**4.0**	**12.2**	0.3	3.5	2.3	4.5	100.0
1980	51.5	**5.4**	16.7	**2.5**	**12.0**	0.9	4.3	0.9	5.7	100.0
1981	56.3	**3.4**	20.0	**2.1**	**9.8**	0.7	3.4	0.4	4.0	100.0
1982	57.5	**4.0**	15.4	**3.1**	**11.4**	1.4	4.5	0.2	2.5	100.0
1983	49.9	**5.1**	9.3	**7.5**	**16.4**	2.8	3.7	1.4	3.8	100.0
1984	46.8	**4.7**	16.8	1.6	17.1	1.3	5.5	3.9	2.2	100.0
1985	43.5	**4.4**	26.7	3.1	14.0	1.0	4.9	2.3	0.0	100.0
1986	40.5	**3.5**	28.4	3.5	14.2	0.6	6.0	2.2	1.0	100.0
1987	45.2	**1.3**	25.1	5.4	9.9	0.6	10.5	1.4	0.6	100.0
1988	46.5	**2.1**	18.8	5.9	9.8	0.7	13.7	1.7	0.7	100.0
1989	48.7	**3.9**	17.3	3.8	9.5	1.8	12.4	1.5	1.1	100.0
1990	45.8	**2.2**	12.1	6.0	13.8	1.5	16.1	1.3	1.2	100.0
1991	52.6	**1.8**	7.9	6.6	14.7	1.3	13.1	0.8	1.2	100.0
1992	58.6	**2.1**	7.8	5.2	17.0	0.3	6.5	1.3	1.1	100.0
1993	58.1	**2.9**	8.9	4.9	15.3	0.2	7.9	0.5	1.1	100.0
1994	55.4	**3.2**	8.9	3.9	18.5	**0.3**	8.3	0.6	1.0	100.0
1995	46.1	**2.0**	13.1	5.6	20.7	**0.4**	9.5	1.7	1.0	100.0
1996	56.2	**0.8**	9.8	3.6	20.3	**0.4**	6.9	0.7	1.2	100.0
1997	50.5	**2.7**	18.2	3.6	14.4	0.4	5.8	1.1	3.2	100.0
1998	47.4	**3.2**	15.7	4.1	15.5	0.2	8.2	1.9	3.9	100.0
1999	47.5	**3.7**	13.9	5.1	17.0	**0.5**	7.3	0.5	4.5	100.0
2000	45.9	**3.9**	18.8	2.5	19.2	1.0	3.8	0.4	4.6	100.0
Avg	34.4	4.5	14.1	10.0	22.2	1.3	7.2	1.8	4.5	100.0
50-64 Avg	20.6	3.7	10.0	17.3	32.2	1.8	6.5	2.5	5.4	100.0
86-00 Avg	49.7	2.6	15.0	4.6	15.3	0.7	9.1	1.2	1.8	100.0
Max	58.6	18.7	36.5	29.6	43.5	9.2	16.1	6.7	12.2	100.0
Min	12.2	0.8	5.3	1.6	8.8	0.2	2.5	0.0	0.0	100.0

Notes:

Data from NASS

Bold - data is estimated using various techniques based on available data. (See spreadsheet "Crop Production w-Estimates.xls")

Data for 1940-47 is estimated using the 1950-60 average

Percentage for column 4 includes wheat and barley.

TABLE 13
IRRIGATED CROP MIX

YUMA COUNTY
(values in percentage)

Year	Corn-Grain	Corn-Silage	Wheat	Other Hay	Alfalfa	Sorghum	Dry Beans	Oats	Sugar Beets	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1940	14.1	1.9	2.6	10.4	56.7	13.3	0.6	0.4	0.0	100.0
1941	14.1	1.9	2.6	10.4	56.7	13.3	0.6	0.4	0.0	100.0
1942	14.1	1.9	2.6	10.4	56.7	13.3	0.6	0.4	0.0	100.0
1943	14.1	1.9	2.6	10.4	56.7	13.3	0.6	0.4	0.0	100.0
1944	14.1	1.9	2.6	10.4	56.7	13.3	0.6	0.4	0.0	100.0
1945	14.1	1.9	2.6	10.4	56.7	13.3	0.6	0.4	0.0	100.0
1946	14.1	1.9	2.6	10.4	56.7	13.3	0.6	0.4	0.0	100.0
1947	14.1	1.9	2.6	10.4	56.7	13.3	0.6	0.4	0.0	100.0
1948	**11.2**	**1.5**	5.4	**35.1**	**24.0**	**18.9**	1.3	2.7	**0.0**	100.0
1949	**9.2**	**1.2**	1.3	**25.0**	**40.7**	**21.3**	1.1	0.2	**0.0**	100.0
1950	**8.3**	**1.1**	1.2	**25.1**	**48.8**	**15.1**	0.0	0.1	**0.2**	100.0
1951	6.7	**0.9**	1.8	**23.9**	**60.9**	**3.8**	**0.6**	**1.4**	**0.0**	100.0
1952	2.7	**0.4**	**2.8**	**9.8**	**75.3**	**6.5**	**0.8**	1.7	**0.0**	100.0
1953	2.7	**0.4**	**2.2**	**8.5**	**78.8**	**5.9**	**1.1**	0.4	**0.0**	100.0
1954	3.0	**0.5**	**1.2**	**8.0**	**67.3**	**18.7**	1.1	0.2	**0.0**	100.0
1955	2.7	**0.4**	1.1	**5.5**	**49.7**	**39.5**	0.9	0.2	**0.0**	100.0
1956	17.8	**2.4**	4.1	**6.5**	**49.7**	**18.7**	0.7	0.1	**0.0**	100.0
1957	24.6	**3.2**	4.3	**10.4**	**53.8**	3.0	0.4	0.3	**0.0**	100.0
1958	31.5	**4.2**	3.2	**12.3**	**44.5**	3.6	0.4	0.3	**0.0**	100.0
1959	27.9	**3.6**	4.0	**8.3**	**48.8**	7.0	0.1	0.3	**0.0**	100.0
1960	20.8	**3.0**	2.1	**13.5**	**50.9**	9.0	0.4	0.4	**0.0**	100.0
1961	13.4	**2.2**	1.4	**14.6**	**56.1**	10.5	0.2	1.6	**0.0**	100.0
1962	11.5	**2.2**	9.4	**18.3**	**43.5**	12.2	0.3	2.4	**0.0**	100.0
1963	15.8	**2.7**	8.0	**20.1**	**36.0**	14.9	0.3	1.0	**1.3**	100.0
1964	16.3	**4.4**	4.9	**19.4**	**35.4**	14.1	0.1	0.1	**5.3**	100.0
1965	24.9	**3.7**	6.0	**12.0**	**33.3**	15.1	0.0	0.8	**4.3**	100.0
1966	33.3	**3.4**	7.5	**8.8**	**30.2**	8.4	1.2	0.4	**6.8**	100.0
1967	43.2	**5.1**	10.9	**5.6**	**22.9**	5.1	0.4	0.6	**6.2**	100.0
1968	42.8	**5.9**	3.3	**6.7**	**18.0**	2.3	3.2	0.9	**17.0**	100.0
1969	42.8	**6.5**	2.5	**6.8**	**16.0**	1.7	3.3	1.0	**19.4**	100.0
1970	43.8	**5.7**	6.1	**5.8**	**16.8**	2.0	3.4	1.6	**14.7**	100.0
1971	56.1	**6.9**	1.9	**5.1**	**14.2**	3.4	2.4	0.1	**10.0**	100.0
1972	57.2	**7.9**	2.8	**5.3**	**11.2**	2.0	5.1	0.1	**8.5**	100.0
1973	59.5	**6.1**	2.2	**4.1**	**12.9**	2.9	3.1	0.2	**8.9**	100.0
1974	69.7	**4.1**	4.3	3.0	8.4	1.2	2.6	0.1	**6.6**	100.0
1975	64.1	**5.4**	8.0	0.8	8.4	1.0	5.5	0.1	**6.7**	100.0
1976	73.6	**6.7**	2.7	0.9	6.8	1.0	3.6	0.1	**4.6**	100.0
1977	78.7	**5.1**	2.3	1.3	6.3	0.8	3.1	0.2	**2.2**	100.0
1978	78.0	**3.7**	3.4	1.4	7.6	0.8	2.9	0.1	**2.2**	100.0
1979	79.6	**3.6**	2.5	**1.7**	**6.0**	1.8	3.2	0.1	**1.5**	100.0
1980	74.0	**2.5**	4.1	**1.6**	**5.9**	2.4	6.8	0.1	**2.8**	100.0
1981	77.2	**1.8**	4.1	**0.9**	**5.2**	1.4	6.7	**0.1**	**2.5**	100.0
1982	75.7	**2.6**	7.4	**1.1**	**4.0**	0.6	7.0	0.1	**1.4**	100.0
1983	68.9	**3.7**	10.5	**1.5**	**6.5**	**0.7**	7.1	0.2	**0.9**	100.0
1984	68.5	**2.6**	13.0	0.5	4.4	0.5	9.3	0.3	**1.0**	100.0
1985	66.4	**1.8**	11.9	0.9	4.2	0.4	14.2	0.2	**0.0**	100.0
1986	66.9	**2.0**	11.6	0.9	3.9	0.7	13.8	0.2	**0.0**	100.0
1987	69.7	**2.9**	10.2	1.9	3.8	0.2	11.1	0.2	**0.0**	100.0
1988	78.8	**1.5**	5.9	1.7	3.6	0.3	8.0	0.2	**0.0**	100.0
1989	80.2	**1.7**	4.4	0.9	3.5	0.8	8.3	0.2	**0.0**	100.0
1990	75.3	**2.5**	4.0	0.8	4.2	0.6	12.4	0.1	**0.0**	100.0
1991	79.0	**2.3**	3.7	1.6	4.5	0.4	8.3	0.0	**0.0**	100.0
1992	78.9	**1.8**	5.0	1.9	5.2	0.4	6.8	**0.0**	**0.0**	100.0
1993	80.7	**1.6**	3.2	1.0	5.4	0.1	7.9	**0.0**	**0.0**	100.0
1994	76.1	**1.6**	3.9	0.6	5.6	0.2	12.0	0.0	**0.0**	100.0
1995	73.8	**1.4**	5.1	1.0	6.3	0.2	12.0	0.2	**0.0**	100.0
1996	75.7	**0.9**	5.0	1.0	6.2	**0.1**	10.7	0.1	**0.4**	100.0
1997	76.5	**0.9**	6.0	1.4	5.3	0.1	7.9	0.0	**1.9**	100.0
1998	76.3	**1.1**	4.2	1.2	5.3	0.0	9.5	0.1	**2.2**	100.0
1999	75.4	**1.1**	4.5	1.5	5.8	0.0	8.7	0.0	**3.0**	100.0
2000	74.9	**0.9**	6.4	0.5	7.0	0.0	7.5	**0.2**	**2.7**	100.0
Avg	45.2	2.8	4.6	7.2	26.9	6.4	4.2	0.4	2.4	100.0
50-64 Avg	13.7	2.1	3.4	13.6	53.3	12.2	0.5	0.7	0.5	100.0
86-00 Avg	75.9	1.6	5.5	1.2	5.0	0.3	9.6	0.1	0.7	100.0
Max	80.7	7.9	13.0	35.1	78.8	39.5	14.2	2.7	19.4	100.0
Min	2.7	0.4	1.1	0.5	3.5	0.0	0.0	0.0	0.0	100.0

Notes:

Data from NASS

Bold - data is estimated using various techniques based on available data. (See spreadsheet "Crop Production w-Estimates.xls")

Data for 1940-47 is estimated using the 1950-60 average

Percentage for column 4 includes wheat and barley.

TABLE 14
POTENTIAL CROP CONSUMPTIVE USE

CHEYENNE COUNTY
(values in inches)

Year	Corn (Grain)	Corn (Silage)	Wheat	Grass Hay	Alfalfa Hay	Sorghum	Dry Beans	Oats	Sugar Beets	Weighted Average
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1940	32.10	26.45	23.08	29.20	30.87	18.95	17.04	19.45	27.98	26.60
1941	31.01	25.35	20.08	28.64	30.00	18.65	16.87	16.89	28.00	25.90
1942	29.78	24.35	22.31	28.54	29.22	19.22	17.39	18.77	26.56	25.78
1943	32.08	25.62	23.92	31.12	32.18	19.12	17.32	19.99	30.22	27.61
1944	33.59	27.05	21.37	29.84	31.52	20.34	18.49	17.72	29.69	27.44
1945	28.76	23.35	22.55	28.36	28.16	19.37	17.61	18.11	25.34	25.37
1946	32.27	26.29	24.23	32.07	32.54	19.87	18.05	20.07	30.43	28.25
1947	31.99	25.24	23.43	29.78	32.00	19.07	17.38	18.57	29.06	27.12
1948	33.03	27.11	22.47	32.15	33.80	19.70	18.05	18.80	32.12	21.89
1949	31.68	25.88	21.64	29.96	31.42	19.45	17.69	18.40	29.26	21.57
1950	29.51	24.66	23.67	28.39	28.80	21.10	19.39	20.28	26.04	27.42
1951	30.06	24.23	22.37	29.39	29.89	19.10	17.27	17.66	27.25	28.32
1952	32.60	27.10	23.51	32.31	35.42	20.17	18.40	19.56	33.04	30.13
1953	32.30	25.91	23.52	30.64	33.42	19.20	17.45	19.13	32.03	27.25
1954	30.58	25.29	23.14	32.99	35.20	18.54	16.83	19.78	34.34	26.79
1955	31.96	25.96	21.99	31.05	33.16	18.52	16.74	19.12	31.24	27.37
1956	33.20	26.61	23.61	32.29	36.21	19.72	18.04	18.71	35.22	32.42
1957	32.31	25.64	21.55	30.52	32.52	18.66	16.89	18.60	30.31	28.56
1958	32.85	26.91	20.79	29.40	31.96	19.33	17.61	17.60	30.68	25.35
1959	33.12	26.62	22.66	30.94	33.19	19.78	17.97	19.55	30.80	27.60
1960	33.96	27.60	24.20	32.15	33.17	20.16	18.29	20.09	31.41	26.93
1961	32.17	26.22	22.89	29.95	31.84	19.67	17.83	19.22	29.17	25.05
1962	33.66	27.20	22.71	31.35	33.07	19.45	17.62	18.50	31.92	26.66
1963	30.82	25.84	23.61	32.31	35.04	18.45	16.70	19.46	33.55	28.94
1964	34.53	28.11	22.35	32.01	34.13	20.08	17.95	19.63	32.51	27.90
1965	30.21	25.85	22.58	29.62	29.42	20.41	18.51	19.67	27.61	25.19
1966	32.72	26.71	23.98	30.38	31.54	19.91	17.80	19.89	29.62	28.00
1967	29.84	24.23	24.10	29.54	29.18	20.43	18.38	19.82	26.88	26.36
1968	31.49	25.00	24.44	30.03	30.63	20.09	18.20	19.42	28.39	27.40
1969	30.68	25.56	22.23	30.13	30.50	18.50	16.69	18.98	28.40	27.40
1970	32.25	25.74	22.30	29.39	32.31	18.28	16.53	19.40	30.26	27.54
1971	31.77	25.84	22.73	29.35	30.88	19.40	17.60	19.39	28.48	28.17
1972	31.43	25.82	23.11	29.51	30.27	19.50	17.68	19.13	28.10	27.75
1973	30.47	25.55	21.17	28.46	29.77	19.30	17.59	18.44	27.24	27.96
1974	33.81	27.02	22.74	31.14	32.95	19.66	17.76	18.48	32.01	29.44
1975	32.62	26.75	22.76	30.70	32.07	19.69	17.86	19.48	30.08	27.51
1976	31.71	26.25	23.51	30.49	31.18	18.92	17.15	19.50	29.04	26.95
1977	31.28	25.86	21.83	30.85	34.00	18.65	16.92	17.91	32.35	28.62
1978	32.41	26.27	23.14	30.27	31.68	19.45	17.62	19.37	29.99	30.07
1979	31.85	25.43	22.98	30.41	31.18	19.72	17.80	19.41	29.37	28.25
1980	30.92	25.14	21.87	30.62	32.88	18.60	16.88	18.56	31.42	27.06
1981	30.83	24.81	22.61	30.28	31.32	19.06	17.28	19.15	29.48	26.81
1982	30.39	24.82	21.33	28.70	29.72	18.84	17.12	18.31	26.79	26.61
1983	31.87	25.62	21.31	29.93	32.24	18.98	17.26	17.56	29.24	28.82
1984	32.90	27.01	21.04	29.72	32.04	19.60	17.85	18.10	29.64	27.70
1985	32.38	26.95	21.97	30.25	31.62	19.56	17.63	18.59	29.21	28.30
1986	31.65	25.29	23.10	30.12	31.99	18.56	16.87	18.73	30.32	27.75
1987	32.72	26.54	21.15	30.38	32.57	18.96	17.17	18.19	30.94	27.67
1988	31.20	25.18	22.58	30.54	32.75	18.51	16.91	18.50	31.72	27.69
1989	30.96	25.21	22.26	29.41	29.72	18.52	16.89	18.05	29.15	27.35
1990	31.63	26.00	22.68	30.52	32.11	19.42	17.70	19.02	31.12	27.21
1991	31.85	26.27	23.16	29.79	31.00	19.02	17.28	19.67	28.71	28.00
1992	31.55	25.29	23.40	30.53	31.48	20.21	18.19	19.62	28.93	28.48
1993	31.45	25.74	22.90	29.97	31.11	19.79	18.02	18.79	28.50	28.56
1994	32.44	26.95	21.96	31.35	34.11	19.77	18.10	18.14	33.62	28.67
1995	30.21	24.29	21.13	28.62	30.25	18.77	17.07	17.14	26.92	26.70
1996	31.41	26.12	22.72	29.78	30.70	18.67	16.89	19.22	28.66	27.92
1997	30.59	24.84	22.52	28.71	30.46	18.65	16.92	17.93	28.40	28.21
1998	30.49	25.27	23.96	29.58	31.61	17.87	16.19	19.38	29.99	28.18
1999	30.64	24.46	21.81	28.94	30.21	17.72	15.96	18.36	28.57	28.13
2000	31.69	26.56	23.33	32.57	35.45	19.00	17.27	19.16	33.83	28.75
Avg	31.71	25.85	22.62	30.26	31.83	19.27	17.48	18.89	29.85	27.47
50-64 Avg	32.24	26.26	22.84	31.05	33.14	19.46	17.67	19.13	31.30	27.78
86-00 Avg	31.37	25.60	22.58	30.05	31.70	18.90	17.16	18.66	29.96	27.95
Max	34.53	28.11	24.44	32.99	36.21	21.10	19.39	20.28	35.22	32.42
Min	28.76	23.35	20.08	28.36	28.16	17.72	15.96	16.89	25.34	21.57

Column Explanations:

1) Year

2 - 10) Potential consumptive use estimated using a calibrated Hargreaves reference ET.

11) Weighted average calculated using the crop mix from NASS data and individual crop potential consumptive use.

TABLE 15
POTENTIAL CROP CONSUMPTIVE USE

KIT CARSON COUNTY
(values in inches)

Year	Corn (Grain)	Corn (Silage)	Wheat	Grass Hay	Alfalfa Hay	Sorghum	Dry Beans	Oats	Sugar Beets	Weighted Average
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1940	32.40	26.89	23.27	29.36	31.07	19.28	17.36	19.76	27.93	27.57
1941	31.63	25.63	21.44	29.58	31.00	18.64	16.83	18.15	28.65	26.92
1942	31.91	26.20	23.28	30.40	31.33	19.90	18.01	19.74	28.75	27.62
1943	32.15	25.68	24.48	31.56	32.66	18.92	17.16	20.64	30.76	27.81
1944	33.92	27.33	22.11	30.13	32.26	19.74	17.91	18.58	30.63	28.44
1945	30.13	23.80	23.66	29.31	29.60	19.19	17.31	18.77	26.81	26.21
1946	31.72	25.77	24.27	31.97	32.60	19.33	17.56	20.16	30.43	27.79
1947	31.66	25.10	22.98	29.69	31.96	18.82	17.09	18.12	28.65	27.13
1948	32.74	26.42	22.69	31.36	32.43	19.45	17.82	18.95	30.79	22.76
1949	31.59	25.58	21.51	29.81	31.35	19.33	17.54	18.22	29.64	23.17
1950	28.69	23.79	24.54	28.28	27.98	20.58	18.81	20.97	25.65	27.06
1951	28.03	22.28	21.59	28.06	28.09	18.85	17.70	17.31	25.28	23.18
1952	33.58	27.30	23.88	32.03	34.93	20.37	18.55	19.91	32.45	26.94
1953	31.91	25.44	23.68	29.24	31.54	19.02	17.26	18.98	30.02	25.06
1954	31.64	26.13	23.86	33.45	35.55	19.25	17.42	20.54	34.31	27.92
1955	32.70	26.49	22.79	31.47	33.52	18.95	17.09	19.81	31.27	24.92
1956	37.67	30.01	24.79	33.28	36.17	22.49	20.57	19.56	35.21	31.93
1957	30.62	24.56	20.97	29.61	30.76	19.83	17.95	18.17	28.13	26.66
1958	32.40	25.94	21.67	28.99	30.36	20.39	18.55	18.34	28.15	29.53
1959	34.90	28.51	24.24	33.05	34.83	21.36	19.50	20.88	32.48	31.77
1960	32.99	26.43	24.69	31.47	31.85	20.03	18.11	20.47	29.64	28.75
1961	31.60	26.27	23.61	30.26	31.22	20.77	18.74	19.75	28.84	27.49
1962	34.51	28.41	23.68	32.33	33.51	20.44	18.63	19.32	32.24	27.41
1963	32.14	27.05	23.70	33.31	36.25	19.27	17.38	19.69	34.57	27.08
1964	33.01	26.51	21.76	31.37	33.11	18.96	16.94	18.87	31.71	26.21
1965	29.78	25.17	21.60	29.02	29.15	18.59	16.75	18.74	27.50	24.28
1966	31.39	25.29	23.31	29.51	31.22	18.09	16.14	19.18	29.30	27.31
1967	30.12	24.42	23.96	28.84	29.54	19.45	17.55	19.58	27.42	27.07
1968	31.32	25.31	24.48	29.87	30.98	19.78	17.95	19.82	28.22	28.20
1969	31.35	25.92	23.46	30.89	31.32	18.83	17.07	19.92	28.75	28.81
1970	32.26	25.90	22.80	29.85	32.85	18.35	16.60	19.85	30.85	29.12
1971	32.35	26.18	22.90	29.93	31.46	20.19	18.45	19.29	28.73	29.05
1972	31.50	25.85	23.25	30.14	30.67	19.72	17.99	19.40	28.34	28.60
1973	30.55	25.62	21.49	28.66	30.13	18.86	17.24	18.76	27.58	27.79
1974	33.55	26.85	23.23	31.27	32.85	19.40	17.55	19.07	31.57	30.43
1975	31.30	25.06	22.58	30.10	31.96	18.33	16.62	19.19	30.11	28.18
1976	31.55	26.00	23.60	30.55	31.33	18.78	17.01	19.48	29.40	28.43
1977	30.45	25.36	21.34	30.46	33.45	18.59	16.91	17.23	32.39	27.98
1978	32.74	26.43	21.89	30.69	32.08	19.70	17.84	18.43	30.69	28.68
1979	30.41	24.26	23.52	29.12	30.03	18.37	16.56	19.82	27.82	27.29
1980	30.28	24.83	21.75	30.44	33.03	18.40	16.65	18.76	31.54	26.68
1981	30.84	24.42	22.40	30.23	31.81	18.76	17.05	18.65	30.12	26.71
1982	29.60	24.18	21.98	28.36	29.23	18.33	16.54	18.97	26.02	25.53
1983	31.10	24.73	21.20	29.41	31.48	18.42	16.69	17.46	28.30	24.46
1984	31.70	25.78	21.18	28.99	31.24	18.73	17.09	17.85	28.64	25.02
1985	31.35	26.00	21.66	29.28	30.55	18.63	16.75	18.44	28.53	25.68
1986	31.20	25.10	23.00	29.50	31.33	18.40	16.69	18.58	29.67	26.43
1987	32.10	26.08	20.22	29.54	31.44	18.81	17.07	17.36	30.14	25.68
1988	31.26	24.90	22.45	29.70	31.58	18.33	16.73	18.47	30.54	26.67
1989	30.48	24.90	22.04	29.13	29.25	18.65	16.92	18.26	28.57	25.83
1990	31.58	25.65	22.33	29.74	30.85	19.52	17.71	18.79	30.11	26.51
1991	31.96	25.82	22.27	29.43	30.90	18.97	17.19	18.72	29.24	27.30
1992	30.39	24.11	23.34	29.68	29.97	20.18	18.72	19.42	27.28	27.20
1993	29.18	23.95	22.93	28.18	28.86	19.75	18.09	18.56	26.05	26.28
1994	33.13	26.91	22.56	30.91	33.23	19.87	18.17	18.48	32.26	28.59
1995	28.98	23.40	20.94	27.75	28.64	19.13	17.42	16.80	25.24	25.24
1996	31.10	24.42	21.46	29.12	30.42	18.29	16.36	17.96	29.67	26.83
1997	31.35	25.34	23.45	29.30	30.84	19.54	17.73	18.63	28.43	27.95
1998	32.18	26.35	24.95	30.40	32.51	18.75	16.96	19.97	30.72	29.33
1999	31.24	25.57	22.26	29.05	30.24	19.02	17.09	18.46	27.92	28.51
2000	32.89	27.43	24.85	33.29	35.67	19.69	17.83	20.47	33.98	30.54
Avg	31.65	25.69	22.82	30.16	31.61	19.28	17.50	19.02	29.58	27.24
50-64 Avg	32.43	26.34	23.30	31.08	32.64	20.04	18.21	19.50	30.66	27.46
86-00 Avg	31.27	25.33	22.60	29.65	31.05	19.13	17.38	18.59	29.32	27.26
Max	37.67	30.01	24.95	33.45	36.25	22.49	20.57	20.97	35.21	31.93
Min	28.03	22.28	20.22	27.75	27.98	18.09	16.14	16.80	25.24	22.76

Column Explanations:

1) Year

2 - 10) Potential consumptive use estimated using a calibrated Hargreaves reference ET.

11) Weighted average calculated using the crop mix from NASS data and individual crop potential consumptive use.

