Memorandum

To: Leeland Murray
New Mexico Abandoned Mine Land Program

Date: August 2, 2024

From: Jean-Luc Cartron, Julie Kutz, and Ken Brinster

Subject: Revegetation Plan, Madrid Stormwater Damage Reduction Project

Daniel B. Stephens & Associates, Inc. (DBS&A) has prepared this memorandum detailing the efforts to determine plant species best suited for revegetation of the Madrid Arroyo project, as well as spatially explicit reseeding prescriptions and recommended quantities of seeds/individual plants and overall method of planting.

Background

The New Mexico Energy, Minerals, and Natural Resources Department (EMNRD) Abandoned Mine Land (AML) Program, in partnership with the U.S. Department of Interior (DOI) Office of Surface Mining Reclamation and Enforcement (OSMRE), is proposing to establish stormwater conveyances, erosion control measures, and fire prevention improvements within the Town of Madrid, New Mexico, located in Santa Fe County, approximately 22 miles southwest of Santa Fe (Figure 1).

The Project Area is a combination of private, state, and county-owned lands totaling approximately 117 acres. This work is based on the Madrid Mining Landscape community outreach effort in 2010-2011 and preliminary design concepts developed in 2013. The Madrid Stormwater & Erosion Safety Project, a partnership with Santa Fe County, the Madrid Landowners Association, Madrid Water, and the New Mexico Department of Transportation (NMDOT), is the latest effort to address ongoing mining related issues. Plans have been developed for 100 percent completion (Riverbend, 2024) (Figure 1).

Following reconstruction of the arroyo, the Project Area will be strategically replanted with vegetation that is native and appropriately suited to Madrid's climate and soil types. Community members and Santa Fe County provided a list of potential plant species to be included in the revegetation. In addition, the AML Program agreed to the installation of a drip irrigation system that would operate for a duration of up to two years to enhance plant

germination and establishment. This supplemental water would be targeted to vegetation that can benefit from additional water, but then be self-sufficient after the period of irrigation is over.

DBS&A has been assisting the AML Program with the task of determining the most appropriate native plant species to revegetate the Project Area following project construction. DBS&A has reviewed environmental documentation for the project, including the biological assessment/ biological evaluation (BA/BE) (Grouse Mountain, 2019) and the environmental assessment (EA) (Grouse Mountain, 2023), public comments provided for the EA, construction drawings, and the list of desired plant species provided by the public and Santa Fe County.

On April 17, 2024, DBS&A personnel met with the Project Engineer for the AML Program and walked the Project Area to discuss the proposed project and determine current vegetation types. DBS&A also collected soil samples to determine the initial soil properties, moisture characteristics, and particle size analysis.

Plants for Project Area

Based on background research, discussions with the AML Program, and site observations, DBS&A first compiled an annotated list of recommended plant species for the revegetation phase of the project (Attachment 1). The list includes the community and Santa Fe County plant species, as well as additional recommended plant species. The annotated list includes information on planting requirements and which species would benefit from supplemental water.

Revegetation using the plant species in the list is described as most to least feasible. Plant list feasibility was determined by climate, ecoregion, and geology/soils. Non-native plants such as Siberian elm were not included in the list due to their status as a listed noxious plant and/or potential to spread into ecologically sensitive habitat.

Climate

Boundaries of soils of major land resource areas (MLRAs) reflect common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses. Climate in New Mexico is dependent on elevation more than latitude. The mean air temperature at Madrid is 50 to 52°F and the mean annual precipitation is 10 to 13 inches. The length of the frost-free period is 150 to 170 days (NRCS, 2024). These ranges of temperature and precipitation are verified by data from a weather station located at Stanley, New Mexico, in

southern Santa Fe County south of Cave Road at Madrid (WRCC, 2024). The station is only about 300 feet higher in elevation than the arroyo by Cave Road (Google Earth Pro, 2013).

Ecoregion

The Project Area is located within the Southern Rocky Mountain Two-needle Pinyon - Juniper Woodland ecoregion (NatureServe, 2024; USGS, 2024, Griffith et al., 2006; Dick-Peddie, 1993). This region is characterized by an open to closed evergreen, conifer tree canopy composed of diagnostic species one-seed juniper (*Juniperus monosperma*) and/or pinyon (*Pinus edulis*), with an understory dominated by shrubs or grasses and lacking Madrean understory species. It occurs in dry mountains and foothills in southern Colorado south into northern and central New Mexico, and extends west across the Colorado Plateau and east to the plains on breaks in the southwestern Great Plains.

Geology/Soils

Madrid, New Mexico is situated on the Cerrillos coal field in the Galisteo Basin south of Santa Fe, New Mexico. The Project Area is an arroyo formed by an ephemeral stream that bisects Madrid. This short discussion of the geology around Madrid is for the purpose of illustrating the origin of the parent material of the soils in the Project Area. A thick Tertiary-age unit called the Galisteo Formation consists of sandstones, shales, mudstones, and claystones, and has an erosional surface covered by more recent alluvial gravels from the Ortiz Mountains. An erosional surface is a break in the depositional sequence, and is called an unconformity. The Galisteo unconformably overlies a Cretaceous coal-bearing formation outcrop called the Mesa Verde Formation. The Mesa Verde unconformably overlies the Mancos Shale. After Cretaceous time, molten material intruded the Mesa Verde beds forming horizontal sills and vertical dikes (Disbrow and Stoll, 1957). These intrusives outcrop east of Madrid, and are composed of monzonite consisting mostly of sodic and calcic feldspars with some quartz. Precipitation events carry sediment consisting of pieces of these formations and smaller particles down to the arroyo forming the soils that are in the arroyo. The Devargas soil parent material is alluvium derived from the monzonite sill and sandstone. Riverwash soil is also derived from the alluvium. Riovista parent material is alluvium derived from the monzonite sill. The Oelop and Charlito parent material is alluvium derived from sandstones and shales (NRCS, 2024) (Figure 2).

During the site visit on April 17, 2024, DBS&A collected soil samples at five sites in the area: two sites located at the upstream end of the Project Area (in the arroyo and in the floodplain) and three sites located near the downstream end of the Project Area (in the arroyo, in the floodplain, and in the upper plain) (Figure 2). There was a 10.1 percent range of soil porosity for the

collected samples. The highest percentages were for the downstream samples from the floodplain and upper plain. The arroyo samples were consistent in having low initial moisture content and low moisture retention. While it was less prevalent in the upstream area, gob, or coal waste, was evident in the arroyo and surrounding areas. Based on the water content and water holding capacity of the soil samples, the soils contain sufficient "available" water to support native vegetation (Attachment 2).

Overview of Recommended Plants

The plant species listed in Attachment 1 were chosen and recommended for revegetation of the Madrid Arroyo project based on the on-site determination of current vegetation types and available literature (Lady Bird Johnson Wildflower Center, 2024; USDA NRCS, 2024; USDA, 2024; NatureServe, 2024; USGS, 2024; Plants of the Southwest, 2022; NMOSE, 2019; NMSU, 2024; Allred, 2005; DeWitt-Ivey, 2006).

The majority of the Project Area is within sunny, very dry, gravelly soil where little moisture is retained for plant uptake. These upland areas will not receive supplemental water and plants must therefore be suited to a harsh, arid environment. The dominant species of the Project Area is currently four-wing saltbush (*Atriplex canescens*), a shrub that is well-adapted to the upland area. In addition, chamisa (*Ericameria nauseosa*) is a colorful shrub currently in abundance in the Project Area near the arroyo. DBS&A therefore recommends these two shrub species for reseeding the upland areas of the Project Area. In addition, the upland areas should be reseeded with drought-adapted and poor-soil-adapted wildflowers to provide color and pollinator food for insects. Included in the wildflower mix would be scarlet globemallow (*Sphaeralcea coccinea*), evening primrose (*Oenothera pallida*), and scarlet penstemon (*Penstemon barbatus* ssp. *Torreyi*). The drier upland areas are also best suited for grasses. Grasses would include blue grama (*Bouteloua gracilis*), sideoats grama (*Bouteloua curtipendula*), and alkali sacaton grass (*Sporobolus airoides*). The reseeding of these areas will be dependent on timing for good germination and plant establishment. Most of the upland species should be planted late spring/early summer as monsoonal moisture moves into the state.

Other shrubs such as Apache plume (*Fallugia paradoxa*) and common hoptree (*Ptelea trifoliata*) are recommended for planting in areas of higher soil moisture content, such as areas where deflectors are constructed around the arroyo. While these areas are not designed to hold water, they are designed to slow any storm runoff; therefore, it is anticipated that the soil moisture would be elevated and would aid in assisting plant establishment.

There are mahonia/desert holly (*Mahonia haematocarpa*) currently present within the Project Area. These old-growth shrubs are highly valued by the community; therefore, to the extent possible, the shrubs, including one very large mahonia located along the channel in the approximate middle of the project area (Attachment 3), will not be disturbed by construction. Additionally, the seed mix recommended will include mahonia seed to be dispersed along the realigned channel to ensure that this valuable species continues to thrive in the Project Area.

There are few native trees in the Project Area; however, it was determined that one species, two-needle pinyon (*Pinus edulis*), may be suitable for planting primarily at the downstream end of the Project Area, where soil moisture would be higher and live tree plantings would be somewhat shaded. That specific location, along with supplemental water, may ensure the tree establishment. The trees would provide some shade, variety, and wildlife habitat.

The full annotated plant species list including all grasses, wildflowers, and shrubs recommended for the Project Area is included in Attachment 1. Species are listed by feasibility for successful revegetation, and include the list provided by Santa Fe County and community members, as well as additional recommended species determined by DBS&A during preparation of the list. The Contractor shall provide submittals for all materials to be used to the AML Program a minimum of 10 working days before revegetation work commences. Submittals shall conform to the specifications and the revegetation plan. After submittals have been approved, the Contractor may substitute products with prior approval through the same process.

The Contractor shall obtain seed mixes from the closest possible source (e.g., Curtis and Curtis in Clovis, New Mexico or a seed supplier in Colorado). The AML Program-approved seed shall be of the latest season's crop delivered in original sealed packages, bearing the producer's guaranteed analysis for percentages of mixtures, purity, germination, weedseed content, and inert material.

Quantities

Quantities of seeds to be planted were estimated from NMDOT seed lists (Zones 2 and 4) (NMDOT, 2019) or from USDA plant guides. Quantities were then adjusted to anticipated site conditions and other recommendations provided by Plants of the Southwest (2022), with additional input from the AML Program and Riverbend Engineering, LLC. See Table 1 of Attachment 4 for quantities.

Revegetation Methods

Attachment 1 specifies the plant species and timing of seeding and planting. The figures (with index provided in Plate 1) show specific seeding/planting locations and refer to the corresponding location shown for each species in Attachment 1.

Soil preparation, seeding, mulching, crimping, and the application of tackifier will be conducted according to the project specifications (Attachment 4). The specifications closely reference the NMDOT Standard Specifications for Highway and Bridge Construction (2019 Edition), Section 632.

Post-Construction Monitoring

Monitoring of the revegetation following the completion of the project will be implemented to assess whether the project area is proceeding toward stated goals and to observe whether management changes are necessary. A monitoring plan will be developed that includes the purpose, scope, parameters for monitoring, frequency, sampling locations, timeline and monitoring procedures for data collection and reporting. It is anticipated that monitoring will be conducted for two years.

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Plate and Figures

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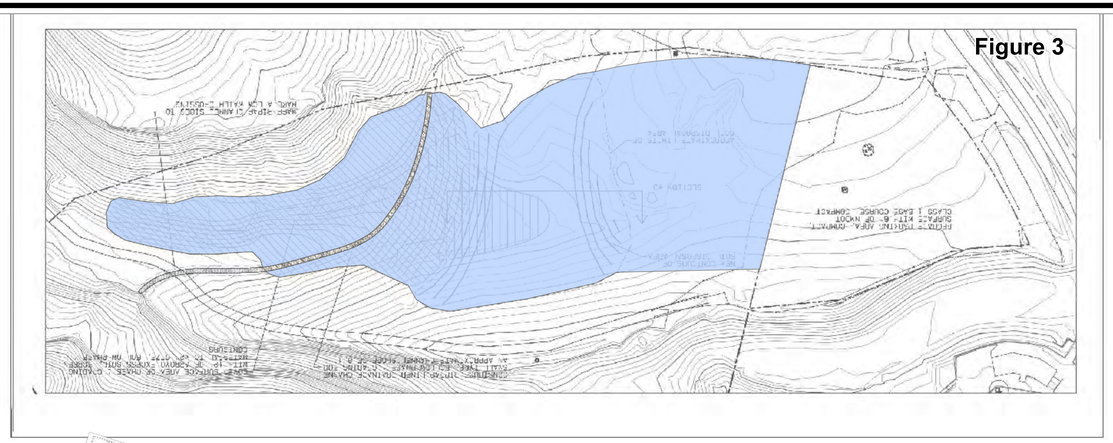

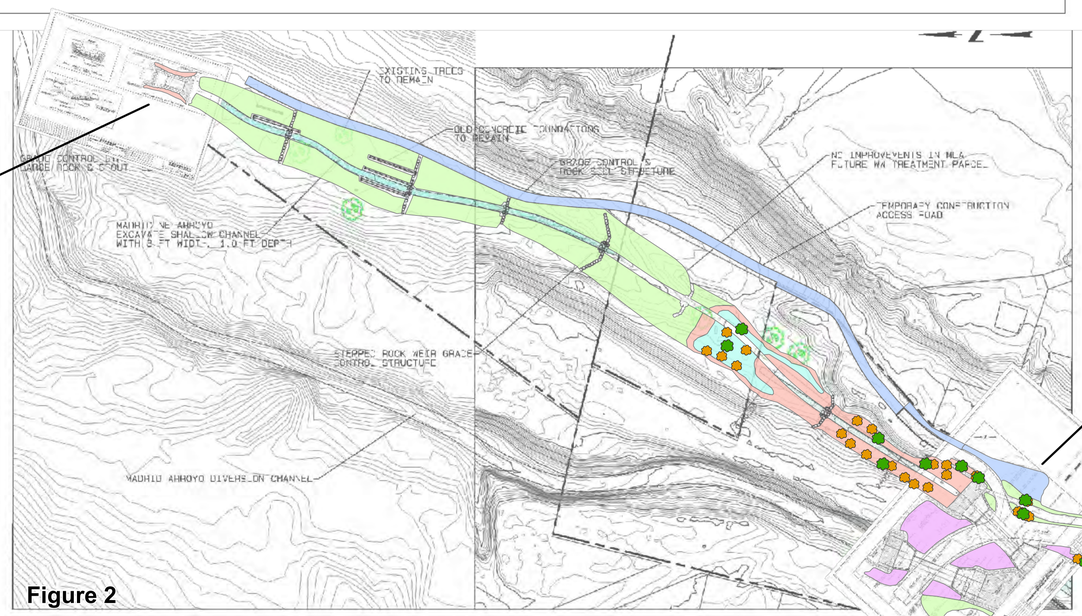

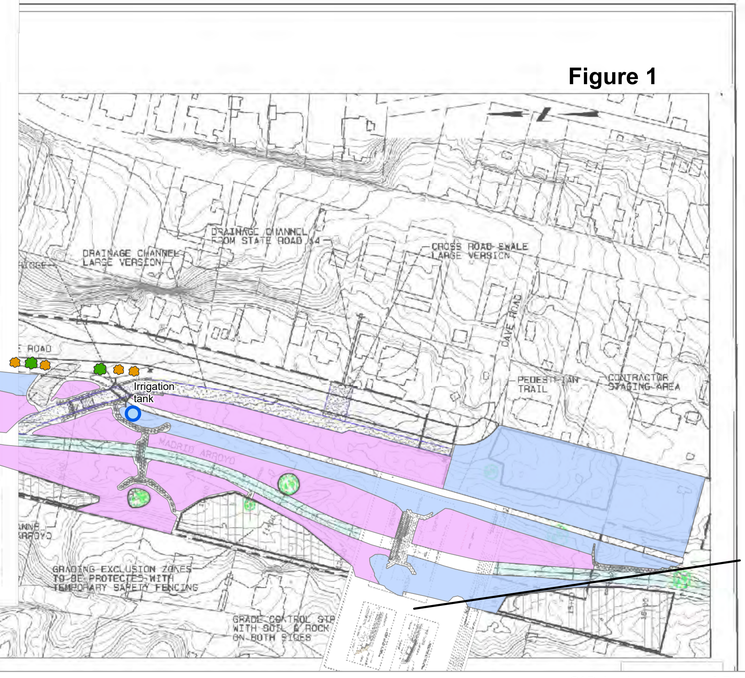

CAD drawings courtesy of: Riverbend Engineering, LLC

Explanation

Live Plantings
- Three-leaf sumac, gambel oak, or wavy leaf (33)
- Two-needle piñon or New Mexico locust (14)
- Existing tree to be preserved
- Irrigation tank

Revegetation area
- A - Dry, upland species mix (5.83 acres)
- B - Higher soil moisture species mix for channel edges and deflectors (1.12 acres)
- C - Higher soil moisture, shade-adapted species mix (0.32 acres)
- Combined A&B prescription (1.93 acres)
- Combined B&C prescription (0.11 acres)

N

0 100 200

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MADRID ARROYO
REVEGETATION PLAN

