2014 ENGINEER'S INSPECTION
A/B POND COMPLEX DIKE
COLSTRIP, MONTANA

Prepared For:

PPL MONTANA, LLC
Colstrip, Montana

Hydrometrics, Inc.
Consulting Scientists and Engineers

SEPTEMBER 2014

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September 2014

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2014 ENGINEER'S INSPECTION
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1.0 PURPOSE AND SCOPE OF STUDY

This report presents the results of a Periodic Engineer's Inspection of the A/B Pond Complex Dike near Colstrip, Montana. The dams at Colstrip fall under the regulation of the Major Facilities Siting Act (MCA, 2007). Although they are exempt from the Montana Dam Safety Rules, PPL Montana has agreed to have them inspected in accordance with these rules (ARM, 1988).

This report has been prepared in accordance with Montana Dam Safety Rules. In general terms, a Periodic Inspection includes:

(a) Review and analysis of previous inspection reports and available data on the design, construction, operation, and maintenance of the dam and its appurtenances;

(b) Visual inspection of the dam, its appurtenances, the downstream area, and all other areas affected by the structure;

(c) Evaluation or plan for a full evaluation over no more than a 5-year period of the general conditions of the dam, spillways, and other appurtenances, including an assessment of the hydrologic and hydraulic capabilities, structural stability, and any other conditions that constitute or could constitute a hazard to the integrity of the structure;

(d) Evaluation of operation, maintenance, emergency, and inspection procedures employed by the owner;

(e) Analysis of piezometric levels or other data from any instrumentation or monitoring of the dam;

(f) Review and analysis of the rate and volume of seepage and condition and maximum flow capability of any seepage collection system;

(g) Review and documentation of the condition of surfaces and vegetation on the crest and slopes of the dam and area beyond the downstream toe of the dam;

(h) Review of maximum operating water surface elevation and amount of freeboard;

(i) Review and documentation of the condition of spillways and water level control structures, including all conduits exiting the dams; and

(j) Other items the engineer determines are necessary to document and determine the safety of the dam. (ARM Rule 36.14.602).

The purpose of the periodic Engineer's Inspection is to identify current and physical operational conditions of the dam and appurtenances and to determine if emergency measures and/or additional studies, investigations and analyses are needed, so that corrections can be made by the owner in a timely manner.

The following tasks were completed by Hydrometrics, Inc.:

1. Review of previous engineering, design and construction data to verify completeness of information in characterizing the general safety of the Pond AB Dike (*Section 5*).
2. Engineering analysis of seepage and piezometer data to determine if internal seepage affects the integrity of the dam (*Section 5*).
3. Visual observations of the dam, appurtenant structures, and downstream areas for evidence of seepage, unstable slopes and erosion characteristics *(Section 6).*
4. Review of the previous inspection reports and comparison of existing conditions with conditions and recommendations noted in those reports *(Section 7).*
5. A summary of conclusions and recommendations (*Section 8*).

2.0 PROJECT DESCRIPTION

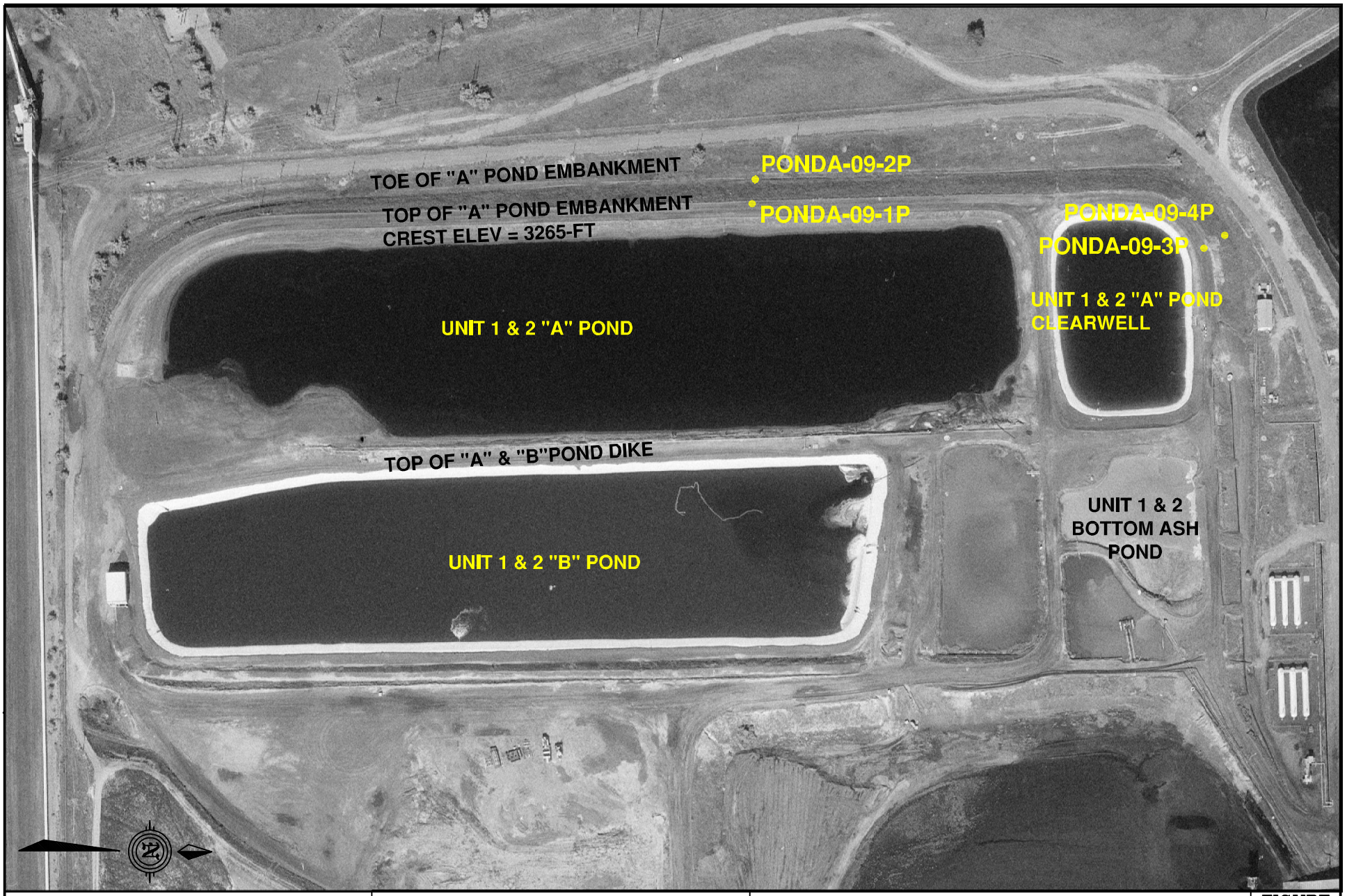
2.1 PROJECT OVERVIEW

The A/B Ponds Complex is currently used for storage of site storm water and occasionally alternative storage of bottom and fly ash slurry from other evaporation ponds. The pond was previously the main bottom and fly ash evaporation pond for Units 1 & 2. The pond is divided into four separate ponds by internal divider dikes, as described below. The dike inspected for this report borders the A Pond on the south and west side, and the Units 1 & 2 Bottom Ash Clearwell on the north and west.

