

RECLAMATION

Managing Water in the West

Twin Buttes Transportation Management Plan

San Angelo Project, Twin Buttes Reservoir, Texas



— BUREAU OF —
RECLAMATION



Bureau of Reclamation
U.S. Department of the Interior
Great Plains Region
Oklahoma-Texas Area Office

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Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Acronyms

APH – Annual Public Hunting

ASI – Area of Special Interest

ATV – All Terrain Vehicle

BMP – Best Management Practice

CFR – Code of Federal Regulation

Forest Service – U.S. Forest Service

LPU – Limited Public Use

OHV – Off-Highway Vehicle

ORV – Off-Road Vehicle

NOHVCC – National Off-Highway Vehicle Conservation Council

Reclamation – U.S. Bureau of Reclamation

TMP – Transportation Management Plan

TPWD – Texas Parks and Wildlife Department

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Executive Summary

The Federal lands associated with the San Angelo Project (Project) and Twin Buttes Reservoir (Reservoir) provide abundant opportunities for recreation. In addition to outdoor activities such as hunting and fishing, national recreation trends indicate that participation in motorized, land-based vehicle use and access to nature based scenic viewing have become a very popular recreation use (Cordell, 2014). As such, off-road vehicle use provides extensive public recreation opportunities and substantial economic benefits. The Bureau of Economic Analysis reported that during 2016, motorcycling/ATV activities represent one of the fastest growing activities with an eight percent increase from the previous year and has accounted for \$20.3 billion in real gross output (BEA, 2018).

In recognition of this, and with the prerequisite to ensure compliance with Federal regulations, the Bureau of Reclamation (Reclamation), Texas Parks and Wildlife (TPWD), and the City of San Angelo (City) developed this Twin Buttes Transportation Management Plan (TMP). Prior to the development of the TMP, the Project was experiencing an abundant amount of unauthorized motorized vehicle use, with an estimated 157¹ miles of routes created by users over the years. The creation of these routes was made possible by several factors, ranging from low Reservoir levels and exposed lands, to limited enforcement capabilities, and the unavailability of alternative ORV areas within the region. Over time, the Project experienced substantial erosion and degradation; and combined with unregulated use and other illegal activities, these factors posed increased risks to environmental resources and public safety.

Through this TMP, a comprehensive condition assessment of the Project was performed by a team of multi-disciplinary experts. The team coordinated extensively with local stakeholders to seek input from the public on preferred ORV uses, as well on overall recreation priorities. Next, the team evaluated criteria for off-road vehicle use (43 CFR 420.22) to determine the suitability of various trails and/or areas for continued ORV use. The team identified several Areas of Special Interest (ASI) that warrant further monitoring and consideration of management strategies to sustain and/or improve conditions. In the end, the assessment resulted in the proposed designation of 73 miles of trails and three ORV areas.

This TMP also presents a road map and guidance on potential future management and operation of the Project with the goal of promoting sustainable ORV use while protecting resources and Federally authorized benefits of the Project. The guidance draws upon Best Management Practices included within a comprehensive National Off-Highway Vehicle Conservation Council publication

¹ Year - 2014

titled “Great Trails: Providing Quality OHV Trails and Experiences” (Duford, 2015).

In conjunction with this TMP, an Environmental Assessment (EA) was prepared by Reclamation in accordance with the National Environmental Policy Act, which requires Federal agencies conducting actions to evaluate and publically disclose impacts caused from such actions. The EA was developed in consultation with stakeholders and with relevant agencies such as the State Historic Preservation Office. The EA evaluated impacts of either: (1) doing nothing and continuing to allow unregulated and unauthorized ORV use; versus (2) development of a TMP that promotes ORV use while protecting environmental resources and public safety. The review under this EA culminated in Reclamation making a Finding of No Significant Impact (FONSI 19-18-TX-TB) on May 17, 2019. This essentially means that the TMP can move forward with no anticipated significant, adverse impacts on the environment. In fact, through the TMP, adverse impacts are avoided or mitigated through the removal and/or designation of various trails, as well as continued monitoring and management in accordance with the guidance and BMPs provided herein.

Chapter 1: Introduction

1.1 Location and Background

Twin Buttes Reservoir (Reservoir) was constructed by the Bureau of Reclamation (Reclamation) in 1963 and is located within the Concho River Basin approximately nine miles southwest of San Angelo in Tom Green County, Texas (Figure 1). The Reservoir is a major component of the San Angelo Project (Project), which was originally authorized by Public Law 85-152 in 1957. The Project is comprised of Twin Buttes Dam and Reservoir, as well as a distribution system that provides municipal and industrial (M&I) water to the City of San Angelo (City) and irrigation water to 15,000 acres within Tom Green County Water Control and Improvement District No. 1. Project operations are integrated with that of O.C. Fisher Lake and Nasworthy Reservoir, both of which were constructed by the U.S. Army Corps of Engineers. In addition to M&I and agricultural water supply, the Project provides flood control, fish and wildlife, and recreation benefits.

When the Reservoir is full (at conservation pool), the Project consists of approximately 9,799 surface acres of water and 3,059 acres of Federally-owned land surrounding the Reservoir. However, for decades, conditions significantly reduced the Reservoir's storage, exposing thousands of acres of land that otherwise would have been inundated. At the time the Transportation Management Plan (TMP) was initiated, approximately 11,000 acres of Federal land were exposed around the Reservoir.

The Project is owned by the United States and administered by Reclamation. Operation and Maintenance (O&M) responsibility for the Project has been transferred to the City through a contract with the U.S., whereby Reclamation reimburses the City on an annual basis for the portion of O&M costs that are attributable to authorized benefits including flood control, fish and wildlife, and recreation.

The Project has faced numerous land management challenges over the years. These challenges primarily stem from lack of enforcement related to legal/enforcement jurisdictions, as well as lack of funding and resources. Illegal activities, including drug activity, dumping, trespasses, and unauthorized motor vehicle use have been prevalent. Motorized vehicle use, in particular ORV use, has increased dramatically over the years as declining Reservoir levels exposed large tracts of land. At the time the TMP was initiated, it was estimated that 157 miles of trails had been created through the approximated 11,000 acres of exposed Federal land. This rapid and continued use resulted in vegetation loss, erosion, adverse water quality impacts, loss of fish and wildlife habitat, and potentially adverse impacts on cultural and archeological resources. Public safety concerns also were raised.

In an effort to address these challenges, the City and Reclamation entered into a Memorandum of Understanding (MOU) with the TPWD on May 13, 2016 to place all Federal lands associated with the Project within the TPWD's Annual Public Hunt (APH) Program. This designation provided the TPWD with the necessary legal jurisdiction to allow game wardens to enforce laws and address illegal activities on Federal land around Twin Buttes Reservoir while also providing opportunities for outdoor recreation activities such as hunting and fishing. Furthermore, strong public interest exists to maintain ORV access while protecting various land resources.

1.2 Purpose and Need

The Code of Federal Regulations (43 CFR 420 - Off-Road Vehicle Use) states that *“Reclamation Lands are closed to off-road vehicle use, except for an area or trail specifically opened to use of off-road vehicles”*. In addition, Executive Order 11644 (Use of Off-Road Vehicles on Public Lands) and Reclamation policy (LND 01-03 - Recreation Program Management) requires the development of a plan *“that ensures that the use of ORVs on public lands may be controlled and directed so as to protect the resources of those lands, to promote the safety of all users of those lands, and to minimize conflicts among the various uses of those lands”*. Furthermore, 43 CFR 420 outlines the procedures and criteria for the designation of off-road vehicle use. Therefore, to authorize and allow continued ORV use at the Project, Reclamation must ensure that proposed activities conform to numerous Federal laws and regulations that outline motor vehicle use on Federal land, as well as the process of doing such. Such a plan, henceforth called a TMP, is required to ensure that the proposed activities do not unreasonably impact the Federal estate or authorized project purposes and are in compliance with all regulations governing such activities.

Reclamation's goals are to:

- Designate motor vehicle routes and areas around Twin Buttes Reservoir while maintaining Project benefits and authorized Project purposes.
- Enhance the public experience at Twin Buttes Reservoir through improved land management and stewardship.
- Improve access to hunting, motorized use, and ORV use while also protecting public safety and important cultural, land, and environmental resources.
- Ensure that management activities are adaptable to the changing needs of the public and evolving conditions on the ground.

To accomplish this goal, Reclamation needs to develop a TMP. This TMP proposes to:

- Utilize only existing trails/routes that are determined to be sustainable and manageable by an interdisciplinary team and in coordination with key stakeholders.
- Provide access designated ORV routes and areas, as well as reasonable access to water-based activities.

Chapter 2: Route Evaluation and Designation

2.1 Evaluation and Designation Summary

Reclamation, TPWD, and the City held an initial public meeting on April 18, 2017 in San Angelo, Texas to collect baseline information from the public on various uses and resources and to perform initial planning of a TMP. Following the public meeting, three “focus group” meetings were held to gather more specific information on the needs and priorities of various user groups. The goal was to develop a preliminary scope prior to initiating a formal scoping period involving a broader public audience. Public involvement was a critical part of the process and integrated into the accompanying Environmental Assessment (EA) that was prepared conjunctively with the TMP pursuant to the National Environmental Policy Act (NEPA). On September 25, 2018, a draft Proposed Action was presented at a public scoping meeting. The scoping meeting marked the beginning of a 35-day public comment period to solicit official input on the preliminary Proposed Action. No significant concerns were raised during the public comment period. On May 17, 2019, Reclamation concluded the EA with the signing of a Finding of No Significant Impact (FONSI). The FONSI marked the end of the NEPA process and paved the way for the TMP to move forward.

Four key priorities were identified by the public during the EA/TMP scoping period and were considered in the development of this TMP: (1) Minimize damage to natural resources; (2) Prevent illegal activity, including littering, dumping, and drug activity; (3) Enhance visitor experience; and (4) Maintain access to Federal lands and to Twin Buttes Reservoir.

Other site-specific considerations also were considered, namely whether or not proposed ORV routes/areas: (1) Contributed to unacceptable resource damage, erosion, or were inconsistent with the Project purposes (i.e. wash outs, deep ruts, detours, steep slopes); (2) Were unnecessarily prolific and lead to the same location; (3) Maintained reasonable access with under a range of water elevations and inundation scenarios.

2.2 Types of Designated Motorized Use

- **Access Routes** - Access routes generally follow the Reservoir shoreline, as well as the South Concho River, which flows into the South Pool of the Reservoir; and Spring Creek and the Middle Concho River, which flow into the North Pool of the Reservoir. Access Routes provide users with connectivity and scenic diversity, yet are considered unimproved routes that may become impassable due to Reservoir fluctuations and in some areas may be limited in width. It is not anticipated that use of these routes will require a TPWD OHV decal, by registered vehicles. Unregistered vehicles and ATV/UTVs will be required to obtain a TPWD OHV decal.

