

2006 NORTHWEST DAM SAFETY
REGIONAL FORUM

FERC HYDROLOGICAL SAFETY
ASSESSMENT

ROUND BUTTE DAM

KEVIN MARSHALL

BOB STEELE



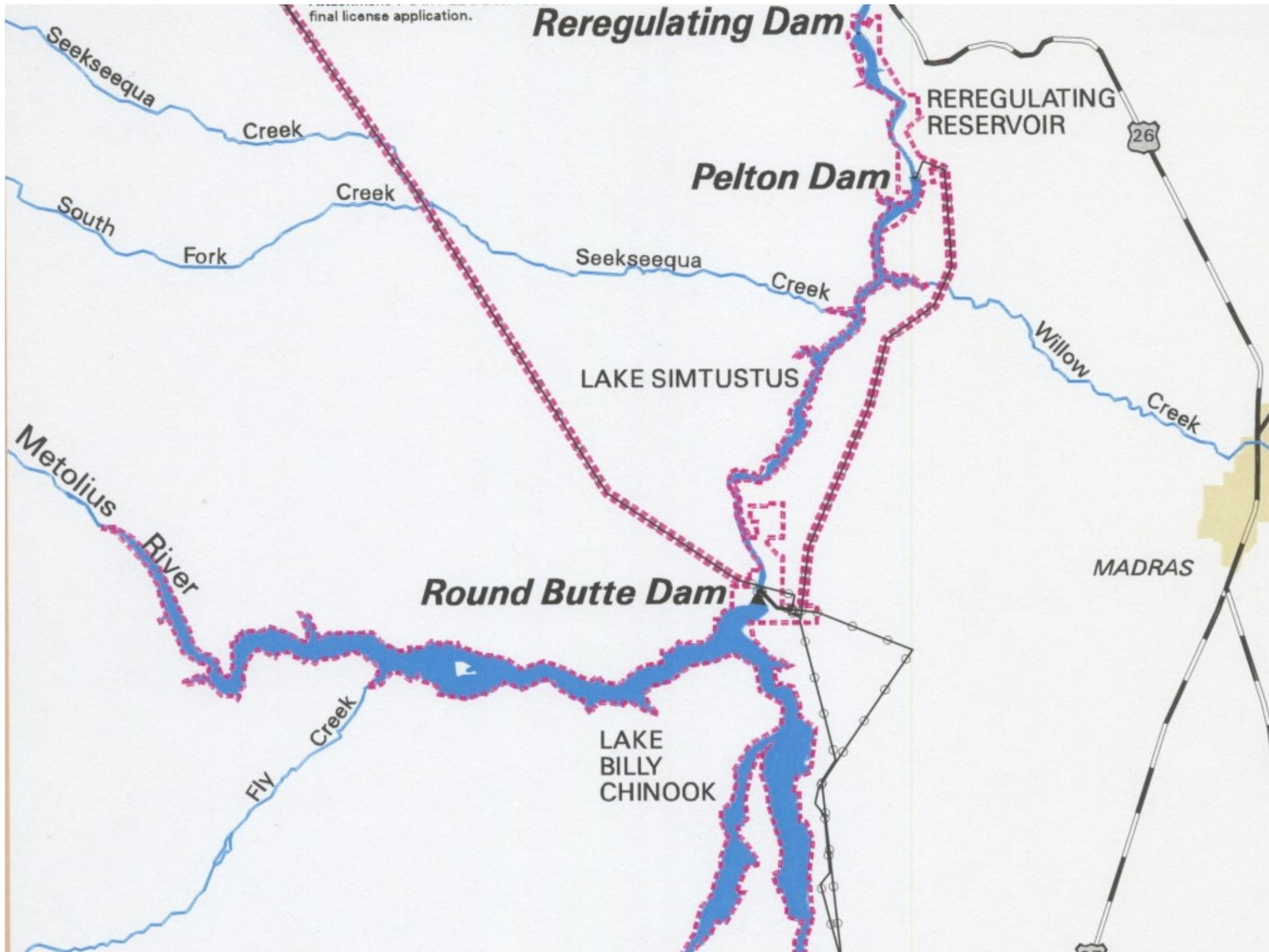
ROUND BUTTE DAM

PROBABLE MAXIMUM FLOOD
STUDY & GAGING PROGRAM



PELTON ROUND BUTTE PROJECT

- OWNED AND OPERATED BY PORTLAND GENERAL ELECTRIC COMPANY AND THE CONFEDERATED TRIBES OF THE WARM SPRINGS RESERVATION.
- FERC LICENSE NO. 2030.
- LOCATED IN CENTRAL OREGON ON THE DESCHUTES RIVER.
- THREE DAM PROJECT WITH CAPACITY OF 367 MW; OPERATES IN A RUN-OF-RIVER MODE.
- PROJECT CONSISTS OF THE ROUND BUTTE DAM, PELTON DAM AND PELTON REREGULATING DAM.
- REREGULATING DAM MAINTAINS RELATIVELY CONSTANT FLOWS DOWNSTREAM OF PROJECT.
- LOCATED DOWNSTREAM OF SIX U. S. BUREAU OF RECLAMATION (USBR) DAMS.



ROUND BUTTE DAM

- **CONSTRUCTED IN 1964 AS THE UPSTREAM DAM IN THREE DAM COMPLEX.**
- **440 FOOT HIGH ROCKFILL EMBANKMENT DAM.**
- **FOREBAY IS LAKE BILLY CHINOOK, WITH A CAPACITY OF ABOUT 535,000 ACRE-FEET.**
- **POWERHOUSE WITH THREE NOMINAL 100MW TURBINE-GENERATORS.**
- **21-FT DIAMETER CONCRETE LINED SPILLWAY TUNNEL WITH SINGLE RADIAL GATE; MAXIMUM CAPACITY OF 33,000 CFS.**
- **LOCATED EIGHT MILES UPSTREAM FROM PELTON DAM.**



