



NWE-2188-3645

Ms. Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

December 27, 2018

Re: Project 2188, NorthWestern Energy filing of License Article 402 2018 Shoreline Erosion Monitoring Report

Dear Secretary Bose:

Per FERC Project 2188 License Order Issued November 26, 2002, NorthWestern Energy (NWE) herein provides the fourth Article 402 shoreline erosion monitoring report for the Missouri-Madison Project titled 2018 Erosion Control Monitoring Surveys. The last shoreline erosion monitoring report for the 2188 Project was filed with the Commission by the previous licensee, PPL Montana, on February 13, 2014 (for years 2008 through 2013).

This report documents the shoreline erosion and classification of each previously classified site on the following reservoirs:

- Morony Reservoir
- Ryan Reservoir
- Cochrane Reservoir
- Rainbow Reservoir
- Black Eagle Reservoir
- Holter Reservoir
- Hauser Reservoir and Lake Helena
- Madison Reservoir (Ennis Lake)
- Hebgen Lake

Each site has been evaluated and classified as minor, moderate, active, or inactive by the observed current condition compared to the condition of the site during the previous survey. Shoreline erosion rate and severity may be caused by many factors including reservoir operations, land use, recreational use, and geologic sensitivity. The focus of NWE's shoreline erosion plan is to evaluate shoreline erosion at a landscape scale over time. Therefore, causal factors at individual observed sites have not been determined. Each site was photographed and comparisons made between the current photos and those taken in 2013. A representative photo was selected for each site that best illustrates the site and any documentable erosion. These photos can be found in Appendix A of the report. Numerous changes have been made to the sites in 2018 based on changes in erosion rates and local conditions. All of these changes are illustrated in tables found in Appendix A. All sites/photos have been geo-referenced and their locations identified on the aerial photos found in Appendix B of the report.

A “repaired” site means that measures have been taken to control the erosion of a site. These measures include riprap embankments and slope modifications. Sites that were labeled as “repaired” in previous evaluations were again labeled as “success” or “partial success” depending on how the repair measure has progressed. Sites that have received some level of repair but require additional measures were labeled as a “partial repair”.

An “inactive” site means that no erosion appears to have occurred since the last evaluation five years ago. An inactive site means that there is little chance of future erosion if the current conditions are maintained. Most areas categorized as inactive are adequately vegetated, thus reducing the possibility of erosion.

Sites categorized as having “minor activity” show little sign of change from the time of last evaluation. A site labeled “moderate activity” shows signs that some erosion has taken place since the last evaluation. An “active” site means that significant erosion has taken place since the last evaluation.

Table 1 below provides a summary of the shoreline erosion sites displaying moderate or active erosion that were surveyed in 2013 and 2018. Most reservoirs showed either no change in the number of moderate or active sites or a decreasing trend in the number of moderate or active sites. There was an increase in the number of moderate erosion sites on Hauser Reservoir (9 new sites), as well as an increase in the number of active erosion sites on Ryan Reservoir (from zero to 1 site) and Ennis Lake (Madison) (from zero to 2 sites).

Table 1. Summary and comparison of moderate and active shoreline erosion sites surveyed

| Facility Name | Sites Surveyed | Moderate Sites (2013) | Moderate Sites (2018) | Percent Change ¹ | Active Sites (2013) | Active Sites (2018) | Percent Change ¹ |
|---------------|----------------|-----------------------|-----------------------|-----------------------------|---------------------|---------------------|-----------------------------|
| Morony | 24 | 2 | 2 | (0%) | 0 | 0 | (0%) |
| Ryan | 20 | 4 | 2 | (-50%) | 0 | 1 | (+100%) |
| Cochrane | 25 | 9 | 8 | (-11%) | 3 | 3 | (0%) |
| Rainbow | 17 | 0 | 0 | (0%) | 0 | 0 | (0%) |
| Black Eagle | 22 | 2 | 0 | (-100%) | 0 | 0 | (0%) |
| Holter | 60 | 17 | 14 | (-18%) | 10 | 10 | (0%) |
| Hauser | 76 | 11 | 20 | (+82%) | 4 | 4 | (0%) |
| Madison | 45 | 0 | 0 | (0%) | 0 | 2 | (+200%) |
| Hebgen | 95 | 23 | 19 | (-17%) | 1 | 1 | (0%) |

¹Numbers in **bold** show no increase or a decrease in the number of shoreline erosion sites

A voluntary nine inch winter drawdown of Hauser Reservoir has been implemented annually with the intent to reduce or eliminate shoreline erosion caused by ice. The increase in the number of moderate erosional sites on Hauser suggests that the benefit of this drawdown may be offset by changes in surrounding land use, recreation use on the reservoir and unusually high water year in 2018.

The voluntary nine inch drawdown of Holter Reservoir, originally contemplated in 2013 to mitigate ice scouring, was never implemented due to public safety concerns over ice stability for fisherman that frequent the reservoir in the wintertime. However, based on the comparison of 2018 moderate and active sites to 2013 results, a winter drawdown does not appear necessary.

NorthWestern will keep this option available but will not routinely implement it unless deemed safe for public recreationists and necessary at a particular site.

Ennis Lake (Madison Project) also showed an increase in the number of actively eroding sites in areas of residential development and recreational use, and therefore it is unknown if the winter drawdown has been effective at reducing ice-caused shoreline erosion on that reservoir, due to the impacts of the shoreline land uses.

NWE provided this report to the Montana Department of Environmental Quality, the Montana State Historic Preservation Office, Montana Fish Wildlife and Parks, the US Forest Service, and the US Bureau of Land Management for 30 day review and comment.

Thank you for your consideration of this report. The next five-year monitoring report (2019 through 2024) will be submitted for your review at the end of 2024.


Sincerely,

A handwritten signature in blue ink, appearing to read 'M. Sullivan', with a long horizontal line extending to the right.

Mary Gail Sullivan
Director, Environmental and Lands

Cc: Andy Welch, NWE
Jordan Tollefson, NWE
Kristen Dawes, NWE
Don Skaar, FWP
Jake Chaffin, USFS
Chris Boone, BLM
Kelly Scarbrough, BLM
Jason Garber, DEQ
Stan Wilmoth, SHPO


Northwestern Energy has consulted with agencies in the preparation and filing of the License Article 402 Five-Year (2013 through 2018) Shoreline Erosion Monitoring Report. As signed below, the following agencies agree with the content described above and in the attached summary report:

By: 
Title: Water Protection Bureau Chief
Representing Montana Department of Environmental Quality

Date: November 5, 2018

By: Stan Wilmoth (Stan Wilmoth)
Title: Deputy SHPO
Representing Montana State Historic Preservation Office

Date: 11/30/2018

By: 
Title: Fish Chief
Representing Montana Department of Fish, Wildlife and Parks

Date: 12/11/18

By: Mary C Euba
Title: Forest Supervisor, Custer Gallatin National Forest
Representing U.S. Forest Service

Date: 11/15/18

By: _____

Title: _____
Representing U.S. Bureau of Land Management

Date: _____

2018 Erosion Control Monitoring Surveys

**Cochrane Reservoir
Black Eagle Reservoir
Morony Reservoir
Ryan Reservoir
Hauser Reservoir & Lake Helena
Holter Reservoir
Hebgen Lake
Madison Reservoir
Rainbow Reservoir**

Appendix A

2018 COCHRANE DEVELOPMENT

| SITE NO. | OBSERVED EROSION CONDITION | | | | | | | | | | | | | |
|----------|----------------------------|-------------------------|-------------------------|-------------------|-------------------|--------|--------|--------|-------------------|-------------------|-------------------|--------|--------|-------------------|
| | 1991 | 1996 | 2003 | 2005 | 2008 | 2009 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
| 1 | active | minor-moderate activity | minor activity | minor activity | minor activity | | | | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 2 | minor activity | minor activity | minor activity | - | minor activity | | | | minor activity | | - | | | minor activity |
| 3 | active | active | active | active | moderate activity | | | | moderate activity | moderate activity | moderate activity | | | minor activity |
| 4 | active | minor activity | minor activity | minor activity | minor activity | | | | minor activity | | - | | | minor activity |
| 5 | active | active | active | moderate activity | active | active | active | active | active | active | active | active | active | moderate activity |
| 6 | active | active | active | active | active | active | active | active | active | active | active | active | active | active |
| 7 | active | active | active | moderate activity | active | active | active | active | active | active | active | active | active | active |
| 8 | minor activity | active | active | no photo taken | moderate activity | | | | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 9 | moderate activity | minor activity | minor activity | - | moderate activity | | | | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 10 | moderate activity | moderate activity | moderate activity | - | moderate activity | | | | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 11 | moderate activity | moderate activity | moderate activity | - | moderate activity | | | | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 12 | moderate activity | moderate activity | moderate activity | - | moderate activity | | | | moderate activity | moderate activity | moderate activity | | | minor activity |
| 13 | moderate activity | minor activity | minor activity | - | minor activity | | | | moderate activity | moderate activity | moderate activity | | | active |
| 14 | moderate activity | minor activity | minor activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 15 | minor activity | minor activity | minor activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 16 | minor activity | minor activity | minor activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 17 | moderate activity | minor activity | minor activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 18 | moderate activity | moderate activity | moderate activity | - | moderate activity | | | | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 19 | minor activity | moderate activity | moderate activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 20 | minor activity | minor activity | minor activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 21 | minor activity | minor activity | minor activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 22 | minor activity | minor-moderate activity | minor-moderate activity | - | minor activity | | | | minor activity | | | | | moderate activity |
| 23 | minor activity | minor activity | minor activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 24 | minor activity | minor activity | minor activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 25 | | minor activity | | - | | | | | minor activity | | | | | minor activity |



