Bat Management Plan for the Stevens Road Tract, Bend, Oregon, with emphasis on Townsend's big-eared bats (*Corynorhinus townsendii*)

Prepared by Matt Skeels
of the Oregon High Desert Grotto

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Executive Summary

The State of Oregon requires a bat mitigation plan to move forward with planning and development on the Stevens Road Tract (SRT) located near Bend, Oregon. This mitigation plan will fulfill the State of Oregon's requirement for a management plan of the significant bat resources located within the eight caves of the Stevens Road Tract.
This requirement was previously outlined during the land transfer from the Bureau of Land Management to the Department of State Lands and originates from the Federal Cave Resources Protection Act of 1988.

Overview

The goal of this plan is to secure and maintain existing bat habitat on site, as well as to accommodate for bat population and habitat changes over time. Emphasis on Townsend's big-eared bat management is the highest priority as they are listed as a sensitive, or a species of concern with the U.S. Fish and Wildlife Service.

Section 1 of this plan outlines specific *Standards and Guidelines* for the SRT. These guidelines will be applied and followed for all eight caves and the encompassing SRT land parcel. These guidelines encompass activities such as overall management of the SRT and the caves as it pertains to bats, bat monitoring, and fire and ecosystem management.

In Section 2, *Cave Classifications* describe specific management strategies for each of the eight caves. Each cave will have its own class and be managed by that classification in conjunction with the general Standards and Guidelines of Section 1. Classifications have been defined according to bat usage, specifically Townsend's big-eared bats.

In Section 3, ancillary management detail has been provided for each cave, as well as procedures on specific activities that will or may be performed on the SRT such as bat monitoring, disturbance mitigation, and restrictive barrier construction. Additional recommendations on SRT cave management and site development have been included in this section.

The appendices include maps, locations, and buffer zones for each cave. Cave history, bat species information, and bat history of the caves has also been described in detail for future management use. Definitions have been provided for key terms in the management plan. In the event a bat gate needs to be constructed, an agency guide by Bat Conservation International has been linked to in the bibliography.

Recommendations

The land of the SRT will require a qualified bat expert to outline periods of bat hibernation and maternity roosting, to determine other mitigating factors (such as disease or disturbance) that may change a cave's management classification. This expert will implement proper bat monitoring. If needed, proper implementation of bat gate construction will be done by a qualified bat gate expert in coordination with a qualified bat expert.

50 foot buffer zones will be created to protect any cave with a maternity or hibernation roost. This buffer zone will prohibit human entry into the cave during roosting periods of the affected caves. Buffer zones will be clearly posted at each affected cave site instructing the general public of the closure. Failure to restrict human activity during these roosting periods can lead to abandonment of the cave site by bat species, particularly Townsend's big-eared bats.

Additional attention will be given to prescribed fire management on the SRT by a qualified expert.

Conclusion

With proper cave and bat management, the bat resources of the eight caves can be maintained and strengthened. Maternity and hibernation roosts of Townsend's big-eared bats supported by cave closures will be the highest priority in this mitigation effort. Properly prescribed fire periods will contribute to that management. Organized cooperation between involved agencies, adjacent landowners, and interested parties will help create an overall development plan for the SRT that benefits the caves and the bat resources found within into the forseeable future.

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Cover page:
Photo of a Townsend's big-eared bat maternity cluster in a cave of the Horse Lava Tube System.

Section 1:
Bat Mitigation Plan
Standards and Guidelines

Introduction

The Stevens Road Tract (SRT) contains 8 lava tube caves within its boundaries. Standards and guidelines will be outlined for the Stevens Road Tract area as applied to bat use in caves. Each of the 8 caves will also be given a class (see Section 2). These classifications are designed to benefit bats that are known to use the caves (see Appendix F for bat species of the region). Each classification will have further guidelines for managing and monitoring bat use (see Sections 2 and 3).

Goal

The goal of these management guidelines is to identify and protect existing or potential Townsend's big-eared bat habitat in the 8 caves of the Stevens Road Tract. Encouraging stewardship of the caves, proper caving/spelunking etiquette, and educating the public in general about these caves, will lead to clean and healthy caves that directly benefit and encourage bat use.

Standards and Guidelines

The following standards and guidelines will be followed:

Management

M1 - *Class*: Caves in the Stevens Road Tract will be each be given a "class" and be managed according to the specifications in Section 2: Cave Classifications. A qualified bat expert may reclassify any cave based on disturbance, bat usage, or other mitigating factors; see Disturbances subsection in Section 3. If no class exists that fits current needs, a new class may be created by that expert. New classes should resemble current classifications and specify public visitation, closures, monitoring periods, and buffer zones.

M2 - *Monitoring*: Caves within the Stevens Road Tract will be monitored for bat use with emphasis on Townsend's big-eared bat use.

M3 - *Periods*: Hibernation and maternity periods for Townsend's big-eared bats will be defined by a qualified expert as needed. These periods will define closure dates. Periods may vary dependent upon climate, disease, or other factors.

M4 - *Buffer Zones*: Only those caves recognized as a Townsend's big-eared bat hibernaculum or maternity roost will have a 50 foot buffer zone (see Class 2 exception). All buffer zones will be aligned with the cave entrance coinciding with the middle of that cave passage. Buffer zones will be adequately and visibly marked with signs or by other means to inform the public of closures and to restrict entry during those periods.

M5 - *Disturbance*: Disturbance to Townsend's big-eared bat roosts shall be greatly diminished or eliminated when possible. If a qualified expert determines that disturbance to Townsend's big-eared bat roosts requires further mitigation efforts, those disturbances will be monitored for assessment and evaluation. Based on that evaluation, further mitigation strategies may be employed; see Disturbances subsection in Section 3.

M6 - *Cooperation*: City, state, federal, private, other management agencies, and local cave enthusiasts will work cooperatively with adjacent landowners to identify and protect the needs of the caves and bats within the Stevens Road Tract. Educational media is encouraged, especially at cave sites, informing visitors about educational values of the bats and caves as well as on proper etiquette.

M7 - *Miscellaneous*: Mitigation efforts will include other efforts when possible, such as public education and outreach, law enforcement, and visitor use management. Visitor use management should be coordinated with local cave enthusiasts such as a Grotto.

Bat Monitoring

B1 - *Who*: Monitoring will be conducted by a qualified bat expert, such as a bat biologist, who is capable of identifying Townsend's big-eared bats and distinguishing them from other bat species.

B2 - *When*: Monitoring will occur when Townsend's big-eared bat hibernation or maternity colonies are present. Hibernation monitoring should occur once, in the middle of hibernation. Maternity monitoring should occur once, 2 to 3 weeks prior to parturition.

B3 - *Frequency*: Frequency of monitoring will be determined by cave class. If possible, monitoring will occur on, or near, monitoring dates of previous years. All cave monitoring will be executed within the same day to avoid tally duplications.

B4 - *Ancillary monitoring*: Additional monitoring of caves for Townsend's big-eared bats may be done if usage has increased. The need for additional monitoring will be determined by a qualified expert. Additional monitoring will end when no longer necessary.

B5 - *Handling*: A qualified expert will determine if mist-netting, trapping, or direct handling of Townsend's big-eared bats is necessary but should be avoided if possible.

B6 - *Records*: Records of monitoring will be kept detailing species, population counts, roost type, and date of monitoring. Records will inform cave classification is accurate and up to date.

Fire and Ecosystem Management

F1 - *Fire dates*: Prescribed fires or burns within the Stevens Road Tract area should be limited between September 1st and September 30th. This will minimize negative impacts to maternity colonies and hibernacula.

F2 - *Fire perimeters*: Prescribed fires or burning of any kind shall not be permitted in, or within, 250 to 1000 feet of any known maternity or hibernation colony. When winds would carry the smoke away from the colonies, the 250 ft. perimeter will be observed. When winds would carry the smoke toward the colonies, the 1000 ft. perimeter will be observed. Prescribed fires or burns shall be permitted 250 ft. away from any non-maternity or non-hibernation roost and only on days when winds would carry smoke away from the cave/s as long as it does not affect maternity or hibernation colonies of other

nearby caves in the SRT.

F3 - *Ecosystem*: Roosts of Townsend's big-eared bats shall have their ecosystem maintained or improved. The quality of the ecosystem at Stevens Road Tract will be determined by a qualified bat expert and environment changes authorized by that expert.

F4 - *Bat Houses*: Installing artificial bat houses could promote species population growth. A qualified bat expert will determine if they're an asset and the measures needed to make them as successful as possible.

F5 - Gates: A qualified bat expert will determine the necessity, or lack thereof, for installing a bat gate, or any restrictive barrier, inside the cave or outside within 50 feet of the cave entrance. Monitoring will be done for any installed gate/barrier for effectiveness. If the gate has failed to accomplish its intended purpose, it will be removed expeditiously. See Disturbances in Section 3 for further detail.

Section 2:
Cave Classifications

Initial Classes

The following classification list represents the initial classification for each cave at time of publication. These classifications represent a starting point for this mitigation plan. Caves may be reclassified moving forward from publication date. Each cave will be managed according to its class.

Class 1 caves: Stevens, Vulture, Braille, Three Pines, and Williams'
Class 2 caves: Garbage Cave no. 1
Class 3 caves: Davenport, Garbage Cave no. 2
Class 4 caves: no caves had this classification

Class Descriptions and Management Specifics

Classes will be defined with detailed management requirements. For protocols on proper monitoring and other miscellanea mentioned herein, see Section 3.

Class 1: Caves with Little or No Bat Use

Definition of a Class 1 cave
A Class 1 cave is any cave within the Stevens Road Tract that has no known long term bat use. Bat usage in a Class 1 cave has been reported to be nearly or completely nonexistent during the calendar year. Bats are not known to roost throughout the entire non-hibernation period in a Class 1 cave. Non-Townsend's bats may utilize the cave for hibernation or other purposes but are not considered to be species of concern. Male Townsend's bats may temporarily use the cave as a day or night roost, but not more than two consecutive weeks.

Management Objective for a Class 1 cave
The objective for a Class 1 cave is to monitor every other year for winter hibernation and summer maternity use in the event that Townsend's big-eared bats begin using the cave.

Management Guidelines
Any cave designated Class 1 will be treated as a non-sensitive site. No buffer zones are required for a Class 1 cave. Information about a Class 1 cave may be shared with the public. Gating a Class 1 cave is not necessary.

Bat Monitoring
Class 1 caves will be monitored for bat use every other year. In the year a Class 1 cave is monitored, it will be once during prime hibernation periods and once again during prime maternity periods (2-3 weeks prior to parturition).

Public Visitation
The public can visit any Class 1 cave at any time during the calendar year within any regulated hours.

Class 2: Potential Hibernaculum Caves

Definition of a Class 2 cave
A Class 2 cave is any cave within the Stevens Road Tract where the potential is great for future Townsend's big-eared bat hibernacula use and is dependent upon restoration of the cave entrance or interior to a more natural state. Bat usage in a Class 2 cave is identical to a Class 1 cave as bat use has been reported to be nearly or completely nonexistent during the calendar year. Bats are not known to roost throughout the entire non-hibernation period in a Class 2 cave. Non-Townsend's bats may utilize the cave for hibernation or other purposes but are not considered to be species of concern. Male Townsend's bats may temporarily use the cave as a day or night roost, but not more than two consecutive weeks.

Management Objective for a Class 2 cave
The objective for a Class 2 cave is to monitor every other year for winter hibernation and summer maternity use in the event that Townsend's big-eared bats begin using the cave. Special attention will be paid to restoration efforts at the cave entrance or interior should they occur. If restoration efforts do occur, monitoring will change immediately but with no monitoring overlap. Monitoring will then be done according to a four year observation period (see *Bat Monitoring* below).

Management Guidelines
Any cave designated Class 2 will be treated as a non-sensitive site. No buffer zone is initially required for a Class 2 cave. Information about a Class 2 cave may be shared with the public. Gating a Class 2 cave is not necessary. If restoration of the cave entrance or interior occurs, the cave will be closed to access during hibernation and maternity periods and a buffer zone enacted. A four year "observation period" of monitoring will begin. After the four year observation period has elapsed the cave will undergo reclassification. If reclassification results in Class 2 again, the cave will return to pre-observation period status (i.e. monitoring every other year and buffer zones removed).

Bat Monitoring
Class 2 caves will be monitored for bat use every other year. In the year a Class 2 cave is monitored, it will be once during prime hibernation periods and once again during prime maternity periods (2-3 weeks prior to parturition). If a four year observation period is in place, monitoring will then consist of winter hibernation and summer maternity monitoring for four consecutive years.

Public Visitation
The public can visit any Class 2 cave at any time during the calendar year within any regulated hours unless a four year observation period is enacted. If a four year observation period is in place, a 50 foot buffer zone will be enacted during hibernation and maternity periods. The public will be restricted from entering the buffer zone. This buffer zone will be marked with adequate signage informing the public why the cave closure is happening and what they can do to help the bats.

Class 3: Hibernaculum Caves

Definition of a Class 3 cave
A Class 3 cave is any cave within the Stevens Road Tract that currently has Townsend's big-eared bat hibernation or has within the past four years. Bats are not known to roost throughout the entire non-hibernation period in a single Class 3 cave. Non-Townsend's bats may utilize the cave for hibernation or other purposes but are not considered to be species of concern.

Management Objective for a Class 3 cave
The objective for Class 3 caves is to monitor the caves every other year for winter hibernation use by Townsend's big-eared bats. Summer maternity use will also be monitored in the event that Townsend's big-eared bats begin using the cave for that purpose. Human disturbance to the cave environment will be minimized as much as possible in the event that Townsend's big-eared bats begin using the cave more than two consecutive weeks out of the year during non-hibernation periods.

Management Guidelines
Any cave designated as Class 3 will be treated as a sensitive site during hibernation periods. A buffer zone will be enacted during the hibernation period. A buffer zone may also be enacted if Townsend's bat use continues throughout the year, for more than two consecutive weeks at a time. Information about a Class 3 cave may be shared with the public. Gating a Class 3 cave is not recommended except as a last resort.

Bat Monitoring
Class 3 caves will be visited every other year to monitor any bat use. The year that a Class 3 cave is to be monitored for bat use, it will occur once during prime hibernation periods and once again during prime maternity periods (2-3 weeks prior to parturition).

Public Visitation
The public can visit any Class 3 cave during non-hibernation periods within any regulated hours so long as no Townsend's bat use is occurring for more than two consecutive weeks. The public will not enter the cave during the hibernation period. During the hibernation period, a 50 foot buffer zone will be enacted. The public will be restricted from entering the buffer zone. This buffer zone will be marked with adequate signage informing the public why the cave closure is enacted and what they can do to help the hibernating bats.

Class 4: Maternity Caves

Definition of a Class 4 cave
A Class 4 cave is any cave within the Stevens Road Tract that has documented Townsend's big-eared bat maternity use currently or within the past four years. Hibernation may also be occurring by Townsend's big-eared bats or other bats. Non-Townsend's bats may utilize the cave for hibernation or other purposes but are not considered to be species of concern.

Management Objective for a Class 4 cave
The objective for Class 4 caves is to monitor the cave for Townsend's bat use with priority on maternity use. Winter hibernation use will also be monitored in the event that Townsend's big-eared bats use the cave for that purpose. A 50 foot buffer zone will be enacted in an effort to protect the maternity colony inside the Class 4 cave. Gating a Class 4 cave is not recommended except as a last resort.

