



WATER PROTECTION BUREAU

Agency Use

Permit No.:

Date Rec'd

Amount Rec'd

Check No.

Rec'd By

FORM PW-1

Produced Water Storage Capacity Self-Evaluation

READ BEFORE COMPLETING THIS FORM: Before completing this form (PW-1), oil and natural gas operators need to read the Produced Water General Permit (PWGP), particularly Parts I and II. This form must be completed by owners or operators of facilities which discharge produced water to ephemeral drainages and are seeking coverage under the MPDES PWGP (MTG310000). Form PW-1 is intended to help oil and natural gas operators perform a site-specific storage capacity self-evaluation to demonstrate the proposed discharge area(s) have enough storage capacity. Sections B and C on your Form PW-1 must state the information exactly the same way as it was stated on the most recently submitted version of your Notice of Intent (NOI)-31. There are three attachments to this PW-1 Form. Attachment I is required, Attachments II and III are optional. Attach additional pages as necessary, indicating the corresponding section number for the PW-1 Form. Please read the attached instructions before completing this form. You must print or type legibly; forms that are not legible, incomplete, or unsigned will be returned. You must maintain a copy of the completed PW-1 Form for your records.

Section A – PW-1 Status (Check one):

- Input boxes for New, Resubmitted, Renewal, Modification with corresponding descriptions: No prior PW-1 submitted, Previous PW-1 Form is deficient, Permit renewal, Permit modification.

Permit Number: MTG 3 1 \_ \_ \_ \_ (Specify the permit number previously assigned to your facility, if any.)

Section B – Facility or Site Information:

Facility Name:
Facility Location:
City, State, Zip: County:
Township: Range:
Section:
Latitude: Longitude:

Section C – Applicant (Owner/Operator) Information:

Owner or Operator Name:
Mailing Address:
City, State, and Zip Code:
Phone Number: ( ) Email Address:

**Section D – Water Balance Calculation:**

Fill out for each ephemeral drainage and/or impoundment. If more than one outfall discharges into an impoundment, the sum of the discharge volumes shall be used in Step 1 as Annual Discharge. Several naturally or artificially connected impoundment areas can be regarded as one impoundment. For separate outfalls discharging into separate drainages/impoundments, fill out a PW-1 for each drainage or impoundment.

**Step 1. Annual Discharge (Include all outfalls which discharge into impoundment):**

Outfall Number	Latitude	Longitude	Average Discharge Rate (gpm)
001			
002			
003			
004			

**Total Discharge Rate (D):** \_\_\_\_\_ gpm × C 1.61 = \_\_\_\_\_ acre-feet

(gpm = gallons per minute ; C is Conversion Factor, C = 525,600 minutes × 3.069×10<sup>-6</sup> acre-feet/gal = 1.61 min.acre-feet/gal)

**Step 2. Impoundment Area and Depth:**

Do you know the impoundment area and average depth?

- Yes, the impoundment area is **A** = \_\_\_\_\_ acres, and the average depth is **d** = \_\_\_\_\_ feet. Attach a topographic map in appropriate scale as **Attachment I** with the impoundment area(s) marked on the map. Continue to step 3.
- No. Please complete the following: **1.** Consult **Appendix A** to estimate the necessary area and average depth of an impoundment based on the acre-foot volume of produced water from Step 1. **2.** Consult a topographical map, or visit the facility, and/or conduct a field survey to establish an appropriate impoundment site based on the needed area and average depth from the previous step. Once an appropriate impoundment site has been established, record the impoundment area and average depth in the blanks below, and attach a topographic map as **Attachment I** with the impoundment area(s) marked on the map.

The impoundment area is **A** = \_\_\_\_\_ acres, and the average depth is **d** = \_\_\_\_\_ feet. Continue to step 3.

**Step 3. Water Balance Components**

**A. Annual Precipitation (P):** Annual average precipitation in the proposed impoundment location is **r** = \_\_\_\_\_ inches. The total annual precipitation received for the impounding area is:

**P** = \_\_\_\_\_ feet ( $r \times \frac{1}{12}$  ft/in) × \_\_\_\_\_ **A** (impoundment area in acres) = \_\_\_\_\_ acre-feet.

**B. Annual Evaporation Loss (E):** **E** = 0.7 (Class A Pan Coefficient) × \_\_\_\_\_ **A** (impoundment area in acres) × \_\_\_\_\_ (Class A Pan Evaporation) ×  $\frac{1}{12}$  ft/inc = \_\_\_\_\_ acre-feet.

(Where: Class A Pan Coefficient = 0.7; Impoundment area is the value identified in Step 2, in acres. Class A Pan Evaporation can be found from **Appendix B**, in inches).

**C. Average annual seepage (select one of the following):**

- I chose not to calculate this number. I accept the default assumption that the seepage loss is 0 acre-feet per year.
- My calculated seepage from the site is **S** = \_\_\_\_\_ acre-feet per year (Attach calculation as *Attachment II*).

