

JUL 29 2004

(Internet)

**WATER RESOURCES
WESTERN REGION**

Transfer No. 70947

Page 1 of 6

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES

APPLICATION FOR TRANSFER OF WATER RIGHT

PART 1

Name of applicant Middleton Mill Ditch Company **Phone** (208) 585-2943
Post Office address 23107 Hartley Lane, Middleton, ID 83644

A. PURPOSE OF TRANSFER

1. ☐ Change point of diversion ☐ Add diversion point(s) ☐ Change place of use
☒ Change nature of use ☐ Change period of use ☐ Other _____
2. Describe the reason for the proposed changes 16.93 acres of ponds are being developed for aesthetic purposes in conjunction with the non-farm development of Rivervine Subdivision in Ada County. This transfer is mitigation for the evaporative loss from the excavated. See accompanying Application Permit.

B. DESCRIPTION OF RIGHT(S) OR PORTION THEREOF, AFTER THE REQUESTED CHANGE

1. Right Number 63-125G Priority 06/01/1871 Amount (cfs/ac-ft) .32 cfs Nature of Use Grnd H2O Recharge Period of Use 3/15 to 11/15

 32.11 Irrigation 3/15 to 11/15

 to

 to

2. Total amount of water being transferred .32 of 32.43 cubic feet per second and/or acre-feet per annum.

3. Source of water Boise River tributary to Snake River

4. Point(s) of Diversion:

[illegible]

5. Lands irrigated or place of use: 9143 acres within service area boundary

[illegible]

Total acres 9143

PART 1

6. General Information:

a. Description of diversion system No diversion systems will be modified. Proposed ponds will fill through groundwater seepage.

b. Are the lands from which you propose to transfer the water right subject to any liens, deeds of trust, mortgages, or contracts? X Yes No. If yes, provide a notarized statement from the holder of the lien, deed of trust, mortgage or contract agreeing to the proposed changes.

c. Describe the affect on the land now irrigated if the place of use is changed pursuant to this transfer:
The use of land is changing from agriculture to residential subdivision so the change in water use will have no negative effect on the land.

d. Remarks:

ACTION OF THE DIRECTOR, DEPARTMENT OF WATER RESOURCES

This is to certify that I have examined Application for Transfer of Water Rights No. _____
 And said application is hereby _____, subject to the following limitations and conditions:

Witness my hand this _____ day of _____, 19 _____.

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES
APPLICATION FOR TRANSFER OF WATER RIGHT

PART 2
(Attach one copy for each right)

A. DESCRIPTION OF RIGHT AS RECORDED

1. Right evidenced by:

a. Decree No. SEE ATTACHED Decreed to SEE ATTACHED
in case of SEE ATTACHED vs. SEE ATTACHED

dated SEE ATTACHED in SEE ATTACHED county of SEE ATTACHED

b. License No. SEE ATTACHED issued by the Idaho Department of Water Resources.

c. Claim No. SEE ATTACHED on file with the Idaho Department of Water Resources.

d. Transfer No. SEE ATTACHED which produced this right.

2. Attach a copy of last year's tax notice for the property to which the water right is appurtenant or other documents which show ownership. Label documents as attachment A. Check appropriate box below:

☐ Tax Notice☐ Warranty Deed☐ Other SEE ATTACHED

3. Source of water SEE ATTACHED tributary to SEE ATTACHED

4. Date or priority NO. 63-125G

5. Water is used for the following purpose:

amount SEE ATTACHED for SEE ATTACHED purposes from SEE ATTACHED to SEE ATTACHED
(cfs/ac-ft)
amount SEE ATTACHED for SEE ATTACHED purposes from SEE ATTACHED to SEE ATTACHED
(cfs/ac-ft)
amount SEE ATTACHED for SEE ATTACHED purposes from SEE ATTACHED to SEE ATTACHED
(cfs/ac-ft)

6. Total amount of water under right SEE ATTACHED cubic feet per second and/or SEE ATTACHED acre-feet per annum.

7. Point(s) of Diversion:

Lot	1/4	1/4	1/4	Sec.	Twp.	Rge.	County	Local name for diversion

8. Lands irrigated or place of use:

Twp.	Rge.	Sec.	NE 1/4				NW 1/4				SW 1/4				SE 1/4				Totals
			NE 1/4	NW 1/4	SW 1/4	SE 1/4	NE 1/4	NW 1/4	SW 1/4	SE 1/4	NE 1/4	NW 1/4	SW 1/4	SE 1/4	NE 1/4	NW 1/4	SW 1/4	SE 1/4	

Total acres SEE ATTACHED

9. Describe any other water rights used for the same purpose as described above SEE ATTACHED

10. To your knowledge, has any portion of this water right undergone a period of five or more consecutive years of non-use?

No

If yes, describe _____

B. DESCRIPTION OF PORTION OF RIGHT BEING TRANSFERRED

(If the entire right is to be changed by the applicant, omit part B and C.)

1. amount _____ for _____ purposes from _____ to _____
 (cfs/ac-ft)
 amount _____ for _____ purposes from _____ to _____
 (cfs/ac-ft)
 amount _____ for _____ purposes from _____ to _____
 (cfs/ac-ft)

2. Point(s) of Diversion: N/C

Lot	1/4	1/4	1/4	Sec.	Twp.	Rge.	County	Local name for diversion

3. Lands irrigated or place of use:

Twp.	Rge.	Sec.	NE 1/4				NW 1/4				SW 1/4				SE 1/4				Totals
			NE 1/4	NW 1/4	SW 1/4	SE 1/4	NE 1/4	NW 1/4	SW 1/4	SE 1/4	NE 1/4	NW 1/4	SW 1/4	SE 1/4	NE 1/4	NW 1/4	SW 1/4	SE 1/4	
<u>4N</u>	<u>1W</u>	<u>15</u>	<u>-</u>	<u>1.84</u>	<u>10.19</u>	<u>4.90</u>													<u>16.93</u>

Total acres 16.93

C. DESCRIPTION OF UNCHANGED PORTION OF RIGHT (omit if there is no change)

1. amount _____ for _____ purposes from _____ to _____
 (cfs/ac-ft)
 amount _____ for _____ purposes from _____ to _____
 (cfs/ac-ft)
 amount _____ for _____ purposes from _____ to _____
 (cfs/ac-ft)

2. Point(s) of Diversion:

Lot	1/4	1/4	1/4	Sec.	Twp.	Rge.	County	Local name for diversion

3. Lands irrigated or place of use:

Twp.	Rge.	Sec.	NE 1/4				NW 1/4				SW 1/4				SE 1/4				Totals
			NE 1/4	NW 1/4	SW 1/4	SE 1/4	NE 1/4	NW 1/4	SW 1/4	SE 1/4	NE 1/4	NW 1/4	SW 1/4	SE 1/4	NE 1/4	NW 1/4	SW 1/4	SE 1/4	

Total acres _____

**STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES
APPLICATION FOR TRANSFER OF WATER RIGHT
PART 3**

- A. Draw a map or attach a USGS map indicating the new point(s) of diversion and/or the new place of use for rights described in part 1. Clearly depict the land by section, township and range number.**

SEE
ATTACHED
DRAWINGS IN
NARRATIVE
APP. A

PART 3**B. CHANGES IN NATURE OF USE**

1	New Nature of Use	Amount (cfs/ac-ft)	Hours/days/year	Period of Use
<i>AF</i>	Groundwater Recharge	<u>.32</u> (cfs/ac-ft) <u>0.24</u> cfs	<u>24/214/1</u>	<u>3/15</u> to <u>11/15</u> to

2. Quantity and quality of return flows and location of discharge:
REFER TO ATTACHED NARRATIVE.

3. Describe effects on other water uses resulting from the proposed change:

Other water users should not be effected as a result of this change. There are no other water users downstream of this property. This property is the downstream most property before the Middleton-Mill ditch's confluence (and return to) the Boise River. REFER TO ATTACHED NARRATIVE.

I hereby assert that no one will be injured by such change and that the change does not constitute an enlargement in use of the original right. The information contained in this application is true to the best of my knowledge.

I understand that any willful misrepresentations made in this application may result in voiding its approval.

Subscribed and sworn to before me this 15th day of September, 2003

Allen F. [Signature]
(Signature of Applicant)

Jerry A. Kiser
(Notary Public)

My commission expires 12/15/09

**FOR DEPARTMENT USE ONLY**

fee received 12/18/03

Transfer contains 6 pages and 6 attachments

Received by KG Date 9/29/03 Protest filed by _____

Prelim. check by G Fee \$250 W031196

Received by _____ Date _____

Published in _____ Copies of protest forwarded by _____

Pub. dates _____ Hearing held by _____ Date _____

Watermaster recommendation requested on _____ Recommended for ☐ approval ☐ denial

_____ rec'd. _____ by _____

Copy of transfer sent to lien holder _____

IDAHO DEPARTMENT OF WATER RESOURCES

Adjudication Recommendation Report 63-125G V1

WATER RIGHT NUMBER: 63-125G V1

<u>Owner Type</u>	<u>Name and Address</u>
Attorney	JERRY A KISER 620 W HAYS ST BOISE, ID 83702 (208)336-1020
Current Owner	MIDDLETON MILL DITCH CO MAX NISHIOKA 23107 HARTLEY LN MIDDLETON, ID 83644 (208)585-2943

Priority Date: 06/01/1871

Basis: Decreed

Status: Active

<u>Source</u>	<u>Tributary</u>
BOISE RIVER	SNAKE RIVER

<u>Beneficial Use</u>	<u>From</u> <u>To</u>	<u>Diversion Rate</u>	<u>Annual Volume</u>
IRRIGATION	03/01 to 11/15	32.430 CFS	
	<u>Total Diversion:</u>	32.430 CFS	

Location of Point(s) of Diversion

BOISE RIVER	L1 (NE1/4NE1/4)	Sec. 13, Twp 04N, Rge 01W, B.M.
ADA County		

Place of UseConditions of Approval:

1. C18 This partial decree is subject to such general provisions necessary for the definition of the rights or for the efficient administration of the water rights as may be ultimately determined by the Court at a point in time no later than the entry of a final unified decree. Section 42-1412(6), Idaho Code.
2. S45 Diversion for irrigation under this water right prior to April 1 and after October 31 shall occur only as authorized by the Water District 63 Water Master and only when water is being released for flood control by the United States from the Lucky Peak Dam outlet under procedures and requirements for the Memorandum of Agreement between the U.S. Department of the Army and the U.S. Department of the Interior for Flood Control Operations of the Boise River Reservoirs, dated November 20, 1953, the Water Control Manual for Boise River Reservoir dated April 1985 and any future amendments or revisions made thereto pursuant to state or federal procedures or law; provided that any such use of this water right prior to April 1 and after October 31 shall be subordinated to water rights for storage in Lucky Peak Reservoir, Lake Lowell, Arrowrock Reservoir, and/or Anderson Ranch Reservoir, as decreed in SRBA Case No. 39576.

Remarks:

1. Explanatory THIS RIGHT IS DESIGNATED AS NO 54 IN THE STEWART DECREE AND THE BOISE RIVER WATER MASTERS RECORDS.

ATTACHMENT A

IDAHO DEPARTMENT OF WATER RESOURCES

Adjudication Recommendation Report 63-125G V1

2. Quantity THIS RIGHT WHEN COMBINED WITH ALL OTHER RIGHTS SHALL PROVIDE NO MORE THAN .02 CFS PER ACRE.
3. Explanatory WATER IS DELIVERED THROUGH THE MIDDLETON IRRIGATION ASSOCIATION AND THE MIDDLETON MILL COMPANY DITCH SYSTEM
4. Explanatory THE FOLLOWING RIGHTS ARE ALSO DIVERTED THROUGH POINT OF DIVERSION DESCRIBED ABOVE: 63-124N, 63-126E, 63-161X, 63-168B, 63-168D, 63-173, 63-198AC, 63-254, 63-255, 63-370.
5. Place of Use - Irrigation THIS RIGHT IS LIMITED TO THE IRRIGATION OF 9159 ACRES WITHIN THE BOUNDARY OF THE MIDDLETON MILL DITCH COMPANY AND THE MIDDLETON IRRIGATION ASSOCIATION.
6. Explanatory THIS RIGHT IS A SPLIT FROM FORMER RIGHT 63-125.

Comments:

1. mcase 7/21/2004 POD
Comment: Correlated PODID 609414 from SpatialDataID 342561 to SpatialDataID 302230
2. mcase 7/21/2004 POD
Comment: Correlated PODID 609414 from SpatialDataID 342561 to SpatialDataID 302230

Dates and Other Information:

Decreed Date:
 Enlargement Use Priority Date:
 Enlargement Statute Priority Date:
 Defendant:
 Plaintiff:
 Civil Case Number:
 Judicial District:
 Notice of Error Flag:
 State or Federal: S
 Owner Name Connector:
 Water District Number: 63
 Generic Max Rate Per Acre:
 Generic Max Volume Per Acre:
 Swan Falls Trust or Nontrust:
 Swan Falls Dismissed:
 DLE Act Number:
 Carey Act Number:
 Mitigation Plan: False

Combined Use Limits:

STOPPELLO & KISER
ATTORNEYS AND COUNSELORS AT LAW
620 WEST HAYS STREET
BOISE, IDAHO 83702

FRANK W. STOPPELLO
JERRY A. KISER
F. MATTHEW STOPPELLO

TELEPHONE (208) 336-1020
FACSIMILE (208) 336-1027

April 13, 2004

TRANSMITTED VIA FACSIMILE
TO (208) 334-2348 AND
SENT BY FIRST CLASS MAIL

RECEIVED

APR 14 2004

WATER RESOURCES
WESTERN REGION

Lori Graves
Idaho Department of Water Resources
2735 Airport Way
Boise, ID 83705

Re: Water Right Transfer Applications/
Middleton Mill Ditch Company

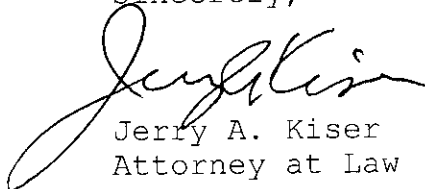
Dear Ms. Graves:

As we previously discussed, I am by this letter providing you with the Board members of the Middleton Mill Ditch Company and informing you that Allen Funkhouser is the Chairman of the Board of the Middleton Mill Ditch Company. The Board members are as follows:

1. Allen Funkhouser, Chairman
2. J.R. Ivie
3. Harold Foote
4. Marty Galvin
5. James Payne

If I can be of further assistance or if you need additional information, please feel free to contact me.

Sincerely,



Jerry A. Kiser
Attorney at Law

JAK:jf

cc: Middleton

ATTACHMENT B

BOISE IDAHO 02/10/03 04:11 PM

DEPUTY Ali Larrondo

RECORDED - REQUEST OF

TROUT, WEEKS, NEMEC

AMOUNT 12.00



103022235

RECEIVED

QUIT CLAIM DEED

DEC 18 2003

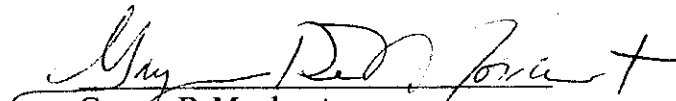
WATER RESOURCES
WESTERN REGION

FOR VALUE RECEIVED, Reed DeMordaunt and Gayann DeMordaunt, husband and wife, the Grantors, do hereby convey, release, remise and forever quit claim all of Grantors' right, title and interest in and to the real property hereinafter described, unto Castle Rock Development, Inc., an Idaho corporation, the Grantee, whose address is 1639 Lakemoor Way, Eagle, Idaho 83616, the following described premises, to wit:

See the attached Exhibit A, which is made a part hereof, for the proper legal description, together with its appurtenances.

IN WITNESS WHEREOF, the Grantors have caused their names to be hereunto subscribed this 10th day of February, 2003.

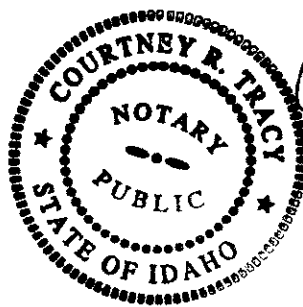

Reed DeMordaunt


Gayann DeMordaunt

STATE OF IDAHO)
) ss.
County of ADA)

On this 10th day of February, 2003, before me, the undersigned, a Notary Public in and for said State, personally appeared Reed DeMordaunt and Gayann Demordaunt, husband and wife, known or identified to me to be the persons whose names are subscribed to the within instrument, and acknowledged to me that they executed the same.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal the day and year in this certificate first above written.



Courtney R. Tracy
Notary Public for Idaho
Residing at Boise, Idaho
My commission expires: 02/01/2007

EXHIBIT A

Legal Description
for
Phase 2 Boundary

All Reel Property located at 7011 W. Moon Valley Road, together with all appurtenances, Consisting of approximately 52 acres, more particularly described as follows.'

Parcel I:

Government Lot 2. Section 15, Township 4 North, Range 1 West, Boise Meridian Ada County, Idaho. .

EXCEPTING THEREFROM rights of way for ditches, canals and laterals

FURTHER EXCEPTING THEREFROM any portion that may lie South of the Northerly high water line of the Boise River.

Parcel II:

That portion of the W ½ of the NE ¼ of Section 15, Township 4 North, Range 1 West, Boise Meridian, Ada County, Idaho, lying Southerly of the Southerly boundary at Moon Valley Road.

EXCEPTING THEREFROM any portion that may lie South of the Northerly high water line of the Boise River.

FURTHER EXCEPTING THEREFROM rights of way for ditches, canals, and laterals.

FURTHER EXCEPTING THEREFROM that portion conveyed to JOHN C. LINDBLOOM and PATSY T. LINDBLOOM, husband and wife In Quitclaim Deed recorded June 26, 1997, as Instrument No. 97050663.

FURTHER EXCEPTING THEREFROM PARCEL I AND PARCEL II a parcel of land located in the a portion of the East 112 6f Section 151 Township 4 North1 Range I West of the Boise Meridian, Ada County, Idaho, being more particularly described as follows: Commencing at the northwest corner of the Northeast ¼ of Section 15, T.3N., R.1W., B.M., Ada County, Idaho; thence South 00°50'21" West a distance of 1026.31 feet along the Westerly boundary of said Northeast ¼ of Section 15 to a point on the Southerly right-of-way line of Moon Valley Road, said point being the **TRUE POINT OF BEGINNING**; thence along said right-of-way line South 89°06'10" East a distance of 678.82 feet to a point on the Easterly line of proposed Vintage Street; thence along said easterly line the following courses and distances: thence South 00°00'00" West a distance of 49.69 feet; thence 88.70 feet long the arc of a 87.97 foot radius curve to the right (through a central angle of 57°46'09", the chord which bears South 28°53'04" West a distance of 84.99 feet) to a point of a reverse curve; thence 38.28 feet along the arc of a 37.97 foot curve to the left (through a central angle of 57°46'09", the chord which bears South 28°53'04" West a distance of 36.68 feet) to point of a compound curve; thence 76.62 feet along a 223.81 foot radius curve to the left (through a central angle of 19°36'50", the chord

EXHIBIT A

which bears South.09°48'25" East a distance 76.24 feet) to a point of a reverse curve; thence 69.58 feet along the arc of a 273.81 foot radius curve to the right through a central angle of 14°33'38". the chord which bears South 12°20'01" East a distance of 69.40 feet) to a point of reverse curve; thence 14.83 feet along the arc of a 10.00 foot radius curve to the left through a central angle of 84°56'47", the chord which bears South 47°31'36" East a distance of 13.50 feet) to a point of a non-tangent line; thence South 00°48'47" West a distance of 30.00 feet to a point being non- tangent to a curve; thence 14.49 feet along the arc of a 10.00 foot radius curve to the left (through a central angle of 83°00'02", the chord which bears South 48°29'59" West a distance of 13.25 feet) to a point of a reverse curve; thence 98.88 feet along the arc of a 195.15 foot radius curve to the right through a central angle of 29°01'54" the chord which bears South 21°30'55" West a distance of 97.83 feet) to a point of a reverse curve; thence 99.07 feet along the arc of a 145.15 foot radius curve to the left (through a central angle of 39°06'20", the chord which bears South 16°28'42" West a distance of 97.16 feet) to a point of a compound curve: thence 113.42 feet along the arc of a 125.00 foot radius curve to the left (through a central angle of 51°59'19", the chord which bears South 29°04'07" East a distance of 109.57 feet) to a point of a reverse curve; thence 404.64 feet along the arc of a 275.00 foot radius curve to the right (through a central angle of 84°18'21", the chord which bears South 12°54'36" East a distance of 369.11 feet) to a point of a reverse curve; thence 129.78 feet along the arc of a 222.11 foot radius curve to the left (through a central angle of 33°28'47", the chord which bears South 11°17'17" West a distance of 127.95 feet) to a point being non-tangent to a curve; thence 74.22 feet along the arc of a 50.00 foot radius curve to the right (through a central angle of 85°02'45", the chord which bears South 28°22'23" East a distance of 67.59 feet) to a non-tangent point on a curve; thence leaving said easterly line, 80.21 feet along the arc of a 105.06 foot radius curve to the right (through a central angle of 43°44'21", the chord which bears South 37-48-17 East a distance of 78.27 feet) to a point of a reverse curve; thence 44.89 feet along the arc of a 75.00 foot radius curve to the left (through a central angle of 34°17'34", the chord which bears South 33°04'54" East a distance of 44.22 feet) to a point of a reverse curve; thence 121.10 feet along the arc of a 1128.19 foot radius curve to the right (through a central angle of 06°09'00", the chord which bears South 47°09'12" East a distance of 121.04 feet); thence South 45°55'50" West a distance of 230.02 feet; thence South 53°00'00" West a distance of 120.35 feet to a point on the Northerly bank of the Boise River; thence a long said Northerly Bank the following courses and distances: thence North 37°00'00" West a distance of 53.63 feet; thence North 55°00'00" West a distance of 200.00 feet; thence North 73°00'00" West a distance of 200.00 feet; thence North 86°44'59" West a distance of 234.21 feet to a point on the Easterly line of a certain Quitclaim Deed recorded June 26, 1997, as Instrument No. 9705066; thence leaving said Northerly bank and along the Easterly and Northerly boundaries of a said Quitclaim Deed the following courses and distances: North 00°15'13" East a distance of 345.73 feet; thence South 57°20'49" West a distance of 25.75 feet to a point on the Westerly boundary of said Northeast 1/4 of Section 15; thence leaving said Northerly boundary North 00°50'21" East a distance of 1034.95 feet along said Westerly boundary to the POINT OF BEGINNING.

End of Description

RECEIVED

DEC 18 2003

WATER RESOURCES
WESTERN REGION

ADA COUNTY RECORDER
DAVID NAVARRO
QUIT CLAIM DEED

2002 NO - 1 AM 10:30

Steve Weeks
RECORDED - REQUEST OF

FEE

12-

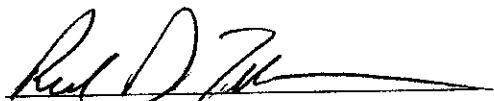
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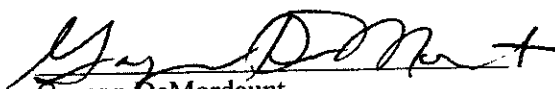
102127709

FOR VALUE RECEIVED, Reed DeMordaunt and Gayann DeMordaunt, husband and wife, the Grantors, do hereby convey, release, remise and forever quit claim all of Grantors' right, title and interest in and to the real property hereinafter described, unto Castle Rock Development, Inc., an Idaho corporation, the Grantee, whose address is 1639 Lakemoor Way, Eagle, Idaho 83616, the following described premises, to wit:

See the attached Exhibit A, which is made a part hereof, for the proper legal description, together with its appurtenances.

IN WITNESS WHEREOF, the Grantors have caused their names to be hereunto subscribed this 1st day of November, 2002.

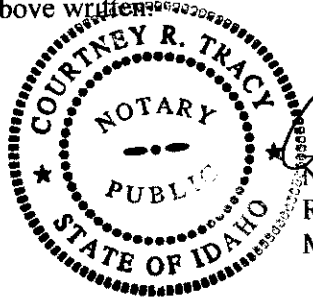

Reed DeMordaunt


Gayann DeMordaunt

STATE OF IDAHO)
) ss.
County of ADA)

On this 1st day of November, 2002, before me, the undersigned, a Notary Public in and for said State, personally appeared Reed DeMordaunt and Gayann Demordaunt, husband and wife, known or identified to me to be the persons whose names are subscribed to the within instrument, and acknowledged to me that they executed the same.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal the day and year in this certificate first above written.