- **Motorcycle and ATV Routes** - A network of one-way directional routes that are designed for use by motorcycles and smaller ATVs (50” or less). It is anticipated that use of these routes will require a TPWD OHV decal.
- **ORV Areas** - These areas are designed for more demanding four-wheel drive opportunities, including three distinct areas known as “The Bowl”, “South Butte”, and “Tin Can”. Within the boundaries of the designated ORV areas, motorized vehicles may be allowed on existing routes. It is anticipated that use of these areas will require a TPWD OHV Decal

Table 1. Designated Motorized Use Type

Use Type	Miles/ Acres	Description	TPWD OHV Decal
Access Routes	56 miles	Designated routes providing reasonable access to lands surrounding Twin Buttes’ North and South Pools, shoreline, boat ramps, etc.	No (registered vehicles) Yes (unregistered vehicles & ATV/UTVs)
Moto/ATV Routes	17 miles	A network of one directional trails designed for motorized use by motorcycles and small ATVs. In general these trail widths are less than 50 inches.	Yes
ORV Areas	338 acres	Tracts of land that consist of variable terrain, and require varying skill levels.	Yes
- Area I: <i>Tin Can</i>	224 <i>acres</i>		
- Area II: <i>The Bowl</i>	20 <i>acres</i>		
- Area III: <i>South Butte</i>	94 <i>acres</i>		

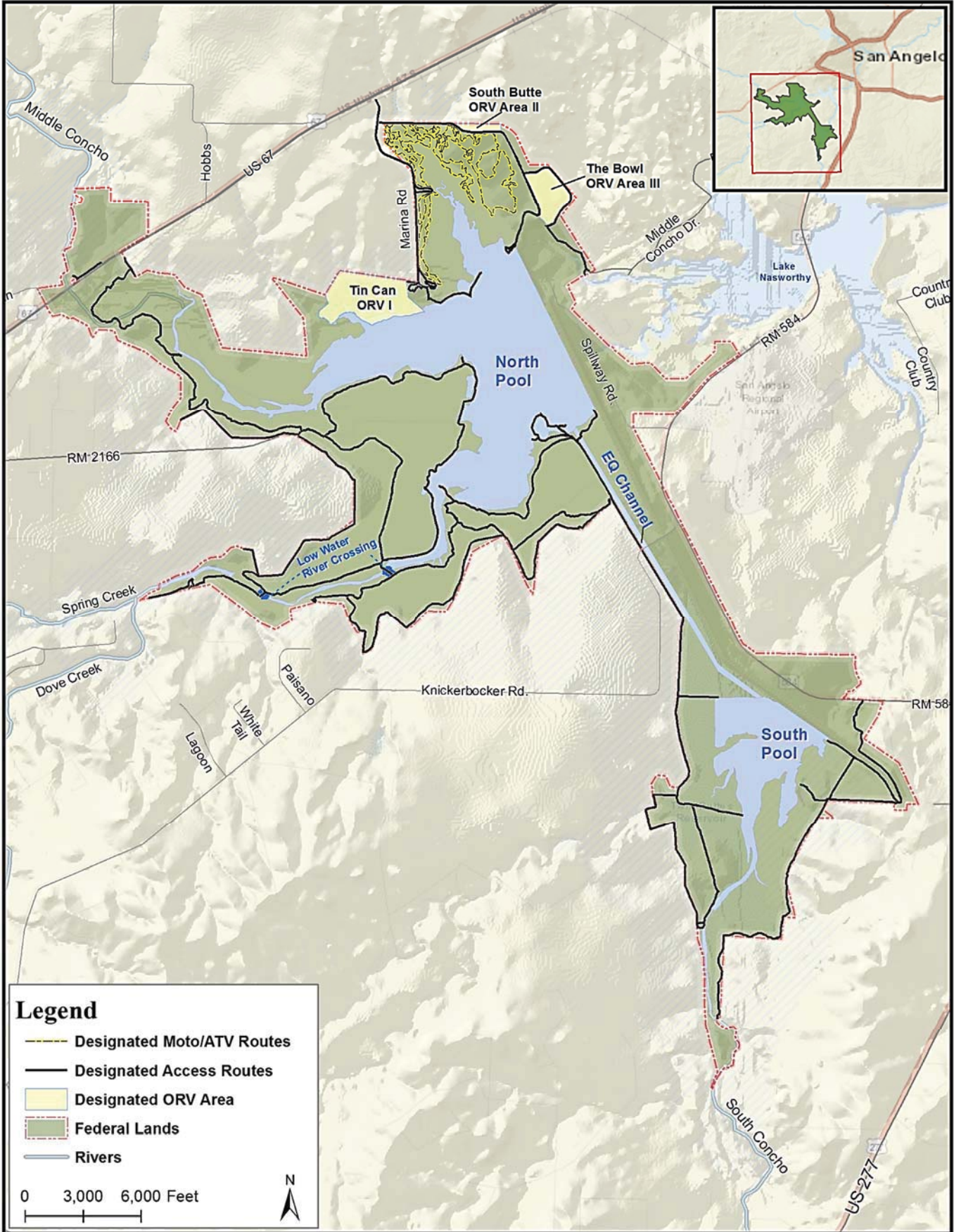


Figure 1. Twin Buttes Motorized Use Map

Chapter 3: Areas of Special Interest

In the development of the TMP, subject matter experts performed a comprehensive condition assessment of Project lands, including existing ORV trails and areas that had developed over the years. The team documented existing conditions and identified Areas of Special Interest (ASI) that are or could experience increased degradation risks and thus warrant monitoring and adaptive management considerations. Management considerations are discussed in more detail in Chapter 4. The ASIs identified and included in this chapter serve to inform and help prioritize potential future management actions. Some ASIs are directly related to designated trails/areas while others may be associated with trails/areas that are now deemed inappropriate for ORV use but which would be designated in the future if actions are taken to mitigate risks.

3.1 Access Routes ASIs

Access routes generally follow the Reservoir shoreline, as well as the South Concho River, which flows into the South Pool of the Reservoir; and Spring Creek and the Middle Concho River, which flow into the North Pool of the Reservoir. The likelihood of eroded sediment reaching the Reservoir is increased by proximity of the access route to either a stream channel or the Reservoir. The primary area containing the ASIs exists on the south side of the Reservoir's North Pool (Figure 2), which contains several large, cleared areas that are particularly vulnerable to erosion and contributing sediment to the Reservoir. While the area generally has low gradients and low risks of erosion, there are patches that are poorly drained and can become seasonally wet, and which may contain cultural resources that warrant protection. The area also contains duplicate roads leading to the same location (a.k.a., trail braiding). The location, condition, and management considerations associated with each ASI are provided in Figure 2 and Table 2 below.

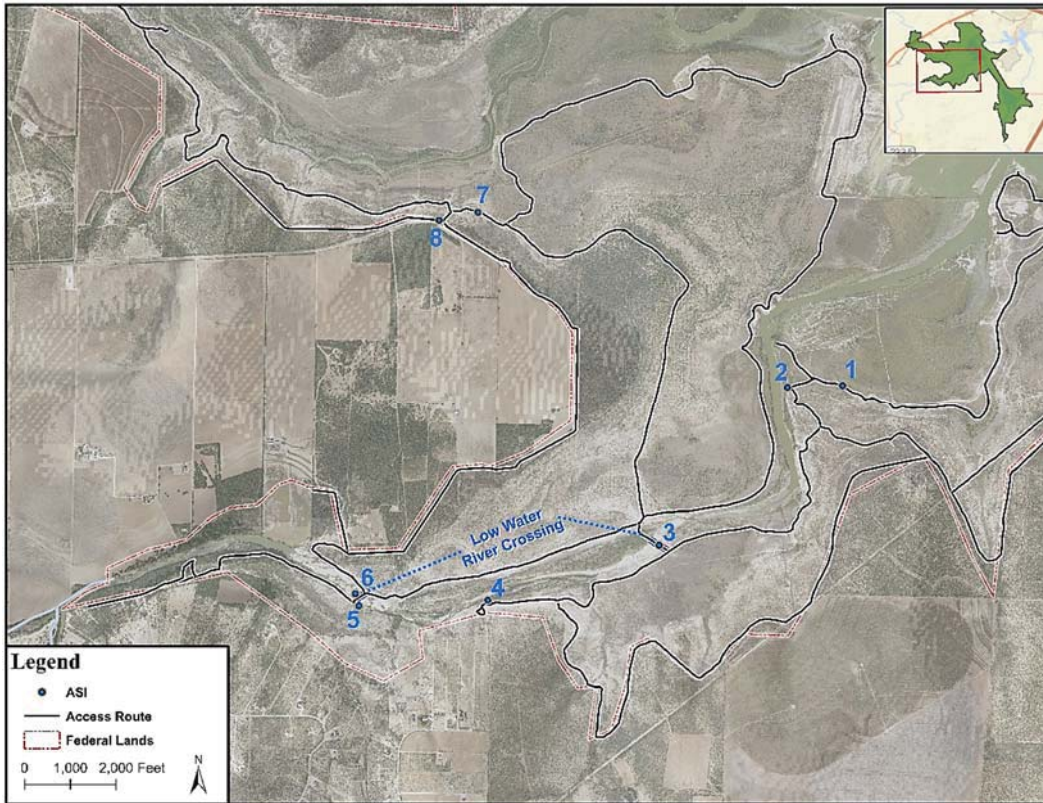


Figure 2. Access Routes – Areas of Special Interest (only access routes with an ASI shown)

Table 2. Access Routes - Areas of Special Interest

ASI ID #	Observed Conditions	Managerial Considerations
1	Muddy Area/Rutting	Monitor to ensure stability of the area, as it may continue to degrade; potential seasonal restriction to avoid degradation during wet periods
2	Rocky climb	Monitor to ensure effective route closure; widen the route turn, reduce the route gradient and/or harden the route gravel
3	River crossing	Monitor approaches into the crossing; harden the route gravel
4	Muddy Area/Rutting	Monitor to ensure the route does not migrate
5	Bank Erosion	Monitor and evaluate stability of the area, as it may continue to degrade
6	Multiple River Crossing	Consolidate and/or harden route to avoid further degradation
7	Muddy Area/Rutting	Monitor to ensure stability of the area, as it may continue to degrade; potential seasonal restriction to avoid degradation during wet periods
8	Muddy Area/Rutting	Monitor to ensure stability of the area, as it may continue to degrade; potential seasonal restriction to avoid degradation during wet periods

3.2 Moto/ATV ASIs

The routes in this area are generally stable with a limited number of low elevation areas which are prone to saturation during wet periods. Runoff is generally diverted off the trails adequately and surface erosion is generally light. Many of the trails are composed of native surface materials and do not appear to need additional hardening in order to be suitable for motorcycle or small ATV traffic. Intermittent streams do occur in this area, which increases the risk of widening gullies that erode and transport sediment to the Reservoir. In fact, an existing large gully leads directly to the Reservoir and likely to transport sediment to the Reservoir. The location, condition, and management considerations associated with each ASI are provided in Figure 3 and Table 3 below.

