



State of Idaho

DEPARTMENT OF WATER RESOURCES

322 East Front Street • P.O. Box 83720 • Boise, Idaho 83720-0098

Phone: (208) 287-4800 • Fax: (208) 287-6700 • Website: www.idwr.idaho.gov

C.L. "BUTCH" OTTER
Governor

GARY SPACKMAN
Director

September 26, 2013

DAVID J WARD
GREGORY S WARD
ORPHA G WARD
1760 BANKS LOWMAN RD
GARDEN VALLEY ID 83622

RE: License Nos. 65-13344A & 65-13588

Issuance of Licenses

Dear Water Right Holder(s):

The Department of Water Resources has issued the enclosed Water Right Licenses confirming that water rights have been established in accordance with your permits. Please be sure to thoroughly review the conditions of approval and remarks listed on your licenses.

The licenses are PRELIMINARY ORDERS issued by the Department pursuant to section 67-5243, Idaho Code. They can and will become final orders without further action by the Department unless a party petitions for reconsideration or files an exception and/or brief within fourteen (14) days of the service date as described in the enclosed information sheet.

Please note that water right owners are required to report any change of water right ownership and/or mailing address to the Department within 120 days of the change. Failure to report these changes could result in a \$100 late filing fee. Contact any office of the Department or visit the Department's homepage on the Internet to obtain the proper forms and instructions.

If you have any questions, please contact me at 208-287-4916.

Sincerely,

Craig L. Saxton
Water Rights Supervisor

Enclosure(s)

CERTIFICATE OF SERVICE

I hereby certify that on September 27, 2013, I mailed a true and correct copy, postage prepaid, of the foregoing PRELIMINARY ORDERS (Approved Licenses) to the person(s) listed below:

RE: WATER RIGHT NOS.

65-13344A & 65-13588

**DAVID J WARD
1760 BANKS LOWMAN RD
GARDEN VALLEY ID 83622**

**GREGORY S WARD
1760 BANKS LOWMAN RD
GARDEN VALLEY ID 83622**

**ORPHA G WARD
1760 BANKS LOWMAN RD
GARDEN VALLEY ID 83622**



**Darla Block
Technical Records Specialist**

EXPLANATORY INFORMATION TO ACCOMPANY A PRELIMINARY ORDER

(To be used in connection with actions when a hearing was **not** held)

(Required by Rule of Procedure 730.02)

The accompanying order or approved document is a "Preliminary Order" issued by the department pursuant to section 67-5243, Idaho Code. **It can and will become a final order without further action of the Department of Water Resources ("department") unless a party petitions for reconsideration, files an exception and brief, or requests a hearing as further described below:**

PETITION FOR RECONSIDERATION

Any party may file a petition for reconsideration of a preliminary order with the department within fourteen (14) days of the service date of this order. **Note: the petition must be received by the department within this fourteen (14) day period.** The department will act on a petition for reconsideration within twenty-one (21) days of its receipt, or the petition will be considered denied by operation of law. See Section 67-5243(3) Idaho Code.

EXCEPTIONS AND BRIEFS

Within fourteen (14) days after: (a) the service date of a preliminary order, (b) the service date of a denial of a petition for reconsideration from this preliminary order, or (c) the failure within twenty-one (21) days to grant or deny a petition for reconsideration from this preliminary order, any party may in writing support or take exceptions to any part of a preliminary order and may file briefs in support of the party's position on any issue in the proceeding with the Director. Otherwise, this preliminary order will become a final order of the agency.

REQUEST FOR HEARING

Unless a right to a hearing before the Department or the Water Resource Board is otherwise provided by statute, any person aggrieved by any final decision, determination, order or action of the Director of the Department and who has not previously been afforded an opportunity for a hearing on the matter may request a hearing pursuant to section 42-1701A(3), Idaho Code. A written petition contesting the action of the Director and requesting a hearing shall be filed within fifteen (15) days after receipt of the denial or conditional approval.

ORAL ARGUMENT

If the Director grants a petition to review the preliminary order, the Director shall allow all parties an opportunity to file briefs in support of or taking exceptions to the preliminary order and may schedule oral argument in the matter before issuing a final order. If oral arguments are to be heard, the Director will within a reasonable time period notify each party of the place, date and hour for the argument of the case. Unless the Director orders otherwise, all oral arguments will be heard in Boise, Idaho.

CERTIFICATE OF SERVICE

All exceptions, briefs, requests for oral argument and any other matters filed with the Director in connection with the preliminary order shall be served on all other parties to the proceedings in accordance with IDAPA Rules 37.01.01302 and 37.01.01303 (Rules of Procedure 302 and 303).

FINAL ORDER

The Director will issue a final order within fifty-six (56) days of receipt of the written briefs, oral argument or response to briefs, whichever is later, unless waived by the parties or for good cause shown. The Director may remand the matter for further evidentiary hearings if further factual development of the record is necessary before issuing a final order. The department will serve a copy of the final order on all parties of record.

Section 67-5246(5), Idaho Code, provides as follows:

Unless a different date is stated in a final order, the order is effective fourteen (14) days after its service date if a party has not filed a petition for reconsideration. If a party has filed a petition for reconsideration with the agency head, the final order becomes effective when:

- (a) The petition for reconsideration is disposed of; or
- (b) The petition is deemed denied because the agency head did not dispose of the petition within twenty-one (21) days.

APPEAL OF FINAL ORDER TO DISTRICT COURT

Pursuant to sections 67-5270 and 67-5272, Idaho Code, if this preliminary order becomes final, any party aggrieved by the final order or orders previously issued in this case may appeal the final order and all previously issued orders in this case to district court by filing a petition in the district court of the county in which:

- i. A hearing was held,
- ii. The final agency action was taken,
- iii. The party seeking review of the order resides, or
- iv. The real property or personal property that was the subject of the agency action is located.

The appeal must be filed within twenty-eight (28) days of this preliminary order becoming final. See section 67-5273, Idaho Code. The filing of an appeal to district court does not itself stay the effectiveness or enforcement of the order under appeal.

State of Idaho
Department of Water Resources
Water Right License

WATER RIGHT NO. 65-13344A

Priority: October 07, 1991

Maximum Diversion Rate: 0.87 CFS
Maximum Diversion Volume: 16.3 AF

It is hereby certified that DAVID J WARD

And

GREGORY S WARD

And

ORPHA G WARD
1760 BANKS LOWMAN RD
GARDEN VALLEY ID 83622

has complied with the terms and

conditions of the permit, issued pursuant to Application for Permit dated December 31, 1992 has submitted Proof of Beneficial Use on December 20, 1995. An examination confirms water is diverted from:

SOURCE

SOUTH FORK PAYETTE RIVER

Tributary: PAYETTE RIVER

and a water right has been established as follows:

BENEFICIAL USE
COMMERCIAL

PERIOD OF USE
01/01 to 12/31

DIVERSION RATE
0.87 CFS

**ANNUAL
DIVERSION VOLUME**
16.3 AF

LOCATION OF POINT(S) OF DIVERSION:

SOUTH FORK PAYETTE RIVER L2 (SW1/4NE1/4) Sec. 10, Twp 08N, Rge 05E, B.M. BOISE County

PLACE OF USE: COMMERCIAL

Twp Rge Sec	NE				NW				SW				SE				
	NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	Totals
08N 05E 9				X													

CONDITIONS OF APPROVAL

1. Use of water under this water right will be regulated by the watermaster of State Water District No.65.
2. Commercial use is for plant watering, showers, restrooms, and chemical mixing for greenhouses.
3. Place of use is located within HES 494.
4. When water is not available to fill this right, the right holder shall cease diversion or shall rent water from the Payette River Rental Pool.

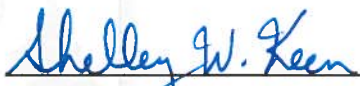
State of Idaho
Department of Water Resources
Water Right License

WATER RIGHT NO. 65-13344A

5. The right holder shall maintain a measuring device and lockable controlling works of a type approved by the Department in a manner that will provide the watermaster suitable control of the diversion(s).
6. This right does not grant any right-of-way or easement across the land of another.
7. Rights 65-7904 and 65-13344A when combined shall not exceed a total diversion rate of 0.87 cfs, and a total annual maximum diversion volume of 16.7.
8. Rights 65-509, 65-7167, 65-7903, 65-13344A and 65-13588 when combined shall not exceed a total annual maximum diversion volume of 37 af for the non-heating uses for the commercial greenhouses.
9. Rights 65-509, 65-7167, 65-7903, 65-13344A and 65-13588 when combined shall not exceed a total diversion rate of 2.81 cfs, and a total annual maximum diversion volume of 461 af for all uses.

This license is issued pursuant to the provisions of Section 42-219, Idaho Code. The water right confirmed by this license is subject to all prior water rights and shall be used in accordance with Idaho law and applicable rules of the Department of Water Resources.

Signed this 25th day of September, 2013.

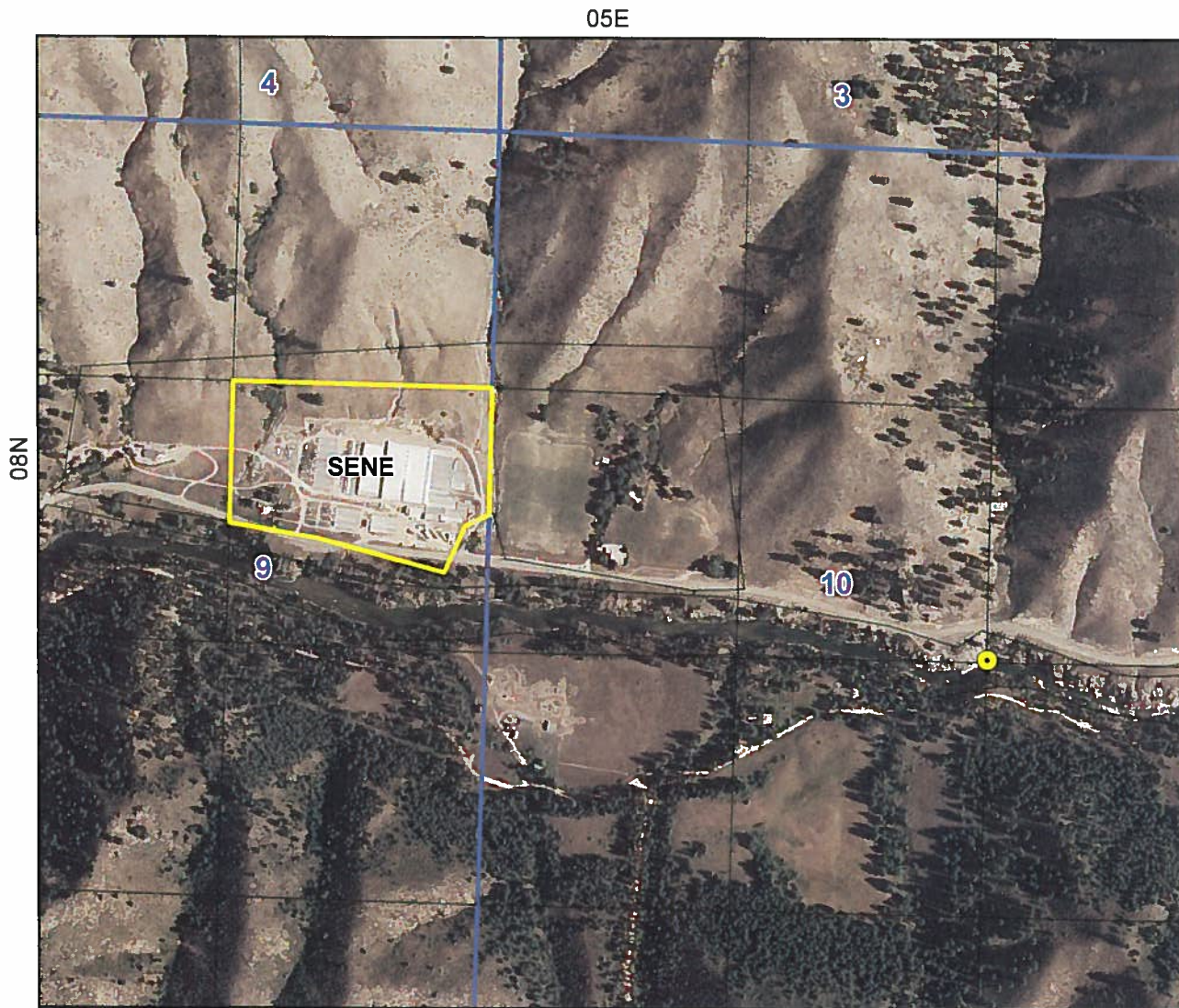

for GARY SPACKMAN
Director

State of Idaho
Department of Water Resources

Attachment To Water Right License

65-13344a

This map depicts the COMMERCIAL place of use boundary for this water right at the time of this approval and is attached to the approval document solely for illustrative purposes.



