



Permit Application for Appropriation of Waters of the State NON-IRRIGATION

WARNING: ALL INFORMATION AND SUPPORTING DOCUMENTS SUBMITTED AS PART OF THIS APPLICATION BECOME PUBLIC INFORMATION. Omission of any data requested will delay the processing of your application and may result in its denial.

WHO APPLIES: Any individual, agency, corporation, or entity appropriating in **excess of 10,000 gallons/day and/or 1 million gallons/year** must obtain a Water Appropriation Permit from the Department of Natural Resources as prescribed by Minnesota Statutes, Chapter 103G and Minnesota Rules 6115.0600-6115.0810.

PROCEEDING WITHOUT A PERMIT. Any appropriation in excess of the above stated amounts without a permit constitutes a misdemeanor.
Note: Other federal, state, or local permits or approvals may also be required which are the responsibility of the applicant to obtain.

Application Instructions

Each number below corresponds to the appropriate section on the application form. Read **ALL** instructions carefully before filling out the application. Please type or print clearly.

APPLICANT

1-6. Fill in as directed.

PROJECT INFORMATION

7. PURPOSE: Mark the box that best describes your project and provide a written explanation of what the water will be used for. Attach a letter of explanation if there is not enough space on the application to completely describe the purpose of the project and how the water is used.

Note: Temporary appropriations are one-time projects that do not continue from year to year. Temporary permits are issued for appropriations with durations of up to 12 months. Time extensions may be requested, but the total length of time the permit remains in force cannot exceed two years.

8. SOURCE OF WATER: Mark only one box.

Note: Submit one application for each source of water or system. For example, several wells in the same aquifer manifolded into **one system** constitute **one source**; however, a stream and a gravel pit are **two** sources of water and would require separate applications. (Contact a DNR Waters office if you are unsure whether your project would require one or more applications).

a. WELL - Submit 1) a copy of the official **Water Well Record**, 2) test hole logs and 3) pumping test data, all of which are available from the driller.

Note: Applications for dewatering projects can be submitted before the wells are constructed. Information on the estimated diameter, depth and location of all dewatering wells must be submitted with the application. Water Well Records must be submitted upon completion of well construction. When Water Well Records are not required by Minnesota Rules relating to wells and borings, then a summary of the actual depth, diameter, static water level and location of each well must be submitted.

b. MANIFOLD WELLS - Indicate the number of wells to be manifolded into one system. Submit the SAME information requested in 8.a. for EACH well to be used.

Note: If your well(s) is located in an aquifer for which hydrologic data are limited or unavailable, you may request to submit data regarding area wells.

c. STREAM, DITCH, or RIVER - Identify it and submit a **contingency plan** describing the alternatives you would utilize if the appropriation is restricted because of low water conditions. If no alternative water supply is available, you must submit a written statement agreeing to withstand the results of no appropriation.

Note: Only temporary appropriations from designated trout streams may be approved.

d. WETLAND, LAKE or IMPOUNDMENT - Identify it and submit the following:

1) A contingency plan (see 8.c.).

2) For basins less than 500 acres in size you must:

a) Notify all riparian landowners and submit a list of those landowners.

b) Obtain a signed statement from as many of those riparian landowners as possible which states their support of the proposed appropriation.

c) Provide an accounting of the number of signatures of riparian owners you are unable to obtain.

e. OTHER - Gravel pits, farm ponds, dug pits, etc. Submit information on:

1) Physical dimensions (length-width-depth)

2) Depth to water from land surface

Note: Any proposed alteration of the beds or banks of the above mentioned water basins or streams may require a public waters permit from this Department. This may also include the construction of a pit in a wetland area. Contact a DNR Waters office for details.

9. POINT(S) OF TAKING/PUMPING SITE(S): Indicate the location of your well(s) or pumping site by completing a.-e. Indicate this location to the nearest 10-acre tract by completing a. (ex. NW1/4 of NE 1/4 of SE 1/4). If you plan to install multiple wells or pumping sites, attach a letter of explanation including the legal description of each well/pump site, its pumping rate and method of measurement.