Cochrane 1



Cochrane 2



Cochrane 3



Cochrane 4



Cochrane 5



Cochrane 6



Cochrane 7



Cochrane 8



Cochrane 9



Cochrane 10



Cochrane 11



Cochrane 12



Cochrane 13



Cochrane 14



Cochrane 15



Cochrane 16



Cochrane 17



Cochrane 18



Cochrane 19



Cochrane 20



Cochrane 21



Cochrane 22



Cochrane 23



Cochrane 24

2018 BLACK EAGLE DEVELOPMENT

| SITE NO. | OBSERVER EROSION CONDITION | | | | | | 2014 | 2015 | 2016 | 2017 | 2018 |
|----------|----------------------------|---------------------------|-------------------------|-------------------|--------------------------|--------------------------|-------------------|-------------------|-------------------|-------------------|--------------------------|
| | 1991 | 1996 | 2003 | 2005 | 2008 | 2013 | | | | | |
| 1 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 2 | moderate activity | moderate activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 3 | active | active | moderate activity | moderate activity | moderate activity | moderate activity | moderate activity | moderate activity | moderate activity | moderate activity | minor activity |
| 4 | moderate activity | moderate activity | minor-moderate activity | - | minor activity | minor activity | | | | | minor activity |
| 5 | minor activity | minor activity | inactive | - | inactive | inactive | | | | | minor activity |
| 6 | moderate activity | minor activity | inactive | - | inactive | inactive | | | | | minor activity |
| 7 | minor activity | minor activity | inactive | - | inactive | inactive | | | | | minor activity |
| 8 | minor activity | minor activity | inactive | - | inactive | inactive | | | | | inactive |
| 9 | minor activity | minor activity | minor activity | - | inactive | inactive | | | | | minor activity |
| 10 | minor activity | minor activity | inactive | - | inactive | inactive | | | | | inactive |
| 11 | minor activity | minor-moderate - activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 12 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 13 | active | active | minor activity | minor activity | minor activity | minor activity | | | | | minor activity |
| 14 | minor activity | minor activity | minor activity | - | repaired-success | repaired-success | | | | | repaired-success |
| 15 | moderate activity | moderate activity | minor activity | - | repaired-partial success | repaired-partial success | | | | | repaired-partial success |
| 16 | active | moderate activity | minor activity | minor activity | minor activity | minor activity | | | | | repaired-success |
| 17 | moderate activity | moderate activity | minor activity | - | repaired-success | repaired-success | | | | | repaired-success |
| 18 | moderate activity | moderate activity | minor activity | - | repaired-success | repaired-success | | | | | repaired-success |
| 19 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | partial repair |
| 20 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 21 | moderate activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 22 | moderate activity | moderate activity | moderate activity | - | moderate activity | moderate activity | moderate activity | | | | minor activity |



Black Eagle 1



Black Eagle 2



Black Eagle 3



Black Eagle 5



Black Eagle 6



Black Eagle 7



Black Eagle 8



Black Eagle 9



Black Eagle 10



Black Eagle 11



Black Eagle 12



Black Eagle 13



Black Eagle 14



Black Eagle 15



Black Eagle 16



Black Eagle 17



Black Eagle 18



Black Eagle 19



Black Eagle 20



Black Eagle 21



Black Eagle 22

2018 MORONY DEVELOPMENT

| SITE NO. | OBSERVER EROSION CONDITION | | | | | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|----------|----------------------------|-------------------------|-------------------------|----------------|-------------------|-------------------|-------------------|------|------|------|-------------------------|
| | 1991 | 1996 | 2003 | 2005 | 2008 | | | | | | |
| 1 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 2 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 3 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 4 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 5 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 6 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 7 | active | moderate activity | moderate activity | minor activity | minor activity | minor activity | | | | | minor activity |
| 8 | moderate activity | moderate activity | moderate activity | - | minor activity | minor activity | | | | | minor activity |
| 9 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 10 | moderate activity | moderate activity | moderate activity | - | moderate activity | moderate activity | moderate activity | | | | minor-moderate activity |
| 11 | moderate activity | moderate activity | moderate activity | - | moderate activity | moderate activity | moderate activity | | | | moderate activity |
| 12 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 13 | active | minor-moderate activity | minor-moderate activity | inactive | minor activity | minor activity | | | | | minor activity |
| 14 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 15 | moderate activity | minor-moderate activity | minor-moderate activity | - | minor activity | minor activity | | | | | moderate activity |
| 16 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 17 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 18 | active | moderate activity | minor-moderate activity | minor activity | minor activity | minor activity | | | | | minor activity |
| 19 | moderate activity | moderate activity | moderate activity | - | minor activity | minor activity | | | | | minor activity |
| 20 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 21 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 22 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 23 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 24 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |



Morony 1



Morony 2



Morony 4



Morony 5



Morony 6



Morony 7



Morony 8



Morony 9



Morony 10



Morony 11



Morony 12



Morony 13



Morony 14



Morony 15



Morony 15 (2)



Morony 16



Morony 17



Morony 18



Morony 19



Morony 20



Morony 21



Morony 22



Morony 23



Morony 24

2018 RYAN DEVELOPMENT

| SITE NO. | OBSERVER EROSION CONDITION | | | | | | 2014 | 2015 | 2016 | 2017 | 2018 |
|----------|----------------------------|-------------------------|-------------------------|-------------------|-------------------|-------------------|-------------------|------|------|-------------------|-------------------------|
| | 1991 | 1996 | 2003 | 2005 | 2008 | 2013 | | | | | |
| 1 | moderate activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor-moderate activity |
| 2 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 3 | moderate activity | minor activity | minor-moderate activity | - | minor activity | moderate activity | moderate activity | | | moderate activity | active |
| 4 | minor activity | minor-moderate activity | moderate activity | - | moderate activity | moderate activity | moderate activity | | | moderate activity | moderate activity |
| 5 | minor activity | minor activity | minor-moderate activity | - | minor activity | moderate activity | moderate activity | | | moderate activity | minor-moderate activity |
| 6 | active | minor-moderate activity | minor-moderate activity | moderate activity | moderate activity | moderate activity | moderate activity | | | moderate activity | moderate activity |
| 7 | moderate activity | minor-moderate activity | minor-moderate activity | - | minor activity | minor activity | | | | | minor-moderate activity |
| 8 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 9 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 10 | minor activity | minor-moderate activity | minor-moderate activity | - | minor activity | minor activity | | | | | minor activity |
| 11 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 12 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 13 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 14 | moderate activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 15 | moderate activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 16 | moderate activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 17 | moderate activity | minor activity | minor activity | - | minor activity | no photo taken | | | | | minor activity |
| 18 | moderate activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 19 | minor activity | minor activity | minor activity | - | no photo taken | no photo taken | | | | | minor activity |
| 20 | minor activity | minor activity | minor activity | - | no photo taken | no photo taken | | | | | minor activity |