Proposed Revegetation Seed Prescription

Plate 1

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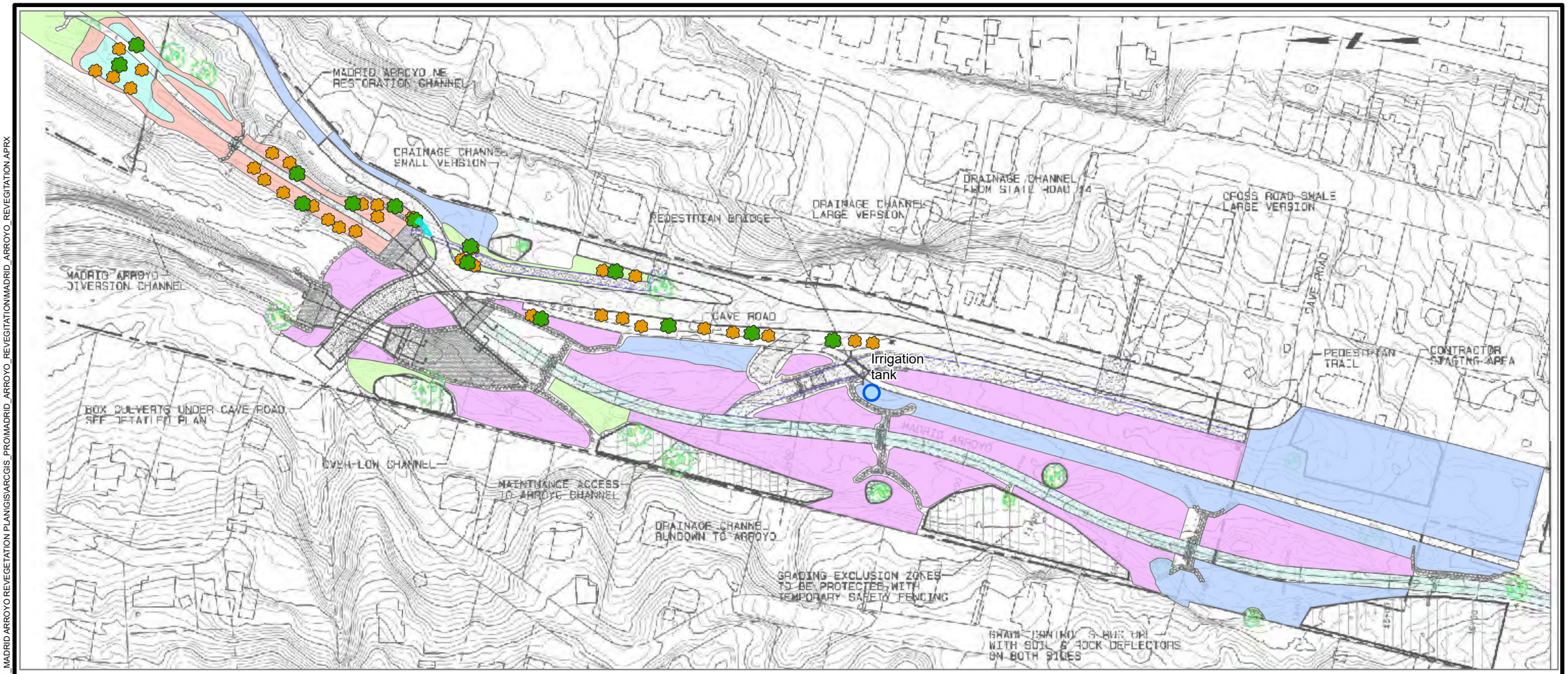

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N

0 55 110 ft

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MADRID ARROYO
REVEGETATION PLAN
Proposed Revegetation Seed Prescription

Figure 1

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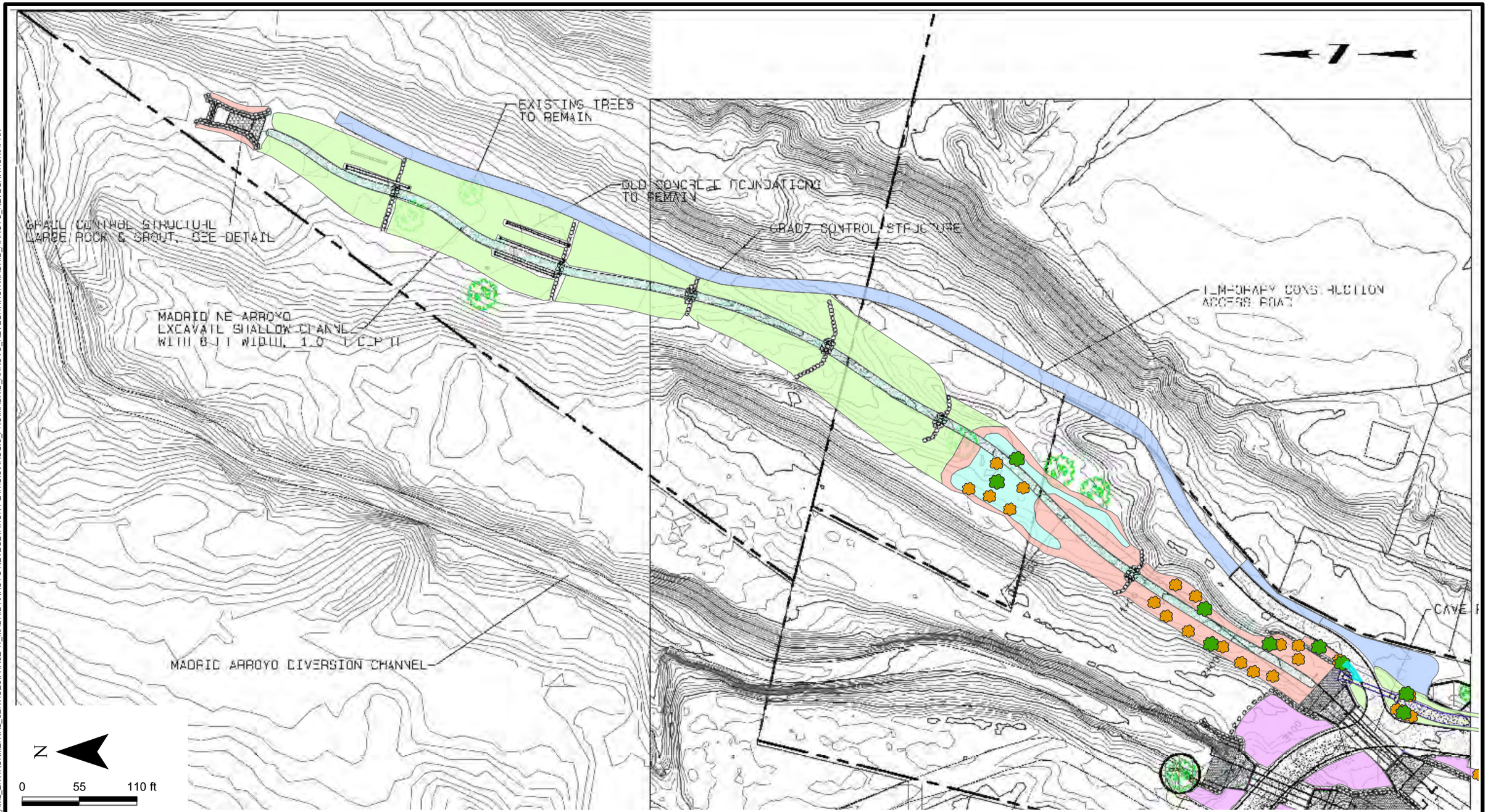

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Adapted from CAD drawings provided by Riverbend Engineering, LLC

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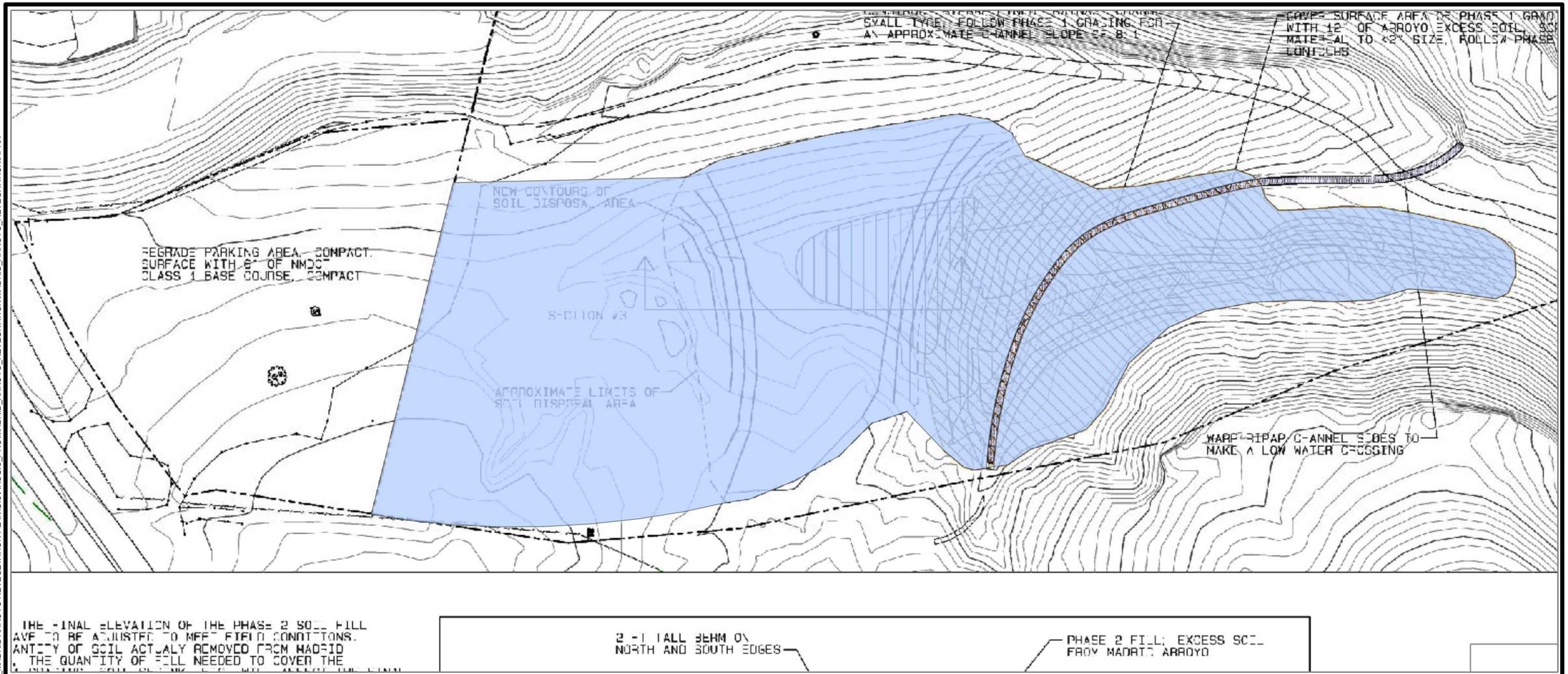
MADRID ARROYO
REVEGETATION PLAN

Proposed Revegetation Seed Prescription

Figure 2



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N

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MADRID ARROYO
REVEGETATION PLAN
Proposed Revegetation Seed Prescription

Figure 3

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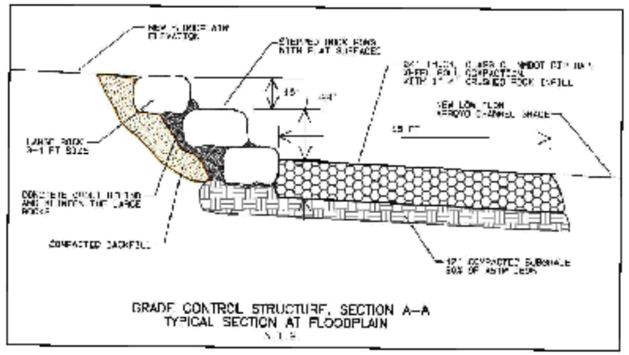

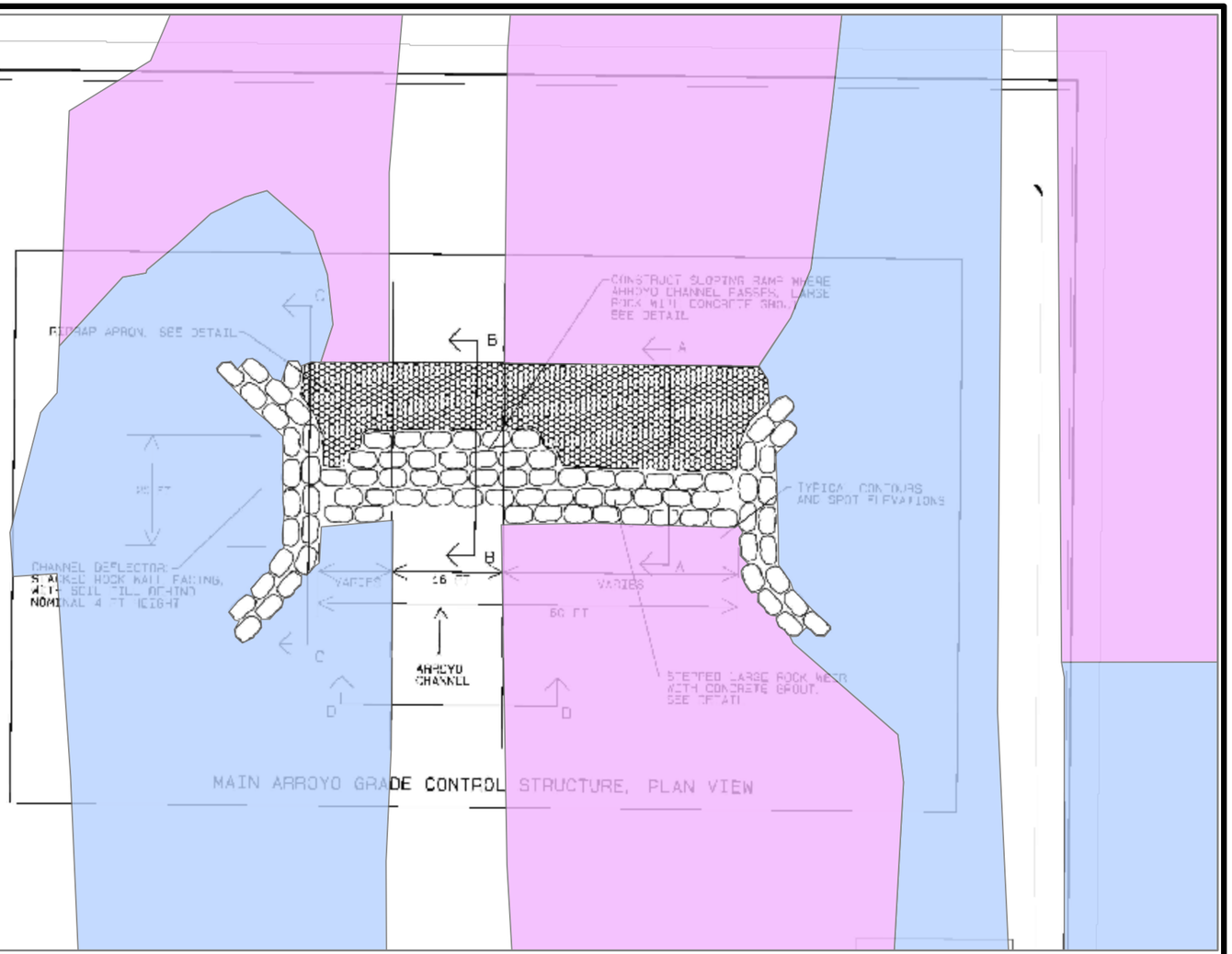

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MADRID ARROYO
REVEGETATION PLAN
Proposed Revegetation Seed Prescription

Figure 4

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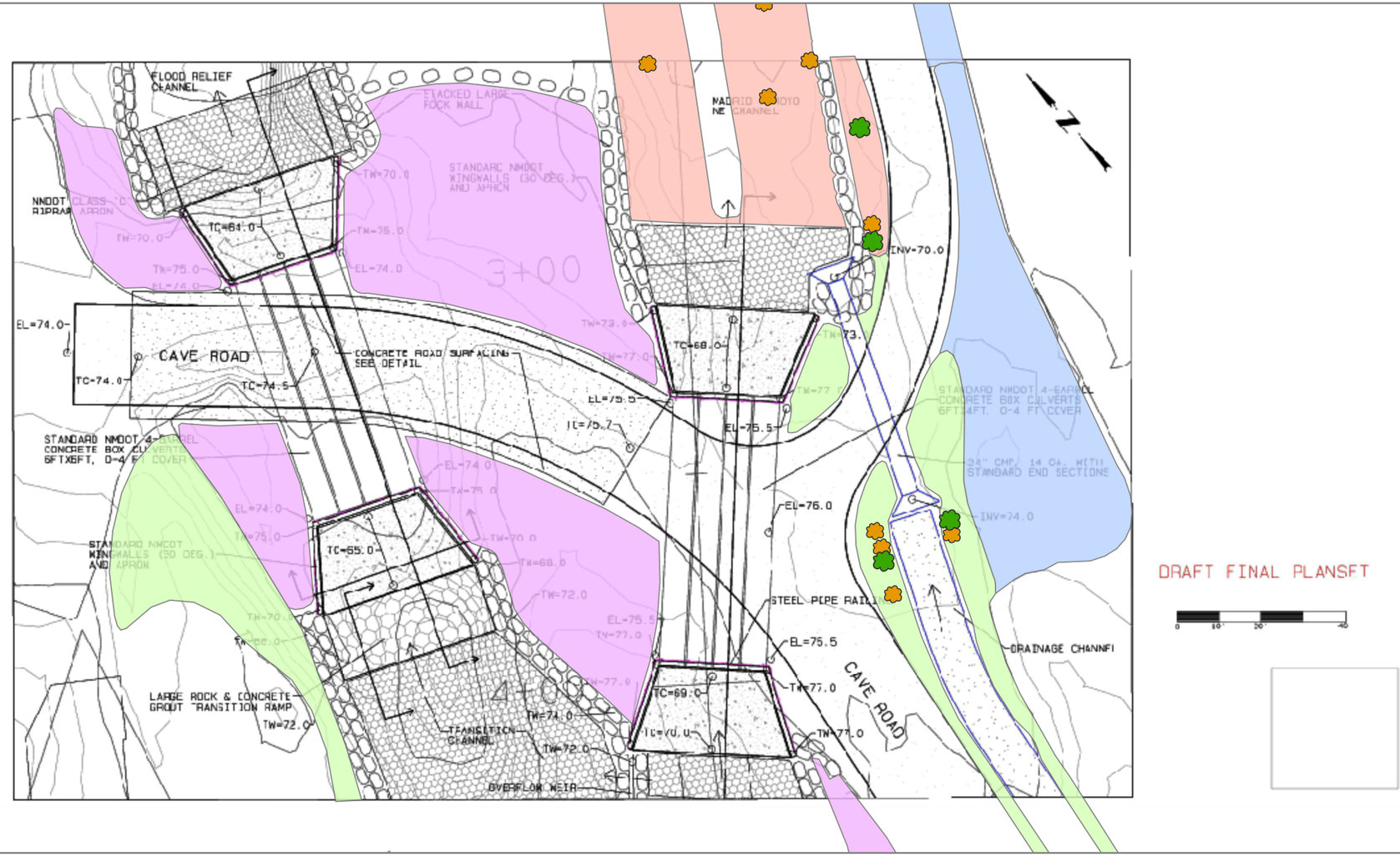