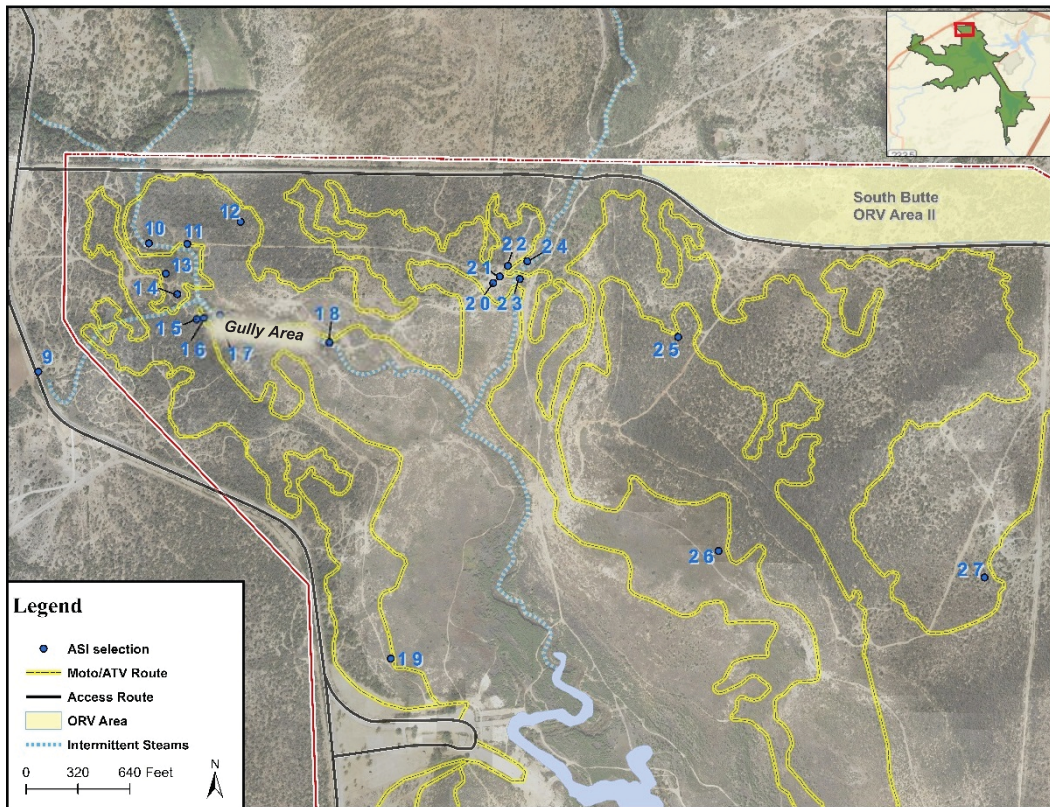


Figure 3. Moto/ATV – Areas of Special Interest

Table 3. Moto/ATV – Areas of Special Interest

ASI ID #	Observed Conditions	Management Considerations
9	Head Cut Erosion	Monitor the progression of the head cut; further evaluation may be required
10	Gully Erosion	Monitor to ensure the gully does not expand
11	Gully Erosion	Monitor to ensure the gully does not expand

12	Gully Erosion	Monitor to ensure the gully does not expand
13	Channel crossing	Consolidate the crossings; monitor the effectiveness of closure
14	Erosion	Monitor and potentially stabilized or rerouted
15	Erosion	Monitor, consolidate, and potentially reroute out of the drainage or stabilized
16	Erosion	Monitor erosion within drainage and potentially reroute or eliminate
17	Erosion	Monitor further progression of erosion
18	Multiple (off network) trails	Monitor to ensure use of designated trail
19	Muddy Area/Rutting	Monitor to ensure stability of the area, as it may continue to degrade
20	Eroded crossing	Monitor to ensure use does not continue
21	Eroded crossing	Monitor to ensure use does not continue
22	Erosion	Monitor to ensure stability of the area, as it may continue to degrade; may require gravel hardening to stabilize
23	Unnecessary crossing	Monitor to ensure use does not continue
24	Erosion	Monitor to ensure use does not continue and erosion does not progress
25	Erosion at Road crossing	Monitor to ensure use does not continue; may require gravel hardening to stabilize
26	Erosion	Monitor to ensure erosion does not progress; may require gravel hardening to stabilize
27	Gully	Monitor to ensure the gully does not expand

3.3 ORV Area I – “Tin Can” ASIs

The “Tin Can” ORV Area is generally in stable condition with minimal risk of erosion into drainages that connect to the Reservoir. Similar to the Moto/ATV Area, intermittent streams within the Tin Can Area have the potential to contribute sediment from eroded trails; however, most of the trails are located away from these existing drainages. Trail surfaces are native surface, well-drained, and do not show evidence of adverse surface erosion. The trails with the greatest erosion potential are relatively far from the intermittent streams. Only one ASI was identified in this ORV Area. The location, condition, and management considerations are provided in Figure 4 and Table 4 below.

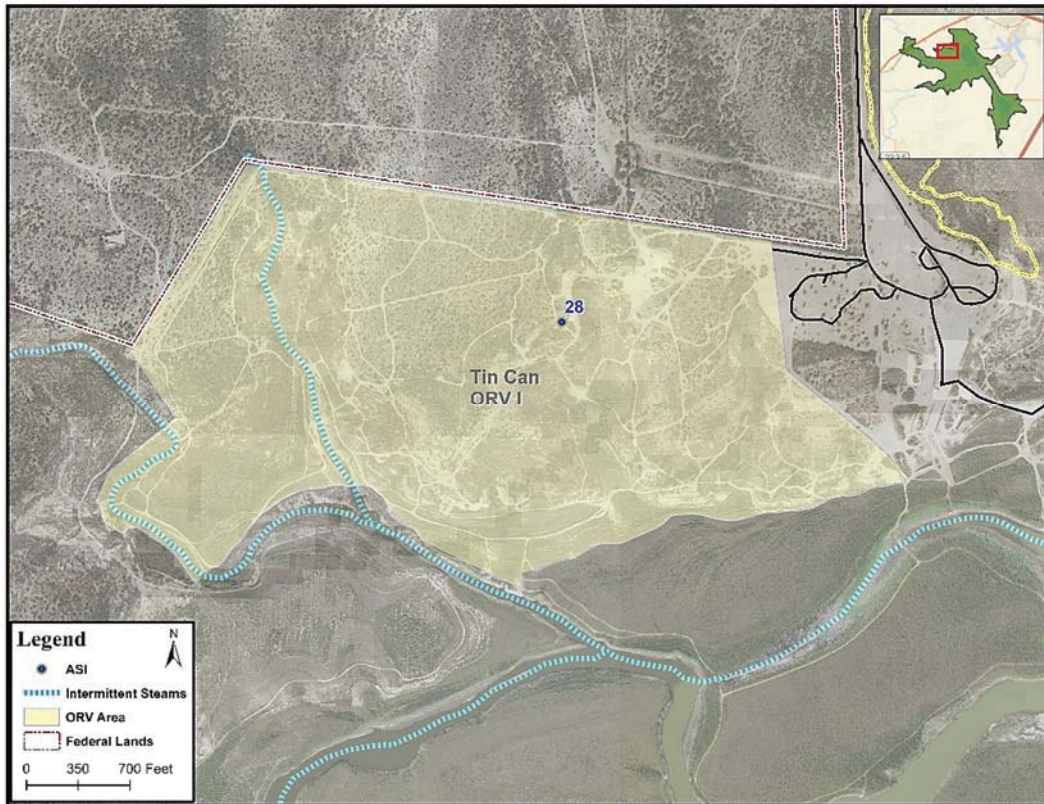


Figure 4. Tin Can ORV Area – Areas of Special Interest

Table 4. Tin Can ORV Area – Areas of Special Interest

ASI ID #	Observed Conditions	Management Considerations
28	Muddy Area/Rutting	Monitor to ensure stability of the area, as it may continue to degrade; potential seasonal restrictions to avoid degradation during wet periods

3.4 ORV Area II – “South Butte” ASIs

The South Butte area consists of rolling topography with trails that are generally native surface, stable, and lacks intermittent streams. Therefore, any erosion likely settles out locally and has a very low potential, if any, to reach the Reservoir. Only one ASI was identified in this ORV area. The location, condition, and management considerations are provided in Figure 5 and Table 5 below.

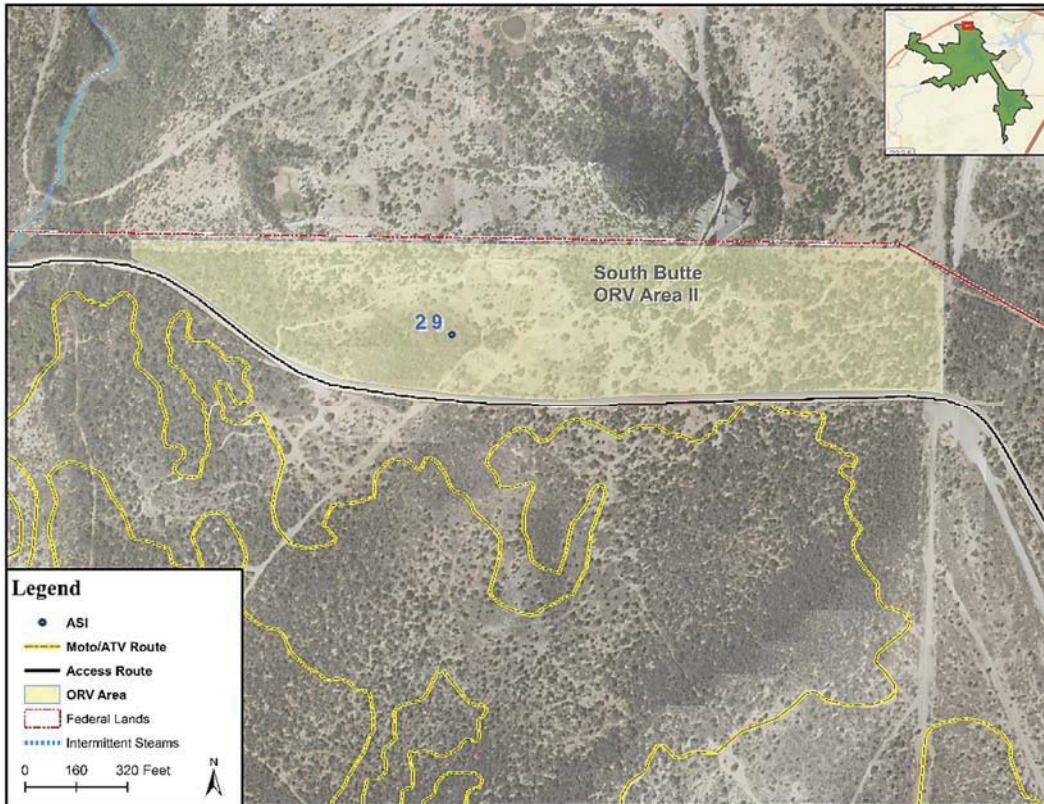


Figure 5. South Butte ORV Area – Areas of Special Interest

Table 5. South Butte ORV Area - ASI

ASI ID #	Observed Conditions	Management Considerations
29	Muddy Area/Rutting	Monitor to ensure stability of the area, as it may continue to degrade Potential seasonal restriction or other mitigation measures

3.5 ORV Area III – “The Bowl” ASIs

The Bowl ORV Area is surrounded by low-gradient designated access routes and contains a dense network of routes located on much steeper hillslopes. The landforms within “The Bowl” are predominantly flat-topped mesas in the San Angelo formation. The geologic layers are a cap limestone with complex and discontinuous underlying sandstone, mudstone, and lower mudstone and clay layers. The layering has harder rock types like sandstone near the mesa top, which serves to protect the underlying rock and clay layers from erosion. The routes typically are directly down slope, and gradients can exceed 90 percent. Slope lengths can vary from 50 to over 100 feet, depending on the trail. Erosion exists on routes located on the steeper slopes and when softer layers underneath are exposed to runoff from repeated use. As softer layers erode, sandstone layers can collapse, leading to further erosion of the underlying softer layers. Increased runoff from the steeper slopes has led to route gully erosion on the east side of this area. Runoff from these areas appear to flow into flat areas and disperse before reaching local water courses. Rates of erosion are variable depending on the slope of the land feature, vegetation, and underlying geology. The location, condition, and management considerations are provided in Figure 6 and Table 6 below.