10. MEANS OF TAKING AND RATE: If you mark "d", specify the method to be used and the rate of taking (in gallons per minute or cubic feet per second). If multiple wells or pump sites are to be used, attach a letter of explanation (see #9).

11. METHOD OF MEASUREMENT: Fill in as appropriate.

Note: Flow meters are required by Minnesota Statutes 103G.281, Subdivision 2, for measuring the quantity of water appropriated within the degree of accuracy required by rule (10%). The DNR can approve other methods of measurement. Timing devices, including hour meters and electric meters, are approved devices if there is a constant rate of appropriation. To obtain approval for other methods of measurement, applicants must submit a written request with the application that includes a description of the proposed method.

Also of Note: All permit holders are required to measure and keep monthly and yearly records of the quantity of water used or appropriated.

12. MEANS OF CONVEYANCE: Fill in as appropriate.

13. LEGAL DESCRIPTION: Describe the property that will be affected by your project (example: T101N, R14W, Section 5, NW1/4 and N1/2 SW1/4). **If property other than what you own will be affected, you must attach a copy of the land agreement** which includes a) the legal description of the property, b) the termination date of the agreement, and c) the signature of all parties.

14. MONTHS OF APPROPRIATION: Fill in as appropriate.

15. SCHEDULE OF APPROPRIATION: Mark only one box to indicate your schedule. For temporary projects, the appropriate year(s) should be included with the beginning/ending dates.

16. TOTAL ANNUAL USE: (In million of gallons per year).

Note: Appropriation in excess of 2 million gallons/day may need legislative approval (See Minnesota Statutes 103G.265, Subdivision 3, for exemptions); appropriation averaging 30 million gallons/month for commercial or industrial purposes may require the preparation of an Environmental Assessment Worksheet (see Minnesota Rules 4410.4300, Subpart 24).

17-19. Complete if applicable. In Question 17, indicate the quantity of water to be discharged.

20. ADDITIONAL REQUIREMENTS: Submit the following as part of your application. All applications must include:

- a. Map or air photo showing the project site.
- b. Describe alternative sources of water and methods, including conservation practices that were considered and why the proposed alternative was selected.
- c. Additional documents, letters, or statements required.

21. APPLICATION FEE: A minimum application fee of \$150 is required for each permit application. An application fee of \$300 is required for after-the-fact permit applications. Water use reporting and fees for years in which water appropriations occurred without a permit will also apply. **Please do not submit fees with the permit application, you will be billed separately.** Permits cannot be issued until all fees have been paid.

MAILING: Submit the following to the appropriate DNR Area office (see map on back page for addresses):

- 1) application (keep a copy for your records).
- 2) supporting documents.
- 3) **do not send application fee with the application. You will be billed separately.**

Make sure that you furnish all information that is requested. Forms that are incorrectly filled out or lack requested information will cause a delay in your application.

LOCAL REVIEW: Minnesota Statutes allow local units of government 30 days to review your project and submit comments to the DNR.

A copy of your application will be submitted by the DNR to:

- 1) local soil & water conservation district
- 2) watershed district
- 3) city

ADDITIONAL DATA: You may be required to submit additional information regarding your project. You will be notified if this information is required.

Questions

If you have any questions on the procedure for completing the application, please contact the DNR Area office serving you. The address and telephone number of each DNR office can be found on the back side of the application form.



A-02623-04
(Rev. 3/06)

Minnesota
DNR Waters

Permit Application for Appropriation of Waters of the State NON-IRRIGATION

OFFICE USE ONLY	P.A. No. _____
	Date(s) Served _____
	<input type="checkbox"/> SWCD _____ <input type="checkbox"/> WSD _____ <input type="checkbox"/> CITY _____

NOTICE OF WARNING: All information provided on this form is considered to be public information in accordance with the Minnesota Data Privacies Act (M.S. 15.1611 to 15.1698).