Ryan 1



Ryan 2



Ryan 3



Ryan 4



Ryan 5



Ryan 6



Ryan 7



Ryan 8



Ryan 9



Ryan 10



Ryan 11



Ryan 12



Ryan 13



Ryan 14



Ryan 15



Ryan 16



Ryan 17



Ryan 18

2018 HAUSER DEVELOPMENT

| SITE NO. | OBSERVED EROSION CONDITION | | | | | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|----------|----------------------------|-------------------------|-------------------------|--------|-------------------|--------|--------|-------------------------|-------------------|-------------------|--------|--------|--------|--------------------|
| | 1991 | 1996 | 2003 | 2005 | 2008 | 2009 | | | | | | | | |
| 1 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 2 | minor activity | minor activity | minor activity | - | moderate activity | | | minor activity | | | | | | moderate activity |
| 3 | minor activity | minor activity | minor activity | - | moderate activity | | | moderate activity | moderate activity | moderate activity | | | | moderate activity |
| 4 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | moderate activity |
| 5 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 6 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 7 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | inactive |
| 8 | moderate activity | moderate activity | moderate activity | - | moderate activity | | | moderate activity | moderate activity | moderate activity | | | | minor activity |
| 9 | active | active | active | active | active | active | active | active | active | active | active | active | active | active |
| 10 | moderate activity | moderate activity | minor-moderate activity | - | no photo taken | | | moderate activity | moderate activity | moderate activity | | | | minor activity |
| 11 | moderate activity | minor-moderate activity | minor-moderate activity | - | minor activity | | | minor-moderate activity | | | | | | minor activity |
| 12 | minor activity | minor-moderate activity | minor-moderate activity | - | minor activity | | | minor-moderate activity | | | | | | moderate activity |
| 13 | minor activity | minor-moderate activity | minor-moderate activity | - | minor activity | | | minor-moderate activity | | | | | | moderate activity |
| 14 | moderate activity | moderate activity | minor-moderate activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 15 | minor activity | minor-moderate activity | repaired | - | minor activity | | | minor activity | | | | | | minor activity |
| 16 | minor activity | minor-moderate activity | repaired | - | in-active | | | in-active | | | | | | minor activity |
| 17 | moderate activity | moderate activity | moderate activity | - | active | active | active | active | active | active | active | active | active | active |
| 18 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 19 | moderate activity | moderate activity | moderate activity | - | minor activity | | | minor activity | | | | | | moderate activity |
| 20 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 21 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 22 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 23 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 24 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | in-active |
| 25 | minor activity | minor activity | repaired | - | minor activity | | | minor activity | | | | | | minor activity |
| 26 | minor activity | minor activity | minor activity | - | no photo taken | | | minor activity | | | | | | minor activity |
| 27 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | inactive |
| 28 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 29 | moderate activity | minor activity | minor activity | - | minor activity | | | minor-moderate | | | | | | minor-moderate |
| 30 | | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | minor-moderate |
| 31 | minor activity | minor activity | minor activity | - | minor activity | | | active | active | | | | | moderate activity |
| 32 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | moderate activity |
| 33 | minor activity | minor activity | minor activity | - | minor activity | | | moderate activity | moderate activity | | | | | Partially Repaired |
| 34 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | minor activity |

2018 HAUSER DEVELOPMENT

| SITE NO. | OBSERVED EROSION CONDITION | | | | | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|----------|----------------------------|-------------------------|-------------------------|----------------|--------------------------|------|------|-------------------------|-------------------|------|------|------|------|-------------------------|
| | 1991 | 1996 | 2003 | 2005 | 2008 | 2009 | | | | | | | | |
| 35 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 36 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | Repaired - success |
| 37 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 38 | moderate activity | moderate activity | minor-moderate | - | minor activity | | | minor activity | | | | | | minor activity |
| 39 | moderate activity | moderate activity | moderate activity | - | minor activity | | | minor-moderate | | | | | | minor-moderate |
| 40 | active | moderate activity | minor activity | minor activity | repaired-partial success | | | moderate activity | moderate activity | | | | | moderate activity |
| 41 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 42 | moderate activity | minor-moderate activity | minor-moderate | - | inactive | | | moderate activity | moderate activity | | | | | moderate activity |
| 43 | minor activity | minor activity | minor activity | - | no photo taken | | | moderate activity | moderate activity | | | | | minor activity |
| 44 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | moderate activity |
| 45 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | moderate activity |
| 46 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | moderate activity |
| 47 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 48 | minor activity | moderate activity | moderate activity | - | moderate activity | | | moderate activity | moderate activity | | | | | moderate activity |
| 49 | minor activity | moderate activity | minor-moderate activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 50 | moderate activity | minor activity | minor activity | - | no photo taken | | | moderate activity | moderate activity | | | | | active |
| 51 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 52 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 53 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 54 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 55 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 56 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | inactive |
| 57 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 58 | moderate activity | minor activity | inactive | - | minor activity | | | minor activity | | | | | | minor activity |
| 59 | minor activity | minor activity | inactive | - | minor activity | | | minor activity | | | | | | minor activity |
| 60 | moderate activity | minor activity | inactive | - | minor activity | | | minor activity | | | | | | minor activity |
| 61 | minor activity | minor-moderate activity | minor activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 62 | moderate activity | moderate activity | minor-moderate activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 63 | minor activity | minor activity | inactive | - | minor activity | | | minor activity | | | | | | In-active |
| 64 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 65 | minor activity | minor-moderate activity | minor activity | - | minor activity | | | minor activity | | | | | | minor activity |
| 66 | moderate activity | moderate activity | minor-moderate activity | - | minor activity | | | minor-moderate activity | | | | | | moderate activity |
| 67 | minor activity | minor activity | in-active | - | no photo taken | | | minor activity | | | | | | moderate activity |
| 68 | moderate activity | minor activity | minor activity | - | minor activity | | | minor-moderate activity | | | | | | minor-moderate activity |

2018 HAUSER DEVELOPMENT

| SITE NO. | OBSERVED EROSION CONDITION | | | | | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|----------|----------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|------|-------------------|-------------------|--------|--------|------|------|--------------------|
| | 1991 | 1996 | 2003 | 2005 | 2008 | 2009 | | | | | | | | |
| 69 | minor activity | moderate activity | minor activity | - | minor activity | | | moderate activity | moderate activity | | | | | minor activity |
| 70 | active | active | active | active | moderate activity | | | minor activity | | | | | | minor activity |
| 71 | active | active | active | moderate activity | moderate activity | | | minor activity | | | | | | moderate activity |
| 72 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | moderate activity |
| 73 | minor activity | minor activity | minor activity | - | minor activity | | | minor activity | | | | | | Repaired - success |
| 74 | active | active | moderate activity | minor activity | minor activity | | | moderate activity | moderate activity | | | | | moderate activity |
| 75 | moderate activity | moderate activity | moderate activity | - | minor activity | | | minor activity | | | | | | moderate activity |
| 76 | active | active | moderate activity | minor activity | minor activity | moderate activity | | | active | active | active | | | active |



Hauser 1



Hauser 2



Hauser 3



Hauser 4



Hauser 5



Hauser 6



Hauser 7



Hauser 8



Hauser 9.2



Hauser 10



Hauser 12.1



Hauser 13



Hauser 15



Hauser 16



Hauser 17



Hauser 18



Hauser 19



Hauser 20.1



Hauser 21



Hauser 22



Hauser 23



Hauser 23.1



Hauser 24



Hauser 25



Hauser 26



Hauser 27



Hauser 28



Hauser 29



Hauser 30



Hauser 31



Hauser 32



Hauser 33



Hauser 34.1



Hauser 35



Hauser 36



Hauser 37



Hauser 38



Hauser 39.1



Hauser 40



Hauser 41.1



Hauser 42.5



Hauser 44



Hauser 45



Hauser 46



Hauser 47.1



Hauser 48.4



Hauser 49



Hauser 50



Hauser 50a



Hauser 51



Hauser 52



Hauser 53



Hauser 54



Hauser 55



Hauser 56



Hauser 57



Hauser 58



Hauser 59



Hauser 60.1



Hauser 61



Hauser 62



Hauser 63



Hauser 64



Hauser 65



Hauser 67



Hauser 68.2



Hauser 69



Hauser 70



Hauser 71



Hauser 72



Hauser 73



Hauser 74



Hauser 75



Hauser 76

2018 HOLTER DEVELOPMENT

| SITE NO. | OBSERVED EROSION CONDITION | | | | | | | | | | | | | |
|----------|----------------------------|-------------------------|-------------------------|-------------------|--------------------------------|--------|--------|--------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|------|--------------------------------|
| | 1991 | 1996 | 2003 | 2005 | 2008 | 2009 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
| 1 | minor activity | minor activity | minor activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 2 | minor activity | minor-moderate activity | minor-moderate activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 3 | active | active | moderate activity | moderate activity | moderate activity | | | | moderate activity | moderate activity | moderate activity | | | minor activity |
| 4 | moderate activity | minor-moderate activity | minor-moderate activity | - | minor activity | | | | minor activity | | | | | inactive |
| 5 | minor activity | moderate activity | minor-moderate activity | - | minor activity | | | | moderate activity | moderate activity | moderate activity | | | minor activity |
| 6 | moderate activity | moderate activity | minor-moderate activity | - | minor activity | | | | minor activity | | | | | minor-moderate activity |
| 7 | minor activity | minor activity | minor activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 8 | moderate activity | minor activity | minor activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 9 | moderate activity | minor-moderate activity | minor-moderate activity | - | minor activity | | | | minor activity | | | | | inactive |
| 10 | minor activity | minor activity | minor activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 11 | moderate activity | moderate activity | minor activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 12 | moderate activity | moderate activity | minor-moderate activity | - | minor activity | | | | minor activity | | | | | minor-moderate activity |
| 13 | moderate activity | minor-moderate activity | minor activity | - | minor activity | | | | minor activity | | | | | minor-moderate activity |
| 14 | moderate activity | minor-moderate activity | minor-moderate activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 15 | moderate activity | minor-moderate activity | minor-moderate activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 16 | moderate activity | minor-moderate activity | minor-moderate activity | - | minor activity | | | | minor activity | | | | | inactive |
| 17 | moderate activity | minor-moderate activity | minor-moderate activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 18 | moderate activity | minor-moderate activity | minor-moderate activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 19 | moderate activity | minor-moderate activity | moderate activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 20 | moderate activity | minor-moderate activity | minor-moderate activity | - | minor activity | | | | minor activity | | | | | minor-moderate activity |
| 21 | moderate activity | minor-moderate activity | minor-moderate activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 22 | moderate activity | moderate activity | moderate activity | - | minor activity | | | | minor activity | | | | | minor-moderate activity |
| 23 | moderate activity | moderate activity | moderate activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 24 | moderate activity | moderate activity | moderate activity | - | moderate activity | | | | minor-moderate activity | | | | | minor-moderate activity |
| 25 | moderate activity | moderate activity | minor-moderate activity | - | minor activity | | | | minor activity | | | | | minor-moderate activity |
| 26 | minor activity | moderate activity | minor-moderate activity | - | repaired-success | | | | repaired-success | | | | | repaired-success |
| 27 | active | moderate activity | active | repaired | repaired-success | | | | repaired-success | | | | | Under Construction |
| 28 | active | active | active | active | active | active | active | active | active | active | active | active | | moderate activity |
| 29 | active | active | active | active | moderate activity | | | | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 30 | moderate activity | moderate activity | moderate activity | - | partial repair-partial success | | | | partial repair-partial success | partial repair-partial success | partial repair-partial success | partial repair-partial success | | partial repair-partial success |
| 31 | moderate activity | minor-moderate activity | minor-moderate activity | - | moderate activity | | | | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 32 | moderate activity | moderate activity | moderate activity | - | moderate activity | | | | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 33 | active | active | active | active | active | active | active | active | active | active | active | active | | active |
| 34 | active | active | active | active | active | active | active | active | active | active | active | active | | active |