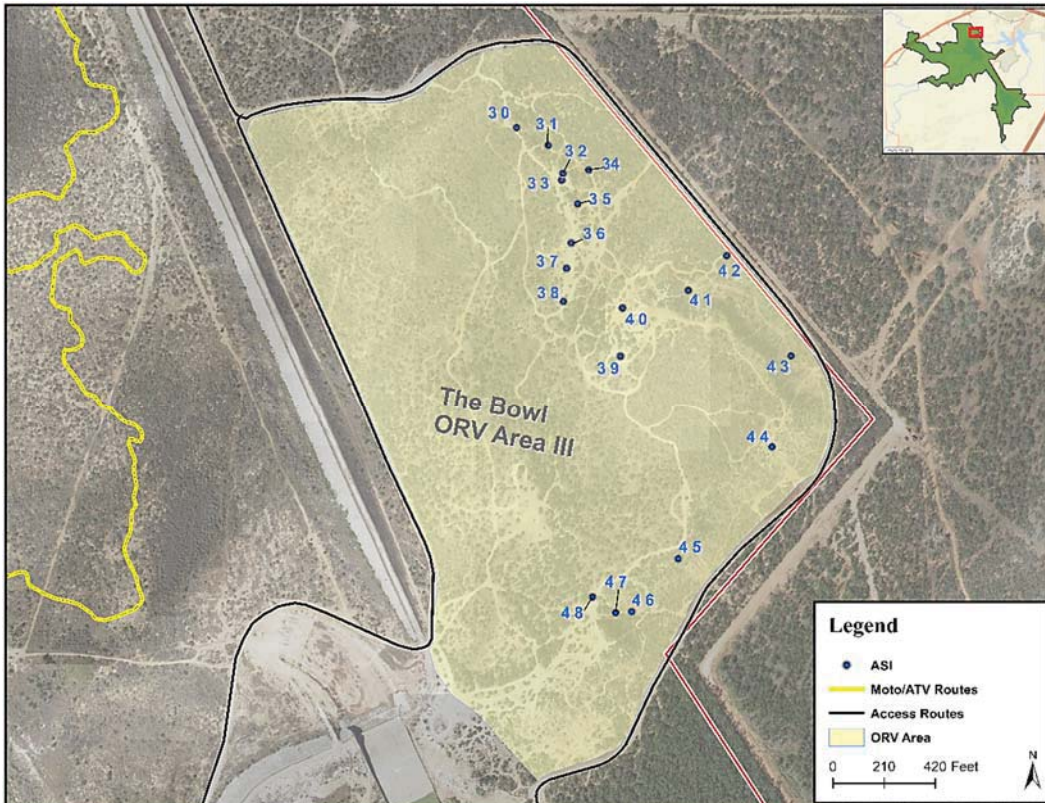


Figure 6. The Bowl ORV Area – Areas of Special Interest

Table 6. The Bowl ORV Area – Areas of Special Interest

ASI ID #	Observed Conditions	Management Considerations
30	Minor Erosion	Monitor for any changes in conditions
31	Erosion with sediment fan deposits	Monitor for any changes in conditions
32	Gully Erosion	May require stabilization; further inspection is recommended
33	Erosion	Monitor for any changes in conditions
34	Head Cut Erosion	Monitor for progression; stabilization may be necessary
35	Erosion	Monitor for any changes in conditions
36	Gully Erosion	May require stabilization
37	Gully Erosion	Monitor for any changes in conditions
38	Erosion	Monitor for any changes in conditions
39	Erosion	Monitor; stabilization may be necessary
40	Erosion	Monitor; stabilization may be necessary
41	Erosion	Potential for instability with increased use Monitor for any changes in conditions
42	Erosion	Potential of impacting the access route Monitor; stabilization may be necessary
43	Erosion	Monitored for any changes in conditions
44	Gully Erosion	May require stabilization; further inspection is recommended
45	Erosion	Monitor for any changes in conditions
46	Gully Erosion	Monitor; stabilization may be necessary
47	Stormwater Runouts	Monitored for impacts to access route and stabilization measures may be necessary
48	Erosion	Monitor for any changes in conditions

Chapter 4: Road Map for Implementation

This chapter provides a general roadmap for implementing the TMP to achieve sustainable ORV use, in accordance with the 43 CFR 420, while protecting resources and Federally authorized benefits at the Project. This includes management considerations to help address issues identified within ASIs, as well as BMPs to help avoid and/or mitigate existing and future impacts of continued ORV use. The road map and BMPs described follow the National Off-Highway Vehicle Conservation Council publication, titled: “Great Trails: Providing Quality OHV Trails and Experiences” (Duford, 2015). This publication provides a comprehensive guide for the planning, design, and operation of ORV areas through four fundamental principles: Engineering, Education, Enforcement, and Evaluation, (4Es; Figure 7). In this Chapter, we summarize the applicable strategies to aid in the effective application of the 4Es set forth in Duford, 2015.

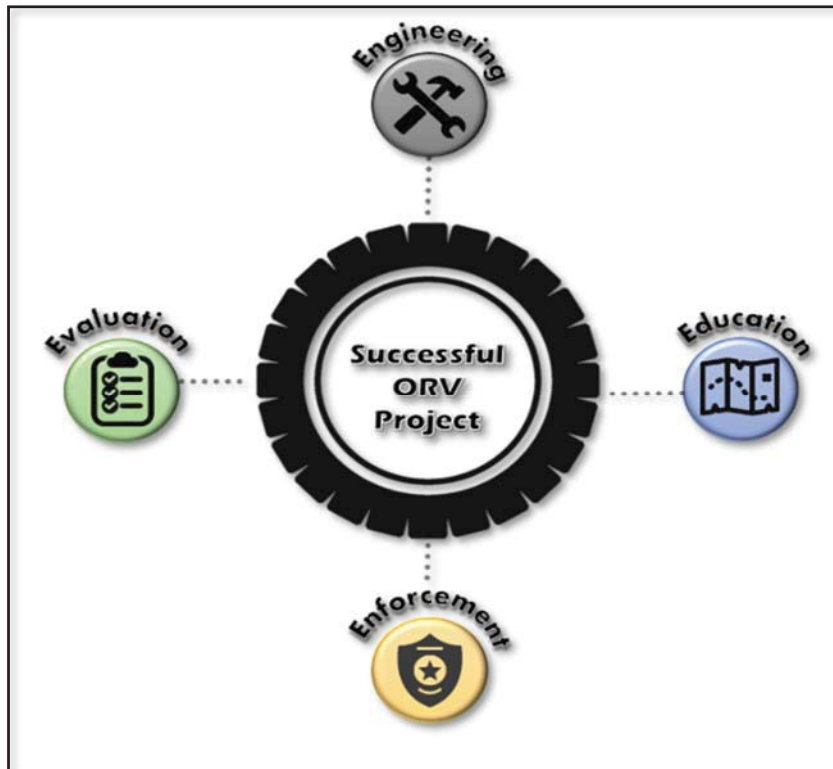


Figure 7. 4Es-Essential Principles for Successful ORV Management. (Duford, 2015)

4.1 Engineering

4.1.1 Barriers

Physical barriers, when utilized properly, provide an effective means to guide use and allow rehabilitation of closed routes. Effective barrier design utilizes a consistent theme that allows users to quickly and easily recognize the following:

- Routes and areas that may be eliminated from use by utilizing a combination of natural barriers and rehabilitation efforts. Natural barriers include soil berms, rocks or boulders, or vegetation placed to prevent travel on closed routes or where use is deemed necessary.
- Gates at main access points may be used to limit travel during wet road conditions, as determined necessary by on-the-ground managers,
- Fences and gates may be used where natural barriers are not feasible or effective, or where occasional administrative travel may be needed.
- Gates may be locked if determined to be necessary.

4.1.2 Rehabilitation

Rehabilitation is comprised of methods, tools, and techniques that may be applied to closed routes or undesignated areas. Effective rehabilitation is essential in controlling and directing use while protecting resources.

- Rehabilitation efforts such as re-contouring and re-seeding and may be used in combination with barriers.
- Determining rehabilitation actions may require a multifaceted progressive approach. Potential considerations may include:
 - Leave route to naturally re-vegetate, if the route is not currently visible, there is no need to sign.
 - Sign route and leave to natural re-vegetate.
 - Sign route and reclaim the portion of the route that is visible from all intersections with open routes.
 - Sign route and reclaim the entire route.
 - Once rehabilitation efforts are determined to be complete, all signs may be removed.
- Additional field review and design may be needed for site specific rehabilitation projects.
- Weed treatment and control measures may be implemented as needed to promote revegetation with native plants and prevent any new weed establishment and/or control of existing weed sources.

- A comprehensive list of reclamation techniques may be found in the National Off-Highway Vehicle Conservation Council publication “Great Trails: Providing Quality OHV Trails and Experiences”².

4.2 Education

Education is used to welcome the public, set expectations, inform visitors of the rules and regulations, inform riders of open trails and areas and the allowable vehicle types, and inform the rationale for closed or restricted trails. Education generally utilizes maps and signs to clearly and concisely delineate routes and areas of authorized use.

4.2.1 Maps

An official TMP map would clearly and concisely document route and area designations. Official maps would be based on those included in Appendix A – Detailed Map. Access routes, Motorcycle and ATV Routes, and ORV Areas would be designated similar to those described in Table 1. Designated Motorized Use Type, above. Routes not specifically designated for use on the official TMP map will be closed to motorized vehicle use. Where appropriate, these routes may be eliminated through remediation efforts, while others may be left to naturally re-vegetate. The TMP focuses on motorized use and does not alter non-motorized use such as hiking, mountain biking, and horseback riding. Non-motorized use shall be managed in accordance with 43 CFR 423 – Public Conduct on Bureau of Reclamation Facilities, Lands, and Waterbodies.

- A handout with the official map may be produced for distribution to the public and may be posted on the City and TPWD websites. Refer to the Education and Information section below.
- Development of an electronic map that is made available on TPWD and/or the City’s webpage, and potentially provide downloadable route files.
- The official TMP Map may be updated as needed to reflect any approved modifications or additions.

4.2.2 Signs and Markers

Signs and markers provide vital on-the-ground visual references that aid in identification of designated routes in a clear and consistent manner, to facilitate compliance and enforcement of the route designations. Sign design, color, and placement would be considered to reduce potential impacts to visual resources. As compliance with route designations increases, the density of signs may be reduced.

