OPERATING PERMIT APPLICATION
MONTANA LIMESTONE RESOURCES

APPENDIX B-2
PRELIMINARY SEDIMENT BASIN DESIGN

June 2018
NORTH RESERVOIR
FOOTPRINT AREA = 0.21 ACRES
WATER STORAGE VOL = 1.4 AC-FT
SEDIMENT STORAGE VOL = 0.6 AC-FT

NORTH SEDIMENT BASIN
MAX HEIGHT @ CENTERLINE = 32'
FOOTPRINT AREA = 0.32 ACRES
FILL VOLUME = 5747 CUBIC YARDS
CONCRETE RISER
TOP ELEVATION = 4022.50'
24"Ø HDPE OUTLET PIPE

RIPRAP LINED STILLING BASIN
(SEE PROFILE SHEET 3)

RIPRAP LINED SPILLWAY CHANNEL
(SEE PROFILE SHEET 3)

PERMIT BOUNDARY

SCALE:

LEGEND

PREPROPOSED EMBANKMENT CONTOURS (PART)
RESERVOIR EXTENT AT NORMAL POOL ELEVATION OF 4022.5':
SEDIMENT EXTENT AT DESIGN VOLUME OF 0.6 AC-FT
CONSTRUCTION OF EMBANKMENT CRESC
EMBANKMENT DISTURBANCE AREA
DRAINAGE AREA OF BOUNDARY

APPROVED BY

REVISIONS

NO

DATE

DRAWN BY

DESCRIPTION

THIS SHEET, ADJUST SCALES ACCORDINGLY

ECOLOGICAL RISER
TOP ELEVATION = 4022.50'
24"Ø HDPE OUTLET PIPE

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RIPRAP LINED STILLING BASIN
(SEE PROFILE SHEET 3)

RIPRAP LINED SPILLWAY CHANNEL
(SEE PROFILE SHEET 3)

PERMIT BOUNDARY
TABLE 1. RIPRAP GRADATION

<table>
<thead>
<tr>
<th>PERCENT PASSING</th>
<th>STONE DIAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>24&quot;</td>
</tr>
<tr>
<td>85</td>
<td>21&quot;</td>
</tr>
<tr>
<td>50</td>
<td>18&quot;</td>
</tr>
<tr>
<td>15</td>
<td>9&quot;</td>
</tr>
</tbody>
</table>

TABLE 2. RIPRAP GRADATION

<table>
<thead>
<tr>
<th>PERCENT PASSING</th>
<th>STONE DIAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>24&quot;</td>
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</tr>
<tr>
<td>50</td>
<td>18&quot;</td>
</tr>
<tr>
<td>15</td>
<td>12&quot;</td>
</tr>
</tbody>
</table>

PROFILE: NORTH SEDIMENT BASIN AUXILIARY SPILLWAY

Scale: 1" = 10' (H&V)

SECTION

RIPRAP LINED STILLING BASIN

MAX. SECTION

Scale: 1" = 4' (H&V)

SECTION

RIPRAP LINED STILLING BASIN

Scale: 1" = 4' (H&V)

SECTION

RIPRAP LINED STILLING BASIN

Scale: 1" = 4' (H&V)

PROFILE: NORTH SEDIMENT BASIN AUXILIARY SPILLWAY

Scale: 1" = 4' (H&V)
Rock Chute Design Data

(Version 4.01 - 04/23/03, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

**Project:** North Embank Stilling Basin  
**Designer:** AWJ  
**County:**  
**Date:** 5/10/2018  
**Checked by:**

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### Input Channel Geometry

<table>
<thead>
<tr>
<th>Inlet Channel</th>
<th>Chute</th>
<th>Outlet Channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bw = 6.0 ft.</td>
<td>Bw = 6.0 ft.</td>
<td>Bw = 6.0 ft.</td>
</tr>
<tr>
<td>Side slopes = 2.0 (m:1)</td>
<td>Factor of safety = 1.00 (F_s)</td>
<td>Side slopes = 2.0 (m:1)</td>
</tr>
<tr>
<td>n-value = 0.030</td>
<td>Side slopes = 2.0 (m:1)</td>
<td>n-value = 0.055</td>
</tr>
<tr>
<td>Bed slope = 0.0100 ft./ft.</td>
<td>Bed slope (2.5:1) = 0.400 ft./ft.</td>
<td>Bed slope = 0.0500 ft./ft.</td>
</tr>
<tr>
<td>Freeboard = 1.0 ft.</td>
<td>Outlet apron depth, d = 2.5 ft.</td>
<td>Base flow = 82.3 cfs</td>
</tr>
</tbody>
</table>

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### Design Storm Data (Table 2, NHCP, NRCS Grade Stabilization Structure No. 410)