Management Guidelines
Any cave designated as Class 4 will be treated as a sensitive site and a buffer zone will be enacted during maternity periods. If Townsend's bat hibernation is occurring, a buffer zone will be enacted during that period as well. Information sharing about a Class 4 cave should be limited to parties on a need to know basis.

Bat Monitoring
Class 4 caves will be visited every other year to monitor bat use. The year that a Class 4 cave is to be monitored for bat use, it will occur once during prime hibernation periods and once again during prime maternity periods (2-3 weeks prior to parturition).

Public Visitation
The public may not visit or enter a Class 4 cave starting 2 weeks prior to the onset of the maternity period. If hibernation of Townsend's bats is also occurring, the cave will not be visited or entered during the hibernation period. A buffer zone will be enacted 2 weeks prior to the onset of the maternity period and last until that maternity period ends. A buffer zone will also be enacted again during hibernation periods if hibernation by Townsend's bats is occurring. Adequate signage informing the public of the cave closure is required. The signs will instruct the public on how to help protect the bats.

Section 3:
Further Management Detail and Recommendations

This section will discuss in further detail some of the requirements described in Section 1 and classifications in Section 2. It will also include specific cave information and final recommendations on the Stevens Road Tract and other management strategies for the caves.

Additional Management Protocol

Monitoring

A qualified bat expert should determine the beginning and ending dates for Townsend's bat hibernation and maternity colonies on a yearly basis. Generally for the central Oregon region, hibernation periods will begin around October 1st and end April 30th. Similarly, maternity periods will generally begin around April 15th and end September 30th. Both these periods may vary over time as climate, disease, and other factors change.

With these periods established, a qualified bat expert will set monitoring dates as outlined for each cave by its class. Monitoring procedures may change over time as science and strategies improve. Generally, hibernation monitoring will occur during prime daylight hours, and maternity monitoring will occur during prime evening hours. The methodology of monitoring will not be discussed in detail here, however B6 of the Standards and Guidelines (Section 1) requires that monitoring will, at a minimum, keep track of species type (known or unknown), population count, roost type (if any), and date of monitoring. Synchronized monitoring of caves should be done so that duplication of population counts is not a factor. All other procedures for monitoring will be left to the discretion of the qualified bat expert.

Some bat experts may be unfamiliar with cave interiors. Preferably, when visiting a cave, any person should have adequate gear to be safe and efficient. This includes at least three sources of light, a protective helmet, gloves, knee pads, durable boots, and adequate clothing to remain comfortably warm in the event a protracted stay inside a cave is necessary. In case of emergency, a small first-aid kit should be carried at all times. If possible, another person should accommodate the expert on any visitation to the caves and will allow for training opportunities. All participants monitoring in caves should be aware of potential claustrophobia effects.

Disturbances

In Section 1, the Standards and Guidelines M1 and M5 refer to disturbances in caves. M1 refers to reclassification based on disturbances. A qualified bat expert may reclassify a cave at any time if disturbances are observed. These disturbances should be monitored and evaluated before reclassification occurs if possible.

Structural or ancillary developments to a cave are also disturbances and will be monitored and evaluated by a qualified expert. Any development should have minimal or no impact on bat use. Environmental compliance procedures must be completed prior to installation or relocation of any preexisting development. Developments to a cave must be maintained after completion.

Other disturbances exist and are too many to list. Some examples of disturbances include human visitation into a cave or buffer zone, gate or restrictive barriers, restoration of a cave to its natural state, smoke, domesticated pets, illegal dumping, vandalism, defacement, depositing garbage, change in cave air ventilation, loud noises, vibrations, artificial light, disease, acts of mother nature, and many more. Disturbances must be evaluated for their impact to the cave environment and any bat inhabitants.

Restrictive Barriers (e.g. Bat Gates)

If a disturbance continues and becomes impossible to prevent, constructing a restrictive barrier, such as a bat gate, may be done in or near a cave, so long as it is agreed upon by a qualified bat expert. Any restrictive barrier will be built with the intention that it encourages or maintains use of the cave by Townsend's big-eared bats for hibernation or maternity use. Construction of a restrictive barrier should be considered a last resort and an unfavorable option. Any restrictive barrier that has failed its intended function, either in part or whole, or is restrictive to Townsend's big-eared bat use, shall be fully removed within two years of its completed construction. Proper bat gate management will require annual funding for monitoring and repairs to be successful.

Management Recommendations

Bat Gates

Any bat gate or other restrictive barrier intended to help bats is strongly discouraged from being constructed and should only be implemented as a last option. Bat gates are expensive to install, difficult to maintain, and are not 100% effective. By comparison, all four gated caves of China Hat Road in the nearby Deschutes National Forest have been breached in recent times. Improper installation can lead to undesirable outcomes and lost gate keys can hinder access for monitoring.
Any restrictive barrier can be met with disdain and become targets of public dissatisfaction. Restrictive barriers are also a blight to the natural beauty of the landscape which will have a negative impact on property values. For more information, contact a trained expert, experienced in designing and constructing bat gates in a wide variety of situations such as Jim Kennedy of Bat Conservation International (jim@ka-ug.com). A gating guide has been supplied in the bibliography appendix under Fant, J.

Visibility and Development

Caves are environments that are invisible from the surface. Any development on the Stevens Road Tract should not increase invisibility of cave entrances. It is recommended that development be brought as close to cave entrances and passages without jeopardizing their structural integrity. The caves should be fully integrated into the city setting. Unfortunately, the natural semi-desert landscape for these caves has been forfeited long ago. The desired landscape is where a cave entrance is highly visible to car and pedestrian traffic, greatly illuminated by street lamps, and overlooked by several buildings within very close proximity, but not so close as to further obscure the cave entrance/s. The caves should not "feel" or be thought of as a hidden place to escape to. They should "feel" as if they are right out in the open and visible to all. The best policy for managing the caves and bats is by eliminating undesirable activities which gravitate toward dark and secretive locales. By decreasing or eliminating the conditions that foster them, you will give the caves and the bats the best chance for survival.

The Redmond Caves of Redmond, Oregon represent an opportunity to review a similar set of circumstances that will be increasingly seen at the caves of the Stevens Road Tract. The Redmond Caves are a group of 5 densely clustered lava tubes in a natural park setting within city limits. Most of the caves are not highly visible to car or pedestrian traffic, are not illuminated at night, and are not properly monitored. They remain as invisible landscapes holding desperately to a natural setting that no longer exists.

Cave location secrecy

Cave location secrecy is not recommended for the caves of the Stevens Road Tract. Many cave management and bat management programs exercise cave location secrecy policies to protect caves and their natural resources. Most of these policies are enacted for caves residing in natural ecosystem settings commonly found on federal lands. The caves of the Stevens Road Tract haven't existed in a natural ecosystem for many decades and are completely surrounded by urban and rural development with more planned for the future. Their existence is already well known. The best strategy is teaching proper cave etiquette to the public and by creating stewards out of adjacent landowners and the rest of the community. Working toward a mutual goal outlined in this mitigation plan will benefit everyone.

Stewardship

There is not one entity, whether a government agency, cave enthusiast, bat biologist, or neighboring landowner that can singlehandedly protect the caves of the Stevens Road Tract. It will take cooperation between all parties to steer the caves toward a future that is beneficial to the community as well as the bats calling it home. It is recommended that a local interest group be created with participation of all parties.

Specific Cave Detail

Garbage Cave no. 1
This cave exists in an unnatural state with garbage and other yard debris choking the entrance.
In 1970, Ronald Greeley surveyed the cave and found the entrance to be more open and contained less garbage and other debris. It's very likely the entrance was part of a deeper collapse trench that is no longer visible. The cave should be restored as much as possible to this natural state. This may change the interior microclimate of the cave to more favorable conditions for bats. Currently, Garbage Cave no. 1 is the most humid cave on the Stevens Road Tract which is generally unfavorable for Townsend's bat hibernation needs. If the entrance to this cave is restored to a more natural state, the physical conditions within the cave should be reevaluated to see if bats have adopted the cave as a hibernaculum or maternity roost. It is also noted this cave did not receive an archaeological evaluation and should be performed after any natural restoration performed on the cave entrance area.

Garbage Cave no. 2
This cave exists in an unnatural state with garbage and other yard debris choking the entrance.
Currently, the cave is known to be a Townsend's bat hibernaculum, though to a lesser degree than nearby Davenport Cave. It is likely the entrance was part of a collapse trench that is no longer visible. The entrance should be restored to a natural state because currently it's a health hazard.
The removal of this garbage will undoubtedly change the interior microclimate of the cave and may become unsuitable for bat hibernation. It is recommended after entrance reconstruction is completed that rocks and boulders are placed in the entrance so as to reconstruct the current entrance configuration (without damaging the cave), while at the same time allowing for an easier accessibility into the

cave for human entry. This cave also did not receive an archaeological evaluation and should be performed during any natural restoration to cave.

Davenport Cave
The entrance configuration to this cave is likely responsible for the suitability of the cave as a hibernaculum for the Townsend's bats documented there. Though the entrance slope appears to be unnatural, it doesn't appear to have any superficial garbage. The entrance configuration of the cave should be maintained as much as possible, though small alterations could be made for easier accessibility.

Three Pines Cave
The entrance configuration to this cave is not natural. Small amounts of garbage and debris can be seen mixed in the sloping entrance. Any garbage removal should be replaced with natural rock and dirt to reconstruct the entrance slope to its current state. It's unlikely a fully restoration can be performed at the entrance or surrounding area. Extensive graffiti defacement would need to be removed from both the exterior and interior. This cave may receive too much light in its interior to be a favorable bat hibernaculum.

Williams' Cave
This cave is in relatively great condition and close to a natural state. Recent acts of graffiti defacement to the exterior entrance would need to be removed. Non-Townsend's bat use has been documented in the cave, but is inconsistent from year to year.

Braille Cave
This cave, as a whole, is in relatively great condition and close to a natural state. No bat use has been recorded. It's likely this cave is unfavorable for bat use due to low ceiling heights. It's also noted this cave did not receive an archaeological evaluation.

Vulture Cave
The entrance to this cave is in relatively great condition and close to a natural state despite recent graffiti and other vandalism to the cave. The interior of the cave needs extensive restoration.
The cave has been heavily pothunted by illegal artifact hunters and was also studied by an archaeological team in 1996. The floor of the cave is now left in a hummocky state with unnatural berms and depressions. Recent camp sites have been set up in the cave and camp fires have blackened the ceiling. During the winter bat survey of 2015, the scent of smoke was still present in the cave. In its current state, the cave will never be preferred as a bat hibernation or maternity site. Restoring the floors to a more level state should be done. Graffiti removal techniques may also work on the blackened ceilings and walls, but technical advice for that technique must be sought from an appropriate specialist. In summary, the cave may be too small in too many ways to be preferable for bat use as the cave has no true dark zone and the ceilings are low and within reach of predators.

Stevens Cave
This is probably the best known and recognized cave of the Stevens Road Tract due to its visibility from the nearby road. The cave has been used repeatedly by the general public, sometimes in unfavorable ways. Recently, the cave had three camp tents inside and a campfire circle. Campfire circles are common in the cave and the ceiling has been coated black from smoke. Graffiti removal techniques may also work on the blackened ceilings and walls, but technical advice on that technique must be sought from an appropriate specialist. This cave may have never been suitable for bat hibernation.

Cave Name Changes

Name changes for many of the caves are recommended to improve expectations. Titles like “Garbage Cave” and “Davenport Cave” are relics associated with historical garbage disposal. Continued use of these names while trying to maintain a clean and natural cave environment would complicate management of the caves. Surnames of local and historical caving figures associated with the SRT caves would suffice. Each name recommendation is listed below:

Garbage Cave no. 1 → Greeley Cave
Named after the deceased Ronald Greeley who studied the SRT area for NASA during the 1970s. Ronald Greeley was one of the seminal investigators of the Horse System and named many of the caves in the Bend and central Oregon area.

Garbage Cave no. 2 → Brogan Cave
Named after the deceased Phil F. Brogan who pioneered the exploration of Lavacicle Cave with Phil Coyner and Jim Anderson. Explored other caves in central Oregon in addition to authoring “*East of the Cascades*.” Brogan was greatly familiar with the caves “east of Bend.”

Davenport Cave → Larson Cave
Named after recently deceased Charles V. Larson who studied and mapped many of the caves of Oregon and who gave Davenport Cave its current moniker. Larson’s influence on the caving community is felt throughout the states of Washington and Oregon. Dozens of cavers thank him for spawning their interest in caving, myself included.

Three Pines → Coyner Cave
Named after the deceased Phil Coyner who explored the caves of the SRT with his friend Jim Anderson during the 1960s. It’s likely many, or all of the trees, after which Three Pines is named, will be cut down for development.

Williams’ Cave → Williams Cave
The survey done by Stephen Wells and Sherry Williams shows an apostrophe. Since this cave has no previous documentation, it’s recommended to remove the apostrophe and keep the name.

Braille Cave
No change recommended. The original name of “My Cave I” was given by local caver Dennis Welbourn who visited many of the Horse System caves in the 1970s. It was subsequently renamed Braille Cave by Matt Skeels to remove moniker ownership.

Vulture Cave → Anderson Cave
Possible name change recommendation. The original “Three Vulture Cave” moniker was confusing, as it lacked plurality. The origins behind the name remain obscure and the caving community has since truncated the name. If the decision is made for renaming, it should be named Anderson Cave after naturalist Jim Anderson, companion and fellow cave explorer to the aforementioned Phil Coyner.

Stevens Cave
No change recommended. The majority of cave literature refers to it as “Stevens Road Cave,” but it was officially renamed to Stevens Cave to remove locational clues, a practice upheld by the caving community to aid in cave management. The current name matches the theme of other recommended name changes.