▶ SEE INSTRUCTIONS...TYPE OR PRINT CLEARLY

1. Applicant Name (landowner or renter)		2. Business Name																																													
3. Authorized Agent (if applicable)		4. Phone Numbers (with area codes)																																													
5. Mailing Address		6. City, State, Zip Code																																													
7. Purpose (Explain what the water will be used for) <input type="checkbox"/> Pollution Containment <input type="checkbox"/> Temporary (1 year or less) <input type="checkbox"/> Public Water Supply <input type="checkbox"/> Commercial/Industrial <input type="checkbox"/> Water Level Maintenance <input type="checkbox"/> Other _____																																															
8. Source of Water ("X" one and complete) a. <input type="checkbox"/> One well b. <input type="checkbox"/> _____ manifolded wells c. <input type="checkbox"/> Stream, ditch, or river (name) _____ d. <input type="checkbox"/> Wetland, lake, or impoundment (name) _____ e. <input type="checkbox"/> Other _____		9. Point of Taking/Pumping Site a. _____ 1/4 of _____ 1/4 of _____ 1/4 b. Section No. _____ c. Township No. _____ d. Range No. _____ e. County _____																																													
10. Means of Taking and Rate a. <input type="checkbox"/> Stationary Pump(s) at _____ gpm b. <input type="checkbox"/> Portable Pump at _____ gpm c. <input type="checkbox"/> Gravity Flow at _____ gpm/cfs d. <input type="checkbox"/> Other _____ gpm/cfs (circle one)		11. Method of Measurement a. <input type="checkbox"/> Flow Meter b. <input type="checkbox"/> Timing Device c. <input type="checkbox"/> Electric Power Consumption d. <input type="checkbox"/> Other _____																																													
12. Means of Distribution a. <input type="checkbox"/> pipe _____ diam. _____ length b. <input type="checkbox"/> tank _____ gal. capacity c. <input type="checkbox"/> channel _____ length d. <input type="checkbox"/> other _____		13. Legal Description-Land Owned/Rented * <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <thead> <tr> <th style="width: 15%;">Township No.</th> <th style="width: 15%;">Range No.</th> <th style="width: 15%;">Section</th> <th style="width: 55%;">Fractional Sect. Gov't. Lots</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>		Township No.	Range No.	Section	Fractional Sect. Gov't. Lots																																								
Township No.	Range No.	Section	Fractional Sect. Gov't. Lots																																												
14. Months of Appropriation <input type="checkbox"/> JAN <input type="checkbox"/> JUL <input type="checkbox"/> FEB <input type="checkbox"/> AUG <input type="checkbox"/> MAR <input type="checkbox"/> SEP <input type="checkbox"/> APR <input type="checkbox"/> OCT <input type="checkbox"/> MAY <input type="checkbox"/> NOV <input type="checkbox"/> JUN <input type="checkbox"/> DEC		15. Schedule of Appropriation ("X" one and complete) a. <input type="checkbox"/> Continuous _____ hrs./day _____ days/mo. _____ mo./yr. b. <input type="checkbox"/> Seasonal Beginning date _____ c. <input type="checkbox"/> Temporary End date _____																																													
16. Total Annual Use (Gallons per Year)		17. Discharge To and Quantity a. <input type="checkbox"/> Stream, Ditch or River _____ (name) () MGY b. <input type="checkbox"/> Wetland, Lake or Impoundment _____ (name) () MGY c. <input type="checkbox"/> Sewer System () MGY d. <input type="checkbox"/> Other () MGY																																													
18. Discharge Point a. _____ 1/4 of _____ 1/4 of _____ 1/4 b. Section No. _____ c. Township No. _____ d. Range No. _____ e. County _____		19. Means of Discharge and Rate a. <input type="checkbox"/> _____ (no.) stationary pump(s) at _____ gpm ea. b. <input type="checkbox"/> _____ (no.) portable pump(s) at _____ gpm ea. c. <input type="checkbox"/> Gravity Flow at _____ gpm/cfs d. <input type="checkbox"/> Other _____ gpm/cfs (circle one)																																													
20. Additional Requirements: a. <input type="checkbox"/> Map or Air Photo which shows: <ol style="list-style-type: none"> 1) Point of Taking or Pumping Site 2) Test Hole Location 3) Boundaries of Property Controlled and Area of Use 4) Discharge Point b. <input type="checkbox"/> \$150 Minimum Application Fee will be billed after receipt of application. c. <input type="checkbox"/> Statement of Justification/Alternative Sources d. <input type="checkbox"/> Additional Documents Required																																															