ROUND BUTTE DAM PMF

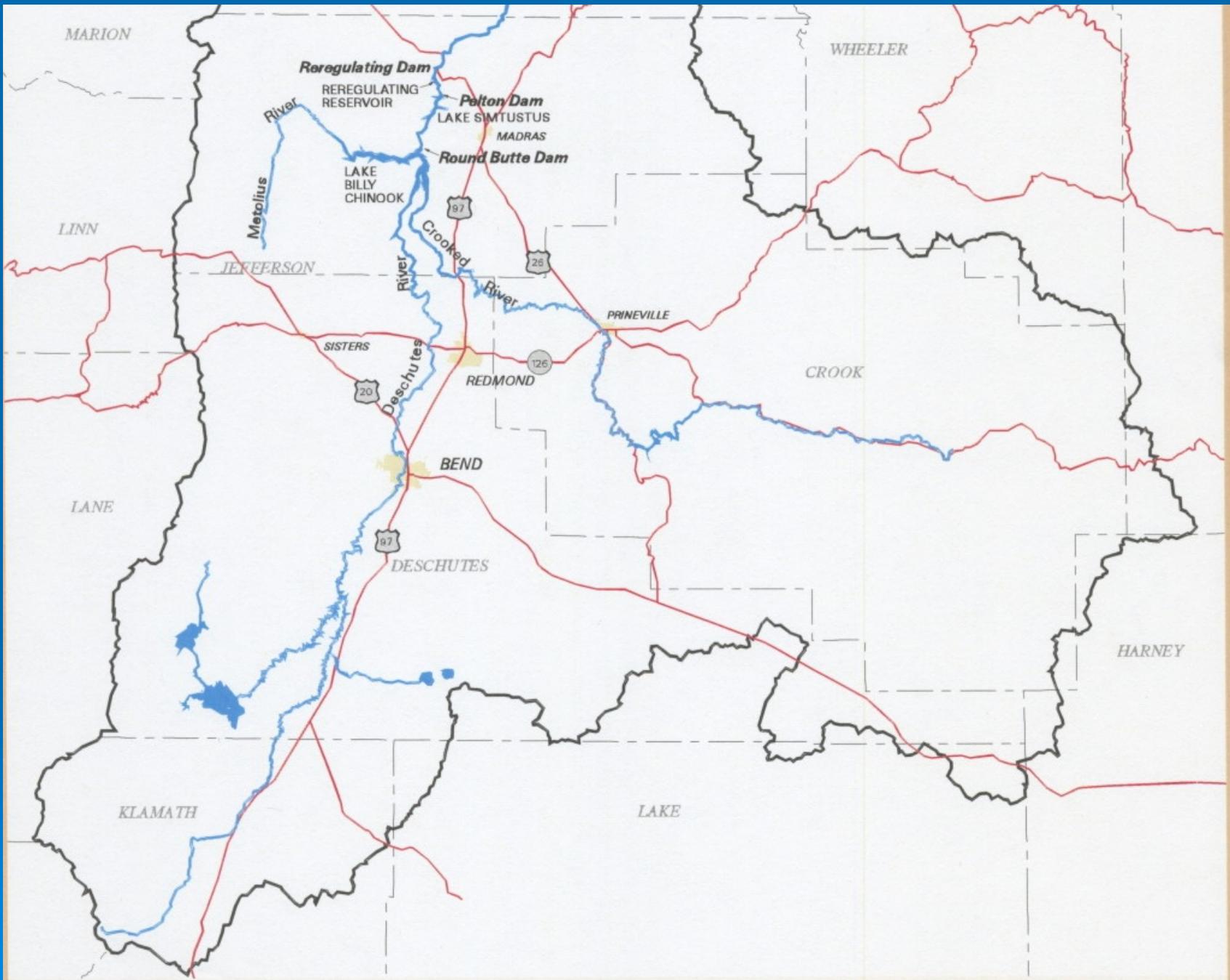
- ORIGINAL PROBABLE MAXIMUM FLOOD (PMF) CALCULATED BY ARCHITECT-ENGINEER IN EARLY 1960'S.
- STUDY PREDATED HYDROMETEROLOGICAL REPORT NO. 43.
- ASSUMED A 36-HOUR STORM WITH CUMULATIVE PRECIPITATION FROM 4.2 TO 7.7 INCHES.
- SPILLWAY DESIGN & RESERVOIR STORAGE PLAN BASED ON PMF INFLOW OF 56,700 CFS ASSUMING FLOOD STORAGE AT UPSTREAM USBR DAMS.
- THE FLOOD OF RECORD IN DECEMBER 1964 PRODUCED A PEAK INFLOW OF APPROXIMATELY 22,000 CFS.