-  Point of Diversion
-  Place Of Use Boundary
-  Townships
-  PLS Sections
-  Quarter Quarters

0 0.1 0.2 0.4 Miles



Nelson, Dan

From: Riley [Riley@wardsgreenhouse.com]
Sent: Monday, September 16, 2013 4:05 PM
To: Nelson, Dan
Subject: Ward's Greenhouse Flowmeter Photo
Attachments: flowmeter.pdf

Attached is a picture of the flow meter installed at Ward's Greenhouse in Garden Valley.

Please reply with confirmation that you received the photo.

Thanks

Riley Ward



MEMORANDUM

TO: Water Right File – 65-13344A and 65-13588

FROM: Daniel Nelson – Staff Hydrologist

DATE: July 30, 2013

SUBJECT: Additional Information for File

During the licensing review for water right files 65-13344A and 65-13588 there were some concerns that needed to be addressed in more detail. This memo is designed to provide a more in depth discussion for those issues.

JUSTIFICATION OF THE 0.87 CFS FOR THE COLD WATER SYSTEM:

I recommended a diversion rate for water right 65-13344A of 0.87 cfs. The question was raised as to whether this was just the capacity of the system, or if the owner really needed the 0.87 cfs. The answer to this question is that the owner needs this diversion rate to cool the hot water that is mixed to supply the greenhouses. There are 4 acres being irrigated in the facility. According to the file a diversion rate of 1.00 cfs was allowed to irrigate 6 acres within a 2 hour period. The file provides justification for this need. If it takes 1.00 cfs to irrigate 6 acres, then it would take 0.67 cfs to irrigate the 4 acres for this complex based on the ratio allowed by the permit. My calculations show that it would take 0.96 cfs to irrigate 4 acres in a 2 hour period using the following equation:

$$[(0.02\text{cfs/acre} \times 4 \text{ acres}) \times 24 \text{ hours}] / 2 \text{ hours} = 0.96 \text{ cfs.}$$

Whether you use the ratio calculation of 0.61 cfs or my calculation of 0.96 cfs, when you add in the office, restroom, showers, and chemical mixing uses a diversion rate of 0.87 cfs matching the capacity of the system seems reasonable. The owner also informed me that they need this diversion rate to mix the cold water system with the hot water system. The hot water system has minerals that are harmful to the Poinsettia plants that they grow, and the temperature of the hot water after it is used for heating is often high to use for irrigation of any of the plants. Therefore, they need to dilute the hot water when the two sources are mixed when the heating system is being used. Mixing 1.94 cfs of hot water with 0.87 cfs of cold water provides a 1/3 mixture of cold water to the hot water. After being used, the hot water exits the heating system at approximately 100 degrees. The cold water should drop that temperature by about 1/3 or to an estimated 70 degrees, which would be suitable for irrigation of plants.

There is no long term storage tank in this facility. The mixing tanks only hold approximately 300 gallons per vault. There are three vaults, so the total amount of water in the tanks is not more than 900 gallons of water. Each vault is 3 ft by 3 ft by 4 ft or 36 square feet times 7.48 equals 270 gallons per vault.

THE 2.81 CFS COMBINED LIMIT CONDITION FOR ALL WATER RIGHTS:

There are several water rights for both hot water springs and various cold water sources. All of these water rights are intermixed with some of the water rights having multiple sources. It is very difficult to determine the overall diversion rate of water that can go into this facility. The maximum rate of diversion of the cold water used in this facility is 0.87 cfs and a maximum rate of diversion of the hot water used in this facility is 1.94 cfs. The maximum rate of diversion of both the cold water and hot water that is used in the facility at the same time is 2.81 cfs. All of the water rights describe a common use of commercial use, and don't differentiate between heating and non-heating commercial uses. If you add all of the water rights up, the total combined diversion rate for both the cold and hot water greatly exceeds this maximum diversion rate of 2.81 cfs. Therefore, when all of the rights are combined, the maximum amount that can be diverted for this commercial use including the heating and other uses must be limited to maximum use of 2.81 cfs.

MEMORANDUM

TO: Water Right File – 65-13344 and 65-13588

FROM: Daniel Nelson – Staff Hydrologist

DATE: June 24, 2013

SUBJECT: Review of Water Right File for Licensing

I performed the field exams on these two files in 1999. Both of the exams were done at the same time, and they are in a related system. Water right 65-13344 is for the use of cold water from the South Fork of the Payette River, and 65-13588 is for hot springs that are found at the edge of the South Fork of the Payette River. Both uses claim to be commercial uses. The system uses approximately 37 acre feet of water for commercial use and 445 acre feet of water for heating. Approximately 20.7 acre feet of the hot water system is used for commercial use in this system after the heat value has been used for heating the greenhouses and the remaining 16.3 acre feet of commercial use comes from the cold water system directly from the South Fork of the Payette River. The hot water is run into the greenhouses for heating and then mixed with cold water to supply water for bathrooms and irrigation of the crops in the greenhouses. Although I will discuss both rights in this memo for convenience and clarity, I will discuss each right separately below:

65-13344:

This water right is diverted directly out of the South Fork of the Payette River. The water is run to the greenhouse facility approximately $\frac{3}{4}$ of a mile to the east of the point of diversion. This system has a flow meter on the line, and volume was attained using this meter. A measurement and flow meter calibration was also done on this system, so the diversion rate and volume should be accurate. The total commercial use includes irrigation, bathroom and shower facilities at the greenhouse. The irrigation use is year round, so there is no limitation on the season of use. The total commercial use was calculated to be 37 acre feet.

There are other irrigation rights that appear to overlap the place of use, but those rights appear to be for irrigation outside of the greenhouses, since they all have a normal irrigation season of use. The owner informed me at the time of the exam that water right 65-5638 was used to irrigate a tree farm that is no longer in use, and water rights 65-503 and 65-5640 appear to be attached to the homes that are on the site. All of the irrigation in the greenhouses is described as commercial use on the remaining water rights.

I have recommended that this permit be licensed using the measured amounts of 0.87 cfs and 16.3 acre feet of water for commercial use. This permit had several conditions that needed updated, so I added conditions R04, X60, X22, R43, 004, and X05.

Water right 65-7904 is the only other water right that only supplies cold water to this system. Water rights 65-7904 and 65-13344A do not contribute to the heating of the greenhouses, so there is no heating conditions or descriptors. All of the cold water commercial use for this facility at the time of my exam was being taken through the South Fork of Payette River diversion, so when all cold water sources are combined, they need to be limited to 0.87 cfs and 16.3 af per year. Therefore, the following conditions are needed.

When water rights 65-7904 and 65-13344A are combined, they are limited to 0.87 cfs and 16.3 af per year.

The hot springs do supply some of the water supplied for commercial and irrigation water for this facility. It is run through the heating system and then is run into a cooling tank to mix with the cold water to attain a usable temperature. Therefore, another condition will be needed to describe the maximum developed volume for the non-heating uses.

When water rights 65-509, 65-7167, 65-7903, 65-7904, 65-13344 and 65-13588 are combined, they are limited to a maximum diversion volume for non-heating uses to 37 af.

Another condition will be needed to address the maximum rate of diversion for both the heating and non heating uses for the greenhouses. This amount would include the rate of .087 cfs and volume of 16.3 af diverted from the cold water system and the 1.94 cfs and 445 af diverted from the hot water system combined for a maximum combined total of 2.81 cfs and 461 af.

When water rights 65-509, 65-7167, 65-7903, 65-7904, 65-13344 and 65-13588 are combined, they are limited to a maximum diversion rate 2.81 cfs and 461af.

65-13588:

This water right supplies heating to the greenhouses from 3 springs along the South Fork of the Payette River and a portion of the non-heating uses after the heat value has been used. The springs are in the river bank, so they appear to be right on the river or in the river. The source temperature of these springs was described by the Geo-Heat Center to be 138 degrees. I determined that the total square footage being heated to 166,445 sq feet.

During the field exam, I used a spreadsheet commonly used by the Department to determine the amount of water needed for heating purposes. This spreadsheet was designed for a home, and this use is for greenhouses that generate a certain amount of solar heat by their design. Therefore, I worked with Michele Eld to create a new estimation of the volume of water needed for heating the greenhouses. The original volume calculated was 498 af, and the new volume calculated is 445 acre feet. Please see attached sheets for the new calculations. The heating component for the greenhouses will be limited to 445 acre feet.

Water rights 65-509, 65-7167, and 65-7903 allow a total of 9.5 af for commercial and industrial uses that would include the heating component and the irrigation use within the green house. The volume for water right 65-509 of 74.8 af was removed during the adjudication process, so no volume limitation is given on this water right. Water rights 65-7167 and 65-7903 grossly underestimate the amount of commercial water used for this system for heating, irrigation, and commercial uses described as a single commercial use. Therefore, a combined limitation must be done to ensure that there is a volume limitation for the commercial, heating, and irrigation uses described by commercial use in this water right.

There are two homes on this system that were not included in this calculation, because they are included in water rights 65-7167 and 65-7903. No volume for heating was given by water rights 65-7167 and 65-7903, so those two rights will supply the full heating requirements for the two homes that is taken out before the hot water reaches the green houses. This water right is for heating, irrigation, and commercial components described within commercial use descriptor for this water right, so it will not include the volume for the heating of the homes.

The diversion rate measured from the three hot springs was 1.94 cfs. Water rights 65-7903, 65-7167, and 65-5639 do allow a total diversion rate of 1.33 cfs from two of the three hot springs described in this water right. If we limit this license to the difference of 0.61 cfs developed with the third spring, there would not be enough water to supply the heating volume needed for this facility. This permit limits the diversion rate to 1.16 cfs, which can supply the full heating volume for the commercial use under this right if needed.

I have recommended that this permit be licensed using the maximum allowed by the permit of 1.16 cfs and 445 acre feet of water for commercial use. Water rights 65-7167 and 65-7903 included the heating of the greenhouses in the commercial use, and the permit was filed to include the heating component in the commercial use, so we will continue to describe the heating of the greenhouses as a commercial use and not a heating use. Any non-heating commercial use under this permit is used after the heat value of the water has been used, so the maximum volume diverted from the springs is 445 af, and shouldn't be increased.

Since there is so much confusion between the existing water rights from the three hot springs, it is important to create combined limitations to avoid further confusion down the road.

When water rights 65-509, 65-7167, 65-7903 and 65-13588 are combined, they are limited to a maximum diversion rate of **1.94 cfs and 445 af for heating** the commercial greenhouses from the three hot springs described in water right 65-13588.

As stated in the review of water right 65-13344, some of the hot water is used for commercial purposes after the heat value is extracted from the hot water. Therefore, the following condition will be needed on this water right.

When water rights 65-509, 65-7167, 65-7903, 65-13344 and 65-13588 are combined, they are limited to a diversion rate for non-heating uses of 37 af.

Another condition will be needed to address the maximum rate of diversion for both the heating and non heating uses for the greenhouses. This amount would include the rate of .087 cfs and volume of 16.3 af diverted from the cold water system and the 1.94 cfs and 445 af diverted from the hot water system combined for a maximum combined total of 2.81 cfs and 461 af.

When water rights 65-509, 65-7167, 65-7903, 65-7904, 65-13344 and 65-13588 are combined, they are limited to a maximum diversion rate 2.81 cfs and 461af.

This permit had several conditions that needed updated, so I added conditions R04, X60, X22, R43, 004, and X05. The permitted rates will be 1.16 cfs and 445 af.