▶ I hereby make application pursuant to Minnesota Statutes Chapter 103G.261 and all supporting rules for a permit to appropriate water in accordance with all supporting maps, plans, and other information submitted with this application. The information submitted and statements made concerning this application are true and correct to the best of my knowledge.

21. Signature of Landowner or Authorized Agent	22. Date
--	----------

▶ IMPORTANT: Submit this application and all supporting data to the DNR Office serving you (see back for addresses).
 APPLICANT: KEEP A COPY FOR YOUR RECORDS.

This information is available in an alternative format upon request.

Northwest Region 1

vacant

246 125th Ave NE
Thief River Falls, MN 56701
(218) 681-0947 ext 223
FAX (218) 681-0948
Kittson/Marshall/Pennington
Polk/Red Lake/Roseau

Darrin Hoverson

darrin.hoverson@state.mn.us
Cass/Hubbard
(218) 699-7297

Dan Thul

dan.thul@state.mn.us
Beltrami/Clearwater/Lake of
the Woods

2115 Birchmont Beach NE
Bemidji, MN 56601
(218) 308-2620
FAX (218) 755-4066

vacant

14583 County Hwy 19
Detroit Lakes, MN 56501
(218) 846-8383
FAX (218) 846-8397
Becker/Clay/Mahnomen
Norman

Julie Aadland ext 243

julie.aadland@state.mn.us
Otter Tail/Traverse/Wadena
Wilkin

Janell Miersch ext 232

janell.miersch@state.mn.us
Douglas/Grant/Pope/Stevens

1509 1st Ave N
Fergus Falls, MN 56537
(218) 739-7576
FAX (218) 739-7601

Northeast Region 2

Amy Loiselle

amy.loiselle@state.mn.us
7979 Highway 37
Eveleth, MN 55734
(218) 744-7450 ext 222
FAX (218) 744-7451
St. Louis

Erika Herr

erika.herr@state.mn.us
1201 East Highway 2
Grand Rapids, MN 55744
(218) 327-4106
FAX (218) 327-4263
Itasca/Koochiching

Patricia Fowler

patricia.fowler@state.mn.us
Carlton/Duluth Metro Area
Cliff Bentley
cliff.bentley@state.mn.us
Cook/Lake

1568 Highway 2
Two Harbors, MN 55616
(218) 834-1440
FAX (218) 834-6639

Lonnie Thomas

lonnie.thomas@state.mn.us
Aitkin/Crow Wing/Pine

1601 Minnesota Drive
Brainerd, MN 56401
(218) 828-2605
FAX (218) 828-6043

Central Region 3

Tim Crocker

tim.crocker@state.mn.us
16543 Haven Road
Little Falls, MN 56345
(320) 616-2450 ext 234
FAX (320) 616-2473
Mille Lacs/Morrison/Todd

vacant

Benton/Stearns
Roger Stradal ext 233
roger.stradal@state.mn.us
Sherburne/Wright
940 Industrial Dr. So. #103
Sauk Rapids, MN 56379
(320) 255-4279
FAX (320) 255-3999

Craig Wills

craig.wills@state.mn.us
800 Oak Savanna Ln SW
Cambridge, MN 55008
(763) 689-7100 x225
FAX (763) 689-7120
Chisago/Isanti/Kanabec

Jack Gleason

john.gleason@state.mn.us
Carver/Hennepin-South

Kate Drewry

kate.drewry@state.mn.us
Anoka/Hennepin-North

Molly Shodeen

molly.shodeen@state.mn.us
Ramsey/Washington

Jeff Berg (acting)

jeff.berg@state.mn.us
Dakota/Scott

1200 Warner Road
St. Paul, MN 55106
(651) 259-5845
FAX (651) 772-7977

Bill Huber

bill.huber@state.mn.us
1801 South Oak Street
Lake City, MN 55041
(651) 345-5601 ext 244
FAX (651) 345-3975
Goodhue/Houston/Wabasha
Winona

