

**MILL CANYON DINOSAUR TRACKSITE
PALEONTOLOGICAL ASSESSMENT
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INTRODUCTION

The Mill Canyon Dinosaur Tracksite (MCDT) is an Early Cretaceous (approximately 112 million years ago) dinosaur tracksite located north of Moab in Grand County, Utah. First reported in 2009, the site contains over 200 tracks and traces (i.e., trace fossils) representing at least ten different types of animals (e.g., nonavian theropods, sauropods, ornithopods, ankylosaurs, birds, and crocodiles). These well-preserved trace fossils preserve the movements and activities of a unique and diverse Mesozoic fauna. Several of these tracks are either new to North America, or from animals not currently known to science from this area. These trace fossils are preserved in a mudstone of the Ruby Ranch Member of the Cedar Mountain Formation. During the Early Cretaceous this area was an algal covered mudflat along the shores of a shallow lake. The MCDT is internationally known and is ranked as one of the top ten dinosaur tracksites in the United States. With over a decade of cartographic and photogrammetric data collected at the site, the MCDT is one of the most extensively documented dinosaur tracksites in the world. This site is the largest and most diverse tracksite known in the Cedar Mountain Formation and represents one of the world's largest and most significant Early Cretaceous tracksites. In addition to its scientific significance, the site has been developed and interpreted for public visitation (i.e., Mill Canyon Dinosaur Tracksite Trail). The tracksite attracts thousands of visitors from around the world. In January of 2022, as part of a site maintenance project, replacement of the boardwalk at the MCDT was undertaken. During that project, impacts and damage

occurred to some of the trace fossils at the site. This report is the paleontological assessment of those impacts.

TERMINOLOGY AND AREAS OF CONCERN

For this report it is important to define specific terminology. First will be defining the areas of interest. The Mill Canyon Dinosaur Tracksite (MCDT) consists of approximately 2.3 acres, currently enclosed by a fence (see Figure 1). Within the MCDT there are various areas of concern. The Interpreted Area (IA) is approximately 0.15 acres in size. Herein, the term Interpretive Area (see Figure 2) is used to describe the area previously encompassed by the boardwalk and trail (i.e., walkways). This area has sometimes been referred to as the “Main Area.” In addition, areas east, south, and north peripheral to the boardwalk are referred to throughout the document. In the future, those areas proximate to the walkways should also be formally considered part of the IA, as they contain areas of the track-bearing surface with trace fossils visible for interpretive and educational purposes.

To the north of the IA is an area (see Figure 3) designated as the Northern Area (NA). At approximately 0.42 acres, this area contains several exposures of the track-bearing unit with significant tracks and traces. This is also the area of previous vehicular travel into the site. The access road to this area has been closed for many years. Within this report, the term “Protected Area” is not used for the IA, as BLM is mandated to manage and protect important paleontological resources on all BLM-administered lands (FLPMA, PRPA). The track-bearing unit is located throughout this region, but there are only certain areas where this unit is exposed or located close to the surface. In many places the track-bearing unit is only covered by a few centimeters of sediment. In these locations potential impacts and possible damage to fossilized tracks and traces is highest.

In addition, the terms impact and damage are used separately here. Impact is used to indicate the forceful contact to tracks, traces, and the track-bearing surface by human activity. Whereas damage is used to indicate degradation of tracks, traces, and the track-bearing surface. Degradation is used to describe the fragmentation, fracturing, erosion, and weathering of the track-bearing surface and its associated

features. This degradation may have natural causes (e.g., rain, snow, wind, freeze/thaw, temperature, etc.) or be human influenced (e.g., walking, driving, vandalizing, etc.). The site is vulnerable to natural erosion and weathering, as it is in an active arroyo and regularly floods.

CHRONOLOGY OF EVENTS

Necessary improvements and maintenance were required at the MCDT to improve visitor safety, accessibility, and enjoyment. To that end, a project was developed to replace the boardwalks at this site. In 2021, development plans and an EA (Environmental Assessment) were created for this project. During the week of January 23, 2022, the project began with the removal of the previously installed boardwalks at the site. A small crew of BLM staff traveled to the site with a truck, trailer, and backhoe equipped with a forklift. Utilizing the previously driven (but closed to the public but available for administrative purposes) access road they entered the site from the north where they setup a staging area. Crews drove on various areas peripheral to the IA to remove the boardwalk and used the backhoe to load the boardwalk palettes onto the trailer. In addition, roughly a dozen palettes were piled in the staging area for later loading. Work was done from January 25-27, 2022, wherein it was stopped for the weekend.