The A/B Ponds Complex Dike is in Rosebud County, in the east half of Section 33, Township 2 North (T2N), Range 41 East (R41E). The dike is located just to the southwest of the Units 1 & 2 power plant. The project is shown on Figure 2-1. Figure 2-1 is taken from the 2013 annual monitoring report for PPL Montana Colstrip impoundments (Womack & Associates, 2013). Figure 2-1 shows piezometers installed on the embankments in 2009. Piezometer data and analysis will be discussed in Section 4.2. Original design drawings (Bechtel, 1974) and (Bechtel, 1975) show the original pond layout and dike configurations. Pond layout has since changed.

2.2 DESIGN AND CONSTRUCTION

Little information is available on the design and construction of the Pond A/B Dike. The A/B Ponds Complex consists of four cells: A Pond on the southwest corner, B Pond on the southeast corner, Units 1 & 2 Bottom Ash Ponds on the northeast corner, and the Units 1 & 2 Bottom Ash Clearwell on the northwest corner. A Pond is used for storm water containment. B Pond is used to manage scrubber process water. Units 1 & 2 Bottom Ash Pond is used for bottom ash process water containment. The Units 1 & 2 Bottom Ash Clearwell is used to return decant water to the plant. Available technical data pertaining to the A/B Ponds Complex Dike is listed in Table 2-1. The A/B Ponds Complex Dike is located south of Willow Avenue to the east of Highway 39 and Colstrip.



Scale: 1" = N.T.S	EPA Mandated Groundwater Monitoring PPL Colstrip Steam Electric Station Units 1 & 2 Pond A Colstrip, Montana	Piezometer Location Map	FIGURE 2-1

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WOMACK & ASSOCIATES, INC.

TABLE 2-1. A/B PONDS COMPLEX DIKE DESIGN SUMMARY

- Owner/Operator: PPL Montana (formerly the Montana Power Company).
- Date Constructed: 1975
- Purpose: Storage of site storm water (Pond A), scrubber process water (Pond B), storage of bottom ash.
- Location: East half Section 33, Township 2 North (T2N), Range 41 East (R41E), Rosebud County, Montana.
- Watershed: Armells Creek, a tributary of the Yellowstone River.
- Drainage Area: Unknown

RESERVOIR DATA

- Maximum Normal Pool Elevation 3260 feet
- Crest Elevation 3,266.6 NGVD
- Storage to Dam Crest 600 acre feet
- No Spillway

EMBANKMENTS DATA

- Type: Zoned Earth
- Wave Protection: None
- Maximum Height, feet: 30.4
- Crest Elevation, feet NGVD: 3266.6
- Crest Length, feet: 5700
- Crest Width, feet: 20
- Upstream & Downstream Slopes, H:V: 2:1

One access point is near the southwest corner of A Pond and the other is near the northeast corner of the Units 1 & 2 Bottom Ash Ponds south of the plant. Additional access can be gained south from Willow Avenue through the plant complex.

3.0 HAZARD POTENTIAL

In 2009, Hydrometrics conducted a breach analysis of the A/B Ponds Complex Dike and developed breach flood mapping for an Emergency Action Plan (EAP) (Hydrometrics, 2009a). The flood evacuation area extends along East Fork Armells Creek to the floodplain of the Castle Rock Main Dam, shown in Appendix B. Hazards included in the floodway downstream of the ponds include portions of the plant, Willow Avenue, Box Elder Avenue, and City of Colstrip Maintenance Facilities located between these two streets. Due to flood water flowing underneath the railroad bridge and ponding behind Willow Avenue, a small area of residential housing to the west of the A/B Ponds Complex will also be inundated to very shallow depths. The dikes have not had a hazard classification completed. PPL Montana maintains and operates the dike according to Montana Dam Safety criteria for high hazard dams by conducting a 5-year period engineers inspection that includes evaluation of the dike stability, seepage and flood routing (flood storage in this case).

PPL Montana updates the EAP for the A/B Ponds Complex Dike annually. The plan was last reviewed and updated in December 2013. The EAP is on file in the Colstrip plant offices and with local emergency response agencies.

4.0 REVIEW OF ENGINEERING DATA

Engineering data related to the safety aspects of the dam was reviewed as part of this inspection. This review included reports from previous investigations and inspections.

4.1 PREVIOUS INVESTIGATIONS AND INSPECTIONS

The original Bechtel Power Corporation's embankment design report is not available. The only available Bechtel documents reflecting the original design are Bottom and Fly Ash Ponds "For Construction" drawings (Bechtel, 1974) and the civil general plot plan (Bechtel, 1975). These drawings have been used for establishing the embankment geometry in slope stability analyses in subsequent reports.

GEI Consultants conducted an EPA-mandated site-specific assessment of the PPL Montana coal ash impoundments in 2009 (GEI, 2009). This report encompassed evaluation of the impoundment and embankments for geologic and seismic considerations, instrumentation, spillway adequacy, structural stability, maintenance and methods of operation, and the emergency action plan. GEI conducted an independent slope stability of the dike and concluded it possessed adequate factors of safety. The report also recommended installation of embankment piezometers to monitor internal seepage. All recommendations in the GEI report were addressed in PPL Montana's responses to EPA's recommendations (PPL Montana, 2009). Action items considered pending in PPL Montana's response have since been completed and verified during this 2014 inspection.

In 2009, Womack & Associates completed two geotechnical analyses of embankments in the A/B Pond Complex in response to EPA recommendations. The first was for the Pond A embankment (Womack & Associates, 2010a) and the second was for the Bottom Ash Pond (Womack & Associates, 2010b). Both reports concluded the factors of safety for slope stability of the Pond A and Bottom Ash embankments exceeded those required by the Federal Energy Regulatory Commission (FERC).

A previous periodic inspection report (Hydrometrics, 2009b) was reviewed as part of this inspection. The 2009 report included only field observations and did not address safety items normally included in a periodic engineer's inspection. However, recommendations were made in the 2009 report. The status of each of those recommendations is summarized below.