TABLE 16
POTENTIAL CROP CONSUMPTIVE USE

LINCOLN COUNTY
(values in inches)

Year	Corn (Grain)	Corn (Silage)	Wheat	Grass Hay	Alfalfa Hay	Sorghum	Dry Beans	Oats	Sugar Beets	Weighted Average
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1940	32.40	26.89	23.27	29.36	31.07	19.28	17.36	19.76	27.93	28.88
1941	31.63	25.63	21.44	29.58	31.00	18.64	16.83	18.15	28.65	28.55
1942	31.91	26.20	23.28	30.40	31.33	19.90	18.01	19.74	28.75	29.17
1943	32.15	25.68	24.48	31.56	32.66	18.92	17.16	20.64	30.76	29.95
1944	33.92	27.33	22.11	30.13	32.26	19.74	17.91	18.58	30.63	29.77
1945	30.13	23.80	23.66	29.31	29.60	19.19	17.31	18.77	26.81	27.74
1946	31.72	25.77	24.27	31.97	32.60	19.33	17.56	20.16	30.43	29.99
1947	31.66	25.10	22.98	29.69	31.96	18.82	17.09	18.12	28.65	29.05
1948	32.74	26.42	22.69	31.36	32.43	19.45	17.82	18.95	30.79	28.40
1949	31.59	25.58	21.51	29.81	31.35	19.33	17.54	18.22	29.64	27.14
1950	28.69	23.79	24.54	28.28	27.98	20.58	18.81	20.97	25.65	27.12
1951	28.03	22.28	21.59	28.06	28.09	18.85	17.70	17.31	25.28	27.23
1952	33.58	27.30	23.88	32.03	34.93	20.37	18.55	19.91	32.45	31.64
1953	31.91	25.44	23.68	29.24	31.54	19.02	17.26	18.98	30.02	28.26
1954	31.64	26.13	23.86	33.45	35.55	19.25	17.42	20.54	34.31	31.48
1955	32.70	26.49	22.79	31.47	33.52	18.95	17.09	19.81	31.27	30.61
1956	37.67	30.01	24.79	33.28	36.17	22.49	20.57	19.56	35.21	33.33
1957	30.62	24.56	20.97	29.61	30.76	19.83	17.95	18.17	28.13	28.73
1958	32.40	25.94	21.67	28.99	30.36	20.39	18.55	18.34	28.15	29.02
1959	34.90	28.51	24.24	33.05	34.83	21.36	19.50	20.88	32.48	32.74
1960	32.99	26.43	24.69	31.47	31.85	20.03	18.11	20.47	29.64	28.21
1961	31.60	26.27	23.61	30.26	31.22	20.77	18.74	19.75	28.84	27.98
1962	34.51	28.41	23.68	32.33	33.51	20.44	18.63	19.32	32.24	29.72
1963	32.14	27.05	23.70	33.31	36.25	19.27	17.38	19.69	34.57	31.96
1964	33.01	26.51	21.76	31.37	33.11	18.96	16.94	18.87	31.71	28.80
1965	29.78	25.17	21.60	29.02	29.15	18.59	16.75	18.74	27.50	27.06
1966	31.39	25.29	23.31	29.51	31.22	18.09	16.14	19.18	29.30	29.29
1967	30.12	24.42	23.96	28.84	29.54	19.45	17.55	19.58	27.42	27.22
1968	31.32	25.31	24.48	29.87	30.98	19.78	17.95	19.82	28.22	28.52
1969	31.35	25.92	23.46	30.89	31.32	18.83	17.07	19.92	28.75	28.83
1970	32.26	25.90	22.80	29.85	32.85	18.35	16.60	19.85	30.85	29.28
1971	32.35	26.18	22.90	29.93	31.46	20.19	18.45	19.29	28.73	27.94
1972	31.50	25.85	23.25	30.14	30.67	19.72	17.99	19.40	28.34	26.55
1973	30.55	25.62	21.49	28.66	30.13	18.86	17.24	18.76	27.58	24.81
1974	33.55	26.85	23.23	31.27	32.85	19.40	17.55	19.07	31.57	27.57
1975	31.30	25.06	22.58	30.10	31.96	18.33	16.62	19.19	30.11	28.11
1976	31.55	26.00	23.60	30.55	31.33	18.78	17.01	19.48	29.40	26.96
1977	30.45	25.36	21.34	30.46	33.45	18.59	16.91	17.23	32.39	25.38
1978	32.74	26.43	21.89	30.69	32.08	19.70	17.84	18.43	30.69	28.95
1979	30.41	24.26	23.52	29.12	30.03	18.37	16.56	19.82	27.82	24.93
1980	30.28	24.83	21.75	30.44	33.03	18.40	16.65	18.76	31.54	26.65
1981	30.84	24.42	22.40	30.23	31.81	18.76	17.05	18.65	30.12	25.46
1982	29.60	24.18	21.98	28.36	29.23	18.33	16.54	18.97	26.02	25.12
1983	31.10	24.73	21.20	29.41	31.48	18.42	16.69	17.46	28.30	27.43
1984	31.70	25.78	21.18	28.99	31.24	18.73	17.09	17.85	28.64	26.51
1985	31.35	26.00	21.66	29.28	30.55	18.63	16.75	18.44	28.53	26.21
1986	31.20	25.10	23.00	29.50	31.33	18.40	16.69	18.58	29.67	27.47
1987	32.10	26.08	20.22	29.54	31.44	18.81	17.07	17.36	30.14	27.78
1988	31.26	24.90	22.45	29.70	31.58	18.33	16.73	18.47	30.54	28.55
1989	30.48	24.90	22.04	29.13	29.25	18.65	16.92	18.26	28.57	26.97
1990	31.58	25.65	22.33	29.74	30.85	19.52	17.71	18.79	30.11	27.26
1991	31.96	25.82	22.27	29.43	30.90	18.97	17.19	18.72	29.24	26.77
1992	30.39	24.11	23.34	29.68	29.97	20.18	18.72	19.42	27.28	27.89
1993	29.18	23.95	22.93	28.18	28.86	19.75	18.09	18.56	26.05	26.31
1994	33.13	26.91	22.56	30.91	33.23	19.87	18.17	18.48	32.26	28.27
1995	28.98	23.40	20.94	27.75	28.64	19.13	17.42	16.80	25.24	24.94
1996	31.10	24.42	21.46	29.12	30.42	18.29	16.36	17.96	29.67	26.87
1997	31.35	25.34	23.45	29.30	30.84	19.54	17.73	18.63	28.43	27.62
1998	32.18	26.35	24.95	30.40	32.51	18.75	16.96	19.97	30.72	28.93
1999	31.24	25.57	22.26	29.05	30.24	19.02	17.09	18.46	27.92	28.89
2000	32.89	27.43	24.85	33.29	35.67	19.69	17.83	20.47	33.98	30.39
Avg	31.65	25.69	22.82	30.16	31.61	19.28	17.50	19.02	29.58	28.18
50-64 Avg	32.43	26.34	23.30	31.08	32.64	20.04	18.21	19.50	30.66	29.79
86-00 Avg	31.27	25.33	22.60	29.65	31.05	19.13	17.38	18.59	29.32	27.66
Max	37.67	30.01	24.95	33.45	36.25	22.49	20.57	20.97	35.21	33.33
Min	28.03	22.28	20.22	27.75	27.98	18.09	16.14	16.80	25.24	24.81

Column Explanations:

1) Year

2 - 10) Potential consumptive use estimated using a calibrated Hargreaves reference ET.

11) Weighted average calculated using the crop mix from NASS data and individual crop potential consumptive use.

TABLE 17
POTENTIAL CROP CONSUMPTIVE USE

LOGAN COUNTY
(values in inches)

Year	Corn (Grain)	Corn (Silage)	Wheat	Grass Hay	Alfalfa Hay	Sorghum	Dry Beans	Oats	Sugar Beets	Weighted Average
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1940	32.69	27.52	23.53	29.23	30.98	20.21	18.21	20.52	27.12	28.75
1941	30.66	25.23	20.52	28.33	29.72	19.05	17.32	17.29	27.13	27.05
1942	29.41	24.53	21.68	28.46	28.65	20.12	18.39	18.69	25.47	26.45
1943	30.82	24.84	23.84	30.34	30.99	19.64	17.92	19.75	28.12	28.17
1944	31.98	25.96	21.38	28.72	30.43	19.47	17.69	18.00	28.02	27.93
1945	27.33	21.76	21.86	27.74	27.14	19.84	18.49	17.55	23.54	24.99
1946	30.31	24.58	24.97	30.80	31.00	20.18	18.29	20.68	27.58	28.18
1947	30.87	24.49	21.98	28.94	30.67	18.56	16.90	17.73	27.39	27.55
1948	34.26	27.63	23.89	32.67	34.22	20.06	18.36	19.98	32.11	29.31
1949	33.72	27.61	22.14	31.04	32.72	21.09	19.15	18.81	31.14	28.52
1950	30.62	25.61	24.02	29.24	29.18	22.20	20.20	20.67	26.72	27.39
1951	28.79	23.63	22.94	29.22	28.75	19.57	18.39	18.47	25.55	25.94
1952	36.03	29.06	24.50	33.16	35.84	21.69	19.85	20.66	33.20	31.55
1953	33.79	26.85	24.90	30.71	33.01	20.52	18.74	19.99	30.44	29.73
1954	34.38	28.02	25.03	34.71	36.22	20.69	18.70	21.57	34.53	31.95
1955	33.49	27.17	24.29	32.54	34.37	19.47	17.60	20.89	31.40	30.13
1956	35.78	28.81	25.56	33.25	36.51	21.02	19.19	19.96	35.34	32.79
1957	33.64	27.08	21.95	31.69	33.48	20.99	19.06	19.15	30.52	30.48
1958	34.63	28.54	22.33	30.43	32.63	20.26	18.47	19.18	30.49	30.54
1959	34.69	28.04	23.98	32.59	35.04	20.76	18.89	20.63	32.27	32.05
1960	34.42	27.60	25.00	32.43	32.63	21.60	19.52	20.90	30.59	30.83
1961	32.45	26.83	23.99	30.36	31.96	19.96	18.23	19.78	29.27	29.55
1962	33.95	28.46	24.04	32.01	32.64	21.31	19.14	20.02	31.09	30.87
1963	32.95	27.71	24.86	33.32	35.86	19.75	17.97	20.80	33.28	32.50
1964	35.24	28.39	23.38	32.91	34.72	20.05	17.99	20.43	32.79	32.43
1965	30.62	25.93	23.29	30.42	30.37	19.61	17.64	20.40	28.01	28.33
1966	34.55	28.42	25.71	31.98	33.98	20.23	18.06	21.60	31.73	31.74
1967	31.32	25.17	25.42	30.76	30.85	20.87	18.81	20.63	28.28	28.96
1968	33.90	27.22	26.17	32.09	33.60	20.48	18.58	21.28	30.42	31.19
1969	33.66	27.87	24.15	32.77	33.64	19.47	17.67	20.62	31.36	31.19
1970	36.22	29.57	24.26	32.31	35.65	20.85	18.98	21.36	32.88	32.89
1971	32.87	26.84	24.21	30.94	32.15	21.21	19.32	20.51	28.90	30.39
1972	33.36	27.54	24.49	31.07	31.78	21.16	19.24	20.60	29.10	30.27
1973	33.09	28.11	23.91	30.98	32.42	21.18	19.26	20.90	29.36	30.65
1974	35.98	29.78	24.82	33.14	34.60	21.91	19.76	20.71	32.52	32.81
1975	32.99	27.37	24.00	31.61	32.88	21.82	19.76	20.48	29.82	30.76
1976	34.40	28.59	25.37	32.67	33.21	21.95	19.85	21.27	30.58	31.77
1977	34.66	28.39	23.62	31.91	34.05	20.49	18.58	19.97	31.77	32.13
1978	35.30	28.36	25.89	32.61	34.19	21.15	19.13	21.46	31.74	32.58
1979	32.28	25.84	24.75	31.04	31.49	20.48	18.47	20.91	29.14	29.76
1980	35.16	28.30	23.42	32.32	34.51	21.26	19.21	20.11	32.68	32.52
1981	32.16	25.89	24.22	31.86	32.67	21.12	19.08	20.36	30.08	30.08
1982	30.52	25.04	23.49	29.38	29.55	20.39	18.72	20.08	26.19	28.37
1983	32.27	25.59	22.31	30.34	32.43	19.12	17.43	18.66	28.68	30.09
1984	33.69	27.89	22.84	30.36	32.52	19.85	18.13	19.39	29.62	31.14
1985	33.31	28.50	23.71	31.31	32.42	20.02	17.99	20.51	29.38	30.86
1986	31.47	26.25	24.60	29.99	31.14	19.72	17.95	20.19	28.56	29.52
1987	31.48	25.67	20.94	29.03	30.45	19.40	17.55	17.88	28.80	28.74
1988	32.48	26.28	23.36	29.64	31.14	19.15	17.55	19.18	29.38	29.81
1989	28.61	23.78	22.76	28.04	27.77	18.62	17.13	18.80	26.03	26.52
1990	30.14	24.19	22.57	28.67	28.94	19.27	17.57	19.06	27.40	27.43
1991	30.45	24.71	21.55	27.73	28.74	18.57	16.88	17.84	26.83	27.74
1992	27.59	21.85	22.98	27.73	27.39	18.48	18.13	19.24	24.46	26.31
1993	26.21	21.61	22.09	26.14	26.26	18.31	17.47	17.62	23.03	25.05
1994	32.84	26.61	21.90	30.04	31.61	19.26	17.67	18.15	30.61	30.27
1995	27.51	22.36	20.36	26.54	27.37	18.48	16.84	16.31	23.70	26.06
1996	27.09	22.47	21.43	26.71	26.35	18.24	16.52	18.46	23.97	25.77
1997	29.30	23.66	22.26	27.71	28.92	18.25	16.57	17.82	26.36	27.80
1998	30.24	24.19	23.82	28.44	29.95	17.88	16.18	18.90	28.08	29.00
1999	28.89	23.78	21.39	26.90	27.90	17.66	15.97	18.08	25.44	27.36
2000	31.48	26.35	23.49	31.96	34.20	18.82	17.10	19.40	32.62	31.25
Avg	32.21	26.33	23.48	30.52	31.74	20.05	18.25	19.69	29.22	29.55
50-64 Avg	33.66	27.45	24.05	31.91	33.52	20.66	18.80	20.21	31.17	30.58
86-00 Avg	29.72	24.25	22.37	28.35	29.21	18.67	17.14	18.46	27.02	27.91
Max	36.22	29.78	26.17	34.71	36.51	22.20	20.20	21.60	35.34	32.89
Min	26.21	21.61	20.36	26.14	26.26	17.66	15.97	16.31	23.03	24.99

Column Explanations:

1) Year

2 - 10) Potential consumptive use estimated using a calibrated Hargreaves reference ET.

11) Weighted average calculated using the crop mix from NASS data and individual crop potential consumptive use.

TABLE 18
POTENTIAL CROP CONSUMPTIVE USE

PHILLIPS COUNTY
(values in inches)

Year	Corn (Grain)	Corn (Silage)	Wheat	Grass Hay	Alfalfa Hay	Sorghum	Dry Beans	Oats	Sugar Beets	Weighted Average
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1940	31.55	26.51	23.76	28.50	30.16	19.38	17.43	20.68	26.25	28.86
1941	29.62	24.33	20.70	27.67	28.99	18.31	16.61	17.47	26.33	27.55
1942	28.37	23.60	21.96	27.79	27.89	19.34	17.65	18.97	24.71	26.90
1943	29.74	23.88	24.23	29.63	30.14	18.85	17.18	20.04	27.31	28.60
1944	30.92	25.06	21.38	28.01	29.68	18.72	16.99	18.03	27.21	28.27
1945	26.40	20.94	22.08	27.06	26.41	19.14	17.82	17.68	22.88	25.58
1946	29.25	23.65	25.30	30.12	30.18	19.38	17.54	20.96	26.78	28.68
1947	29.81	23.58	22.17	28.23	29.88	17.83	16.21	17.86	26.59	28.09
1948	33.11	26.66	24.41	32.00	33.39	19.26	17.61	20.40	31.19	31.09
1949	32.58	26.64	22.39	30.34	31.94	20.26	18.37	19.06	30.24	30.09
1950	29.57	24.69	24.18	28.54	28.42	21.37	19.41	20.80	25.95	28.14
1951	27.80	22.76	23.11	28.53	28.04	18.87	17.71	18.58	24.84	27.82
1952	34.80	28.01	24.69	32.35	34.93	20.79	19.00	20.82	32.20	34.27
1953	32.64	25.87	24.95	29.93	32.14	19.69	17.96	20.00	29.55	31.28
1954	33.16	26.98	25.36	33.94	35.29	19.81	17.87	21.92	33.49	33.12
1955	32.33	26.16	24.59	31.80	33.51	18.69	16.86	21.19	30.48	29.26
1956	34.60	27.83	25.89	32.46	35.63	20.15	18.38	20.08	34.29	32.67
1957	32.47	26.06	21.99	30.88	32.58	20.15	18.26	19.21	29.63	30.83
1958	33.50	27.58	22.46	29.71	31.83	19.48	17.74	19.34	29.60	31.68
1959	33.51	27.02	24.25	31.83	34.16	19.91	18.09	20.87	31.32	31.82
1960	33.25	26.59	25.45	31.70	31.76	20.75	18.73	21.23	29.69	30.35
1961	31.32	25.84	24.17	29.61	31.13	19.14	17.46	19.87	28.41	28.96
1962	32.84	27.49	24.46	31.36	31.90	20.50	18.39	20.39	30.20	30.58
1963	31.81	26.73	25.37	32.58	34.98	18.90	17.17	21.14	32.26	31.47
1964	34.04	27.38	23.58	32.14	33.87	19.21	17.21	20.64	31.82	30.96
1965	29.58	25.01	23.68	29.80	29.64	18.84	16.93	20.80	27.20	27.82
1966	33.41	27.44	25.99	31.27	33.18	19.41	17.30	21.82	30.81	30.42
1967	30.26	24.25	25.92	30.10	30.07	20.08	18.08	20.98	27.49	27.66
1968	32.74	26.23	26.49	31.33	32.73	19.64	17.79	21.44	29.53	30.00
1969	32.51	26.87	24.55	32.07	32.81	18.69	16.95	21.02	30.44	28.40
1970	35.00	28.53	24.43	31.52	34.79	20.00	18.17	21.53	31.89	29.78
1971	31.75	25.86	24.49	30.21	31.31	20.36	18.53	20.70	28.05	28.30
1972	32.24	26.56	24.80	30.37	30.98	20.34	18.47	20.90	28.25	29.28
1973	31.95	27.10	24.09	30.24	31.59	20.33	18.47	21.06	28.49	29.10
1974	34.76	28.72	25.21	32.39	33.76	21.02	18.92	20.97	31.53	31.60
1975	31.85	26.36	24.19	30.86	32.07	20.98	18.97	20.67	28.95	29.37
1976	33.22	27.55	25.65	31.91	32.33	21.08	19.04	21.48	29.68	31.24
1977	33.50	27.39	23.99	31.20	33.24	19.65	17.79	20.29	30.82	31.56
1978	34.09	27.32	26.26	31.83	33.30	20.28	18.31	21.71	30.78	32.28
1979	31.19	24.91	25.01	30.35	30.69	19.68	17.72	21.16	28.30	29.61
1980	33.96	27.27	23.55	31.54	33.62	20.39	18.39	20.26	31.71	31.19
1981	31.05	24.93	24.66	31.18	31.85	20.28	18.29	20.71	29.20	29.07
1982	29.46	24.11	23.76	28.69	28.79	19.62	17.99	20.31	25.43	27.43
1983	31.14	24.62	22.38	29.57	31.56	18.34	16.70	18.74	27.83	28.74
1984	32.53	26.89	22.91	29.60	31.69	19.05	17.37	19.46	28.73	29.73
1985	32.19	27.51	24.16	30.65	31.63	19.21	17.24	20.88	28.50	30.26
1986	30.41	25.32	25.11	29.35	30.40	18.93	17.20	20.52	27.72	28.66
1987	30.42	24.76	21.19	28.39	29.73	18.63	16.83	18.15	27.96	27.97
1988	31.39	25.36	23.69	28.96	30.36	18.37	16.81	19.39	28.51	29.19
1989	27.63	22.92	23.18	27.42	27.08	17.91	16.45	19.07	25.27	26.04
1990	29.13	23.32	22.75	28.02	28.20	18.51	16.86	19.24	26.61	26.94
1991	29.44	23.85	21.85	27.10	28.02	17.84	16.19	18.08	26.04	27.76
1992	26.68	21.08	23.31	27.17	26.77	17.82	17.48	19.55	23.80	25.74
1993	25.32	20.83	22.34	25.54	25.64	17.65	16.83	17.73	22.39	24.44
1994	31.78	25.72	22.19	29.40	30.86	18.49	16.95	18.42	29.72	30.07
1995	26.55	21.50	20.52	25.84	26.58	17.76	16.16	16.40	23.01	25.09
1996	26.17	21.66	21.68	26.13	25.68	17.53	15.86	18.72	23.28	24.58
1997	28.29	22.79	22.45	27.04	28.17	17.52	15.89	17.94	25.60	27.04
1998	29.23	23.33	24.19	27.79	29.23	17.18	15.53	19.09	27.29	26.97
1999	27.89	22.91	21.58	26.24	27.17	16.94	15.29	18.19	24.67	26.23
2000	30.40	25.43	23.87	31.26	33.38	18.03	16.37	19.73	31.65	29.11
Avg	31.12	25.38	23.75	29.82	30.95	19.25	17.50	19.91	28.37	29.11
50-64 Avg	32.51	26.47	24.30	31.16	32.68	19.83	18.02	20.41	30.25	30.88
86-00 Avg	28.71	23.39	22.66	27.71	28.49	17.94	16.45	18.68	26.23	27.06
Max	35.00	28.72	26.49	33.94	35.63	21.37	19.41	21.92	34.29	34.27
Min	25.32	20.83	20.52	25.54	25.64	16.94	15.29	16.40	22.39	24.44

Column Explanations:

1) Year

2 - 10) Potential consumptive use estimated using a calibrated Hargreaves reference ET.

11) Weighted average calculated using the crop mix from NASS data and individual crop potential consumptive use.

TABLE 19
POTENTIAL CROP CONSUMPTIVE USE

SEDGWICK COUNTY
(values in inches)

Year	Corn (Grain)	Corn (Silage)	Wheat	Grass Hay	Alfalfa Hay	Sorghum	Dry Beans	Oats	Sugar Beets	Weighted Average
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1940	32.69	27.52	23.53	29.23	30.98	20.21	18.21	20.52	27.12	27.98
1941	30.66	25.23	20.52	28.33	29.72	19.05	17.32	17.29	27.13	26.54
1942	29.41	24.53	21.68	28.46	28.65	20.12	18.39	18.69	25.47	26.01
1943	30.82	24.84	23.84	30.34	30.99	19.64	17.92	19.75	28.12	27.58
1944	31.98	25.96	21.38	28.72	30.43	19.47	17.69	18.00	28.02	27.37
1945	27.33	21.76	21.86	27.74	27.14	19.84	18.49	17.55	23.54	24.64
1946	30.31	24.58	24.97	30.80	31.00	20.18	18.29	20.68	27.58	27.57
1947	30.87	24.49	21.98	28.94	30.67	18.56	16.90	17.73	27.39	26.90
1948	34.26	27.63	23.89	32.67	34.22	20.06	18.36	19.98	32.11	30.49
1949	33.72	27.61	22.14	31.04	32.72	21.09	19.15	18.81	31.14	28.26
1950	30.62	25.61	24.02	29.24	29.18	22.20	20.20	20.67	26.72	27.71
1951	28.79	23.63	22.94	29.22	28.75	19.57	18.39	18.47	25.55	25.66
1952	36.03	29.06	24.50	33.16	35.84	21.69	19.85	20.66	33.20	30.99
1953	33.79	26.85	24.90	30.71	33.01	20.52	18.74	19.99	30.44	28.96
1954	34.38	28.02	25.03	34.71	36.22	20.69	18.70	21.57	34.53	31.03
1955	33.49	27.17	24.29	32.54	34.37	19.47	17.60	20.89	31.40	30.16
1956	35.78	28.81	25.56	33.25	36.51	21.02	19.19	19.96	35.34	32.50
1957	33.64	27.08	21.95	31.69	33.48	20.99	19.06	19.15	30.52	30.19
1958	34.63	28.54	22.33	30.43	32.63	20.26	18.47	19.18	30.49	27.85
1959	34.69	28.04	23.98	32.59	35.04	20.76	18.89	20.63	32.27	31.10
1960	34.42	27.60	25.00	32.43	32.63	21.60	19.52	20.90	30.59	29.66
1961	32.45	26.83	23.99	30.36	31.96	19.96	18.23	19.78	29.27	28.01
1962	33.95	28.46	24.04	32.01	32.64	21.31	19.14	20.02	31.09	29.93
1963	32.95	27.71	24.86	33.32	35.86	19.75	17.97	20.80	33.28	30.31
1964	35.24	28.39	23.38	32.91	34.72	20.05	17.99	20.43	32.79	30.92
1965	30.62	25.93	23.29	30.42	30.37	19.61	17.64	20.40	28.01	27.36
1966	34.55	28.42	25.71	31.98	33.98	20.23	18.06	21.60	31.73	29.75
1967	31.32	25.17	25.42	30.76	30.85	20.87	18.81	20.63	28.28	27.75
1968	33.90	27.22	26.17	32.09	33.60	20.48	18.58	21.28	30.42	28.89
1969	33.66	27.87	24.15	32.77	33.64	19.47	17.67	20.62	31.36	28.98
1970	36.22	29.57	24.26	32.31	35.65	20.85	18.98	21.36	32.88	30.33
1971	32.87	26.84	24.21	30.94	32.15	21.21	19.32	20.51	28.90	28.64
1972	33.36	27.54	24.49	31.07	31.78	21.16	19.24	20.60	29.10	28.62
1973	33.09	28.11	23.91	30.98	32.42	21.18	19.26	20.90	29.36	28.83
1974	35.98	29.78	24.82	33.14	34.60	21.91	19.76	20.71	32.52	31.06
1975	32.99	27.37	24.00	31.61	32.88	21.82	19.76	20.48	29.82	28.90
1976	34.40	28.59	25.37	32.67	33.21	21.95	19.85	21.27	30.58	30.05
1977	34.66	28.39	23.62	31.91	34.05	20.49	18.58	19.97	31.77	31.21
1978	35.30	28.36	25.89	32.61	34.19	21.15	19.13	21.46	31.74	31.83
1979	32.28	25.84	24.75	31.04	31.49	20.48	18.47	20.91	29.14	29.46
1980	35.16	28.30	23.42	32.32	34.51	21.26	19.21	20.11	32.68	32.07
1981	32.16	25.89	24.22	31.86	32.67	21.12	19.08	20.36	30.08	29.40
1982	30.52	25.04	23.49	29.38	29.55	20.39	18.72	20.08	26.19	27.91
1983	32.27	25.59	22.31	30.34	32.43	19.12	17.43	18.66	28.68	28.80
1984	33.69	27.89	22.84	30.36	32.52	19.85	18.13	19.39	29.62	29.95
1985	33.31	28.50	23.71	31.31	32.42	20.02	17.99	20.51	29.38	28.59
1986	31.47	26.25	24.60	29.99	31.14	19.72	17.95	20.19	28.56	27.94
1987	31.48	25.67	20.94	29.03	30.45	19.40	17.55	17.88	28.80	27.99
1988	32.48	26.28	23.36	29.64	31.14	19.15	17.55	19.18	29.38	29.48
1989	28.61	23.78	22.76	28.04	27.77	18.62	17.13	18.80	26.03	26.63
1990	30.14	24.19	22.57	28.67	28.94	19.27	17.57	19.06	27.40	27.58
1991	30.45	24.71	21.55	27.73	28.74	18.57	16.88	17.84	26.83	27.96
1992	27.59	21.85	22.98	27.73	27.39	18.48	18.13	19.24	24.46	26.29
1993	26.21	21.61	22.09	26.14	26.26	18.31	17.47	17.62	23.03	24.86
1994	32.84	26.61	21.90	30.04	31.61	19.26	17.67	18.15	30.61	30.28
1995	27.51	22.36	20.36	26.54	27.37	18.48	16.84	16.31	23.70	25.93
1996	27.09	22.47	21.43	26.71	26.35	18.24	16.52	18.46	23.97	25.91
1997	29.30	23.66	22.26	27.71	28.92	18.25	16.57	17.82	26.36	27.52
1998	30.24	24.19	23.82	28.44	29.95	17.88	16.18	18.90	28.08	28.29
1999	28.89	23.78	21.39	26.90	27.90	17.66	15.97	18.08	25.44	26.48
2000	31.48	26.35	23.49	31.96	34.20	18.82	17.10	19.40	32.62	29.63
Avg	32.21	26.33	23.48	30.52	31.74	20.05	18.25	19.69	29.22	28.68
50-64 Avg	33.66	27.45	24.05	31.91	33.52	20.66	18.80	20.21	31.17	29.67
86-00 Avg	29.72	24.25	22.37	28.35	29.21	18.67	17.14	18.46	27.02	27.52
Max	36.22	29.78	26.17	34.71	36.51	22.20	20.20	21.60	35.34	32.50
Min	26.21	21.61	20.36	26.14	26.26	17.66	15.97	16.31	23.03	24.64

Column Explanations:

1) Year

2 - 10) Potential consumptive use estimated using a calibrated Hargreaves reference ET.

11) Weighted average calculated using the crop mix from NASS data and individual crop potential consumptive use.