MEMORANDUM

TO: Water Right File – 65-13344A and 65-13588

FROM: Daniel Nelson – Staff Hydrologist

DATE: June 24, 2013

SUBJECT: Review of Water Right File for Licensing

I performed the field exams on these two files in 1999. Both of the exams were done at the same time, and they are in a related system. Water right 65-13344A is for the use of cold water from the South Fork of the Payette River, and 65-13588 is for hot springs that are found at the edge of the South Fork of the Payette River. Both uses claim to be commercial uses. The system uses approximately 37 acre feet of water for commercial use and 445 acre feet of water for heating. Approximately 20.7 acre feet of the hot water system is used for commercial use in this system after the heat value has been used for heating the greenhouses and the remaining 16.3 acre feet of commercial use comes from the cold water system directly from the South Fork of the Payette River. The hot water is run into the greenhouses for heating and then mixed with cold water to supply water for bathrooms and irrigation of the crops in the greenhouses. Although I will discuss both rights in this memo for convenience and clarity, I will discuss each right separately below:

65-13344A:

This water right is diverted directly out of the South Fork of the Payette River. The water is run to the greenhouse facility approximately $\frac{3}{4}$ of a mile to the east of the point of diversion. This system has a flow meter on the line, and volume was attained using this meter. A measurement and flow meter calibration was also done on this system, so the diversion rate and volume should be accurate. The total commercial use includes irrigation, bathroom and shower facilities at the greenhouse. The irrigation use is year round, so there is no limitation on the season of use. The total commercial use was calculated to be 37 acre feet.

There are other irrigation rights that appear to overlap the place of use, but those rights appear to be for irrigation outside of the greenhouses, since they all have a normal irrigation season of use. The owner informed me at the time of the exam that water right 65-5638 was used to irrigate a tree farm that is no longer in use, and water rights 65-503 and 65-5640 appear to be attached to the homes that are on the site. All of the irrigation in the greenhouses is described as commercial use on the remaining water rights.

I have recommended that this permit be licensed using the measured amounts of 0.87 cfs and 16.3 acre feet of water for commercial use. This permit had several conditions that needed updated, so I added conditions R04, X60, X22, R43, 004, and X05.

Water right 65-7904 is the only other water right that only supplies cold water to this system. Water rights 65-7904 and 65-13344A do not contribute to the heating of the greenhouses, so there is no heating conditions or descriptors. All of the cold water commercial use for this facility at the time of my exam was being taken through the South Fork of Payette River diversion, so when all cold water sources are combined, they need to be limited to 0.87 cfs and 16.3 af per year. Therefore, the following conditions are needed.

When water rights 65-7904 and 65-13344A are combined, they are limited to 0.87 cfs and 16.3 af per year.

The hot springs do supply some of the water supplied for commercial and irrigation water for this facility. It is run through the heating system and then is run into a cooling tank to mix with the cold water to attain a usable temperature. Therefore, another condition will be needed to describe the maximum developed volume for the non-heating uses.

When water rights 65-509, 65-7167, 65-7903, 65-7904, 65-13344A and 65-13588 are combined, they are limited to a maximum diversion volume for non-heating uses to 37 af.

Another condition will be needed to address the maximum rate of diversion for both the heating and non heating uses for the greenhouses. This amount would include the rate of .087 cfs and volume of 16.3 af diverted from the cold water system and the 1.94 cfs and 445 af diverted from the hot water system combined for a maximum combined total of 2.81 cfs and 461 af.

When water rights 65-509, 65-7167, 65-7903, 65-7904, 65-13344A and 65-13588 are combined, they are limited to a maximum diversion rate 2.81 cfs and 461af.

65-13588:

This water right supplies heating to the greenhouses from 3 springs along the South Fork of the Payette River and a portion of the non-heating uses after the heat value has been used. The springs are in the river bank, so they appear to be right on the river or in the river. The source temperature of these springs was described by the Geo-Heat Center to be 138 degrees. I determined that the total square footage being heated to 166,445 sq feet.

During the field exam, I used a spreadsheet commonly used by the Department to determine the amount of water needed for heating purposes. This spreadsheet was designed for a home, and this use is for greenhouses that generate a certain amount of solar heat by their design. Therefore, I worked with Michele Eld to create a new estimation of the volume of water needed for heating the greenhouses. The original volume calculated was 498 af, and the new volume calculated is 445 acre feet. Please see attached sheets for the new calculations. The heating component for the greenhouses will be limited to 445 acre feet.

Water rights 65-509, 65-7167, and 65-7903 allow a total of 9.5 af for commercial and industrial uses that would include the heating component and the irrigation use within the green house. The volume for water right 65-509 of 74.8 af was removed during the adjudication process, so no volume limitation is given on this water right. Water rights 65-7167 and 65-7903 grossly underestimate the amount of commercial water used for this system for heating, irrigation, and commercial uses described as a single commercial use. Therefore, a combined limitation must be done to ensure that there is a volume limitation for the commercial, heating, and irrigation uses described by commercial use in this water right.

There are two homes on this system that were not included in this calculation, because they are included in water rights 65-7167 and 65-7903. No volume for heating was given by water rights 65-7167 and 65-7903, so those two rights will supply the full heating requirements for the two homes that is taken out before the hot water reaches the green houses. This water right is for heating, irrigation, and commercial components described within commercial use descriptor for this water right, so it will not include the volume for the heating of the homes.

The diversion rate measured from the three hot springs was 1.94 cfs. Water rights 65-7903, 65-7167, and 65-5639 do allow a total diversion rate of 1.33 cfs from two of the three hot springs described in this water right. If we limit this license to the difference of 0.61 cfs developed with the third spring, there would not be enough water to supply the heating volume needed for this facility. This permit limits the diversion rate to 1.16 cfs, which can supply the full heating volume for the commercial use under this right if needed.

I have recommended that this permit be licensed using the maximum allowed by the permit of 1.16 cfs and 445 acre feet of water for commercial use. Water rights 65-7167 and 65-7903 included the heating of the greenhouses in the commercial use, and the permit was filed to include the heating component in the commercial use, so we will continue to describe the heating of the greenhouses as a commercial use and not a heating use. Any non-heating commercial use under this permit is used after the heat value of the water has been used, so the maximum volume diverted from the springs is 445 af, and shouldn't be increased.

Since there is so much confusion between the existing water rights from the three hot springs, it is important to create combined limitations to avoid further confusion down the road.

When water rights 65-509, 65-7167, 65-7903 and 65-13588 are combined, they are limited to a maximum diversion rate of **1.94 cfs and 445 af for heating** the commercial greenhouses from the three hot springs described in water right 65-13588.

As stated in the review of water right 65-13344A, some of the hot water is used for commercial purposes after the heat value is extracted from the hot water. Therefore, the following condition will be needed on this water right.

When water rights 65-509, 65-7167, 65-7903, 65-13344A and 65-13588 are combined, they are limited to a diversion rate for non-heating uses of 37 af.

Another condition will be needed to address the maximum rate of diversion for both the heating and non heating uses for the greenhouses. This amount would include the rate of .087 cfs and volume of 16.3 af diverted from the cold water system and the 1.94 cfs and 445 af diverted from the hot water system combined for a maximum combined total of 2.81 cfs and 461 af.

When water rights 65-509, 65-7167, 65-7903, 65-7904, 65-13344A and 65-13588 are combined, they are limited to a maximum diversion rate 2.81 cfs and 461af.

This permit had several conditions that needed updated, so I added conditions R04, X60, X22, R43, 004, and X05. The permitted rates will be 1.16 cfs and 445 af.

LICENSING OVERLAP REVIEW

WATER RIGHT	SOURCE	USE	RATE (CFS)	VOLUME (AFA)	RECOMMENDED DIVERSION RATE	RECOMMENDED VOLUME	COMMENTS
65-503 SRBA Decree	HANKS CREEK	IRRIGATION	0.04				2 acres of irrigation, but no volume limitation has been given.
65-509 SRBA Decree	SPRING	INDUSTRIAL	0.21				industrial Use is for Heating no volume given in decree.
65-5638 SRBA Decree	RUSSELL CREEK	IRRIGATION	0.24				This is an irrigation right for 12 acres, but are not for the same acres as greenhouses. This right was for a tree farm that is no longer in use. No volume given.
65-5639 (SRBA Decree)	RANE SPRING	DOMESTIC	0.02	1.2			This is a domestic right for the home at the site. This system is not connected into the heating component, but the home is heated using these rights.
65-5640 SRBA Decree	UNNAMED STREAM	IRRIGATION DOMESTIC	0.04	1.2			This is a domestic and irrigation right for the home at the site. This system is not connected into the heating component, but the home is heated using these rights.
65-7167 (SRBA Decree)	SPRING	COMMERCIAL HEATING	0.12	4.2			This right is for heating and commercial use. The commercial use is limited to a 4.2 af volume, but the heating use has no volume limitation. Both uses are allowed to use 0.12 cfs.
65-7903 SRBA Decree	SPRING	COMMERCIAL HEATING	1	5.3			The commercial use is for 1.00 cfs and 5.3 af. The heating component is for 0.04 cfs for a home without a volume limitation.
65-7904 SRBA Decree	HANKS CREEK	COMMERCIAL	0.08	16.7			There is no heating component associated with this right.
65-13344A	SOUTH FORK OF THE PAYETTER RIVER	COMMERCIAL	1		0.87	16.3	
65-13588	SPRING	COMMERCIAL	1.16		0.63	457.2	

	RATE IN CFS	VOLUME IN AFA	These numbers do not include water rights 65-13344A and 65-13588. It should also be noted that other than the springs the volumes and diversion rates are from different sources. All of the heating rates are drawn from the same springs.
DECREED COMMERCIAL COLD WATER RATES	0.08	26.2	
DECREED HEATING RATES	1.33		

	RATE IN CFS	VOLUME IN AFA	These numbers show the maximum water use. All of the heating uses are drawn from the same set of springs shown in red above.
MAXIMUM COMMERCIAL AND IRRIGATION COLDS	1.00	37	
MAXIMUM HEATING USE (also used for commercial use after heat value used)	1.94	445	

Please Note:

Water right 65-5638, 65-5639, and 65-5640 should not be included in the overlapping water rights, since it was used for a tree farm that is not connected to the greenhouses system. The only connection between these rights is the home described in 65-5640 is included in the heating component, but the these two rights are for cold water use only.

Conditions will need to be included that when the above rights are combined, they are limited to 1.00 cfs and 37 af for the cold water use and 1.94 cfs an 445 af for the heating use.

Heating Spreadsheet

License Review = 65-13588

Review by Dan Nelson

Date 6/26/2013

$$\frac{(HL) \times (DD) \times (C_D) \times (24 \text{ hrs/day})}{(\Delta t_1) \times (k) \times C \times (\Delta t_2)} = V$$

15100000.00	8052.00	0.85	24.00	=	V
65.00	0.90	2720000.00	35.00		

445.367

V = Volume

HL = Peak Heating Load

DD = Annual Heating Degree Days

24 = Hours/day

C_D = empirical correction factor for heating vs. 65 f degree days

Δt_1 = design temperature difference

k = correction factor to account for losses in system

C = Constant to correct for Desired Units (2.72×10^6 for acre feet)

Δt_2 = temperature of incoming geothermal water minus temperature of outgoing geothermal water.

Please Note:

The Δt_1 used was attained from the NOAA Western Regional Climate Center. The About.com Gardening webpage states that a Poinsettias requires a temperature range of 65 to 75 degrees. I assumed the average designed temperature for the greenhouses would be 70 degrees. Therefore to attain the Δt_1 , I subtracted the smallest average minimum temperature at the Garden Valley Ranger Station of 5.27 degrees from the 70 degree inside temperature or 65 degrees.

The annual degree heating days was also attained from the NOAA Western Regional Climate Center. The Δt_2 and the HL was supplied by the owner from the Geo-Heat Center. The rest of the information was attain from the Rick Sterling 1998 memo attached to this spreadsheet. Michele Eld assisted me in attaining all of this information, and creating this worksheet. The maximum volume should be 445 af instead of the 498 af recommended in the field exam using the outdated spreadsheets.

GARDEN VALLEY R S, IDAHO

Monthly Total Heating Degree Days -103448

Base Temperature = 65 F

File last updated on Apr 4, 2013

*** Note *** Provisional Data *** After Year/Month 201303

a = 1 day missing, b = 2 days missing, c = 3 days, ..etc.,

z = 26 or more days missing, A = Accumulations present

Long-term means based on columns; thus, the monthly row may not
sum (or average) to the long-term annual value.