Recommendation 1: Remove willow shoots and bushes growing on the upstream slope of the dike.

Status: Complete. No willows were observed.

Recommendation 2: Re-contour the southwest corner area near the toe where the road and drainage ditch come together to eliminate the over-steepened slope.

Status: This has been accomplished. The area has been revegetated but is sparse.

Recommendation 3: Initiate rodent control program on downstream slope and repair rodent holes.

Status: A rodent control program was started in 2009. Several rodent holes were found on the 2014 inspection. We recommend backfilling the holes and monitoring. If rodents return, reinstate a control program.

Recommendation 4: Monitor recently disturbed areas on the downstream slope and in the downstream area to ensure that vegetation becomes established and erosion does not occur. Revegetation efforts may need to be initiated in bare areas.

Status: Disturbed areas observed in 2009 appear to be in good condition. Other recently disturbed areas found during the 2014 inspection require more seeding to establish vegetation.

Recommendation 5: Remove abandoned pipes no longer in use at the pond. Repair disturbed areas.

Status: Completed.

Recommendation 6: Complete installation of pipe at the toe of the west dike and compact backfill to avoid sinkholes over the pipe.

Status: Completed.

Recommendation 7: Repair erosion damage from runoff at the shoulders of the crest. Provide erosion protection at drainage locations.

Status: Eroded areas still are on the crest shoulders. We recommend a drainage plan to prevent further erosion damage.

Recommendation 8: Have an engineer evaluate seepage and groundwater data for impacts to embankment stability and potential piping.

Status: Four piezometers have been installed and are being monitored.

Recommendation 9: Collect data on the pond capacity to allow the impoundment's hydrologic capacity to be analyzed.

Status: Pond capacity has been determined. A rainfall hydrologic analysis was completed as part of this report. See Section 4.3.

Recommendation 10: Collect data on the embankment geometry and composition to allow the structural stability of the embankment to be analyzed.

Status: Completed. Slope stability is adequate according to the GEI report of 2009.

4.2 SEEPAGE

Design and construction drawings indicate the A/B Ponds Complex Dike is constructed as a zoned earth embankment with an internal clay core. In the northwest corner and the north portion of the dike, the core extends down into a foundation key trench. In 2009, four piezometers were installed in the embankment in locations shown on Figure 2-1. The piezometers are monitored approximately every 6 months. As indicated in Figures 4-1 and 4-2, the data available indicates that the internal core is effective in maintaining a low phreatic surface in the embankment.

FIGURE 4-1. PHREATIC SURFACE IN THE WEST PORTION OF THE A/B PONDS COMPLEX DIKE

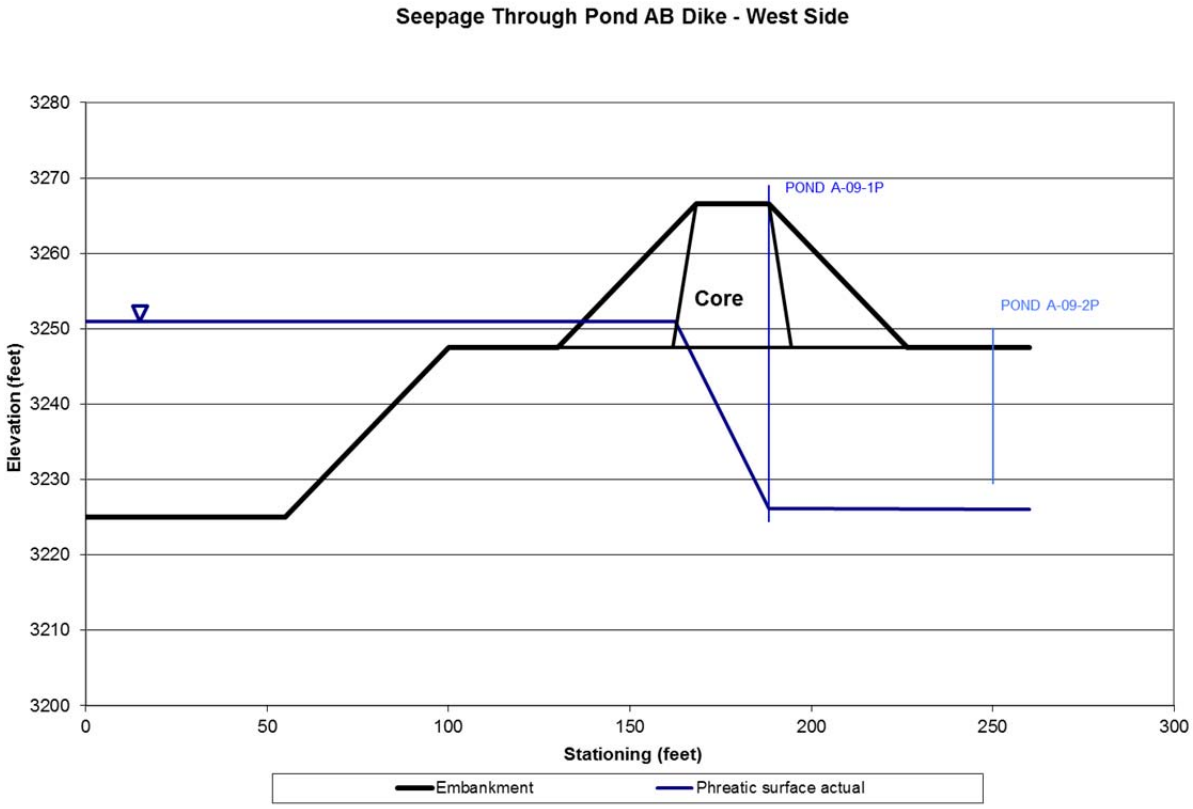
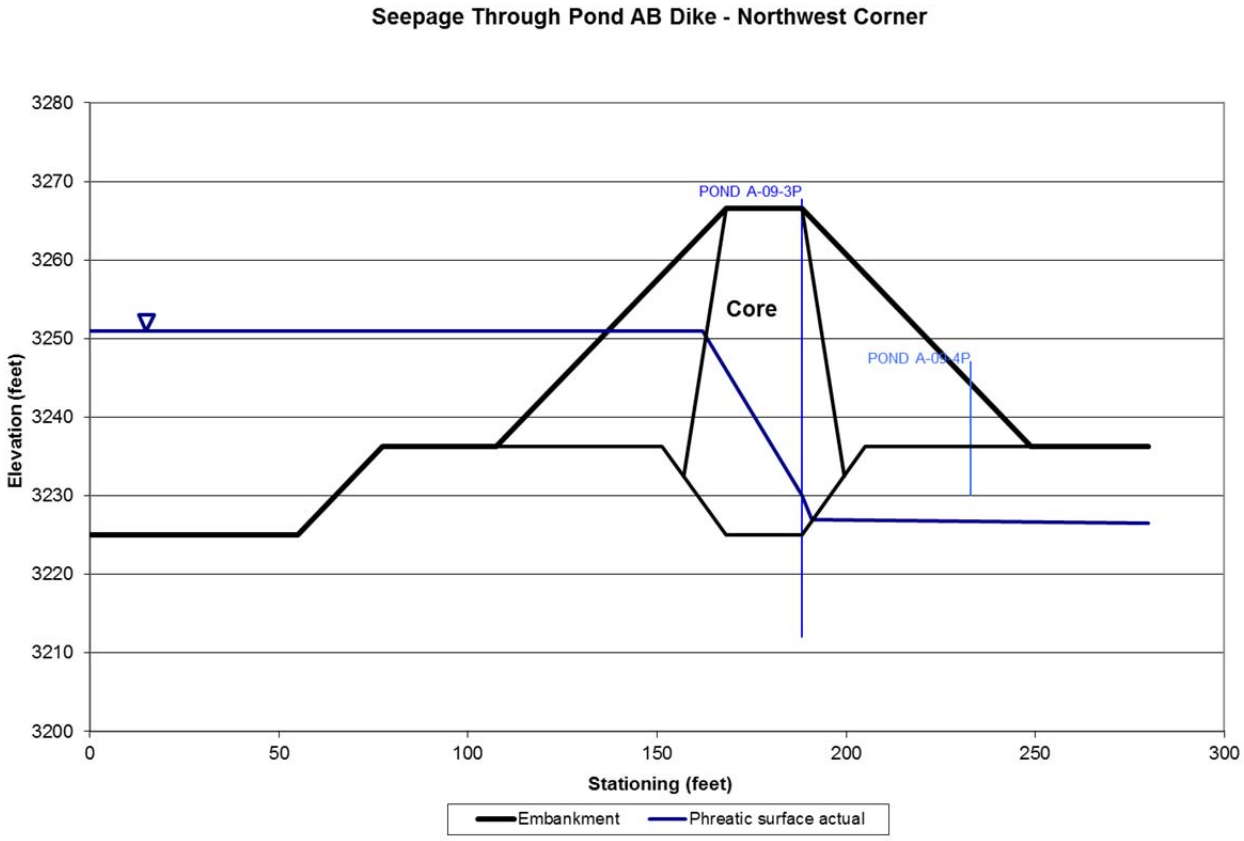