TABLE 20
POTENTIAL CROP CONSUMPTIVE USE

WASHINGTON COUNTY
(values in inches)

Year	Corn (Grain)	Corn (Silage)	Wheat	Grass Hay	Alfalfa Hay	Sorghum	Dry Beans	Oats	Sugar Beets	Weighted Average
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1940	29.16	23.34	19.02	26.14	27.26	20.66	18.65	16.83	23.35	25.35
1941	29.10	23.32	20.21	28.08	28.82	20.62	18.62	16.84	25.40	26.33
1942	29.10	23.32	20.20	28.06	28.81	20.62	18.62	16.84	25.39	26.32
1943	29.10	23.32	20.20	28.06	28.81	20.62	18.62	16.84	25.39	26.32
1944	29.16	23.34	20.20	28.10	28.85	20.66	18.65	16.83	25.44	26.36
1945	29.10	23.32	20.21	28.08	28.82	20.62	18.62	16.84	25.40	26.33
1946	29.10	23.32	20.20	28.06	28.81	20.62	18.62	16.84	25.39	26.32
1947	29.10	23.32	20.20	28.06	28.81	20.62	18.62	16.84	25.39	26.32
1948	29.16	23.34	20.20	28.10	28.85	20.66	18.65	16.83	25.44	24.57
1949	28.10	22.47	19.30	27.61	27.19	19.82	19.90	15.89	24.17	24.32
1950	25.54	20.62	20.77	26.30	24.91	20.30	19.92	16.80	22.02	23.21
1951	26.40	21.11	19.54	27.70	26.23	18.29	19.05	15.42	22.71	23.89
1952	33.07	26.25	22.11	30.54	31.96	21.43	19.41	18.38	29.47	28.43
1953	31.12	24.27	21.61	28.73	29.52	21.79	19.60	16.47	27.89	26.91
1954	32.39	25.63	23.25	31.62	31.70	21.45	19.33	19.69	29.67	28.98
1955	29.84	23.64	20.90	29.16	29.71	20.44	18.22	17.51	26.96	26.36
1956	33.38	26.68	23.00	30.02	30.66	23.21	21.27	17.79	29.44	29.82
1957	27.70	22.02	18.75	27.82	27.57	20.61	19.90	15.29	24.44	25.77
1958	31.41	25.35	19.75	28.29	28.85	21.05	19.77	16.59	26.87	27.84
1959	31.71	25.75	21.10	29.65	30.68	21.21	19.29	17.69	28.03	28.96
1960	30.50	24.42	22.82	29.58	28.85	22.02	20.18	18.34	26.60	27.65
1961	27.82	22.84	20.79	27.60	27.39	20.88	19.70	16.68	24.62	25.73
1962	30.14	24.51	22.52	29.79	29.15	21.50	20.17	18.26	26.90	27.98
1963	32.46	26.50	23.36	30.20	31.04	20.12	18.14	18.79	29.09	29.34
1964	31.10	25.12	20.47	29.72	30.21	21.74	19.75	17.51	28.03	28.52
1965	26.49	22.21	20.26	27.55	26.06	20.33	19.12	17.35	23.56	24.95
1966	29.88	24.06	22.00	28.87	29.14	20.90	19.03	17.58	26.82	27.16
1967	26.49	20.82	21.77	27.40	26.24	19.80	19.76	16.53	23.33	25.19
1968	28.23	22.13	21.42	27.85	27.73	21.45	19.51	16.33	24.82	25.47
1969	29.44	23.48	21.59	29.16	28.77	19.35	17.44	17.70	26.36	25.04
1970	32.12	26.20	20.17	28.41	30.58	19.71	17.90	17.61	28.13	25.97
1971	29.37	23.92	21.27	28.32	28.63	21.01	19.18	17.77	25.32	25.77
1972	29.95	24.54	22.50	28.56	28.63	20.84	19.08	18.40	25.97	25.95
1973	28.70	23.73	19.43	27.46	28.24	20.32	18.36	16.45	25.28	25.38
1974	32.14	26.48	22.59	30.17	31.09	21.42	19.31	18.70	28.84	29.33
1975	28.52	22.87	20.51	28.51	28.85	20.30	18.44	17.02	26.03	25.89
1976	30.31	24.86	23.06	29.91	29.62	20.84	18.69	18.68	27.10	26.80
1977	32.99	26.30	21.78	30.16	32.14	19.81	18.03	17.70	30.35	29.91
1978	31.86	25.36	22.80	29.69	30.62	20.51	18.53	18.31	28.45	27.50
1979	28.98	22.57	21.31	28.50	28.27	20.59	18.85	17.50	26.13	26.96
1980	31.68	25.29	21.26	29.93	31.09	20.09	18.13	17.97	29.43	28.53
1981	29.66	23.05	22.27	29.31	30.07	20.67	18.69	18.18	27.43	27.42
1982	27.59	22.21	19.67	27.33	27.48	19.22	17.58	16.67	24.31	25.46
1983	29.00	22.48	17.50	27.56	28.90	18.73	17.00	14.13	25.50	26.40
1984	30.02	24.50	19.30	27.75	28.81	19.34	17.48	16.02	26.26	26.24
1985	30.09	25.18	22.25	28.80	29.04	20.30	18.22	18.63	26.30	26.64
1986	30.48	25.10	23.18	29.16	29.67	20.48	18.59	18.35	27.27	26.98
1987	30.38	24.79	20.81	28.80	29.42	20.87	19.00	17.79	27.36	26.28
1988	32.93	26.74	22.86	29.98	31.08	20.42	18.68	18.48	29.60	28.23
1989	29.23	23.87	22.63	28.77	28.10	20.08	18.68	18.25	26.78	26.09
1990	29.62	23.22	22.21	28.64	28.30	21.12	19.19	18.52	26.47	26.36
1991	31.44	25.30	21.74	28.87	29.51	20.56	18.65	17.70	27.53	28.13
1992	28.33	22.18	23.01	28.68	27.95	19.37	19.54	18.91	25.16	26.98
1993	27.03	22.11	22.13	27.60	26.96	19.76	19.59	17.40	23.50	25.77
1994	34.51	28.07	22.01	31.10	32.57	21.02	19.19	18.26	31.52	31.27
1995	27.51	22.00	18.15	26.72	27.14	20.53	18.64	14.31	23.32	24.92
1996	28.83	23.49	21.53	28.20	27.73	20.58	18.73	18.29	25.26	26.97
1997	29.99	24.03	21.68	28.64	29.37	20.80	18.84	17.08	26.48	27.24
1998	31.59	24.86	24.44	29.64	30.97	19.80	17.86	18.49	28.82	28.57
1999	28.99	23.73	21.12	27.28	27.76	19.55	17.71	16.99	25.31	26.31
2000	33.53	27.46	24.01	31.56	32.82	20.10	18.21	19.87	30.48	30.41
Avg	29.88	24.04	21.26	28.69	29.06	20.53	18.86	17.42	26.46	26.83
50-64 Avg	30.30	24.31	21.38	29.11	29.23	21.07	19.58	17.41	26.85	27.29
86-00 Avg	30.29	24.46	22.10	28.91	29.29	20.34	18.74	17.91	26.99	27.37
Max	34.51	28.07	24.44	31.62	32.82	23.21	21.27	19.87	31.52	31.27
Min	25.54	20.62	17.50	26.14	24.91	18.29	17.00	14.13	22.02	23.21

Column Explanations:

1) Year

2 - 10) Potential consumptive use estimated using a calibrated Hargreaves reference ET.

11) Weighted average calculated using the crop mix from NASS data and individual crop potential consumptive use.

TABLE 21
POTENTIAL CROP CONSUMPTIVE USE

YUMA COUNTY
(values in inches)

Year	Corn (Grain)	Corn (Silage)	Wheat	Grass Hay	Alfalfa Hay	Sorghum	Dry Beans	Oats	Sugar Beets	Weighted Average
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1940	28.44	23.87	22.87	26.75	28.54	16.60	14.92	19.85	25.09	26.40
1941	27.14	22.08	19.86	25.86	27.57	15.63	14.13	16.90	25.14	25.31
1942	26.52	22.10	21.27	26.02	26.43	16.49	14.96	18.39	23.75	24.76
1943	27.55	22.08	23.31	27.66	28.39	16.25	14.70	19.53	25.99	26.21
1944	28.39	22.88	20.97	26.05	28.18	15.86	14.38	17.76	25.79	25.93
1945	24.82	19.96	22.15	25.19	25.02	16.55	15.00	17.84	22.04	23.62
1946	27.20	22.17	24.17	28.14	28.51	16.57	14.98	20.13	25.63	26.35
1947	26.93	21.79	21.90	26.29	28.27	15.39	13.97	17.80	25.34	25.74
1948	28.22	22.99	22.43	28.09	29.01	16.25	14.84	18.75	26.88	25.28
1949	28.88	23.58	20.83	27.50	28.30	19.21	17.45	17.65	27.25	25.93
1950	26.43	22.31	24.33	26.33	26.03	18.44	16.58	20.92	23.59	24.92
1951	25.52	20.88	22.15	26.03	26.31	15.90	14.44	17.94	23.42	25.48
1952	27.84	23.57	22.55	28.91	31.99	17.05	15.57	18.95	29.62	29.95
1953	28.76	23.11	23.70	27.55	29.84	16.60	15.01	19.34	27.89	28.47
1954	29.79	24.42	24.86	31.04	32.12	17.55	15.80	21.81	29.73	28.91
1955	27.57	22.58	21.87	28.28	30.19	15.76	14.14	18.90	27.83	24.04
1956	29.90	24.22	23.89	28.65	31.23	17.28	15.80	18.78	30.06	27.62
1957	26.75	21.68	20.38	26.12	27.57	16.22	14.72	17.77	24.63	26.31
1958	29.86	24.84	20.97	26.77	28.74	17.18	15.58	18.12	26.64	27.94
1959	30.00	24.02	22.09	28.43	30.84	17.43	15.85	18.90	28.39	28.82
1960	29.14	23.58	23.70	28.41	28.55	17.42	15.71	19.95	26.52	27.32
1961	27.82	23.03	22.61	26.56	27.89	16.31	14.82	19.10	25.66	26.13
1962	29.70	24.42	22.67	28.62	30.06	16.75	15.15	18.89	28.53	26.98
1963	27.31	23.40	23.75	29.35	31.47	15.97	14.47	19.92	28.91	27.04
1964	28.73	23.66	22.45	29.48	31.36	16.09	14.51	19.74	29.53	27.51
1965	27.50	23.13	21.81	27.34	27.43	16.16	14.51	19.16	25.67	25.10
1966	28.42	23.28	24.08	28.09	30.27	15.67	14.00	20.11	27.86	27.13
1967	27.40	22.18	23.62	27.20	27.65	16.44	14.83	19.61	25.38	25.99
1968	28.16	22.76	24.57	27.85	29.25	16.37	14.80	20.30	26.04	26.78
1969	26.90	22.95	22.28	28.58	29.53	15.56	13.98	19.23	27.42	26.47
1970	27.88	23.74	22.44	28.24	31.67	15.97	14.48	19.83	29.26	27.35
1971	28.77	23.24	22.73	28.04	29.68	16.91	15.29	19.27	26.99	27.46
1972	28.29	23.25	22.43	27.55	28.63	16.31	14.89	18.80	26.46	26.65
1973	27.90	23.47	22.17	26.90	28.50	16.45	14.89	19.63	25.65	26.59
1974	29.81	24.70	22.85	30.09	32.46	16.93	15.28	19.07	30.78	29.05
1975	29.08	23.44	22.75	28.90	30.64	16.51	14.90	19.33	28.63	27.45
1976	27.75	22.95	22.99	29.74	30.98	15.72	14.09	19.24	29.07	26.97
1977	27.87	23.28	25.31	29.22	31.94	16.32	14.73	21.02	28.91	27.36
1978	30.85	25.10	24.75	30.68	31.79	18.30	16.49	21.10	29.72	29.95
1979	28.51	23.40	24.04	29.15	30.26	16.47	14.89	20.35	28.26	27.67
1980	28.95	24.01	22.41	30.36	33.27	17.15	15.53	19.32	31.68	27.72
1981	28.22	22.88	22.61	29.64	31.86	16.50	14.94	18.87	29.86	27.08
1982	27.70	22.72	22.27	26.60	27.80	16.08	14.55	19.10	24.80	26.11
1983	27.58	23.01	22.98	28.70	31.92	16.15	14.60	19.10	28.52	26.21
1984	28.89	24.22	22.55	29.09	31.32	16.87	15.27	19.39	29.05	26.70
1985	28.85	24.67	23.00	29.18	30.87	16.70	15.00	19.81	28.21	26.14
1986	28.44	23.51	23.84	28.56	30.52	16.60	15.04	19.54	28.24	25.94
1987	29.94	23.77	20.70	28.40	30.41	16.51	14.99	18.07	28.97	27.10
1988	29.19	24.03	24.92	29.63	31.86	17.18	15.65	20.43	30.20	27.83
1989	25.91	21.52	22.48	25.76	25.84	15.51	14.08	18.65	24.15	24.61
1990	27.49	22.41	22.41	26.83	27.46	16.65	15.10	19.04	26.05	25.54
1991	27.18	21.93	21.38	25.71	27.04	15.57	14.12	17.71	25.12	25.67
1992	25.69	20.61	22.66	25.84	26.10	16.47	14.81	19.26	23.23	24.70
1993	25.86	21.64	21.64	24.84	26.06	16.55	15.02	17.53	23.32	24.78
1994	28.18	23.57	21.45	27.74	29.87	16.68	15.22	17.78	28.70	26.36
1995	25.66	20.82	20.35	24.85	25.97	16.20	14.68	16.63	22.66	23.98
1996	26.58	21.99	22.29	26.20	26.32	16.30	14.69	19.15	23.87	25.01
1997	27.43	22.55	23.04	26.46	27.76	16.38	14.80	18.73	25.18	26.08
1998	27.64	23.07	24.41	27.66	29.92	15.85	14.32	19.66	27.69	26.30
1999	27.48	22.49	21.63	25.97	27.25	15.86	14.26	18.34	24.78	25.89
2000	28.47	24.09	24.17	29.90	31.98	16.55	14.96	20.18	29.71	27.42
Avg	27.96	23.01	22.68	27.76	29.25	16.51	14.94	19.11	26.95	26.53
50-64 Avg	28.34	23.32	22.80	28.04	29.61	16.80	15.21	19.27	27.40	27.16
86-00 Avg	27.41	22.53	22.49	26.96	28.29	16.32	14.78	18.71	26.12	25.81
Max	30.85	25.10	25.31	31.04	33.27	19.21	17.45	21.81	31.68	29.95
Min	24.82	19.96	19.86	24.84	25.02	15.39	13.97	16.63	22.04	23.62

Column Explanations:

1) Year

2 - 10) Potential consumptive use estimated using a calibrated Hargreaves reference ET.

11) Weighted average calculated using the crop mix from NASS data and individual crop potential consumptive use.

TABLE 22
POTENTIAL CROP CONSUMPTIVE USE
(values in inches)

	County								Basin
Year	Cheyenne	Kit Carson	Lincoln	Logan	Phillips	Sedgwick	Wash-ington	Yuma	Weighted Average
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1940	26.60	27.57	28.88	28.75	28.86	27.98	25.35	26.40	27.88
1941	25.90	26.92	28.55	27.05	27.55	26.54	26.33	25.31	26.72
1942	25.78	27.62	29.17	26.45	26.90	26.01	26.32	24.76	26.45
1943	27.61	27.81	29.95	28.17	28.60	27.58	26.32	26.21	27.69
1944	27.44	28.44	29.77	27.93	28.27	27.37	26.36	25.93	27.39
1945	25.37	26.21	27.74	24.99	25.58	24.64	26.33	23.62	25.68
1946	28.25	27.79	29.99	28.18	28.68	27.57	26.32	26.35	27.39
1947	27.12	27.13	29.05	27.55	28.09	26.90	26.32	25.74	26.79
1948	21.89	22.76	28.40	29.31	31.09	30.49	24.57	25.28	25.29
1949	21.57	23.17	27.14	28.52	30.09	28.26	24.32	25.93	25.26
1950	27.42	27.06	27.12	27.39	28.14	27.71	23.21	24.92	25.73
1951	28.32	23.18	27.23	25.94	27.82	25.66	23.89	25.48	24.96
1952	30.13	26.94	31.64	31.55	34.27	30.99	28.43	29.95	29.50
1953	27.25	25.06	28.26	29.73	31.28	28.96	26.91	28.47	27.61
1954	26.79	27.92	31.48	31.95	33.12	31.03	28.98	28.91	29.12
1955	27.37	24.92	30.61	30.13	29.26	30.16	26.36	24.04	25.31
1956	32.42	31.93	33.33	32.79	32.67	32.50	29.82	27.62	30.44
1957	28.56	26.66	28.73	30.48	30.83	30.19	25.77	26.31	26.86
1958	25.35	29.53	29.02	30.54	31.68	27.85	27.84	27.94	28.93
1959	27.60	31.77	32.74	32.05	31.82	31.10	28.96	28.82	30.58
1960	26.93	28.75	28.21	30.83	30.35	29.66	27.65	27.32	28.33
1961	25.05	27.49	27.98	29.55	28.96	28.01	25.73	26.13	27.04
1962	26.66	27.41	29.72	30.87	30.58	29.93	27.98	26.98	27.55
1963	28.94	27.08	31.96	32.50	31.47	30.31	29.34	27.04	27.54
1964	27.90	26.21	28.80	32.43	30.96	30.92	28.52	27.51	27.08
1965	25.19	24.28	27.06	28.33	27.82	27.36	24.95	25.10	24.87
1966	28.00	27.31	29.29	31.74	30.42	29.75	27.16	27.13	27.54
1967	26.36	27.07	27.22	28.96	27.66	27.75	25.19	25.99	26.61
1968	27.40	28.20	28.52	31.19	30.00	28.89	25.47	26.78	27.65
1969	27.40	28.81	28.83	31.19	28.40	28.98	25.04	26.47	27.52
1970	27.54	29.12	29.28	32.89	29.78	30.33	25.97	27.35	28.26
1971	28.17	29.05	27.94	30.39	28.30	28.64	25.77	27.46	28.07
1972	27.75	28.60	26.55	30.27	29.28	28.62	25.95	26.65	27.65
1973	27.96	27.79	24.81	30.65	29.10	28.83	25.38	26.59	27.28
1974	29.44	30.43	27.57	32.81	31.60	31.06	29.33	29.05	29.91
1975	27.51	28.18	28.11	30.76	29.37	28.90	25.89	27.45	27.89
1976	26.95	28.43	26.96	31.77	31.24	30.05	26.80	26.97	28.05
1977	28.62	27.98	25.38	32.13	31.56	31.21	29.91	27.36	28.41
1978	30.07	28.68	28.95	32.58	32.28	31.83	27.50	29.95	29.80
1979	28.25	27.29	24.93	29.76	29.61	29.46	26.96	27.67	27.84
1980	27.06	26.68	26.65	32.52	31.19	32.07	28.53	27.72	28.08
1981	26.81	26.71	25.46	30.08	29.07	29.40	27.42	27.08	27.34
1982	26.61	25.53	25.12	28.37	27.43	27.91	25.46	26.11	26.16
1983	28.82	24.46	27.43	30.09	28.74	28.80	26.40	26.21	26.22
1984	27.70	25.02	26.51	31.14	29.73	29.95	26.24	26.70	26.73
1985	28.30	25.68	26.21	30.86	30.26	28.59	26.64	26.14	26.71
1986	27.75	26.43	27.47	29.52	28.66	27.94	26.98	25.94	26.62
1987	27.67	25.68	27.78	28.74	27.97	27.99	26.28	27.10	26.80
1988	27.69	26.67	28.55	29.81	29.19	29.48	28.23	27.83	27.77
1989	27.35	25.83	26.97	26.52	26.04	26.63	26.09	24.61	25.38
1990	27.21	26.51	27.26	27.43	26.94	27.58	26.36	25.54	26.16
1991	28.00	27.30	26.77	27.74	27.76	27.96	28.13	25.67	26.70
1992	28.48	27.20	27.89	26.31	25.74	26.29	26.98	24.70	25.83
1993	28.56	26.28	26.31	25.05	24.44	24.86	25.77	24.78	25.33
1994	28.67	28.59	28.27	30.27	30.07	30.28	31.27	26.36	28.00
1995	26.70	25.24	24.94	26.06	25.09	25.93	24.92	23.98	24.68
1996	27.92	26.83	26.87	25.77	24.58	25.91	26.97	25.01	25.70
1997	28.21	27.95	27.62	27.80	27.04	27.52	27.24	26.08	26.90
1998	28.18	29.33	28.93	29.00	26.97	28.29	28.57	26.30	27.52
1999	28.13	28.51	28.89	27.36	26.23	26.48	26.31	25.89	26.78
2000	28.75	30.54	30.39	31.25	29.11	29.63	30.41	27.42	28.86
Avg	27.47	27.24	28.18	29.55	29.11	28.68	26.83	26.53	27.23
50-64 Avg	27.78	27.46	29.79	30.58	30.88	29.67	27.29	27.16	27.77
86-00 Avg	27.95	27.26	27.66	27.91	27.06	27.52	27.37	25.81	26.60
Min	21.6	22.8	24.8	25.0	24.4	24.6	23.2	23.6	24.7
Max	32.4	31.9	33.3	32.9	34.3	32.5	31.3	30.0	30.6

Column Explanations:

1) Year

2 - 9) Weighted average potential consumptive use estimated using a calibrated Hargreaves reference ET from Tables 14 to 21.

10) Potential consumptive use calculated using columns 2 through 9 weighted by county acreages.

TABLE 23
CALIBRATED HARGREAVES VS. MODIFIED BLANEY CRIDDLE
(potential consumptive use, values in inches)

	County																Basin	
Year	Cheyenne		Kit Carson		Lincoln		Logan		Phillips		Sedgwick		Washington		Yuma		Weighted Average	
	Har-greaves	Blaney Criddle	Har-greaves	Blaney Criddle	Har-greaves	Blaney Criddle	Har-greaves	Blaney Criddle	Har-greaves	Blaney Criddle	Har-greaves	Blaney Criddle	Har-greaves	Blaney Criddle	Har-greaves	Blaney Criddle	Har-greaves	Blaney Criddle
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
1940	26.60	25.99	27.57	24.18	28.88	27.99	28.75	25.38	28.86	28.10	27.98	25.29	25.35	23.45	26.40	29.44	27.88	26.54
1941	25.90	24.62	26.92	22.87	28.55	26.93	27.05	24.60	27.55	27.22	26.54	24.44	26.33	23.45	25.31	28.48	26.72	25.70
1942	25.78	23.83	27.62	22.18	29.17	26.59	26.45	23.55	26.90	26.02	26.01	23.46	26.32	23.45	24.76	27.22	26.45	25.15
1943	27.61	25.38	27.81	23.74	29.95	27.64	28.17	24.14	28.60	26.71	27.58	24.14	26.32	23.45	26.21	27.96	27.69	25.71
1944	27.44	23.49	28.44	22.18	29.77	26.42	27.93	23.72	28.27	26.39	27.37	23.65	26.36	23.45	25.93	27.69	27.39	25.22
1945	25.37	21.98	26.21	20.85	27.74	24.58	24.99	21.23	25.58	23.62	24.64	21.25	26.33	23.45	23.62	25.29	25.68	23.33
1946	28.25	25.16	27.79	23.37	29.99	27.47	28.18	24.00	28.68	26.57	27.57	23.95	26.32	23.45	26.35	27.81	27.39	25.14
1947	27.12	25.14	27.13	23.50	29.05	27.40	27.55	25.14	28.09	27.79	26.90	25.08	26.32	23.45	25.74	29.09	26.79	25.72
1948	21.89	18.78	22.76	20.15	28.40	25.63	29.31	23.94	31.09	28.81	30.49	25.95	24.57	20.49	25.28	25.73	25.29	22.54
1949	21.57	18.21	23.17	20.21	27.14	25.46	28.52	22.52	30.09	27.66	28.26	22.19	24.32	20.04	25.93	24.97	25.26	22.52
1950	27.42	24.77	27.06	24.57	27.12	25.85	27.39	22.52	28.14	26.22	27.71	22.38	23.21	19.25	24.92	26.00	25.73	23.85
1951	28.32	25.02	23.18	21.58	27.23	25.91	25.94	21.91	27.82	26.61	25.66	21.97	23.89	19.56	25.48	27.56	24.96	23.77
1952	30.13	28.12	26.94	24.16	31.64	29.49	31.55	25.19	34.27	31.60	30.99	25.19	28.43	23.56	29.95	32.66	29.50	27.99
1953	27.25	26.02	25.06	24.25	28.26	26.67	29.73	23.66	31.28	29.72	28.96	23.60	26.91	22.26	28.47	31.55	27.61	27.03
1954	26.79	26.89	27.92	26.51	31.48	30.25	31.95	26.98	33.12	31.07	31.03	26.65	28.98	24.45	28.91	30.08	29.12	28.03
1955	27.37	26.57	24.92	22.14	30.61	28.76	30.13	25.77	29.26	27.49	30.16	26.20	26.36	22.78	24.04	26.83	25.31	24.23
1956	32.42	30.15	31.93	25.29	33.33	27.25	32.79	26.66	32.67	28.21	32.50	26.82	29.82	23.04	27.62	28.56	30.44	26.49
1957	28.56	25.83	26.66	23.07	28.73	25.84	30.48	24.42	30.83	25.79	30.19	24.53	25.77	21.65	26.31	27.28	26.86	24.58
1958	25.35	22.74	29.53	25.00	29.02	25.45	30.54	25.70	31.68	27.67	27.85	25.74	27.84	23.55	27.94	28.01	28.93	26.02
1959	27.60	24.56	31.77	24.56	32.74	26.79	32.05	26.53	31.82	27.50	31.10	26.05	28.96	24.03	28.82	28.43	30.58	25.95
1960	26.93	23.83	28.75	23.93	28.21	25.24	30.83	24.64	30.35	26.83	29.66	24.52	27.65	24.51	27.32	27.92	28.33	25.40
1961	25.05	20.40	27.49	22.87	27.98	24.46	29.55	25.41	28.96	25.35	28.01	24.19	25.73	22.29	26.13	27.99	27.04	24.51
1962	26.66	23.25	27.41	22.73	29.72	26.37	30.87	26.67	30.58	27.16	29.93	25.58	27.98	24.66	26.98	27.39	27.55	24.52
1963	28.94	27.69	27.08	24.85	31.96	31.07	32.50	30.31	31.47	30.00	30.31	28.64	29.34	27.26	27.04	29.48	27.54	26.53
1964	27.90	23.13	26.21	22.29	28.80	26.88	32.43	28.21	30.96	27.23	30.92	27.08	28.52	24.90	27.51	28.40	27.08	24.42
1965	25.19	20.32	24.28	20.22	27.06	26.54	28.33	25.59	27.82	25.87	27.36	24.92	24.95	22.79	25.10	25.75	24.87	22.43
1966	28.00	23.12	27.31	23.33	29.29	28.95	31.74	26.91	30.42	26.01	29.75	24.90	27.16	22.93	27.13	27.47	27.54	24.96
1967	26.36	21.11	27.07	22.42	27.22	25.59	28.96	25.24	27.66	23.75	27.75	23.88	25.19	21.80	25.99	25.15	26.61	23.61
1968	27.40	22.53	28.20	24.79	28.52	25.79	31.19	27.22	30.00	26.41	28.89	24.89	25.47	21.12	26.78	27.10	27.65	25.70
1969	27.40	24.54	28.81	26.16	28.83	26.25	31.19	27.74	28.40	26.33	28.98	25.61	25.04	20.24	26.47	28.49	27.52	26.89
1970	27.54	22.77	29.12	26.02	29.28	26.93	32.89	27.87	29.78	25.81	30.33	25.58	25.97	20.40	27.35	28.09	28.26	26.59
1971	28.17	22.23	29.05	24.60	27.94	24.29	30.39	25.79	28.30	23.59	28.64	23.98	25.77	21.18	27.46	26.92	28.07	25.28
1972	27.75	23.05	28.60	24.37	26.55	22.94	30.27	26.04	29.28	24.25	28.62	23.56	25.95	21.97	26.65	26.32	27.65	25.07
1973	27.96	24.20	27.79	24.03	24.81	21.00	30.65	26.32	29.10	24.35	28.83	24.12	25.38	21.89	26.59	26.28	27.28	24.96
1974	29.44	23.29	30.43	24.75	27.57	24.22	32.81	26.07	31.60	24.24	31.06	23.86	29.33	23.65	29.05	27.15	29.91	25.64
1975	27.51	21.84	28.18	23.94	28.11	26.56	30.76	25.23	29.37	23.10	28.90	22.74	25.89	22.26	27.45	25.82	27.89	24.51
1976	26.95	21.01	28.43	23.68	26.96	23.67	31.77	25.46	31.24	24.02	30.05	22.77	26.80	22.07	26.97	27.58	28.05	25.32
1977	28.62	25.11	27.98	25.50	25.38	23.93	32.13	26.80	31.56	24.97	31.21	24.59	29.91	24.76	27.36	27.48	28.41	26.26
1978	30.07	24.16	28.68	23.40	28.95	25.98	32.58	26.60	32.28	25.13	31.83	24.70	27.50	20.76	29.95	26.33	29.80	24.88
1979	28.25	22.17	27.29	22.73	24.93	22.64	29.76	25.22	29.61	23.76	29.46	23.57	26.96	22.25	27.67	26.39	27.84	24.55
1980	27.06	23.40	26.68	23.47	26.65	25.48	32.52	26.61	31.19	24.17	32.07	24.58	28.53	22.76	27.72	27.44	28.08	25.41
1981	26.81	21.65	26.71	21.98	25.46	22.91	30.08	25.05	29.07	23.04	29.40	23.28	27.42	22.03	27.08	26.64	27.34	24.33
1982	26.61	21.70	25.53	21.13	25.12	22.15	28.37	23.73	27.43	21.76	27.91	21.90	25.46	21.28	26.11	24.33	26.16	22.75
1983	28.82	23.29	24.46	17.83	27.43	23.04	30.09	26.30	28.74	23.95	28.80	23.79	26.40	23.10	26.21	25.89	26.22	23.04
1984	27.70	20.84	25.02	18.53	26.51	23.68	31.14	25.78	29.73	23.63	29.95	23.09	26.24	21.38	26.70	24.94	26.73	22.57
1985	28.30	22.51	25.68	20.87	26.21	24.93	30.86	25.48	30.26	23.75	28.59	22.34	26.64	20.87	26.14	24.43	26.71	22.99
1986	27.75	23.17	26.43	22.44	27.47	26.77	29.52	25.10	28.66	23.30	27.94	22.52	26.98	21.08	25.94	24.76	26.62	23.57
1987	27.67	22.37	25.68	21.33	27.78	26.56	28.74	25.22	27.97	22.73	27.99	22.92	26.28	20.64	27.10	24.40	26.80	23.00
1988	27.69	24.09	26.67	23.25	28.55	27.63	29.81	25.94	29.19	23.89	29.48	23.98	28.23	21.94	27.83	26.36	27.77	24.76
1989	27.35	22.52	25.83	21.57	26.97	25.50	26.52	23.80	26.04	22.51	26.63	22.55	26.09	20.91	24.61	23.63	25.38	22.68
1990	27.21	22.20	26.51	22.23	27.26	24.62	27.43	24.70	26.94	23.23	27.58	23.23	26.36	21.48	25.54	24.32	26.16	23.37
1991	28.00	22.27	27.30	22.25	26.77	24.88	27.74	25.37	27.76	23.74	27.96	23.70	28.13	23.01	25.67	24.90	26.70	23.79
1992	28.48	21.78	27.20	21.52	27.89	24.44	26.31	23.18	25.74	21.53	26.29	21.72	26.98	21.73	24.70	22.94	25.83	22.23
1993	28.56	21.84	26.28	21.56	26.31	22.75	25.05	23.11	24.44	21.30	24.86	21.44	25.77	20.85	24.78	23.11	25.33	22.21
1994	28.67	24.16	28.59	23.86	28.27	25.44	30.27	26.62	30.07	24.63	30.28	25.03	31.27	24.75	26.36	25.58	28.00	24.89
1995	26.70	20.68	25.24	20.85	24.94	21.29	26.06	24.95	25.09	23.21	25.93	23.54	24.92	20.43	23.98	23.88	24.68	22.65
1996	27.92	22.89	26.83	22.24	26.87	25.62	25.77	25.13	24.58	22.64	25.91	23.35	26.97	22.69	25.01	23.76	25.70	23.11
1997	28.21	22.33	27.95	21.66	27.62	23.30	27.80	25.43	27.04	23.97	27.52	23.85	27.24	21.24	26.08	24.42	26.90	23.34
1998	28.18	23.57	29.33	23.97	28.93	24.89	29.00	27.11	26.97	24.42	28.29	24.89	28.57	22.62	26.30	26.15	27.52	25.01
1999	28.13	24.33	28.51	23.96	28.89	23.74	27.36	25.72	26.23	23.96	26.48	23.95	26.31	22.03	25.89	24.98	26.78	24.33
2000	28.75	24.85	30.54	25.26	30.39	25.89	31.25	28.62	29.11	26.54	29.63	26.60	30.41	24.13	27.42	26.75	28.86	26.10
Avg	27.47	23.43	27.24	23.00	28.18	25.63	29.55	25.41	29.11	25.42	28.68	24.17	26.83	22.41	26.53	26.68	27.23	24.65
50-64 Avg	27.78	25.26	27.46	23.85	29.79	27.08	30.58	25.64	30.88	27.90	29.67	25.27	27.29	23.18	27.16	28.54	27.77	25.55
86-00 Avg	27.95	22.87	27.26	22.53	27.66	24.89	27.91	25.33	27.06	23.44	27.52	23.55	27.37	21.97	25.81	24.66	26.60	23.67
Min	21.57	18.21	22.76	17.83	24.81	21.00	24.99	21.23	24.44	21.30	24.64	21.25	23.21	19.25	23.62	22.94	24.68	22.21
Max	32.42	30.15	31.93	26.51	33.33	31.07	32.89	30.31	34.27	31.60	32.50	28.64	31.27	27.26	29.95	32.66	30.58	28.03

