FINAL
Conceptual Restoration Plan Update: Existing Conditions and Initial Assessment of a Rio Grande River Reach in Central New Mexico

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PREPARED FOR

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EXECUTIVE SUMMARY

The Save Our Bosque Task Force (Task Force) contracted with Tetra Tech to undertake the first phase of updating the Task Force's 2004 Conceptual Restoration Plan (CRP) for New Mexico's Middle Rio Grande through Socorro County. Phase 1 task components include expanding the Task Force watershed group, developing a geodatabase to aid in watershed management project conceptualization and using the geodatabase data to develop this Existing Conditions and Initial Assessment Report discussing changes over the past 15 years since the original Task Force CRP. Initial trends related to changes in infrastructure, channel width and capacity, overbank flood potential, and vegetation are summarized here.

Since 2004, six miles of engineered levees have been constructed in the Project Area in the vicinity of Socorro. Other changes in infrastructure include the location and operation of several pumps whose function is to bring water from the low flow conveyance channel (LFCC) to the Rio Grande in order to support endangered species. The pump station at Neil Cup, which is the Middle Rio Grande Conservancy District's Socorro Main Distribution Hub, was recently converted to a dedicated pumping facility with a check structure and pipelines to direct water to two discharge points. Additional temporary pumping stations still exist at both the north and south boundaries of Bosque Del Apache National Wildlife Refuge though the goal is to also change them out to permanent structures. Since 2000, the Rio Grande has dried at the Bernardo Gage, which is near the upstream end of the project reach, in 12 of the last 21 years and nine of the last ten years.

A number of factors affect the channel width and capacity in the Project Area including larger tributary inputs (the Rio Salado and Rio Puerco), smaller arroyo inputs, the San Acacia Diversion Dam (SADD), the LFCC, and Elephant Butte Reservoir. Broadly speaking, moving from the upstream end of the Project Area downstream, the Rio Grande is fairly well connected to its floodplain between the Socorro County line and the Rio Salado, although there is some channel degradation. The Rio Salado contributes coarse sediment to the river which creates a natural grade control in this area. The influx of sand, gravel, cobble, and small boulders creates a dynamic channel that inundates a new lower floodplain at higher flows, although the historic floodplain is elevated above the channel bed. The SADD traps sediments above it and the reach is incised with high banks and a coarse-armored bed of gravel and cobble immediately downstream. The effects lessen moving further downstream, but in general there is very little floodplain connectivity. The LFCC begins at the SADD and diverted up to 2,000 cfs of river flow from the 1950s through the 1980s. This led to channel narrowing and vegetation encroachment on the banks and bars. The subreach from Escondida downstream to the south boundary of Bosque del Apache National Wildlife Refuge (BDANWR) was historically a wide, open channel with dynamic, unvegetated bars but recently has experiencing significant channel narrowing with bars and islands becoming vegetated. There have been multiple channel widening projects through this area so it's difficult to tease apart the overall narrowing trend from widening occurring at discrete locations without further analysis. In general, there is good floodplain connectivity although the channel bed has incised at the downstream end. The channel bed is perched above the floodplain in some areas which has resulted in sediment plugs forming in the river. However, as the Elephant Butte Reservoir pool has dropped, a headcut has moved upstream and sediment plugs have continued to develop above the headcut. There are high sediment inputs from arroyos entering from the east in this area. Aggradation in the river has elevated the channel bed above the LFCC elevation and water seeps from the channel to the LFCC. From the south boundary of BDANWR moving downstream, the sand bed channel is historically an aggradational reach with a wide-open channel, unvegetated bars, and good floodplain connectivity. However, as the headcut from Elephant Butte moved upstream, it incised the channel which narrowed it, lowered groundwater elevation, and greatly reduced floodplain connectivity. The downstream end of the Rio Grande through the Project Area is in an area that was part of Elephant Butte Reservoirs full pool through the late 1990s. The river is aggradational in this area and a channel is regularly dredged to maintain connection with the reservoir. This maintenance dredging prevents any change in channel width from occurring and spoil bank levees created from dredged material prevents floodplain connectivity. The LFCC ends but water moves to the west creating large open water areas that reconnect with the Rio Grande farther downstream.

Prolonged drought in New Mexico has led to decreased peak spring runoff flows which have resulted in a less dynamic channel. There have multiple years since 2004 when overbanking flows have not occurred, vegetation has become established, and the trend through the Project Area has been a narrower, deeper channel with less floodplain connectivity. Additionally, augmented base flows during dry times to support endangered species, which typically occur during peak vegetation growing seasons, may also contribute to the increase in vegetated bars and islands. The geomorphic trends described above contributed to less overbank flood potential in much of the project area and a river becoming increasingly disconnected from its floodplain.

Vegetation in the Project Area is influenced by many of the same factors that shape the geomorphology of the river. Disconnection of the river from the historic floodplain, both by periodic overbank flows as well as groundwater connections, have led to a rise in nonnative invasive vegetation and a decline in native riparian shrubs in some areas. Habitat restoration projects have led to the removal of invasive saltcedar in many locations and where the hydrology is suitable or the river can be manually reconnected to the floodplain, native vegetation is maintaining or increasing. Fire, which was not natural disturbance mechanism in the bosque has been an increasingly prevalent factor. Saltcedar, which has proliferated, burns readily and resprouts more effectively than native vegetation. Drought and the introduction of tamarisk leaf beetle have further stressed vegetation in the Project Area and approximately 20,000 acres have burned since 2004.

Conceptual Restoration Plan Update:

Existing Conditions and Initial Assessment Report

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1.0 INTRODUCTION

The Save Our Bosque Task Force (Task Force) contracted with Tetra Tech to carry out provisions in the Request for Proposals (dated July 9, 2019) for “Updating and Expanding the Restoration Plan for New Mexico’s Middle Rio Grande through Socorro County” (referred to as Plan Update, Phase 1). Phase 1 task components include expanding the Task Force watershed group, development of a geodatabase to aid in watershed management project conceptualization, and use of geodatabase data to develop this Existing Conditions and Initial Assessment Report discussing changes over the past 15 years since the original Task Force Conceptual Restoration Plan (CRP) was developed in 2004. These tasks are discussed in greater detail in Section 2.0.

1.1 SAVE OUR BOSQUE TASK FORCE

The Task Force is a grassroots watershed group and 501(c)(3) nonprofit organization based in Socorro, New Mexico, that has been active in river and bosque restoration, outdoor recreation, conservation, and education efforts in Socorro County for the past 25 years. In 1994, a group of local agencies formed the Task Force to address the issues causing degradation of the ecosystem along the Rio Grande bosque: dumping of trash, off-road vehicle use, illegal fuelwood cutting, and wildfire. Local citizens got involved with the Task Force in 1998. Today it is a 501(c)(3) organization governed by a board of directors that includes private landowners along the river, agency personnel, and other interested citizens. The mission for the Task Force is:

> The Save Our Bosque Task Force works collaboratively to support a healthy Rio Grande bosque and riparian ecosystem while celebrating its benefits to the communities of central New Mexico.

How the Task Force Has Evolved and Accomplishments to Date

Initially, the Task Force focused its efforts on river and riparian restoration work between the San Acacia Diversion Dam (SADD) and the San Marcial railroad bridge in Socorro County. Early projects include improving the Escondida Lake and Socorro Nature Area, creating 13 riverine parks, and creating a 3-mile trail to bring people to the Rio Grande in Socorro. Since 1994, it has been involved in restoring more than 1,200 acres of riparian habitat on private property, state land, and a national wildlife refuge. The Task Force partnered with various agencies and funding sources to obtain more than $3 million to help support partner efforts. In addition, the Task Force has been instrumental in monitoring its restoration sites, developing a long-term vegetation monitoring protocol, and providing support to landowners in maintaining sites on their property. Because of interest from northern Socorro County residents, the Task Force is currently focused on expanding the footprint of the area in which they work to include the Rio Grande bosque throughout all of Socorro County.

The Task Force has also expanded the scope of services it provides and is addressing additional recreation opportunities and concerns in the bosque. The Task Force is leading a planning and design effort for a Socorro Valley Bosque Trail with assistance from the National Park Service and other partners. The Task Force is continuing its efforts on developing recreation access points and facilities in designated areas, developing designated areas for motor vehicle access and restricting unauthorized access, coordinating maintenance and management of existing facilities, and facilitating waste removal.

Another main area of focus for the Task Force is education and community outreach. The organization has successfully implemented a summer internship program for recent graduates in conservation in which the interns conduct monitoring at restoration sites, assist design of restoration projects, maintain project quality through invasive plant control, develop and implement public outreach, and develop educational tools. It also developed Bosque Conservation Day for area fifth graders, and for over 30 years has shared with them topics ranging from bosque ecology, fire safety, archaeology, water conservation, to local geology. The Task Force leads two Bosque Trash Pickup Days each year as well as Agency Workdays and Volunteer Planting Days. The Task Force also regularly hosts other public events to inform the community on current river issues.

1.2 TASK FORCE CONCEPTUAL RESTORATION PLAN

The Task Force led an initiative and raised funds for research and development of a planning tool for landowners and management agencies interested in improving the health of the San Acacia Reach. The resulting technical report, completed in 2004, is the "Conceptual Restoration Plan for the Active Floodplain of the Rio Grande from San Acacia to San Marcial, NM." The Conceptual Restoration Plan (CRP) is a long-range planning document identifying current vegetation, potential for flooding, habitat restoration options, and guiding development of implementation strategies. Scientific studies guide these strategies. The plan also takes into consideration social, political, and environmental issues affecting this reach of the river. Over the past 15 years, the Task Force has worked to implement the plan by cooperating with water management agencies, local land managers, and private landowners to restore sites designated as priorities.

Funding support for development of the 2004 CRP was provided by the US Fish and Wildlife Service (Service), the US Army Corps of Engineers (USACE), and the Middle Rio Grande Endangered Species Act Collaborative Program (Collaborative Program). Support was also provided by the McCune Charitable Foundation, the Turner Foundation, the World Wildlife Fund, and the Friends of the Bosque del Apache National Wildlife Refuge. This analysis determined that the restoration priorities with the highest ranking were managing future development, increasing frequency/duration of flooding, reducing fire danger, planting and seeding native vegetation and focusing restoration on locations where it can be most successful. Additional priorities included: spring flushing flows, eliminating structural limitations on flooding, removing exotic vegetation (selective and clear cut), creating wetlands and marshes, enhancing groundwater storage and interaction, planting and seeding native vegetation, creating flooded bottomlands, variable floodplain topography, reconnecting oxbow and old channels, channel widening, increasing groundwater storage on the east side, destabilizing and lowering banks (terrace lowering), and fall maintenance flows. The 2004 CRP represents a comprehensive analysis of data and information available on biotic and abiotic resources as well as water rights and water allocation in and around the Middle Rio Grande (Table 1) at that time. Volume 1 of the CRP discusses phases I–III of plan development: data collection and analysis, specific river issues, and concepts and strategies for river restoration activities. Volume 2 discusses phases IV and V: river/riparian restoration plan, and monitoring and adaptive strategy. Volumes 3 and 4 contain appendices and supporting mapping.

Table 1. Save Our Bosque Task Force 2004 CRP Volumes and Phases

Volume 1		
	Phase I	Data collection and analysis
	Phase II	Specific river issues
	Phase III	Concepts and strategies for river restoration activities
Volume 2		
	Phase IV	River/riparian restoration plan
	Phase V	Monitoring and adaptive management strategy
Volume 3		
		Phase I and II appendices
Volume 4		
		Supporting mapping

1.3 PROJECT AREA

For most of the Task Force's existence, the group has been focused on the Rio Grande from the SADD south to the San Marcial railroad bridge. The Project Area for the current effort (described in Section 2.0) will expand the footprint to include the Rio Grande through all of Socorro County (Figure 1). The Project Area is approximately 85 miles long and contains a significant amount of infrastructure, including the SADD, the Low Flow Conveyance Channel (LFCC), a continuous levee along the west side of the river, and intermittent sections of spoil berms on the east side. The infrastructure, along with invasive woody species, water management and drought, has affected the morphology and dynamics of the river and floodplain and their hydrologic connectivity, the nature of the soils that underlie the floodplain and form the channel boundary, and the surface water-groundwater interactions that sustain riparian vegetation.

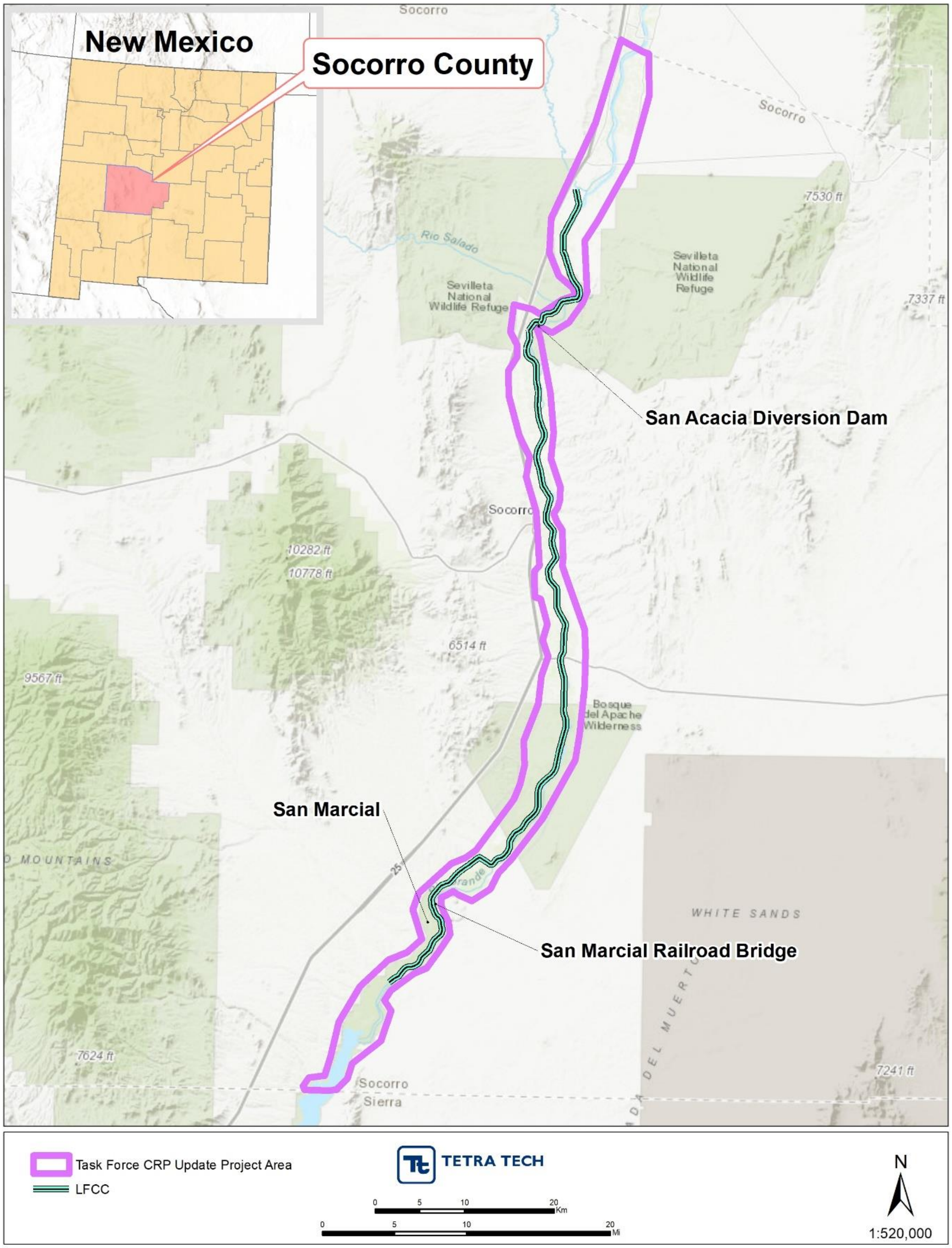


Figure 1. The Task Force CRP Update Project Area.

2.0 CURRENT UPDATE

In 2019, the U.S. Bureau of Reclamation (Reclamation) awarded the Task Force a WaterSMART (Sustain and Manage America's Resources for Tomorrow) Cooperative Watershed Management Program grant to update and expand the organization's 2004 CRP. Updating the CRP will be accomplished in two phases.

- Phase 1 includes expanding the watershed group, compiling a geodatabase (GDB) of data and information relevant to the Project Area, and completing an Existing Conditions and Initial Assessment Report.
- Phase 2 will include conducting detailed trend analyses of ecosystem components, developing a tiered restoration plan, and identifying a minimum of five priority restoration projects. Phase 2 will commence if the Task Force is able to secure additional funding. Per the Task Force proposal, this phase will: "develop a Watershed Restoration Planning project to update to its 2004 CRP as well as expanding this plan throughout Socorro County. This update would include evaluating the current hydrology/geomorphology and riparian habitat conditions in our area as well as modeling trends due to land use changes, drought, and climate change. This plan would identify general, potential project areas based on their long-term sustainability, partner efforts, and ability to address area interests and issues. To ensure that it meets the needs of our community, we will reach out to private landowners and increase our collaborative efforts with other groups within our focus area. Funding will be used to conduct outreach to stakeholders, to gather and combine available information, analyze current conditions, produce a geodatabase of all relevant information and current projects within our study area, and prepare a final report of current conditions."

Phase 1 of the CRP update comprises three main tasks which are described in detail below as follows:

- Expand the watershed group – Section 2.1
- Geodatabase of digital data and information – Sections 2.2-2.3
- This Existing Conditions and Initial Assessment Report - a review of the geodatabase components (digital data and reports) collected focused on information for the Project Area for the past 15 years, an initial assessment of that data, and recommendations for Phase 2 analysis – Section 3

2.1 EXPANDING THE WATERSHED GROUP

Expanding the footprint of the Task Force's Project Area requires expanding the involvement of landowners and land managers who either have not been part of the watershed group to date or have interests in the area into which the Task Force wishes to expand. The original restoration planning process that resulted in the 2004 CRP was designed to be as inclusive as possible and involved close coordination between various federal and state agencies, local entities, individual stakeholders, and a project oversight committee. The Task Force seeks to bring the same variety of perspectives to the updated planning process.

Outreach Activities

The CRP update team had two main objectives for their outreach efforts to accomplish this first of the Phase 1 update tasks. The first objective was to expand the watershed group to include landowners from northern Socorro County, bringing new perspectives to the planning process. To that end, a public meeting was held on December 11, 2019, in Veguita, New Mexico. Attendees identified fire risk as one of the most pressing concerns. This included an increased risk because of nonnative invasive weeds in the bosque. Another concern was the difficulty of getting members of the public into the bosque to collect firewood and otherwise aid in hazardous fuel removal activities.

The second objective was to update the specific river issues identified in Volume 1 of the 2004 CRP. To accomplish this objective, the Task Force and Tetra Tech met individually with agencies and entities that have performed restoration work in the Project Area since 2004 to obtain updated data and information regarding riverine processes, management, vegetation, and species occurrence that might have changed since 2004. Meetings were held with the Service Partners for Fish and Wildlife Program (Partners Program), Sevilleta National Wildlife Refuge (NWR), Middle Rio Grande Conservancy District (MRGCD), New Mexico Department of Game and Fish (NMDGF), New Mexico Interstate Stream Commission (NMISC), and Audubon Society. There has also been extensive coordination with Reclamation regarding its WaterSMART grant as well as agencies working on similar planning efforts in the Isleta Reach. The conversations between the Task Force and these agencies and entities were primarily focused on the habitat restoration work each has completed since 2004 as well as the most pressing concerns faced by each as they implement their respective missions in the Project Area.

The team also provided notification of the planning process and requests for information regarding data, restoration work, or planned efforts since 2004 to all agencies, nonprofit groups, and potentially interested parties identified through the Phase 1 process (see Appendix A for list of agencies and individuals contacted).

The following project goals were defined as a result of the outreach efforts to expand the Task Force's watershed group:

- Long-term health of the river ecosystem
- Fire prevention in the bosque
- Maintaining and enhancing wildlife habitat diversity
- Increasing public awareness and value of Rio Grande ecosystem

The following community issues were identified:

- Sustainable Rio Grande
- Wildfire risk to homes and bosque
- Invasive plant species
- Sensitive species habitat availability
- Loss of overall biodiversity
- Threats to a living Rio Grande ecosystem due to drought, climate change, and water management
- Loss of human connection to the river as a part of our community
- Lack of opportunities for recreation along the river

These goals and issues are inclusive of some of the main themes of the original 2004 CRP and the scope for this update, including improved biodiversity, water delivery, and fire prevention. Input on these goals was received during the outreach efforts described above as well as agency meetings with Reclamation, MRGCD, and NMISC. The 2004 CRP contained one broad goal: "create riparian restoration opportunities by establishing favorable hydrogeomorphic conditions in the San Acacia to San Marcial reach of the Middle Rio Grande." During development of this update, additional goals have been identified which reflect the management concerns that regularly come up in the Project Area. Conversely, the restoration and community issues for this update are much more focused than those identified in 2004, presumably because much of the science that was synthesized then still holds in this update. The restoration issues from 2004 were a wide-ranging list that included administrative and legal concerns, hydrologic issues, geomorphic and hydraulic topics, biological and ecological concerns (Appendix B).

During Phase 2 of the CRP update, the team will review the goals and objectives and refine them further if necessary. In order to update the CRP, development of proposed restoration and other project features will be evaluated in relation to project goals. Having a clear definition of goals and objectives is key to determining if proposed efforts meet those goals, as well as evaluating implemented projects for success. Section 4.0 discusses this topic further.

2.2 DEVELOPING A GEODATABASE

Outreach efforts have been instrumental in developing the geodatabase (GDB) for the CRP update. Datasets include landownership, surface water and groundwater, vegetation, wildlife, geomorphology, climate, topography, landscape-level planning, current and proposed water management, and current or planned restoration information.

This section outlines the GDB development process, including the conceptual and physical design phases. This document is also intended to highlight the database model as a structural representation of physical features in Socorro County and their application to habitat restoration and ecosystem management. The final deliverable consists of two Esri file GDBs: one GDB containing all vector data and a second GDB made up of raster data and a table that functions to describe each data layer within both GDBs.

All vector data is projected into EPSG:26913 NAD83 / UTM zone 13N spatial reference, whereas raster data is preserved in its native format.

The purpose of developing a GDB is to identify the best available information to support the Task Force and other stakeholders' work in habitat restoration and ecosystem management within Socorro County. The first step developing the GDB was assembling all available spatial data products and identifying core thematic categories within those datasets. The datasets were reviewed to determine how they might contribute to resolving spatial questions relating to habitat restoration in Socorro County. A review of available data resulted in the identification of the following 17 core thematic data categories:

- Biologic
- Fire
- Habitat restoration
- Habitat restoration proposed

- Historic
- Hydrology
- Imagery
- Infrastructure
- Land cover
- Landownership
- Reference
- Soils
- Topographic
- Vegetation
- Wetlands

These thematic categories are a superclass of information, also referred to as a “feature dataset,” which consists of individual feature classes or layers. Each feature class was evaluated for its spatial representation and attributes to contribute to habitat restoration workflows, and cartographic production functions. Certain data categories were merged to simplify the projection of these layers. A processes outlining the method of incorporating new data through a merge function is provided in the GDB table. The scale range for each feature class was generally clipped to include only data within the county; however, certain layers such as completed habitat restoration features were retained in their original extent because of their importance in providing contextual ecosystem information outside the county. They were included to promote system-level analysis in areas outside Socorro County. Each specific feature class was identified, categorized into a specific thematic category, and imported into each GDB. A total of 86 feature classes, as well as approximately five tables, were imported into the vector GDB. The raster deliverable includes six raster datasets. A list and description of the feature classes included in the GDB are presented in Appendix C.

The table provided with vector and raster GDB deliverables is intended to supplement project data layers and be referenced in tandem with each GDB. The name of each layer is matched to the layers located in the GDB. An explanation of each data layer—organized by core theme, name, geometry type (when applicable), function, potential application of these data in the form of geographic information system (GIS) tools and workflows, and a notes field—is provided in an accompanying table. The table also includes columns describing geometry type, function, and a notes column. When applicable, the table notes column is designated to highlight specific data types (i.e., multispectral satellite data and dataset updates), their potential use in image analysis and classification, and their application to site identification, habitat restoration, monitoring, and promoting riparian biological diversity.

The Task Force identified core feature datasets that should be periodically merged into a master layer for use in the GDB. Other layers will be catalogued in the table and included in the GDB. A detailed “readme” tab in the table is provided which outlines the details of this process to maintain data standards, streamline the function of the GDB, and integrate new data.

If new data are brought into the Task Force vector or raster GDB, the project table can be updated, which will assist in future efforts to update this data model and its contents.

2.3 RELEVANT PLANS AND PROJECTS IN THE AREA

Habitat restoration work in the Middle Rio Grande, including treatment of nonnative species, began as early as the mid-1980s and has been ongoing since that time. Projects have been implemented along the San Acacia Reach over the past 35 years, primarily on the National Wildlife Refuges with Bosque del Apache NWR (BDANWR) leading research and best practices development in the early years. The Task Force began restoration efforts on private lands in 1999 and continued with a restoration projects in priority areas called out in the 2004 CRP. A significant number of projects have been planned and implemented in this reach since the CRP of 2004, especially by the Collaborative Program and its signatories. The GDB is used to catalog the digital data associated with these projects, for both implemented and planned projects. Many of the projects have planning, compliance, or other documents associated with them. In addition to the habitat restoration work, strategic planning for other types of projects including water management has occurred. There are also several guiding documents that set vision, goals, objectives, and regulatory requirements for managing wildlife and their habitats. This section briefly describes some of those documents as well as other plans and documentation that might be relevant to the Task Force Project Area. Chapter 3 summarizes water management projects, infrastructure changes, hydrology and geomorphology changes, habitat restoration completed to date, vegetation changes, and use by threatened and endangered species.

Middle Rio Grande River Operations 2016 Biological Opinion

In 2016, consultation for water management and maintenance activities on the Middle Rio Grande conducted under section 7 of the Endangered Species Act between the U.S. Fish and Wildlife Service (Service), Reclamation, the Bureau of Indian Affairs, the MRGCD, and the NMISC concluded and the Final Biological and Conference Opinion (2016 BiOp) was released (Service 2016a). The 2016 BiOp directs water management agencies to avoid creating jeopardy conditions for endangered species by implementing Hydrobiological Objectives; restoring river connectivity; constructing large-scale habitat restoration and enhancement projects; and conserving storage water. These measures and others specified in the 2016 BiOp will guide management activities on the Middle Rio Grande in the immediate future. In 2018, a Lower Reach Plan was released that described several projects to accomplish that goal (Reclamation 2018). Efforts in the vicinity of the Task Force Project Area (approximately river mile [RM] 85 to Elephant Butte Reservoir) are listed in Table 2.

Table 2. Immediately foreseeable projects planned for implementation in the Project Area.

	Reach 1 (RM 140-119)	**Reach 2 (RM 119-116)**	**Reach 3 (RM 116-102)**	**Reach 4 (RM 102-74)**	**Reach 5 (RM 74-62)**	**Reach 6 (RM 62-52)**
Reclamation's Lower Reach Plan (Reclamation 2018)						
San Acacia Diversion Dam fish passage				T&E species (P)		
Bosque del Apache North Boundary infrastructure				Hydrologic; T&E species (P)		
Bosque del Apache channel realignment				Bosque HR; T&E species (I)		

River Mile 60 restoration						Bosque HR; T&E species (P)
Armendaris Ranch, Rio Grande Floodplain Strategic Plan (Dello Russo 2015)						
Habitat restoration on Armendaris Ranch					Bosque HR; Upland HR; T&E species (I, P)	Bosque HR; Upland HR; T&E species (I, P)
Socorro – Sierra Regional Water Plan (NMISC 2016)						
Socorro – Sierra Regional Water Plan	Water planning; Watershed restoration and community wildfire protection; Infrastructure evaluation; Groundwater-surface water interactions; Riparian wildlife habitat availability analysis; Hydrologic adaptations to get ephemeral flows to the river					
Sevilleta National Wildlife Refuge Comprehensive Conservation and Habitat Management Plans						
Habitat restoration on the Sevilleta	Bosque HR; Upland HR; T&E species (I)	Bosque HR; Upland HR; T&E species (I)	Bosque HR; Upland HR; T&E species (I)			
Tiffany Fire Rehabilitation Plan (under development)						
Habitat restoration in the Tiffany Area					Bosque HR; Upland HR; T&E species (P)	

P – in planning stages; I – implemented since 2004

Middle Rio Grande Conservation Action Plan

The Middle Rio Grande Conservation Action Plan (MRG-CAP) was produced by Natural Heritage New Mexico and the Colorado Natural Heritage Program in 2019 and is based on the dynamic patch mosaic concept for management. The MRG-CAP is a framework that identifies major conservation targets with measurable indicators of their current and desirable future conditions. The MRG-CAP was designed to help set objective stewardship goals for the MRG ecosystem. The framework is based on the project planning process developed by The Nature Conservancy and input came from a team of practitioners, managers, and scientists with regional expertise. The plan identifies the following five major conservation targets:

- Riparian and wetland vegetation communities
- Native bird habitat
- Native fish community
- Wildlife corridors
- Ditch and drain habitat

For each of the conservation targets, key attributes and associated indicators were defined and the indicators were assessed for current status and goal (from very poor to very good). Nine threats were identified and assessed across the conservation targets. This provides a risk assessment matrix that can inform restoration strategies to be implemented in and among specific reaches to meet goals in collaboration with partners and stakeholders (Muldavin et al. 2019).

The data used for this CRP update is also being utilized to assist in updating the MRG-CAP document and is described further in Section 3.4.

Middle Rio Grande Conservancy District Drought Contingency Plan

MRGCD plays an important role in the Project Area by providing drainage and mainstem river flood control operations and supplying water to agricultural users within its jurisdictional boundaries. The 2019 Drought Contingency Plan (MRGCD 2019) serves to increase MRGCD's resilience to water shortages, should they occur, while meeting obligations to water users, the Rio Grande Compact, and the 2016 BiOp. The document contains not only a process for monitoring near- and long-term water availability and a framework for predicting the probability of future droughts and conducts a vulnerability assessment, but it also proposes a set or mitigation and response actions that may have bearing on other projects in the Project Area.

Socorro County Community Wildfire Protection Plan

The Community Wildfire Protection Plan (CWPP) was updated in 2018 and summarizes plans and activities targeted at reducing the risk of catastrophic fire in Socorro County's wildland-urban interface and provides coordination and guidance to first responders and their respective jurisdictions in the event of wildfire (Socorro County 2018). Risk assessments are conducted for discrete watersheds and wildland-urban interfaces within Socorro County and they are prioritized as being at high, medium, or low risk of catastrophic fire. The CWPP also presents hazardous fuel reduction programs, prioritizes fuel reduction projects, and includes strategies for firefighting.

Socorro-Sierra Regional Water Plan

Regional water planning in New Mexico is conducted to protect the state's water resources and to ensure that each region is prepared to meet future water demands. In 2003, the NMISC accepted the initial Socorro-Sierra Regional Water Plan, which covers all of Socorro and Sierra counties, and, in 2016, the document was updated to provide new and changed information and to evaluate projections of future water supply and demand for the region using a common technical approach to all 16 regions statewide (NMISC 2016). In addition to an in-depth analysis of relevant water and environmental law, the water supply, and projected demand through 2060, the Socorro-Sierra Regional Water Plan recommends other projects, programs, and policies, many of which originated in the 2003 Water Plan and were reviewed and refocused by the steering committee for the 2016 update. While most of the proposed projects, programs, and policies differ from the other habitat restoration projects described in this section implementing them could influence and/or inform recommendations for the Task Force's CRP update.

Tiffany Fire Rehabilitation Plan

In mid-2017, a single lightning strike ignited the Tiffany Fire near the Burlington Northern-Santa Fe Railroad bridge near San Marcial in Socorro County. The fire quickly spread through the nearby Rio Grande bosque, burning primarily in stressed tamarisk defoliated by the tamarisk leaf beetle (*Diorhabda* spp.). The fire also burned in mature cottonwood (*Populus* spp.) and willow (*Salix* spp.) stands. Sierra Soil and Water Conservation District (Sierra SWCD) partnered with the Task Force to identify and bring together a large group of diverse stakeholders to initiate a large-scale restoration project. Sierra SWCD was awarded funding from the New Mexico Water Trust Board for the project and this work is currently in progress. Phase 1 of this project is evaluating and prioritizing watershed restoration to address the potential for future fires within the Tiffany Fire Project Area. The long-term goal of this effort is to use natural processes such as native plant succession to accomplish this work.

New Mexico Department of Game and Fish State Wildlife Action Plan

The State Wildlife Action Plan (SWAP) was finalized in 2016 and builds upon the previous 2006 Comprehensive Wildlife Conservation Strategy for New Mexico in several important ways (NMDGF 2016). Both documents are nonregulatory planning documents developed using best available science to provide a high-level view of the need and opportunities to conserve New Mexico's wildlife and their habitats. Both documents identify species of greatest conservation need (SGCNs) for the state of New Mexico. The SWAP goes farther, however, by identifying conservation actions that could be taken to mitigate threats to SGCNs and their habitats, providing a more in-depth analysis of climate change, analyzing conservation opportunity areas, and refining ecoregion and vegetation classification schemes. The Task Force Project Area is located within the Chihuahuan Desert Level II ecoregion, where a total of 136 SGCNs are identified with birds making up the dominate taxa. The SWAP's most useful feature for project planning is its identification of threats to habitats and associated SGCNs for each ecoregion and detailed proposed conservation actions for those threats. Threats to southwest riparian forest and perennial warm water streams in the Task Force Project Area include agriculture and aquaculture, energy and mining, transportation and utilities, biological resource use, human intrusion and disturbance, natural system modifications, invasive and problematic species, pollution, and climate change.

SECURE Water Act 2016 Report—Rio Grande Basin

The SECURE (Science and Engineering to Comprehensively Understand and Responsibly Enhance) Water Act of 2009 was part of the Omnibus Public Land Management Act of 2009, and it recognizes that climate change poses a significant challenge to the protection of adequate and safe supplies of water. Section 9503 of the SECURE Water Act authorizes Reclamation to coordinate and partner with others to ensure the use of best available science, to assess specific risks to water supply, to analyze the extent to which water supply risks will impact various water-related benefits and services, to develop appropriate mitigation strategies, and to monitor water resources to support these analyses and assessments. Chapter 7 of the report addresses the Rio Grande Basin (Reclamation 2016b). Climate change is affecting water supply, infrastructure, and management practices of the Rio Grande Basin and impacting Reclamation's ability to meet resource needs, including water allocations and deliveries for municipal, industrial, and agricultural use; recreation; fish, wildlife, and their habitats; water quality, including salinity; flow- and water-dependent ecological systems; and flood control reliability. In order to better understand these implications, Reclamation has funded and conducted four studies in the Rio Grande Basin through the Department of Interior's WaterSMART Initiative (https://pubs.er.usgs.gov/publication/70040236). These studies are used to define current and future imbalances in water supply and demand in the basin and subbasins over a long-term planning horizon (more than 50 years) and to develop and analyze adaptation and mitigation strategies to address those imbalances. Partners for the Upper Rio Grande Study (which includes Socorro County) were Sandia National Laboratories and the USACE. Key findings of the report, which was completed in 2013, include a projected increase in temperature with the range of annual possibility widening through time; a projected decrease in mean-annual precipitation, a projected decrease in snowpack; a projected decline in annual runoff; a shift in seasonality of runoff to more rainfall rather than snowpack accumulation; changes in the magnitude of flood peaks; a projected increase in low-flow periods; and a projected decrease in the availability of water supplies. This is all likely to lead to a greater reliance on nonrenewable groundwater resources, which has the potential to impact the Rio Grande and the riparian communities that rely on the shallow groundwater associated with the river.

3.0 EXISTING CONDITIONS AND INITIAL ASSESSMENT

This report provides an assessment of the current hydrology/geomorphology and riparian habitat conditions in the area as well as related wildfire history and risk, wildlife, and threatened and endangered species use in the Project Area.

3.1 SETTING AND SUBREACHES OF PLAN

There are distinct geomorphic reaches of the Rio Grande throughout the Task Force Project Area that have developed as a result of the underlying geology, infrastructure construction, sediment inputs from the numerous tributaries, and changing climate conditions affecting surface water inputs and the Elephant Butte Reservoir pool elevation. While the Project Area has been significantly modified by local anthropogenic factors, the dynamics of the area are also affected by upstream modifications. Construction of upstream dams, a transbasin diversion (the San Juan Chama Project), and operation and then cessation of diversion of flows to the LFCC have affected the peak flows and flow durations in the Project Area. These reaches will have different restoration goals and objectives and different proposed plans and solutions developed in Phase 2.

The Project Area is divided into the following six subreaches, which are shown in Figure 2:

- Reach 1—from the north boundary of Socorro County (RM 140) to the Rio Salado confluence (RM 119)
- Reach 2—Rio Salado confluence downstream to SADD (RM 116)
- Reach 3—downstream of SADD to approximately the Pueblitos Road Bridge in Escondida (RM 102)
- Reach 4—Pueblitos Road Bridge to the south boundary of BDANWR (RM 74)
- Reach 5—from the south boundary of BDANWR to RM 62
- Reach 6—RM 62 to the south boundary of Socorro County (RM 52)

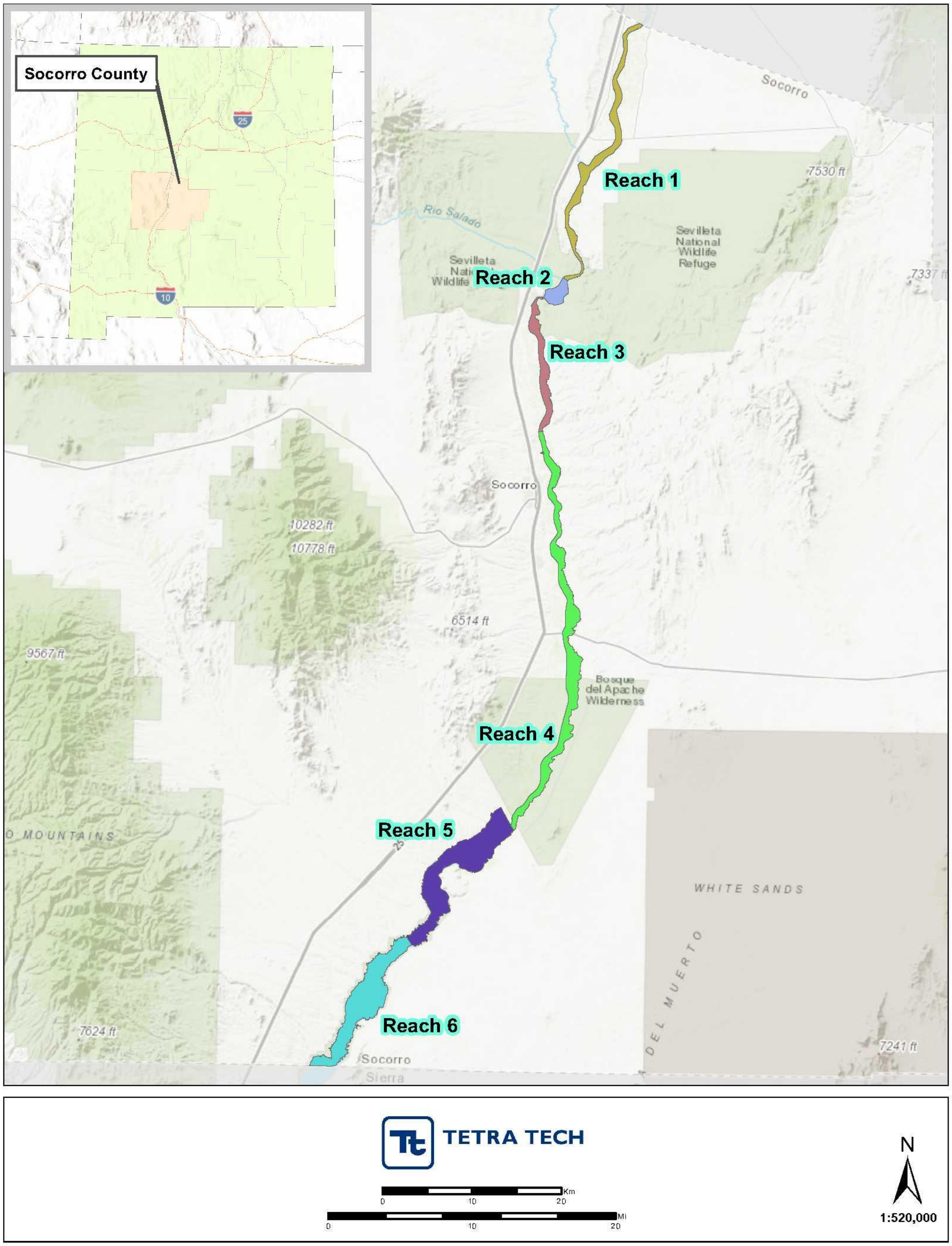


Figure 2. Task Force Project Area and Subreaches.

3.2 WATER AVAILABILITY TRENDS

Rio Grande Compact

In 1938, after years of negotiation, the states of Colorado, New Mexico, and Texas agreed to the Rio Grande Compact (Compact). The Compact is one of the legal cornerstones governing operation of the Rio Grande and its reservoirs above Caballo Dam. It apportions the river water among the three states according to a specified annual delivery schedule that depends on the flow at designated index stations. The Compact is administered by a commission that has a delegate from each state and a nonvoting federal representative.

The Rio Grande Compact apportions the waters of the Rio Grande north of Fort Quitman, Texas, between the states of Colorado, New Mexico, and Texas. This division of the total drainage basin of the Rio Grande was adopted by the Treaty of 1906 between the United States and Mexico and has been used consistently since that time. The adoption of the Compact represented the culmination of a lengthy and sometimes contentious debate among the three states and the federal government over the water resources of the basin (Tetra Tech 2004).

The SECURE Water Act (discussed in Section 2.3) also predicts water availability and describes trends that are considered within implementation of the Compact as well as for planning future water use.

Middle Rio Grande Water Management

Operation of the Middle Rio Grande in the Project Area is guided by these regulations as well as agency authorities and requirements. Upstream water storage facilities include Cochiti Reservoir on the mainstem of the Rio Grande, Heron, El Vado and Abiquiu Reservoirs in the Rio Chama Watershed, and other smaller dams situated on Rio Grande tributaries. These facilities store snowmelt runoff water to meet industrial, municipal, and agricultural needs in the Middle Rio Grande, and provide flood protection, sediment retention and recreation. All of these effect delivery of Rio Grande flows to the project area.

Multiple agencies are involved with Middle Rio Grande water operations including the USACE whose authority is flood control, Reclamation whose authority is water management for Federal Projects and river maintenance, the MRGCD whose authority is irrigation water supply, river control, and subsurface drainage, and NMISC whose authority is water delivery for the Rio Grande Compact. These agencies may also have specific documents in relation to operation, such as Reclamation's Operating Agreement for the Rio Grande Project (Reclamation 2016c) and the 2016 BiOp described above. In addition, municipalities use water from the Rio Grande for water supply and industrial use. Other considerations such as recreational opportunities and limiting river drying are a collaborative effort by multiple agencies and private enterprise. Changes in river channel and floodplain dynamics based upon that operation is described below.

