

RECLAMATION

Managing Water in the West

Reservoir Sedimentation Information Database Stewardship

**Research and Development Office
Science and Technology Program
(Final Report) ST-2017-8988
Report SRH-2017-39**



**U.S. Department of the Interior
Bureau of Reclamation
Research and Development Office**

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Mission Statements

Protecting America's Great Outdoors and Powering Our Future

The Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

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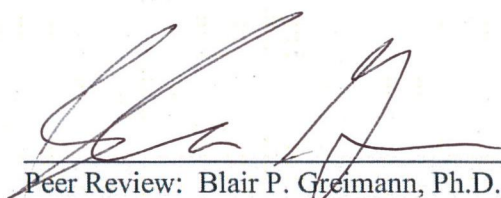
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Reservoir Sedimentation Information Database Stewardship



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Prepared by: Sean Kimbrel, M.S., P.E.
Hydraulic Engineer
Sedimentation and River Hydraulics Group (85-824000)



12-20-17

Peer Review: Blair P. Greimann, Ph.D., P.E.
Hydraulic Engineer
Sedimentation and River Hydraulics Group (85-824000)

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Executive Summary

The objective of this research study is split into two components relevant to monitoring and planning for reservoir sediment accumulation (sedimentation) impacts:

1. Developing the means to integrate previous and future Reclamation reservoir surveys into the Army Corps of Engineers Reservoir Sediment Information (RSI) database.
2. Developing a Quality Assurance/ Quality Control (QA/QC) protocol as part of uploading previous and future Reclamation reservoir sedimentation information data into RSI.

Entering data into an electronic database is nothing new in the modern age of information and technology. However, developing the means to detect errors in the entry of reservoir sedimentation data is necessary to assure quality of the database for future planning and prioritization efforts.

As part of this database stewardship project, a data call was made in February 2016 to all Reclamation Regional and Area Offices to collect any reservoir sedimentation information available at their respective facilities. Any new Reclamation data was incorporated in the RSI database. As of September 2017, this database is tentatively proposed to be publicly available once further review by multiple agencies such as Reclamation is completed.

The following future improvements in can be made in RSI with future builds:

- Adding in range of operations data for all Reclamation reservoirs
- Adding in available sediment sample data in the database
- The capability in the RSI database to add only total capacity at certain pool allocations when no historical elevation-area-capacity table is available
- Discretizing where storage loss is calculated in report card
- Adding in the original elevation-area-capacity data for reservoirs with no repeat surveys

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1 Introduction

The objective of this research study is split into two components relevant to monitoring and planning for reservoir sediment accumulation (sedimentation) impacts:

1. Developing the means to integrate previous and future Reclamation reservoir surveys into the Army Corps of Engineers Reservoir Sediment Information (RSI) database.
2. Developing a Quality Assurance/ Quality Control (QA/QC) protocol as part of uploading previous and future Reclamation reservoir sedimentation information data into RSI.

Entering data into an electronic database is nothing new in the modern age of information and technology. However, developing the means to detect errors in the entry of reservoir sedimentation data is necessary to assure quality of the database for future planning and prioritization efforts.

2 Integration of Reclamation Reservoir Survey Data

This section details the process of integrating previous and future Reclamation reservoir sediment surveys into the RSI database. Reclamation reservoir survey data was integrated into RSI in three distinct steps.

First, a data call was made in February 2016 to all Reclamation Regional and Area Offices requesting any available reservoir sediment survey information. Any new survey information was compiled with other existing and available reservoir survey data.

Second, existing reservoir survey datasets from 1) Reclamation reservoir survey reports published by Reclamation's Sedimentation and River Hydraulics Group, and 2) existing reservoir sediment survey data from the last comprehensive reservoir sediment survey database, which was the REservoir SEDimentation Database (RESSSED, Gray et. al, 2010) were incorporated into an interim Microsoft Access database. The Microsoft Access database included the pertinent dam information (NID Number, Name, Area Office, BOR Region, Project Name, etc), and Elevation-Area-Capacity Data by Year of Survey, annual Reservoir Operation Range, Storage Allocation, and any succeeding survey data (e.g. Original Survey, First, Second, Third, etc.). A screen shot of the Microsoft Access Database is shown in Figure 1.

Third, the Microsoft Access database served as the common data source to incorporate Reclamation reservoir survey data into RSI by Reclamation and Army Corps Staff.