Months with 5 missing days or less use mean for missing day(s)

Individual Months not used for annual or monthly statistics if more than 5 days are missing.

Individual Years not used for annual statistics if any month in that year has more than 5 days missing.

Period of Record Statistics

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
MEAN	1235.89	973.11	834.01	558.17	325.59	140.15	20.01	33.35	202.09	520.35	895.93	1188.76	6819.75
S.D.	149.36	112.16	100.3	90.49	76.06	53.31	24.4	27.84	132.28	76.97	96.32	120.44	399.89
SKEW	0.96	0.36	0.35	0.17	-0.29	0.08	3.15	0.8	4.75	0.1	0.29	0.25	1.14
MAX	1851.73	1286.5	1167	800	498	262	169	107.5	1165.71	698.5	1095	1482	8052
MIN	940.5	740.92	611.5	358	116.25	25	0	0	39	343.5	697	915.02	6115.06
NO YRS	86	88	86	84	86	89	91	94	83	76	77	76	46

GARDEN VALLEY R S, IDAHO

Monthly Average Temperature (Degrees Fahrenheit)

-103448

File last updated on Apr 4, 2013

*** Note *** Provisional Data *** After Year/Month 201303

a = 1 day missing, b = 2 days missing, c = 3 days, ..etc.,

z = 26 or more days missing, A = Accumulations present

Long-term means based on columns; thus, the monthly row may not
sum (or average) to the long-term annual value.

MAXIMUM ALLOWABLE NUMBER OF MISSING DAYS : 5

Individual Months not used for annual or monthly statistics if more than 5 days are missing.

Individual Years not used for annual statistics if any month in that year has more than 5 days missing.

Period of Record Statistics

YEAR(S)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
MEAN	25.13	30.53	38.1	46.4	54.68	61.67	69.76	67.98	58.97	48.23	35.14	26.65	47.25
S.D.	4.82	3.93	3.24	3.02	2.58	2.7	2.65	2.43	4.75	2.48	3.21	3.89	1.23
SKEW	-0.96	-0.44	-0.35	-0.17	0.34	0.59	-0.51	0.14	-3.99	-0.11	-0.29	-0.25	-0.73
MAX	34.66	38.54	45.27	53.07	62.27	70.72	76.27	74.47	66.33	53.92	41.77	35.48	50.17
MIN	5.27	19.05	27.35	38.33	48.94	56.3	59.81	63.02	26.14	42.47	28.5	17.19	43.64
NO YRS	86	88	86	84	86	89	91	94	83	76	77	76	46

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Poinsettias - Keepers or Compost?

Caring For Your Holiday Poinsettia and Getting It To Bloom Again Next Year

By Marie Iannotti, About.com Guide

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Poinsettias (*Euphorbia pulcherrima*) remain one of the most popular holiday flowers. Hybridizers have expanded the range of colors from the familiar red to pastel yellow and vibrant bi-colors. One of the most common questions after Christmas is "How can I care for my poinsettia so that it will bloom again next Christmas?". While this can be done, it's a very fussy, exacting process and since the plants are not that expensive, you might just choose to start fresh next year.

For those of you who are undaunted, the process for saving your poinsettia and getting it to rebloom begins with the care you give it the first season.



Marie Iannotti

When You First Bring Your Poinsettia Home

Light - Place it near a sunny window. South, east or west facing windows are preferable to a north facing window. Poinsettias appreciate as much direct sunlight as you can provide.

Heat - To keep the poinsettia in bloom as long as possible, maintain a temperature of 65 - 75 degrees F. during the day and 60 degrees F. at night will not hurt the plant. However, cold drafts or allowing the leaves to touch a cold window can cause leaf drop. If you've ever seen a gangly poinsettia in bloom, with only a couple of sad looking leaves hanging on, it was probably too cool or extreme shifts in temperature.

Water - Water the plant whenever the surface feels dry to the touch. Water until it drains out the bottom, but don't let it sit in water. Overwatering is another common cause of leaf drop. A wilted plant can be revived and salvaged, but it will take another season to rebloom.

Humidity - Lack of humidity during dry seasons, in particular winter, is an ongoing houseplant problem. If you place the plant in direct light, you will find yourself watering frequently, possibly every day.

After Christmas Care

January - March: Keep watering the poinsettia whenever the surface is dry.

April: Starting April 1st, gradually decrease water, allowing the to get dry between waterings. Be careful the the plant is too stressed and is dying. In a week or two, when the plant has acclimated to this drying process: heated garage. You want to keep it at about 60 degrees F.

May: In mid-May, cut the stems back to about 4 inches and repot in a slightly larger container, with new potting soil. Put the plant back into the brightest window you have and once again keep it at a temperature of 65 - 75 degrees F until the soil feels dry.

Watch for new growth. Once new growth appears, begin fertilizing every two weeks with a complete fertilizer.

June: Move the poinsettia outside, pot and all. Keep it in a partially shaded location and maintain your watering schedule.

July: In early July, pinch back each stem by about one inch. This is to encourage a stout, well branched plant and spindly.

August: By mid-August, the stems should have branched and leafed out. Once again, pinch or cut the new growth. Move the plant back indoors and back into your brightest window. Continue watering and fertilizing.

September: Continue regular watering and fertilizing. Make sure the temperature stays above 65 degrees F.

October Poinsettias are short-day plants, meaning their bud set is affected by the length of daylight. To re-set the buds, you need 14 hours or less of sunlight per day. You will have to artificially create these conditions and it's crucial that you

Beginning October 1st, keep your plant in complete darkness from 5 pm to 8 am. Any exposure to light will cause the buds to drop. To block out light. Many people place their plants in a closet, but if light gets in through the cracks or if you can

Move the plant back to the sunny window during the daytime and continue watering and fertilizing.

November: Around the last week of November, you can stop the darkness treatment and allow the plant to set buds at this point.

December - Stop fertilizing about December 15th. Keep watering and treat your plant the way you did when it was young. If it goes well, it should be back in bloom and ready to begin the process all over again. What about poinsettias I

Related Searches [Premature Leaf Drop](#) [Extreme Shifts](#) [Cold Window](#) [Holiday Flowers](#) [Day After Christmas](#)

MEMORANDUM

TO: Terry Blau

FROM: Rick Sterling *RS*

SUBJECT: Estimating annual water requirements for geothermal heating

DATE: March 25, 1988

I have come up with a procedure for estimating annual water requirements for geothermal heating that I hope will give reasonably accurate results, yet still be fairly simple to use. Note that the method was developed for predicting residential energy use; consequently, applying it to anything else greatly increases the margin for error. Also note that an underlying assumption in using this procedure is that the heating system in question has an adequate means of adjusting flow rates. The procedure is outlined below in a step-by-step format. Necessary graphs and tables of data are attached.

- Step 1 - Estimate the peak heating requirement per square foot of floor area using the attached graph. Select the design temperature difference along the x-axis, which is the desired indoor temperature minus the design outdoor temperature. Design outdoor temperatures are given for several Idaho locations on the attached table "Climatic Conditions for the United States."
- Step 2 - Multiply the peak heating requirement per square foot of floor area by the dimensions of the building to be heated to obtain a peak heating load in BTU/hr.
- Step 3 - Apply the equation shown below to estimate annual water requirements.

$$V = \frac{HL * DD * 24 * C_D}{\Delta t_1 * k * C \Delta t_2}$$

Where

V= annual volume of geothermal water required

HL= peak heating load in BTU/hr

DD= annual heating degree days (see attached table)

24= 24 hrs/day

C_D = empirical correction factor for heating effect vs. 65 F degree days

Use 0.85 (conservative) for greenhouses - Geo-Heat center research indicates C_D varies from 0.70 to 0.82 for greenhouses.

For standard construction, choose C_D from ASHRAE Figure 1 (attached).

Δt_1 = design temperature difference, i.e., desired indoor temperature minus design outdoor temperature (same as for determining peak heating requirement)

k = correction factor to account for losses in system which do not contribute to space heating of structure, i.e., system efficiency. Use 0.90.

C = constant to correct for desired units

for V in acre-ft use $C = 2.72 \times 10^6$ BTU/AF-°F

for V in gallons use $C = 8.33$ BTU/gal-°F

for V in ft³ use $C = 62.4$ BTU/ft³-°F

Δt_2 = temperature of incoming geothermal water minus temperature of outgoing geothermal water in degrees F.

Example -

*Glass greenhouse located in Twin Falls

*Design indoor temperature = 60 °F

*Greenhouse dimensions are 100 x 120

$$V = \frac{HL * DD * 24 * C_D}{\Delta t_1 * k * C \Delta t_2}$$

Where

V= annual volume of geothermal fluid

HL= peak heating load

DD= annual heating degree days

24= 24 hrs/day

C_D = empirical correction factor for heating effect vs. 65 F degree days

Use 0.85 (conservative) for greenhouses - Geo-Heat center research indicates C_D varies from 0.70 to 0.82 for greenhouses.

For standard construction, choose C_D from ASHRAE Figure 1 (attached).

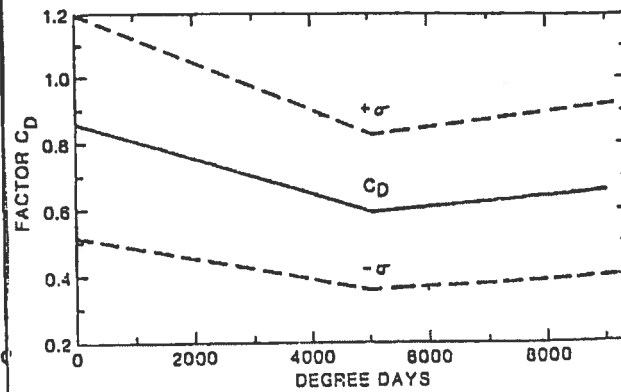


Fig. 1 Correction Factor C_D vs. Degree-Days

Δt_1 = design temperature difference, i.e., desired indoor temperature minus design outdoor temperature (same as for determining peak heating requirement)

k= correction factor to account for losses in system which do not contribute to space heating of structure, i.e., system efficiency. Use 0.90.

C= constant to correct for desired units

for V in acre-ft use $C=2.72 \times 10^6$ BTU/AF-°F

for V in gallons use $C=8.33$ BTU/gal-°F

for V in ft³ use $C=62.4$ BTU/ft³-°F

Δt_2 = temperature of incoming geothermal water minus temperature of outgoing geothermal water in degrees F.

