



Dam Safety Section

INTEROFFICE MEMORANDUM

COPY

TO: Lyle Swank, Eastern Region Office Manager
CC: Steve Bosworth, James Cefalo, Pam Skaggs
FROM: John Falk PE, Dam Safety Manager
DATE: March 20, 2015
SUBJECT: Reservoir Storage Capacity

Devil Creek Dam (ID00229)

Based on my review of IDWR Dam Safety files, the Malad Valley Irrigating Company (MVIC) made application and was awarded a combination loan/grant via the *Small Reclamation Projects Act of 1956 (PL-984)*. The award was administered by the U.S. Bureau of Reclamation (USBR), who reportedly was responsible both for engineering and construction oversight; duties similar to those performed by USBR during construction of Daniels Reservoir. Like the Daniels project, little record exists in IDWR files related to pre-construction site reconnaissance, foundation investigations and laboratory test results.

Design plans and specifications for construction of Daniels Dam were prepared by professional engineers Wendell H. Smith and J. William Jewell. The design consists of plans and project specifications dated May 1968 that were submitted to the State Reclamation Office and which subsequently were approved for construction by R. Keith Higginson, State Reclamation Engineer on 10/23/1968. Construction of the dam was substantially complete by winter 1969, and the first filling of the reservoir occurred in 1970.

Permit R-682 was initially issued to MVIC on 9/6/1940 for 6,000 acre-feet (AF) of storage; however Water Right License 15-2081 issued 8/31/1984 limits the reservoir capacity to 4,464 AF. This smaller value likely is based on the approved design, noting that the design drawings indicate the reservoir capacity to be slightly less by 14 AF (Figure 1). Reference is made in the water right files indicating the volume for the License was based on information obtained from the *1982 Phase I Inspection Report*. Although said report lists a value of 4,464 AF in the text, the report also includes a volume of 4,450 AF as stated directly on the design drawings (sheet 2/10); therefore, the report is inconsistent with itself.

Figure 2 was discovered in IDWR Dam Safety file archives and appears to be a copy of tabulated capacity calculations; unfortunately, this single page is undated and absent any source reference. Possibly, this copy represents the design engineer's handiwork performed during his preparation of the area/capacity diagram which is shown on the design drawings. But this raises the question of why the engineer would write the smaller volume of 4,450 AF directly on the drawings if he already had calculated what appears to be a more precise accounting of reservoir storage capacity. Again, unfortunately, there are no asbuilt drawings in IDWR archives, suggesting either: a) none were prepared by the design engineer and/ or b) none were provided by the USBR Upper Colorado Region 4 Offices in Salt Lake City, Utah.

Figure 3 is a copy of my recent construction using the *Capacity Table* included on sheet 2/10 of the design drawings. This graph plots the closest elevations both above and below the spillway crest against each corresponding capacity to determine an interpolated value for storage at the spillway crest. Note that the sketch assumes a linear relationship. Nonetheless, the graphical estimate of ± 4465 AF agrees relatively closely with the tabular data shown on Figure 2, and also the value listed on Water Right License 15-2081.

I checked also the USGS Quadrangle Map (1968) which was photo-revised in 1984 to include the outlines of the reservoir. Based on said map, the datum that was used by the design engineer to construct his area/ capacity diagram appears consistent with USGS (NGVD 1929); however, yet to be confirmed. An independent estimate of storage capacity was performed by IDWR staff using height measurements from a 2000 Dam Safety survey and surface areas calculated using 2011 aerial photographs. The following equation was used to obtain an estimate for total reservoir capacity at or near full-pool conditions:

$$\rightarrow 73.4 \text{ feet (hydraulic height)} \times 135.1 \text{ acres (surface area)} \times 0.4 \text{ (shape factor)} = 3,967 \text{ acre-feet}$$

Note that this calculation is included only as another comparison against the storage values variously reported per Figure 1 (May-1968 design drawings), Figure 2 (tabulated capacity data), and Figure 3 (recent IDWR graphical sketch).

Recommendation: Until such time that an area/ capacity survey has been performed by a licensed professional *and* submitted to IDWR for review and approval, the physical volume of water impounded by Devil Creek Dam measured at the spillway crest, elevation 5172.4 feet (USGS-NGVD 1929), is presumed to be 4,464 acre-feet. This value also is consistent with Water Right License 15-2081.

An important item to note is that both Figure No's 1 & 2 indicate that 650 AF of the total reservoir capacity is impounded as "dead" storage in the bottom of the pool at any given time. Consequently, the volume of active storage available for release is equal to 3,814 AF. The 650 AF of inactive (dead) storage is due to the rim of the riser pipe in the reservoir constructed at elevation 5133 feet; approximately 27 feet above the low-level sluice gate (invert elevation 5106'). The inactive storage apparently was included in the design to maintain a minimum year-round pool for fish and wildlife habitat, and to account for some deposition of sediment. At this time, the volume of sediment has not been determined; however, this inactive storage component of 650 AF likely has been reduced to some degree during the 36 years since the reservoir was initially filled in 1970.