NID Number	Reservoir Name	Reservoir ID	Ownership	Area Office	BOR Region	Project Name	Dam Name	BOR ID	Other IDenti	Status	Stream	HUC
D00279	ANDERSON RANCH	100546 RECLAMATION	SRAD	PN	BOISE	ANDERSON RA	ID00279			IN SERVICE	SOUTH FORK B	1705011
SD01059	ANGOSTURA	38005 RECLAMATION	DKAO	GP	PSMBP-ANGOS	ANGOSTURA	SD01059			IN SERVICE	CHEYENNE RIV	1012010
ID00280	ARROWROCK	78004 RECLAMATION	SRAD	PN	BOISE	ARROWROCK	ID00280			IN SERVICE	BOISE RIVER	1705011
SD01100	BELLE FOURCHE	100569 RECLAMATION	DKAO	GP	BELLE FOURCHI	BELLE FOURCHI	SD01100			IN SERVICE	OWA CREEK	1012020
OR00589	BEULAM	100591 RECLAMATION	SRAD	PN	VALE	AGENCY VALLE	OR00589		BEULAM [AGEN	IN SERVICE	NORTH FORK I	1705011
MT00576	BIGHORN LAKE	100592 RECLAMATION	MTAO	GP	PSMBP-LOWER	YELLOWTAIL	MT00576		BIGHORN LAKE	IN SERVICE	BIGHORN RIV	1008001
NE01069	BOX BUTTE	100593 RECLAMATION	NKAO	GP	MIRAGE FLATS	BOX BUTTE	NE01069			IN SERVICE	NIORARA RIV	1015000
WY01299	BOYSEN	43007 RECLAMATION	WYAO	GP	PSMBP-BOYSET	BOYSEN	WY01299			IN SERVICE	WIND RIVER	1008000
NM00500	BRANTLEY	RECLAMATION	ALB	UC	BRANTLEY	BRANTLEY				IN SERVICE	PECOS RIVER	
WY01300	BUFFALO BILL	43001 RECLAMATION	WYAO	GP	SHOSHONE	BUFFALO BILL	WY01300			IN SERVICE	SHOSHONE RIV	1009001
OR00578	BULLY CREEK	100598 RECLAMATION	SRAD	PN	VALE	BULLY CREEK	OR00578			IN SERVICE	BULLY CREEK	1705011
WA00083	BUMPING LAKE	100599 RECLAMATION	CCAO	PN	YAKIMA	BUMPING LAKE	WA00083			IN SERVICE	BUMPING RIVE	1703000
NM00131	CABALLO	57002 RECLAMATION	ALB	UC	RIO GRANDE	CABALLO	NM00131			IN SERVICE	RIO GRANDE R	1303010
NE02287	CALAMUS	RECLAMATION	NKAO	GP	PSMBP-NORTH	VIRGINIA SMIT				IN SERVICE	CALAMUS RIVE	
MT00568	CANYON FERRY	100601 RECLAMATION	MTAO	GP	PSMBP-CANYO	CANYON FERRY	MT00568			IN SERVICE	MISSOURI RIVE	1003010
ID00283	CASCADE	100602 RECLAMATION	SRAD	PN	BOISE	CASCADE	ID00283			IN SERVICE	NORTH FORK P	1705012
KS00019	CEDAR BLUFF	100603 RECLAMATION	NKAO	GP	PSMBP-CEDAR	CEDAR BLUFF	KS00019			IN SERVICE	SMOKY HILL R	1025000
MT00569	CLARK CANYON	100604 RECLAMATION	MTAO	GP	PSMBP-EAST B	CLARK CANYO	MT00569			IN SERVICE	BEAVERHEAD F	1002000
CA10141	CLEAR LAKE	RECLAMATION	KBAA	MP	KLAMATH	CLEAR LAKE				IN SERVICE	LOST RIVER	
ID00284	DEADWOOD	100606 RECLAMATION	SRAD	PN	BOISE	DEADWOOD	ID00284			IN SERVICE	DEADWOOD R	1705012