Section 4. Appendices

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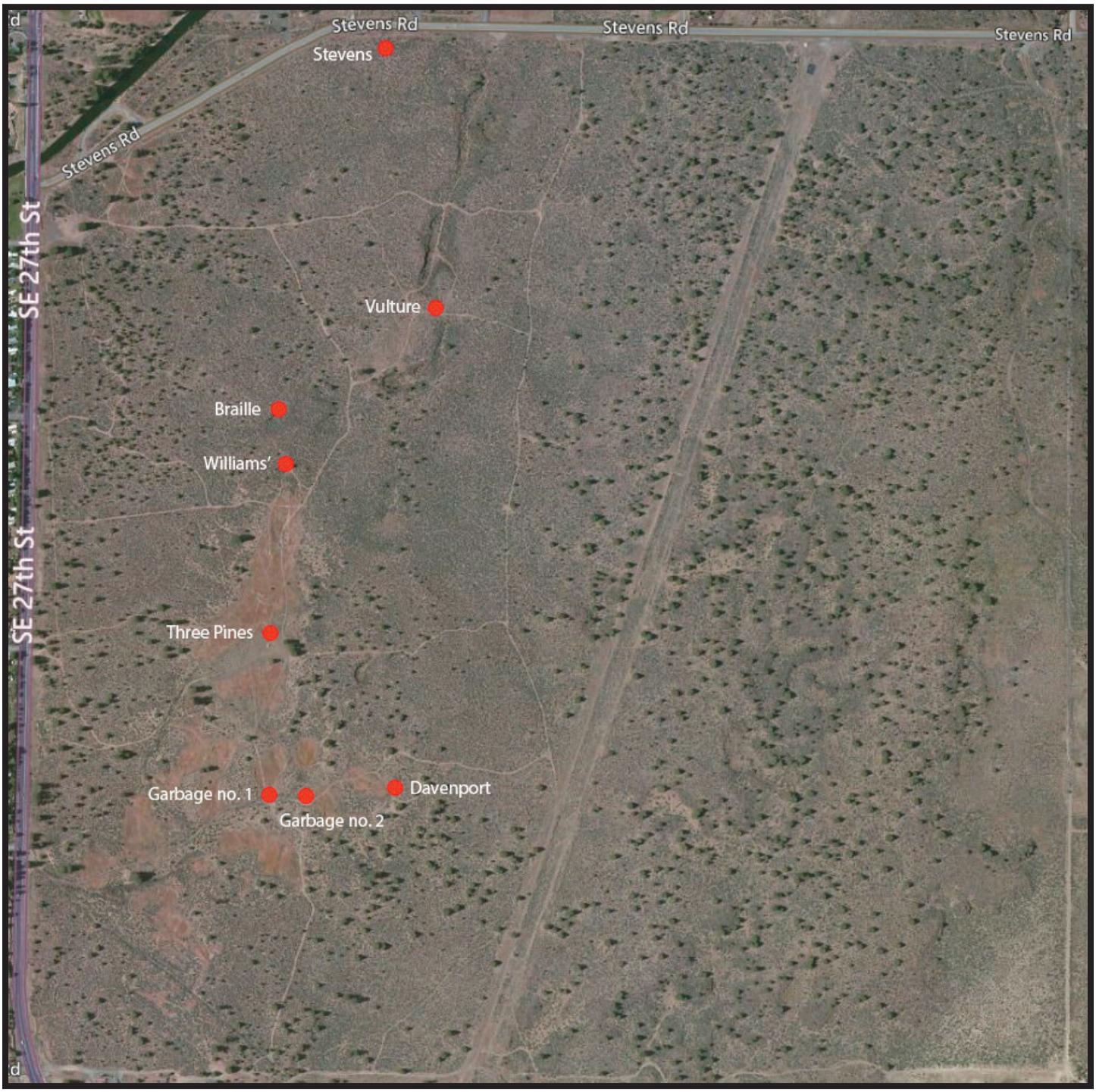
Appendix A:

Stevens Road Tract Area
Cave Location Map



- Cave entrance location

Appendix B:

50 Foot Buffer Zone Boundary Maps

In Appendix B four aerial photos have been edited depicting 50 foot buffer zones. These zones are placed directly above the central passage of the entrances to each cave. Each cave has had its interior passage outlined in white as if visible through the surface terrain.

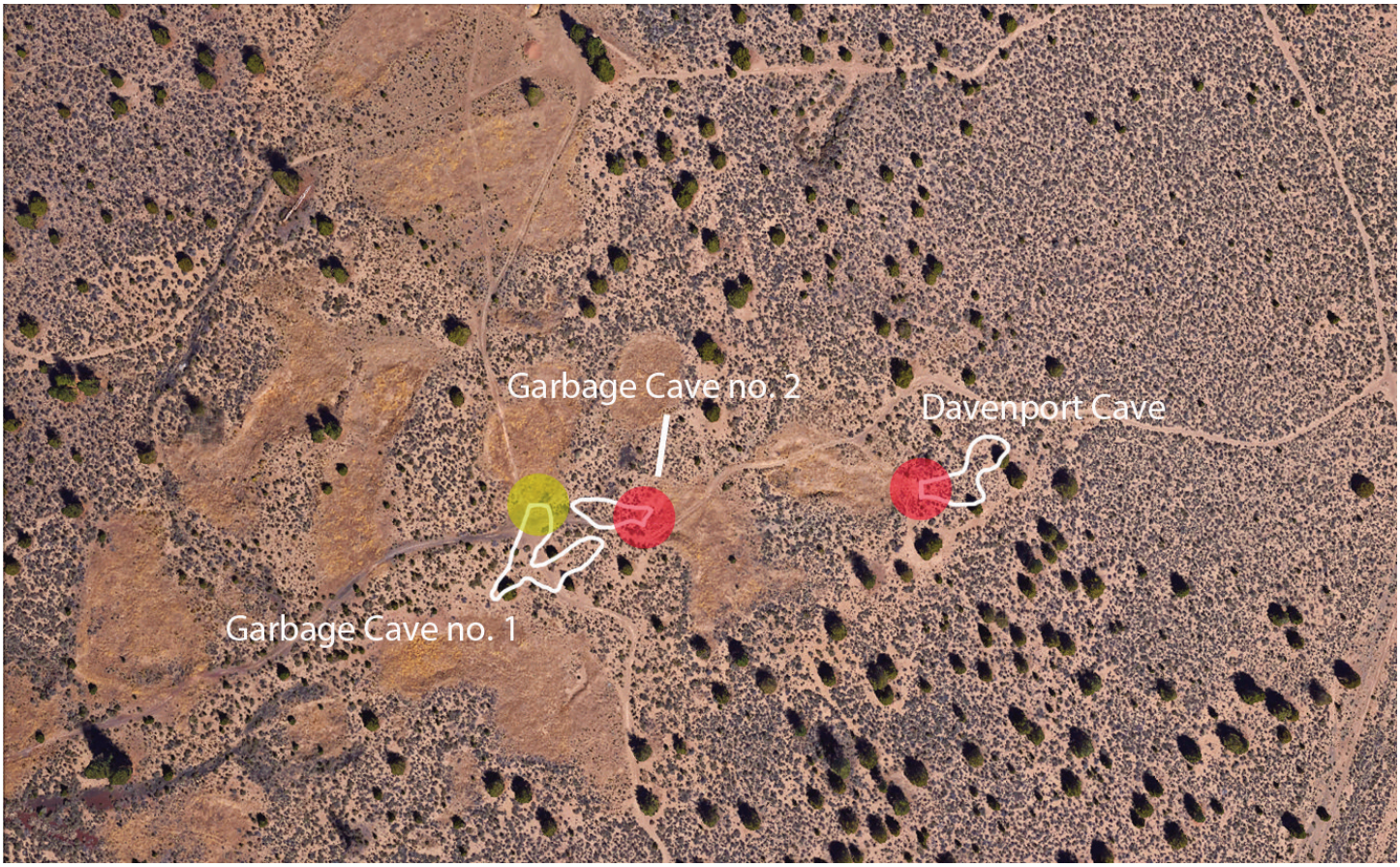
The area within these buffer zones represents zones of no sound disturbance and no permitted entry into the buffer zone during certain times of the year should contingencies require it. See Section 2 Cave Classifications for full details on which caves require buffer zones.

Green buffer zone - Green buffer zones represent Class 1 Caves that do not need buffer zones but have been depicted in the event these caves are reclassified.

Yellow buffer zone - Yellow buffer zones represent Class 2 Caves that do not need buffer zones but have been depicted in the event a four year observation period is enacted which requires a buffer zone.

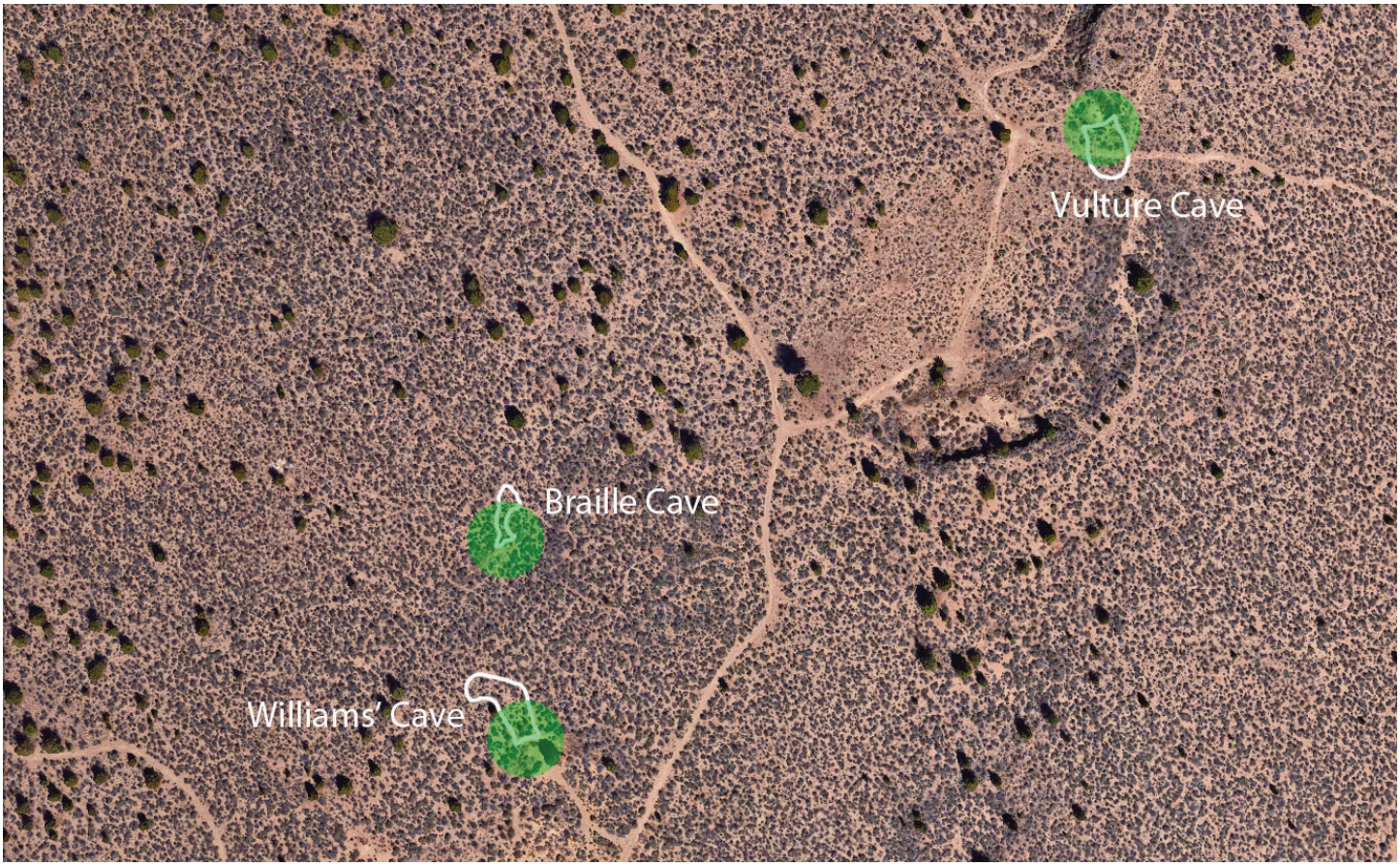
Red buffer zone - Red buffer zones represent Class 3 Caves that need buffer zones to limit sound disturbances by restricting entry into the buffer zone and the cave proper.

Any cave reclassified as Class 4 would have a 50 foot buffer zone and would be identical to a buffer zone depicted in the following aerial photos.



Above: Garbage Cave no. 1, no. 2 and Davenport Cave buffer zones.

Below: Three Pines Cave buffer zone.



Above: Williams', Braille and Vulture Cave buffer zones.

Below: Stevens Cave buffer zone.

Appendix C:
Cave Site Description and History

The Horse Lava Tube System

The caves of the Stevens Road Tract (SRT), also known as Section 11, are a part of the Horse Lava Tube System. The Horse Lava Tube System (HLTS) is a series of lava tubes originating on the far northern flank of Newberry Volcano in Deschutes County, Oregon. The HLTS is also a part of a larger series of geologic events that created what is collectively called the Lava Top Butte basalt. This basalt includes basalts from the Arnold Lava Tube System, the Badlands, and the Lava Top Butte Lava Tube System. The entire Lava Top Butte basalts, which includes the HLTS, have been dated to around 80,000 years old.

The vent for the Horse system erupted from a location in T18S R12E Section 26 located within Deschutes National Forest. During the active period of eruption, the lava flowed north into an ancient channel of the Deschutes River that occupied the area east of Bend and in the Redmond area at the Redmond Canyon. The lava flow now occupies the area immediately south of the city of Bend, east Bend proper, the adjacent areas east of Bend (such as the Bend airport), and north through the Pronghorn Resort, the Redmond Caves, the Redmond Canyon, and finally into the Crooked River Gorge by the unincorporated community of Crooked River Ranch. See Figure 1.

The caves of the HLTS vary in size and morphology and, depending on your definition of a cave, at least 122 have been identified. The majority of these caves are located in or near the city of Bend, with a small minority located at the Pronghorn resort and the Redmond Caves area north of Bend. Of the 122 known caves, approximately 59 are spatter cone caves located at the south end of Bend and in the Deschutes National Forest. Excluding the 11 caves of Pronghorn and Redmond, 52 lava tubes of varying sizes remain in and nearby the SRT mitigation area. This assessment does not account for other nearby caves including the 20 caves of the Arnold system, the 50 caves of the Lava Top Butte system, Skeleton Cave, Boyd Cave, Lava River Cave and many others, which are important in determining bat ranges of certain species.

The HLTS is positioned on the east side of Bend and was more or less untouched by man prior to their arrival in the late 19th century, omitting any native American usage which existed in limited areas of the HLTS. By the time bat use was the focus of any scientific studies, many of the caves of the HLTS were already greatly disturbed. There is no data on prehistoric bat use in the HLTS.

Stevens Road Tract

The SRT is roughly one square mile of land adjacent to the eastern city limits of Bend, located mostly south of Stevens Road and east of 27th St. Mixed reports on the total number of caves within the SRT have been filed over the years, with none being accurate or comprehensive except for those submitted by Matt Skeels in 2008. The caves are situated in an alignment that runs SSW to NNE (South-southwest to North-northeast), although a short, eastern-trending alignment is also present as an offshoot of the main branch starting at Garbage Cave no. 2. All of the caves are located west of the gas pipeline easement that bisects the SRT.