**D. Annual water use (select one of the following):**

- I chose not to calculate this number. I accept DEQ's conservative approach and assume the water use is 0 acre-feet for the purpose of impoundment capacity assessment.
- My calculated livestock and wildlife water use is **L** = \_\_\_\_\_ acre-foot (Attach calculation work as *Attachment III* following the template provided. Please reference **Appendix C** for Livestock and Wildlife Water Use Requirement).

**Step 4. Annual Water Balance – Required Storage Volume**

$$\frac{\text{_____}(\mathbf{D})}{\text{Discharge}} + \frac{\text{_____}(\mathbf{P})}{\text{Precipitation}} - \frac{\text{_____}(\mathbf{E})}{\text{Evaporation}} - \frac{\text{_____}(\mathbf{S})}{\text{Seepage}} - \frac{\text{_____}(\mathbf{L})}{\text{Livestock Water Use}} = \frac{\text{_____}}{\text{Annual Storage Volume}} \text{ acre-feet}$$

**Step 5. Impoundment Storage Capacity Evaluation**

Using **Appendix A**, locate the closest Annual Volume in Column B, which corresponds to the Annual Storage Volume calculated in Step 4. Then, in the Impounded Area row, find the number which corresponds to the area (**A**) recorded in Step 2. Then, follow these two numbers across and down until intersecting in the Impounded Depth table. Record this number here: \_\_\_\_\_ ft. This is the depth of the impoundment needed to store the produced water proposed to be discharged. Compare this number to the impoundment depth (**d**) \_\_\_\_\_ feet recorded in Step 2. Is this number less than the number determined from the Impounded Depth table?

- Yes. Then the impoundment storage capacity is adequate.
- No. The impoundment storage capacity is not adequate. You should increase your impoundment storage capacity by either increasing the impoundment area or depth. Continue this process until the impoundment storage capacity is adequate. The final location and boundary of the impoundment must be identified and indicated on your topographic map, and attached to this form. If you are unable to find enough storage capacity for your discharge, you may apply for an individual MPDES permit.

**Step 6. Attachment check list for Section D (select boxes for any included attachments)**

- Attachment I – Topographic Map (required)
- Attachment II – Seepage Calculation and Supporting Documents (optional)
- Attachment III – Animal Water Use Estimation Worksheet (optional)

### Animal Water Use Estimation Worksheet <sup>(1)</sup>

Animal Type or/and Condition <sup>(2)</sup>	Number of Animals	Typical Annual Water Use (Gal per head per year)	Annual Water Use (Gal)	Annual Water Use (acre-feet) <sup>(3)</sup>
Total:				

Footnotes:

- 1. This page can be copied and extra pages added if necessary.**
- 2. See Appendix C for more details about animal type and conditions.**
- 3. 1 acre-feet = 325,851 gal.**

**Section E - CERTIFICATION**

**Applicant Information:** This form must be completed, signed, and certified as follows:

- For a corporation, by a principal officer of at least the level of vice president;
- For a partnership or sole proprietorship, by a general partner or the proprietor, respectively; or
- For a municipality, state, federal, or other public facility, by either a principal executive officer or ranking elected official.

**All Applicants Must Complete the Following Certification:**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information; including the possibility of fine and imprisonment for knowing violations. [75-5-633, MCA].

**Name (Type or Print)**

**Title (Type or Print)**

**Phone Number**

**Signature**

**Date Signed**

*DEQ will not process this form until all of the requested information is supplied, and the appropriate fees are paid.* Return this PW-1 Form, a complete and signed NOI-31 Form, and the applicable fee to:

Department of Environmental Quality  
Water Protection Bureau  
PO Box 200901  
Helena, MT 59620-0901  
(406) 444-3080

**INSTRUCTIONS FOR**  
**Form PW-1 – Produced Water Impoundment Capacity Self-Evaluation for Oil**  
**and Natural Gas Produced Water Discharge to Ephemeral Drainages under**  
**Produced Water General Permit (MTG310000)**

**The purpose of this form:** The Produced Water General Permit authorizes the discharge of produced water from oil and gas production facilities into ephemeral drainages and/or impoundments constructed in ephemeral drainages. The PW-1 Form is designed to help applicants evaluate the storage capacity of the receiving ephemeral drainage and/or impoundment to demonstrate adequate storage for their produced water discharge.

**Fill out the form for each impoundment.** Generally, a facility will have one outfall which discharges to a single ephemeral drainage or impoundment. Several naturally or artificially connected impoundments will be regarded as a single impoundment. Additionally, where a facility has multiple outfalls discharging to a single ephemeral drainage or impoundment, the sum of the outfall discharge rates will be used in Step 1 of this form. If a facility has multiple outfalls, each discharging to a separate ephemeral drainages or impoundments, a PW-1 Form must be completed for each individual outfall/impoundment combination.

