Reclamation Plan for Erosional Gully
El Cajete Mine
Permit No. SA001RE

July 2021

THE ESPANOLA MERCANTILE COMPANY

Established in 1905

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Introduction

This plan describes proposed reclamation activities to address an erosional feature located at the reclaimed El Cajete Mine (Permit No SA001RE). The mine is located north of New Mexico State Road 4, approximately 12.5 miles west of Los Alamos, and 8.5 miles east of Jemez Springs. The average annual precipitation at the nearby Valles Caldera National Preserve is 23.8 inches per year. Most surface water run-off events occur during summer rainstorms and spring snowmelt.

The erosional feature is located within a ravine (Drainage 1) that is not part of previously mined areas but is adjacent to reclaimed land. Surface water generated on an approximate 3-acre portion of the reclaimed mine is discharged through a metal culvert into the ravine and has created a relatively large head cut in the soil just below the culvert. The remainder of the drainage is situated at the bottom of the ravine which acts to keep surface flows concentrated and has resulted in the formation of several additional head cuts. The drainage is densely vegetated with trees and shrubs which have likely slowed erosion but has not been sufficient to completely arrest continued down cutting. The affected portion of the drainage is 400 ft in length, 5 – 10 ft in width, 2 – 6 ft in depth and flows east to west at an approximate 14% grade. Soil conditions within the eastern portion of the drainage consist of a sandy loam, and the western portion consists of unconsolidated pumice that has been deposited from upstream erosion.

A second drainage (Drainage 2) located on the reclaimed surface received surface flows from Drainage 1 as well a larger watershed (approximately 10 acres) that consists mostly of unmined forested land and reclaimed mine land further west. The forested area was burned in the 2017 Cajete Fire. Drainage 2 is 400 ft in length, 5 – 15 ft in width, and 2 – 8 ft in depth and flows east to west at an approximate 10% grade. Soil conditions consist of 12-24 inches of a sandy loam overlying unconsolidated backfilled pumice. Surface flows that occurred after the Cajete fire and subsequent timber salvaging operations resulted in the formation of a series of relatively deep head cuts that have exposed the underlying unconsolidated pumice. It is likely that the fire in combination with a lack of stormwater controls and soil stabilization measures associated with the timber harvesting operation resulted in increased surface water flows volumes and velocities and the subsequent erosion.