ND00148	EDWARD ARTHUR PATTE	100617 RECLAMATION	DKAO	GP	PSMBP-DICKIN	DICKINSON	ND00148		E. A. PATTERSC	IN SERVICE	HEART RIVER	1013020
NM10008	EL VADO	100642 RECLAMATION	ALB	UC	MIDDLE RIO GR	EL VADO	NM10008			IN SERVICE	RIO CHAMA R	1302010
NM00129	ELEPHANT BUTTE	57001 RECLAMATION	ALB	UC	RIO GRANDE	ELEPHANT BUT	NM00129		ENGLE DAM	IN SERVICE	RIO GRANDE	1303010
NE01070	ENDERS	100649 RECLAMATION	NKAO	GP	PSMBP-FRENCH	ENDERS	NE01070			IN SERVICE	FRENCHMAN C	1025000
CO10154	FLATIRON	RECLAMATION	ECAD	GP	COLORADO-BK	FLATIRON AFTE				IN SERVICE	CHIMNEY HOLL	
CA10148	FOLSOM LAKE	100651 RECLAMATION	CCAO	MP	CENTRAL VALLI	FOLSOM	CA10153			IN SERVICE	AMERICAN RIV	1802012
OK02502	FORT COBB	100652 RECLAMATION	OTAO	GP	WASHITA BASI	FORT COBB	OK02502			IN SERVICE	PONO (COBB) I	1113030
OK02503	FOSS	RECLAMATION	OTAO	GP	WASHITA BASI	FOSS				IN SERVICE	WASHITA RIVE	
WA00262	FRANKLIN D. ROOSEVELT	RECLAMATION	GP	PN	COLUMBIA BAS	GRAND COULEI				IN SERVICE	COLUMBIA RIV	
MT00570	FRESNO	40004 RECLAMATION	MTAO	GP	MILK RIVER	FRESNO	MT00570			IN SERVICE	MILK RIVER	1009000
MT00571	GIBSON	41004 RECLAMATION	MTAO	GP	SUN RIVER	GIBSON	MT00571			IN SERVICE	NORTH FORK S	1003010
WY01291	GLENDO	33019 RECLAMATION	WYAO	GP	PSMBP-GLENDO	GLENDO	WY01291			IN SERVICE	NORTH PLATTE	1018000
NE01073	HARRY STRUNK LAKE	33003 RECLAMATION	NKAO	GP	PSMBP-FRENCH	MEDICINE CREE	NE01073		HARRY STRUNK	IN SERVICE	MEDICINE CREE	1025000
OR10020	HENRY HAGG LAKE	100662 RECLAMATION	CCAO	PN	TUALATIN	SCOGGINS	OR10020		HENRY HAGG L	IN SERVICE	SCOGGINS CRE	1709001
NM00122	HERON LAKE	RECLAMATION	ALB	UC	SAN JUAN-CHA	HERON				IN SERVICE	WILLOW CREEK	
NE01076	HUGH BUTLER LAKE	100663 RECLAMATION	NKAO	GP	PSMBP-FRENCH	RED WILLOW	NE01076		HUGH BUTLER I	IN SERVICE	RED WILLOW C	1025000
ND00151	JAMESTOWN	RECLAMATION	DKAO	GP	PSMBP-JAMES	JAMESTOWN				IN SERVICE	JAMES RIVER	
OR00591	KEENE CREEK	100666 RECLAMATION	CCAO	PN	ROGUE RIVER R	KEENE CREEK	OR00591			IN SERVICE	KEENE CREEK	1801000
WY01380	KEYHOLE	39010 RECLAMATION	DKAO	GP	PSMBP-KEYHO	KEYHOLE	WY01380			IN SERVICE	BELLE FOURCHI	1012020
KS00022	KIRWIN	100667 RECLAMATION	NKAO	GP	PSMBP-SOLOV	KIRWIN	KS00022			IN SERVICE	NORTH FORK S	1026001
NV10123	LAHONTAN	100668 RECLAMATION	LBAO	MP	NEWLANDS	LAHONTAN	NV10123			IN SERVICE	CARSON RIVER	1601020