46 x

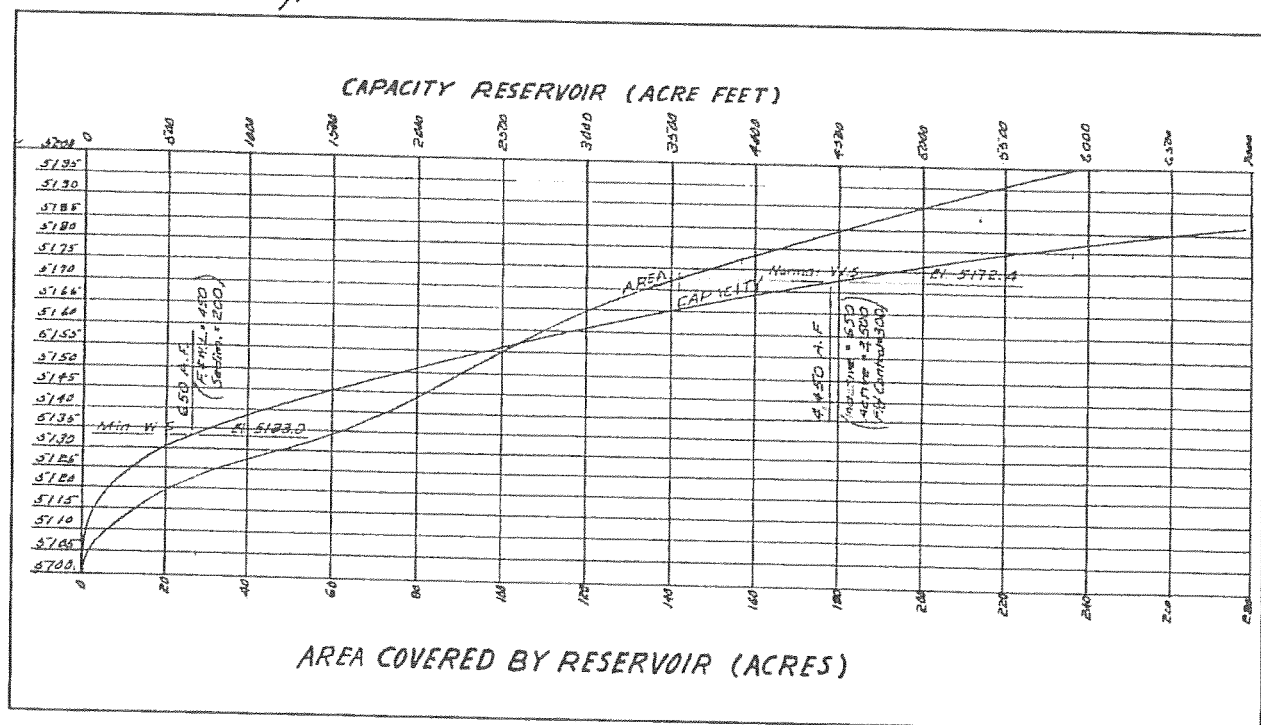


Figure 1 – Reprint from May, 1968 Design Drawings prepared by W.H. Smith, P.E. and J.W. Jewell, P.E. The drawings were approved for construction on 10/23/1968. However, IDWR has no record of as-constructed (asbuilts) drawings in the dam safety archives; neither have any been located in the water right backfiles.

DEVIL CREEK DAM
Malad, Idaho

RESERVOIR CAPACITY - Acre-Feet

ELEVATION	TOTAL CAPACITY	ACTIVE CAPACITY	CAPACITY FOR EACH TENTH
5133	650	0	
34	705	55	5.50
5135	760	110	
36	827	177	
37	895	245	6.74
38	962	312	
39	1,030	380	
5140	1,097	447	
41	1,175	525	
42	1,252	602	7.75
43	1,330	680	
44	1,407	757	
5145	1,485	835	
46	1,571	921	
47	1,658	1,008	8.65
48	1,744	1,094	
49	1,830	1,181	
5150	1,917	1,267	
51	2,012	1,362	
52	2,107	1,457	9.52
53	2,203	1,553	
54	2,298	1,648	
5155	2,393	1,743	
56	2,497	1,847	
57	2,601	1,951	10.38
58	2,704	2,054	
59	2,808	2,158	
5160	2,912	2,262	
61	3,027	2,377	
62	3,141	2,491	11.45
63	3,256	2,606	
64	3,370	2,720	
5165	3,485	2,835	
66	3,613	2,963	
67	3,741	3,091	12.80
68	3,869	3,219	
69	3,997	3,347	
5170	4,125	3,475	
71	4,266	3,616	
72	4,408	3,758	14.44
Spillway Crest (72.4')	(4,465)	(3,814)	
73	4,549	3,899	

Figure 2 (left)

Copy of single page tabulation that lists elevation and capacity relationships. Although included in IDWR Dam Safety archives, this copy is undated and does not include any information regarding its source. Apparently, the value for reservoir volume that is included on Water Right License 15-2081 was based on the information included herein. Note the distinction between Total Capacity and Active Capacity.

Figure 3 (below)

A recent plot of selected values listed on the Capacity Table which also is illustrated on sheet 2/10 of the 1968 approved design drawings. As sketched, the linear interpolation of reservoir capacity at the spillway crest (elevation 5172.4') is determined to be ±4,465 AF.