FIGURE 4-2. PHREATIC SURFACE IN THE NORTHWEST PORTION OF THE A/B PONDS COMPLEX DIKE



4.3 FLOOD ROUTING

To our knowledge, a flood analysis using State of Montana inflow design flood criteria has not been previously done for the A/B Pond Complex. As part of this report, we have conducted a rainfall analysis to determine if the pond complex can contain the rainfall volume from a design storm in accordance with State of Montana criteria. As mentioned in Section 2.0 of this report, the ponds are used for storage of site storm water and occasionally alternative storage of bottom and fly ash slurry from other evaporation ponds. Inflow to the ponds is controlled, except for rain that falls directly over the ponds area. So the drainage catchment area is equal to the ponds surface area and the design inflow flood is equal to the design rainfall event. According to the Administrative Rules of Montana (ARM) 36.14.502 (Hydrologic Standard for Emergency and Principal Spillways), spillway conveyance for

high-hazard dams is based on estimated loss of life downstream from the dam caused by spillway failure. Also, ARM 36.14.502 requires the reservoir and spillway to safely store and pass the runoff resulting from the minimum inflow design flood. In order to meet State of Montana criteria for a high-hazard dam, the A/B Ponds, which do not have a spillway, must be operated with sufficient freeboard to contain the volume of the inflow design flood, or in this case, rainfall, without overtopping the dike. Because a loss of life analysis is required to determine the design rainfall, but has not been completed for failure of the dike, we have analyzed the necessary freeboard capacity of the ponds based upon a calculated design rainfall amount using the probable maximum precipitation (PMP), which according to ARM 36.14.502 is the volume maximum rainfall amount that may be required for the hydrologic analysis of a high-hazard dam.

The PMP calculations were conducted according to the procedures found in Hydrometeorological Report No. 55a (U.S. Department of Commerce, 1988). The procedures consider two different storms (a local storm PMP or a general storm PMP) to determine the maximum precipitation depth for the design precipitation. From the calculations, the general storm PMP resulted in the greatest depth, which was 29 inches of rainfall over a 72-hour period. The 6-hour local PMP resulted in a total precipitation depth of 13.70 inches. Calculations for the PMP are found in Appendix C.

To determine the effect of the PMP on the A/B Ponds Complex, ARM 36.14.502 requires the rainfall to begin when the reservoir is at normal operation pool. For the A/B Ponds, the normal operation level is elevation 3260 feet (Bechtel, 1974). When the total PMP depth of 29 inches (2.42 feet) is applied to the normal operation pool of the ponds, the resulting level will be elevation 3262.42 feet. The top of the dikes, from various references, appear to range in elevation from 3265 to 3267 feet. Therefore, even after addition of the rainfall from the PMP, the A/B Ponds include an additional 2.58 feet of freeboard to the lowest dike top elevation of 3265 feet.

Because of the results of our conservative hydrologic analysis, our conclusion is the A/B Ponds Complex has the capacity to contain the volume of a PMP storm without overtopping

the dike, and is therefore in compliance with the criteria of the State of Montana for high hazard dams.

4.4 SLOPE STABILITY

As mentioned in Section 4.1, GEI Consultants conducted an EPA-mandated site-specific assessment of the PPL Montana coal ash impoundments in 2009 (GEI, 2009) and found that the embankments had adequate factors of safety for slope stability. In response to EPA recommendations concerning slope stability and seepage monitoring, geotechnical investigations for the embankments were performed by Womack & Associates (2010a and 2010b). Both reports concluded the factors of safety for slope stability of the Pond A and Bottom Ash embankments exceeded those required by the Federal Energy Regulatory Commission (FERC).

The project lies in a Seismic Zone 0 (UBC, 1994), which is characterized by little seismic risk. The original design report selected a seismic coefficient of 0.05 g for use in slope stability analysis, which is a conservative value for this seismic zone.