In the last 15 years, water and land managers, regulatory agencies and interested groups have worked together to develop management strategies that allow for flexible water management for multiple goals. The source of Rio Grande flows entering the project reach is a combination of flows coming down the main stem of the Rio Grande from Colorado, inputs from the Rio Chama and contributions from numerous other New Mexico tributaries including the Jemez, Rio Puerco and Rio Salado. Mainstem flows from Colorado are determined by the Rio Grande Compact and are a function of the winter snowpack. The flows entering the Rio Grande from the Rio Chama are also a function of winter snowpack and the Rio Grande Compact and are controlled by releases from Heron, El Vado and Abiquiu Reservoirs. The timing and magnitude of these releases are determined by MRGCD irrigation needs and municipal water users demands. Flows entering from other New Mexico tributaries are mostly unregulated and are a function of the winter snowpack and summer monsoon events.

The winter snowpack in the watersheds of the Upper Rio Grande determines the magnitude of flows in the Rio Grande through the Project Area that year, with average and above average snowpack typically delivering spring runoff flows large enough to exceed the channel capacity resulting in floodplain inundation and channel reworking. In years with below average snowpack there typically are no high spring runoff flows and water management becomes critical as the limited supply is managed to supply irrigation demands while trying to maintain flow in the river or at least control how the river dries to cause the least damage to wildlife.

MRGCD irrigation diversions are from March 1st through October with limited irrigation for the Pueblos continuing through November. There are three irrigation diversion dams in the Middle Rio Grande; Angostura, Isleta, and San Acacia which is within the Project reach. Currently San Acacia is rarely used to divert irrigation water, instead irrigation water for the area historically supplied by San Acacia diversions is diverted farther upstream at Isleta and transported to the San Acacia headworks through MRGCD ditches. This decreases flow in the Rio Grande between Isleta and San Acacia during irrigation season. Another diversion in the Middle Rio Grande is for the Albuquerque Bernalillo County Water Utility Authority which diverts water for municipal use at Albuquerque.

Pump stations are located throughout the Project Area. These are in place in order to pump water from the LFCC into the river thereby using this additional water source as a means of keeping flows connected in the Rio Grande and to reduce channel drying. Since 2000, the Rio Grande has dried at the Bernardo Gage, which is near the upstream end of the project reach, in 12 of the last 21 years and nine of the last ten years.

The Socorro Main Distribution Hub (or Neil Cupp) is located upstream of Hwy 380 at RM 90. Per the Lower Reach Plan (Reclamation 2018). The Hub pump station project withdraws from the Riverside drain and is designed to deliver water to the Mosley irrigation ditch and/or to the river channel. MRGCD will construct a dedicated pumping facility, check structure, and installation of pipelines to direct water to two discharge points. The project will use the existing structure along with a new check structure. The new check structure will optimize delivery to the pump station.

North of the LFCC diversion on the BDANWR, is another set of pumps operated by Reclamation. Another pump station exists at the south boundary of the BDANWR. Improvements to infrastructure are planned at both locations so that more permanent facilities can be provided and the pump stations may be removed.

Water is delivered to Socorro County with 85-90% of the water arriving via drain systems diverted at Isleta Dam and to the Belen drain, which eventually gets to the Unit 7 drain to San Acacia. SADD only delivers about 15% of diversions that arrive through drains.

MRGCD has implemented a Conservation Program over the past 15 years to manage outfall delivery, generate sources of water to be used for habitat restoration, and improve efficiencies (https://www.mrgcd.com/conservation-program-1.aspx). The Program is a comprehensive effort to increase MRGCD 'resilience to variable water supply, and to address new challenges faced by water users.' MRGCD is also working to implement projects with private landowners.

Some examples of Rio Grande water users working together to increase the beneficial use of Rio Grande water include short term storage of water in Cochiti Reservoir which is released at a higher flow to generate a spawning pulse for the Rio Grande silvery minnow (*Hybognathus amarus)* during dry years, and stopping irrigation diversions for several days, again to generate a spawning pulse but also moving water down the Rio Chama at higher flows on summer weekends to benefit rafting. Reclamation works with water users to purchase water for supplemental flows to limit river drying in dry years per the 2016 BiOp.

More recent construction of the San Acacia levee project (USACE 2014) in Socorro also authorized the removal of existing spoil bank levees and replacement with engineered earthen levee that provide protection from the 1% exceedance flood event and include seepage control. Other flood risk management features included a concrete floodwall immediately upstream of the SADD, placement of soil cement embankment downstream from the SADD, riprap protection on the level slope, and revegetation and nonnative species management on disturbed areas. In 2017, approximately 6 miles of engineered levees were completed in Socorro.

3.3 CURRENT HYDROLOGY AND GEOMORPHOLOGY

Rio Grande hydrology has an effect on all the reaches in the Task Force Project Area. It is characterized through the Project Area by a variable spring runoff from snowmelt in the upstream watersheds, summer monsoon events, and periods of channel drying in the summer and fall. Over the past century, there have been major alterations to the hydrology through construction of upstream dams on the mainstem and major tributaries, a transbasin diversion (the San Juan Chama Project), narrowing of the river channel through construction of levees and installation of jetty jacks, and increased urban and agricultural water use. Jetty jacks were installed in the early 1930s to establish and confine the river to a stable channel (USACE 2004).

Recent changes to the hydrology of the Project Area have been predominantly controlled by releases from Cochiti Dam and include the following:

- A decrease in overall volume of water in the river because of drought in New Mexico that started in approximately 2000.
- A decrease in the peak spring runoff flows released from Cochiti Reservoir because of concerns about levee stability.
- An increase in the flows during the low-flow periods of summer and fall to support endangered species.
- Cessation of Reclamation's river maintenance due to compliance with the Endangered Species Act (ESA) changing the geomorphology of the river channel.

The drought in New Mexico has resulted in a decreased spring runoff both in magnitude and duration during most years since 2000. An analysis of flows at the Rio Grande Floodway Near Bernardo Gage (USGS 08332010), which is at the upstream end of the project area, shows how flood events have decreased in the period from 2000 to 2020 when compared to the earlier post Cochiti Dam period 1975 to 2000. The return period flows from 2 years to 50 years are all lower with the greatest percent change in the more frequent return periods.

Table 3. Comparison of Average Daily Flow at Bernardo Gage before and after 2000

AEP	Return Period (yrs)	1975 – 2000 Q(cfs)	2000 – 2020 Q(cfs)
0.5	2	5234	2164
0.2	5	6169	3807
0.1	10	6871	5049
0.04	25	7843	6760
0.02	50	8630	8120
0.01	100	9468	9540
0.005	200	10368	11031

As shown in Table 3, flood events have decreased in the 2000 to 2020 timeframe compared to earlier post Cochiti flows. However, the yearly volume of flow into the Middle Rio Grande, as measured by total flow at the Otowi Gage, has been variable with no consistent trend (see Table 4).

Table 4. Total Yearly Flow at Otowi Gage 2000 to 2018 (1000 ac/ft)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Flow Volume	735	775	539	507	679	1289	656	826	1265	1018
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	
Flow Volume	1018	984	655	643	547	655	863	812	1287	

The decreased peak flows result in a less dynamic channel because of decreases in bank erosion, vegetation scour on islands and bars, and sediment transport. There have been multiple years during this time period when spring runoff flows have decreased to the point at which there is limited overbank flooding or scour of vegetation, allowing the establishment of permanent vegetation. As a result, the trend through the Project Area has been a narrower, deeper channel with increasing vegetation on the bars and islands, and channel incision resulting in less floodplain connectivity. The increase in base flows during dry times to support endangered species, which typically occur during peak vegetation growing seasons, may also contribute to the increase in vegetated bars and islands.

While the Rio Grande hydrology affects all reaches in the Project Area, the other significant driver of change in the past 20 years, the pool elevation of Elephant Butte Reservoir, mainly affects downstream Reaches 4, 5, and 6. During the most recent wet period in the 1980s and 1990s, the reservoir filled, topping 2 million acre-feet of storage in May 1984, and remained close to capacity through 1998. By 2003, it had dropped to below 10 percent of capacity and has remained below 25 percent capacity, with a few minor exceptions, through 2020 to date. As the pool elevation dropped, the delta of the reservoir moved downstream approximately 25 miles, dropping the elevation of the river channel bed. The drop in the reservoir's pool elevation and the corresponding lowering of the river channel bed elevation has caused a headcut to move upstream, resulting in incision of over 11 feet in Reach 6, incision from 11 feet to 2 feet moving upstream in Reach 5, and from 2 feet to zero in the lower part of Reach 4.

Geomorphology and Sedimentation Trends

There have been significant historical geomorphic changes to the Project Area; however, this report focuses on the past 15 years since publication of the Task Force's CRP and the changes that have occurred to the Rio Grande hydrology and river channel and floodplain characteristics and geomorphology in the Project Area during that time.

Breaking the Project Area into individual subreaches enables the differences in channel and floodplain characteristics to be defined and individual reach restoration options to be pursued that fit these specific characteristics. The boundaries of the reaches are generally approximate as the river channel characteristics tend to change gradually. The exception is Reach 2, with definitive boundaries at the Rio Salado confluence and the SADD. The individual reaches have been developed both by natural conditions such as underlying geology, number and size of tributaries, channel slope, vegetation encroachment, and bed and bank material size and cohesion and through constructed facilities such as levees, the SADD, the LFCC, Elephant Butte Reservoir, and the dredged delta channel just upstream of the reservoir pool.

Reach 1 starts at the north boundary of Socorro County and the channel characteristics are a continuation of conditions upstream. From the county line to the Rio Puerco confluence, the channel is wider but narrows between the Rio Puerco and Rio Salado confluences. In the early 2000s, this reach had unvegetated, dynamic mid-channel bars. Since that time, the channel has narrowed as more bars have vegetated and islands have developed. Channel degradation is the prevailing trend, although it is generally limited with good channel floodplain connectivity. It is a sand bed channel. Most of the reach has levees on both sides of the river. The Rio Puerco is the major tributary in the reach, entering on the west side of the river. In addition, there are several smaller arroyos that enter from the east side.

Reach 2 begins at the confluence of the Rio Salado, which contributes substantial coarse sediment to the Rio Grande, creating a natural grade control. This influx of sand, gravel, cobble, and small boulders creates a dynamic reach downstream to the SADD pool with riffles, extensive bank erosion, channel reworking, and small channel evulsions. Bank erosion has widened the channel, creating a new lower elevation floodplain that is inundated during higher flows, but in general the historic floodplain is elevated above the channel bed, which allows for no channel connectivity. The downstream end of the reach is a backwater of the SADD. There is a levee along the west side of the reach, and one arroyo entering on the east side.

Reach 3 begins downstream of the SADD. Because of sediment being trapped behind the dam, this reach is incised with high banks and a coarse-armored bed of gravel and cobble. The effects lessen moving further downstream from the dam, but in general there is very limited floodplain connectivity. As in Reach 2, bank erosion has created a narrow lower elevation floodplain within the historical channel banks. The LFCC begins at the SADD and, while it was in operation from the 1950s to the 1980s, river flow up to 2,000 cfs was diverted from the channel into the LFCC. The resulting decrease in channel flows resulted in channel narrowing and vegetation encroachment on the banks and bars. After flows were returned to the channel the increased flow and narrower channel caused thalweg degradation, comparison of the thalweg elevations from 1990 to 2010 shows and average decrease in thalweg elevation of 5.1 feet for the six miles downstream of SADD (Tetra Tech 2011). There is a levee along the west side of the reach, and several arroyos entering on the east side.

Reach 4 begins at Escondida. Historically this reach was a wide, open channel with dynamic unvegetated bars, but the recent trend has been significant channel narrowing with bars and islands becoming vegetated, causing a loss of channel capacity and a decrease in channel width. Table 4 shows the channel widening slightly from 2005 to 2019 in this reach, the only reach without significant narrowing. While the overall trend of narrowing is occurring in this reach there have been multiple channel widening projects that cause the reach average to show a widening reach. Further analysis is necessary to separate the overall narrowing trend from the widening occurring at select locations. In general, the reach maintains good floodplain connectivity. The channel bed has incised at the downstream end of the reach because of the headcut that moved upstream from Elephant Butte Reservoir when the reservoir pool dropped. The channel is perched above the floodplain in some areas, which has resulted in sediment plugs forming in the Rio Grande. Several times in the late 1990s and in 2005 sediment plugs formed in Reach 5 just upstream of the San Marcial Railroad Bridge. After the headcut from Elephant Butte moved through Reach 5 the channel capacity increased so that plugs no longer formed there and instead began forming farther upstream in Reach 4 in the BDANWR. Plugs formed here in 2008, 2017 and 2019. Recent construction of the BDANWR Channel Relocation Project should prevent sediment plugs at this location in the future.

The channel is predominantly sand bed, and sediment supply in the reach is high due to sediment inputs from arroyos entering from the east. The tributaries supply coarse-grained sediment with deposits that act as grade control where they enter the Rio Grande. There is a levee that runs continuously along the west side of the reach.

The LFCC runs parallel to the river on the west side of the levee. Aggradation in Reach 4 has elevated the channel bed and floodplain so that it is significantly higher than the LFCC. The elevation difference increases moving downstream, from less than five feet at Escondida Bridge to over 10 feet at the south boundary of BDANWR. This difference in elevation has remained constant over the past 15 years, probably due to the decreased flows in the Rio Grande limiting the reach wide aggradation that had been occurring during wetter periods. The elevation difference and the porosity of the sand bed result in high seepage rates from the channel to the LFCC, reducing flows in the channel. Based on a 2018 seepage study there was essentially no seepage from San Acacia to Escondida Bridge, and an average of 6 cfs of seepage to the LFCC from Escondida Bridge to the south boundary, and again basically zero seepage from the south boundary to the LFCC convergence with the Rio Grande (Reach 5) (West 2018).

Reach 5 begins at the south boundary of BDANWR. The reach is a sand bed channel and is historically an aggregational reach that resulted in a wide open channel with unvegetated bars and good floodplain connectivity. However, the lowering of the pool elevation in Elephant Butte over the past 20 years resulted in a headcut moving through this reach, causing channel incision, channel narrowing, lowered groundwater elevation, and greatly reduced floodplain connectivity. Because the floodplain is generally unconsolidated sands and the headcut has dropped the river channel below the root systems of the floodplain vegetation, the banks are easily erodible, resulting in areas of rapid bank erosion and the corresponding development of small areas of new floodplain within the historical channel banks. A levee runs continuously along the west side of the reach, and several small arroyos enter from the east side at the upstream end of the reach. These arroyos do not connect to the river channel. In this reach the Rio

Grande channel is again significantly higher than the LFCC at the upstream end of the reach, with an elevation difference of close to 15 feet in the Tiffany Basin area. However due to the depth of the headcut increasing moving downstream the Rio Grande and LFCC elevations are the same at the lower end of the reach.

Reach 6 begins at the upstream end of a full pool in Elephant Butte and most of the reach was underwater through 1999. As the pool elevation dropped, Reclamation and NMISC dredged a channel through this reach to maintain connection between the Rio Grande and the reservoir; the delta channel. The reach is aggradational, so the channel needs constant maintenance dredging, which prevents any change in channel width. Spoil bank levees built from the dredge material maintain a narrow straight channel with no floodplain connectivity. The floodplain outside of these nonengineered levees has become densely vegetated. The channel is sand bed supplied by sand transported downstream from the reaches above; however, the banks and surrounding floodplain are predominantly fines, deposited when the pool was full. Sediment plugs occasionally form in this reach causing levee breaches, which inundate the surrounding floodplain. Numerous arroyos enter this reach from the west, but none of them connect to the river channel. The LFCC ends at the upstream end of the reach but flows delivered by the LFCC move to the west providing water in large open water areas. These flows reconnect with the Rio Grande farther downstream in the reach.

Table 5 shows the average changes in channel width by reach from 2005 to 2019. These were calculated by selecting one cross section each mile and calculating the width based on 2005 and 2019 aerial imagery.

Table 5. Change in Channel Width by Reach from 2005 to 2019

Change in Channel Width from 2005 to 2019				
	Average Channel Width (ft)		Average Channel Width Difference (ft)	Percent Change in Channel Width
Reach	Year (2019)	Year (2005)	Years (2005 to 2019)	Years (2005 to 2019)
1	187	291	-104	-36%
2	202	273	-71	-26%
3	176	231	-54	-23%
4	248	235	13	6%
5	118	143	-26	-18%
6	157	215	-57	-27%

* Based on one cross section analyzed per mile

Existing Data

Reclamation has collected extensive hydrologic data throughout the Project Area over the past 25 years, including cross-section surveys, channel thalweg profiles, bed material sampling, suspended sediment sampling, and bed load sampling. One example of the extensive data collection is cross section surveys every 1,000 feet from the Highway 380 Bridge in San Antonio to the pool in Elephant Butte, which have been performed every year since 2008. The cross-section surveys are especially relevant for tracking geomorphic changes such as channel widening/ narrowing, bed aggradation/ degradation, channel slope increase/ decrease, and bank erosion. This data is used in conjunction with historical aerial photography and LiDAR data to determine geomorphic trends and for habitat restoration planning.

Hydraulic models of the Rio Grande have been developed within the Project Area. The USACE has developed a mobile bed 1D HEC-RAS model of the Project Area downstream to San Marcial railroad bridge to analyze hydraulic conditions and sediment transport rates. In addition, Reclamation has developed several reach specific hydraulic models within the Project Area. These models are existing tools which can be refined and used for habitat restoration planning at specific sites.

Recommendations for Phase 2

During Phase 2, further compilation of existing data, analysis of existing data, and recommendations for data collection to fill data gaps will be conducted. This includes the analysis of the historic hydrology of the Rio Grande and how climate change scenarios could affect future water flows. These future water flows are fundamental to developing future trends in river channel dynamics but also play an outsized role in the lower reach of the Project Area because of the influence of Elephant Butte pool elevation on the geomorphic characteristics of this reach, and water management as described above. Aggradation and degradation trends in the lower reach will influence both floodplain connectivity and groundwater levels and will be an important consideration in developing modeling scenarios, developing habitat restoration plans, and predicting successful vegetation establishment. Basin-scale hydrology and surface water inflows and management considerations to Elephant Butte, both historical and estimated future scenarios, can be evaluated using the Upper Rio Grande Water Operations Model (URGWOM). URGWOM is a comprehensive surface water model that is used to simulate reservoir and river operations given hydrologic inflows and downstream demands and to estimate Rio Grande Compact annual accounting. Particularly applicable to this work are stochastic hydrology and climate change runs, which can indicate probable storage levels in Elephant Butte Reservoir in the future and water available throughout the year to the reach as a whole. Tetra Tech has developed a mobile-boundary hydraulic model (HEC-RAS v.5.0.6) that includes the Project Area which can be used to simulate river channel hydraulics and aggradation/degradation through time as a function of Elephant Butte storage and climate predictions.

Specific data and analysis for consideration during Phase 2 related to river and floodplain dynamics include the following:

- Analysis of flows and drought
    - Analysis of U.S. Geological Survey gage flow data and drought cycles
    - Analysis of major high spring runoff events (2005, 2019)
    - Analysis of significant monsoon events
- Climate change (change in timing, peak and duration of flows)
    - Further collection of existing tools and analysis of change in timing, peak and duration of flows in consideration of restoration planning
    - A review of the current status of planning tools such as URGWOM and Middle Rio Grande climate change analysis being conducted by the U.S. Forest Service Rocky Mountain Research Station, Reclamation’s Rio Grande Basin Study and others
- Analysis of deviation studies and implementation (Cochiti Reservoir Operations Studies, water operating group flow alteration implementation)
- Geomorphic analysis – collection of all data documented in the geodatabase (and additional information collected), analysis of geomorphic trends in the Project Area and how they have affected previous local habitat restoration projects and lessons learned for new projects

- Groundwater analysis—collection of all data contained in the GDB (and any additional collected data), summary of trends, groundwater modeling development, and use of specific well data for restoration planning
  - 2012 URGWOM and the Riparian Evapotranspiration MODFLOW 2005
- Water depletions—based upon development of data listed above (in the GDB and under Existing Data), analysis of potential water use and depletions for restoration planning

3.4 CURRENT CONDITION OF RIVERINE AND RIPARIAN HABITATS

Restoration Projects Implemented

The Task Force has been instrumental in implementing and facilitating riparian restoration projects implemented in the Project Area. With state and federal funding, the Task Force completed its first private lands restoration projects on 6 parcels on the east side of the river in the small communities of Bosquecito and Pueblito in 1999. Following these projects, the Task Force began its long term partnership with owners of a large ranch along the river north of Bosquecito. This project began in 2006 and included invasive plant control and native plant establishment.

Beginning in 2016, the Task Force established its collaboration with the Service's Partners Program, which provides technical and financial assistance to private landowners in order to restore or enhance fish and wildlife habitat for the benefit of migratory birds and threatened, endangered, or declining species. Since 2016, private land in the Project Area has been restored with support from the Partners Program and others. Rio Grande Agricultural Land Trust was an instrumental partner with the Task Force in completing six projects authorized by the North American Wetland Conservation Act (NAWCA).

One of the larger restoration projects that has been a focus of the Task Force is the Rhodes property. The Rhodes property is approximately 550 acres on the east side of the Rio Grande and includes approximately 2 miles of river frontage. Restoration efforts on this property have focused on: a) restoring willow and cottonwood-willow habitat that would meet specific habitat requirements of the Southwestern Willow Flycatcher *(Empidonax traillii extimus)* (flycatcher), and restore the conditions and processes that would support the long-term persistence of this habitat; and b) establishing a new population of Pecos sunflower (*Helianthus paradoxus)* on the site as well as the conditions and processes that would support the long-term persistence of this population (Keystone Assoc. 2007). Approximately 1,200 acres of this restoration have been completed to date using various funding sources.

The Sevilleta NWR and BDANWR have also been actively restoring and enhancing riparian habitat since before 2004. The Sevilleta NWR has actively been treating saltcedar (*Tamarix* spp.) and Russian olive (*Elaeagnus angustifolia)* as well as resprouts. They have planted riparian trees and shrubs, including cottonwood, Goodding's willow (*Salix gooddingii)*, and coyote willow (*Salix exigua)* in the riparian and upland shrubs such as fourwing saltbush (*Atriplex canescens)* and screwbean mesquite (*Prosopis pubescens)* in drier habitats. BDANWR has been engaged in similar riparian and near-upland restoration projects. Work completed here has occurred both inside and outside the levee, has improved overall ecosystem health, and improved the knowledge base of restoration practices. Since the 1980s, the Service has completed several vegetation management and habitat enhancement projects at BDANWR. Over 4,000 acres of floodplain forest and wetlands have been restored. During 2015, 2016, and 2018, fuel breaks were constructed, nonnative invasive saltcedar and Russian olive were removed, and native vegetation was allowed to naturally regenerate. The goal of this work was to improve and increase the amount of native riparian habitat available for all wildlife including sensitive species, the flycatcher, and Yellow-billed Cuckoo (*Coccyzus americanus)* (cuckoo). Additional work includes nonnative species removal and planting of native species following fires and partnering with Reclamation to widen and realign the Rio Grande channel to improve habitat for endangered species.

Reclamation manages the Rio Grande and delta area of Elephant Butte Reservoir within the Project Area and has engaged in riparian restoration activities in partnership with the NMISC, the Service, New Mexico State Forestry, private landowners, and the Task Force. Work in the reach has primarily focused on maintaining the river channel, improving endangered species habitat, and addressing flood control. Reclamation has completed a number of riparian habitat restoration projects in the Task Force Project Area by removing dead or nonnative vegetation and replacing it with native vegetation, planting native vegetation in burn scars, and reconnecting floodplain and river habitat.

New Mexico State Forestry has been instrumental in treating nonnative vegetation in the Project Area to address the risk of wildfire on both private lands as well as on lands owned by NMDGF and New Mexico Institute of Mining and Technology. Management activities have included reducing hazardous fuels and creating residential defensible space by removing dead and burned material as well as saltcedar and Russian olive. One of the larger nonnative species treatment projects conducted in the county was the Severance Project, which totaled 648 acres. This work occurred between approximately RM 104 and RM 90 on land managed by MRGCD and Reclamation on the west side of the river and is referred to as the Central Socorro Bosque project. Riparian bosque habitat was restored using money appropriated by the New Mexico State Legislature. Most of the other treatment projects were conducted with the Socorro SWCD or under the Service's Partners Program. Socorro County has completed planning for additional treatments, especially on private lands, and is coordinating efforts for funding for project implementation.

The NMISC has implemented restoration projects along the Rio Grande within Socorro County in 2016 (SWCA 2016). Five habitat restoration projects were constructed above the SADD and five below it. The restoration sites are managed by Reclamation and MRGCD. The projects benefit the silvery minnow, flycatcher, and cuckoo.

Additional restoration projects completed by others are discussed in Section 2.3 and supporting data are provided in the GDB.

Fire Recurrence

Fire has not historically been a major driver of low-elevation riparian vegetation in the Southwest. However, the widespread proliferation of saltcedar, the presence of the tamarisk leaf beetle (Diorhabda spp.) (TLB), other stressors such as drought, and an increase in human-caused ignitions have promoted an increase in fire frequency and severity (Smith and Finch 2017).

Table 6 lists the fires that have occurred within the Project Area since 2004, which have burned over 19,000 acres. While 2017's Tiffany Fire in Reach 5 was ignited by a lightning strike, the other listed factors led to the largest fire seen in the Project Area or throughout the Middle Rio Grande of New Mexico, in the last 20 years. The recurrence interval on these large catastrophic fires is approximately every 10-12 years.

Table 6. Fires Since 2004 in the Project Area

Fire name (data source)	Year	Approximate acres
Reach 1		
Bernardo Fire (1)	2004	202.1
Sevilleta Fire (1)	2011	2,775.1
North Fire (4)	2012	483.8
Reach 2		
None		
Reach 3		
Escondida (5)	2016	524
Reach 4		
Unnamed fire (2)	2004	8.5
Unnamed fire (2)	2004	12.7
Mitchell Fire (2)	2005	879.3
Bosquecito Fire (2)	2006	506.2
Marcial Fire (2)	2006	3,565.3
Pasqual Fire	2015	700
Brown Fire (3)	2016	177
Reach 5		
Tiffany Fire (4)	2017	9,199.8
Reach 6		
None		
Approximate Total Acres Burned		**19,033**

Notes: Data sources in the GDB: 1: mrgcd_known_fire_perimeters layer; 2: fires_various layer; 3: brown_20160330 layer; 4: GeoMAC Wildfire Viewer 5: Reclamation Lower Reach Plan.

Native cottonwood and willow are poorly adapted to fire and lack an efficient post-fire resprouting mechanism such as those found in saltcedar (Sher and Quigley 2013). A large loss of cottonwood gallery forest has occurred over time due to these fires. Post-fire vegetation growth is highly dependent on specific site conditions. Post-fire soils have significantly higher salinity than unburned soils, which might suppress the growth of cottonwood and willow seedlings if saturated soils are present when seeding occurs and allow saltcedar seedings to proliferate (Sher and Quigley 2013). On the other hand, following the 2017 Tiffany Fire in Reach 5, early observations suggest that site conditions are conducive to native willow and cottonwood resprouts rather than saltcedar. For this reason, local soil and hydrological conditions must be carefully considered in post-fire vegetation restoration efforts.

Tamarisk Leaf Beetle

The TLB was released by the U.S. Department of Agriculture in 2001 as a biocontrol agent to manage saltcedar in riparian areas in the western United States. TLB biocontrol of saltcedar occurs through repeated defoliation events that ultimately results in full or partial mortality of saltcedar stands and effective suppression. Defoliation effects also initiate changes in overall plant community composition and structure, with consequential impacts to habitat structure, wildlife population dynamics, and riparian ecosystem function. TLB biocontrol is viewed as an effective method for suppressing invasive saltcedar at a landscape scale; however, the use of the beetle as a biocontrol agent produces contradictions in ecosystem function and management objectives. For example, biocontrol of saltcedar might result in reduced plant species diversity (Harms and Hiebert 2006), secondary invasions of other exotic plant species (González et al. 2017), and reduced habitat suitability for wildlife (Bateman and Johnson 2015). Moreover, it has been assumed using TLB as a biocontrol might render post-treatment mechanical or chemical treatments unnecessary. Such presumptions, however, erroneously depict riparian successional processes under anthropogenically modified floodplain settings (DeLoach et al. 2000).

TLB arrived in the upstream end of the Project Area in approximately 2013 and has been steadily dispersing south (RiversEdge West 2018). A separate study of TLB in the Rio Grande between Escondida and San Antonio (approximately Reach 4 for this Project) indicates that the northern tamarisk beetle (*D. carinulata*) arrived in Reach 4 in 2015, and both the subtropical beetle (*D. sublineata*) and Mediterranean beetle (*D. elongata)* arrived in summer 2017. This particular area was targeted as a potential convergence of the three species, but implications of that activity are not yet known (Tetra Tech in press(a)). Vegetation monitoring in Reach 4 indicates the proportion of understory saltcedar that is dead or dead on live suggests saltcedar-dominated areas might shift to a different species composition over time or might be undergoing self-thinning and self-pruning, a normal process in very dense forests. This shift may be induced or accelerated by the presence of TLB and associated defoliation events and effective saltcedar suppression in the sampled locations. Under altered hydrologic conditions in which cottonwood-willow regeneration is reduced, the proportion of Russian olive may increase in TLB-impacted stands. Vegetation successional patterns in altered floodplains are of particular concern for land managers and these baseline results can provide a means of comparison as vegetation structure, composition, density, and regeneration shift under disturbance factors such as TLB and altered hydrologic and floodplain conditions (Tetra Tech in press(a)).

Vegetation Class Diversity

The vegetation classification system used throughout the Middle Rio Grande is the methodology developed by Hink and Ohmart (1984), which identifies six community structure (CS) types and is used to characterize major riparian habitat types. An update to the classification is conducted every 4 years by Reclamation. The original dataset was collected in 1984, was updated in 2002, and has been updated every 4 years since 2008.

Five vegetation types were derived from Hink and Ohmart vegetation mapping data: native, mixed native and nonnative, open, exotic, and saltcedar (Reclamation 2016a). Open water is also noted in reaches 4–6. Hink and Ohmart vegetation was evaluated based on species codes, which were spatially delineated based on each reach. Pure native stands contained no exotic species codes. Mixed stands contained both native and exotic species codes, exotic types contained a variety of non-native species codes. Saltcedar was identified as the leading Hink and Ohmart species code with no other co-dominant species within each stand.

Only data for Reaches 1 and 2 are available for all years. Data for 2002 and 2016 (see Appendix D for maps) are available for the remaining reaches, except Reach 6. An analysis of the four datasets available since 2002 (2002, 2008, 2012, 2016) was conducted for Reaches 1 and 2 and provided in the graphs below (Figures 3 and 4).

Reach 1 (Figure 3) shows a fairly steady increase in both native and mixed stands from 2002 to 2016, with the change being attributed to exotic and saltcedar removal. There was a slight increase in native and mixed to exotic and saltcedar from 2002 to 2008, but this was reduced again by 2012.

In **Reach 2** (Figure 4), the percentage of native stands remain low, but mixed stands have increased over time. Saltcedar has been reduced by over 40 percent in this reach.

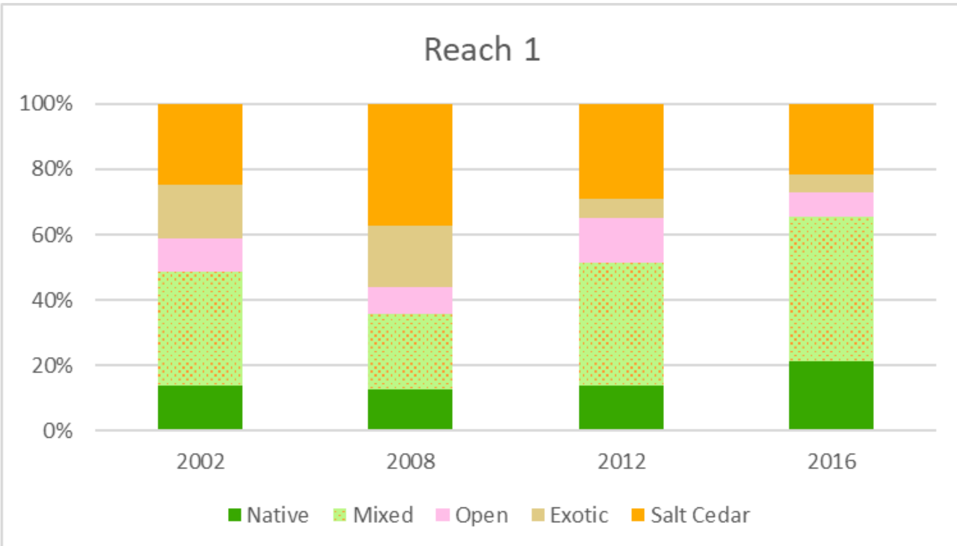


Figure 3. Reach 1 Hink and Ohmart Vegetation Change.

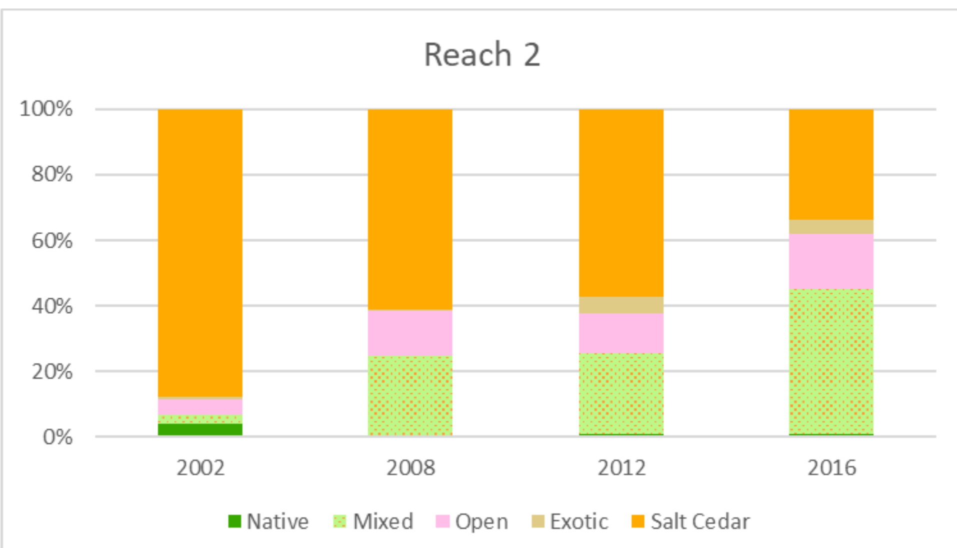


Figure 4. Reach 2 Hink and Ohmart Vegetation Change.

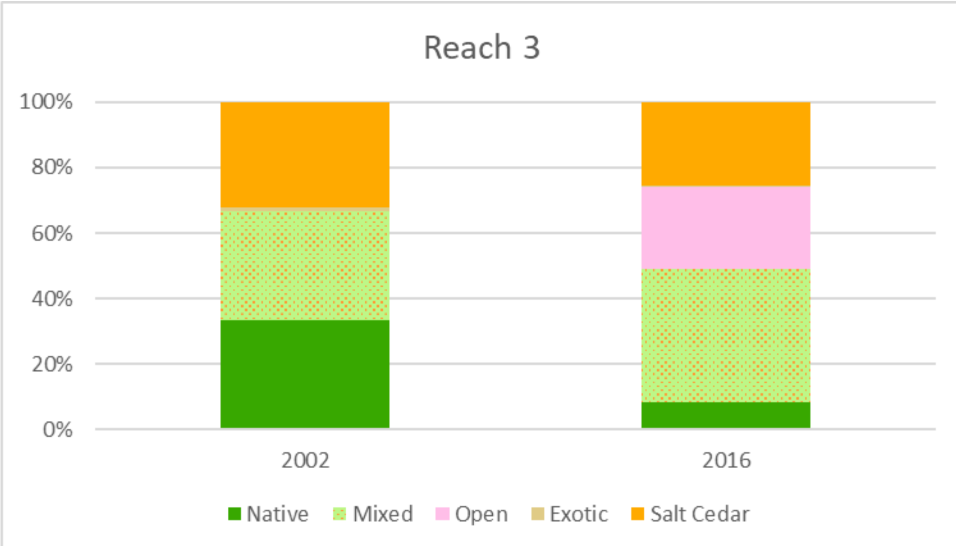


Figure 5. Reach 3 2016 Hink and Ohmart Vegetation.

Reach 3 (Figure 5) has almost a 50-50 split of native/mixed and exotic/saltcedar.

Reaches 4–6 (Figures 6–9) all show a portion of open water that is not present in the previous reaches. These open water areas are interior to each reach (within the floodplain, not riverine open water) and are due to the open water areas present at BDANWR and the Tiffany Basin area.

Reaches 4 and 4a (Figure 6-7) shows a decrease in saltcedar, increase in mixed stands and decrease in native stands which could all be attributed to fires (and saltcedar removal projects) in that reach during that time.

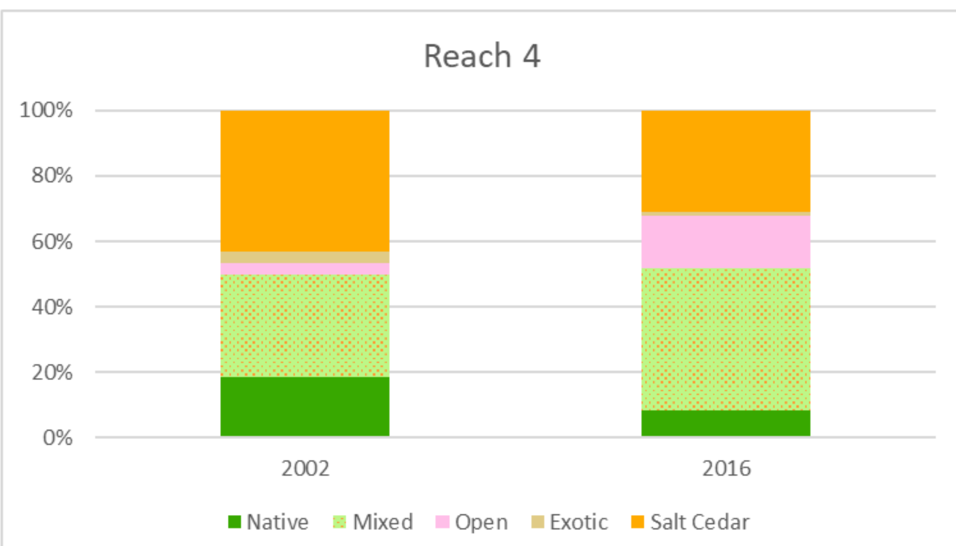


Figure 6. Reach 4 2016 Hink and Ohmart Vegetation.

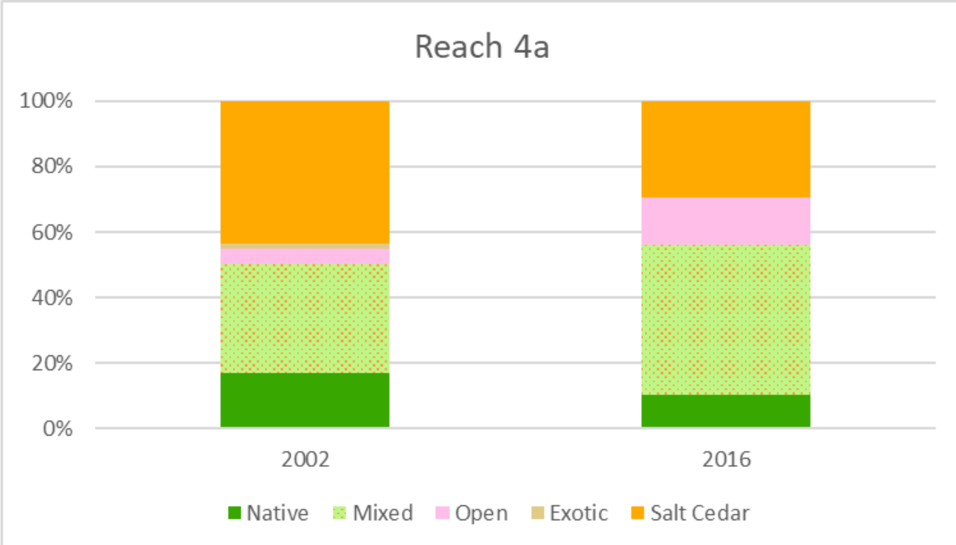


Figure 7. Reach 4a 2016 Hink and Ohmart Vegetation.

Reach 5 (Figure 8) shows and increase in saltcedar, and a decrease in mixed stands. This could be attributed to saltcedar invasion during this time (and is prior to the Tiffany fire that has affected that proportion). Based upon field investigation of the Tiffany fire project area, previously native and mixed stands and returning as such with additional mixed, open and even meadows habitat (Tetra Tech in press(b)). Saltcedar patches were burned with high severity and are resprouting as saltcedar or mixed stands.

Reach 6 (Figure 9) has approximately 40 percent each native/mixed and saltcedar, with the rest being open (almost 20 percent) and open water (~5 percent).

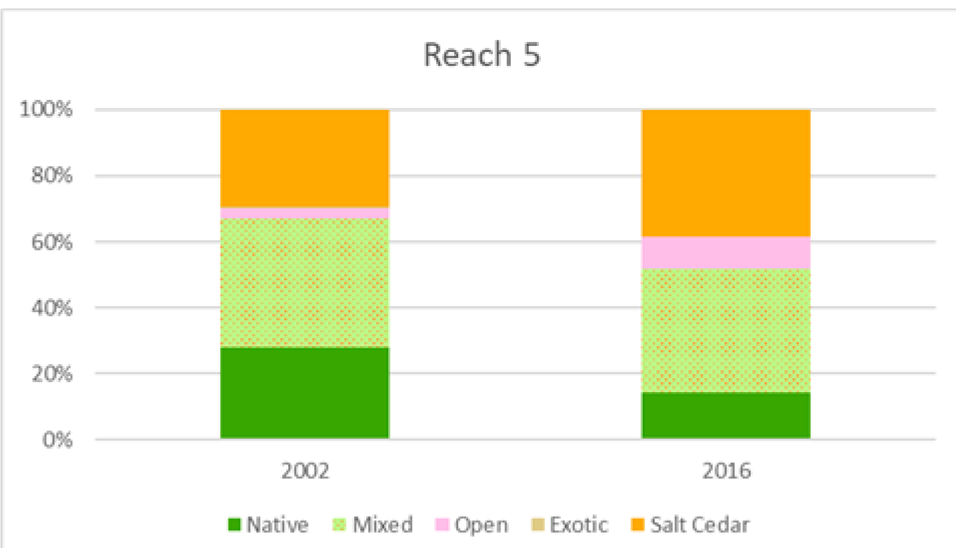


Figure 8. Reach 5 2016 Hink and Ohmart Vegetation.

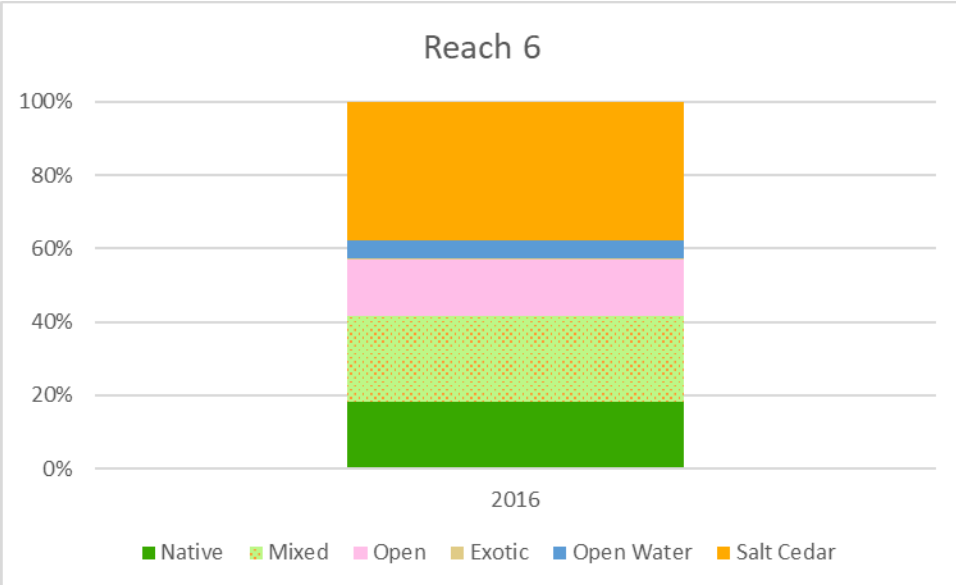


Figure 9. Reach 6 2016 Hink and Ohmart Vegetation.