Project Location

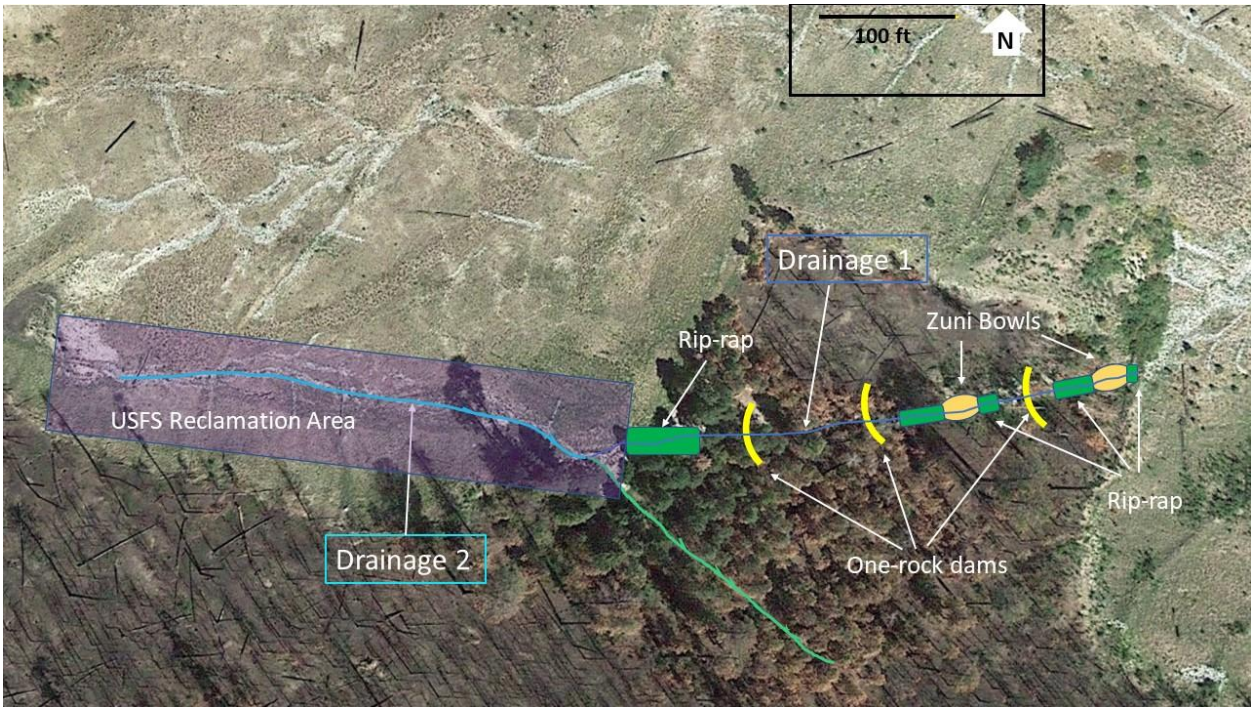
Reclamation

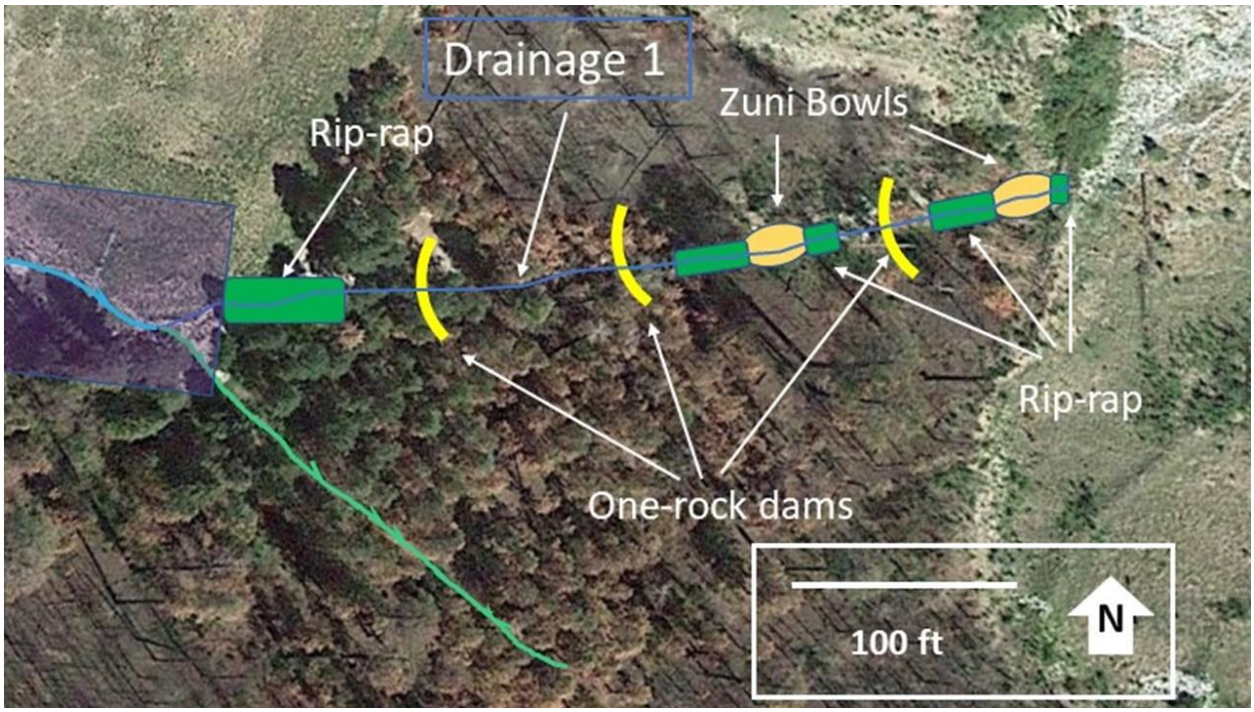
The primary cause of the erosion in Drainage 1 is that surface water flows from the reclaimed mine area are concentrated in a small rip-rap lined pond and discharge through a metal culvert into the ravine as high velocity channel flow. The unconsolidated nature of the materials underlying the drainage downstream of the culvert in combination with the concentrated flows has resulted in downcutting. Due to the shape of the ravine, it would be unfeasible to disperse surface water into sheet flows without significant regrading of the local topography. Therefore, the goal of the reclamation is to reduce surface water flow velocity, increase infiltration and stabilize the drainage bed and banks to allow perennial vegetation to become established and minimize future down-cutting. Proposed reclamation activities consists of:

- Remove the metal culvert and replace it with a rock spillway. The spill way construction materials will consist of 4 – 12-inch rip rap combined with 18+ inch boulders keyed into the pond berm to prevent undercutting.
- Construct several Zuni Bowls along the length of the gully to stabilize the current bed elevation and prevent additional head cutting. The Zuni Bowl construction materials will consist of 4 – 12-inch rip rap and 18-inch diameter boulders (See Attachment 1 for construction details).
- Construct one rock dams between and downgradient of the Zuni-bowls (See Attachment 1 for construction details).
- Add a rip-rap rock mulch below the Zuni bowls to stabilize the plunge pools, decrease water velocity, encourage sediment deposition, and provide a stable surface to allow perennial vegetation to become established.
- Add a rip-rap rock apron at the area where Drainage 1 coalesces with drainage 2.
- The areas adjacent to the gully have good established vegetative cover. Disturbance to these side slopes will be minimized to the extent possible. The bed and banks of the gully as well as other areas disturbed by reclamation activity will be hand seeded with a mix of native perennial grasses (See seed list).

Reclamation within Drainage 2 will be carried out the United States Forest Service (USFS) or their contractor. The Espanola Mercantile Company will attempt to coordinate reclamation activities with the USFS to minimize disturbance and improve the effectiveness of the combined projects.

Reclamation Drawing





Photos

Photo 1: Drainage 1 below culvert

Photo 2: Drainage 1 above confluence w/ Drainage 2

Seed list

Four perennial native grass species are included in the proposed seed mix. The selected grasses are currently well established within the mine site. Seed will be in compliance with State and Federal noxious weed laws with proper labeling and documentation. Upon request, a seed certification can be provided that identifies individual species, lots, varieties, origin, and pure live seed information.

COMMON NAME	SCIENTIFIC NAME	PLS/LBS/ACRE
Western Wheatgrass	*Pascopyrum smithii*	3.0
Nodding Brome	*Brumus anomalus*	4.0
Arizona fescue	*Festuca arizonica*	0.5
Sheep fescue	*Fescuta Ovina*	0.5

Equipment

The majority of the work to construct the Zuni Bowls and place rip-rap will be completed with hand tools and by hand placement. Rip-rap and small boulders will be transported from a material stockpile area north of NM4 to the worksite with a small, tracked skid steer. Operators will avoid sharp turns and will fan out the delivery route to avoid creating excessive disturbance and to mitigate establishing a road. A compact excavator with a thumb attachment for may be used to place small boulders in the Zuni Bowls.

<u>Equipment List</u>

- John Deere 35G Compact Excavator

- John Deere 331 Skid Steer

Timing

Reclamation activity will take 5 – 10 working days to complete. Weather permitting, work is proposed to begin the week of September 13, 2021.