Local members of the public became aware of the project on January 26th and visited the site shortly thereafter, wherein they reported this possible damaging activity to the local BLM. In addition, other interested parties were contacted via social media and the story went viral over the weekend of January 28th-29th. Eventually the national media also wrote stories on the situation. Upon hearing of these concerns the BLM shut the project down on Monday January 31st to evaluate the circumstances.

Later that week the author was requested and authorized to travel to the site to do a paleontological assessment. After amassing the necessary photos and information, he travelled to the MCDT on Thursday February 3, 2022. During the late afternoon of February 3rd, he visited the site and began his documentation of the impacts to the tracks, traces, and track-bearing surfaces. He visited all recently reported areas of impact and damage. On Friday February 4th and Saturday February 5th, he

spent the day continuing his investigation collecting data and talking with various individuals both at the site and in the Moab Field office

As the incidents happened during the week of January 23rd, it was imperative that he interact with the people who visited the site shortly after the impacts occurred to get first-hand accounts of the possible damage. Numerous people visited the site in the course of the week prior to his arrival because of the news and social media reports on the incident. During his visit, he met with various members of the local Utah Friends of Paleontology (UFOP), the Utah State Paleontologist, the former Canyon Country District BLM Paleontologist, and a member of the BLM construction crew. He requested that these individuals show him the areas of impact and damage they had observed the previous week. He also requested photographs from them and made notes of their observations. This information was used along with his notes, observations, photographs (ground level and UAS), and high-resolution photogrammetrically derived orthophotos from past years. The author is quite familiar with the MCDT and has been documenting tracks at this site since 2010. He has personally collected thousands of the ground-based photogrammetric images of the tracksite, as well as being involved with the UAS (Unmanned Aircraft System) imagery taken in 2017.

On Saturday afternoon (February 5th), he returned to Wyoming. The remainder of the February was spent amassing and comparing imagery, notes, and observations. These were used in the preparation of this report.

PALEONTOLOGICAL ASSESSMENT

The following is the Paleontological Assessment for the areas of concern at the MCDT (see Figure 1) associated with this project.

1) Interpretive Area (IA) within walkways (see Figure 2)

Construction crews appear to have avoided driving on the track-bearing surface in the IA within the boardwalk and trails. This “Main Area” (referred to as the “Protected Area” in earlier reports) shows few signs of impacts due to removal of the boardwalk. However, there are some tracks that are fragmented in this area, although this damage cannot be associated with the construction crews. This

degradation was noted on only a few isolated tracks and appears to be the result of natural weathering, although these trace fossils may also have been stepped on at some point in time. The damaging effects of foot traffic on the delicate impact rims and other footprint features at the site illustrates the need to keep the public off the track-bearing surface as much as possible. Replacement of the walkways and signage are important to alleviate this concern. In addition, when the walkways are replaced in the IA, great care should be exercised by the construction crews to not step on the tracks. In addition, the use of stall (cattle) mats is encouraged for those areas immediately around the walkways, where inadvertent foot impact is possible.

2) Interpretive Areas Peripheral and East of Boardwalk (see Figure 2)

Construction crews impacted track-bearing surfaces directly east of the walkways with vehicles during the removal and loading of boardwalk palettes onto the trailer. As a result, trace fossils were damaged. In this area, the track-bearing unit is either exposed or located very close to the surface. Proximate to and along the northeastern side of the boardwalk an important crocodile slide track (similar to the one formally interpreted on the trail) is partially buried by sediment. Unfortunately, this trace was repeatedly driven over, as recent tire tracks indicate that this area was impacted by the backhoe and other vehicles. This trace fossil appears to have sustained some fracturing damage. The location of this trace is within the area designated as cleared for traffic in the development plans. However, this spot is well-documented and should have been located and flagged for avoidance.

In addition, areas along the southeastern side of the boardwalk are also known to contain significant footprints. This area was not cleared for vehicle travel and tracks are known to occur there. However, this area was also impacted by vehicle traffic associated with the removal and loading of the boardwalk. Although a few damaged tracks were noted in this area, it is unclear when and why degradation occurred. This damage most likely happened from natural weathering and foot traffic at some undetermined point in time. This location should have been flagged for avoidance and construction crews should have avoided driving vehicles in the area. In addition, construction crews need to be informed that the previous boardwalk was laid nearby and in some cases over areas that contain tracks.

3) Areas Peripheral and South of Boardwalk (see Figure 2)

Areas immediately to the southwest and southeast of the boardwalk contain

exposures of the track-bearing unit. Although it does not appear that these areas were affected by the boardwalk removal, crews should be cautious in these areas when replacing the boardwalk. Again, areas containing tracks should be designated and flagged for avoidance and special care should be taken when working in those areas (e.g., crew briefings and use of stall mats).