In addition to the Hink and Ohmart analysis conducted above, this data was used to aid in updating data for the MRG-CAP for Socorro County from 2012 to 2016. The MRG-CAP planning team includes a riparian and wetland communities group that is working on updating the dynamic patch mosaic (DPM) measurements for the MRG-CAP study boundaries. The use of the 2012 and 2016 data was utilized to update DPM measurements for the Socorro County reach. Both the Task Force and Tetra Tech are working together on this analysis and will continue to coordinate with the MRG-CAP planning team.

Recommendations for Phase 2

A high-accuracy CS vegetation map of the area will be developed by refining the 2016 High and Ohmart vegetation mapping product. Through image segmentation processing of high-resolution 2017 Pleiades imagery, dominant overstory species can be extracted and 2010 LiDAR (or the most recent available with full Project Area coverage) point cloud data can be used to model canopy height and density. An existing conditions vegetation map can then be developed by overlaying CS classification, Landsat and Sentinel satellite imagery, and targeted field investigations to assess vegetation components within project areas. The existing conditions mapping will enable identification of areas that are on a successional pathway to native system recovery and of areas where the successional trajectory is biased towards exotic species dominance.

Restoration planning and revegetation efforts will include site moisture availability (including consideration of intra-annual and interannual groundwater variation) and appropriate species selection appropriate for these settings. Floodplain salinity is an important site factor that might limit suitable plant species in the areas. Of concern in sites dominated by *Tamarix* monocultures for extended years is the lack of mycorrhizal fungi, which limit survivorship of native plants in restoration areas. Sites formerly dominated by *Tamarix* might require mycorrhizal inoculum to support the competitive ability of native plant species.

These and other factors will be overlaid with existing and project-specific site condition datasets. A weighted GIS analysis might be included to identify desired site conditions for varied restoration treatments. This dataset will be used to identify specific restoration actions and integrated with other project goals to be evaluated (including benefits for threatened and endangered species, but also all wildlife).

3.5 ENDANGERED SPECIES HABITAT OCCURRENCE AND TRENDS IN OCCUPIED HABITAT

A review of the Service's Information for Planning and Consulting (IPaC) database, the Biota Information System of New Mexico (BISON-M), and the New Mexico Rare Plants website identified a federally and state-listed species for Socorro County (Service 2019a; BISON-M 2019; NMRPTC 1999). Federally and state-listed threatened and endangered species with the potential to occur in the Project Area also were identified (Table 7). Federally listed species with the potential to occur, and that have been documented to occur, in the Project Area are addressed in detail following the table.

Table 7. Federally and State-Listed Species for Socorro County, NM

Common name	Scientific name	Federally listed (with critical habitat?)	State listed	Potential to occur
Birds				
Aplomado Falcon	*Falco femoralis*	E	E	
Baird's Sparrow	*Centronyx bairdii*		T	
Bald Eagle	*Haliaeetus leucocephalus*		T	X
Bell's Vireo	*Vireo bellii*		T	X
Brown Pelican	*Pelecanus occidentalis*		E	
Common Black Hawk	*Buteogallus anthracinus*		T	X
Common Ground-Dove	*Columbina passerina*		E	X
Gray Vireo	*Vireo vicinior*		T	
Least Tern	*Sternula antillarum*	E	E	
Mexican Spotted Owl	*Strix occidentalis lucida*	T (CH)		
Neotropic Cormorant	*Phalacrocorax brasilianus*		T	
Peregrine Falcon	*Falco peregrinus*		T	
Piping Plover	*Charadrius melodus*	T	T	
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	E (CH)	E	X
Varied Bunting	*Passerina versicolor*		T	X
Violet-Crowned Hummingbird	*Amazilia violiceps*		T	
Yellow-Billed Cuckoo (western pop)	*Coccyzus americanus occidentalis*	T		X
Mammals				
Meadow Jumping Mouse	*Zapus hudsonius luteus*	E (CH)	E	X
Mexican Gray Wolf	*Canis lupus baileyi*	E	E	
Oscura Mountains Colorado Chipmunk	*Neotamias quadrivittatus oscuraensis*		T	
Spotted Bat	*Euderma maculatum*		T	X
Fish				

Common name	Scientific name	Federally listed (with critical habitat?)	State listed	Potential to occur
Rio Grande Silvery Minnow	*Hybognathus amarus*	E (CH)	E	X
Herptiles				
Chiricahua Leopard Frog	*Lithobates chiricahuensis*	T (CH)		
Western River Cooter	*Pseudemys gorzugi*		T	
Invertebrates				
Alamosa Springsnail	*Pseudotryonia alamosae*	E	E	
Chupadera Springsnail	*Pyrgulopsis chupaderae*	E (CH)	E	
Socorro Isopod	*Thermosphaeroma thermophilum*	E	E	
Socorro Springsnail	*Pyrgulopsis neomexicana*	E	E	
Plants				
Dune Pricklypear	*Opuntia arenaria*		E	
Pecos Sunflower	*Helianthus paradoxus*	T	E	X
Wright's Marsh Thistle	*Cirsium wrightii*	C	E	

Notes: C = candidate; CH = designated critical habitat; E = endangered; T = threatened.

Southwestern Willow Flycatcher

The flycatcher was listed as endangered in February 1995 (60 FR 10694, February 27, 1995). Critical habitat was finalized in 2013 (78 FR 343, February 4, 2013), and the Project Area is wholly contained within the MRG Management Unit within the Rio Grande Recovery Unit. The flycatcher is an obligate riparian species and nests in thickets associated with rivers, streams, and wetlands where dense growth of willow, Russian olive, saltcedar, or other plants are present (Finch and Stoleson 2000).

Presence in the Project Area

Reclamation personnel have conducted presence/absence surveys and nest monitoring for the flycatcher during the May–July survey season within the Rio Grande Basin since 1995. Presence/absence surveys based on established survey protocols are conducted to determine the distribution and abundance of the endangered flycatcher during the relatively brief breeding season when it becomes a seasonal resident of the southwestern United States. Because of the detailed survey data available, flycatcher presence and the presence of suitable habitat will be addressed reach by reach.

Reach 1

Most sites within Reach 1 are bounded by an extensive levee system on each side. The majority of habitat in this reach consists of a mix of cottonwood (*Populus deltoides*) gallery, with sparse saltcedar, Russian olive, and/or coyote willow understory. Suitable flycatcher habitat is patchy and consists primarily of developing stands of willows and Russian olive on lower terraces and recently established river bars. While the overall flycatcher population has been slowly growing north of the reach since pairing was first documented in 2005, only one mating pair was documented during 2017 and 2018 surveys in a cottonwood-Russian olive/coyote willow vegetation community adjacent to the Rio Grande.

Reach 2

The river channel within Reach 2 is contained by levees on both the east and west sides but is extremely active within the floodplain due to the high sediment loads brought in by the Rio Salado. Habitat ranges from highly suitable flycatcher habitat composed of coyote willow and Russian olive along the banks of the river to overstory cottonwood gallery and sparse, decadent saltcedar. On lower terraces and river bars, moderate overbank flooding occurs during high-flow events. Based on 2016 habitat mapping/modeling, 895 acres of suitable or moderately suitable habitat are located within this reach. Either coyote willow, Russian olive, or young cottonwood was the dominant vegetation feature in occupied habitat during 2017 and 2018 surveys. No mating pairs were documented within vegetation communities with a significant saltcedar component.

Reach 3

Habitat within Reach 3 is dominated by dry, decadent exotic vegetation in the form of saltcedar and Russian olive with an occasional cottonwood overstory. Quality flycatcher habitat within this reach is very limited—only 516 acres were mapped in 2016—and composed of small patches of native vegetation along the river channel. Very little overbank flooding occurs due to the degraded nature of the river channel. Sporadic high river flows during the past several years combined with the formation of river bars and lower terraces have resulted in reestablishment of riparian vegetation, both native and exotic, along these bars and terraces, but they have not resulted in increased utilization from the flycatcher. No territorial flycatchers were documented in this reach between 2010 and 2018. Due to the limited habitat within this reach, it is unlikely that a substantial number of flycatcher territories will become established here in the near future without restoration treatment or changes in hydrologic conditions.

Reach 4

Habitat within Reach 4 varies widely from decadent, dense saltcedar to large, mature cottonwood galleries to dense patches of coyote willow and Russian olive. High aggradation and sediment plugs cause major portions of the active floodplain to be inundated during high flows. Although ephemeral in nature, sediment plug formation enhances flycatcher habitat value within the reach when it occurs. Flooding of existing habitat increased suitability for breeding flycatchers between 2008 and 2010. Subsequently, multiple years of extreme drought eliminated overbank flooding and drew down the water table. Much of the native component of the occupied habitat in this reach was either severely stressed or died between 2010 and 2013. Recently, however, native vegetation has begun to recover in certain areas and, in 2017, high river flows and the sediment plug covered the floodplain with as much as 10 feet of water. A total of 873 acres of suitable flycatcher habitat was mapped within this reach in 2016, but channel realignment activities at BDANWR will likely dramatically shift the hydrologic and vegetation conditions of this reach as well as the reaches downstream of it. Although small in number, resident flycatcher mating pairs have consistently used this reach since 2002.

Reach 5

Much of the habitat in Reach 5 was burned by the Tiffany Fire, which began on June 26, 2017. Prior to the fire, vegetation in this reach consisted primarily of various age classes of saltcedar with occasional patches of Russian olive and native willows and cottonwoods, particularly near the river. A large, dry marsh also exists at the foot of Black Mesa, upstream from the railroad trestle. Portions of this reach receive overbank flooding during high river flows, and a sediment plug in the southern end of this reach in both 2005 and 2008 forced river water through habitat in the southern end.

Reach 6

More flycatcher territories occur within Reach 6 than in all the other reaches in the Project Area combined. Habitat in this reach consists of some of the best native flycatcher habitat within the subspecies' range. Vast expanses of native Goodding's willow and coyote willow habitat formed in the conservation pool of Elephant Butte Reservoir as the reservoir receded during the late 1990s and early 2000s. This habitat, located primarily on the west side of the floodplain, is irrigated by the LFCC outfall, which filters through the interspersed patches of willow, saltcedar, and cattail (*Typha* sp.) marsh. River channel degradation through the reach in 2005 lowered the water table in this reach, which negatively impacted suitable flycatcher habitat.

Habitat Needs and Habitat Restoration Potential

Flycatcher nests are frequently associated with an overstory of scattered cottonwood. Throughout the flycatcher's range, these riparian habitats are now reduced, widely separated, and occur in small and/or linear patches. Flycatchers nest in thickets of trees and shrubs approximately 623 feet in height or taller, with a densely vegetated understory approximately 12 feet or more in height. Surface water or saturated soil is usually present beneath or adjacent to occupied thickets (Muiznieks et al. 1994). Habitats not selected for nesting include narrow (less than 30 feet wide) riparian strips, small willow patches, and stands with low stem density (Service 2002). Areas not used for nesting may still be used during migration (Yong and Finch 1997). The two greatest ongoing threats to flycatchers in the MRG are the decline in the quality of critical nesting habitat related to the current prolonged drought conditions and reduced annual water supply, currently thought to be due to climate change, and to the invasion of TLB, which causes loss of important nesting substrate and opens the nesting canopy habitat to produce nest failure. In some areas, nest predation by the brown-headed cowbird (*Molothrus ater*) can be a third threat.

Recommendations for Phase 2

In 2018-2019, USACE and the Collaborative Program conducted an evaluation of potential flycatcher habitat restoration projects (Tetra Tech in press; 2015). Potential priority locations were identified within the Project Area. It is recommended that this information, along with the evaluation of potential habitat based upon the Hink and Ohmart vegetation type (Reclamation 2017) and more recent survey data (2019–2020), be evaluated in Phase 2. Data from 2004–2016 has also been requested for the Project Area and can be evaluated for past use and what the riverine and riparian habitat conditions were during that use (e.g., flow, vegetation, and so forth). The Collaborative Program has also been developing Conceptual Ecological Models (CEMs) for each of the listed species. The latest version of this information will be used for analysis during Phase 2.

Rio Grande Silvery Minnow

The silvery minnow was listed by the Service as endangered in 1994 because of widespread decline of the species' range (59 FR 36988, July 20, 1994). The listing also cited the presence of mainstream dams; growth of agriculture and cities in the Rio Grande Valley; overutilization for commercial, recreational, scientific, or educational purposes; disease or predation, particularly during periods of low or no flow; inadequacy of existing regulatory mechanisms, including the lack of recognition that instream flows are a beneficial use of state waters; and dewatering of a large percentage of its habitat, including dewatering downstream from San Acacia, as threats to the continued survival of the species. The silvery minnow prefers habitats of moderate depth with low velocities over sand and silt substrates. Designated critical habitat for the silvery minnow extends from Cochiti Dam to the full pool at RM 62 (68 FR 8088, February 19, 2003), including the entire Project Area. The recovery plan was updated in 2010 (Service 2010) and no species status assessments have been published.

Presence in the Project Area

Population data on silvery minnow and the associated ichthyofaunal community in the entire Middle Rio Grande have been gathered since 1987. These population monitoring surveys provide an assessment of recruitment over short time periods, a basis for comparing the changes in recruitment success over the years, and timely information about the status of the species during periods of reduced abundance and could be used to assess seasonal survivorship (Dudley et al. 2018). Platania (1993) conducted the first studies (1987–1992) to determine spatial and temporal changes in the Middle Rio Grande ichthyofaunal community and to provide resolution of species-specific habitat use patterns. Sampling efforts during 1989 and 1990 revealed that silvery minnow population numbers had declined markedly since 1987 (Platania 1993), supporting the need for listing under the ESA.

Annual population monitoring from the Angostura Diversion Dam in Sandoval County to below the San Marcial railroad bridge in Socorro County has consistently found that occurrence and density of silvery minnows is highest in the furthest downstream reaches of the Rio Grande (Dudley et al. 2018), which is in the Project Area. Pronounced changes in the occurrence and density of silvery minnow since at least the early 2000s appear to be closely related to the duration, magnitude, and timing of river flows during spring and summer (e.g., spring spawning and sustained summer flows) (Dudley et al. 2018). Because of limitations of the survey methodology and much that is still not understood about the biology of the silvery minnow, it is difficult to identify with any certainty trends in population since 2004 in the Project Area. As of 2018, Reclamation surveys have confirmed the persistence of the silvery minnow in the Rio Grande within the Project Area (Dudley et al. 2018).

Habitat Needs and Habitat Restoration Potential

Silvery minnow are pelagic spawners, producing numerous semi-buoyant, non-adhesive eggs. Most spawning typically has been observed in the spring, from late April through June, accompanying the period of snowmelt runoff (Reclamation 2012). Spawning also has been observed during some runoff events following summer monsoons. Both juvenile and adult silvery minnow primarily use mesohabitats with moderate depths (15–40 centimeters), low water velocities (4–9 centimeters per second), and silt/sand substrates. Successful recruitment appears to be linked with sustained elevated spring flows (1–2 months) that allow for longer term inundation of nursery habitat, necessary for growth through early larval stages (Dudley et al. 2017). During winter months, these silvery minnows become less active and seek habitats with cover such as debris piles and other areas with low water velocities. During spring sampling, large concentrations of reproductively mature silvery minnow are often collected on inundated lateral overbank habitats (Hatch and Gonzales 2008). Surveys of inundated overbank habitats often have captured large numbers of gravid females and ripe male silvery minnows (Gonzales and Hatch 2009).

Analysis of potential habitat at two locations in the Project Area using a FLO 2D model across a range of flows indicates that the area around Bosque del Apache contains the highest quality feeding and rearing habitat and highest quality spawning and egg/larval retention habitat compared to model locations in the Albuquerque and Isleta reaches (Tetra Tech 2014). Farther downstream at San Marcial, however, there is relatively little highest quality feeding and rearing or highest quality spawning and egg/larval retention habitats and, as flows increase, they drop off precipitously because of the lack of channel complexity (Tetra Tech 2014).

An evaluation of potential restoration projects within the Project Area was conducted in the San Acacia Reach Analysis and Recommendations (Parametrix 2007); the Lower Reach Plan (Reclamation 2018); and planning documents from the Sevilleta NWR (Service 2000, 2015) reports described in Section 2.3.

Recommendations for Phase 2

Population data being collected will be evaluated. The Collaborative Program CEMs for silvery minnow will also be used for analysis during Phase 2. The previous evaluation of potential habitat for silvery minnow (Tetra Tech 2014) can also be reviewed to provide potential updated specific recommendations for data collection and analysis to identify potential habitat during Phase 2.

Yellow-Billed Cuckoo

The western distinct population segment of Yellow-Billed Cuckoo was listed by the Service as threatened in 2014 (79 FR 59992, October 3, 2014) and critical habitat was proposed at that time. Since then, the public comment period on proposed critical habitat has been reopened twice (Service 2014b; 85 FR 11458, February 27, 2020). There is no designated critical habitat at this time. The cuckoo is an obligate riparian species occurring in scattered locations in the western United States during the breeding season. Threats to the cuckoo include a decrease in habitat availability and suitability from loss and degradation of riparian habitat and habitat regeneration. Major factors contributing to habitat loss are the disruption of hydrological processes necessary to maintain a healthy riparian system, including fluctuating reservoir levels, poorly managed grazing, development activities, extractive uses, expansion of nonnative vegetation, and uncontrolled wildfire.

Presence in the Project Area

Reclamation personnel have conducted presence/absence surveys for the cuckoo during the June–August survey season within the Rio Grande Basin since 2006 from Isleta Pueblo south to Elephant Butte Reservoir. Presence/absence surveys based on established survey protocols are conducted to determine the distribution and abundance of the threatened cuckoo during the breeding season, when they are present in the southwestern United States.

Cuckoo detections and territories have consistently been documented in each of the six reaches identified in the Project area with much higher numbers at the furthest downstream end of the reach (Dillon et al. 2019). The area identified in the Reclamation surveys as the San Marcial Reach extends from RM 68.5 to RM 31.5 and represents the furthest downstream end of Reach 5 and all of Reach 6 for this Project. The San Marcial Reach has maintained a fairly large and consistent population of cuckoos since 2009, ranging from 49 to 70 territories annually (Dillon et al. 2019). The Escondida Reach (RMs 104–84) and BDANWR Reach (RMs 84–74) jointly correspond with the Project Area’s Reach 4, and these reaches also have consistently high numbers of detections and territories, although not nearly as high as San Marcial (Dillon et al. 2019).

Habitat Needs and Habitat Restoration Potential

The cuckoo nests almost exclusively in low-to-moderate elevation riparian woodlands with native, broadleaf trees and shrubs that are at least 50 acres in size and at least 325 feet (100 meters) in width (79 FR 59992, October 3, 2014). Mature cottonwood forest with well-developed willow understory appears to be an important characteristic of habitat for the cuckoo (Buffington et al. 1997; Gaines and

Laymon 1984). While willows appear to be a preferred nest tree, the species will also nest in dense saltcedar stands. In addition, as the proportion of saltcedar increases, the suitability of the habitat for cuckoos decreases, and sites with a monoculture of saltcedar are unsuitable for breeding cuckoos (Service 2014b). Fire is also a threat to cuckoo breeding habitat (78 FR 61621, December 2, 2013). Because of the loss of habitat, cuckoos now breed in small, isolated populations. These populations are increasingly at risk for further declines as a result of increased predation rates, lack of abundance of prey, migratory obstacles (e.g., weather events, collision with structures, and so forth), conversion of habitat from native to exotic vegetation, defoliation of saltcedar caused by TLBs, increased fire risk, and climate change (Thompson 1961; Wilcove et al. 1986). Riparian habitat restoration activities in the Project Area would be conducive to enhancing and maintaining habitat for the cuckoo.

Recommendations for Phase 2

Reclamation conducted an evaluation of the habitat potential for the cuckoo similar to the evaluation of potential flycatcher habitat using Hink and Ohmart vegetation types (Reclamation 2018). Those data along with recent and more historic survey data will be evaluated in Phase 2. The data have been requested for the Project Area and can be evaluated for past use and what riverine and riparian habitat conditions existed during that use. Using those data, a more detailed evaluation by reach can also be conducted. The Collaborative Program has also been developing CEMs for each of the listed species, and the latest version of that information will also be used for analysis during Phase 2.

New Mexico Meadow Jumping Mouse

The New Mexico meadow jumping mouse (mouse) was listed as endangered by the Service in 2014 (79 FR 33119, June 10, 2014), and there is designated critical habitat within BDANWR, which is within the Project Area (81 FR 14263, March 16, 2016). The mouse is a small, nocturnal, solitary mammal and an obligate riparian subspecies. The Service found a significant reduction in occupied localities likely due to cumulative habitat loss and fragmentation across the range for this mouse. Because the species occurs only in areas that are water-saturated, populations have a high potential for extirpation when habitat dries due to groundwater and surface water depletion, draining of wetlands, or drought.

The habitat within this area is believed to be occupied by the subspecies within the middle Rio Grande having the capability to support breeding and reproduction. While this is close to the north end of the Project Area, there is no critical habitat designated within the Project Area (81 FR 14263, March 16, 2016).

Presence in the Project Area

The most recent data for the mouse in the Project Area was conducted by Frey and Kopp (2014). They completed a preliminary assessment of mouse habitat down to RM 38 using GIS-based vegetation mapping and field evaluations of irrigation drains and the LFCC. The study area included riparian areas along the Rio Grande from U.S. Highway 60 to Elephant Butte Dam. The evaluation was based on interpretation of 2007 aerial photography and 2008 field verifications (Ahlers et al. 2010). Mapping did identify potentially suitable habitat (herbaceous and regenerating willow) but, because of the coarseness of the available data, it was a conservative effort and overestimated the amount of habitat. No potentially suitable habitat was identified on the LFCC. The only known occupied habitat is within Bosque del Apache, where the mouse has been documented annually through 2017 (Lehnen et al. 2018).

Habitat Needs and Habitat Restoration Potential

The mouse hibernates for about 8 or 9 months of the year and is active for only 3 or 4 months during the summer. Within this short timeframe, it must breed, birth, and raise young and store up sufficient fat reserves to survive the next year's hibernation period. As a result, if resources are not available in a single season, populations can be greatly impacted. In addition, the mouse lives only 3 years or less and has one small litter annually, with seven or fewer young. Because of this low fecundity (reproductive potential), the subspecies has limited capacity for high population growth rates (79 FR 33119, June 10, 2014). As a result, the mouse has exceptionally specialized habitat requirements to support these life history needs and maintain adequate population sizes. The subspecies chiefly uses patches or narrow strips of riparian vegetation composed of well-developed, tall (averaging at least 24 inches), dense riparian herbaceous vegetation (plants with no woody tissue) primarily composed of sedges—plants in the Cyperaceae family that superficially resemble grasses but usually have triangular stems—and forbs—broad-leafed herbaceous plants. This suitable habitat is found only when wetland vegetation achieves full growth potential associated with saturated soils along the edge of open, perennial flowing water. This vegetation is an important resource need for the mouse because it provides vital food sources (insects and seeds) as well as the structural material for building day nests that are used for shelter from predators. In addition, individual mice also need intact upland areas—up gradient and beyond the floodplain of rivers and streams—adjacent to riparian wetland areas to build nests or use burrows to give birth to young in the summer and to hibernate over the winter (79 FR 33119, June 10, 2014).

Historically, these wetland habitats would have been in large patches to allow for movements of 650–2,300 feet to disperse to other habitat patches within stream segments. Connectivity between patches of suitable habitat is necessary to facilitate daily and seasonal movements, as well as dispersal to increase the likelihood of long-term viability of jumping mouse populations (Service 2014d). In the MRG valley, the mouse is known to use both natural wetlands and riparian habitats associated with irrigation channels (Morrison 1988, cited in Service 2016b; Frey and Wright 2012). The Service estimates that resilient populations of mice need connected areas of suitable habitat in the range of at least about 68–181 acres along 6–15 miles of flowing streams, ditches, or canals. The suitable habitat patches must be no more than about 650 feet apart, because the mouse has limited movement and dispersal capacity for natural recolonization (Service 2014d, 2016b).

The mouse was originally listed as endangered due to the:

> …present or threatened destruction, modification, or curtailment of its habitat or range; the inadequacy of existing regulatory mechanisms; and the natural and manmade factors affecting its continued existence (79 FR 33119, June 10, 2014).

In addition, the isolated state of existing populations makes natural recolonization of impacted areas highly unlikely or impossible in most areas (79 FR 33119, June 10, 2014).

The primary causes of current and future habitat losses include grazing pressure (which removes the needed vegetation) and water management and use (which causes vegetation loss from mowing and drying of soils), lack of water due to drought (exacerbated by climate change), and wildfires (also exacerbated by climate change). Additional causes of habitat loss are likely to occur from scouring floods, loss of beaver, highway reconstruction, residential and commercial development, coal bed methane development, and unregulated recreation. Nearly all current populations of the species are isolated and widely separated, and all of the 29 populations located since 2005 have patches of suitable habitat that are too small to support resilient populations.

Recommendations for Phase 2

Mouse studies have been mainly conducted at BDANWR. A draft protocol for evaluating mouse habitat based upon those studies and input from the Service exists and has been used for project planning and environmental compliance needs in the Middle Rio Grande. Based upon the initial Hink and Ohmart vegetation analysis, further analysis can be conducted to specifically look for potential mouse habitat areas. Based upon potential habitat factors, sites can be evaluated on the ground in relation to restoration planning goals that include protecting or creating habitat for the mouse. This can be done in concert with habitat evaluation for the other species to determine potential multiple species benefits.

Pecos Sunflower

The Pecos sunflower was listed as threatened in 1999 and, at the time, was known only from 25 sites in New Mexico (none of which were in Socorro County) and Texas (64 FR 56582, October 20, 1999). It is an annual member of the sunflower family, a wetland species that requires saturated saline soils of desert wetlands, and usually associated with desert springs, or "cienegas," or the wetlands created from modifying desert springs at 3,300–6,600 feet of elevation (NMRPTC 1999). Threats to the species include wetlands drying from groundwater depletions, alteration of wetlands, competition from nonnative plant species, excessive livestock grazing, and highway maintenance (NMRPTC 1999; 64 FR 56582, October 20, 1999). The Service published a recovery plan in 2005 (Service 2005), and critical habitat was designated in 2008 (73 FR 17761, April 1, 2008). There have been no published species status assessments of the Pecos sunflower.

Presence in Project Area

There are two populations of Pecos sunflower known to exist in the Project Area. One population is at La Joya State Wildlife Management Area near the confluence of the Rio Grande and the Rio Puerco; it was not known to be occupied at the time the Pecos sunflower was listed but was discovered in 2004. It is one of the largest populations of sunflower in NM (between 100,000 and 1,000,000 plants) and is currently threatened by encroachment of nonnative vegetation (73 FR 17761, April 1, 2008). The area has been excluded from critical habitat designation because there is currently a Pecos Sunflower Habitat Management Plan in place (73 FR 17761, April 1, 2008). The second population is located on private property in Socorro County and is the result of collaborative restoration efforts dating from approximately 2006–2012 and funded largely by a grant from the Service's Management of Exotics for Recovery of Endangered Species habitat restoration program.

Habitat Needs and Habitat Restoration Potential

The Pecos sunflower grows in permanently saturated soils, areas most commonly associated with cienegas, but also may include stream and lake margins (64 FR 56582, October 20, 1999). These soils are typically saline or alkaline because the waters are high in dissolved solids and associated plant species include saltgrass, alkali sacaton, and other indicators of those soils (Service 2005). Like all sunflowers, the species requires open areas that are not shaded by taller vegetation. In the Rio Grande, the largest threat to the sunflower is encroachment of nonnative vegetation, especially saltcedar. High densities of saltcedar can dry out shallow groundwater and create an overstory canopy that reduces light to the understory (Service 2005). Riparian habitat restoration activities in the Project Area would be conducive to creating conditions required by the Pecos sunflower, and there is an opportunity to support additional populations. This possibility can be evaluated during Phase 2 as well.

Wildlife Habitat Evaluation and Discussion

As noted in Sections 3.4 and 3.5, Phase 2 will include an evaluation of habitat for potential species of interest and restoration planning. This can also include an evaluation of all wildlife use and benefit in the Project Area. A focus on a specific endangered species of wildlife can provide input that could benefit all species in that group such as riparian obligate species (fish, small mammals, and birds), which can be included in the evaluation to identify potential benefits for multiple species. State-listed species and SGCNs shown in Table 3, as well as those identified in the SWAP, can also be integrated into the Phase 2 evaluation. An evaluation of potential restoration features in relation to project goals will be further discussed in order to provide criteria for evaluation of potential restoration projects in Phase 2.

For example, recent investigations have hypothesized that hydrologic and geomorphic conditions in the San Acacia Reach of the Middle Rio Grande would determine the vegetative and avian communities. The researchers evaluated modeled inundation at a range of flows, vegetation, and avian use at three subreaches occurring between SADD and the Elephant Butte full pool boundary (Hamilton et al. 2019). They found that saltcedar was the dominant vegetation species in all three subreaches, even when there is regular overbank flooding. Legacy native overstory, including cottonwood and Goodding's willow, are surviving in more incised reaches, but these habitats are not sustainable given the geomorphic change. Canopy-nesting bird species were most abundant in plots where the native overstory was the highest, but their continued persistence is doubtful where hydrogeomorphic conditions are not conducive to regeneration of the native overstory plants. Birds that use understory vegetation such as round-nesting birds showed less sensitivity to hydrogeomorphic changes.

3.6 OTHER CONSIDERATIONS

Other factors have been initially evaluated during Phase 1 of this CRP update project and will be further evaluated during Phase 2, including the following:

- General wildlife use
- Land use
- Recreation

General Wildlife Use

While general wildlife use of the Project Area has been mentioned and will be considered in detail during Phase 2 analysis and evaluation of protection and restoration efforts.

There are over 400 species of birds that utilize this reach of the Middle Rio Grande. In order to benefit these diverse species, habitats present must be diverse in structure, plant species composition and patch size. Generally, the abundance of breeding birds increases with the complexity and density of vegetation structure, which is thought to be related to the increased food, cover, or nest substrate it provides (Crawford et al. 1996). Along the Rio Grande, the highest breeding densities typically have been found in marshes, cottonwood stands with a well-developed shrub understory, and in tall shrub stands (Hink and Ohmart 1984; Hoffman 1990; Thompson et al. 1994; Stahlecker and Cox 1997). Within this woodland type, avian abundance is approximately four times greater along the riverward and landward edges of the bosque than in the interior of the stand (Hink and Ohmart 1984). Bosque stands with a sparse understory generally support fewer breeding birds. Stands of intermediate age or structure vary widely in breeding bird use among the studies conducted (Farley et al. 1994), but in light of the general lack of natural cottonwood and willow regeneration along the Rio Grande, are important for their potential to develop into mature stands.

Some specific wildlife uses also should be considered. This includes use of riparian habitat by elk and other nondomestic ungulates, as well as cattle grazing. As noted above, avian use is high in the Middle Rio Grande migratory flyway.

Phase 2 will consider shifts in wildlife use based on trend analysis of water availability, habitat establishment and viability, patch size and plant succession. A detailed analysis of patch mosaic and related wildlife habitat use will be conducted at this phase. The patch mosaic has been introduced in various documentation (Crawford et al 1993; Najmi et al 2005; USACE 2011; and Muldavin et al 2019). A patch mosaic can be viewed at the landscape scale targeting a mixture of habitat types such as a riparian gallery forest mosaic (targeting a combination of tree, shrub, grassland/herbaceous and meadow/wetland communities) (USACE 2011). The patch mosaic should also consider uneven-aged stands of trees, shrubs, wetlands and other community types (Najmi et al 2005).

Communities for habitat but also specific wildlife groups (birds, fish, wildlife corridors, etc.) should be considered for evaluation of habitat types or targets. This patch mosaic can provide linkages between terrestrial and aquatic habitats (Muldavin et al 2019) that can benefit each other and allow for wildlife corridor use.

Land Use

Current land use consists of grazing on both public and private lands, and there are several grazing allotments within the Project Area managed by the U.S. Bureau of Land Management. Much of the area is farmland, and alfalfa is the dominant crop. Some landowners have made the decision to convert land that was previously used for agriculture to wetland and wildlife habitat. There are some existing conservation easements with the Rio Grande Agricultural Land Trust on the Project Area as well as some completed Partners Program-funded projects such as the Rhodes Property and Boys and Girls Club who have conducted restoration efforts on their properties. Whether the land has been designated as official conservation easements or not, the agricultural land can create a bridge with river, bosque, and floodplain habitat and should be evaluated as part of the overall system.

Recreation

There is an extensive amount of recreation in the Project Area, including hunting, fishing, hiking, and birdwatching. The Armendaris Ranch offers guided recreational experiences, but primarily on parts of the ranch not in the Project Area. The Camino Real de Tierra Adentro National Historic Trail passes through the Project Area, but it is not clear whether it receives many visitors. The proposed Rio Grande Trail would likely pass through the Project Area, although the alignment has not been finalized and there is no schedule for completion. These and other potential recreational uses should be considered during Phase 2 planning efforts.

4.0 DATA GAPS AND NEXT STEPS

Data gaps are identified in the appropriate sections earlier in this report. Recommendations for filling them and proposed analysis are described under each section above. The Phase 2 analysis will be conducted using an integrated method so that the Project Area and all its components can be viewed as a whole from the watershed perspective. Potential impacts from one alternative might affect another and would need to be weighed, balanced, and mitigated if possible.

To develop a tiered restoration plan, a watershed view of inputs, features, and changes over time is critical. This larger, long-term view will be applied to refining goals and objectives, resulting alternatives, and discussions during outreach events.

Before and during this process, it is recommended that evaluation criteria be developed (tied to the goals/objectives) to enable proposed efforts to be evaluated, ranked, and/or prioritized. This would be done in line with the goals discussed in Section 2 and the key focus areas of improved biodiversity, water delivery, and fire prevention discussed in the original 2004 CRP and the scope for this work.

4.1 RECOMMENDED APPROACH FOR PHASE 2

One of the biggest uncertainties that must be addressed while updating the CRP is the impact that climate change will have on future conditions. Modeling future climate change scenarios, particularly with respect to hydrology, will be instrumental in developing restoration plans that will have a better chance of success. These future water flows are fundamental to developing future trends in river channel dynamics but also play an outsized role in the lower reach of the Project Area because of the influence of Elephant Butte pool elevation on the geomorphic characteristics of this reach, and water management as described above. Aggradation and degradation trends in the lower reach will influence both floodplain connectivity and groundwater levels and will be an important consideration in developing modeling scenarios, developing habitat restoration plans, and predicting successful vegetation establishment.

Specific needs for consideration during Phase 2 include the following:

- Analysis of flows and drought;
- Climate change scenarios (change in timing, peak and duration of flows);
- Analysis of deviation studies and implementation (Cochiti Reservoir Operations Studies, water operating group flow alteration implementation);
- Geomorphic analysis – collection of all data documented in the geodatabase (and additional information collected), analysis of geomorphic trends in the Project Area and how they have affected previous local habitat restoration projects and lessons learned for new projects;
- Groundwater analysis—collection of all data contained in the GDB (and any additional collected data), summary of trends, groundwater modeling development, and use of specific well data for restoration planning;
- Water depletions—based upon development of data listed above (in the GDB and under Existing Data), analysis of potential water use and depletions for restoration planning;
- Updating and refining Hink and Ohmart vegetation mapping using remote sensing tools;

- Better understanding of site moisture availability, soil salinity; and the potential for mycorrhizal inoculation;
- Updated Conceptual Ecological Models developed for listed species;
- Applying updated Hink and Ohmart vegetation mapping to the identification and prioritization of habitat restoration projects to benefit listed species;
- Applying updated Hink and Ohmart vegetation mapping and other tools to an evaluation of all wildlife use and benefit in the Project Area; and
- Further outreach to landowners and land managers and refinement of restoration goals and issues.

This document represents the existing conditions, as of 2020, and an initial assessment of a variety of factors in the Project Area. The intent of this effort was to identify, at a broad scale, the biggest changes since the original CRP was published in 2004. This rapid assessment approach has laid the framework for more detailed analysis and the development of an updated conceptual restoration plan for the Rio Grande in Socorro County into the future.

REFERENCES CITED

Ahlers, D., V. Johanson, S. Ryan, and R. Siegle. 2010. *Southwestern Willow Flycatcher Habitat Suitability 2008: Highway 60 Downstream to Elephant Butte Reservoir, New Mexico*. U.S. Department of the Interior, Bureau of Reclamation, Denver, CO, and Albuquerque Area Office, NM.

Bateman, H.L., and M.J. Johnson. 2015. *Effects of Biocontrol and Restoration on Wildlife in Southwestern Riparian Habitats*. Report submitted to Southern Rockies and Desert Landscape Conservation Cooperative.

BISON-M. 2019. https://bison-m.org/Index.aspx. New Mexico Department of Game and Fish: New Mexico Conservation Information System.

Buffington, J.M., J.C. Kilgo, R.A. Sargent, K.V. Miller, and B. R. Chapman. 1997. Comparison of breeding bird communities in bottomland hardwood forests of different successional stages. *Wilson Bulletin* 109:314–319.

Crawford, C. S., A. C. Cully, R. Leutheuser, M. S. Sifuentes, L. H. White, and J. P. Wilber. 1993. Middle Rio Grande Ecosystem: Bosque Biological Management Plan. Biological Interagency Team, US Fish and Wildlife Service, Albuquerque, NM.

Crawford, C. S., L. M. Ellis, and M. C. Molles, Jr. 1996. The Middle Rio Grande bosque: an endangered ecosystem. New Mexico Journal of Science 36:276-299.

Dello Russo, G. 2015. Strategic Plan: Armendaris Ranch Rio Grande Floodplain. Plan prepared for Armendaris Ranch, Socorro, New Mexico. 81pp. including appendices.

DeLoach, C. J., R.I. Carruthers, J.E. Lovich, T.L Dudley, and S.D. Smith. 2000. Ecological Interactions in the Biological Control of Saltcedar (*Tamarix* spp.) in the United States: Toward a New Understanding. In *Proceedings of the X International Symposium on Biological Control of Weeds*, Montana State University, Bozeman, Montana, July 4–14, 1999, pp. 819–873, ed. N.R. Spencer.

Dillon, K. G., D. Ahlers, and Moore, D. 2018. Yellow-billed Cuckoo Study Results- 2017. Middle Rio Grande from Los Lunas to Elephant Butte Reservoir, New Mexico. Bureau of Reclamation, Technical Service Center, Fisheries and Wildlife Resources. Denver, CO.

Dillon, K. G., D. Ahlers, and Moore, D. 2019. Yellow-billed Cuckoo Study Results- 2018. Middle Rio Grande from Los Lunas to Elephant Butte Reservoir, New Mexico. Bureau of Reclamation, Technical Service Center, Fisheries and Wildlife Resources. Denver, CO.

Dudley, R.K., S.P. Platania, and G.C. White. 2017. *Rio Grande Silvery Minnow Population Monitoring Results from February to December 2016*. Report to the U.S. Bureau of Reclamation, Albuquerque, NM.

Dudley, R.K., S.P. Platania, and G.C. White. 2018. *Rio Grande Silvery Minnow Population Monitoring during 2019: Draft Report*. Submitted to U.S. Bureau of Reclamation, Albuquerque, NM.

Farley, G.H., L.M. Ellis, J.N. Stuart, and N.J. Scott. 1994. Avian species richness in different-aged stands of riparian forest along the Middle Rio Grande, New Mexico. Conservation Biology 8:1098-1108.

Finch, D.M., and S.H. Stoleson (eds.). 2000. *Status, Ecology, and Conservation of the Southwestern Willow Flycatcher*. General Technical Report RMRS-GTR-60. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Ogden, UT.

Frey, J.K., and G.D. Wright. 2012. *Multiple Scale Habitat Selection by a Small Mammal Habitat Specialist (Zapus hudsonius luteus) in a Managed Floodplain Landscape*. Final Report submitted to U.S. Fish and Wildlife Service, Cooperative Agreement 201819J806.

Frey, J.K., and D.A. Kopp. 2014. Preliminary Assessment of Jumping Mouse Habitat Associate with the Middle Rio Grande Project. Final Report: Contract R12PX43055. Report to the U.S. Bureau of Reclamation, Albuquerque, NM.

Gaines, D., and S. A. Laymon. 1984. Decline, status, and preservation of yellow-billed cuckoo in California. *Western Birds* 15:49–80.

Gonzales, E. J., and M. D. Hatch. 2009. Habitat Restoration Monitoring. Report to the New Mexico Interstate Stream Commission.

González, E., A.A. Sher, R.M. Anderson, R.F. Bay, D.W. Bean, G.J. Bissonnete, and D.K. Kennard. 2017. Secondary invasions of noxious weeds associated with control of invasive *Tamarix* are frequent, idiosyncratic and persistent. Biological Conservation 213:106–114.

Hamilton, S.G., S.L. King, G. Dello Russo, and M.D. Kaller. 2019. Effects of hydrologic, geomorphic, and vegetative conditions on avian communities in the Middle Rio Grande of New Mexico. *Wetlands* 39:1029–1042.

Harms, R. S., and R.D. Hiebert. 2006. Vegetation response following invasive tamarisk (*Tamarix* spp.) removal and implications for riparian restoration. *Restoration Ecology* 14(3), 461-472.

Harvey, B.C. 1987. Susceptibility of Young-of-the-Year Fishes to Downstream Displacement by Flooding. Transactions of the American Fisheries Society 116:851-855.

Hatch, M.D., and E.J. Gonzales. 2008. *Habitat Restoration Monitoring*. Report to the New Mexico Interstate Stream Commission, Albuquerque, NM.

Hink, V. C., and R.D. Ohmart. 1984. Middle Rio Grande Biological Survey. Prepared for U.S. Army Corps of Engineers, Albuquerque, NM. Arizona State University, Center for Environmental Studies, Tempe, AZ.

Hoffman, S.W. 1990. Bosque Biological Monitoring Program: Bird population surveys in Rio Grande Valley State Park (1987-1990). Prepared for City of Albuquerque, Open Space Division, New Mexico.

Keystone Associates. 2007. Rhodes Property Habitat Restoration Project Environmental Assessment. Prepared for the Save Our Bosque Task Force. 58 pp.

Lehnen, S., Sanchez, J., and Goyette, M. 2018. The New Mexico Meadow Jumping Mouse at Bosque del Apache National Wildlife Refuge: Camera Monitoring 2016-2017. U.S. Fish and Wildlife Service, Albuquerque, NM, U.S. Fish and Wildlife Service, Bosque del Apache National Wildlife Refuge, NM.

Middle Rio Grande Conservancy District. 2020. MRGCD's Conservation Program. https://www.mrgcd.com/conservation-program-1.aspx. Access on July 29, 2020.

Middle Rio Grande Conservancy District. 2019. Middle Rio Grande Conservancy District Drought Contingency Plan. Report prepared with support from WEST Consultants and Davis Engineering. 299 pp.

Morrison, J. L. 1988 (as cited in Service 2016b). Distribution, life history, and ecology of the meadow jumping mouse, *Zapus hudsonius luteus*, at four sites along the Rio Grande Valley in New Mexico. Report submitted to the New Mexico Department of Game and Fish, contract number 516.6-75-21, 57 pp. Muldavin, E., E. Milford, L. Grunau, and R. Rondeau. 2019. Middle Rio Grande Conservation Action Plan: Framework and Status Assessment. March 2015. Updated September 2019. Natural Heritage New Mexico and Colorado Natural Heritage Program.