Courtney R. Tracy
Notary Public for Idaho
Residing at Boise
My commission expires: 10/01/2007

EXHIBIT A

Legal Description
For
Phase 1 Boundary

A parcel of land located in the a portion of the East 1/2 of Section 15, Township 4 North, Range 1 West of the Boise Meridian, Ada County, Idaho, being more particularly described as follows:

Commencing at the northwest corner of the Northeast 1/4 of Section 15, T.3N., R.1W., B.M., Ada County, Idaho; thence South 00°50'21" West a distance of 1026.31 feet along the Westerly boundary of said Northeast 1/4 of Section 15 to a point on the Southerly right-of-way line of Moon Valley Road, said point being the **TRUE POINT OF BEGINNING**; thence along said right-of-way line South 89°06'10" East a distance of 678.82 feet to a point on the Easterly line of proposed Vintage Street; thence along said easterly line the following courses and distances: thence South 00°00'00" West a distance of 49.69 feet; thence 88.70 feet long the arc of a 87.97 foot radius curve to the right (through a central angle of 57°46'09", the chord which bears South 28°53'04" West a distance of 84.99 feet) to a point of a reverse curve; thence 38.28 feet along the arc of a 37.97 foot curve to the left (through a central angle of 57°46'09", the chord which bears South 28°53'04" West a distance of 36.68 feet) to point of a compound curve; thence 76.62 feet along a 223.81 foot radius curve to the left (through a central angle of 19°36'50", the chord which bears South 09°48'25" East a distance 76.24 feet) to a point of a reverse curve; thence 69.58 feet along the arc of a 273.81 foot radius curve to the right 9through a central angle of 14°33'38", the chord which bears South 12°20'01" East a distance of 69.40 feet) to a point of reverse curve; thence 14.83 feet along the arc of a 10.00 foot radius curve to the left 9through a central angle of 84°56'47", the chord which bears South 47°31'36" East a distance of 13.50 feet) to a point of a non-tangent line; thence South 00°48'47" West a distance of 30.00 feet to a point being non-tangent to a curve; thence 14.49 feet along the arc of a 10.00 foot radius curve to the left (through a central angle of 83°00'02", the chord which bears South 48°29'59" West a distance of 13.25 feet) to a point of a reverse curve; thence 98.88 feet along the arc of a 195.15 foot radius curve to the right 9through a central angle of 29°01'54", the chord which bears South 21°30'55" West a distance of 97.83 feet) to a point of a reverse curve; thence 99.07 feet along the arc of a 145.15 foot radius curve to the left (through a central angle of 39°06'20", the chord which bears South 16°28'42" West a distance of 97.16 feet) to a point of a compound curve: thence 113.42 feet along the arc of a 125.00 foot radius curve to the left (through a central angle of 51°59'19", the chord which bears South 29°04'07" East a distance of 109.57 feet) to a point of a reverse curve;

Land Surveying Services

EXHIBIT A

thence 404.64 feet along the arc of a 275.00 foot radius curve to the right (through a central angle of $84^{\circ}18'21''$, the chord which bears South $12^{\circ}54'36''$ East a distance of 369.11 feet) to a point of a reverse curve; thence 129.78 feet along the arc of a 222.11 foot radius curve to the left (through a central angle of $33^{\circ}28'47''$, the chord which bears South $11^{\circ}17'17''$ West a distance of 127.95 feet) to a point being non-tangent to a curve; thence 74.22 feet along the arc of a 50.00 foot radius curve to the right (through a central angle of $85^{\circ}02'45''$, the chord which bears South $28^{\circ}22'23''$ East a distance of 67.59 feet) to a non-tangent point on a curve; thence leaving said easterly line, 80.21 feet along the arc of a 105.06 foot radius curve to the right (through a central angle of $43^{\circ}44'21''$, the chord which bears South $37^{\circ}48'17''$ East a distance of 78.27 feet) to a point of a reverse curve; thence 44.89 feet along the arc of a 75.00 foot radius curve to the left (through a central angle of $34^{\circ}17'34''$, the chord which bears South $33^{\circ}04'54''$ East a distance of 44.22 feet) to a point of a reverse curve; thence 121.10 feet along the arc of a 1128.19 foot radius curve to the right (through a central angle of $06^{\circ}09'00''$, the chord which bears South $47^{\circ}09'12''$ East a distance of 121.04 feet); thence South $45^{\circ}55'50''$ West a distance of 230.02 feet; thence South $53^{\circ}00'00''$ West a distance of 120.35 feet to a point on the Northerly bank of the Boise River; thence a long said Northerly Bank the following courses and distances: thence North $37^{\circ}00'00''$ West a distance of 53.63 feet; thence North $55^{\circ}00'00''$ West a distance of 200.00 feet; thence North $73^{\circ}00'00''$ West a distance of 200.00 feet; thence North $86^{\circ}44'59''$ West a distance of 234.21 feet to a point on the Easterly line of a certain Quitclaim Deed recorded June 26, 1997, as Instrument No. 9705066; thence leaving said Northerly bank and along the Easterly and Northerly boundaries of a said Quitclaim Deed the following courses and distances: North $00^{\circ}15'13''$ East a distance of 345.73 feet; thence South $57^{\circ}20'49''$ West a distance of 25.75 feet to a point on the Westerly boundary of said Northeast 1/4 of Section 15; thence leaving said Northerly boundary North $00^{\circ}50'21''$ East a distance of 1034.95 feet along said Westerly boundary to the **POINT OF BEGINNING**.

Said parcel contains 1,014,837 square feet or 23.30 acres, more or less.

End of Description

Project No. 01-237



**CASTLE ROCK DEVELOPMENT, INC.
UNANIMOUS CONSENT OF DIRECTORS
IN LIEU OF FIRST MEETING**

RECEIVED

DEC 18 2003

WATER RESOURCES
WESTERN REGION

THE UNDERSIGNED, being the sole director of CASTLE ROCK DEVELOPMENT, INC., an Idaho corporation, does hereby consent to, adopt and approve in writing the following corporate action without a meeting in accordance with the provisions of the Idaho Business Corporations Act.

RESOLVED, that the Articles of Incorporation of the Corporation as filed, are approved and adopted and shall be inserted in the corporate record book, together with the Certificate of Incorporation issued by the Secretary of State of the State of Idaho;

RESOLVED, that the form of Bylaws for the regulation of the affairs of the Corporation which are attached hereto as Exhibit A, and made a part hereof, are approved and adopted as the Bylaws of the Corporation and said Bylaws shall be filed in the corporate record book;

RESOLVED, that the following person is hereby confirmed as the initial Director of the Corporation who shall hold such office until his successor is hereafter elected and qualified:

Reed P. DeMordaunt

RESOLVED, that the following persons are hereby elected as the officers of the Corporation, to hold office for the ensuing year or until such time as their respective successors are duly elected and qualified:

<u>Office</u>	<u>Name</u>
President	Reed P. DeMordaunt
Treasurer	Gayann DeMordaunt
Secretary	Gayann DeMordaunt

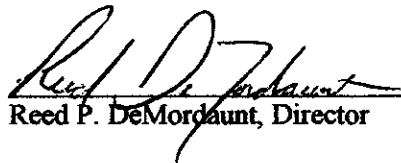
RESOLVED, that Reed P. DeMordaunt is hereby confirmed as the initial Registered Agent of the Corporation and whose office located at 1639 Lakemoore Way, Eagle, Idaho 83616 shall constitute the registered office of the Corporation.

RESOLVED, that the Treasurer be, and hereby is, authorized and directed to pay out of any funds belonging to this Corporation the expenses incurred in connection with its incorporation and for the supplies ordered or to be purchased in connection with the organization of the Corporation and the establishment of its business, and such other obligations, if any, as the Corporation has incurred incidental to its organization.

UNANIMOUS CONSENT OF DIRECTORS - 1
D:\W&N\DEMORDAUNT\RESOLU01

RESOLVED, that this Corporation open a bank account for the general bank business of this Corporation, and the standard banking resolution used by said bank for a corporate account is hereby adopted as if said resolution had been set forth herein in full and that Reed P. DeMordaunt, as President, and Gayann DeMordaunt as Secretary or Treasurer, and such other persons as hereafter authorized by the directors, shall be authorized to sign checks and drafts of the Corporation and to endorse checks payable to the Corporation.

DATED effective as of the 10 day of January, 2002.


Reed P. DeMordaunt, Director

Nº 3367

Shares 42

Incorporated 1889 Under the Laws of the State of Idaho

Middleton Mill Ditch Company

MIDDLETON, IDAHO

This Certifies That *Reed on Layann DeMordaunt* is entitled to
Forty-two (42) Shares of the Capital Stock of the

Middleton Mill Ditch Company

MIDDLETON, IDAHO

Transferable only on the books of the Company in person or by attorney on the surrender of this certificate duly endorsed.

WITNESS the signature of the President and Secretary, and the Corporate Seal of said Company this

3rd day of *October* of 20 *02*

Diane Foster Secretary

Allen Fung President

THE
 TRANSFER
 THE CERTIFICATE
 SECRETARY, WHO
 NEW OWNER ALONE
 HAVE ANY OTHER
 YOU SHOULD CH
 IFY THE SECRETARY
 214 MIDDLETON, ID
 72

ATTACHMENT C4



ADA COUNTY RECORDER
J. DAVID NAVARRO
BOISE, IDAHO

2002 MAY 31 PM 3:22

RECORDED-REQUEST OF

FEE 3⁰⁰ DEPUTY K. Vaughn

102061669

TITLEONE

Escrow Number: A028341 ES / KB

WARRANTY DEED

FOR VALUE RECEIVED, Dwight Walker and Ruth Walker, husband and wife, the Grantors, do hereby grant, bargain sell and convey unto The Harrison Fund LLC, an Idaho limited liability company, 7010 Moon Valley Road, Eagle, Idaho 83616, an undivided fifty-five percent interest (55%) and unto Moon Valley Ranch LLC, an Idaho limited liability company, 9815 Hwy 44, Star, Idaho 83669, an undivided forty-five percent interest (45%), as tenants in common, collectively the Grantees, the following described premises, in Ada County, Idaho, TO WIT:

The Southeast Quarter of the Northeast Quarter and that part of the Northeast Quarter of the Northeast Quarter lying South of the public highway in Section 15, Township 4 North, Range 1 West, Boise Meridian, Ada County, Idaho.

TO HAVE AND TO HOLD the said premises, with their appurtenances unto the said Grantees, their heirs and assigns forever. And the said Grantors do hereby covenant to and with the said Grantees, that they are the owners in fee simple of said premises; that they are free from all encumbrances EXCEPT: Subject to all existing patent reservations, easements, right(s) of way, protective covenants, zoning ordinances, and applicable building codes, laws and regulations, general taxes and assessments, including irrigation and utility easements (if any) for the current year, which are not due and payable, and that Grantors will warrant and defend the same from all lawful claims whatsoever.

Dated: 5/31, 2002

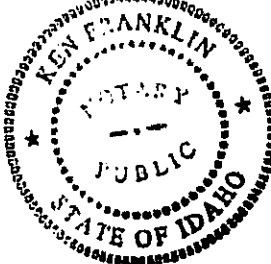
Dwight Walker
Dwight Walker

Ruth M. Walker
Ruth Walker

State of Idaho)
)ss.
County of Ada)

On this 31ST day of May, 2002, before me, the undersigned, a Notary Public in and for said State, personally appeared **Dwight Walker and Ruth Walker**, known or proven to me on the basis of satisfactory evidence to be the persons whose names are subscribed to the within instrument, and acknowledged to me that they executed the same.

Ken Franklin
Notary Public
Residing at: BOISE
Comm. Exp: 10/5/04



ATTACHMENT D1

No. W 3186 Return to: SECRETARY OF STATE 700 WEST JEFFERSON PO BOX 83720 BOISE, ID 83720-0080 NO FILING FEE IF RECEIVED BY DUE DATE		Due no later than Dec 31, 2003 Annual Report Form 1. Entity Name HARRISON FUND LLC (THE) WYLIE H GRIFFITH 4205 W EMERALD ST BOISE, ID 83706		2. Registered Agent and Office NO PO BOX WYLIE H GRIFFITH 7010 MOON VALLEY RD EAGLE, ID 83616 3. New Registered Agent Signature	
4. Limited Liability Companies: Enter Names and Addresses of Members.					
<u>Office held</u>		<u>Name</u>		<u>City</u>	<u>State</u>
<u>Street or P.O. Address</u>		<u>City</u>		<u>State</u>	<u>Zip</u>
1. <i>Wylie H. Griffith</i>		7010 Moon Valley Rd		Boise	ID 83616
2. <i>James W. Humphreys</i>		1919 Phillippi		Boise	ID 83705
5. Organized Under the Laws of IDAHO W 3186		6. Signature <i>[Signature]</i> Name <i>Wylie H Griffith</i> (Typed or Printed)		Date <i>1-7-04</i>	Title <i>Member</i>

Do Not Tape or Staple

Issued 01/09/2004

Moore Valley Co.

Shares 19

Nº 3431

Incorporated 1889 Under the Laws of the State of Idaho

Middleton Mill Ditch Company

MIDDLETON, IDAHO

This Certifies That *The Harrison Lumber Co.* is entitled to
Twenty Nine Shares of the Capital Stock of the

Middleton Mill Ditch Company

MIDDLETON, IDAHO

Transferable only on the books of the Company in person or by attorney on the surrender of this certificate duly endorsed.

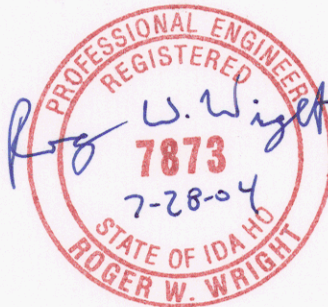
WITNESS the signature of the President and Secretary, and the Corporate Seal of said Company this

12th day of *February*, of 20*04*
D. J. Harrison Secretary
William Harrison President

Rivervine Subdivision IDWR Submittal Package: Narrative And Calculations

RECEIVED
JUL 29 2004
WATER RESOURCES
WESTERN REGION

**Appendix A Site Plans
Appendix B Calculations
Appendix C Endnote Attachments**



Prepared for IDWR
Engineer of Record: Roger Wright, PE
July 28, 2003

Rivervine Subdivision IDWR Submittal Narrative:

INTRODUCTION

Rivervine Subdivision is a proposed non-farm development located at 7011 Moon Valley Road in Ada County, ID. Rivervine Subdivision consists of approximately 53 acres of land owned by Reed DeMordaunt (Castlerock Development, Inc.) and 31 acres owned jointly by Mr. DeMordaunt and Wylie Griffith. Originally the proposed subdivision consisted of 53 acres owned by Mr. DeMordaunt and a Conditional Use Permit has been obtained from Ada County for that portion of the development. The landowners are currently in the process of obtaining a Conditional Use Permit for the additional 31 acres, which will be combined with the original land to comprise the Rivervine Subdivision. Refer to the attached site map for locations of ponds and configuration of the proposed subdivision.

Associated with Rivervine Subdivision is the creation of six aesthetic ponds. Ponds 1 and 2 associated with Phase I of the subdivision have already been constructed. Ponds 3, 4, 5, and 6 are proposed for construction during Phase II of the subdivision.

Prior to the development of the Rivervine Subdivision all of the land that is now occupied by ponds or is proposed to be ponds in later phases of construction was used agriculturally for the production of Alfalfa Cropsⁱ. Irrigation of the alfalfa crops was carried out by the previous owner's use of Middleton-Mill Ditch Company water rights. These water rights were passed onto the current owners at the time they purchased the land to develop Rivervine Subdivision.

Due to the size of the ponds it is understood that their creation will lead to the exposure of ground water to the atmosphere and the subsequent evaporative loss of that ground water. It is this evaporative loss that is driving the need for this submittal to IDWR. The intent of this submittal package is to 1) apply for an "*Application for Permit*" for the new aesthetic groundwater use associated with each existing and proposed pond to be filed on behalf of the owner; 2) to mitigate for the evaporative loss from each pond with existing Middleton-Mill Irrigation Water Shares by applying for an "*Application of Transfer of Water Right*" from existing "irrigation use" to a proposed "groundwater recharge use" for each pond, this application is being filed on behalf of the Middleton-Mill Ditch Company; 3) finally, to file the "Request to Process" forms required by IDWR to accompany all "*Application for Permit*" and "*Application of Transfer of Water Right*" submittals.

Currently Mr. DeMordaunt has 42 shares of Middleton Mill Ditch Company and Mr. Griffith has 19 shares of Middleton Mill Ditch Company for a total of 61 shares of Middleton Mill Ditch Company water rightsⁱⁱ. With each share representing the owner's right to 9 GPM or 0.02 CFS of Middleton-Mill irrigation water. This submittal will establish that only 15.80 of the 61 shares are required to mitigate for the calculated loss in groundwater through evaporation. It is not anticipated that this change in the nature of

use of some of the water shares will have any impact on downstream water shareholders, as the current developers represent the final water users on the Middleton-Mill Ditch before its confluence with the Boise River.

It is anticipated that the proposed change in use from irrigation to groundwater recharge will have no negative effect on the existing quality of irrigation water. In fact, by conveying the irrigation water in question into the proposed ponds where it will mix with existing groundwater we anticipate a higher quality of water will return to the Boise River. This water quality improvement is anticipated because now ultimately the irrigation water will return to the Boise River via underground percolation through the soil where filtration will take place. This filtering process will result in a higher quality of water than that of the irrigation water currently being returned to the Boise River via and open channel confluence. Ultimately we anticipate no change in the quantity of return flows to the Boise River.

CALCULATION PROCEDURE

The following section will outline the procedure used to determine the irrigation shares required to mitigate for the evaporative loss associated with each pond. The process used was developed through accepted engineering practice and verbal and written direction from Steve Lester of the Idaho Department of Water Resources (IDWR), with additional input from Jeff Peppersack of IDWR.

The first step was to calculate the anticipated loss of groundwater (CFS) through evaporation during each month of the irrigation season. The Middleton-Mill Ditch Company recognizes and provides water for a 214 day irrigation season Starting on April 15 and lasting until November 15th. To arrive at the total evaporative loss for each pond pan evaporation ratesⁱⁱⁱ in inches/day specific for the Eagle area were multiplied by a pan coefficient^{iv} specific to the southern Idaho region. The total loss associated with each pond in CFS was then calculated by taking the difference of the overall evaporation rate for each month, and the precipitation rate^v for each month, and multiplying this value by the surface area of the pond.

Next, the gross irrigation requirement (CFS) of Alfalfa crops for the area represented by the ponds was calculated to verify that it was greater than the calculated evaporative loss. This step is necessary because IDWR will not allow the flowrate of the proposed use of water for the land (ground water recharge) to exceed the flowrates associated with the previous use of water for the land (crop irrigation). As directed by IDWR the gross irrigation requirement was calculated by taking published values of the mean irrigation requirement for alfalfa in IN/DAY and dividing by the anticipated irrigation efficiency^{vi}. For each pond it was determined that the gross irrigation requirement of alfalfa at our location exceeded the anticipated evaporative loss of each pond. As directed by IDWR there cannot be an increase of water use over the historical water use. Based on this information, alfalfa crop consumption was used to determine the amount of shares to be forfeited for the proposed ponds

Refer to attached calculations for the specific details the steps described above for each pond.

POND 1 SUMMARY

Pond 1 is an existing pond located in Phase I of the Rivervine subdivision. The pond was created to function as a year round amenity to the Rivervine Subdivision. The pond resides on land that formerly produced alfalfa during the irrigation season and was irrigated by the Middleton Mill Ditch Company. Soon after its creation pond 1 filled by seepage of shallow groundwater into the pond's excavated basin. Refer to the following table for the physical characteristics associated with Pond 1.

Surface Area	129,816 Square Feet	2.98 Acres
Location of Point of Diversion	SW ¼, NE ¼, Sect 15, T4N, R1W	
Surface Elev.	2497 Feet	
Seasonal High Ground Water Elev. ^{vii}	2492.96 Feet	
Total Volume of Pond	14.81 Mgal	45.44 Ac-Ft
Volume of Ground Water	11.20 Mgal	34.36 Ac-Ft

Table 1: Physical Characteristics of Pond 1

It is proposed that **2.78 shares of Middleton-Mill irrigation water rights** be used to mitigate the anticipated loss of groundwater due to evaporation from Pond 1 during the irrigation season, refer to the attached calculations for outline of the process that was used to determine this value. One "*Application for Transfer of Water Right*" form has been prepared by CSHQA on behalf of the Middleton-Mill Ditch Company to accommodate this change in nature of use for all six ponds. The change in nature of use will include the transfer of 2 shares of water rights from an "irrigation use" to a "groundwater recharge use" for Pond 1. Please refer to attached Pond 1 "*Application for Transfer of Water Right*" form for processing.

IDWR has indicated that we will not need to account for evaporative loss of groundwater during the non-irrigation season. However, IDWR requires that an "*Application for Permit*" form be prepared by CSHQA on behalf of the developer to establish an aesthetic groundwater use associated with the ponds during the non-irrigation season. Please refer to the attached Pond 1 "*Application for Permit*" form for processing.

Finally, at the requirement of IDWR a "*Request to Process*" form was prepared by CSHQA on behalf of the owner to accompany the "*Application for Transfer of Water Right*" and "*Application for Permit*" forms associated with Pond 1. Please refer to attached Pond 1 "*Request to Process*" form for processing.

POND 2 SUMMARY

Pond 2 is an existing pond located in Phase I of the Rivervine subdivision. The pond was created to function as a year round amenity to the Rivervine Subdivision. The pond resides on land that formerly produced alfalfa during the irrigation season and was irrigated by the Middleton Mill Ditch Company. Soon after its creation pond 2 filled by seepage of shallow groundwater into the pond's excavated basin. Refer to the following table for the physical characteristics associated with Pond 2.

Surface Area	59,799 Square Feet	1.37 Acres
Location of Point of Diversion	SW ¼, NE ¼, Sect 15, T4N, R1W	
Surface Elev.	2498 Feet	
Seasonal High Ground Water Elev. ^{viii}	2492.8 Feet	
Total Volume of Pond	4.27 Mgal	13.09 Ac-Ft
Volume of Ground Water	2.38 Mgal	7.29 Ac-Ft

Table 2: Physical Characteristics of Pond 2

It is proposed that **1.28 share of Middleton-Mill irrigation water rights** be used to mitigate the anticipated loss of groundwater due to evaporation from Pond 2 during the irrigation season, refer to the attached calculations for outline of the process that was used to determine this value. One "*Application for Transfer of Water Right*" form has been prepared by CSHQA on behalf of the Middleton-Mill Ditch Company to accommodate this change in nature of use for all six ponds. The change in nature of use will include a transfer of 1 share of water rights from an "irrigation use" to a "groundwater recharge use" for Pond 2. Please refer to attached Pond 2 "*Application for Transfer of Water Right*" form for processing.

IDWR has indicated that we will not need to account for evaporative loss of groundwater during the non-irrigation season. However, IDWR requires that an "*Application for Permit*" form be prepared by CSHQA on behalf of the developer to establish an aesthetic groundwater use associated with the ponds during the non-irrigation season. Please refer to the attached Pond 2 "*Application for Permit*" form for processing.

Finally, at the requirement of IDWR a "*Request to Process*" form was prepared by CSHQA on behalf of the owner to accompany the "*Application for Transfer of Water Right*" and "*Application for Permit*" forms associated with Pond 2. Please refer to attached Pond 2 "*Request to Process*" form processing.

POND 3 SUMMARY

Pond 3 is a proposed pond located in Phase II of the Rivervine subdivision. The pond will be created to function as a year round amenity to the Rivervine Subdivision. The pond resides on land that formerly produced alfalfa during the irrigation season and was irrigated by the Middleton Mill Ditch Company. It is anticipated that after its creation pond 3 will fill by seepage of shallow groundwater into the pond's excavated basin. Refer to the following table for the physical characteristics associated with Pond 3.

Surface Area	57,220 Square Feet	1.31 Acres
Location of Point of Diversion	SW ¼, NE ¼, Sect 15, T4N, R1W	
Surface Elev.	2499 Feet	
Seasonal High Ground Water Elev. ^{viii}	2496 Feet	
Total Volume of Pond	4.02 Mgal	12.32 Ac-Ft
Volume of Ground Water	2.86 Mgal	8.79 Ac-Ft

Table 3: Physical Characteristics of Pond 3

It is proposed that **1.22 share of Middleton-Mill irrigation water rights** be used to mitigate the anticipated loss of groundwater due to evaporation from Pond 3 during the irrigation season, refer to the attached calculations for outline of the process that was used to determine this value. One "*Application for Transfer of Water Right*" form has been prepared by CSHQA on behalf of the Middleton-Mill Ditch Company to accommodate this change in nature of use for all six ponds. The change in nature of use will include the transfer of 1 share of water rights from an "irrigation use" to a "groundwater recharge use" for Pond 3. Please refer to attached Pond 6 "*Application for Transfer of Water Right*" for processing.