Figure 1. Screen Capture of the Reclamation Reservoir Survey Data in Microsoft Access

The website for accessing RSI is located at: <https://corpsmapz.usace.army.mil/apex/f?p=303:1:>

In order for Reclamation staff to gain access to the RSI database, a log-in request was made to the Army Corps of Engineers, who are Bryan Baker (bryan.e.baker@usace.army.mil) and Jim Gade (james.t.gade@usace.army.mil). Along with the log-in request, the installation of Department of Defense (DoD) certificates is provided by the database managers.

The log-in access page is shown in Figure 2. Once accessed is granted, the RSI Home Portal page shows up (Figure 2). The user the selects the ‘Reservoirs’ Tab to view the list of dams/reservoirs and pertinent information. With the proper administration access right, to learn how to enter in new or modify reservoir survey data, select the ‘Help’ tab to download the RSI Quick Guide, and the “Area-Capacity Template” spreadsheet (Figure 4).

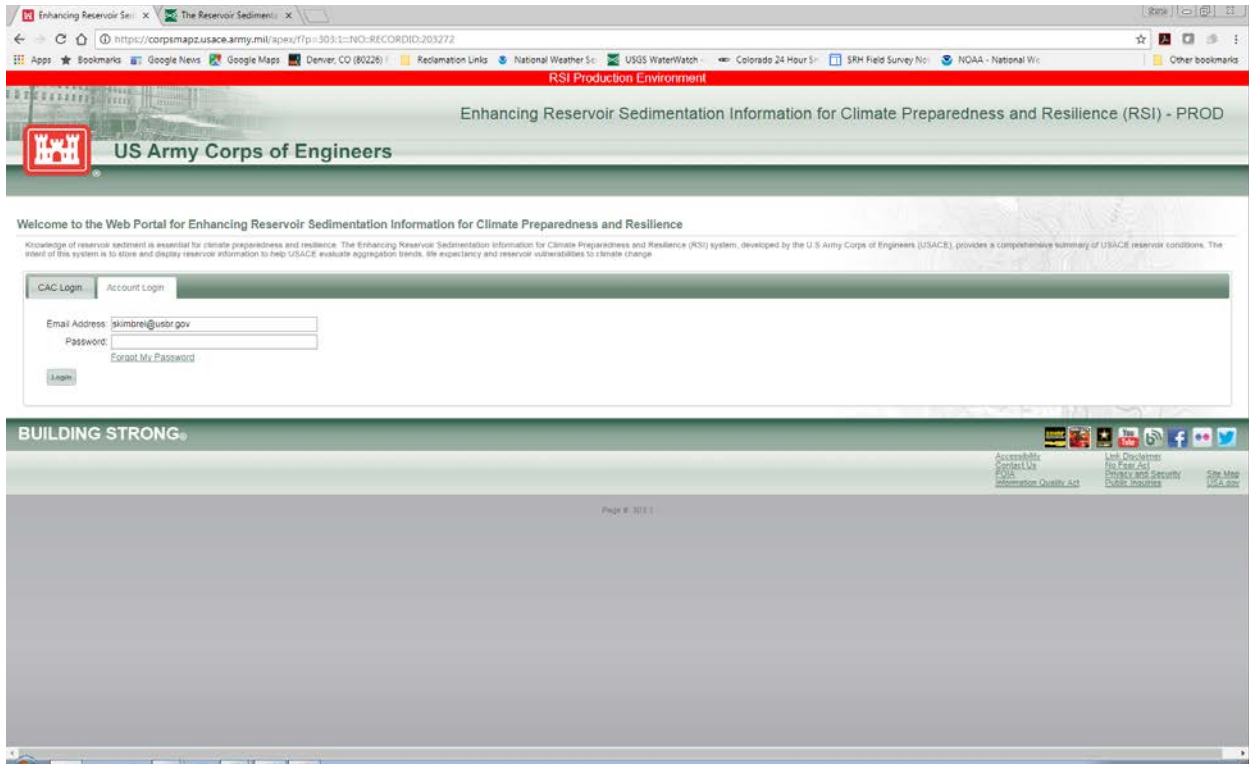


Figure 2. Screen Capture of RSI Log-in Access Page

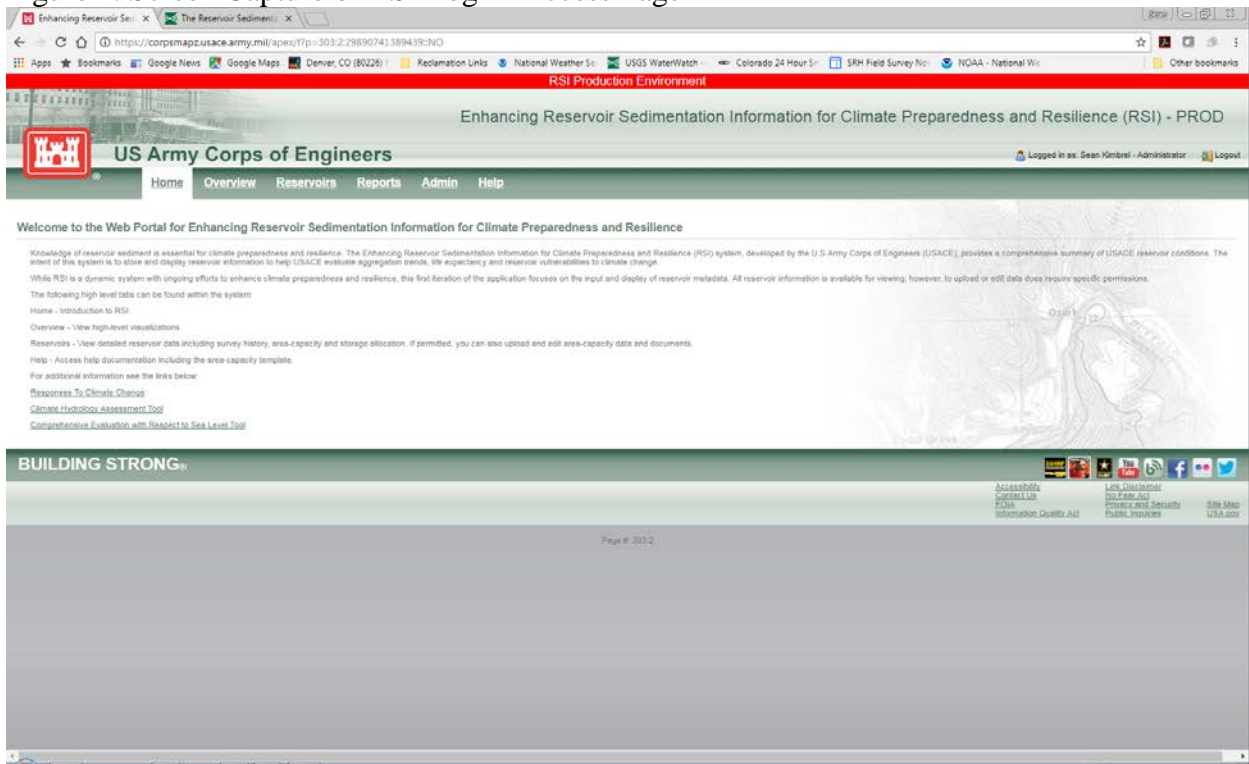


Figure 3. Screen Capture of RSI Home Portal

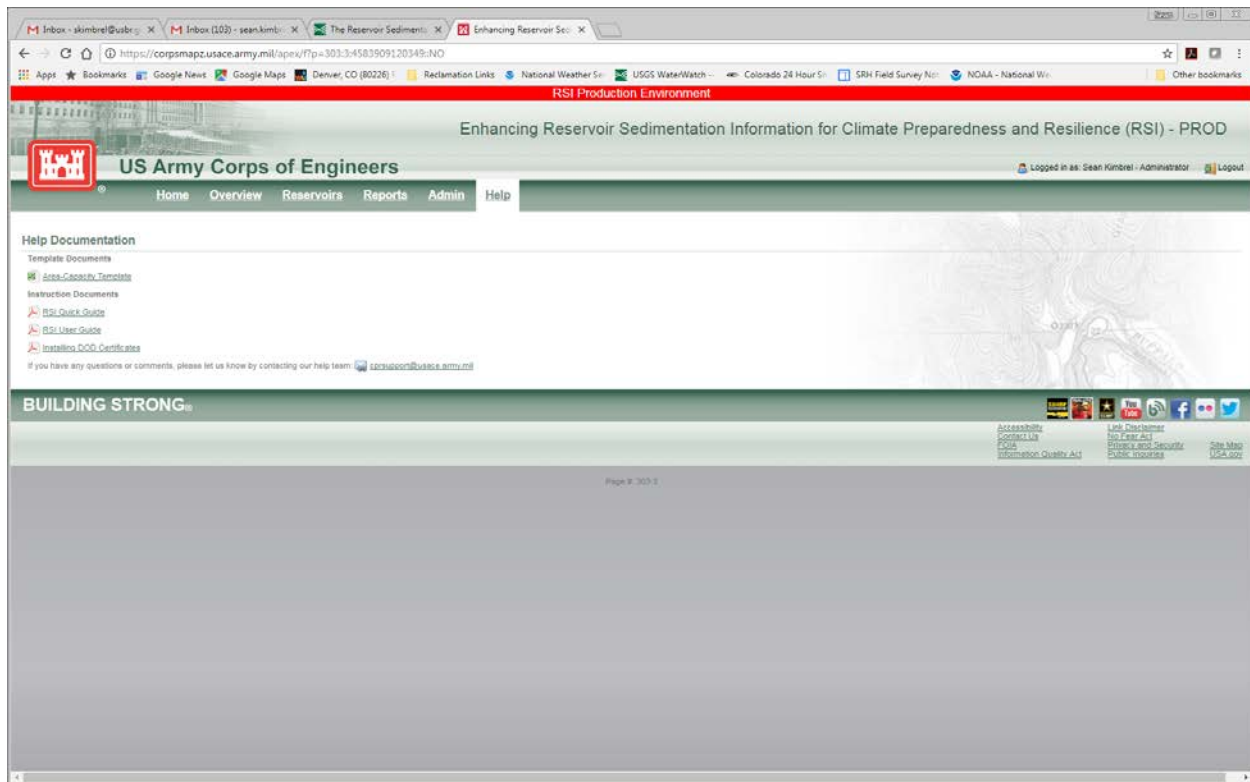


Figure 4. Screen Capture of RSI Help Documentation

3 Quality Assurance/Quality Controls with Reservoir Sediment Information Data

The Reservoir Sedimentation Information database has features which allow for Quality Assurance/Quality Control (QA/QC) of the survey data entered into the database. The RSI database keeps track of who first entered and last modified reservoir survey information, and when the modification occurred. In addition, graphics are available in the database to compare the elevation-area and elevation-capacity data between successive surveys to assure consistency.

During the period of data incorporation/entry all existing and new reservoir survey data into RSI, the entered survey data information was compare to published reservoir survey reports or from the RESSED data sheets, particularly the Form 34 data sheet for pertinent information. As a means of final quality assurance, the elevation-area and elevation-capacity graphics were used to visually compare data between successive surveys to assure consistency. In addition, the depletion analysis was compared to the storage loss estimates provided on the Form 34 data sheet.