² <https://www.nohvcc.org/education/manager-education/great-trails-guidebook/>

- Consideration would be given to the placement of informational signs at each main entry point onto Project lands, as shown on Figure 3.
Information that may be included, but not limited to:
 - A map of the area showing the designated routes/areas, and an explanation of the route marker system.
 - An explanation of the importance of ORV designations and their link to protecting and restoring resource values such as: reducing soil erosion, reducing weed spread, improving water quality and improving wildlife habitat.
 - Information on low impact ORV use and outdoor ethics, such as the principles of Leave No Trace and Tread Lightly!
 - A description of the rules and regulations.

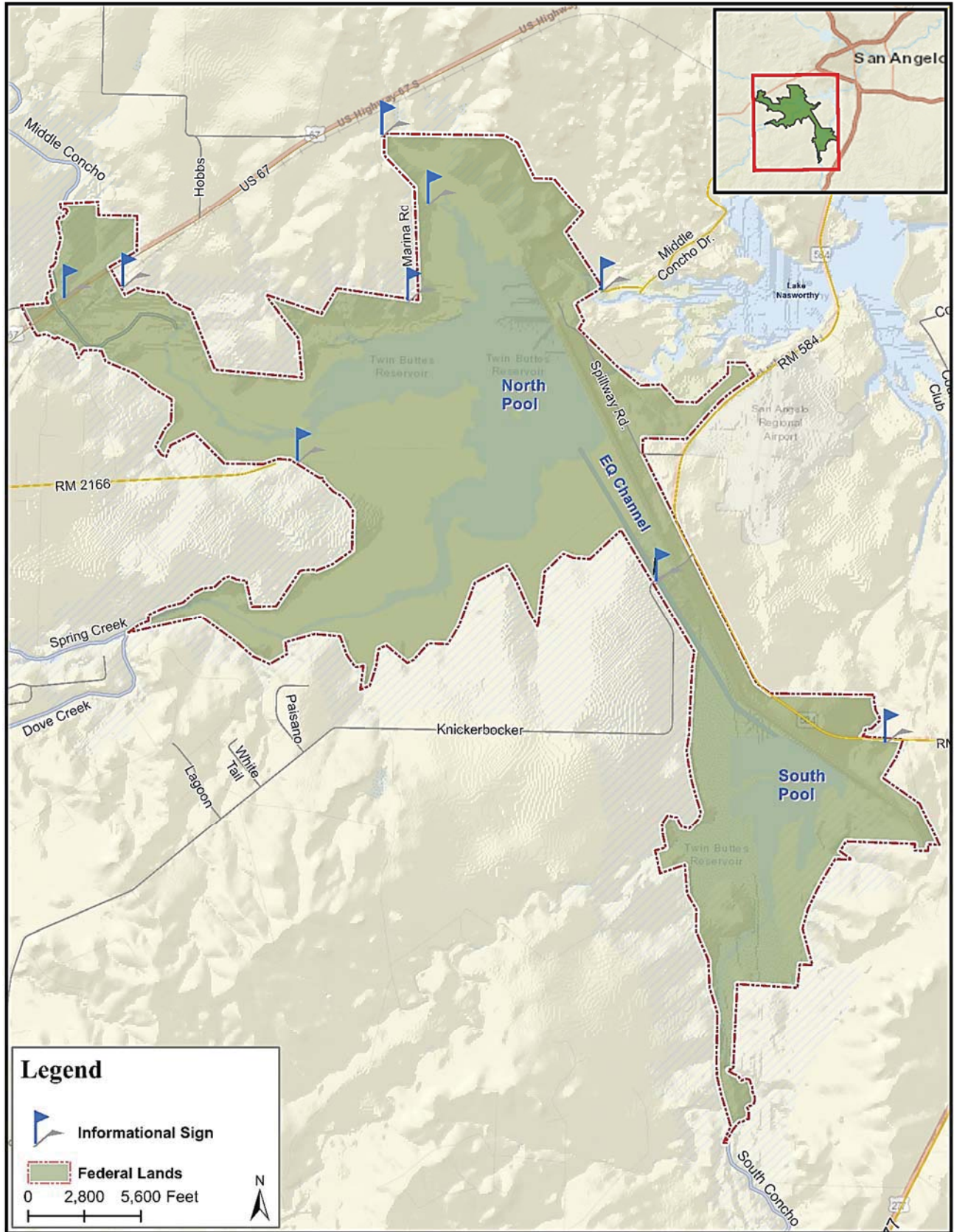


Figure 8. Informational Sign Locations

- Route designations may be marked with brown flexible markers with standard decals as follows:
 - Routes designated as “open” may be marked with “Designated Route” or white arrow decals at intersections and periodically along the route as necessary to indicate routes that are open for vehicle travel.
 - “ATV and Motorcycle” routes may be marked with standard ATV symbol decals, indicating that the route is closed to full size vehicles.
 - The boundaries of the 4-wheel drive/ORV areas may be marked with “entering” and “leaving” designated area decals.
 - Routes closed may be marked with “No Motor Vehicle” or “Route Closed” decals with standard vehicle symbols, as deemed necessary. As closed routes heal through natural re-vegetation or reclamation efforts, and markers are no longer necessary, they may be removed. Closed route markers may remain in place as necessary for resource protection or public safety.



Example Marker

4.2.3 Information and Education

Information and education provide clear and consistent information related to the route and area designations and the implementation process that may help ensure public understanding and compliance with the designations.

- A handout showing the route and area designations along with relevant information may be developed and disseminated to the public. Information included in the handout would focus on aiding public understanding, including but not limited to; principles of low impact ORV use (Leave No Trace and Tread Lightly!), protection and restoration of resource values, prevention of spreading noxious weeds, and outdoor ethics.
- News releases may be prepared for key phases of the TMP, to be published in local newspapers and posted on the Reclamation/City/State website.
- Emphasis would be placed on self-regulation by user groups. As the largest presence within the area, user groups are uniquely situated to aid in informing visitors of the rules and setting expectations.

4.3 Enforcement

Effective enforcement leads to increased compliance, increased agency and management visibility, less vandalism, increased visitor security, and support for field personnel or volunteers.

- Law enforcement efforts utilize a variety of tools, simply being visible and face-to face communication, progressing to warnings and citations.

- Upon full implementation, TPWD and the City would utilize their authorities and discretion to ensure compliance.
- Increased patrols may be implemented in areas where monitoring efforts detect non-compliance with route designations.
- It is anticipated that the Memorandum of Understanding that provides TPWD jurisdictional authority, would continue.

4.4 Evaluation

4.4.1 Monitoring and Maintenance

Monitoring is a continual evaluation process to assess the effectiveness, viability, and sustainability of the TMP. Monitoring may be formal, requiring specific and detailed information, or informal, including reported observations. Included in this section are examples of proactive monitoring activities. The monitoring results and documentation of any management actions taken in response to monitoring efforts may be documented by the City and TPWD. This information may be used to determine priority areas for future monitoring efforts, law enforcement emphasis, and funding. The monitoring results may also be used to evaluate the effectiveness of the TMP and to identify the need for plan amendments or modifications. Modifications or additions to the route designations would be done through an appropriate level of environmental analysis and NEPA documentation.

The nature of uses outlined in the TMP will require continual maintenance and timely action to ensure sustainability. It is anticipated that the continual monitoring and evaluation of the TMP will identify areas of special interest that may require maintenance. Many of the actions may be accomplished by utilizing volunteers from local user groups, yet will require coordination and oversight.

- Reclamation will conduct an annual condition assessment for five years to identify and analyze potential changes in the condition of resources, including archaeological sites. Data collected through the condition assessments will aid Reclamation in determining whether actions would need to be taken to develop treatment methods to ensure site integrities. Supplemental environmental compliance documentation may be prepared, if necessary, pursuant to NEPA requirements.
- Photo-monitoring points may be established in key locations to monitor implementation actions and their effectiveness. Example photo points are: known areas where cross-country travel has occurred, closed routes, rehabilitation projects, known erosion areas, and areas of good road quality for future reference. Photo monitoring points may be documented using GPS and a monitoring schedule.
- The monitoring data collected would be used to assess the effectiveness of the TMP and associated implementation actions. Closed routes would be

monitored for signs of use, rehabilitated routes would be monitored to determine effectiveness of rehabilitation efforts, and the plan area would be monitored for sign conditions. Modifications to the TMP would be considered if monitoring indicates that the goals are not being met.

- Monitoring may be focused on three indicators: (1) Occurrence of Resource Damage (i.e. braided routes, rutting, created routes, etc.); (2) Compliance with Route Designation (i.e. vandalism of sign or barriers, trends in citations, success of rehab, etc.); and (3) User Conflicts (i.e. conflicts with adjacent landowners, or other users).
- If monitoring indicates resource damage is occurring:
 - Increase educational efforts regarding resource damage and its consequences, ie: not driving on wet or muddy roads, staying on designated roads.
 - Consider the need for a seasonal closure, type of vehicle restrictions, or complete closure of the route.
 - On designated routes: consider the need for road maintenance efforts, road re-routes, or installation of waterbars, culverts, etc and the feasibility to complete the maintenance in a timely manner.
- If monitoring indicates a lack of compliance with use designations:
 - Increase public education and signing efforts by publishing a news release as a reminder of the use designations and rules.
 - Increase law enforcement patrol efforts in the problem areas.
 - Install additional and more prominent route markers and signs.
 - Install additional and more prominent barriers on closed routes.
- If monitoring indicates that user group conflicts are occurring:
 - Increase public education and signing efforts.
 - Increase law enforcement patrol efforts in the problem areas.
 - Consider designating routes for single uses to prevent user conflicts.
- The maintenance standards for each designated route may be documented and modifications may be identified and recommended if necessary.
- Routine maintenance of designated routes and areas would be completed in such a manner that minimizes soil erosion and degradation of other resources.
- Monitoring efforts and condition assessments, would inform the need for sign maintenance and replacement schedules. A sign inventory and photo database may be created to facilitate tracking of sign maintenance.
- Maintenance procedures for physical barriers would be based on monitoring and condition assessments.

References

- BEA. 2018. Outdoor Recreation Satellite Account: Updated Statistics for 2012-2016.
- Dufourd, Dick. 2015. National Off-Highway Vehicle Conservation Council. Great Trails: Providing Quality OHV Trails and Experiences.
- White, Eric M.; Bowker, J.M.; Askew, Ashley E.; Langner, Linda L.; Arnold, J. Ross; English, Donald B.K. 2015. Federal outdoor recreation trends: Effects on economic opportunities. Report prepared for the National Center for Natural Resources Economic Research (NCNRER). NCNRER Working Paper Number 1. http://www.fs.fed.us/research/docs/outdoor-recreation/ficor_2014_rec_trends_economic_opportunities.pdf.
- 43 CFR 420. Off Road Vehicle Use. Public Land: Interior.