Example -

*Glass greenhouse located in Twin Falls

*Design indoor temperature = 60 °F

*Greenhouse dimensions are 100 x 120

*Geothermal supply water temp = 140° F

*Geothermal water exit temp = 105° F ($\Delta t = 35^\circ$ F)

Inside minus outside temp = $60 - (-3) = 63^\circ$ F

Peak heat required = 137 BTU/hr-ft²

Peak heat load = $137 * 100 * 120 = 1,644,000$ BTU/hr

Heating degree days = 6146

$\Delta t_1 = 63^\circ$ F

k = 0.90

C = 2.72×10^6

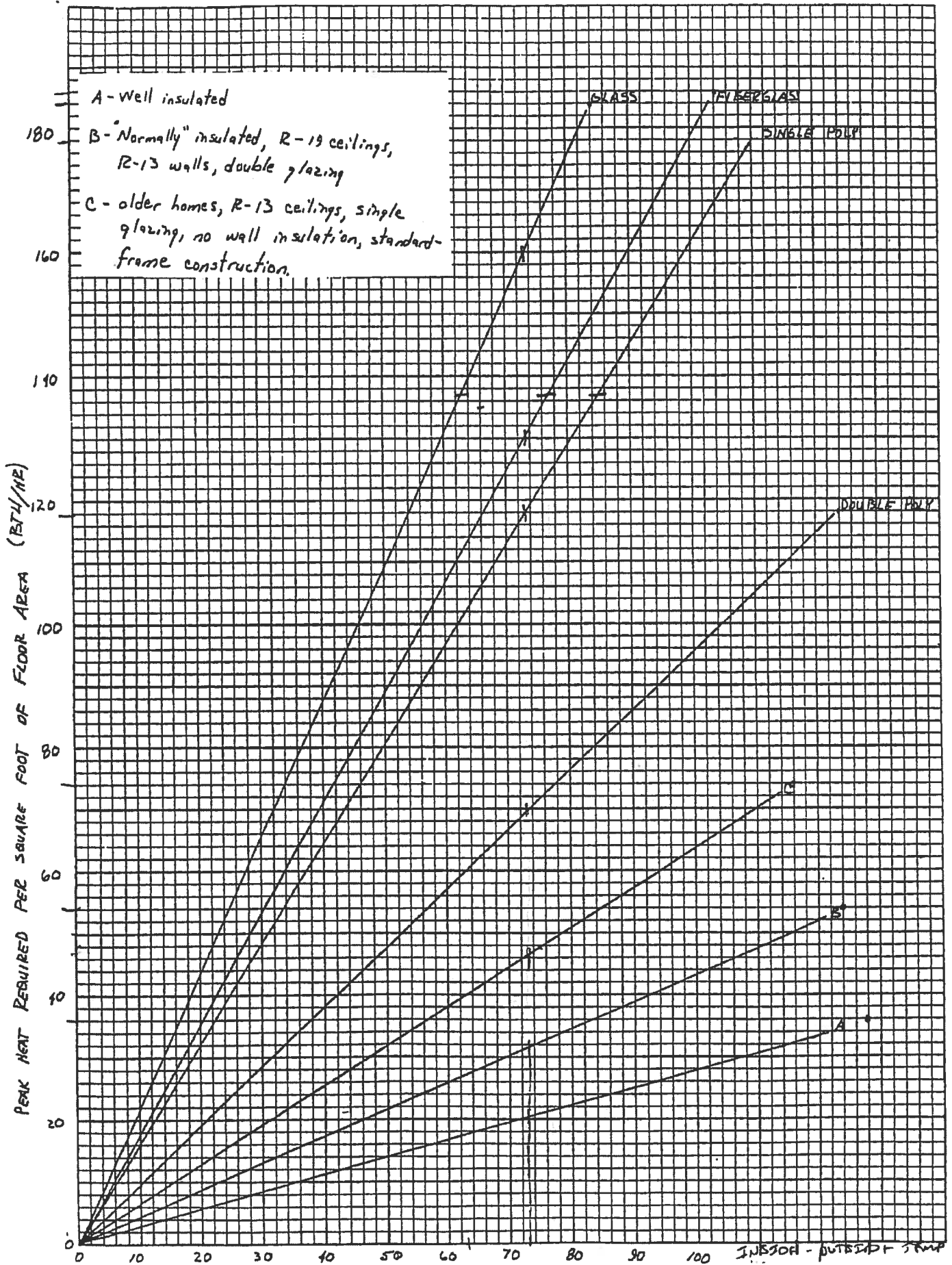
$\Delta t_2 = 140 - 105 = 35^\circ$ F

$$V = \frac{(1644000)(6146)(24)(0.85)}{(63)(0.90)(2.72 \times 10^6)(35)}$$

$$= 38.2 \text{ AF/yr}$$

(NOTE: the larger Δt_2 gets, the smaller V gets, i.e., big Δt_2 's require less water.)

Call me if you have any questions.



Often energy calculations lead to an economic analysis to establish cost effectiveness of conservation measures. Thus, thorough energy analysis provides intermediate data, such as time of energy usage and maximum demand, so that utility charges can be accurately estimated. Although not actually part of the energy calculations, it is necessary to estimate capital equipment costs to complete this process. This is often done in conjunction with the energy analysis.

Methods Available

The sophistication of the calculation procedure can often be inferred from the number of separate ambient conditions and/or time increments used in the calculations. Thus, a simple procedure may use only one measure, such as annual degree days, and will be appropriate only for simple systems and applications. In this case, these methods are called *single-measure methods*. Accuracy can be improved by using more information, such as the number of hours anticipated under particular operating conditions. These methods, of which the *bin method* is best known, are referred to as *simplified multiple-measure methods*. The most elaborate methods perform energy balance calculations hourly over a given analysis period, typically one year. These are called *detailed simulation methods*. There are a number of variations. These methods require hourly weather data, as well as hourly estimates of internal loads such as lighting and occupants. Although not widely accepted as necessary, some calculations are made over shorter time intervals.

The tendency in the literature to classify methods of energy calculations as either "hand calculation" or "computer" methods are no longer appropriate, since even the simplest methods today are programmed for computer or programmable calculator solution.

The growing importance of solar heating and/or cooling of buildings requires that methods for energy analysis be available to the engineer or designer. Solar systems differ from conventional systems primarily in that they require mathematical models of solar collectors and other specialized components. Also, assumptions that are suitable for analysis in conventional systems may not be applicable to solar systems, because of the greater sensitivity of solar systems to climate variation. Therefore, this chapter includes a separate section on the analysis of active and passive solar heating and cooling systems.

PART I: SINGLE MEASURE METHODS

While the single measure methods described in this section generally apply only to residences, the equivalent full-load hour technique for estimating cooling is also used in light commercial applications.

Records of past energy requirements and/or fuel consumption for a particular residence are the best basis for estimating future energy use. However, in the absence of past records for a particular residence, the data from similar local dwellings can be used, but with caution. Living habits vary greatly and identical residences can have very different energy use patterns. Averages taken from many types of plants in many types of residences in various localities can be inaccurate when applied to a particular residence. Therefore, it is often necessary to estimate energy consumption from computed heating and/or cooling loads.

In preparing energy estimates, it is important to know that any estimating method produces a more reliable result over a long period of operation than over a short period. Nearly all of the methods used give reasonable results over a full annual heating season, but estimates for shorter periods, such as a

month, can produce inaccurate results. As the estimation period is shortened, there is more chance that some factor not taken directly into account in the estimating method will deviate from its long-term average value, causing an error in the predicted energy requirement.

Single-measure methods can be divided into those applicable to estimating heating energy requirements and cooling energy requirements. Generally, heating methods have existed longer and are more refined than cooling methods.

HEATING ENERGY

The traditional degree day procedure for estimating heating energy requirements is based on the assumption that, on a long-term average, solar and internal gains will offset heat loss when the mean daily outdoor temperature is 65 F or higher and that fuel consumption will be proportional to the difference between the mean daily temperature and 65 F. In other words, on a day when the mean temperature is 20 deg F below 65 F, twice as much fuel is consumed as on days when the mean temperature is 10 deg F below 65 F. This basic concept can be represented in an equation stating that energy consumption is directly proportional to the number of degree days in the estimation period. The equation has undergone several stages of refinement¹⁻⁴ in an attempt to make it agree as closely as possible with the available measured data on an average basis. The currently recommended form is:

$$E = \frac{H_L \cdot D \cdot 24}{\Delta t \cdot k \cdot V} (C_D) \quad (1)$$

where

E = fuel or energy consumption for the estimate period, Btu.

H_L = design heat loss, including infiltration and ventilation, Btu/h.

D = number of 65 F degree days for the estimate period.

Δt = design temperature difference, deg F.

k = a correction factor that includes the effects of rated full load efficiency, part load performance, oversizing and energy conservation devices.

V = heating value of fuel, units consistent with H_L and E .

C_D = empirical correction factor for heating effect vs. 65 F degree days.

Although empirical, this equation has some basis in physical fact. In an approximate sense, $H_L / \Delta t$ can be thought of as an overall inside-to-outside thermal conductance (UA) for the building. In a similar sense, the D can be thought of as the inside-to-outside temperature difference averaged over the day, so that the product yields the daily heating load. Division by the fuel heating value yields the ideal amount of fuel required for the day. The constant is for unit conversion, i.e., 24 h/d. The factors k and C_D are empirical and attempt to account for the various effects noted in their definitions.

Values of heating load H_L must be determined for the residence for which the estimate is being made. It must account for size, building materials, architectural features, use and climatic conditions. Generally, the peak design heating load is used. This is normally calculated without consideration to solar and internal gains to reflect the peak heating requirement. Although the transmission loss is independent of the type of heating system, duct or pipe losses and air infiltration losses are not. Thus, the design heat loss should include duct or pipe losses to unconditioned spaces, reflecting the average warm air, water or steam temperature, and should reflect the additional air infiltration resulting from a stack in or adjacent to the conditioned space. Recent work^{5,6} suggests infiltration increases about 20% in fuel-heated homes without sealed combustion systems. Reeves, *et al.*⁷ suggest an increase

of 12.5% when an unsealed combustion system is in an unconditioned space such as a basement. This factor is important because it accounts for a significant portion of the annual heat loss. Typical values of residential infiltration are 0.5 to 0.75 air changes per hour for noncombustion systems and combustion systems that do not draw from the conditioned space, and 0.5 to 1.0 air changes per hour for other combustion heating systems.

Degree day values are calculated from monthly mean temperature statistics for the 30-y long-term period 1941-1970 using a procedure developed by H.C.S. Thom.^{8,9} The statistics are the monthly means and the standard deviation of the means around the 30-y normal. Degree days are not accumulated from the period of record on a day-by-day basis. The U.S. Weather Bureau, National Climatic Center, has published degree days to base 65 F, and to a wide range of other base temperatures.¹⁰ Degree days for Canadian cities were supplied by the Canadian Climatic Centre, Atmospheric Environmental Service, 4905 Dufferin St., Downsview, Ontario, Canada M3H 5T4, and were computed from mean temperature normals on record for various stations.

Studies made by the American Gas Association before 1932,¹¹ and by the National District Heating Association in 1932,¹² indicated that 65 F was an appropriate base. However, residential insulation practices have improved from virtually none in 1930 to R-11 in walls and R-30 in ceilings today.

Internal gains also have increased dramatically. Edison Electric Institute reports¹³ show average residential electric usage of 675 kWh per month in 1973 versus 46 kWh in 1930. Recent research indicates that *monthly average* internal and solar gains are sufficient to offset a home's heat loss at mean daily temperature below 65 F. This suggests that the degree day procedure might be developed in the future to consider the use and effect of lower base temperatures. This is discussed later (see Variable Base Degree Day Method).

The errors inherent in the established 65 F-based method can be adjusted by using an empirical factor C_D . Figure 1 gives available values for C_D . These values are calculated using typical modern single-family construction (ASHRAE Standard 90-1980), and generally agree with electric utility experience. Local estimates of C_D values may be available from the energy supplier and would be more applicable to a specific site, since this value is highly variable. The dashed lines on the figure indicate $\pm$ one standard deviation, based on EPRI tests in the Denver area.¹⁴ An Edison Electric Institute study of low income apartments recommended a C_D of approximately 0.5.¹⁵

The correction factor k is empirical, for use in Eq. (1), and should not be confused with any ratings for "seasonal efficiency," such as the DOE tests. For electric resistance

heating, a value of 1.0 should be used. For fossil fuels, analysis of 140 gas-heated homes³ participating in the AGA "Space Heating System Efficiency Improvement Program" using Eq. (1) and Fig. 1 yielded a mean value of 0.55 with a standard deviation of 0.22.³ While a k value of 0.55 is indicated for the group of homes in this program, there are other indications that a somewhat higher value of 0.65 is appropriate for newer homes with energy conservation features. Other values of k for gas heating systems are available from the AGA. The National Oil Jobbers Council has values for oil-heating systems and the Edison Electric Institute has information about electrical heating systems. Variations because of oversizing and conservation techniques are reported in Ref. 16 and the references in the Energy Conservation Effects section of this chapter.

Estimating Oil or Gas Consumption

Equation 1 is applicable to estimates of oil or gas consumption.

Example 1: Estimate the annual gas consumption for a residence with a design heat loss of 65,730 Btu/h at 0 F outdoor and 70 F indoor design temperatures. The home is in an area where the heating season averages 5610 F degree days and natural gas is sold by the therm—100,000 Btu/therm. A 100,000 Btu/h (input) furnace is planned.