2018 HOLTER DEVELOPMENT

| SITE NO. | OBSERVED EROSION CONDITION | | | | | | | | | | | | | |
|----------|----------------------------|-------------------------|-------------------------|-------------------|-------------------|--------|--------|--------|-------------------|-------------------|-------------------|--------|--------|-------------------------|
| | 1991 | 1996 | 2003 | 2005 | 2008 | 2009 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
| 35 | moderate activity | moderate activity | moderate activity | - | moderate activity | | | | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 36 | moderate activity | moderate activity | minor activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 37 | moderate activity | minor-moderate activity | minor activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 38 | active | moderate activity | moderate activity | - | moderate activity | | | | active | active | active | active | | active |
| 39 | active | active | active | active | active | active | active | active | active | active | active | active | active | active |
| 40 | moderate activity | minor-moderate activity | minor-moderate activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 41 | moderate activity | minor-moderate activity | minor-moderate activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 42 | minor activity | moderate activity | minor-moderate activity | - | minor activity | | | | minor activity | | | | | minor activity |
| 43 | moderate activity | moderate activity | minor-moderate activity | - | minor activity | | | | minor activity | | | | | inactive |
| 44 | active | moderate activity | moderate activity | moderate activity | minor activity | | | | minor activity | | | | | moderate activity |
| 45 | active | active | active | active | active | active | active | active | active | active | active | active | active | active |
| 46 | moderate activity | moderate activity | moderate activity | - | moderate activity | | | | moderate activity | moderate activity | moderate activity | | | active |
| 46A | | | moderate activity | - | moderate activity | | | | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 47 | moderate activity | moderate activity | moderate activity | - | moderate activity | | | | moderate activity | moderate activity | moderate activity | | | minor-moderate activity |
| 48 | moderate activity | moderate activity | moderate activity | - | moderate activity | | | | moderate activity | moderate activity | moderate activity | | | minor-moderate activity |
| 49 | moderate activity | moderate activity | moderate activity | - | moderate activity | | | | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 50 | moderate activity | minor-moderate activity | moderate activity | - | moderate activity | | | | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 51 | moderate activity | minor activity | minor activity | - | minor activity | | | | minor activity | | | | | minor-moderate activity |
| 52 | moderate activity | moderate activity | moderate activity | - | moderate activity | | | | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 53 | moderate activity | moderate activity | moderate activity | - | moderate activity | | | | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 54 | active | active | active | active | active | active | active | active | active | active | active | | | active |
| 55 | moderate activity | moderate activity | active | active | active | active | active | active | active | active | active | | | active |
| 56 | moderate activity | moderate activity | moderate activity | - | moderate activity | | | | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 57 | active | active | active | active | active | active | active | active | active | active | active | | | active |
| 58 | moderate activity | moderate activity | moderate activity | - | moderate activity | | | | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 59 | active | active | active | active | active | active | active | active | active | active | active | | | active |
| 60 | moderate activity | moderate activity | moderate activity | - | moderate activity | | | | moderate activity | moderate activity | moderate activity | | | moderate activity |



Holter 1



Holter 2



Holter 3



Holter 4



Holter 5



Holter 6



Holter 7



Holter 8



Holter 8a



Holter 9



Holter 10



Holter 11



Holter 12



Holter 13



Holter 14



Holter 15



Holter 16



Holter 18



Holter 19



Holter 20



Holter 21



Holter 22



Holter 23



Holter 24



Holter 25



Holter 26



Holter 26a



Holter 27



Holter 27uc



Holter 28



Holter 29



Holter 30



Holter 31



Holter 32



Holter 33



Holter 34



Holter 35



Holter 36



Holter 37



Holter 38



Holter 39



Holter 40



Holter 41



Holter 42



Holter 43



Holter 44



Holter 45



Holter 46



Holter 47



Holter 48



Holter 49



Holter 50



Holter 51



Holter 52



Holter 53



Holter 54



Holter 55



Holter 56



Holter 57



Holter 58



Holter 59



Holter 60

2018 HEBGEN DEVELOPMENT

| SITE NO. | OBSERVER EROSION CONDITION | | | | | | 2014 | 2015 | 2016 | 2017 | 2018 |
|----------|----------------------------|-------------------|--------------------------|----------------|--------------------------|--------------------------|-------------------|-------------------|------|------|--------------------------|
| | 1991 | 1996 | 2003 | 2005 | 2008 | 2013 | | | | | |
| 1 | moderate activity | moderate activity | minor-moderate activity | - | repaired-success | repaired-success | | | | | repaired-success |
| 2 | active | active | moderate activity | minor activity | repaired-partial success | repaired-partial success | | | | | repaired-partial success |
| 3 | moderate activity | moderate activity | minor activity | - | repaired-success | repaired-success | | | | | repaired-success |
| 4 | moderate activity | moderate activity | minor activity | - | repaired-partial success | repaired-partial success | | | | | repaired-partial success |
| 5 | active | moderate activity | minor activity | minor activity | minor activity | minor activity | | | | | minor activity |
| 6 | moderate activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 7 | moderate activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor-moderate activity |
| 8 | moderate activity | moderate activity | minor activity | - | moderate activity | minor-moderate activity | | | | | minor activity |
| 9 | moderate activity | moderate activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 10 | moderate activity | moderate activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 11 | moderate activity | moderate activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 12 | moderate activity | moderate activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 13 | moderate activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 14 | moderate activity | moderate activity | minor activity | - | minor activity | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 15 | moderate activity | moderate activity | minor activity | - | minor activity | minor-moderate activity | | | | | minor-moderate activity |
| 16 | moderate activity | moderate activity | moderate activity | - | moderate activity | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 17 | moderate activity | moderate activity | minor activity | - | minor activity | minor-moderate activity | | | | | moderate activity |
| 18 | moderate activity | minor activity | minor activity | - | minor activity | minor-moderate activity | | | | | moderate activity |
| 19 | moderate activity | moderate activity | minor activity | - | minor activity | minor-moderate activity | | | | | moderate activity |
| 20 | moderate activity | minor activity | minor activity | - | minor activity | minor-moderate activity | | | | | moderate activity |
| 21 | moderate activity | minor activity | minor activity | - | minor activity | minor-moderate activity | | | | | moderate activity |
| 22 | moderate activity | moderate activity | moderate activity | - | minor activity | minor-moderate activity | | | | | moderate activity |
| 23 | moderate activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 24 | moderate activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor-moderate activity |
| 25 | active | moderate activity | moderate-active activity | active | moderate activity | moderate activity | moderate activity | moderate activity | | | active |
| 26 | | | | | minor activity | minor activity | | | | | moderate activity |