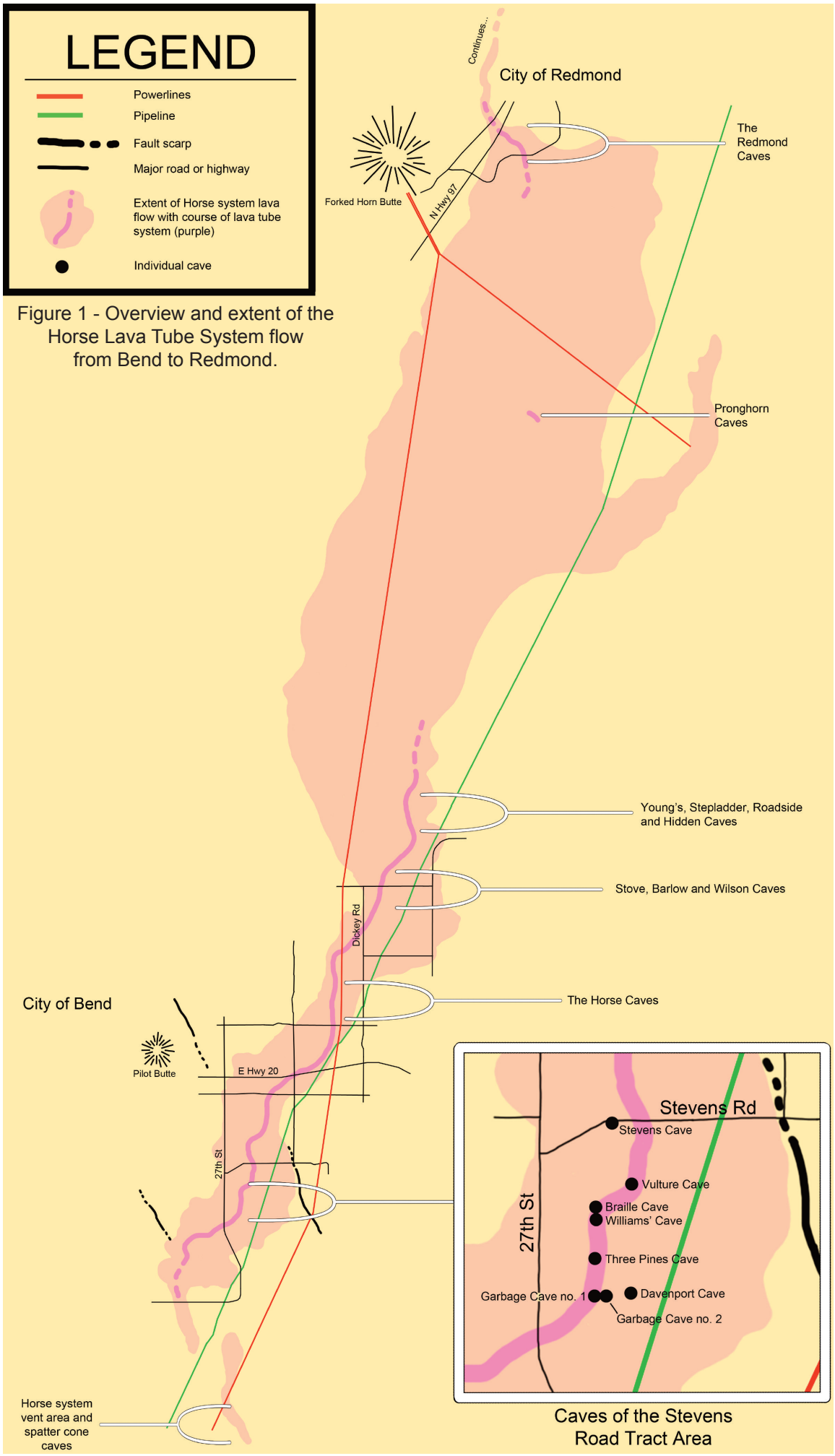


Figure 1 - Overview and extent of the Horse Lava Tube System flow from Bend to Redmond.

Caves of the Stevens Road Tract Area

Eight caves have been identified, mapped and inventoried in the SRT area. They are officially referred to as:

Garbage Cave no. 1
Garbage Cave no. 2
Davenport Cave
Three Pines Cave
Williams' Cave
Braille Cave
Vulture Cave
Stevens Cave

Various other aliases are known for the caves and are listed here to eliminate confusion and to acknowledge previous use in the event of future reference:

Garbage Cave no. 1: Garbage Cave, Garbage Caves
Garbage Cave no. 2: Garbage Cave, Garbage Caves, Dead Dog Cave
Davenport Cave: Garbage Cave no. 1, Garbage Cave no. 2
Three Pines Cave: Garbage Cave no. 2
Williams' Cave: Williams Cave
Braille Cave: My Cave I
Vulture Cave: Three Vulture Cave, Lava Pond Cave, Hobo Cave
Stevens Cave: Stevens Road Cave, Stephens Cave, Steven Roadside Cave

The most noteworthy of these aliases is of Davenport Cave originally being known as Garbage Cave no. 2 as first documented by Ronald Greeley of NASA in 1971. It has since been renamed by others, most notably Charles V. Larson who gave it the current moniker. Additionally, Vulture Cave has had variations in its name, starting out as Lava Pond Cave, then surveyed as Three Vulture Cave by the BLM, then renamed by BLM archaeologists as Hobo Cave, before settling on Vulture Cave by the caving community. It should be noted that another Hobo cave has been referred to as a completely separate talus cave in a collapse trench east of Braille Cave. This "Hobo Cave" is not a lava tube, and lacks characteristic properties to be considered a true cave and therefore will not be further acknowledged in this report.

Cave Characteristics

The 8 caves of the SRT make up some of the smallest caves of the HLTS in terms of length. Garbage Cave no. 1 is 355 feet long and nearly double the length of the next longest, the 195 foot long Davenport Cave. By contrast, Vulture Cave is the shortest at 65 feet long.

Cave passages in the SRT are fairly spacious, with most having walking passage, meaning you can easily stand up and walk around inside. Braille Cave is the most restrictive and difficult cave to explore with a small entrance, low crouching entrance room, and a middle passage traversable only by crawling on your belly. Williams' Cave is the second most restrictive with an average ceiling height around 4.5 feet.The most spacious cave is Garbage Cave no. 1 with the highest ceilings of any cave in the SRT.

Most of the caves have easy walking floors, meaning there are no obstacles to traverse, though a couple have substantial amounts of breakdown (piles of rock that have collected on the floor from the ceiling). Garbage Cave no. 1 had large amounts of boulders in both of its passages. Davenport Cave has one medium-sized pile of breakdown mid-passage. Williams' Cave is the only other cave with

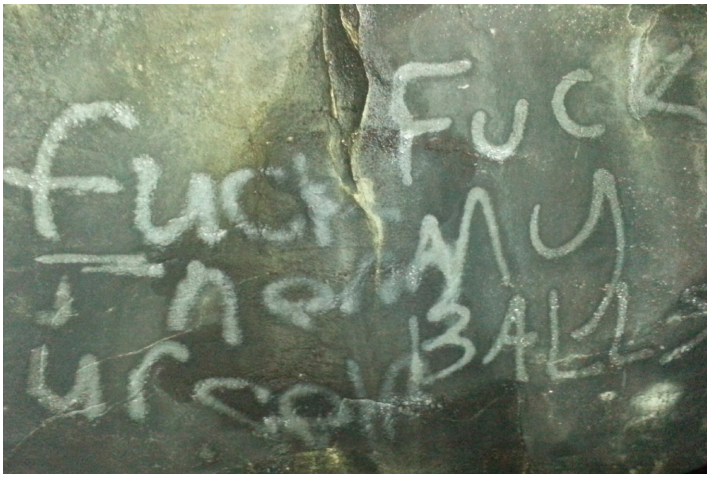
boulders, but most can by bypassed with no effort aside from crouching to avoid the ceiling.

Seven of the eight caves have single, linear passages. Garbage Cave no. 1 has parallelling passages making it the most complex cave in the SRT area. By central Oregon cave standards, however, Garbage Cave no. 1 is a fairly simple cave to explore, though its large amounts of breakdown require awareness of proper footing which can be challenging for the public (e.g. kids between the ages of 0 and 9, adults older than 40).

Until recently, and aside from their use as garbage disposal in the 1970s, the caves of the SRT have seen little defacement or vandalism from the public, with most examples being limited to Stevens Cave by proximity to the adjacent road. Starting in 2010, the caves started to receive an increased amount of traffic. Williams' and Three Pines Caves received their first examples of spray paint graffiti. Following that, Davenport and Vulture Caves also received graffiti. Use then increased two or three-fold amongst caves like Three Pines, Stevens, Vulture, and even Garbage Cave no. 1. Stevens, Vulture, and Three Pines have had tent sites and camp fire circles inside. Three Pines received more graffiti. Stevens, Vulture, Three Pines and Garbage Cave no. 1 all now contain modest amounts of garbage deposited within the last five years. See Figure 2.

Maps for each cave have been updated and are included in Appendix D.

Above: Interior of Vulture Cave - the cave had the largest amounts of modern garbage deposits.



Above: Graffiti found just inside the entrance to Three Pines Cave.

Above: Three tents (one on left in darkness) inside Stevens Cave.

Above: Interior of Garbage Cave no. 1 in the Lavacicle Room (see map in Appendix D).

Figure 2: Four examples of modern defacement and garbage disposal in select caves of the Stevens Road Tract area. Each picture was obtained on a visit to the area on 3/15/2015 during a bat hibernation survey.

Appendix D:

Stevens Road Tract Area Cave Maps

Page 39. Garbage Cave no. 1

Page 40. Garbage Cave no. 2

Page 41. Davenport Cave

Page 42. Three Pines Cave

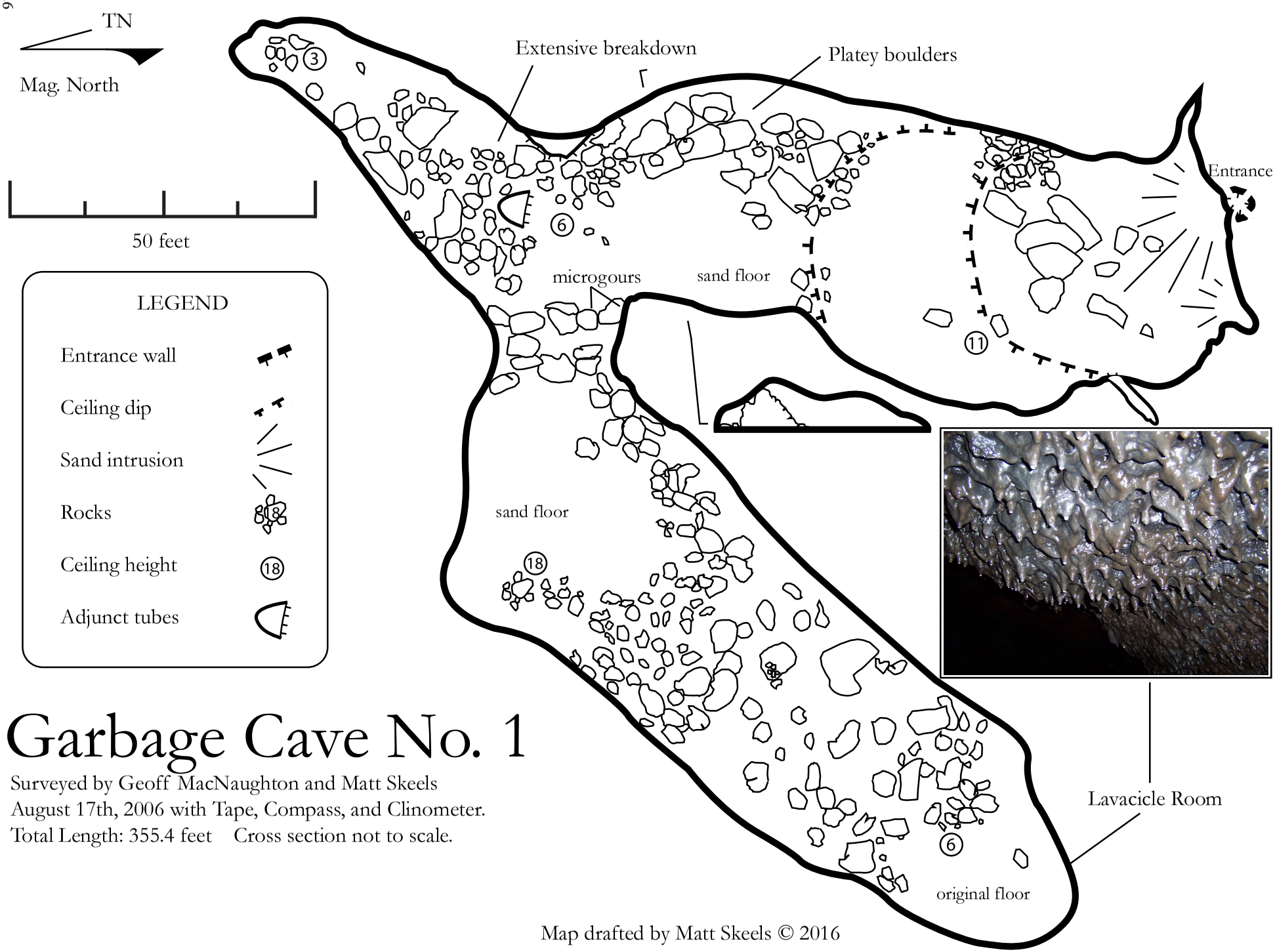
Page 43. Williams' Cave

Page 44. Braille Cave

Page 45. Vulture Cave

Page 46. Stevens Cave

These maps were updated from the Oregon Department of State Lands 2008 submissions.



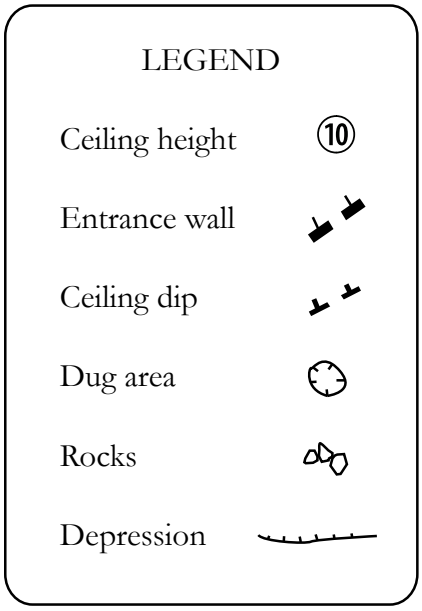
Garbage Cave No. 1

Surveyed by Geoff MacNaughton and Matt Skeels
August 17th, 2006 with Tape, Compass, and Clinometer.
Total Length: 355.4 feet Cross section not to scale.

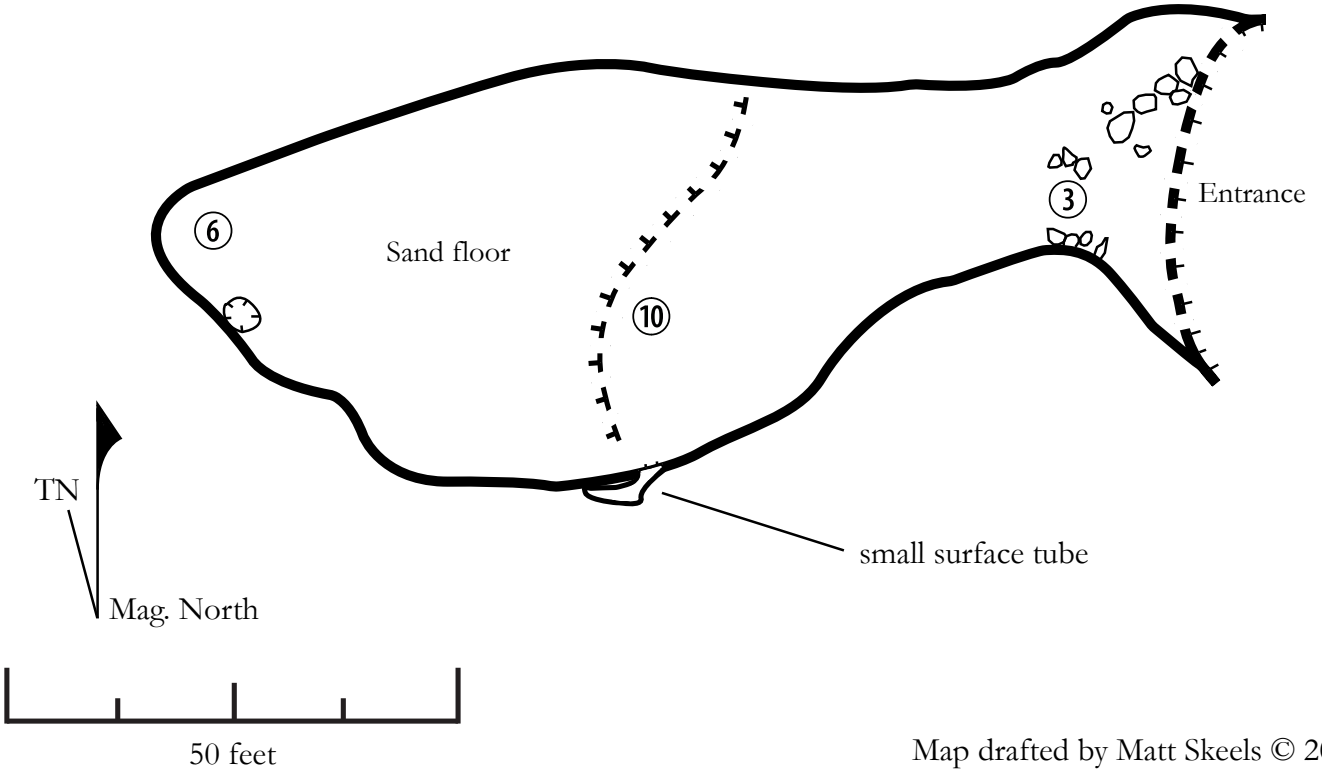
Map drafted by Matt Skeels © 2016

Garbage Cave no. 2

Surveyed by Geoff MacNaughton and Matt Skeels
August 17th, 2006 with Tape, Compass, and Clinometer
Total Length: 123.4 feet



Garbage Cave no. 2 entrance.