Muiznieks, B., S. Sferra, T. Corman, M. Sogge, and T. Tibbitts. 1994. Arizona partners in flight Southwestern Willow Flycatcher survey, 1993. Draft technical report: Nongame and Endangered Wildlife Program, Arizona Game and Fish Department, Phoenix, AZ.

Muldavin, E., E. Milford, L. Grunau, R. Rondeau. 2019. Middle Rio Grande Conservation Action Plan Framework and Status Assessment. March 2015 (Updated September 2019). Natural Heritage New Mexico and Colorado Natural Heritage Program. 52 pp.

Najmi, Y., S. Grogon, C. Crawford 2005. Bosque Landscape Alteration Strategy. 2005. Utton Transboundary Workshops report. Middle Rio Grande Conservancy District.

NMDGF (New Mexico Department of Game and Fish). 2016. State Wildlife Action Plan for New Mexico. New Mexico Department of Game and Fish, Santa Fe, NM.

NMRPTC (New Mexico Rare Plant Technical Council). 1999. New Mexico Rare Plants, Albuquerque, New Mexico Rare Plants Home Page (latest update July 25, 2017). Accessed in August 2017. http://nmrareplants.unm.edu.

Parametrix. 2007. Restoration Analysis and Recommendations for the San Acacia Reach of the Middle Rio Grande, NM. Prepared for Middle Rio Grande Endangered Species Collaborative Program c/o Bureau of Reclamation. Prepared by Parametrix, Albuquerque, New Mexico.

Parametrix. 2006. Marcial Fire Burned Area Emergency Stabilization Plan. Report prepared for the U.S. Fish and Wildlife Service, Albuquerque, NM. 46pp including appendices.

Platania, S. 1993. *The Fishes of the Rio Grande between Velarde and Elephant Butte Reservoir and Their Habitat Associations*. U.S. Bureau of Reclamation, Albuquerque, NM.

Reclamation (U.S. Bureau of Reclamation). 2012. Joint Biological Assessment Bureau of Reclamation and Non-Federal Water Management and Maintenance Activities on the Middle Rio Grande, New Mexico. Middle Rio Grande Project, New Mexico, San Juan-Chama Project, New Mexico. U.S. Bureau of Reclamation, Upper Colorado Region.

Reclamation (U.S. Bureau of Reclamation). 2016a. Hink and Ohmart Mapping of Vegetation in the Middle Rio Grande, New Mexico. U.S. Bureau of Reclamation, Upper Colorado Region, Albuquerque, NM.

Reclamation (U.S. Bureau of Reclamation). 2016b. SECURE Water Act Section 9503(c) –Reclamation Climate Change and Water. Prepared for United States Congress. Denver, CO: Bureau of Reclamation, Policy and Administration.

Reclamation (U.S. Bureau of Reclamation). 2016c. Continued Implementation of the 2008 Operating Agreement for the Rio Grande Project, New Mexico and Texas Final Environmental Impact Statement. Albuquerque, NM: Bureau of Reclamation, Upper Colorado Region.

Reclamation (U.S. Bureau of Reclamation). 2017. Southwestern Willow Flycatcher Habitat Suitability 2016. Middle Rio Grande, New Mexico. Technical Service Center Fisheries and Wildlife Resources Group, Denver, CO.

Reclamation (U.S. Bureau of Reclamation). 2018. Western Yellow-billed Cuckoo Habitat Suitability 2016 Draft. Middle Rio Grande, New Mexico. Technical Service Center Fisheries and Wildlife Resources Group, Denver, CO.

RiversEdge West. 2018. RiversEdge West's 2018 Tamarisk Beetle Distribution Map. Accessed March 4, 2020. http://arcg.is/2jWRaBM.

Sher. A. and M. Quigley, eds. 2013. Tamarix: A Case Study of Ecological Change in the American West. Oxford University Press.

Smith, D. M. and D. M. Finch. 2017. Climate Change and Wildfire Effects in Aridland Riparian Ecosystems: An Examination of Current and Future Conditions. Gen Tech. Rep. RMRS-GTR-364. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, 65 p.

Socorro County. 2018. Socorro County Community Wildfire Protection Plan. Socorro, NM. 158 pp.

Stahlecker, D. W. and N. S. Cox. 1997. Bosque Biological Monitoring Program: Bird populations in Rio Grande Valley State Park, Winter 1996-97 and Spring 1997. City of Albuquerque Open Space Division, Albuquerque, New Mexico.

SWCA. 2016. San Acacia Habitat Restoration Project from River Mile 116 to 99, Socorro County, New Mexico Environmental Assessment. Prepared for Bureau of Reclamation, on behalf of New Mexico Interstate Stream Commission. 62 pp.

Tetra Tech, Inc. In press (a). Draft tamarisk leaf beetle species and habitat analysis along the Rio Grande in Socorro County, NM, USA. Albuquerque, NM.

Tetra Tech, Inc. In press (b). Tiffany Fire Rehabilitation Plan: Existing Conditions Report. Prepared for the Sierra Soil and Water Conservation District.

Tetra Tech, Inc. 2004. Conceptual Restoration Plan Active Floodplain of the Rio Grande San Acacia to San Marcial, NM. Volumes 1-4. Prepared for Save Our Bosque Task Force.

Tetra Tech, Inc. 2011. San Acacia Fish Passage Geomorphic Assessment. Report prepared for Bureau of Reclamation, Albuquerque Area Office, NM.

Tetra Tech, Inc. 2014. Ecohydrological relationships along the Middle Rio Grande of New Mexico for the Endangered Rio Grande silvery minnow. Report prepared for the U.S. Army Corps of Engineers, Albuquerque District. Albuquerque, NM.

Tetra Tech, Inc. 2015. Habitat relationships along the Middle Rio Grande of New Mexico for the Endangered Southwestern Willow Flycatcher. Report prepared for the U.S. Army Corps of Engineers, Albuquerque District. Albuquerque, NM.

Thompson, K. 1961. Riparian forests of the Sacramento Valley, California. Annals of the Association of American Geographers 51(3):294–315. DOI: 10.1111/j/1467-8306.1961.tb00380.x. University of California, Davis.

Thompson, B.C., D.A. Leal, and R.A. Meyer. 1994. Bird Community Composition and Habitat Importance in the Rio Grande System of New Mexico with Emphasis on Neotropical Migrant Birds. New Mexico Cooperative Fish and Wildlife Research Unit and Fishery and Wildlife Sciences Department, New Mexico State University, Las Cruces, New Mexico.

U.S. Army Corps of Engineers (USACE). 2013.Rio Grande Floodway, San Acacia to Bosque del Apache Unit, Socorro County, New Mexico. Prepared by USACE Albuquerque District. 271 pp.

USACE. 2011. Environmental Assessment for the Middle Rio Grande Bosque Restoration Project. Prepared by USACE Albuquerque District. 137 pp.

USACE. 2004. Final Supplemental Environmental Assessment for the Rio Grande Bosque Jetty Jack Removal Evaluation Study. Prepared by USACE Albuquerque District. 27 pp.

U.S. Fish and Wildlife Service [Service]. 1994. Endangered and threatened wildlife and plants; final rule to list the Rio Grande silvery minnow as an endangered species. Federal Register volume 59, number 138, pages 36988-36995.

Service. 1995. Endangered and threatened wildlife and plants: Final rule to list the Southwestern Willow Flycatcher (*Empidonax traillii extimus*) as endangered with proposed critical habitat. Federal Register volume 60, number 38, pages 10694-10715.

Service. 1999. Endangered and threatened wildlife and plants; determination of threatened status for the plant *Helianthus paradoxus* (Pecos sunflower)(final rule). Federal Register volume 64, number 202, pages 56582-56590.

Service. 2000. Sevilleta National Wildlife Refuge Comprehensive Conservation Plan, San Acacia, NM. Albuquerque, NM.

Service. 2002. Final Southwestern Willow Flycatcher Recovery Plan. U.S. Fish and Wildlife Service, Albuquerque, NM.

Service. 2003. Endangered and threatened wildlife and plants; designation of critical habitat for the Rio Grande Silvery Minnow; Final Rule. Federal Register volume 68, number 33, pages 8088-8135.

Service. 2005. Pecos Sunflower Recovery Plan. Albuquerque, New Mexico. 39 pp.

Service. 2008. Endangered and threatened wildlife and plants; designation of critical habitat for *Helianthus paradoxus* (Pecos Sunflower)(final rule). Federal Register volume 73, number 63, pages 17762-17807.

Service. 2010. Rio Grande Silvery Minnow (*Hybognathus amarus*) Recovery Plan, First Revision. Albuquerque, NM. viii + 210 pp.

Service. 2013a. Endangered and threatened wildlife and plants; designation of critical habitat for the Southwestern Willow Flycatcher. Federal Register volume 78, number 2, pages 344-534.

Service. 2013b. Endangered and threatened wildlife and plants; proposed threatened status for the Western Distinct Population Segment of the Yellow-billed Cuckoo (*Coccyzus americanus*)(proposed rule). Federal Register volume 78, number 192, pages 61622-61666.

Service. 2014a. Endangered and threatened wildlife and plants; determination of threatened status for the Western Distinct Population Segment of the Yellow-billed Cuckoo (*Coccyzus americanus*). Federal Register volume 79, number 192, pages 59992-60038.

Service. 2014b. Endangered and threatened wildlife and plants; designation of critical habitat for the Western Distinct Population Segment of the Yellow-billed Cuckoo (*Coccyzus americanus*) (proposed rule). Federal Register volume 79, number 231, pages 71373-71375.

Service. 2014c. Endangered and threatened wildlife and plants; determination of endangered status for the New Mexico Meadow Jumping Mouse throughout its range (final rule). Federal Register volume 79, number 111, pages 33119-33137.

Service. 2014d. Recovery Outline New Mexico Meadow Jumping Mouse (*Zapus hudsonius luteus*). June 2014.

Service. 2015. Sevilleta National Wildlife Refuge Habitat Management Plan. U.S. Fish and Wildlife Service, Southwest Region, Albuquerque, NM.

Service. 2016a. Final Biological and Conference Opinion for Bureau of Reclamation, Bureau of Indian Affairs, and Non-Federal Water Management and Maintenance Activities on the Middle Rio Grande, New Mexico.

Service. 2016b. Endangered and threatened wildlife and plants; designation of critical habitat for the New Mexico Meadow Jumping Mouse (final rule). Federal Register volume 80, number 51, pages 14264-14325.

Service. 2020. Endangered and threatened wildlife and plants; revised designation of critical habitat for the Western Distinct Population Segment of the Yellow-billed Cuckoo (*Coccyzus americanus*). Federal Register volume 85, number 39, pages 11458-11594.

West Consultants. 2018. Seepage Measurements along the Rio Grande and Low Flow Conveyance Channel in the San Acacia Reach of the Middle Rio Grande, New Mexico. Winter 2018. Prepared for the New Mexico Interstate Stream Commission by West Consultants. 25 pp.

Wilcove, D.D., C.H. McLellan, and A.P. Dobson. 1986. Habitat Fragmentation in the Temperate Zone. Chapter 11. *Conservation Biology: The Science of Scarcity and Diversity*. ed M. E. Soulê, University of Michigan, Sinauer Associates Inc.

Wright, G.D., and J.K. Frey. 2014. Herbal feeding behavior of the New Mexico meadow jumping mouse (*Zapus hudsonius luteus*). *Western North American Naturalist* 74(2):231–235.

Yong, W., and D.M. Finch. 1997. Migration of the willow flycatcher along the Middle Rio Grande. *Wilson Bulletin* 109:253–268.

APPENDIX A: AGENCIES AND INDIVIDUALS WHO PARTICIPATED IN OUTREACH ACTIVITIES TO DATE

Middle Rio Grande Conservancy District

- Jason Casuga
- David Gensler
- Yasmeen Najmi
- Doug Stretch

New Mexico Audubon Society

- Amy Erickson
- Paul Tashjian

New Mexico Department of Game and Fish

- Ryan Darr
- Carrie Parris
- Chuck Schultz

New Mexico State Forestry

- Jacky Dickey
- Russ Thrun

U.S. Fish and Wildlife Service

- Kathy Granillo
- Gwen Kolb
- Renee Robichaud

Abeytas Volunteer Fire Department

- Steve Billingsley

Other

- Tony Bridgman

APPENDIX B: RESTORATION ISSUES IDENTIFIED IN 2004

The following excerpt is from pages 5 and 6 of Volume 1, Phase 1 of the 2004 Conceptual Restoration Plan: Active Floodplain of the Rio Grande, San Acacia to San Marcial, NM.

Restoration Issues

An email memo was distributed to the Oversight Committee during the week of June 10th requesting a list of issues related to potential restoration activities in the reach from San Acacia to San Marcial. From the responses, a list of restoration issues has been compiled and is broken down into categories associated with administrative/legal, hydrologic, geomorphic, biological and ecological topics. This list contains only those issues and objectives that have been identified by members of the Oversight Committee either through email correspondence or verbally at the Oversight Committee meeting. Tetra Tech ISG has not contributed to this list. This list is by no means all-encompassing and additional issues will be raised as the project proceeds.

Administrative/Legal:

- Private landowner rights and wishes.
- Communication and planning between water management agencies.
- Environmental education for the general public.
- Provide a useful tool for Bosque management.
- Tie together various small projects with this restoration effort.
- Create a model plan for other restoration projects in the Middle Rio Grande.
- Bring together different area entities and provide input to various water management issues.
- Limited funding.
- Integrate restoration projects across private and government lands.
- Keep investigation independent of the ESA project.
- Residents of the valley driving restoration not endangered species.
- Address floodplain encroachment with structures.
- Level of management required to maintain restoration activities.

Hydrologic

- In drought years, water may be inadequate for flows south of San Acacia.
- River and riparian restoration must consider flow intermittency.
- Shallow aquifer hydrology must be understood to sustain restoration projects.
- Habitat restoration projects must include depletion analysis to insure Rio Grande Compact deliveries.
- Understand the inter-connectivity between the river and LFCC with respect to seepage and flow characteristics.
- Understand the surface/groundwater interaction.

Geomorphic/Hydraulic

- Restoration plans should consider the future disposition of the Low Flow Conveyance Channel (LFCC).

- Restoration plans should consider the Bureau of Reclamation's plan to shift the river channel and LFCC to the west near San Marcial.
- Investigations related to the San Acacia diversion dam may result in operational constrains that could affect restoration activities.
- Levee rehabilitation in the San Acacia reach may require that some MRGCD bosque land will have to be reserved for levee project mitigation.
- Levee integrity must be maintained with habitat restoration projects.
- Potential future operations of the Low Flow Conveyance Canal.
- San Marcial Railroad Bridge conveyance capacity.

Biological

- Enhance habitat for the endangered species.
- Restoration removal of exotic vegetation should consider habitat enhancement for the southwestern willow flycatcher.
- The restoration plan should consider the Armendaris Ranch proposed Rio Grande silvery minnow habitat project using tailwater from Bosque del Apache NWR.

Ecological

- Removal of non-native vegetation; restoration of native vegetation.
- Alleviate stress on agricultural community to provide suitable wildlife habitat.
- Fire management for old growth cottonwood/willow bosque.
- Determine how historic flow regimes and groundwater levels affect vegetation.
- Types of habitats that are possible within existing flow regimes.

It should be noted that the Low Flow Conveyance Canal future operation scenarios and its possible relocation will not be addressed in this restoration plan.

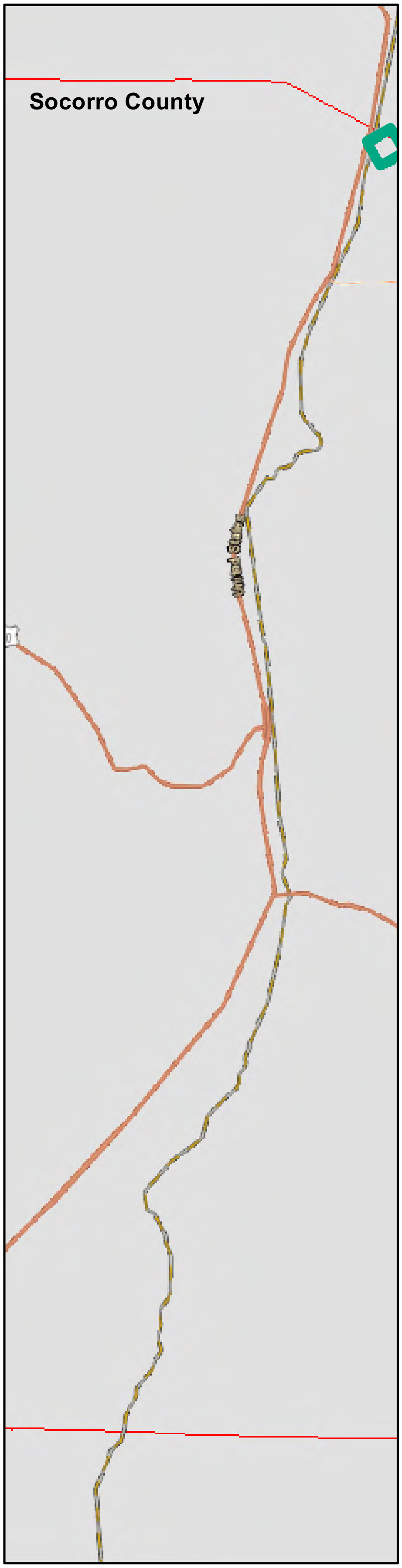
APPENDIX C: GEODATABASE FEATURE CLASSES

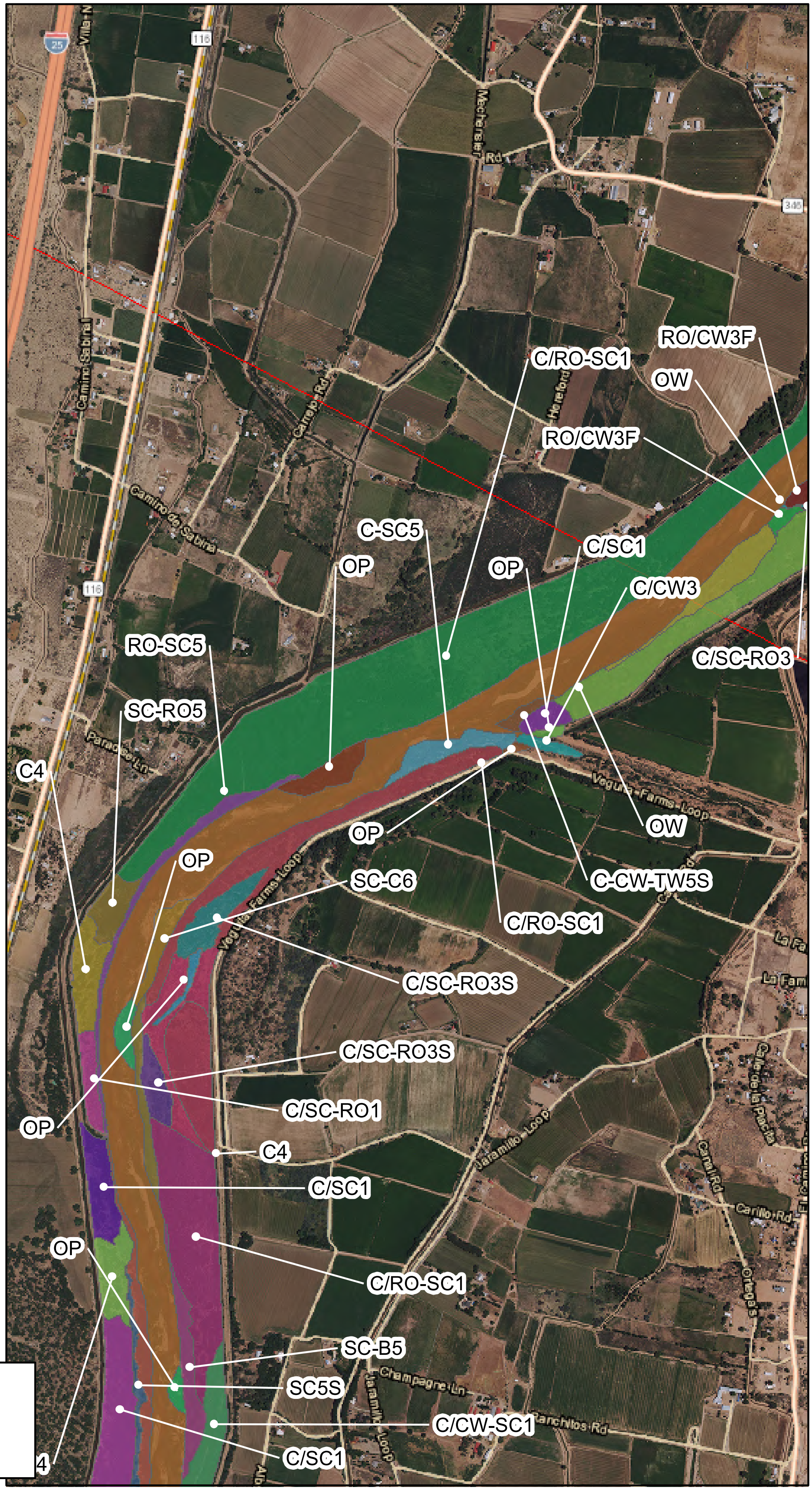
Category	Merge (y or n)	Category description
biologic	n	Flycatcher (SWFL) and cuckoo territories and habitat suitability layers. Diorhabda monitoring data is also presented here.
easements	n	Conservation easement layers.
fire	y	Various fire polygons showing extent of fire events. Includes a point file with ignition points.
habitat_restoration_completed	y	Completed habitat restoration projects.
habitat_restoration_proposed	y	Proposed habitat restoration projects.
historic	n	Historic layers primarily consist of features present at points in time prior to the construction of Cochiti Dam. Includes a layer with floodplain features mapped in 1918.
hydrology	n	Model outputs of engineering analysis. Includes hydrologic and hydraulic modeling outputs.
imagery	n/a	This category refers to raster data, including aerial imagery and multi/hyperspectral data. No specific multi/hyperspectral data is provided; however, the paths and rows are provided as an index of satellite coverage for the SOBTF area of analysis.
infrastructure	n	This feature dataset includes roads, railroad features, and agriculture water conveyance infrastructure.
land ownership	n	This feature dataset includes a general surface landownership layer with parcel-level landownership information.
location	n	Location layers consists of named places as a point layer and a polygon layer.
monitoring	n	This category includes biological monitoring stations, such as Diorhabda sample points.
process	n	Layers in this category include SOBTF reaches and a polygon layer that is useful for clipping the data to the extent of the floodplain in Socorro County.
reference	n	Reference layers include an index of Sentinel-2 and LANDSAT tiles. River miles is also included in this feature dataset.
soils	n	This category includes a general NRCS soils layer for clipped using the general polygon layer located in the "Process" feature dataset.
topographic	n	This category contains all USGS 7.5-minute quadrangles that intersect with the general polygon layer located in the "Process" feature dataset.
vegetation	n	Layer in this category include Hink & Ohmart vegetation mapping polygons and SEINET occurrence points.
wetlands	n	This category contains National Wetlands Inventory wetland polygons and historic wetland features.

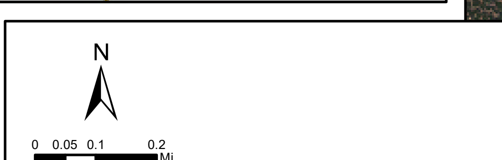
APPENDIX D: 2002 AND 2016 HINK AND OHMART VEGETATION MAPS

Locator Map

2002
Hink and Ohmart Vegetation Type







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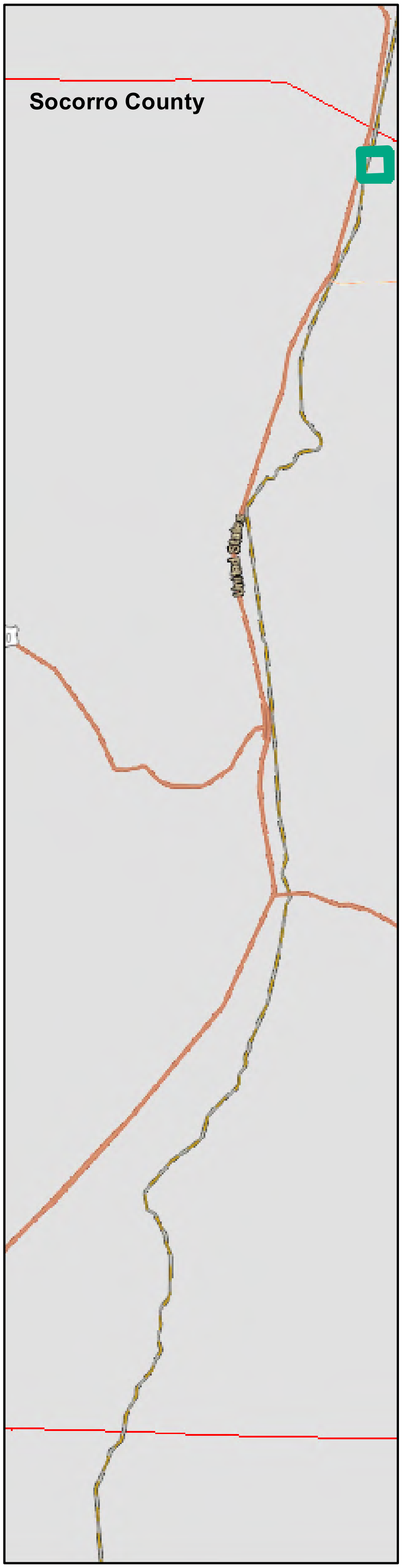
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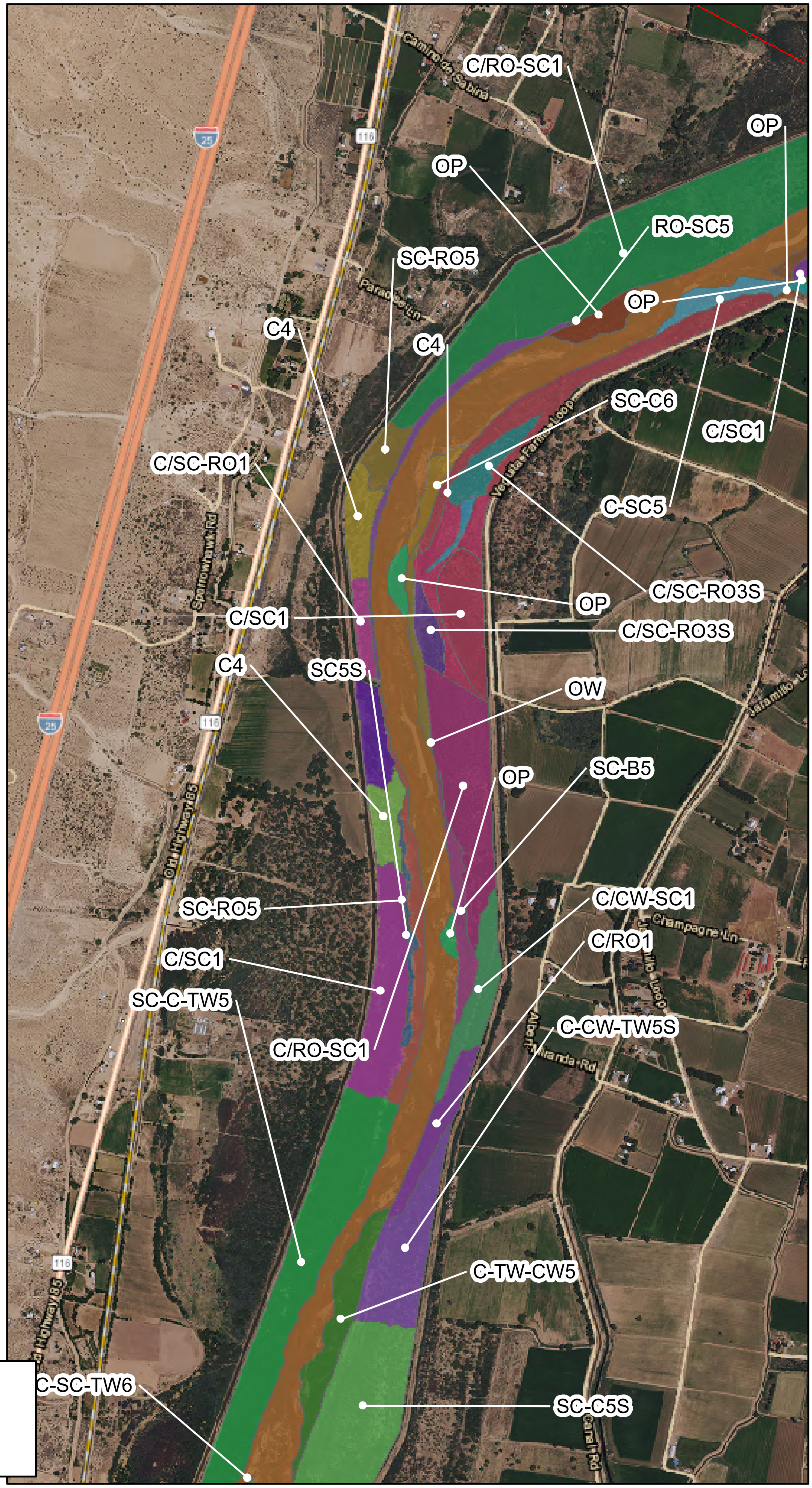
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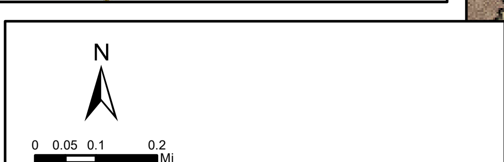
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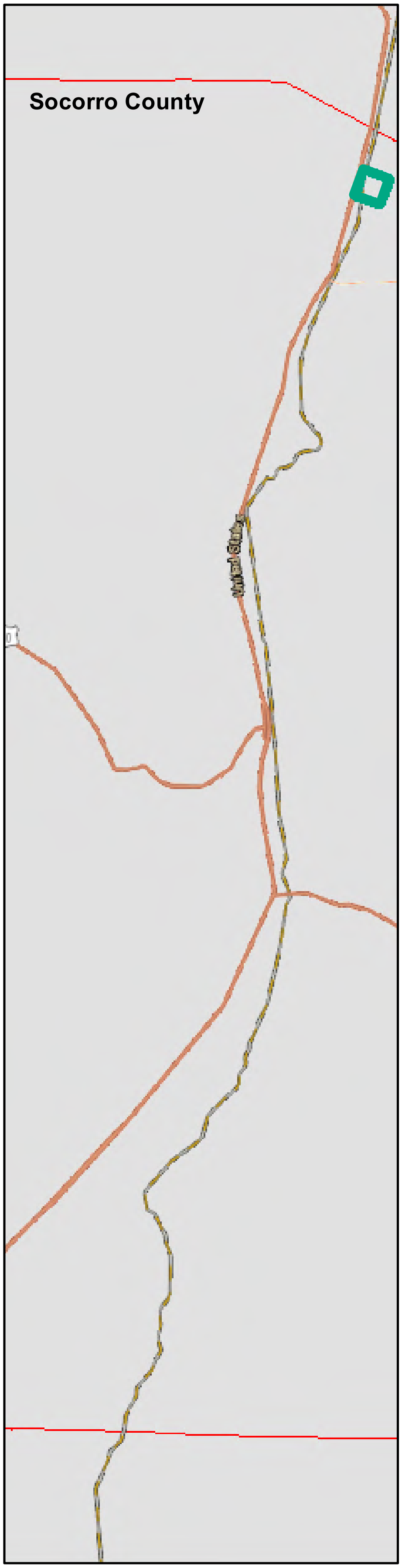
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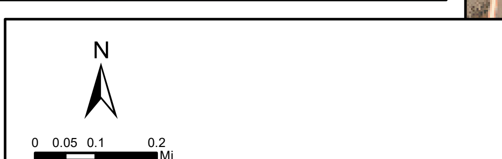
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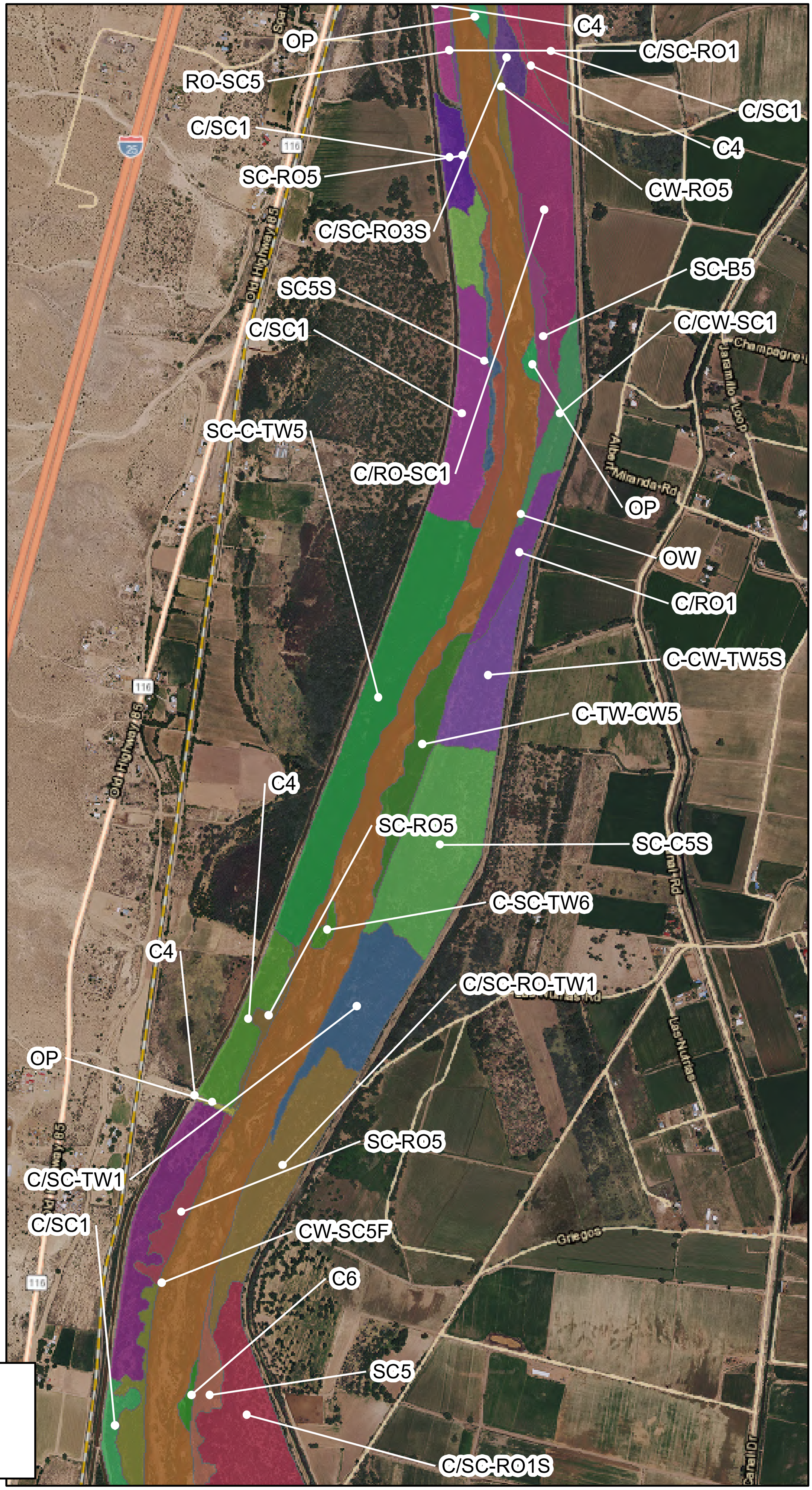
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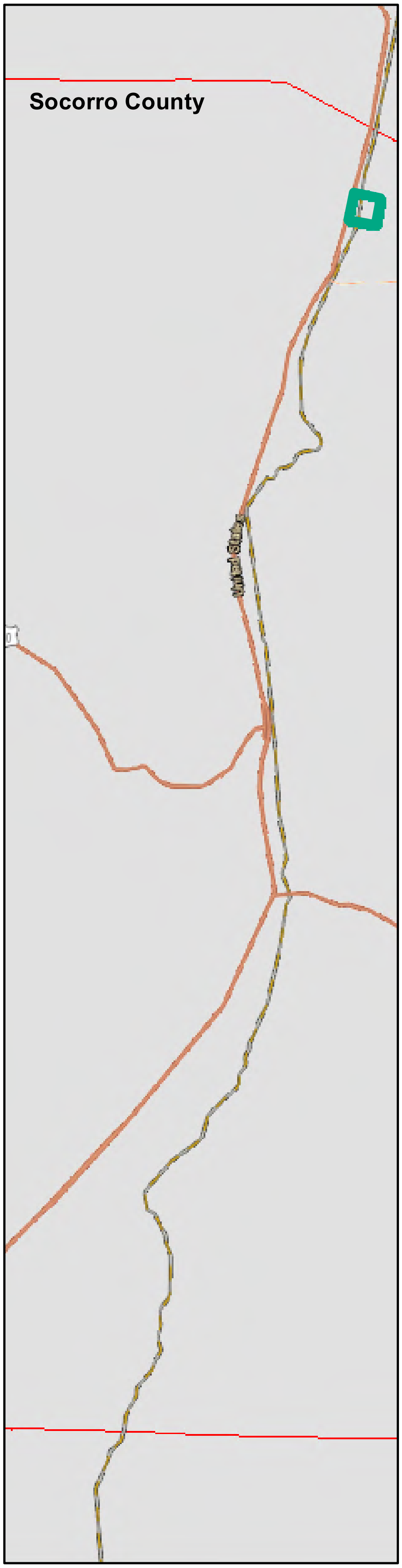

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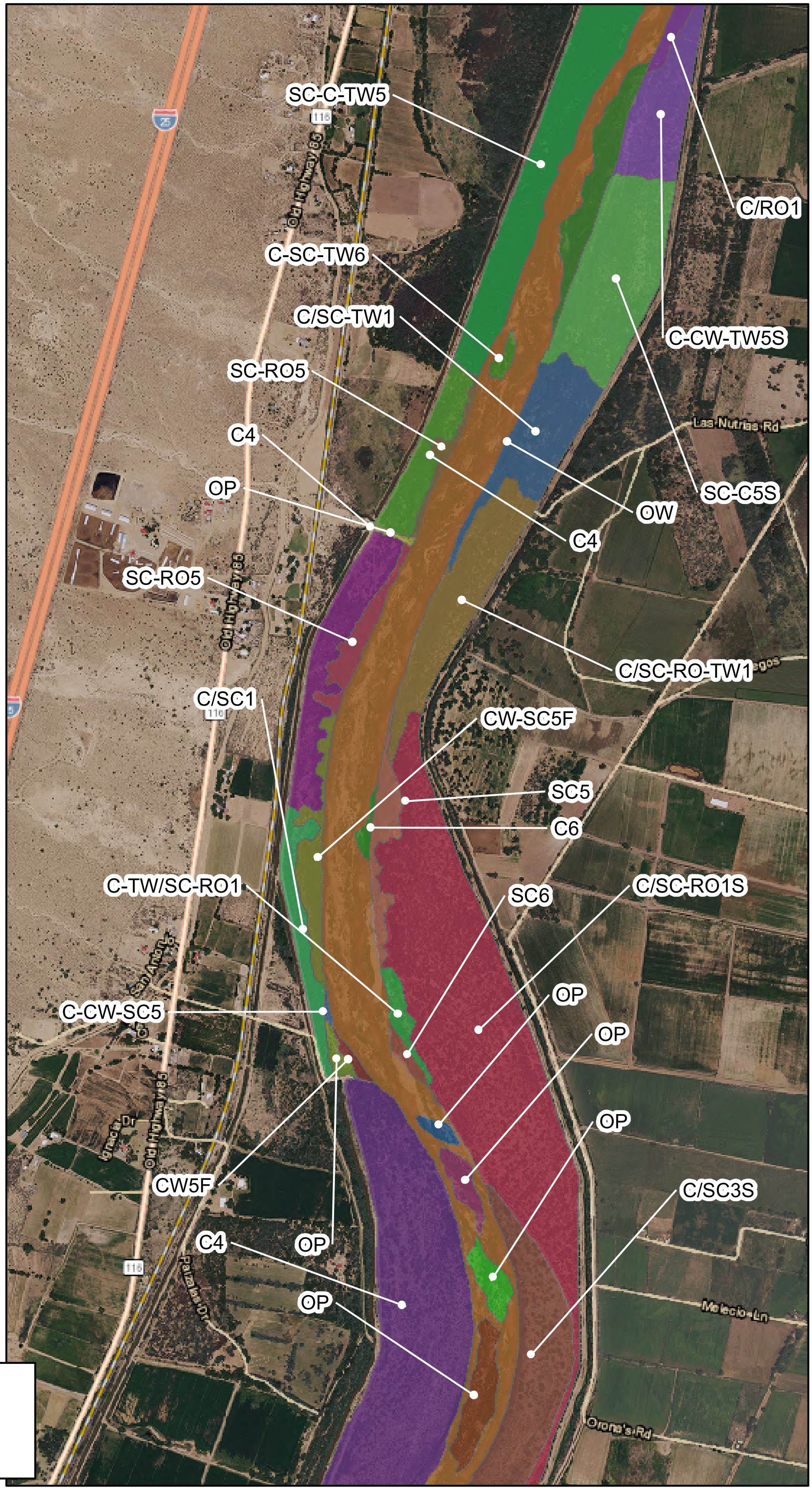