2018 HEBGEN DEVELOPMENT

| SITE NO. | OBSERVER EROSION CONDITION | | | | | | 2014 | 2015 | 2016 | 2017 | 2018 |
|----------|----------------------------|-------------------------|-------------------------|-------------------|-------------------|-------------------------|-------------------|-------------------|------|------|-------------------------|
| | 1991 | 1996 | 2003 | 2005 | 2008 | 2013 | | | | | |
| 27 | moderate activity | minor activity | minor activity | - | minor activity | minor activity | | | | | moderate activity |
| 28 | moderate activity | moderate activity | minor activity | - | minor activity | minor activity | | | | | minor-moderate activity |
| 29 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | inactive |
| 30 | moderate activity | moderate activity | minor-moderate | - | minor activity | minor activity | | | | | minor activity |
| 31 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | inactive |
| 32 | moderate activity | minor-moderate activity | minor-moderate activity | - | minor activity | minor activity | | | | | minor activity |
| 33 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 34 | active | moderate activity | minor activity | minor activity | partial repaired | partial repaired | | | | | minor activity |
| 35 | minor activity | minor activity | minor activity | - | inactive | minor-moderate activity | | | | | minor activity |
| 36 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | inactive |
| 37 | moderate activity | minor-moderate activity | minor-moderate activity | - | minor activity | minor activity | | | | | minor activity |
| 38 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | inactive |
| 39 | moderate activity | moderate activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 40 | moderate activity | moderate activity | moderate activity | - | minor activity | minor activity | | | | | minor activity |
| 41 | moderate activity | minor-moderate activity | minor-moderate activity | - | minor activity | minor activity | | | | | minor activity |
| 42 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 43 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor-moderate activity |
| 44 | moderate activity | moderate activity | moderate activity | - | moderate activity | moderate activity | moderate activity | moderate activity | | | minor-moderate activity |
| 45 | active | moderate activity | minor-moderate activity | minor activity | minor activity | moderate activity | moderate activity | moderate activity | | | minor-moderate activity |
| 46 | moderate activity | moderate activity | minor-moderate activity | - | minor activity | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 47 | moderate activity | moderate activity | minor-moderate activity | - | minor activity | moderate activity | moderate activity | moderate activity | | | minor-moderate activity |
| 48 | moderate activity | moderate activity | moderate activity | - | moderate activity | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 49 | moderate activity | moderate activity | moderate activity | - | moderate activity | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 50 | active | active | moderate activity | moderate activity | moderate activity | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 51 | | | | | | | | | | | minor-moderate activity |
| 52 | moderate activity | moderate activity | moderate activity | - | moderate activity | moderate activity | moderate activity | moderate activity | | | moderate activity |

2018 HEBGEN DEVELOPMENT

| SITE NO. | OBSERVER EROSION CONDITION | | | | | | | | | | |
|----------|----------------------------|-----------------------------------|-------------------------|-------------------|--------------------------|-------------------------------|-------------------|-------------------|-------------------|------|-------------------------------|
| | 1991 | 1996 | 2003 | 2005 | 2008 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
| 53 | moderate activity | moderate activity | moderate activity | - | moderate activity | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 54 | moderate activity | moderate activity | moderate activity | - | moderate activity | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 55 | moderate activity | moderate activity | moderate activity | - | moderate activity | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 56 | moderate activity | moderate activity | moderate activity | - | moderate activity | moderate activity | moderate activity | moderate activity | | | moderate activity |
| 57 | moderate activity | moderate activity | moderate activity | - | minor activity | moderate activity | moderate activity | moderate activity | | | minor-moderate activity |
| 58 | moderate activity | moderate activity | moderate activity | - | minor activity | moderate activity | moderate activity | moderate activity | | | minor-moderate activity |
| 59 | active | active | moderate activity | moderate activity | moderate activity | moderate activity | moderate activity | moderate activity | | | minor-moderate activity |
| 60 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 61 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | inactive |
| 62 | moderate activity | moderate activity | minor activity | - | minor activity | moderate activity | moderate activity | moderate activity | | | minor-moderate activity |
| 63 | moderate activity | moderate activity-possibly active | minor-moderate activity | - | minor activity | active | active | active | moderate activity | | minor-moderate activity |
| 64 | moderate activity | moderate activity-possibly active | moderate activity | - | moderate activity | moderate activity | moderate activity | moderate activity | | | minor-moderate activity |
| 65 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 66 | moderate activity | moderate activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 67 | active | moderate activity | minor-moderate activity | minor activity | minor activity | minor activity | | | | | minor activity |
| 68 | active | moderate activity | minor-moderate activity | minor activity | minor activity | minor activity | | | | | minor activity |
| 69 | moderate activity | moderate activity | minor-moderate activity | - | minor activity | minor activity | | | | | minor-moderate activity |
| 70 | active | active | moderate activity | minor activity | minor activity | moderate activity | moderate activity | moderate activity | | | minor-moderate activity |
| 71 | active | minor-moderate activity | minor-moderate activity | minor activity | minor activity | minor-moderate activity | | | | | minor-moderate activity |
| 72 | minor activity | minor activity | repaired with rip-rap | - | success | success | | | | | success |
| 73 | active | moderate activity | repaired | repaired | success | success | | | | | success |
| 74 | minor activity | minor activity | repaired | - | success | success | | | | | success |
| 75 | active | moderate activity | minor activity | minor activity | repaired-success | repaired-success | | | | | repaired-success |
| 76 | active | moderate activity | moderate activity | minor activity | repaired-partial success | partial repair-minor activity | | | | | partial repair-minor activity |
| 77 | active | minor-moderate activity | minor-moderate activity | moderate activity | moderate activity | moderate activity | moderate activity | moderate activity | | | repaired-success |
| 78 | moderate activity | moderate activity | minor activity | - | minor activity | minor activity | | | | | minor activity |

2018 HEBGEN DEVELOPMENT

| SITE NO. | OBSERVER EROSION CONDITION | | | | | | 2014 | 2015 | 2016 | 2017 | 2018 |
|----------|----------------------------|-------------------------|-------------------------|-------------------|-------------------------------|-------------------------------|-------------------|-------------------|------|------|-------------------------|
| | 1991 | 1996 | 2003 | 2005 | 2008 | 2013 | | | | | |
| 79 | moderate activity | moderate activity | minor-moderate activity | - | minor activity | minor activity | | | | | minor activity |
| 80 | active | moderate activity | minor-moderate activity | minor activity | minor activity | minor-moderate activity | | | | | minor activity |
| 81 | moderate activity | moderate activity | moderate activity | - | minor activity | minor activity | | | | | minor activity |
| 82 | active | active | moderate activity | minor activity | partial repair-minor activity | partial repair-minor activity | | | | | minor activity |
| 83 | moderate activity | moderate activity | repaired | - | success | success | | | | | success |
| 84 | moderate activity | moderate activity | minor activity | - | repaired-success | repaired-success | | | | | repaired-success |
| 85 | moderate activity | moderate activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 86 | active | active | moderate activity | minor activity | minor activity | minor activity | | | | | minor activity |
| 87 | moderate activity | moderate activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 88 | moderate activity | moderate activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 89 | active | active | active | moderate activity | moderate activity | moderate activity | | | | | minor-moderate activity |
| 90 | moderate activity | moderate activity | minor activity | - | minor activity | moderate activity | | | | | minor activity |
| 91 | moderate activity | moderate activity | minor-moderate activity | - | minor activity | moderate activity | | | | | minor activity |
| 92 | moderate activity | moderate activity | minor-moderate activity | - | minor activity | moderate activity | moderate activity | moderate activity | | | minor-moderate activity |
| 93 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | | | | inactive |
| 94 | moderate activity | minor-moderate activity | minor activity | - | minor activity | minor activity | | | | | minor activity |
| 95 | moderate activity | minor-moderate activity | minor activity | - | repaired-success | repaired-success | | | | | repaired-success |



Hebgen 1



Hebgen 2



Hebgen 3



Hebgen 4



Hebgen 5



Hebgen 6



Hebgen 7



Hebgen 8



Hebgen 9



Hebgen 10



Hebgen 11



Hebgen 12



Hebgen 13



Hebgen 14



Hebgen 14.5



Hebgen 15



Hebgen 16



Hebgen 17



Hebgen 18



Hebgen 19



Hebgen 20



Hebgen 21



Hebgen 22



Hebgen 23



Hebgen 24



Hebgen 25



Hebgen 26



Hebgen 27



Hebgen 28



Hebgen 29



Hebgen 30



Hebgen 30.6



Hebgen 31



Hebgen 31 (2)