South Region 4

Ethan Jenzen

ethan.jenzen@state.mn.us
10590 County Rd 8 NE
PO Box 457
Spicer, MN 56288
(320) 796-2161 ext 232
FAX (320) 796-6282
Chippewa/Kandiyohi/Meeker
Swift

Lucas Youngsma

lucas.youngsma@state.mn.us
1400 E. Lyon, Box 111
Marshall, MN 56258
(507) 537-7258
FAX (507) 537-6368
Big Stone/Lac Qui Parle
Lincoln/Lyon/Redwood
Yellow Medicine

Tom Kresko

tom.kresko@state.mn.us
175 County Road 26
Windom, MN 56101-1868
(507) 831-2900 ext 224
FAX (507) 831-2921
Cottonwood/Jackson/Murray
Nobles/Pipestone/Rock

Leo Getsfried

leo.getsfried@state.mn.us
21009 547TH Ave
Mankato, MN 56001
(507) 389-2151
FAX (507) 389-6093
Blue Earth/Brown/Martin/Nicollet
Watsonwan

Garry Bennett

garry.bennett@state.mn.us
20596 Highway 7
Hutchinson, MN 55350
(320) 234-2550 ext 238
FAX (320) 234-2555
McLeod/Renville/Sibley

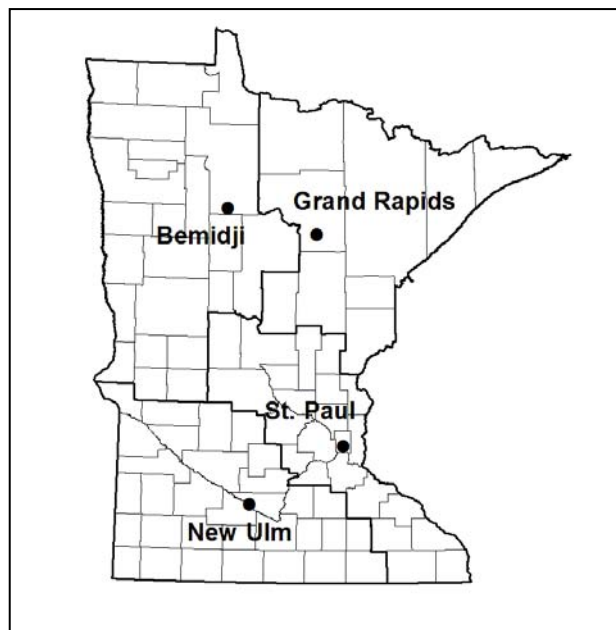
Corey Hanson

corey.hanson@state.mn.us
Dodge/Fillmore/Freeborn
Mower/Olmsted

Randy Bradt

randy.bradt@state.mn.us
Faribault/LeSueur/Rice/Steele
Waseca

2300 Silver Creek Rd NE
Rochester, MN 55906
(507) 206-2852
FAX (507) 285-7144



Region 1-Northwest
Region 2-Northeast
Region 3-Central
Region 4-South

Measuring Water Use & Flow Meter Requirements

Flow Meter Requirements

Minnesota Statutes § 103G.281, Subdivision 2, requires all installations for appropriating water to be equipped with a flow meter to measure the quantity of water appropriated within the degree of accuracy required by rule (10%). The commissioner may approve alternate methods of measurement based on the quantity of water used, the method of appropriating or using water and any other information supplied by an applicant.

Why require Flow Meters ?

The law is aimed at improving the accuracy of water use reporting and has many benefits. Careful monitoring of water withdrawals can be used to: provide valuable information for management of the resource, detect well and pump problems, improve irrigation efficiency, and determine pumping plant efficiency. As a management tool, accurate flow monitoring can help to conserve both energy and water resources. Accurate data is necessary to evaluate the capability of the resource to sustain water withdrawals and is also important for investigation of well interference complaints.