Column Explanations:

1) Year

2-16 Even) Potential consumptive use weighted by NASS crop mix as calculated using calibrated Hargreaves.

3-17 Odd) Potential consumptive use weighted by NASS crop mix as calculated using modified Blaney Criddle.

18) Potential consumptive use calculated using columns 2-16 (Even) weighted by county acreages. (See "Irrigated acreage estimates - Republican River Basin in Colorado" for description of county acreage.)

19) Potential consumptive use calculated using columns 3-17 (Odd) weighted by county acreages. (See "Irrigated acreage estimates - Republican River Basin in Colorado" for description of county acreage.)

TABLE 24
TOTAL AND EFFECTIVE PRECIPITATION
1940 - 2000 Average
(values in inches)

	Corn (Grain)			Corn (Silage)			Wheat			Grass Hay			Alfalfa Hay		
County	Total	Effective	%	Total	Effective	%	Total	Effective	%	Total	Effective	%	Total	Effective	%
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Cheyenne	11.56	8.43	73.6	10.16	7.46	74.2	8.39	6.03	72.4	13.74	9.49	69.6	13.00	9.09	70.8
Kit Carson	11.43	8.14	72.5	10.27	7.38	73.1	8.78	6.42	73.7	13.81	9.51	69.7	12.98	8.97	69.8
Lincoln	11.43	8.14	72.5	10.27	7.38	73.1	8.78	6.42	73.7	13.81	9.51	69.7	12.98	8.97	69.8
Logan	12.66	8.62	69.3	11.11	7.70	70.7	10.67	7.62	72.6	15.46	10.22	67.2	14.36	9.76	69.0
Phillips	12.66	8.50	68.4	11.11	7.60	69.7	10.67	7.64	72.8	15.46	10.18	67.0	14.36	9.68	68.5
Sedgwick	12.66	8.62	69.3	11.11	7.70	70.7	10.67	7.62	72.6	15.46	10.22	67.2	14.36	9.76	69.0
Washington	10.20	6.94	69.6	9.20	6.31	69.1	8.33	5.93	72.0	12.63	8.30	66.3	11.62	7.79	67.1
Yuma	12.08	8.17	68.5	10.78	7.36	69.4	9.76	6.98	72.5	14.81	9.73	66.3	13.64	9.21	68.3
Average	11.83	8.19	70.5	10.50	7.36	71.3	9.51	6.83	72.8	14.40	9.64	67.9	13.42	9.15	69.0

	Sorghum			Dry Beans			Oats			Sugar Beets		
County	Total	Effective	%	Total	Effective	%	Total	Effective	%	Total	Effective	%
	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)
Cheyenne	8.21	5.94	73.5	8.91	5.87	67.6	6.29	4.94	79.7	12.38	8.11	66.3
Kit Carson	8.05	5.79	73.3	8.62	5.69	67.6	6.74	5.30	79.9	12.32	7.86	65.1
Lincoln	8.05	5.79	73.3	8.62	5.69	67.6	6.74	5.30	79.9	12.32	7.86	65.1
Logan	8.59	5.94	71.1	9.37	5.83	65.0	8.24	6.44	79.3	13.71	8.16	60.8
Phillips	8.59	5.83	69.8	9.37	5.72	63.8	8.24	6.46	79.5	13.71	8.08	60.2
Sedgwick	8.59	5.94	71.1	9.37	5.83	65.0	8.24	6.44	79.3	13.71	8.16	60.8
Washington	7.20	5.14	72.2	7.69	5.09	67.3	6.51	4.93	76.8	11.11	6.58	60.1
Yuma	8.40	5.60	68.3	9.05	5.48	62.6	7.65	5.86	78.2	13.10	7.96	61.5
Average	8.21	5.75	71.6	8.88	5.65	65.8	7.33	5.71	79.1	12.79	7.84	62.5

Note:
Effective precipitation calculated using the SCS method as outlined in Technical Release No. 21.
Total precipication columns are the sum of monthly precipitation during the crop growing season.
Effective precipitation columns are the sum of the calculated effective precipitation for the crop.
The percentage columns is calculated as Effective Precipitation divided by Total Precipitation.

TABLE 25
CROP IRRIGATION REQUIREMENT

CHEYENNE COUNTY

(potential consumptive use minus effective precipitation, values in inches)

Year	Corn (Grain)	Corn (Silage)	Wheat	Grass Hay	Alfalfa Hay	Sorghum	Dry Beans	Oats	Sugar Beets	Weighted Average
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1940	23.04	19.26	18.13	20.44	21.79	13.16	11.24	15.80	19.32	18.77
1941	17.74	15.75	13.83	15.72	17.09	10.11	8.65	11.78	15.64	14.55
1942	18.74	15.36	14.28	16.43	18.11	11.59	9.86	12.70	16.60	15.55
1943	26.81	20.32	17.81	21.83	24.97	15.14	13.37	15.59	23.83	20.94
1944	28.42	22.05	15.57	23.65	25.56	17.09	15.05	12.44	25.08	22.27
1945	18.32	14.83	16.63	17.05	17.70	11.28	9.58	14.04	14.86	15.56
1946	25.42	19.59	21.19	25.56	25.75	14.60	12.88	17.44	24.04	22.11
1947	26.27	19.43	15.84	20.81	23.77	14.76	13.22	12.45	23.03	20.05
1948	24.35	18.60	16.35	22.57	25.02	12.97	11.78	14.23	23.66	14.69
1949	21.33	15.47	14.06	18.25	19.85	11.81	10.65	11.16	19.64	13.13
1950	20.13	16.84	22.15	19.78	20.35	13.17	10.99	19.92	17.56	18.95
1951	23.05	16.99	13.75	20.34	21.33	15.51	14.02	9.53	21.48	19.89
1952	26.37	21.72	19.15	25.47	29.09	15.95	14.23	15.91	26.73	24.10
1953	26.24	19.98	18.50	23.71	26.73	14.68	13.15	14.35	25.97	21.30
1954	24.80	20.20	21.70	27.80	29.75	14.48	12.97	18.48	28.75	22.05
1955	27.12	22.08	16.67	24.66	27.63	15.83	13.82	15.26	25.95	22.81
1956	28.35	21.90	21.28	27.83	31.49	16.20	14.42	16.49	30.71	28.02
1957	21.23	15.14	13.19	18.21	20.52	9.90	8.15	10.87	20.10	17.54
1958	18.82	13.51	12.29	14.79	17.84	8.66	7.08	9.94	17.97	13.09
1959	21.29	16.45	17.21	19.18	21.50	10.97	9.31	15.30	19.46	17.16
1960	26.24	20.95	16.72	21.85	24.63	14.95	12.81	14.60	23.55	19.61
1961	22.70	17.68	14.18	18.37	20.37	12.47	10.72	12.37	19.93	15.90
1962	24.52	18.05	15.97	21.35	23.29	13.37	11.85	12.57	23.52	18.46
1963	23.85	20.76	20.29	25.32	27.78	13.89	11.97	17.97	26.25	22.89
1964	29.18	23.51	16.76	25.16	27.25	17.10	14.63	14.58	27.52	22.57
1965	17.82	15.20	14.82	17.22	16.66	12.95	10.99	12.35	16.81	15.25
1966	22.75	20.34	18.57	18.65	21.34	13.60	11.27	17.79	19.20	19.25
1967	22.07	17.45	17.83	20.12	19.87	14.61	12.34	14.40	19.59	18.93
1968	24.45	17.86	22.06	23.26	24.01	14.16	12.50	17.14	22.01	21.11
1969	18.54	16.52	13.39	16.72	16.99	11.91	10.45	11.48	16.83	16.33
1970	23.45	17.87	14.93	18.02	22.03	12.29	10.39	14.19	21.17	19.16
1971	24.13	19.46	16.63	19.60	22.23	13.92	11.93	15.08	20.97	20.85
1972	21.57	16.92	16.98	19.34	20.50	12.10	10.47	14.10	18.90	18.95
1973	23.06	21.47	16.31	20.13	21.58	16.05	14.07	14.91	20.12	20.99
1974	29.07	22.29	19.19	26.06	28.23	16.13	14.41	15.32	27.49	25.06
1975	26.13	21.29	16.75	22.56	24.78	15.45	13.37	14.79	23.46	21.37
1976	24.93	22.35	19.51	23.33	24.11	15.84	13.87	16.71	22.41	21.75
1977	25.04	19.76	15.74	21.92	25.79	14.28	12.69	12.38	26.10	22.28
1978	24.07	17.89	17.25	20.80	22.45	12.90	11.38	13.46	22.05	22.15
1979	23.88	17.25	16.03	20.44	21.42	13.23	11.58	12.94	21.96	20.49
1980	24.38	19.65	13.78	22.13	24.89	14.21	12.48	11.63	24.75	20.31
1981	21.68	16.47	17.17	19.85	20.70	11.73	9.98	14.63	20.70	19.01
1982	22.28	18.04	12.81	18.64	19.90	14.30	12.58	10.81	19.79	18.71
1983	27.45	21.90	13.17	23.33	26.28	16.27	14.73	10.86	24.61	23.54
1984	25.93	20.32	17.05	22.83	25.35	14.04	12.33	14.38	23.13	21.77
1985	24.75	19.92	14.68	19.21	21.87	14.03	11.97	13.08	21.50	20.68
1986	23.30	19.21	16.78	21.19	23.38	13.72	12.26	14.04	22.03	20.31
1987	24.07	17.79	13.33	19.58	22.22	12.62	11.28	11.72	22.49	19.20
1988	20.39	16.54	16.78	19.86	21.93	11.47	9.70	13.75	21.27	18.46
1989	16.85	12.15	15.13	15.53	15.39	8.74	7.47	11.39	15.75	15.14
1990	22.68	19.47	16.77	21.02	22.09	13.93	12.12	14.57	22.39	19.60
1991	21.03	16.37	17.02	18.94	20.08	10.88	9.06	14.74	18.71	18.82
1992	20.67	14.14	18.58	20.16	21.02	11.77	10.40	15.04	19.12	19.63
1993	22.89	17.64	19.54	21.24	22.84	12.65	11.07	16.14	20.13	21.48
1994	23.70	18.85	15.56	20.70	25.13	12.84	11.20	13.74	24.44	20.64
1995	24.93	19.36	9.75	20.13	22.75	15.07	13.67	7.59	21.71	19.09
1996	20.29	15.84	17.55	18.45	19.07	10.20	8.27	14.70	18.53	18.66
1997	19.45	13.96	17.22	17.60	19.73	9.57	8.38	12.99	17.95	18.37
1998	20.68	15.82	17.94	18.08	21.46	10.21	8.73	14.95	19.98	19.39
1999	21.60	16.73	12.93	17.91	20.08	11.27	9.64	11.26	19.43	19.33
2000	25.90	21.36	19.37	26.28	29.58	14.98	13.13	15.85	28.04	23.47
Average										
40-00	23.28	18.39	16.60	20.77	22.74	13.34	11.62	13.95	21.75	19.70
50-64	24.26	19.05	17.32	22.25	24.64	13.81	12.01	14.54	23.70	20.29
86-00	21.89	17.01	16.28	19.78	21.78	11.99	10.42	13.50	20.80	19.44
Max	29.18	23.51	22.15	27.83	31.49	17.10	15.05	19.92	30.71	28.02
Min	16.85	12.15	9.75	14.79	15.39	8.66	7.08	7.59	14.86	13.09

Column Explanations:

1) Year

2 - 10) Crop irrigation requirement calculated as potential consumptive use minus effective precipitation.

11) Weighted average calculated using the crop mix from NASS data and individual crop's irrigation requirement.

TABLE 26
CROP IRRIGATION REQUIREMENT

KIT CARSON COUNTY

(potential consumptive use minus effective precipitation, values in inches)

Year	Corn (Grain)	Corn (Silage)	Wheat	Grass Hay	Alfalfa Hay	Sorghum	Dry Beans	Oats	Sugar Beets	Weighted Average
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1940	24.12	20.43	19.72	21.59	23.11	13.88	11.84	17.50	20.02	20.58
1941	18.99	15.22	13.03	16.86	18.53	10.40	8.95	11.26	16.93	15.86
1942	22.02	17.79	15.09	18.61	21.09	12.96	11.30	13.67	19.16	18.46
1943	25.00	18.58	18.68	20.94	24.07	13.35	11.66	16.63	22.82	20.56
1944	24.85	18.95	16.13	20.83	23.38	13.26	11.17	13.61	22.42	20.26
1945	18.76	13.13	13.93	15.75	16.92	11.36	9.94	10.46	16.61	15.46
1946	23.24	18.43	17.70	21.86	22.57	13.05	11.12	14.93	22.33	19.71
1947	24.05	17.86	13.17	18.62	21.68	13.82	12.55	10.27	21.14	19.32
1948	24.40	18.08	15.96	21.52	22.78	13.08	11.93	12.78	22.96	15.47
1949	22.80	17.14	13.10	18.86	20.54	12.99	11.74	10.39	21.00	15.18
1950	20.60	16.54	20.91	19.51	20.10	13.92	11.96	18.56	17.69	18.83
1951	18.08	12.07	12.90	16.18	17.03	12.51	11.55	9.09	16.81	14.46
1952	27.63	22.95	19.14	24.55	28.21	16.77	14.83	16.97	26.05	21.74
1953	26.51	20.03	20.59	23.38	25.97	14.84	13.29	15.97	24.70	20.18
1954	29.05	23.57	21.82	30.65	32.82	17.83	16.00	18.73	31.84	25.68
1955	27.27	21.88	16.12	24.24	27.22	15.95	14.32	14.32	25.48	20.43
1956	31.78	24.31	22.31	27.28	30.78	17.58	15.61	17.57	29.65	26.74
1957	19.98	14.23	11.11	17.69	18.29	11.00	9.75	8.69	18.18	16.30
1958	19.25	13.79	12.30	13.61	15.90	10.29	8.60	10.90	15.75	16.72
1959	27.95	23.19	19.35	25.82	27.67	17.04	15.15	17.65	25.70	25.44
1960	26.34	20.02	16.02	21.79	24.25	15.35	13.54	13.81	22.79	21.91
1961	24.34	20.31	15.38	20.07	21.80	15.73	13.25	13.69	21.54	20.48
1962	23.17	18.85	16.99	21.14	22.35	12.69	11.28	13.81	21.47	18.06
1963	25.11	22.20	19.19	25.81	28.29	15.62	13.56	16.97	26.91	21.50
1964	28.80	22.78	16.70	25.68	27.90	16.80	14.57	14.34	27.60	22.41
1965	13.81	11.75	12.13	12.36	12.40	9.41	8.27	9.67	13.63	11.75
1966	23.40	18.56	17.13	20.08	23.01	12.12	9.97	14.85	21.18	19.84
1967	20.93	16.90	16.20	17.88	18.96	12.80	10.90	13.11	18.51	18.38
1968	24.12	18.07	20.64	22.10	23.60	13.88	12.15	16.17	21.61	21.40
1969	24.47	19.04	18.81	22.68	23.22	13.53	11.96	15.31	22.15	21.97
1970	26.48	20.74	16.99	21.88	26.32	14.47	12.62	15.94	24.40	23.22
1971	27.35	21.82	14.68	21.18	24.18	16.91	14.99	12.82	23.40	23.78
1972	22.67	17.66	17.34	20.32	21.15	13.13	11.24	14.45	20.12	20.21
1973	23.84	21.27	16.04	20.94	22.61	15.56	13.66	14.31	21.15	21.65
1974	28.40	21.68	19.55	25.67	27.85	15.09	13.45	15.86	26.61	25.48
1975	25.19	18.89	14.99	22.23	24.70	14.92	13.63	12.11	24.14	22.19
1976	28.11	24.80	20.81	26.84	27.78	17.75	15.75	17.82	25.79	25.49
1977	24.24	19.18	15.12	22.38	26.09	14.49	12.83	11.70	26.31	21.84
1978	24.79	18.36	16.16	21.82	22.88	13.50	12.02	12.59	23.33	21.19
1979	19.80	13.57	17.40	17.75	19.14	9.52	8.14	14.47	17.82	17.72
1980	23.03	18.49	13.43	20.91	24.36	13.38	11.60	12.00	23.84	19.29
1981	25.34	19.14	16.36	22.24	24.45	14.61	12.83	13.30	24.64	21.08
1982	20.57	15.95	12.85	17.18	18.35	13.03	11.45	10.74	18.66	16.89
1983	23.72	17.44	14.42	20.51	23.00	12.62	11.37	11.31	21.13	17.43
1984	27.91	21.93	16.61	24.48	27.29	15.97	14.43	13.72	24.93	21.02
1985	21.88	17.75	14.93	17.34	19.52	11.85	9.75	13.88	19.18	17.43
1986	25.25	19.86	17.35	22.14	24.98	14.41	12.50	14.03	23.56	20.79
1987	23.91	18.20	12.05	19.05	21.38	13.22	11.69	10.64	22.20	17.67
1988	24.69	19.53	15.19	20.92	23.46	14.38	12.63	12.66	23.78	20.15
1989	21.76	17.33	15.73	19.98	19.92	13.22	11.63	12.59	20.14	18.31
1990	24.85	19.86	17.53	22.18	23.34	14.69	12.63	14.70	23.62	20.56
1991	21.28	15.81	16.41	18.69	20.36	10.94	9.00	14.04	19.44	18.05
1992	20.16	13.78	19.42	19.47	20.11	11.65	10.68	16.30	17.80	18.77
1993	19.58	14.16	18.84	18.11	19.17	11.62	10.20	14.94	17.09	18.02
1994	23.13	17.72	15.11	19.20	22.99	12.11	10.33	12.99	22.06	19.43
1995	21.64	17.15	9.72	17.60	19.53	13.74	12.20	7.93	18.10	17.10
1996	21.41	15.25	15.74	17.85	19.34	10.55	8.71	12.90	20.33	18.29
1997	20.79	15.68	17.75	18.93	20.52	11.34	9.92	13.48	18.52	18.80
1998	18.96	13.56	17.27	15.09	18.29	8.36	6.82	14.26	17.78	17.33
1999	18.42	13.80	12.21	14.80	16.48	9.12	7.87	10.34	15.50	16.39
2000	24.15	20.10	19.75	24.09	27.04	13.01	11.07	16.73	25.29	22.73
Average										
40-00	23.51	18.31	16.39	20.65	22.64	13.49	11.81	13.72	21.73	19.73
50-64	25.06	19.78	17.39	22.49	24.57	14.93	13.15	14.74	23.48	20.73
86-00	22.00	16.79	16.01	19.21	21.13	12.16	10.53	13.24	20.35	18.83
Max	31.78	24.80	22.31	30.65	32.82	17.83	16.00	18.73	31.84	26.74
Min	13.81	11.75	9.72	12.36	12.40	8.36	6.82	7.93	13.63	11.75

Column Explanations:

1) Year

2 - 10) Crop irrigation requirement calculated as potential consumptive use minus effective precipitation.

11) Weighted average calculated using the crop mix from NASS data and individual crop's irrigation requirement.

TABLE 27
CROP IRRIGATION REQUIREMENT

LINCOLN COUNTY

(potential consumptive use minus effective precipitation, values in inches)

Year	Corn (Grain)	Corn (Silage)	Wheat	Grass Hay	Alfalfa Hay	Sorghum	Dry Beans	Oats	Sugar Beets	Weighted Average
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1940	24.12	20.43	19.72	21.59	23.11	13.88	11.84	17.50	20.02	21.53
1941	18.99	15.22	13.03	16.86	18.53	10.40	8.95	11.26	16.93	16.82
1942	22.02	17.79	15.09	18.61	21.09	12.96	11.30	13.67	19.16	19.25
1943	25.00	18.58	18.68	20.94	24.07	13.35	11.66	16.63	22.82	21.71
1944	24.85	18.95	16.13	20.83	23.38	13.26	11.17	13.61	22.42	21.22
1945	18.76	13.13	13.93	15.75	16.92	11.36	9.94	10.46	16.61	15.86
1946	23.24	18.43	17.70	21.86	22.57	13.05	11.12	14.93	22.33	20.91
1947	24.05	17.86	13.17	18.62	21.68	13.82	12.55	10.27	21.14	19.76
1948	24.40	18.08	15.96	21.52	22.78	13.08	11.93	12.78	22.96	19.52
1949	22.80	17.14	13.10	18.86	20.54	12.99	11.74	10.39	21.00	17.56
1950	20.60	16.54	20.91	19.51	20.10	13.92	11.96	18.56	17.69	19.30
1951	18.08	12.07	12.90	16.18	17.03	12.51	11.55	9.09	16.81	16.23
1952	27.63	22.95	19.14	24.55	28.21	16.77	14.83	16.97	26.05	25.10
1953	26.51	20.03	20.59	23.38	25.97	14.84	13.29	15.97	24.70	23.04
1954	29.05	23.57	21.82	30.65	32.82	17.83	16.00	18.73	31.84	29.01
1955	27.27	21.88	16.12	24.24	27.22	15.95	14.32	14.32	25.48	24.67
1956	31.78	24.31	22.31	27.28	30.78	17.58	15.61	17.57	29.65	27.93
1957	19.98	14.23	11.11	17.69	18.29	11.00	9.75	8.69	18.18	17.21
1958	19.25	13.79	12.30	13.61	15.90	10.29	8.60	10.90	15.75	15.60
1959	27.95	23.19	19.35	25.82	27.67	17.04	15.15	17.65	25.70	26.10
1960	26.34	20.02	16.02	21.79	24.25	15.35	13.54	13.81	22.79	20.99
1961	24.34	20.31	15.38	20.07	21.80	15.73	13.25	13.69	21.54	20.06
1962	23.17	18.85	16.99	21.14	22.35	12.69	11.28	13.81	21.47	19.72
1963	25.11	22.20	19.19	25.81	28.29	15.62	13.56	16.97	26.91	25.06
1964	28.80	22.78	16.70	25.68	27.90	16.80	14.57	14.34	27.60	24.21
1965	13.81	11.75	12.13	12.36	12.40	9.41	8.27	9.67	13.63	11.94
1966	23.40	18.56	17.13	20.08	23.01	12.12	9.97	14.85	21.18	21.08
1967	20.93	16.90	16.20	17.88	18.96	12.80	10.90	13.11	18.51	17.58
1968	24.12	18.07	20.64	22.10	23.60	13.88	12.15	16.17	21.61	21.31
1969	24.47	19.04	18.81	22.68	23.22	13.53	11.96	15.31	22.15	21.40
1970	26.48	20.74	16.99	21.88	26.32	14.47	12.62	15.94	24.40	22.99
1971	27.35	21.82	14.68	21.18	24.18	16.91	14.99	12.82	23.40	21.96
1972	22.67	17.66	17.34	20.32	21.15	13.13	11.24	14.45	20.12	18.61
1973	23.84	21.27	16.04	20.94	22.61	15.56	13.66	14.31	21.15	18.79
1974	28.40	21.68	19.55	25.67	27.85	15.09	13.45	15.86	26.61	23.00
1975	25.19	18.89	14.99	22.23	24.70	14.92	13.63	12.11	24.14	21.33
1976	28.11	24.80	20.81	26.84	27.78	17.75	15.75	17.82	25.79	24.01
1977	24.24	19.18	15.12	22.38	26.09	14.49	12.83	11.70	26.31	18.88
1978	24.79	18.36	16.16	21.82	22.88	13.50	12.02	12.59	23.33	20.89
1979	19.80	13.57	17.40	17.75	19.14	9.52	8.14	14.47	17.82	15.31
1980	23.03	18.49	13.43	20.91	24.36	13.38	11.60	12.00	23.84	18.97
1981	25.34	19.14	16.36	22.24	24.45	14.61	12.83	13.30	24.64	19.16
1982	20.57	15.95	12.85	17.18	18.35	13.03	11.45	10.74	18.66	15.49
1983	23.72	17.44	14.42	20.51	23.00	12.62	11.37	11.31	21.13	19.40
1984	27.91	21.93	16.61	24.48	27.29	15.97	14.43	13.72	24.93	22.57
1985	21.88	17.75	14.93	17.34	19.52	11.85	9.75	13.88	19.18	16.99
1986	25.25	19.86	17.35	22.14	24.98	14.41	12.50	14.03	23.56	21.55
1987	23.91	18.20	12.05	19.05	21.38	13.22	11.69	10.64	22.20	18.18
1988	24.69	19.53	15.19	20.92	23.46	14.38	12.63	12.66	23.78	20.54
1989	21.76	17.33	15.73	19.98	19.92	13.22	11.63	12.59	20.14	18.64
1990	24.85	19.86	17.53	22.18	23.34	14.69	12.63	14.70	23.62	20.72
1991	21.28	15.81	16.41	18.69	20.36	10.94	9.00	14.04	19.44	17.62
1992	20.16	13.78	19.42	19.47	20.11	11.65	10.68	16.30	17.80	19.07
1993	19.58	14.16	18.84	18.11	19.17	11.62	10.20	14.94	17.09	17.86
1994	23.13	17.72	15.11	19.20	22.99	12.11	10.33	12.99	22.06	18.88
1995	21.64	17.15	9.72	17.60	19.53	13.74	12.20	7.93	18.10	16.26
1996	21.41	15.25	15.74	17.85	19.34	10.55	8.71	12.90	20.33	17.48
1997	20.79	15.68	17.75	18.93	20.52	11.34	9.92	13.48	18.52	18.02
1998	18.96	13.56	17.27	15.09	18.29	8.36	6.82	14.26	17.78	16.36
1999	18.42	13.80	12.21	14.80	16.48	9.12	7.87	10.34	15.50	16.34
2000	24.15	20.10	19.75	24.09	27.04	13.01	11.07	16.73	25.29	22.45
Average										
40-00	23.51	18.31	16.39	20.65	22.64	13.49	11.81	13.72	21.73	20.00
50-64	25.06	19.78	17.39	22.49	24.57	14.93	13.15	14.74	23.48	22.28
86-00	22.00	16.79	16.01	19.21	21.13	12.16	10.53	13.24	20.35	18.66
Max	31.78	24.80	22.31	30.65	32.82	17.83	16.00	18.73	31.84	29.01
Min	13.81	11.75	9.72	12.36	12.40	8.36	6.82	7.93	13.63	11.94

Column Explanations:

1) Year

2 - 10) Crop irrigation requirement calculated as potential consumptive use minus effective precipitation.