The process to visually QA/QC the reservoir elevation-area-capacity curve data is as follows, and is shown in Figure 5 and Figure 6:

Select 'Graphs' and review the 'Capacity' Graph for visual consistency. Go back to the 'Surveys' data page to correct any elevation/capacity data entry errors and review the 'Capacity' graph for corrections. Repeat if necessary.

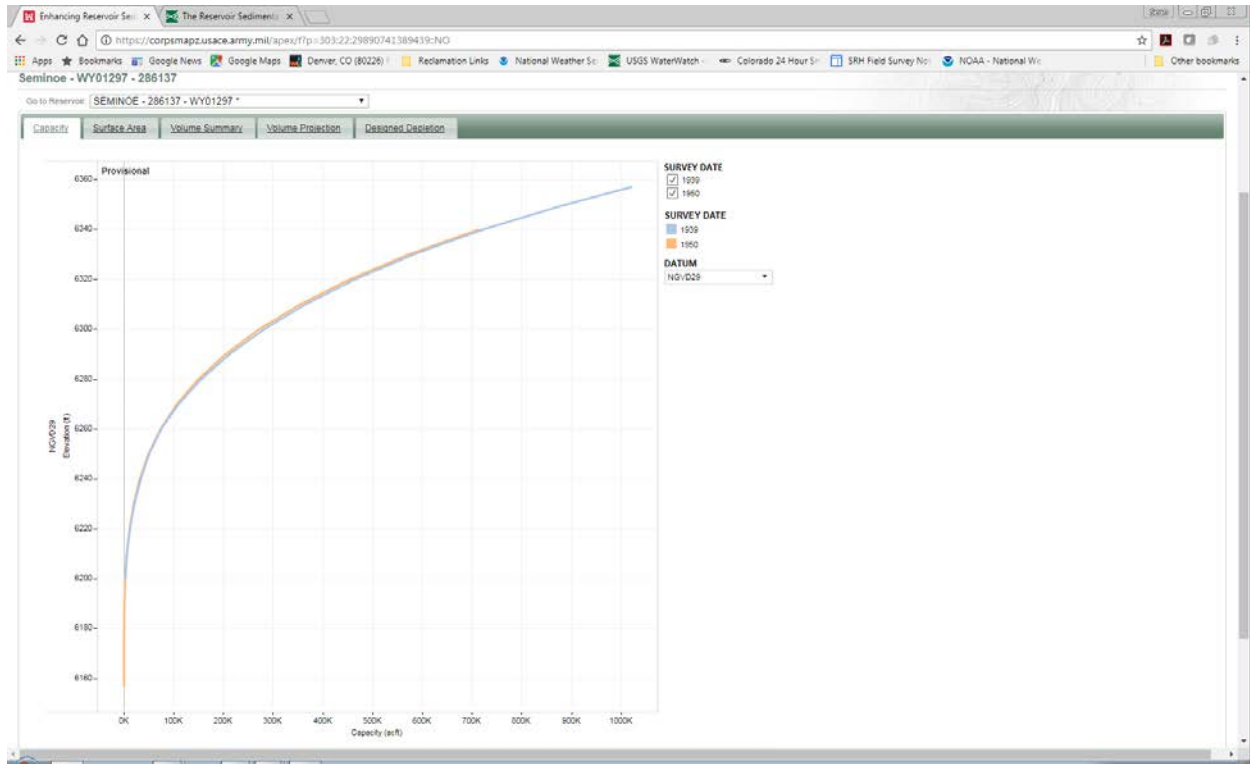


Figure 5. Screen Capture of Elevation-Capacity Curve Comparison.

Select and Review the 'Surface Area' Graph for visual consistency. Go back to the 'Surveys' data page to correct any elevation/area data entry errors and review the 'Surface Area' graph for corrections. Repeat if necessary.