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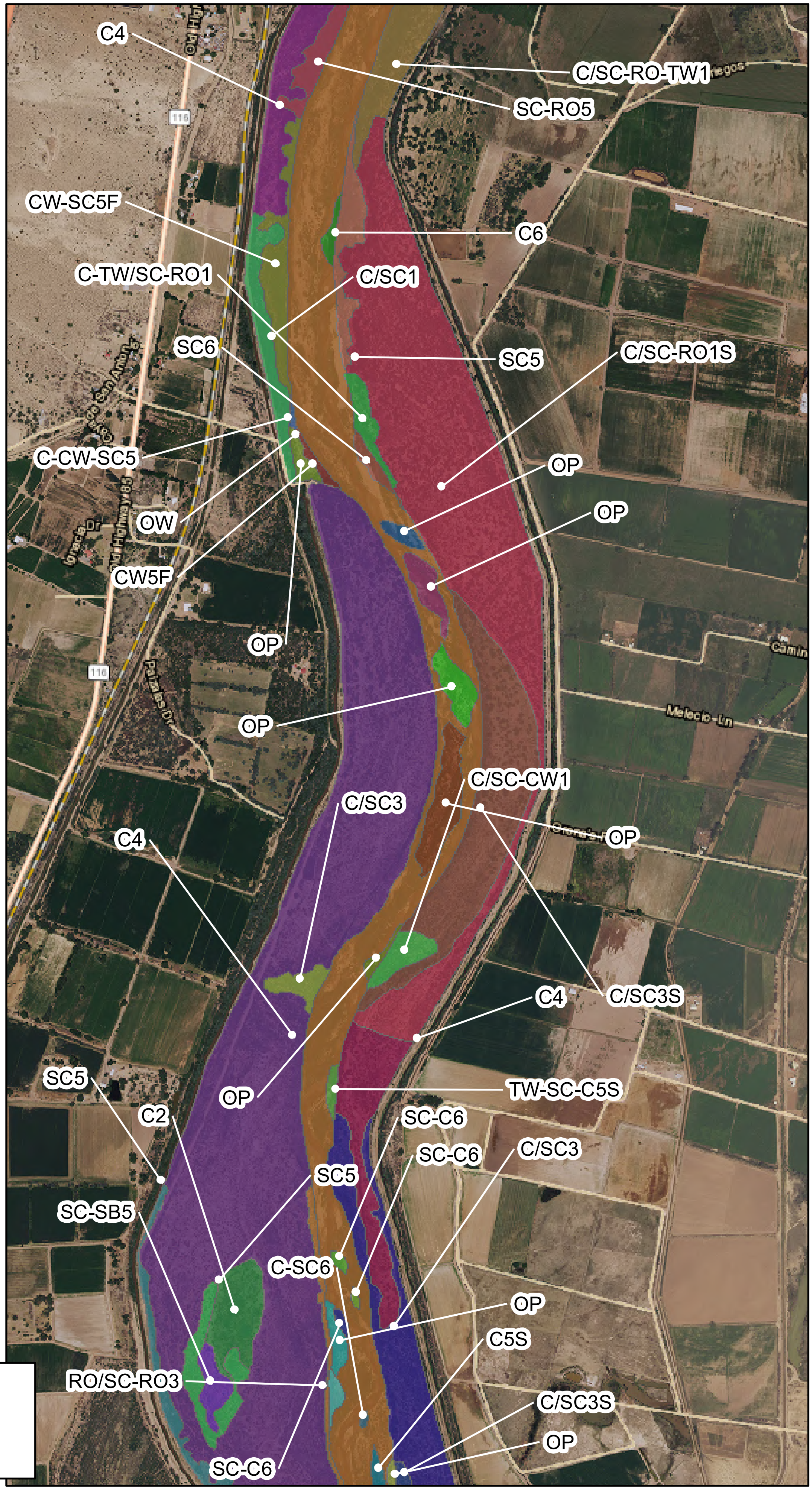
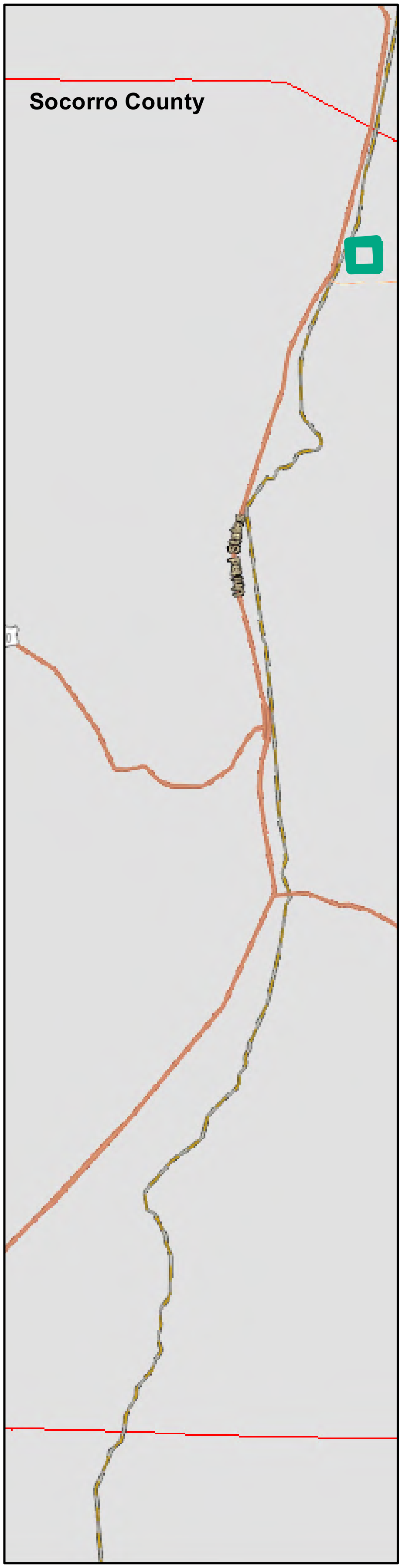
Hink and Ohmart Vegetation Type

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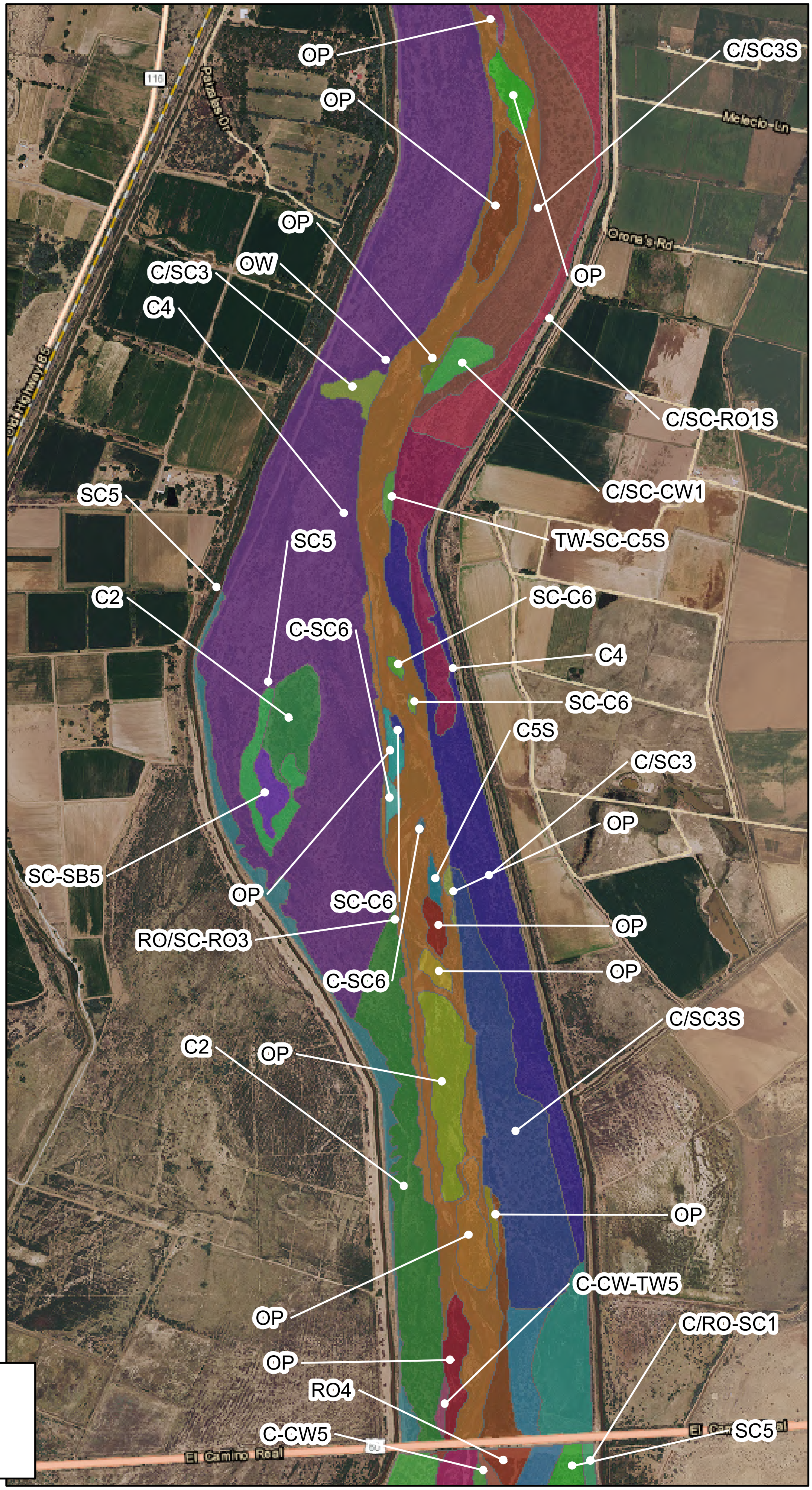
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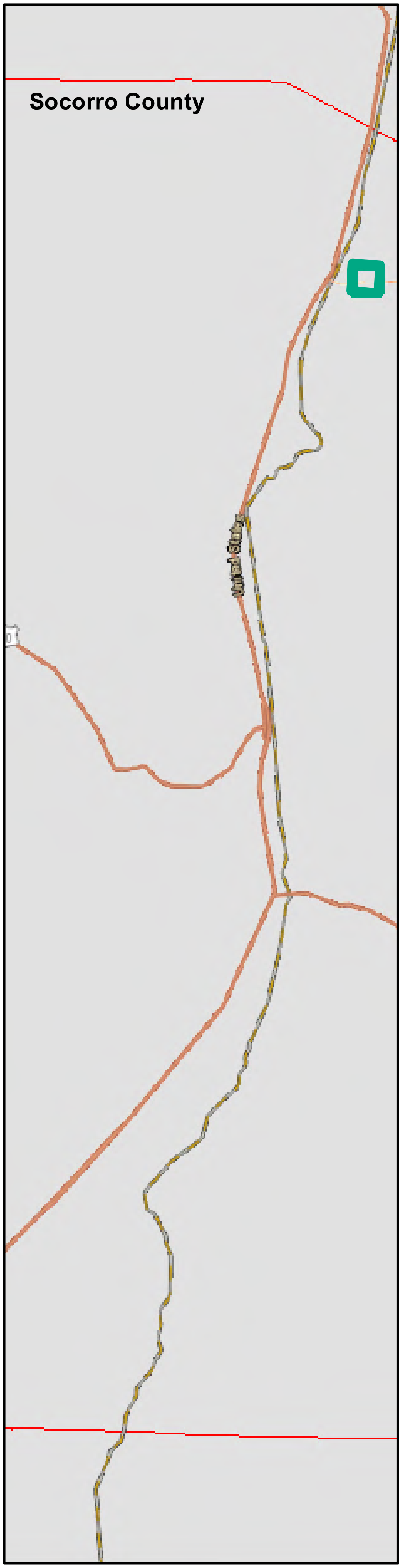
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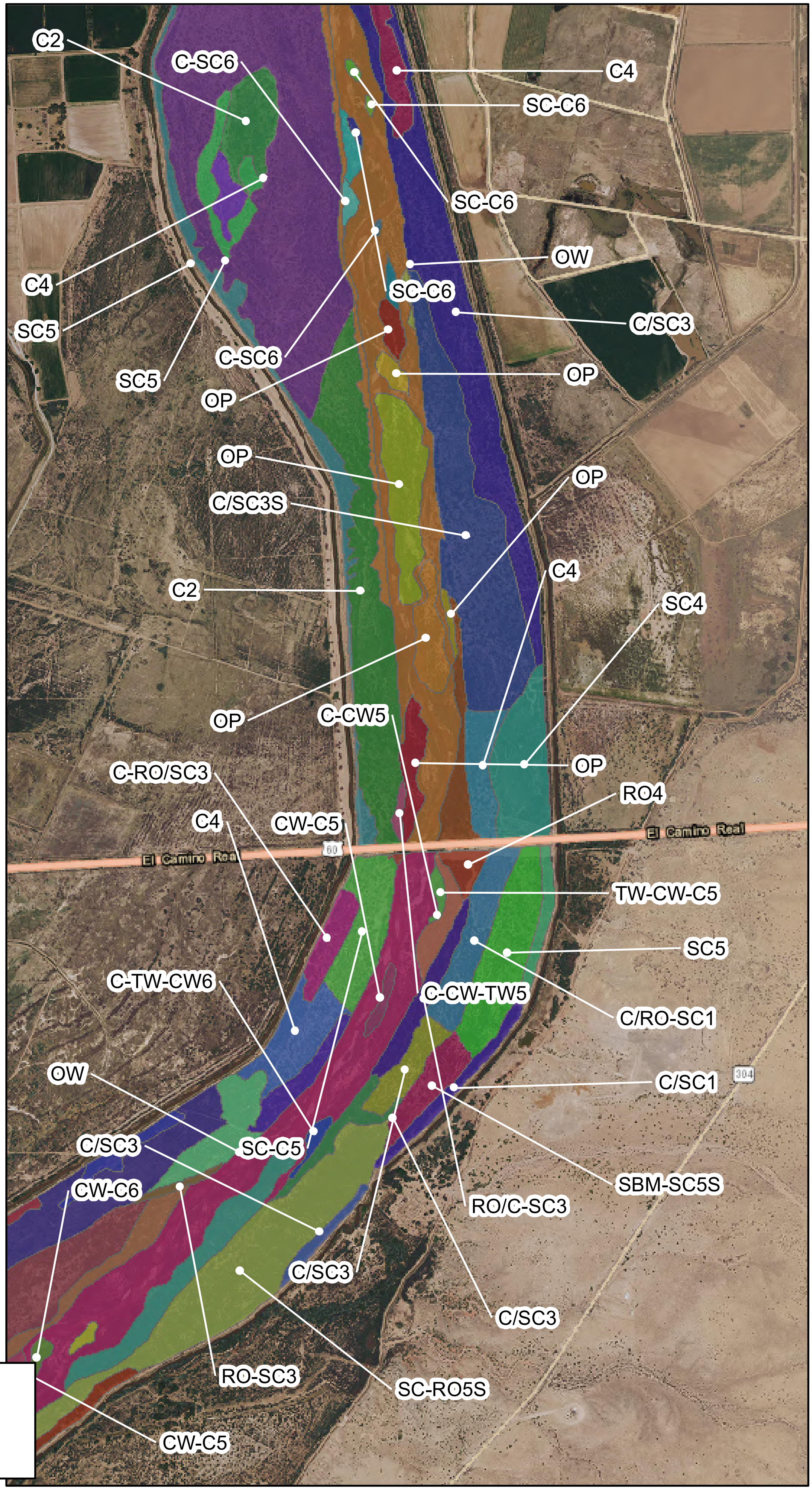
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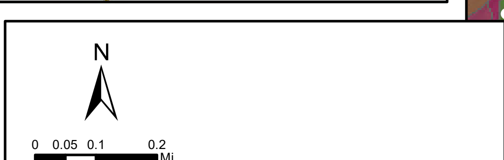
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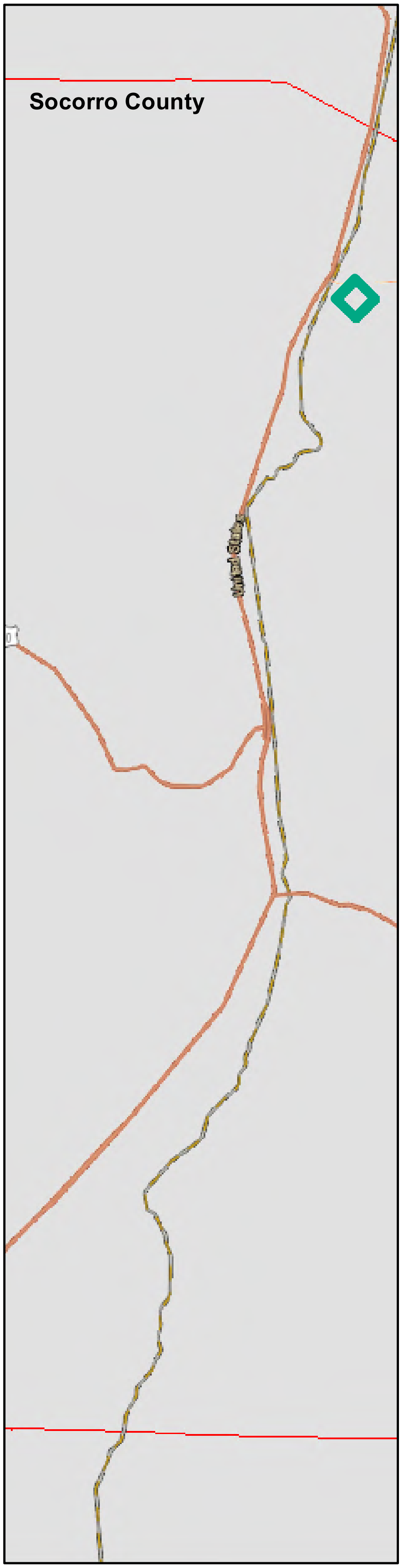
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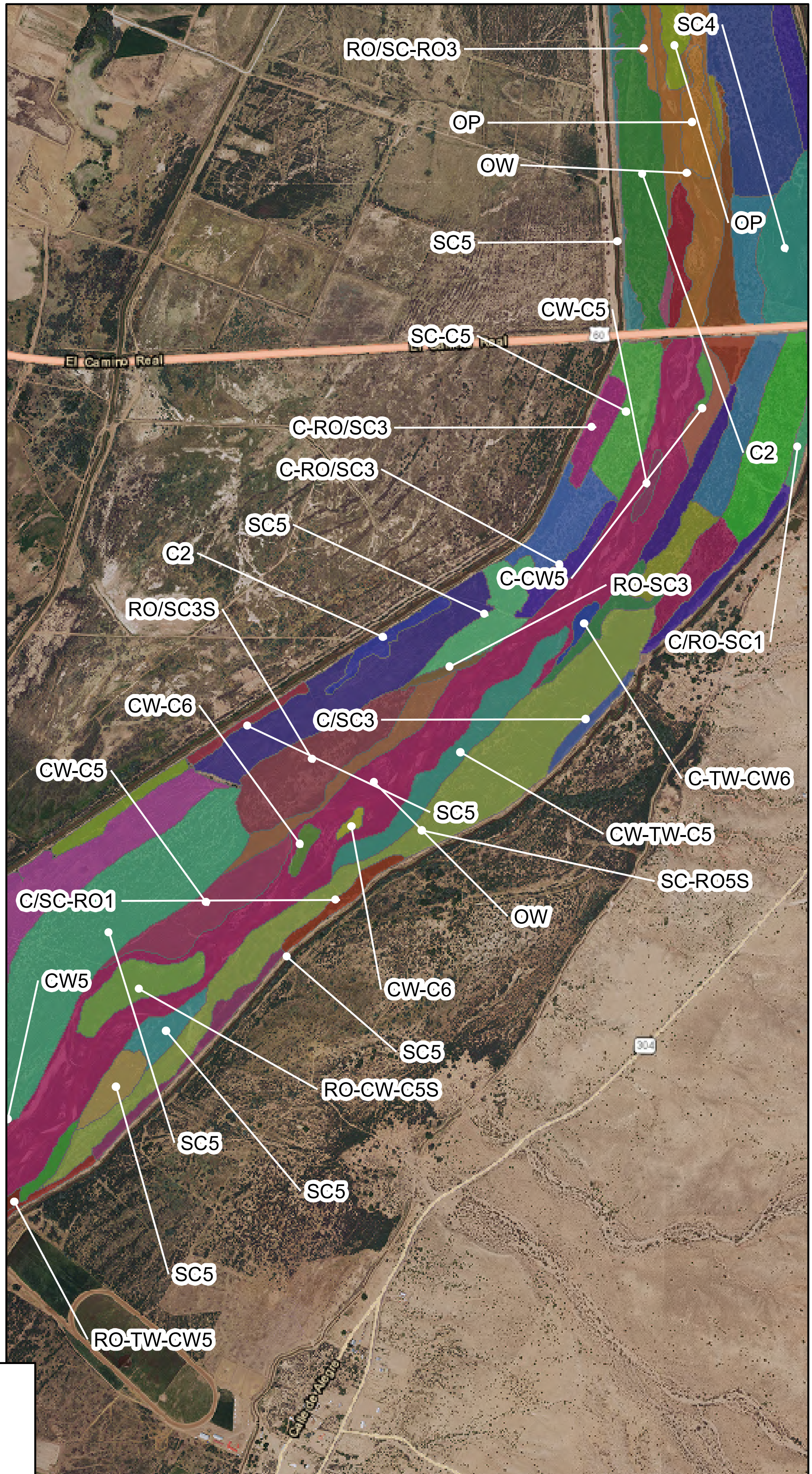
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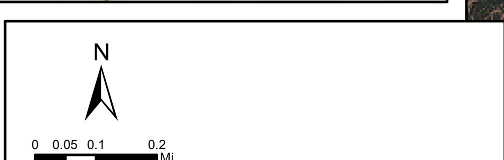
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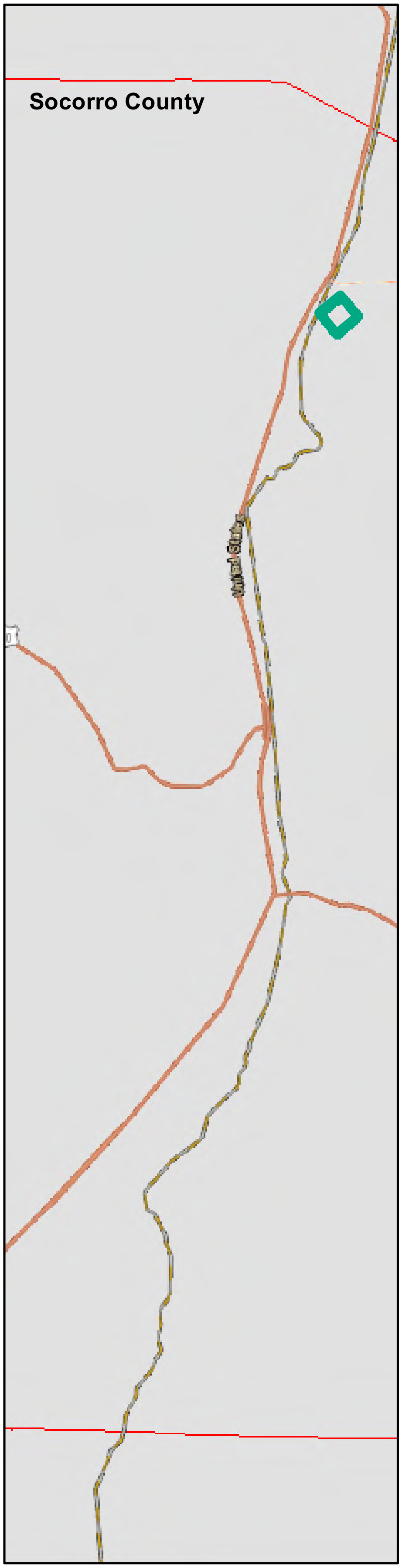
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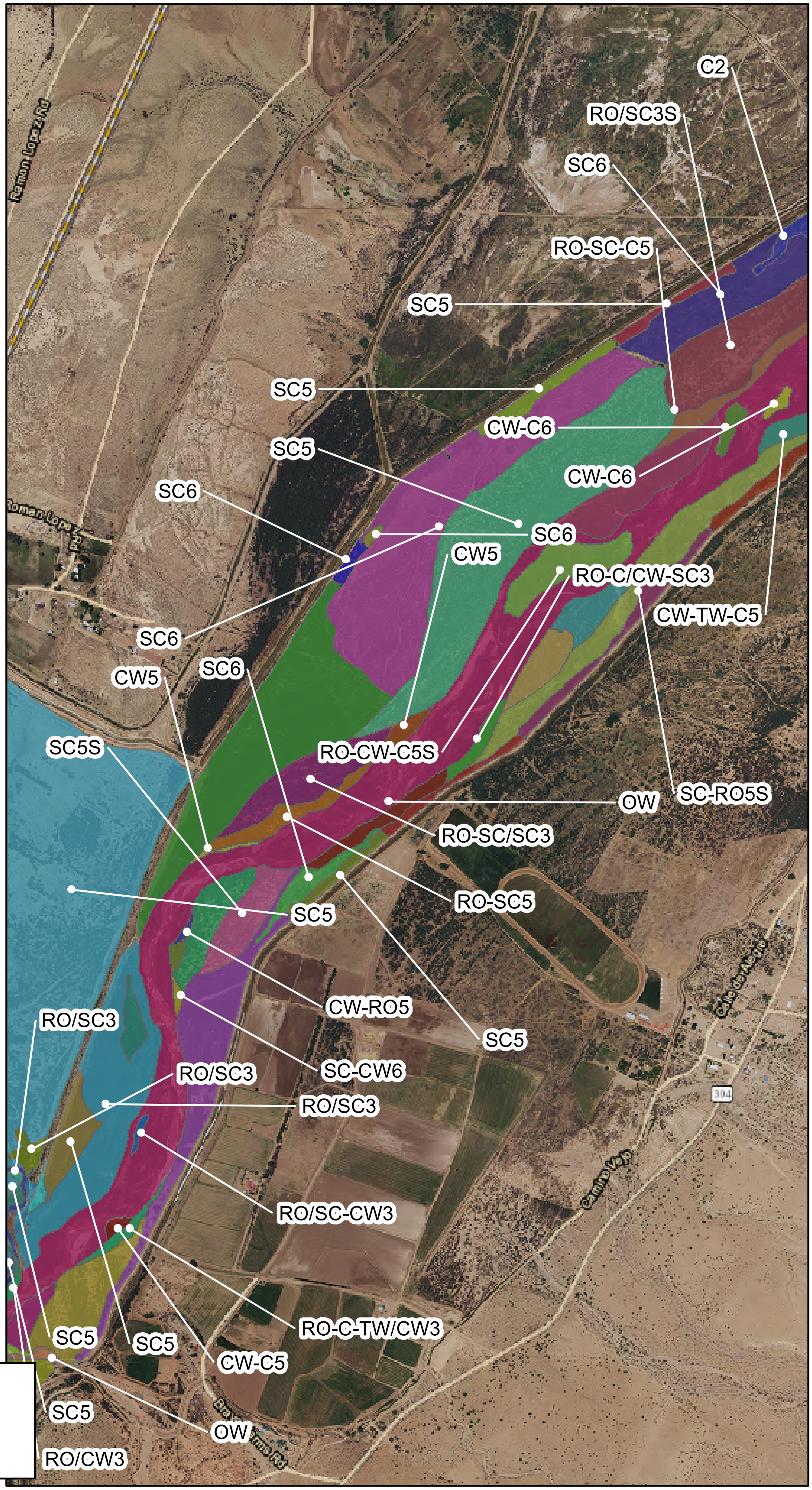
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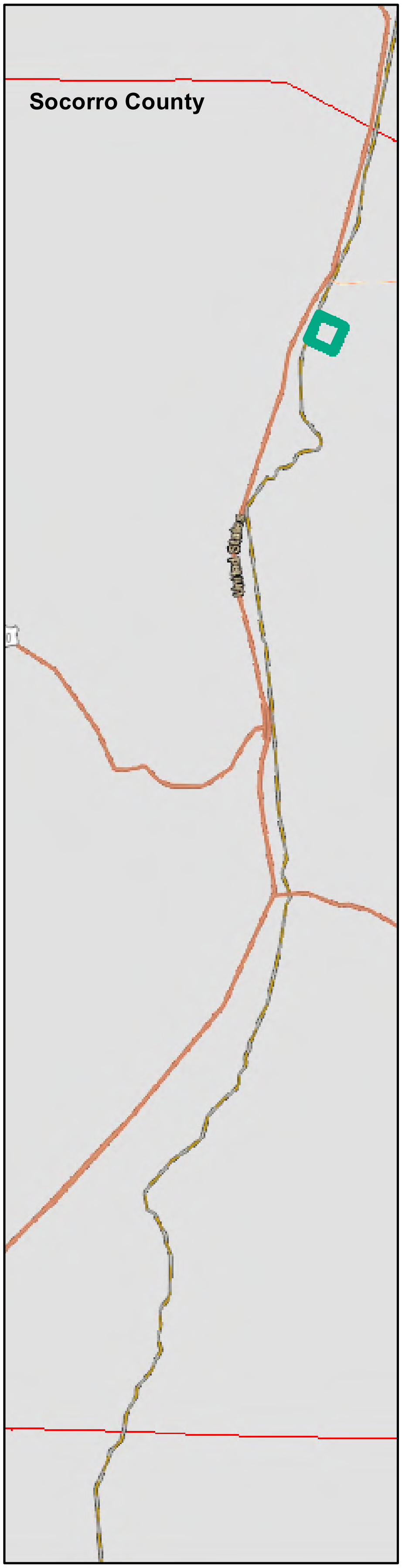
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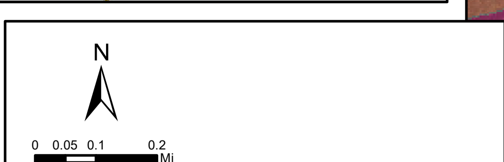
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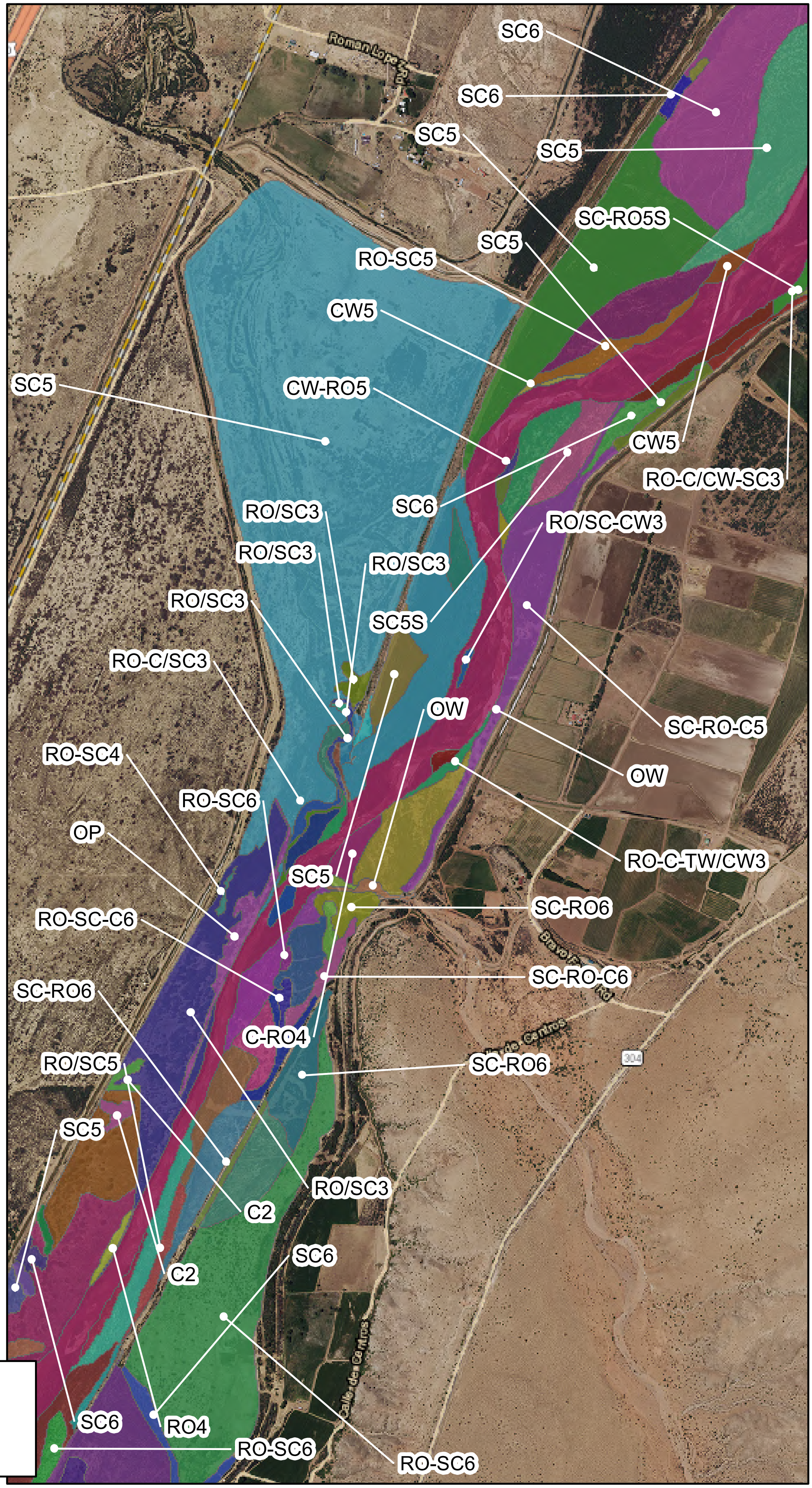
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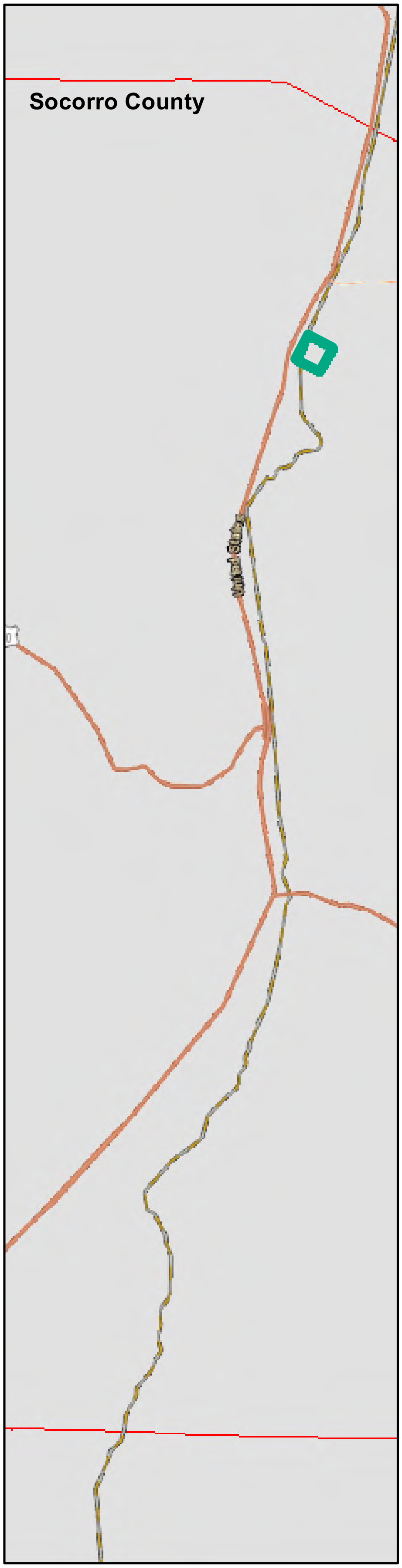
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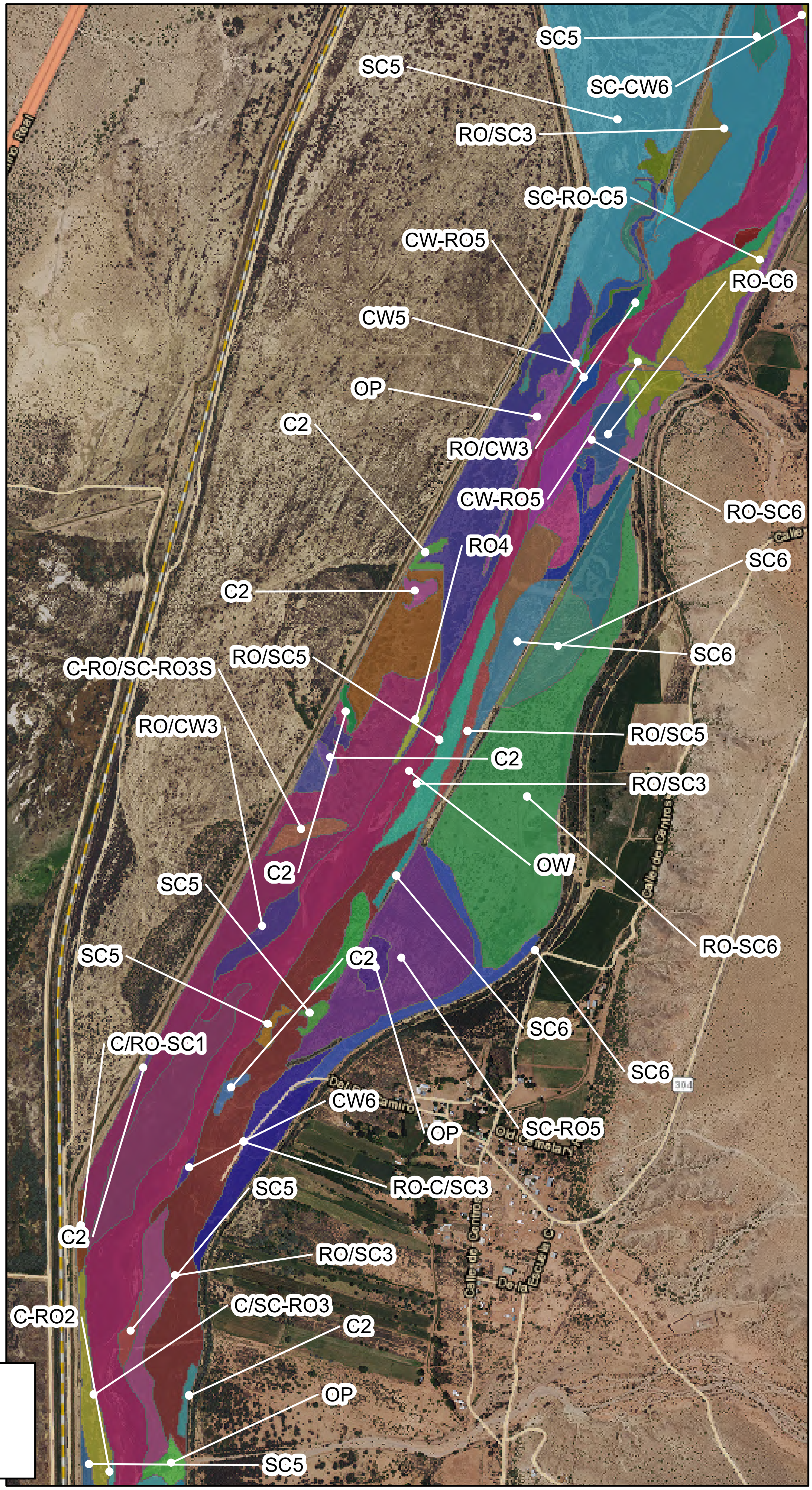
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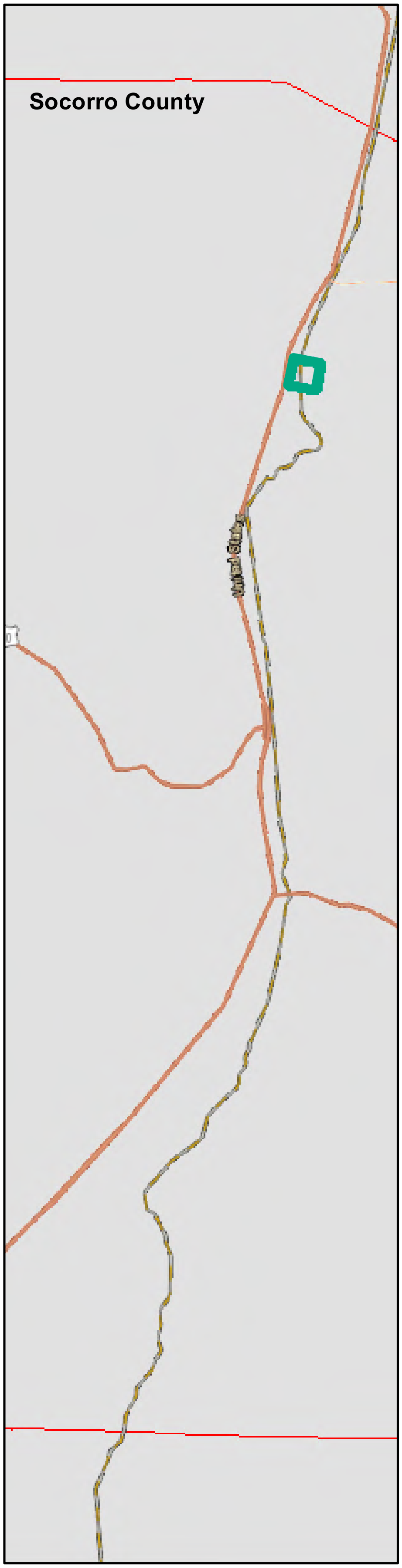
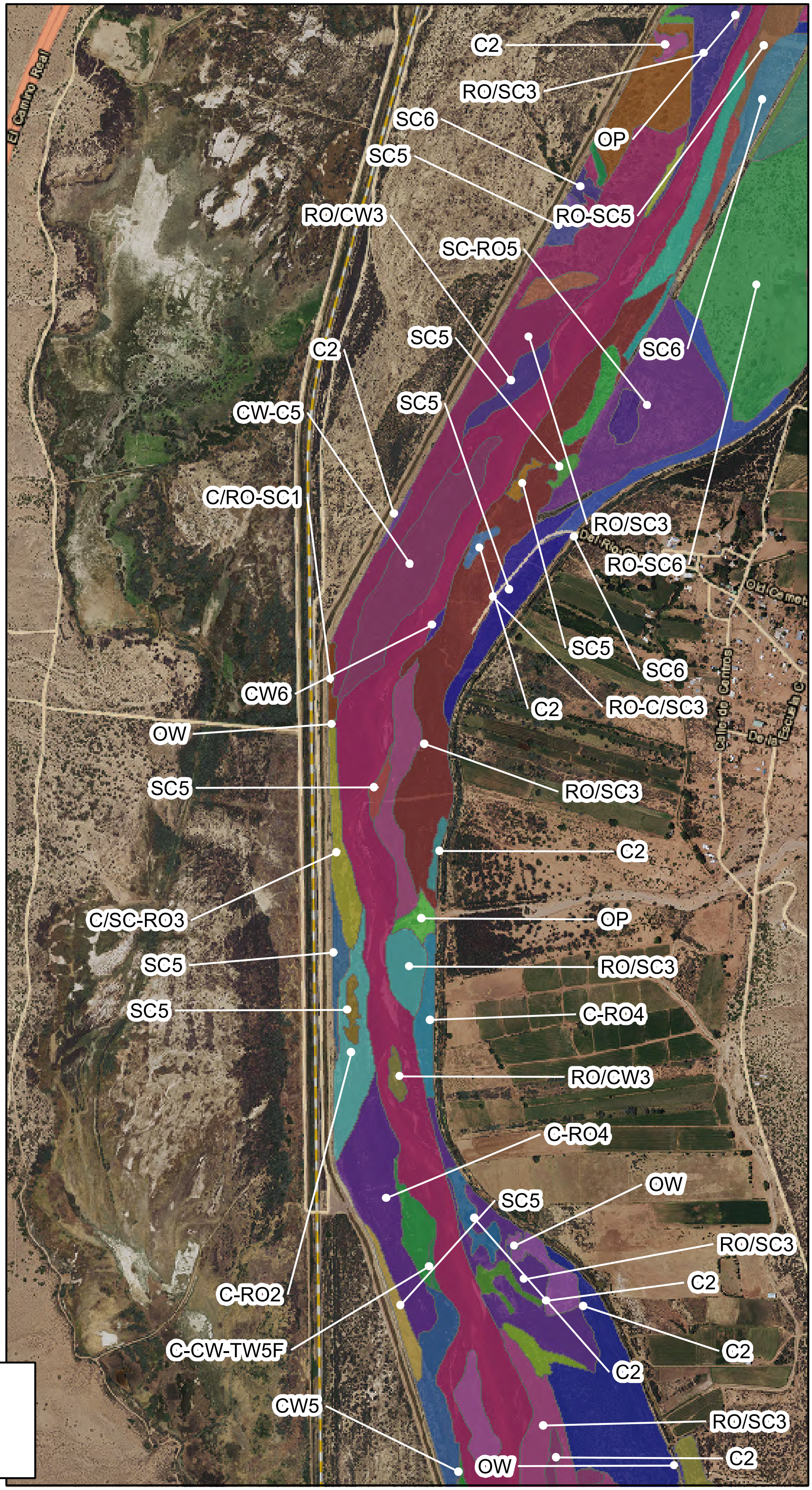
CW6
OP
SC-RO5
RO-C/SC3
SC5
C2
RO/SC3
C-RO2
C/SC-RO3
C2
OP
SC5