Hebgen 32



Hebgen 33



Hebgen 34



Hebgen 35



Hebgen 36



Hebgen 37



Hebgen 38



Hebgen 39



Hebgen 40



Hebgen 41



Hebgen 41.15



Hebgen 41.6



Hebgen 42



Hebgen 43



Hebgen 43.7



Hebgen 44



Hebgen 44.10



Hebgen 45



Hebgen 46



Hebgen 47



Hebgen 47.13



Hebgen 48.5



Hebgen 49



Hebgen 50



Hebgen 51



Hebgen 51.5



Hebgen 52



Hebgen 53



Hebgen 54



Hebgen 55



Hebgen 56



Hebgen 57



Hebgen 57.3



Hebgen 58



Hebgen 59



Hebgen 60



Hebgen 61



Hebgen 61.6



Hebgen 62



Hebgen 63



Hebgen 64



Hebgen 65



Hebgen 66



Hebgen 67



Hebgen 68



Hebgen 69



Hebgen 70



Hebgen 71



Hebgen 72



Hebgen 73



Hebgen 74



Hebgen 75



Hebgen 76



Hebgen 77



Hebgen 78



Hebgen 79



Hebgen 80



Hebgen 81



Hebgen 82



Hebgen 83



Hebgen 84



Hebgen 85



Hebgen 86



Hebgen 87



Hebgen 88



Hebgen 89



Hebgen 90



Hebgen 91



Hebgen 91.5



Hebgen 92



Hebgen 93



Hebgen 94



Hebgen 95

2018 MADISON DEVELOPMENT

| SITE NO. | OBSERVER EROSION CONDITION | | | | | | 2014 | 2018 |
|----------|----------------------------|-------------------------|----------------|----------------|--------------------------------|--------------------------------|------|----------------|
| | 1991 | 1996 | 2003 | 2005 | 2008 | 2013 | | |
| 1 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | minor activity |
| 2 | minor activity | moderate activity | minor activity | - | repair-success | repair-success | | active |
| 3 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | repair-success |
| 4 | moderate activity | moderate activity | minor-moderate | - | minor activity | minor activity | | minor activity |
| 5 | active | active | minor activity | inactive | repair-success | repair-success | | repair-success |
| 6 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | minor activity |
| 7 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | repair-success |
| 8 | minor activity | minor activity | minor activity | - | partial repair-success | partial repair-success | | repair-success |
| 9 | moderate activity | minor-moderate activity | minor activity | - | minor activity | minor activity | | repair-success |
| 10 | active | minor activity | repaired | repaired | success | success | | repair-success |
| 11 | active | minor activity | repaired | repaired | success | success | | success |
| 12 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | minor activity |
| 13 | active | active | minor activity | minor activity | minor activity | minor activity | | minor activity |
| 14 | moderate activity | minor-moderate activity | minor activity | - | minor activity | minor activity | | minor activity |
| 15 | moderate activity | minor-moderate activity | minor activity | - | minor activity | minor activity | | inactive |
| 16 | active | active | minor activity | minor activity | minor activity | minor activity | | active |
| 17 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | minor-moderate |
| 18 | active | active | minor activity | minor activity | partial repair-partial success | partial repair-partial success | | repair-success |
| 19 | active | minor activity | minor activity | minor activity | minor activity | minor activity | | minor activity |

2018 MADISON DEVELOPMENT

| SITE NO. | OBSERVER EROSION CONDITION | | | | | | 2014 | 2018 |
|----------|----------------------------|-------------------|---------------------------------|------|----------------|----------------|------|----------------|
| | 1991 | 1996 | 2003 | 2005 | 2008 | 2013 | | |
| 20 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | minor activity |
| 21 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | minor activity |
| 22 | moderate activity | moderate activity | minor-moderate | - | minor activity | minor-moderate | | minor-moderate |
| 23 | moderate activity | minor activity | minor activity | - | minor activity | minor-moderate | | repair-success |
| 24 | minor activity | minor activity | minor activity | - | minor activity | minor activity | | partial repair |
| 25 | moderate activity | moderate activity | minor activity | - | minor activity | minor activity | | minor activity |
| 26 | moderate activity | moderate activity | minor activity | - | minor activity | minor activity | | minor activity |
| 27 | moderate activity | minor activity | minor-moderate | - | minor activity | minor activity | | inactive |
| 28 | varies | minor-moderate | Lake too shallow - No photos | - | minor activity | minor activity | | inactive |
| 29 | moderate activity | minor activity | Lake too shallow - No photos | - | minor activity | minor activity | | inactive |
| 30 | | minor activity | Lake too shallow - No photos | - | minor activity | minor activity | | inactive |
| 31 | | minor activity | Lake too shallow - No photos | - | minor activity | minor activity | | inactive |
| 32 | | minor activity | Lake too shallow - No photos | - | minor activity | minor activity | | inactive |
| 33 | | minor activity | Lake too shallow - No photos | - | minor activity | minor activity | | minor activity |
| 34 | | minor activity | Lake too shallow - No photos | - | minor activity | minor activity | | inactive |
| 35 | | minor activity | Lake too shallow - No photos | - | minor activity | minor activity | | inactive |
| 36 | | minor activity | Lake too shallow - No photos | - | minor activity | minor activity | | inactive |
| 37 | | minor activity | Lake too shallow - No photos | - | minor activity | minor activity | | inactive |
| 38 | | minor activity | Lake too shallow - No photos | - | minor activity | minor activity | | inactive |

2018 MADISON DEVELOPMENT

| SITE NO. | OBSERVER EROSION CONDITION | | | | | | 2014 | 2018 |
|----------|----------------------------|----------------|---------------------------------|------|----------------|----------------|------|----------------|
| | 1991 | 1996 | 2003 | 2005 | 2008 | 2013 | | |
| 39 | | minor activity | Lake too shallow - No photos | - | minor activity | minor activity | | minor activity |
| 40 | | minor activity | Lake too shallow - No photos | - | minor activity | minor activity | | minor activity |
| 41 | | minor activity | Lake too shallow - No photos | - | minor activity | minor activity | | minor activity |
| 42 | | minor activity | Lake too shallow - No photos | - | minor activity | minor activity | | minor activity |
| 43 | | minor activity | Lake too shallow - No photos | - | minor activity | minor activity | | minor activity |
| 44 | | minor activity | Lake too shallow - No photos | - | minor activity | minor activity | | minor activity |
| 45 | | minor activity | Lake too shallow - No photos | - | minor activity | minor activity | | minor activity |



Madison 1



Madison 2



Madison 3



Madison 4



Madison 5



Madison 6



Madison 7



Madison 8



Madison 9



Madison 10



Madison 11



Madison 14



Madison 15



Madison 16



Madison 17



Madison 18



Madison 19



Madison 20



Madison 21



Madison 22



Madison 23



Madison 24



Madison 25



Madison 26



Madison 27



Madison 28



Madison 29



Madison 29 (2)



Madison 30.1



Madison 31



Madison 31 (2)



Madison 32



Madison 33



Madison 34



Madison 35



Madison 36



Madison 37



Madison 38



Madison 39



Madison 40



Madison 41



Madison 42



Madison 43



Madison 44



Madison 45

2018 RAINBOW DEVELOPMENT

| SITE NO. | OBSERVER EROSION CONDITION | | | | | | | 2018 |
|----------|----------------------------|-------------------------|-------------------------|----------------|----------------|----------------|----------------|-------------------------|
| | 1991 | 1996 | 2003 | 2005 | 2008 | 2013 | 2014 | |
| 1 | active | minor-moderate activity | minor activity | minor activity | minor activity | minor activity | minor activity | minor-moderate activity |
| 2 | minor activity | minor activity | inactive | - | inactive | minor activity | minor activity | minor-moderate activity |
| 3 | minor activity | minor activity | inactive | - | inactive | minor activity | minor activity | minor activity |
| 4 | minor activity | minor activity | minor activity | - | minor activity | minor activity | minor activity | minor activity |
| 5 | minor activity | minor activity | minor activity | - | minor activity | minor activity | minor activity | minor activity |
| 6 | minor activity | minor activity | minor activity | - | inactive | minor activity | minor activity | Repaired - succes |
| 7 | moderate activity | moderate activity | minor-moderate activity | - | minor activity | minor activity | minor activity | minor activity |
| 8 | minor activity | minor-moderate activity | minor activity | - | no photo taken | minor activity | minor activity | minor activity |
| 9 | moderate activity | moderate activity | minor activity | - | minor activity | minor activity | minor activity | minor activity |
| 10 | moderate activity | moderate activity | moderate activity | - | minor activity | minor activity | minor activity | minor activity |
| 11 | active | moderate activity | moderate activity | minor activity | minor activity | minor activity | minor activity | minor activity |
| 12 | moderate activity | moderate activity | minor activity | - | minor activity | minor activity | minor activity | minor activity |
| 13 | active | minor-moderate activity | minor activity | inactive | minor activity | minor activity | minor activity | minor activity |
| 14 | minor activity | minor activity | minor activity | - | minor activity | minor activity | minor activity | minor-moderate activity |
| 15 | moderate activity | minor-moderate activity | minor activity | - | minor activity | minor activity | minor activity | minor-moderate activity |
| 16 | moderate activity | minor-moderate activity | minor activity | - | minor activity | minor activity | minor activity | minor-moderate activity |
| 17 | moderate activity | moderate activity | minor activity | - | minor activity | minor activity | minor activity | minor activity |