**You may need the following items in order to complete this form:** A copy of your NOI-31 Form; Appendix A, B, and C of this form (provided).

Please type or print legibly; forms that are not legible, incomplete, or unsigned will be returned.

**SPECIFIC ITEM INSTRUCTIONS**

**Section A – PW-1 Status:**

Check the box that applies and provide the requested information. If a PW-1 Form has not been previously submitted for this facility, select the box next to “New.” If a PW-1 Form has been previously submitted and DEQ returned it to you as deficient or incomplete, select the box next to “Resubmitted.” If a PW-1 Form is being submitted for permit renewal, select the box next to “Renewal.” If a PW-1 Form is being submitted for permit modification, select the box next to “Modification.” Fill in the permit number if applicable. If a PW-1 Form or NOI-31 Form has been submitted and returned as incomplete the permit number appears in the upper right hand corner of the forms and on any correspondence sent to you by DEQ. The permit number must be included on any correspondence with DEQ regarding this facility.

**Section B – Facility or Site Information:**

The information must be stated exactly the same way as it was stated on your NOI-31 Form.

**Section C – Applicant (Owner/Operator) Information:**

The information must be stated exactly the same way as it was stated on your NOI-31 Form.

**Section D – Water Balance Calculation:**

**Step 1. Annual Discharge:** Include all outfalls discharging into the impoundment and convert the discharge rate from gallons per minute (gpm) to acre-foot.

**Step 2. Impounding Area and Depth:** When proposing an ephemeral drainage area and/or impoundment for produced water storage, the applicant shall conduct a facility visit or land survey, if necessary, to determine the total area and average depth of the impoundment. The impoundment area shall be marked on a topographic map with sufficient details including the boundary of the impoundment area. The topographic map is a required attachment (*Attachment I*) to this PW-1 Form. The applicant is responsible for acquiring any necessary permit or license for any impoundment structure construction.

**Step 3. Annual Water Balance Calculations:** To determine annual precipitation, please consult the local conservation district or county.

For annual evaporation loss, use **Appendix B** to determine the Class A Pan Evaporation for your area.

As a conservative approach, DEQ assumes the default seepage loss is zero, as seepage rates are generally site specific and variable. However, including seepage loss may decrease the required storage volume. When determining an appropriate seepage rate, applicants must follow hydrogeology principles and use legitimate data sources. Seepage loss calculations, methodology, and sources must be included as *Attachment II* with the application package.

The livestock annual water use can be estimated based on number and type of animals, and average annual water consumption of each animal. The annual water consumption rates for common livestock and wildlife animals are provided in **Appendix C**. If consumption is based on animals that are not listed in Appendix C, please provide supporting documentation to demonstrate the average annual water consumption. The livestock annual water use calculation shall be attached as *Attachment III* following the template provided in this PW-1 Form.

**Step 4. Annual Water Balance:** Enter the water balance components calculated in Steps 1 and 3 into the blank equation, and calculate the annual amount of water needed to be stored.

**Step 5. Impoundment Capacity Evaluation:** Follow the instructions of Step 5 to determine the depth of the impoundment needed.

If the answer is **Yes**, then stop, as the impoundment storage capacity is adequate. Submit your Form PW-1 together with your new or renewal application materials.

If the answer is **No**, the impoundment storage capacity is not adequate. You should increase your impoundment storage capacity by either increasing the impoundment area or depth. Continue this process until the impoundment storage capacity is adequate. The final location and boundary of the impoundment must be identified and indicated on your topographic map, and attached to this form. If you are unable to find enough storage capacity for your discharge, you may apply for an individual MPDES permit.

**Step 6. Attachment check list:** Attachment I is required, Attachments II and III are optional.

#### **Section F – Certification:**

The PW-1 Form certification must be completed by the applicant (owner/operator) responsible for the authorization as identified in Section C, and as described in ARM 17.30.1323.

The PW-1 Form and other forms for oil and natural gas produced water discharge permitting or authorization are available at Montana Department of Environmental Quality's Water Protection Bureau website: <http://deq.mt.gov/wqinfo/MPDES/ProducedWater.mcp>. If you have any questions concerning how to fill out this form, or other forms related to the Montana Pollutant Discharge Elimination System (MPDES) discharge permitting program, please contact DEQ at:

Water Protection Bureau  
1520 East Sixth Avenue  
P.O. Box 200901  
Helena, MT 59620-0901  
Phone: (406) 444-3080  
Fax: (406) 444-1374