IDWR has indicated that we will not need to account for evaporative loss of groundwater during the non-irrigation season. However, IDWR requires that an "*Application for Permit*" form be prepared by CSHQA on behalf of the developer to establish an aesthetic groundwater use associated with the ponds during the non-irrigation season. Please refer to the attached Pond 3 "*Application for Permit*" form for processing.

Finally, at the requirement of IDWR a "*Request to Process*" was prepared by CSHQA on behalf of the owner to accompany the "*Application for Transfer of Water Right*" and "*Application for Permit*" form associated with Pond 3. Please refer to attached Pond 3 "*Request to Process*" form for processing.

POND 4 SUMMARY

Pond 4 is a proposed pond located in Phase II of the Rivervine subdivision. The pond will be created to function as a year round amenity to the Rivervine Subdivision. The pond resides on land that formerly produced alfalfa during the irrigation season and was irrigated by the Middleton Mill Ditch Company. It is anticipated that after its creation pond 4 will fill by seepage of shallow groundwater into the pond's excavated basin. Refer to the following table for the physical characteristics associated with Pond 4.

Surface Area	151,968 Square Feet	3.49 Acres
Location of Point of Diversion	SW ¼, NE ¼, Sect 15, T4N, R1W	
Surface Elev.	2500 Feet	
Seasonal High Ground Water Elev. ^{viii}	2496 Feet	
Total Volume of Pond	15.76 Mgal	48.37 Ac-Ft
Volume of Ground Water	11.53 Mgal	35.40 Ac-Ft

Table 3: Physical Characteristics of Pond 4

It is proposed that **3.26 share of Middleton-Mill irrigation water rights** be used to mitigate the anticipated loss of groundwater due to evaporation from Pond 4 during the irrigation season, refer to the attached calculations for outline of the process that was used to determine this value. One "*Application for Transfer of Water Right*" form has been prepared by CSHQA on behalf of the Middleton-Mill Ditch Company to accommodate this change in nature of use for all six ponds. The change in nature of use will include the transfer of 3 shares of water rights from an "irrigation use" to a "groundwater recharge use" for Pond 4. Please refer to attached Pond 6 "*Application for Transfer of Water Right*" for processing.

IDWR has indicated that we will not need to account for evaporative loss of groundwater during the non-irrigation season. However, IDWR requires that an "*Application for Permit*" form be prepared by CSHQA on behalf of the developer to establish an aesthetic groundwater use associated with the ponds during the non-irrigation season. Please refer to the attached Pond 4 "*Application for Permit*" form for processing.

Finally, at the requirement of IDWR a "*Request to Process*" was prepared by CSHQA on behalf of the owner to accompany the "*Application for Transfer of Water Right*" and "*Application for Permit*" form associated with Pond 4. Please refer to attached Pond 4 "*Request to Process*" form for processing.

POND 5 SUMMARY

Pond 5 is a proposed pond located in Phase II of the Rivervine subdivision. The pond will be created to function as a year round amenity to the Rivervine Subdivision. The pond resides on land that formerly produced alfalfa during the irrigation season and was irrigated by the Middleton Mill Ditch Company. It is anticipated that after its creation pond 5 will fill by seepage of shallow groundwater into the pond's excavated basin. Refer to the following table for the physical characteristics associated with Pond 5.

Surface Area	125,281 Square Feet	2.88 Acres
Location of Point of Diversion	SW ¼, NE ¼, Sect 15, T4N, R1W	
Surface Elev.	2500 Feet	
Seasonal High Ground Water Elev. ^{viii}	2495.5 Feet	
Total Volume of Pond	12.74 Mgal	39.10 Ac-Ft
Volume of Ground Water	8.87 Mgal	27.24 Ac-Ft

Table 3: Physical Characteristics of Pond 5

It is proposed that **2.69 share of Middleton-Mill irrigation water rights** be used to mitigate the anticipated loss of groundwater due to evaporation from Pond 5 during the irrigation season, refer to the attached calculations for outline of the process that was used to determine this value. One "*Application for Transfer of Water Right*" form has been prepared by CSHQA on behalf of the Middleton-Mill Ditch Company to accommodate this change in nature of use for all six ponds. The change in nature of use will include the transfer of 2 shares of water rights from an "irrigation use" to a "groundwater recharge use" for Pond 5. Please refer to attached Pond 5 "*Application for Transfer of Water Right*" for processing.

IDWR has indicated that we will not need to account for evaporative loss of groundwater during the non-irrigation season. However, IDWR requires that an "*Application for Permit*" form be prepared by CSHQA on behalf of the developer to establish an aesthetic groundwater use associated with the ponds during the non-irrigation season. Please refer to the attached Pond 5 "*Application for Permit*" form for processing.

Finally, at the requirement of IDWR a "*Request to Process*" was prepared by CSHQA on behalf of the owner to accompany the "*Application for Transfer of Water Right*" and "*Application for Permit*" form associated with Pond 5. Please refer to attached Pond 5 "*Request to Process*" form for processing.

POND 6 SUMMARY

Pond 6 is a proposed pond located in Phase II of the Rivervine subdivision. The pond will be created to function as a year round amenity to the Rivervine Subdivision. The pond resides on land that formerly produced alfalfa during the irrigation season and was irrigated by the Middleton Mill Ditch Company. It is anticipated that after its creation pond 6 will fill by seepage of shallow groundwater into the pond's excavated basin. Refer to the following table for the physical characteristics associated with Pond 6.

Surface Area	213,329 Square Feet	4.90 Acres
Location of Point of Diversion	SE ¼, NE ¼, Sect 15, T4N, R1W	
Surface Elev.	2503 Feet	
Seasonal High Ground Water Elev. ^{vii}	2498 Feet	
Total Volume of Pond	25.54 Mgal	78.39 Ac-Ft
Volume of Ground Water	18.04 Mgal	55.37 Ac-Ft

Table 6: Physical Characteristics of Pond 6

It is proposed that **4.57 shares of Middleton-Mill irrigation water rights** be used to mitigate the anticipated loss of groundwater due to evaporation from Pond 6 during the irrigation season, refer to the attached calculations for outline of the process that was used to determine this value. One "*Application for Transfer of Water Right*" form has been prepared by CSHQA on behalf of the Middleton-Mill Ditch Company to accommodate this change in nature of use for all six ponds. The change in nature of use will include the transfer of 4 shares of water rights from an "irrigation use" to a "groundwater recharge use" for Pond 6. Please refer to attached Pond 6 "*Application for Transfer of Water Right*" form for processing.

IDWR has indicated that we will not need to account for evaporative loss of groundwater during the non-irrigation season. However, IDWR requires that an "*Application for Permit*" form be prepared by CSHQA on behalf of the developer to establish an aesthetic groundwater use associated with the ponds during the non-irrigation season. Please refer to the attached Pond 6 "*Application for Permit*" form for processing.

Finally, at the requirement of IDWR a "*Request to Process*" form was prepared by CSHQA on behalf of the owner to accompany the "*Application for Transfer of Water Right*" and "*Application for Permit*" forms associated with Pond 6. Please refer to attached Pond 6 "*Request to Process*" form for processing.

CONCLUSION

In summary, the intent of this submittal package is to establish the aesthetic use of groundwater in the Rivervine Subdivision in the form of two existing ponds and two proposed ponds with the Idaho Department of Water Resources. To meet this end four "*Application for Transfer of Water Rights*", "*Application for Permit*", and *Request for*

Processing IDWR forms have been completed to the fullest extent possible and submitted for review and approval.

ⁱ "Estimating Consumptive Irrigation Requirement for Crops in Idaho" Appendix E, University of Idaho Report as published by R.G. Allen and C.E. Brockway, 1983.
<http://www.Kimberly.uidaho.edu/water/appndxet/index.html>

ⁱⁱ Historical information as provided by owner in email dated March 2003.

ⁱⁱⁱ Values obtained from the WRCC from the Emmett 2 E, Idaho Climate Station (1948-2000).
<http://www.wrcc.dri.edu/htmlfiles/westevap.final.html>

^{iv} Pan Coefficient Value obtained from "Hydrologic Analysis and design", McCuen et al.

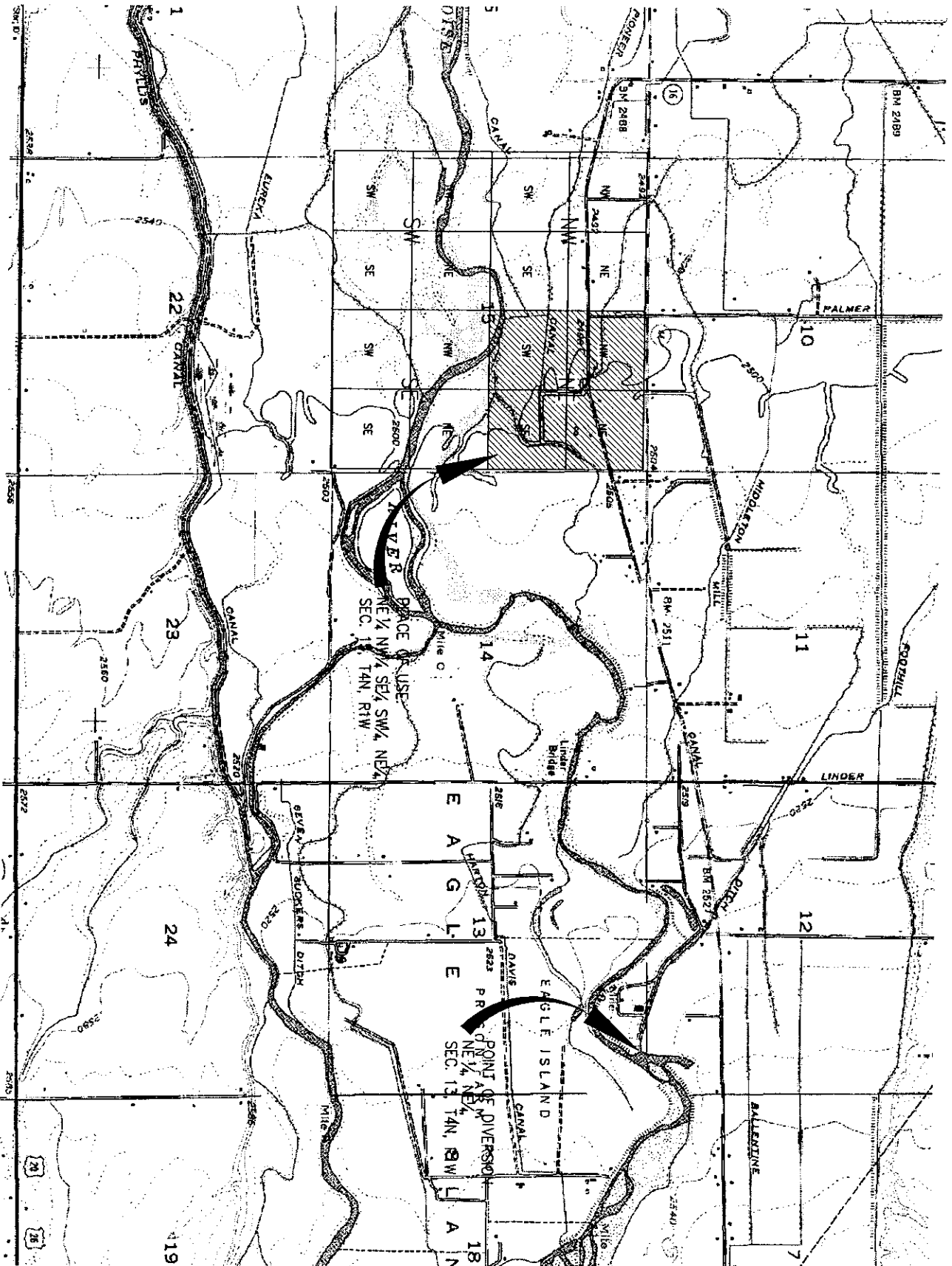
^v Values obtained from the WRCC from the Boise WSFO Airport, Idaho Climate Station (1/1/1940-12/31/01). <http://www.wrcc.dri.edu/cgi-bin/cliRECtM.pl?idboise>

^{vi} Irrigation Efficiencies obtained from "Handbook of Applied Hydrology, Chow et al.

^{vii} Seasonal High Groundwater Values as determined by the "Nutrient Pathogen Study Resource Inventory Proposed Moon Valley Road, Ada County, ID. Prepared by Material Testing & Inspection dated October 6, 2000.

^{viii} High Groundwater Values as determined by the "Geotechnical Investigation Rivervine Subdivision Moon Valley Road Eagle, ID. Prepared by American Geotechnics dated September 9, 2002

APPENDIX A

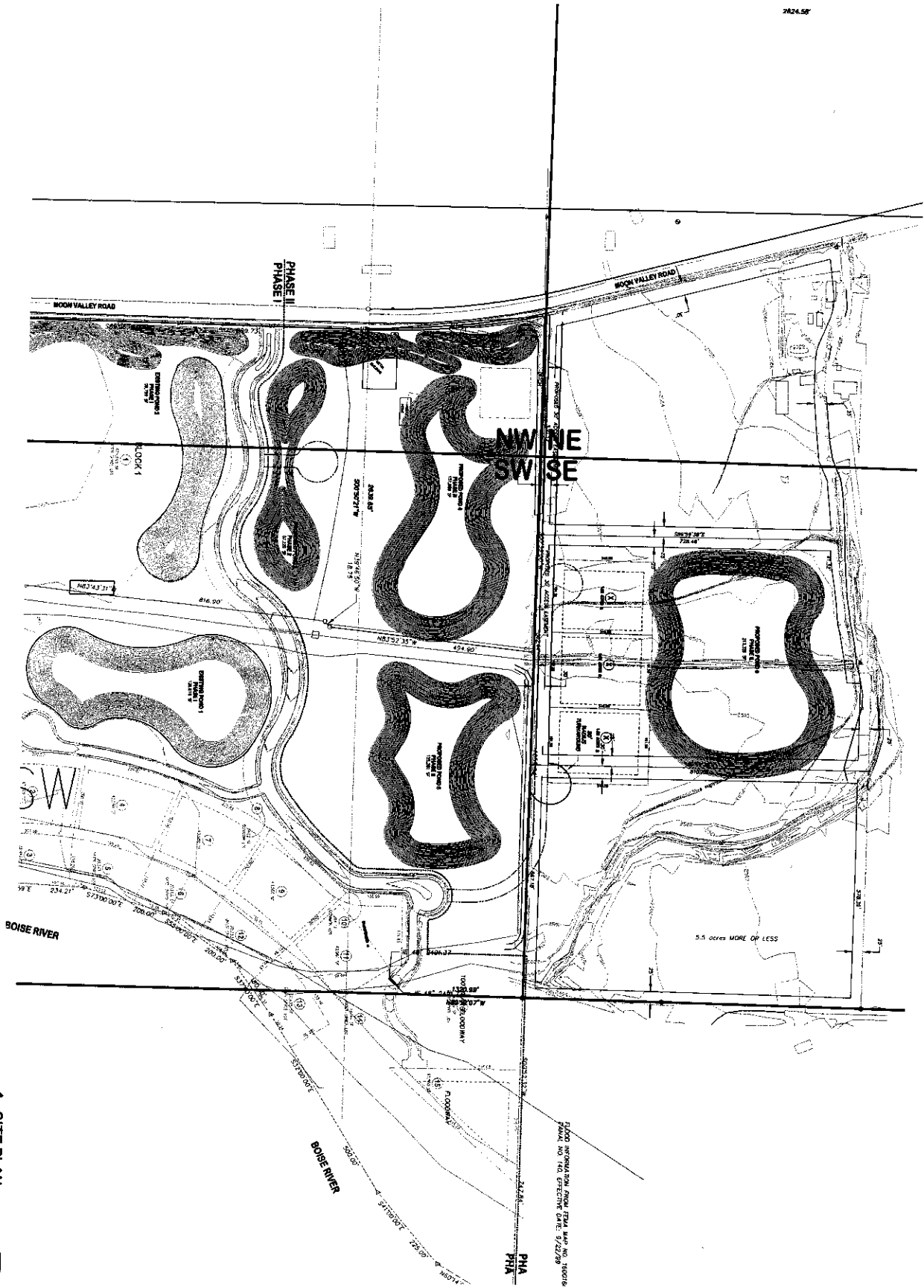


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RIVERVINE SUBD. PNT OF DIVERSION MAP

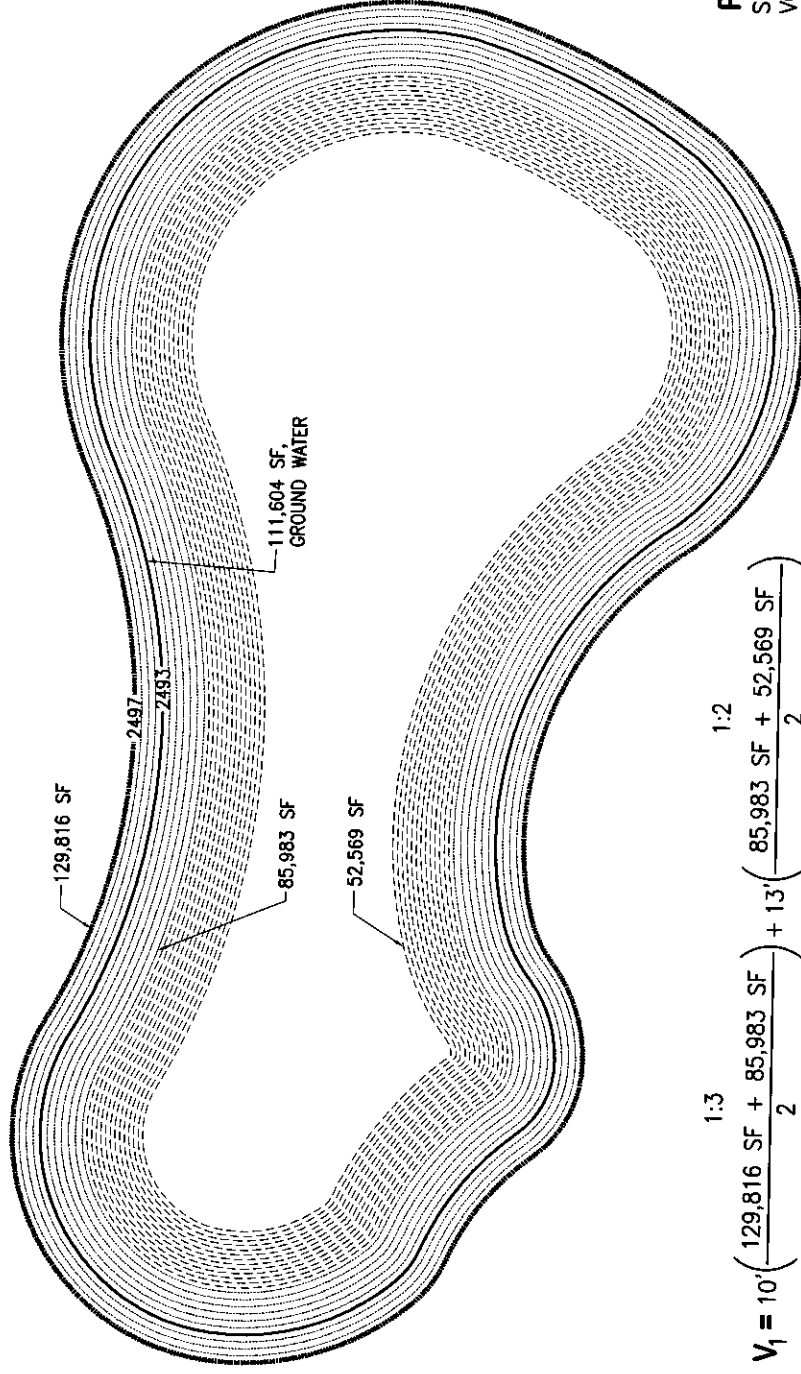
GENERAL NOTES

PROJECT: RIVERVINE	DATE: 3-10-03
BY: MDW	SHEET: 1



1 SITE PLAN
 SCALE: 1"=100'
 0 50 100 150 200 250
 SCALE IN FEET

RIVERVINE SUBDIVISION PHASE II MOON VALLEY ROAD ADA COUNTY, IDAHO CSHQ		NO. 01260.20C C. W. MOORE PLAZA 280 E. 9TH ST. - BOISE, ID 83704 (208) 343-4430 - FAX (208) 343-4804 http://www.cshq.com	C. W. MOORE PLAZA 280 E. 9TH ST. - BOISE, ID 83704 (208) 343-4430 - FAX (208) 343-4804 http://www.cshq.com	PRELIMINARY NOT FOR CONSTRUCTION
SHEET 1	REVISIONS	DRAWN BY PROJECT CHECKED CITY DATE	SUBMITTED BY OWNER / AGENCY	PROJECT TITLE



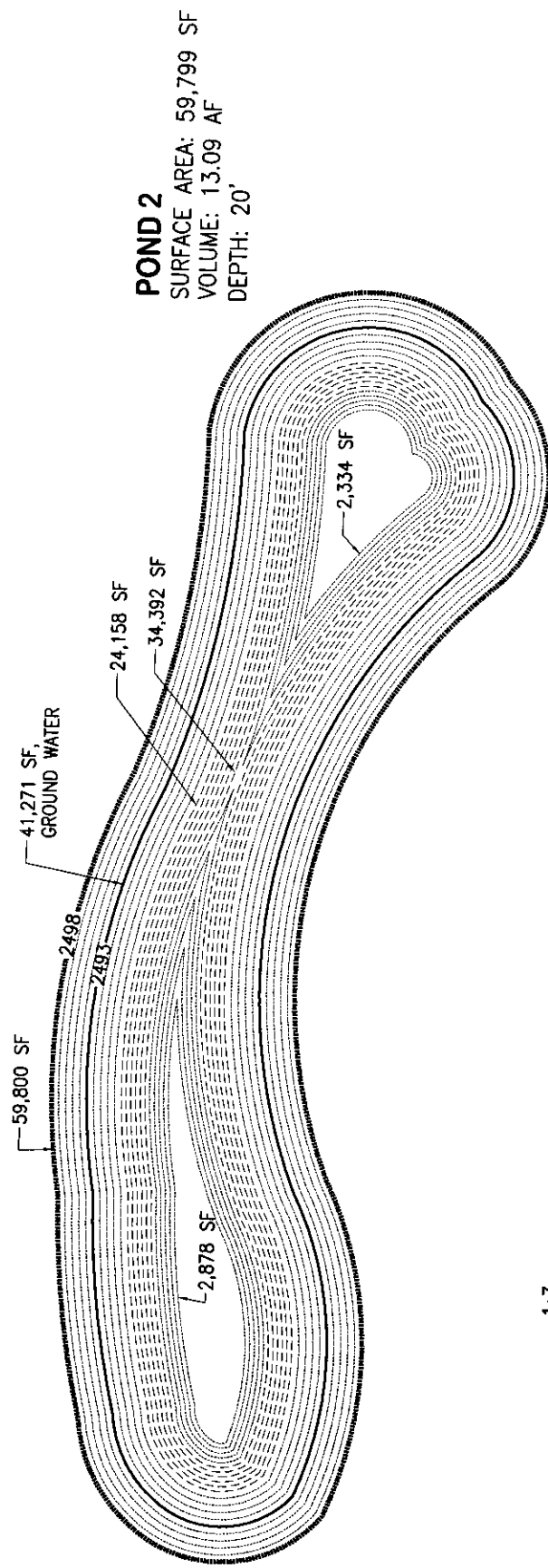
POND 1
 SURFACE AREA: 129,816 SF
 VOLUME: 45.44 AF
 DEPTH: 23'

$$V_1 = 10' \left(\frac{129,816 \text{ SF} + 85,983 \text{ SF}}{2} \right) + 13' \left(\frac{85,983 \text{ SF} + 52,569 \text{ SF}}{2} \right)$$

$$V_1 = 1,979,583 \text{ CF} = 14.81 \text{ MGAL}$$

$$V_{GW1} = 1,979,583 \text{ CF} - 4' \left(\frac{129,816 \text{ SF} + 111,604 \text{ SF}}{2} \right)$$