11) Weighted average calculated using the crop mix from NASS data and individual crop's irrigation requirement.

TABLE 28
CROP IRRIGATION REQUIREMENT

LOGAN COUNTY

(potential consumptive use minus effective precipitation, values in inches)

Year	Corn (Grain)	Corn (Silage)	Wheat	Grass Hay	Alfalfa Hay	Sorghum	Dry Beans	Oats	Sugar Beets	Weighted Average
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1940	24.64	22.87	17.05	20.84	22.60	16.71	14.49	15.34	19.21	21.43
1941	15.23	11.18	11.50	12.85	14.47	7.71	6.03	9.71	13.08	13.21
1942	18.54	16.83	10.58	14.45	16.29	13.41	11.95	10.18	14.58	15.54
1943	28.75	22.89	16.88	23.54	26.24	18.57	16.77	14.72	24.70	24.26
1944	25.90	19.71	16.81	21.85	24.06	14.91	13.28	14.02	22.32	22.08
1945	11.76	13.20	15.00	13.53	12.61	8.88	8.43	12.29	8.60	12.25
1946	21.63	16.63	18.36	20.71	20.75	13.35	11.29	14.98	19.67	19.58
1947	23.67	17.74	10.10	18.15	21.14	14.34	13.02	8.63	20.61	19.04
1948	28.33	22.14	18.30	25.73	27.49	16.23	14.44	15.35	26.34	23.50
1949	22.47	16.35	11.31	17.60	18.76	13.63	12.22	8.74	20.78	17.13
1950	22.56	18.52	17.90	19.52	20.67	16.17	13.84	16.17	18.85	19.78
1951	16.99	14.40	10.99	15.49	13.94	12.70	11.01	7.69	15.38	13.88
1952	32.68	26.16	17.84	26.17	29.95	19.85	17.87	15.54	29.27	26.55
1953	24.19	17.18	20.13	21.43	23.87	11.78	10.50	15.90	21.31	21.50
1954	24.94	19.49	16.04	22.84	24.99	13.89	12.08	14.52	25.10	22.18
1955	24.51	18.72	14.70	21.18	24.22	14.57	13.02	12.54	23.29	21.18
1956	27.34	20.88	19.89	24.75	27.66	15.30	13.36	14.84	27.73	24.88
1957	26.41	19.78	15.45	22.97	24.64	15.19	13.50	12.78	23.68	22.89
1958	21.63	17.02	11.98	16.51	19.36	11.90	10.22	10.78	18.56	18.25
1959	26.58	21.40	13.91	22.52	23.94	15.45	13.59	11.93	24.54	23.13
1960	27.56	21.59	17.29	23.38	24.51	17.09	15.25	14.86	23.68	23.57
1961	22.94	19.62	16.43	19.06	21.27	13.97	12.06	14.22	20.03	20.18
1962	21.97	17.21	13.47	18.36	19.02	14.49	12.45	10.43	20.24	18.74
1963	22.64	19.33	21.60	23.78	25.97	12.14	10.26	18.82	23.35	23.23
1964	29.47	22.65	15.63	25.60	28.45	16.61	14.97	13.54	27.17	26.34
1965	17.98	15.11	15.52	17.46	17.19	11.81	10.12	13.19	16.88	16.51
1966	20.31	16.39	18.49	17.45	20.33	9.32	7.62	16.50	18.13	18.74
1967	20.10	14.44	14.65	16.72	17.28	13.68	11.92	10.71	18.93	17.10
1968	26.68	20.03	21.77	24.47	26.24	14.84	13.07	17.21	23.73	24.21
1969	25.06	18.96	15.55	22.47	23.32	14.67	13.46	12.13	23.90	22.15
1970	30.08	24.37	16.45	23.58	28.32	17.24	15.17	15.82	25.98	26.27
1971	23.26	19.04	14.40	18.91	20.77	14.40	12.38	12.25	19.80	20.54
1972	22.46	17.06	15.93	18.32	19.80	12.67	11.21	13.17	18.82	19.25
1973	23.28	20.50	16.57	20.58	22.42	14.84	12.81	14.84	20.06	21.37
1974	29.84	23.43	18.84	25.65	28.21	17.24	15.52	15.52	26.48	26.60
1975	26.17	20.68	16.40	22.49	24.00	16.94	14.92	13.32	23.45	23.44
1976	28.67	23.14	20.31	25.62	26.77	17.90	15.77	16.42	25.27	25.97
1977	24.82	19.36	14.43	20.39	22.83	13.34	11.39	11.83	22.41	22.08
1978	30.10	23.03	21.59	26.65	28.37	17.41	15.53	17.15	26.95	27.28
1979	22.87	16.41	16.63	19.94	21.03	13.23	11.85	13.41	20.19	20.19
1980	26.88	20.07	16.34	22.60	25.48	14.86	13.01	13.81	24.52	24.17
1981	23.17	16.98	15.23	20.11	21.11	13.57	11.73	11.98	21.44	20.47
1982	19.25	13.95	11.06	14.47	15.45	13.37	11.88	9.11	16.84	16.65
1983	25.45	18.87	15.22	21.77	24.17	14.00	12.55	12.03	22.34	22.81
1984	27.19	21.69	16.75	23.55	26.03	15.34	13.54	13.94	23.63	24.81
1985	25.80	22.29	16.23	21.06	23.79	15.33	13.05	15.35	21.84	23.22
1986	25.20	20.75	17.20	21.46	23.95	15.71	13.68	14.50	21.98	22.97
1987	24.05	18.34	12.17	19.18	19.90	13.99	12.29	10.04	21.59	20.29
1988	25.22	20.31	15.84	20.53	21.60	14.26	12.43	12.60	22.49	22.10
1989	18.81	14.84	15.51	18.08	17.85	13.04	11.76	12.04	17.56	17.41
1990	23.31	18.05	18.23	20.71	21.47	14.05	12.16	15.29	20.87	20.82
1991	23.25	18.74	11.73	18.22	18.95	14.01	12.16	9.72	19.99	19.89
1992	19.81	14.18	17.58	19.12	19.39	12.81	12.81	15.14	17.10	18.76
1993	16.53	12.29	16.08	14.95	15.62	10.45	9.46	12.51	13.81	15.38
1994	27.13	21.65	18.58	23.32	26.07	14.67	12.83	15.94	24.87	24.77
1995	21.41	17.40	10.83	17.69	19.46	14.12	12.56	9.02	17.61	19.23
1996	12.63	10.17	11.15	10.06	9.88	6.99	5.69	10.07	10.01	11.03
1997	22.52	16.76	15.70	19.95	21.60	13.84	12.62	11.40	20.42	20.98
1998	20.78	14.85	17.22	16.72	19.40	10.67	9.09	14.07	18.85	19.35
1999	18.48	14.35	11.01	14.43	16.23	11.07	9.82	9.39	15.95	16.74
2000	27.49	23.90	20.68	27.35	30.01	16.12	14.24	17.95	28.22	27.31
Average										
40-00	23.60	18.62	15.85	20.31	21.99	14.11	12.43	13.24	21.06	20.90
50-64	24.83	19.60	16.22	21.57	23.50	14.74	12.93	13.64	22.81	21.75
86-00	21.77	17.11	15.30	18.78	20.09	13.05	11.57	12.65	19.42	19.80
Max	32.68	26.16	21.77	27.35	30.01	19.85	17.87	18.82	29.27	27.31
Min	11.76	10.17	10.10	10.06	9.88	6.99	5.69	7.69	8.60	11.03

Column Explanations:

1) Year

2 - 10) Crop irrigation requirement calculated as potential consumptive use minus effective precipitation.

11) Weighted average calculated using the crop mix from NASS data and individual crop's irrigation requirement.

TABLE 29
CROP IRRIGATION REQUIREMENT

PHILLIPS COUNTY

(potential consumptive use minus effective precipitation, values in inches)

Year	Corn (Grain)	Corn (Silage)	Wheat	Grass Hay	Alfalfa Hay	Sorghum	Dry Beans	Oats	Sugar Beets	Weighted Average
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1940	23.58	21.91	17.31	20.15	21.84	15.92	13.79	15.51	18.40	21.19
1941	14.44	10.52	11.66	12.28	13.90	7.18	5.56	9.88	12.46	12.94
1942	17.61	15.98	10.85	13.78	15.60	12.74	11.34	10.42	13.91	15.29
1943	27.66	21.92	17.26	22.84	25.40	17.79	16.03	15.00	23.88	24.39
1944	24.93	18.89	16.68	21.15	23.35	14.24	12.65	13.93	21.54	22.14
1945	11.11	12.49	15.22	12.97	12.09	8.40	7.95	12.41	8.15	11.74
1946	20.72	15.85	18.67	20.12	20.04	12.66	10.65	15.25	18.96	19.34
1947	22.68	16.89	10.03	17.42	20.39	13.69	12.40	8.58	19.86	19.36
1948	27.22	21.20	18.81	25.09	26.70	15.48	13.72	15.77	25.44	24.57
1949	21.48	15.52	11.56	16.96	18.07	12.96	11.58	9.00	20.03	16.97
1950	21.64	17.72	18.05	18.88	19.99	15.44	13.15	16.30	18.13	19.53
1951	16.19	13.64	11.19	14.80	13.26	12.10	10.42	7.81	14.75	13.84
1952	31.48	25.14	17.98	25.27	29.06	18.98	17.06	15.67	28.27	28.55
1953	23.21	16.37	20.18	20.69	23.10	11.09	9.84	15.79	20.52	22.21
1954	23.85	18.57	16.38	22.15	24.16	13.11	11.38	14.89	24.16	22.44
1955	23.45	17.81	15.00	20.44	23.45	13.88	12.37	12.85	22.45	20.46
1956	26.28	20.00	20.21	24.04	26.86	14.53	12.64	14.97	26.77	24.52
1957	25.35	18.86	15.48	22.14	23.82	14.44	12.78	12.84	22.83	22.84
1958	20.69	16.24	12.11	15.85	18.69	11.29	9.67	10.94	17.78	18.77
1959	25.48	20.45	14.17	21.79	23.08	14.66	12.85	12.18	23.65	22.70
1960	26.45	20.64	17.73	22.70	23.70	16.33	14.53	15.19	22.82	22.64
1961	21.96	18.76	16.63	18.40	20.54	13.27	11.40	14.32	19.26	19.33
1962	20.99	16.38	13.88	17.80	18.37	13.81	11.81	10.78	19.51	17.88
1963	21.73	18.56	22.10	23.18	25.25	11.49	9.66	19.16	22.51	22.51
1964	28.34	21.71	15.82	24.79	27.63	15.85	14.26	13.75	26.21	24.74
1965	17.09	14.33	15.93	16.96	16.57	11.19	9.56	13.60	16.23	15.98
1966	19.44	15.67	18.81	16.86	19.72	8.75	7.10	16.74	17.37	17.53
1967	19.25	13.67	15.14	16.12	16.61	13.04	11.31	11.06	18.26	16.77
1968	25.63	19.15	22.09	23.79	25.45	14.10	12.37	17.39	22.91	23.22
1969	24.01	18.07	15.95	21.85	22.55	14.00	12.81	12.53	23.09	20.79
1970	28.94	23.41	16.63	22.80	27.50	16.43	14.46	15.99	25.02	23.68
1971	22.27	18.18	14.67	18.18	20.02	13.67	11.70	12.43	19.02	19.10
1972	21.49	16.23	16.23	17.72	19.09	12.01	10.58	13.46	18.05	18.93
1973	22.28	19.61	16.73	19.85	21.68	14.11	12.13	14.98	19.26	20.06
1974	28.71	22.47	19.23	24.96	27.43	16.41	14.78	15.79	25.56	25.81
1975	25.14	19.78	16.56	21.81	23.25	16.17	14.23	13.50	22.63	22.81
1976	27.57	22.18	20.55	24.83	25.94	17.11	15.03	16.62	24.41	25.75
1977	23.79	18.48	14.71	19.67	22.09	12.61	10.70	12.09	21.53	22.05
1978	28.96	22.06	21.94	25.92	27.53	16.60	14.77	17.39	26.02	27.29
1979	21.90	15.60	16.89	19.34	20.31	12.57	11.23	13.67	19.43	20.54
1980	25.79	19.16	16.45	21.82	24.66	14.09	12.28	13.95	23.60	23.31
1981	22.22	16.18	15.56	19.36	20.33	12.87	11.07	12.27	20.64	20.33
1982	18.38	13.22	11.36	13.86	14.85	12.72	11.26	9.38	16.20	16.69
1983	24.43	18.01	15.27	21.00	23.36	13.31	11.92	12.11	21.52	22.07
1984	26.15	20.79	16.65	22.79	25.25	14.61	12.85	13.87	22.78	23.56
1985	24.79	21.41	16.62	20.36	23.07	14.63	12.41	15.66	21.01	22.99
1986	24.19	19.88	17.66	20.76	23.24	14.96	12.98	14.80	21.15	22.43
1987	23.08	17.52	12.40	18.56	19.24	13.30	11.67	10.30	20.80	20.61
1988	24.25	19.49	16.10	19.81	20.84	13.59	11.80	12.76	21.67	22.20
1989	17.92	14.06	15.94	17.53	17.23	12.41	11.16	12.34	16.91	16.96
1990	22.41	17.29	18.38	20.06	20.78	13.40	11.55	15.45	20.13	20.51
1991	22.30	17.94	12.01	17.61	18.25	13.32	11.56	9.94	19.24	20.70
1992	18.99	13.51	17.92	18.62	18.84	12.25	12.23	15.47	16.53	18.32
1993	15.77	11.64	16.31	14.38	15.08	9.89	8.91	12.61	13.22	15.14
1994	26.20	20.87	18.84	22.66	25.38	14.00	12.20	16.18	24.05	24.63
1995	20.52	16.60	10.98	16.97	18.70	13.48	11.98	9.10	16.97	19.11
1996	11.88	9.53	11.41	9.57	9.30	6.47	5.22	10.33	9.46	10.84
1997	21.57	15.95	15.91	19.33	20.91	13.20	12.01	11.54	19.73	20.53
1998	19.93	14.15	17.59	16.18	18.79	10.09	8.58	14.26	18.15	18.09
1999	17.55	13.55	11.21	13.77	15.56	10.45	9.23	9.52	15.27	16.26
2000	26.47	23.02	21.03	26.68	29.24	15.39	13.56	18.25	27.31	25.31
Average										
40-00	22.62	17.78	16.11	19.64	21.26	13.42	11.78	13.45	20.28	20.52
50-64	23.81	18.72	16.46	20.86	22.73	14.02	12.26	13.83	21.97	21.53
86-00	20.87	16.33	15.58	18.17	19.42	12.41	10.98	12.86	18.71	19.44
Max	31.48	25.14	22.10	26.68	29.24	18.98	17.06	19.16	28.27	28.55
Min	11.11	9.53	10.03	9.57	9.30	6.47	5.22	7.81	8.15	10.84

Column Explanations:

1) Year

2 - 10) Crop irrigation requirement calculated as potential consumptive use minus effective precipitation.

11) Weighted average calculated using the crop mix from NASS data and individual crop's irrigation requirement.

TABLE 30
CROP IRRIGATION REQUIREMENT

SEDGWICK COUNTY

(potential consumptive use minus effective precipitation, values in inches)

Year	Corn (Grain)	Corn (Silage)	Wheat	Grass Hay	Alfalfa Hay	Sorghum	Dry Beans	Oats	Sugar Beets	Weighted Average
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1940	24.64	22.87	17.05	20.84	22.60	16.71	14.49	15.34	19.21	20.80
1941	15.23	11.18	11.50	12.85	14.47	7.71	6.03	9.71	13.08	12.67
1942	18.54	16.83	10.58	14.45	16.29	13.41	11.95	10.18	14.58	15.28
1943	28.75	22.89	16.88	23.54	26.24	18.57	16.77	14.72	24.70	23.91
1944	25.90	19.71	16.81	21.85	24.06	14.91	13.28	14.02	22.32	21.57
1945	11.76	13.20	15.00	13.53	12.61	8.88	8.43	12.29	8.60	11.62
1946	21.63	16.63	18.36	20.71	20.75	13.35	11.29	14.98	19.67	19.07
1947	23.67	17.74	10.10	18.15	21.14	14.34	13.02	8.63	20.61	18.92
1948	28.33	22.14	18.30	25.73	27.49	16.23	14.44	15.35	26.34	24.56
1949	22.47	16.35	11.31	17.60	18.76	13.63	12.22	8.74	20.78	16.78
1950	22.56	18.52	17.90	19.52	20.67	16.17	13.84	16.17	18.85	19.82
1951	16.99	14.40	10.99	15.49	13.94	12.70	11.01	7.69	15.38	14.13
1952	32.68	26.16	17.84	26.17	29.95	19.85	17.87	15.54	29.27	26.26
1953	24.19	17.18	20.13	21.43	23.87	11.78	10.50	15.90	21.31	20.54
1954	24.94	19.49	16.04	22.84	24.99	13.89	12.08	14.52	25.10	21.57
1955	24.51	18.72	14.70	21.18	24.22	14.57	13.02	12.54	23.29	21.31
1956	27.34	20.88	19.89	24.75	27.66	15.30	13.36	14.84	27.73	24.62
1957	26.41	19.78	15.45	22.97	24.64	15.19	13.50	12.78	23.68	22.83
1958	21.63	17.02	11.98	16.51	19.36	11.90	10.22	10.78	18.56	16.27
1959	26.58	21.40	13.91	22.52	23.94	15.45	13.59	11.93	24.54	22.71
1960	27.56	21.59	17.29	23.38	24.51	17.09	15.25	14.86	23.68	22.84
1961	22.94	19.62	16.43	19.06	21.27	13.97	12.06	14.22	20.03	19.07
1962	21.97	17.21	13.47	18.36	19.02	14.49	12.45	10.43	20.24	18.58
1963	22.64	19.33	21.60	23.78	25.97	12.14	10.26	18.82	23.35	21.01
1964	29.47	22.65	15.63	25.60	28.45	16.61	14.97	13.54	27.17	25.40
1965	17.98	15.11	15.52	17.46	17.19	11.81	10.12	13.19	16.88	15.98
1966	20.31	16.39	18.49	17.45	20.33	9.32	7.62	16.50	18.13	17.12
1967	20.10	14.44	14.65	16.72	17.28	13.68	11.92	10.71	18.93	16.93
1968	26.68	20.03	21.77	24.47	26.24	14.84	13.07	17.21	23.73	22.23
1969	25.06	18.96	15.55	22.47	23.32	14.67	13.46	12.13	23.90	20.92
1970	30.08	24.37	16.45	23.58	28.32	17.24	15.17	15.82	25.98	24.09
1971	23.26	19.04	14.40	18.91	20.77	14.40	12.38	12.25	19.80	19.36
1972	22.46	17.06	15.93	18.32	19.80	12.67	11.21	13.17	18.82	18.20
1973	23.28	20.50	16.57	20.58	22.42	14.84	12.81	14.84	20.06	20.01
1974	29.84	23.43	18.84	25.65	28.21	17.24	15.52	15.52	26.48	25.16
1975	26.17	20.68	16.40	22.49	24.00	16.94	14.92	13.32	23.45	22.24
1976	28.67	23.14	20.31	25.62	26.77	17.90	15.77	16.42	25.27	24.61
1977	24.82	19.36	14.43	20.39	22.83	13.34	11.39	11.83	22.41	21.64
1978	30.10	23.03	21.59	26.65	28.37	17.41	15.53	17.15	26.95	26.80
1979	22.87	16.41	16.63	19.94	21.03	13.23	11.85	13.41	20.19	20.30
1980	26.88	20.07	16.34	22.60	25.48	14.86	13.01	13.81	24.52	24.01
1981	23.17	16.98	15.23	20.11	21.11	13.57	11.73	11.98	21.44	20.43
1982	19.25	13.95	11.06	14.47	15.45	13.37	11.88	9.11	16.84	16.83
1983	25.45	18.87	15.22	21.77	24.17	14.00	12.55	12.03	22.34	22.08
1984	27.19	21.69	16.75	23.55	26.03	15.34	13.54	13.94	23.63	23.76
1985	25.80	22.29	16.23	21.06	23.79	15.33	13.05	15.35	21.84	21.52
1986	25.20	20.75	17.20	21.46	23.95	15.71	13.68	14.50	21.98	21.79
1987	24.05	18.34	12.17	19.18	19.90	13.99	12.29	10.04	21.59	20.37
1988	25.22	20.31	15.84	20.53	21.60	14.26	12.43	12.60	22.49	22.20
1989	18.81	14.84	15.51	18.08	17.85	13.04	11.76	12.04	17.56	17.55
1990	23.31	18.05	18.23	20.71	21.47	14.05	12.16	15.29	20.87	21.06
1991	23.25	18.74	11.73	18.22	18.95	14.01	12.16	9.72	19.99	20.72
1992	19.81	14.18	17.58	19.12	19.39	12.81	12.81	15.14	17.10	18.85
1993	16.53	12.29	16.08	14.95	15.62	10.45	9.46	12.51	13.81	15.48
1994	27.13	21.65	18.58	23.32	26.07	14.67	12.83	15.94	24.87	24.78
1995	21.41	17.40	10.83	17.69	19.46	14.12	12.56	9.02	17.61	19.63
1996	12.63	10.17	11.15	10.06	9.88	6.99	5.69	10.07	10.01	11.67
1997	22.52	16.76	15.70	19.95	21.60	13.84	12.62	11.40	20.42	20.89
1998	20.78	14.85	17.22	16.72	19.40	10.67	9.09	14.07	18.85	19.13
1999	18.48	14.35	11.01	14.43	16.23	11.07	9.82	9.39	15.95	16.41
2000	27.49	23.90	20.68	27.35	30.01	16.12	14.24	17.95	28.22	25.83
Average										
40-00	23.60	18.62	15.85	20.31	21.99	14.11	12.43	13.24	21.06	20.37
50-64	24.83	19.60	16.22	21.57	23.50	14.74	12.93	13.64	22.81	21.13
86-00	21.77	17.11	15.30	18.78	20.09	13.05	11.57	12.65	19.42	19.76
Max	32.68	26.16	21.77	27.35	30.01	19.85	17.87	18.82	29.27	26.80
Min	11.76	10.17	10.10	10.06	9.88	6.99	5.69	7.69	8.60	11.62

Column Explanations:

1) Year

2 - 10) Crop irrigation requirement calculated as potential consumptive use minus effective precipitation.

11) Weighted average calculated using the crop mix from NASS data and individual crop's irrigation requirement.