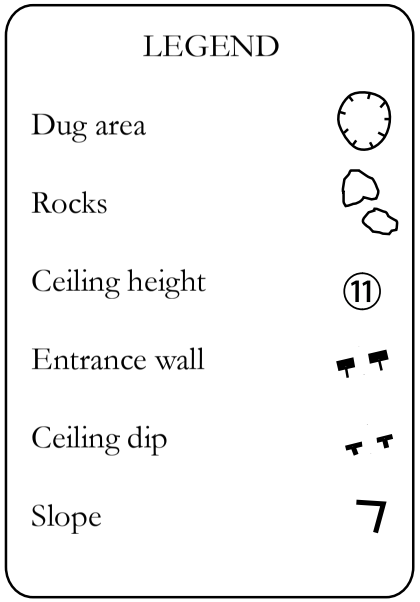


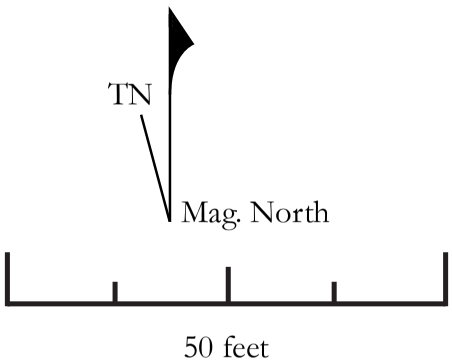
Map drafted by Matt Skeels © 2015

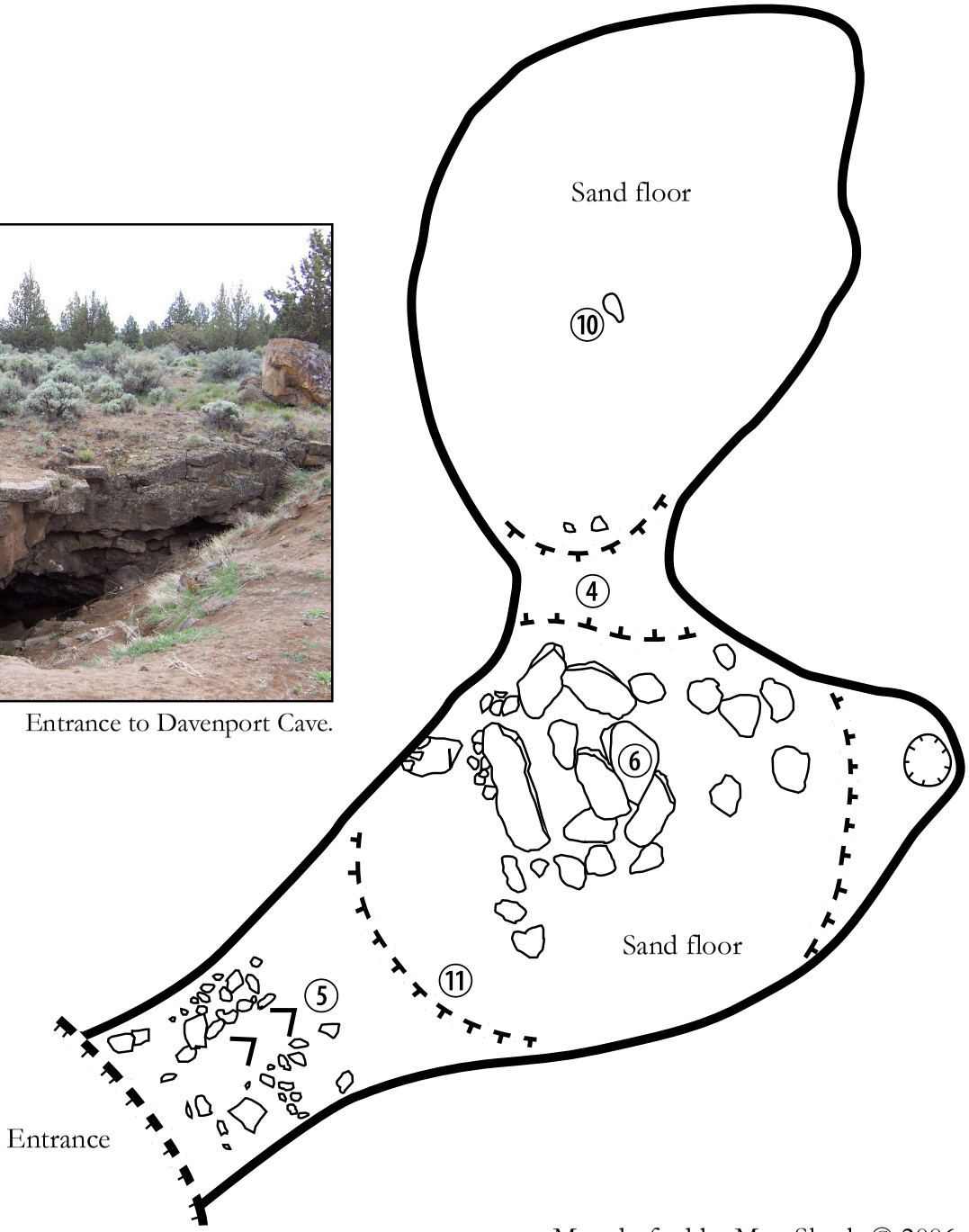
Davenport Cave

Surveyed by Geoff MacNaughton and Matt Skeels
August 17th, 2006 with Tape,
Compass, and Clinometer.
Total Length: 195.6 feet

Entrance to Davenport Cave.





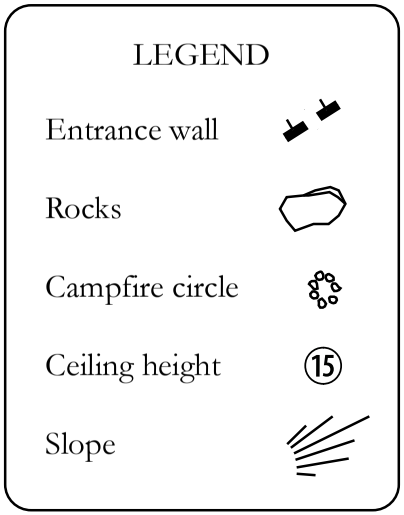


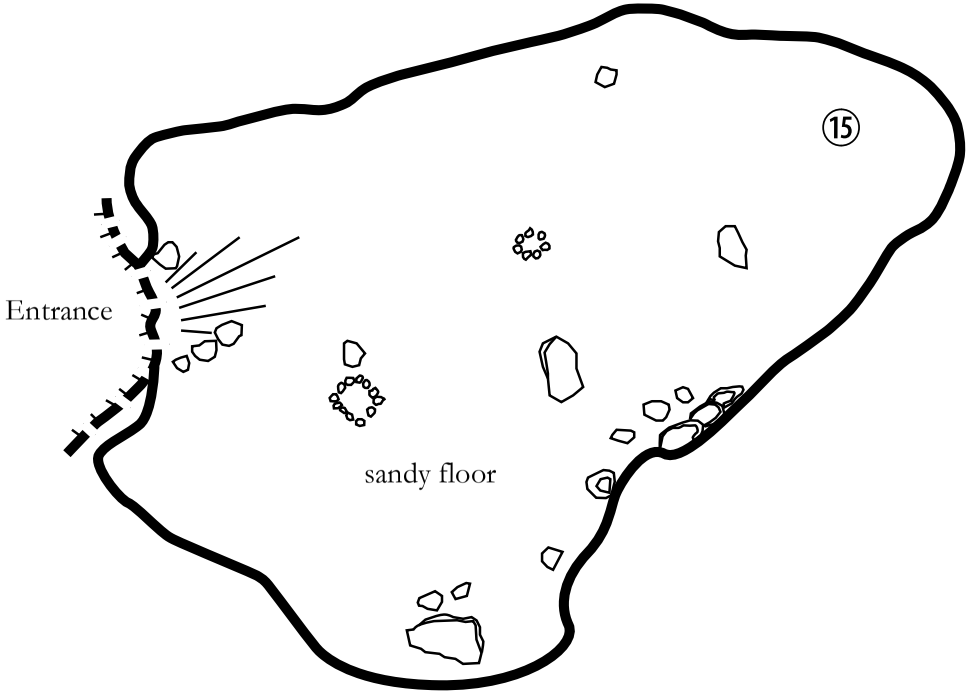
Map drafted by Matt Skeels © 2006

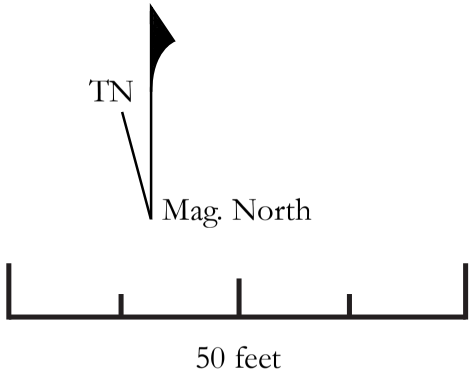
Three Pines Cave

Surveyed by Geoff MacNaughton
and Matt Skeels Dec. 7th 2006
with Tape, Compass, and Clinometer.
Total length: 91.9 ft

Three Pines entrance; note the three pine trees in the background.





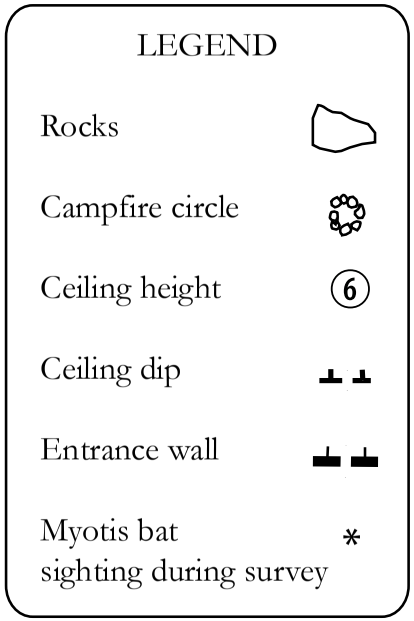


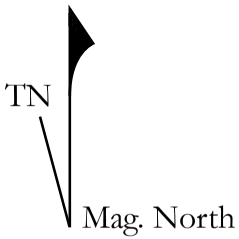
Map drafted by Matt Skeels © 2015

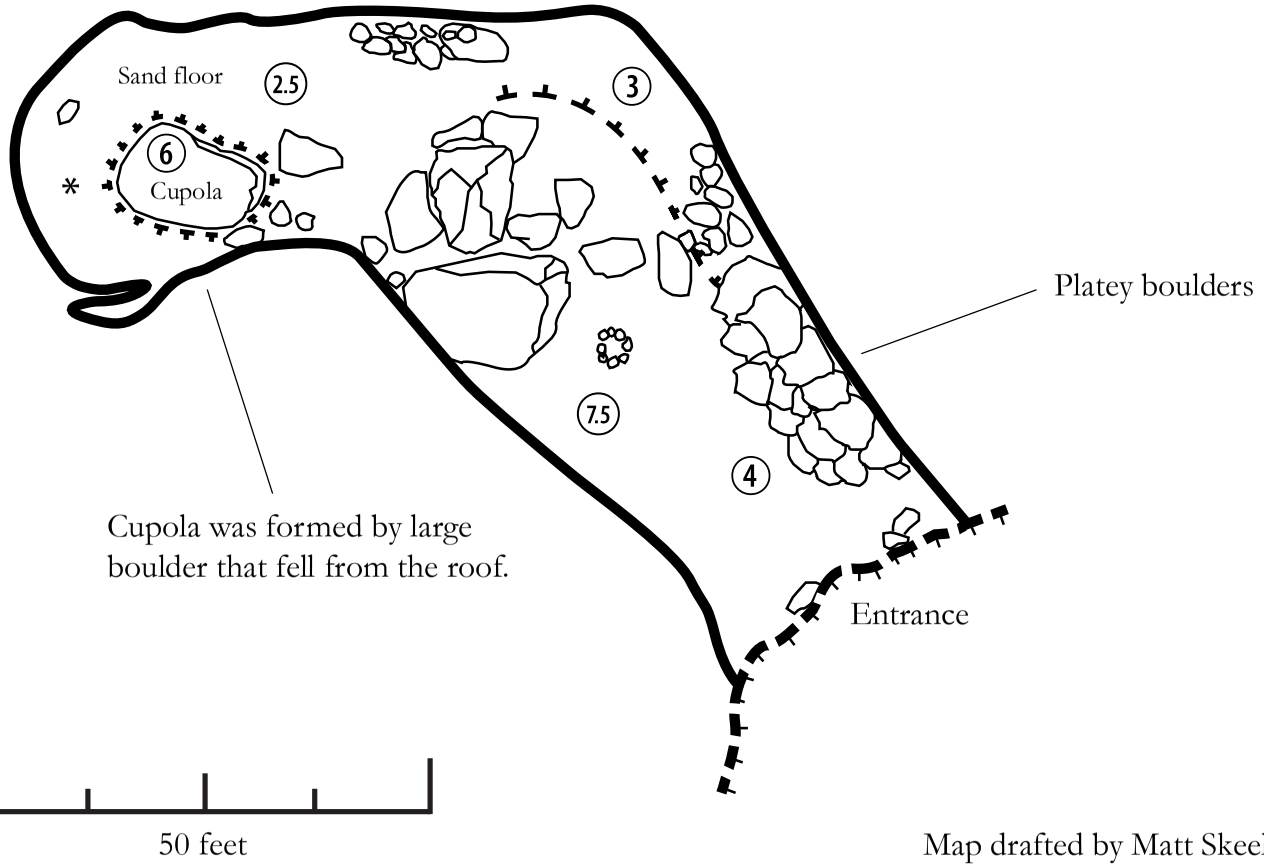
Williams' Cave

Surveyed by Geoff MacNaughton and
Matt Skeels December 7th, 2006 with
Tape, Compass, and Clinometer.
Total Length: 112.9 feet

Entrance to Williams' Cave.







