McDowell Mountain Regional Park

Degraded Lands Mapping Summary and Results

July 2020

MCDOWELL SONORAN CONSERVANCY

science is in our nature

www.mcdowellsonoran.org
7729 E. Greenway Road, Suite 100
Scottsdale, AZ 85260
Phone: 480-998-7971

MCDOWELL SONORAN CONSERVANCY

science is in our nature

Table of Contents

Background and Introduction

In the Sonoran Desert, many barriers exist to successful ecological restoration including both climatic (e.g. drought) and logistical constraints (e.g. a lack of available native plant materials). To support future restoration planning in McDowell Mountain Regional Park (MMRP or the Park) we mapped degraded areas, categorized these by types of disturbance, and then provided information to help the Park prioritize and support restoration efforts.

Methodology

Two scans of MMRP were completed by volunteers, the first on Google Earth Pro (GE) and the second using ArcMap 10.6 and ArcGIS Online with aerial imagery provided by Maricopa County Parks and Recreation (MCP). The GE imagery was dated August 2019 and had average resolution per Google of 15–65 cm/pixel. The aerial imagery was taken September–December 2018 and had resolution of 10 cm/pixel.

Data from MCP and the Arizona Department of Water Resources (ADWR) showing the following were added to both GE and to the higher-resolution ArcGIS scans:

1. MMRP boundary
2. MMRP trails
3. River 10-foot Countywide – centerline or boundary of water features including washes as defined by the ADWR 2001 10-foot countywide mapping project.

We also created a map layer showing “designated” (official) service roads as indicated on the MMRP Park Map from the MCP website (https://www.maricopacountyparks.net/assets/1/6/mcdowell-8x11-mi1.pdf).

MMRP was divided into 10 sections from north to south. Each section extended about 1 km north-south and the full east-west width of the Park, an area averaging roughly 2100 acres per section. Citizen scientists were trained to scan assigned sections of the Park at a scale of about 1" (on screen) = 25 m. When they saw a candidate degraded location, they zoomed in and marked it if it met the following criteria:

1. At least 10 m x 10 m in extent
2. Bare dirt with no or limited visible vegetation
3. Human-caused rather than animal-caused or natural features

Citizen scientists did not mark existing trails, washes, or designated service roads but did note distinct, extended, generally linear features that were not designated as official trails or service roads. Each section was reviewed by two different volunteers.

All the potential disturbed sites compiled by the volunteers were verified by a third trained observer to confirm whether the sites fit the above criteria. False positives were removed, and the remaining candidate sites were transferred to ArcMap 10.6 and ArcGIS Online. The sites were then examined by two different people using high-resolution (10 cm/pixel) aerial imagery. This review round eliminated some previously-identified sites, adjusted the sizes and shapes of some identified areas, and, in a few cases, added sites. Sites were eliminated based on these determinations:

- Did not meet the minimum size requirement. (Note, however, that some degraded trail or road junctions were retained even if they did not meet the minimum size criterion because such areas often increase in size over time.)
- Were actually natural areas with no large plants rather than bare earth sites (a distinction that could be made with the higher resolution of the aerial photos).
- Were animal (rather than human) trail clusters characterized by short, indistinct pathways in random directions.
- Were previously-unmarked wash extensions or branches.

In summary, "degraded areas" were defined either as dirt areas generally >100 m^2 with no or limited vegetation and likely to have been caused by human use or as concentrated clusters of unauthorized human trails. Three different categories of degraded areas were identified:

1. Polygons identifying either bare areas or clusters of use trails (61 features).
2. Linear features identifying isolated unauthorized trails, i.e., easily visible trails that generally run linearly for extended distances with a destination, but which are not marked on the trails map provided by MCP (24 features).
3. Linear features identifying possible additional service roads, i.e., wide bare features that generally run linearly for extended distances with a destination, but which are not indicated as service roads on the MMRP map from the MCP website (24 features).

Results

Tables 1–3 show the final results for identified disturbed areas, including length for linear features (unauthorized trails and possible service roads) and area for polygons. For planning purposes, further information is provided for polygons including type of disturbance and distance to the nearest official trail, official service road, or paved road. These tables should be used in conjunction with the degraded lands map described in Appendix A: Deliverables.