4) Area Northwest of Boardwalk in Northern Area (see Figures 2 and 3)

An area of outcrop proximate to the northwest corner of the boardwalk in the Northern Area (NA) contains a variety of footprints (e.g., theropod, ornithopod, and sauropod) many of which can be seen from the interpretive boardwalk and trail. Tracks in this area were previously noted and the area was not cleared for impacts. This area should have been flagged and avoided. The track-bearing unit in this area is partially covered by sediment, although impact rims of the tracks are clearly visible. Recent tire tracks indicate that this area was impacted by the backhoe and perhaps other vehicles. Heavy foot traffic was also noted. Close examination of the trace fossils in this area shows signs of recent breakage and fracturing of the brittle impact rims around a few of the tracks.

5) Other Areas North of Boardwalk in Northern Area (see Figure 3)

During construction activities, various areas north of the boardwalk in the Northern Area (NA) were heavily impacted by vehicular traffic and a staging area for palette loading. This area was cleared for disturbance, as it had been previously used for vehicular access to the tracksite and some of the outcrops were covered with sediment. However, the track-bearing unit is located throughout the area and is either exposed or buried by a thin layer of sediment. In many places, tracks are clearly visible at the surface. Recent tire tracks indicate that this area was impacted by the backhoe and other vehicles. Tracks and track-bearing surfaces were repeatedly driven and walked over in this area and sections of the boardwalk were stacked on top of an already fragmented exposure of the track-bearing surface. In the NA there are several very important exposures containing previously documented tracks. These outcrops should have been marked and flagged for avoidance. Several tracks in this area experienced fragmentation from construction activities, especially a large theropod footprint, which is part of a long trackway (step #25) that extends from the IA north. Although a large ornithopod

(“hadrosaur”) track was reported as damaged and vehicle impacts occurred on this feature, high-resolution orthophotos indicate that it was already fractured when the photos were taken five years earlier. Other track features that were buried under boardwalk palettes also appear to show fracturing that was recorded years earlier. Outcrops in this area have been naturally degrading for well over a decade. Other outcrops of the track-bearing layer in this area have clearly exposed tracks. Although driven over, they don’t appear to show evidence of recent damage.

6) All Areas

Overall, damage to the tracks and traces as the result of impacts from construction activities appears minor. Unfortunately, little can be done to restore broken or eroded tracks left exposed in situ. In addition, small microfractures may well have formed because of the weight of the machinery on the track-bearing surface. As such, natural degradation may be accelerated in these areas in the future.

RECOMMENDATIONS

The Mill Canyon Dinosaur Tracksite (MCDT) is a very popular, paleontologically interpreted, BLM recreation site and is ranked as one of the top 10 dinosaur tracksites in North America. As such, the walkways and interpretive signage need to be restored. It is recommended that the project be reevaluated with regard to its impact to paleontological resources. This document should be reviewed by a knowledgeable BLM paleontologist and be made available for public comment. Much concern has been raised recently about the proposed use of cement for the walkways. The use of cement and other options (already considered) should be made public and the rationale for the current plan articulated. In addition, once the final plan is accepted, the areas of impact need to be properly surveyed and areas of avoidance clearly marked on maps for construction crews. These crews need to be thoroughly briefed on the tracks and traces at the site and how to recognize, avoid, and not impact these trace fossils while installing the walkways. Plans for proper mitigation of the potential impacts to the tracks and track-bearing surface at the MCDT need to be clearly outlined. Prior to and during construction of the walkways a qualified paleontologist needs to be present to flag areas of avoidance and oversee construction activities. Although general maintenance of walkways,

signs, and the shade structure usually do not require paleontological oversight, it is recommended that all future actions at the MCDT be reviewed, assessed, and possibly monitored by a qualified paleontologist.

The following is a list of specific recommendations for the Rebuilding of the Mill Canyon Dinosaur Tracksite Trail Project.

- 1) Evaluate current development plans for the restoration of the walkways, interpretive signs, and replacement shade structure platform at the MCDT. The platform by the interpreted crocodile slide mark should also be considered for replacement if needed.
- 2) Review Environmental Assessment (EA) for completeness and explore construction alternatives. Address paleontological resources and describe protective measures to reduce impacts to the fragile track/trace features.
- 3) In the EA, utilize previous notes, documents, records, maps, and photos of the MCDT to determine the location of outcrops with tracks and traces and identify areas to avoid.
- 4) Have the EA reviewed by a qualified BLM paleontologist.
- 5) Provide EA for comments by the general public and paleontologists.
- 6) Explore other construction access routes to the site that avoid track-bearing exposures in the Northern Area.
- 7) Hire a permitted, qualified, and knowledgeable (i.e., familiar with dinosaur footprints) paleontologist to survey the MCDT and designate/flag locations of avoidance (i.e., those areas where tracks and traces are known to occur).
- 8) Do not drive near the walkways on the North, South, and East sides, as tracks are either at the surface or close to it.
- 9) Construction crews should consist of enough people to properly do the work.
- 10) Provide construction crews with information about the tracks and traces at the tracksite so that they are careful working in areas of trace fossils when replacing the walkways; keeping in mind that tracks are located very near and sometimes under the proposed the walkways.