ROUND BUTTE DAM PMF

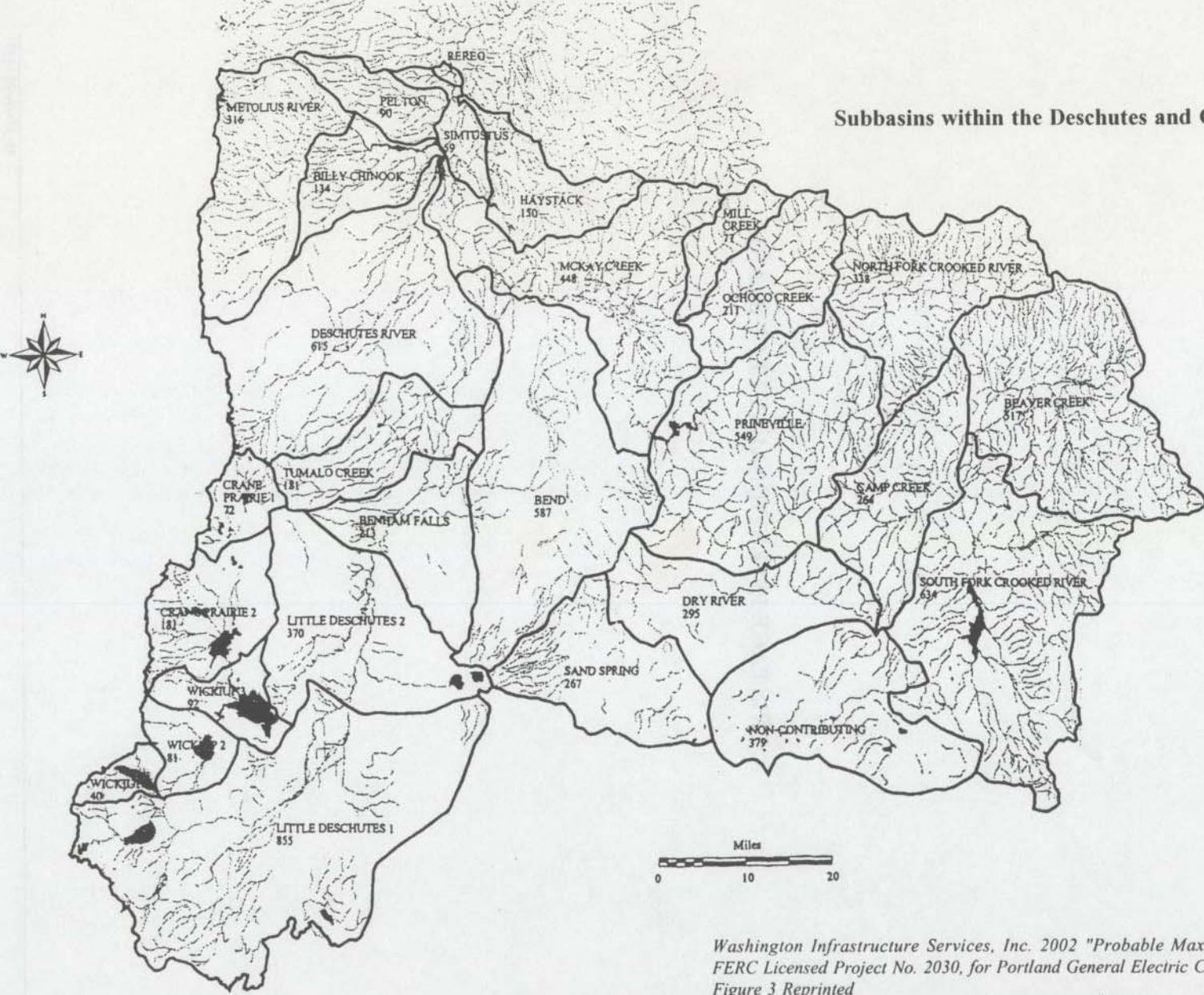
- **HYDROMETEROLOGICAL REPORT NO. 57 PUBLISHED IN 1994 PROVIDED NEW PROBABLE MAXIMUM PRECIPITATION VALUES.**
- **FERC LETTER DIRECTING PGE TO PERFORM AN UPDATED PMF ANALYSIS.**
- **INITIATED PMF STUDIES IN 1996.**
- **MAJOR FLOODS OCCUR IN THE WINTER MONTHS AND HAVE A SNOWMELT COMPONENT.**

DESCHUTES RIVER HYDROLOGY

- **THE DESCHUTES, METOLIUS, AND CROOKED RIVERS FLOW INTO LAKE BILLY CHINOOK (ROUND BUTTE FOREBAY).**
- **ROUND BUTTE DAM IS LOCATED JUST BELOW THE CONFLUENCE OF THE THREE RIVERS.**
- **RIVER FLOWS ARE RELATIVELY CONSTANT THROUGHOUT THE YEAR DUE TO THE LARGE GROUNDWATER INFLOWS.**
- **MEAN JANUARY FLOW IS 4840 CFS AND MEAN AUGUST FLOW IS ABOUT 3800 CFS.**



Subbasins within the Deschutes and Crooked Rivers



Washington Infrastructure Services, Inc. 2002 "Probable Maximum Flood Evaluation. FERC Licensed Project No. 2030, for Portland General Electric Company, September 2002, Figure 3 Reprinted

Subbasin Boundary Map

METOLIUS RIVER SUBBASIN

- **THE METOLIUS RIVER IS ON THE EASTERN SLOPES OF THE CASCADE MOUNTAINS AND IS LARGELY SPRING FED.**
- **THE SUBBASIN DRAINAGE AREA IS RELATIVELY SMALL AT 316 SQUARE MILES.**
- **THE METOLIUS RIVER IS IN A REGION OF POROUS VOLCANIC DEPOSITS CONSISTING OF BASALTS, ANDESITE LAVAS, CINDER CONES AND PUMICE.**
- **HAS RELATIVELY CONSTANT FLOWS.**