TABLE 31
CROP IRRIGATION REQUIREMENT

WASHINGTON COUNTY

(potential consumptive use minus effective precipitation, values in inches)

Year	Corn (Grain)	Corn (Silage)	Wheat	Grass Hay	Alfalfa Hay	Sorghum	Dry Beans	Oats	Sugar Beets	Weighted Average
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1940	21.10	17.73	12.62	17.46	19.00	15.46	13.19	11.94	16.08	17.76
1941	22.27	18.36	13.73	20.79	21.83	15.95	13.77	11.64	19.06	19.73
1942	22.60	17.24	12.10	18.98	21.36	15.65	14.11	11.11	18.50	19.15
1943	25.24	19.44	15.12	21.25	23.79	17.84	15.83	13.72	20.90	21.61
1944	25.15	19.51	16.48	23.15	24.75	17.88	15.74	13.92	21.59	22.35
1945	19.09	14.17	13.17	17.57	18.75	12.99	11.34	10.66	16.47	16.95
1946	20.60	15.83	16.43	19.69	20.65	13.92	11.66	13.95	17.60	18.80
1947	28.48	23.32	16.92	25.55	27.67	20.41	18.16	15.06	24.07	24.95
1948	25.09	19.37	18.50	23.94	24.63	17.45	15.59	15.17	21.58	21.30
1949	17.73	12.17	10.83	15.69	14.81	12.24	12.66	8.15	15.50	14.41
1950	17.95	16.25	15.54	16.94	16.32	15.28	13.56	13.30	14.42	16.03
1951	18.06	14.02	12.54	18.23	16.93	12.80	13.39	9.22	15.29	15.80
1952	26.40	19.74	18.21	22.82	25.20	15.83	14.12	15.63	22.50	22.27
1953	23.88	16.89	16.72	21.44	22.44	15.35	13.41	12.24	21.03	20.27
1954	27.79	21.49	18.98	26.01	26.74	18.29	16.06	16.41	25.10	24.36
1955	21.81	16.22	13.64	19.25	20.33	15.16	13.28	11.15	19.65	18.38
1956	26.71	19.89	19.67	23.48	24.34	17.66	15.90	14.67	23.33	23.77
1957	21.11	15.32	12.18	20.00	19.53	15.26	14.68	9.17	18.43	18.67
1958	23.91	18.97	12.13	19.33	20.68	16.17	14.83	10.54	19.78	20.18
1959	25.57	20.86	15.94	22.45	23.36	16.85	14.71	13.58	22.18	22.40
1960	26.18	20.60	17.20	23.54	23.76	19.22	17.52	13.91	22.17	22.82
1961	21.34	17.62	13.71	18.84	19.30	16.13	14.49	11.63	18.00	18.40
1962	23.07	17.48	15.35	21.30	20.91	17.42	16.46	11.47	20.95	20.39
1963	23.15	19.10	18.55	21.27	22.06	13.26	11.07	15.33	20.28	20.84
1964	25.70	19.63	14.38	23.12	24.42	17.63	16.31	12.10	22.49	22.69
1965	19.31	15.20	13.09	18.59	17.53	15.96	14.81	10.71	17.65	17.31
1966	22.53	17.53	16.10	20.15	21.54	15.42	13.83	13.23	19.61	19.97
1967	21.01	14.84	12.96	18.35	17.86	16.19	16.52	8.28	18.57	18.12
1968	23.19	16.98	17.74	21.60	21.94	17.19	15.39	12.90	20.10	20.47
1969	24.68	18.78	15.81	22.66	22.80	16.55	15.05	12.18	21.81	19.64
1970	27.34	21.92	13.39	21.25	24.93	16.93	15.41	12.82	22.76	20.49
1971	25.75	20.83	15.48	22.72	23.84	18.62	16.59	12.94	21.77	21.49
1972	21.96	17.01	18.28	20.25	20.52	14.55	12.69	14.65	18.75	18.75
1973	22.07	19.14	10.97	19.40	19.82	16.06	13.48	9.20	18.99	18.51
1974	26.71	20.94	19.37	24.02	25.85	16.46	14.49	16.22	23.60	24.13
1975	22.18	16.70	13.07	20.35	20.43	15.33	13.83	9.98	20.01	19.43
1976	25.01	20.81	18.46	23.39	23.64	17.37	14.85	14.87	22.03	21.80
1977	28.68	21.79	15.24	23.52	26.02	16.81	15.12	11.54	26.23	24.98
1978	24.31	17.67	17.40	20.94	21.74	14.06	12.52	12.93	21.21	20.67
1979	19.18	12.94	13.71	16.51	17.10	12.78	11.54	10.75	17.03	17.37
1980	23.21	17.78	16.00	20.72	22.35	13.57	11.31	13.71	21.50	20.76
1981	21.38	14.63	15.94	18.96	20.04	13.64	11.73	12.35	19.75	19.41
1982	18.90	14.13	12.51	17.00	16.93	12.77	11.47	10.59	16.49	16.95
1983	22.99	16.17	10.67	19.62	21.29	14.38	13.21	7.92	20.26	20.05
1984	21.13	15.86	13.82	18.51	19.67	12.10	10.69	11.00	17.99	18.20
1985	21.30	18.07	14.81	17.56	19.05	14.20	11.52	13.21	17.84	18.25
1986	25.29	20.37	16.03	21.89	23.30	17.13	15.52	12.08	21.95	21.12
1987	20.89	16.12	13.75	17.51	18.17	13.36	11.38	12.01	18.20	17.40
1988	25.70	20.23	15.87	21.33	21.97	15.13	13.21	12.35	22.91	21.07
1989	20.34	15.65	17.72	20.04	19.42	13.74	12.64	13.72	18.61	18.42
1990	19.86	13.97	16.67	17.70	17.69	12.82	10.86	13.54	17.34	17.25
1991	25.09	18.76	15.30	20.43	21.57	15.59	13.78	12.15	21.55	21.62
1992	20.46	14.23	18.09	20.71	20.09	13.72	14.32	14.48	18.37	19.57
1993	19.74	15.32	17.41	19.43	19.60	14.14	13.77	13.67	16.64	18.82
1994	29.79	23.75	17.33	23.73	27.33	17.37	15.45	15.74	26.01	26.45
1995	21.16	17.05	6.23	16.37	18.12	16.30	14.28	5.22	16.97	17.24
1996	18.03	15.16	14.33	16.42	15.60	12.53	10.37	12.37	15.21	16.46
1997	21.98	16.78	15.75	19.76	20.83	14.62	12.98	11.87	18.82	19.70
1998	24.74	18.22	21.09	21.49	24.08	14.23	12.30	16.78	21.88	22.42
1999	16.91	12.76	13.57	14.38	15.34	9.94	8.50	10.81	13.72	15.07
2000	26.36	21.79	20.38	24.23	25.97	14.83	12.74	17.61	23.56	24.14
Average										
40-00	22.94	17.72	15.33	20.39	21.27	15.39	13.77	12.49	19.88	19.96
50-64	23.51	18.27	15.65	21.20	21.75	16.15	14.65	12.69	20.37	20.48
86-00	22.42	17.34	15.97	19.69	20.61	14.36	12.81	12.96	19.45	19.78
Max	29.79	23.75	21.09	26.01	27.67	20.41	18.16	17.61	26.23	26.45
Min	16.91	12.17	6.23	14.38	14.81	9.94	8.50	5.22	13.72	14.41

Column Explanations:

1) Year

2 - 10) Crop irrigation requirement calculated as potential consumptive use minus effective precipitation.

11) Weighted average calculated using the crop mix from NASS data and individual crop's irrigation requirement.

TABLE 32
CROP IRRIGATION REQUIREMENT

YUMA COUNTY

(potential consumptive use minus effective precipitation, values in inches)

Year	Corn (Grain)	Corn (Silage)	Wheat	Grass Hay	Alfalfa Hay	Sorghum	Dry Beans	Oats	Sugar Beets	Weighted Average
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1940	21.81	19.45	16.84	19.50	21.44	13.30	11.48	15.08	18.42	19.96
1941	13.30	9.79	11.52	11.86	13.96	5.62	4.43	9.95	11.97	12.32
1942	16.91	16.06	10.91	13.97	15.75	12.14	10.86	10.41	13.88	15.07
1943	25.51	20.04	16.76	21.22	23.93	15.20	13.61	14.73	22.63	22.34
1944	22.62	17.16	16.25	19.52	22.16	11.77	10.31	13.66	20.30	20.21
1945	14.43	11.21	15.76	14.04	14.60	8.65	7.09	12.79	11.99	13.64
1946	18.94	15.32	17.43	18.21	18.40	10.72	8.93	14.66	17.83	17.28
1947	20.16	15.35	10.52	16.55	19.56	11.35	10.22	8.72	18.67	17.82
1948	19.26	14.08	14.16	17.23	18.26	10.74	9.62	11.08	18.79	16.00
1949	18.60	13.14	11.73	15.21	15.48	11.86	10.63	9.08	17.48	14.79
1950	16.00	12.27	19.59	15.55	15.58	9.73	7.89	16.84	13.83	14.74
1951	15.82	14.27	13.55	14.46	14.03	9.67	8.41	10.39	14.03	14.00
1952	24.04	20.19	15.99	22.37	26.41	14.86	13.27	13.49	25.30	24.55
1953	24.06	18.51	18.80	22.45	25.17	12.67	11.25	15.39	23.20	23.81
1954	22.90	18.47	22.14	24.62	25.38	12.65	10.78	19.64	23.12	22.62
1955	22.25	17.86	15.42	20.99	23.46	12.59	11.18	13.50	22.30	18.77
1956	23.02	17.78	21.07	22.22	24.42	12.47	11.20	15.97	23.69	21.39
1957	20.16	14.87	10.90	16.97	18.23	10.97	9.92	8.92	18.29	17.88
1958	19.58	14.90	10.15	14.00	16.56	10.31	8.97	8.56	17.05	16.65
1959	22.35	17.80	17.00	20.52	22.74	12.44	10.83	15.30	21.02	21.29
1960	20.45	15.15	16.23	17.72	18.84	11.30	9.93	13.73	17.98	18.13
1961	18.22	14.81	14.62	14.50	16.95	9.43	7.95	13.57	15.79	15.83
1962	13.85	8.49	12.25	12.06	13.99	8.41	7.01	8.94	15.39	12.51
1963	18.39	16.76	19.81	20.44	22.22	10.05	8.50	17.60	19.75	18.99
1964	23.16	18.67	16.10	22.71	25.38	12.64	10.97	14.09	23.99	21.86
1965	14.08	11.69	15.00	14.26	14.27	8.13	6.84	13.09	13.48	13.20
1966	14.30	11.57	18.31	14.06	16.57	5.17	3.99	16.09	14.12	14.28
1967	20.09	15.18	14.12	16.57	17.92	12.26	10.89	10.93	18.61	17.91
1968	19.85	14.51	19.19	18.65	19.97	9.86	8.52	14.98	18.15	18.53
1969	19.53	15.44	14.08	18.45	19.80	10.50	9.42	11.31	20.41	18.70
1970	20.86	17.13	16.44	19.37	23.87	10.81	9.52	15.53	21.58	20.23
1971	22.56	18.74	15.74	19.58	22.30	13.38	11.64	13.91	20.66	21.21
1972	20.03	15.80	14.85	17.47	18.89	10.69	9.37	12.87	18.42	18.42
1973	16.51	14.32	16.06	14.98	17.20	8.69	6.99	14.86	14.75	15.71
1974	23.73	18.47	16.57	22.47	26.16	12.50	11.37	13.54	24.79	22.98
1975	23.20	17.21	14.41	20.49	22.10	12.69	11.60	11.32	23.08	21.29
1976	22.15	18.10	18.48	23.26	25.14	12.09	10.20	15.24	23.54	21.52
1977	20.86	16.35	15.27	19.59	23.17	11.43	9.87	12.11	22.00	20.22
1978	25.16	19.23	18.81	23.25	24.66	14.19	12.50	15.21	24.38	24.18
1979	20.77	15.62	18.60	20.69	22.24	10.61	9.13	15.52	20.86	20.06
1980	19.27	16.12	14.96	18.94	22.43	10.57	8.86	13.75	21.50	18.35
1981	20.57	16.03	15.62	19.49	22.50	10.78	9.12	12.92	22.06	19.50
1982	17.54	13.64	8.13	13.00	14.00	10.88	9.73	6.67	16.15	15.94
1983	20.76	16.38	16.39	20.92	24.58	11.29	10.15	13.13	21.86	19.56
1984	25.36	20.61	15.94	24.54	27.33	15.00	13.48	13.32	25.70	22.91
1985	19.94	17.39	16.23	17.91	20.80	11.12	9.31	14.96	19.11	17.92
1986	20.88	16.94	17.41	19.32	22.21	11.60	9.91	14.35	20.52	18.85
1987	22.61	16.88	14.10	19.51	21.84	11.69	9.97	12.68	21.76	20.04
1988	23.55	19.41	18.16	21.32	23.82	13.78	12.06	14.49	24.41	22.18
1989	17.32	13.61	16.44	16.81	17.10	10.15	9.00	12.95	15.78	16.45
1990	19.41	15.33	16.75	16.95	18.00	10.43	8.69	14.23	18.13	17.73
1991	16.34	11.22	12.40	12.38	14.99	7.08	5.97	10.52	14.60	15.04
1992	17.52	12.60	17.79	16.60	17.78	9.38	8.21	15.42	15.00	16.78
1993	17.32	13.44	14.99	14.38	16.37	9.97	8.28	12.05	15.01	16.38
1994	20.26	16.18	14.17	17.74	21.47	10.82	9.21	12.33	20.35	18.66
1995	18.10	14.14	11.82	14.55	16.94	10.46	9.21	10.41	15.29	16.52
1996	15.70	12.51	15.80	13.69	14.15	7.87	6.25	13.78	13.46	14.53
1997	17.58	13.22	17.06	15.71	17.04	8.59	6.99	13.11	15.91	16.58
1998	19.81	15.59	19.36	18.62	21.50	10.27	8.54	15.97	20.09	18.75
1999	17.41	13.70	13.38	14.04	16.35	8.83	7.78	12.13	14.45	16.15
2000	20.74	17.80	19.64	21.70	24.25	10.65	8.94	17.04	21.93	20.04
Average										
40-00	19.79	15.65	15.70	18.04	20.04	10.91	9.46	13.26	18.99	18.36
50-64	20.28	16.05	16.24	18.77	20.62	11.35	9.87	13.73	19.65	18.87
86-00	18.97	14.84	15.95	16.89	18.92	10.10	8.60	13.43	17.78	17.64
Max	25.51	20.61	22.14	24.62	27.33	15.20	13.61	19.64	25.70	24.55
Min	13.30	8.49	8.13	11.86	13.96	5.17	3.99	6.67	11.97	12.32

Column Explanations:

1) Year

2 - 10) Crop irrigation requirement calculated as potential consumptive use minus effective precipitation.

11) Weighted average calculated using the crop mix from NASS data and individual crop's irrigation requirement.

TABLE 33
CROP IRRIGATION REQUIREMENT
(potential consumptive use minus effective precipitation, values in inches)

	County								Basin
Year	Cheyenne	Kit Carson	Lincoln	Logan	Phillips	Sedgwick	Wash-ington	Yuma	Weighted Average
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1940	18.77	20.58	21.53	21.43	21.19	20.80	17.76	19.96	20.26
1941	14.55	15.86	16.82	13.21	12.94	12.67	19.73	12.32	15.24
1942	15.55	18.46	19.25	15.54	15.29	15.28	19.15	15.07	16.32
1943	20.94	20.56	21.71	24.26	24.39	23.91	21.61	22.34	23.26
1944	22.27	20.26	21.22	22.08	22.14	21.57	22.35	20.21	22.04
1945	15.56	15.46	15.86	12.25	11.74	11.62	16.95	13.64	14.40
1946	22.11	19.71	20.91	19.58	19.34	19.07	18.80	17.28	19.23
1947	20.05	19.32	19.76	19.04	19.36	18.92	24.95	17.82	21.23
1948	14.69	15.47	19.52	23.50	24.57	24.56	21.30	16.00	19.22
1949	13.13	15.18	17.56	17.13	16.97	16.78	14.41	14.79	15.18
1950	18.95	18.83	19.30	19.78	19.53	19.82	16.03	14.74	17.21
1951	19.89	14.46	16.23	13.88	13.84	14.13	15.80	14.00	14.76
1952	24.10	21.74	25.10	26.55	28.55	26.26	22.27	24.55	23.94
1953	21.30	20.18	23.04	21.50	22.21	20.54	20.27	23.81	21.76
1954	22.05	25.68	29.01	22.18	22.44	21.57	24.36	22.62	23.89
1955	22.81	20.43	24.67	21.18	20.46	21.31	18.38	18.77	19.84
1956	28.02	26.74	27.93	24.88	24.52	24.62	23.77	21.39	24.62
1957	17.54	16.30	17.21	22.89	22.84	22.83	18.67	17.88	17.58
1958	13.09	16.72	15.60	18.25	18.77	16.27	20.18	16.65	17.04
1959	17.16	25.44	26.10	23.13	22.70	22.71	22.40	21.29	23.58
1960	19.61	21.91	20.99	23.57	22.64	22.84	22.82	18.13	20.85
1961	15.90	20.48	20.06	20.18	19.33	19.07	18.40	15.83	18.79
1962	18.46	18.06	19.72	18.74	17.88	18.58	20.39	12.51	16.63
1963	22.89	21.50	25.06	23.23	22.51	21.01	20.84	18.99	20.93
1964	22.57	22.41	24.21	26.34	24.74	25.40	22.69	21.86	22.50
1965	15.25	11.75	11.94	16.51	15.98	15.98	17.31	13.20	12.83
1966	19.25	19.84	21.08	18.74	17.53	17.12	19.97	14.28	17.76
1967	18.93	18.38	17.58	17.10	16.77	16.93	18.12	17.91	18.01
1968	21.11	21.40	21.31	24.21	23.22	22.23	20.47	18.53	20.35
1969	16.33	21.97	21.40	22.15	20.79	20.92	19.64	18.70	20.20
1970	19.16	23.22	22.99	26.27	23.68	24.09	20.49	20.23	21.79
1971	20.85	23.78	21.96	20.54	19.10	19.36	21.49	21.21	21.88
1972	18.95	20.21	18.61	19.25	18.93	18.20	18.75	18.42	19.13
1973	20.99	21.65	18.79	21.37	20.06	20.01	18.51	15.71	18.57
1974	25.06	25.48	23.00	26.60	25.81	25.16	24.13	22.98	24.32
1975	21.37	22.19	21.33	23.44	22.81	22.24	19.43	21.29	21.68
1976	21.75	25.49	24.01	25.97	25.75	24.61	21.80	21.52	23.36
1977	22.28	21.84	18.88	22.08	22.05	21.64	24.98	20.22	21.31
1978	22.15	21.19	20.89	27.28	27.29	26.80	20.67	24.18	23.54
1979	20.49	17.72	15.31	20.19	20.54	20.30	17.37	20.06	19.28
1980	20.31	19.29	18.97	24.17	23.31	24.01	20.76	18.35	19.67
1981	19.01	21.08	19.16	20.47	20.33	20.43	19.41	19.50	20.08
1982	18.71	16.89	15.49	16.65	16.69	16.83	16.95	15.94	16.46
1983	23.54	17.43	19.40	22.81	22.07	22.08	20.05	19.56	19.49
1984	21.77	21.02	22.57	24.81	23.56	23.76	18.20	22.91	22.17
1985	20.68	17.43	16.99	23.22	22.99	21.52	18.25	17.92	18.64
1986	20.31	20.79	21.55	22.97	22.43	21.79	21.12	18.85	20.16
1987	19.20	17.67	18.18	20.29	20.61	20.37	17.40	20.04	19.25
1988	18.46	20.15	20.54	22.10	22.20	22.20	21.07	22.18	21.45
1989	15.14	18.31	18.64	17.41	16.96	17.55	18.42	16.45	17.20
1990	19.60	20.56	20.72	20.82	20.51	21.06	17.25	17.73	19.00
1991	18.82	18.05	17.62	19.89	20.70	20.72	21.62	15.04	17.35
1992	19.63	18.77	19.07	18.76	18.32	18.85	19.57	16.78	17.87
1993	21.48	18.02	17.86	15.38	15.14	15.48	18.82	16.38	16.94
1994	20.64	19.43	18.88	24.77	24.63	24.78	26.45	18.66	20.45
1995	19.09	17.10	16.26	19.23	19.11	19.63	17.24	16.52	17.24
1996	18.66	18.29	17.48	11.03	10.84	11.67	16.46	14.53	15.21
1997	18.37	18.80	18.02	20.98	20.53	20.89	19.70	16.58	18.12
1998	19.39	17.33	16.36	19.35	18.09	19.13	22.42	18.75	18.54
1999	19.33	16.39	16.34	16.74	16.26	16.41	15.07	16.15	16.24
2000	23.47	22.73	22.45	27.31	25.31	25.83	24.14	20.04	22.07
Avg	19.70	19.73	20.00	20.90	20.52	20.37	19.96	18.36	19.47
50-64 Avg	20.29	20.73	22.28	21.75	21.53	21.13	20.48	18.87	20.26
86-00 Avg	19.44	18.83	18.66	19.80	19.44	19.76	19.78	17.64	18.47
Min	13.09	11.75	11.94	11.03	10.84	11.62	14.41	12.32	12.83
Max	28.02	26.74	29.01	27.31	28.55	26.80	26.45	24.55	24.62

Column Explanations:

1) Year

2 - 9) Weighted average potential consumptive minus effective precipitation use estimated using a calibrated Hargreaves reference ET from Tables 13 to 20.

10) Potential consumptive use minus effective precipitation calculated using columns 2 through 9 weighted by county acreages.
(See "Irrigated acreage estimates - Republican River Basin in Colorado" for description of county acreage.)

ATTACHMENT A

WEATHER STATION SITE ASSESSMENT
Republican River Basin, State of Colorado

prepared by
Thomas W. Ley, PE, PhD
State of Colorado Division of Water Resources
22 August 2002

INTRODUCTION

It is recommended that weather data intended for reference ET estimation be collected at weather stations sited over well-watered, clipped grass surfaces in open, well-watered settings (Allen et al, 1983; Yoder et al. 2000; Allen, 1996). Reference ET (and therefore crop ET) estimates will be artificially high when weather data are collected in environments that are drier than these reference conditions (Brown and Ley, 1993; Ley, et al., 1996). Specifically, when located in environments that are drier than the reference condition, weather stations will measure increased air temperatures, reduced water vapor in the air, and potentially greater wind speeds, resulting in increased reference ET estimates compared to the reference environment. In such cases, a greater portion of the energy available is used in sensible heating of the air and soil and less in evaporation (which results in cooling and humidification of the air) because of the reduced amount of environmental moisture available for evaporation. This effect has generally been termed an aridity effect.

Site visits were conducted on July 31 and August 21, 2002 to observe station installations with respect to irrigated cropping in each area, the condition and status of the weather measurement surface, and other site factors (obstructions, etc.) to assess the suitability of data collected at each specific location for reference ET estimation. The following summarizes observations noted at each site. Digital photos were taken of each station in the four coordinate directions to further document site observations.

This assessment does not address the quality of the collected data. In the author's experience careful screening of the data from any site must be also be conducted prior to their use for reference ET estimation.

Six NOAA Cooperative Observer weather station sites were also observed during these site visits.

ELECTRONIC WEATHER STATIONS

Kirk (krk01)

The Kirk CoAgMet electronic weather station is located in southwestern Yuma County approximately 2.5 miles east of Joes CO on Hwy 36, and about 200 ft south of Hwy 36 on the east side of the Liberty School grounds. The station is situated over

clipped dry grass. The station is bordered on all sides by non-irrigated grass and dryland crops for distances not less than 0.5 miles. The closest irrigated cropping is center pivot irrigated corn fields approximately 0.5 miles to the east of the station.

The station is equipped with the standard set of sensors: wind speed and direction at 2 m height, solar radiation at 2 m height, air temperature and relative humidity in a multiplate radiation shield at 1.5 m height and a tipping bucket rain gage. There are no sensor exposure problems. A row of trees is planted about 70 yards south of the station and school housing is situated about 100 yards west of the station.

The weather data measured at this location will be affected by aridity in the immediate environment of the sensors, because of the dry weather measurement surface, and in the local area because of the dry fetch in all directions for up to 0.5 miles. These data should **not** be used for reference ET estimation using any form of the Penman equation without careful review of the temperature and humidity data. It is highly probable the data will need correction prior to reference ET computation if they are used at all for this purpose.

Burlington No. 2 (brl02)

The Burlington No. 2 CoAgMet electronic weather station is located in southeastern Kit Carson County approximately 6 miles southeast of Burlington CO on the east side of County Rd 57 between County Roads S and T. The station is situated about 50 yards east of Road 57 over dry, grazed rangeland. The station is bordered on all sides by dry rangeland. The closest irrigated cropping is a center pivot irrigated field approximately 200 yards to the southwest of the station.

The station is equipped with the standard set of sensors: wind speed and direction at 2 m height, solar radiation at 2 m height, air temperature and relative humidity in a multiplate radiation shield at 1.5 m height and a tipping bucket rain gage. There are no sensor exposure problems. A farmhouse and trees are located about 70 yards west of the station across the county road and trees and a farmhouse are located about ¼ mile south of the station.

The weather data measured at this location will be affected by aridity in the immediate environment of the sensors, because of the dry weather measurement surface, and in the local area and general region because of the dry fetch in all directions and relative paucity of irrigated fields. These data should **not** be used for reference ET estimation using any form of the Penman equation without careful review of the temperature and humidity data. It is highly probable the data will need correction prior to reference ET computation if they are used at all for this purpose.

Burlington No. 1 (brl01)

The Burlington No. 1 CoAgMet electronic weather station is located in northeastern Kit Carson County approximately 18 miles northeast of Burlington CO in

the southwest corner of the intersection of Roads 59 and KK. The station is situated about 50 yards south of Road KK over non-irrigated dry crop stubble. The station is bordered on all sides by dryland crops or rangeland for approximately ¼ mile. The closest irrigated cropping is a center pivot irrigated field approximately 400 yards to the southwest of the station. Center pivot fields are located about 0.5 mile to the north, west and east.

The station is equipped with the standard set of sensors: wind speed and direction at 2 m height, solar radiation at 2 m height, air temperature and relative humidity in a multiplate radiation shield at 1.5 m height and a tipping bucket rain gage. There are no sensor exposure problems. There are trees located within about 200 yards to the west, south and east of the station.

The weather data measured at this location will be affected by aridity in the immediate environment of the sensors, because of the dry weather measurement surface, and in the local area because of the dry fetch in all directions for up to about ¼ mile. These data should **not** be used for reference ET estimation using any form of the Penman equation without careful review of the temperature and humidity data. It is highly probable the data will need correction prior to reference ET computation if they are used at all for this purpose.

Idalia (idl01)

The Idalia CoAgMet weather station is situated 2 miles north of Idalia CO in southeastern Yuma County approximately 0.5 mile west of Road DD on Road 11. The station sits on the north side of Road 11 about 30 feet from the shoulder over dry, unirrigated grass, weeds, and crop stubble. Center pivot irrigated crops of corn and alfalfa hay were observed to the northwest and northeast within 100-200 yards. Across Road 11 to the southeast and southwest were unirrigated tilled fields. The field to the southwest can be surface irrigated.

The station is equipped with the standard set of sensors: wind speed and direction at 2 m height, solar radiation at 2 m height, air temperature and relative humidity in a multiplate radiation shield at 1.5 m height and a tipping bucket rain gage. Power poles and an irrigation well with an electric motor within 15-20 feet to the west and northwest of the station may cause some minor effects on wind and solar radiation measured by the station. The electric motor may cause some heat loading in the area on calm days.

The weather data measured at this location will be affected by aridity in the immediate environment of the sensors, because of the dry weather measurement surface, and in the local area because of the dry fetch in all directions for up to about 200 yards. These data should **not** be used for reference ET estimation using any form of the Penman equation without careful review of the temperature and humidity data. It is probable the data will need correction prior to reference ET computation if they are used for this purpose.

Wray (wry01)

The Wray CoAgMet electronic weather station is located in northeastern Yuma County approximately 10 miles north of Wray CO in the vicinity of the intersection of Roads 43 and KK. The station is situated about 0.5 mile to the west-northwest of the intersection amongst several circles of center pivot irrigated corn. A farm road and corridor of dryland about 100 yards wide lead into the station from the northeast. The area in between the circles where the station is situated (approximately 100 yards (N-S) by 300 yards (E-W)) is bare soil and weeds with the weedy areas at the fringes of the irrigated circles being greener due to some water application from the pivots.

The station is equipped with the standard set of sensors: wind speed and direction at 2 m height, solar radiation at 2 m height, air temperature and relative humidity in a multiplate radiation shield at 1.5 m height and a tipping bucket rain gage. The weather measurement surface is non-irrigated bare soil and dry stubble. The anemometer was noted to not be moving under the light breeze in the area at the time of visit. Pipe fence panels about five feet tall surround the station within a few feet. There is a metal stock water tank on a concrete pad on the immediate east side of the station.

The weather data measured at this location are probably suitable for reference ET estimation without adjustment for aridity. The air temperature data may be biased to the high side due to reflection and heat loading from the nearby pipe fence panels, concrete pad under the stock tank, and the dry measurement surface.

Holyoke (hyk02)

The Holyoke CoAgMet electronic weather station is located in southeastern Phillips County approximately 12 miles southeast of Holyoke CO on Road 61 at Road 8.5. The station is situated about 100 yards east of Road 61 over non-irrigated range grass. The station is bordered on the north side by an extensive fetch of dry rangeland. A center pivot irrigated field is within 100 yards to the south and southeast. Center pivot irrigated fields are also located to the southwest and northwest within 0.5 miles across County Road 61.

The station is equipped with the standard set of sensors: wind speed and direction at 2 m height, solar radiation at about 1.7 m height, air temperature and relative humidity in a multiplate radiation shield at 1.5 m height and a tipping bucket rain gage. There are no sensor exposure problems. There are trees located within about 200 yards to the west across County Road 61.

The weather data measured at this location will be affected by aridity in the immediate environment of the sensors, because of the dry weather measurement surface, and in the local area because of the dry fetch in the north, east and west directions. These data should **not** be used for reference ET estimation using any form of the Penman equation without careful review of the temperature and humidity data. It is highly

probable the data will need correction prior to reference ET computation if they are used for this purpose.

Haxtun (hxt01)

The Haxtun CoAgMet electronic weather station is located in northwestern Phillips County approximately 2.5 miles northwest of Haxtun CO in the northwest corner of the intersections of Roads 34 and 3. The station is situated over non-irrigated grass and dry crop stubble in the southeast corner of a center pivot irrigated field. Center pivot irrigated cornfields are located within 100-200 yards to the southwest and northwest. Dryland crop fields are located to the southeast and northeast within 100-200 yards across County Road 34.

The station is equipped with the standard set of sensors: wind speed and direction at 2 m height, solar radiation at 2 m height, air temperature and relative humidity in a multiplate radiation shield at 1.5 m height and a tipping bucket rain gage. The anemometer was noted to not be moving under the light breeze in the area at the time of visit. There are no sensor exposure problems.

The weather data measured at this location will be affected by aridity in the immediate environment of the sensors, because of the dry weather measurement surface, and in the local area because of the dry fetch in the northeast and southeast directions. These data should **not** be used for reference ET estimation using any form of the Penman equation without careful review of the temperature and humidity data. It is highly probable the data will need correction prior to reference ET computation if they are used for this purpose.