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N

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MADRID ARROYO
REVEGETATION PLAN
Proposed Revegetation Seed Prescription

Figure 5

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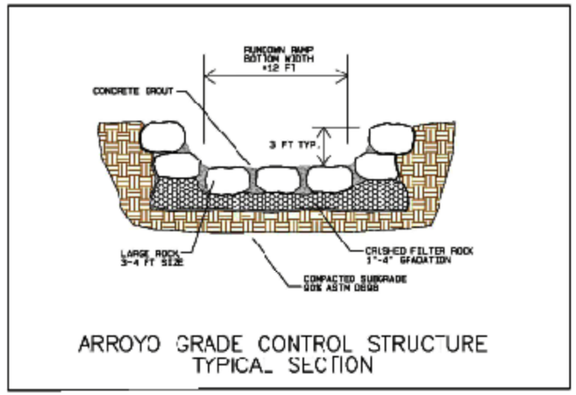
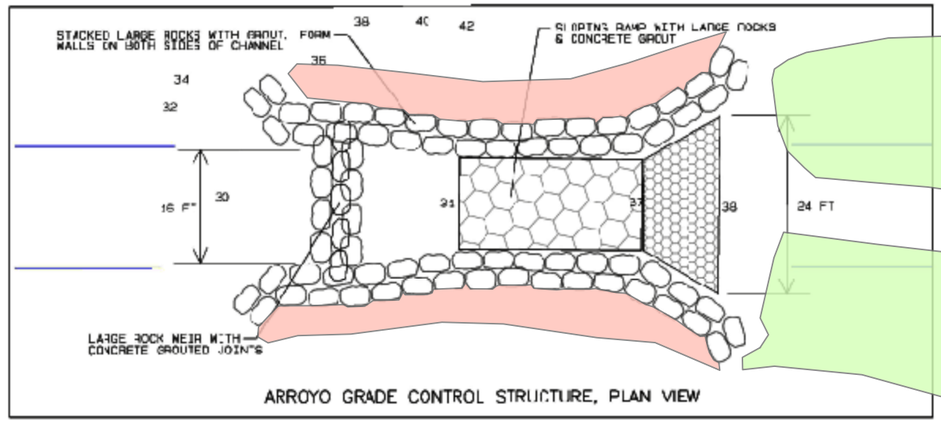
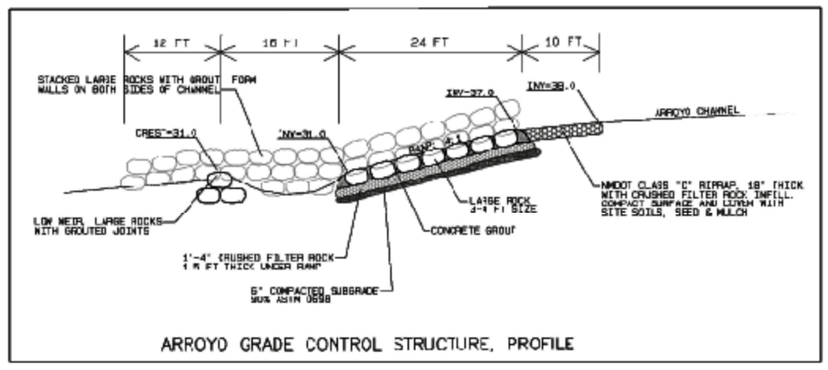


ARROYO GRADE CONTROL STRUCTURE
TYPICAL SECTION



ARROYO GRADE CONTROL STRUCTURE, PLAN VIEW



ARROYO GRADE CONTROL STRUCTURE, PROFILE

DRAFT FINAL PLANSET

Adapted from CAD drawings provided by Riverbend Engineering, LLC

Explanation

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Attachment 1

Recommended Plant List

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Upland Dry Mix

Plant Name	Scientific Name	Supplemental (up to 2 years) Water Needed	Planting Timing/Method	Revegetation Mix	Project Area Location for Planting	Notes
WOODY PLANTS - seed mix						
Four-winged saltbush	*Atriplex canescens*	No	Sow seeds in late fall, early winter or very early spring	A	Plant throughout open, dry areas above channel.	Grows very well from seed, include in seed mix
HERBACEOUS PLANTS - wildflower seed mix						
Scarlet globemallow	*Sphaeralcea coccinea*	No	Sow seed in spring	A	Plant in open, dry parts of the project area, throughout.	Native, drought tolerant
Evening primrose	*Oenothera pallida*	No	Sow seeds anytime of year	A	Plant in open, dry parts of the project area, throughout.	Native
Winterfat	*Krascheninnikovia lanata*	No, if planted in June/early July to receive monsoon moisture	Sow seeds in spring or summer	A	Plant in open, dry parts of the project area, throughout.	Native, drought tolerant
Butterfly-weed (showy milkweed)	*Asclepias speciosa*	No, if seed planted in fall	Sow seed in the fall or cold-stratify for two months and sow in the spring.	A,B	Plant throughout areas above channel.	Native, pollinator species
Palmer's Penstemon	*Penstemon palmeri*	No	Sow seed in the fall or cold stratify and sow in the spring.	A,B	Plant throughout in open, unshaded areas, flat areas and slopes	Plant anytime except heat of summer, middle of winter. *Erosion control/reclamation* : All species are mentioned for their value in mixes for erosion control and beautification values. See USDA for full planting guidance.

Plant Name	Scientific Name	Supplemental (up to 2 years) Water Needed	Planting Timing/Method	Revegetation Mix	Project Area Location for Planting	Notes
Scarlet penstamon	*Penstemon barbatus ssp. torreyi*	No	Sow seed in the fall or cold stratify and sow in the spring.	A,B,C	Plant throughout in open areas or partially shaded areas, flat areas and slopes	Does well in poor soil. Plant anytime except heat of summer, middle of winter.
Scarlet gilia	*Ipomopsis aggregata*	No	Sow seed in late spring/early summer.	A,B,C	Plant throughout in open areas or partially shaded areas, flat areas and slopes	
Desert marigold	*Baileya multiradiata*	No	Sow seed anytime	A,B	Plant throughout in open, unshaded areas, flat areas and slopes	
Sand verbana	*Abronia villosa*	No - especially if planted in late spring before monsoon season	Scarify seed, sow in the fall or spring.	A,B	Plant in open areas, as well as on rocky slopes around deflectors.	Vibrant purple color, blooms 3 seasons. Difficult to germinate - try scarification. Butterfly attractant.
Common hoptree	*Ptelea trifoliata*	Yes, temporarily, up to 2 years	Sow seeds in late fall through early spring.	C	Plant in shaded area at the downstream north end of the project.	Have been seen in Madrid, have been seen growing in dry spots
Utah juneberry	*Amelanchier utahensis*	Yes, at least 2 years	Sow seeds in the fall.	B	Sow near deflectors where potential for increased soil moisture is.	Fruit for people and animals
Datura	*Datura wrightii*	Yes, for up to 2 years	Sow seeds in spring or summer.	B,C	Plant in wetter areas - around deflectors, downstream end.	Native
Desert four o'clock	*Mirabolis multiflora*	Would benefit from temporary supplemental water.	Sow seeds in the fall or cold-stratify and plant in spring.	C	Near the downstream end of the project in partial shade, near planted pinyon pine trees.	colorful, spreading ground cover
GRASSES PLANTS						
Alkali sacaton grass	*Sporobolus airoides*	No	Sow seed in late spring prior to monsoon season.	A,B	Plant in open, dry parts of the project area, throughout.	Native, erosion control

Plant Name	Scientific Name	Supplemental (up to 2 years) Water Needed	Planting Timing/Method	Revegetation Mix	Project Area Location for Planting	Notes
Sideoats grama	*Bouteloua curtipendula*	No, if planted late spring before monsoons	Direct seed in late spring prior to monsoon season.	A,B	Plant in open areas of the project area, throughout.	Native, drought tolerant
Blue grama	*Bouteloua gracilis*	No, if planted late June/early July for monsoonal precipitation	Sow seed in late spring/early summer.	A,B	Plant throughout in open, unshaded areas, flat areas and slopes	
Western wheatgrass	*Agropyron smithii*	No, if planted late June/early July for monsoonal precipitation	Sow seed in late spring/early summer.	A,B,C	Plant throughout in open, unshaded areas, flat areas and slopes. May tolerate shade	Cool season grass to balance warm season grasses in mix
sand dropseed	*Sporobolus cryptandrus*	No, plant prior to monsoon season	Sow seed in late spring/early summer.	A,B	Plant throughout in open, unshaded areas, flat areas and slopes	Sand dropseed is widely used in disturbed area plantings in the Southwest.
James galleta	*Pleuraphis jamesii*	No, if planted late June/early July for monsoonal precipitation	Sow seed in late spring/early summer.	A,B,C	Plant throughout in open, unshaded areas, flat areas and slopes. May tolerate shade	

Plant Name	Scientific Name	Supplemental (up to 2 years) Water Needed	Planting Timing/Method	Revegetation Mix	Project Area Location for Planting	Notes
Deflector Areas, Channel and Downstream Area						
WOODY						
Chamisa	*Ericameria nauseosa*	No	Sow seeds in late fall, early winter or very early spring.	B,C	Plant in areas around channel, deflectors or other areas of higher soil moisture for biggest chance for success.	seed
Apache plume	*Fallugia paradoxa*	No	Sow seeds in late fall, early winter or very early spring.	B,C	Plant in areas around channel, deflectors or other areas of higher soil moisture for biggest chance for success.	Native shrubs
New Mexico locust	*Robinia newmexicana*	No	Scarify seed by nicking with file, soak overnight in water, sow anytime	C	Plant in shaded area downstream at north end of the project	
Mahonia/desert holly	*Mahonia haematocarpa*	No	Sow seed in the fall or cold stratify	B	Plant along channel edges, near deflectors.	
HERBACEOUS PLANTS						
Broadleaf milkweed	*Asclepias latifoliav*	No	Sow seed in the fall or cold stratify for 1 -2 months and sow in the spring.	B	Plant on slopes above the channel, and around deflectors in areas of increased moisture.	

Plant Name	Scientific Name	Supplemental (up to 2 years) Water Needed	Planting Timing/Method	Revegetation Mix	Project Area Location for Planting	Notes
Antelope horns milkweed	*Asclepias asperula*	No	Sow seed in the fall or cold stratify for 1 -2 months and sow in the spring.	A,B	Plant in dry areas and in area of deflectors for increased moisture.	Full sun. Fairly common species however, info on commercial availability not found.
Sweet sand verbana	*Abronia fragrans*	No	Sow seed in the fall.	B,C	Plant near the downstream end of the project, with mahonia, pinyon pine in areas of partial shade.	Attracts butterflies. Scarify seed with sandpaper or soak in water 6-8 hours. Easily raised from fall-sown seed in mild-winter areas. Perennial, very cold hardy, does well in sandy soils.
No Supplemental (up to 2 years) Water Required						
Live Plantings (plugs)						
Native grasses (see above species)		No	See above grass seeding	A,B,C	Plant throughout with seeded areas	
Shrubs (Chamisa, Apache Plume)		No	See above shrub seeding	A,B,C	Plant throughout with seeded areas	
Supplemental (up to 2 years) Water Required						
Live plantings and supplemental water						
Two-needle pinyon	*Pinus edulis*	Yes, temporarily, up to 2 years	Plant saplings in fall or early spring with supplemental watering	B,C	Plant tree saplings in locations near the downstream end of the project and/or in the area of proposed deflectors where water may collect.	Live tree, commercially available, plant in spring or fall, in shade of other trees. ~5 quantity as mostly are not in the area.

Plant Name	Scientific Name	Supplemental (up to 2 years) Water Needed	Planting Timing/Method	Revegetation Mix	Project Area Location for Planting	Notes
New Mexico locust	*Robinia neomexicana*	Yes, temporarily, up to 2 years	Plant saplings in fall or early spring with supplemental watering	B,C	Plant tree saplings in locations near the downstream end of the project and/or in the area of proposed deflectors where water may collect.	Commercially available. Trees are flowering and do well in reclamation areas.
Three-leaf sumac	*Rhus trilobata*	Yes, temporarily, up to 2 years	Plant seedlings in spring with supplemental watering.	B,C	Plant in areas with increased soil moisture, at deflectors and downstream end of project area.	Native
Scrub oak - gambel or wavyleaf	*Quercus sp.*	Yes, temporarily, up to 2 years	Plant seedlings in spring with supplemental watering.	C	Plant at downstream end where there is increased moisture and some shade.	On hillsides

Attachment 2

Soil Testing Memorandum

DBS&A
a Geo-Logic Company

Memorandum

To: Leeland Murray
New Mexico Abandoned Mine Land Program

Date: May 28, 2024

From: Samantha Ramirez, Chris Wolf, and Jean-Luc Cartron

Subject: Soil Sampling Findings, Madrid Arroyo

Daniel B. Stephens & Associates, Inc. (DBS&A) has prepared this memorandum detailing the laboratory results of soil samples collected to determine plants that would best be supported for revegetation in the Madrid Arroyo. On April 17, 2024, DBS&A personnel collected soil samples at five sites in the area: two sites located at the upstream end of the Project Area (in the arroyo and in the floodplain) and three sites located near the downstream end of the Project Area (in the arroyo, in the floodplain, and in the upper plain). Two samples were collected at each site: one undisturbed sample collected with a hand auger beginning at a depth of 1 to 7 inches from the surface into a 6-inch by 2.5-inch brass sleeve and one collected into a 1-gallon resealable bag. The samples were then delivered to the DBS&A Soil Testing & Research Laboratory (DBS&A laboratory) on the same day and were tested for the following:

- Initial Soil Properties
- Moisture Characteristics
- Particle Size Analysis

Laboratory Results

The laboratory report is provided as Attachment 1. The initial soil properties were taken to determine the gravimetric moisture content and the volumetric moisture content. Volumetric moisture content results for the samples collected from the arroyo were the lowest, at 9.9 percent cubic centimeters per cubic centimeter (cm^3/cm^3) upstream and 9.3 percent cm^3/cm^3 downstream. Volumetric moisture content results for the floodplains samples were 20.6 percent cm^3/cm^3 upstream and 27.5 percent cm^3/cm^3 downstream. The volumetric moisture content result for the upper plain sample at the downstream location was 19.3 percent cm^3/cm^3 (Attachment 1, Table 1).

Dry bulk density results for the samples ranged from 1.24 to 1.57 grams per cubic centimeter (g/cm^3). The lowest result was for the sample collected in the upper plain downstream, while the highest result was for the arroyo upstream sample. The calculated porosity ranged from 40.2 to 50.3 percent; the lowest result was for the arroyo downstream sample, while the highest result was for the upper plain downstream sample (Attachment 1, Table 1).

Moisture retention was determined at pressures of –1/3 bar and –15 bars. Moisture retention between –1/3 bar and –15 bars is typically defined as the water holding capacity or "available water" to plants. The volumetric moisture contents of the samples were closer to the –1/3 bar volumetric. The greatest difference between the two was 3.2 percent cm^3/cm^3 in the downstream floodplain sample and the smallest difference was 0.6 percent cm^3/cm^3 in the upper plain downstream sample. The lowest water holding capacity was determined for the arroyo samples, at 7.8 percent cm^3/cm for the upstream sample and 7.4 percent cm^3/cm for the downstream sample. For the floodplain samples, the holding capacities were 10.0 percent cm^3/cm for the upstream location, 15.2 percent cm^3/cm for the downstream location, and 10.1 percent cm^3/cm for the upper plain downstream location (Attachment 1, Table 2).

Based on the particle size analyses, the uniformity coefficient was lowest for the arroyo samples, at 27 for the upstream sample and 28 for the downstream sample. For the floodplains samples, the uniformity coefficients were 40 for the upstream sample, 327 for the downstream sample, and 89 for the upper plain downstream sample (Attachment 1, Table 3).