Solution: Fig. 1 indicates a heating correction factor C_D of 0.60 in the 4000 to 7000 degree day range.

a. With a fully-condensing boiler, assume that k is 0.90:

$$E = \frac{65,730 \cdot 5610 \cdot 24}{70 \cdot 0.90 \cdot 100,000} (0.6) = 842 \text{ therms}$$

b. With an induced draft, spark-ignition forced air furnace, assume a k of 0.80:

$$E = \frac{65,730 \cdot 5610 \cdot 24}{70 \cdot 0.80 \cdot 100,000} (0.6) = 948 \text{ therms}$$

c. With a good quality, conventional, atmospherically-vented furnace, assume a k of 0.60:

$$E = \frac{65,730 \cdot 5610 \cdot 24}{70 \cdot 0.60 \cdot 100,000} (0.6) = 1264 \text{ therms}$$

Example 2: Estimate the seasonal oil consumption of a boiler designed for oil firing in a new, energy-efficient residence located in Toledo, Ohio. The residence has a calculated heat loss of 65,500 Btu/h. The oil heat value is 144,000 Btu/gal. The outdoor design temperature for Toledo is -10 F; indoor design temperature is 70 F.

Solution: Toledo has a normal annual degree day rating of 6494 F. Since the building is new and "energy efficient," including efficient oil burners and so forth, use $k = 0.65$. From Eq. (1):

$$E = \frac{65,500 \cdot 6494 \cdot 24}{80 \cdot 0.65 \cdot 144,000} (0.60) = 818 \text{ gal}$$

Estimating Electrical Energy

These procedures apply only to resistance-type heating devices such as baseboard, electric furnaces and electric boilers. Equation (1) has been used for heat pumps by adding a "seasonal performance factor," but estimating this factor, without comparable building data, is hazardous. The bin method calculation presented later is recommended for heat pumps. For other electric heat systems, Eq. (1) applies.

Example 3: Estimate the energy requirements to heat a residence in Atlanta. The design heat loss is 35,000 Btu/h based on 15 F outdoor and 70 F indoor.

Solution: From Eq. (1):

$$E = \frac{35,000 \cdot 2961 \cdot 24}{55 \cdot 1.0 \cdot 3413} (0.79) = 10,468 \text{ kWh}$$

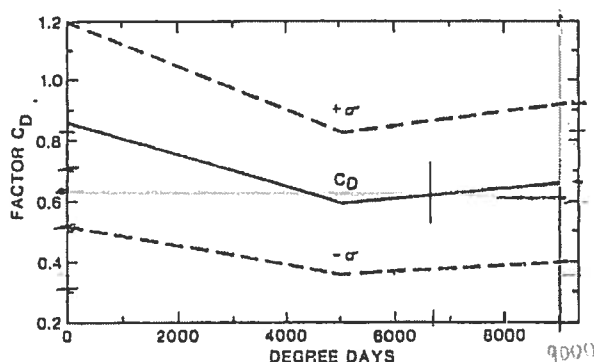


Fig. 1 Correction Factor C_D vs. Degree-Days

Degree Day Method

The simplicity of the above procedure is attractive, but certain facts must be understood to interpret the results.

Several organizations, including the National Bureau of Standards, the Electric Power Research Institute, the Institute of Gas Technology and ASHRAE are developing more valid, simplified procedures, but use of the degree day procedure probably will continue because it is easy to use and allows for quick estimates. It is important to remember that the wide variations in occupant living habits and the assumptions inherent in this procedure can result in large variations from actual fuel use on an annual basis. A study of 46 homes across the U.S. indicated that individual houses experience differences of 30 to 40% for heating.¹⁷ The entire sample of 46 homes had a total error of less than 7%.

Any method of estimating energy use based primarily on calculating heat losses or gains must also take into account the efficiency with which the energy is used. For estimating purposes, the efficiency of energy usage over the calculation period has been used. This is distinct from heating unit efficiency which expresses the heat delivered by a furnace or boiler as a percentage of the heat provided in the fuel; it is the efficiency normally used in describing the performance of a unit under rated or stated load conditions.

On one hand, a University of Illinois study¹⁸ showed that in a two-story residence with an inside chimney, as much as 35% of the heat delivered to the chimney, which would normally be considered a loss so far as heating unit efficiency is concerned, can be delivered to the house through the heated chimney walls. Much of this recovered heat may be available for heating. On the other hand, the same study showed that at times only about 50% of the heating requirement was supplied directly by the heating unit. People, lighting, appliance use and solar gains all contribute substantially. As insulation standards have improved and appliance and lighting use have increased, even larger percentages of the heating requirement are provided by such internal sources. This results in frequent operation at part load and, consequently, at lower than design efficiency.¹⁹

The utilization efficiency can vary widely even in similar residences in the same area. A fixed value could be misleading because of many factors affecting it. A system's efficiency depends on the operation of the equipment, the control arrangement and human habits. The location of the heating unit and the chimney and the net effect of infiltration often are important in determining the efficiency of utilization for heating. Efficiency also can vary with the time of year because the average load on the furnace varies. Some reasons for this have been demonstrated in intermittently fired oil furnaces.²⁰ In buildings other than residences, the efficiency of utilization of the heat supplied in the fuel also can vary widely.

THE VARIABLE BASE DEGREE DAY METHOD

Overview

The variable base degree day (VBDD) method²¹⁻²⁶ is a generalization of the widely used degree day method. It retains the familiar degree day concept, but counts degree days based on the *balance point temperature*, defined as the average outdoor temperature at which the building requires neither heating nor cooling. (Note that this balance temperature is not related to the balance temperature used in heat pump performance modeling). The use of the method for calculating heating fuel requirements is described in this section, but variations on the method have also been used for cooling calculations.^{21,24,26}

The degree-day procedure is intended to recognize that, although the energy transferred out of a building is proportional to the difference between interior space temperature and the outside temperature, the heating equipment needs to meet only the part not covered by "free heat" from internal sources such as lights, equipment, occupants and solar gain. In other words, the free heat covers energy requirements down to the *balance point temperature*, below which the energy requirements of the space are proportional to the difference between the balance point temperature and the outside temperature.

The balance temperature T_b for a building depends on indoor temperature, thermal properties the heat gains from appliances, sun and any other sources not related to the space conditioning system. The steady-state heating requirements of a building Q_H can be expressed as:

$$Q_H = \text{BLC}(T_i - T_o) - Q_g \quad (2)$$

where

BLC = building loss coefficient, Btu/h · F

T_i = indoor temperature, F

T_o = outdoor temperature, F

Q_g = all space heat gains not attributed to the space conditioning system, Btu/h

The balance temperature is determined by setting $Q_H = 0$ and solving Eq. (2) for $T_o = T_b$, so:

$$T_b = T_i - Q_g/\text{BLC} \quad (3)$$

While Eq. (2) and (3) are strictly true only for steady-state conditions, the variable base degree day method assumes that these equations can be used for analysis if all quantities are replaced by appropriate average values for the period analyzed, typically ranging from a month to a heating season.

Once the balance temperature is determined, the energy consumption can be calculated as:

$$E_H = \frac{24 \cdot \text{BLC} \cdot \text{DD}_{T_b}}{k} \quad (4)$$

where

DD_{T_b} = degree days calculated to the base temperature T_b

k = a correction factor that includes the effects of rated full load efficiency, part load performance, oversizing and energy conservation devices

There is considerable flexibility inherent in the VBDD concept since E_H can be calculated for periods as short as a few days and as long as a season. If E_{HT} is calculated for less than an entire season, then the total seasonal requirement E_{HT} becomes:

$$E_{HT} = \sum_{L=1}^N E_{HL} \quad (5)$$

(where e.g., $N = 12$ if E_{HL} is calculated on a monthly basis).

The concept also lends itself to different levels of complexity in calculating each factor in Eq. (2) and (3). This method implicitly assumes that storage in the building is adequate to average out and use the free heat provided from internal gains and sunlight. Since it is known that passive solar buildings continue to require auxiliary heating when the average value of the free heat (Q_g) is greater than the average losses, the VBDD method should not be used for buildings where a large portion of the heat is provided by Q_{solar} . Methods suitable for use on such buildings are described in Section IV.

TABLE 1 CLIMATIC CONDITIONS FOR THE UNITED STATES^a

Col. 1 State and Station	Col. 2 Latitude ^b	Col. 3 Longitude ^c	Col. 4 Elevation ^c Ft	Winter, ^d F		Summer, ^e F								
				Col. 5		Col. 6			Col. 7		Col. 8			
				Design Dry-Bulb		Design Dry-Bulb and Mean Coincident Wet-Bulb			Mean Daily Range		Design Wet-Bulb			
				99%	97.5%	1%	2.5%	5%			1%	2.5%	5%	
Cape Kennedy AP	28	3	80	3	16	35	38	90/78	88/78	87/78	15	80	79	79
Daytona Beach AP	29	1	81	0	31	32	35	92/78	90/77	88/77	15	80	79	78
Fort Lauderdale	26	0	80	1	13	42	46	92/78	91/78	90/78	15	80	79	79
Fort Myers AP	26	4	81	5	13	41	44	93/78	92/78	91/77	18	80	79	79
Fort Pierce	27	3	80	2	10	38	42	91/78	90/78	89/78	15	80	79	79
Gainesville AP (S)	29	4	82	2	155	28	31	95/77	93/77	92/77	18	80	79	78
Jacksonville AP	30	3	81	4	24	29	32	96/77	94/77	92/76	19	79	79	78
Key West AP	24	3	81	5	6	55	57	90/78	90/78	89/78	9	80	79	79
Lakeland CO (S)	28	0	82	0	214	39	41	93/76	91/76	89/76	17	79	78	78
Miami AP (S)	25	5	80	2	7	44	47	91/77	90/77	89/77	15	79	79	78
Miami Beach CO	25	5	80	1	9	45	48	90/77	89/77	88/77	10	79	79	78
Ocala	29	1	82	1	86	31	34	95/77	93/77	92/76	18	80	79	78
Orlando AP	28	3	81	2	106r	35	38	94/76	93/76	91/76	17	79	78	78
Panama City, Tyndall AFB	30	0	85	4	22	29	33	92/78	90/77	89/77	14	81	80	79
Pensacola CO	30	3	87	1	13	25	29	94/77	93/77	91/77	14	80	79	79
St. Augustine	29	5	81	2	15	31	35	92/78	89/78	87/78	16	80	79	79
St. Petersburg	28	0	82	4	35	36	40	92/77	91/77	90/76	16	79	79	78
Sanford	28	5	81	2	14	35	38	94/76	93/76	91/76	17	79	78	78
Sarasota	27	2	82	3	30	39	42	93/77	92/77	90/76	17	79	79	78
Tallahassee AP (S)	30	2	84	2	58	27	30	94/77	92/76	90/76	19	79	78	78
Tampa AP (S)	28	0	82	3	19	36	40	92/77	91/77	90/76	17	79	79	78
West Palm Beach AP	26	4	80	1	15	41	45	92/78	91/78	90/78	16	80	79	79
GEORGIA														
Albany, Turner AFB	31	3	84	1	224	25	29	97/77	95/76	93/76	20	80	79	78
Americus	32	0	84	2	476	21	25	97/77	94/76	92/75	20	79	78	77
Athens	34	0	83	2	700	18	22	94/74	92/74	90/74	21	78	77	76
Atlanta AP (S)	33	4	84	3	1005	17	22	94/74	92/74	90/73	19	77	76	75
Augusta AP	33	2	82	0	143	20	23	97/77	95/76	93/76	19	80	79	78
Brunswick	31	1	81	3	14	29	32	92/78	89/78	87/78	18	80	79	79
Columbus, Lawson AFB	32	3	85	0	242	21	24	95/76	93/76	91/75	21	79	78	77
Dalton	34	5	85	0	720	17	22	94/76	93/76	91/76	22	79	78	77
Dublin	32	3	83	0	215	21	25	96/77	93/76	91/75	20	79	78	77
Gainesville	34	2	83	5	1254	16	21	93/74	91/74	89/73	21	77	76	75
Griffin (S)	33	1	84	2	980	18	22	93/76	90/75	88/74	21	78	77	76
La Grange	33	0	85	0	715	19	23	94/76	91/75	89/74	21	78	77	76
Macon AP	32	4	83	4	356	21	25	96/77	93/76	91/75	22	79	78	77
Marietta, Dobbins AFB	34	0	84	3	1016	17	21	94/74	92/74	90/74	21	78	77	76
Moultrie	31	1	83	4	340	27	30	97/77	95/77	92/76	20	80	79	78
Rome AP	34	2	85	1	637	17	22	94/76	93/76	91/76	23	79	78	77
Savannah-Travis AP	32	1	81	1	52	24	27	96/77	93/77	91/77	20	80	79	78
Valdosta-Moody AFB	31	0	83	1	239	28	31	96/77	94/77	92/76	20	80	79	78
Waycross	31	2	82	2	140	26	29	96/77	94/77	91/76	20	80	79	78
HAWAII														
Hilo AP (S)	19	4	155	1	31	61	62	84/73	83/72	82/72	15	75	74	74
Honolulu AP	21	2	158	0	7	62	63	87/73	86/73	85/72	12	76	75	74
Kaneohe Bay MCAS	21	2	157	5	18	65	66	85/75	84/74	83/74	12	76	76	75
Wahiaawa	21	3	158	0	900	58	59	86/73	85/72	84/72	14	75	74	73
IDAHO														
Boise AP (S)	43	3	116	1	2842	3	10	96/65	94/64	91/64	31	68	66	65
Burley	42	3	113	5	4180	-3	2	99/62	95/61	92/66	35	64	63	61
Coeur d'Alene AP	47	5	116	5	2973	-8	-1	89/62	86/61	83/60	31	64	63	61
Idaho Falls AP	43	3	112	0	4730r	-11	-6	89/61	87/61	84/59	38	65	63	61
Lewiston AP	46	2	117	0	1413	-1	6	96/65	93/64	90/63	32	67	66	64
Moscow	46	4	117	0	2660	-7	0	90/63	87/62	84/61	32	65	64	62
Mountain Home AFB	43	0	115	5	2992	6	12	99/64	97/63	94/62	36	66	65	63
Pocatello AP	43	0	112	4	4444	-8	-1	94/61	91/60	89/59	35	64	63	61
Twin Falls AP (S)	42	3	114	3	4148	-3	2	99/62	95/61	92/60	34	64	63	61