**PW-1 Appendix A: Estimating Impoundment Capacity Look-up Table**

Discharge		-----Impounded Area (acre)-----																
A: Rate (gpm)	B: Annual volume (acre-feet)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		-----Impounded Depth (feet)-----																
1	2	1.6	0.8	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2	3	3.2	1.6	1.1	0.8	0.6	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2
3	5	4.8	2.4	1.6	1.2	1.0	0.8	0.7	0.6	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.3
4	6	6.4	3.2	2.1	1.6	1.3	1.1	0.9	0.8	0.7	0.6	0.6	0.5	0.5	0.5	0.4	0.4	0.4
5	8	8.1	4.0	2.7	2.0	1.6	1.3	1.2	1.0	0.9	0.8	0.7	0.7	0.6	0.6	0.5	0.5	0.5
6	10	9.7	4.8	3.2	2.4	1.9	1.6	1.4	1.2	1.1	1.0	0.9	0.8	0.7	0.7	0.6	0.6	0.6
7	11	11.3	5.6	3.8	2.8	2.3	1.9	1.6	1.4	1.3	1.1	1.0	0.9	0.9	0.8	0.8	0.7	0.7
8	13	12.9	6.4	4.3	3.2	2.6	2.1	1.8	1.6	1.4	1.3	1.2	1.1	1.0	0.9	0.9	0.8	0.8
9	14	14.5	7.2	4.8	3.6	2.9	2.4	2.1	1.8	1.6	1.4	1.3	1.2	1.1	1.0	1.0	0.9	0.9
10	16	16.1	8.1	5.4	4.0	3.2	2.7	2.3	2.0	1.8	1.6	1.5	1.3	1.2	1.2	1.1	1.0	0.9
11	18	17.7	8.9	5.9	4.4	3.5	3.0	2.5	2.2	2.0	1.8	1.6	1.5	1.4	1.3	1.2	1.1	1.0
12	19	19.3	9.7	6.4	4.8	3.9	3.2	2.8	2.4	2.1	1.9	1.8	1.6	1.5	1.4	1.3	1.2	1.1
13	21	20.9	10.5	7.0	5.2	4.2	3.5	3.0	2.6	2.3	2.1	1.9	1.7	1.6	1.5	1.4	1.3	1.2
14	23	22.5	11.3	7.5	5.6	4.5	3.8	3.2	2.8	2.5	2.3	2.0	1.9	1.7	1.6	1.5	1.4	1.3
15	24	24.2	12.1	8.1	6.0	4.8	4.0	3.5	3.0	2.7	2.4	2.2	2.0	1.9	1.7	1.6	1.5	1.4
16	26	25.8	12.9	8.6	6.4	5.2	4.3	3.7	3.2	2.9	2.6	2.3	2.1	2.0	1.8	1.7	1.6	1.5
17	27	27.4	13.7	9.1	6.8	5.5	4.6	3.9	3.4	3.0	2.7	2.5	2.3	2.1	2.0	1.8	1.7	1.6
18	29	29.0	14.5	9.7	7.2	5.8	4.8	4.1	3.6	3.2	2.9	2.6	2.4	2.2	2.1	1.9	1.8	1.7
19	31	30.6	15.3	10.2	7.6	6.1	5.1	4.4	3.8	3.4	3.1	2.8	2.5	2.4	2.2	2.0	1.9	1.8
20	32	32.2	16.1	10.7	8.1	6.4	5.4	4.6	4.0	3.6	3.2	2.9	2.7	2.5	2.3	2.1	2.0	1.9
21	34	33.8	16.9	11.3	8.5	6.8	5.6	4.8	4.2	3.8	3.4	3.1	2.8	2.6	2.4	2.3	2.1	2.0
22	35	35.4	17.7	11.8	8.9	7.1	5.9	5.1	4.4	3.9	3.5	3.2	3.0	2.7	2.5	2.4	2.2	2.1
23	37	37.0	18.5	12.3	9.3	7.4	6.2	5.3	4.6	4.1	3.7	3.4	3.1	2.8	2.6	2.5	2.3	2.2
24	39	38.6	19.3	12.9	9.7	7.7	6.4	5.5	4.8	4.3	3.9	3.5	3.2	3.0	2.8	2.6	2.4	2.3
25	40	40.3	20.1	13.4	10.1	8.1	6.7	5.8	5.0	4.5	4.0	3.7	3.4	3.1	2.9	2.7	2.5	2.4
26	42	41.9	20.9	14.0	10.5	8.4	7.0	6.0	5.2	4.7	4.2	3.8	3.5	3.2	3.0	2.8	2.6	2.5
27	43	43.5	21.7	14.5	10.9	8.7	7.2	6.2	5.4	4.8	4.3	4.0	3.6	3.3	3.1	2.9	2.7	2.6
28	45	45.1	22.5	15.0	11.3	9.0	7.5	6.4	5.6	5.0	4.5	4.1	3.8	3.5	3.2	3.0	2.8	2.7
29	47	46.7	23.3	15.6	11.7	9.3	7.8	6.7	5.8	5.2	4.7	4.2	3.9	3.6	3.3	3.1	2.9	2.7
30	48	48.3	24.2	16.1	12.1	9.7	8.1	6.9	6.0	5.4	4.8	4.4	4.0	3.7	3.5	3.2	3.0	2.8
31	50	49.9	25.0	16.6	12.5	10.0	8.3	7.1	6.2	5.5	5.0	4.5	4.2	3.8	3.6	3.3	3.1	2.9