USDA classifications of the soils are as follows:

- Sand in the arroyo upstream, with greater than 10 percent gravel
- Sandy loam in the floodplain upstream
- Loamy sand in the arroyo downstream, with greater than 10 percent gravel
- Loam in the floodplain downstream
- Sandy loam in the upper plain downstream, with greater than 10 percent gravel

Conclusion

There was a 10.1 percent range of soil porosity for the collected samples. The highest percentages were for the downstream samples from the floodplain and upper plain. The arroyo samples were consistent in having low initial moisture content and low moisture retention. While it was less prevalent in the upstream area, gob, or coal waste, was evident in the arroyo

and surrounding areas. Based on the water content and water holding capacity of the soil samples, the soils contain sufficient "available" water to support native vegetation.

Attachment 1

Soils Laboratory Report

DBS&A
a Geo-Logic Company

Laboratory Report, Madrid Arroyo New Mexico Abandoned Mine Land Program, Mining and Minerals Division

Prepared for

Daniel B. Stephens & Associates, Inc.

Prepared by

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DB21.1363.00 P11T3

May 6, 2024

DBS&A
a Geo-Logic Company

May 6, 2024

Jean-Luc E. Cartron
Daniel B. Stephens & Associates, Inc.
6020 Academy Road NE, Suite 100
Albuquerque, New Mexico 87109

Re: DBS&A Laboratory Report for the New Mexico Abandoned Mine Land Program, Madrid Arroyo Revegetation

Dear Jean-Luc E. Cartron:

Enclosed is the report for the requested laboratory services. Please review this report and provide any comments as samples will be held for a maximum of 30 days. After 30 days samples will be returned or disposed of in an appropriate manner.

All testing results were evaluated subjectively for consistency and reasonableness, and the results appear to be reasonably representative of the material tested. However, DBS&A does not assume any responsibility for interpretations or analyses based on the data enclosed, nor can we guarantee that these data are fully representative of the undisturbed materials at the field site. We recommend that careful evaluation of these laboratory results be made for your particular application.

The testing utilized to generate the enclosed report employs methods that are standard for the industry. The results do not constitute a professional opinion by DBS&A, nor can the results affect any professional or expert opinions rendered with respect thereto by DBS&A. You have acknowledged that all the testing undertaken by us, and the report provided, constitutes mere test results using standardized methods, and cannot be used to disqualify DBS&A from rendering any professional or expert opinion, having waived any claim of conflict of interest by DBS&A.

We are pleased to provide this service and look forward to future laboratory testing on other projects. If you have any questions about the enclosed data, please do not hesitate to call.

Sincerely,
DANIEL B. STEPHENS & ASSOCIATES, INC.
SOIL TESTING & RESEARCH LABORATORY

William Seward
Assistant Laboratory Manager

Joleen Hines
Laboratory Manager

Summaries

Summary of Tests Performed

Laboratory Sample Number	Initial Soil Properties[1]			Saturated Hydraulic Conductivity[2]			Moisture Characteristics[3]								Particle Size[4]			Specific Gravity[5]		Air Perm-eability	Atterberg Limits	Proctor Compaction
	G	VM	VD	CH	FH	FW	HC	PP	FP	DPP	RH	EP	WHC	K_{unsat}	DS	WS	H	F	C			
DFP-20240417	X	X						X		X			X			X	X					
DUP-20240417	X	X						X		X			X			X	X					
DA-20240417	X	X						X		X			X			X	X					
UA-20240417	X	X						X		X			X			X	X					
UFP-20240417	X	X						X		X			X			X	X					

[1] G = Gravimetric Moisture Content, VM = Volume Measurement Method, VD = Volume Displacement Method

[2] CH = Constant Head Rigid Wall, FH = Falling Head Rigid Wall, FW = Falling Head Rising Tail Flexible Wall

[3] HC = Hanging Column, PP = Pressure Plate, FP = Filter Paper, DPP = Dew Point Potentiometer, RH = Relative Humidity Box, EP = Effective Porosity, WHC = Water Holding Capacity, Kunsat = Calculated Unsaturated Hydraulic Conductivity

[4] DS = Dry Sieve, WS = Wet Sieve, H = Hydrometer

[5] F = Fine (<4.75mm), C = Coarse (>4.75mm)

Notes

Sample Receipt:
Five samples, each in one 2.5” diameter x 6” length brass sleeve and one 1-gallon resealable bag, were received on April 17, 2024. Each sleeve was sealed with an endcap and tape, and was contained within a resealable bag. Each bag sample was double bagged. All samples were delivered together in a 5-gallon bucket, and all were received in good order.

Sample Preparation and Testing Notes:
Each sample was subjected to water holding capacity (WHC) testing and particle size analysis. An intact section from each sleeve sample was obtained for the 1/3-bar measurement by pressure chamber for the WHC. Bag material was used for the particle size analysis and for the 15-bar measurement by dewpoint potentiometer for the WHC.

Porosity calculations, and the particle diameter calculations in the hydrometer portion of the particle size analysis testing, are based on the use of a specific gravity value estimated based on material texture and saturated volumetric water content.

Summary of Initial Moisture Content, Dry Bulk Density Wet Bulk Density and Calculated Porosity

Sample Number	Moisture Content				Dry Bulk Density (g/cm^3)	Wet Bulk Density (g/cm^3)	Calculated Porosity (%)
	As Received		Remolded				
	Gravimetric (%, g/g)	Volumetric (%, cm^3/cm^3)	Gravimetric (%, g/g)	Volumetric (%, cm^3/cm^3)			
DFP-20240417	21.2	27.5	---	---	1.30	1.57	48.1
DUP-20240417	15.5	19.3	---	---	1.24	1.44	50.3
DA-20240417	6.2	9.3	---	---	1.49	1.59	40.2
UA-20240417	6.3	9.9	---	---	1.57	1.67	42.8
UFP-20240417	13.5	20.6	---	---	1.53	1.73	42.4

--- = This sample was not remolded

Summary of Moisture Retention (1/3, 15 Bar Points and Water Holding Capacity*)

Sample Number	1/3 Bar Volumetric (%, cm^3/cm^3)	15 Bar Volumetric (%, cm^3/cm^3)	Water Holding Capacity (%, cm^3/cm^3)	Oversize Corrected 1/3 Bar Volumetric (%, cm^3/cm^3)	Oversize Corrected 15 Bar Volumetric (%, cm^3/cm^3)	Oversize Corrected Water Holding Capacity (%, cm^3/cm^3)
DFP-20240417	30.7	15.5	15.2	NA	NA	NA
DUP-20240417	19.9	9.8	10.1	NA	NA	NA
DA-20240417	12.3	5.0	7.4	NA	NA	NA
UA-20240417	11.2	3.4	7.8	NA	NA	NA
UFP-20240417	21.3	11.3	10.0	NA	NA	NA

*Water Holding Capacity (WHC) is defined here as the difference in the volumetric moisture content of the sample at -1/3 bar of water potential (commonly referred to as 'Field Capacity') and the volumetric moisture content of the sample at -15 bars of water potential (commonly referred to as 'Wilting Point').

NA = Not applicable

Summary of Particle Size Characteristics

Sample Number	d_{10} (mm)	d_{50} (mm)	d_{60} (mm)	C_u	C_c	Method	USCS Classification	USDA Classification	
DFP-20240417	0.00022	0.044	0.072	327	2.1	WS/H	Classification by ASTM 2487 requires Atterberg test	Loam	(Est)
DUP-20240417	0.0027	0.12	0.24	89	4.2	WS/H	Classification by ASTM 2487 requires Atterberg test	Sandy Loam †	
DA-20240417	0.12	2.0	3.3	28	1.1	WS/H	Classification by ASTM 2487 requires Atterberg test	Loamy Sand †	
UA-20240417	0.20	2.7	5.4	27	0.53	WS/H	Classification by ASTM 2487 requires Atterberg test	Sand †	
UFP-20240417	0.0050	0.15	0.20	40	4.2	WS/H	Classification by ASTM 2487 requires Atterberg test	Sandy Loam	

Est = Reported values for d_{10}, C_u, C_c, and soil classification are estimates, since extrapolation was required to obtain the d_{10} diameter

$$C_u = \frac{d_{60}}{d_{10}}$$

$$C_c = \frac{(d_{30})^2}{(d_{10})(d_{60})}$$

DS = Dry sieve

H = Hydrometer

WS = Wet sieve

† Greater than 10% of sample is coarse material

d_{50} = Median particle diameter

Percent Gravel, Sand, Silt and Clay

Sample Number	% Gravel (>4.75mm)	% Sand (<4.75mm, >0.075mm)	% Silt (<0.075mm, >0.002mm)	% Clay (<0.002mm)
DFP-20240417	1.2	38.1	37.9	22.8
DUP-20240417	2.9	54.4	33.4	9.3
DA-20240417	32.2	59.7	5.2	2.9
UA-20240417	41.8	53.0	3.2	1.9
UFP-20240417	2.0	63.2	26.7	8.0

Initial Properties

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: DFP-20240417
Date Sampled: 4/17/24
Time Sampled: 1213

	As Received	Remolded
Test Date:	23-Apr-24	---
Field weight of sample* (g)*:*	341.77	
Tare weight, ring (g)*:*	122.10	
Tare weight, pan/plate (g)*:*	0.00	
Tare weight, other (g)*:*	0.00	
Dry weight of sample (g)*:*	181.28	
Sample volume (cm^3)*:*	139.79	
Assumed particle density (g/cm^3)*:*	2.50	
Gravimetric Moisture Content (% g/g)*:*	21.2	
Volumetric Moisture Content (% vol)*:*	27.5	
Dry bulk density (g/cm^3)*:*	1.30	
Wet bulk density (g/cm^3)*:*	1.57	
Calculated Porosity (% vol)*:*	48.1	
Percent Saturation:	57.1	

Laboratory analysis by: D. O'Dowd
Data entered by: W. Seward
Checked by: J. Hines

Comments:

* Weight including tares
NA = Not applicable
--- = This sample was not remolded

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: DUP-20240417
Date Sampled: 4/17/24
Time Sampled: 1234

	As Received	Remolded
Test Date:	23-Apr-24	---
Field weight of sample* (g)*:*	296.34	
Tare weight, ring (g)*:*	91.74	
Tare weight, pan/plate (g)*:*	0.00	
Tare weight, other (g)*:*	0.00	
Dry weight of sample (g)*:*	177.15	
Sample volume (cm^3)*:*	142.57	
Assumed particle density (g/cm^3)*:*	2.50	
Gravimetric Moisture Content (% g/g)*:*	15.5	
Volumetric Moisture Content (% vol)*:*	19.3	
Dry bulk density (g/cm^3)*:*	1.24	
Wet bulk density (g/cm^3)*:*	1.44	
Calculated Porosity (% vol)*:*	50.3	
Percent Saturation:	38.3	

Laboratory analysis by: D. O'Dowd
Data entered by: W. Seward
Checked by: J. Hines

Comments:

* Weight including tares
NA = Not applicable
--- = This sample was not remolded

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: DA-20240417
Date Sampled: 4/17/24
Time Sampled: 1243

	As Received	Remolded
Test Date:	23-Apr-24	---
Field weight of sample* (g)*:*	316.53	
Tare weight, ring (g)*:*	89.39	
Tare weight, pan/plate (g)*:*	0.00	
Tare weight, other (g)*:*	0.00	
Dry weight of sample (g)*:*	213.88	
Sample volume (cm^3)*:*	143.15	
Assumed particle density (g/cm^3)*:*	2.50	
Gravimetric Moisture Content (% g/g)*:*	6.2	
Volumetric Moisture Content (% vol)*:*	9.3	
Dry bulk density (g/cm^3)*:*	1.49	
Wet bulk density (g/cm^3)*:*	1.59	
Calculated Porosity (% vol)*:*	40.2	
Percent Saturation:	23.0	

Laboratory analysis by: D. O'Dowd
Data entered by: W. Seward
Checked by: J. Hines

Comments:

* Weight including tares
NA = Not applicable
--- = This sample was not remolded

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: UA-20240417
Date Sampled: 4/17/24
Time Sampled: 1303

	As Received	Remolded
Test Date:	23-Apr-24	---
Field weight of sample* (g)*:*	325.49	
Tare weight, ring (g)*:*	91.86	
Tare weight, pan/plate (g)*:*	0.00	
Tare weight, other (g)*:*	0.00	
Dry weight of sample (g)*:*	219.84	
Sample volume (cm^3)*:*	139.67	
Assumed particle density (g/cm^3)*:*	2.75	
Gravimetric Moisture Content (% g/g)*:*	6.3	
Volumetric Moisture Content (% vol)*:*	9.9	
Dry bulk density (g/cm^3)*:*	1.57	
Wet bulk density (g/cm^3)*:*	1.67	
Calculated Porosity (% vol)*:*	42.8	
Percent Saturation:	23.1	

Laboratory analysis by: D. O'Dowd
Data entered by: W. Seward
Checked by: J. Hines

Comments:

* Weight including tares
NA = Not applicable
--- = This sample was not remolded

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: UFP-20240417
Date Sampled: 4/17/24
Time Sampled: 1314

	As Received	Remolded
Test Date:	23-Apr-24	---
Field weight of sample* (g)*:*	352.93	
Tare weight, ring (g)*:*	109.98	
Tare weight, pan/plate (g)*:*	0.00	
Tare weight, other (g)*:*	0.00	
Dry weight of sample (g)*:*	214.08	
Sample volume (cm^3)*:*	140.23	
Assumed particle density (g/cm^3)*:*	2.65	
Gravimetric Moisture Content (% g/g)*:*	13.5	
Volumetric Moisture Content (% vol)*:*	20.6	
Dry bulk density (g/cm^3)*:*	1.53	
Wet bulk density (g/cm^3)*:*	1.73	
Calculated Porosity (% vol)*:*	42.4	
Percent Saturation:	48.6	

Laboratory analysis by: D. O'Dowd
Data entered by: W. Seward
Checked by: J. Hines

Comments:

* Weight including tares
NA = Not applicable
--- = This sample was not remolded

Water Holding Capacity

Moisture Retention Data

Dew Point Potentiometer

(-15 Bars)

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: DFP-20240417
Date Sampled: 4/17/24
Time Sampled: 1213

Initial sample calculated total porosity (cm^3*):* 48.13
Assumed particle density (g/cm^3)*:* 2.50
Initial sample bulk density (g/cm^3)*:* 1.30
Fraction of sample used (<2.00mm fraction) (%)*:* 97.18

Dry weight of dew point potentiometer sample* (g)*:* 148.05
Tare weight, jar (g)*:* 113.16

	Date	Time	Weight* (g)	Water Potential (-cm water)	Moisture Content † (% vol)
Dew point potentiometer:	29-Apr-24	10:30	152.42	14073	15.83
	30-Apr-24	10:35	152.12	18764	14.73

Volume Adjusted Data [1]

	Water Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calc. Porosity (%)
Dew point potentiometer:	14073	---	---	---	---
	18764	---	---	---	---

Moisture content at -15 bars **(% cm^3/cm^3)*:*** **15.5**
Oversize Corrected Moisture content at -15 bars **(% cm^3/cm^3)*:*** **NA**

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent the volume change measurements obtained after the pressure plate point. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

† Adjusted for >2.00mm (#10 sieve) material not used in DPP testing. Assumed moisture content of material >2.00mm is zero, and assumed density of water is 1.0 g/cm^3.

‡‡ Volume adjustments are applicable at this matric potential (see comment #1). Changes in volume, if applicable, are estimated based on obtainable measurements of changes in sample length and diameter.

NA Not Applicable

--- Oversize correction is unnecessary since coarse fraction < 5% of composite mass

NR Not Requested

Laboratory analysis by: D. O'Dowd
Data entered by: W. Seward
Checked by: J. Hines

Moisture Retention Data

Pressure Plate

(-1/3 Bar)

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: DFP-20240417
Date Sampled: 4/17/24
Time Sampled: 1213

Dry wt. of sample (g)*:* 181.28
Tare wt., ring (g)*:* 122.10
Tare wt., screen & clamp (g)*:* 28.20
Initial sample volume (cm^3)*:* 139.79
Initial dry bulk density (g/cm^3)*:* 1.30
Assumed particle density (g/cm^3)*:* 2.50
Initial calculated total porosity (%)*:* 48.13

	Date	Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content † (% vol)
Pressure plate:	1-May-24	9:00	374.53	337	30.73

Volume Adjusted Data [1]

	Matric Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calculated Porosity (%)
Pressure plate:	337	---	---	---	---

Moisture content at -1/3 bar (% cm^3/cm^3): **30.7**

Oversize Corrected Moisture content at -1/3 bar (% cm^3/cm^3): **NA**

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent volume change measurements obtained after the pressure plate testing. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

† Assumed density of water is 1.0 g/cm^3

‡‡ Volume adjustments are applicable at this matric potential (see comment #1). Changes in volume, if applicable, are estimated based on obtainable measurements of changes in sample length and diameter.