Appendix A – Detailed Maps

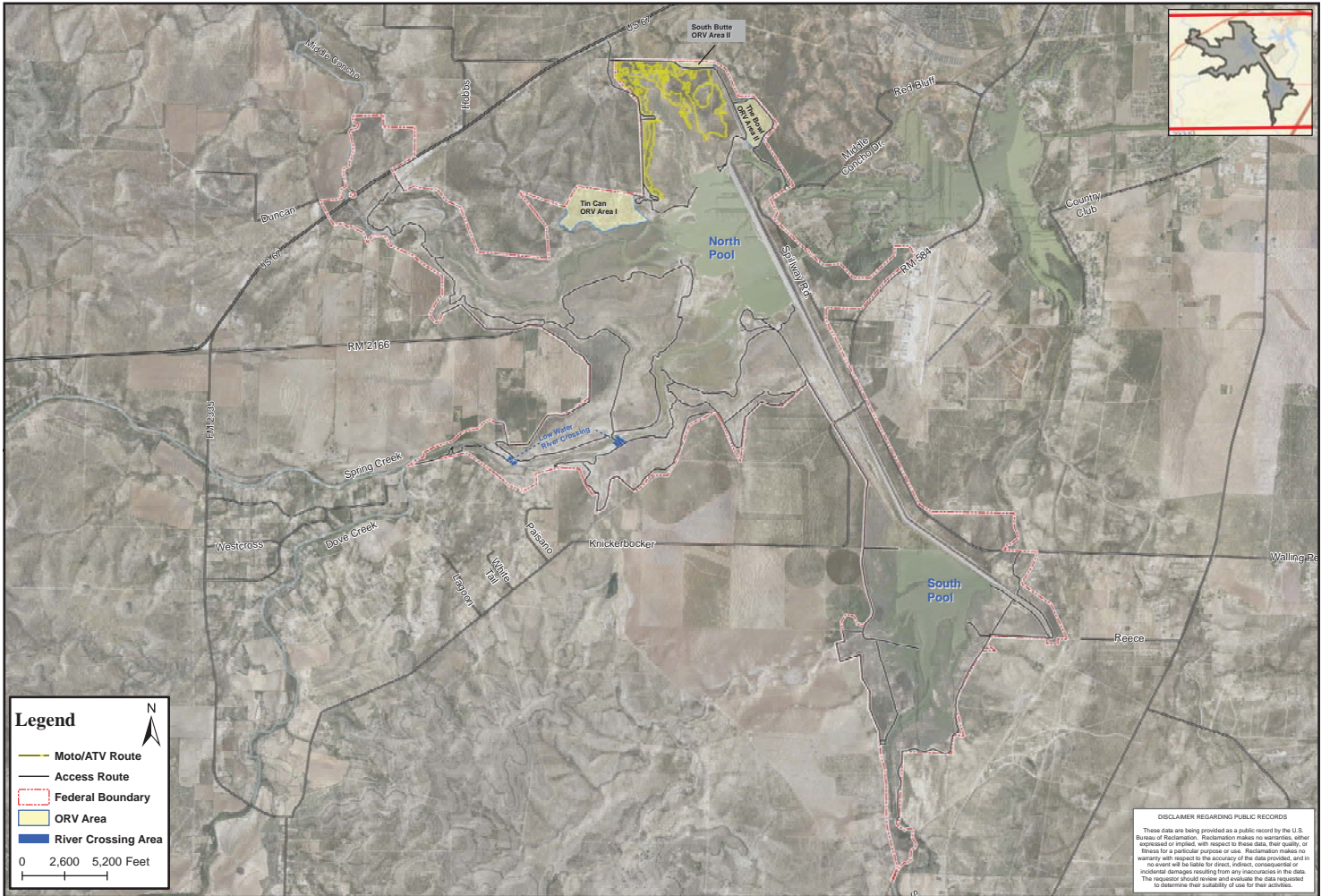


FIGURE A-1
DETAILED MAPS
TWIN BUTTES TWP

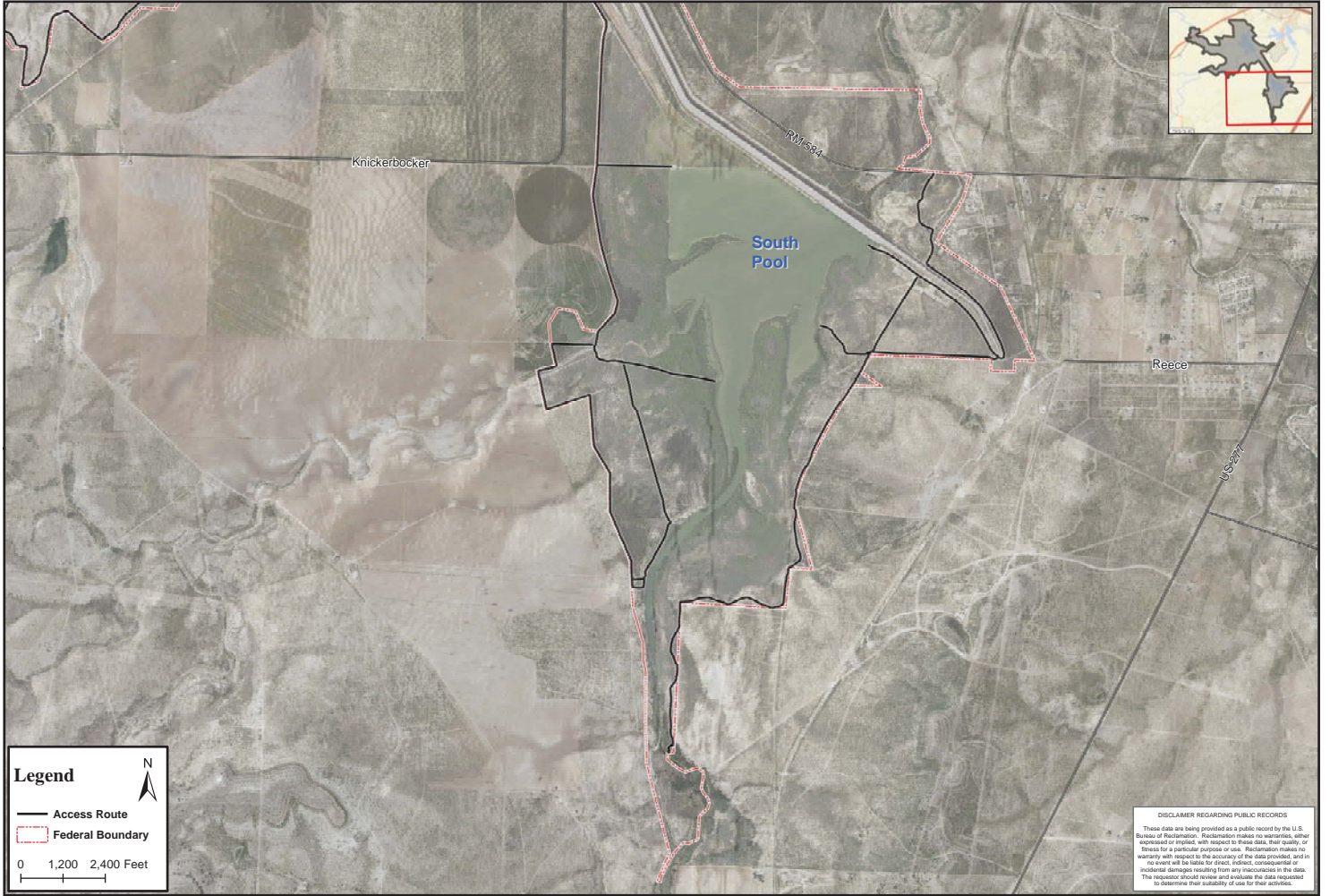


FIGURE A-2
DETAILED MAPS

SOUTH POOL

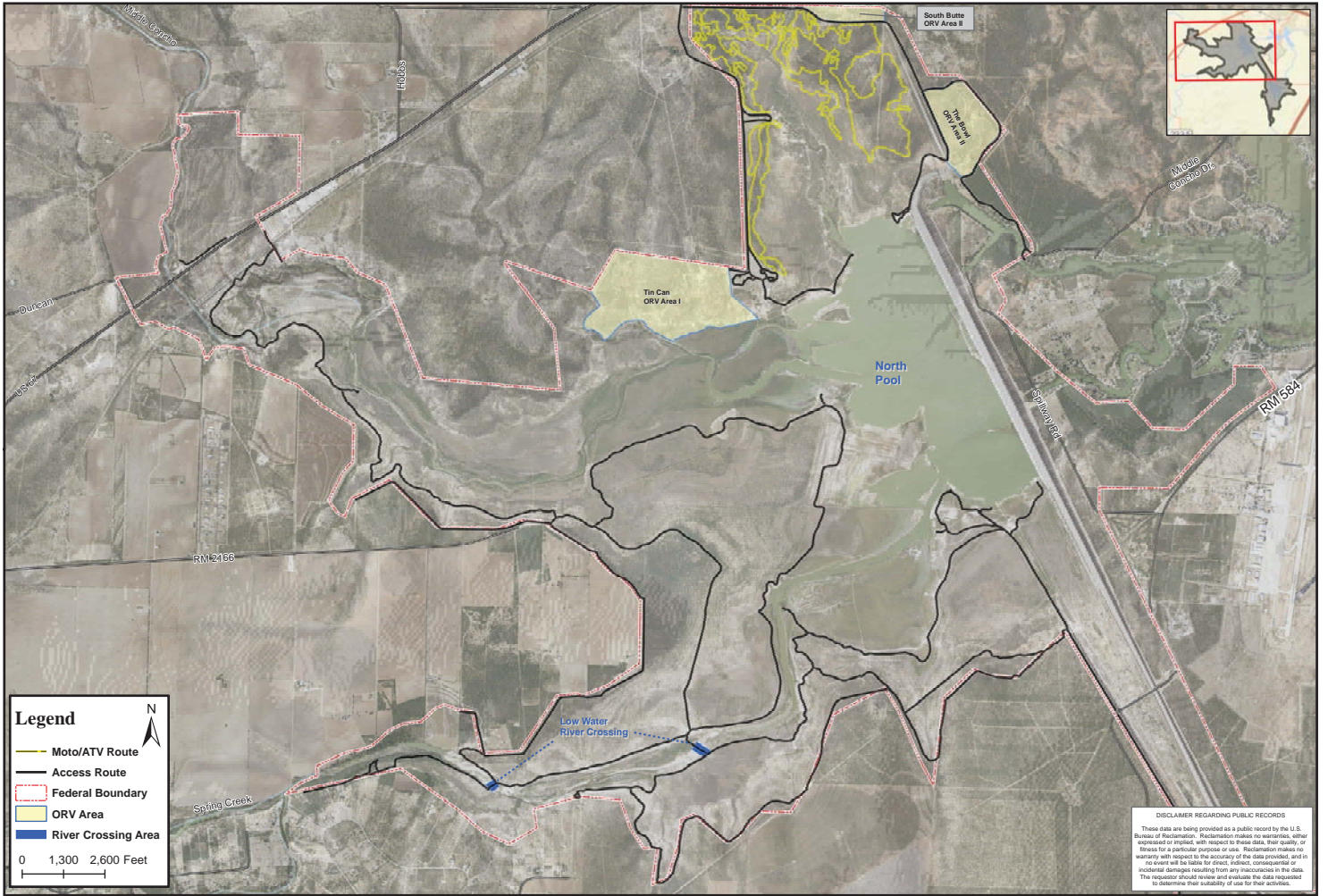


FIGURE A-3
DETAILED MAPS
NORTH POOL



FIGURE A-4
ORV Areas and Moto/ATV Routes
DETAILED MAPS

Appendix B – Detailed ASI Maps

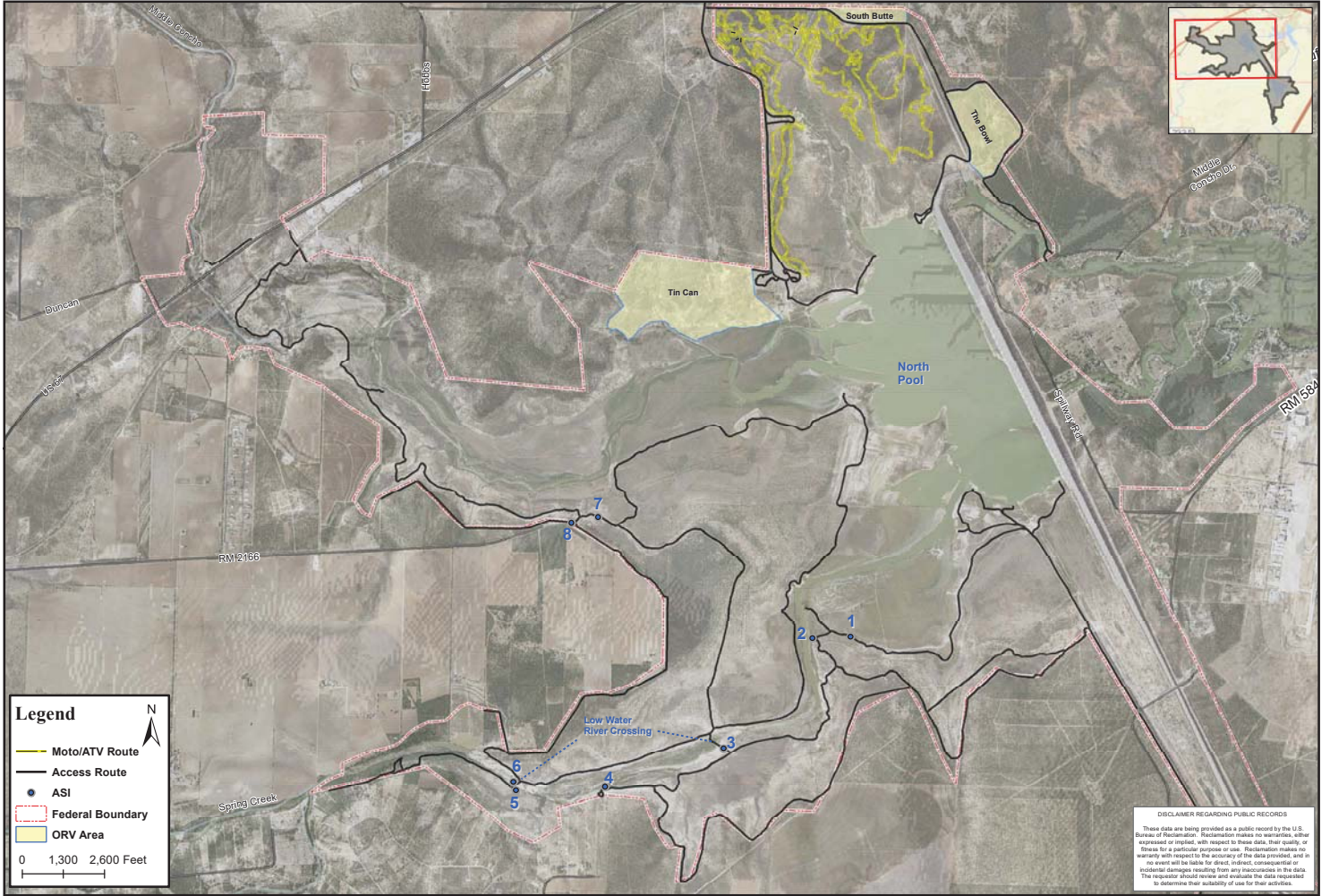


FIGURE B-1
DETAILED MAPS

NORTH POOL
ASIS



Legend

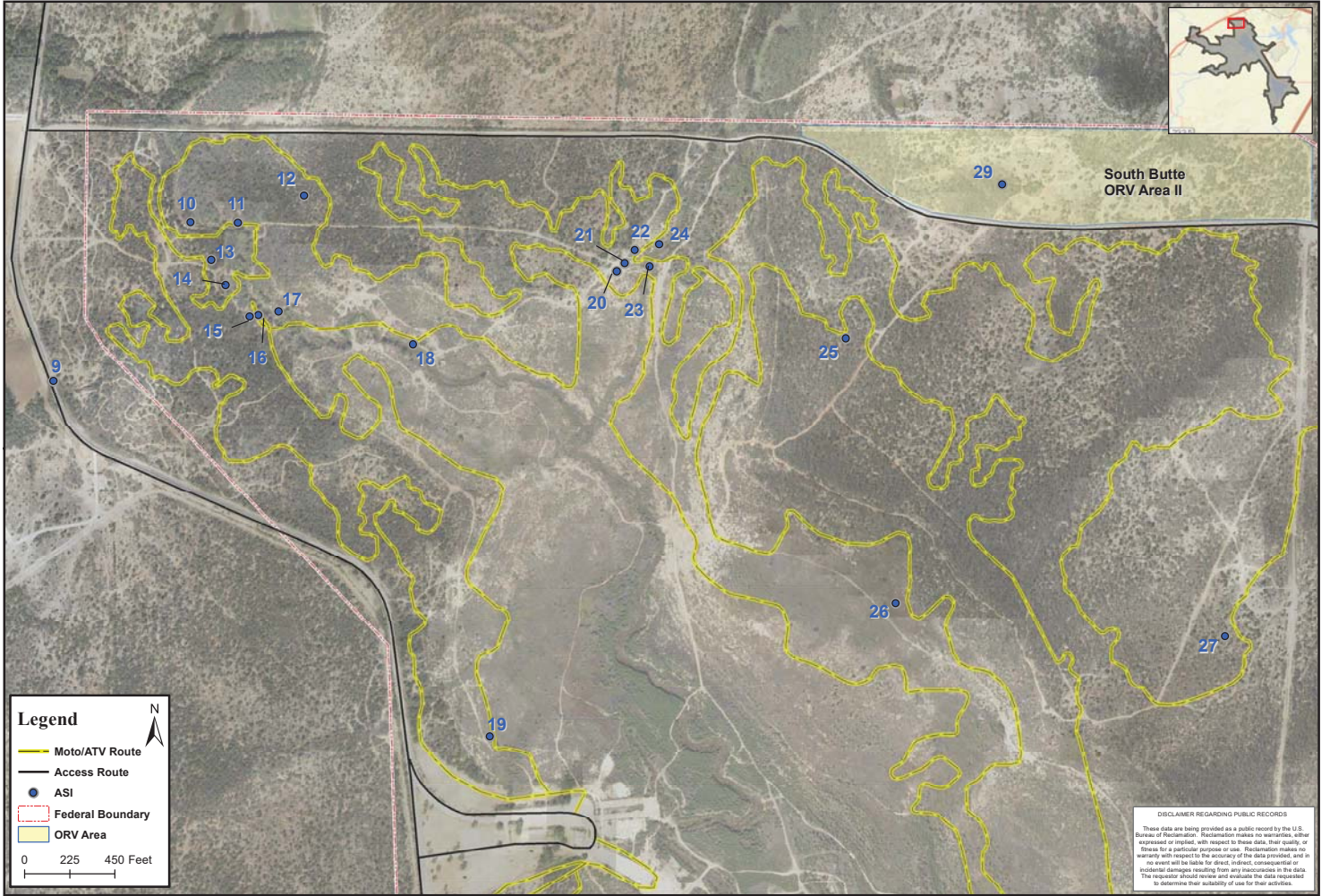
- Moto/ATV Route
- Access Route
- ASI
- Federal Boundary
- ORV Area

0 200 400 Feet

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**TIN CAN - ORV AREA II
 ASIS**

**FIGURE B-2
 DETAILED MAPS**



**MOTO/ATV & SOUTH BUTTE
ASIS**

**FIGURE B-3
DETAILED MAPS**