Map drafted by Matt Skeels © 2015

Braille Cave

Surveyed by Geoff MacNaughton and Matt Skeels
on January 2nd, 2007 with Tape, Compass, and Clinometer.
Total Length: 84.9 feet

Map drafted by Matt Skeels © 2015

LEGEND

Ceiling height (4.5)

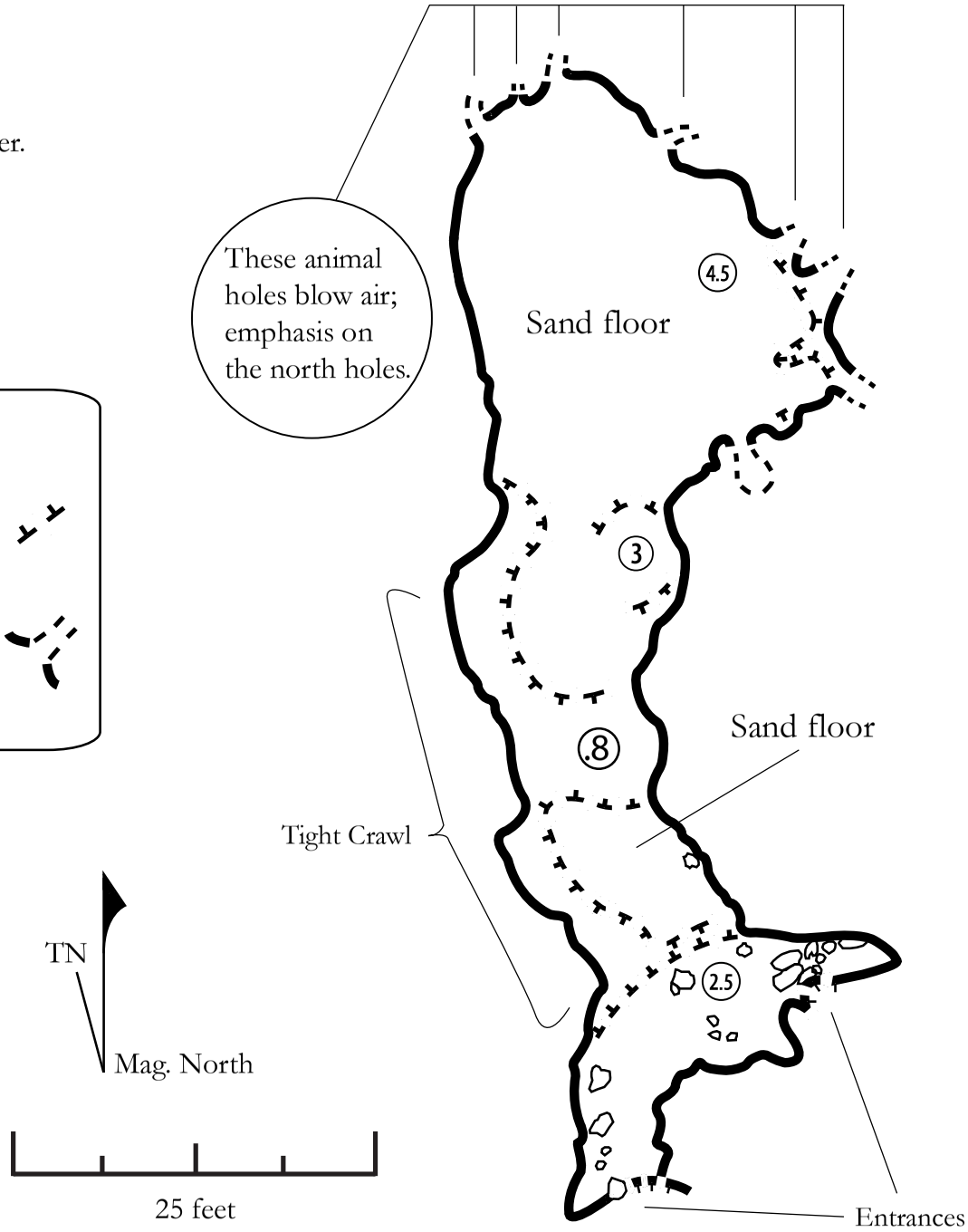
Ceiling dip

Rocks

Animal holes that go beyond traversable passage, some blow air

Entrance wall

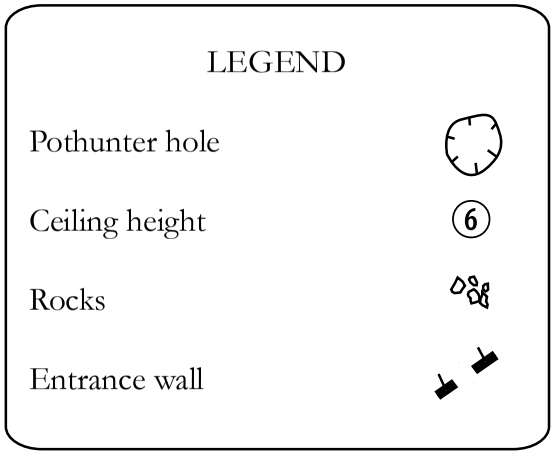
Entrances to Braille Cave.

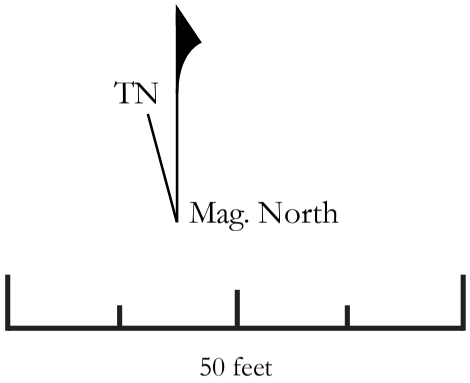


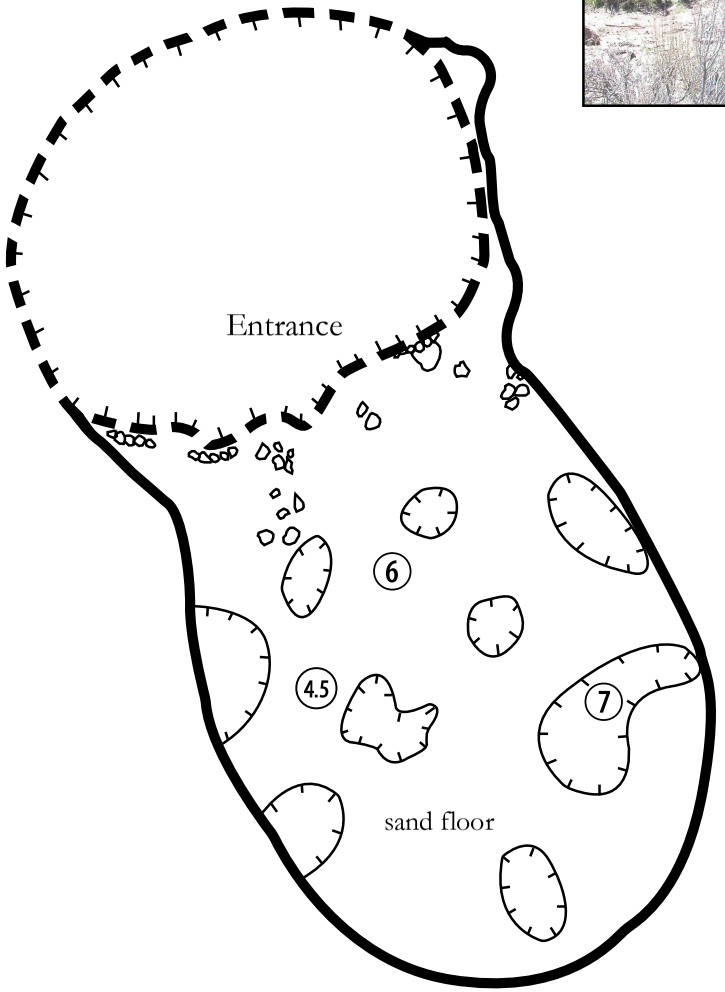
Vulture Cave

Surveyed by Geoff MacNaughton and Matt Skeels December 7th, 2006 with Tape, Compass, and Clinometer.
Total Length: 65.7 feet

View of the entrance.





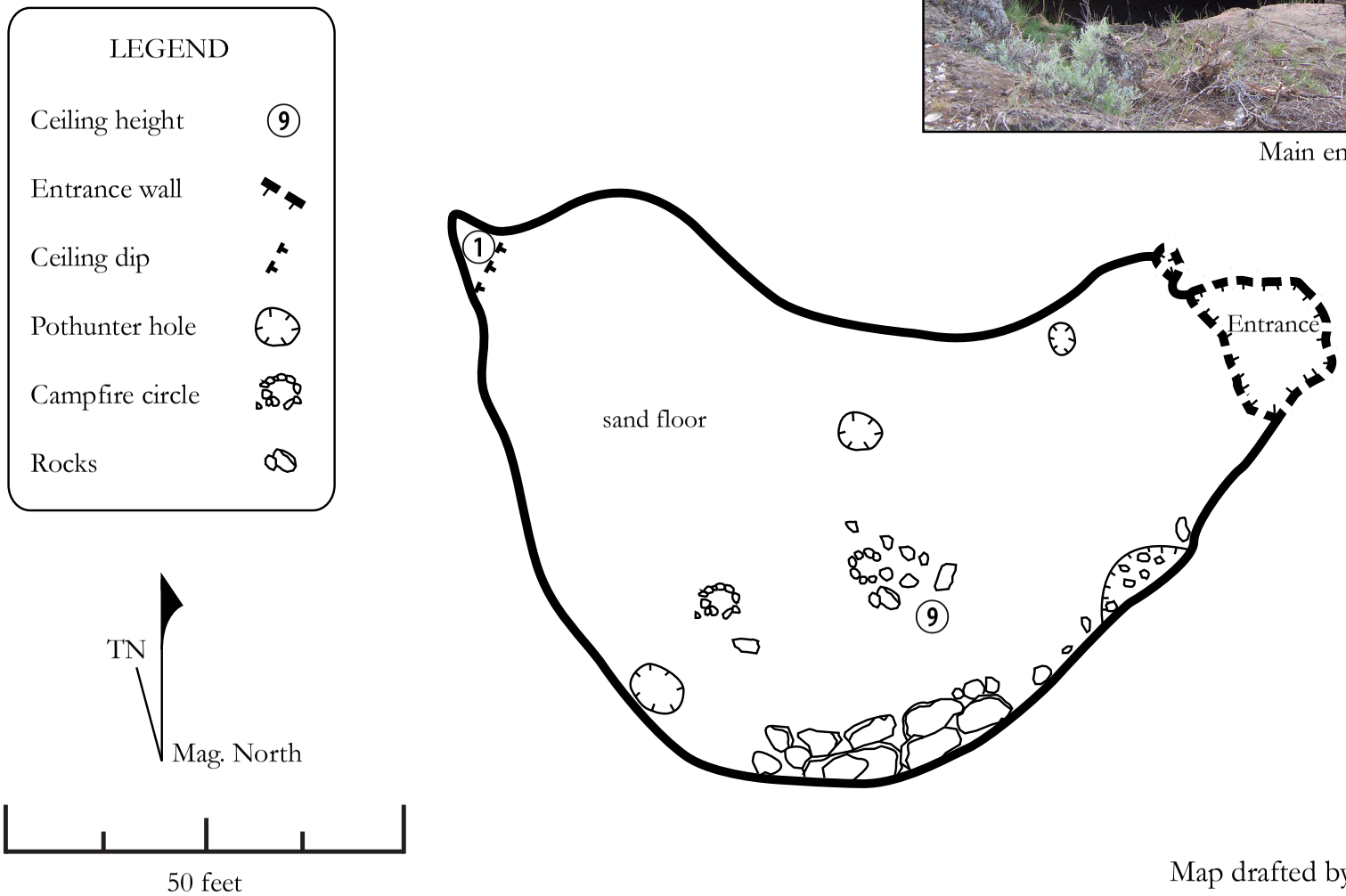


Map drafted by Matt Skeels © 2015

Stevens Cave

Surveyed by Geoff MacNaughton
Matt Skeels December 7th, 2006
with Tape, Compass, and Clinometer.
Total Length: 115.2 feet

Main entrance to Stevens Cave.



Map drafted by Matt Skeels © 2015

Appendix E:
Stevens Road Tract Bat Species Information

The number of bat species capable of utilizing caves in central Oregon is fairly robust, however, in field observations, the usage has been predominantly by Townsend's big-eared bats which prefer caves for roosting. Other species have been observed in central Oregon caves, typically little brown bats (*Myotis lucifugus),* Canyon bats (*Parastrellus hesperus)* and others. Literature on bats note many different western bat species use caves at one time or another, but unlike the Townsend's big-eared bat, these other bats don't strictly prefer caves or mines to other roosting sites. For this reason, the Townsend's big-eared bat will be the focus of this appendix as it applies to the Stevens Road Tract.

Townsend's Big-eared Bat Species

The species of main concern that have been observed in the Stevens Road Tract are the Townsend's big-eared bats (*Corynorhinus townsendii*), which prefer caves or mines as their primary roosting (maternity, night, or day roosts) or hibernacula sites. Townsend's bats have also been known to occasionally use houses, bridges and hollow trees for day and night roosting.

The Townsend's big-eared bat was previously identified as a part of the *Corynorhinus* subgenera of *Plecotus townsendii* by C.O. Handley in 1959. The species was recognized as a separate genus by Koopman and others in 1993. References by J. Mark Perkins found within this document refer to *Plecotus* which have subsequently been recognized as *Corynorhinus*.

Townsend's bats are a colonial species, meaning they prefer living together, although the males and females of the species don't always live together. Females will form a maternity site to raise their young during the spring until late summer or early fall. If left undisturbed, the species will reuse their roosts indefinitely. Nearly all female bats prefer returning to their natal roost sites. When using a maternity site, the females will form dense clusters. Unlike the female bats, males will disperse to live solitary lives during the summer months.

The species are inclined to be sedentary, with one central Oregon monitoring program noting a Townsend's bat returning to the same cave for 21 consecutive years, possibly longer. No long distance migrations have been noted. Western species of *Corynorhinus* have not been documented travelling further than 30 miles in seasonal movements. In central Oregon, migration from cave sites is generally limited to a range of 15 miles. Townsend's bats usually don't associate with other bats, especially in maternity roosts or hibernaculums, though the occasional unrelated species may be seen elsewhere in the same cave or mine site at these times.

The average Townsend's big-eared bat lives about 16 years but can live longer. The mortality rate in juveniles is rather high the first year, with chances of survival greatly increasing in following years.

Maternity Roosts

The prerequisites for a Townsend's bat maternity roost are varied. Roosting temperature, roost dimensions, light quality, and air flow seem to be key factors, with roosting temperature being critical. Bats may cluster to maintain higher body temperatures and to protect their young. Temperatures of maternity sites may vary depending on regional locations. It is also not uncommon to have a

maternity colony switch roosting sites in an effort to find cooler locations during early pregnancy or warmer spots for later pregnancy and after the pups are born. Generally, maternity sites are warmer than hibernation sites.

The species also prefer relatively spacious maternity roosts. In California, roosts were examined as being at least 98 feet in length and at least 6.5 feet above the ground. Maternity clusters are commonly located in ceiling pockets or along walls of the roost area within the twilight zone. At Poverty Flat Cave in Jackson County, Oregon, a maternity site of Townsend's was observed in the twilight zone, with bat pups visible in nearly direct sunlight at the cave entrance during afternoon hours.