- 11) For the safety of the public and the resource, restrict public access to the site during construction. Without walkways and appropriate signage, foot traffic on the fragile track features is likely to occur, possibly damaging the tracks.
- 12) During construction activities, provide occasional docents outside the MCDT to explain the progress of the project and BLM's mitigation practices to the public.
- 13) Remove loose rubble and cobbles along the old path that was under the boardwalk. These rocks were previously used to indicate the location of trails. They have no practical purpose and will impede construction efforts, as well as get washed or kicked onto the track-bearing surface.
- 14) Hire a qualified paleontologist to monitor construction activities so that areas with tracks and traces are avoided and that impacts to trace fossils within and around the IA are mitigated.
- 15) Once the walkways and signage are restored, utilize experienced volunteers (e.g., UFOP members) with appropriate oversight by a paleontologist, to carefully clean (as in past years) the site for better visibility of tracks. Cleaning of the site should be part of a general site maintenance plan, with care being taken not to overclean and possibly damage the trace fossils.
- 16) Celebrate the site with a grand reopening of the MCDT after the walkways and signage are restored.
- 17) Develop plans for future interpretive signage and walkways within the MCDT (e.g., areas north of boardwalk).
- 18) When possible, refill the BLM Paleontologist positions in the Canyon Country District Office and the Utah State Office.
- 19) Have a qualified paleontologist survey areas peripheral to the MCDT for exposures of the track-bearing unit containing trace fossils.
- 20) Future Unmanned Aircraft System (UAS) documentation of the MCDT should be planned.

SUMMARY

Improvements and maintenance of the interpretive walkways at the MCDT were necessary. Although development plans and an EA were created, they were not reviewed by qualified paleontologists and were not well distributed for public comment. As a result, paleontological concerns were not properly addressed and adequate assessment and mitigation measures for paleontological resources did not occur.

In the first phase of this project, vehicles were driven into the site when the preexisting boardwalk was removed in late January 2022. Because no paleontological survey was done and previous documentation was not reviewed, areas of avoidance were not properly designated. Areas were not flagged for avoidance nor was a paleontological monitor present during the removal of the boardwalk. As a result, many areas of the track-bearing unit were impacted, and some tracks and traces were damaged. The events that transpired in January at the MCDT are unfortunate and could have been avoided. Although a large area of the tracksite was impacted during the removal of the boardwalk, the damage to the site was minor. Numerous tracks throughout the area were impacted, fortunately only a small number were damaged.

In addition, construction crews were not properly instructed on where tracks might be located, especially those under thin sheets of sediment. Insufficient information was used to locate where tracks and traces had previously been documented and areas considered cleared for disturbance were not adequately assessed and surveyed prior to construction. As such, construction crews did not have the information they needed to avoid impacts to the paleontological resources.

Although not all areas of the site impacted were damaged, some trace fossils show minor damage. This damage should not have occurred. In addition, driving on these surfaces may have increased natural weathering and erosion of these areas, as the track-bearing surface is a brittle surface that is naturally degrading.

Even though the overall damage to the site was minimal, had the project not been stopped, it is likely that much greater damage would have occurred with increased construction activities. When the project continues, better paleontological oversight is needed for all aspects of the project, beginning with a reevaluation of

the development plans and EA. Paleontologists both within and outside the BLM should be utilized as the project moves forward. Assessments, surveys, reviews, and monitoring should all be done by qualified paleontologists familiar with dinosaur tracks and the public should be allowed to comment on the project. Finally, the vacant BLM paleontology positions at the Canyon Country District and State offices in Utah should be filled to provide for better internal review of projects such as this.

The public's keen interest in the site is gratifying and their willingness to assist as stewards is commendable. As such, it is recommended that interested members of the local public be engaged in future developments of this site. Once the new walkways are put in place, the IA should be cleared of sediment to allow better viewing of the tracks and traces. This cleaning activity should be monitored by a paleontologist and should be done before the formal reopening of the site. Partners such as UFOP should be invited to assist. Future UAS documentation of the MCDT should be planned.