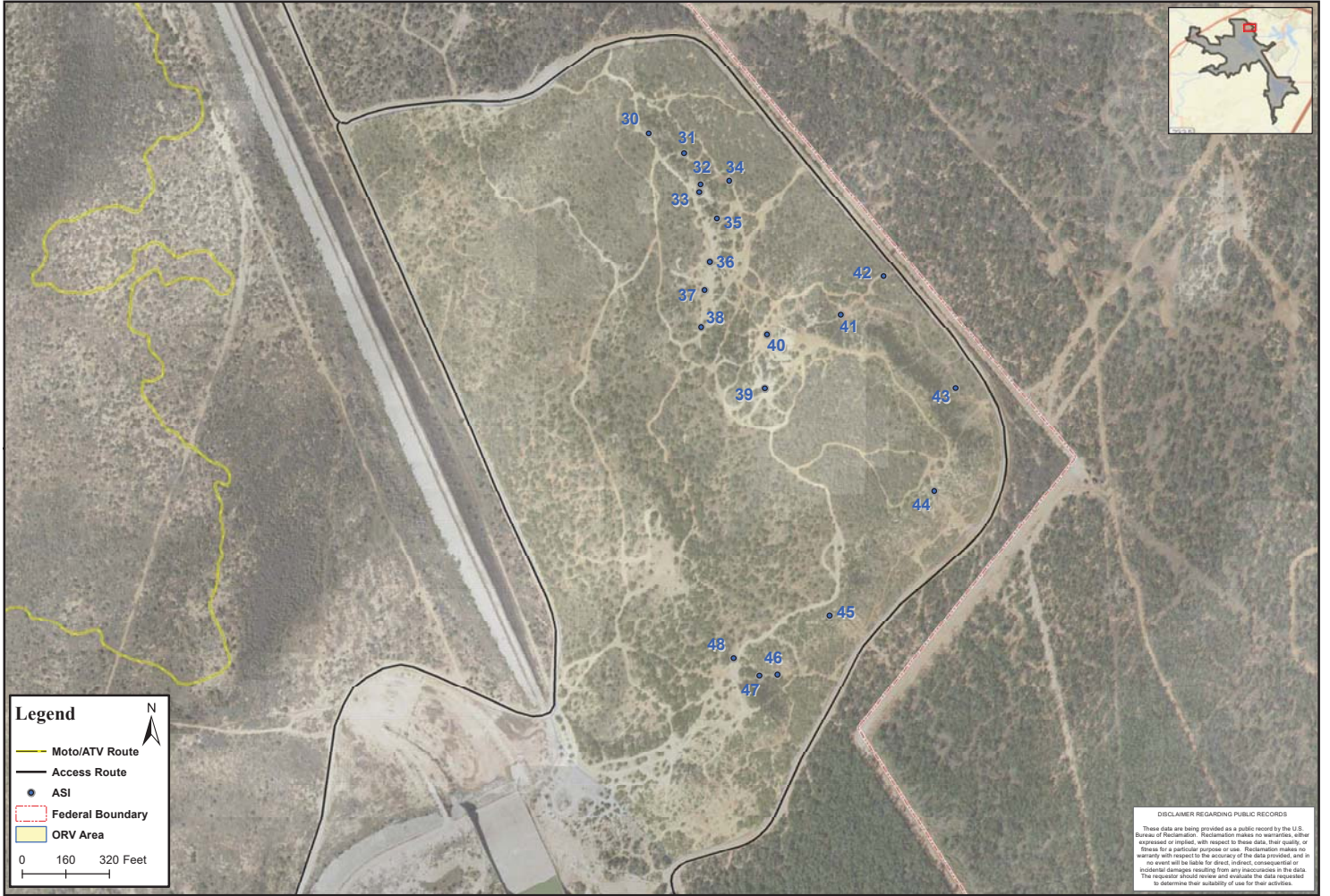


FIGURE B-4
DETAILED MAPS

THE BOWL - ORV AREA III
ASIS

Appendix C –Engineering Report

Appendix C
Engineering Report for the Twin Buttes Transportation Management Plan
for the Bureau of Reclamation, Oklahoma-Texas Area Office
December 2018

In support of developing a Transportation Management Plan for the Twin Buttes Reservoir within lands owned by the Bureau of Reclamation, two Forest Service employees gathered observations during a field visit in April of 2018. Mike McNamara, a Forest Service Soil Scientist and Hydrologist, and Jordan Burge, a Forest Service Civil Engineer, traveled a majority of the proposed routes. The following observations, recommendations, and considerations were developed from that site visit.