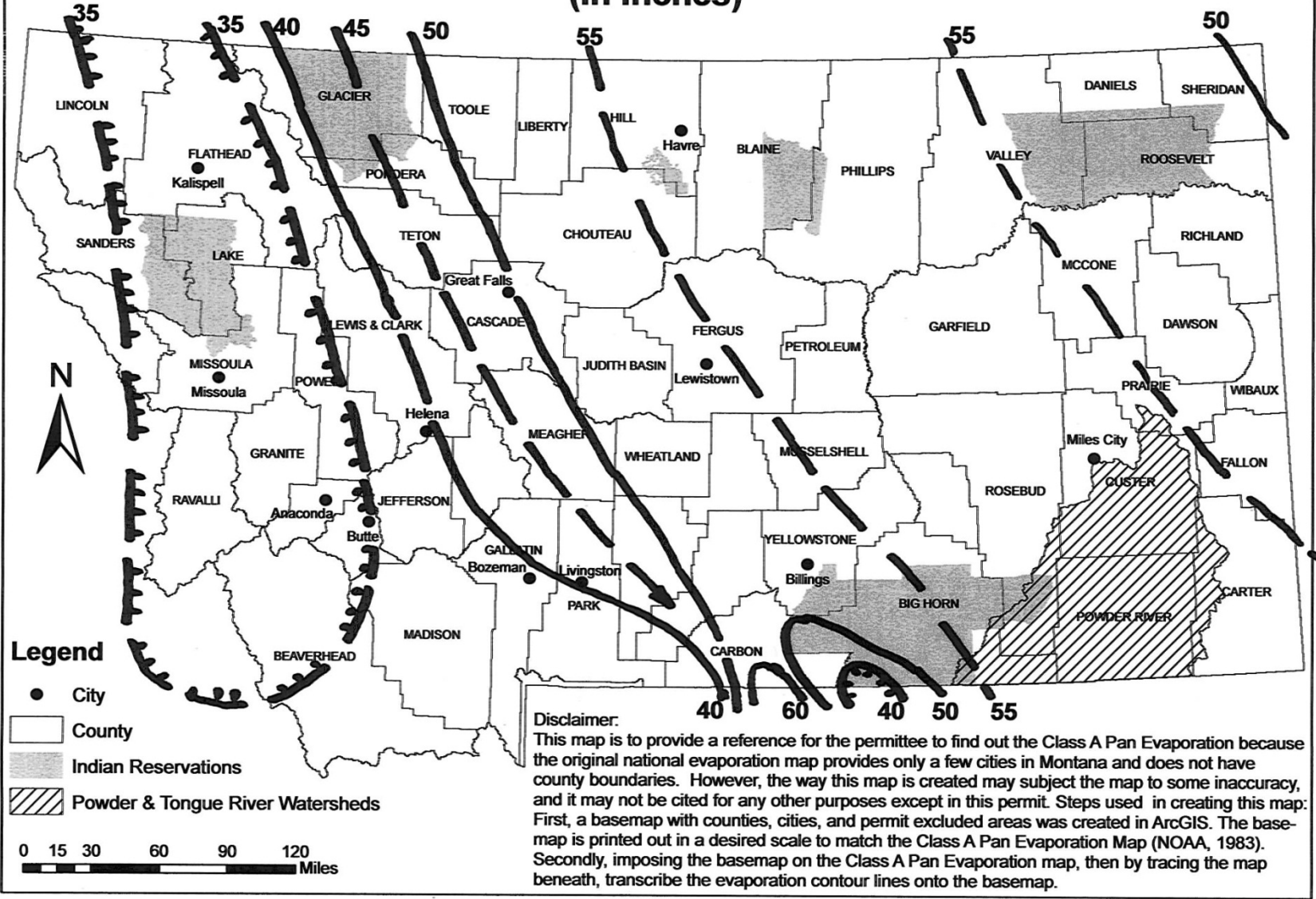
**PW-1 Appendix A: Estimating Impoundment Capacity Look-up Table (Continued)**