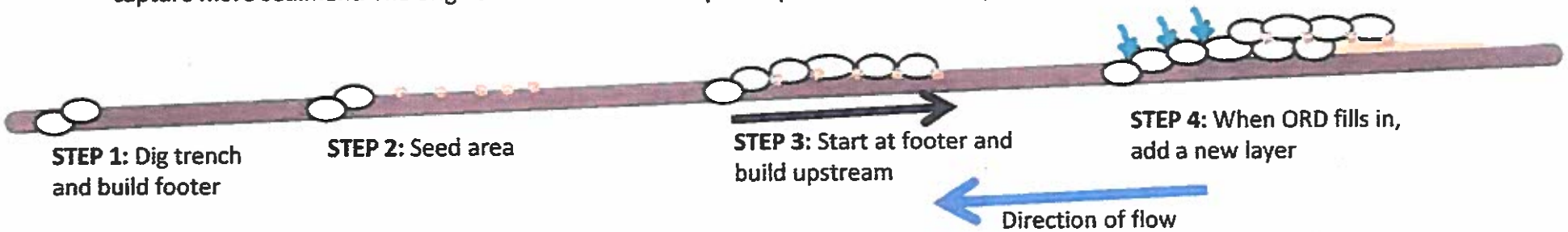
Attachment 1

ONE ROCK DAM "ORD"

*A low grade control structure built with a single layer of rock on the bed of the channel. ORDs stabilize the bed of the channel by slowing the flow of water, increasing roughness, recruiting vegetation, capturing sediment, and **gradually** raising the bed level over time. ORDs are also passive water harvesting structures. The single layer of rock is an effective rock mulch that increases soil moisture, infiltration, and plant growth.*

Design & Construction

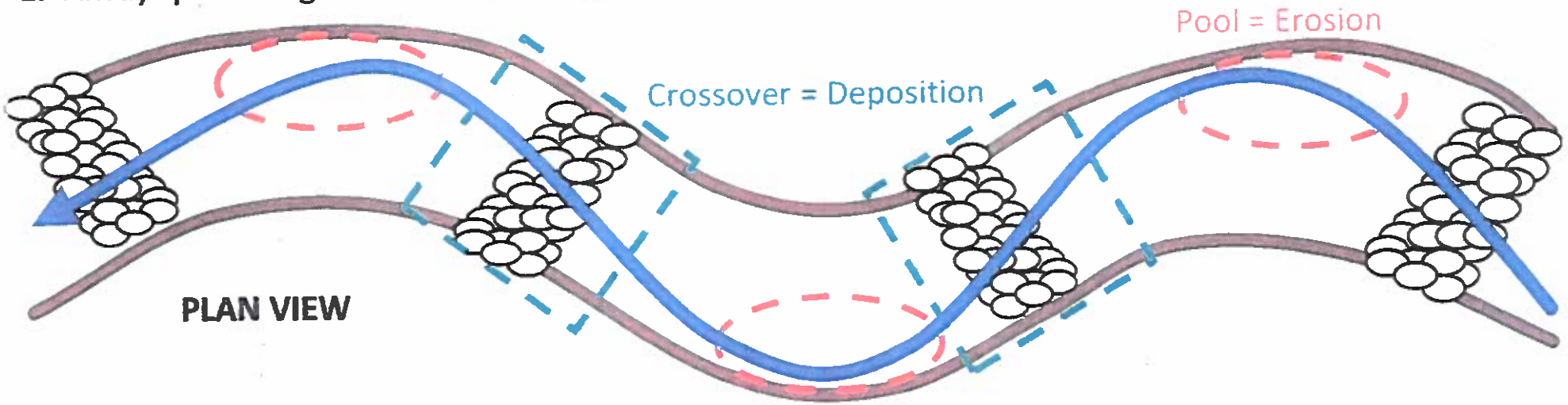
1. Select area to build the ORD; dig a shallow footer trench and fill with one or two rows of rock, so that no rock protrudes more than two inches above the bed of the channel. This will serve as the ***splash apron*** for the ORD.
2. Scatter native grass and wildflower seeds in the area where the ORD is to be built.
3. Start building at the footer and continue upstream, laying down one layer of rock horizontally, as if you were building a rock wall.
4. Once the ORD is completely filled with sediment, another layer can be added to further raise the bed of the channel and capture more sediment. The original ORD becomes the splash apron for the new layer.