The final degraded lands map is provided in several formats for ease of inspection and use. See Appendix A: Deliverables for details.

The complete degraded lands map includes the following layers:

1. Three layers of identified disturbed areas:
    - Polygons (types: widened trail/road junctions, widened areas along roads/trails, possible mining sites, human use-trail clusters)
    - Unauthorized trails
    - Possible service roads
2. Official MMRP trails layer
3. Designated service roads layer
4. Wash centerlines or boundaries
5. USDA Web Soil Survey soil map units, useful for identifying native plant communities before disturbance
6. Park boundary

Summary of findings and map information tools

We identified 61 disturbed sites, 55 were at least 100 m2 in size and another six (four junctions, one trailside widened area, and one possible mining test site) are <100 m2, but were documented here because they may also be good candidates to consider for interventions. An additional 24 linear disturbances were assumed to be unauthorized trails (Tables 1 & 2). Sites ranged from 45 m2 to 46,165 m2 (Table 1). We provided information associated with each disturbance to help managers prioritize mitigation or restoration activities. Information includes type of disturbance (trail junction, mining site, trail widening, and trail cluster) and distance to the nearest access point (Table 1). Additional considerations in prioritizing restoration activities may include whether the disturbance has ceased or can be stopped and available resources. We have also provided the table information in Excel workbook format (Deliverable 1, Appendix A), which can be useful for sorting data according to size of disturbance or distance to nearest access, for prioritizing. For example, one may choose to prioritize the largest disturbances with the nearest access.

Note that the lists of degraded areas also may include some sites that receive official use and, therefore, may not be suitable for mitigation:

- Some of the identified degraded areas are near the high-voltage lines that run along the eastern portion of MMRP. Although we did not include areas directly under the power lines in the list of degraded areas, we did include some nearby areas that may be associated with access to the power lines, subject to power company easements, etc.

- Some of the identified degraded areas are alongside paved roads through MMRP. These areas may be the result of roadway construction or be within roadway easements, associated with power line access, etc.

- Some of the linear features labeled as “possible service roads” actually may be active MMRP roads, planned firebreaks, emergency access routes, closed roads with mitigation in progress, etc., even though they are not shown on the MMRP Park Map (Table 3).

Overview of degraded areas and possible mitigation actions

One of the most heavily degraded areas of MMRP is the western half of the northern boundary, which is bordered by development. This area includes many "social" trails originating from the adjacent neighborhoods, and many of the identified degraded area features are concentrated in this part of the Park. The degraded land map can be used by MCP to review this area and consider available approaches for stopping the disturbance and active restoration.

In terms of closures, it may be more cost-effective to close the whole area to further use with a robust fence and signage rather than attempt to halt use of every individual degraded area in that vicinity. Note that three official spur trails to the northern boundary already exist; perhaps in conjunction with partial closure of this portion of the boundary, managers can consider reconfiguring the trail system in that area to better direct local use. For resources on active restoration, see sections below regarding treatments for linear disturbances as well as the following section about how to choose plant species for restoration.

There are many obvious but apparently unofficial trails visible throughout the Park in the aerial photos. We tried to distinguish between animal use-trails, which tend to be faint and random in direction, and those caused by human activity, which tend to be better defined, more linear, longer, and often have a rationale (e.g., a shortcut) or a destination (e.g., an official park trail). We did not mark all possible human-caused trails but rather selected those that ran for extended distances and appeared better established. Experience with mitigation of closed roads and trails in the McDowell Sonoran Preserve indicates that an effective treatment for keeping traffic off of linear features is to close off the ends and junctions with some combination of ripping, transplants, deadfall, boulders, and signage to stop further use. We recently completed a study that assessed restoration outcomes of a combination of these restoration techniques (journal article in press).

Historical records indicate that a number of test sites for possible clay mining were excavated by bulldozers before the Park area was protected. However, we cannot find any map showing the location of these sites. We identified a number of possible mining test sites in several clusters. Whenever possible, we looked for proximity to a service road (official or possible), a trail (official or unauthorized), or a large wash that could serve as an access corridor. Most of the marked sites had such associated access, which supports the conclusion that they were human-caused rather than natural geologic features. When in doubt, we included these locations on the degraded area list. However, we suggest that they be examined more closely to determine conclusively whether they are manmade or natural.