Discharge		-----Impounded Area (acre)-----																
A: Rate (gpm)	B: Annual volume (acre-feet)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		-----Impounded Depth (feet)-----																
32	52	51.5	25.8	17.2	12.9	10.3	8.6	7.4	6.4	5.7	5.2	4.7	4.3	4.0	3.7	3.4	3.2	3.0
33	53	53.1	26.6	17.7	13.3	10.6	8.9	7.6	6.6	5.9	5.3	4.8	4.4	4.1	3.8	3.5	3.3	3.1
34	55	54.7	27.4	18.2	13.7	10.9	9.1	7.8	6.8	6.1	5.5	5.0	4.6	4.2	3.9	3.6	3.4	3.2
35	56	56.4	28.2	18.8	14.1	11.3	9.4	8.1	7.0	6.3	5.6	5.1	4.7	4.3	4.0	3.8	3.5	3.3
36	58	58.0	29.0	19.3	14.5	11.6	9.7	8.3	7.2	6.4	5.8	5.3	4.8	4.5	4.1	3.9	3.6	3.4
37	60	59.6	29.8	19.9	14.9	11.9	9.9	8.5	7.4	6.6	6.0	5.4	5.0	4.6	4.3	4.0	3.7	3.5
38	61	61.2	30.6	20.4	15.3	12.2	10.2	8.7	7.6	6.8	6.1	5.6	5.1	4.7	4.4	4.1	3.8	3.6
39	63	62.8	31.4	20.9	15.7	12.6	10.5	9.0	7.8	7.0	6.3	5.7	5.2	4.8	4.5	4.2	3.9	3.7
40	64	64.4	32.2	21.5	16.1	12.9	10.7	9.2	8.1	7.2	6.4	5.9	5.4	5.0	4.6	4.3	4.0	3.8
41	66	66.0	33.0	22.0	16.5	13.2	11.0	9.4	8.3	7.3	6.6	6.0	5.5	5.1	4.7	4.4	4.1	3.9
42	68	67.6	33.8	22.5	16.9	13.5	11.3	9.7	8.5	7.5	6.8	6.1	5.6	5.2	4.8	4.5	4.2	4.0
43	69	69.2	34.6	23.1	17.3	13.8	11.5	9.9	8.7	7.7	6.9	6.3	5.8	5.3	4.9	4.6	4.3	4.1
44	71	70.8	35.4	23.6	17.7	14.2	11.8	10.1	8.9	7.9	7.1	6.4	5.9	5.4	5.1	4.7	4.4	4.2
45	72	72.5	36.2	24.2	18.1	14.5	12.1	10.4	9.1	8.1	7.2	6.6	6.0	5.6	5.2	4.8	4.5	4.3
46	74	74.1	37.0	24.7	18.5	14.8	12.3	10.6	9.3	8.2	7.4	6.7	6.2	5.7	5.3	4.9	4.6	4.4
47	76	75.7	37.8	25.2	18.9	15.1	12.6	10.8	9.5	8.4	7.6	6.9	6.3	5.8	5.4	5.0	4.7	4.5
48	77	77.3	38.6	25.8	19.3	15.5	12.9	11.0	9.7	8.6	7.7	7.0	6.4	5.9	5.5	5.2	4.8	4.5
49	79	78.9	39.4	26.3	19.7	15.8	13.1	11.3	9.9	8.8	7.9	7.2	6.6	6.1	5.6	5.3	4.9	4.6
50	81	80.5	40.3	26.8	20.1	16.1	13.4	11.5	10.1	8.9	8.1	7.3	6.7	6.2	5.8	5.4	5.0	4.7
51	82	82.1	41.1	27.4	20.5	16.4	13.7	11.7	10.3	9.1	8.2	7.5	6.8	6.3	5.9	5.5	5.1	4.8
52	84	83.7	41.9	27.9	20.9	16.7	14.0	12.0	10.5	9.3	8.4	7.6	7.0	6.4	6.0	5.6	5.2	4.9
53	85	85.3	42.7	28.4	21.3	17.1	14.2	12.2	10.7	9.5	8.5	7.8	7.1	6.6	6.1	5.7	5.3	5.0
54	87	86.9	43.5	29.0	21.7	17.4	14.5	12.4	10.9	9.7	8.7	7.9	7.2	6.7	6.2	5.8	5.4	5.1
55	89	88.6	44.3	29.5	22.1	17.7	14.8	12.7	11.1	9.8	8.9	8.1	7.4	6.8	6.3	5.9	5.5	5.2
56	90	90.2	45.1	30.1	22.5	18.0	15.0	12.9	11.3	10.0	9.0	8.2	7.5	6.9	6.4	6.0	5.6	5.3
57	92	91.8	45.9	30.6	22.9	18.4	15.3	13.1	11.5	10.2	9.2	8.3	7.6	7.1	6.6	6.1	5.7	5.4
58	93	93.4	46.7	31.1	23.3	18.7	15.6	13.3	11.7	10.4	9.3	8.5	7.8	7.2	6.7	6.2	5.8	5.5
59	95	95.0	47.5	31.7	23.7	19.0	15.8	13.6	11.9	10.6	9.5	8.6	7.9	7.3	6.8	6.3	5.9	5.6
60	97	96.6	48.3	32.2	24.2	19.3	16.1	13.8	12.1	10.7	9.7	8.8	8.1	7.4	6.9	6.4	6.0	5.7
61	98	98.2	49.1	32.7	24.6	19.6	16.4	14.0	12.3	10.9	9.8	8.9	8.2	7.6	7.0	6.5	6.1	5.8
62	100	99.8	49.9	33.3	25.0	20.0	16.6	14.3	12.5	11.1	10.0	9.1	8.3	7.7	7.1	6.7	6.2	5.9
63	101	101.4	50.7	33.8	25.4	20.3	16.9	14.5	12.7	11.3	10.1	9.2	8.5	7.8	7.2	6.8	6.3	6.0