Technician Notes:

Laboratory analysis by: D. O'Dowd
Data entered by: W. Seward
Checked by: J. Hines

Moisture Retention Data

Dew Point Potentiometer

(-15 Bars)

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: DUP-20240417
Date Sampled: 4/17/24
Time Sampled: 1234

Initial sample calculated total porosity (cm^3*):* 50.30
Assumed particle density (g/cm^3)*:* 2.50
Initial sample bulk density (g/cm^3)*:* 1.24
Fraction of sample used (<2.00mm fraction) (%)*:* 88.32

Dry weight of dew point potentiometer sample* (g)*:* 147.71
Tare weight, jar (g)*:* 114.79

	Date	Time	Weight* (g)	Water Potential (-cm water)	Moisture Content † (% vol)
Dew point potentiometer:	26-Apr-24	9:15	150.95	13053	10.80
	29-Apr-24	10:15	150.54	16215	9.45

Volume Adjusted Data [1]

	Water Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calc. Porosity (%)
Dew point potentiometer:	13053	---	---	---	---
	16215	---	---	---	---

Moisture content at -15 bars **(% cm^3/cm^3)*:*** **9.8**
Oversize Corrected Moisture content at -15 bars **(% cm^3/cm^3)*:*** **NA**

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent the volume change measurements obtained after the pressure plate point. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

† Adjusted for >2.00mm (#10 sieve) material not used in DPP testing. Assumed moisture content of material >2.00mm is zero, and assumed density of water is 1.0 g/cm^3.

‡‡ Volume adjustments are applicable at this matric potential (see comment #1). Changes in volume, if applicable, are estimated based on obtainable measurements of changes in sample length and diameter.

NA Not Applicable

--- Oversize correction is unnecessary since coarse fraction < 5% of composite mass

NR Not Requested

Laboratory analysis by: D. O'Dowd
Data entered by: W. Seward
Checked by: J. Hines

Moisture Retention Data

Pressure Plate

(-1/3 Bar)

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: DUP-20240417
Date Sampled: 4/17/24
Time Sampled: 1234

Dry wt. of sample (g)*:* 177.15
Tare wt., ring (g)*:* 91.74
Tare wt., screen & clamp (g)*:* 26.48
Initial sample volume (cm^3)*:* 142.57
Initial dry bulk density (g/cm^3)*:* 1.24
Assumed particle density (g/cm^3)*:* 2.50
Initial calculated total porosity (%)*:* 50.30

	Date	Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content † (% vol)
Pressure plate:	1-May-24	9:00	323.73	337	19.89

Volume Adjusted Data [1]

	Matric Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calculated Porosity (%)
Pressure plate:	337	---	---	---	---

Moisture content at -1/3 bar (% cm^3/cm^3): 19.9

Oversize Corrected Moisture content at -1/3 bar (% cm^3/cm^3): NA

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent volume change measurements obtained after the pressure plate testing. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

† Assumed density of water is 1.0 g/cm^3

‡‡ Volume adjustments are applicable at this matric potential (see comment #1). Changes in volume, if applicable, are estimated based on obtainable measurements of changes in sample length and diameter.

Technician Notes:

Laboratory analysis by: D. O'Dowd
Data entered by: W. Seward
Checked by: J. Hines

Moisture Retention Data

Dew Point Potentiometer

(-15 Bars)

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: DA-20240417
Date Sampled: 4/17/24
Time Sampled: 1243

Initial sample calculated total porosity (cm^3*):* 40.23
Assumed particle density (g/cm^3)*:* 2.50
Initial sample bulk density (g/cm^3)*:* 1.49
Fraction of sample used (<2.00mm fraction) (%)*:* 50.02

Dry weight of dew point potentiometer sample* (g)*:* 151.07
Tare weight, jar (g)*:* 113.22

	Date	Time	Weight* (g)	Water Potential (-cm water)	Moisture Content† (% vol)	
Dew point potentiometer:	30-Apr-24	10:25	153.34	12238	4.71	‡‡
	26-Apr-24	9:05	153.49	15909	5.02	‡‡

Volume Adjusted Data [1]

	Water Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calc. Porosity (%)
Dew point potentiometer:	12238	136.25	-4.82%	1.57	37.21
	15909	136.25	-4.82%	1.57	37.21

Moisture content at -15 bars **(% cm^3/cm^3)*:*** **5.0**
Oversize Corrected Moisture content at -15 bars **(% cm^3/cm^3)*:*** **NA**

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent the volume change measurements obtained after the pressure plate point. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

† Adjusted for >2.00mm (#10 sieve) material not used in DPP testing. Assumed moisture content of material >2.00mm is zero, and assumed density of water is 1.0 g/cm^3.

‡‡ Volume adjustments are applicable at this matric potential (see comment #1). Changes in volume, if applicable, are estimated based on obtainable measurements of changes in sample length and diameter.

NA Not Applicable

--- Oversize correction is unnecessary since coarse fraction < 5% of composite mass

NR Not Requested

Laboratory analysis by: D. O'Dowd
Data entered by: W. Seward
Checked by: J. Hines

Moisture Retention Data

Pressure Plate

(-1/3 Bar)

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: DA-20240417
Date Sampled: 4/17/24
Time Sampled: 1243

Dry wt. of sample (g)*:* 213.88
Tare wt., ring (g)*:* 89.39
Tare wt., screen & clamp (g)*:* 27.44
Initial sample volume (cm^3)*:* 143.15
Initial dry bulk density (g/cm^3)*:* 1.49
Assumed particle density (g/cm^3)*:* 2.50
Initial calculated total porosity (%)*:* 40.23

	Date	Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content † (% vol)	
Pressure plate:	1-May-24	9:00	347.51	337	12.33	‡‡

Volume Adjusted Data [1]

	Matric Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calculated Porosity (%)
Pressure plate:	337	136.25	-4.82%	1.57	37.21

Moisture content at -1/3 bar (% cm^3/cm^3): 12.3

Oversize Corrected Moisture content at -1/3 bar (% cm^3/cm^3): NA

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent volume change measurements obtained after the pressure plate testing. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

† Assumed density of water is 1.0 g/cm^3

‡‡ Volume adjustments are applicable at this matric potential (see comment #1). Changes in volume, if applicable, are estimated based on obtainable measurements of changes in sample length and diameter.

Technician Notes:

Laboratory analysis by: D. O'Dowd
Data entered by: W. Seward
Checked by: J. Hines

Moisture Retention Data

Dew Point Potentiometer

(-15 Bars)

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: UA-20240417
Date Sampled: 4/17/24
Time Sampled: 1303

Initial sample calculated total porosity (cm^3*):* 42.76
Assumed particle density (g/cm^3)*:* 2.75
Initial sample bulk density (g/cm^3)*:* 1.57
Fraction of sample used (<2.00mm fraction) (%)*:* 45.54

Dry weight of dew point potentiometer sample* (g)*:* 164.74
Tare weight, jar (g)*:* 113.34

	Date	Time	Weight* (g)	Water Potential (-cm water)	Moisture Content† (% vol)	
Dew point potentiometer:	29-Apr-24	10:00	166.97	13461	3.42	‡‡
	26-Apr-24	8:50	166.96	18356	3.40	‡‡

Volume Adjusted Data [1]

	Water Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calc. Porosity (%)
Dew point potentiometer:	13461	127.10	-9.00%	1.73	37.10
	18356	127.10	-9.00%	1.73	37.10

Moisture content at -15 bars **(% cm^3/cm^3)*:*** **3.4**
Oversize Corrected Moisture content at -15 bars **(% cm^3/cm^3)*:*** **NA**

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent the volume change measurements obtained after the pressure plate point. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

† Adjusted for >2.00mm (#10 sieve) material not used in DPP testing. Assumed moisture content of material >2.00mm is zero, and assumed density of water is 1.0 g/cm^3.

‡‡ Volume adjustments are applicable at this matric potential (see comment #1). Changes in volume, if applicable, are estimated based on obtainable measurements of changes in sample length and diameter.

NA Not Applicable

--- Oversize correction is unnecessary since coarse fraction < 5% of composite mass

NR Not Requested

Laboratory analysis by: D. O'Dowd
Data entered by: W. Seward
Checked by: J. Hines

Moisture Retention Data

Pressure Plate

(-1/3 Bar)

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: UA-20240417
Date Sampled: 4/17/24
Time Sampled: 1303

Dry wt. of sample (g): 219.84
Tare wt., ring (g): 91.86
Tare wt., screen & clamp (g): 28.05
Initial sample volume (cm^3): 139.67
Initial dry bulk density (g/cm^3): 1.57
Assumed particle density (g/cm^3): 2.75
Initial calculated total porosity (%): 42.76

	Date	Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content † (% vol)	
Pressure plate:	1-May-24	9:00	353.99	337	11.20	‡‡

Volume Adjusted Data [1]

	Matric Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calculated Porosity (%)
Pressure plate:	337	127.10	-9.00%	1.73	37.10

Moisture content at -1/3 bar (% cm^3/cm^3): 11.2

Oversize Corrected Moisture content at -1/3 bar (% cm^3/cm^3): NA

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent volume change measurements obtained after the pressure plate testing. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

† Assumed density of water is 1.0 g/cm^3

‡‡ Volume adjustments are applicable at this matric potential (see comment #1). Changes in volume, if applicable, are estimated based on obtainable measurements of changes in sample length and diameter.

Technician Notes:

Laboratory analysis by: D. O'Dowd
Data entered by: W. Seward
Checked by: J. Hines

Moisture Retention Data

Dew Point Potentiometer

(-15 Bars)

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: UFP-20240417
Date Sampled: 4/17/24
Time Sampled: 1314

Initial sample calculated total porosity (cm^3*):* 42.39
Assumed particle density (g/cm^3)*:* 2.65
Initial sample bulk density (g/cm^3)*:* 1.53
Fraction of sample used (<2.00mm fraction) (%)*:* 96.16

Dry weight of dew point potentiometer sample* (g)*:* 163.76
Tare weight, jar (g)*:* 114.72

	Date	Time	Weight* (g)	Water Potential (-cm water)	Moisture Content † (% vol)
Dew point potentiometer:	25-Apr-24	15:00	167.62	14685	11.55
	26-Apr-24	9:00	167.49	15603	11.18

Volume Adjusted Data [1]

	Water Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calc. Porosity (%)
Dew point potentiometer:	14685	---	---	---	---
	15603	---	---	---	---

Moisture content at -15 bars **(% cm^3/cm^3)*:*** **11.3**
Oversize Corrected Moisture content at -15 bars **(% cm^3/cm^3)*:*** **NA**

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent the volume change measurements obtained after the pressure plate point. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

† Adjusted for >2.00mm (#10 sieve) material not used in DPP testing. Assumed moisture content of material >2.00mm is zero, and assumed density of water is 1.0 g/cm^3.

‡‡ Volume adjustments are applicable at this matric potential (see comment #1). Changes in volume, if applicable, are estimated based on obtainable measurements of changes in sample length and diameter.

NA Not Applicable

--- Oversize correction is unnecessary since coarse fraction < 5% of composite mass

NR Not Requested

Laboratory analysis by: D. O'Dowd
Data entered by: W. Seward
Checked by: J. Hines

Moisture Retention Data

Pressure Plate

(-1/3 Bar)

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: UFP-20240417
Date Sampled: 4/17/24
Time Sampled: 1314

Dry wt. of sample (g)*:* 214.08
Tare wt., ring (g)*:* 109.98
Tare wt., screen & clamp (g)*:* 27.95
Initial sample volume (cm^3)*:* 140.23
Initial dry bulk density (g/cm^3)*:* 1.53
Assumed particle density (g/cm^3)*:* 2.65
Initial calculated total porosity (%)*:* 42.39

	Date	Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content † (% vol)
Pressure plate:	1-May-24	9:00	381.93	337	21.34

Volume Adjusted Data [1]

	Matric Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calculated Porosity (%)
Pressure plate:	337	---	---	---	---

Moisture content at -1/3 bar (% cm^3/cm^3): 21.3

Oversize Corrected Moisture content at -1/3 bar (% cm^3/cm^3): NA

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent volume change measurements obtained after the pressure plate testing. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

† Assumed density of water is 1.0 g/cm^3

‡‡ Volume adjustments are applicable at this matric potential (see comment #1). Changes in volume, if applicable, are estimated based on obtainable measurements of changes in sample length and diameter.

Technician Notes:

Laboratory analysis by: D. O'Dowd
Data entered by: W. Seward
Checked by: J. Hines

Particle Size Analysis

Particle Size Analysis
Sieve Data (#10 Split)

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: DFP-20240417
Date Sampled: 4/17/24
Time Sampled: 1213
Test Date: 25-Apr-24

Initial Dry Weight of Sample (g): 2230.46
Weight Passing #10 (g): 2167.45
Weight Retained #10 (g): 63.01
Weight of -10 Sub-Sample (g): 65.09
Calculated Weight of Sieve Sample (g): 66.98

Test Fraction	Sieve Number	Diameter (mm)	Wt. Retained	Cum Wt. Retained	Wt. Passing	% Passing
+10						
	3"	75	0.00	0.00	2230.46	100.0
	2"	50	0.00	0.00	2230.46	100.0
	1.5"	38.1	0.00	0.00	2230.46	100.0
	1"	25	0.00	0.00	2230.46	100.0
	3/4"	19.0	0.00	0.00	2230.46	100.0
	3/8"	9.5	5.55	5.55	2224.91	99.8
	4	4.75	20.36	25.91	2204.55	98.8
	10	2.00	37.10	63.01	2167.45	97.2
-10			(Based on calculated sieve wt.)			
	20	0.85	1.49	3.38	63.60	95.0
	40	0.425	3.16	6.54	60.44	90.2
	60	0.250	5.09	11.63	55.35	82.6
	100	0.150	7.18	18.81	48.17	71.9
	140	0.106	4.40	23.21	43.77	65.3
	200	0.075	3.08	26.29	40.69	60.7
	dry pan		0.25	26.54	40.44	
	wet pan			40.44	0.00	

d_{10} (mm): 0.00022
d_{16} (mm): 0.00062
d_{30} (mm): 0.0057
d_{50} (mm): 0.044
d_{60} (mm): 0.072
d_{84} (mm): 0.28

Median Particle Diameter --d_{50} (mm): 0.044
Uniformity Coefficient, Cu --$[d_{60}/d_{10}]$ (mm): 327
Coefficient of Curvature, Cc --$[(d_{30})^2/(d_{10}*d_{60})]$ (mm): 2.1
Mean Particle Diameter --$[(d_{16}+d_{50}+d_{84})/3]$ (mm): 0.11

Note: Reported values for d_{10}, C_u, C_c, and soil classification are estimates, since extrapolation was required to obtain the d_{10} diameter

USCS Soil Classification: Classification by ASTM 2487 requires Atterberg test
USDA Soil Classification: Loam

Laboratory analysis by: L. Hooker
Data entered by: L. Hooker
Checked by: J. Hines

Particle Size Analysis
Hydrometer Data

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: DFP-20240417
Date Sampled: 4/17/24
Time Sampled: 1213

Test Date: 29-Apr-24
Start Time: 8:54

Type of Water Used: DISTILLED
Reaction with H_2O_2*:* MODERATE
Dispersant:* $(NaPO_3)_6$
Assumed particle density: 2.50

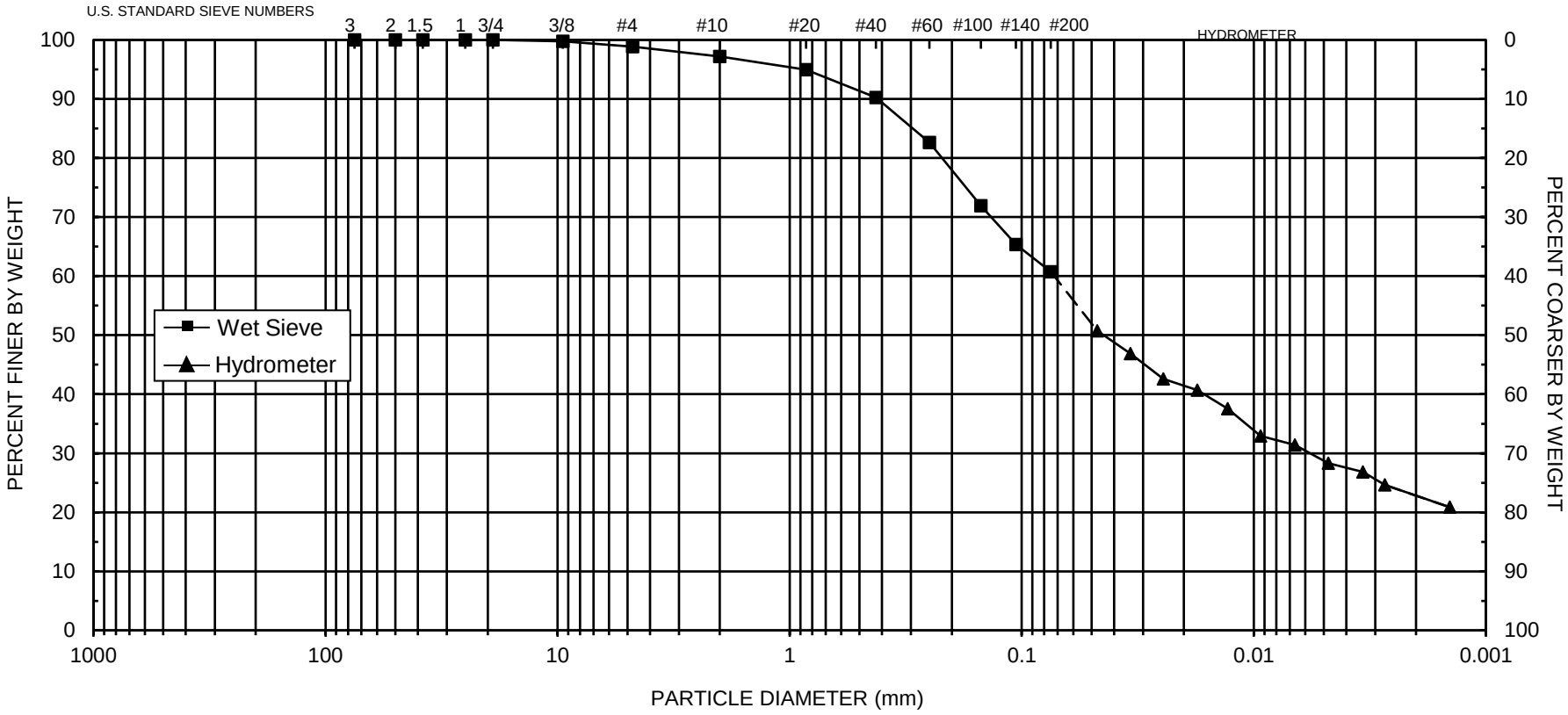
Initial Wt. (g)*:* 65.09
Total Sample Wt. (g)*:* 2230.46
Wt. Passing #10 (g)*:* 2167.45