<table>
<thead>
<tr>
<th>Drainage area = 221.0 acres</th>
<th>Rainfall = 0.3 in. 3.5 in. 5+ in.</th>
<th>Note: The total required capacity is routed through the chute (principal spillway) or in combination with an auxiliary spillway.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apron elev. --- Inlet = 4023.0 ft. --- Outlet = 3978.0 ft. --- (H_high = 42.5 ft.)</td>
<td>Chute capacity = Q25-year</td>
<td>Minimum capacity (based on a 5-year, 24-hour storm with a 0 - 3 inch rainfall)</td>
</tr>
<tr>
<td>Total capacity = Q100-year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q_high = 88.0 cfs</td>
<td>High flow storm through chute</td>
<td>Tw (ft.) = Program</td>
</tr>
<tr>
<td>Q_low = 0.0 cfs</td>
<td>Low flow storm through chute</td>
<td>Tw (ft.) = Program</td>
</tr>
</tbody>
</table>

---

### Profile and Cross Section (Output)

**Notes:**
1) Output given as **High Flow (Low Flow)** values.
2) Tailwater depth plus d must be at or above the hydraulic jump height for the chute to function.
3) Critical depth occurs 2yc - 4yc upstream of crest.
4) Use min. 8 oz. non-woven geotextile under rock.

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### Profile Along Centerline of Chute

- **q_t:** 11.16 cfs/ft.  
  Equivalent unit discharge
- **F_s:** 1.00  
  Factor of safety (multiplier)
- **z_t:** 0.83 ft.  
  Normal depth in chute
- **n-value:** 0.061  
  Manning's roughness coefficient
- **D_50(F_s):** 15 in. (246 lbs. - 50% round / 50% angular)
- **z_2:** 2.61 ft.  
  Hydraulic jump height

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**Typical Cross Section**  
**High Flow Storm Information**

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*Use H_p along chute but not less than z_2.*
TABLE 1. RIPRAP GRADATION

<table>
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<tr>
<th>Percent Passing</th>
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<tbody>
<tr>
<td>100</td>
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</table>

PROFILE VIEW: SOUTH SEDIMENT BASIN AUXILIARY SPILLWAY

SCALE: 1" = 10' (H&V)

EXISTING GROUND CREST

RIPRAP LINED SPILLWAY CHANNEL
FINISH GRADE @ CENTERLINE

RIPRAP LINED STILLING BASIN
FINISH GRADE @ CENTERLINE

SCALE: 1" = 4' (H&V)

SECTIONS

SEE TABLE 1, THIS SHEET FOR RIPRAP GRADATION

SEE TABLE 2, THIS SHEET FOR RIPRAP GRADATION

12 OZ./YD NON-WOVEN GEOTEXTILE

PROJECT NO.

REVISIONS

DATE

AWJ

RCA

5/11/18

5/11/18

SOUTH SEDIMENT BASIN

AUXILIARY SPILLWAY PROFILE AND SECTIONS

Hydrometrics, Inc.

Helena, Montana 59601

3020 Bozeman Avenue

(406) 443-4150

APPENDIX B2

MONTANA LIMESTONE RESOURCES

1302701H104B

AUTOCAD 2004 DRAWING (DWG)
Rock Chute Design Data

(Version 4.01 - 04/23/03, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: South Embankment Spillway
Designer: AWJ
Date: 5/11/2018

Input Channel Geometry

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<tr>
<td>Side slopes = 2.0 (m:1)</td>
<td>Factor of safety = 1.00 (F_s)</td>
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</tr>
<tr>
<td>Bed slope = 0.0100 ft./ft.</td>
<td>Bed slope (7.1:1) = 0.140 ft./ft.</td>
<td>Bed slope = 0.0300 ft./ft.</td>
</tr>
<tr>
<td>Freeboard = 1.0 ft.</td>
<td>Outlet apron depth, d = 2.0 ft.</td>
<td>Base flow = 55.0 cfs</td>
</tr>
</tbody>
</table>

Design Storm Data (Table 2, NHCP, NRCS Grade Stabilization Structure No. 410)

| Drainage area | 356.0 acres |
| Rainfall | 0 - 3 in., 3 - 5 in., 5+ in. |
| Chute capacity | Q25-year |
| Total capacity | Q100-year |
| Q_high | 118.0 cfs |
| Q_low | 0.0 cfs |

Note: The total required capacity is routed through the chute (principal spillway) or in combination with an auxiliary spillway.

Profile and Cross Section (Output)

Profile Along Centerline of Chute

| Auxiliary Spillway |
| Freeboard = 1 ft. |
| 1 |
| H_p* |
| m = 2 |
| 6 ft. |
| Rock Chute Bedding |
| 8 oz. Min. Geotextile |
| 15(D_50)(F_s) |
| D_50(F_s) = 12.4 in. (139 lbs. - 50% round / 50% angular) |

High Flow Storm Information

| q_t | 14.29 cfs/ft. |
| F_s | 1.00 |
| z_1 | 1.18 ft. |
| n-value | 0.051 |
| D_50(F_s) | 24.8 in. |
| Tw + d | 3.44 ft. |
| z_2 | 2.71 ft. |

Notes:
1) Output given as High Flow (Low Flow) values.
2) Tailwater depth plus d must be at or above the hydraulic jump height for the chute to function.
3) Critical depth occurs 2y_c - 4y_c upstream of crest.
4) Use min. 8 oz. non-woven geotextile under rock.