Types of Routes:

Generally, the routes in the Twin Buttes area can be categorized using the following:

- Access Routes: main access routes to lands around the reservoir and to boat ramps and other shoreline access points.
- Motorcycle and ATV Routes: a network of one-way directional trails that are designed for use by motorcycles and smaller ATVs.
- Official Use Only Routes: administrative access for management of the walk-in hunting area located North of Highway 67.
- 4-Wheel Drive/ORV Areas: within the boundaries of the designated ORV areas, motorized vehicles would be allowed on existing routes. These areas are designated for more challenging four-wheel drive opportunities, including three distinct areas known as “The Bowl”, “South Butte” and “Tin Can.”

Observations and Main Concerns:

Access routes:

- *Sedimentation into reservoir:*
This is a general concern for all areas in close proximity to the reservoir. There are quite a few existing routes adjacent to Twin Buttes Reservoir. Roads or trails that have started to unravel contribute to erosion and sedimentation directly into the reservoir. This has several negative effects, including increased maintenance costs. To avoid dredging, regrading of existing routes, import of surfacing material, or other ongoing maintenance needs, hardening or rerouting these roads and trails will decrease overall erosion into the reservoir and the future maintenance that would create.
- *Rutting and Expansion*
A small rill or rut in a route may not be a major concern at first, but can lead to drainage problems that are expensive to correct. Rills and ruts that are not corrected quickly typically

develop into trail or road incision. Because the trail or road profile becomes lower in elevation, effective drainage may not be possible without importing material on the travel way to match surrounding grades. Typical practices to prevent this include frequent drainage dips, aggressive outloping, and lead-off ditches.

When the main route becomes wet and rutted, users will also attempt to bypass the existing route in search of an easier path. This creates multiple or widened routes, creating more resource damage than is needed to effectively provide access. Hardening the preferred route and potentially restricting access provides a reliable route from which users won't deviate.

- *Channel crossings:*

Users have selected several main crossings based on natural, existing conditions, such as hardened rock bottom and constrained flow. One of the main concerns is duplicate approaches into these crossings. Consolidating these to one approach on each side of the crossing will reduce erosion and sedimentation into the reservoir. Signage, barriers, and route hardening can all help define the preferred approach and reduce future maintenance.



Multiple, unnecessary approaches



Unnecessarily wide route



Steep route depositing material directly into reservoir

Motorcycle and ATV routes:

- *Rutting and Expansion*
See above section "Access Routes."

- *Route Density*

The area specifically dedicated to motorcycles (“Motocross”) has a clearly defined route. This route has been designated as a large, one-way loop that accommodates off-road vehicles less than 50 inches in width. The density of trails in this immediate area is quite high, and has led to expansion of the trail system, beyond the main loop detailed on current maps. A higher density of routes increases the surface area of bare soil, contributing to more erosion and sedimentation. Maintaining the trail system to its current length and monitoring for route expansion will be essential for minimizing resource concerns. High speeds and one-way travel also introduce safety concerns, so maintaining clear directional signage is vital.

- *Channel Crossings*

The motorcycle loop crosses the same channel in quite a few locations. Even channels that are dry for most of the year concentrate storm water flows, and have greater potential for erosion and sedimentation. Users have created more crossings than currently designated and are using them as large jumps. Once again, maintaining the current or a lower density of trail crossings will be essential in preventing excessive erosion and sedimentation, as well as with unauthorized expansion. Focusing preventative maintenance techniques, such as identifying proper crossing locations and approach hardening, on authorized routes will not only help with resource damage, but also with maintaining a safe travel system.



Ruts and rills can lead to an incised route



Multiple channel crossings in motorcycle trail area



Eroded approach into channel in motorcycle trail area

Official Use Only Routes: there are no major engineering concerns in this area. It is relatively far from the reservoir, and access would be primarily on foot.

4-Wheel Drive/ORV Areas: “The Bowl”, “South Butte” and “Tin Can.”

- *Hillside erosion:*
Maintaining sustainable rock crawler routes is always a challenge. A small amount of erosion must be accepted, but also balanced with a low level of routine maintenance. Once material has eroded from a crawler slope, it can be extremely difficult to recover. Besides losing material from the actual route, eroded material can also be deposited onto main access routes, plugging drainage features and making them impassable. In order to achieve an acceptable level of stability, features like check dams or grade breaks must be implemented.
- *Density*
Because this designation is for open areas instead of specific designated routes, consistent monitoring will have to occur to verify more routes are not being developed. “The Bowl,” “South Butte,” and “Tin Can” all have high densities of roads and trails, and further development could result in unacceptable resource degradation.



Alluvial deposit from eroded crawler trails in “The Bowl”



Heavy erosion in “The Bowl”

General Recommendations

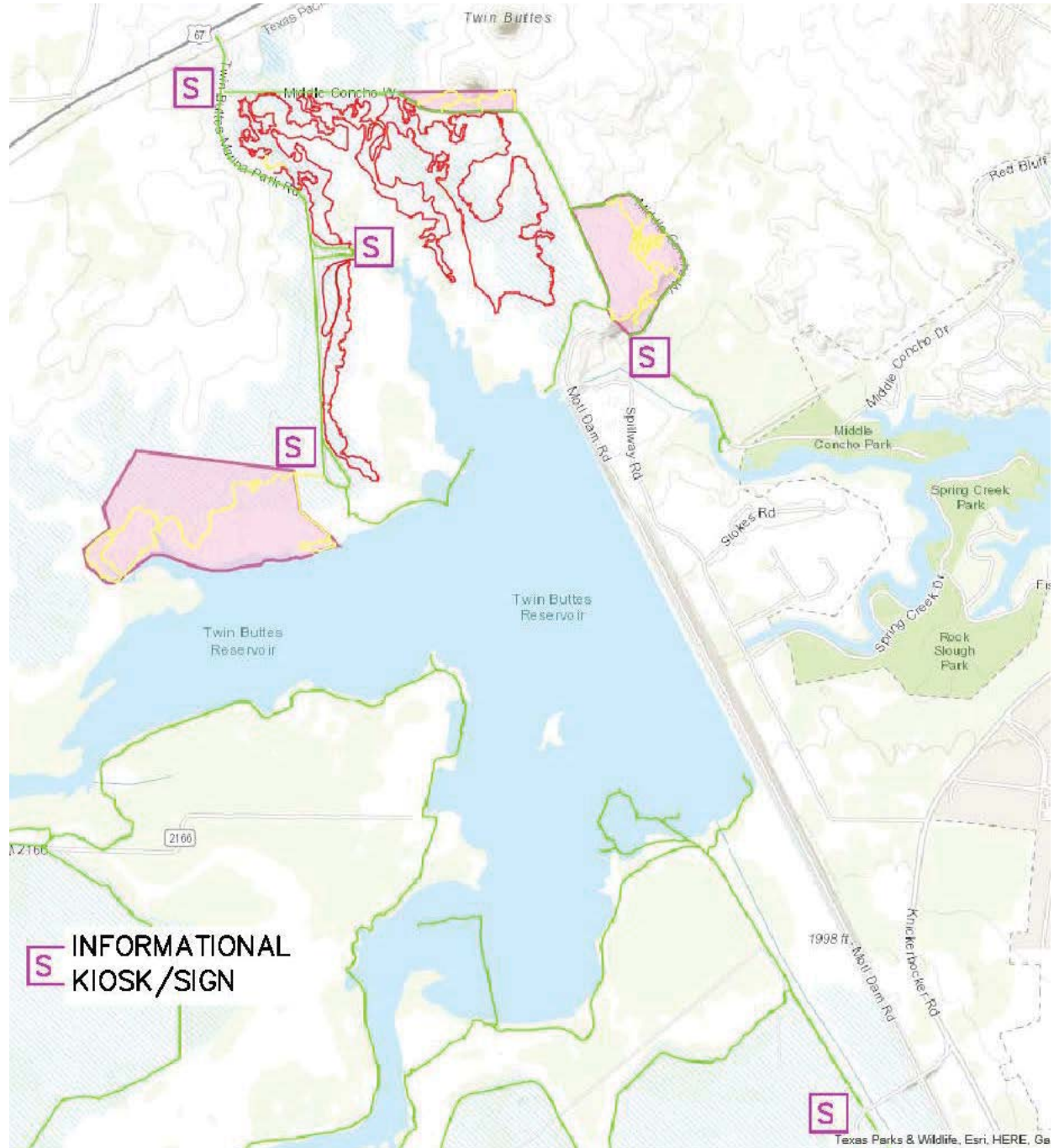
The following specifications and standard drawings demonstrate general recommendations specific to the Twin Buttes Transportation System. They were developed using field observations, Forest Service Handbook standards, and recommendations from “Great Trails,” a publication by the National Off-Highway Vehicle Conservation Council (NOHVCC). “Great Trails” provides a very detailed approach to determine the most applicable solution for the problem.

Prioritizing reconstruction and maintenance needs for the Twin Buttes area could take a scaled approach. Simple and inexpensive techniques could be implemented first, then monitored for success. If the first approach proves unsuccessful, more aggressive approaches can be applied.

One of the most effective implementation techniques is keeping users on authorized routes, allowing unauthorized areas to naturally recover and restore. Placing informational signage displaying maps at key locations gives responsible users the opportunity to stay on designated and authorized routes. This first level of implementation is inexpensive, and it gives the manager a tool to display the regulation to support compliance.

If resource damage is still occurring after giving the user the opportunity to stay on designated routes, more aggressive techniques can be deployed. There are many techniques to keep users out of unauthorized areas, such as pipe rail fencing or boulder barriers. Camouflaging areas with natural materials can also be a very successful technique.

After finding successful methods for keeping users on designated routes, the next step is focusing on stabilizing those routes from further resource damage. Methods for stabilization depend on the specific area. See the following drawings for detailed information on implementation.



Informational kiosk locations, displaying maps with designated routes and types of allowed usage

Each of the following photos are from NOHVCC's "Great Trails"



In chronically wet areas, fabric can be used to contain dry, compacted material. This is an initially expensive treatment, but will keep users on one route and reduce long-term maintenance costs.



Constricted entrances can be used to control the width of vehicles allowed in the route system.



Pipe-rail fencing is an inexpensive tool to close areas to users.