**PW-1 Appendix A: Estimating Impoundment Capacity Look-up Table (Continued)**

Discharge		-----Impounded Area (acre)-----																
A: Rate (gpm)	B: Annual volume (acre-foot)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		-----Impounded Depth (feet)-----																
64	103	103.0	51.5	34.3	25.8	20.6	17.2	14.7	12.9	11.4	10.3	9.4	8.6	7.9	7.4	6.9	6.4	6.1
65	105	104.7	52.3	34.9	26.2	20.9	17.4	15.0	13.1	11.6	10.5	9.5	8.7	8.1	7.5	7.0	6.5	6.2
66	106	106.3	53.1	35.4	26.6	21.3	17.7	15.2	13.3	11.8	10.6	9.7	8.9	8.2	7.6	7.1	6.6	6.3
67	108	107.9	53.9	36.0	27.0	21.6	18.0	15.4	13.5	12.0	10.8	9.8	9.0	8.3	7.7	7.2	6.7	6.3
68	109	109.5	54.7	36.5	27.4	21.9	18.2	15.6	13.7	12.2	10.9	10.0	9.1	8.4	7.8	7.3	6.8	6.4
69	111	111.1	55.5	37.0	27.8	22.2	18.5	15.9	13.9	12.3	11.1	10.1	9.3	8.5	7.9	7.4	6.9	6.5
70	113	112.7	56.4	37.6	28.2	22.5	18.8	16.1	14.1	12.5	11.3	10.2	9.4	8.7	8.1	7.5	7.0	6.6
71	114	114.3	57.2	38.1	28.6	22.9	19.1	16.3	14.3	12.7	11.4	10.4	9.5	8.8	8.2	7.6	7.1	6.7
72	116	115.9	58.0	38.6	29.0	23.2	19.3	16.6	14.5	12.9	11.6	10.5	9.7	8.9	8.3	7.7	7.2	6.8
73	118	117.5	58.8	39.2	29.4	23.5	19.6	16.8	14.7	13.1	11.8	10.7	9.8	9.0	8.4	7.8	7.3	6.9
74	119	119.1	59.6	39.7	29.8	23.8	19.9	17.0	14.9	13.2	11.9	10.8	9.9	9.2	8.5	7.9	7.4	7.0
75	121	120.8	60.4	40.3	30.2	24.2	20.1	17.3	15.1	13.4	12.1	11.0	10.1	9.3	8.6	8.1	7.5	7.1
76	122	122.4	61.2	40.8	30.6	24.5	20.4	17.5	15.3	13.6	12.2	11.1	10.2	9.4	8.7	8.2	7.6	7.2
77	124	124.0	62.0	41.3	31.0	24.8	20.7	17.7	15.5	13.8	12.4	11.3	10.3	9.5	8.9	8.3	7.7	7.3
78	126	125.6	62.8	41.9	31.4	25.1	20.9	17.9	15.7	14.0	12.6	11.4	10.5	9.7	9.0	8.4	7.8	7.4
79	127	127.2	63.6	42.4	31.8	25.4	21.2	18.2	15.9	14.1	12.7	11.6	10.6	9.8	9.1	8.5	7.9	7.5
80	129	128.8	64.4	42.9	32.2	25.8	21.5	18.4	16.1	14.3	12.9	11.7	10.7	9.9	9.2	8.6	8.1	7.6
81	130	130.4	65.2	43.5	32.6	26.1	21.7	18.6	16.3	14.5	13.0	11.9	10.9	10.0	9.3	8.7	8.2	7.7
82	132	132.0	66.0	44.0	33.0	26.4	22.0	18.9	16.5	14.7	13.2	12.0	11.0	10.2	9.4	8.8	8.3	7.8
83	134	133.6	66.8	44.5	33.4	26.7	22.3	19.1	16.7	14.8	13.4	12.1	11.1	10.3	9.5	8.9	8.4	7.9
84	135	135.2	67.6	45.1	33.8	27.0	22.5	19.3	16.9	15.0	13.5	12.3	11.3	10.4	9.7	9.0	8.5	8.0
85	137	136.9	68.4	45.6	34.2	27.4	22.8	19.6	17.1	15.2	13.7	12.4	11.4	10.5	9.8	9.1	8.6	8.1
86	138	138.5	69.2	46.2	34.6	27.7	23.1	19.8	17.3	15.4	13.8	12.6	11.5	10.7	9.9	9.2	8.7	8.1
87	140	140.1	70.0	46.7	35.0	28.0	23.3	20.0	17.5	15.6	14.0	12.7	11.7	10.8	10.0	9.3	8.8	8.2
88	142	141.7	70.8	47.2	35.4	28.3	23.6	20.2	17.7	15.7	14.2	12.9	11.8	10.9	10.1	9.4	8.9	8.3
89	143	143.3	71.6	47.8	35.8	28.7	23.9	20.5	17.9	15.9	14.3	13.0	11.9	11.0	10.2	9.6	9.0	8.4
90	145	144.9	72.5	48.3	36.2	29.0	24.2	20.7	18.1	16.1	14.5	13.2	12.1	11.1	10.4	9.7	9.1	8.5
91	147	146.5	73.3	48.8	36.6	29.3	24.4	20.9	18.3	16.3	14.7	13.3	12.2	11.3	10.5	9.8	9.2	8.6
92	148	148.1	74.1	49.4	37.0	29.6	24.7	21.2	18.5	16.5	14.8	13.5	12.3	11.4	10.6	9.9	9.3	8.7
93	150	149.7	74.9	49.9	37.4	29.9	25.0	21.4	18.7	16.6	15.0	13.6	12.5	11.5	10.7	10.0	9.4	8.8
94	151	151.3	75.7	50.4	37.8	30.3	25.2	21.6	18.9	16.8	15.1	13.8	12.6	11.6	10.8	10.1	9.5	8.9
95	153	153.0	76.5	51.0	38.2	30.6	25.5	21.9	19.1	17.0	15.3	13.9	12.7	11.8	10.9	10.2	9.6	9.0