How to choose plant species for restoration: Soil Map and Ecological Site Descriptions

A critical first step before commencing ecological restoration is to stop the disturbance (Society for Ecological Restoration primer). In some cases, if the disturbance was not extensive, this may be all that is required to allow for natural recovery. In cases with extensive disturbance, more active restoration may be desired.

One common technique for active restoration is seeding with a native plant seed mixture and/or transplanting native plant seedlings or cuttings. However, with extensive degradation and disturbance, the native species in an area may not be obvious. Also, there can be significant changes in the dominant and common species over surprisingly short distances due to ecological changes related to soil type, slope, exposure, etc. This means that sometimes simply using the species that are visible in nearby areas may not be the best guide for active restoration.

> https://cdn.ymaws.com/www.ser.org/resource/resmgr/custompages/publications/ser_publications/ser_primer.pdf

The USDA Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx) (WSS) can be helpful in identifying the most common native species associated with the soil type of a specific area. To determine appropriate species for MMRP, we established an “area of interest” that covered the park, then generated a soil map for that area and included it as a layer in the restoration maps. The soil report generated by the WSS shows the soil map, lists the soil types, and provides a description of various characteristics of each soil type in the area (Deliverable 6a, Appendix A). An Ecological Site Description (ESD) is associated with each soil type. These are accessed via the hyperlinks provided in the “Links to MMRP Ecological Site Descriptions” document (Deliverable 6b, Appendix A). Each ESD document includes a state and transition model that describes the general impact on local species of ecological transitions such as the introduction of exotic species or degradation followed by extended recovery and provides a list of plant species in the potential plant community generally associated with the particular soil type of the ESD, listed as the “historical climax plant community,”. An Excel workbook (ESD plant communities.xlsx) containing sheets listing the plant species associated with each ESD is attached (Deliverable #6c, Appendix A).

These species lists can be very useful as the basis for deciding what seed mix or transplants are most appropriate in restoration of a specific degraded site. On the map package, AGOL map, or GE (Deliverables 2, 3, and 5, respectively, in Appendix A), simply zoom to a specific degraded site and observe the map unit(s) of the local soil. Then go to the “ESD plant communities.xlsx” workbook (Deliverable #6c, Appendix A) and refer to the correct sheet (sheets are named by the ESD code).

Because the plant communities listed in the ESDs are generalized with soil type and not specific to any particular location, these can be further refined by comparing them with a list of native flora for the area if available. The “ESD plant communities.xlsx” workbook (Deliverable #6c, Appendix A) also includes a restoration priority list of Sonoran Desert plant species developed by USGS. This sheet is useful for choosing species with particular habitat benefits to wildlife and pollinators and for identifying species that may be easier to propagate.

Table 1: Polygons of Degraded Lands at MMRP

NAME	Area (sq m)	Type[1]	Approx Distance (m) to Nearest Access[2]	Nearest Access Type[2]
202004301348	1090.8	Trail_road_side	0	Paved Road
202005071319	6221.79	Use_trail_cluster	78	Designated Service Road
202005071320	13416.94	Use_trail_cluster	0	Designated Service Road
202005071322	46165.05	Use_trail_cluster	54	Designated Service Road
202005071324	37378.99	Use_trail_cluster	294	Designated Service Road
202005071325	25467.06	Use_trail_cluster	200	Designated Service Road
202005071326	15008.91	Use_trail_cluster	0	Park Trail
202005071340	13992.58	Use_trail_cluster	0	Designated Service Road
202005071346	2863.35	Use_trail_cluster	0	Designated Service Road
202005071807	219.67	Mining_site	138	Park Trail
202004301344	1104.49	Trail_road_side	0	Paved Road
202005051343	770.99	Trail_road_side	0	Paved Road
202005051350	2168.94	Trail_road_side	0	Paved Road
202005011418	802.74	Trail_road_side	0	Paved Road
202005011419	790.63	Trail_road_side	0	Paved Road
202005011445	2989.27	Use_trail_cluster	50	Paved Road
202005011447	1244.88	Trail_road_side	18	Paved Road
202005020716	1017.24	Junction	0	Park Trail
202005020808	1344.11	Trail_road_side	0	Paved Road
202005020810	968.51	Trail_road_side	0	Paved Road
202005031438	2271.37	Mining_site	0	Park Trail
202005021701	8676.61	Mining_site	7	Park Trail
202005031435	1744.43	Mining_site	60	Park Trail
202005031525	2348.63	Mining_site	81	Park Trail
202005031359	1472.21	Mining_site	9	Park Trail
202005031400	1318.92	Mining_site	24	Park Trail
202005031402	401.61	Mining_site	35	Park Trail
202005031404	446.11	Mining_site	145	Designated Service Road
202005031415	514.81	Mining_site	180	Designated Service Road
202005031406	73.84	Mining_site	225	Designated Service Road
202005031408	640.49	Mining_site	118	Designated Service Road
202005031419	647.04	Trail_road_side	0	Designated Service Road
202005031426	478.4	Mining_site	45	Park Trail
202005050706	1501.53	Junction	0	Park Trail
202005051317	754.42	Trail_road_side	4	Designated Service Road
202005051320	3751.36	Mining_site	118	Designated Service Road
202005131535	270.5	Trail_road_side	0	Park Trail
202005141458	2748.1	Trail_road_side	0	Paved Road
202005141522	5852.58	Use_trail_cluster	97	Designated Service Road
202005141554	21214.81	Use_trail_cluster	0	Park Trail
202005141620	11438.42	Use_trail_cluster	0	Park Trail
202005151008	3092.02	Use_trail_cluster	224	Designated Service Road