Does everyone need a flow meter ?

All new permitted installations will be required to have flow meters unless **prior** DNR approval has been given for an alternate method. Existing systems may be allowed to use an approved alternate method. Depending upon the type of system, water use and quantity of water used, the commissioner may approve alternate methods for measuring water use. Requests for approval of alternate methods must be submitted in writing to DNR Waters. Proper record keeping is required for all approved methods of determining water use.

When is a flow meter required ?

Flow meters are required when alternate methods cannot provide an accurate measurement of water use. Flow meters will be required where the following circumstances exist:

1. Systems with widely fluctuating discharge rates or when variable speed pumps are used.
2. Systems with alternating zone coverage, such as golf course irrigation systems.
3. Instances where the permit holder has a history of providing inaccurate pumping reports or has failed to submit water use fees and reports.
4. Situations where the adequacy of the resource is a concern or there is a history of well interference problems.

What methods are approved ?

The following methods are approved for measuring water use:

1. Flow meters with a totalizer.
2. Flow rate meters used with timing devices. † ‡
3. Timing devices (hour meters and electric meters). † ‡
4. Vehicle gallon capacities (i.e. water trucks). †

† Daily records of water use and time pumped **must** be kept for these methods.

‡ Methods 2 and 3 **are required** to have a **constant** pumping rate.

What if I am using a gravity flow system ?

Special instructions regarding gravity flow operations are available by calling DNR Waters and requesting the "Measuring Appropriations from Gravity Flow Installations" information sheet.

Which methods are not approved ?

The following methods are not approved for measuring water use:

1. Rain gauges or other methods using application rates, such as irrigation systems that are set to apply a certain amount of water per acre or pass.
2. Buckets used to measure discharge rates.
3. Fuel consumption by gasoline or diesel engines.
4. Estimates using a set volume of water per person or animal.

How do I get my method approved ?

Each year permittees are required to sign an affidavit of compliance on the water use report indicating compliance with the law requiring a flow meter or an approved measuring device. The affidavit of compliance and the annual report of water use are due by February 15 of each year.

Permittees using a method of measurement that has not been approved must submit a written request for approval of an alternate method. Requests should include a detailed description of the proposed method (i.e. diagrams, calculations). Requests for approval of an alternate method should be sent to DNR Waters, Permits Unit, 500 Lafayette Road, St. Paul, MN 55155-4032. Only methods that measure water use within 10 percent accuracy will be considered for approval. Records of water use must be kept for all methods of water use.

Failure to have an approved method is a violation of Minnesota Statutes and permit conditions and is punishable as a misdemeanor with fines up to \$700 and/or 90 days in jail.

General

To obtain information about the purchase and/or installation of a flow meter, contact a licensed well driller, irrigation equipment dealer or plumbing supply company.

(continued on next page)

Minnesota DNR Waters

651-259-5700

This information is available in an alternative format upon request

Calculating Monthly Water Use

To calculate monthly water use from:

A. **Flow Meter:** Subtract the reading at the beginning of the month from the reading at the end of the month. If the meter is in cubic feet, multiply the monthly use by 7.48 to convert the usage into gallons.

B. **Timing Device:** Multiply the hours pumped for the month by the pump rate (in gallons per minute, gpm) times 60 (minutes). [Example; 150 hrs x 800 gpm x 60 min/hr = 7,200,00 gallons].

Hourly timing device options:

1. An hourly time clock connected directly to irrigation pumping plant system.
2. Kilowatt Hours: Monthly hours of pumping determined by dividing monthly electric usage by electric meter's monthly power demand rate (Kw). [Example: 3000 Kwh of electricity was used in the month of June and the electric meter recorded a peak demand for the month of 25 Kw, then the total hours pumped is found by dividing 3000 Kwh by 25 Kw, which yields 120 hours pumped for the month. To find water use take 120 hrs x 300 gpm x 60 min/hr = 2,160,000 gallons].

* Approved Alternatives for Estimating Water Pumping Rate from Agricultural Irrigation Systems

The following alternate methods are approved by the Department for agricultural irrigation systems.