Ultimately, because the development plans and EA did not have proper paleontological review, the site was not flagged for avoidance areas, and a paleontologist was not on site, unnecessary impacts and damage occurred. Although several procedural missteps happened, the overall damage was minor. With proper paleontological oversight, this project should proceed in order to restore the interpretive areas at the MCDT. Utilizing proper scientific principles and expertise, the BLM can manage and protect the paleontological resources at this significant site, which is an important part of America's Natural Heritage.

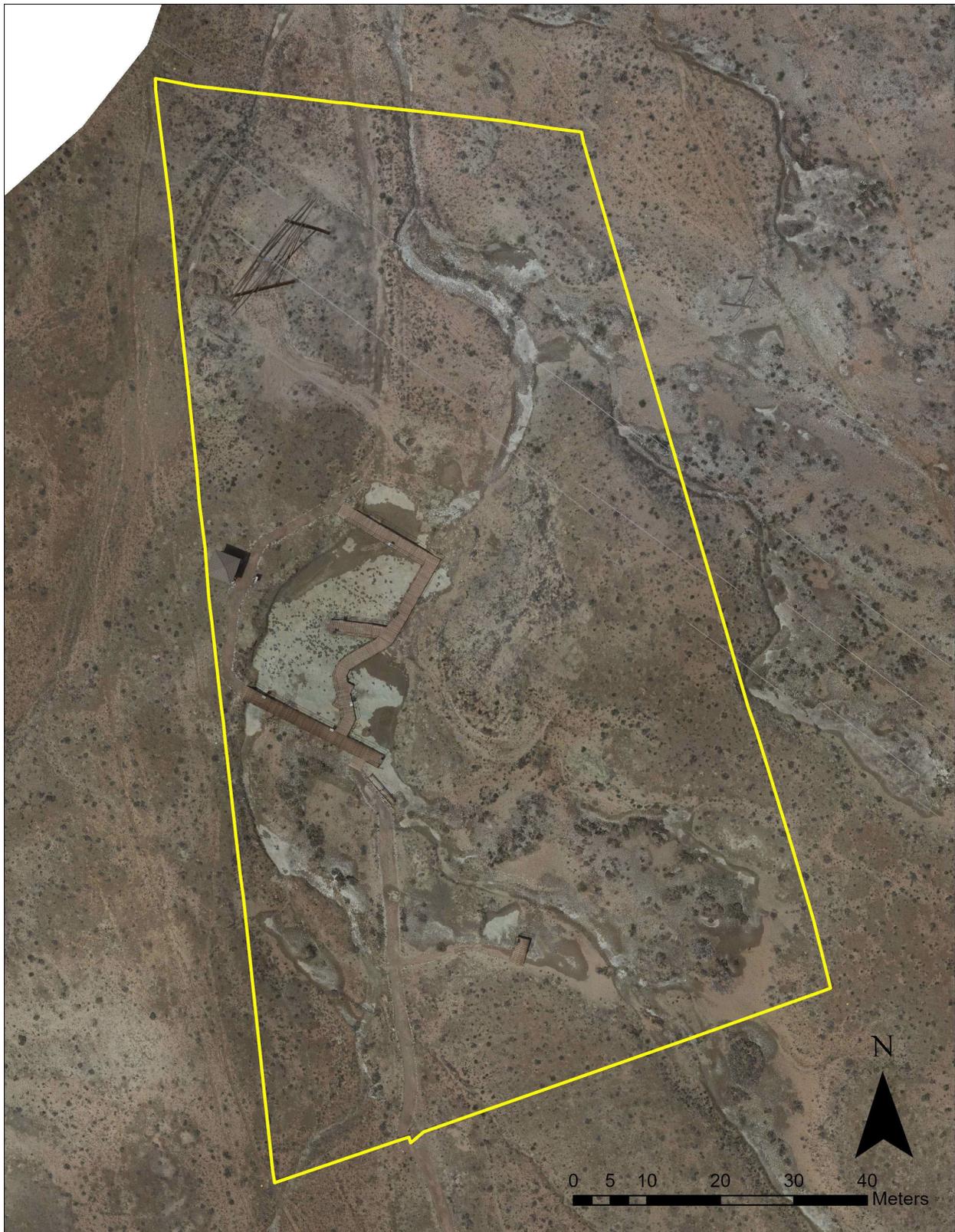


Figure 1: 2017 UAS Orthophoto of MCDT Tracksite (yellow polygon).



Figure 2: 2017 UAS Orthophoto of MCDT Main Interpretive Area.



Figure 3: 2017 UAS Orthophoto of MCDT Northern Area.