DESCHUTES RIVER SUBBASIN

- **THE DESCHUTES RIVER IS LOCATED IN CENTRAL OREGON IN AN AREA OF DRY GRASSLAND AND TIMBERED SLOPES IN THE UPPER BASIN.**
- **THE DESCHUTES RIVER IS IN A REGION OF POROUS VOLCANIC DEPOSITS CONSISTING OF BASALTS, ANDESITE LAVAS, CINDER CONES AND PUMICE.**
- **THE SUBBASIN AREA IS 2700 SQUARE MILES.**
- **THE RIVER FLOWS ARE RELATIVELY CONSTANT AND ARE AFFECTED BY IRRIGATION WITHDRAWALS AND STORAGE AT UPSTREAM RESERVOIRS.**

CROOKED RIVER SUBBASIN

- **THE CROOKED RIVER BASIN IS COMPRISED OF RELATIVELY FLAT AREAS, ROLLING HILLS AND IS SEMI-ARID.**
- **THE CROOKED RIVER BASIN SOILS ARE TYPICALLY FINE GRAINED, HAVE BEEN WEATHERED LONGER, AND ARE CONSIDERED TO HAVE A LOWER PERMEABILITY, ALTHOUGH STILL RELATIVELY HIGH.**
- **THE BASIN AREA IS ABOUT 2300 SQUARE MILES.**
- **ARTHUR R. BOWMAN DAM IS A MAJOR STORAGE FACILITY THAT AFFECTS CROOKED RIVER FLOWS.**

ARTHUR R. BOWMAN DAM

- U.S. BUREAU OF RECLAMATION DAM LOCATED ON CROOKED RIVER UPSTREAM OF PRINEVILLE, OREGON.
- CONTROLS ABOUT 75% OF THE CROOKED RIVER BASIN.
- LOCATED ABOUT 67 MILES UPSTREAM FROM THE ROUND BUTTE DAM.
- CREATES PRINEVILLE RESERVOIR, WHICH HAS A STORAGE CAPACITY OF 154,700 ACRE-FEET.
- ZONED EMBANKMENT DAM ABOUT 240 FEET HIGH.
- UNGATED OVERFLOW SPILLWAY WITH A CAPACITY OF 8120 CFS.
- LOW LEVEL DISCHARGE RATED AT 3300 CFS.

ROUND BUTTE PMF STUDY

- **INITIATED PMF STUDY IN 1996.**
- **EXPERIENCED DIFFICULTY IN CALIBRATING PMF SIMULATION MODEL TO HISTORICAL EVENTS IN THE CROOKED RIVER BASIN.**
- **INITIAL MODEL RUNS RESULTED IN AN INFLOW OF 168,000 CFS, ALMOST ALL FROM THE CROOKED RIVER BASIN. (20 x FLOOD OF RECORD FLOWS ON CROOKED RIVER).**
- **LACK OF COINCIDENT RAINFALL AND FLOW DATA FOR THE CROOKED RIVER BASIN.**
- **MEETINGS WITH USBR TO IDENTIFY APPROPRIATE INFILTRATION RATES FOR THIS BASIN & DISCUSS OPERATION OF BOWMAN DAM.**

CROOKED RIVER BASIN ASSESSMENT

- **EVALUATION OF BASIN SOILS AND GEOLOGY.**
- **CONSULTANTS, PGE AND FERC CONDUCTED AERIAL SURVEY OF BASIN IN LATE 1999.**
- **ASSESSED AREAS THAT ARE ESSENTIALLY NON-CONTRIBUTING TO RUNOFF IN THE BASIN.**
- **DEVELOPMENT OF A RAIN AND STREAM GAGING PLAN TO SUPPORT CALIBRATION OF MODEL.**
- **USE OF AN INFILTRATION RATE OF 0.20 INCHES/HOUR IN THE CROOKED RIVER BASIN.**
- **THIS INFILTRATION VALUE IS REDUCED FROM 0.24 INCHES/HOUR USED BY THE USBR.**