Rainbow 1



Rainbow 2



Rainbow 3



Rainbow 4



Rainbow 5



Rainbow 6



Rainbow 7



Rainbow 8



Rainbow 9



Rainbow 10



Rainbow 11



Rainbow 12



Rainbow 13



Rainbow 14



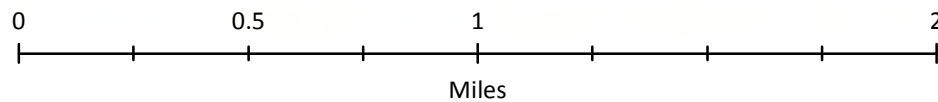
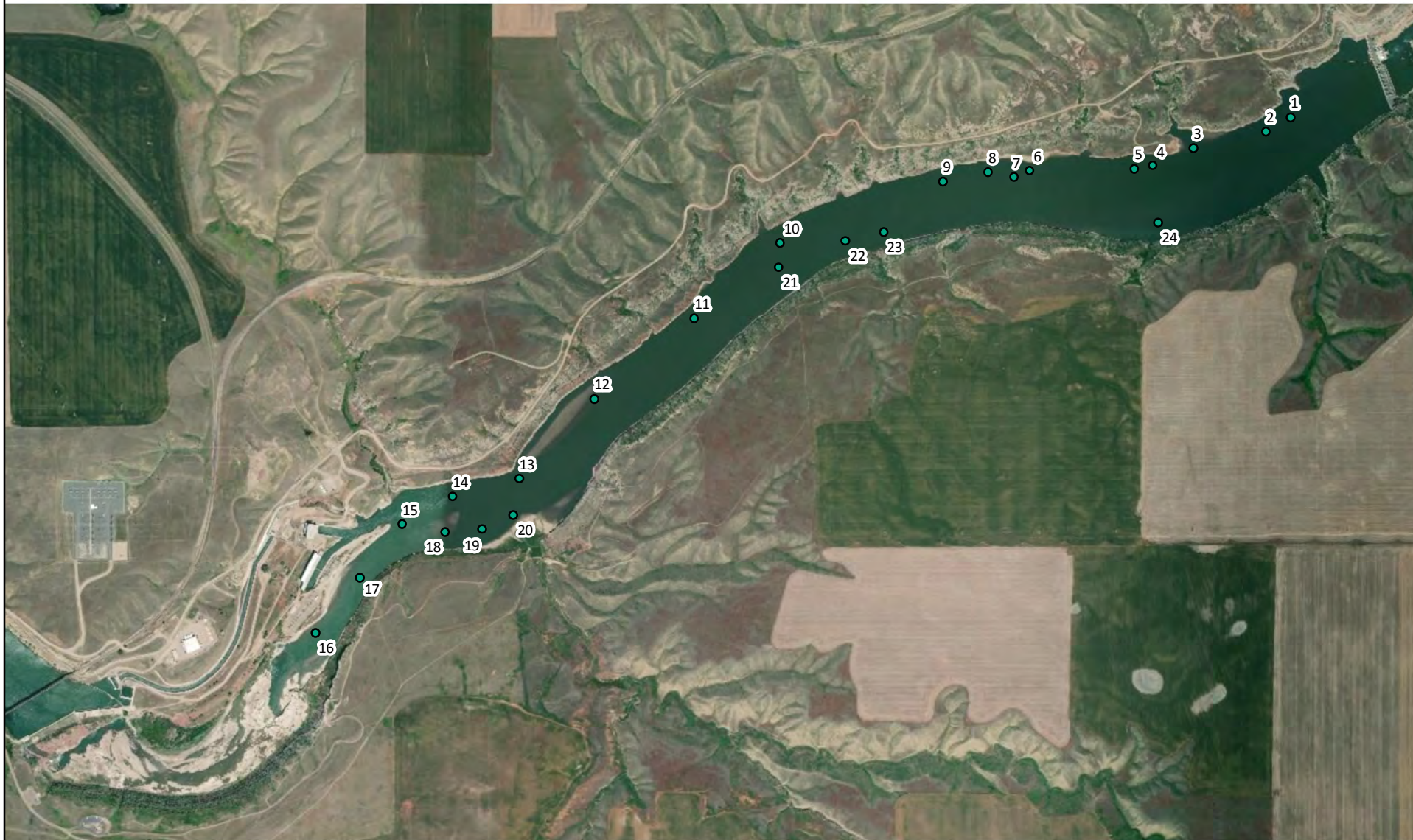
Rainbow 15



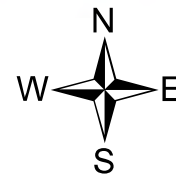
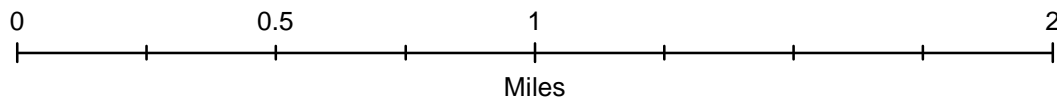
Rainbow 16

Appendix B

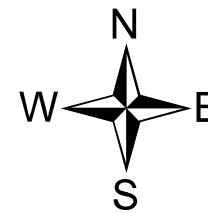
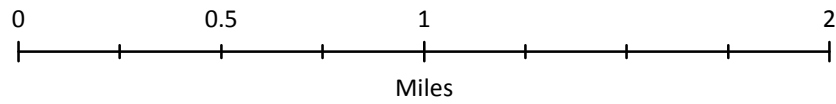
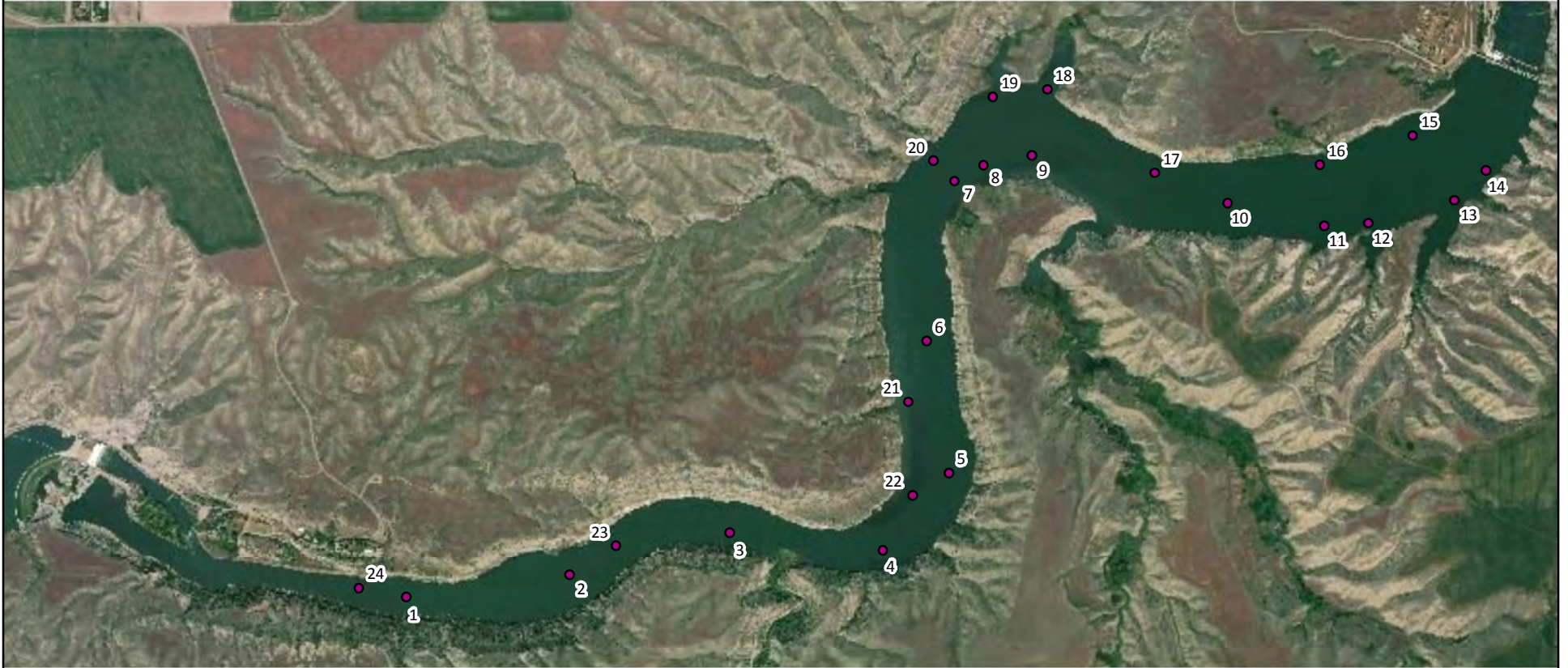
2018 NWE Erosion Monitoring Survey: Cochrane Reservoir



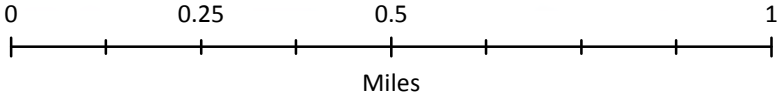
2018 NWE Erosion Monitoring Survey: Black Eagle Reservoir