$$V_{GW1} = 1,496,730 \text{ CF} = 11.20 \text{ MGAL}$$



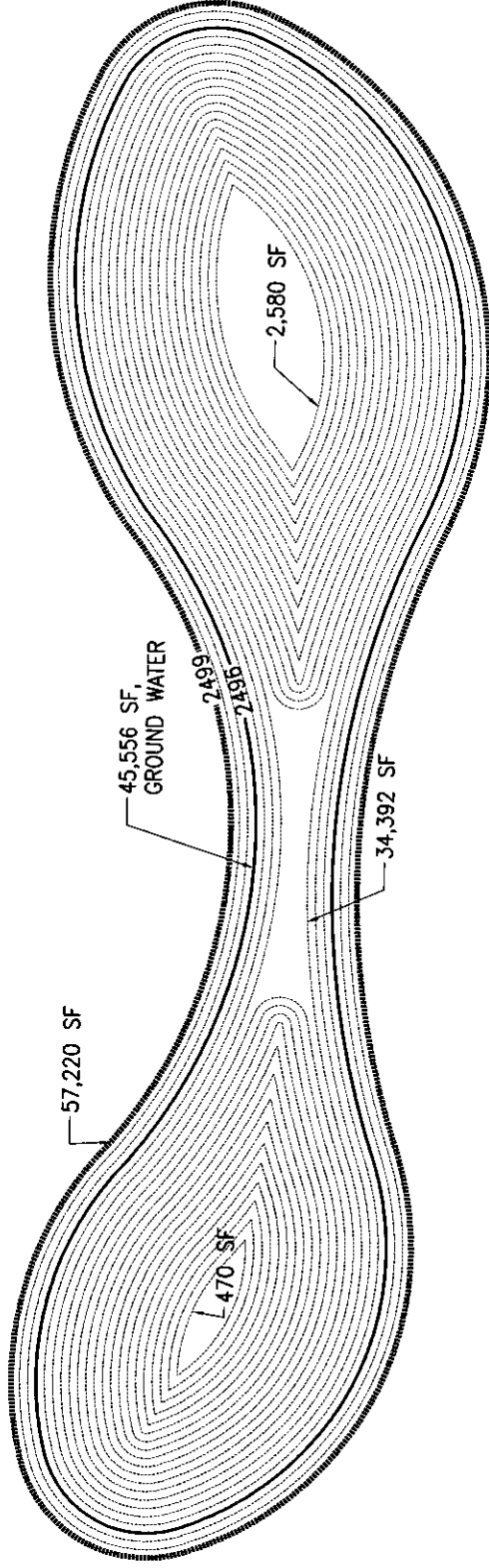
POND 2
 SURFACE AREA: 59,799 SF
 VOLUME: 13.09 AF
 DEPTH: 20'

$$V_2 = 10' \left(\frac{59,799 \text{ SF} + 24,158 \text{ SF}}{2} \right) + 6' \left(\frac{24,158 \text{ SF} + 13,352 \text{ SF}}{2} \right) + 4' \left(\frac{13,352 \text{ SF} + (2,878 + 2,334) \text{ SF}}{2} \right)$$

$$V_2 = 570,343 \text{ CF} = 4.27 \text{ MGAL}$$

$$V_{GW2} = 570,343 \text{ CF} - 5' \left(\frac{59,800 \text{ SF} + 41,271 \text{ SF}}{2} \right)$$

$$V_{GW2} = 317,666 \text{ CF} = 2.38 \text{ MGAL}$$



POND 3

SURFACE AREA: 57,220 SF

VOLUME: 12.32 AF

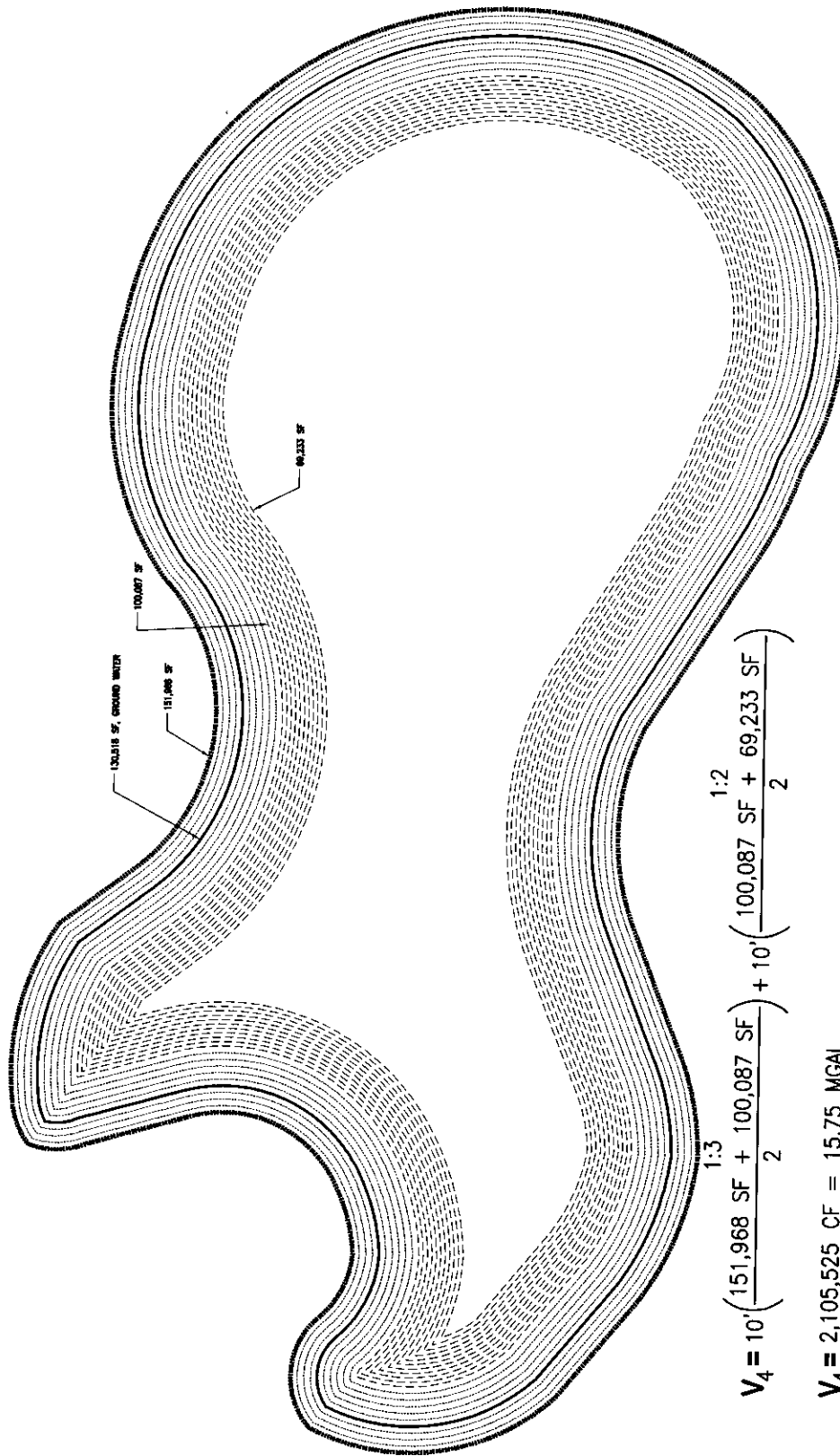
DEPTH: 20'

$$V_3 = 6' \left(\frac{57,220 \text{ SF} + 34,392 \text{ SF}}{2} \right) + 14' \left(\frac{34,392 \text{ SF} + (470 + 2,580) \text{ SF}}{2} \right) \quad 1:2$$

$$V_3 = 536,930 \text{ CF} = 4.02 \text{ MGAL}$$

$$V_{\text{GW}3} = 536,930 \text{ CF} - 3' \left(\frac{57,220 \text{ SF} + 45,556 \text{ SF}}{2} \right) \quad 1:3$$

$$V_{\text{GW}3} = 382,766 \text{ CF} = 2.86 \text{ MGAL}$$



$$V_4 = 10' \left(\frac{151,968 \text{ SF} + 100,087 \text{ SF}}{2} \right) + 10' \left(\frac{100,087 \text{ SF} + 69,233 \text{ SF}}{2} \right)$$

$$V_4 = 2,105,525 \text{ CF} = 15.75 \text{ MGAL}$$

$$V_{GW4} = 2,106,875 \text{ CF} - 4' \left(\frac{151,968 \text{ SF} + 130,518 \text{ SF}}{2} \right)$$

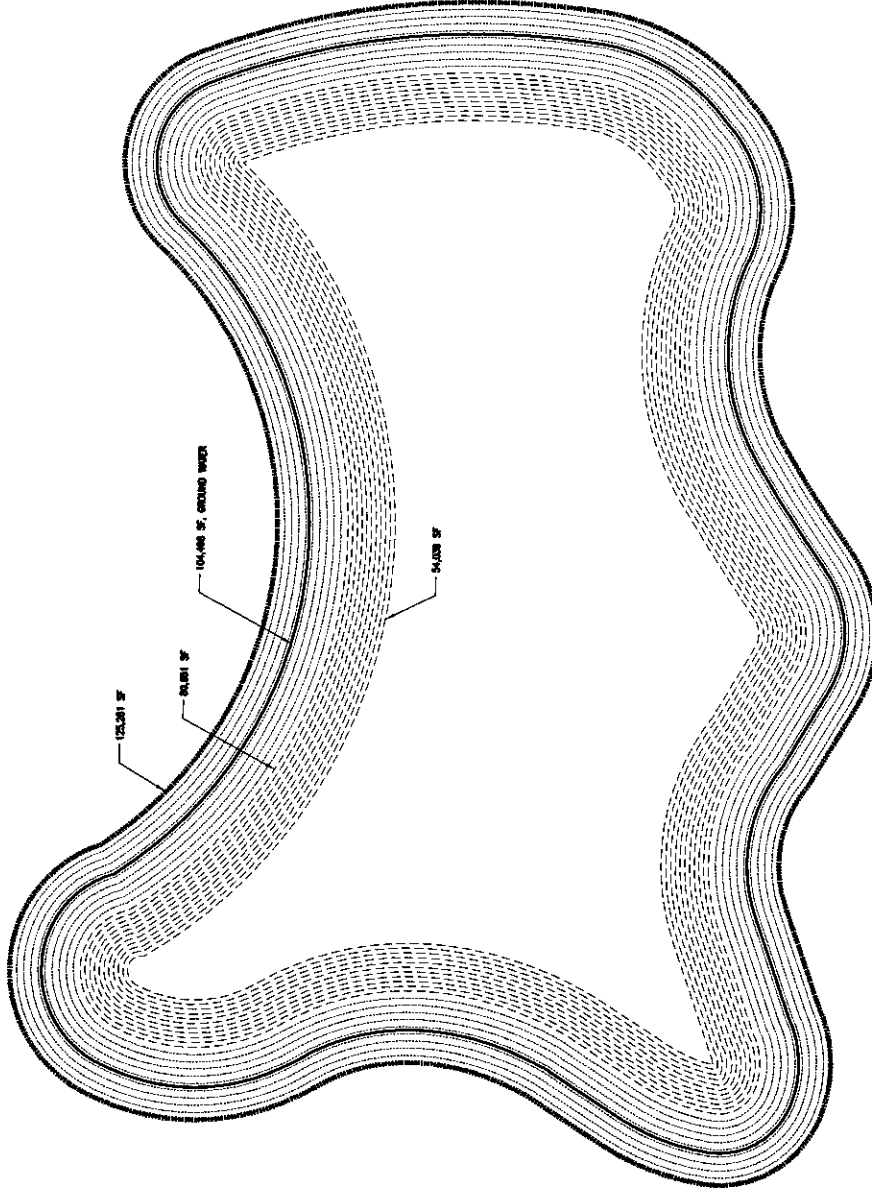
$$V_{GW4} = 1,541,903 \text{ CF} = 11.53 \text{ MGAL}$$

POND 4

SURFACE AREA: 151,968 SF

VOLUME: 48.37 AF

DEPTH: 20'



POND 5

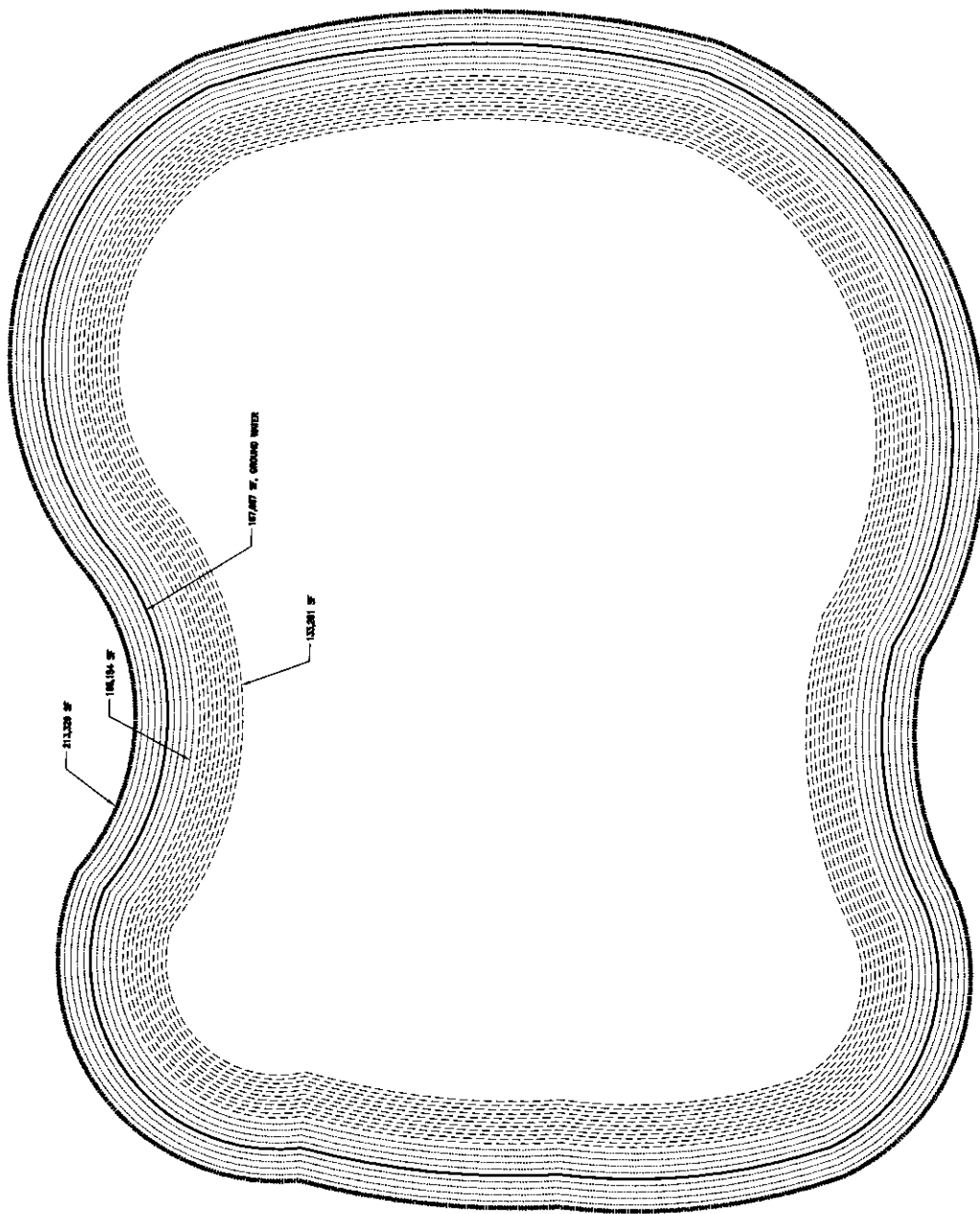
SURFACE AREA: 125,281 SF
 VOLUME: 39.10 AF
 DEPTH: 20'

$$V_5 = 10' \left(\frac{125,281 \text{ SF} + 80,651 \text{ SF}}{2} \right) + 10' \left(\frac{80,651 \text{ SF} + 54,093 \text{ SF}}{2} \right)$$

$$V_5 = 1,703,380 \text{ CF} = 12.74 \text{ MGAL}$$

$$V_{GW5} = 1,703,380 \text{ CF} - 4.5' \left(\frac{125,281 \text{ SF} + 104,498 \text{ SF}}{2} \right)$$

$$V_{GW5} = 1,186,377 \text{ CF} = 8.87 \text{ MGAL}$$



POND 6
 SURFACE AREA: 213,329 SF
 VOLUME: 78.39 AF
 DEPTH: 20'

$$V_6 = 10' \left(\frac{213,329 \text{ SF} + 168,154 \text{ SF}}{2} \right) + 10' \left(\frac{168,154 \text{ SF} + 133,281 \text{ SF}}{2} \right)$$

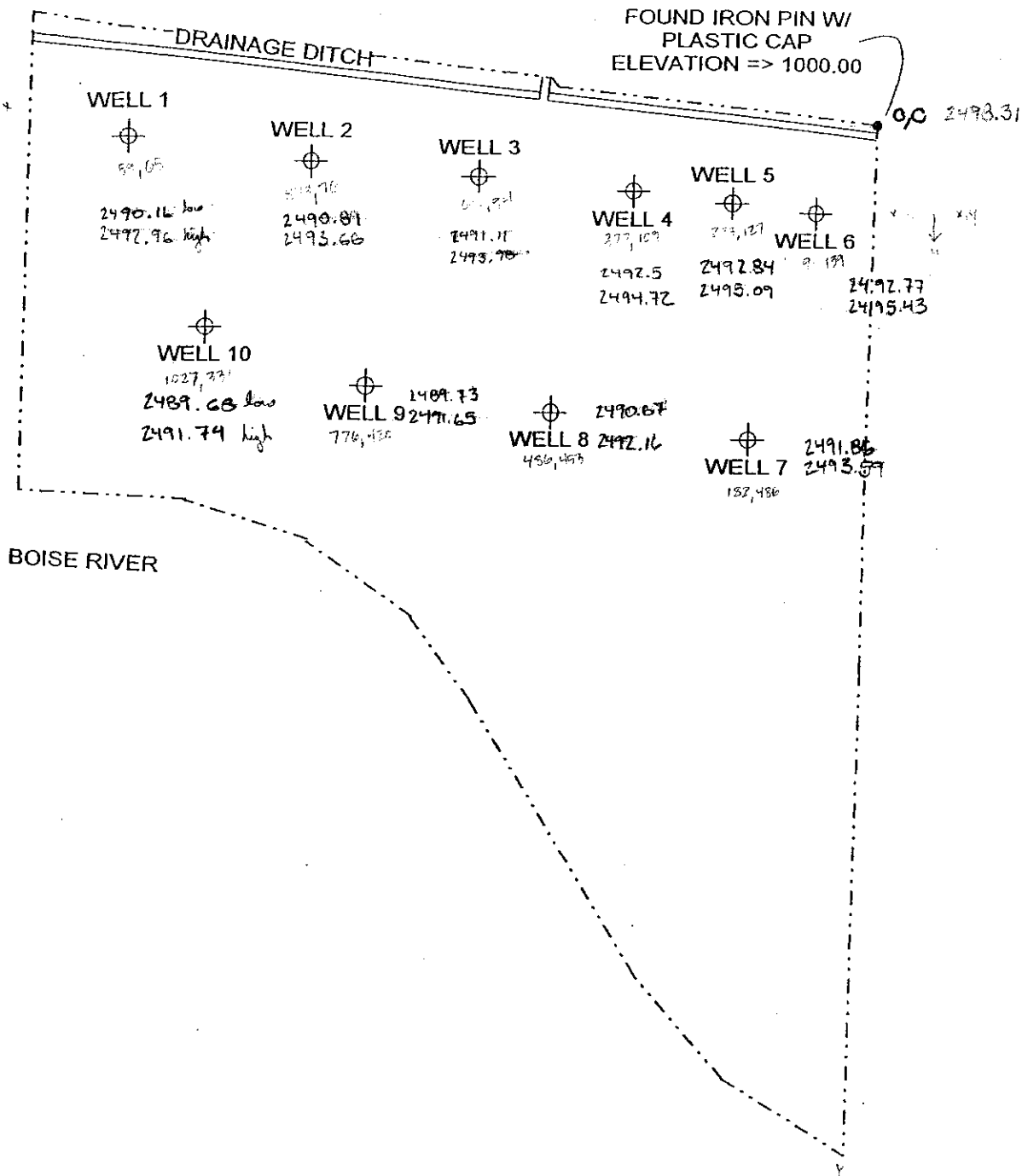
$$V_6 = 3,414,590 \text{ CF} = 25.54 \text{ MGAL}$$

$$V_{\text{GW6}} = 3,414,590 \text{ CF} - 5' \left(\frac{213,329 \text{ SF} + 187,667 \text{ SF}}{2} \right)$$

$$V_{\text{GW6}} = 2,412,100 \text{ CF} = 18.04 \text{ MGAL}$$

01260/3.00

Site Plan with Well Locations



Legend



APPROXIMATE SCALE

1 INCH = 263 FEET



**Materials
Testing &
Inspection**

7446 West Lemhi Street
BOISE, IDAHO 83709
(208) 376-4748 FAX (208) 322-6515
E-MAIL: mti@mti-id.com

Preliminary Nutrient Pathogen Study
Moon Valley Road
Eagle, Idaho
Drawing NO. B99706geo
Date: 7 February 2000
Drawn By: PBD

PROJECT: Rivervine Subdivision
LOCATION: 7011 Moon Valley Road

LOGGED BY: Vaughn Thurgood
EXCAVATION EQUIPMENT:
DATE OF EXCAVATION: September 6, 2002
WATER LEVEL (depth/date): 2.9 ft on 9/6/02

TEST PIT LOG NO. TP-21
AMERICAN
GEO
TECHNICS

DEPTH (ft.)	SAMPLE		DESCRIPTION	REMARKS
	TYPE - No.	SYMBOL		
0			Silty Sand with Gravel (SM)- About 60% fine to medium sand; about 20% fine to coarse, rounded gravel to 2"; about 20% non-plastic fines; dry; brown.	(Stratification lines represent approximate boundaries between materials.)
1				
2			Poorly Graded Gravel with Sand (GP)- About 60% fine to coarse, hard, rounded gravel to 3"; about 40% fine to coarse, subangular sand; moist to wet; gray to dark gray.	
3				Groundwater encountered at 2.9 feet on 9/6/02.
4				
5			Bottom of pit at 5.0 feet.	
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

PROJECT: Rivervine Subdivision
LOCATION: 7011 Moon Valley Road

LOGGED BY: Vaughn Thurgood
EXCAVATION EQUIPMENT:
DATE OF EXCAVATION: September 6, 2002

WATER LEVEL (depth/date): 2.9 ft on 9/6/02

TEST PIT LOG NO. TP-22
A M E R I C A N
GEO
T E C H N I C S

DEPTH (ft.)	SAMPLE		DESCRIPTION	REMARKS
	TYPE - No.	SYMBOL		
0			Silty Sand (SM)- About 85% fine to medium sand; about 15% non-plastic fines; moist to wet; brown.	(Stratification lines represent approximate boundaries between materials.)
1				
2				
3			Poorly Graded Gravel with Sand and Cobbles (GP)- About 55% fine to coarse, hard, rounded gravel to 3"; about 45% fine to coarse, subangular sand; by volume about 10% rounded cobbles to 8"; wet; gray.	Groundwater encountered at 2.9 feet on 9/ 6/02.
4				
5				
6			Bottom of pit at 5.5 feet.	
7				
8				
9				
10				
11				
12				
13				
14				
15				

PROJECT: Rivervine Subdivision
 LOCATION: 7011 Moon Valley Road

LOGGED BY: Vaughn Thurgood
 EXCAVATION EQUIPMENT:
 DATE OF EXCAVATION: September 6, 2002

WATER LEVEL (depth/date): 5.2 ft on 9/6/02

TEST PIT LOG NO. TP-20
 AMERICAN
GEO
 TECHNICS

DEPTH (ft.)	SAMPLE		DESCRIPTION	REMARKS
	TYPE - No.	SYMBOL		
0			Sandy Lean Clay (CL)- About 60% low to medium plasticity fines; about 40% fine to medium sand; dry; brown.	(Stratification lines represent approximate boundaries between materials.) Soils were sluffing significantly.
1				
2			Poorly Graded Gravel with Sand (GP)- About 60% fine to coarse, hard, rounded gravel to 2"; about 40% fine to coarse, subangular sand; dry; gray.	
3			Poorly Graded Sand (SP)- Medium to coarse, angular sand; trace of fines; moist to wet; orange-brown.	
4				Groundwater encountered at 5.2 feet on 9/6/02.
5				
6			Poorly Graded Gravel with Sand (GP)- About 55% fine to coarse, hard, rounded gravel to 3"; about 45% fine to coarse, subangular sand; wet; gray.	
7			Bottom of pit at 7.0 feet.	
8				
9				
10				
11				
12				
13				
14				
15				

APPENDIX B

Acres to Dry Up for Pond 1

[illegible]

Gross Irrigation Requirement = Net IR/IE
IRa = IRn/IE

2.78
and 1

CSHQ, Civil Engineering
T:\01260\01260_10C (Phase I)\Doc\Civil Design\DWG\Waterbudget_july04.xls

Water Balance for Phase I: Pond 2: 1.37 Acres of the Proposed Rivervine Subdivision