N
0 0.05 0.1 0.2
Mi

2002
Hink and Ohmart Vegetation Type

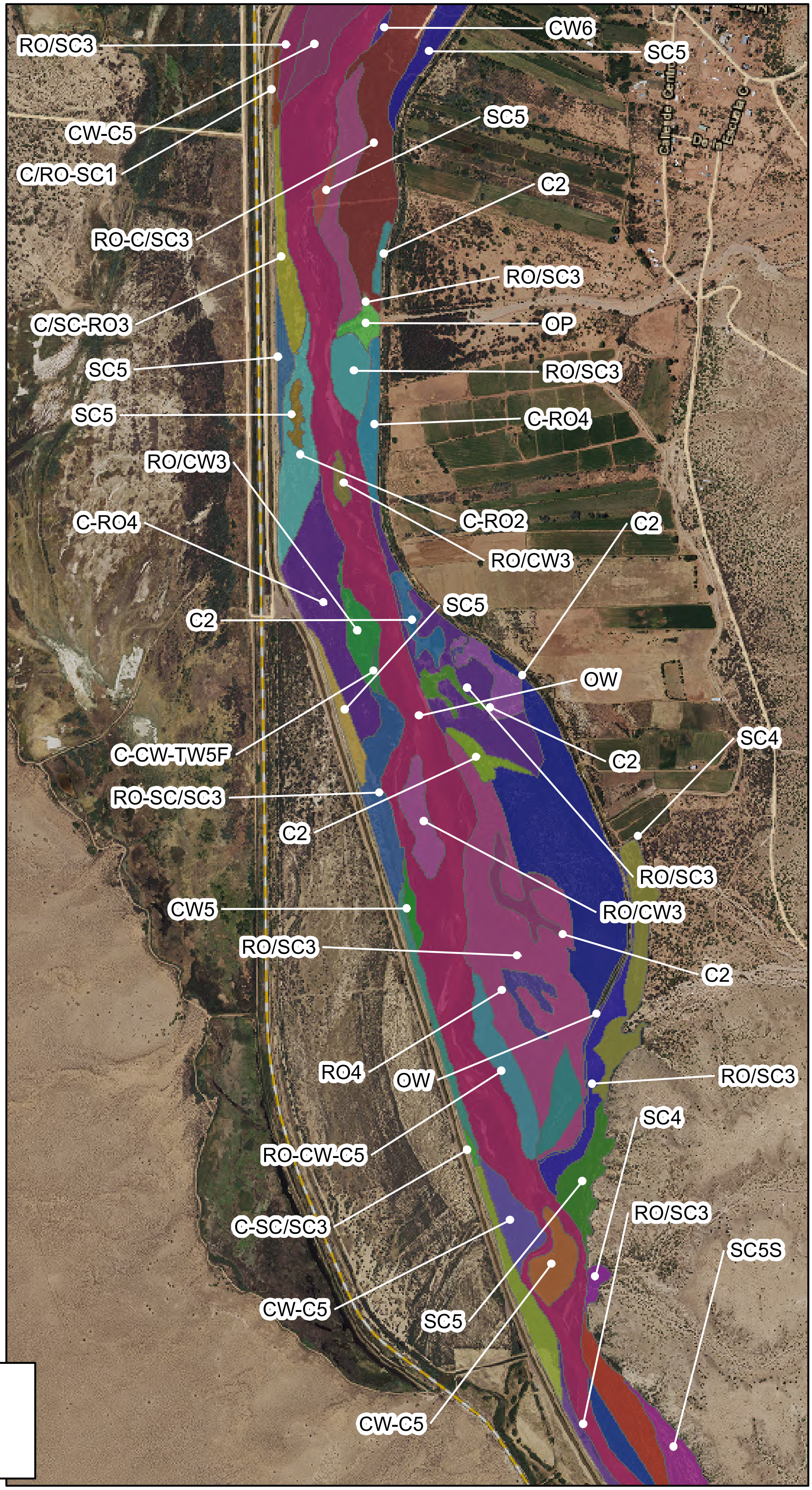
Locator Map



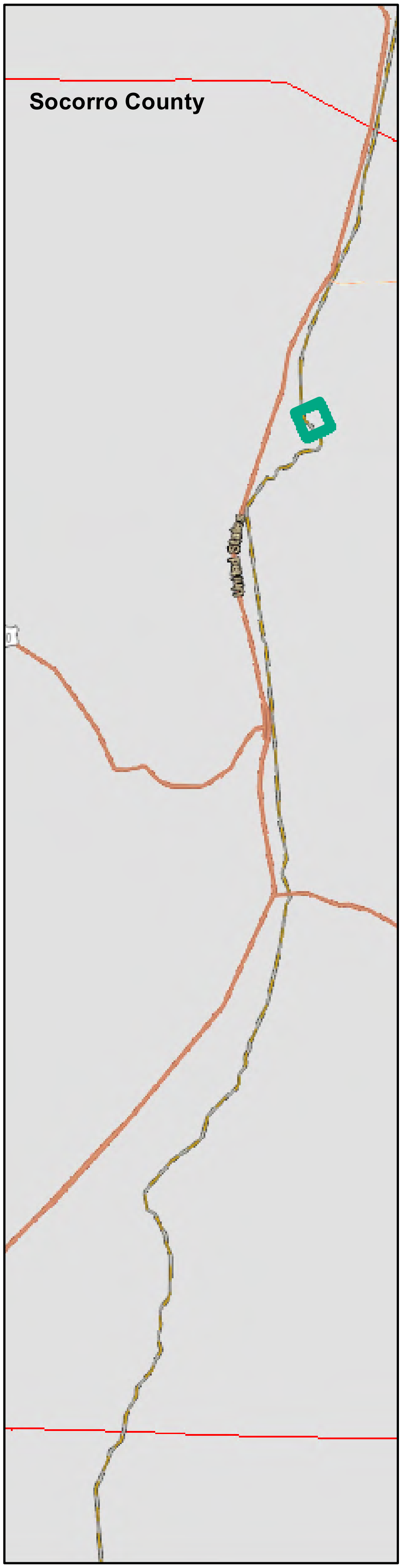


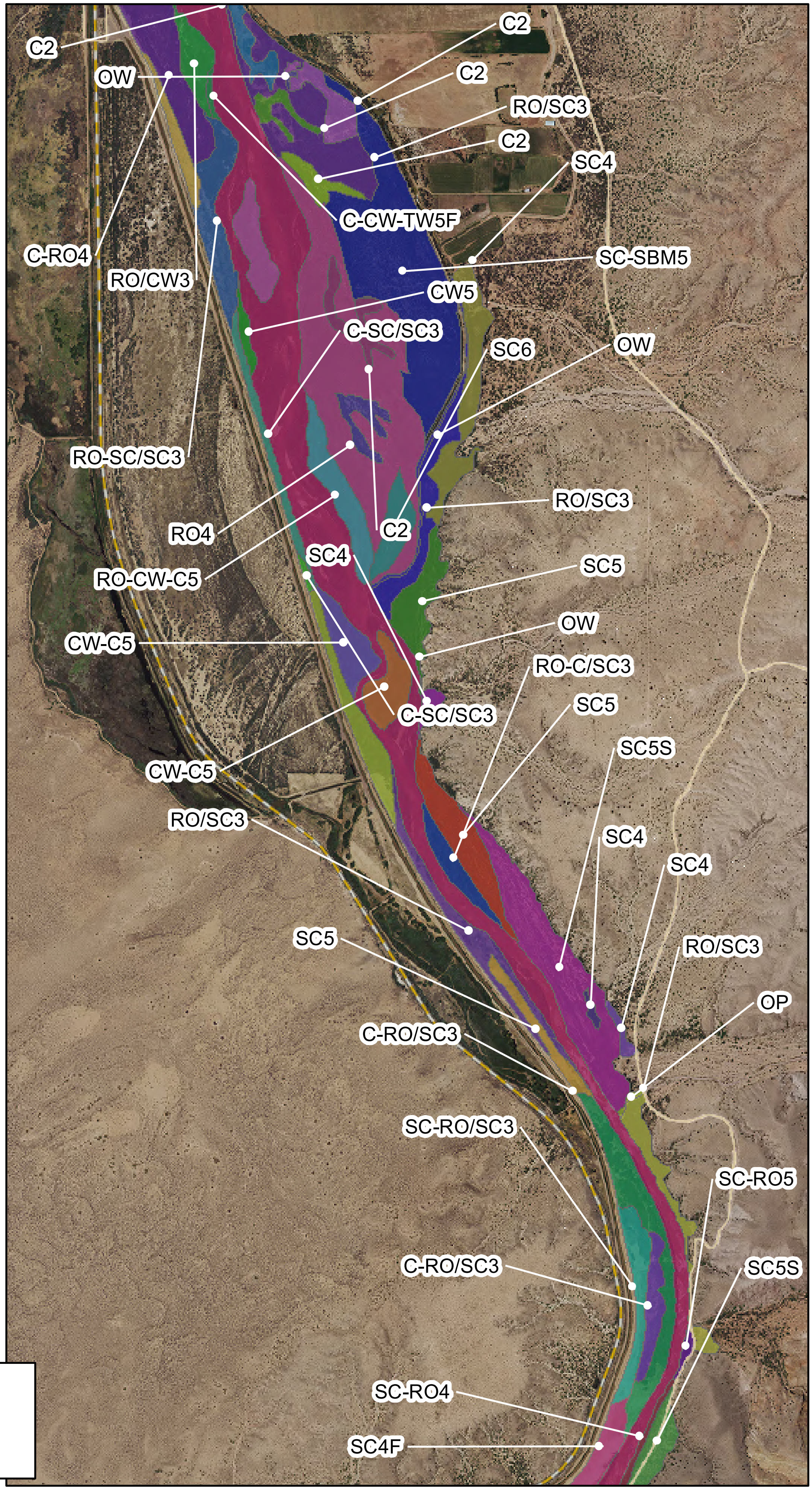
Locator Map

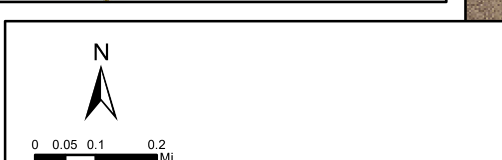

Socorro County
N
0 0.05 0.1 0.2
Mi


RO/SC3
CW6
SC5
CW-C5
C/RO-SC1
SC5
RO-C/SC3
C2
RO/SC3
C/SC-RO3
OP
SC5
RO/SC3
SC5
C-RO4
RO/CW3
C-RO2
C-RO4
C2
RO/CW3
C2
SC5
OW
C-CW-TW5F
C2
SC4
RO-SC/SC3
C2
RO/SC3
RO/CW3
CW5
RO/SC3
C2
RO4
OW
RO/SC3
SC4
RO-CW-C5
RO/SC3
C-SC/SC3
SC5S
CW-C5
SC5
CW-C5

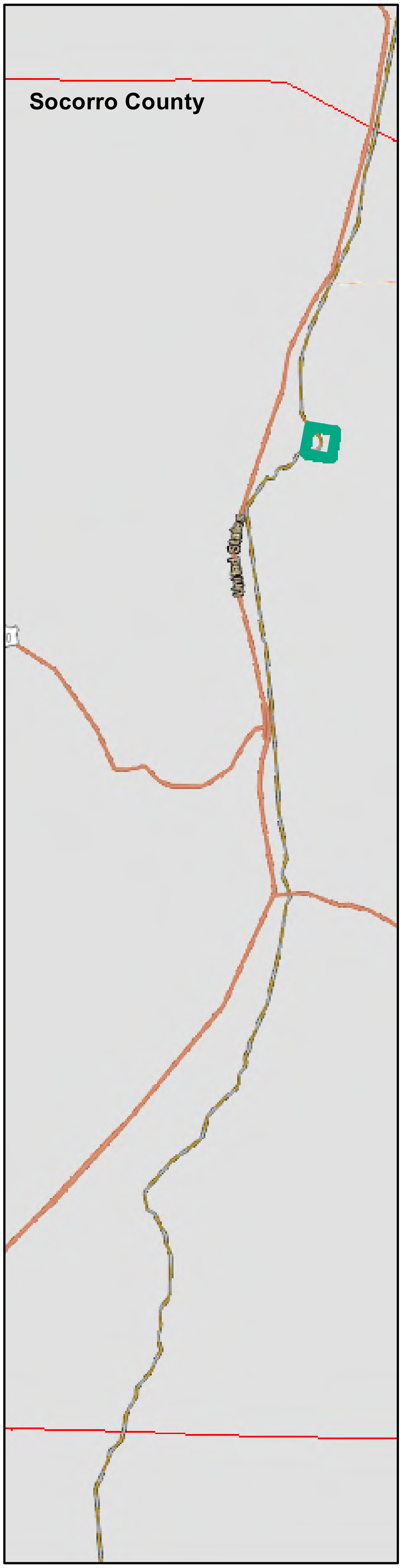
Locator Map

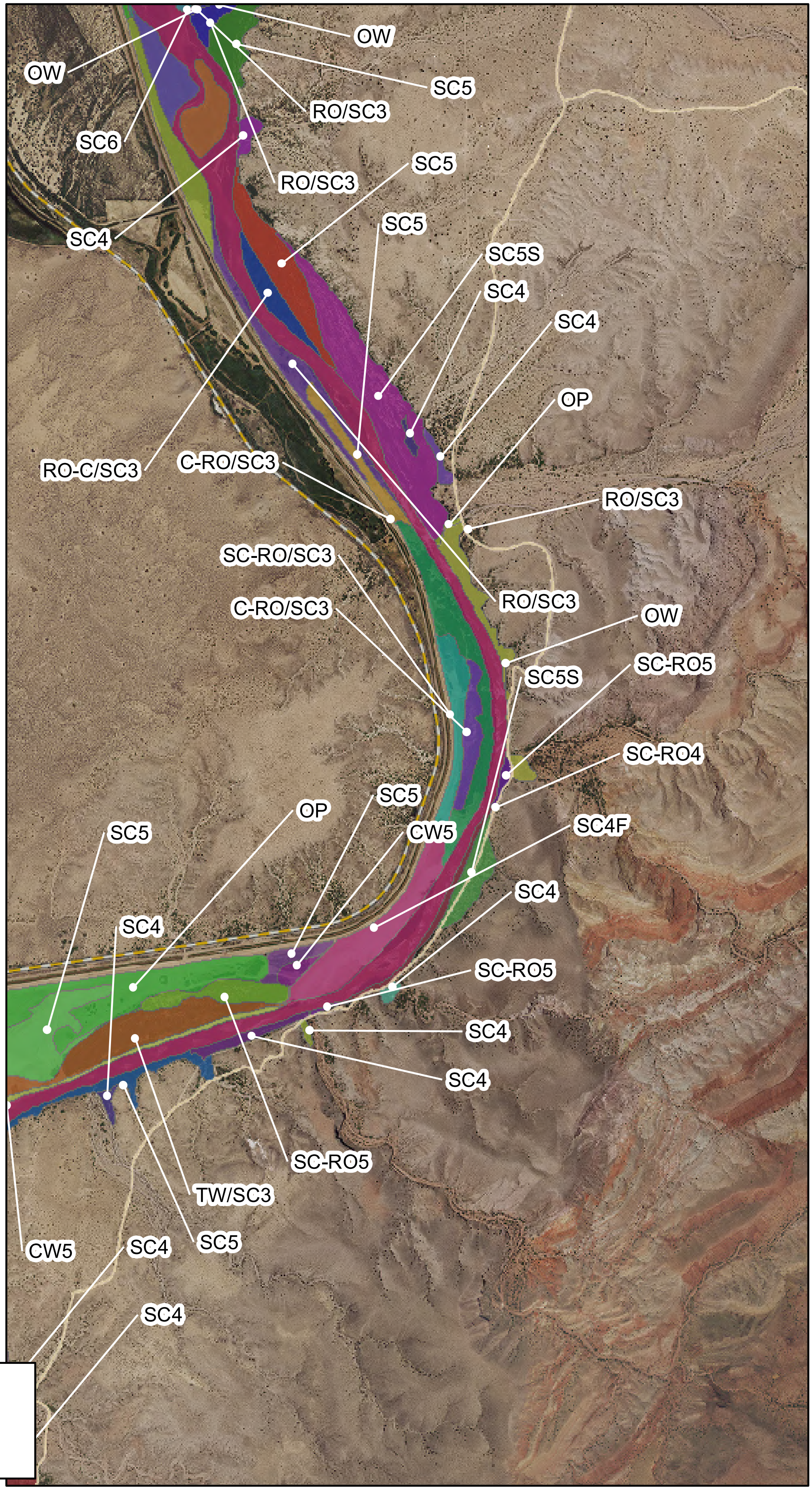

Socorro County


C2
OW
C2
C2
RO/SC3
C2
SC4
C-CW-TW5F
C-RO4
RO/CW3
SC-SBM5
CW5
C-SC/SC3
SC6
OW
RO-SC/SC3
RO/SC3
RO4
C2
SC4
RO-CW-C5
SC5
OW
CW-C5
RO-C/SC3
C-SC/SC3
SC5
SC5S
CW-C5
RO/SC3
SC4
SC4
SC5
RO/SC3
OP
C-RO/SC3
SC-RO/SC3
SC-RO5
C-RO/SC3
SC5S
SC-RO4
SC4F


N
0 0.05 0.1 0.2
Mi

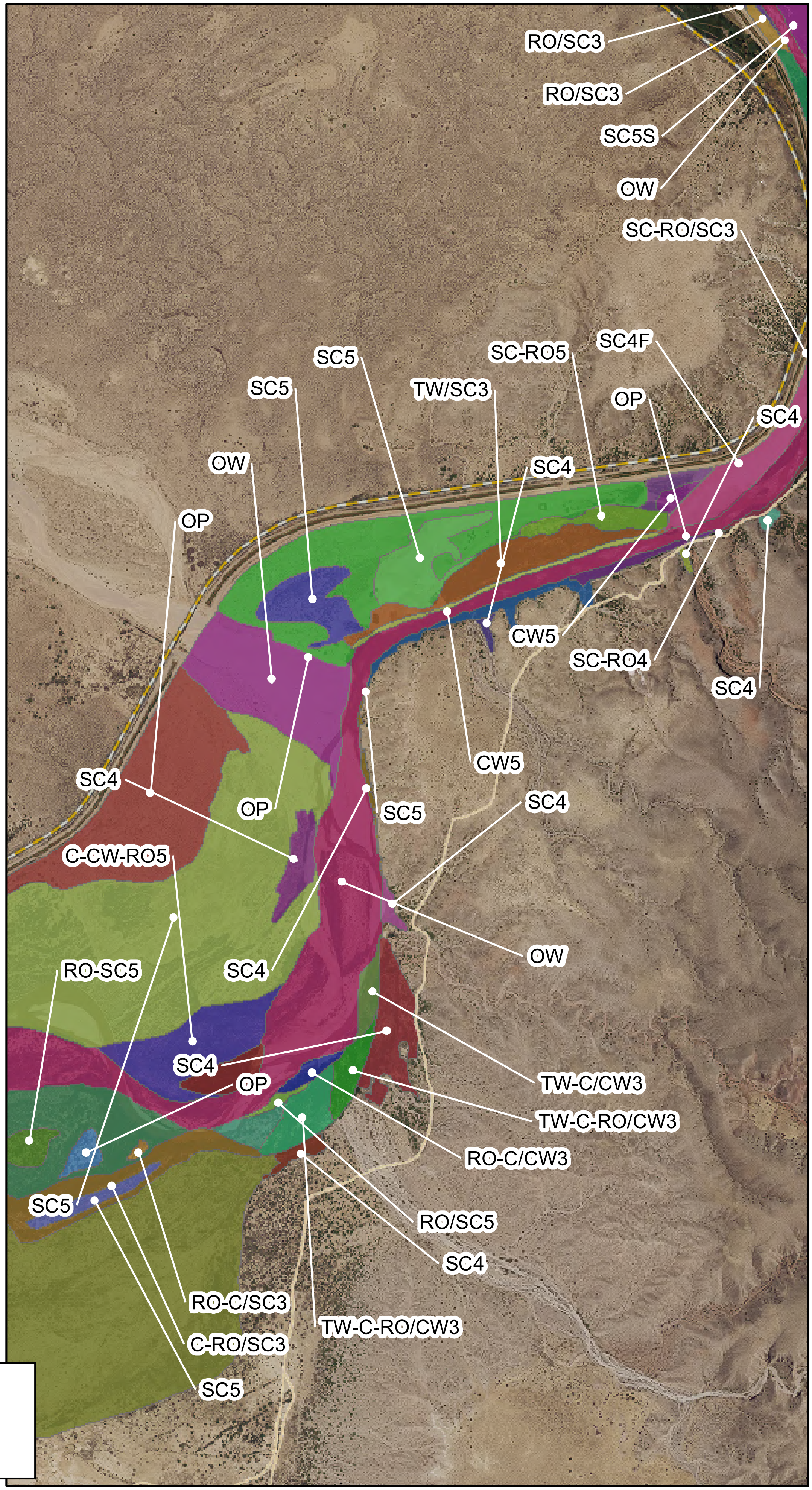
Locator Map


Socorro County


OW
OW
SC5
SC6
RO/SC3
SC5
RO/SC3
SC4
SC5
SC5S
SC4
SC4
OP
RO-C/SC3
C-RO/SC3
RO/SC3
SC-RO/SC3
RO/SC3
C-RO/SC3
OW
SC5S
SC-RO5
SC-RO4
SC5
OP
SC5
CW5
SC4F
SC4
SC4
SC-RO5
SC4
SC4
SC-RO5
TW/SC3
CW5
SC4
SC5
SC4
N
0 0.05 0.1 0.2
Mi

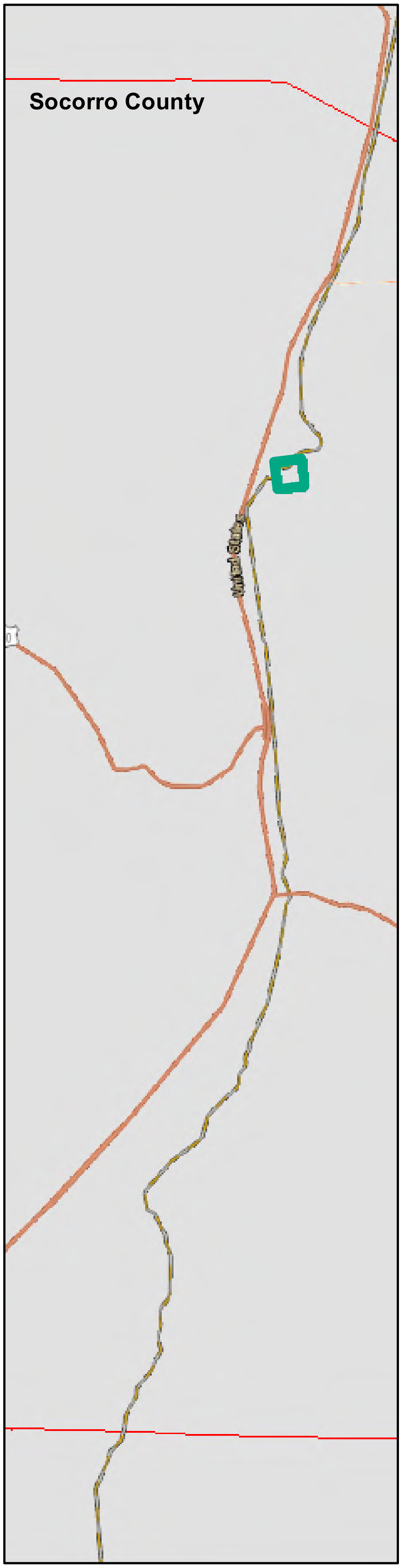
Locator Map

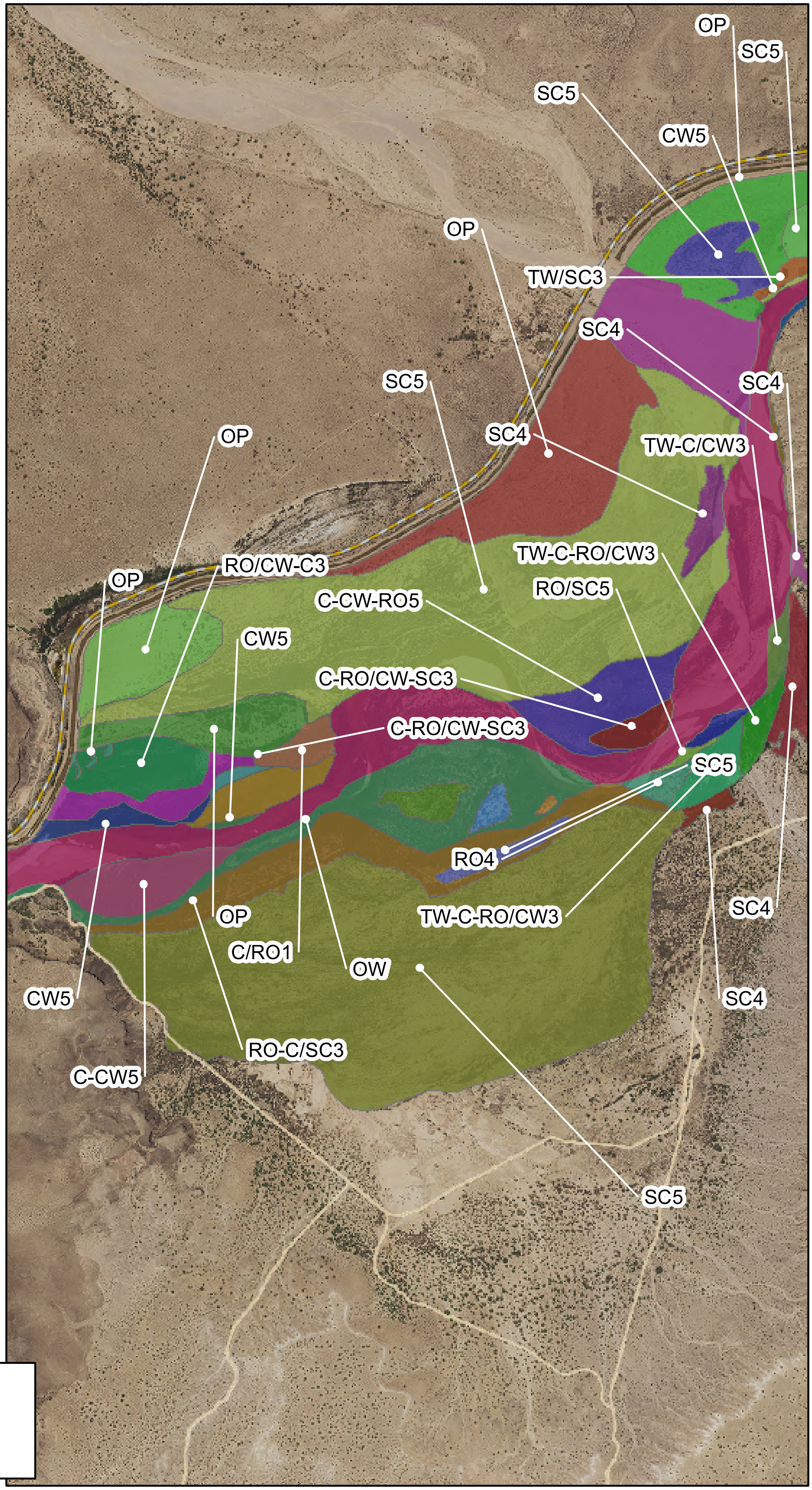
2002
Hink and Ohmart Vegetation Type

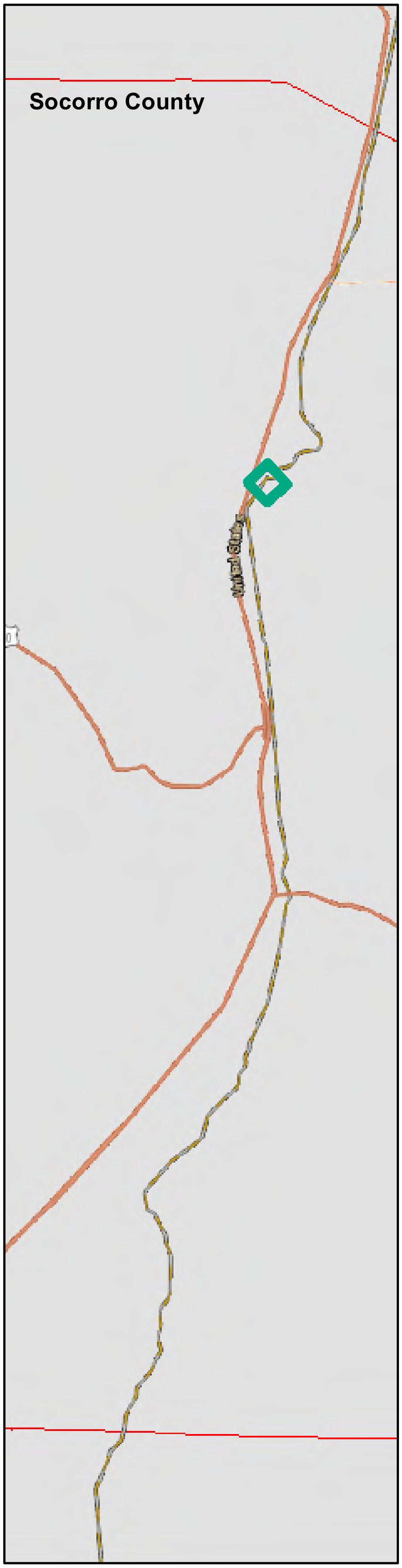


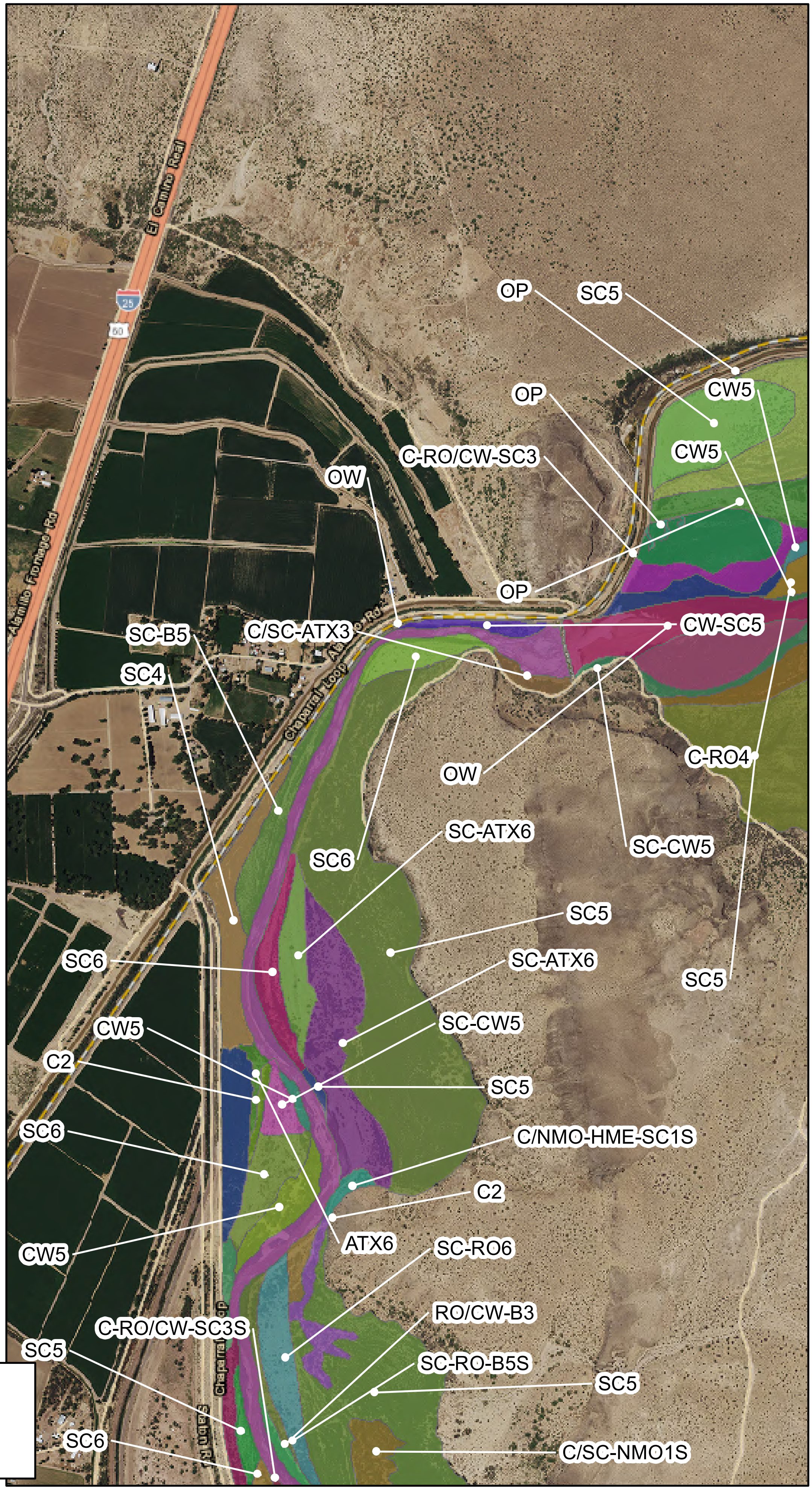
Locator Map

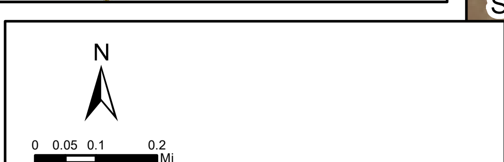
2002
Hink and Ohmart Vegetation Type





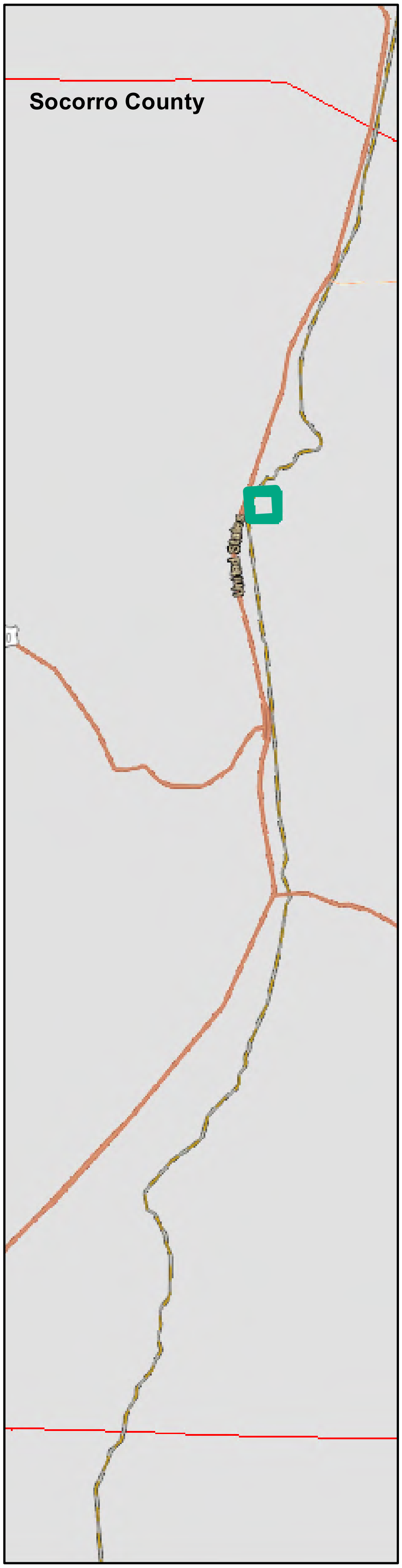

Socorro County

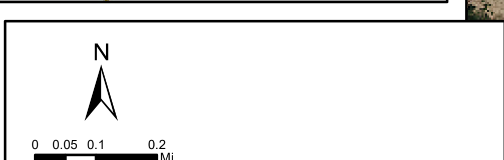

El Camino Real
Alamillo Frontage Rd
Chaparral Loop
OP
SC5
OP
CW5
CW5
C-RO/CW-SC3
OW
OP
CW-SC5
SC-B5
C/SC-ATX3
SC4
OW
C-RO4
SC-ATX6
SC6
SC-CW5
SC5
SC6
SC-ATX6
SC5
CW5
SC-CW5
C2
SC5
SC6
C/NMO-HME-SC1S
C2
CW5
ATX6
SC-RO6
RO/CW-B3
C-RO/CW-SC3S
SC5
SC-RO-B5S
SC5
SC6
C/SC-NMO1S

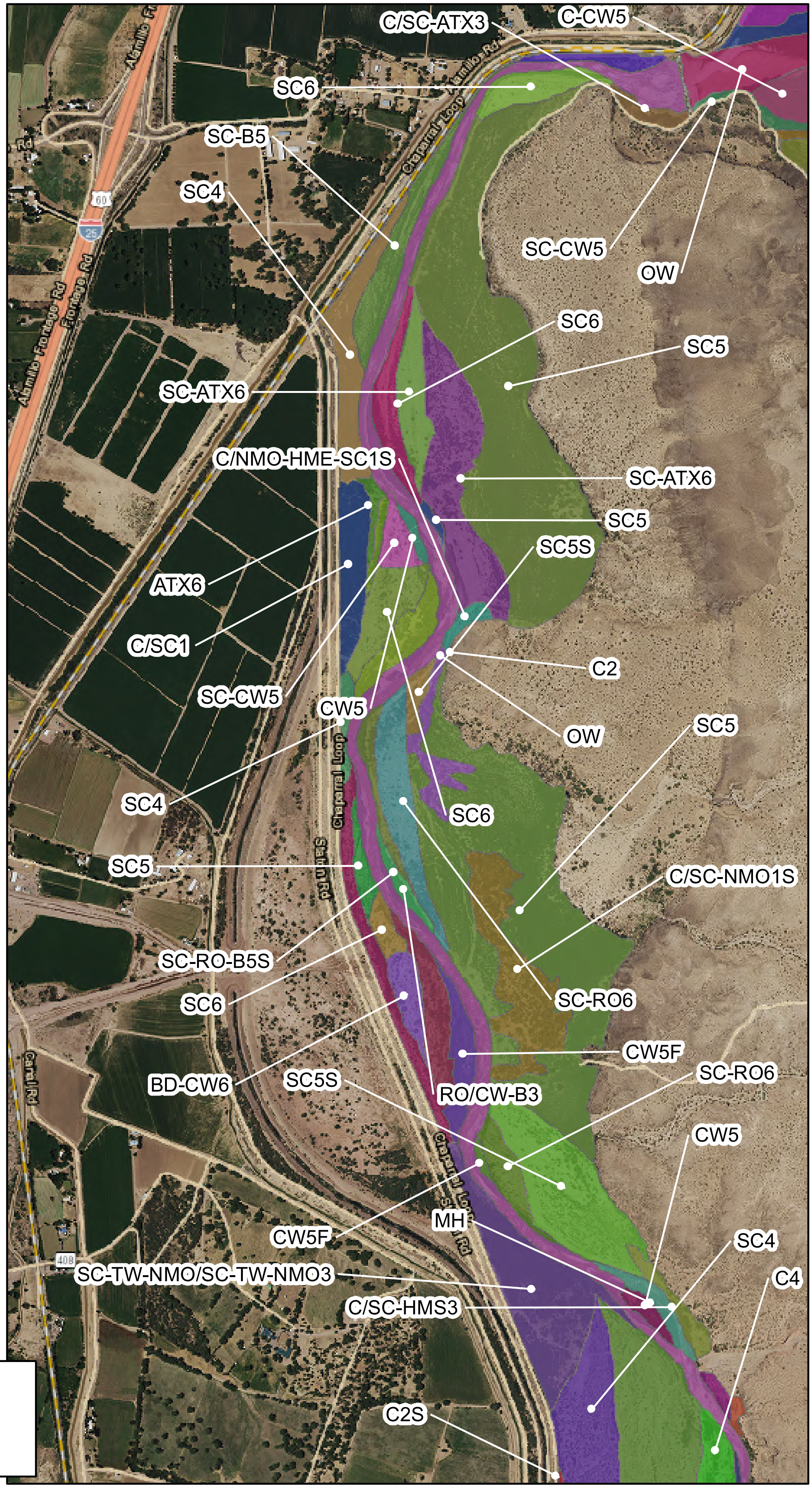

N
0 0.05 0.1 0.2
Mi

Locator Map

2002
Hink and Ohmart Vegetation Type

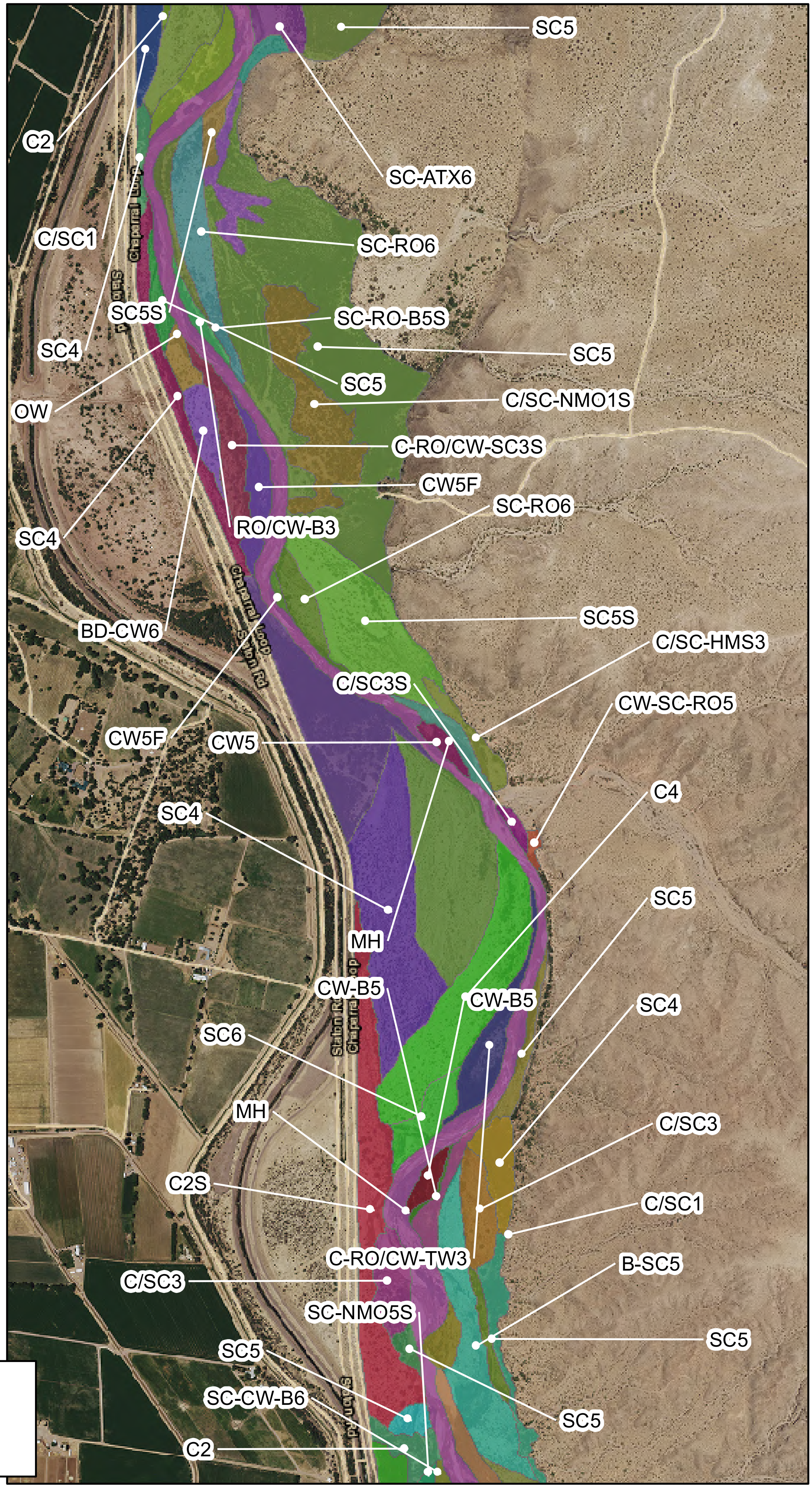




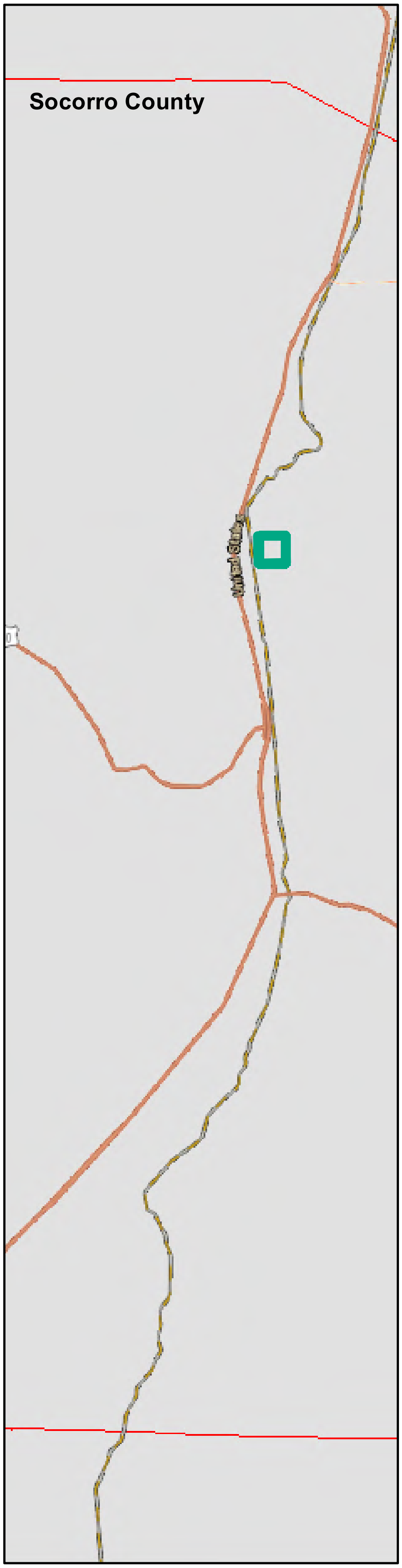


Locator Map

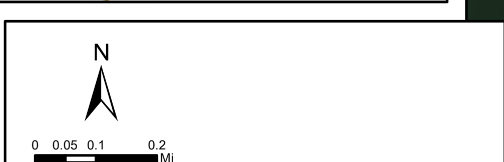

Socorro County
N
0 0.05 0.1 0.2
Mi


SC5
C2
SC-ATX6
C/SC1
SC-RO6
SC5S
SC-RO-B5S
SC4
SC5
SC5
OW
C/SC-NMO1S
C-RO/CW-SC3S
CW5F
SC-RO6
RO/CW-B3
SC4
SC5S
BD-CW6
C/SC-HMS3
C/SC3S
CW-SC-RO5
CW5F
CW5
C4
SC4
SC5
MH
CW-B5
CW-B5
SC4
SC6
MH
C/SC3
C2S
C/SC1
C-RO/CW-TW3
B-SC5
C/SC3
SC-NMO5S
SC5
SC5
SC-CW-B6
SC5
C2