NAME	Area (sq m)	Type[1]	Approx Distance (m) to Nearest Access[2]	Nearest Access Type[2]
202005151007	6810.08	Use_trail_cluster	118	Designated Service Road
202005151103	4635.32	Use_trail_cluster	0	Park Trail
202005201213	405.23	Junction	0	Paved Road
202005201215	45.12	Junction	0	Park Trail
202005201217	116.99	Junction	0	Park Trail
202005201220	175.59	Trail_road_side	0	Park Trail
202005201222	58.46	Trail_road_side	0	Park Trail
202005201224	79.18	Junction	0	Park Trail
202005201226	61.66	Junction	0	Park Trail
202005201228	330.87	Trail_road_side	0	Paved Road
202005201229	247.87	Junction	0	Designated Service Road
202005201231	100.15	Junction	0	Park Trail
202005201232	85.18	Junction	0	Park Trail
202005201234	247.57	Trail_road_side	0	Designated Service Road & Paved Road
202005201236	454.85	Trail_road_side	148	Designated Service Road
202005201238	160.3	Junction	1165	Park Trail
202005201239	326.69	Trail_road_side	0	Designated Service Road
202005201341	357.77	Trail_road_side	0	Designated Service Road
202005201345	189.7	Trail_road_side	0	Park Trail

1. "Trail_road_side" means degraded areas directly alongside official trails or service roads.
"Use_trail_cluster" means multiple unauthorized trails caused by human use in a compact area.
"Mining_site" means a bare area that may be related to historical bulldozed excavations to test clay mining sites.
"Junction" means a widened junction of several trails, several service roads, or trails with roads.

2 This is the approximate closest distance from some portion of the degraded site to the nearest paved road or official trail or service road. Note that there may be unauthorized trails, possible service roads, and wash corridors that are closer to the degraded site.

3 Note that the "NAME" column shows the label applied to the feature on the map. These tables correspond to the attribute tables for the three degraded area layers on the map. The contents of Tables 1–3 are included in the Excel workbook attached to this report

Table 2: Unauthorized Trails at MMRP

NAME	Length (m)
202005071420.00	133.66
202005071304.00	116.72
202005071305.00	203.94
202005071334.00	292.4
202005071341.00	112.87
202004271513.00	2209.19
202004271517.00	754.33
202004271542.00	614.69
202004271551.00	684.25
202004271556.00	282.74
202004301354.00	38.17
202005021648.00	244.88
202005031301.00	84.11
202005050707.00	194.57
202005050729.00	2957.27
202005131515.00	513.63
202005131525.00	705.23
202005131530.00	150.92
202005141627.00	584.26
202005141632.00	212.48
202005151012.00	323.29
202005171350.00	331.62
202005171459.00	177.39
202005201428.00	72.78