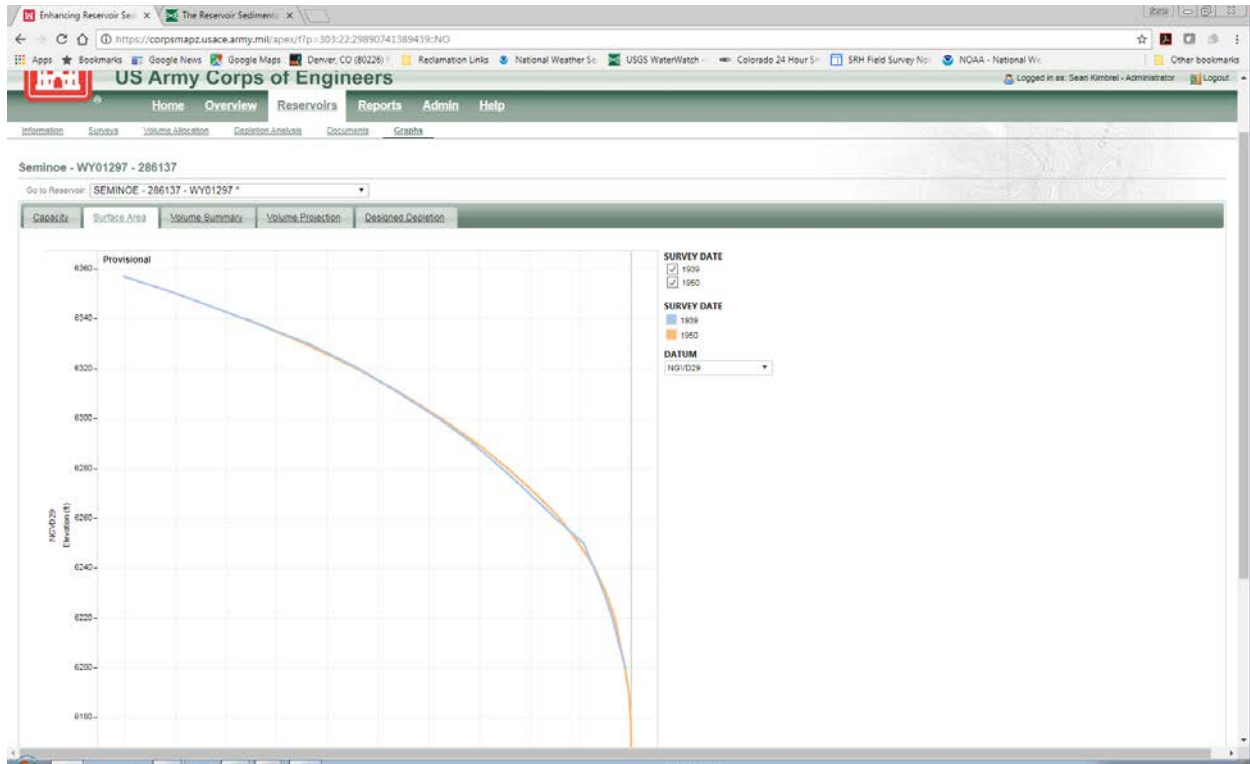


Figure 6. Screen Capture of Elevation-Area Curve Comparison

Finally, review the ‘Depletion Analysis’ page for consistent storage loss numbers compared to reservoir survey reports.