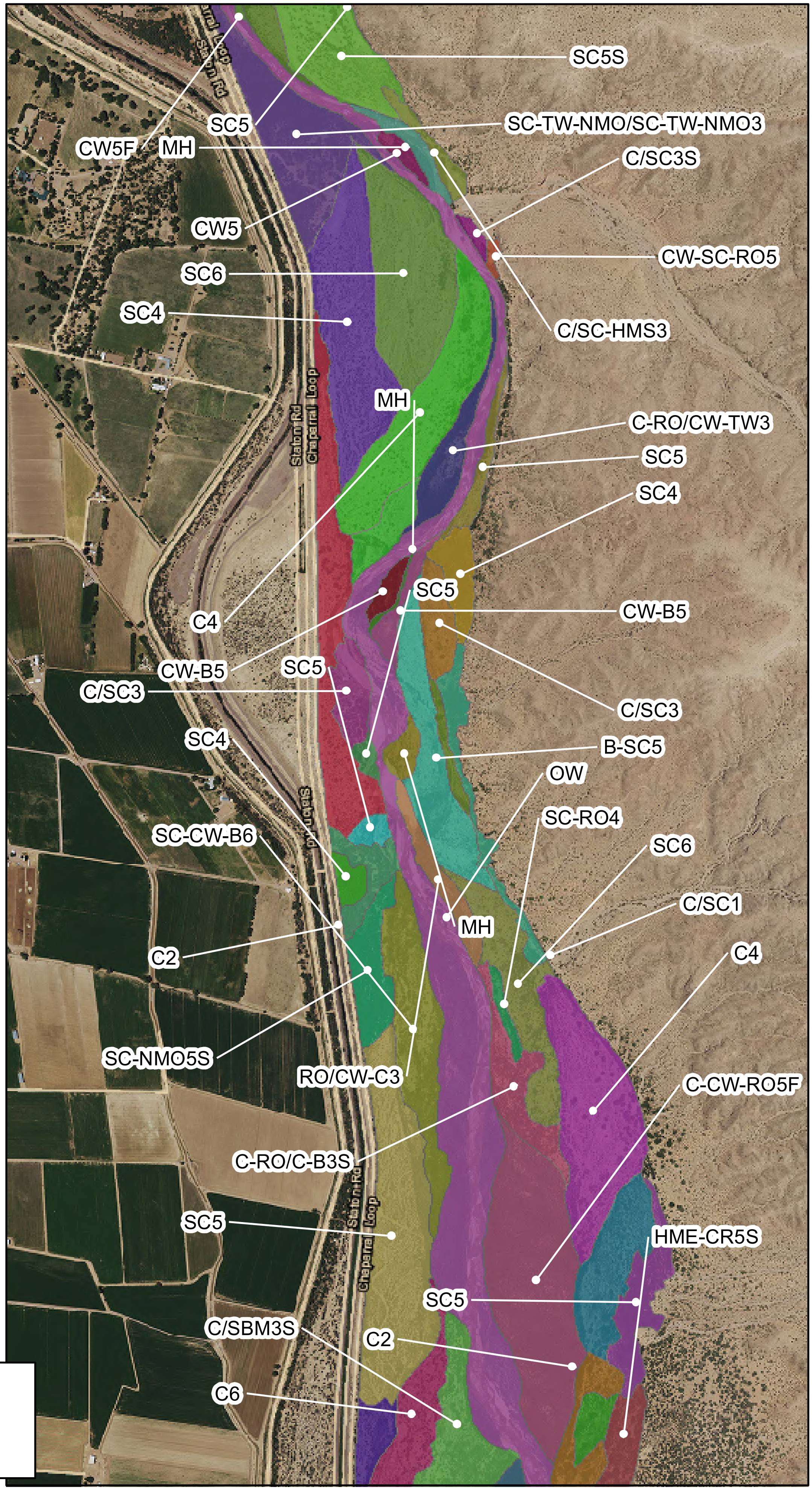
Locator Map



Socorro County

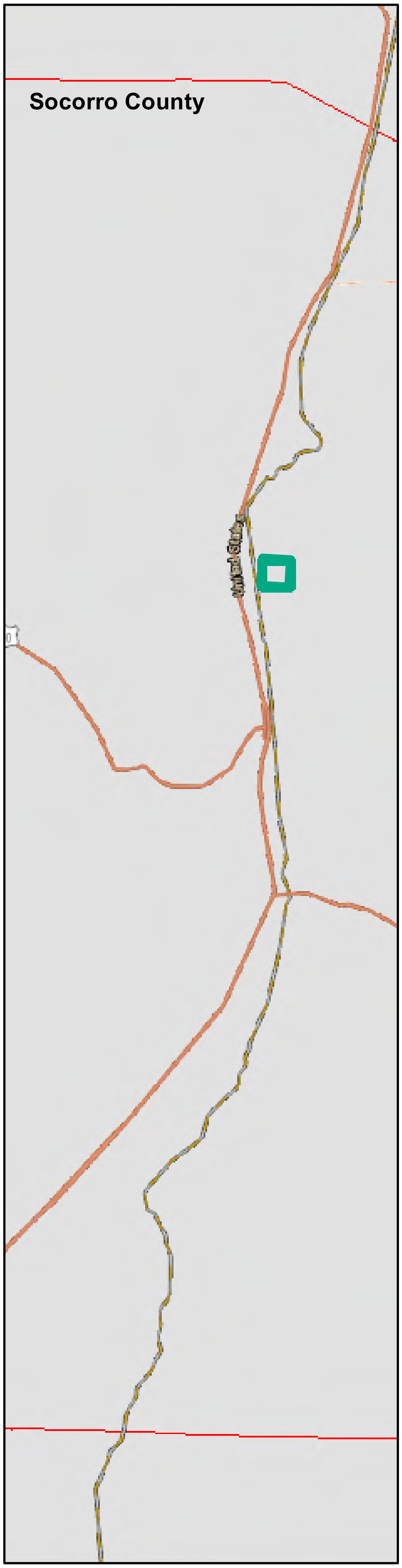


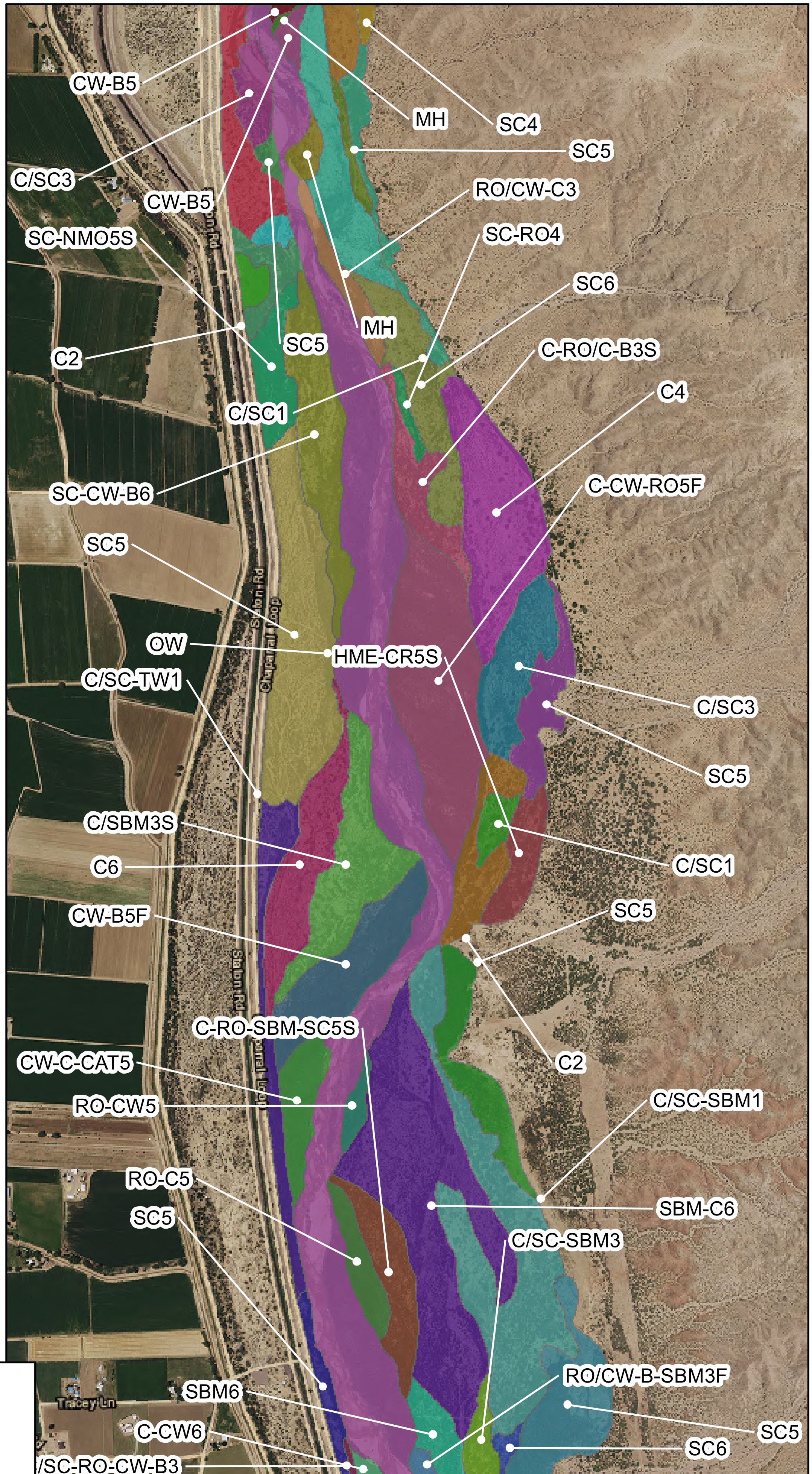
N
0 0.05 0.1 0.2
Mi



SC5S
SC5
SC-TW-NMO/SC-TW-NMO3
CW5F
MH
C/SC3S
CW5
CW-SC-RO5
SC6
SC4
C/SC-HMS3
MH
C-RO/CW-TW3
SC5
SC4
SC5
C4
CW-B5
CW-B5
SC5
C/SC3
C/SC3
SC4
B-SC5
OW
SC-RO4
SC-CW-B6
SC6
MH
C/SC1
C2
C4
SC-NMO5S
RO/CW-C3
C-CW-RO5F
C-RO/C-B3S
SC5
HME-CR5S
SC5
C/SBM3S
C2
C6
Station Rd
Chaparral Loop

Locator Map


Socorro County


CW-B5
MH
SC4
SC5
C/SC3
CW-B5
RO/CW-C3
SC-NMO5S
SC-RO4
SC6
MH
SC5
C2
C-RO/C-B3S
C/SC1
C4
SC-CW-B6
C-CW-RO5F
SC5
OW
HME-CR5S
C/SC-TW1
C/SC3
SC5
C/SBM3S
C/SC1
C6
SC5
CW-B5F
C-RO-SBM-SC5S
C2
CW-C-CAT5
C/SC-SBM1
RO-CW5
RO-C5
SBM-C6
SC5
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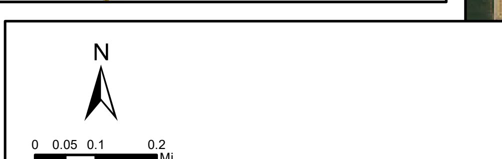
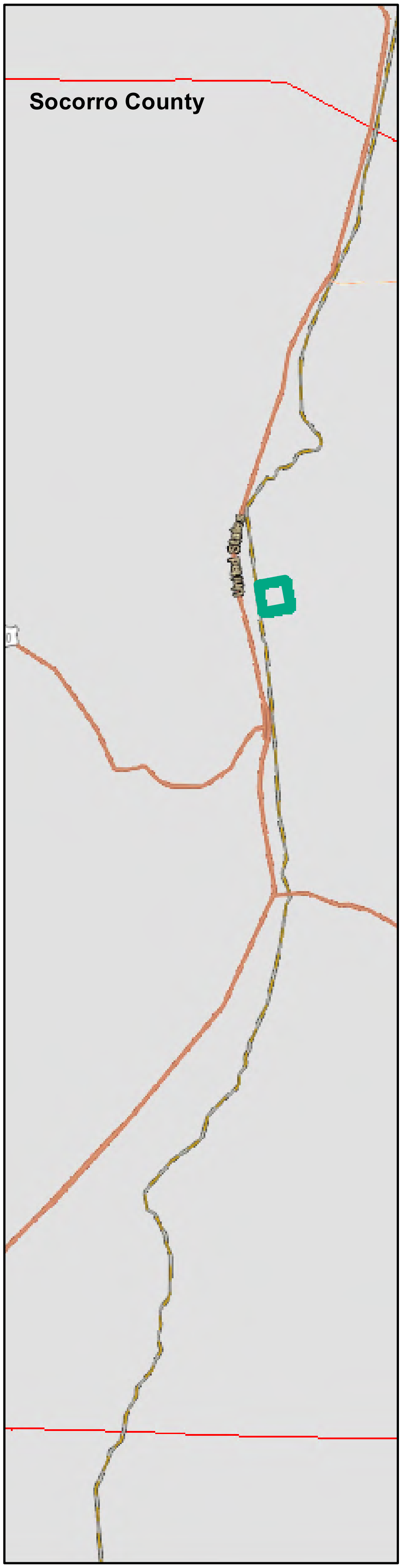
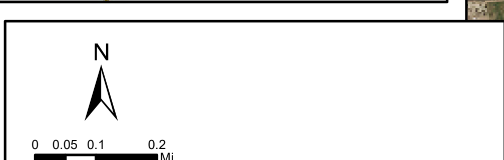
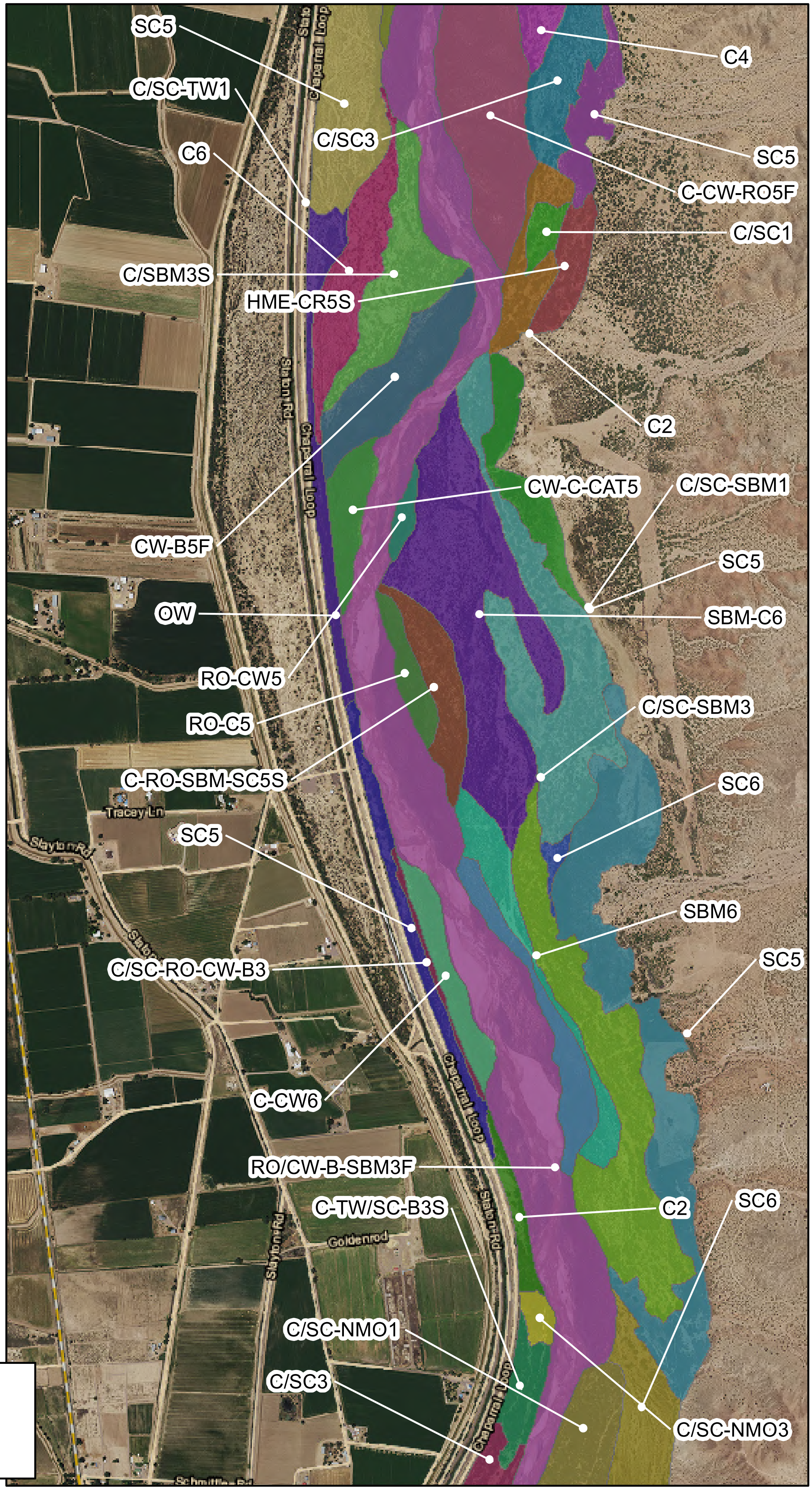
RO/CW-B-SBM3F
SBM6
SC5
C-CW6
SC6
/SC-RO-CW-B3


N
0 0.05 0.1 0.2
Mi

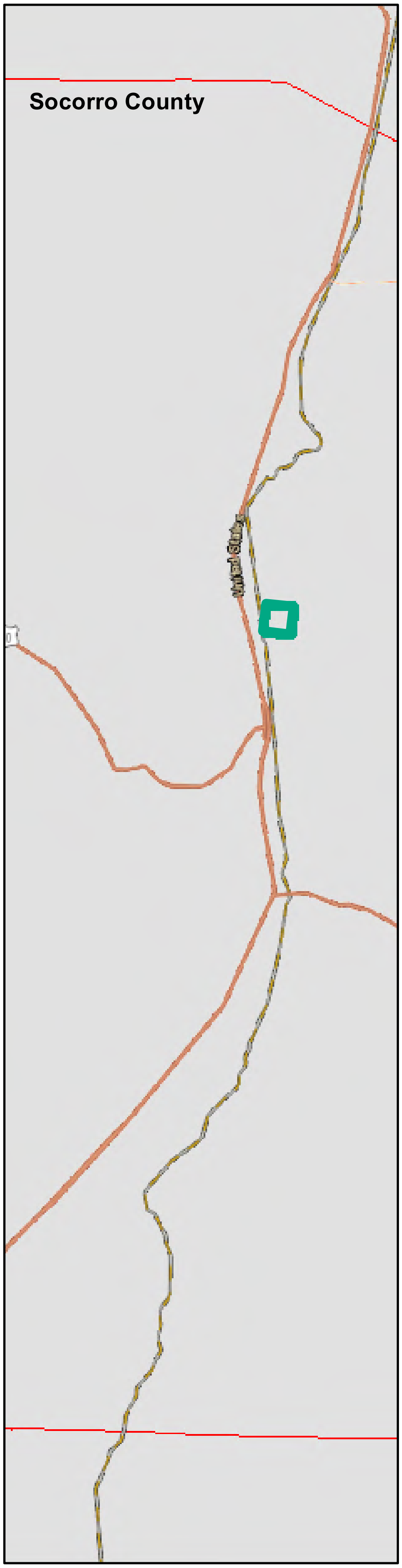
Locator Map

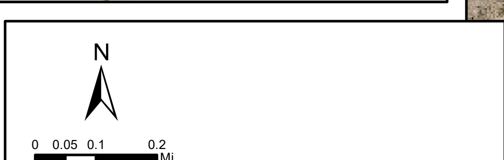

Socorro County

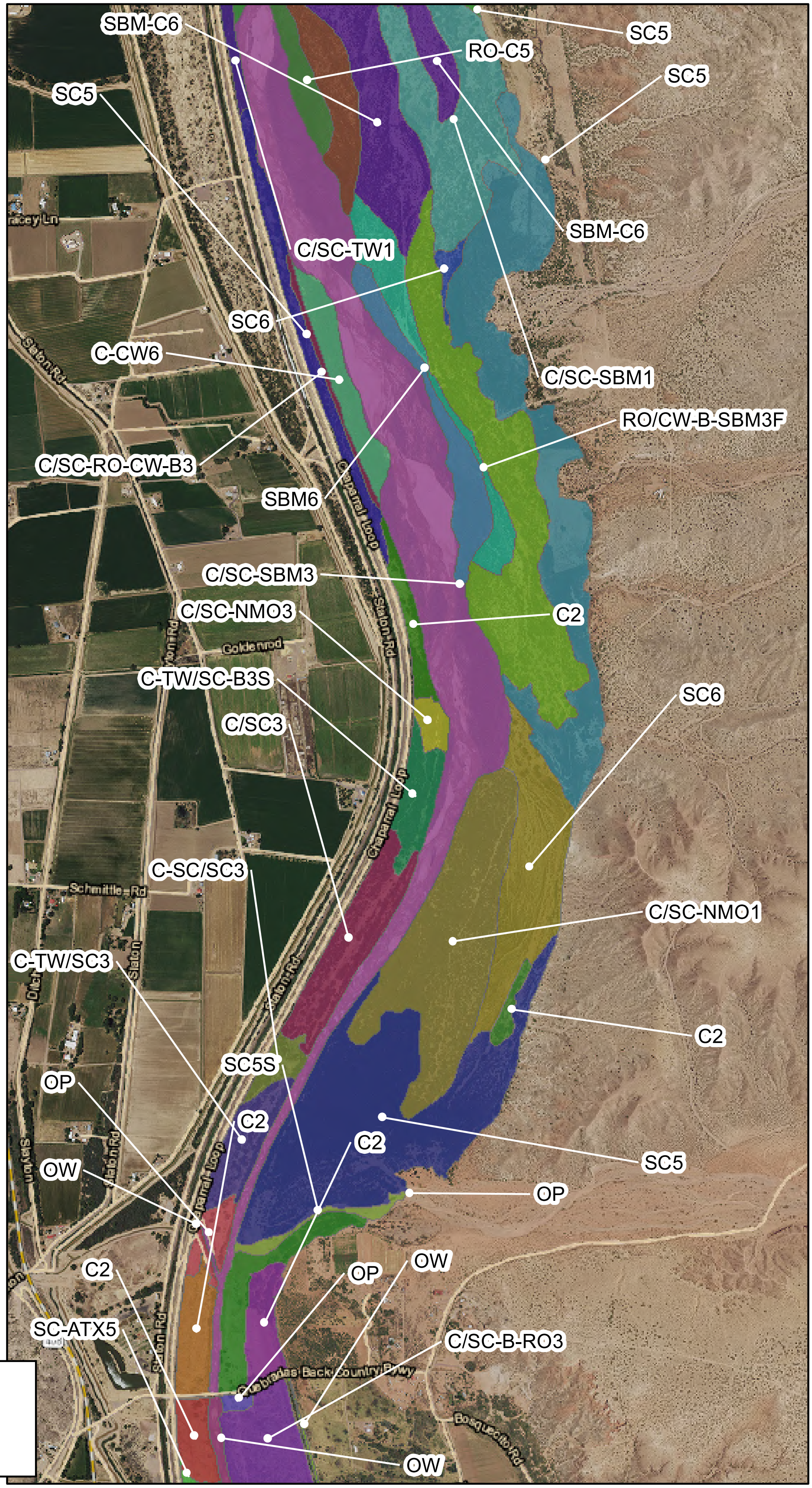

N
0 0.05 0.1 0.2
Mi


SC5
C/SC-TW1
C6
C/SBM3S
HME-CR5S
C/SC3
C4
SC5
C-CW-RO5F
C/SC1
C2
CW-B5F
CW-C-CAT5
C/SC-SBM1
SC5
SBM-C6
OW
RO-CW5
RO-C5
C-RO-SBM-SC5S
C/SC-SBM3
SC6
Tracey Ln
SC5
SBM6
SC5
C/SC-RO-CW-B3
C-CW6
RO/CW-B-SBM3F
C-TW/SC-B3S
C2
SC6
C/SC-NMO1
C/SC3
C/SC-NMO3

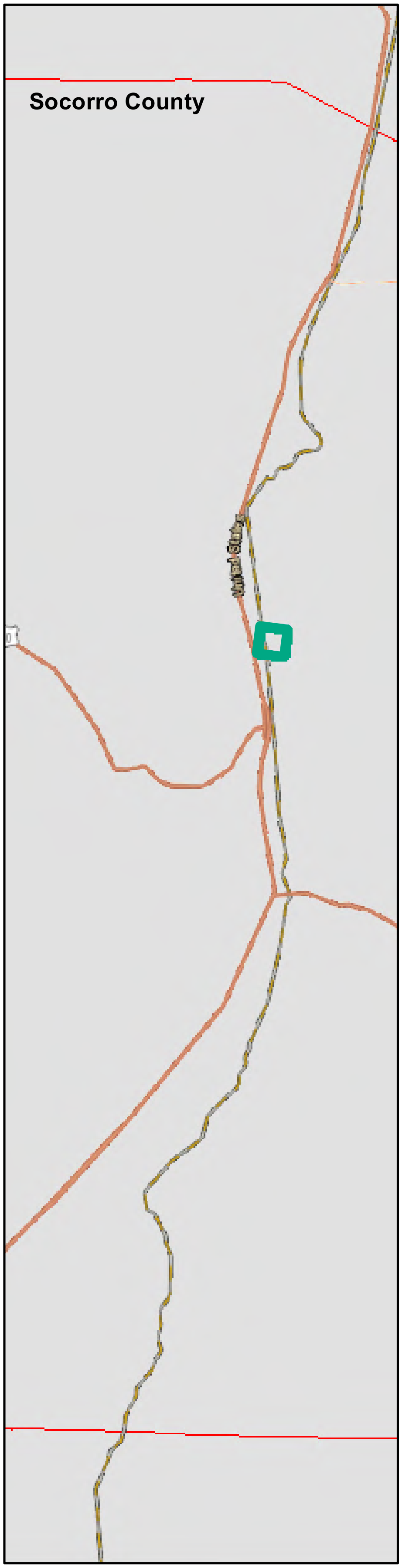
Locator Map

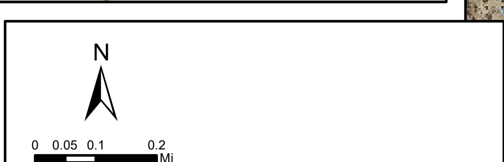

Socorro County


N
0 0.05 0.1 0.2
Mi

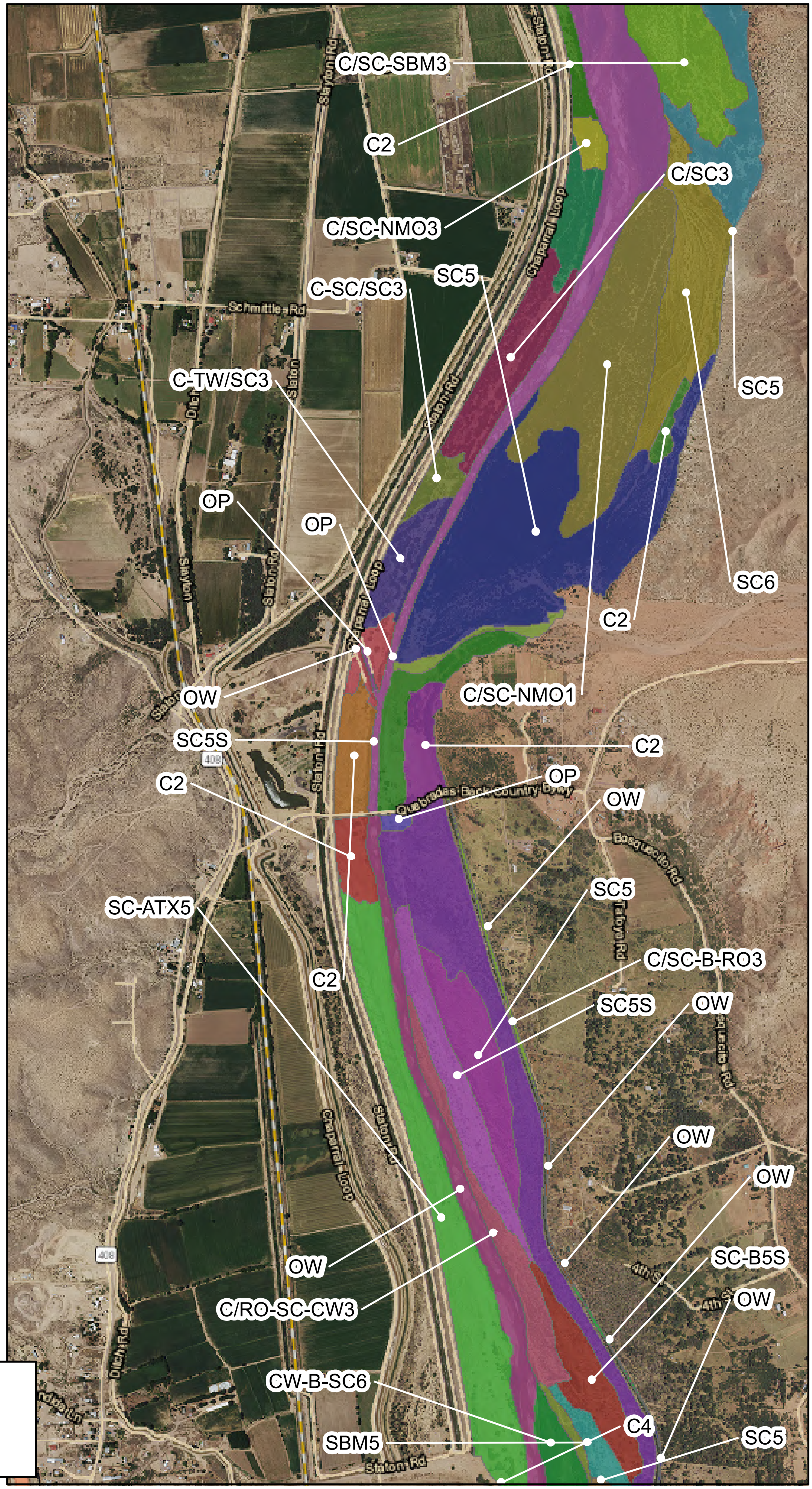

SBM-C6
SC5
RO-C5
SC5
SC5
SBM-C6
C/SC-TW1
SC6
C-CW6
C/SC-SBM1
RO/CW-B-SBM3F
C/SC-RO-CW-B3
SBM6
C/SC-SBM3
C/SC-NMO3
C2
C-TW/SC-B3S
SC6
C/SC3
C-SC/SC3
C/SC-NMO1
C-TW/SC3
C2
SC5S
OP
C2
C2
SC5
OW
OP
C2
OP
OW
SC-ATX5
C/SC-B-RO3
OW

Locator Map

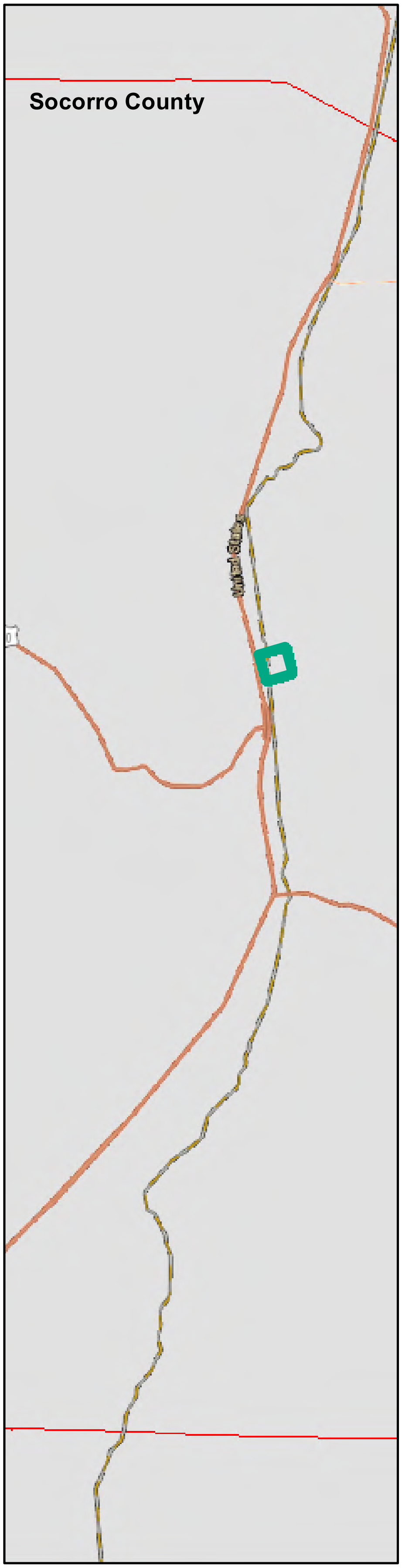


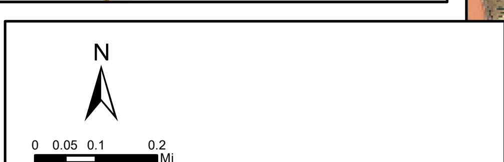


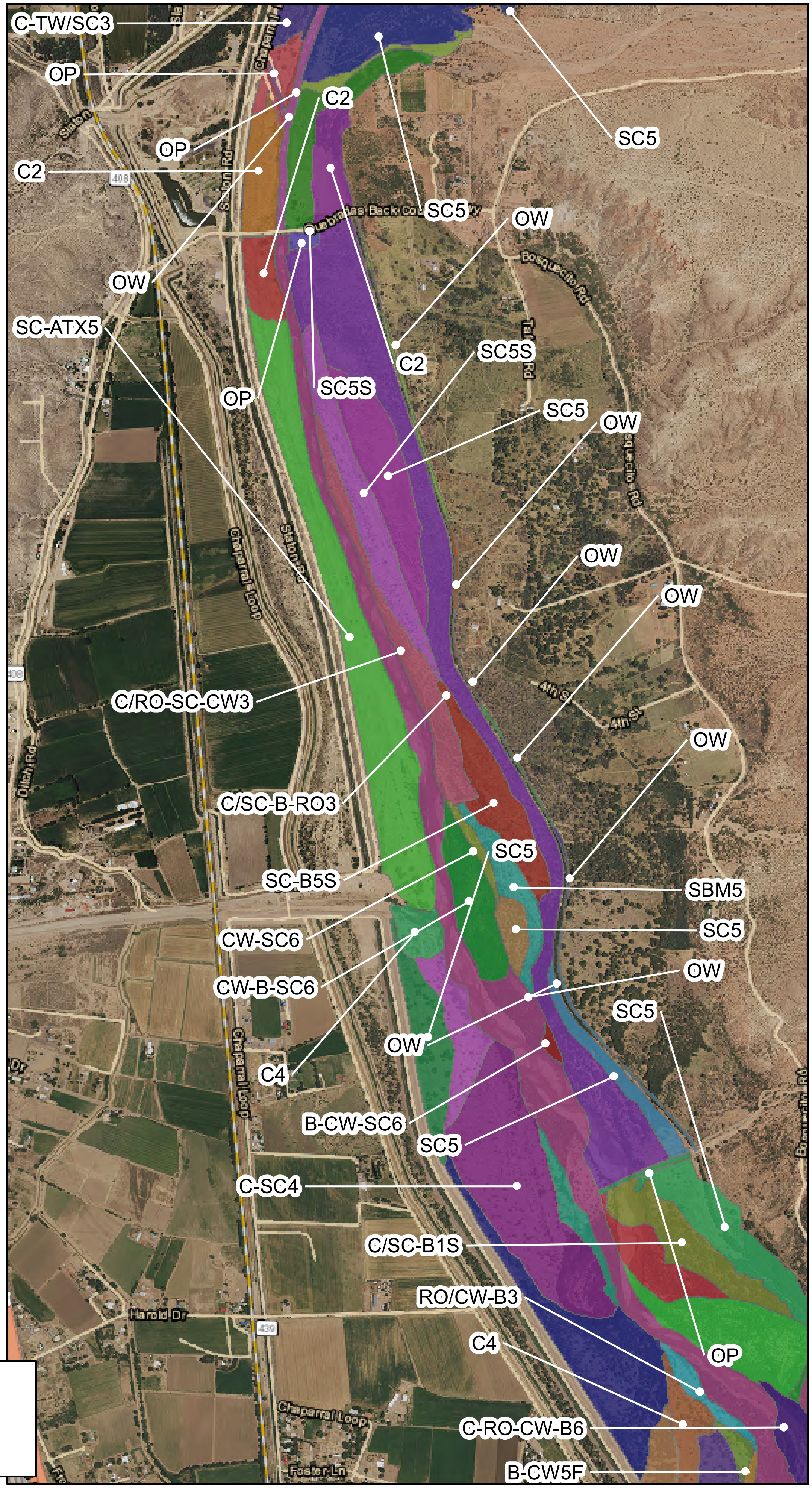
2002
Hink and Ohmart Vegetation Type



Locator Map

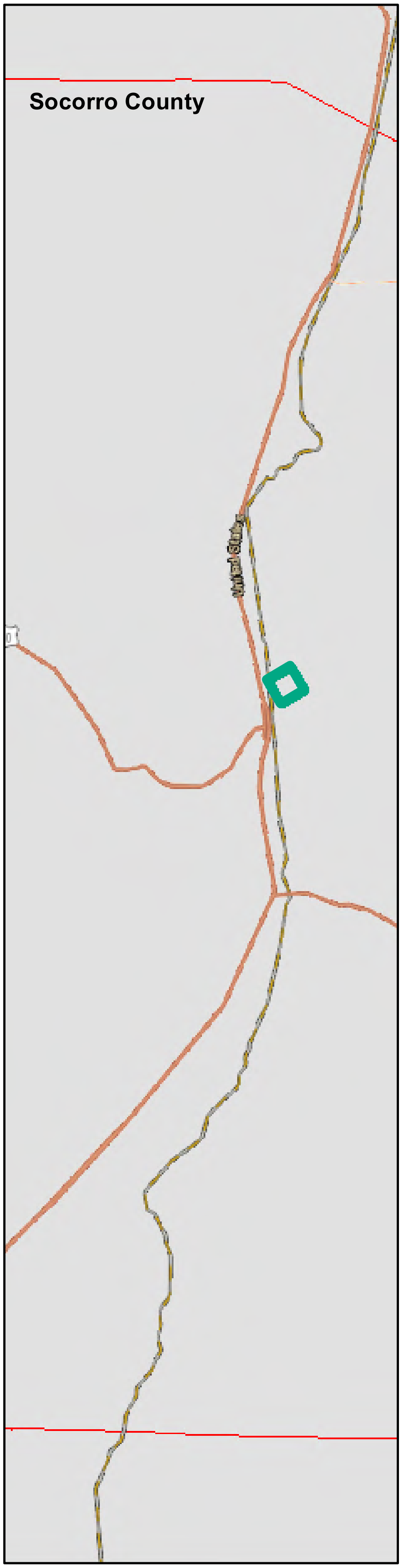

Socorro County

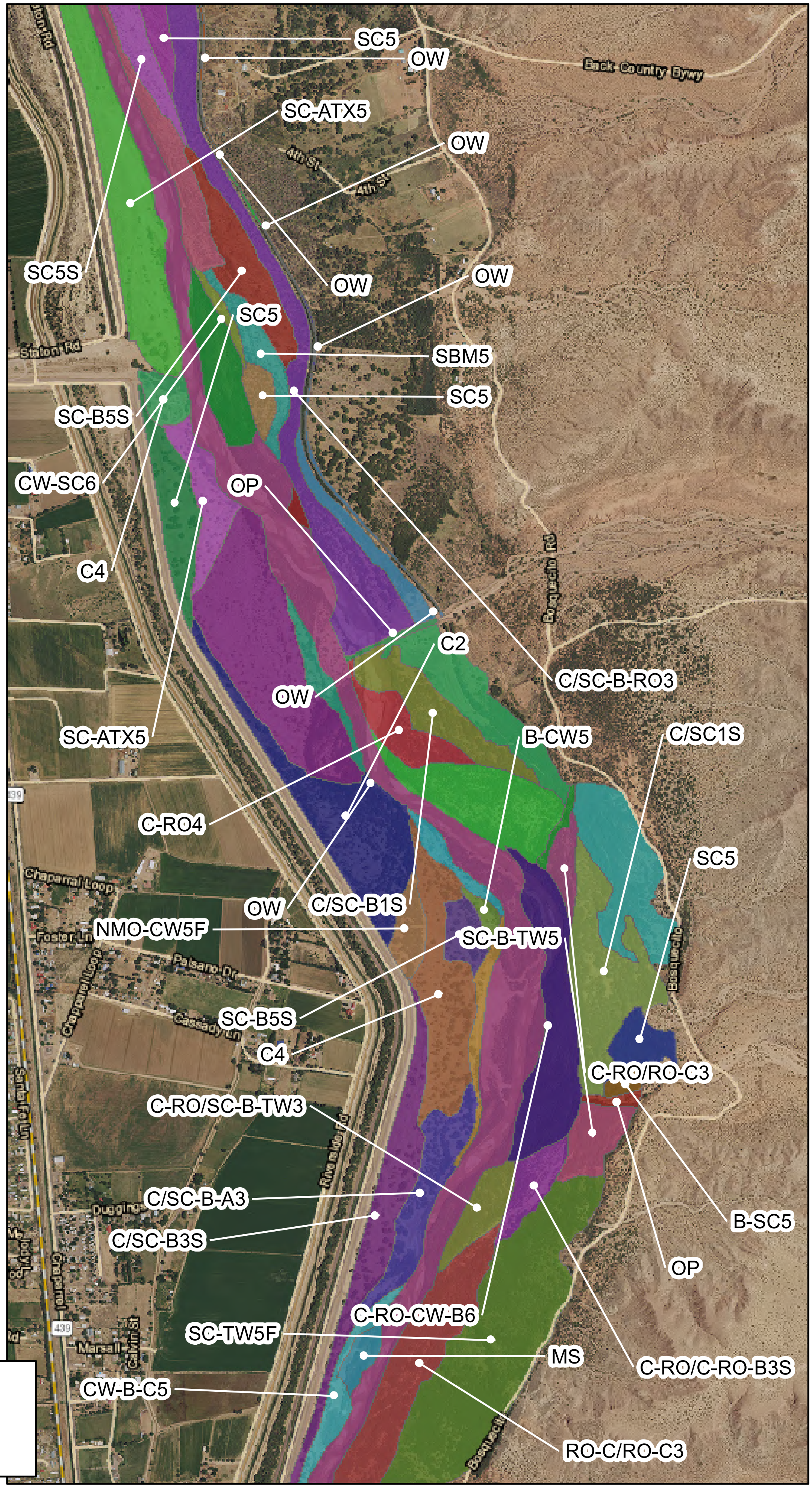

N
0 0.05 0.1 0.2
Mi

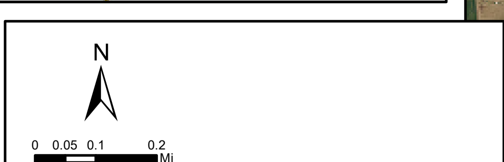

C-TW/SC3
OP
C2
OP
C2
SC5
SC5
OW
OW
SC-ATX5
C2
SC5S
SC5S
OP
SC5
OW
OW
OW
C/RO-SC-CW3
OW
C/SC-B-RO3
SC5
SC-B5S
SBM5
CW-SC6
SC5
CW-B-SC6
OW
SC5
OW
C4
B-CW-SC6
SC5
C-SC4
C/SC-B1S
RO/CW-B3
C4
OP
C-RO-CW-B6
B-CW5F