5.0 FIELD INSPECTION

5.1 METHODOLOGY

Gary Fischer, P.E., conducted a detailed field inspection of the A/B Ponds Complex Dike on July 15, 2014. Mr. Fischer was accompanied by Mike Holzwarth of PPL Montana, Charles Freshman of the Montana Department of Environmental Quality, and Sam Johnson of the Montana Department of Natural Resources and Conservation. Observations were made for surface evidence of potential problems relating to settlement, seepage, slope stability, erosion and general condition of appurtenant structures. Inspection photographs document both general conditions and specific items which merit remedial action (Appendix A). Copies of the field inspection forms are contained in Appendix B.

Access to the Pond AB Dike is through a continually manned security gate to the power plant facility.

Notation in the following text is referenced as “right” or “left” looking downstream of the dam.

5.2 A/B POND COMPLEX DIKE INSPECTION

5.2.1 Crest

The crest of the Pond AB Dike is approximately 20 feet wide. The horizontal alignment of the crest appears to be good with no surface cracking, areas of unusual movement or cave in. There are no ruts, puddles or low areas. There are two areas where surface runoff breached the small berms on the shoulders of the crest and caused some erosion on the side slopes. These areas should be repaired and the surface drainage of the crest should be evaluated for modifications to control drainage without causing erosion. The crest is used as a road and was bare of vegetation. See Photos 1, 6, 7, 8 and 9.

5.2.2 Upstream Slope

The upstream slopes of the dike form the sides of the Units 1 & 2 Bottom Ash Clearwell (northwest pond) and A Pond (southwest pond). There are no signs of sliding, sloughing,

escarpment, sinkholes, animal burrows, or unusual movement. The contact between the embankment and south abutment is good.

There is no slope protection on the southwest pond upstream slope, but little or no wave erosion has occurred (Photos 4 and 5). The northwest pond is lined with a reinforced polypropylene liner (Photos 38 and 39). Erosion rills exist in places where surface runoff broke through the crest shoulder berms. The erosion damage requires repair.

Vegetation is sparse and appears to be mostly grass where it is growing.

5.2.3 Downstream Slope

The downstream slope did not exhibit signs of sliding, sloughing, or unusual movement. There are two areas where surface runoff from the crest eroded the slope (Photo 14). These areas require repair. There are several small woody bushes that need removing (Photo 34). Neither wet areas nor seepage are present on the surface of the slope. The contact between the embankment and south abutment is in good condition.

Several rodent holes are on the downstream slope (Photo 13). We recommend backfilling the holes and monitoring the area to determine if rodents return. If rodents are present, the rodent control program should be reinstated. For the most part, grass cover along the slope is well established with the exception of some areas of pipe installations where vegetation is not yet established (Photo 24). These areas may need to be reseeded. The downstream slope is over-steepened on the northwest corner of the dike where backfill from a recent pipeline installation did not match the existing embankment slope (Photo 30).

5.2.4 Downstream Area

The downstream area of the A/B Pond Dike does not have abutment or foundation seepage showing on the surface. There is no evidence of sliding or sloughing. There is standing water in one part of the downstream area, which appears to be from surface runoff (Photo 15). The area should be monitored to determine if the water remains or evaporates. The depression where water collects should be modified to allow it to drain. This area is used as

a surface runoff channel for water draining from the south haul road. As mentioned in the 2009 inspection report, the area should be monitored for signs of erosion.

5.2.5 Instrumentation

As mentioned in Section 4.2, four piezometers were installed on or near the dike in 2009 in response to recommendations by the EPA. These are monitored approximately every six months.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based upon our review of previous reports and recent field observations, the A/B Ponds Complex Dike presently conforms to the Montana Dam Safety guidelines with respect to seepage and slope stability. A flood routing analysis is detailed in Section 4.3 of this report and the Ponds Complex complies with State of Montana hydrologic criteria. No major deficiencies are identified in this inspection. Several items are identified which merit remedial action and/or monitoring. Those items lead us to provide the following recommendations:

1. Backfill rodent holes and monitor to determine if rodents are active. If rodents are present, reinstate a rodent control program.
2. Reseed recently disturbed areas where a pipeline was installed to establish vegetation.
3. Repair eroded areas in the crest shoulder berms and the downstream and upstream slopes. Prepare a drainage plan to prevent further erosion damage.

7.0 REFERENCES

Administrative Rules of Montana (ARM), 1988. Chapter 36, Natural Resources and Conservation, Rule 14, Dam Safety. Enacted 1988.

Bechtel, Inc., 1974. Drawing Nos. C1-31 and C1-32, Job No. 8680, Bottom and Fly Ash Ponds Plan and Sections. Issued May 16, 1974.

Bechtel, Inc., 1975. Drawing No. C1-25, Rev. 5, Job No. 8680, Civil General Plot Plan for Ponds "A", "B", "C" and "D". Issued November 11, 1975.

GEI Consultants, 2009. Coal Ash Impoundment – Specific Site Assessment Report, PPL Montana, Colstrip Power Plant. Mandated by EPA and conducted for Lockheed-Martin Corporation. August 2009.

Hydrometrics, Inc., 2009a. Emergency Action Plan, Stage II Dam, Castle Rock Lake Main Dam, Castle Rock Lake Castle Dam, 3&4 EHP Main Dam, and 3&4 EHP Saddle Dam. For PPL Montana. May 18, 2009.

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Womack & Associates, 2010a. Geotechnical Investigation Report, EPA Recommended Corrective Measures at the Colstrip Power Plant, Units 1 & 2 Pond "A" Waste Impoundment Embankment. January.

Womack & Associates, 2010b. Geotechnical Investigation Report, EPA Recommended Corrective Measures at the Colstrip Power Plant, Units 1 & 2 Bottom Ash Waste Impoundment Pond. January.

Womack & Associates, 2013. Annual Report for Instrumentation Measurements and Assessment for PPLM's Colstrip Effluent Holding Ponds (EHP). December 31.

APPENDIX A

FIELD INSPECTION PHOTOGRAPHS
A/B POND COMPLEX DIKE

Photo 1. Pond AB Dike, July 15, 2014.
Crest, south dike, erosion on inboard shoulder.

Photo 2. Pond AB Dike, July 15, 2014.
View of Pond A from south side.

Photo 3. Pond AB Dike, July 15, 2014.
View of Pond A from south side.

Photo 4. Pond AB Dike, July 15, 2014.
Upstream slope, south dike

Photo 5. Pond AB Dike, July 15, 2014.
Upstream slope, west dike taken from south side.

Photo 6. Pond AB Dike, July 15, 2014.
Erosion on downstream shoulder of crest, west dike.

Photo 7. Pond AB Dike, July 15, 2014.
Erosion on downstream shoulder of crest, west dike.