Irrigation Season:		April	May	June	July	August	September	October	November	Totals
Month	Days	15	31	30	31	31	30	31	15	214
Precipitation* (in/month)		1.21	1.28	0.89	0.27	0.3	0.6	0.79	1.35	6.690
Precipitation (in/day)		0.040	0.041	0.030	0.009	0.010	0.020	0.025	0.045	0.220
Pan Evaporation** (in/month)		5.62	7.06	8.78	10.55	9.37	6.54	4.57	0.00	52.490
Pan Evaporation (in/day)		0.187	0.228	0.293	0.340	0.302	0.218	0.147	0.000	1.716
Cp*** (Pan Coefficient)		0.730	0.730	0.730	0.730	0.730	0.730	0.730	0.730	5.840
Evaporation (Pan Evap * Cp, in/month)		4.103	5.154	6.409	7.702	6.840	4.774	3.336	0.000	38.318
Evaporation (in/day)		0.137	0.166	0.214	0.248	0.221	0.159	0.108	0.000	1.252
Loss (Evap. - Precip., in/day)		0.096	0.125	0.184	0.240	0.211	0.139	0.082	-0.045	1.032
Pond Surface Area (Acres)		1.370	1.370	1.370	1.370	1.370	1.370	1.370	1.370	N/A
Q _{loss} (Loss Pond Area, gpm)		2.490	3.227	4.751	6.191	5.448	3.593	2.121	-1.162	26.659
Q _{loss} (cfs)		0.006	0.007	0.011	0.014	0.012	0.008	0.005	-0.003	0.059

***Coefficient Value obtained from Fig. 14-4 "Hydrologic Analysis and Design", Richard McCuen

Water Balance Assumes that the Pond Surface Elevation will equal ground water elevation

1 Pioneer Canal Water Share = 9.00 gpm (According to the Pioneer Ditch Company's definition of a water share)

9 gpm = 0.02 cfs

		Boise WSO AP Consumptive Use from Allen and Brockway 83											
		** Monthly average daily (mm/day) and Seasonal Totals (mm) **											
		Mar			Apr			May			Jun		
		mm/d	in/d	mm/d	mm/d	in/d	mm/d	mm/d	in/d	mm/d	mm/d	in/d	mm/d
Etr	2.17	0.085433071	4.29	0.168897638	5.91	0.232677165	7.65	0.301181102	8.29	0.326378	6.72	0.264567	5.24
STDEV Etr	0.31	0.012204724	0.38	0.01498063	0.46	0.018110236	0.47	0.018503937	0.32	0.012598	0.4	0.015748	0.44
Alfalfa Hay													
MEAN CU	0.76	0.02982126	3.76	0.148031496	5.41	0.212992126	6.61	0.26023622	6.73	0.264961	5.11	0.201181	3.68
MEAN IR	0.22	0.008661417	2.93	0.115354331	4.63	0.182283465	5.86	0.230708661	6.56	0.258268	4.84	0.190551	3.33
STDEV CU	0.11	0.004330709	0.32	0.012598425	0.42	0.016535433	0.41	0.016141732	0.26	0.010236	0.3	0.011811	0.31
STDEV IR	0.32	0.012598425	0.64	0.02519685	0.75	0.029527559	0.76	0.02992126	0.31	0.012205	0.57	0.022441	0.59
Irrigation Efficiency (IE):													
From Handbook of Applied Hydrology, Chow et al.													
Assume Flood Irrigation, Level Borders													
Gross Irrigation Requirement = Net IR/IE													
IRg = IR/IE													
Total Gross Irrigation Requirement for Previous Use of Pond 2 Area as Irrigated Alfalfa (cfs)													
Month	Days	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Totals		
IRg (in/day)	15	0.1154	0.1823	0.2307	0.2583	0.2583	0.1906	0.1311	0.0409	0.0409	214		
IRg (ac-in)	1.73	5.65	6.92	8.01	8.01	8.01	5.91	3.93	1.27	1.27	35.39		
IRg (ac-ft)	0.14	0.47	0.58	0.67	0.67	0.67	0.49	0.33	0.11	0.05	2.95		
Acres to Dry Up for Pond 2													

Irrigation Efficiency (IE): 60%

From Handbook of Applied Hydrology, Chow et al.

Assume Flood Irrigation, Level Borders

Gross Irrigation Requirement = Net IR/IE

IRg = IR/IE

Total Gross Irrigation Requirement for Previous Use of Pond 2 Area as Irrigated Alfalfa (cfs)

Month	Days	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Totals
IRg (in/day)	15	0.1154	0.1823	0.2307	0.2583	0.2583	0.1906	0.1311	0.0409	0.0409	214
IRg (ac-in)	1.73	5.65	6.92	8.01	8.01	8.01	5.91	3.93	1.27	1.27	35.39
IRg (ac-ft)	0.14	0.47	0.58	0.67	0.67	0.67	0.49	0.33	0.11	0.05	2.95

Acres to Dry Up for Pond 2 1.28

Water Balance for Phase II: Pond 3: 1.31 Acres of the Proposed Rivervine Subdivision

Irrigation Season:		April	May	June	July	August	September	October	November	Totals
Month	Days	15	31	30	31	31	30	31	15	214
Precipitation* (in/month)		1.21	1.28	0.89	0.27	0.3	0.6	0.79	1.35	6.890
Pan Evaporation** (in/month)		0.040	0.041	0.030	0.009	0.010	0.020	0.025	0.045	0.220
Pan Evaporation*** (in/month)		5.62	7.06	8.78	10.55	9.37	6.54	4.57	0.00	52.490
Cp*** (Pan Coefficient)		0.730	0.730	0.293	0.340	0.302	0.218	0.147	0.000	1.716
Evaporation (Pan Evap. Cp. in/month)		4.103	5.154	6.409	7.702	6.840	4.774	3.336	0.000	38.318
Evaporation (in/month)		0.137	0.166	0.214	0.248	0.221	0.159	0.108	0.000	1.252
Loss (Evap. - Precip. in/day)		0.096	0.125	0.184	0.240	0.211	0.139	0.082	-0.045	1.032
Pond Surface Area (Acres)		1.310	1.310	1.310	1.310	1.310	1.310	1.310	1.310	N/A
Q _{loss} (Loss*Pond Area, gpm)		2.381	3.086	4.543	5.920	5.210	3.436	2.028	-1.111	25.492
Q _{loss} (cfs)		0.005	0.007	0.010	0.013	0.012	0.003	0.005	-0.002	0.057

***Coefficient Value obtained from Fig. 14-4 "Hydrologic Analysis and Design", Richard McCuen

Water Balance Assumes that the Pond Surface Elevation will equal ground water elevation

1 Pioneer Canal Water Share = 9.00 gpm (According to the Pioneer Ditch Company's definition of a water share)

9 gpm = 0.02 cfs

		Boise WSO AP Consumptive Use from Allen and Brockway 83											
		** Monthly average daily (mm/day) and Seasonal Totals (mm) **											
		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total			
		mm/d	in/d	mm/d	in/d	mm/d	in/d	mm/d	in/d	mm	in	mm	in
Elr	2.17	0.085433071	0.18897638	5.91	0.232677165	7.65	0.301181102	8.29	0.326378	0.133071	1335	52.55906	
MEAN Elr	0.31	0.012204724	0.01496063	0.46	0.018110236	0.47	0.018503937	0.32	0.012598	0.012598	35	1.377953	
STDEV Elr													
Alfalfa Hay													
MEAN CU	0.76	0.02992126	0.148031496	5.41	0.212992126	6.61	0.26023622	6.73	0.264951	0.057087	1021	40.19685	
MEAN IR	0.22	0.008661417	0.115354331	4.63	0.182283465	5.86	0.230708661	6.56	0.258268	0.131102	899	35.3937	
STDEV CU	0.11	0.004330709	0.012598425	0.42	0.016535433	0.41	0.016141732	0.26	0.010236	0.011811	27	1.052992	
STDEV IR	0.32	0.012598425	0.02519685	0.75	0.029527559	0.76	0.02992126	0.31	0.012205	0.022441	47	1.850394	

Irrigation Efficiency (IE): 60%

From Handbook of Applied Hydrology, Chow et al.

Assume Flood Irrigation, Level Borders

Gross Irrigation Requirement = Net IR/IE
IRg = IRn/IE

Total Gross Irrigation Requirement for Previous Use of Pond 3 Area as Irrigated Alfalfa (cfs)		April	May	June	July	August	September	October	November	Totals
Month	Days	15	31	30	31	31	30	31	15	214
IRg (in/day)		0.1154	0.1823	0.2307	0.2563	0.1906	0.1311	0.0409	0.0409	35.39
IRg (ac-in)		1.73	5.65	6.92	8.01	5.91	3.93	1.27	0.61	2.95
IRg (ac-ft)		0.14	0.47	0.58	0.67	0.49	0.33	0.11	0.05	
Acres to Dry Up for Pond 3										1.22

Water Balance for Phase II: Pond 4: 3.49 Acres of the Proposed Rivervine Subdivision

Irrigation Season:											
Month	April	May	June	July	August	September	October	November	Totals		
Days	15	31	30	31	31	30	31	15	214		
Precipitation* (in/month)	1.21	1.28	0.89	0.27	0.3	0.6	0.79	1.35	6.690		
Precipitation (in/day)	0.040	0.041	0.030	0.009	0.010	0.020	0.025	0.045	0.220		
Pan Evaporation** (in/month)	5.62	7.06	8.78	10.55	9.37	6.54	4.57	0.00	52.490		
Pan Evaporation (in/day)	0.187	0.228	0.293	0.340	0.302	0.218	0.147	0.000	1.716		
Cp*** (Pan Coefficient)	0.730	0.730	0.730	0.730	0.730	0.730	0.730	0.730	5.840		
Evaporation (Pan Evap * Cp, in/month)	4.103	5.154	6.409	7.702	6.840	4.774	3.336	0.000	38.318		
Evaporation (in/day)	0.137	0.166	0.214	0.248	0.221	0.159	0.108	0.000	1.252		
Loss (Evap - Precip, in/day)	0.096	0.125	0.184	0.240	0.211	0.139	0.082	-0.045	1.032		
Pond Surface Area (Acres)	3.490	1.310	1.310	1.310	1.310	1.310	1.310	1.310	N/A		
Q _{loss} (Loss Pond Area, gpm)	6.343	3.086	4.543	5.920	5.210	3.436	2.028	-1.111	29.454		
Q_{net} (gpm)	0.014	0.007	0.010	0.013	0.012	0.008	0.006	-0.002	0.066		

***Coefficient Value obtained from Fig. 14-4 "Hydrologic Analysis and Design"; Richard McCuen

Water Balance Assumes that the Pond Surface Elevation will equal ground water elevation

1 Pioneer Canal Water Share = 9.00 gpm (According to the Pioneer Ditch Company's definition of a water share)

9 gpm = 0.02 cfs

Boise WSO AP Consumptive Use from Allen and Brockway 83																										
** Monthly average daily (mm/day) and Seasonal Totals (mm) **																										
Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Total		
	mm/d	in/d	mm/d	in/d	mm/d	in/d	mm/d	in/d	mm/d	in/d	mm/d	in/d	mm/d	in/d	mm/d	in/d	mm/d	in/d	mm/d	in/d	mm	in				
Eir	2.17	0.085433071	4.29	0.168857638	5.91	0.232677165	7.65	0.301181102	8.29	0.326378	6.72	0.264567	5.24	0.206299	3.38	0.133071	1335	52.55906								
MEAN Eir	0.31	0.012204724	0.38	0.01496063	0.46	0.018110236	0.47	0.018503937	0.32	0.012598	0.4	0.015748	0.44	0.017323	0.32	0.012598	35	1.377953								
STDV Eir																										
Alfalfa Hay																										
MEAN CU	0.76	0.02992126	3.76	0.148031496	5.41	0.212992126	6.61	0.26023622	6.73	0.264961	5.11	0.201181	3.68	0.144882	1.45	0.057087	1021	40.19665								
MEAN IR	0.22	0.008661417	2.93	0.115354331	4.63	0.182283465	5.86	0.230708661	6.56	0.259268	4.84	0.190551	3.33	0.131102	1.04	0.040945	899	35.3937								
STDV CU	0.11	0.004330709	0.32	0.01258425	0.42	0.016535433	0.41	0.016141732	0.26	0.010236	0.3	0.011811	0.31	0.012205	0.14	0.005512	27	1.062392								
STDV IR	0.32	0.01258425	0.64	0.02519685	0.75	0.029527559	0.76	0.02992126	0.31	0.012205	0.57	0.022441	0.59	0.023228	0.19	0.005512	47	1.850394								

Irrigation Efficiency (IE):

From Handbook of Applied Hydrology, Chow et al.

Assume Flood Irrigation, Level Borders

Gross Irrigation Requirement = Net IR/IE

IRg = IRn/IE

Total Gross Irrigation Requirement for Previous Use of Pond 3 Area as Irrigated Alfalfa (cfs)

Month	April	May	June	July	August	September	October	November	Totals
Days	15	31	30	31	31	30	31	15	214
IRg (in/day)	0.1154	0.1823	0.2307	0.2583	0.1906	0.1311	0.0409	0.0409	6.56
IRg (ac-in)	1.73	5.65	6.92	8.01	5.91	3.93	1.27	0.61	35.39
IRg (ac-ft)	0.14	0.47	0.58	0.67	0.49	0.33	0.11	0.05	2.95

Acres to Dry Up for Pond 4

3.26

Water Balance for Phase II: Pond 5: 2.88 Acres of the Proposed Rivervine Subdivision

Irrigation Season:		April	May	June	July	August	September	October	November	Totals
Month	Days	15	31	30	31	31	30	31	15	214
Precipitation* (in/month)	1.21	0.040	1.28	0.89	0.27	0.3	0.6	0.79	1.35	6.690
Pan Evaporation** (in/day)	5.62	0.041	0.041	0.030	0.009	0.010	0.020	0.025	0.045	0.220
Pan Evaporation*** (in/month)	0.187	7.06	7.06	8.78	10.55	9.37	6.54	4.57	0.00	52.490
Cp*** (Pan Coefficient)	0.730	0.228	0.228	0.293	0.340	0.302	0.218	0.147	0.000	1.716
Evaporation (Pan Evap * Cp, in/month)	4.103	0.730	0.730	0.730	0.730	0.730	0.730	0.730	0.000	5.840
Evaporation (in/day)	0.137	5.154	5.409	7.702	4.774	6.840	4.774	3.336	0.000	38.318
Loss (Evap - Precip, in/day)	0.096	0.166	0.214	0.248	0.221	0.159	0.159	0.108	0.000	1.252
Pond Surface Area (Acres)	2.880	0.125	0.184	0.240	0.240	0.211	0.139	0.082	-0.045	1.032
Q _{loss} (Loss Pond Area, gpm)	5.234	1.310	1.310	1.310	1.310	1.310	1.310	1.310	-1.111	28.345
Q _{loss} (cfs)	0.012	0.007	0.010	0.013	0.012	0.008	0.005	0.002	0.002	0.063

***Coefficient Value obtained from Fig. 14-4 "Hydrologic Analysis and Design", Richard McCuen

Water Balance Assumes that the Pond Surface Elevation will equal ground water elevation

1 Pioneer Canal Water Share = 9.00 gpm (According to the Pioneer Ditch Company's definition of a water share)

9 gpm = 0.02 cfs

		Boise WSO AP Consumptive Use from Allen and Brockway 83											
		**Monthly average daily (mm/day) and Seasonal Totals (mm) **											
		Mar			Apr			May			Jun		
		mm/d	in/d	mm/d	in/d	mm/d	in/d	mm/d	in/d	mm/d	in/d	mm/d	in/d
Eir	2.17	0.085433071	4.29	0.168897638	5.91	0.232677165	7.65	0.326378	6.72	0.264567	5.24	0.206299	3.38
STDV Eir	0.31	0.012204724	0.38	0.01496063	0.46	0.018110236	0.47	0.012598	0.4	0.015748	0.44	0.017323	0.32
Alfalfa Hay													
MEAN CU	0.76	0.02992126	3.76	0.148031496	5.41	0.212992126	6.61	0.264951	5.11	0.201181	3.68	0.144892	1.45
MEAN IR	0.22	0.008661417	2.93	0.115354331	4.63	0.182283465	5.86	0.258268	4.84	0.190551	3.33	0.131102	1.04
STDEV CU	0.11	0.004330709	0.32	0.012598425	0.42	0.016535433	0.41	0.010236	0.3	0.011811	0.31	0.012205	0.14
STDEV IR	0.32	0.012598425	0.64	0.02519685	0.75	0.029527559	0.76	0.012205	0.57	0.022441	0.59	0.023228	0.39
Irrigation Efficiency (IE):	60%												
From Handbook of Applied Hydrology, Chow et al.													
Assume Flood Irrigation, Level Borders													
Gross Irrigation Requirement = Net IR/IE													
IRg = IR/IE													
Total Gross Irrigation Requirement for Previous Use of Pond 3 Area as Irrigated Alfalfa (cfs)													
Month	April	May	June	July	August	September	October	November	Totals				
Days	15	31	30	31	31	30	31	15	214				
IRg (in/day)	0.1154	0.1823	0.2307	0.2583	0.1906	0.1311	0.0409	0.0409	21.4				
IRg (ac-in)	1.73	5.65	6.92	8.01	5.91	3.93	1.27	0.61	35.39				
IRg (ac-ft)	0.14	0.47	0.58	0.67	0.49	0.33	0.11	0.05	2.95				

Acres to Dry Up for Pond 5

2.69

Water Balance for Phase II: Pond 6: 4.90 Acres of the Proposed Rivervine Subdivision

Irrigation Season:		Month	April	May	June	July	August	September	October	November	Totals
		Days	15	31	30	31	31	30	31	15	214
Precipitation** (in/month)			1.21	1.28	0.89	0.27	0.3	0.6	0.79	1.35	6.890
Precipitation (in/day)			0.040	0.041	0.030	0.009	0.010	0.020	0.025	0.045	0.220
Pan Evaporation** (in/month)			5.62	7.06	8.78	10.55	9.37	6.54	4.57	0.00	52.490
Pan Evaporation (in/day)			0.187	0.228	0.293	0.340	0.302	0.218	0.147	0.000	1.716
Cp*** (Pan Coefficient)			0.730	0.730	0.730	0.730	0.730	0.730	0.730	0.730	5.840
Evaporation (Pan Evap * Cp, in/month)			4.103	5.154	6.409	7.702	6.840	4.774	3.336	0.000	38.318
Evaporation (in/day)			0.137	0.166	0.214	0.248	0.221	0.159	0.108	0.000	1.252
Loss (Evap - Precip, in/day)			0.096	0.125	0.184	0.240	0.211	0.139	0.082	-0.045	1.032
Pond Surface Area (Acres)			4.900	1.310	1.310	1.310	1.310	1.310	1.310	1.310	N/A
Q _{loss} (Loss * Pond Area, gpm)			8.908	3.086	4.543	5.920	5.210	3.436	2.028	-1.111	32.017
Q _{net} (%)			0.020	0.107	0.010	0.013	0.012	0.008	0.005	-0.002	0.071

***Coefficient Value obtained from Fig. 14-4 "Hydrologic Analysis and Design", Richard McCuen

Water Balance Assumes that the Pond Surface Elevation will equal ground water elevation

1 Pioneer Canal Water Share = 9.00 gpm (According to the Pioneer Ditch Company's definition of a water share)

9 gpm = 0.02 cfs

		Boise WSO AP Consumptive Use from Allen and Brockway 83											
		** Monthly average daily (mm/day) and Seasonal Totals (mm) **											
		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total	mm	in	
Eir	MEAN Eir	2.17	0.085433071	4.29	0.168897638	5.91	0.232677165	6.61	0.26023622	6.73	0.264961	5.11	0.201181
	STDEV Eir	0.31	0.012204724	0.38	0.01496063	0.46	0.018110236	0.47	0.016141732	0.26	0.012598	0.4	0.015748
Alfalfa Hay	MEAN CU	0.76	0.02992126	3.76	0.148031496	5.41	0.212992126	5.86	0.230708651	6.56	0.258268	4.84	0.190551
	STDEV CU	0.11	0.004330709	0.32	0.012598425	0.42	0.016535433	0.41	0.016141732	0.26	0.012598	0.3	0.011811
IRg	MEAN IR	0.22	0.008661417	2.93	0.115354331	4.63	0.182283465	5.96	0.230708651	6.56	0.258268	4.84	0.190551
	STDEV IR	0.32	0.012598425	0.64	0.02519685	0.75	0.029527559	0.76	0.02992126	0.31	0.012598	0.57	0.022441
Irrigation Efficiency (IE):		60%											
From Handbook of Applied Hydrology, Chow et al.													
Assume Flood Irrigation, Level Borders													
Gross Irrigation Requirement = Net IR/IE													
IRg = IR _{net} /IE													

Total Gross Irrigation Requirement for Previous Use of Pond 3 Area as Irrigated Alfalfa (cfs)		Month	April	May	June	July	August	September	October	November	Totals
		Days	15	31	30	31	31	30	31	15	214
IRg (in/day)			0.1154	0.1823	0.2307	0.2583	0.1906	0.1311	0.0409	0.0409	35.39
IRg (ac-in)			1.73	5.65	6.92	8.01	5.91	3.93	1.27	0.61	2.95
IRg (ac-ft)			0.14	0.47	0.58	0.67	0.49	0.33	0.11	0.05	2.95
Acres to Dry Up for Pond 6			4.57								

APPENDIX C

Boise WSO AP Consumptive Use from Allen and Brockway 83

** Monthly average daily (mm/day) and Seasonal Totals (mm) **

Mar Apr May Jun Jul Aug Sep Oct Total

ETr

MEAN ETr 2.17 4.29 5.91 7.65 8.29 6.72 5.24 3.38 1335.

STDEV ETr 0.31 0.38 0.46 0.47 0.32 0.40 0.44 0.32 35.

Alfalfa Hay

MEAN CU 0.76 3.67 5.41 6.61 6.73 5.11 3.68 1.45 1021.

MEAN IR 0.22 2.93 4.63 5.86 6.56 4.84 3.33 1.04 899.

STDEV CU 0.11 0.32 0.42 0.41 0.26 0.30 0.31 0.14 27.

STDEV IR 0.32 0.64 0.75 0.76 0.31 0.57 0.59 0.39 47.

Alfalfa Seed

MEAN CU 1.20 3.67 5.29 6.32 4.53 2.53 1.18 0.25 762.

MEAN IR 0.65 2.93 4.52 5.59 4.38 2.31 0.88 -0.13 645.

STDEV CU 0.17 0.32 0.41 0.39 0.18 0.15 0.10 0.02 24.

STDEV IR 0.35 0.64 0.74 0.74 0.24 0.41 0.39 0.32 44.

Dry Beans

MEAN CU 1.77 3.87 7.63 3.25 0.56 525.

MEAN IR 1.25 3.34 7.47 3.05 0.31 474.

STDEV CU 0.14 0.24 0.30 0.19 0.05 16.

STDEV IR 0.42 0.51 0.33 0.41 0.31 29.

Field Corn

MEAN CU 1.77 3.54 7.58 6.15 3.77 0.91 728.

MEAN IR 1.19 2.96 7.40 5.88 3.43 0.53 656.

STDEV CU 0.14 0.22 0.30 0.36 0.32 0.09 19.

STDEV IR 0.46 0.53 0.34 0.63 0.58 0.34 34.

Silage Corn

MEAN CU 1.77 3.54 7.58 6.15 3.77 700.

MEAN IR 1.19 2.96 7.40 5.88 3.43 640.

STDEV CU 0.14 0.22 0.30 0.36 0.32 19.

STDEV IR 0.46 0.53 0.34 0.63 0.58 37.

Sweet Corn

MEAN CU 1.77 3.54 7.48 5.83 574.

MEAN IR 1.19 2.96 7.30 5.56 524.

STDEV CU 0.14 0.22 0.29 0.34 18.

STDEV IR 0.46 0.53 0.34 0.61 32.

Peas

MEAN CU 1.38 4.13 5.43 2.09 397.

MEAN IR 0.82 3.50 4.82 1.98 338.

STDEV CU 0.12 0.32 0.34 0.08 15.

STDEV IR 0.41 0.60 0.63 0.16 33.

Potatoes

MEAN CU 1.29 2.18 5.81 6.90 5.03 2.64 729.

MEAN IR 0.81 1.71 5.28 6.76 4.83 2.40 667.

STDEV CU 0.11 0.17 0.36 0.27 0.30 0.22 20.

STDEV IR 0.35 0.40 0.59 0.29 0.48 0.41 36.

Sugar Beets

MEAN CU 1.29 1.79 4.18 8.16 6.52 4.42 2.07 871.

MEAN IR 0.66 1.19 3.55 7.98 6.23 4.07 1.66 777.

STDEV CU 0.11 0.14 0.26 0.32 0.39 0.37 0.20 21.

STDEV IR 0.44 0.47 0.58 0.36 0.66 0.64 0.43 40.

Spring Grain

MEAN CU 0.65 1.39 4.77 7.64 6.52 1.27 680.

MEAN IR 0.20 0.84 4.13 6.95 6.37 1.09 598.