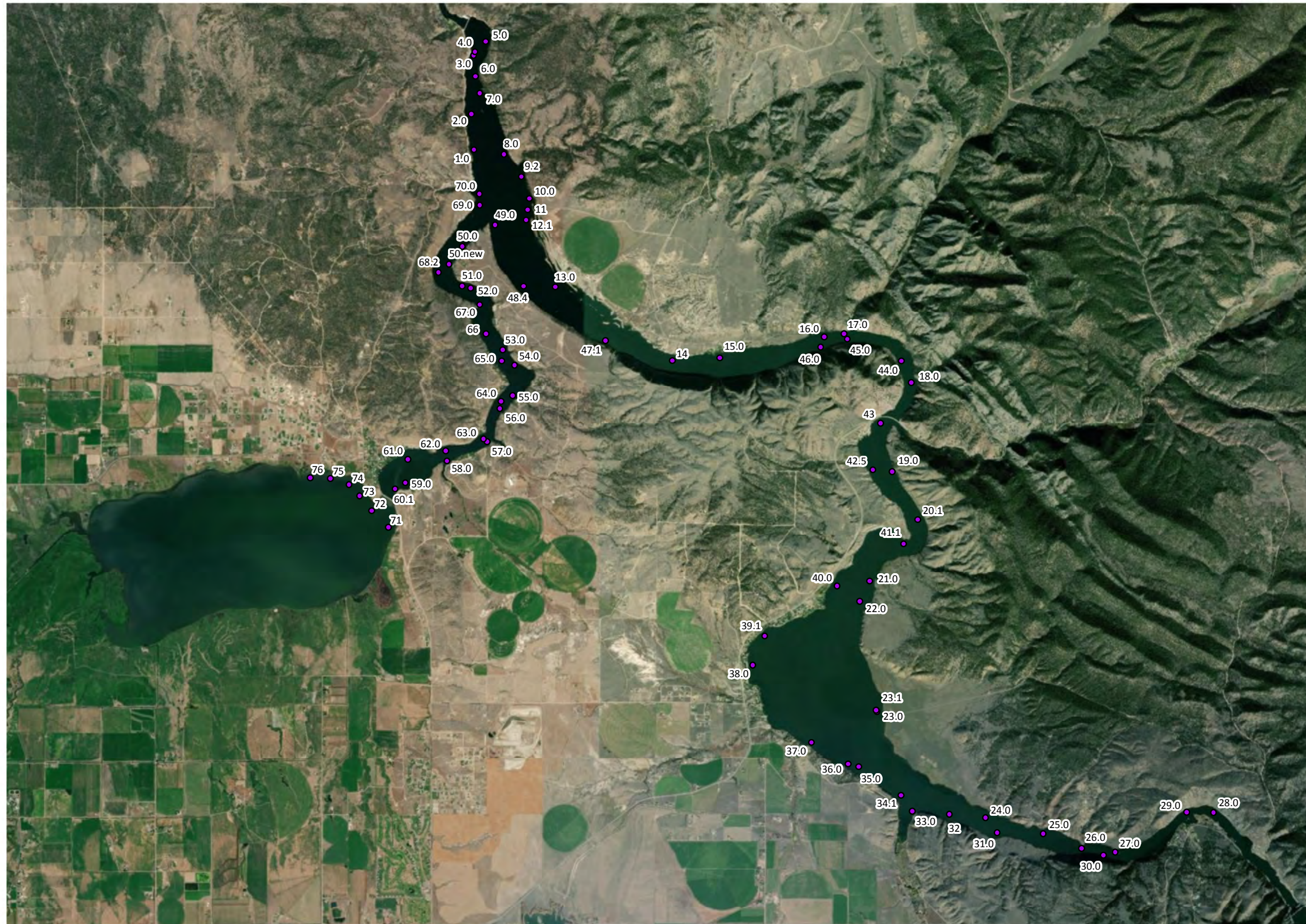
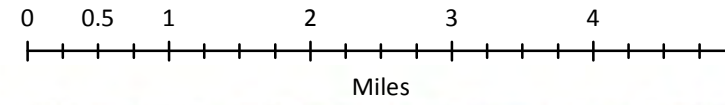
2018 NWE Erosion Monitoring Survey: Morony Reservoir



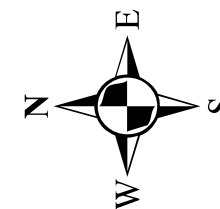
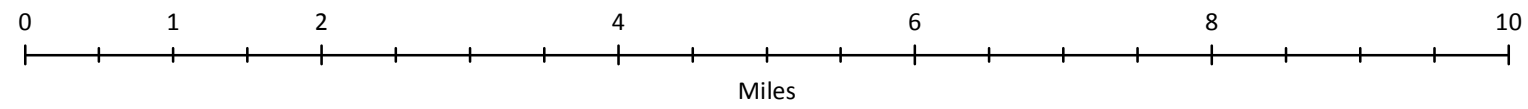
2018 NWE Erosion Monitoring Survey: Ryan Reservoir



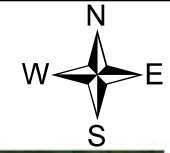
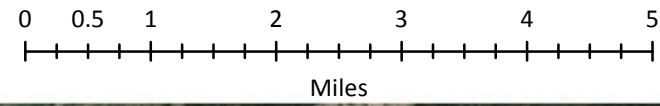
2018 NWE Erosion Monitoring Survey: Hauser Reservoir



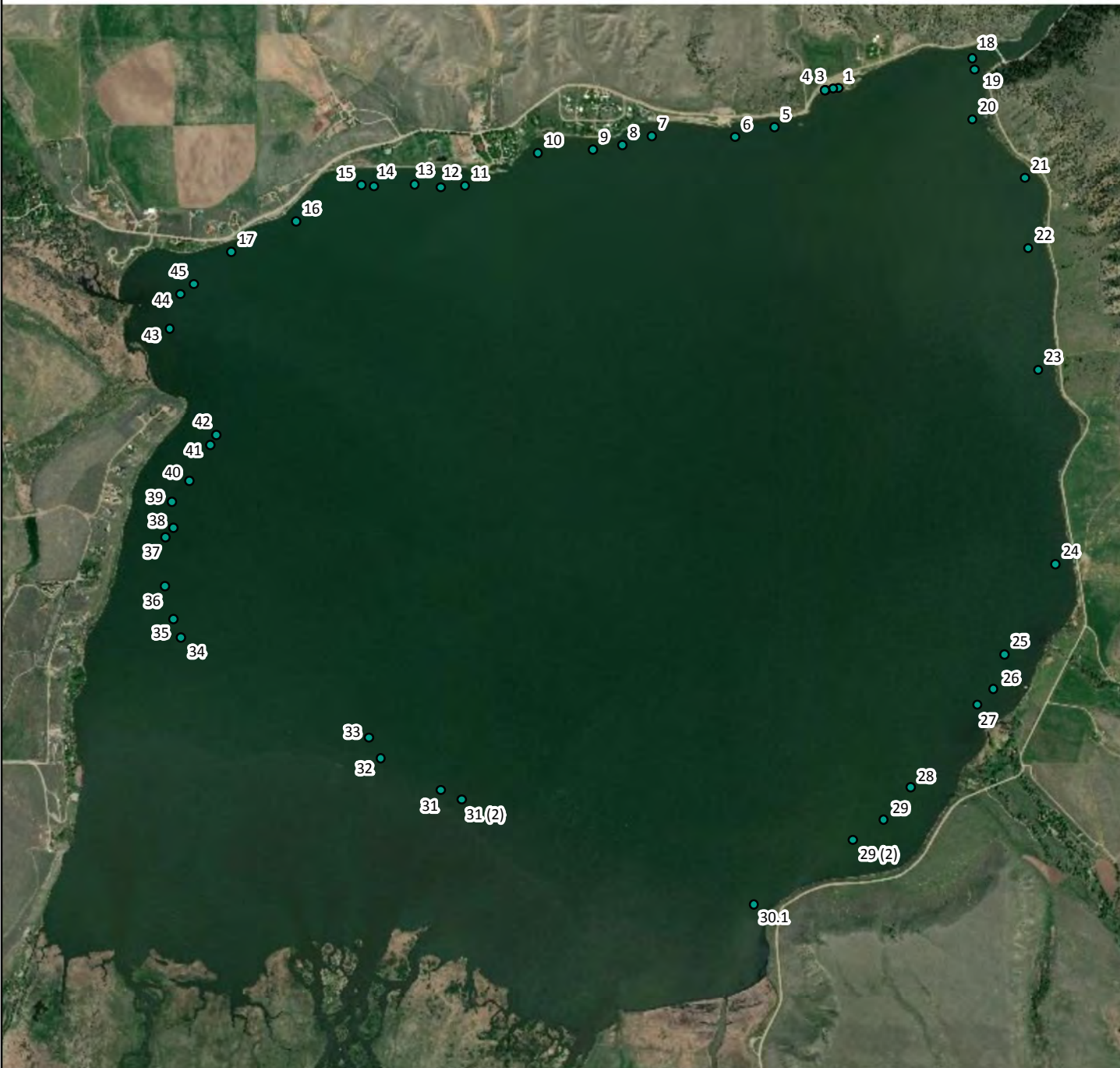
2018 NWE Erosion Monitoring Survey: Holter Reservoir



2018 NWE Erosion Monitoring Survey: Hebgen Reservoir



2018 NWE Erosion Monitoring Survey: Madison Reservoir



2018 NWE Erosion Monitoring Survey: Rainbow Reservoir