- Pumping flow rate test.
- Center pivot/linear system's manufacturers nozzling chart.
 - for a center pivot with a corner swing unit, refer to the following section.
- Traveling gun nozzling chart.
- Lateral line irrigation systems nozzling chart.

- _____ gph per 100' of trickle tube* _____ feet/100 = _____ gpm
- Open discharge pump's manufacture curve.

ESTIMATING DISCHARGE OF A CENTER PIVOT WITH CORNER UNIT

A good average discharge flow rate estimate for a center pivot with a corner arm can be determined by taking the average of the discharge rate when the corner arm is fully extended and fully retracted.

The water discharge from a center pivot with a corner swing arm varies depending on the position of the swing arm, usage of flow control/regulators, and the slope of the pump performance curve.

STEPS TO ESTIMATE GPM FOR A TRAVELING GUN

1. Determine nozzle size to nearest 1/100th of an inch and nozzle type (bore or ring): [ex: 1-1/4" = 1.25 inches taper & bore nozzle].
2. Determine average operating pressure at the base of the sprinkler. If pressure varies between first and last travel runs, take the average between the first and last runs: [ex: 1st run = 95 psi, last run = 85 psi, average = (95 + 85)/2 = 90 psi].
3. Select the appropriate discharge table (bore or ring nozzle) listed below and find the estimated gpm for your nozzle size and average operating pressure or use gun manufacturer's published discharge table.

If your nozzle size or operating pressure values follow between the table numbers, make an interpolation between the smaller and larger numbers to get a more accurate estimate of flow: [ex: have 1.25" bore nozzle @ 90 psi; table gives at 90 psi 405 gpm @ 1.2" and 545 @ 1.4"; then to estimate the gpm for 1.25" nozzle calculate as follows:

$$\begin{aligned} \text{gpm} &= 405 \text{ gpm} + [(1.25" - 1.2") / (1.4" - 1.2")] * (545 \\ &\quad \text{gpm} - 405 \text{ gpm}) \\ &= 405 + (0.05 / 0.20) * 140 \\ &= 405 + 0.25 * 140 \\ &= 405 + 35 = 440 \text{ gpm} \end{aligned}$$

Typical Discharges for Single Large Nozzle Sprinkler Guns

Sprinkler Pressure (psi)	Straight or taper bore nozzle sizes (inches)				
	0.8	1.0	1.2	1.4	1.6
	Sprinkler discharge in gpm				
60	145	225	330	445	585
70	155	245	355	480	630
80	165	260	380	515	675
90	175	275	405	545	715
100	185	290	425	575	755
110	195	305	445	605	790
120	205	320	465	630	825

(psi)	Ring Nozzle Sizes (inches)				
	0.9	1.1	1.3	1.5	1.7
	Sprinkler discharge in gpm				
60	110	185	275	385	510
70	120	200	295	410	550
80	130	215	310	435	585
90	135	225	325	460	620
100	140	240	340	485	655
110	150	250	350	510	690
120	155	260	360	530	720

Table Sources: Nelson Irrigation Corp. - sprinkler charts. Rain Bird, Agri Products Division - sprinkler charts. SCS National Sprinkler Irrigation Book - Chapter 15.

*Prepared by: Jerry Wright, Extension Agricultural Engineer, University of Minnesota, 1990.

Equal opportunity to participate in and benefit from programs of the Minnesota Department of Natural Resources is available to all individuals regardless of race, color, national origin, sex, sexual orientation, marital status, status with regard to public assistance, age or disability. Discrimination inquiries should be sent to: MN/DNR, 500 Lafayette Road, St. Paul, MN 55155-4031; or the Equal Opportunity Office, Department of the Interior, Washington, D.C. 20240.

The DNR Information Center phone numbers:

Twin Cities: (651)296-6157
 MN Toll Free: 1-888-646-6367 (or 888-MINNDNR)
 Telecommunication Device for the Deaf:
 (651)296-5484
 1-800-657-3929 MN Toll Free