IDAHO

MONTHLY AND ANNUAL HEATING DEGREE DAY NORMALS

STATION	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANNUAL
ABERDEEN EXP STATION	14	44	242	567	915	1221	1355	1047	942	812	362	161	7482
AMERICAN FALLS 1 SW	0	23	178	498	855	1141	1268	986	899	576	335	145	6902
ANDERSON DAM	0	12	143	408	783	1082	1203	863	880	540	284	121	6430
ARROWROCK DAM	0	14	150	460	819	1081	1215	835	837	525	288	117	6451
ASHTON 1 S	70	123	338	639	1035	1358	1460	1187	1169	728	434	251	8793
AVERY R 5 NO 2	36	58	211	515	870	1088	1163	889	859	573	333	153	6758
BLACKFOOT 2 SSW	7	23	200	487	878	1187	1280	994	893	546	298	118	6822
BLISS	0	13	139	411	785	1045	1144	874	775	474	242	88	5870
BOISE WSO	0	12	127	406	756	1020	1116	826	741	480	252	87	5833
BONNERS FERRY 1 SW	31	71	253	588	918	1125	1240	949	877	558	323	148	7091
BURLEY FAA AIRPORT	0	28	204	505	834	1107	1221	927	859	573	331	141	6731
CALDWELL	8	28	150	440	765	1011	1107	804	681	420	217	95	5738
CAMBRIDGE	12	25	184	512	855	1156	1318	1005	940	504	279	119	6808
CASCADE 1 NW	85	135	354	657	993	1287	1388	1126	1084	758	518	323	8720
CHALLIS	27	68	237	558	948	1305	1407	1072	970	621	381	187	7781
CHILLY BARTON FLAT	157	223	438	747	1118	1488	1603	1291	1209	816	561	351	10000
COEUR D'ALENE 1 E	16	44	192	502	825	1042	1165	896	859	564	316	142	6864
CONDA	85	118	350	670	1050	1352	1451	1212	1206	804	521	312	9132
COUNCIL	0	25	163	474	831	1128	1246	966	853	518	283	122	6610
DEADWOOD DAM	160	202	405	704	1044	1376	1454	1173	1178	864	614	381	9555
DEER FLAT DAM	0	12	137	428	783	1001	1110	818	707	435	230	78	5708
DRIGGS	81	113	349	660	1065	1367	1476	1207	1187	788	524	305	9123
DUBOIS EXP STATION	20	48	256	588	1020	1342	1457	1190	1150	705	419	215	8424
EMMETT 2 E	0	18	135	412	750	995	1094	804	681	423	218	84	5623
FENN RANGER STATION	5	18	167	481	789	1020	1116	832	775	498	283	105	6090
FORT HALL INDIAN AGENCY	0	28	193	505	882	1184	1290	994	911	588	333	138	7044
GARDEN VALLEY RS	16	30	181	508	879	1163	1248	848	862	561	320	145	6863
GLENN'S FERRY	0	19	127	390	729	883	1070	798	698	411	187	61	5469
GRACE	47	84	288	611	987	1302	1411	1162	1107	717	450	252	8418
GRAND VIEW 2 W	0	11	124	403	753	1017	1084	780	685	395	172	63	5507
GRANDVILLE	55	108	281	555	858	1088	1159	802	883	633	425	231	7146
HAILEY RANGER STATION	34	75	258	570	889	1214	1423	1137	1076	681	418	225	8184
HAZELTON	7	22	165	455	804	1078	1187	899	818	522	286	109	6353
HILL CITY	46	98	310	638	1005	1358	1504	1228	1178	738	459	268	8830
HOLLISTER	8	36	207	484	822	1076	1169	910	877	591	362	183	6725
IDAHO CITY	45	91	269	567	906	1190	1296	1025	873	651	412	218	7643
IDAHO FALLS FAA AP	10	47	252	580	963	1302	1428	1117	1008	633	371	176	7888
IDAHO FALLS 46 W	21	67	283	651	1053	1407	1507	1210	1104	690	412	204	8618
ISLAND PARK DAM	147	197	441	766	1181	1487	1603	1330	1242	821	614	375	10394
JEROME	0	18	148	435	782	1079	1181	904	815	504	274	106	6256
KELLOGG	34	76	222	533	849	1073	1181	896	859	573	339	163	6798
KOOSKIA	0	24	147	443	780	992	1088	778	704	447	235	92	5730
KUNA 2 NNE	8	29	166	440	768	1020	1116	826	735	471	267	105	5949
LEWISTON WSO	0	17	124	409	735	935	1048	753	685	441	232	84	5464
LIFTON PUMPING STATION	21	72	315	657	1014	1327	1466	1266	1218	765	440	213	8778
LOWMAN 3 E NO 2	87	102	291	586	938	1218	1296	997	946	638	412	227	7720
PACKAY RANGER STATION	45	81	284	614	1020	1392	1485	1190	1113	717	465	245	8661
PAIAD	0	18	188	493	878	1184	1293	1028	924	579	330	147	7061
PAI RANGER STATION	54	99	304	611	1005	1358	1463	1117	1011	675	431	239	8357
PC CALL	96	162	372	676	1014	1286	1411	1156	1183	840	561	330	9077
MONTPELIER RANGER STA	46	84	312	654	1032	1349	1457	1229	1184	758	465	254	8825
MOSCOW U OF I	44	80	288	493	813	1038	1150	865	822	561	357	182	6614
MOUNTAIN HOME	0	20	152	420	768	1029	1125	851	772	483	262	97	5879
NEW MEADOWS RANGER STA	80	154	372	685	990	1308	1429	1123	1078	720	490	276	8718
NEZPERCE	68	97	262	561	873	1088	1200	921	899	630	415	236	7250
OAKLEY	8	28	178	450	786	1051	1144	888	840	561	340	153	6428
OROFINO	0	13	119	425	744	961	1057	758	681	414	200	71	5454
PARMA EXPERIMENT STA	7	19	151	456	783	1035	1144	837	718	441	236	101	5928
PAUL 1 ENE	8	40	218	518	843	1107	1231	952	877	582	338	152	6867
PAYETTE	0	7	128	428	774	1032	1141	840	691	414	198	64	5717
PIERCE	83	133	332	654	986	1218	1321	1033	1020	738	470	248	8218
POCATELLO WSO	0	20	192	515	879	1181	1296	997	918	591	336	138	7083
PORTHILL	38	81	273	617	927	1150	1277	994	921	578	328	158	7336
POTLATCH 3 NNE	67	98	258	533	816	1026	1139	860	840	578	377	200	8785
PRESTON 3 NE	8	27	209	521	891	1208	1336	1064	952	600	343	164	7324
PRIEST RIVER EXP STA	88	117	303	638	957	1188	1280	1000	898	654	400	212	7755
RICHFIELD	20	86	231	548	903	1221	1355	1075	964	618	368	179	7549
RIGGINS RANGER STATION	0	7	92	316	646	877	961	700	626	372	189	61	4849
ST ANTHONY 1 NW	97	81	288	592	981	1311	1435	1156	1091	675	398	206	8311
SAINT MARIES	40	77	222	521	840	1057	1163	876	840	574	333	155	6688
SALMON 1 N	18	62	288	605	969	1318	1432	1064	933	594	356	188	7789
SANDPOINT EXP STATION	52	97	277	598	897	1113	1218	946	808	600	363	181	7250
SHOSHONE 1 NW	6	36	165	468	831	1156	1271	983	874	534	282	127	6733
STREVELL	10	34	227	546	921	1203	1299	1036	964	651	404	205	7600
SUGAR	62	83	298	617	990	1324	1448	1156	1076	660	402	204	8320

IDAHO

MONTHLY AND ANNUAL HEATING DEGREE DAY NORMALS

STATION	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANNUAL
SUN VALLEY	176	223	426	732	1008	1448	1558	1274	1252	843	588	388	10007
SWAN FALLS POLICE HOUSE	0	0	61	212	857	824	1011	728	817	338	138	46	4808
THREE CREEK	80	134	345	620	903	1158	1234	988	992	717	505	208	7870
TWIN FALLS 2 NNE	0	23	168	446	783	1048	1150	885	784	501	288	102	8148
TWIN FALLS 3 SE	0	22	178	468	795	1060	1159	882	818	522	289	131	8324
WALLACE WOODLAND PARK	78	128	305	588	814	1122	1228	953	858	558	437	250	7618
WEISER 2 SE	0	14	137	448	786	1051	1163	854	704	420	202	59	8839