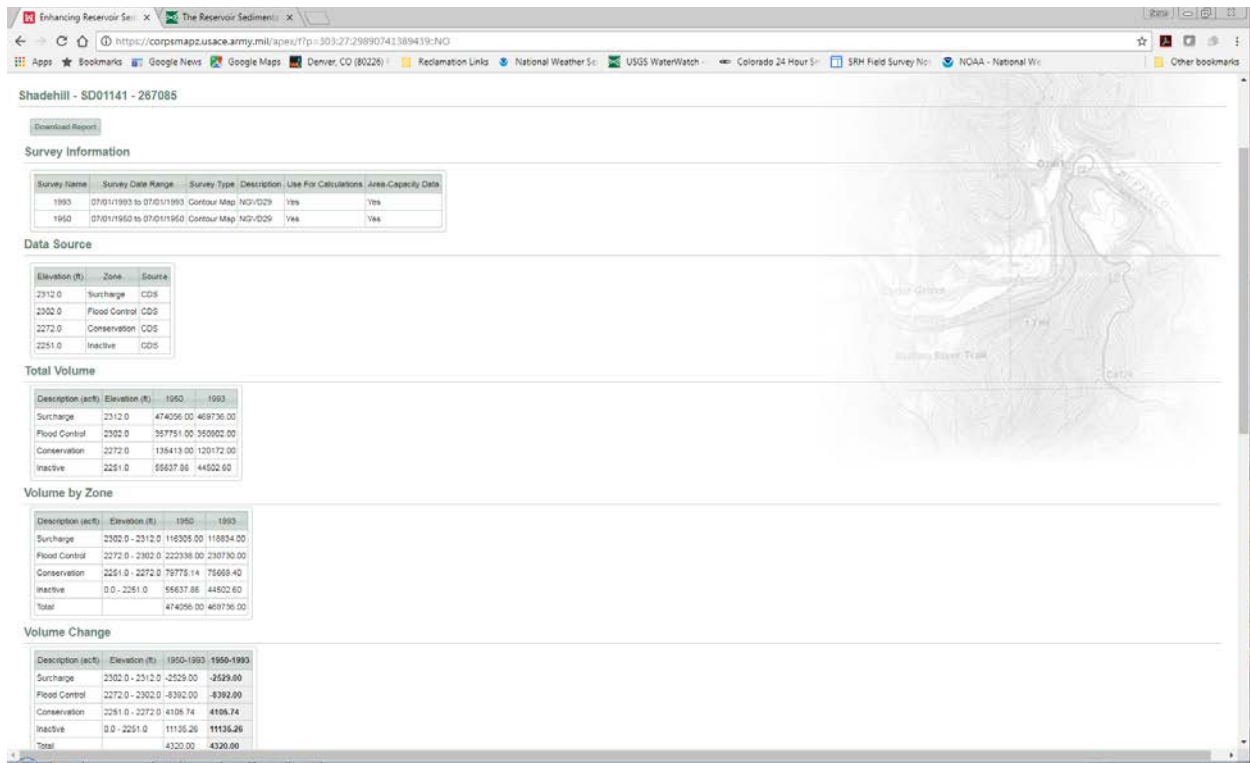


Figure 7. Screen Capture of Elevation-Area Curve Comparison

4 Summary

The objective of this research study is to develop the means to integrate Reclamation reservoir surveys into the Army Corps of Engineers Reservoir Sediment Information (RSI) database, and to develop a Quality Assurance/ Quality Control (QA/QC) protocol as part of uploading previous and future Reclamation reservoir sedimentation information data into RSI.

As an example of the current functionality of the latest build of RSI, a Report Card summary of the Top 10 reservoirs according to percent storage loss is shown in Figure 8.

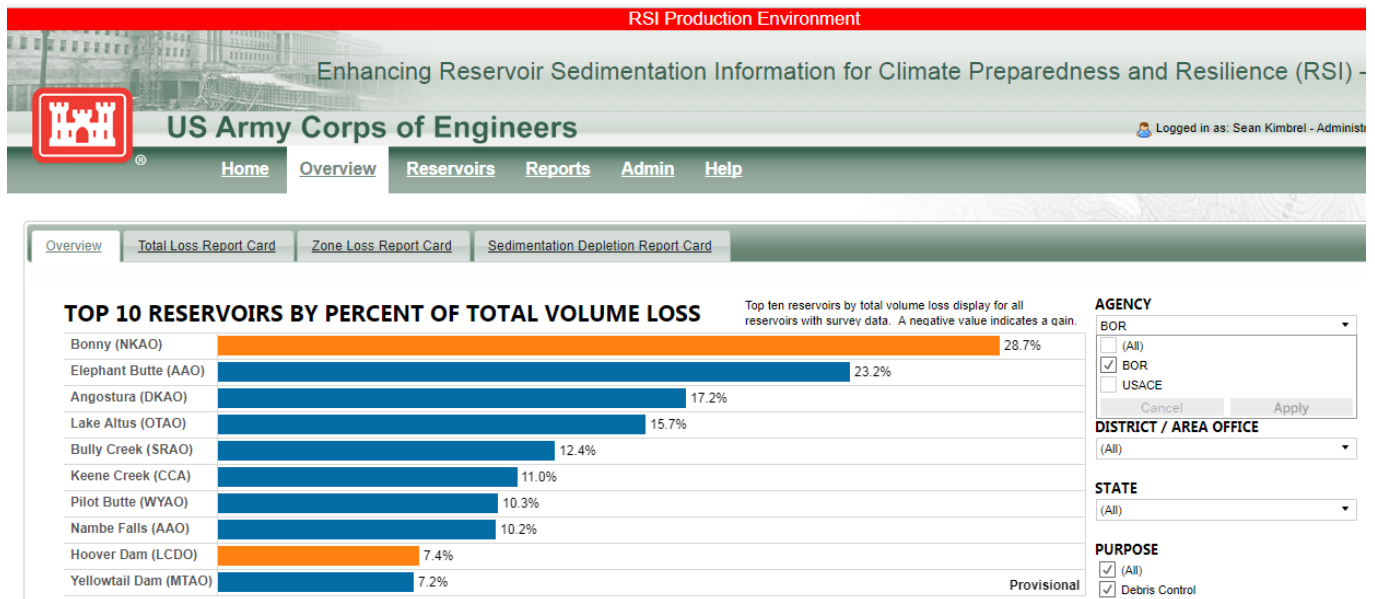


Figure 8. Screen Capture of the RSI Score Card, Showing Top 10 Reservoirs According to Percent Storage Loss

The following future improvements can be made in RSI with future builds to increase planning and management capabilities:

- Adding in range of operations data for all Reclamation reservoirs
- Adding in available sediment sample data in the database
- The capability in the RSI database to add only total capacity at certain pool allocations when no historical elevation-area-capacity table is available
- Discretizing where storage loss is calculated in report card
- Adding in the original elevation-area-capacity data for reservoirs with no repeat surveys

5 References

Gray, J.R., Bernard, J.M., Stewart, D.W., McFaul, E.J., Laurent, K.W., Schwarz, G.E., Stinson, J.T, Jonas, M.R., Randle, Timothy, and Webb, J.W. (2010) “Development of a National, Dynamic Reservoir Sedimentation Database”. Proc. 9th Federal Interagency Sedimentation Conference, June 27–July 1, Las Vegas, Nevada, 12 p.