Photo 8. Pond AB Dike, July 15, 2014.
Erosion on downstream shoulder of crest, west dike.

Photo 9. Pond AB Dike, July 15, 2014.
Erosion on downstream shoulder of crest, west dike.

Photo 10. Pond AB Dike, July 15, 2014.
Downstream slope, south dike.

Photo 11. Pond AB Dike, July 15, 2014.
Downstream slope, southwest corner, repair fill material.

Photo 12. Pond AB Dike, July 15, 2014.
Downstream slope, south side of west dike, rodent holes by person.

Photo 13. Pond AB Dike, July 15, 2014.
Downstream slope, south side of west dike, rodent hole.

Photo 14. Pond AB Dike, July 15, 2014.
Downstream slope, south side of west dike, erosion rills near toe.

Photo 15. Pond AB Dike, July 15, 2014.
Downstream slope, south side of west dike, seepage or runoff ponded.

Photo 16. Pond AB Dike, July 15, 2014.
Downstream slope, looking south at southwest corner.

Photo 17. Pond AB Dike, July 15, 2014.
Downstream slope, south side of west embankment, seepage/runoff ponding.

Photo 18. Pond AB Dike, July 15, 2014.
Downstream slope, south side of west embankment, seepage/runoff ponding.

Photo 19. Pond AB Dike, July 15, 2014.
Downstream toe area, south side of west embankment.

Photo 20. Pond AB Dike, July 15, 2014.
Rodent hole, downstream toe, middle of west dike.

Photo 21. Pond AB Dike, July 15, 2014.
Downstream toe area, middle of west dike, water line manhole.

Photo 22. Pond AB Dike, July 15, 2014.
Downstream slope, middle of west dike.

Photo 23. Pond AB Dike, July 15, 2014.
Piezometer Pond A-00-2P, downstream toe, middle of west dike.

Photo 24. Pond AB Dike, July 15, 2014.
Downstream slope, repair area after pipe installation.

Photo 25. Pond AB Dike, July 15, 2014.
Downstream slope and toe, pipe installation area.

Photo 26. Pond AB Dike, July 15, 2014.
Downstream slope and toe, pipe installation area.

Photo 27. Pond AB Dike, July 15, 2014.
Downstream slope and toe, west dike.

Photo 28. Pond AB Dike, July 15, 2014.
Downstream slope and toe, west dike.

Photo 29. Pond AB Dike, July 15, 2014.
Downstream slope and toe, west dike, northwest corner.

Photo 30. Pond AB Dike, July 15, 2014.
Downstream slope, northwest corner, pipe installation at toe.

Photo 31. Pond AB Dike, July 15, 2014.
Drainage channel in downstream toe, northwest corner.

Photo 32. Pond AB Dike, July 15, 2014.
Downstream slope, northwest corner.

Photo 33. Pond AB Dike, July 15, 2014.
Downstream slope, northwest corner.

Photo 34. Pond AB Dike, July 15, 2014.
Downstream slope, northwest corner, woody vegetation near crest.

Photo 35. Pond AB Dike, July 15, 2014.
Downstream slope, north dike.

Photo 36. Pond AB Dike, July 15, 2014.
Downstream slope, north dike.

Photo 37. Pond AB Dike, July 15, 2014.
Downstream slope, north dike.

Photo 38. Pond AB Dike, July 15, 2014.
Crest and pond, northwest corner.

Photo 39. Pond AB Dike, July 15, 2014.
Pond, northwest corner.

Photo 40. Pond AB Dike, July 15, 2014.
Crest and downstream slope, north dike.

Photo 41. Pond AB Dike, July 15, 2014.
Downstream slope, north dike.

Photo 42. Pond AB Dike, July 15, 2014.
Downstream slope, north dike.

Photo 43. Pond AB Dike, July 15, 2014.
Old seepage area, repaired, north dike.

Photo 44. Pond AB Dike, July 15, 2014.
Old seepage area, repaired, north dike.

APPENDIX B

FIELD INSPECTION NOTES

NAME OF DAM: Pond AB Dike

INSPECTION DATE: 7/15/2014

EMBANKMENT
1 of 2

AREA INSPECTED	ITEM NO.	CONDITION	OBSERVATIONS	CHECK ( ) ACTION NEEDED: MONITOR	INVESTIGATE	REPAIR
CREST	1	SURFACE CRACKING	none			
	2	CAVE IN, ANIMAL BURROW	none			
	3	LOW AREA(S)	none			
	4	HORIZONTAL ALIGNMENT	OK			
	5	RUTS AND/OR PUDDLES	See #13 and #22			
	6	VEGETATION CONDITION	Bare - used as road			
	7					
	8					
UPSTREAM SLOPE	9	SLIDE, SLOUGH, SCARP	none			
	10	SLOPE PROTECTION	none - OK condition; lined in NW pond			
	11	SINKHOLE, ANIMAL BURROW	none			
	12	EMB.-ABUT. CONTACT	OK			
	13	EROSION	Erosion rills where surface runoff came off crest			✓
	14	VEGETATION CONDITION	bare or lined - some grassy patches			
	15					
	16					

ADDITIONAL COMMENTS: REFER TO ITEM NO. IF APPLICABLE.

NAME OF DAM: Pond AB Dike

INSPECTION DATE: 7/15/2014

EMBANKMENT
2 of 2

AREA INSPECTED	ITEM NO.	CONDITION	OBSERVATION	CHECK ( ) ACTION NEEDED: MONITOR	INVESTIGATE	REPAIR
DOWNSTREAM SLOPE	17	WET AREA(S) (NO FLOW)	none			
	18	SEEPAGE	none			
	19	SLIDE, SLOUGH, SCARP	none - slightly undercut at toe after new			✓
	20	EMB.-ABUT. CONTACT	OK			
	21	CAVE IN, ANIMAL BURROW	several rodent holes throughout slope		✓	✓
	22	EROSION	erosion off crest near south west corner			✓
	23	UNUSUAL MOVEMENT	none			
	24	VEGETATION CONTROL	ok - reveg needed in area of disturbance where			✓
	25					
	26					
INSTRUMENTATION	27	PIEZOMETERS/OBSERV. WELLS	measured by PPL or Womack staff			
	28	STAFF GAUGE AND RECORDER	pond level measured by PPL or contractors			
	29	WEIRS	NA			
	30	SURVEY MONUMENTS	↓			
	31	DRAINS				
	32	FREQUENCY OF READINGS	monthly or quarterly			
	33	LOCATION OF RECORDS	PPL offices			
	34					
	35					

ADDITIONAL COMMENTS: REFER TO ITEM NO. IF APPLICABLE.