Date	Time (min)	Temp (°C)	R (g/L)	R_L (g/L)	R_{corr} (g/L)	H_m (cm)	D (mm)	P (%)	% Finer
29-Apr-24	1	21.80	37.50	4.75	32.8	11	0.0473	52	50.7
	2	21.80	35.00	4.75	30.3	11	0.0341	48	46.9
	4	21.80	32.25	4.75	27.5	12	0.0246	44	42.6
	8	21.80	31.00	4.75	26.3	12	0.0175	42	40.7
	15	21.80	29.00	4.75	24.3	12	0.0130	39	37.6
	30	21.80	26.00	4.75	21.3	13	0.0094	34	32.9
	60	21.90	25.00	4.71	20.3	13	0.0067	32	31.4
	120	21.90	23.00	4.71	18.3	13	0.0048	29	28.3
	240	22.00	22.00	4.68	17.3	14	0.0034	28	26.8
	378	22.20	20.50	4.60	15.9	14	0.0027	25	24.6
30-Apr-24	1414	22.40	18.00	4.53	13.5	14	0.0014	21	20.9

Comments:

* Dispersion device: mechanically operated stirring device

Laboratory analysis by: W. Seward
Data entered by: W. Seward
Checked by: J. Hines



USCS	COBBLES	GRAVEL		SAND			SILT OR CLAY				
		Coarse	Fine	Coarse	Medium	Fine					
USDA	COBBLES	GRAVEL		SAND					SILT	CLAY	
				Very coarse	Coarse	Medium	Fine	Very fine			

d_{10} = **0.00022**	d_{30} = **0.0057**	d_{50} = **0.044**	d_{60} = **0.072**	C_u = **327**	C_c = **2.1**

SAMPLE NUMBER	TIME SAMPLED	USCS CLASSIFICATION	USDA CLASSIFICATION
DFP-20240417	**1213**	**Classification by ASTM 2487 requires Atterberg test**	**Loam**

Note: Reported values for d_{10}, C_u, C_c, and USCS classification are estimates, since extrapolation was required to obtain the d_{10} diameter

Particle Size Analysis
Sieve Data (#10 Split)

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: DUP-20240417
Date Sampled: 4/17/24
Time Sampled: 1234
Test Date: 25-Apr-24

Initial Dry Weight of Sample (g): 1995.14
Weight Passing #10 (g): 1762.05
Weight Retained #10 (g): 233.09
Weight of -10 Sub-Sample (g): 73.90
Calculated Weight of Sieve Sample (g): 83.68

Test Fraction	Sieve Number	Diameter (mm)	Wt. Retained	Cum Wt. Retained	Wt. Passing	% Passing
+10						
	3"	75	0.00	0.00	1995.14	100.0
	2"	50	0.00	0.00	1995.14	100.0
	1.5"	38.1	0.00	0.00	1995.14	100.0
	1"	25	0.00	0.00	1995.14	100.0
	3/4"	19.0	0.00	0.00	1995.14	100.0
	3/8"	9.5	0.00	0.00	1995.14	100.0
	4	4.75	57.32	57.32	1937.82	97.1
	10	2.00	175.77	233.09	1762.05	88.3
-10			(Based on calculated sieve wt.)			
	20	0.85	9.54	19.32	64.36	76.9
	40	0.425	7.87	27.19	56.49	67.5
	60	0.250	5.96	33.15	50.53	60.4
	100	0.150	5.53	38.68	45.00	53.8
	140	0.106	4.31	42.99	40.69	48.6
	200	0.075	4.96	47.95	35.73	42.7
	dry pan		0.34	48.29	35.39	
	wet pan			35.39	0.00	

d_{10} (mm): 0.0027
d_{16} (mm): 0.015
d_{30} (mm): 0.052
d_{50} (mm): 0.12
d_{60} (mm): 0.24
d_{84} (mm): 1.4

Median Particle Diameter --d_{50} (mm): 0.12
Uniformity Coefficient, Cu --$[d_{60}/d_{10}]$ (mm): 89
Coefficient of Curvature, Cc --$[(d_{30})^2/(d_{10}*d_{60})]$ (mm): 4.2
Mean Particle Diameter --$[(d_{16}+d_{50}+d_{84})/3]$ (mm): 0.51

USCS Soil Classification: Classification by ASTM 2487 requires Atterberg test
USDA Soil Classification: Sandy Loam †

† Greater than 10% of sample is coarse material

Laboratory analysis by: L. Hooker
Data entered by: L. Hooker
Checked by: J. Hines

Particle Size Analysis
Hydrometer Data

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: DUP-20240417
Date Sampled: 4/17/24
Time Sampled: 1234

Test Date: 29-Apr-24
Start Time: 9:00

Type of Water Used: DISTILLED
Reaction with H_2O_2*:* MODERATE
Dispersant:* $(NaPO_3)_6$
Assumed particle density: 2.50

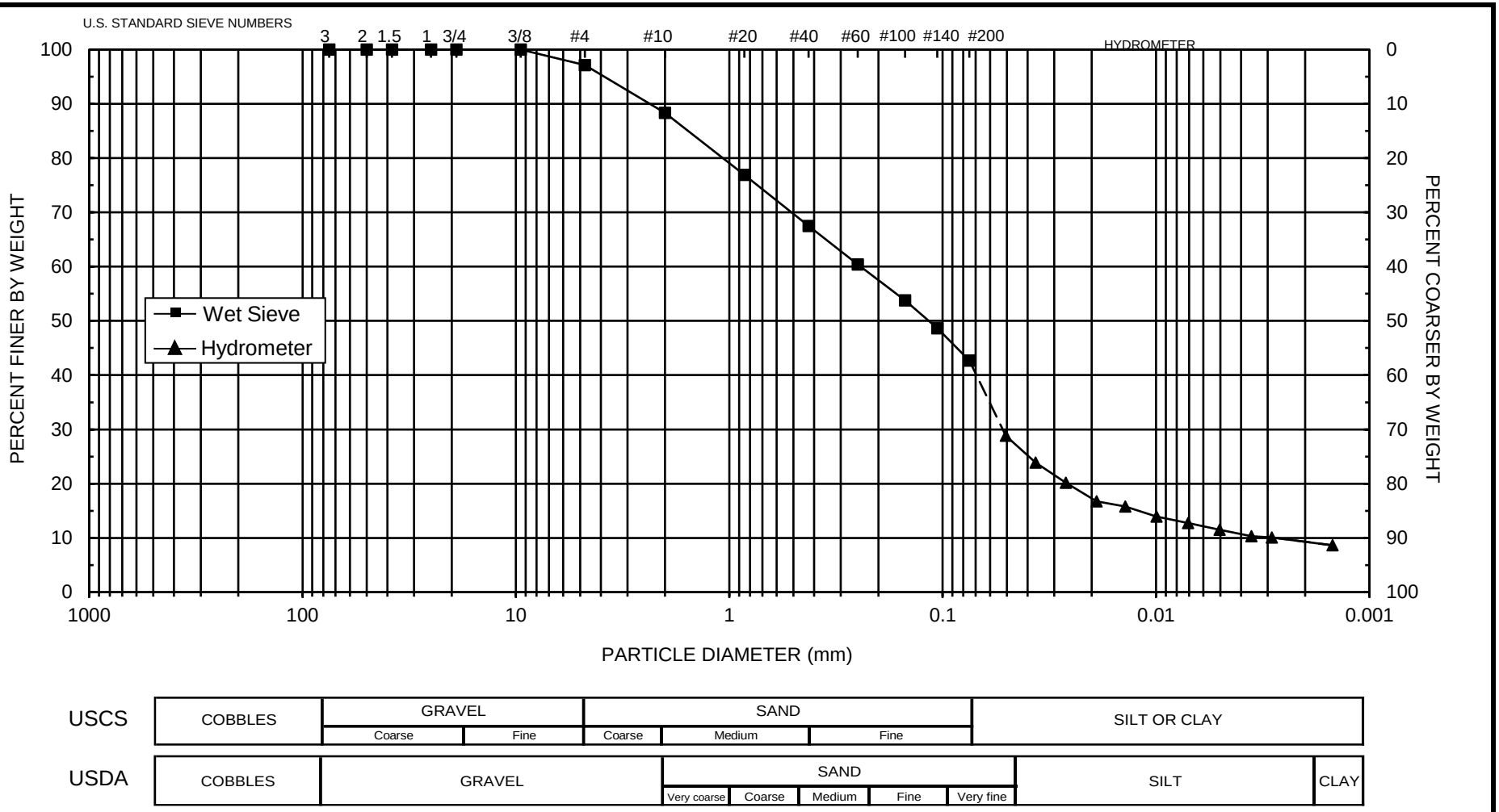
Initial Wt. (g)*:* 73.90
Total Sample Wt. (g)*:* 1995.14
Wt. Passing #10 (g)*:* 1762.05

Date	Time (min)	Temp (°C)	R (g/L)	R_L (g/L)	R_{corr} (g/L)	H_m (cm)	D (mm)	P (%)	% Finer
29-Apr-24	1	21.80	28.00	4.75	23.3	13	0.0506	33	28.8
	2	21.80	24.00	4.75	19.3	13	0.0367	27	23.9
	4	21.80	21.00	4.75	16.3	14	0.0264	23	20.2
	8	21.80	18.25	4.75	13.5	14	0.0190	19	16.7
	15	21.80	17.50	4.75	12.8	14	0.0139	18	15.8
	30	21.80	16.00	4.75	11.3	15	0.0099	16	14.0
	60	21.90	15.00	4.71	10.3	15	0.0071	14	12.8
	120	21.90	14.00	4.71	9.3	15	0.0050	13	11.5
	240	22.00	13.00	4.68	8.3	15	0.0036	12	10.3
	375	22.20	12.75	4.60	8.1	15	0.0029	11	10.1
30-Apr-24	1409	22.40	11.50	4.53	7.0	15	0.0015	10	8.6

Comments:

* Dispersion device: mechanically operated stirring device

Laboratory analysis by: W. Seward
Data entered by: W. Seward
Checked by: J. Hines



d_{10} = **0.0027**	d_{30} = **0.052**	d_{50} = **0.12**	d_{60} = **0.24**	C_u = **89**	C_c = **4.2**

SAMPLE NUMBER	TIME SAMPLED	USCS CLASSIFICATION	USDA CLASSIFICATION
DUP-20240417	**1234**	**Classification by ASTM 2487 requires Atterberg test**	**Sandy Loam †**

† Greater than 10% of sample is coarse material

Particle Size Analysis
Sieve Data (#10 Split)

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: DA-20240417
Date Sampled: 4/17/24
Time Sampled: 1243
Test Date: 25-Apr-24

Initial Dry Weight of Sample (g): 3009.22
Weight Passing #10 (g): 1505.07
Weight Retained #10 (g): 1504.15
Weight of -10 Sub-Sample (g): 60.98
Calculated Weight of Sieve Sample (g): 121.92

Test Fraction	Sieve Number	Diameter (mm)	Wt. Retained	Cum Wt. Retained	Wt. Passing	% Passing
+10						
	3"	75	0.00	0.00	3009.22	100.0
	2"	50	0.00	0.00	3009.22	100.0
	1.5"	38.1	56.00	56.00	2953.22	98.1
	1"	25	140.15	196.15	2813.07	93.5
	3/4"	19.0	171.46	367.61	2641.61	87.8
	3/8"	9.5	143.76	511.37	2497.85	83.0
	4	4.75	457.84	969.21	2040.01	67.8
	10	2.00	534.94	1504.15	1505.07	50.0
-10			(Based on calculated sieve wt.)			
	20	0.85	18.77	79.71	42.21	34.6
	40	0.425	15.51	95.22	26.70	21.9
	60	0.250	7.34	102.56	19.36	15.9
	100	0.150	5.50	108.06	13.86	11.4
	140	0.106	2.55	110.61	11.31	9.3
	200	0.075	1.39	112.00	9.92	8.1
	dry pan		0.10	112.10	9.82	
	wet pan			9.82	0.00	

d_{10} (mm): 0.12
d_{16} (mm): 0.25
d_{30} (mm): 0.66
d_{50} (mm): 2.0
d_{60} (mm): 3.3
d_{84} (mm): 11

Median Particle Diameter --d_{50} (mm): 2.0
Uniformity Coefficient, Cu --$[d_{60}/d_{10}]$ (mm): 28
Coefficient of Curvature, Cc --$[(d_{30})^2/(d_{10}*d_{60})]$ (mm): 1.1
Mean Particle Diameter --$[(d_{16}+d_{50}+d_{84})/3]$ (mm): 4.4

USCS Soil Classification: Classification by ASTM 2487 requires Atterberg test
USDA Soil Classification: Loamy Sand †

† Greater than 10% of sample is coarse material

Laboratory analysis by: L. Hooker
Data entered by: L. Hooker
Checked by: J. Hines

Particle Size Analysis
Hydrometer Data

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: DA-20240417
Date Sampled: 4/17/24
Time Sampled: 1243

Test Date: 29-Apr-24
Start Time: 8:42

Type of Water Used: DISTILLED
Reaction with H_2O_2*:* MODERATE
Dispersant:* $(NaPO_3)_6$
Assumed particle density: 2.50

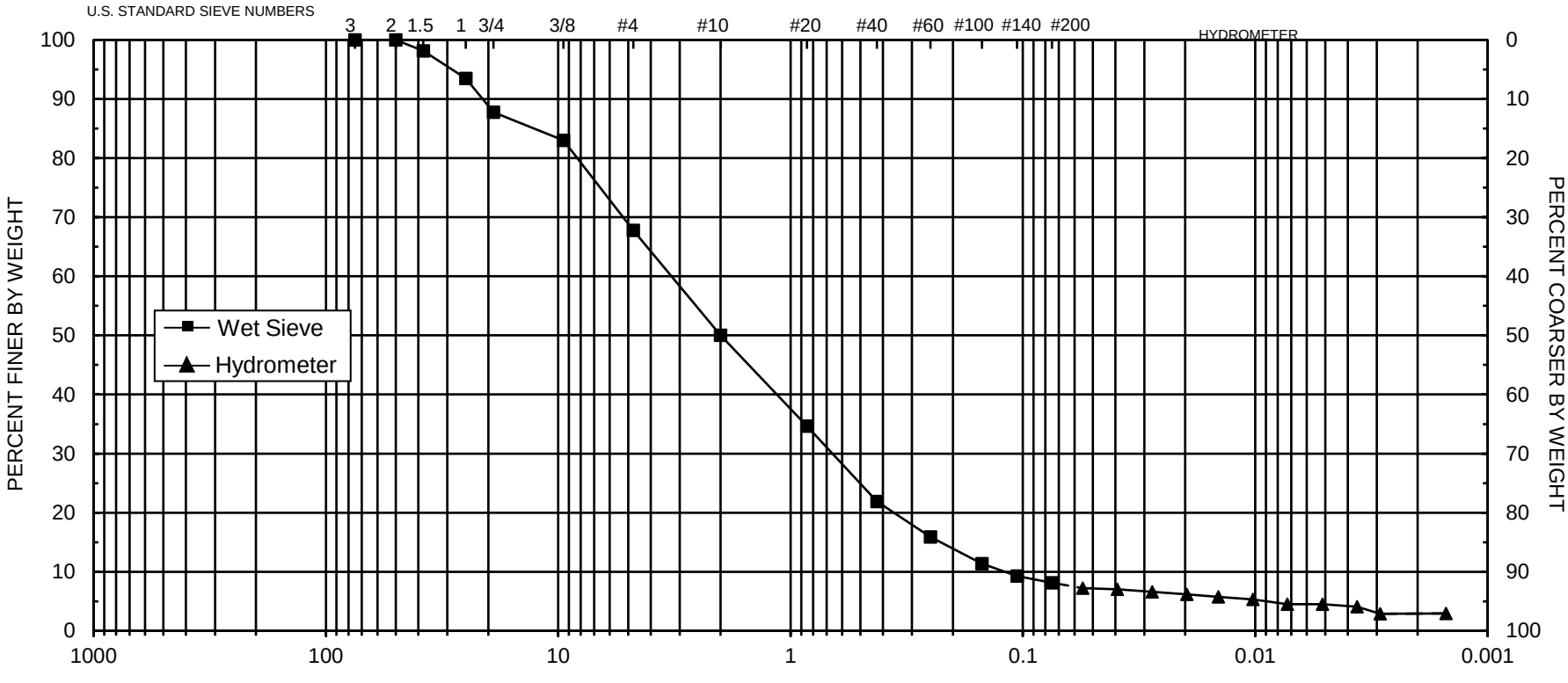
Initial Wt. (g)*:* 60.98
Total Sample Wt. (g)*:* 3009.22
Wt. Passing #10 (g)*:* 1505.07