Yuma No. 2 (yum02)

The Yuma No. 2 CoAgMet electronic weather station is located in western Yuma County approximately 2.5 miles north of Yuma CO on the west side of Hwy 59 on an industry sponsored Irrigation Research Farm. The station is situated over bare soil and a small patch of grass in an area between several small pivot irrigated fields. Dryland crop fields are located to the southeast and northeast within 100-200 yards across County Road 34.

The station is equipped with the standard set of sensors: wind speed and direction mounted slightly high at about 2.1 m height, solar radiation at 2 m height, air temperature and relative humidity in a multiplate radiation shield (also mounted high) at about 1.8 m height and a tipping bucket rain gage. The center pivot irrigated cornfield located within 10-15 yards to the south and west of the station may cause seasonal sheltering of the anemometer when the corn crop has grown tall enough.

The weather data measured at this location are suitable for reference ET estimation. The air temperature data may be biased to the high side and humidity to the low side due to reflection and heat loading from the bare soil measurement surface. The

temperature and humidity data should be assessed using accepted procedures to check this.

Yuma No. 1 (yum01)

The Yuma No. 1 CoAgMet electronic weather station was located in western Yuma County approximately 6 miles east of Yuma CO in the southeast corner of the intersection of Roads M and 37. The CoAgMet station site index lists gives the period of record for this site as 5-19-1993 to 5-9-2001. Apparently the station has been discontinued and moved. The area investigated would have had the station situated over non-irrigated grass in the northwest corner of a center pivot irrigated field. Dryland cropping or dry rangeland was observed to the north and northeast. Center pivot irrigated fields are located to the south and southeast, and to the west and southwest across County Road M.

The weather data measured at this location will be affected by aridity in the immediate environment of the sensors, because of the dry weather measurement surface, and in the local area because of the dry fetch in the northeast and north directions. These data should **not** be used for reference ET estimation using any form of the Penman equation without careful review of the temperature and humidity data. It is highly probable the data will need correction prior to reference ET computation if they are used for this purpose.

Akron (akr02)

The Akron CoAgMet and High Plains Climate Center (HPCC) electronic weather station is located in central Washington County approximately 4 miles east of Akron CO on the grounds of the USDA-ARS Great Plains Research Center. The station is located in a weather measurement compound on the Center. The Akron 4E NOAA station is co-located at the site. The compound is planted to non-irrigated clipped grass. The only irrigated fields in the region are small irrigation research plots (irrigated by a linear move sprinkler and solid set overcrop sprinklers) to the south and southwest of the weather instruments. Dryland cropping was observed to the west, north and east of the compound.

The station is equipped with the standard set of sensors: wind speed and direction at **3 m** height, solar radiation at 2 m height, air temperature and relative humidity in a multiplate radiation shield at 1.5 m height and a tipping bucket rain gage. There are no sensor exposure problems.

The weather data measured at this location will be affected by aridity in the immediate environment of the sensors, because of the dry weather measurement surface, and in the local area and general region, because of the dry fetch in almost all directions and relative paucity of irrigated fields. These data should **not** be used for reference ET estimation using any form of the Penman equation without careful review of the

temperature and humidity data. It is highly probable the data will need correction prior to reference ET computation if they are used for this purpose.

Stratton

The Stratton High Plains Climate Center (HPCC) electronic weather station is located in central Kit Carson County approximately 5 miles east of Stratton CO between Highway 24 and Interstate 70. The station is situated over bare soil and unmanaged weeds. The closest irrigated fields in the region are center pivots approximately 1 to 2 miles away to the northeast and northwest, and 3-4 miles to the west. Dryland cropping was observed in all directions for up to 1-2 miles around the station.

The station is equipped with the standard set of sensors: wind speed and direction at **3 m** height, solar radiation at 2.5 m height, air temperature and relative humidity in a multiplate radiation shield at 1.5 m height and a tipping bucket rain gage. There are no sensor exposure problems, although a tractor parked within 15 feet south of the station may cause heat loading on the station. The tipping bucket rain gage funnel was partially filled with rainwater due to debris and spider webs in the funnel.

The weather data measured at this location will be affected by aridity in the immediate environment of the sensors, because of the dry weather measurement surface, and in the local area and general region, because of the dry fetch in all directions and the lack of nearby irrigated fields. These data should **not** be used for reference ET estimation using any form of the Penman equation without careful review of the temperature and humidity data. It is highly probable the data will need correction prior to reference ET computation if they are used for this purpose.

NOAA STATIONS

Akron 1N

Station was located at the Akron airport approximately 1 mile north of Akron CO. It appears the station has been closed or replaced with electronic equipment as there was no max/min thermometer in the cotton shelter and the rain gage was upside down.

Akron 4E

Station is located on the USDA-ARS Great Plains Research Center 4 miles east of Akron CO. It is co-located in a compound with the Akron CoAgMet/HPCC electronic weather station. Station includes a max/min thermometer in a cotton shelter, rain gage and Class A evaporation pan.

Wray 2E

Station is located 2 miles east of Wray CO on Hwy 34 at the KRDZ radio station. A maximum-minimum temperature sensor (MMTS) is located west of the building over

clipped green grass but shield by satellite dishes. A cotton shelter is located immediately behind (south) the building. The rain gage is located on the north side of the building.

Holyoke

Station is located in the side and backyard of residence on the northwest corner of Furny and Baxter Streets in Holyoke CO. An MMTS is located in the side yard over grass and concrete near the house and the rain gage is located in the backyard.

Burlington 4S

Station is located at a residence on the grounds of the Burlington Kit Carson County Airport 4 miles south of Burlington CO. An MMTS is located over dry clipped grass on the east side of the house between the house and shelter belt of trees. The rain gage is located in the front yard.

Cheyenne Wells

Station is located on the south side of a farm/barnyard and north across the railroad tracks from the Cheyenne Wells Farm Service Center. Station consists of a poorly maintained cotton shelter and rain gage located over dry ground.

SUMMARY

Eleven electronic weather station sites in the Colorado Republican River Basin were visited. Of these eleven stations, only two of them are located in irrigated environments (Wray and Yuma No. 2) that approach the recommended reference environment conditions for reference ET estimation. The remaining sites were all affected by aridity in each of the immediate measurement surface, local area, and region. Temperature and humidity data collected at these locations should be carefully evaluated using recommended procedures to determine and adjust for aridity effects. All weather data collected at any of the sites should be carefully screened for outliers, sensor calibration problems, internal consistency, etc. prior to their use for reference ET estimation.

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Ley, T.W., R.G. Allen, and R.W. Hill. 1996. Weather Station Siting Effects on Reference Evapotranspiration. In: Evapotranspiration and Irrigation Scheduling. Proc. of the ASAE International Conference, San Antonio, Texas, Nov. 3-6. pp. 727-734.

Yoder, R.E., T.W. Ley, and R.L. Elliott. 2000. Measurement and Reporting Practices for Automatic Agricultural Weather Stations. Proc. ASAE National Irrigation Symposium. Phoenix, Nov. 14-16.

ATTACHMENT A - PHOTOGRAPHS

Kirk (krk01) view to East

Kirk (krk01) view to North

Kirk (krk01) view to South

Kirk (krk01) view to West

ATTACHMENT A - PHOTOGRAPHS

Burlington No. 2 (brl02) view to East

Burlington No. 2 (brl02) view to North

Burlington No. 2 (brl02) view to South

Burlington No. 2 (brl02) view to West

ATTACHMENT A - PHOTOGRAPHS

Burlington No. 1 (brl01) view to East

Burlington No. 1 (brl01) view to North

Burlington No. 1 (brl01) view to South

Burlington No. 1 (brl01) view to West

ATTACHMENT A - PHOTOGRAPHS

Idalia (idl01) view to East

Idalia (idl01) view to North

Idalia (idl01) view to South

Idalia (idl01) view to West

ATTACHMENT A - PHOTOGRAPHS

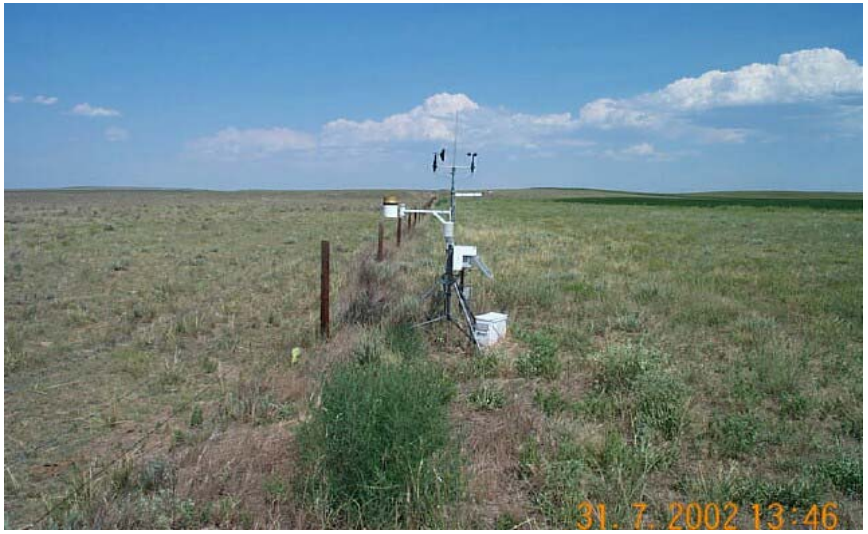
Wray (wry01) view to East

Wray (wry01) view to North

Wray (wry01) view to South

Wray (wry01) view to West

ATTACHMENT A - PHOTOGRAPHS



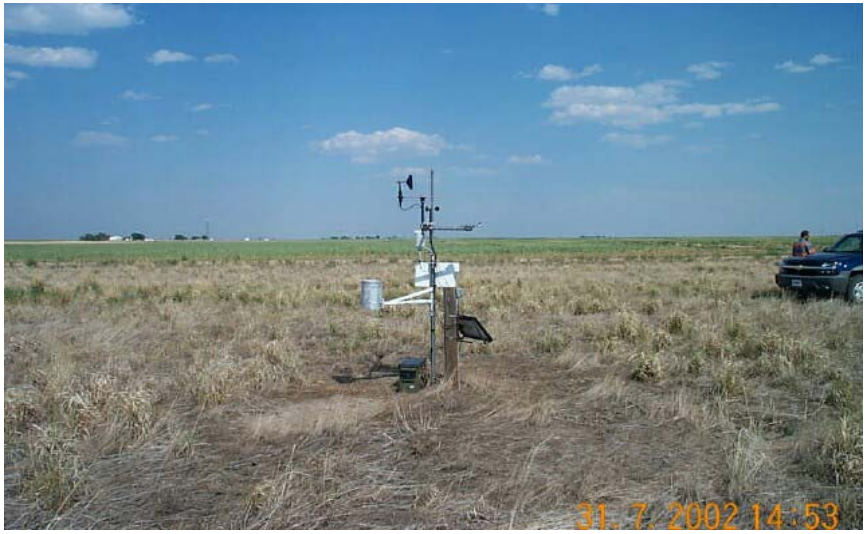
Holyoke (hyk02) view to East

Holyoke (hyk02) view to North

Holyoke (hyk02) view to South

Holyoke (hyk02) view to West

ATTACHMENT A - PHOTOGRAPHS



Haxtun (hxt02) view to East

Haxtun (hxt02) view to North

Haxtun (hxt02) view to South

Haxtun (hxt02) view to West

ATTACHMENT A - PHOTOGRAPHS

Yuma No. 2 (yum02) view to West

Yuma No. 2 (yum02) view to Northeast

Yuma No. 2 (yum02) view to South

ATTACHMENT A - PHOTOGRAPHS

Akron (akr02 & HPCC) view to East

Akron (akr02 & HPCC) view to North

Akron (akr02 & HPCC) view to South

Akron (akr02 & HPCC) view to West

ATTACHMENT A - PHOTOGRAPHS

Stratton (HPCC) view to East

Stratton (HPCC) view to North

Stratton (HPCC) view to South

Stratton (HPCC) view to West

ATTACHMENT A - PHOTOGRAPHS

Akron 1N (NOAA) view to West

Akron 1N (NOAA) view to East

Wray 2E (NOAA) MMTS view to South

Wray 2E (NOAA) cotton shelter view to West

ATTACHMENT A - PHOTOGRAPHS

Akron 4E (NOAA) view to East

Akron 4E (NOAA) view to North

Akron 4E (NOAA) view to South

Akron 4E (NOAA) view to West

ATTACHMENT A - PHOTOGRAPHS

Akron 4E (NOAA) view to East Northeast

Burlington 4S (NOAA) MMTS view to North

Burlington 4S (NOAA) MMTS view to North

Holyoke (NOAA) view to East Southeast

ATTACHMENT A - PHOTOGRAPHS

Cheyenne Wells (NOAA) view to East

Cheyenne Wells (NOAA) view to Northeast

ATTACHMENT B

WEATHER DATA INTEGRITY ASSESSMENT AND REFERENCE EVAPOTRANSPIRATION ESTIMATION

Republican River Basin, State of Colorado

prepared by
Thomas W. Ley, PE, PhD
State of Colorado Division of Water Resources
October 7, 2002

INTRODUCTION

Daily weather data collected at several electronic weather station sites in the Republican River Basin of Colorado were assessed for their integrity and suitability for estimation of reference evapotranspiration using the Penman-Monteith equation. Required data include daily maximum and minimum air temperature, daily dewpoint temperature or average vapor pressure, daily total solar radiation, and daily average wind speed.

Several electronic weather stations that collect these detailed weather data have been operated in the Republican River Basin for a number of years. The Colorado Agricultural Meteorological (CoAgMet) Network operated by the Colorado Climate Center at Colorado State University has operated nine electronic weather stations in the Basin over the past several years. Location data are given in Table 1. In addition, the High Plains Climate Center Automated Weather Data Network (HPCC AWDN) operates two electronic weather stations in the Basin. Location data for these two stations are also given in Table 1.

The individual weather station installations and site conditions have been documented in a separate report. The site assessment revealed that all of the stations are not located in the prescribed reference environment recommended if the measured data are to be used for reference evapotranspiration estimation and are thus affected by aridity of the local and regional environment to varying degrees. Due to these aridity effects, weather data collected at the Burlington No.1, Burlington No. 2, and Kirk CoAgMet sites were not included in this study. The Yuma No.1 station was also not included as it is no longer in operation and has been moved.

In addition to location data, Table 1 also lists the data source, parameters evaluated, and period of record evaluated for the electronic weather stations. Daily CoAgMet data evaluated in this study were downloaded from the CoAgMet web site by Mr. Randy Hendrix of Helton and Williamson and provided to the author by him. The period evaluated for the CoAgMet sites is generally from station installation through 2001. Data for the two HPCC AWDN sites were also obtained by Mr. Hendrix from HPCC and provided to the author. The initial data sets for the AWDN sites contained only daily average relative humidity. This is a poor predictor for daily average vapor pressure or dewpoint temperature due to the non-linear nature of the vapor pressure-

temperature relationship. The daily average relative humidity data were used to assess the performance of the relative humidity sensor. Additional data sets for the two AWDN sites were obtained which contained the daily average vapor pressure and vapor pressure deficit. All data were obtained and evaluated in metric units.

Table 1. Electronic weather station locations and data evaluated.

Site	Latitude	Longitude	Elev (m)	Data Source	Period Evaluated	Data Type[1]	Time Step
Haxtun (hxt01)	40.67	102.65	1231	CoAgMet Web Page[2]	3/1997 – 12/2001	Rs, Tx, Tn, VP, WR, RHx, RHn	Daily
Holyoke (hyk02)	40.49	102.09	1138	CoAgMet Web Page	5/1991 – 12/2001	Rs, Tx, Tn, VP, WR, RHx, Rhn	Daily
Idalia (idl01)	39.73	102.09	1212	CoAgMet Web Page	5/1991 – 12/2001	Rs, Tx, Tn, VP, WR, RHx, RHn	Daily
Wray (wry01)	40.19	102.20	1097	CoAgMet Web Page	1/1997 – 12/2001	Rs, Tx, Tn, VP, WR, RHx, RHn	Daily
Yuma No. 2 (yum02)	40.15	102.72	1219	CoAgMet Web Page	5/1996 – 12/2001	Rs, Tx, Tn, VP, WR, RHx, RHn	Daily
Burlington No. 1 (brl01)	39.50	102.07	1189		not		
Burlington No. 2 (brl02)	39.26	102.11	1271		not		
Kirk (krk01)	NA	NA	NA		not		
Yuma No. 1 (yum01)	40.10	102.61	1219		not		
Akron	40.15	103.14	1384	HPCC AWDN	1/1986 – 12/2001	Rs, Tx, Tn, VP, WR, ave. RH	Daily
Stratton	39.30	102.50	1390	HPCC AWDN	1/1989 – 12/2001	Rs, Tx, Tn, VP, WR, ave. RH	Daily

[1] Rs-Daily total solar radiation, Tx-Daily maximum air temperature, Tn-daily minimum air temperature, VP-average daily vapor pressure, WR-daily wind travel or wind run, ave RH-daily average relative humidity, RHx-daily maximum relative humidity, RHn-daily minimum relative humidity.
[2] http://ulysses.atmos.colostate.edu/~coag/

WEATHER DATA INTEGRITY ASSESSMENT

Faulty weather measurement sensors (poor calibration, sensor failure, etc.) and inadequate weather data quality control/quality assurance procedures can result in inaccurate reference ET estimates. Procedures and guidelines for assessing the integrity of weather data for reference ET estimation have been developed (Allen, 1996; ASCE TC Draft Report, 2002; Allen et al., 1998). These procedures and guidelines were used in this assessment. Methods for "correcting" data collected by poorly calibrated sensors, for adjusting temperature data collected at non-reference sites to reflect reference conditions, and for filling in missing weather data are also available (Allen, 1996; Temesgen et al., 1999; ASCE TC Draft Report, 2002; Allen, et al., 1998; Ley, et al., 1996). Some of these methods were employed here.

Missing Data Replacement

Missing data were typically filled in by substituting values for the given parameter and date with values from the physically nearest neighboring electronic weather station site having the measured data available on that date. Table 2 is a summary of the missing values found at each site and how they were replaced.

Table 2. Summary of missing and replacement data at electronic weather station sites.

Site/Year	Missing Data	Replacement Data
Haxtun		
1997	Days 1-90 not available all parameters.	Not replaced.
1998	Day 140 all parameters	Used Akron 1998 same day
1999	None	
2000	None	
2001	None	
Holyoke		
1991	Days 1-120 not available all parameters	Not replaced.
1992	None	
1993	Days 90, 301-302 all parameters	Used Akron 1993, days 90, 301-302
1994	None	
1995	Tx (day 118); Tn (days 115, 117-119) Tn,, VP (day 157)	Used Akron 1995 same days
1996	Day 152	Used Yuma 1996 day 152
1997	Days 1-155 not available all parameters	Not replaced
1998	Days 130, 140-141, 159, 161, 277-287 all Parameters; Rs (days 298-313)	Used Akron 1998 for day 140 and Haxtun 1998 for the other days Used Haxtun 1998 same days
1999	None	
2000	Day 59 all parameters	Used Haxtun 2000
2001	Days 236-237, 252, 259-261, 330-331 all parameters	Used Haxtun 2001 same days
Idalia		
1991	Days 1-151 not available all parameters	Not replaced
1992	None	

1993	Days 90, 301-302 all parameters	Used Stratton 1993, days 90, 301-302
1994	None	
1995	None	
1996	None	
1997	Days 96, 151-155 all parameters	Used Wray 97 same days
1998	Day 140 all parameters	Used Stratton 98 same day
1999	None	
2000	None	
2001	None	
Wray		
1997	Days 307-365 not available all parameters	Not replaced
1998	Day 140 all parameters	Used Akron 1998 same day
	Days 307-365 not available all parameters	Not replaced
1999	None	
2000	Day 59 all parameters	Used Yuma 2000 same day
2001	Day 137 all parameters	Used Yuma 2001 same day
Yuma No. 2		
1996	Days 1-128 not available all parameters	Not replaced
1997	Days 96, 113-114, 138-139, 146 all parameters	Used Wray 1997 same days
1998	Day 140 all parameters	Used Akron 1998 same day
	Day 289 all parameters	Used Wray 1998 same day
1999	None	
2000	Days 60-61 all parameters	Used Wray 2000 same days
2001	Day 138 all parameters	Used Wray 2001 same day
Akron		
1986	Days 1-127 not available all parameters	Not replaced
1987	VP (days 185-189, 264)	Used average of day 184 and day 190 for days 185-189; and average of days 263 and 265 for day 264
1988-1991	None	
1992	VP (day 77)	Used average of days 76 and day 78
1993-1995	None	
1996	VP (day 237)	Used average of days 236 and day 238
1997-2001	None	
Stratton		
1989-2001	None	

Daily Maximum and Minimum Air Temperature

Daily maximum and minimum air temperatures were assessed by graphing the data year by year at each site and checking for obvious outliers (very large or small data values which do not follow the trends of the preceding or following periods) and/or inconsistent trends. In general, very few problems were found with these data.

During 1995, maximum air temperature (days 105-156), and minimum air temperature (days 1-156) were considered low at the Holyoke CoAgMet site. These data were replaced with the maximum and minimum air temperature data for the same days using the Akron 1995 AWDN station data. In 1996, large negative minimum air temperature values on days 150-151 at the Holyoke CoAgMet site were found. These were replaced with values for the same days using the 1996 Yuma CoAgMet station data.

Dewpoint Temperature and Relative Humidity

Penman-type equations typically require daily (or other time step) average vapor pressure of the air or dewpoint temperature data (one may be computed from the other) as input to represent the moisture status of the air. Typically, average vapor pressure or dewpoint temperature are computed from paired simultaneous readings of air temperature and relative humidity (RH), from which hourly or daily averages are computed. For these data sets, average daily vapor pressure of the air was included. Daily dewpoint temperature was computed from these data. Similar to air temperature, dewpoint temperature was graphed over time to check for outliers and inconsistent trends. Graphical comparison of daily minimum air temperature and dewpoint temperature was also done. In an irrigated reference environment, daily minimum air temperature should often approach to within 2-4°C of the daily dewpoint temperature even in arid areas (Allen, 1996; Temesgen et al., 1999).

Further evaluation involved graphing the daily maximum and minimum relative humidity data to assess the performance of the RH sensor. In the case of the AWDN stations daily average relative humidity was graphed.

For the years evaluated all of the CoAgMet sites had calibration problems with the relative humidity sensor. The vast majority of the time this problem is seen in the preponderance of daily maximum relative humidity values in the range of 104% to 105%. An example of this is illustrated in the lower graph of Figure 1, which is a plot of the daily maximum and minimum relative humidity values measured at the Holyoke CoAgMet site in 1998. This lower graph shows the large number of days (typical of the other CoAgMet sites evaluated) when maximum relative humidity is about 105%. This is a sensor calibration error and results in the relation between minimum air temperature and dewpoint temperature exhibited in the upper graph of Figure 1. This graph shows that for a large percentage of the time the minimum air temperature is less than dewpoint temperature. This typically occurs only in humid and/or maritime climates. Such data values and relationships do not occur at sites like the Holyoke (or any of the other) CoAgMet sites where site documentation indicates substantial aridity impacts.

At other times (i.e., Holyoke 1993-1995, and Idalia 1992-1994) plots of the relative humidity data showed the RH sensor was degrading resulting in bad vapor pressure or dewpoint temperature values. For example, see Figure 3.

Daily maximum and minimum relative humidity data for all years and all CoAgMet sites (except Holyoke 1993-1995, and Idalia 1992-1994) were adjusted by multiplying the daily values by the reciprocal of the maximum value of daily maximum RH, usually 1.05. Once the daily maximum and minimum RH had been adjusted new daily average air vapor pressure values (and consequently dewpoint temperatures) were computed using the relationship:

$$e_a = [(RH_{max}/100)\, e°(Tn) + (RH_{min}/100)\, e°(Tx)] / 2$$

where:

e_a = vapor pressure of the air,
$e°(Tn)$ = saturation vapor pressure at the daily minimum air temperature,
$e°(Tx)$ = saturation vapor pressure at the daily maximum air temperature,
RH_{max} = adjusted daily maximum relative humidity (%), and,
RH_{min} = adjusted daily minimum relative humidity (%).

Figure 2 shows the 1998 Holyoke data after adjustment of the relative humidity data and computation of new dewpoint temperature values in a format similar to that of Figure 1. The adjustment process described results in much more reasonable values of dewpoint temperature and a more reasonable relationship between minimum air temperature and dewpoint temperature.

The Holyoke 1993-1995 and Idalia 1992-1994 relative humidity data were not considered usable. Rather, daily dewpoint temperature for these years at these sites were computed using regressions of daily dewpoint temperature (after the above adjustments) on daily minimum air temperature for the other years of record at these two sites. For Holyoke, daily dewpoint temperature was estimated using the regression relationship developed for the years 1991-92 and 1996-2001:

$$Td = 0.9409 \times Tn - 0.3596 \qquad (r^2=0.87)$$

For Idalia, daily dewpoint temperature was estimated using the regression relationship developed for the years 1991 and 1995-2001:

$$Td = 0.9104 \times Tn - 1.3135 \qquad (r^2=0.83)$$

Only daily average relative humidity data were available for the two AWDN sites, Akron and Stratton. Plots of the daily average RH did not reveal any sensor calibration problems at Akron. Thus, the average vapor pressure and resulting dewpoint temperature data for Akron were used without modification. However, sensor calibration problems were evident for the years 1991, 1993-1996, and 1999-2001 at Stratton. For example, see Figure 4. This figure shows in the lower graph, RH sensor degradation through the year (problem with degradation was estimated to start about day 280 in 1993) and the resulting large differences between minimum air temperature and dewpoint temperature. Since daily maximum and minimum RH data were not available for the Stratton site that would allow a calibration adjustment similar to that performed on the CoAgMet sites described above, the author elected to not use the Stratton data further in this study.

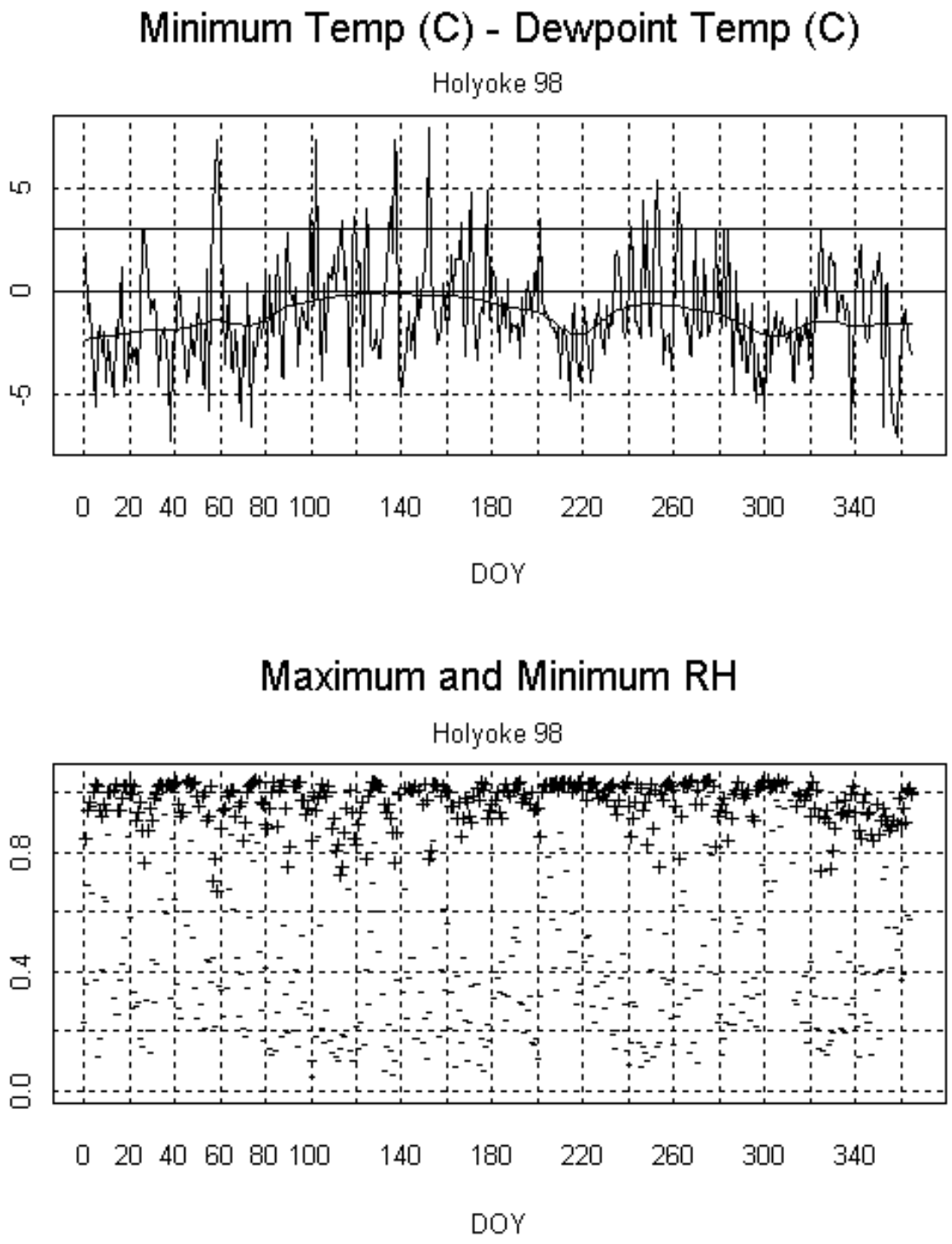


Figure 1. (upper) 1998 Holyoke CoAgMet measured daily minimum air temperature minus daily dewpoint temperature and (lower) daily maximum and minimum relative humidity.