CROOKED RIVER BASIN ASSESSMENT

- **DEVELOPED A NETWORK OF SIX STREAM GAGES AND 19 RAIN GAGES IN THE BASIN TO COLLECT DATA.**
 - **REQUIRED THE INSTALLATION OF THREE NEW STREAM GAGES**
 - **ALSO INSTALLED OR LOCATED 19 RAIN GAGES TO PROVIDE PRECIPITATION DATA IN THE BASIN.**
 - **STARTED COLLECTING DATA FALL 2001.**
 - **NO SIGNIFICANT STORM EVENTS THROUGH FALL 2005.**
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CROOKED RIVER BASIN RAIN & STREAM GAGES



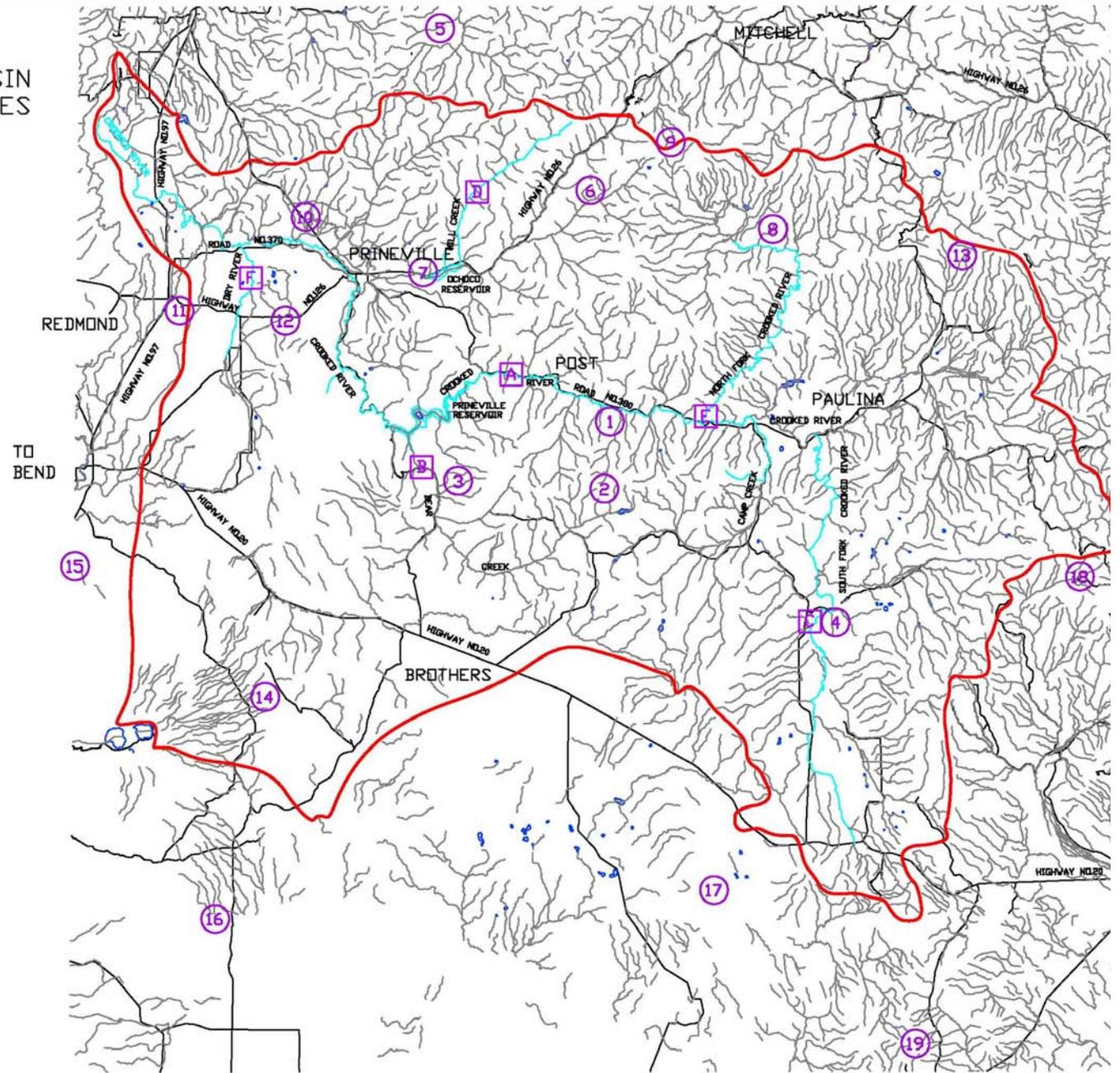
- A STREAM GAGE
- 1 RAIN GAGE
- BASIN BOUNDARY
- RIVERS
- MAJOR HIGHWAYS
- MAIN RIVER