[1] Note that the "NAME" column shows the label applied to the feature on the map. These tables correspond to the attribute tables for the three degraded area layers on the map. The contents of Tables 1–3 are included in the Excel workbook attached to this report

Table 3: Possible Service Roads at MMRP

NAME	Length (m)
1	320.49
2	1697.32
3	779.74
4	2505.36
5	124.59
6	544.72
7	699
8	2220.88
9	471.89
10	1169.25
11	94.62
12	201.03
13	1503.15
14	600.63
15	217.48
16	467.28
17	61.89
18	54.57
19	317.59
20	144.44
21	169.4
22	60.27
23	310.87
24	1065.83

[1] Note that the "NAME" column shows the label applied to the feature on the map. These tables correspond to the attribute tables for the three degraded area layers on the map. The contents of Tables 1–3 are included in the Excel workbook attached to this report

Appendix A: Deliverables

Deliverables from this project include the following:

1. An Excel workbook ("MMRP Degraded Lands – Results_v2.xlsx") with a separate worksheet for each class of potential restoration candidates is attached. We suggest using this workbook as a reference in conjunction with the various maps. Each worksheet includes type of feature, length or area, and names that correspond to map labels. For polygons, the area is an approximation of the actual size of the degraded site. Polygons are classified into 4 types: degraded areas along the side of a road or trail; widened junctions; extended, dense use-trail clusters; possible mining sites. Also, the approximate distance to the nearest access is shown and the access type is identified, although there may be washes, unauthorized trails, or possible service roads that are closer to the polygon. The contents of this workbook are shown in Tables 1 – 3.

The degraded lands map is provided in several formats for ease of access and use. All versions of the map contain the same information except for inherent differences related to the formats, as noted.

2. A map package showing the final results is publicly available on ArcGIS Online (AGOL) and can be accessed by anyone with an ESRI license by searching for "MMRP_Degraded_Lands_Final_Results_v2." This package contains the map and also all the associated data, so it will open showing all layers on any computer. It is a very large file (1.7 GB) that must be downloaded before opening. Note that the map has a reference scale of 1:4000, which means that all the degraded lands-related labels will display at their intended size when zoomed to this scale. At the scale needed to display the entire map (1:40,000), the labels will be tiny and not legible.

3. A complete ArcGIS Online (AGOL) map publicly available to anyone with an ESRI license can be accessed by searching for "MMRP_Degraded_Lands_Results_Final." Note that this map contains some additional embedded (non-removable) features: a white 200-meter grid and horizontal teal lines, both of which were used in the original scanning process and can be ignored. The symbology for the types of degraded polygons is different from that used in the map package (deliverable 2) and the aerial photos on this map cannot be zoomed in quite as far as those in the map package, both due to limitations in AGOL. This map can be used on AGOL or it can be downloaded and opened in ArcMap or ArcPro.

4. A low-resolution PDF of the "final results" map is attached. A higher-resolution image can be accessed through https://www.dropbox.com/s/fmvuszqrnityz8p/MMRP_Degraded_Lands_Final_Results_v2.pdf?dl=0

The labels for all the potential restoration candidate features on the map package, AGOL map, and PDFs correspond to those in the Excel workbook, shown in Tables 1–3.

5. A KMZ file ("MMRP Degraded Lands Mapping Final_GE_soilmap.kmz"), which will open the final results in Google Earth, is attached. Note that on GE the different types of degraded polygons cannot be distinguished, and the labels cannot be displayed but can be seen by expanding each layer in the "Places" panel. Also note that the imagery on GE has lower resolution than that provided in the map package and on AGOL (deliverables 2 and 3).

6. Several documents associated with soil data information are attached:
    a) The "MMRP_WSS_Soil_Report," which shows the soil map for MMRP and describes the various soil types in the area.
    b) "Links to MMRP Ecological Site Descriptions," which provides access to the ESDs associated with each soil map unit in the Park and immediate vicinity.
    c) An Excel workbook ("ESD plant communities.xlsx") which shows the plant lists associated with each ESD in the Park plus a restoration priority list of Sonoran Desert plant species developed by USGS.

MCDOWELL
SONORAN
CONSERVANCY

Science is in our nature

www.mcdowellsonoran.org
7729 E. Greenway Road, Suite 100
Scottsdale, AZ 85260
Phone: 480-998-7971