Date	Time (min)	Temp (°C)	R (g/L)	R_L (g/L)	R_{corr} (g/L)	H_m (cm)	D (mm)	P (%)	% Finer
29-Apr-24	1	21.80	13.25	4.75	8.5	15	0.0553	14	7.2
	2	21.80	13.00	4.75	8.3	15	0.0392	14	7.0
	4	21.80	12.50	4.75	7.8	15	0.0278	13	6.6
	8	21.80	12.00	4.75	7.3	15	0.0197	12	6.2
	15	21.80	11.50	4.75	6.8	15	0.0144	11	5.7
	30	21.80	11.00	4.75	6.3	15	0.0102	11	5.3
	60	21.90	10.00	4.71	5.3	16	0.0073	9	4.5
	120	21.90	10.00	4.71	5.3	16	0.0051	9	4.5
	240	22.00	9.50	4.68	4.8	16	0.0036	8	4.1
	386	22.20	8.00	4.60	3.4	16	0.0029	6	2.9
30-Apr-24	1424	22.40	8.00	4.53	3.5	16	0.0015	6	3.0

Comments:

* Dispersion device: mechanically operated stirring device

Laboratory analysis by: W. Seward
Data entered by: W. Seward
Checked by: J. Hines



USCS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		Coarse	Fine	Coarse	Medium	Fine	
USDA	COBBLES	GRAVEL	SAND				SILT	CLAY
			Very coarse	Coarse	Medium	Fine	Very fine		

d_{10} = **0.12**	d_{30} = **0.66**	d_{50} = **2.0**	d_{60} = **3.3**	C_u = **28**	C_c = **1.1**

SAMPLE NUMBER	TIME SAMPLED	USCS CLASSIFICATION	USDA CLASSIFICATION
DA-20240417	**1243**	**Classification by ASTM 2487 requires Atterberg test**	**Loamy Sand †**

† Greater than 10% of sample is coarse material

Particle Size Analysis
Sieve Data (#10 Split)

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: UA-20240417
Date Sampled: 4/17/24
Time Sampled: 1303
Test Date: 25-Apr-24

Initial Dry Weight of Sample (g): 4340.57
Weight Passing #10 (g): 1976.48
Weight Retained #10 (g): 2364.09
Weight of -10 Sub-Sample (g): 79.36
Calculated Weight of Sieve Sample (g): 174.28

Test Fraction	Sieve Number	Diameter (mm)	Wt. Retained	Cum Wt. Retained	Wt. Passing	% Passing
+10						
	3"	75	0.00	0.00	4340.57	100.0
	2"	50	304.35	304.35	4036.22	93.0
	1.5"	38.1	383.90	688.25	3652.32	84.1
	1"	25	217.89	906.14	3434.43	79.1
	3/4"	19.0	281.73	1187.87	3152.70	72.6
	3/8"	9.5	200.74	1388.61	2951.96	68.0
	4	4.75	425.82	1814.43	2526.14	58.2
	10	2.00	549.66	2364.09	1976.48	45.5
-10			(Based on calculated sieve wt.)			
	20	0.85	23.10	118.02	56.26	32.3
	40	0.425	23.56	141.58	32.70	18.8
	60	0.250	11.72	153.30	20.98	12.0
	100	0.150	7.54	160.84	13.44	7.7
	140	0.106	3.01	163.85	10.43	6.0
	200	0.075	1.43	165.28	9.00	5.2
	dry pan		0.05	165.33	8.95	
	wet pan			8.95	0.00	

d_{10} (mm): 0.20
d_{16} (mm): 0.34
d_{30} (mm): 0.76
d_{50} (mm): 2.7
d_{60} (mm): 5.4
d_{84} (mm): 38

Median Particle Diameter --d_{50} (mm): 2.7
Uniformity Coefficient, Cu --$[d_{60}/d_{10}]$ (mm): 27
Coefficient of Curvature, Cc --$[(d_{30})^2/(d_{10}*d_{60})]$ (mm): 0.53
Mean Particle Diameter --$[(d_{16}+d_{50}+d_{84})/3]$ (mm): 14

USCS Soil Classification: Classification by ASTM 2487 requires Atterberg test
USDA Soil Classification: Sand †

† Greater than 10% of sample is coarse material

Laboratory analysis by: L. Hooker
Data entered by: L. Hooker
Checked by: J. Hines

Particle Size Analysis
Hydrometer Data

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: UA-20240417
Date Sampled: 4/17/24
Time Sampled: 1303

Test Date: 29-Apr-24
Start Time: 8:48

Type of Water Used: DISTILLED
Reaction with H_2O_2*:* MODERATE
Dispersant:* $(NaPO_3)_6$
Assumed particle density: 2.75

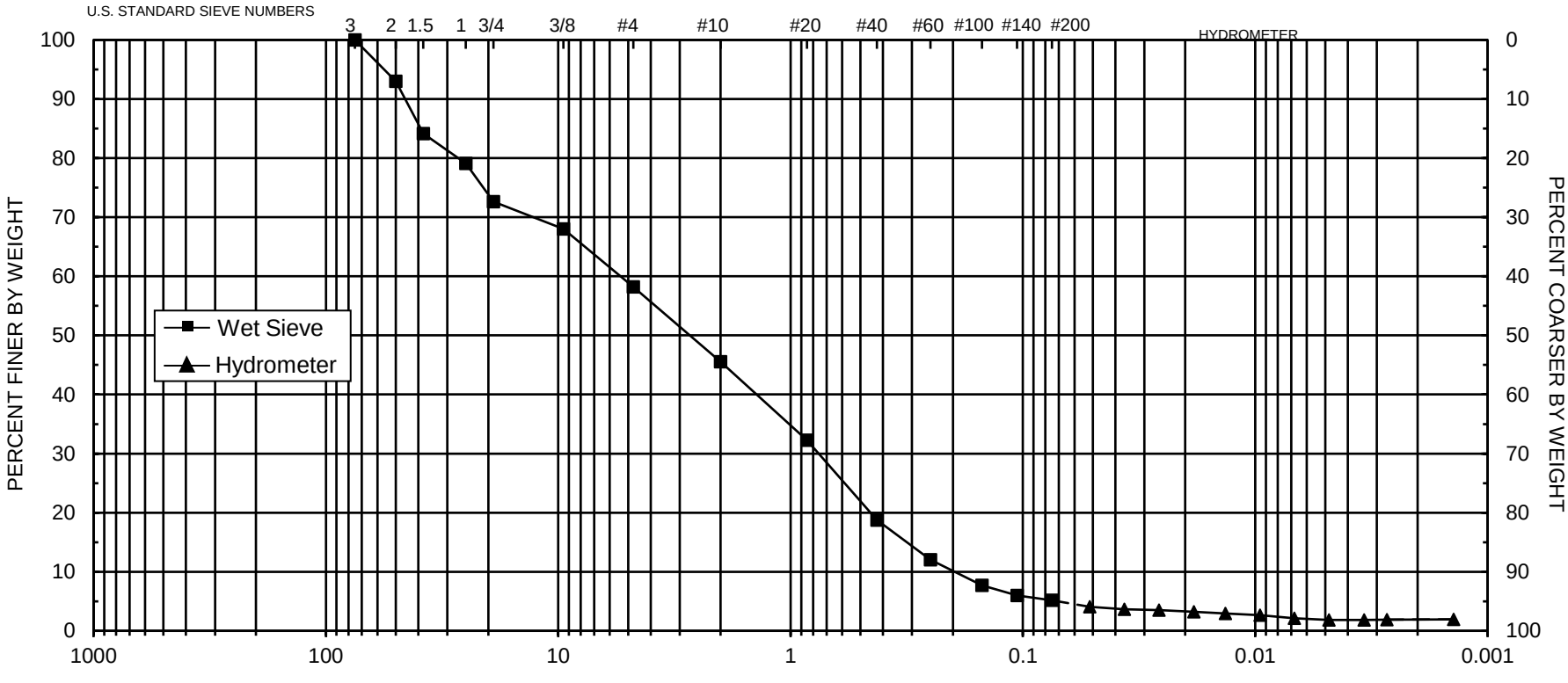
Initial Wt. (g)*:* 79.36
Total Sample Wt. (g)*:* 4340.57
Wt. Passing #10 (g)*:* 1976.48

Date	Time (min)	Temp (°C)	R (g/L)	R_L (g/L)	R_{corr} (g/L)	H_m (cm)	D (mm)	P (%)	% Finer
29-Apr-24	1	21.80	12.00	4.75	7.3	15	0.0516	9	4.1
	2	21.80	11.25	4.75	6.5	15	0.0366	8	3.6
	4	21.80	11.00	4.75	6.3	15	0.0259	8	3.5
	8	21.80	10.50	4.75	5.8	15	0.0184	7	3.2
	15	21.80	10.00	4.75	5.3	16	0.0135	6	2.9
	30	21.80	9.50	4.75	4.8	16	0.0095	6	2.7
	60	21.90	8.50	4.71	3.8	16	0.0068	5	2.1
	120	21.90	8.00	4.71	3.3	16	0.0048	4	1.8
	240	22.00	8.00	4.68	3.3	16	0.0034	4	1.9
	378	22.20	8.00	4.60	3.4	16	0.0027	4	1.9
30-Apr-24	1418	22.40	8.00	4.53	3.5	16	0.0014	4	1.9

Comments:

* Dispersion device: mechanically operated stirring device

Laboratory analysis by: W. Seward
Data entered by: W. Seward
Checked by: J. Hines



USCS	COBBLES	GRAVEL		SAND		SILT OR CLAY
		Coarse	Fine	Coarse	Medium	Fine	
USDA	COBBLES	GRAVEL	SAND				SILT	CLAY
			Very coarse	Coarse	Medium	Fine	Very fine		

d_{10} = **0.20**	d_{30} = **0.76**	d_{50} = **2.7**	d_{60} = **5.4**	C_u = **27**	C_c = **0.53**

SAMPLE NUMBER	TIME SAMPLED	USCS CLASSIFICATION	USDA CLASSIFICATION
UA-20240417	**1303**	**Classification by ASTM 2487 requires Atterberg test**	**Sand †**

† Greater than 10% of sample is coarse material

Particle Size Analysis
Sieve Data (#10 Split)

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: UFP-20240417
Date Sampled: 4/17/24
Time Sampled: 1314
Test Date: 25-Apr-24

Initial Dry Weight of Sample (g): 2836.79
Weight Passing #10 (g): 2727.74
Weight Retained #10 (g): 109.05
Weight of -10 Sub-Sample (g): 61.81
Calculated Weight of Sieve Sample (g): 64.28

Test Fraction	Sieve Number	Diameter (mm)	Wt. Retained	Cum Wt. Retained	Wt. Passing	% Passing
+10						
	3"	75	0.00	0.00	2836.79	100.0
	2"	50	0.00	0.00	2836.79	100.0
	1.5"	38.1	0.00	0.00	2836.79	100.0
	1"	25	0.00	0.00	2836.79	100.0
	3/4"	19.0	18.76	18.76	2818.03	99.3
	3/8"	9.5	6.22	24.98	2811.81	99.1
	4	4.75	32.92	57.90	2778.89	98.0
	10	2.00	51.15	109.05	2727.74	96.2
-10			(Based on calculated sieve wt.)			
	20	0.85	2.46	4.93	59.35	92.3
	40	0.425	7.28	12.21	52.07	81.0
	60	0.250	8.89	21.10	43.18	67.2
	100	0.150	10.66	31.76	32.52	50.6
	140	0.106	6.02	37.78	26.50	41.2
	200	0.075	4.17	41.95	22.33	34.7
	dry pan		0.23	42.18	22.10	
	wet pan			22.10	0.00	

d_{10} (mm): 0.0050
d_{16} (mm): 0.023
d_{30} (mm): 0.065
d_{50} (mm): 0.15
d_{60} (mm): 0.20
d_{84} (mm): 0.51

Median Particle Diameter --d_{50} (mm): 0.15
Uniformity Coefficient, Cu --[d_{60}/d_{10}] (mm): 40
Coefficient of Curvature, Cc --[$(d_{30})^2/(d_{10}*d_{60})$] (mm): 4.2
Mean Particle Diameter --[$(d_{16}+d_{50}+d_{84})/3$] (mm): 0.23

USCS Soil Classification: Classification by ASTM 2487 requires Atterberg test
USDA Soil Classification: Sandy Loam

Laboratory analysis by: L. Hooker
Data entered by: L. Hooker
Checked by: J. Hines

Particle Size Analysis
Hydrometer Data

Job Name: EMNRD, Madrid Arroyo Revegetation
Job Number: DB21.1363.00 P11T3
Sample Number: UFP-20240417
Date Sampled: 4/17/24
Time Sampled: 1314

Test Date: 29-Apr-24
Start Time: 8:36

Type of Water Used: DISTILLED
Reaction with H_2O_2*:* MODERATE
Dispersant:* $(NaPO_3)_6$
Assumed particle density: 2.65

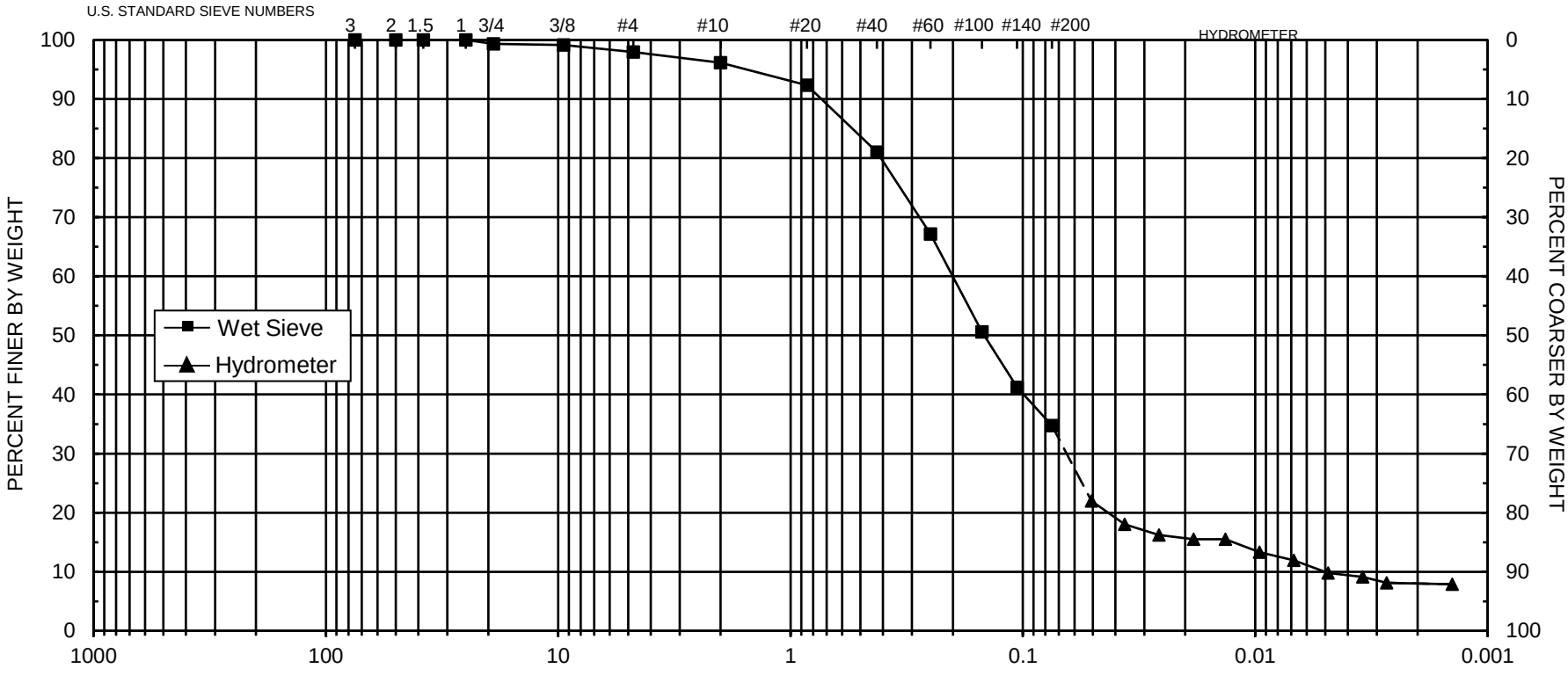
Initial Wt. (g)*:* 66.70
Total Sample Wt. (g)*:* 2836.79
Wt. Passing #10 (g)*:* 2727.74

Date	Time (min)	Temp (°C)	R (g/L)	R_L (g/L)	R_{corr} (g/L)	H_m (cm)	D (mm)	P (%)	% Finer
29-Apr-24	1	21.80	20.00	4.75	15.3	14	0.0507	23	22.0
	2	21.80	17.25	4.75	12.5	14	0.0364	19	18.0
	4	21.80	16.00	4.75	11.3	15	0.0260	17	16.2
	8	21.80	15.50	4.75	10.8	15	0.0184	16	15.5
	15	21.80	15.50	4.75	10.8	15	0.0134	16	15.5
	30	21.80	14.00	4.75	9.3	15	0.0096	14	13.3
	60	21.90	13.00	4.71	8.3	15	0.0068	12	11.9
	120	21.90	11.50	4.71	6.8	15	0.0049	10	9.8
	240	22.00	11.00	4.68	6.3	15	0.0034	9	9.1
	389	22.20	10.25	4.60	5.6	15	0.0027	8	8.1
30-Apr-24	1429	22.40	10.00	4.53	5.5	16	0.0014	8	7.9

Comments:

* Dispersion device: mechanically operated stirring device

Laboratory analysis by: W. Seward
Data entered by: W. Seward
Checked by: J. Hines



USCS	COBBLES	GRAVEL		SAND			SILT OR CLAY				
		Coarse	Fine	Coarse	Medium	Fine					
USDA	COBBLES	GRAVEL		SAND				SILT	CLAY		
				Very coarse	Coarse	Medium	Fine	Very fine			

d_{10} = **0.0050**	d_{30} = **0.065**	d_{50} = **0.15**	d_{60} = **0.20**	C_u = **40**	C_c = **4.2**

SAMPLE NUMBER	TIME SAMPLED	USCS CLASSIFICATION	USDA CLASSIFICATION
UFP-20240417	**1314**	**Classification by ASTM 2487 requires Atterberg test**	**Sandy Loam**

Laboratory Tests and Methods

Tests and Methods

Dry Bulk Density:	ASTM D7263
Moisture Content:	ASTM D7263, ASTM D2216
Calculated Porosity:	ASTM D7263
Particle Size Analysis:	ASTM D7928, ASTM D6913
USDA Classification:	ASTM D7928, ASTM D6913, USDA Soil Textural Triangle
Water Holding Capacity (calc):	ASTM D6836; Stephens, D. B. 1996, pp.11-12, Vadose Zone Hydrology. CRC Press, Inc., Boca Raton, FL

Attachment 3

Photographs

DBS&A
a Geo-Logic Company

1. Historic mahonia to be preserved

2. Apache plume

3. *Atriplex canescens*

4. Chamisa

5. Evening primrose

6. *Sphaeralcea coccinea*

Attachment 4

Technical Specification

DBS&A
a Geo-Logic Company

SECTION 32 92 19

SEEDING

PART 1 GENERAL

1.1 References

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

B. ASTM International (ASTM)
1. ASTM C602 Agricultural Liming Materials (2020)
2. ASTM D4427 Standard Classification of Peat Samples by Laboratory Testing (2018)
3. ASTM D4972 Standard Test Methods for pH of Soils (2018)

C. U.S. Department of Agriculture (USDA)
1. AMS Seed Act (1940; R 1988; R 1998) Federal Seed Act
2. DOA SSIR 42 Soil Survey Investigation Report No. 42, Soil Survey Laboratory Methods Manual, Version 3.0

D. Federal Highway Administration (FHWA). Roadside Revegetation: An Integrated Approach to Establishing Native Plants and Pollinator Habitat. Chapter 5 Implementation

1.2 Definitions

A. Stand of Turf: 60 percent ground cover of the established species.

1.3 Related Requirements

A. New Mexico Department of Transportation (NMDOT) Standard Specification for Highway and Bridge Construction, 2019 edition, Section 632 Revegetation.