Stream Gages:

- | | |
|----|--|
| A. | Crooked River at Post (existing) |
| B. | Bear Creek at Route. No.27 crossing |
| C. | South Fork at G.I. Ranch (existing) |
| D. | Mill Creek (existing) |
| E. | North Fork Crooked River near confluence |
| F. | Dry River between Routes No.370 and No.126 |

Rain Gages:

- | | |
|-----|-----------------------|
| 1. | McCullough Ranch |
| 2. | Badger Creek |
| 3. | Salt Creek |
| 4. | G.I. Ranch (proposed) |
| 5. | Board Hollow |
| 6. | Ochoco Ranger Station |
| 7. | Ochoco Reservoir |
| 8. | Cold Springs |
| 9. | Slide Mountain |
| 10. | Prineville 4 NW |
| 11. | Redmond |
| 12. | Powell Butte |
| 13. | Briar Rabbit |
| 14. | Camp 2 |
| 15. | Lava Butte |
| 16. | Cabin Lake |
| 17. | Browns Well |
| 18. | Allison |
| 19. | Wagontite |

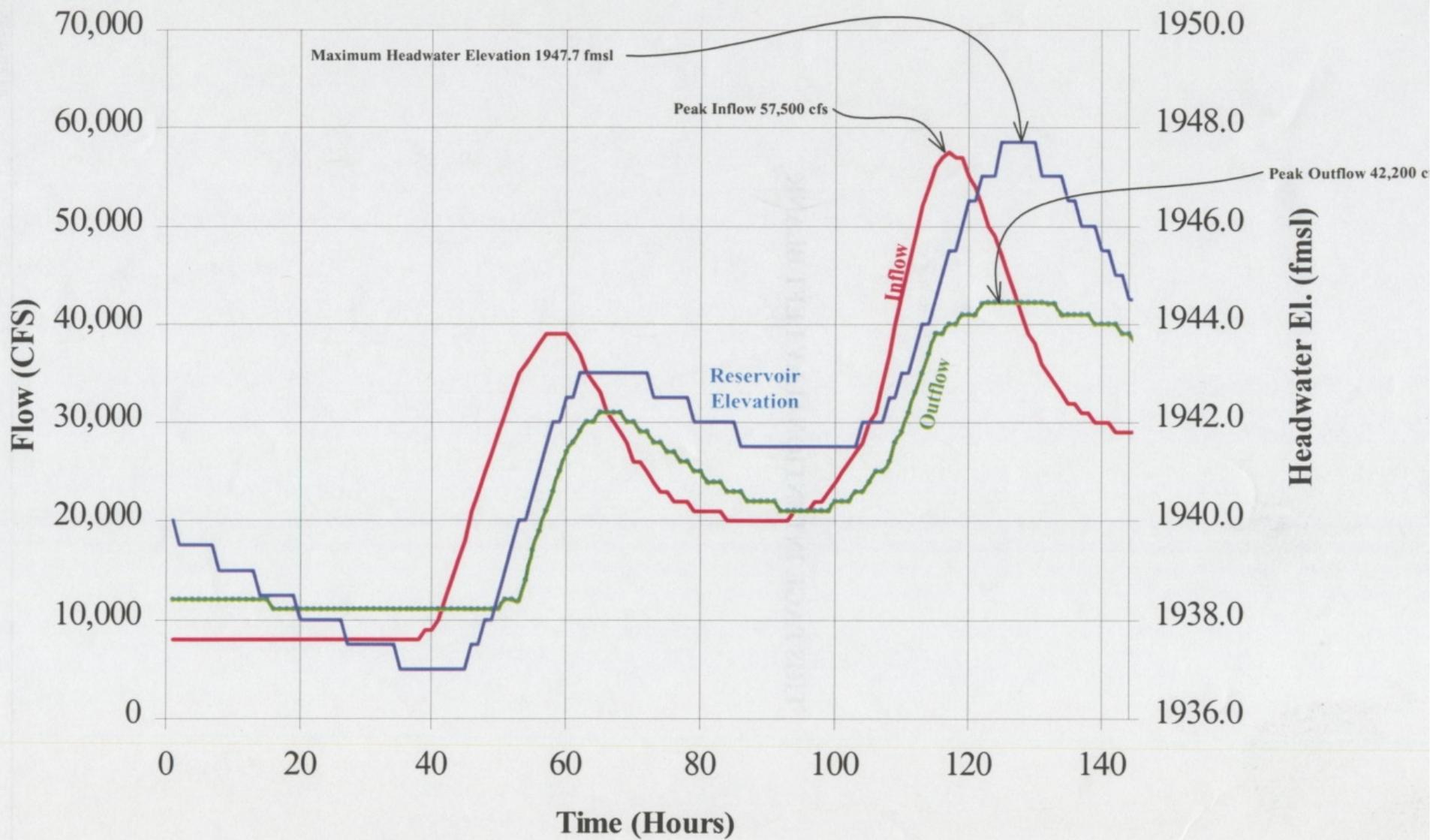


ROUND BUTTE DAM PMF STUDY

- **USED HMR 57 PRECIPITATION VALUES.**
- **BASIN WEIGHTED AVERAGE 72-HOUR PMP OF 8.6 INCHES.**
- **CONTROLLING CASE USED A CROOKED RIVER STORM CENTERING.**
- **STUDY USED THE 0.20 INCH/HOUR INFILTRATION RATE IN THE CROOKED RIVER BASIN.**