19. Pipeline installation. Place fill to provide stable toe.
24. new pipeline was installed; just a couple of woody brush to remove

NAME OF DAM: Pond AB Dike

INSPECTION DATE: 7/15/2014

OUTLET WORKS
1 of 1

AREA INSPECTED	ITEM NO.	CONDITION	OBSERVATIONS	CHECK ( ) ACTION NEEDED: MONITOR	INVESTI-GATE	REPAIR
OUTLET WORKS	70	INTAKE STRUCTURE	NA			
	71	TRASHRACK				
	72	STILLING BASIN				
	73	PRIMARY CLOSURE				
	74	SECONDARY CLOSURE				
	75	CONTROL MECHANISM				
	76	OUTLET PIPE				
	77	OUTLET TOWER				
	78	EROSION ALONG DAM TOE				
	79	SEEPAGE				
	80	UNUSUAL MOVEMENT				
	81					
	82					
	83					

ADDITIONAL COMMENTS: REFER TO ITEM NO. IF APPLICABLE.

NAME OF DAM: Pond A B Dike

INSPECTION DATE: 7/15/2014

SPILLWAYS

1 of 1

AREA INSPECTED	ITEM NO.	CONDITION	OBSERVATIONS	CHECK ( ) ACTION NEEDED: MONITOR	INVESTI-GATE	REPAIR
ERODIBLE CHANNEL	51	SLIDE, SLOUGH, SCARP	NA			
	52	EROSION				
	53	VEGETATION CONDITION				
	54	DEBRIS				
	55					
	56					
NON-ERODIBLE CHANNEL	57	SIDEWALLS				
	58	CHANNEL FLOOR				
	59	UNUSUAL MOVEMENT				
	60	APPROACH AREA				
	61	WEIR OR CONTROL				
	62	DISCHARGE AREA				
	63					
	64					
DROP INLET	65	INTAKE STRUCTURE				
	66	TRASHRACK				
	67	STILLING BASIN				
	68					
	69					

ADDITIONAL COMMENTS: REFER TO ITEM NO. IF APPLICABLE.

NAME OF DAM: Pond AB Dike

INSPECTION DATE: 7/15/2014

DOWNSTREAM AREA AND MISC.

1 of 1

AREA INSPECTED	ITEM NO.	CONDITION	OBSERVATIONS	CHECK ( ) ACTION NEEDED: MONITOR	INVESTIGATE	REPAIR
DOWNSTREAM AREA	36	ABUTMENT LEAKAGE	none			
	37	FOUNDATION SEEPAGE	one area of ponded water near southwest	✓		
	38	SLIDE, SLOUGH, SCARP				
	39	DRAINAGE SYSTEM				
	40	repaired seep	M. Holzworth mention a repaired seep at toe	✓		
	41					
	42	DOWNSTREAM HAZARD DESCRIPTION	see latest EAP			
	43	DATE OF LAST UPDATE OF EMERGENCY ACTION PLAN	2013			
MISCELLANEOUS	44	RESERVOIR SLOPES	OK			
	45	ACCESS ROADS	secured			
	46	SECURITY DEVICES	guarded gate			
	47					
	48					
	49					
	50					

ADDITIONAL COMMENTS: REFER TO ITEM NO. IF APPLICABLE.

37. corner - could be ponded runoff.

40. of north dike where seepage was flowing from an abandoned pipe. A drainage system was installed and is being monitored.

APPENDIX C

PROBABLE MAXIMUM PRECIPITATION CALCULATIONS

Hydrometeorological PMP Calculation Spreadsheet

General Storm Procedure

User fill in cells shaded

Dam or Location: A/B Pond Complex Dike, PPL Montana, Colstrip

Step Number	Step Description	
1	Drainage Outline	See Map in Inspection report
2	1-, 6-, 24-, and 72-hr index PMP estimates	

Duration (hours)	Index PMP Estimate[1] (inches)
1	11.6
6	19.5
24	26
72	29

[1] Plates I, Ii, III, and IV of Hydrometeorological Report No. 55a, June 1988 (reference)

3 Selection of subregion and subdivision

Subregion*	Subdivision**	Percent of Drainage Area
A	Minimum Nonorographic	100

*Figure 11.1 of reference

**Plate V of reference

4 and 5 Areal reduction factors and Adjusted PMP Depths

Drainage area: 0.1 mi²

Duration (hours)	Depth-duration	Areal Reduction Percentage (%)[2]	Corrected PMP Depth (inches)[3]
1	11.6	100	11.6
6	19.5	100	19.5
24	26	100	26
72	29	100	29

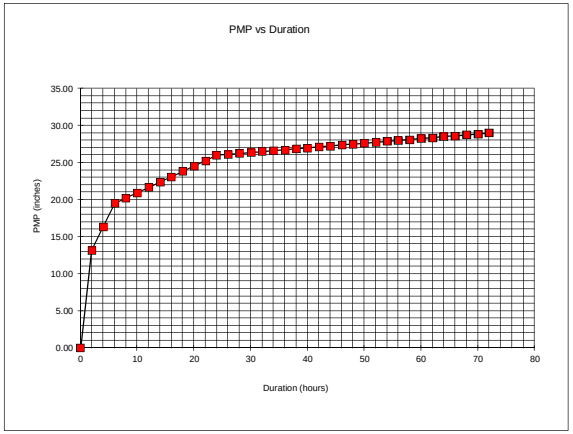
[2]See Figures 11.3 through 11.23 (reference)

::

7 Incremental estimates 2-hour increment:

Duration (hours)	PMP (inches)[3]
0	0.00
2	13.18
4	16.34
6	19.50
8	20.22
10	20.94
12	21.67
14	22.39
16	23.11
18	23.83
20	24.56
22	25.28
24	26.00
26	26.13
28	26.25
30	26.38
32	26.50
34	26.63
36	26.75
38	26.88
40	27.00
42	27.13
44	27.25
46	27.38
48	27.50
50	27.63
52	27.75
54	27.88
56	28.00
58	28.13
60	28.25
62	28.38
64	28.50
66	28.63
68	28.75
70	28.88
72	29.00

[3]See Attachment C



2-hour interval number	PMP increment (inches)
1	13.18
2	3.16
3	3.16
4	0.72
5	0.72
6	0.72
7	0.72
8	0.72
9	0.72
10	0.72
11	0.72
12	0.72
13	0.13
14	0.13
15	0.13
16	0.13
17	0.13
18	0.13
19	0.13
20	0.13
21	0.13
22	0.13
23	0.13
24	0.13
25	0.13
26	0.13
27	0.13
28	0.13
29	0.13
30	0.13
31	0.13
32	0.13
33	0.13
34	0.13
35	0.13
36	0.13