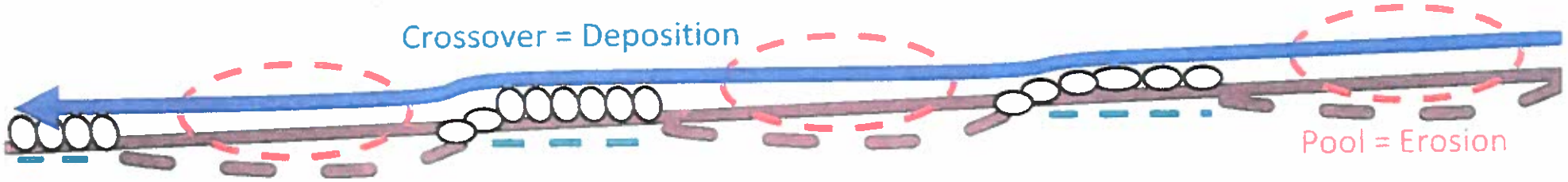
Orientation of Rocks: Placing rocks vertically is called book-stacking, this makes a very strong structure, especially when using small rocks. It is also a good way to make a slightly higher structure.

ONE ROCK DAM

1. Always position grade control structures at meander crossovers.



2. Placement at crossovers maintains natural erosion and deposition patterns.



3. Always maintain channel cross section to protect banks.

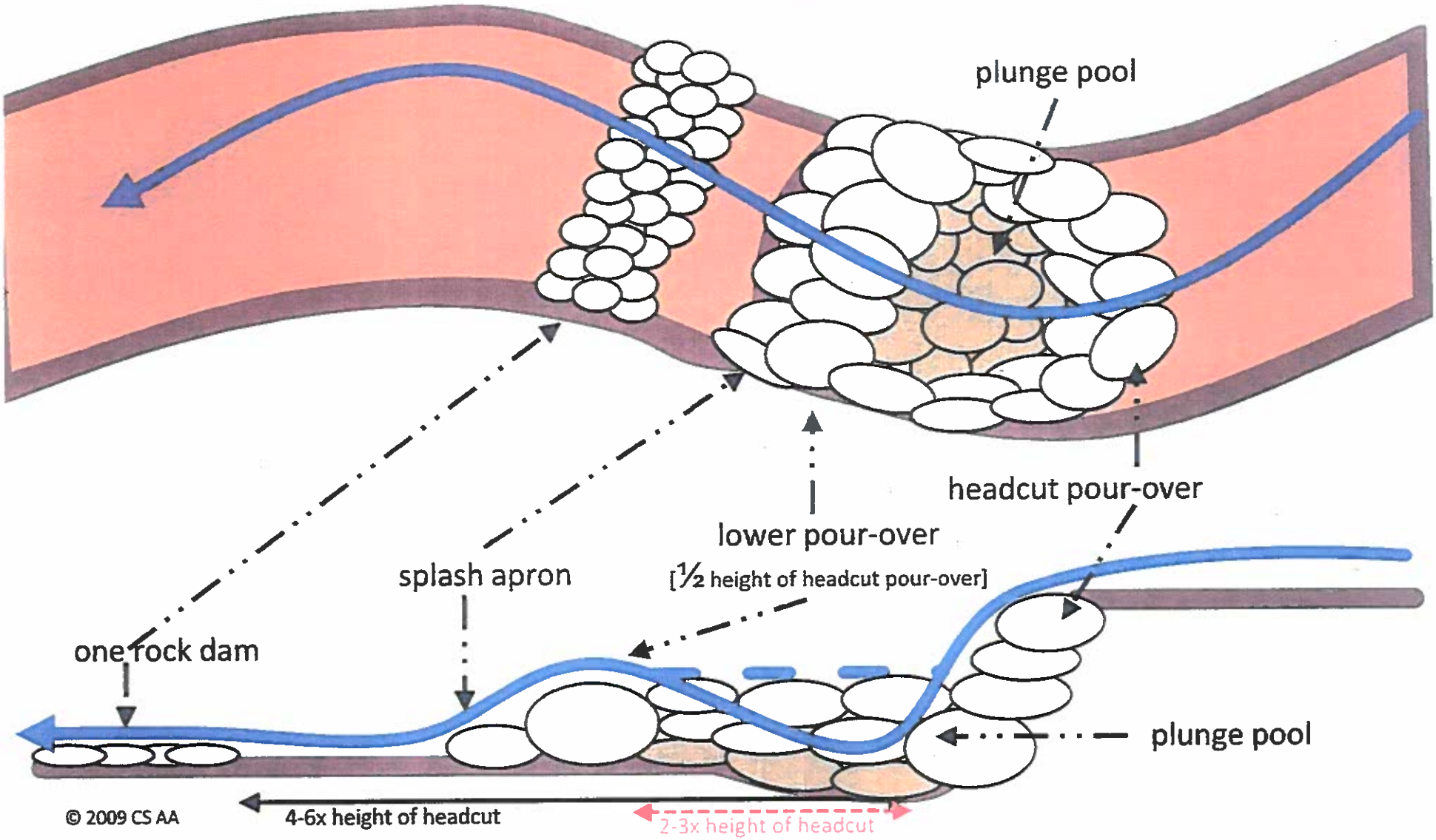
ZUNI BOWL

A headcut control structure composed of rock lined step falls and plunge pools that prevents headcuts from continuing to migrate upstream. Zuni Bowls stabilize actively eroding headcuts by dissipating the energy of falling water at the headcut pour-over and the bed of the channel. The structure converts the single cascade of an eroding headcut into a series of smaller step falls. Zuni Bowls also serve to maintain soil moisture on the face of the headcut, encouraging the establishment of protective vegetation.

Design & Construction

1. Select a headcut for treatment; shape and layback the face of the headcut to create a uniform surface on which to build.
2. Determine the height of the headcut. Next measure and mark the location downstream from the face of the headcut that is three times the height of the headcut. At this location dig a shallow trench and fill with one or two rows of rock, so that no rock protrudes more than two inches above the bed of the channel. This will serve as the ***splash apron*** for the Zuni Bowl.