STDEV CU 0.09 0.12 0.37 0.47 0.25 0.07 23.

STDEV IR 0.27 0.40 0.64 0.77 0.29 0.29 40.

Winter Grain

MEAN CU 1.24 4.12 5.91 7.65 5.23 1.05 769.

MEAN IR 0.73 3.40 5.16 6.91 5.09 0.86 675.

STDEV CU 0.18 0.36 0.46 0.47 0.20 0.06 27.

STDEV IR 0.34 0.65 0.76 0.80 0.25 0.30 47.

Pasture

MEAN CU 0.86 3.29 4.55 5.89 6.38 5.17 4.04 2.60 1003.

MEAN IR	0.35	2.59	3.85	5.21	6.22	4.91	3.70	2.19	887.
STDEV CU	0.12	0.29	0.35	0.36	0.25	0.31	0.34	0.25	25.
STDEV IR	0.31	0.59	0.66	0.69	0.30	0.56	0.60	0.47	43.
Orchard									
MEAN CU		1.84	3.81	6.31	7.04	5.71	4.32	2.09	952.
MEAN IR		1.20	3.14	5.61	6.87	5.44	3.97	1.69	854.
STDEV CU		0.16	0.30	0.39	0.28	0.34	0.36	0.20	24.
STDEV IR		0.48	0.60	0.72	0.32	0.60	0.63	0.43	42.
Vegetables									
MEAN CU			1.80	4.00	6.38	5.34	3.58		647.
MEAN IR			1.35	3.54	6.25	5.14	3.32		600.
STDEV CU			0.14	0.25	0.25	0.32	0.30		18.
STDEV IR			0.37	0.47	0.27	0.50	0.49		30.
Onions									
MEAN CU		1.39	2.94	5.05	6.51	5.37	4.05		774.
MEAN IR		0.91	2.45	4.55	6.38	5.17	3.78		711.
STDEV CU		0.12	0.23	0.31	0.25	0.32	0.34		21.
STDEV IR		0.36	0.45	0.54	0.27	0.50	0.53		36.
Hops									
MEAN CU		1.34	4.14	7.26	7.87	6.37	4.72		969.
MEAN IR		0.73	3.46	6.51	7.69	6.09	4.36		882.
STDEV CU		0.12	0.32	0.45	0.31	0.38	0.40		27.
STDEV IR		0.44	0.63	0.79	0.35	0.64	0.66		49.

End of Data Set

This page provides access to crop evapotranspiration and irrigation water requirement information for various weather stations from Appendix E of the University of Idaho report: "Estimating Consumptive Irrigation Requirements for Crops in Idaho" published in 1983 by R. G. Allen and C. E. Brockway. This report is a Research Technical Completion Report submitted to Idaho Department of Water Resources. Appendix E was not published with the report for general distribution. A copy of Appendix E is on file with IDWR.

The data forms retrieved via this procedure are an inverted copy of the original tables contained within the appendix to be conducive for import into spreadsheets. Additionally, the columns referencing the number of years in the historical record and precipitation are not included, nor are the estimates of the distribution skewness. To retrieve the data, please select a location from the following selection list and press the retrieve button.

Select location:

Brief background on the report "Estimating Consumptive Irrigation Requirements for Crops in Idaho"
R.G. Allen and C.E. Brockway
University of Idaho
August, 1983

The FAO-modified Blaney-Criddle (FAO-BC) method (Doorenbos and Pruitt, 1977) was used as the basis for the 1983 report for estimating consumptive use on a statewide basis for Idaho, based on accuracy and responsiveness of the equation and the primary data requirement of air temperature, only. The originally grass-based FAO-BC method was converted into an alfalfa-reference method by multiplying by conversion ratios developed using Kimberly lysimeter data and the Kimberly Penman equation. These ratios were found to be transferable to other Idaho sites. Following conversion to an alfalfa reference method, the FAO-BC calculated reference ET was multiplied by alfalfa-based crop coefficients by Wright (1981). These Kc's include impacts of evaporation from wet soil due to irrigation and rainfall.

The FAO-BC method application utilized wind, humidity and solar radiation data from seven regional locations in Idaho. A ten percent upward adjustment to FAO-BC estimates per 1000 meters elevation as suggested by Pruitt (Doorenbos and Pruitt, 1977) was found to be necessary in Idaho and was applied.

NOAA weather stations throughout Idaho were objectively rated according to the degree of station aridity and environmental effects on air temperatures. Mean monthly temperatures at each NOAA site were adjusted downward according to the station aridity rating and maximum aridity effects. Monthly statistics were computed for consumptive use for 98 weather sites in Idaho using the calibrated FAO-BC with elevation correction and alfalfa/FAO-BC reference ratios.

Parameters in the tables are defined as follow:

MEAN CU	Mean monthly consumptive use over the historical period of record for the station. Units are mm/day for monthly values and mm per season for the growing season period. CU is synonymous with crop evapotranspiration.
MEAN IR	Mean net irrigation requirement for the historical period of record for the station. Units are mm/day for monthly values and mm per season for the growing season period. IR was calculated as $IR = CU - Pe$ where Pe is effective precipitation, calculated in the 1983 study as $Pe = 0.7 P$. IR must be divided by irrigation efficiency to obtain the gross irrigation water requirement.
STDEV CU	Standard deviation of monthly consumptive use by month or of seasonal consumptive use over the historical period of record for the station. Units are mm/day for monthly values and mm per season for the growing season period.
STDEV IR	Standard deviation of monthly IR by month or of seasonal IR over the historical period of

	record for the station. Units are mm/day for monthly values and mm per season for the growing season period.
--	--

Mat Weaver

From: Reed DeMordaunt [reed@demordaunt.com]
Sent: Saturday, April 05, 2003 1:49 PM
To: Mat Weaver
Subject: Agriculture use of the land

Mat,

In regards to the agricultural use of my property during at least the last 15 years. I can tell you that the crop has been exclusively alfalfa. My guess is that been alfalfa for a considerable amount of time before that has well.

Thanks,
Reed



BOISE WSFO AIRPORT, IDAHO (101022)**Period of Record Monthly Climate Summary****Period of Record : 1/ 1/1940 to 12/31/2001**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	36.8	44.3	52.8	61.7	71.0	79.6	90.2	88.3	77.6	64.8	48.4	38.4	62.8
Average Min. Temperature (F)	21.9	27.4	31.7	37.2	44.3	51.5	58.1	57.0	48.7	39.3	30.5	23.7	39.3
Average Total Precipitation (in.)	1.44	1.16	1.23	<u>1.21</u> 2	1.28	0.89	0.27	0.30	0.60	0.79	<u>1.35</u> 2	1.36	11.88
Average Total SnowFall (in.)	6.4	3.6	1.7	0.6	0.1	0.0	0.0	0.0	0.0	0.1	2.2	5.7	20.5
Average Snow Depth (in.)	1	0	0	0	0	0	0	0	0	0	0	1	0

Percent of possible observations for period of record.

Max. Temp.: 99.9% Min. Temp.: 99.9% Precipitation: 99.9% Snowfall: 99.9% Snow Depth: 98%

Check [Station Metadata](#) or [Metadata graphics](#) for more detail about data completeness.

Western Regional Climate Center, wrcc@dri.edu

IDAHO

ANNUAL PRECIPITATION SUMMARY
(Inches)

	PERIOD OF RECORD	MEAN	PRECIPITATION				MAX DAY	YEAR
			MAX YEAR	YR	MIN YEAR	YR		
ABERDEEN EXPERIMNT STN	1914-2000	8.83	14.07	80	4.87	39	2.41	19521
AMERICAN FALLS 1 SW	1948-2000	11.30	21.88	83	4.64	66	2.06	19870
ANDERSON DAM	1948-2000	19.38	35.45	70	12.82	49	2.18	19641
ARBON 2 NW	1962-2000	16.22	31.55	83	10.01	92	3.20	19641
ARCO 3 SW	1948-2000	9.76	15.33	68	6.31	56	2.44	19850
ARROWROCK DAM	1916-2000	18.86	30.10	83	12.32	66	2.20	19530
ASHTON	1948-2000	19.41	29.27	82	12.51	53	2.61	19820
ATLANTA	1955-1975	28.51	36.25	70	24.33	74	2.78	19641
ATLANTA 1 E	1948-1955	33.19	39.53	51	28.24	54	11.14	19520
AVERY RANGER STN	1913-1968	32.39	44.72	64	21.09	44	3.25	19231
AVERY RANGER STN 2	1968-2000	38.07	47.60	75	23.42	87	2.80	19771
BAYVIEW MODEL BASIN	1948-2000	24.33	34.30	96	16.90	91	2.02	19550
BERN	1992-2000	17.96	21.66	96	13.65	94	1.43	19930
BIG CREEK 1 S	1948-1970	28.92	36.05	55	16.28	52	2.62	19641
BLACKFOOT 2 SSW	1948-2000	10.07	23.09	63	5.78	56	2.07	20000
BLISS 4 NW	1931-2000	9.45	18.10	70	4.17	39	2.00	19831
BOISE 7 N	1973-2000	19.38	28.76	83	11.85	87	2.28	19760
BOISE LUCKY PEAK DAM	1951-2000	13.74	19.62	80	6.97	54	2.41	19530
BOISE WSFO AIRPORT	1940-2000	11.88	18.77	83	6.64	66	1.91	19580
BONNERS FERRY	1907-2000	22.49	34.01	50	10.93	44	2.80	19990
BROWNLEE DAM	1966-2000	17.26	26.00	70	11.30	87	1.70	19980
BRUNEAU	1962-2000	7.57	12.84	70	3.67	92	1.80	19710
BUHL	1948-1963	7.90	9.79	57	5.31	60	1.90	19530
BUHL 2	1978-2000	9.58	14.29	95	5.54	92	1.38	19880
BURKE 2 ENE	1948-1967	48.88	67.05	50	26.17	52	2.82	19570
BURLEY	1948-1967	8.82	13.73	64	6.02	66	1.46	19641
BURLEY FACTORY	1948-1955	8.74	11.62	50	5.92	54	0.97	19500
BURLEY FAA AP	1948-2000	10.07	15.77	98	5.74	66	1.75	19641
CABINET GORGE	1956-2000	32.33	41.75	95	22.45	85	2.77	19920
CALDWELL	1904-1997	10.60	17.36	80	5.13	49	2.50	19130
CAMBRIDGE	1931-2000	20.12	32.78	40	11.70	35	2.60	19560
CAMPBELLS FERRY	1976-1985	24.02	29.44	82	20.58	85	2.17	19771
CASCADE 1 NW	1948-2000	22.24	37.00	96	14.05	76	2.73	19641
CASTLEFORD 2 N	1963-2000	10.40	17.28	70	4.90	99	3.01	19701
CENTERVILLE ARBAUGH RAN	1949-2000	28.04	46.83	96	16.56	66	2.28	19551
CHALLIS	1931-1996	7.40	11.98	95	2.62	35	1.85	19830
CHILLY BARTON FLAT	1948-2000	8.27	13.02	51	3.87	60	2.16	19650
CLARK FORK 1 ENE	1948-1956	35.58	44.05	50	33.15	49	9.35	19540
CLARKIA RANGER STN	1950-1975	38.82	47.74	71	29.85	69	2.25	19641
COBALT	1961-1986	17.49	24.38	75	10.29	85	1.67	19710
COBALT BLACKBIRD MINE	1951-1960	21.44	25.20	55	16.09	52	1.52	19560
COEUR D ALENE 1 E	1895-2000	25.41	35.55	27	15.18	29	3.50	19980
CONDA	1948-1978	18.91	29.71	71	13.35	62	2.07	19550
COTTONWOOD	1948-1976	19.70	28.30	75	12.16	74	2.05	19580
COTTONWOOD 2 WSW	1950-2000	22.46	30.06	95	15.44	87	2.10	19820
COUNCIL	1948-2000	24.73	39.75	64	19.73	76	4.10	19820
CRAIGMONT	1950-1996	21.58	29.83	95	15.85	87	1.62	19900
CRATERS OF THE MOON NM	1958-2000	15.58	22.11	69	9.45	74	2.98	19690
CROUCH 2 NNW	1948-1956	27.72	37.17	51	18.43	49	2.65	19530
DEADWOOD DAM	1929-1975	32.26	49.82	70	20.02	30	3.07	19411

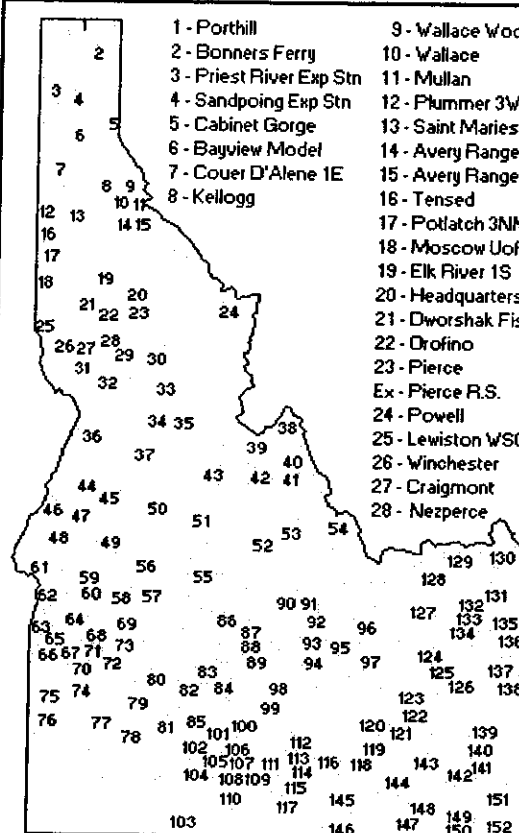
DEADWOOD DAM 15 N	1980-1989	44.40	50.45	84	48.59	81	2.70	19820
DEER FLAT DAM	1916-2000	9.91	15.73	83	5.60	66	1.47	19790
DEER POINT	1954-1970	19.56	24.07	57	15.49	61	2.10	19590
DIXIE	1952-2000	28.54	44.23	64	13.57	91	2.82	19971
DRIGGS	1930-2000	15.66	24.96	45	8.58	58	2.20	19450
DUBOIS EXPERIMENT STN	1925-2000	12.01	21.34	95	5.62	26	2.60	19440
DUBOIS FAA AIRPORT	1948-1962	9.47	11.71	52	6.28	56	1.38	19520
DWORSHAK FISH HATCHERY	1966-2000	25.59	36.55	96	18.03	92	2.21	19771
ELK CITY RANGER STN	1950-2000	30.18	49.84	75	19.70	87	2.99	19771
ELK RIVER 1 S	1952-2000	37.55	56.14	64	24.65	52	3.32	19991
EMMETT 2 E	1948-2000	13.45	20.20	83	6.29	66	2.47	19590
FAIRFIELD R S	1948-2000	15.41	26.79	83	9.50	66	2.38	19641
FAIRFIELD 3 SE	1978-1998	12.55	18.86	95	7.39	92	1.25	19961
FENN RANGER STN	1948-2000	38.11	58.04	75	21.10	52	2.50	19840
FORT HALL INDIAN AGENCY	1948-2000	11.26	17.45	80	6.89	66	1.66	19840
GALENA	1963-1996	24.74	32.70	67	15.06	66	2.75	19800
GARDEN VALLEY R S	1948-2000	24.51	46.75	96	15.15	66	3.36	19820
GIBBONSVILLE	1963-2000	16.19	26.43	64	9.22	87	1.50	19771
GLENNS FERRY	1948-2000	9.58	18.83	70	5.91	92	1.66	19900
GOODING 2 S	1948-1997	9.36	18.76	95	5.91	49	1.43	19590
GRACE	1907-2000	14.84	22.74	82	8.65	35	2.09	19120
GRAND VIEW 2 W	1933-2000	6.97	9.82	38	0.36	49	1.74	19350
GRANGEVILLE	1948-2000	23.79	32.67	75	15.09	74	3.01	19550
GRANGEVILLE 11 SE	1964-1989	26.28	38.13	75	20.30	74	2.55	19870
GRASMERE	1953-1974	8.28	14.02	63	6.62	59	1.69	19680
GRAY	1948-1955	13.89	18.17	51	13.29	52	1.05	19500
GREENCREEK 3 N	1964-1972	18.43	21.03	70	15.70	69	0.98	19650
GROUSE	1948-2000	12.75	20.84	82	5.06	53	1.90	19551
HAGERMAN 2 SW	1982-2000	10.69	15.59	83	6.77	92	1.19	19961
HAILEY 3 NNW	1948-1988	15.89	26.34	64	10.96	74	2.68	19641
HAMER 4 NW	1948-2000	9.03	14.53	83	4.66	53	2.11	19630
HAZELTON	1948-2000	10.08	17.31	83	4.30	66	1.52	19751
HEADQUARTERS	1959-2000	40.08	56.14	96	30.83	79	2.30	19960
HENRY	1971-1987	20.38	30.28	83	17.65	81	1.80	19850
HILL CITY 1 W	1931-2000	14.57	24.60	70	6.67	39	2.49	19421
HOLLISTER	1948-2000	10.26	17.68	63	6.17	74	1.58	19880
HOMEDALE 1 SE	1990-2000	8.17	6.89	97	6.89	97	0.88	19931
HOWE	1948-2000	8.38	12.13	68	4.47	56	2.50	19610
IDAHO CITY	1931-2000	23.86	36.94	83	12.54	35	3.80	19371
IDAHO CITY 11 SW	1948-1963	27.85	36.63	51	20.64	52	2.68	19530
IDAHO FALLS 2 ESE	1952-2000	12.25	19.63	83	5.60	66	1.73	19980
IDAHO FALLS 16 SE	1955-2000	15.67	21.24	82	9.98	56	2.19	19930
IDAHO FALLS FAA ARPT	1948-1994	10.11	15.83	80	5.53	59	1.73	19930
IDAHO FALLS 43 NW WB	1954-1969	8.50	15.60	63	4.37	56	1.78	19630
IDAHO FALLS 46 W	1954-2000	8.92	14.40	63	4.50	66	1.64	19690
IRWIN 2 SE	1948-1960	15.26	19.43	55	11.49	56	1.70	19590
ISLAND PARK	1937-2000	28.96	42.90	70	18.43	90	3.12	19820
JEROME	1919-2000	10.31	17.98	95	4.85	66	1.66	19610
KAMIAH	1948-2000	23.77	31.58	75	16.54	87	1.93	19970
KELLOGG	1905-2000	30.74	47.99	96	19.08	52	4.00	19871
KETCHUM RANGER STN	1973-2000	18.94	27.95	83	10.94	92	2.76	19950
KILGORE	1960-1977	21.13	27.11	70	14.21	74	1.57	19721
KOOSKIA	1908-1987	24.24	36.68	27	15.75	36	2.13	19800
KOOSKIA 5 SSE	1989-2000	25.58	32.08	98	19.79	91	1.67	19980
KUNA 2 NNE	1948-1996	9.83	14.62	81	4.33	66	1.59	19760
LEADORE 2	1965-2000	8.05	10.67	77	3.67	66	1.76	19680
LEWISTON WATER PLANT	1948-1955	12.31	17.77	50	9.98	49	1.45	19550
LEWISTON WSO AP	1948-2000	12.78	18.72	50	8.52	74	1.80	19980
LIFTON PUMPING STN	1935-2000	10.70	19.17	82	4.36	88	1.87	19640
LOWMAN	1948-2000	26.16	41.71	96	17.51	87	3.97	19521

LOWMAN 3E #2	1964-1975	27.86	40.55	70	19.55	66	1.75	19690
MACKAY RANGER STN	1931-2000	9.48	15.61	95	5.51	47	3.20	19320
MACKAY 4 NW	1965-1988	10.07	14.78	67	5.26	74	1.68	19870
MAGIC LAKE RESORT	1966-1975	13.33	18.77	70	10.46	72	1.92	19680
MALAD	1931-1982	14.59	21.92	63	8.11	35	2.83	19470
MALAD CITY	1948-2000	13.41	26.11	83	7.11	66	2.13	19790
MALTA 2 E	1963-2000	11.19	16.83	80	3.60	66	1.85	19650
MALTA AVIATION	1984-2000	9.17	11.97	95	6.15	89	1.44	19940
MASSACRE ROCKS ST PK	1973-2000	12.11	19.91	80	6.93	92	3.30	20000
MAY	1948-2000	7.92	11.85	84	4.46	74	1.45	19530
MCCALL	1930-2000	27.07	36.93	98	17.82	34	2.30	19360
MCCAMMON	1949-2000	16.35	26.39	96	10.32	53	1.42	19551
MERIDIAN 1 SSW	1948-1960	10.74	14.12	53	4.96	49	1.65	19530
MESA	1948-1955	22.76	23.85	50	17.63	49	1.53	19530
MIDDLE FORK LODGE	1971-2000	16.47	24.36	96	10.14	100	2.25	19751
MINIDOKA 10 WNW	1966-1988	9.49	13.07	80	6.35	79	1.95	19850
MINIDOKA DAM	1947-2000	9.51	16.51	83	5.74	66	1.52	19641
MONTPELIER RANGER STN	1931-1991	14.09	20.82	63	8.29	35	2.50	19390
MOSCOW UNIV OF IDAHO	1893-2000	23.50	39.22	96	10.98	11	2.51	19981
MOUNTAIN HOME	1948-2000	10.05	18.99	70	5.56	54	1.97	19760
MULLAN	1975-1997	35.24	49.79	90	28.37	94	3.17	19860
MULLAN AIRPORT	1958-1971	42.87	55.48	64	32.78	69	3.39	19641
MULLAN PASS	1948-1958	39.13	47.70	54	23.93	52	1.84	19540
MURPHY HOT SPRINGS	1987-1996	12.60	19.73	95	11.66	89	1.70	19880
NAMPA 2 NW	1948-1960	9.18	12.28	51	6.57	54	0.95	19530
NAMPA SUGAR FACTORY	1976-2000	11.56	17.67	83	6.80	87	1.69	19800
NEW MEADOWS RANGER STN	1948-2000	24.44	36.39	70	17.45	49	3.58	19990
NEZPERCE	1901-2000	21.23	27.60	68	13.56	87	2.32	19560
NORTH STAR RANCH	1966-1991	25.84	37.29	75	18.08	87	1.93	19801
OAKLEY	1914-2000	10.97	17.33	63	5.85	26	1.65	19250
OBSIDIAN 2 NNW	1948-1962	12.06	16.19	51	7.14	60	1.67	19551
OLA	1948-2000	21.57	31.02	96	12.04	49	1.39	19911
OLA 4 S	1951-1988	19.66	30.49	82	11.32	66	1.70	19630
OROFINO	1948-1981	25.30	35.81	58	15.79	52	2.29	19771
PALISADES	1947-1993	19.72	29.44	83	13.47	66	1.90	19521
PARMA EXPERIMENT STN	1922-2000	10.25	18.88	70	3.27	49	1.70	19990
PAUL 1 ENE	1948-2000	9.73	14.97	64	5.10	66	1.75	19860
PAYETTE	1948-2000	10.78	20.03	83	5.27	49	2.30	19520
PICABO	1958-2000	13.08	21.15	95	7.40	92	2.45	19641
PIERCE	1963-2000	41.26	55.97	64	28.54	87	6.28	19990
PIERCE RANGER STN	1913-1962	41.19	59.17	48	27.65	35	5.75	19481
PLUMMER 3 WSW	1950-2000	29.23	43.72	96	26.85	97	1.95	19500
POCATELLO 2	1899-2000	12.97	19.35	97	7.86	60	1.93	19970
POCATELLO WSO ARPT	1939-2000	11.71	20.33	83	5.34	66	4.31	19410
PORTHILL	1948-2000	21.03	30.17	96	13.43	52	1.97	19980
POTLATCH 3 NNE	1915-2000	24.86	34.10	48	14.81	44	2.55	19230
POWELL	1962-2000	39.36	52.44	64	23.03	87	2.73	19641
PRESTON	1964-2000	16.72	25.60	83	12.61	69	2.20	19860
PRESTON SUGAR FACTRY 2	1948-1980	14.85	20.40	63	10.60	56	2.00	19640
PRIEST RIVER EXP STN	1911-2000	31.22	47.21	96	16.02	29	3.34	19980
REXBURG RICKS COLLEGE	1977-2000	13.71	20.76	83	7.48	88	1.77	19790
REYNOLDS	1961-2000	10.86	16.09	80	6.22	66	2.38	19730
RICHFIELD	1948-2000	11.11	19.08	83	5.28	66	1.86	19630
RIGGINS	1940-2000	16.78	24.01	75	10.93	87	2.49	19780
RIRIE 12 ESE	1955-1978	13.16	18.28	63	9.14	66	2.02	19551
RUNNING CREEK RANCH	1991-1998	28.07	33.09	97	20.99	92	2.20	19961
RUPERT 3 WSW	1931-2000	8.92	16.49	83	3.45	39	1.83	19440
ST ANTHONY 1 WNW	1948-2000	14.38	22.80	95	8.19	76	2.00	19980
SAINT MARIES	1948-2000	30.23	46.95	96	18.32	52	2.33	19941
SALMON AIRPORT	1930-1967	9.12	14.41	67	5.63	49	1.19	19660