# PW-1 Appendix B Montana Mean Annual Class A Pan Evaporation (In Inches)



**PW-1 Appendix C. Livestock and Wildlife Water Use Requirement**

Category of Animal	Type or condition of Animal	Daily Water Use per head (gal)	Average Typical Use (Gal)	Average Annual Use (Gal) **
Beef Cattle	Beef cows in general	10-16	13	4745
	Lactating Cows with Calves	11-18	14.5	5293
	Dry Cows, bred heifers	6-15	10	3650
	Bulls	7-19	10	3650
	Growing beef cattle 400 lbs	3.5-9.5	6.6	2409
	Growing beef cattle 600 lbs	5-13		2409
	Growing beef cattle 800 lbs	6-15		2409
	Finish beef cattle 600 lbs	5.5-14.5	10.8	3942
	Finish beef cattle 800 lbs	7-17.5		3942
	Finish beef cattle 1000 lbs	8.5-20.5		3942
Finish beef cattle 1200 lbs	9.5-22.5	3942		
Dairy Cattle	Calves (1-4 months)	1.3-3.5	2.4	876
	Dairy heifers (5-24 months)	3.8-9.6	6.6	2409
	Milk Cows	18-41	30.4	11096
	Dry Cows	9.0-13	10.8	3942
Horses	Horse in General	10-12	11	4015
	Small (500 lbs)	3.4-5.3	4.4	1606
	Medium (1000 lbs)	6.9-10.3	8.6	3139
	Weanling, 650 lbs	10.3-15.6	12.9	4709
Swine	Weaner (15-49 lbs)	0.3-0.9	0.5	183
	Feeder pig (50-79 lbs)	0.9-1.1	1.2	438
	Feeder pig (80-154 lbs)	1.2-1.9	1.2	438
	Feeder pig (155-243 lbs)	2.0-2.6	2.4	876
	Gesting sow/boar	3.6-4.5	4	1460
	Lactating Sow	4.8-6.0	5.3	1935
Sheep and Goats	Sheep and Goats in general	0.5-2	1.3	475
	Rams	2	2	730
	Dry Ewes	2	2	730
	Lactating ewes with Lambs	2.4-2.8	2.6	949
	Feeder Lambs (60-110 lbs)	1.0-1.4	1.2	438
	5-20 lbs Lambs	0.1-0.3	0.2	73
Other Animals	Elk	2-3	2.5	913
	Deer	0.5-1	0.75	274
	Antelope	0.5-1	0.75	274
	Chickens	0.05-0.1	0.08	29
	Turkeys	0.1-0.16	0.13	47
<p>(1): Zacek, J., 1979. USDA Soil Conservation Service Technical Notes No.26. Bozeman, Montana  (2): Canada Ministry of Agriculture, Food and Rural Affairs, 2007. Water Requirements of Livestock Factsheet. Queen Printer for Ontario. Accessed 09/2009 at <a href="http://www.omafra.gov.on.ca/english/engineer/facts/07-023.htm">http://www.omafra.gov.on.ca/english/engineer/facts/07-023.htm</a>  (3) Lardy, G., C. Stoltenow, and R. Johnson, 2008. Livestock and Water. North Dakota State University Extension Service, Publication AS-954. Fargo, North Dakota 58105  (4) National Academy of Sciences, 1974. Nutrients and toxic substances in water for livestock and poultry. Washington D.C.  ** Numbers are calculated by multiplying 365 days by the average typical use column.</p>				