::

8 Temporal distribution

2-hour increment

a.) Grouped PMP increments (inches)

Placement Order	12 largest	Placement Order	12 middle	Placement Order	12 lowest
1	13.18	13	0.125	25	0.125
2	3.16	14	0.125	26	0.125
3	3.16	15	0.125	27	0.125
4	0.72	16	0.125	28	0.125
5	0.72	17	0.125	29	0.125
6	0.72	18	0.125	30	0.125
7	0.72	19	0.125	31	0.125
8	0.72	20	0.125	32	0.125
9	0.72	21	0.125	33	0.125
10	0.72	22	0.125	34	0.125
11	0.72	23	0.125	35	0.125
12	0.72	24	0.125	36	0.125

b.) PMPs arranged according to US Bureau of Reclamation guideline: max PMP at 48 hr duration (See Attachment D)

Duration (hours)	PMP Increment (inches)	Placement Order
2	0.125	35
4	0.125	33
6	0.125	32
8	0.125	30
10	0.125	29
12	0.125	27
14	0.125	26
16	0.125	24
18	0.125	23
20	0.125	21
22	0.125	20
24	0.125	18
26	0.125	17
28	0.125	15
30	0.125	14
32	0.72	12
34	0.72	11
36	0.72	9
38	0.72	8
40	0.72	6
42	0.72	5
44	3.16	3
46	3.16	2
48	13.18	1
50	0.72	4
52	0.72	7
54	0.72	10
56	0.125	13
58	0.125	16
60	0.125	19
62	0.125	22
64	0.125	25
66	0.125	28
68	0.125	31
70	0.125	34
72	0.125	36

Note: shading indicates user input is required

Prepared by Gary Fischer 8/14/2014

Based on information contained in Hydrometeorological Report No. 55a, June 1988

Hydrometeorological Report 55a Local PMP Calculation Spreadsheet

Local Storm Procedure

User fill in cells shaded

Dam and Location: A/B Ponds Complex, PPL Montana, Colstrip

Step Number	Step Description		
1	1-hour, 1-mi² PMP for an elevation at 5000 feet	9.5	inches[1]
	[1] See Plate VI a in Hydrometeorological Report No. 55a, June 1988 (reference)		
2	Adjustment for mean drainage elevation	a.) From 7.5 minute USGS quadrangle:	3300 feet (rounded to the nearest 100 ft)
		b.) Maximum persisting 12-hr 1000-mb dew point (Figure 4.11, reference)	75 degrees F
		c.) Percent PMP adjustment[2]:	106 %
	[2]Figure 14.3, reference		
3		Adjusted PMP:	10.07 inches
4	Depth-duration curve for 1 square mile:		

Duration (hours)	PMP Depth[3] (%)	PMP (inches)
0.25	68	6.85
0.5	86	8.66
0.75	94	9.47
1	100	10.07
2	116	11.68
3	123	12.39
4	128	12.89
5	132	13.29
6	136	13.70

[3] See Table 12.4 (reference)

5 Adjustment for basin area — Basin area: 0.1 mi²

Duration (hours)	PMP (inches)	Areal Reduction Percentage (%)*	Corrected PMP Depth (inches)**
0.25	6.85	100	6.85
0.5	8.66	100	8.66
0.75	9.47	100	9.47
1	10.07	100	10.07
2	11.68	100	11.68
3	12.39	100	12.39
4	12.89	100	12.89
5	13.29	100	13.29
6	13.70	100	13.70

*See Figure 12.12 (reference)

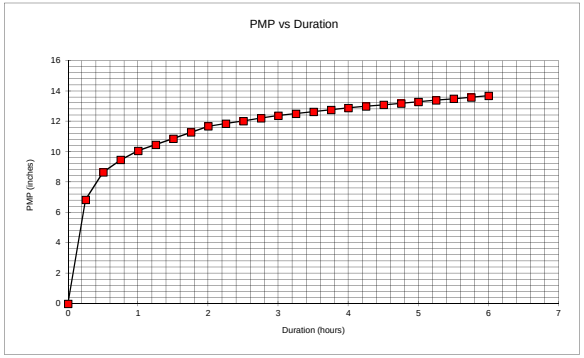
::

5 Temporal distribution

0.25-hour increment:

0.25-hour interval (hours)	PMP** (inches)	PMP increment (inches)
0	0	---
0.25	6.85	6.85
0.5	8.66	1.81
0.75	9.47	0.81
1	10.07	0.60
1.25	10.47	0.40
1.5	10.88	0.40
1.75	11.28	0.40
2	11.68	0.40
2.25	11.86	0.18
2.5	12.03	0.18
2.75	12.21	0.18
3	12.39	0.18
3.25	12.51	0.13
3.5	12.64	0.13
3.75	12.76	0.13
4	12.89	0.13
4.25	12.99	0.10
4.5	13.09	0.10
4.75	13.19	0.10
5	13.29	0.10
5.25	13.39	0.10
5.5	13.49	0.10
5.75	13.59	0.10
6	13.70	0.10

** See Attachment A



a.) Grouped PMP increments

Placement Order	8 highest (inches)	Placement Order	8 middle (inches)	Placement Order	8 lowest (inches)
1	6.85	9	0.18	17	0.10
2	1.81	10	0.18	18	0.10
3	0.81	11	0.18	19	0.10
4	0.60	12	0.18	20	0.10
5	0.40	13	0.13	21	0.10
6	0.40	14	0.13	22	0.10
7	0.40	15	0.13	23	0.10
8	0.40	16	0.13	24	0.10

b.) PMPs arranged according to US Bureau of Reclamation guideline: max PMP at 4 hr duration (See Attachment B)

Duration (hours)	PMP Increment (inches)	Placement Order
0.25	0.10	24
0.5	0.10	22
0.75	0.10	21
1	0.10	19
1.25	0.10	18
1.5	0.13	16
1.75	0.13	15
2	0.13	13
2.25	0.18	12
2.5	0.18	10
2.75	0.18	9
3	0.40	7
3.25	0.40	6
3.5	0.60	4
3.75	0.81	3
4	6.85	1
4.25	1.81	2
4.5	0.40	5
4.75	0.40	8
5	0.18	11
5.25	0.13	14
5.5	0.10	17
5.75	0.10	20
6	0.13	23

*** See Attachment B

6 Areal distribution of general storm PMP Not applicable

Note: shading indicates user input is required
Prepared by Gary Fischer 8/14/2014
Based on information contained in Hydrometeorological Report No. 55a, October 1994