SALMON KSRA	1967-2000	10.04	14.75	77	6.73	99	1.50	19710
SANDPOINT EXPERMNT STN	1910-2000	32.07	46.72	96	18.03	29	2.95	19980
SHOSHONE 1 WNW	1931-2000	10.31	17.29	95	4.11	66	1.70	19630
SHOUP	1966-2000	14.64	25.48	86	9.77	66	2.50	19860
SILVER CITY 5 W	1978-2000	21.76	28.32	95	14.52	85	2.75	19980
SLATE CREEK RANGER STN	1960-1971	17.05	21.17	64	14.28	66	1.57	19681
SODA SPRINGS AIRPORT	1978-2000	16.29	21.09	82	10.14	92	3.31	19850
SPENCER RANGER STN	1948-1960	16.38	19.39	51	12.18	56	1.78	19591
SPRINGFIELD	1948-1956	9.13	12.63	49	6.64	54	1.14	19510
STANLEY	1963-2000	14.33	24.45	95	9.40	97	2.00	19641
STIBNITE	1949-1958	31.14	39.28	55	22.18	52	2.51	19551
STREVELL	1948-1986	11.02	15.69	68	5.18	54	1.60	19690
SUGAR	1948-1976	12.97	17.83	68	7.43	53	2.20	19561
SUN VALLEY	1948-1972	17.26	27.40	64	9.90	53	2.16	19641
SWAN FALLS POWER HOUSE	1948-2000	7.92	11.85	81	4.04	99	1.59	19540
SWAN VALLEY 2 E	1960-2000	17.79	26.84	93	10.66	66	1.83	19850
TAYLOR RANCH	1974-2000	14.83	21.15	95	11.47	89	1.35	19940
TENSED	1963-1983	25.20	32.66	75	16.14	65	2.00	19820
TETONIA EXPERIMENT STN	1952-2000	16.07	25.32	98	10.49	53	2.35	19730
THREE CREEK	1940-1987	12.93	19.85	63	7.12	54	2.05	19480
TWIN FALLS KMT	1980-2000	10.00	15.13	95	7.05	92	1.43	19860
TWIN FALLS 2 NNE	1905-1974	9.33	18.35	7	3.97	33	1.43	19360
TWIN FALLS 3 SE	1948-1977	9.36	14.68	71	4.46	66	1.50	19730
TWIN FALLS WSO	1963-2000	10.82	18.31	95	4.62	66	1.60	19860
WALLACE	1907-1962	39.93	56.96	27	23.23	52	2.96	19461
WALLACE WOODLAND PARK	1948-2000	37.42	53.68	96	25.93	100	3.08	19750
WARREN	1959-2000	26.40	36.18	64	16.38	90	2.45	19621
WAYAN 1 N	1956-2000	18.26	28.58	63	14.86	60	1.75	19630
WEISER 2 SE	1948-2000	11.73	19.62	98	4.95	49	2.55	19860
WINCHESTER 1 SE	1948-1965	24.37	31.55	55	17.15	49	2.39	19580
WINCHESTER	1965-2000	24.63	37.66	75	17.46	92	2.12	19930
YELLOW PINE 7 S	1970-2000	27.43	39.67	96	19.05	89	2.88	19961
YELLOWPINE BAR	1987-2000	22.02	27.51	95	17.20	100	1.80	19870

Idaho Climate Summaries

to
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1 - Porthill	9 - Wallace Woodland Park	29 - Kooskia	63 - Parma Exp. Stn.
2 - Bonners Ferry	10 - Wallace	30 - Fenn R.S.	64 - Emmett 2E
3 - Priest River Exp Stn	11 - Mullan	31 - Cottonwood 2WSW	65 - Caldwell
4 - Sandpoint Exp Stn	12 - Plummer 3WSW	32 - Grangeville	66 - Deer Flat Dam
5 - Cabinet Gorge	13 - Saint Maries	33 - Elk City R.S.	67 - Nampa Sugar Factory
6 - Bayview Model	14 - Avery Ranger Stn 2	34 - Dixie	68 - Boise 7N (Boone BAS)
7 - Couer D'Alene 1E	15 - Avery Ranger Stn	35 - Yellowpine Bar	69 - Idaho City
8 - Kellogg	16 - Tensed	36 - Riggins	70 - Kuna 2NNE
	17 - Potlatch 3NNE	37 - Warren	71 - Boise WSFO APT
	18 - Moscow Uoff	38 - Gibbonsville	72 - Boise Lucky Peak Dam
	19 - Elk River 1S	39 - Shoup	73 - Arrowrock Dam
	20 - Headquarters	40 - Salmon KSRA	74 - Swan Falls P.H.
	21 - Dworshak Fish Hat.	41 - Salmon Airport	75 - Reynolds
	22 - Orofino	42 - Cobalt	76 - Silver City 5W
	23 - Pierce	43 - Taylor Ranch	77 - Grand View 2W
	24 - Ex. Pierce R.S.	44 - New Meadows R.S.	78 - Bruneau
	25 - Powell	45 - McCall	79 - Mountain Home
	26 - Lewiston WSO AP	46 - Brownlee Dam	80 - Anderson Dam
	27 - Winchester	47 - Council	81 - Glenns Ferry
	28 - Craigmont	48 - Cambridge	82 - Hill City 1W
	29 - Nezperce	49 - Cascade 1NW	83 - Fairfield R.S.
		50 - Yellow Pine 7S	84 - Fairfield 3SE
		51 - Middle Fork Lodge	85 - Bliss 4NW
		52 - Challis	86 - Galena
		53 - May	87 - Sun Valley
		54 - Leadore 2	88 - Ketchum R.S.
		55 - Stanley	89 - Hailey 3NNW
		56 - Deadwood Dam	90 - Chilly Barton Flat
		57 - Lowman	91 - Mackay 4NW
		58 - Garden Valley R.S.	92 - Mackay R.S.
		59 - Oia	93 - Grouse
		60 - Oia 4S	94 - Craters of the Moon N.M.
		61 - Weiser 2SE	95 - Arco 3SW
		62 - Payette	96 - Howe
97 - Idaho Falls 46 W	111 - Hazelton	126 - Idaho Falls 16SE	141 - Soda Springs APT
98 - Picabo	112 - Minidoka 10WNW	127 - Hamer 4NW	142 - Grace
99 - Richfield	113 - Paul 1ENE	128 - Dubois Exp. Sta.	143 - McCammon
100 - Shoshone 1 WNW	114 - Rupert 3WSW	129 - Kilgore	144 - Arbon 2NW
101 - Gooding 2S	115 - Burley FAA AP	130 - Island Park	145 - Malta 2E
102 - Hagerman 2SW	116 - Minidoka Dam	131 - Ashton	146 - Strevell
103 - Three Creek	117 - Oakley	132 - St Anthony 1 WNW	147 - Malad City
104 - Castleford 2N	118 - Massacre Rocks S.P.	133 - Sugar	148 - Malad
105 - Buhl 2	119 - American Falls 1SW	134 - Rexburg - Ricks Coll.	149 - Preston
106 - Jerome	120 - Aberdeen Exp. Sta.	135 - Teton Exp. Sta.	150 - Preston Sugar Factory
107 - Twin Falls KMYT	121 - Pocatello WSO APT	136 - Driggs	151 - Montpelier R.S.
Ex - Twin Falls 2NNE	122 - Fort Hall	137 - Swan Valley 2E	152 - Lifton
108 - Twin Falls 3SE	123 - Blackfoot 2SSW	138 - Palisades	
109 - Twin Falls WSO	124 - Idaho Falls FAA APT	139 - Henry	
110 - Hollister	125 - Idaho Falls 2ESE	140 - Conda	



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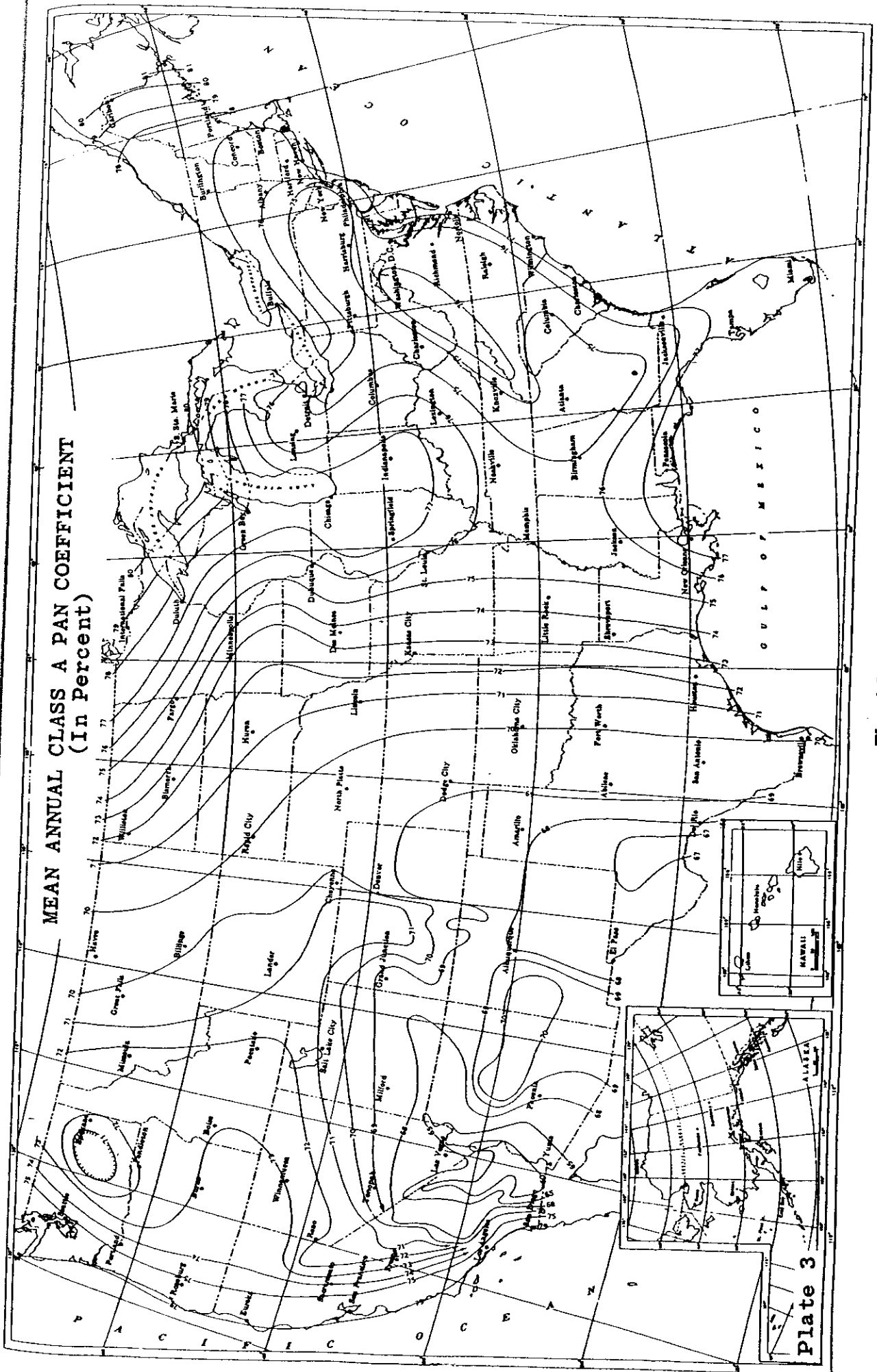


Fig. 14-4

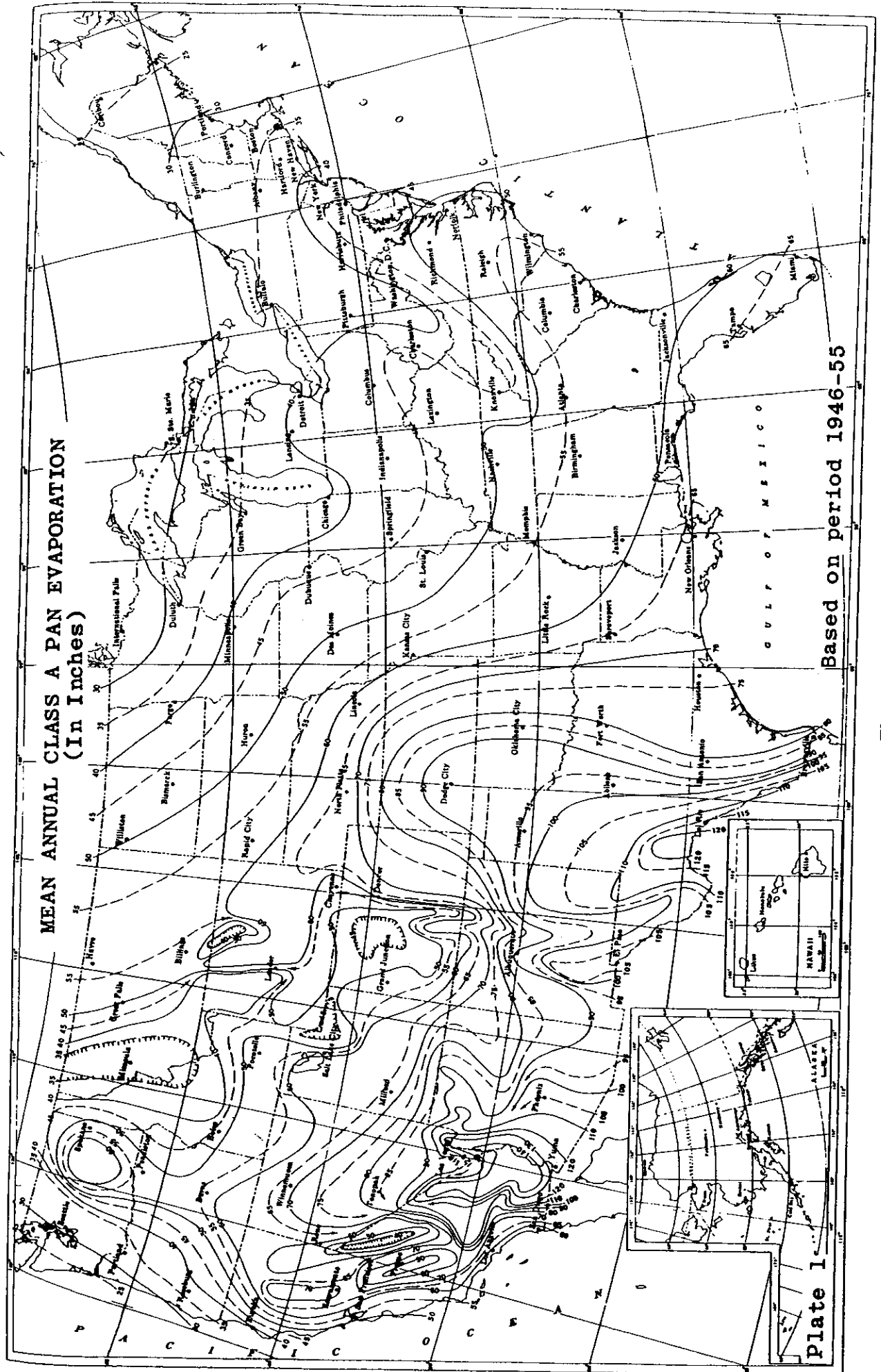


Fig. 14-2

EVAPORATION TABLE FOR THE WESTERN STATES

Standard daily pan evaporation is measured using the four-foot diameter Class A evaporation pan. The pan water level reading is adjusted when precipitation is measured to obtain the actual evaporation. Most Class A pans are installed above ground, allowing effects such as radiation on the side walls and heat exchanges with the pan material. These effects tend to increase the evaporation totals. The amounts can then be adjusted by multiplying the totals by 0.70 or 0.80 to more closely estimate the evaporation from naturally existing surfaces such as a shallow lake, wet soil or other moist natural surfaces.

Many stations do not measure pan evaporation during winter months. A "0.00" total indicates no measurement is taken.

MONTHLY AVERAGE PAN EVAPORATION (INCHES)														
STATION	PERIOD OF RECORD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
LETT DAM	1939-2000	3.92	4.92	7.10	10.02	13.77	16.21	15.56	13.95	12.10	9.66	5.86	4.47	117.54
IS DAM # 2	1958-1977	7.49	7.46	9.75	12.78	16.71	19.48	19.87	17.91	14.64	12.03	8.40	7.80	154.32
ND CANYON N P 2	1948-1961	3.54	5.13	7.60	9.30	11.33	13.33	13.14	12.15	9.51	7.24	5.38	3.88	101.53
LEY LAKE	1976-1988	0.00	0.00	0.00	0.00	7.46	9.80	8.94	7.29	6.10	4.45	0.00	0.00	44.04
A EXPERIMENT FARM	1967-2000	0.00	0.00	0.00	0.00	7.57	8.55	6.89	5.48	4.68	0.00	0.00	0.00	33.17
ALES 6 N	1896-2000	3.03	4.02	6.11	8.64	11.33	12.67	13.10	11.87	9.69	6.81	4.15	2.96	94.38
E	1952-2000	3.59	4.46	7.01	9.35	11.91	13.31	13.06	8.28	8.06	7.17	4.49	3.57	91.20
SPVLT 1 WNW	1957-2000	0.00	2.60	5.84	8.27	10.72	12.86	13.06	11.38	8.42	5.13	2.29	0.00	80.57
AGRICULTURE CTR	1905-2000	2.45	3.54	5.88	8.66	11.96	14.54	14.38	12.24	10.02	6.78	3.65	2.32	96.42
CARLOS RESERVOIR	1948-2000	2.65	3.98	7.18	10.68	13.61	15.34	13.17	10.71	8.65	5.79	3.21	2.48	97.45
SON UNIV OF ARIZONA	1948-2000	2.25	3.29	5.66	8.38	11.62	13.94	13.42	11.40	9.18	6.32	3.50	2.15	91.11
SON U OF ARIZ # 1	1894-2000	3.25	4.57	6.95	9.88	12.87	14.91	13.17	11.65	10.35	7.81	4.73	3.37	103.51
WEAP	1982-2000	3.94	4.68	7.53	10.57	14.14	16.51	14.61	12.17	10.71	8.05	4.93	3.23	111.07
TERIVER	1961-2000	1.95	2.77	6.30	9.42	12.82	14.94	15.26	13.31	10.06	7.06	3.69	2.60	100.18
A CITRUS STATION	1900-2000	1.69	2.94	5.84	8.01	9.92	11.70	9.48	8.47	7.68	5.87	3.51	2.54	77.65
IFORNIA	1920-2000	3.58	4.36	6.81	9.17	11.75	13.19	13.85	12.28	9.51	6.91	4.41	3.37	99.19
URN DAM PROJECT	1972-1984	1.42	1.89	3.13	4.89	7.73	10.08	11.66	10.70	8.08	5.00	1.97	1.36	67.91
OMONT PUMPING PLANT	1948-1975	2.90	3.29	4.08	5.03	6.40	8.15	10.64	9.97	7.90	5.87	3.22	2.90	70.35
RYESSA LAKE	1957-1970	1.53	2.15	3.79	5.82	8.90	11.00	13.22	12.06	8.67	5.72	2.48	1.66	77.00
A	1948-2000	0.00	0.00	0.00	0.00	6.83	8.52	10.00	9.09	6.49	4.32	0.00	0.00	45.25
NNAN ISLAND	1968-1977	1.15	1.74	4.36	7.03	10.49	12.39	13.51	12.02	9.03	4.80	1.83	1.08	79.43
LINGAME	1948-1978	1.27	1.81	3.60	5.28	6.85	7.82	8.42	7.39	5.74	3.78	1.98	1.28	55.22
LER VALLEY RANCH	1970-1975	0.42	0.63	1.44	2.87	4.54	5.38	7.00	6.18	4.12	1.58	0.56	0.46	35.18
HOMA LAKE	1952-2000	2.47	3.62	4.42	6.02	7.52	8.54	9.52	9.01	7.01	5.48	3.55	2.51	69.67
CO EXPERIMENT STN	1906-2000	1.24	2.13	3.81	5.62	8.24	10.11	11.48	9.71	7.36	4.46	2.10	1.30	67.56
IS 1 WSW	1917-2000	1.47	2.34	4.49	7.10	10.08	12.14	12.76	11.25	9.06	6.32	2.89	1.45	81.35
PH VALLEY	1961-2000	3.98	5.44	9.19	13.06	16.81	19.24	21.12	18.98	14.12	9.89	5.56	3.78	141.17
ONS LANDING	1955-1977	1.42	2.09	3.87	5.70	7.74	9.34	9.34	8.27	6.75	4.65	2.25	1.46	62.88
DALE 2 NW	1963-1973	0.70	1.17	2.26	3.21	3.95	4.38	4.49	4.07	3.59	2.06	1.04	0.72	31.64
SOM DAM	1955-1993	0.92	1.90	3.47	5.21	8.07	9.91	11.12	9.93	7.45	4.89	2.06	1.25	66.18
ANT GOVERNMENT CAMP	1948-2000	1.44	2.12	3.78	5.88	9.37	12.04	13.99	12.50	8.98	5.76	2.61	1.36	79.83
ZZLY ISLAND REFUGE	1971-1977	1.45	2.25	4.00	5.72	8.07	9.82	10.69	8.93	6.88	4.33	2.10	1.55	65.79
CO U S DATE GARDEN	1927-2000	2.85	4.38	7.15	9.98	12.73	14.85	14.95	13.59	10.80	7.60	3.98	2.49	105.35
IAN CITY 1 SSW	1955-1975	1.73	2.99	5.80	8.32	11.75	14.27	16.11	14.74	10.82	7.30	3.46	1.74	99.03
SHAS FERRY 2 ESE	1959-1977	1.00	1.69	3.14	5.65	8.54	10.14	11.60	10.31	7.74	4.62	2.69	1.00	68.12
HTS VALLEY	1964-1969	0.81	2.35	2.61	2.75	5.35	0.00	6.68	7.62	4.82	4.23	2.15	1.61	40.98
PILLSBURY 2	1964-1970	0.58	1.42	3.01	4.62	7.41	8.38	10.31	9.35	6.93	3.61	1.19	0.87	57.68

[illegible]