MONTHLY AND ANNUAL COOLING DEGREE DAY NORMALS

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
ABERDEEN EXP STATION	0	0	0	0	6	28	141	108	17	0	0	0	298
AMERICAN FALLS 1 SW	0	0	0	0	7	40	178	150	25	0	0	0	400
ANDERSON DAM	0	0	0	0	15	70	278	229	74	8	0	0	676
ARROWBUCK DAM	0	0	0	0	17	68	265	218	63	0	0	0	824
ASHTON 1 S	0	0	0	0	0	14	30	24	0	0	0	0	66
AVERY R 3 NO 2	0	0	0	0	10	30	128	120	40	0	0	0	329
BLACKFOOT 2 SSW	0	0	0	0	10	46	205	153	35	0	0	0	448
BLISS	0	0	0	0	18	88	285	221	67	5	0	0	885
BOYSE LAGO	0	0	0	0	17	91	285	235	71	0	0	0	714
BONNERS FERRY 1 SW	0	0	0	0	0	22	93	81	16	0	0	0	212
BURLEY FRA AIRPORT	0	0	0	0	9	42	187	134	27	0	0	0	399
CALDWELL	0	0	0	0	34	118	284	217	57	0	0	0	708
CAMBRIDGE	0	0	0	0	10	58	244	188	31	0	0	0	508
CASCADE 1 NW	0	0	0	0	0	14	42	30	8	0	0	0	99
CHALLIS	0	0	0	0	8	25	125	108	18	0	0	0	283
CHILLY BARTON FLAT	0	0	0	0	0	8	24	18	0	0	0	0	49
COEUR D'ALENE 1 E	0	0	0	0	8	37	147	147	38	0	0	0	385
CANON	0	0	0	0	0	0	45	35	8	0	0	0	88
COUNCIL	0	0	0	0	14	85	243	208	55	0	0	0	888
DEERWOOD DAM	0	0	0	0	0	0	14	18	0	0	0	0	30
DEER FLAT DAM	0	0	0	0	18	75	248	182	44	0	0	0	868
DRUMS	0	0	0	0	0	8	43	33	10	0	0	0	104
DUBOIS EXP STATION	0	0	0	0	0	21	138	111	27	0	0	0	297
EMMETT 2 E	0	0	0	0	23	87	253	196	60	0	0	0	818
FERN RANGER STATION	0	0	0	0	14	39	182	159	41	0	0	0	435
FORT HALL IND. AGENCY	0	0	0	0	0	33	171	132	19	0	0	0	363
GARDINER VIA E AS	0	0	0	0	0	43	187	145	4	0	0	0	421
JENNIS FERRY	0	0	0	0	28	110	322	241	70	5	0	0	785
BRACE	0	0	0	0	0	9	60	53	7	0	0	0	128
GRAND VIEW 2 W	0	0	0	0	20	147	347	274	79	0	0	0	896
GRANDEVILLE	0	0	0	0	0	9	92	121	27	0	0	0	252
HAILEY RANGER STATION	0	0	0	0	0	12	105	87	21	0	0	0	235
HAZELTON	0	0	0	0	10	48	230	177	42	5	0	0	513
HILL CITY	0	0	0	0	0	7	64	68	10	0	0	0	149
HOLLISTER	0	0	0	0	9	42	185	145	42	7	0	0	430
IDAHO CITY	0	0	0	0	0	8	82	75	14	0	0	0	178
IDAHO FALLS FRA AP	0	0	0	0	8	26	131	102	21	0	0	0	286
IDAHO FALLS 16 W	0	0	0	0	0	21	117	85	14	0	0	0	237
ISLAND PARK DAM	0	0	0	0	0	0	10	14	3	0	0	0	24
JEROME	0	0	0	0	20	76	267	210	55	0	0	0	628
KELLOGG	0	0	0	0	7	31	118	107	21	0	0	0	284
KOBBSIA	0	0	0	0	15	71	203	173	54	0	0	0	516
KUNA 2 NNE	0	0	0	0	13	48	182	144	31	0	0	0	418
LEWISTON LAGO	0	0	0	0	18	84	264	218	73	0	0	0	657
LIFTON PUMPING STATION	0	0	0	0	0	8	57	41	6	0	0	0	122
LOWMAN 3 E NO 2	0	0	0	0	0	11	73	68	15	0	0	0	187
MACKAY RANGER STATION	0	0	0	0	0	14	78	64	11	0	0	0	188
MALAD	0	0	0	0	7	38	183	146	36	0	0	0	414
MAY RANGER STATION	0	0	0	0	0	8	80	68	10	0	0	0	146
MC CALL	0	0	0	0	0	6	27	28	6	0	0	0	67
MONTPELIER RANGER STA	0	0	0	0	0	8	71	53	6	0	0	0	138

IDAHO

MONTHLY AND ANNUAL COOLING DEGREE DAY NORMALS

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
BOISE U OF I	0	0	0	0	6	23	100	102	28	0	0	0	259
MOUNTAIN HOME	0	0	0	0	20	85	281	225	74	11	0	0	696
NEW MEADOWS RANGER STA	0	0	0	0	0	0	28	27	6	0	0	0	61
NEZPERCE	0	0	0	0	0	11	71	81	27	0	0	0	185
OAKLEY	0	0	0	0	11	42	191	155	38	7	0	0	444
OROFINO	0	0	0	0	20	82	251	218	59	0	0	0	640
PAPA EXPERIMENT STA	0	0	0	0	22	88	252	183	43	0	0	0	608
PAUL J CNE	0	0	0	0	7	36	166	136	21	0	0	0	370
PAYETTE	0	0	0	0	24	103	304	230	59	0	0	0	720
PIERCE	0	0	0	0	8	11	55	44	11	0	0	0	125
POCATELLO WSO	0	0	0	0	7	42	205	155	24	0	0	0	437
PORTHILL	0	0	0	0	0	21	97	71	12	0	0	0	191
PORTLAND 3 MNL	0	0	0	0	5	17	75	62	16	0	0	0	176
PRESTON 3 NE	0	0	0	0	0	35	161	130	25	0	0	0	392
PRIEST RIVER L&N STA	0	0	0	0	0	11	48	48	6	0	0	0	114
RICHFIELD	0	0	0	0	5	20	101	100	21	0	0	0	312
RUGGINS RANGER STATION	0	0	0	0	34	112	347	327	143	15	0	0	864
ST ANTHONY 1 WSW	0	0	0	0	0	11	116	56	9	0	0	0	187
SAINT MARIES	0	0	0	0	0	26	114	105	27	0	0	0	272
SALMON 1 N	0	0	0	0	5	22	112	87	10	0	0	0	236
SANDPOINT EXP STATION	0	0	0	0	0	13	58	57	5	0	0	0	171
SANDS-BONE 1 WSW	0	0	0	0	15	88	273	212	51	0	0	0	641
STANLEY	0	0	0	0	0	34	185	111	32	0	0	0	397
SUGAR	0	0	0	0	5	12	83	46	7	0	0	0	153
SUN VALLEY	0	0	0	0	0	0	15	19	0	0	0	0	34
SWAN FALLS POWER HOUSE	0	0	0	0	8	88	189	452	388	145	13	0	1275
THREE CREEK	0	0	0	0	0	3	55	47	9	0	0	0	111
TWIN FALLS 4 MNE	0	0	0	0	15	68	242	181	45	0	0	0	592
TWIN FALLS 3 SE	0	0	0	0	16	68	217	152	40	0	0	0	486
WALLACE WOODLAND PARK	0	0	0	0	0	10	50	57	14	0	0	0	171
WEISER 2 SE	0	0	0	0	19	82	285	212	50	0	0	0	648

ADMINISTRATOR'S MEMORANDUM

TO: Regional Offices and Water Allocation Section
FROM: Norman C. Young *NCY*
DATE: September 28, 1992 (Replaces version dated May 9, 1984)
RE: Rate of Flow for Heating Use

Application Processing No. 23 (Amended)

The attached guidelines entitled "Method for Estimating Residential Space Heating Load", and "Method for Estimating Rates of Flow for Geothermal Heating Systems" are intended to assist with computation of reasonable rates of flow of geothermal water for heating purposes. The methods are designed to provide straightforward initial estimates for evaluation of applications for permit and are not to be used for final engineering design.

METHOD FOR ESTIMATING RESIDENTIAL SPACE HEATING LOAD

The following is a method to estimate a residential design heat load for sizing heating systems for typical residential buildings.

Design Heat Load

This varies for Idaho from a low of 25 BTU/hr-sq.ft. for a well insulated home in Boise to a high of 75 BTU/hr-sq.ft. for an average insulated home in Soda Springs. These values are appropriate for a single story house. If the house is two stories, then multiply the BTU/hr-sq.ft. ($e \cdot \Delta T$) value by 0.8.

A more precise determination of the BTU's required for a given house can be determined from the formula:

$$E = [e \cdot \Delta T] A \quad \text{where}$$

E = BTU/hr required

e = House efficiency factor BTU/hr-sq.ft.-°F

ΔT = Design temperature difference ($t_i - t_o$) in degrees Fahrenheit for residence

A = Area of livable floor space in the house in sq. ft.

For a two story house the formula becomes $E = [e \cdot \Delta T] 0.8 \times A$.

And,

t_i = the inside design temperatures (approximately 70°F)

t_o = the outside design temperature

Suggested Outside Design Temperatures *

Boise	4°F
Lewiston	6°F
Pocatello	-8°F

* From (American Society of Heating, Refrigeration & Air Conditioning Engineers), Handbook of Fundamentals, 1972.

Values for (e) are as follows:

.28 = Best energy efficiency -

Insulation in addition to that found in the average house, walls are now R19 (5 inches of blanket insulation in a 6 inch wall space), ceilings are R33 (approximately 9 inches of blanket insulation), all windows and doors are caulked and weather stripped.

.44 = Better energy efficiency -

All windows and doors caulked and weather stripped, no additional insulation above the average residence.

.67 = Average residence -

Modern home with no weatherproofing and the following insulation: walls R13 (3-1/2 inches of blanket insulation), ceiling R25 (6 inches of blanket insulation), double pane windows, or single pane with storm windows, concrete floor or concrete block basement wall.

1.11 = Poor energy efficiency -

Older home with the following insulation: walls are approximately R6 (typical frame construction with no insulation between the stud), ceiling R10 (3 inches of loose fill insulation), single pane windows with no storm windows and no weather stripping of the doors and windows.

Table 1 shows some typical BTU's/sq.ft.-hr for the four types of house efficiencies at a variety of design temperatures.

TABLE 1

$e \cdot \Delta T$ = BTU's/sq.ft.-hr for Different House Efficiencies

House Efficiency	Best $e = .28$	Better $e = .44$	Average $e = .67$	Poor $e = 1.11$
Design Temperature Difference $T = (t_i - t_o)$				
50°	14	22	33	56
60°	17	26	40	67
70°	20	31	47	78
80°	22	35	54	89
90°	25	40	60	100
100°	28	44	67	111

Example:

The following is an example problem to determine the design heat load for a hypothetical house. The house is a single story house with 1,250 ft.² of floor with average insulation located in Boise.

The design heat load is estimated from the equation:

$$E = [e \cdot \Delta T] A$$

Where for this case:

$$e = .67 \text{ BTU/hr-ft.}^2\text{-}^\circ\text{F (average insulation)}$$

$$\Delta T = (70-4)^\circ\text{F (assume a } 4^\circ\text{F design temperature for Boise)}$$

$$A = 1,250 \text{ ft.}^2$$

Putting these numbers in the equation gives:

$$E = [.67 \times (66)]1250 = 55,275 \text{ BTU/hr}$$

METHOD FOR ESTIMATING
RATES OF FLOW
FOR
GEOTHERMAL HEATING SYSTEMS

The flow needed from a geothermal heat source depends on the maximum anticipated heat load (design heat load) and the temperature drop across the system (ΔT_s).

Design Heat Load

The design heat load must first be estimated. This can be done several ways. Some examples are:

- 1) Take name plate ratings from equipment
- 2) Take meter readings from existing processes.
- 3) Estimate by heat transfer and/or thermodynamic calculations.

If space heating is required, see attached method for estimation.

Temperature Drop Across System

To determine this, some information about the temperature requirements of the system is required. For instance, for residential space heating a temperature of 70°F is commonly assumed, for drying purposes a temperature of 120°-160° is adequate and to make steam at atmospheric pressure a temperature higher than 212°F is required. Once the system temperature requirement is established, the system temperature drop can be estimated from the formula -

$$\Delta T_s = (0.3)(S - t) \quad \text{where}$$

ΔT_s = Temperature drop across system °F

S = Geothermal source temperature °F

t = Temperature required by system °F

Note that the source temperature must always be higher than the system temperature unless a heat pump is to be used. If a heat pump is used, the temperature required at the evaporator becomes the system temperature.

Flow Rate Required

Once the heat load and temperature drop are estimated, the flow rate can be estimated from the equation -

$$W = \frac{Q}{(500) (\Delta T_s)} \quad \text{where}$$

W = Flow rate in gallons per minute

Q = System heat load in BTU/Hr

ΔT_s = Temperature drop across system °F

These calculations should not be used to design a geothermal heating system, but will give an indication of the approximate flow needed from a geothermal resource when applying for a water right from this Department. An engineer who is knowledgeable about the design of heating systems should be consulted for the actual design.

Example

The following is an example to estimate the flow required to heat a house with a design heat load of 50,000 BTU/hr from a geothermal well with 200°F water.

The heat load is given - 50,000 BTU/hr.

Since the heat load is space heating for comfort, the system temperature is assumed to be 70°F.

The temperature drop across the system is determined from the equation -

$$\Delta T_s = (0.3) (S - t)$$

for this case:

$$\Delta T_s = (0.3) (200^\circ - 70^\circ)$$

$$\Delta T_s = 39^\circ\text{F}$$

The flow rate is determined from

$$W = \frac{Q}{(500) (\Delta T_s)}$$

for this case:

$$W = \frac{50,000 \text{ BTU/Hr}}{500 (39^\circ\text{F})}$$

$$W = \underline{2.56 \text{ GPM}}$$

Therefore, 3 GPM would be a reasonable estimate.