1.4 Submittals

A. Engineer approval is required for submittals with an "E" classification. Submittals not having an "E" classification are for information only. When used, a code following the "E" classification identifies the office that will review the submittal for the Engineer. Submit the following:
1. SD-03 Product Data
   a. Compost Mulch
   b. Hydroseeding Fertilizer
   c. Hydro Mulch with Tackifier
   d. Include physical characteristics, and recommendations
2. SD-06 Test Reports
   a. Topsoil Composition Tests (reports and recommendations).
3. SD-07 Certificates

a. State Certification and Approval for Seed SD-08 Manufacturer's Instructions
b. Erosion Control Materials

1.5 Delivery, Storage, and Handling

A. Delivery
1. Seed Protection: Protect from drying out and from contamination during delivery, on-site storage, and handling.
2. Fertilizer and Lime Delivery: Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer may be furnished in bulk with a certificate indicating the above information.

B. Storage
1. Seed, Fertilizer Storage: Store in cool, dry locations away from contaminants.
2. Topsoil: Prior to stockpiling topsoil, treat growing vegetation with the application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.

C. Handling
1. Do not drop or dump materials from vehicles.

1.6 Time Restrictions and Planting Conditions

A. Restrictions
1. Do not plant when the ground is frozen, snow covered, muddy, or when air temperature exceeds 90°F. Refer to the project plant species list for detailed planting times.

1.7 Time Limitations

A. Seed: Apply seed within 24 hours after seed bed preparation.

PART 2 PRODUCTS

2.1 Seed

A. Classification: Obtain seed mixes from the closest possible source (e.g., Curtis and Curtis in Clovis, New Mexico or a seed supplier in Colorado). Provide AMLP-approved seed of the latest season's crop delivered in original sealed packages, bearing producer's guaranteed analysis for percentages of mixtures, purity, germination, weedseed content, and inert material. Label in conformance with AMS Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will be rejected. Field mixes will be acceptable when field mix is performed on site in the presence of the Engineer.

B. Seed Mixture by Weight: See the following table.

Table 1. Seed Quantities

Plant Name	Scientific name	Live Planting - Each	Seeding (Pure Live Seed) recommended lbs/acre**	Total Area (A, B, C) in acres	Total Quantity (pounds)
WOODY PLANTS - seed mix					
Four-winged saltbush	*Atriplex canescens*		1.20	5.83	6.996
HERBACEOUS PLANTS - wildflower seed mix					
Scarlet globemallow	*Sphaeralcea coccinea*		0.90	5.83	5.247
Evening primrose	*Oenothera pallida*		0.30	5.83	1.749
Winterfat	*Krascheninnikovia lanata*		0.60	5.83	3.498
Butterfly-weed (showy milkweed)	*Asclepias speciosa*		2.10	8.88	18.648
Palmer's Penstemon	*Penstemon palmeri*		0.60	8.88	5.328
Scarlet penstamon	*Penstemon barbatus ssp. torreyi*		0.60	9.31	5.586
Scarlet gilia	*Ipomopsis aggregata*		0.60	9.31	5.586
Desert marigold	*Baileya multiradiata*		0.30	8.88	2.664
Sand verbana	*Abronia villosa*		0.30	8.88	2.664
Common hoptree	*Ptelea trifoliata*		1.00	0.32	0.32
Utah juneberry	*Amelanchier utahensis*		0.50	1.12	0.56
Datura	*Datura wrightii*		0.50	3.37	1.685
Desert four o'clock	*Mirabolis multiflora*		0.60	0.32	0.192
GRASSES PLANTS					
Alkali sacaton grass	*Sporobolus airoides*		0.70	8.88	6.216
Sideoats grama	*Bouteloua curtipendula*		1.75	8.88	15.54
Blue grama	*Bouteloua gracilis*		1.75	8.88	15.54
Western wheatgrass	*Agropyron smithii*		3.75	9.31	34.9125
sand dropseed	*Sporobolus cryptandrus*		0.28	8.88	2.4864
James galleta	*Pleuraphis jamesii*		3.50	9.31	32.585
WOODY					
Chamisa	*Ericameria nauseosa*		0.20	3.37	0.674
Apache plume	*Fallugia paradoxa*		0.20	3.37	0.674
New Mexico locust	*Robinia neomexicana*		1.00	0.36	0.36
Mahonia/desert holly	*Mahonia haematocarpa*		0.75	1.12	0.84
HERBACEOUS PLANTS					
Broadleaf milkweed	*Asclepias latifoliav*		1.50	1.12	1.68
Antelope horns milkweed	*Asclepias asperula*		1.50	8.88	13.32

Plant Name	Scientific name	Live Planting - Each	Seeding (Pure Live Seed) recommended lbs/acre**	Total Area (A, B, C) in acres	Total Quantity (pounds)
Sweet sand verbana	*Abronia fragrans*		0.25	3.37	0.8425
Total pounds of all pure live seed/acre			27.23		186.39
No Supplemental Water Required					
Live plantings (plugs)					
Native grasses (see above species)		400			
Shrubs (Chamisa, Apache Plume)		200			
TOTAL		600			
Supplemental Water Required					
Live plantings (10-gallon containers)					
Two-needle pinyon	*Pinus edulis*	5			
NM Locust	*Robinia neomexicana*	9			
Three-leaf sumac	*Rhus trilobata*	11			
Scrub oak - gambel or wavyleaf	*Quercus sp.*	22			
	TOTAL	47			

*NOTE: Quantities based on NMDOT revegetation quantities and USDA
**DBS&A recommended quantities were increased to ensure seedling establishment and bring closer to quantities provided by Plants of the Southwest (2022).

Areas and Calculations

Species Formulas:

Areas in Acres

A - 5.83, B - 1.12, C - 0.32, A/B - 1.93, B/C - 0.11

Formulas for Seed Ratio

A/B = 6 x A + .4 x B, B/C = .6 x B + .4 x C

Suitable for A or B

Then total Area = A, B, A/B, So A + B + A/B, 5.83 + 1.12 + 1.93 **= 8.88 Acres**

Suitable for B or C

Then total Area = B, C, B/C, So B + C + B/C, 1.12 + 0.32 + 0.11 **= 3.37 Acres**

Suitable for A, B, or C

Then total Area = A, B, C, A/B, B/C, So A + B + C + A/B + B/C, 5.83 + 1.12 + 0.32 + 1.93 + 0.11 **= 9.31 Acres**

2.2 Topsoil

A. On-Site Topsoil: Surface soil stripped and stockpiled on site and modified as necessary to meet the requirements specified for topsoil in paragraph 2.2.C Composition. When available, topsoil must be existing surface soil stripped and stockpiled on-site.

B. Off-Site Topsoil: Conform to requirements specified in paragraph 2.2.C Composition. Additional topsoil must be furnished by the Contractor.

C. Composition: Containing from 5 to 10 percent organic matter as determined by the topsoil composition tests of the Organic Carbon, 6A, Chemical Analysis Method described in DOA SSIR 42. Maximum particle size, ¾ inch, with maximum 3 percent

retained on ¼-inch screen. The pH must be tested in accordance with ASTM D4972. Topsoil must be free of sticks, stones, roots, and other debris and objectionable materials.

2.3 Mulch

A. Compost Mulch: Mulch must be free from noxious weeds, mold, and other deleterious materials. Composted mulch provider must be registered with or permitted by the New Mexico Environment Department Solid Waste Bureau and must be in compliance with 20.9.1 NMAC. Composted mulch is defined as the product of a controlled aerobic thermophilic biological decomposition process that meets the quality requirements in NMDOT Section 632.2.6, Table 632.2.6:1, "Requirements of Compost Mulch." Raw materials used in producing composted mulch may include green waste, animal manure, animal bedding, paper waste, food waste, biosolids or other non-toxic organic matter, but shall not include animal mortalities. Compost mulch shall be 134 cubic yards per acre.

B. Hydro Mulch with Tackifier: Hydro-mulch shall be Bonded Fiber Matrix (BFM). BFM is a hydraulically-applied blanket that controls soil erosion and accelerates seed germination. BFM is a three-dimensional composite of wood or paper fibers bonded by polymer tackifier that provides high performance erosion prevention on slopes. Dye and tackifier shall be included in the BFM formulation. BFM shall be applied at a rate of 2,000 pounds per acre.

2.4 Fertilizer

A. Granular Fertilizer: Not used

B. Hydroseeding Fertilizer:
1. Fertilizer shall be organic, slow release with an N-P-K (nitrogen, phosphorous, potassium) analysis of either 3-6-3 or 3-7-2 and blended with endo-mycorrhiza and humates. (NMDOT Section 632.2.3)
2. Application rate shall be 1,000 pounds per acre. Humates must comprise a minimum of 15% by weight. Endo-mycorrhiza must be arbuscular with a minimum propagule of 1.33 propagules per gram.
3. The Contractor shall provide fertilizer (specified type and formulation) and supplier's certification in accordance with the Contract. Each bag or tote of fertilizer shall have a visible, sealed, and un-altered analysis tag from the manufacturer. The tag must include the manufacturer's information, the N-P-K analysis of the product, and the weight of the bag or tote.

2.5 Water

A. Source of water must be approved by Engineer and of suitable quality for irrigation, containing no elements toxic to plant life.

PART 3 EXECUTION

3.1 Preparation

A. Extent of Work: Provide soil preparation prior to planting (including soil conditioners as required), fertilizing, seeding, and surface topdressing of newly graded finished earth surfaces, unless indicated otherwise, and at areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

B. Prior to seedbed preparation, the Contractor shall grade all disturbed areas as described and roughen the surface as specified. On slopes up to 1.5h:1v, the soil surface in areas to be seeded shall be prepared to be continuously rough and hummocky. This shall be accomplished by using an excavator bucket, or other acceptable methods that produce similar results, to create small pockets and furrows to trap water and create favorable microclimates for plant growth.

C. Topsoil: Provide 4 inches of existing soil with 1 inch compost mulch to meet the indicated finish grade. After areas have been brought to indicated finish grade, incorporate compost mulch into soil a minimum depth of 4 inches by disking, harrowing, tilling or other method approved by the Engineer. Remove debris and stones larger than ¾ inch in any dimension remaining on the surface after finish grading. Correct irregularities in finish surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.

3.2 Seeding

A. Seed Application Seasons and Conditions

1. Seeding shall be accomplished between June 15 and August 31 of each year unless specific permission in writing is issued by the Project Engineer to allow seeding before or after these dates. Refer to the plant species list for exceptions (e.g. allowed fall planting for trees). Immediately before seeding, restore soil to proper grade. Do not seed when the ground is muddy, frozen snow covered, or in an unsatisfactory condition for seeding. If special conditions exist that may warrant a variance in the above seeding dates or conditions, submit a written request to the Engineer stating the special conditions and proposed variance. Apply seed within 24 hours after seedbed preparation. Sow seed by approved sowing equipment. Sow one-half the seed in one direction and sow the remainder at right angles to the first sowing.
2. Any Project areas with slopes less than 3:1 requiring revegetation which are less than 8 feet wide, or are inaccessible to drill seeding equipment, or are too rocky to disk to a 4 inch depth, shall use the following procedure.
    a. The Contractor shall disk soil to a 4 inch depth with 1 inch of incorporated compost mulch. A skid steer with attachments may be used. If the seed bed is too rocky to disk to 4 inches, the Contractor shall chain harrow or hand rake the entire area and proceed with Steps 1 and 2 below.

B. Seed Application Method

1. Seeding method shall be hydroseeding. A hydro-seeder shall be used to apply the seed and hydro seeding fertilizer in the following two steps.
    a. Step 1. The Contractor shall apply seed and fertilizer to the newly disked soil and compost, rake or chain harrow so seed is covered with soil.
    b. Step 2. The Contractor shall apply an approved bonded hydro-mulch BFM with dye and tackifier applied in two coats from opposing directions at rate of 2,000 pounds per acre.
2. Hydroseeding Mix: Mix water and hydroseeding fertilizer. Fertilizer shall be added at 1,000 pounds, dry weight, per acre. Add and mix seed and fertilizer to produce a homogeneous slurry. Seed must be mixed to ensure broadcasting at the rate of 2,000 pounds per acre. When hydraulically sprayed on the ground, material must form a blotter like cover impregnated uniformly with seed. Spread with one application with no second application of mulch.

C. Hydro Mulch with Tackifier: Hydro-mulch shall be BFM, a hydraulically-applied blanket that controls soil erosion and accelerates seed germination. BFM shall be applied at a rate of 2,000 pounds per acre spread by hand, blower-type mulch spreader, or other approved method. Areas installed with seed must be mulched on the same day as the seeding.

D. Erosion Control Material
1. Install in accordance with manufacturer's instructions. Straw Wattles will be used for erosion and sediment control following the completion of earth moving operations, placed along contour of reconstructed slopes, spaced at intervals of 5 feet vertically along slopes with a final grade steeper than 10%, or 10 feet horizontal to 1 foot vertical (10H:1V) throughout the project area.
2. Acceptable straw wattles will be manufactured from rice straw and must be wrapped in tubular plastic netting. The netting, which must have a strand thickness of 0.03 inch, must consist of 85% high density polyethylene (HDPE), 14% ethyl vinyl acetate, and 1% color for ultraviolet inhibition. The wattles must be a nominal 9 inches in diameter and a nominal 25 feet long, with a weight of approximately 35 pounds each.
3. Wattles will be installed on contour in trenches that are 3 to 5 inches in depth, and 9 inches wide. Wattles will be anchored in the trench by l-inch x l-inch by 24-inch stakes on 4-foot centers. The ends of adjacent wattles must be butted one to another. Wattles must be certified weed free.

E. Watering: Start watering areas seeded as required by temperature and wind conditions. Apply water at a rate sufficient to ensure thorough wetting of soil to a depth of 4 to 6 inches without runoff and supplement with hand watering if that depth is not achieved. The 3,000-gallon tank will provide six watering sessions of 500 gallons each and the tank will need to be refilled. The contractor will be responsible for maintaining a sufficient volume of water in the tank during the supplemental watering period. Watering methods can also include the use of a water truck with spray hose for accessible areas.

F. Live Plantings. Refer to the FHWA guidelines for planting methods and irrigation recommendations. Following planting, supplemental irrigation will be provided to the plantings by providing water through a temporary irrigation system that will include a buried 3,000-gallon water tank and 50 emitters (see construction plans for tank location). The irrigation system is to provide water to trees and shrubs for up to two years to help

ensure plant survivability. A total of 400 grass plugs and 200 seedlings of Apache plumes and chamisa will be planted throughout the reseeded areas. Additional live plantings will include 10-gallon shrubs and trees as shown on the attached figures and plate. Only the 10-gallon shrubs and trees will receive supplemental water in the form of drip irrigation.

3.3 Restoration

A. Restore to original condition existing turf areas which have been damaged during turf installation operations at the Contractor's expense. Keep at least one pedestrian access route and one vehicular access route to structure clean. Clean other access routes when work in adjacent areas is complete.

END OF SECTION