<http://www.wrcc.dri.edu/htmlfiles/westevap.final.html>

UCMCARI 4 NE	1904-2000	0.00	0.00	0.00	9.86	11.48	13.11	13.06	11.11	8.93	6.61	0.00	0.00	74.16
'E DAM	1965-1979	4.38	4.91	7.53	8.78	10.75	10.49	10.92	9.42	7.56	6.68	4.98	3.04	89.44
E														
TOR EXPERIMENT STN	1948-1973	0.56	0.96	1.47	2.21	3.75	3.95	4.65	4.10	2.95	1.65	0.87	0.70	27.82
ND 7 NE	1991-2000	0.00	0.00	0.00	0.00	6.05	6.61	8.63	8.05	5.40	0.00	0.00	0.00	34.74
RVALLIS STATE UNIV	1989-2000	0.00	0.00	1.79	2.97	4.56	5.87	7.68	7.06	5.05	2.31	0.96	0.00	38.25
PROIT DAM	1954-2000	0.19	1.16	1.69	2.51	4.38	5.90	7.68	6.64	4.24	2.05	0.88	0.00	37.78
IN RIDGE DAM	1943-2000	0.39	0.79	1.92	3.17	5.03	6.21	8.12	7.09	4.76	2.21	0.67	0.34	40.70
WISTON 2 S	1928-1997	0.00	0.00	3.44	5.43	7.91	9.67	11.32	9.66	6.32	3.97	0.00	0.00	57.72
WATH FALLS AGR STN	1949-2000	0.00	0.00	4.93	7.06	9.66	10.15	9.32	6.24	4.37	0.00	0.00	0.00	51.43
SKOUT POINT DAM	1955-2000	0.00	0.00	2.30	3.09	4.66	5.80	7.67	6.91	4.49	1.99	1.01	0.00	39.68
DRAS 1 NW	1952-2000	0.00	0.00	4.72	7.07	8.65	10.18	9.18	6.20	3.16	1.70	0.00	0.00	50.86
LEHUR BRANCH EXP STN	1943-2000	0.00	0.00	5.65	7.67	9.38	8.52	5.86	3.19	0.00	0.00	0.00	0.00	52.82
STAGE 2 NW	1959-2000	0.00	0.00	4.37	6.22	7.67	9.38	8.52	5.86	3.19	0.00	0.00	0.00	45.41
JOED EXP STN	1937-2000	0.00	0.00	2.26	3.56	5.29	6.54	8.24	6.78	4.05	1.81	0.76	0.44	41.28
JO	1928-2000	0.00	0.00	2.96	5.13	7.71	9.63	12.36	11.25	7.18	3.58	0.00	0.00	59.80
MILANETTE EXP STN	1963-2000	0.66	1.18	2.29	3.28	5.14	5.99	7.41	6.80	4.74	2.42	1.05	0.58	41.54
DETON BR EXP STN	1956-2000	0.00	0.00	3.31	5.10	6.86	8.78	11.77	10.78	6.93	3.81	0.00	0.00	57.34
WER LAKE 1 S	1957-2000	0.00	0.00	5.25	7.25	8.67	10.87	9.80	6.49	3.47	1.90	0.00	0.00	53.70
ON EXP STN	1931-1974	0.00	0.00	4.85	7.21	8.66	11.73	10.19	6.77	3.49	0.00	0.00	0.00	35.32
M SPRINGS RESERVOIR	1941-2000	0.00	0.00	2.99	5.15	6.49	8.01	6.86	4.69	2.46	0.00	0.00	0.00	52.90
XIUP DAM	1950-2000	0.00	0.00	2.25	3.79	5.51	6.93	6.38	4.51	1.33	0.00	0.00	0.00	36.65
ICHESTER	1981-1989	0.91	0.96	2.06	3.62	5.04	6.62	8.48	8.19	4.94	2.46	1.17	0.87	45.32
H														
POSS NATL PARK HQ	1980-2000	0.00	0.00	7.44	9.71	12.40	12.90	11.12	8.15	4.73	0.00	0.00	0.00	65.45
IVER BAY	1969-1996	0.00	0.00	6.27	10.17	12.59	13.86	12.29	7.83	4.89	0.00	0.00	0.00	67.90
R RIVER REFUGE	1948-1984	0.00	0.00	4.80	7.21	8.66	10.46	9.30	6.13	3.27	0.00	0.00	0.00	51.10
CE CANYON NAT'L PRK	1971-1978	0.00	0.00	0.00	6.86	7.86	8.07	7.21	5.30	0.00	0.00	0.00	0.00	35.30
T PORTAL	1948-1955	0.00	0.00	0.00	5.36	7.33	7.30	6.51	5.27	3.07	0.00	0.00	0.00	34.84
MING GORGE	1957-2000	0.00	0.00	0.00	6.23	8.74	9.71	8.62	5.76	3.94	0.00	0.00	0.00	43.00
T DUCHESNE	1994-2000	0.00	0.00	5.16	7.41	8.61	9.06	7.98	5.57	3.25	0.00	0.00	0.00	47.04
EN RIVER AVIATION	1893-2000	0.00	0.00	6.07	8.07	9.29	9.49	7.97	5.74	3.52	1.60	0.00	0.00	51.75
NTSON	1956-1990	0.00	0.00	5.10	7.23	8.70	9.65	8.26	6.03	3.81	0.00	0.00	0.00	48.78
RIVAN	1963-1965	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.19
AN USU EXP STN	1950-1978	0.00	0.00	4.01	5.98	7.05	8.37	7.50	5.02	2.92	0.00	0.00	0.00	40.85
AN 5 SW EXP FARM	1969-2000	0.00	0.00	4.57	6.58	8.53	10.08	9.01	5.88	3.51	0.00	0.00	0.00	51.46
ICAN HAT	1948-2000	0.00	0.00	6.31	8.44	11.92	14.42	14.87	12.47	9.40	5.52	2.25	0.00	85.60
FORD WSMO	1906-2000	0.00	0.00	7.47	10.22	13.54	15.47	13.24	9.88	6.16	2.32	0.00	0.00	78.30
TO DAM	1948-1971	0.00	0.00	0.00	7.91	9.98	10.13	8.40	6.98	4.60	0.00	0.00	0.00	48.00
VO BYU	1980-2000	0.00	0.00	4.73	6.74	8.74	9.79	8.73	5.50	2.88	0.00	0.00	0.00	49.70
ERTON	1965-1968	0.00	0.00	2.59	4.73	6.74	8.74	9.79	8.73	5.50	2.88	0.00	0.00	55.10
GEORGE	1862-2000	0.00	0.00	4.57	7.36	10.08	12.22	13.17	11.55	8.22	4.83	2.68	0.00	74.68
FAIR SALT PLANT	1956-1991	0.00	0.00	3.66	6.20	9.19	11.88	14.40	12.67	8.58	4.86	2.32	0.00	73.76
FIELD DAM	1948-1991	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.62
IER DRY LAKE	1987-1993	0.00	0.00	2.93	6.33	13.52	16.06	18.32	0.00	0.00	0.00	0.00	0.00	57.16
WMBERRY RESERVOIR EA	1956-1977	0.00	0.00	0.00	5.82	7.28	7.87	7.31	5.08	3.02	0.00	0.00	0.00	36.38
LAKE LEHI	1928-2000	0.00	0.00	2.77	5.19	7.17	8.83	9.66	8.63	6.13	3.81	1.42	0.00	53.61
INGTON														
JINGHAM 2 N	1948-1985	0.00	0.00	2.75	4.59	5.35	6.28	5.56	3.34	1.22	0.00	0.00	0.00	29.09
JINGHAM 3 SSW	1985-2000	0.00	0.00	0.00	3.84	4.77	5.31	4.62	2.74	1.41	0.00	0.00	0.00	22.69
LAKE	1931-1967	0.00	0.00	0.00	4.01	4.13	5.58	4.63	3.19	2.34	0.00	0.00	0.00	23.88
ELL 1 W	1960-2000	0.00	0.00	5.43	8.35	9.89	11.90	10.76	6.88	3.00	0.00	0.00	0.00	56.21
PTA 6 W	1954-1973	0.00	0.00	3.23	5.46	6.61	7.73	9.36	7.56	4.93	2.45	0.83	0.00	48.16
PTA 8 SSW	1974-2000	0.00	0.00	4.44	6.10	7.04	8.00	7.00	4.41	1.97	0.62	0.00	0.00	39.58

IND 3 NE EXP STN	1931-2000	0.00	0.00	5.29	7.98	9.36	11.99	10.38	6.84	2.59	0.00	0.00	54.43
ROVILLE 1 S	1960-1970	0.00	0.00	4.49	5.82	6.36	7.42	6.22	4.28	1.99	0.00	0.00	36.58
UPTOP 2 W EXP STN	1931-1995	0.00	0.71	1.58	2.46	3.97	4.63	5.61	4.97	2.92	1.28	0.61	28.74
PC E WSO AIRPORT	1889-2000	0.00	0.00	4.66	7.27	8.57	11.28	10.22	6.41	0.00	0.00	0.00	48.41
ENACHEE EXP STN	1950-1997	0.00	0.00	4.74	6.87	7.87	9.38	7.83	4.19	0.00	0.00	0.00	40.88
HITMAN MISSION	1962-2000	0.00	0.00	4.62	6.59	8.21	10.36	9.11	5.52	2.85	0.00	0.00	47.26
AKITNA WSO AP	1946-2000	0.00	0.00	5.27	7.62	8.71	10.42	9.29	5.90	0.00	0.00	0.00	47.21
FORMING													
CHOR DAM	1961-1979	0.00	0.00	0.00	6.46	7.57	9.66	8.31	5.95	5.33	0.00	0.00	43.28
DYSEN DAM	1948-2000	0.00	0.00	5.44	6.72	8.24	9.86	9.08	5.92	3.20	0.00	0.00	48.46
LETTIE 2 E	1925-2000	0.00	0.00	4.52	6.40	7.50	9.88	9.44	6.18	4.36	2.39	0.00	50.67
REEN RIVER	1915-2000	0.00	0.00	0.00	8.22	9.71	11.08	9.80	6.82	4.62	0.00	0.00	50.25
ART MOUNTAIN	1949-2000	0.00	0.00	3.50	5.81	6.38	7.35	6.89	4.38	3.43	0.00	0.00	37.54
IRAMIE 2 NW	1966-2000	0.00	0.00	0.00	8.21	10.26	10.71	9.58	7.48	4.76	0.00	0.00	51.00
ORTON 1 NW	1949-1968	0.00	0.00	3.91	5.59	6.73	8.27	7.31	4.96	3.35	0.00	0.00	40.12
ATHENDER DAM	1948-1991	0.00	0.00	3.20	5.07	6.78	8.78	10.53	9.75	7.17	4.95	2.81	59.04
WINGE DAM	1948-1991	0.00	0.00	0.00	5.24	8.27	8.99	8.12	5.59	0.00	0.00	0.00	36.21
ERIDAN FIELD STN	1920-2000	0.00	0.00	3.55	6.19	7.80	10.16	9.65	6.45	0.00	0.00	0.00	43.80
IALEN DAM	1949-1991	0.00	0.00	3.32	5.17	7.44	9.00	10.39	9.09	6.24	4.18	0.00	54.83
ASKA													
INTRAL 2	1962-2000	0.00	0.00	0.00	0.00	3.97	4.00	2.43	2.19	0.00	0.00	0.00	12.59
TANUSKA AES	1917-2000	0.00	0.00	4.24	4.40	4.40	3.91	3.02	1.80	0.00	0.00	0.00	17.37
GRATH WB AIRPORT	1939-2000	0.00	0.00	0.00	4.20	4.40	3.70	2.27	1.40	0.00	0.00	0.00	15.97
KINLEY PARK	1949-2000	0.00	0.00	0.00	0.00	3.00	2.63	1.76	0.53	0.00	0.00	0.00	7.92
D EDGERTON	1970-1996	0.00	0.00	0.00	3.31	4.56	4.16	3.04	1.65	0.00	0.00	0.00	16.72
LMER AAES	1949-1998	0.00	0.00	0.00	4.44	4.71	4.12	2.96	1.75	0.00	0.00	0.00	17.98
WALI													
LEGE UNIV EXP STN	1931-2000	0.00	0.00	4.25	5.04	4.56	4.56	2.82	1.38	0.00	0.00	0.00	18.05
NOLUO OBSRVY 702.2	1962-2000	4.74	5.24	7.86	8.90	9.41	10.07	10.08	8.76	7.67	5.99	5.05	90.80
HDE WSO AP 1020.1	1950-2000	5.53	6.18	7.59	8.17	9.17	9.84	10.33	10.20	9.16	7.99	6.24	96.01
S MAGNETIC OBSERVATOR	1960-1962	5.28	5.36	6.00	7.33	8.86	9.08	9.31	8.15	7.20	6.36	4.95	86.76
CIFIC ISLANDS													
AM WSMO	1957-1998	5.84	6.07	7.38	7.82	7.73	6.92	6.02	5.28	5.15	5.36	5.42	74.73
HNSTON ISLAND WSO AIR	1953-2000	8.69	8.76	10.29	10.25	10.79	11.42	11.50	10.82	9.81	9.53	8.19	118.60
RCUS ISLAND WB	1953-1968	6.91	8.06	8.66	8.70	8.71	9.49	8.89	9.40	8.22	7.46	6.91	98.22
SO PAGO WSO AIRPORT	1966-2000	7.96	6.17	6.84	5.95	5.82	6.75	6.92	6.56	7.31	8.08	6.95	84.43
P ISLAND WSO AIRPORT	1953-2000	6.09	6.07	7.31	7.34	7.02	5.47	5.48	5.72	5.43	5.71	5.42	72.90

2. Compute ratios of capacity and width.
 $V = 9,200/16,800 = 0.55$; $W = 300/2,500 = 0.12$.

3. Estimate the levee height. Enter Fig. 21-38 with V and W and find $L =$ about 8.1 ft. Freeboard (additional height) may be used for possible fill or foundation settlement, wave action, or other contingencies.

4. Check floodway velocities and downstream effects. The hydrograph for the design flood can be routed through the floodway.

Figure 21-38 can be used for more complicated problems, such as the determination of the most economic floodway width and levee height. For such cases, data on crop-production costs and benefits, earth-moving costs, and flood frequencies will be needed. Since it is easier to raise the levee height than to widen the floodway, the floodway is generally constructed as wide as possible at the start. The narrower the floodway or the greater the height of the levees, the greater the flood damage when the levees are breached. This potential damage should enter into the economic study if one is made.

b. Floodways. A design flood is routed through the proposed floodway. Where detailed studies are not justified, as with very small projects, the use of Manning's formula may be sufficient for estimating the floodway capacity.

c. Channel Improvements. Since pilot channels are intended to be enlarged by erosion, no hydrology is involved in the channel design. If it is necessary to make an estimate of the eventual effects of the enlarged channel on flood damages downstream, routings of past floods will be sufficient. Flow-duration curves may be needed for studies of upstream degradation due to change in channel slope, although it can generally be assumed that the pilot channel will eventually return to the grade of the original channel unless bedrock interferes. Induced erosion upstream may tend to give the new channel an increased but stable slope temporarily.

Example 21-26. A meandering stream has a slope of 4 ft/mile ($s = 0.00076$). A length of 2.2 miles of the stream is shortened to 1.3 miles by means of a pilot channel. Determine the depth of overfall that can be expected to develop at the head of the pilot channel.

Compute the expected overfall depth using the relation

$$O_e = G(C_o - C_n) \quad (21-30)$$

where O_e is the expected overfall depth in ft, G is the present channel grade in ft/mile, C_o is the old channel length in miles, and C_n is the new channel length in miles. In this example, $O_e = 3.6$ ft.

Minor channel works such as clearing and snagging can be evaluated using Manning's formula to determine channel velocities. The reduced travel time through the reach can be used in routing the design hydrograph to determine downstream effects. The triangular hydrograph of Fig. 21-11 is suitable for such routings.

C. Irrigation

1. **General.** The hydrologic considerations in irrigation design vary with the size and type of project. Large-scale irrigation developments [51] may involve engineering, economic, social, legal, and political problems concerning water and its use; sometimes they may be regional or international in scope. Engineering and legal

problems are common to small-scale projects, and economics may be a critical factor with marginal projects or in the selection of the type of irrigation.

a. Methods of Irrigating. The method or type of irrigation varies with topography, soils, crops, available water supply, and often with the irrigator's personal preference. The most general types are as follows:

(I) Surface irrigation [52]

(A) Flood irrigation

- (1) Graded-border irrigation. A field is normally divided into strips 30 to 60 ft wide and 300 to 1,300 ft long, separated by low dikes; water is applied at the high end of the strip and advances as a sheet.
- (2) Level-border or basin irrigation. Level plots are surrounded by dikes; water is applied rapidly and held until it soaks into the soil.
- (3) Contour-ditch irrigation. Controlled flooding from ditches running along the approximate contour allows the water to flow down the land slope; ditches are from 25 to 200 ft apart, depending on topography, slope, and soils.

(B) Furrow irrigation

- (1) Furrows. Water flows down the furrows between crop rows, which may be on approximate contours or down the slope.
- (2) Corrugations. Shallow furrows 15 to 30 in. apart are run downhill from head ditches; they are used for irrigating hay and small grain.

(II) Subsurface irrigation. An artificial water table is created and maintained at a depth within reach of plant roots. This is used with very permeable soils, such as peats, where topography must be level and smooth [53].

(III) Sprinkler irrigation. Water is pumped through portable pipes and applied by overhead sprinklers. This method is usable with most soils, crops, and land slopes, but water must be clean and free of debris. It is also usable for frost control [54].

b. Hydrologic Aspects. Irrigation project design is a complex field, and specialists, or irrigation engineers, are needed for major projects. These specialists use hydrology in determining the source, amount, quality, and seasonal distribution of water supply; in estimating consumptive use; in planning and designing storage dams and major canals; in planning and designing protection of the irrigation system from cross drainage (flood flows from natural waterways crossing the canals and laterals); in determining infiltration rates and water-storage capacity of the soil; in estimating erosion rates in field distribution systems; and in controlling seepage and excess surface-water drainage.

c. Legal Aspects. Rights to the use of surface water and groundwater are generally subject to the constitutions, statutes, compacts, treaties, and court decisions of the states and countries in which the water exists [55]. These rights vary from state to state. The prospective irrigator should have, or be sure he is able to get, necessary water rights before a detailed planning of the irrigation system begins. (See Sec. 27.)

2. **Hydrologic Considerations.** Useful information on the engineering design and layout of all types of on-farm irrigation systems is given in several sources [56-58]. Methods are available [59] for the evaluation of old irrigation systems and can also be used in the design of new systems. Additional hydrologic design will generally consist of determining the quantity of water available and the capacity of structures needed to control cross drainage. Cross-drainage problems can be greatly reduced (but not completely eliminated) by the use of inverted siphons to convey irrigation water past cross-flowing streams.

a. Small-irrigation-project Design. The major steps in designing a project usually follow the general order shown below, but some may be taken together or may be reversed in different localities. Large projects require much more extensive studies [51, 60].

(1) Water Supply. It is futile to start detailed planning unless necessary water rights are available. A preliminary estimate of the needed supply can be made for a

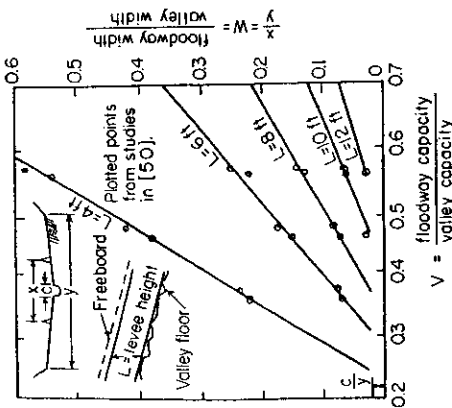


FIG. 21-38. Graph for making preliminary estimates of required levee height. Note: Use 100-year-frequency flood width and discharge when valley boundaries are indefinite. (From U.S. Soil Conservation Service [33].)

very small projects, the use of Manning's formula may be sufficient for estimating the floodway capacity.

c. Channel Improvements. Since pilot channels are intended to be enlarged by erosion, no hydrology is involved in the channel design. If it is necessary to make an estimate of the eventual effects of the enlarged channel on flood damages downstream, routings of past floods will be sufficient. Flow-duration curves may be needed for studies of upstream degradation due to change in channel slope, although it can generally be assumed that the pilot channel will eventually return to the grade of the original channel unless bedrock interferes. Induced erosion upstream may tend to give the new channel an increased but stable slope temporarily.

Example 21-26. A meandering stream has a slope of 4 ft/mile ($s = 0.00076$). A length of 2.2 miles of the stream is shortened to 1.3 miles by means of a pilot channel. Determine the depth of overfall that can be expected to develop at the head of the pilot channel.

Compute the expected overfall depth using the relation

$$O_e = G(C_o - C_n) \quad (21-30)$$

where O_e is the expected overfall depth in ft, G is the present channel grade in ft/mile, C_o is the old channel length in miles, and C_n is the new channel length in miles. In this example, $O_e = 3.6$ ft.

Minor channel works such as clearing and snagging can be evaluated using Manning's formula to determine channel velocities. The reduced travel time through the reach can be used in routing the design hydrograph to determine downstream effects. The triangular hydrograph of Fig. 21-11 is suitable for such routings.

C. Irrigation

1. **General.** The hydrologic considerations in irrigation design vary with the size and type of project. Large-scale irrigation developments [51] may involve engineering, economic, social, legal, and political problems concerning water and its use; sometimes they may be regional or international in scope. Engineering and legal

Example 21-28. Given an average seasonal rainfall at Lincoln, Nebr., of 19.1 in., a crop consumptive use of 32.9 in., and an average irrigation application of 3 in., find the total effective rainfall.

1. Compute the ratio of consumptive use U in inches to rainfall during the growing season R_g in inches. This is $32.9/19.1 = 1.72$.
2. In Table 21-45, for $U/R_g = 1.72$, find the ratio E , which is 0.59 by interpolation.
3. Compute the effective rainfall using Eq. (21-31): $0.59 \times 19.1 + 3 = 14.3$ in.

Table 21-45. Ratios for Use in Estimating Effective Rainfall*

U/R_g	E	U/R_g	E
0	0	2.4	0.72
0.2	0.10	2.6	0.75
0.4	0.19	2.8	0.77
0.6	0.27	3.0	0.80
0.8	0.35	3.5	0.84
1.0	0.41	4.0	0.88
1.2	0.47	4.5	0.91
1.4	0.52	5.0	0.93
1.6	0.57	6.0	0.96
1.8	0.61	7.0	0.98
2.0	0.65	9.0	0.99
2.2	0.69		

* From U.S. Soil Conservation Service [33].

NOTATION: U = consumptive use in in., R_g = rainfall during the growing season in in., and E = ratio for finding total effective rainfall.

j. Field Efficiency. The per cent of the total volume of water delivered to the field and finally consumed by evapotranspiration is referred to as *field efficiency* [57]. Efficiency varies with many factors, including the experience of the irrigation operator. Assuming proper planning and operation of the field irrigation system, the ranges of efficiency to be expected are given in Table 21-46.

Table 21-46. Irrigation Field Efficiencies*

Method of irrigation	Range of efficiency, %
Graded borders	60 to 75
Basins and level borders	60 to 80
Contour ditch	50 to 55
Furrows	55 to 70
Corrugations	50 to 70
Subsurface	Up to 80
Sprinklers	65 to 75

* From Quackenbush et al. [57] and U.S. Soil Conservation Service [58].

Example 21-29. If the expected efficiency is 60 per cent, the consumptive use for the irrigation season is 2.4 acre-ft (28.8 in.) of water per acre, and effective rainfall is 11 in., the amount to be delivered to the farm is $(28.8 - 11) \times 10\% = 29.7$ in., or 2.5 acre-ft/acre.

g. Leaching Requirement. When soils and water are of good quality, large applications of irrigation water will leach out plant nutrients and will require additional drainage and will therefore be wasteful. However, with saline or alkaline conditions, which may result either from poor soil or poor water, it is generally necessary to apply extra water to leach the salts out of the root zone and prevent movement of salts to the surface, where they will further injure crops. Drainage of the leaching water is necessary and is usually accomplished with deep ditches. Level borders or basins rather than furrow irrigation should be used under these conditions. The

amount of water required for leaching can be estimated [62, 63], but usually local experience will govern.

h. Delivery Losses. Canal or ditch seepage is the principal loss between the water source and the delivery point. This not only reduces supply, but may also cause damage to land adjacent to the canal or ditch. Seepage losses may vary from 10 to 70 per cent of the amount entering a canal [68]. Additional losses occur from transpiration by vegetation along a canal or ditch. Where the water supply is limited, control of this vegetation by cutting or spraying with chemicals may be necessary [67]. Evaporation from a canal water surface is ordinarily not considered. In general, where water losses are likely to be large, pipe, chutes, flumes, or lined canals or ditches can be used to convey the water [69, 70]. Table 21-47 can be used as a guide to the average upper limits of losses to be expected. An equation for estimating delivery losses is

$$q_d = q_0 - \frac{SW}{86,400}$$

(21-32)

where q_d is the discharge at the delivery point in cfs, q_0 is the inflow to the ditch in cfs, S is the seepage rate in ft³/ft² of the wetted area, from Table 21-47, and W is the wetted area in ft². The figure 86,400 is the conversion factor to convert days to seconds.

Example 21-30. An irrigation delivery ditch is 1.7 miles long, is cut through sand and sandy loam, and has a 1-ft bottom width with 1.5:1 side slopes. If 4.1 cfs enters the ditch at the design depth of 0.7 ft, estimate the discharge that can be expected at the farm after steady flow is established.

1. Select the seepage rate from Table 21-47. Using the fourth item (sand and sandy loam), this is 3.4 ft³/ft² of wetted area per day.
2. Compute the total wetted area. The wetted perimeter times the length of ditch in feet, or $3.52 \times 1.7 \times 5,280$, is $31,596$ ft² (use $31,600$ ft²).

Table 21-47. Average Maximum Seepage Rates for Canals*

Canal soil material	Seepage, ft ³ /ft ² of wetted area per day
Sandy loam	8.2
Gravelly loam	5.3
Fine sandy loam and adobe	3.8
Sand and sandy loam	3.4
Loam and sandy loam	3.3
Adobe	3.0
Fine sandy loam	2.1
Loam and adobe	1.4
Loam	1.1
Silty clay	0.9
Sand and silty clay	0.4
Sand and clay	0.1
Loam and gravelly loam	0.1

* From Rohwer and Stout [68].

3. Compute the rate at the delivery point: $4.1 - (3.4 \times 31,600)/86,400 = 2.86$ cfs, or about 2.9 cfs after steady flow is established.

i. Storage Losses. These are evaporation and seepage losses in the reservoir and are to some extent controllable [49, 69, 70].

j. Other Losses. An estimate of operational losses, due to accidents or other uncontrolled losses, is generally used as a safety factor in supply design.

k. Recovery of Losses. Seepage and waste water (return flow) are often recovered, in streams or underground, and used for further irrigation. In some localities water is used many times before it becomes unsuitable for further use. Where states permit rights to seepage flows, it may be illegal to reduce seepage or waste if doing so violates someone's water right [69].

l. Estimation of Required Reservoir Storage. A summary of the gains and losses can be made as shown in the following example.