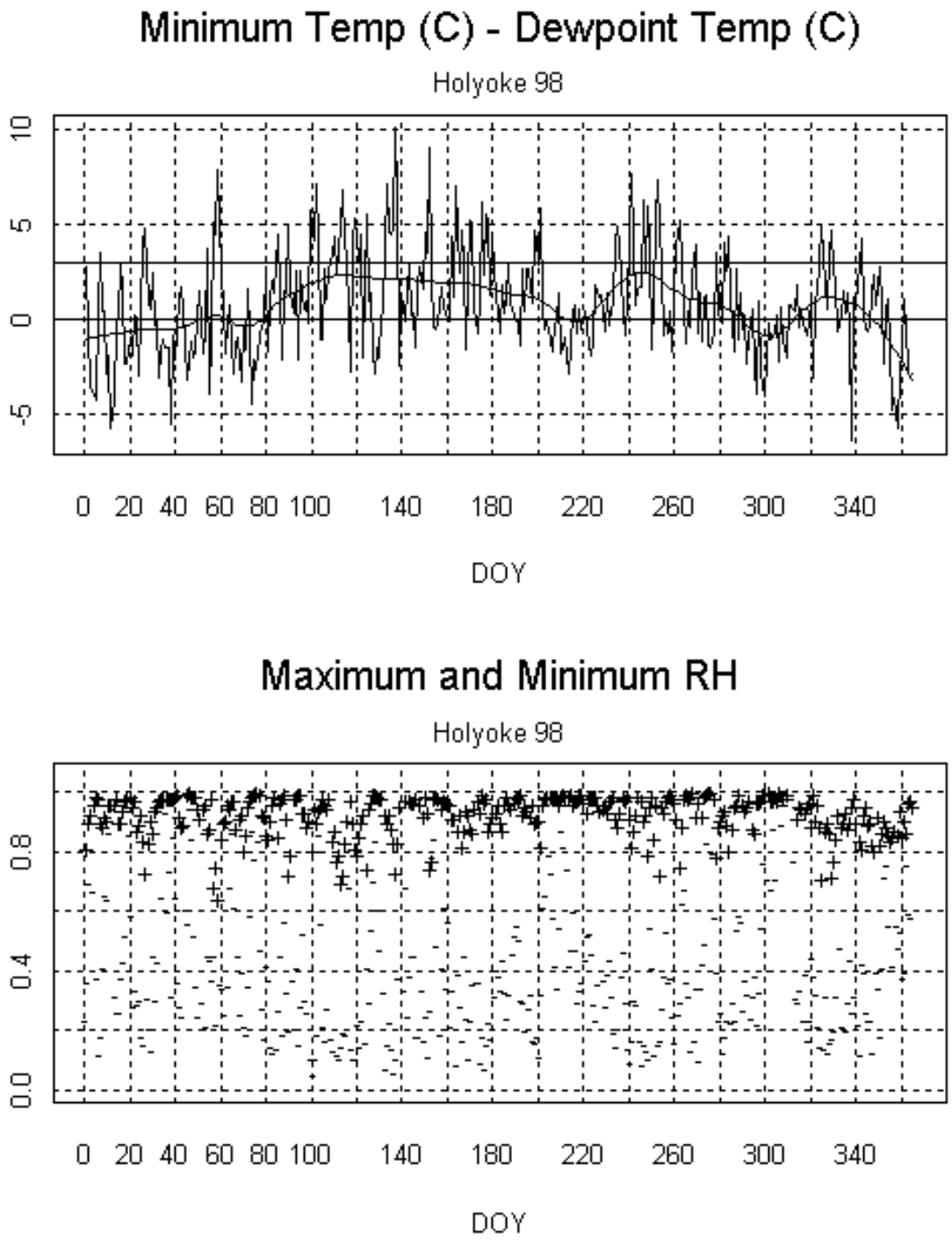
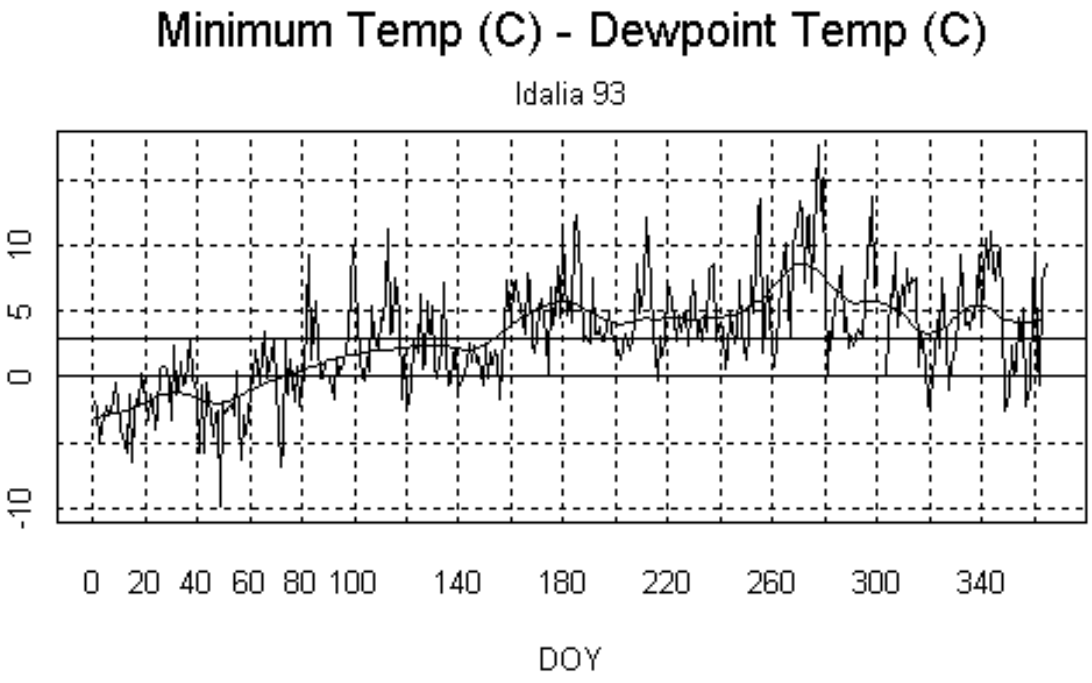


Figure 2. (upper) 1998 Holyoke CoAgMet daily minimum air temperature minus daily dewpoint temperature and (lower) daily maximum and minimum relative humidity after adjustment for RH sensor calibration.



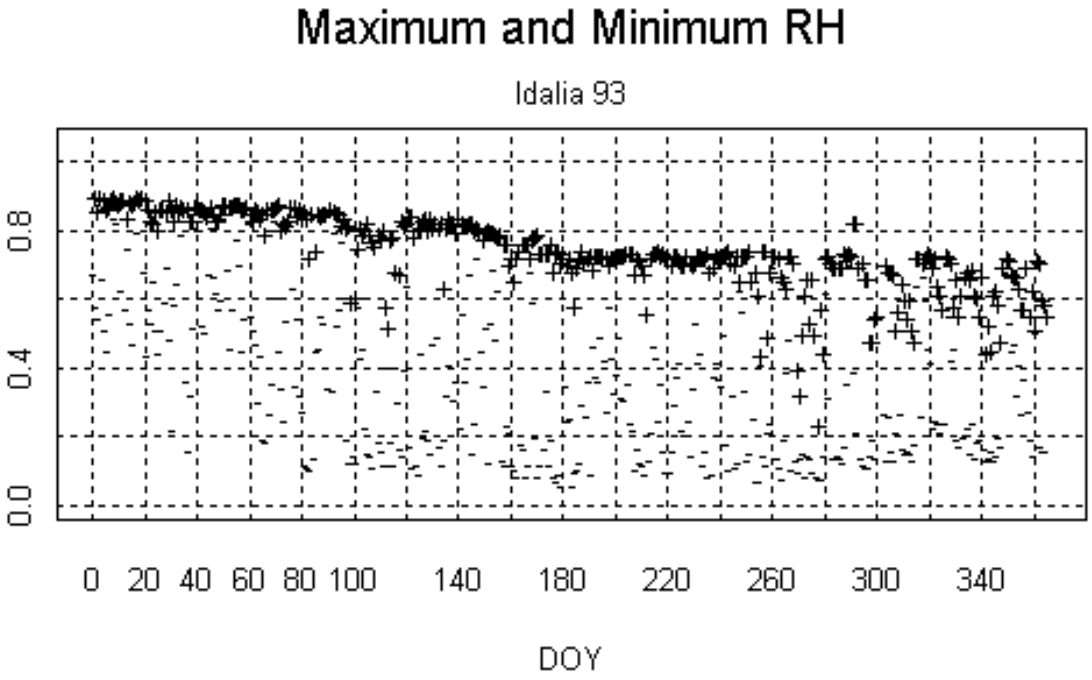
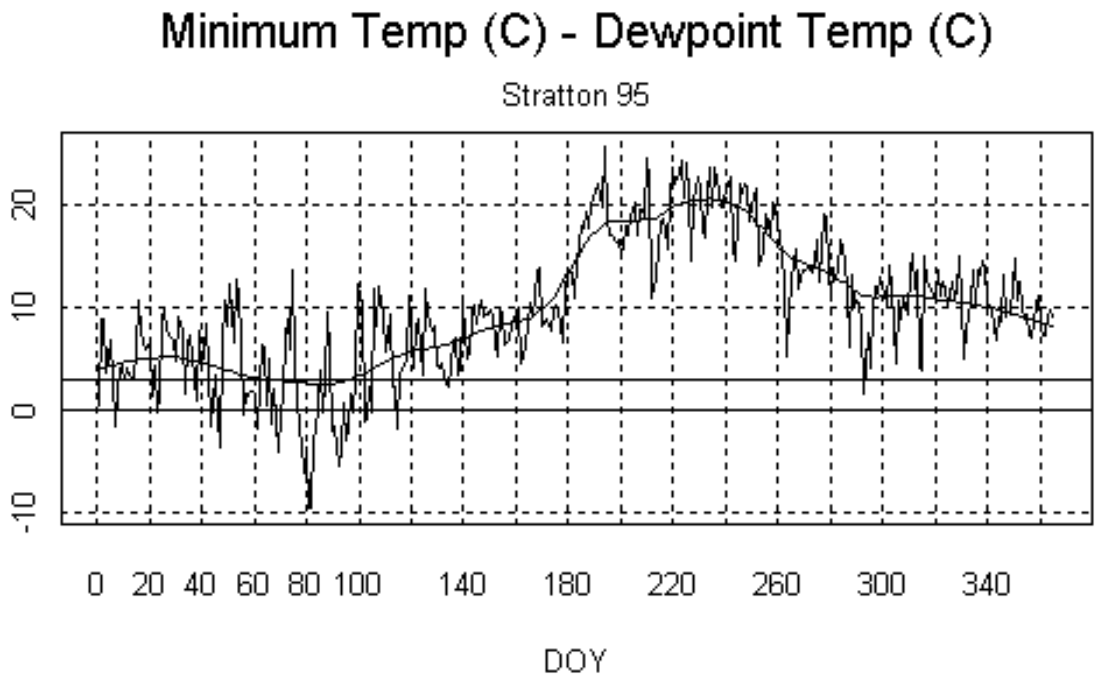


Figure 3. (upper) 1993 Idalia CoAgMet measured daily minimum air temperature minus daily dewpoint temperature and (lower) daily maximum and minimum relative humidity.



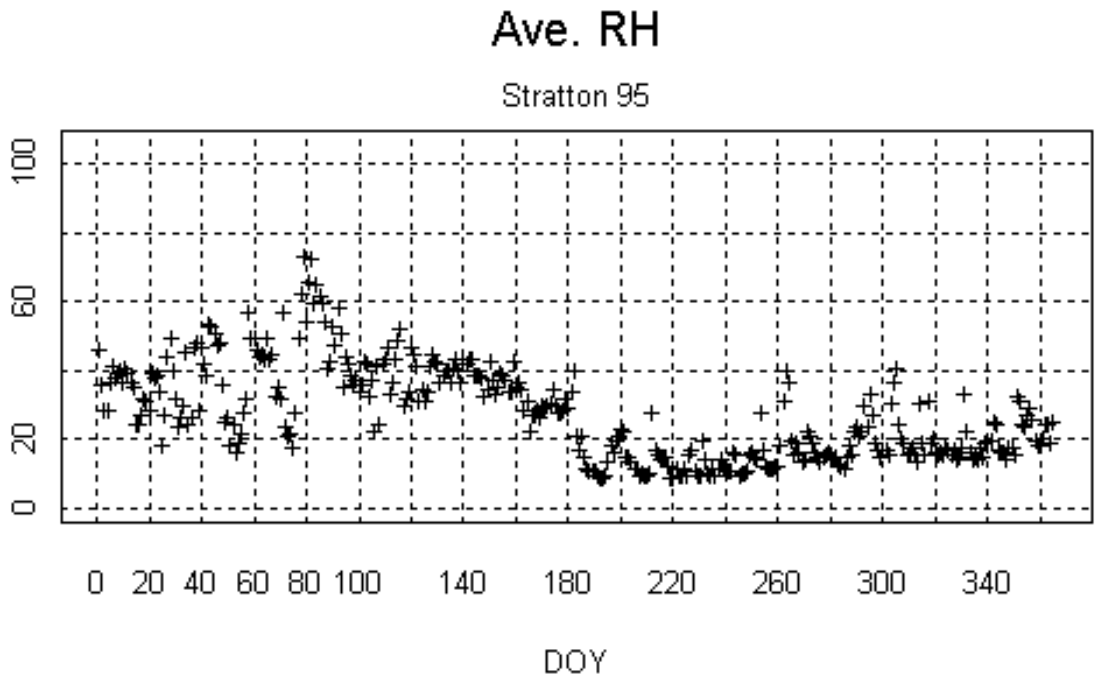


Figure 4. (upper) 1995 Stratton AWDN measured daily minimum air temperature minus daily dewpoint temperature and (lower) daily average relative humidity.

Solar Radiation

Daily solar radiation data were graphed and compared with an envelope clear sky solar radiation curve for each site. Daily clear sky solar radiation was determined by computing the daily extra-terrestrial radiation for each location and then multiplying by a "clearness" index dependent upon weather station elevation.

The calibration of the pyranometer (solar radiation sensor) was evaluated at each site by computing a calibration coefficient for each year of data. This coefficient is determined by searching for the 20 largest ratios of measured to clear sky solar radiation during March 1st to October 31st of each year. The mean and standard deviation of these 20 ratios were computed. Any of the 20 ratios that were greater than or less than one standard deviation from the mean were thrown out. A new mean ratio was then computed. The calibration coefficient is the reciprocal of this resultant ratio. Where this coefficient was more than 3% from unity, correction of the solar data was considered necessary. This correction involved multiplying the daily solar radiation values by the computed calibration coefficient.

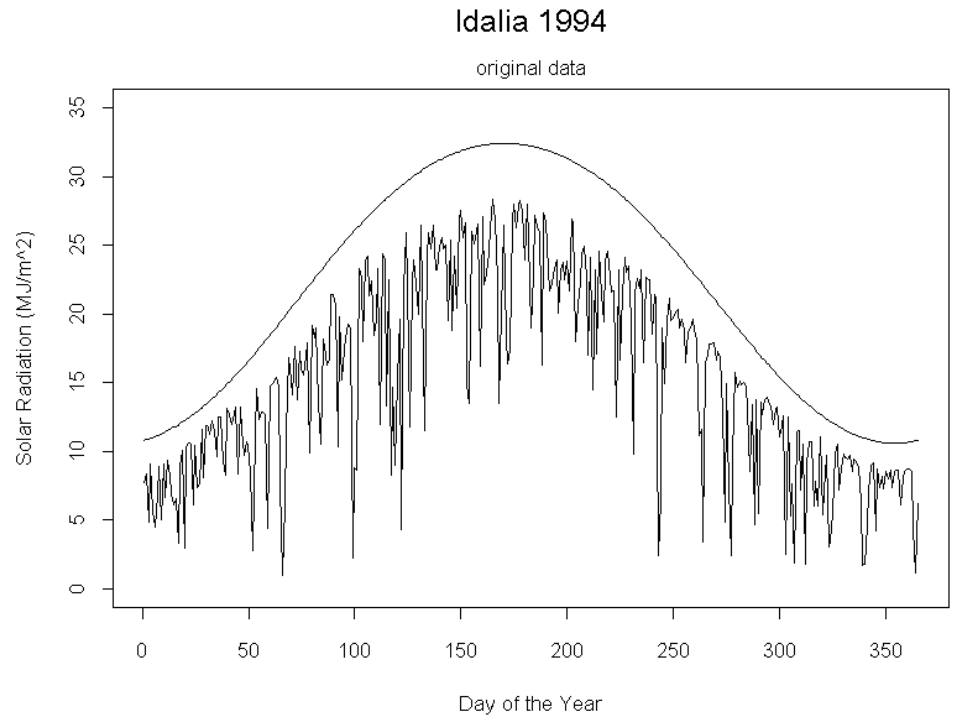
Table 3 presents a summary of the solar radiation data integrity assessment. If a calibration correction was needed, the value of the computed calibration coefficient is shown in the table.

Figure 5 is a graphical example of the process used to check the calibration of the pyranometers at each site and the correction, if necessary. The 1994 solar radiation data measured at the Idalia CoAgMet site are used in this example. The upper figure shows the original measured data plotted on a day by day basis with the clear sky solar radiation data (the smooth envelope curve) computed for this location. There is a very evident departure of the highest measured data (assumed to be clear days) through the year below the expected clear day solar radiation curve. The bottom figure shows the corrected solar radiation data after multiplying by the computed calibration coefficient of 1.155.

Table 3. Summary of solar radiation data assessment and correction.

Site/Year	Data Assessment	Calibration Correction
Haxtun		
1997	Days 91-107 very low. Rest of year ok.	1.79 for days 91-107
1998	All ok	
1999	All ok	
2000	All ok	
2001	All ok	
Holyoke		
1991	Days 202-365 low	1.06 for days 202-365
1992	Low all year	1.100
1993	Low all year	1.102
1994	Low all year	1.093
1995	Low all year	1.095
1996	Low all year	1.116
1997	Low all year	1.143
1998	Low all year	1.133
1999	Low all year	1.393
2000	Low all year	1.313
2001	Days 1-210 low	1.313 for days 1-210
Idalia		
1991	Low all year	1.187
1992	Low all year	1.188
1993	Low all year	1.165
1994	Low all year	1.155
1995	Low all year	1.142
1996	Low all year	1.138
1997	Low all year	1.095
1998	Low all year	1.121
1999	Low all year	1.127
2000	Low all year	1.100
2001	Low all year	1.050
Wray		
1997	Days 1-110 very low	1.800 for days 1-110
1998	Very low all year	1.909
1999	Very low all year	1.906
2000	Days 1-60 very low	1.800 for days 1-59
2001	All ok	
Yuma No. 2		
1996	Days 129-366 very low	2.021 for days 129-366
1997	Days 1-150 very low	1.800 for days 1-150
1998	All ok	
1999	All ok	
2000	All ok	
2001	All ok	
Akron		
1986	Low all year	1.050
1987	All ok	
1988	Slightly low all year	1.033
1989	All ok	
1990	Days 67-84 had constant values, replaced with Stratton 1990 same days; calibration high all year	0.974

1991	Days 68-84 had constant values, replaced with Stratton 1991 same days; calibration slightly high all year	0.980
1992	Days 69-85 had constant values, replaced with Stratton 1992 same days; calibration ok	
1993	All ok	
1994	All ok	
1995	All ok	
1996	All ok	
1997	All ok	
1998	All ok	
1999	Low all year	1.058
2000	Low all year	1.046
2001	Low all year	1.042
Stratton		
1989	All ok	
1990	All ok	
1991	All ok	
1992	Low all year	1.036
1993	Low all year	1.035
1994	All ok	
1995	Low all year	1.115
1996	Low all year	1.129
1997	Low all year	1.053
1998	High days 1-140, then low rest of year	0.940 for days 1-140, then 1.04 for rest of year
1999	Low days 1:260	1.05 for days 1:260
2000	All ok	
2001	All ok	



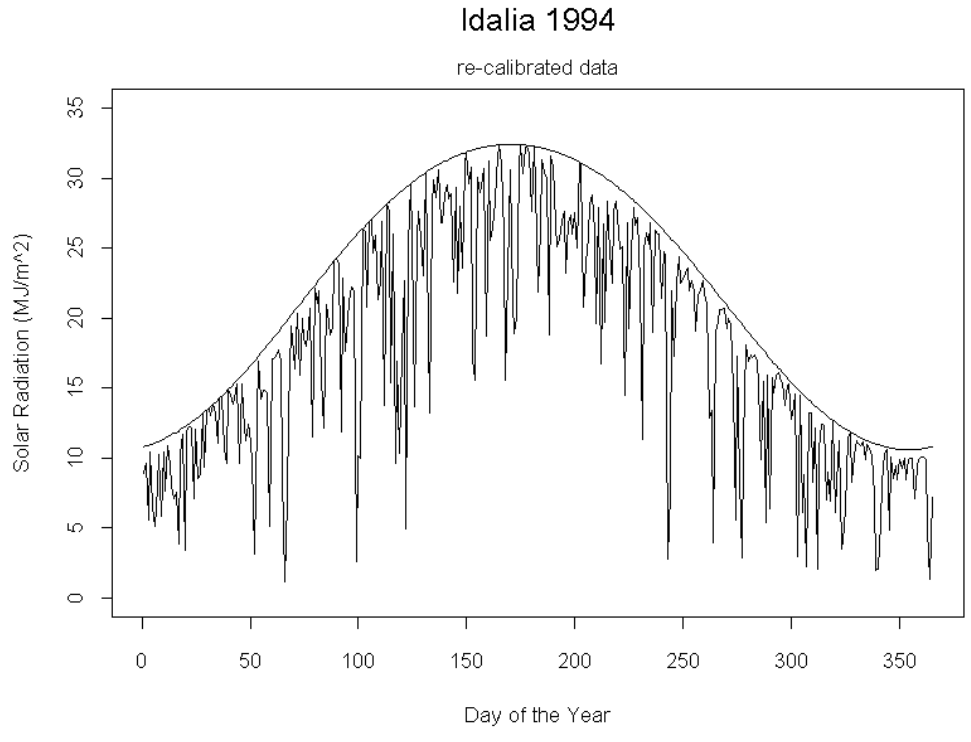


Figure 5. Calibration check and correction of 1994 Idalia CoAgMet solar radiation data.

Wind Run

Wind speed data collected at the electronic weather station sites were plotted as daily total wind run (km/day) on a year by year basis. Plotted data were assessed by checking for periods of constant wind run, constant and unexpectedly low wind run values, seasonal trends and consistency in measured wind run from site to site.

Only a few problems were found that are attributable to sensor degradation or failure. In 1998, wind run at the Holyoke CoAgMet site was a constant small value on several days during the period from day 298-365. This continued at this site in 1999 until day 123. This is a situation in which the anemometer bearings failed to the point of causing it to freeze up. The measured constant small wind run value is the anemometer calibration offset. These bad data were replaced with wind run data for the same days using the 1998 and 1999 Haxtun CoAgMet data sets.

Compared to the other sites, the wind run data at the Wray CoAgMet station are lower during the months of July September during most years. This may be partially due to corn crops being cultivated in the area, as well as due to a ridge of low hills, which border the area about 0.5 miles to the west and southwest.

Wind speed data at the HPCC AWDN sites (Akron and Stratton) are collected at a height above ground surface of about 3 m (10 ft). These data were adjusted to reflect wind speeds at a 2-m height using standard procedures.

Weather Data Adjustment for Weather Station Site Aridity

It is recommended that weather data intended for reference ET estimation be collected at weather stations sited over well-watered, clipped grass surfaces in open, well-watered settings (Allen et al, 1983; Yoder et al. 2000; Allen, 1996; Jensen et al. 1990). Reference ET (and therefore crop ET) estimates will be artificially high when weather data are collected in environments that are drier than these reference conditions (Brown and Ley, 1993; Ley, et al., 1996). Specifically, when located in environments that are drier than the reference condition, weather stations will measure increased air temperatures, reduced water vapor in the air, and potentially greater wind speeds, resulting in increased reference ET estimates compared to the reference environment. In such cases, a greater portion of the energy available is used in sensible heating of the air and soil and less in evaporation (which results in cooling and humidification of the air) because of the reduced amount of environmental moisture available for evaporation.

The weather station site conditions for each of the sites evaluated in this study have been documented in a separate report. Due to the fact that none of the electronic stations is situated over an actively transpiring (well-watered), clipped green grass surface and surrounded by similar surface conditions, especially in the predominant wind direction, the computed reference ET at these sites will be biased to the high side as discussed above.

Daily maximum, minimum, and dewpoint temperatures were adjusted for aridity effects as follows. At all sites except Akron, a constant 1°C (1.8°F) was subtracted from each daily maximum and minimum temperature value. The Akron station is located in a non-irrigated region. A slightly higher adjustment was imposed at this site by subtracting a constant 1.67°C (3 °F) from each daily maximum and minimum temperature value. The departure of daily dewpoint temperature above or below the daily minimum air temperature was constrained to ± 3°C at all sites.

Limit on Daily Wind Run

A limit on daily total wind run of 240 km/day (150 mi/day) was imposed on the wind run data at each site. In other words, any day the total wind movement was greater that 240 km/day, the wind run was limited to a maximum value of 240 km/day.

REFERENCE EVAPOTRANSPIRATION CALCULATION

After application of the aridity adjustments to daily maximum and minimum air temperature, and dewpoint temperature, and application of the wind run limit, daily alfalfa reference evapotranspiration was computed for each site and year using the ASCE Standardized Penman-Monteith formula (ASCE TC Draft Report,2002). Annual total alfalfa reference evapotranspiration (and partial year totals for those sites and years of incomplete data) are reported in Table 4.

Table 4. Annual (or partial year) total alfalfa reference evapotranspiration (inches).

Year	Haxtun	Holyoke	Idalia	Wray	Yuma	Akron
1986	-----	-----	-----	-----	-----	52.85 (days 128-365)
1987	-----	-----	-----	-----	-----	70.93
1988	-----	-----	-----	-----	-----	75.33
1989	-----	-----	-----	-----	-----	73.94
1990	-----	-----	-----	-----	-----	69.93
1991	-----	50.97 (days 121-365)	45.76 (days 152-365)	-----	-----	69.87
1992	-----	61.92	70.85	-----	-----	66.48
1993	-----	59.41	65.65	-----	-----	59.82
1994	-----	73.51	80.91	-----	-----	75.57
1995	-----	70.74	72.60	-----	-----	67.64
1996	-----	67.07	73.99	-----	48.92 (days 129-366)	67.39
1997	56.09 (days 91-365)	43.62 (days 156-365)	71.02	60.29 (days 1-306)	67.65	67.53
1998	69.24	69.50	74.98	63.51 (days 44-365)	69.32	70.60
1999	73.47	70.58	76.42	62.39	73.91	71.91
2000	75.44	76.40	80.10	73.29	80.73	75.45
2001	71.89	71.94	76.31	69.78	71.74	67.75

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