Hibernacula

In hibernation sites of the western United States, Townsend's bats have been observed selecting roosts with stable, cold temperatures and moderate airflow. Individuals will commonly roost on ceilings and walls preferably 10 feet off the ground, though locally in Stookey Ranch Cave (Arnold System) and Davenport Cave (of the SRT) they have been observed less than 6 feet off the ground and sometimes as low as 3 to 4 feet. Temperature seems to be a key factor in hibernation sites, with recorded temperatures in hibernacula ranging from 28.4°F to 55.4°F, with J. Mark Perkins and others noting preferred temperatures below 50°F. The bats will briefly rouse from torpor several times during hibernation to increase blood flow, before settling back into torpor again.

Hibernation periods for Oregon have fluctuated in recent times, but generally start mid-October and end mid-April. Currently, the Deschutes National Forest and Prineville BLM district observe cave closures at hibernation sites between the periods of October 15th and April 15th. As the climate for the region continues to change, so too will the hibernation cycles of the Townsend's bat and adjustments to these closures may be necessary.

Behavior and Diet

The Townsend's bat species may wake up from slumber before nightfall, but won't usually leave the roost until after dark, averaging 45.5 minutes after sunset. In flight, the bat is slow compared to other species, travelling at about 9.5-18 ft/sec, though highly maneuverable and known to navigate through passages less than a 1' x 1' wide. The species is particularly good at avoiding mist nets.

The diet of the Townsend's big-eared bat is highly specialized and consists almost entirely of moths (*Lepidoptera*) with an emphasis on Noctuid moths. Other insects may be ingested infrequently and may include order classifications from *Hemiptera*, *Hymenoptera*, *Homoptera*, *Neuroptera*, *Trichoptera*, and *Plecoptera*. In northern California, the species prefers to forage in forested habitat or along heavily vegetated stream corridors and avoids open pasture land.

Identification of Townsend's Big-eared Bats

For identification purposes, the Townsend's bat can be distinguished from other western bat species by observing the combination of their "2-pronged, horseshoe-shaped lump on the nostrils, and large, rabbit-like ears." Other bats in the Oregon also have long ears, such as the pallid bat (*Antrozous pallidus*), spotted bat (*Euderma maculatum*), and the long-eared myotis (*Myotis evotis*); see Figure 3. Measurements of adult bat forearms range between 39-48mm and ear lengths measure 30-39mm. Generally, the color of a Townsend's bat has been described as dark brown or chocolate brown with their underparts being somewhat paler.

Figure 3 - Left picture: Closeup of a Townsend's big-eared bat. Note long ears and horse-shaped lump on nostrils. Right picture: Long-eared myotis for comparison. Note the slightly less prominent ears and absent pronged nose.

Identifying the Townsend's species is easy once familiarity with the species has been achieved. When the bats are awake and active, identification is easiest and a quick look at the ears will be all that's required. When the bats are sleeping or in torpor, it can be challenging to make accurate identifications. Typically, during hibernation, the bat will curl its ears against its head and tuck them beneath their wings, or alternatively, they may have either ear extended while the other remains tucked. In central Oregon, the species is rarely mistaken for another species because of its uniqueness, making it one of the easiest bats to identify and monitor.

Sensitivity of the Species

The sensitivity of the Townsend's big-eared bat species is familiar to bat biologists. Repeated visits or disturbances to roosting bats will force the species to abandon a site in search of other roosts. Mist-netting a Townsend's big-eared bat has been reported with automatic rejection of a roosting site by the bat. Any form of handling the bats, such as banding or applying a transmitter, also typically leads to roost abandonment.

Status of the Townsend's Big-eared Bat

The Townsend's big-eared bat is currently listed as a critical sensitive species under the Oregon Department of Fish and Wildlife (ODFW) guidelines. The ODFW uses the sensitive species designations to improve the species status via conservation efforts. Efforts applicable to the SRT may include:

- Maintaining, improving, or restoring habitat
- Providing technical expertise, incentives and recognition to landowners who wish to provide wildlife habitat
- Creating cooperative agreements with assurances for private landowners who provide habitat
- Incorporating species' needs into activities that could negatively affect species
- Conducting further research to identify threats and methods to address those threats
- Bringing together land managers, researchers, and other people to share information
- Monitoring populations to detect either positive or negative changes in populations
- Educating people about what the species needs to persist and what actions people can take to assist in the conservation of the species

Though the caves of the SRT may never be privately owned, they will be adjacent to private landowners. Education efforts for these residents will increase the viability of these sites. Imbuing a sense of ownership with local residents, will help discourage disruptive activities and go a long way toward helping sustain and grow local bat populations.

Other species may occasionally utilize caves and have also been recognized as “vulnerable” under the Sensitive Species List by the ODFW. They include:

California Myotis (*Myotis californicus*)
Fringed Myotis (*Myotis thysanodes*)
Long-legged Myotis (*Myotis volans*)
Hoary Bat (*Lasiurus cinereus*)
Silver-haired Bat (*Lasionycteris noctivagans*)
Spotted Bat (*Euderma maculatum*)
Pallid Bat (*Antrozous pallidus*)

None of the above vulnerable species have been observed in the SRT caves.

Appendix F: Bat Use History in the Horse System with Special Attention to the Stevens Road Tract

In this appendix, historical bat use will be noted for the caves of the Horse system, with emphasis on the Stevens Road Tract. There is minimal data on bat use in the Horse system and collectively it is considered deficient. All data for the HLTS has been provided as points of comparison for future bat monitoring in the caves of SRT. For example, a bat study in Barlow Cave (outside of the SRT) may become useful in the future as conditions change and could represent usable data correlations.

Perkins Reports

The first bat study on caves in the HLTS was done by bat biologist J. Mark Perkins. Perkins began a 5 year study in 1980 and published his findings in a 1986 report. Many caves were noted as “potential hibernaculums” but very few of the caves were noted with actual bat use. Perkins noted however, in the past the HLTS likely supported as many bats as the Arnold Lava Tube System did at the time of his 1986 report. Most importantly, Perkins continued to say that bats may begin to reuse certain caves as disturbances are reduced and specifically referred to Young’s Cave, the longest cave in the HLTS system at nearly 4,000 feet in traversable length, as well as Wilson, Lewis Farm caves and the Johnson Farm caves.

The corollary between the Horse and Arnold systems, is partially incorrect, as the size and temperatures between the these two cave systems appears to be overlooked. Most of the caves in the Arnold system are comparatively much longer at over 1,000 feet in length and with greater subsurface depths providing more adequate hibernating temperatures. Arnold Ice Cave, for example, has an overburden of 94 feet at the cave entrance. By contrast, the Horse system consists mostly of caves less than 400 feet in length and an average roof thickness rarely exceeding 20 feet.
The average lava tube in the HLTS is 386 feet long and the median being 200 feet. Only five of the 122 caves in the system are longer than 1,000 feet: Young’s, Barlow, Pronghorn I, Horse no.1 and Johnson Farm no. 1. The short cave lengths and thinner roof thicknesses can mean slightly warmer and unfavorable hibernation temperatures.

The three largest Redmond Caves, also a part of the HLTS, were studied by Perkins and documented in his 1986 reports. The similarity of the Redmond Caves to the SRT caves are striking, consisting of mostly short caves, with the longest cave at 600 feet in length. This cave, known as Cave Next Door (AKA Redmond Cave no. 3), had a single observation of a Townsend’s big-eared bat by Perkins in January of 1986. The Redmond Caves could potentially harbor more bat use, but the Redmond Caves are extensively visited by the citizens of the city of Redmond during all times of the year.

Perkins’ report also notes potential hibernaculums in three SRT caves: Stevens, Garbage Cave no. 1 and Garbage Cave no. 2. Because name changes for the Garbage Caves are very common, it is unknown if Perkins is referring to other caves in the SRT. It is likely the true Garbage Cave no. 1 was partially or fully inaccessible to Perkins at the time of his visit, and therefore might have been referring to Davenport Cave.[1] Perkins reported no bats in the three SRT caves he visited, but suggested these caves might be suitable for bat use but did not acknowledge how or why.

Perkins’ greatest contribution to understanding bat use in the HLTS was the observation of a hibernaculum and maternity roost in Barlow Cave northeast of Bend. Barlow Cave is a segmented cave, totalling 1,794 feet in length and located on private property. Barlow Cave is much larger than

any cave found on the SRT and its location on private land likely contributed to less disturbance to the bats. Barlow Cave is only partially similar to the caves of the SRT because of its greater length. In a later 1990 report by Perkins, he notes that no bats were observed in any of the caves of northeast Bend and this included Barlow Cave. He concluded increased human visitation in the form of party sites had likely extirpated the bats.

An additional article by Perkins, *A Biological Timing Guide for an Ethical Caver*, was published in 1989. The article was a visitation guide to caves as dictated by bat use. Perkins recalls many of the caves from his 1986 report, but by this time, many of the HLTS caves had been labeled as "Open year round" and specifically noted Stevens, Garbage Cave no. 1 and Garbage Cave no. 2 as belonging to this category (it should again be noted in light of the existing alternative names, Perkins may have been referring to Davenport Cave in place of either of the Garbage Caves).
Perhaps Perkins only considered limited use from the small caving community and not prolonged visitation from the general public. Regardless, the caves described in the visitation guide as open year round, do not appear on the "Caves to Avoid" list. Only Barlow Cave, which is outside of the SRT area, is mentioned as a cave to avoid during the summer because of the maternity colony present at that time.

In 1998, a summer bat study was done at the Redmond Caves. Perkins returned to the caves and noted very limited bat use, with only one Townsend's big-eared bat night roosting in Cave Next Door (Redmond Cave no. 3). Two other bats were mist-netted near the caves, but were not Townsend's bats.

BLM Report on the SRT

According to a Finding of No Significant Impact (FONSI) from 1996, a winter bat study was conducted in 1994-95 by the Prineville BLM district staff in five of the SRT caves. The FONSI report is a little unclear as to the total number of caves on the SRT, but it assumed at the time of the report's filing, that the SRT only contained 6 of the 8 known caves. Consequently, it is unknown which caves were or were not visited during the study.

The winter bat study concluded with zero observations of hibernating bats. Coincidentally, the FONSI report also acknowledged an "incidental trip to the cave" in which a Townsend's big-eared bat was discovered. No details are offered on which cave this sighting occurred in, nor the time of year.
An attempt to procure further documentation on the 1994-95 winter bat study or the "incidental trip" with Prineville BLM staff came up with no results for the SRT, though it was noted that hard copies may exist in a warehouse in Portland, Oregon but would likely only contain information available in the FONSI report.

The report continues by noting no summer bat searches were conducted on the SRT. It's assumed the aforementioned "incidental trip" was during a hibernation period for bats. The report further comments on potential summer bat use in the caves by noting the "five caves" surveyed in the report are not suspected to be summer maternity roosts, nor are they historically known to be hibernacula during winter months.

Studies of non-Townsend's bats were not done for the SRT, but the FONSI report noted myotis species can roost in caves though none were observed on site. The report refers to Perkins' studies noting that the availability of suitable roosting sites on the SRT is relatively low.

A summary of the environmental effects to the caves in the FONSI concludes that "there will be no

significant impact on threatened, endangered or sensitive plant or animal species."

Shawn Zumwalt's Study

A study in 2008, for the Oregon Department of State Lands by Shawn Zumwalt and Jess Jordan, attempted to record the sounds of bats in the SRT cave area. The study was conducted during nightfall when bats are active. He reported finding zero Townsend's big-eared bats in the area. According to J. Mark Perkins, it is difficult to record the signatures of Townsend's big-eared bats. Their vocal sounds are comparatively weaker than other species and typically can only be recorded from a distance of 12 feet away or less.

Miscellaneous Reports

Jim Anderson Story

In the book Tales from a Northwest Naturalist, Anderson recalls visiting the area near "Knott Landfill" and describes the area as having many tubes that were later filled in with refuse. In the 1950s, he notes it was a great spot to find bats and other wildlife. During a 1950s trip to a cave that Anderson describes as having a "davenport" in its entrance, he and two other companions went searching for hibernating bats. Inside the cave they found a single "little brown bat." Anderson's story continues to describe the local bat population of central Oregon as very small.

Neil Marchington's Report

Neil Marchington, a member of the Oregon High Desert Grotto, recollected two visits to the SRT. On February 3rd, 2008 he observed 3 hibernating Townsend's big-eared bats in Garbage Cave no. 2 and 8 Townsend's in Davenport Cave. Marchington also visited Garbage Cave no. 1, Vulture, Braille, and Three Pines caves but observed no hibernating bats. Stevens and Williams' caves were not visited during this time.

On August 12th, 2008 Marchington visited both Garbage Caves, Davenport, Braille, Three Pines and Vulture caves without seeing a single bat.

Matt Skeels' Reports

Matt Skeels has been to all accessible caves in the HLTS, many repeatedly, and has recorded some mixed bat usage. With one exception, very little bat use was seen in the HLTS. In most cases, only a few caves were noted with little more than a single bat per cave during non-hibernation periods. Most observations were of a single isolated and unidentified bat.

Bat use is mixed between Townsend's big-eared bats and non-Townsend's for most of the system. On a few visits, two or less bats were seen in the larger caves such as Young's, Barlow, or the Horse Caves. The majority of the bat use appears to be limited to the caves at the north end of town, particularly those caves on the City of Bend's waste treatment plant property.

The previously noted exception to these observations was at Wilson Cave, near Barlow Cave in northeast Bend. During early summer visits, 30 to 40 Townsend's bats were observed on three separate occasions. The first two observations were in early or mid-summer of 2003 and 2004. In 2013, the bats were observed again as well as a bat pup suggestive of a maternity colony. It is likely this 245 foot long cave, with a north-facing entrance, is an ideal maternity site.

The private ownership and restricted visitation by the public lends the cave to increased bat use. It's possible the bats migrated, or were pushed from, nearby Barlow Cave.

Observations within the SRT are uncommon, with a single non-Townsend's bat being observed hibernating during the December 7th, 2006 survey of Williams' Cave by Geoff MacNaughton and Matt Skeels (see map in Appendix D).

A bat hibernation survey was performed on March 15th, 2015. Two of the eight caves had hibernating Townsend's big-eared bats, with the other six caves having no bats. Davenport Cave was observed as having four Townsend's and Garbage Cave no. 2 having one. See Appendix G.

Garbage Cave no. 1 is large enough for hibernation purposes, as noted by Perkins (see Footnote 1 at the end of this appendix), but the cave appears to be too humid for bat hibernation. Instead, the cave might be used for hydration purposes instead. In the event that the cave entrance is cleared of garbage debris, it's possible the interior conditions of the cave may revert to a more arid and natural state resulting in increased suitability for hibernation purposes.

For the remaining caves, only Williams' Cave seems suitable enough for very limited bat hibernation, based on the single observation of a hibernating myotis in late 2006. In general, the other caves are too short in length (Vulture), too low in ceiling height (Braille and Williams'), too bright and lacking sufficient darkness (Vulture, Three Pines), or too heavily impacted by human visitation (Stevens, Vulture, Three Pines) to allow for bat hibernation.

On June 30th, a non-hibernation and maternity survey was conducted in the SRT. No bats were found in any of the 8 caves.

Historical Bat Use Summary

According to Perkins, it's possible the HLTS was more extensively used prior to the arrival of American settlers and this seems likely. What has not been established is *how much more* the bats utilized the system. It is the opinion of your author that usage was not as prolific as observed in the Arnold system as suggested by Perkins as previously noted with capacity and temperature differences.