- **STUDY ASSUMED THAT PRINEVILLE RESERVOIR HAD A MINIMUM OF 60,000 ACRE-FEET OF FLOOD STORAGE.**
- **PMF STUDY ASSUMED BOWMAN DAM PASSES FLOOD FLOWS.**

ROUND BUTTE DAM PMF STUDY

- **CALCULATED PEAK INFLOW TO LAKE BILLY CHINOOK (ROUND BUTTE) IS 57,500 CFS.**
- **THE ROUND BUTTE FOREBAY WAS ASSUMED TO BE DRAWN DOWN FIVE FEET PRIOR TO THE EVENT (NORMAL WINTER OPERATION).**
- **THE PEAK OUTFLOW FROM THE ROUND BUTTE DAM IS 42,200 CFS.**
- **THE OUTFLOW FROM ROUND BUTTE CAN SAFELY BE PASSED BY THE TWO DOWNSTREAM DAMS.**



Washington Infrastructure Services, Inc. 2002 "Probable Maximum Flood Ev.
 FERC Licensed Project No. 2030, for Portland General Electric Company, Septem
 Figure 12 Data Replotted

Probable Maximum Flood Routing (Crooked River Storm Centering)

ROUND BUTTE DAM PMF STUDY

- **FERC CONSIDERS THE PMF STUDY AS PROVISIONAL UNTIL ADEQUATE DATA IS COLLECTED TO CALIBRATE THE CROOKED RIVER BASIN.**
 - **CONTINUING TO COLLECT DATA FROM THE CROOKED RIVER GAGING PROGRAM.**
 - **WILL EVALUATE THE BASIN CHARACTERISTICS FOLLOWING ANY SIGNIFICANT RAIN EVENTS.**
 - **MAY RECALCULATE THE PMF BASED ON THE EVALUATED DATA.**
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