3. Scatter native grass and wildflower seeds in the area where the Zuni Bowl is to be built.
4. Gather the largest rocks available, and place them in a row just upstream from, and in contact with, the splash apron. These rocks should sit at an elevation approximately ½ the total height of the headcut. This will serve as the ***lower pour-over*** of the Zuni Bowl.
5. Armor the bottom of the ***plunge pool*** with a single layer of rocks. Place these rocks at a uniform height to create a stable foundation for the rest of the Zuni Bowl.
6. Starting just upstream from the lower pour-over, lay courses of rock around the face of the headcut. This will form the walls of the bowl. Maintain contact with the shaped surface. The structure will have more integrity if built with layers of off-set rocks that form a sloping wall around the headcut, as opposed to merely lining the face with rocks. Improve the durability of the structure by avoiding gaps in the rock work. As an extra precaution, you can use biodegradable geotextile fabric to line the face of the headcut prior to laying rocks.
7. Continue to lay courses of rock around the face of the headcut until you reach the height of the ***headcut pour-over***. No rocks should protrude above this level.
8. Construct a ***ORD*** downstream from the Zuni Bowl. Place the upstream edge of the ORD approximately four to six times the height of the headcut away from the headcut pour-over.

ZUNI BOWL


plunge pool
headcut pour-over
lower pour-over
[½ height of headcut pour-over]
splash apron
one rock dam
plunge pool
© 2009 CS AA
4-6x height of headcut
2-3x height of headcut