Concerning water access, the HLTS is closer to the Deschutes river. With the advent of canal construction in central Oregon, water access may be a moot point for the bats. Bats are known to hydrate themselves from water drops that accumulate on cave ceilings, as is possible in humid caves like Garbage Cave no. 1. These types of caves eliminate long and energy intensive flights to distant water sources such as the Deschutes river. This would be especially true for any maternity colonies where bat migration is limited. Warmer caves seem ideal for bat maternity colonies, which the HLTS provides in greater quantity compared to the Arnold system. However, very little maternity colony use has been observed and limited to two caves outside of the SRT mitigation area.

It seems plausible that bats could move between the Horse and Arnold systems to fit their needs during the seasons, but the numbers of bats needed to support that scenario have not been observed in the HLTS. Stookey Ranch Cave of the Arnold system is a privately owned and gated cave, approximately ten miles from the SRT. The cave is a large Townsend's big-eared bat hibernaculum (roughly 400 bats) in addition to being a maternity colony site. The cave is unique in that it has a relatively warm upper passage and a colder lower passage. The warmer upper passage is more humid, providing hydration for the bats and their young in the form of water drops that collect on the

ceiling. The lower passage is offers passageway constrictions that provide increased wind friction that can further decrease temperatures for hibernation requirements. Stookey Ranch Cave fulfills multiples habitat requirements which nullifies a need for bat migration between the Arnold and Horse systems.

Soil guano deposits would greatly improve our understanding of historical bat use in the SRT caves but mostly only for non-Townsend's species as Townsend's bats are known to avoid defecating at roosting sites.

In summary, the caves of the SRT area have not received much historical bat use, though it may be slightly increasing in the past decade or two. Until recently, the caves were not known to be used by bats in any significant way. Previous reports note non-existant or very limited observations of bats and it is expected future bat use will fluctuate between nonexistent to limited usage in one or two caves on the site. The mitigation plan of this report will be used to mitigate existing conditions of the past decade, noting bat use could revert to non-usage, sometimes for reasons outside of man's control.

Based on current and historical knowledge, the primary focus of any SRT bat mitigation plan, should be focused on Davenport Cave, Garbage Cave no. 2 and Garbage Cave no. 1. Perkins has identified Garbage Cave no. 1 as a potential bat hibernaculum. If, or when, the entrance to the cave is restored, the cave could see hibernation use. Williams' Cave has not been identified as a Townsend's hibernaculum and will remain as a site to monitor along with the remaining caves of the SRT.

Footnote

[1]Garbage Cave no. 1 was originally accessible to Ronald Greeley of NASA who surveyed the cave in 1970. Between his visit and an unknown later date, the entrance to the cave became completely obstructed with garbage. Later on, what is now known as Davenport Cave, was misidentified as Garbage Cave no. 1 despite the glaring differences between it and the map Greeley had published in Bulletin 71. Garbage Cave no. 2, being the only other known cave nearby (and full of garbage), coincidentally received its incorrect albeit fitting title. Even though Davenport Cave is the cave Greeley surveyed as Garbage Cave no. 2, the renaming of the caves had progressed too far. On October 5th of 2003, Matt Skeels had located the lost and garbage-choked entrance of Greeley's original Garbage Cave no. 1. Garbage Cave no. 1 had been relocated, so what was to be done with the imposter known as Garbage Cave no. 1? It turned out Charles Larson had a cave listed in his files as Davenport Cave (after Jim Anderson's story from *Tales from a Northwest Naturalist*) for the area - named for a large sofa found within the cave. At this time, the cave incorrectly known as Garbage Cave no. 1 had a davenport inside and subsequently the names were reassigned again. Unfortunately, Davenport was a duplicate name for Greeley's Garbage Cave no. 2. Too much time had passed however, as the now, firmly coined Garbage Cave no. 2 had held on to its name for a sufficient period of time and it was certainly no davenport cave. It had far more garbage than Davenport Cave and the title seemed apt, even though it could have been named Garbage Cave no. 3.

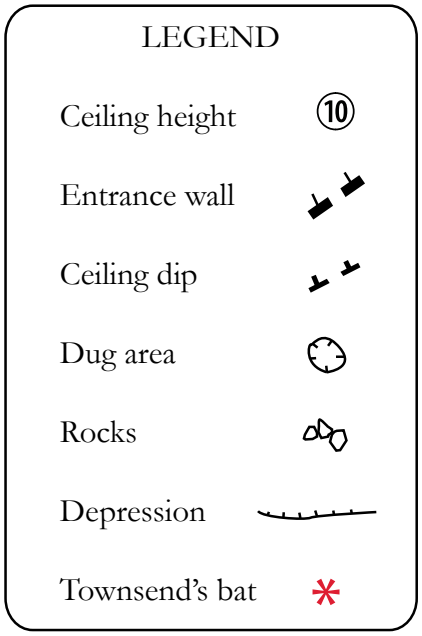
Appendix G:

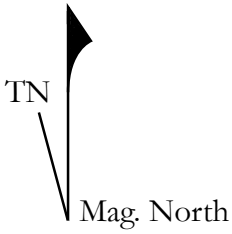
Winter Bat Survey Maps

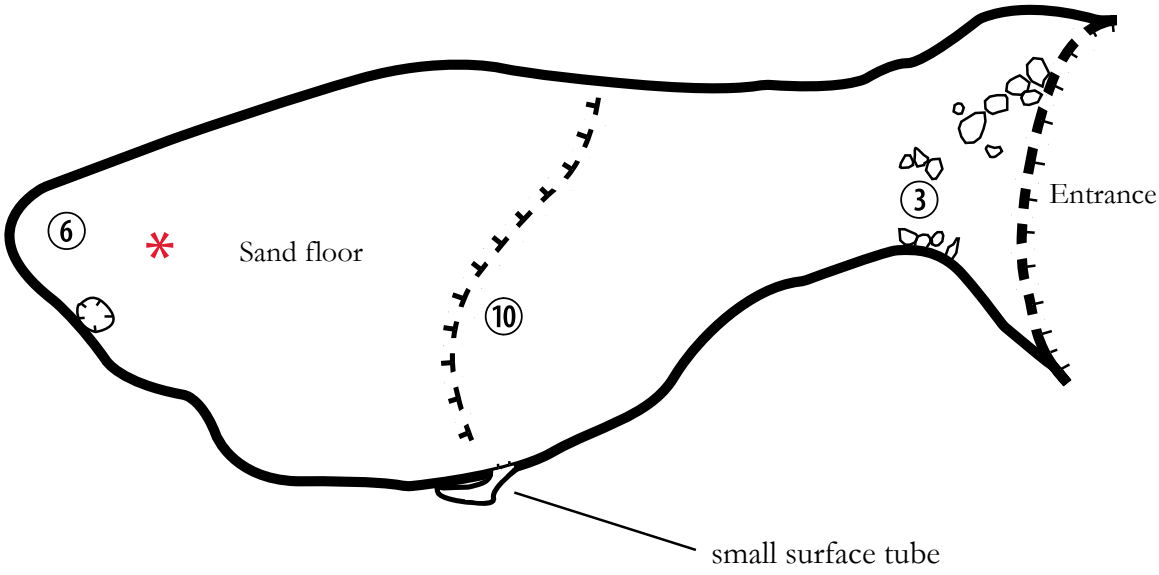
Garbage Cave no. 2
Davenport Cave

Garbage Cave no. 2 Townsend's big-eared bat sighting locations

Winter hibernation bat survey on March 15th, 2015.



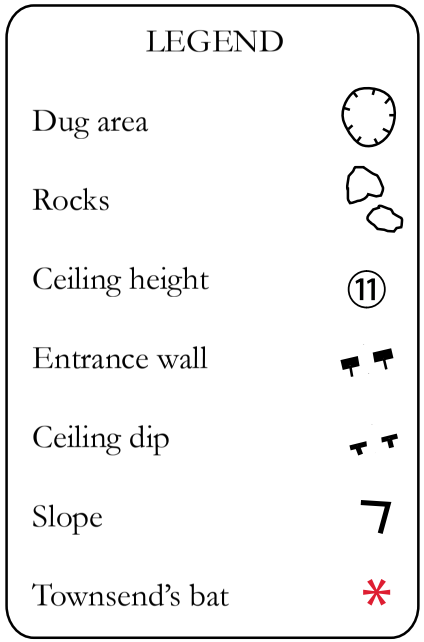


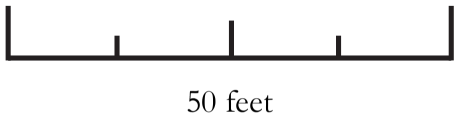


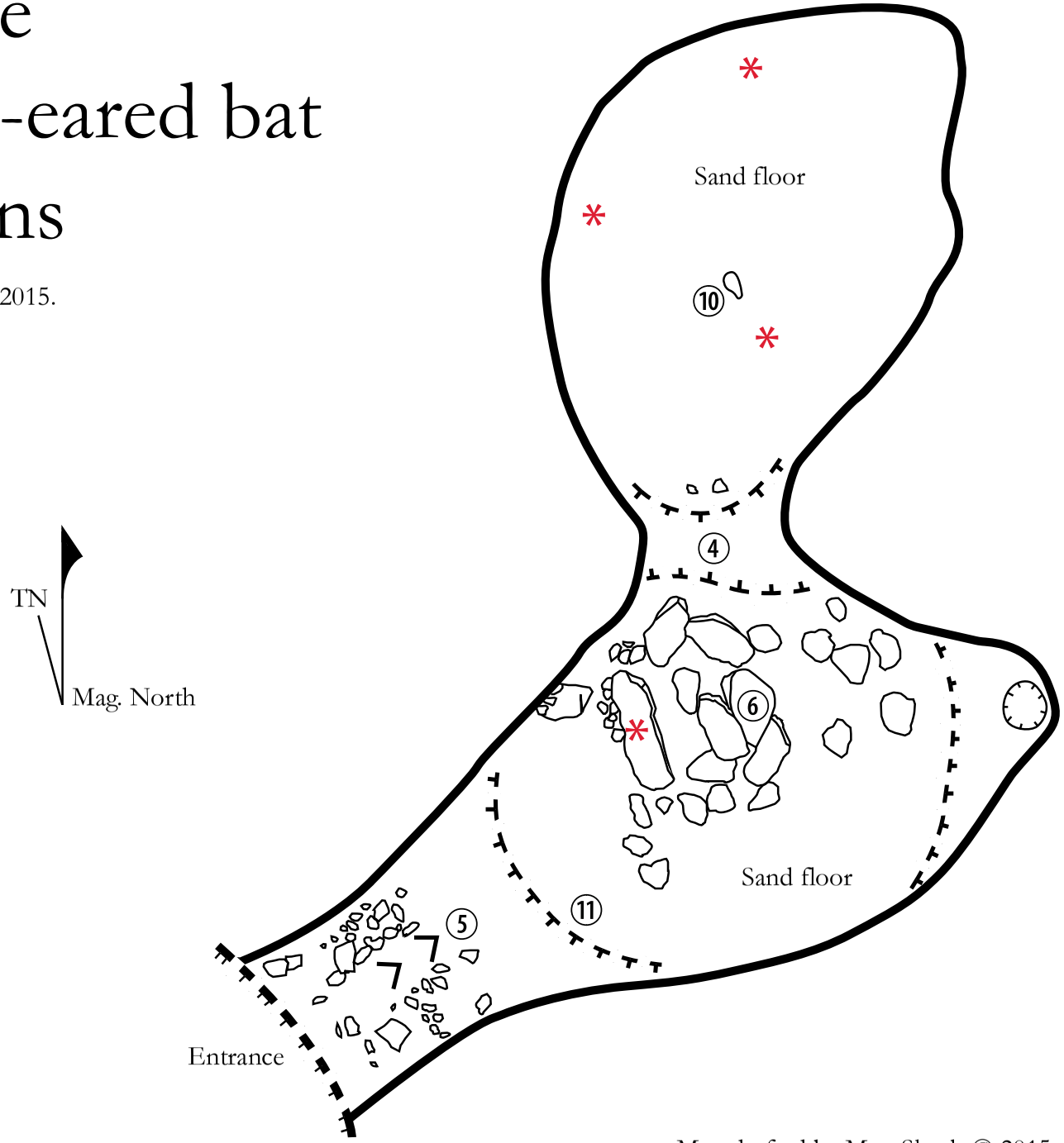
Map drafted by Matt Skeels © 2015

Davenport Cave Townsend's big-eared bat sighting locations

Winter hibernation bat survey on March 15th, 2015.







Map drafted by Matt Skeels © 2015

Appendix H: Definitions

A few key words will be defined for the purposes of clarifying the guidelines of this mitigation plan.

Cave - A cave is defined as any lava tube within the Stevens Road Tract area.

Buffer Zone - A buffer zone is a 50 foot perimeter centered on the cave entrance at the drip line, coinciding with the center of that cave passage. Adequate signage will be placed showing or marking the buffer zone, with notices for the public as to what the buffer zone is for. Entry into a buffer zone and the cave proper is prohibited for the general public until the buffer zone is removed.

Hibernation Period - The hibernation period is a length of time during mid-autumn, winter, and early spring when bats are in torpor. This time period is generally from October 1st to April 30th, however with climate change or other mitigating factors, this hibernation period may fluctuate. Closures for hibernation periods will be adjusted accordingly.

Grotto - A Grotto or Grottoe, is an internal organization of the National Speleological Society. Grottos operate on a local level and serve as a club for cave enthusiasts. Participation of members varies. Grottos typically have invaluable experience and information regarding caves and their management.

Maternity Period - The maternity period is a length of time generally starting at the end of the hibernation period on April 15th and ending in fall, generally around September 30th. This period of time is when female Townsend's big-eared bats are pregnant, rearing their young until they have left the maternity roost around mid-August. Maternity sites may break up at this time or as late as the onset of their hibernation period.

Monitor - A qualified bat expert/s capable of identifying Townsend's big-eared bat species and recording data on the species. Monitor may also refer to the act of monitoring (see below).

Monitoring - Monitoring is a series of tasks conducted by employees or volunteers (called monitors) chosen by the governing agency, who are competent in identifying Townsend's big-eared bats.

Non-hibernation period - A period of time generally between April 30th and October 1st when bats are not hibernating but instead awake and active. This period of time is not referring to the maternity period but generally refers to isolated male Townsend's big-eared bat use or activity.

Observation Period - A temporary period of four years, created specifically for this mitigation plan and implemented for a Class 2 cave. This observation period will consist of four consecutive years of hibernation and maternity monitoring.

Regulated hours - Any time period of lawful visitation. Depending on ownership of the caves, regulated hours may or may not exist.

Restrictive barrier - A manmade construction that is built in, at, or near a cave entrance. It may be a fence, gate, panel, divider, partition, wall, or other similar constructs. The goal of a restrictive barrier is to not allow passage through or beyond the barrier, or to limit passage to certain entities, typically by possession of an access key. Bat gates are a common restrictive barrier in caves.

Roost - A roost, or roosting site, is any cave site location in the Stevens Road Tract that is used by bats. This may be a maternity roost, hibernation roost, or a temporary day or night roost.

Townsend's big-eared bat - A bat species scientifically known as *Corynorhinus townsendii* or truncated as *C. townsendii.* In this document, this bat may also be referred to as Townsend's bat, western big-eared bat, or its previous scientific name of *Plecotus townsendii* or *P. Townsendii*. The preferred habitat of a Townsend's bat in central Oregon are lava tube caves.

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