Locator Map

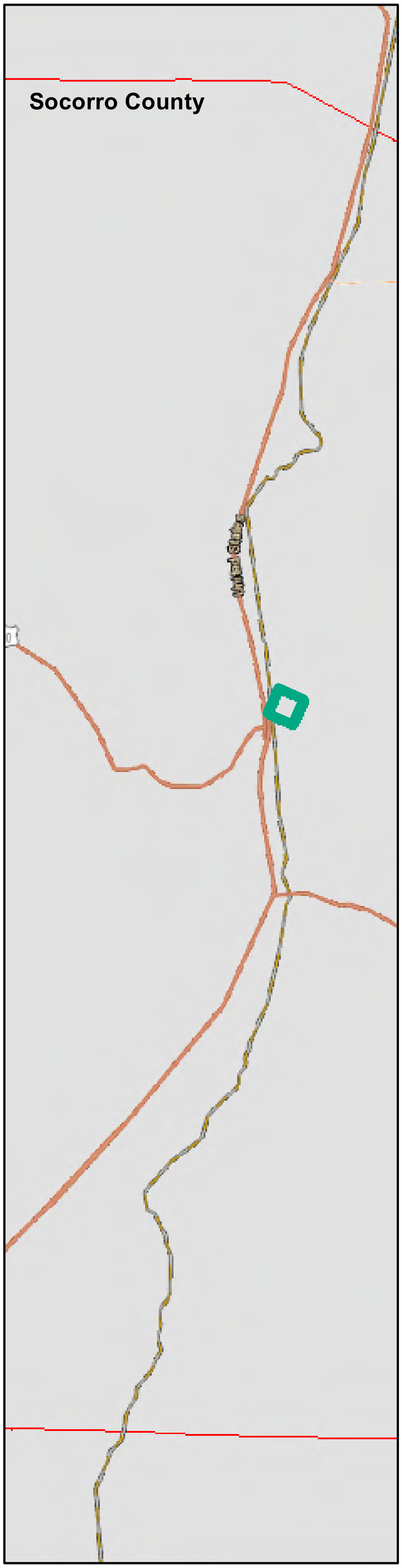
2002
Hink and Ohmart Vegetation Type

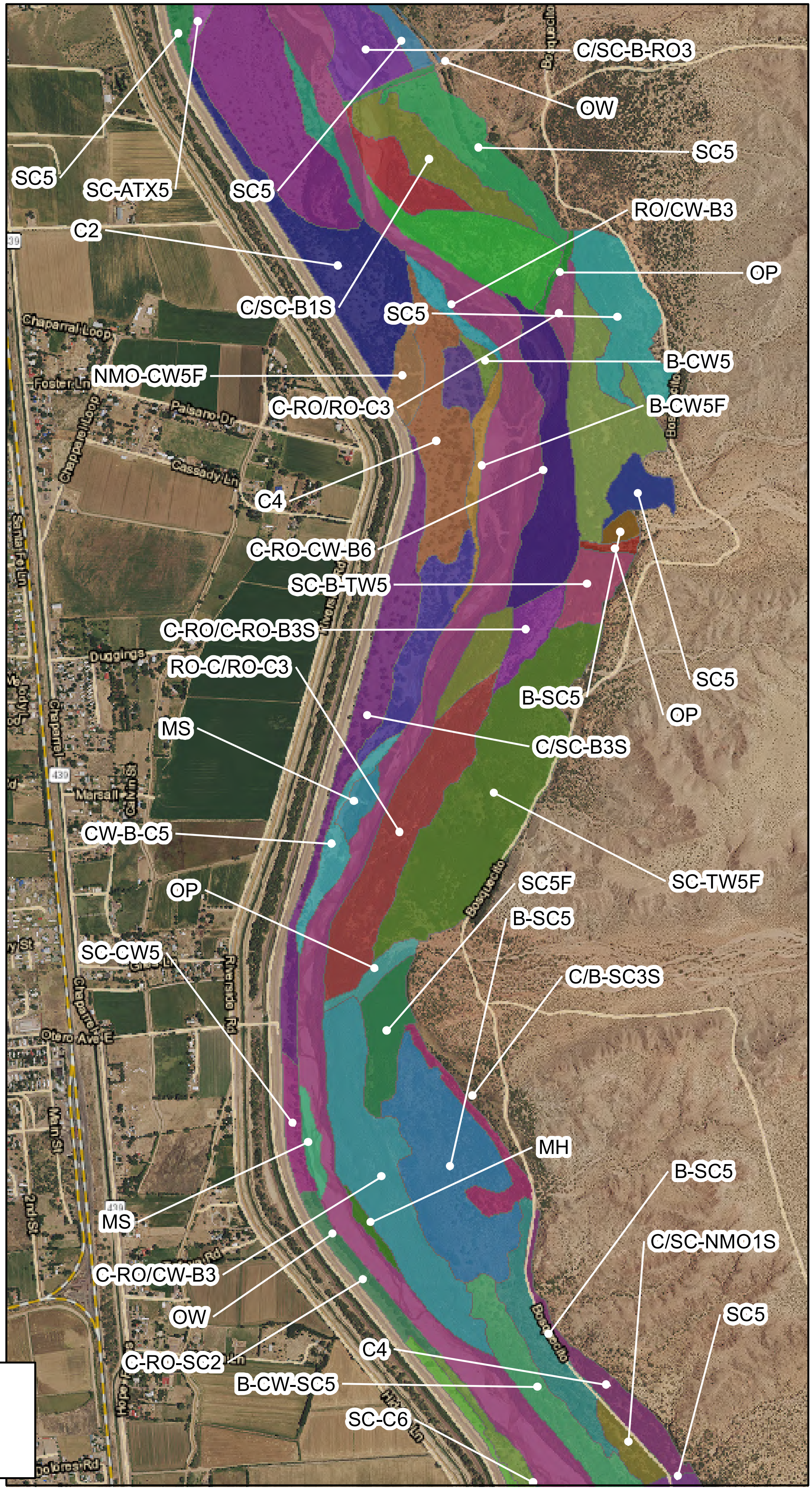


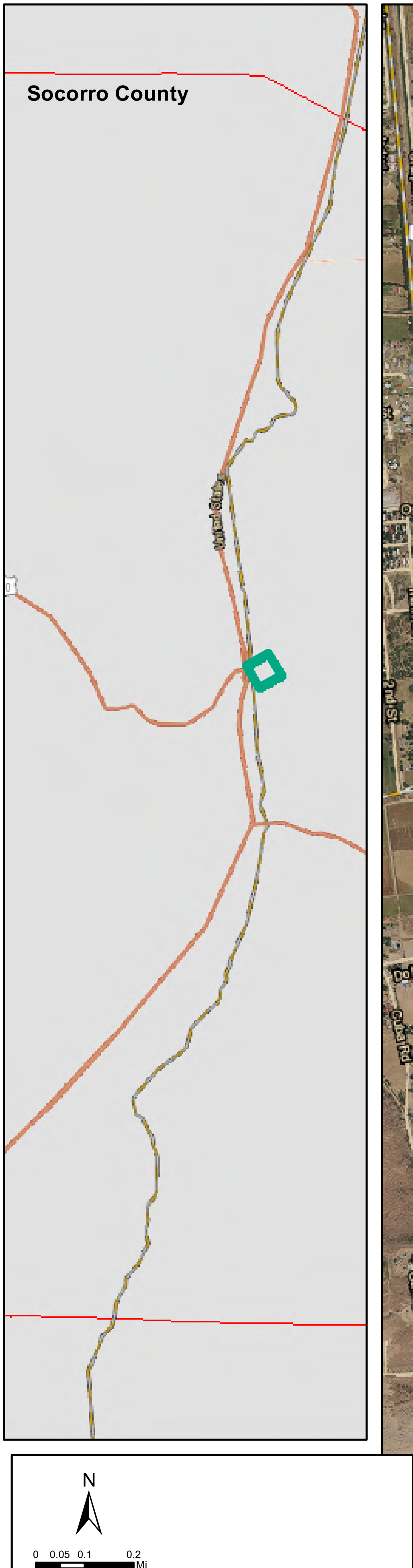


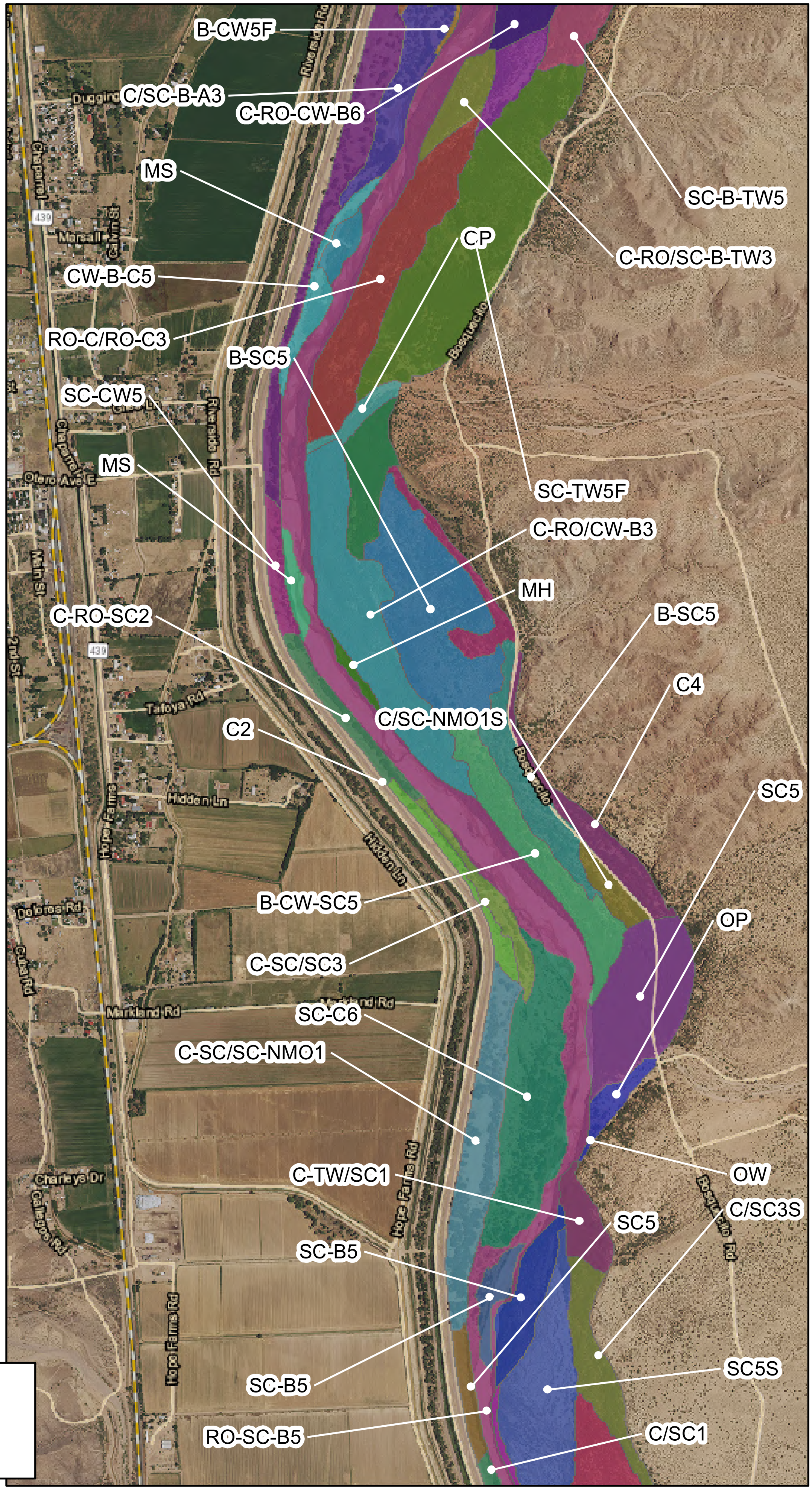


Locator Map


Socorro County
N
0 0.05 0.1 0.2
Mi

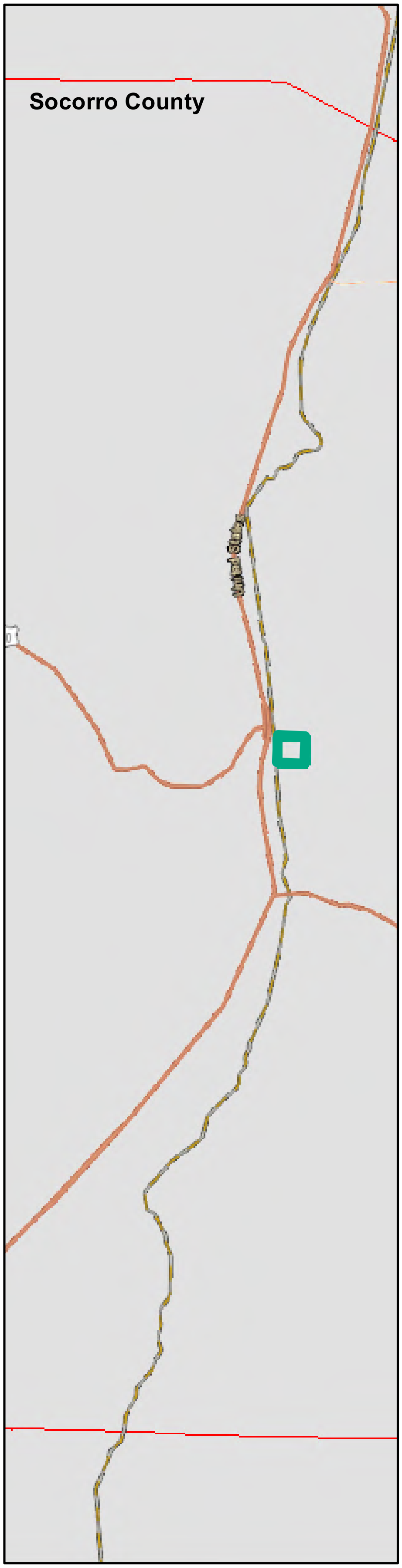

C/SC-B-RO3
OW
SC5
RO/CW-B3
OP
SC5
SC-ATX5
SC5
C2
C/SC-B1S
SC5
B-CW5
NMO-CW5F
B-CW5F
C-RO/RO-C3
C4
C-RO-CW-B6
SC-B-TW5
C-RO/C-RO-B3S
RO-C/RO-C3
SC5
B-SC5
OP
MS
C/SC-B3S
CW-B-C5
SC-TW5F
SC5F
OP
B-SC5
SC-CW5
C/B-SC3S
MH
B-SC5
MS
C/SC-NMO1S
C-RO/CW-B3
SC5
OW
C4
C-RO-SC2
B-CW-SC5
SC-C6

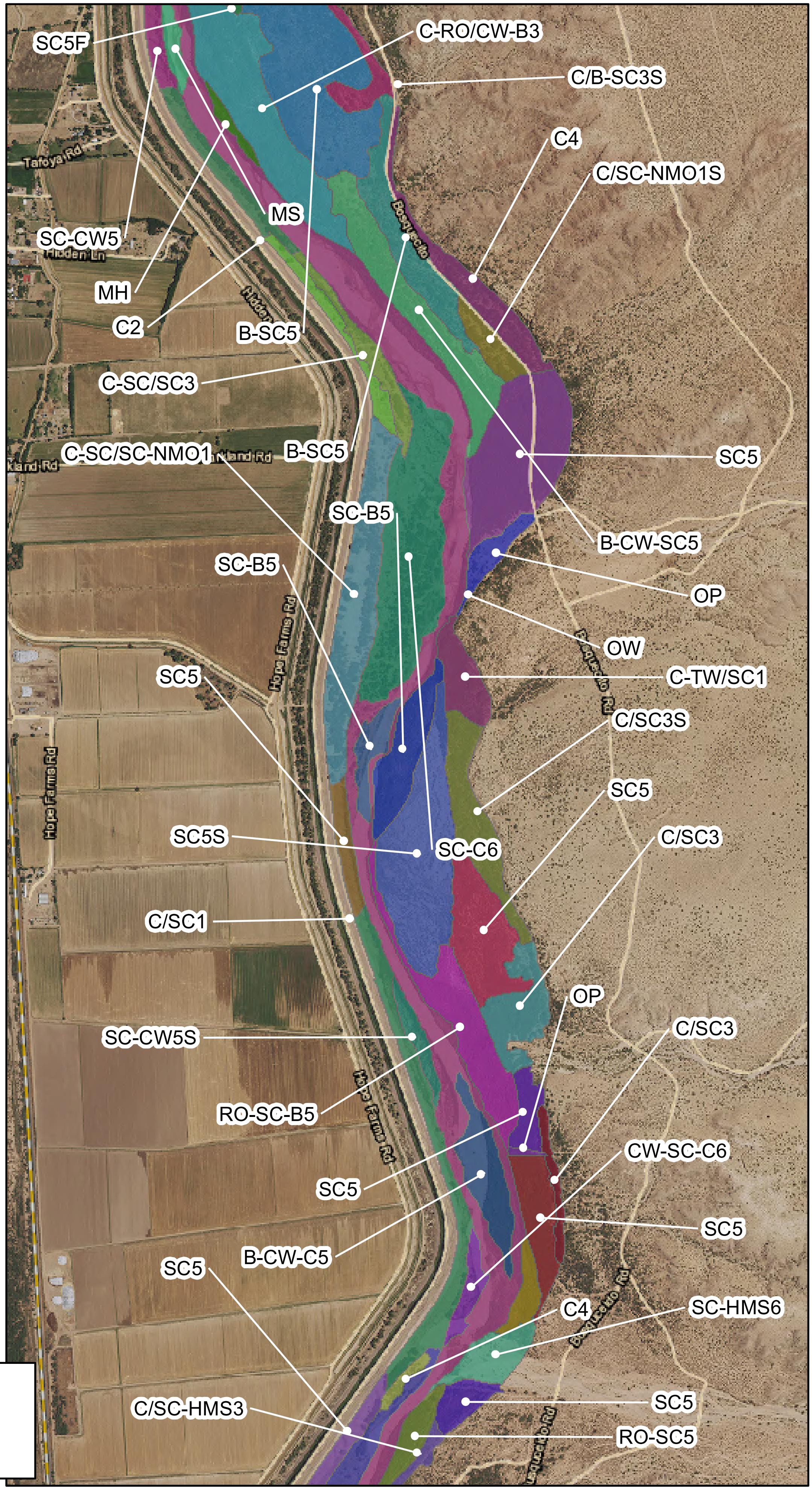

Socorro County
N
0 0.05 0.1 0.2
Mi

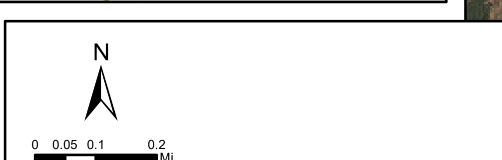

B-CW5F
C/SC-B-A3
C-RO-CW-B6
MS
SC-B-TW5
C-RO/SC-B-TW3
CP
CW-B-C5
RO-C/RO-C3
B-SC5
SC-CW5
MS
SC-TW5F
C-RO/CW-B3
MH
C-RO-SC2
B-SC5
C4
C/SC-NMO1S
C2
SC5
B-CW-SC5
OP
C-SC/SC3
SC-C6
C-SC/SC-NMO1
OW
C-TW/SC1
C/SC3S
SC5
SC-B5
SC-B5
SC5S
RO-SC-B5
C/SC1
Riverside Rd
Dugging
Chaparral
Morsall
Calvin St
Otero Ave E
Main St
2nd St
Tafoya Rd
Hidden Ln
Hope Farms
Dolores Rd
Markland Rd
Charleys Dr
Hope Farms Rd
Bosquecito Rd

Locator Map

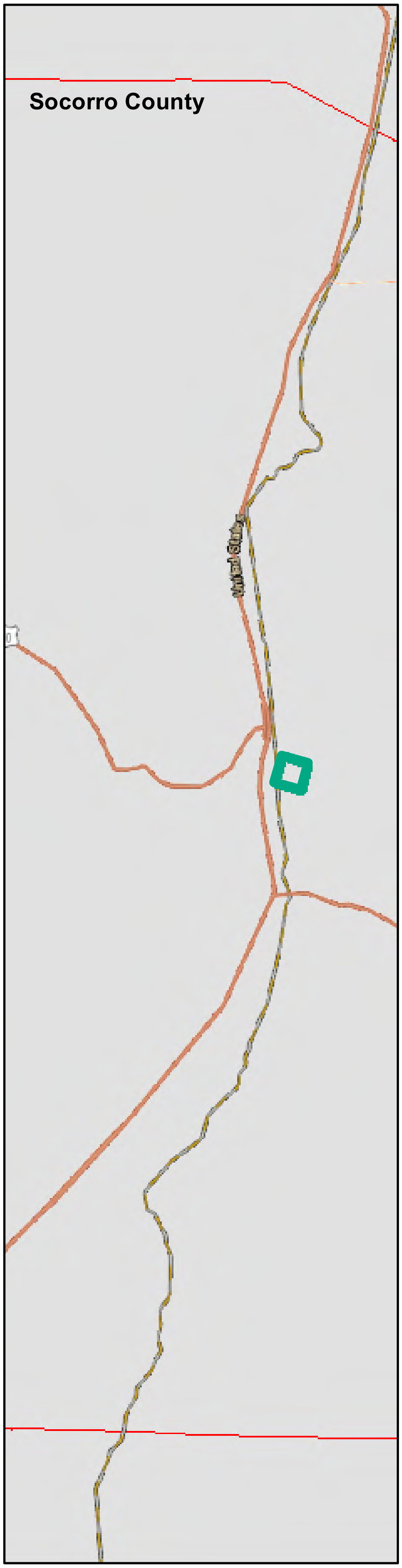
2002
Hink and Ohmart Vegetation Type

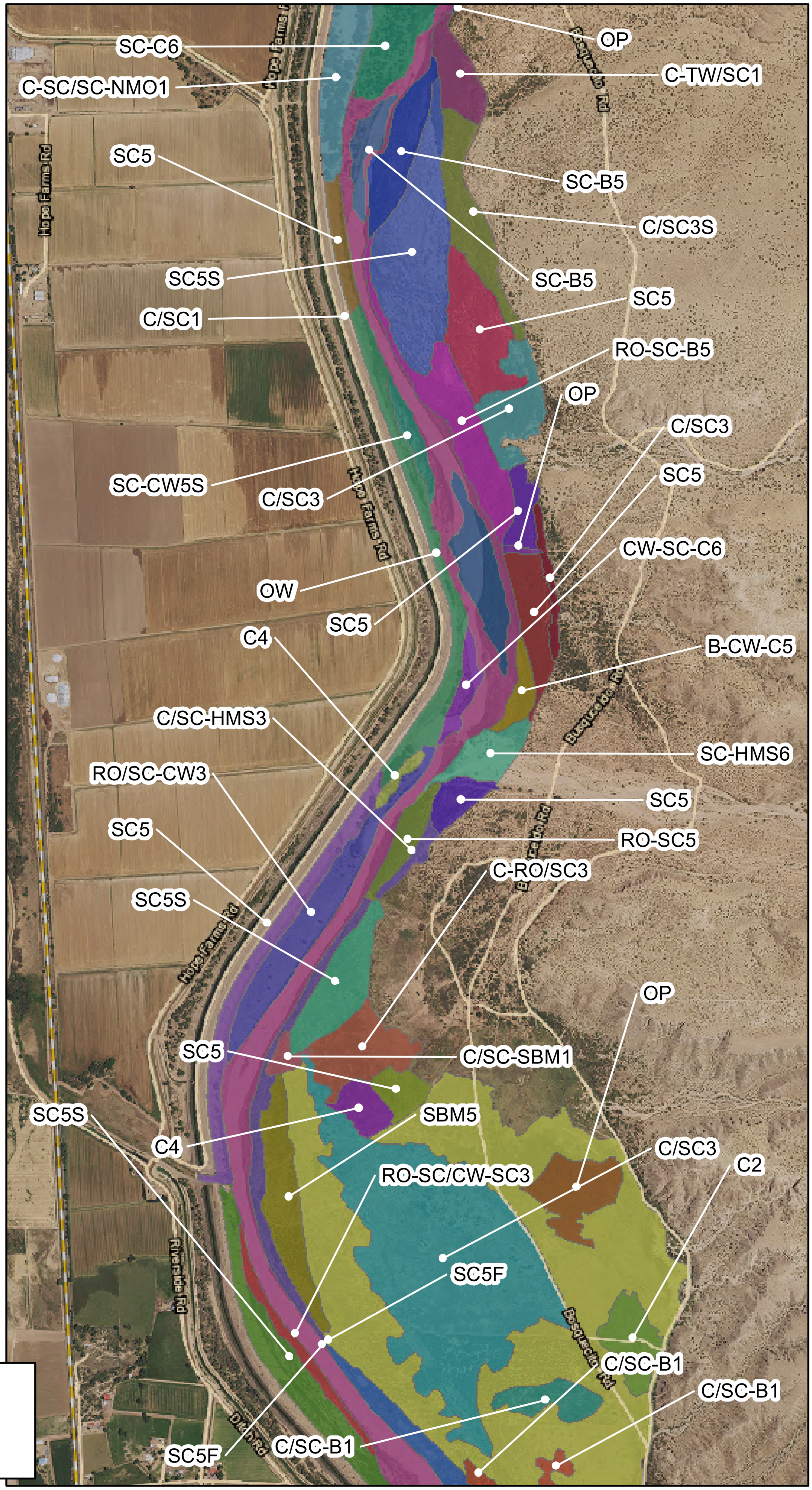


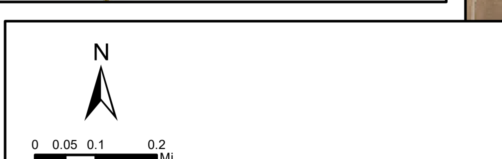




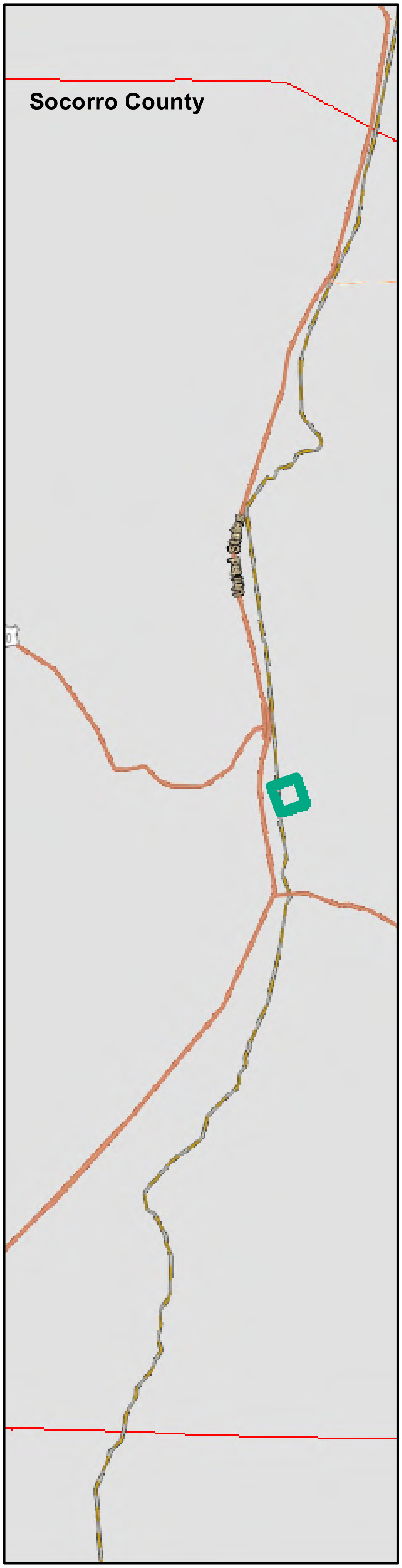
Locator Map

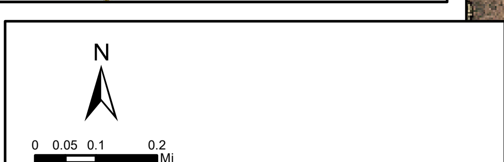

Socorro County


SC-C6
OP
C-TW/SC1
C-SC/SC-NMO1
SC5
SC-B5
C/SC3S
SC5S
SC-B5
C/SC1
SC5
RO-SC-B5
OP
C/SC3
SC-CW5S
C/SC3
SC5
CW-SC-C6
OW
SC5
C4
B-CW-C5
C/SC-HMS3
SC-HMS6
RO/SC-CW3
SC5
SC5
RO-SC5
C-RO/SC3
SC5S
OP
SC5
C/SC-SBM1
SC5S
SBM5
C4
C/SC3
C2
RO-SC/CW-SC3
SC5F
C/SC-B1
C/SC-B1
SC5F
C/SC-B1
Hope Farms Rd

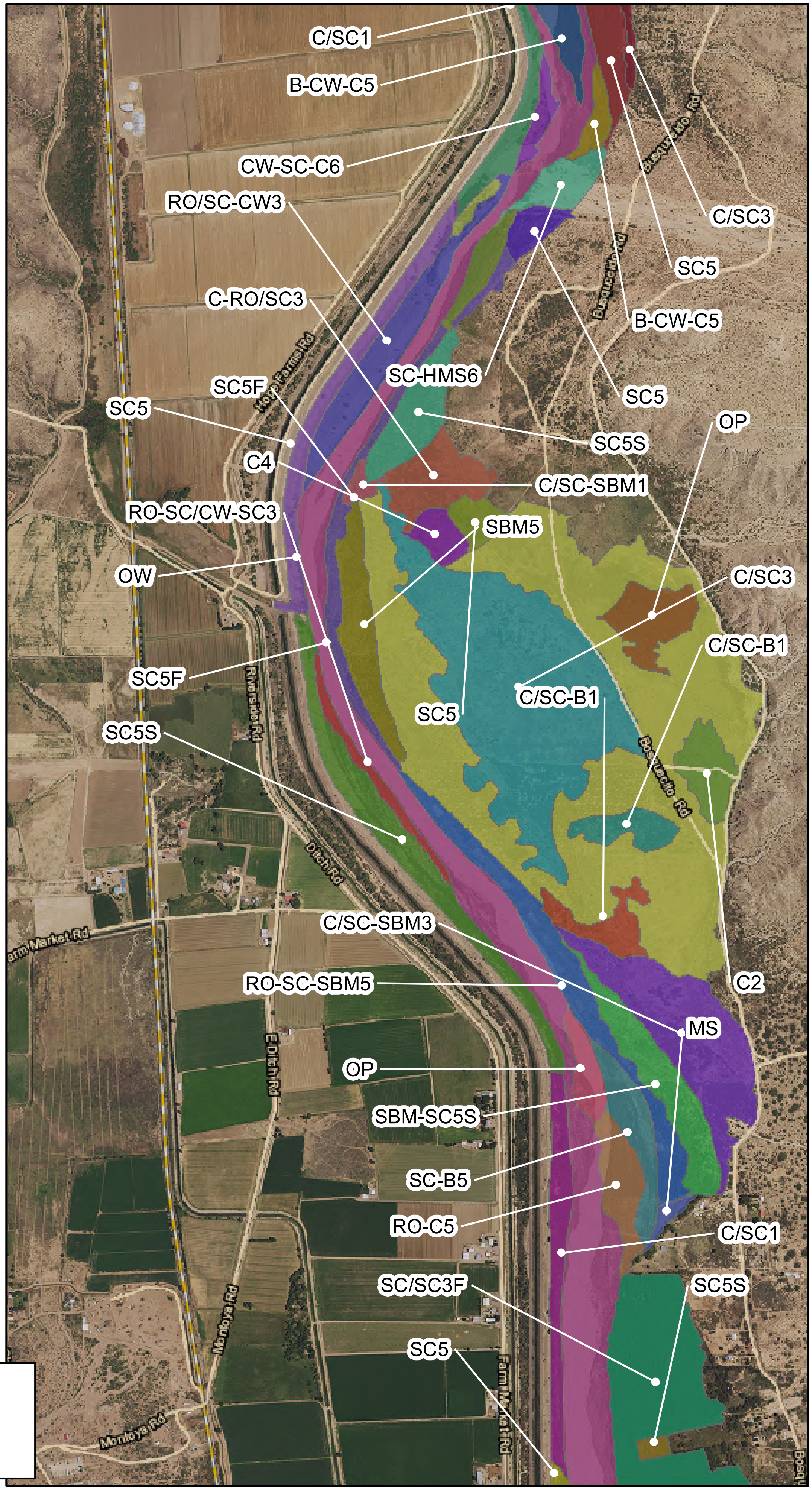

N
0 0.05 0.1 0.2
Mi

Locator Map

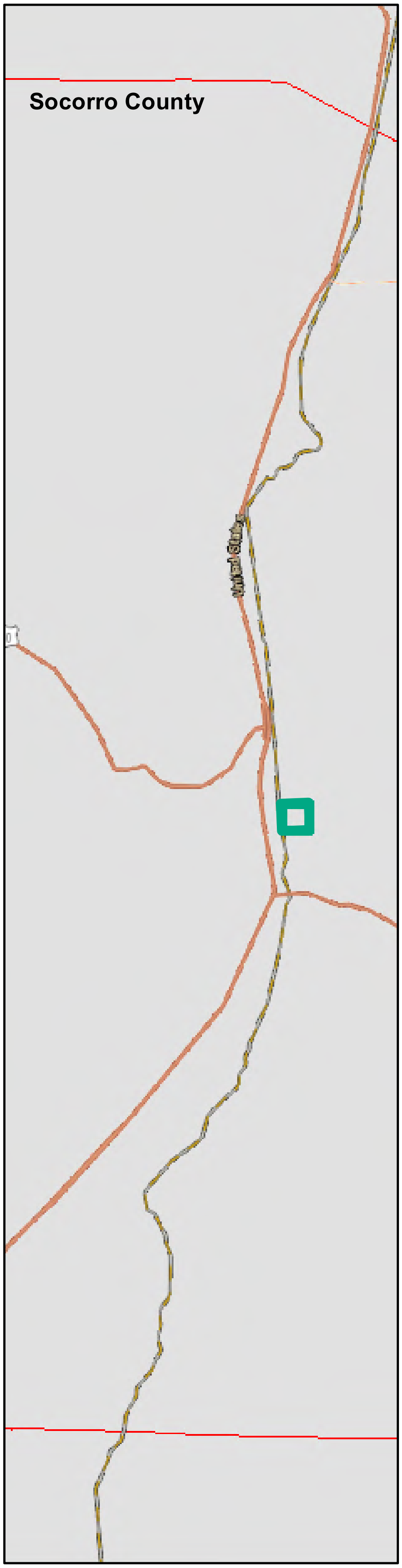


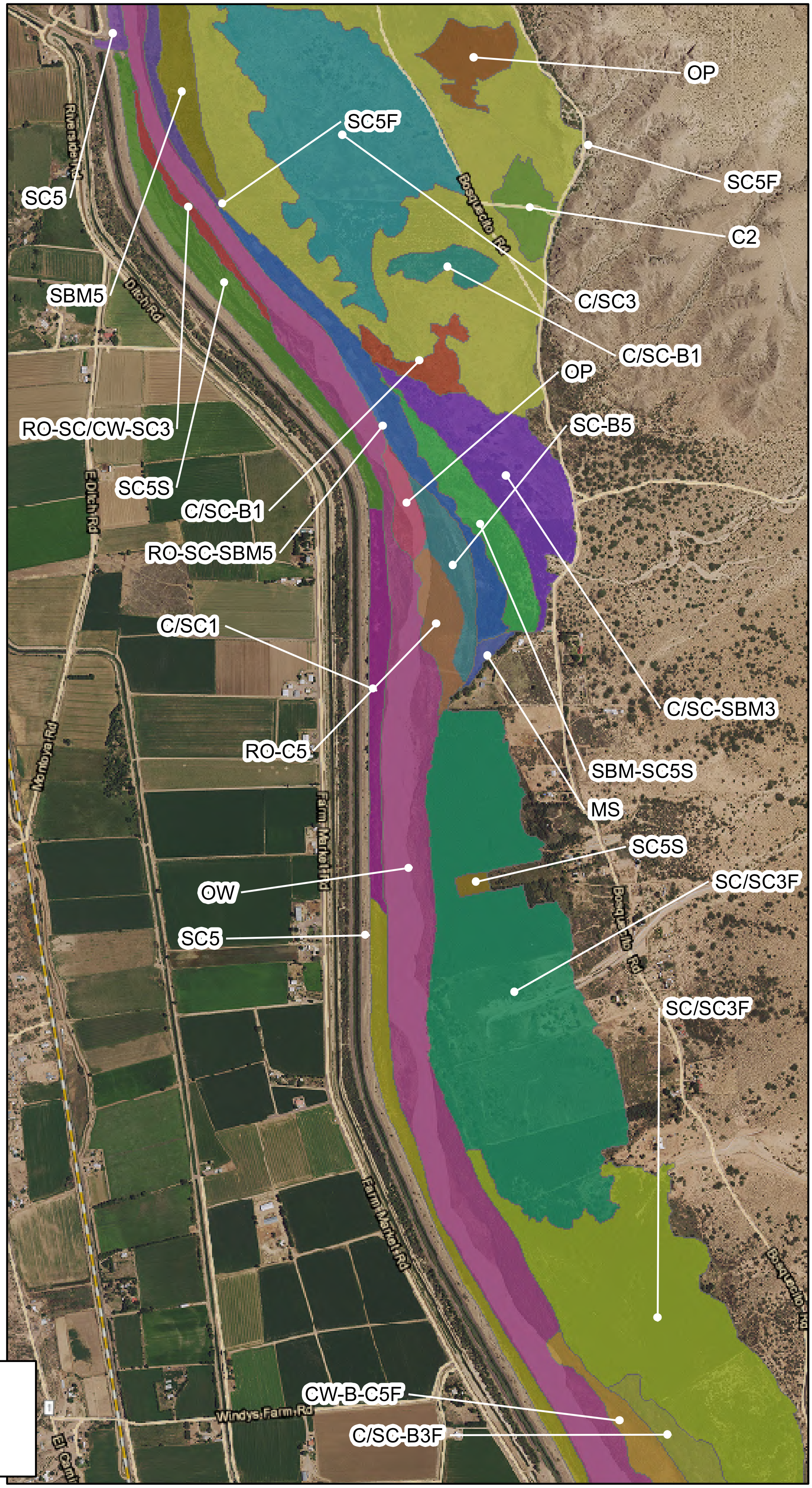


2002
Hink and Ohmart Vegetation Type



Locator Map

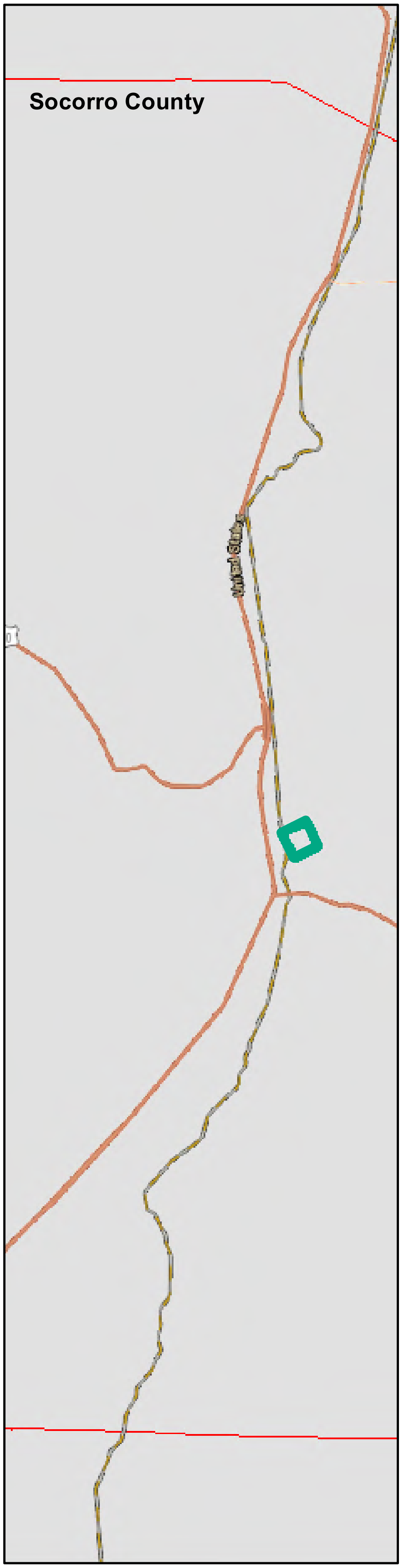


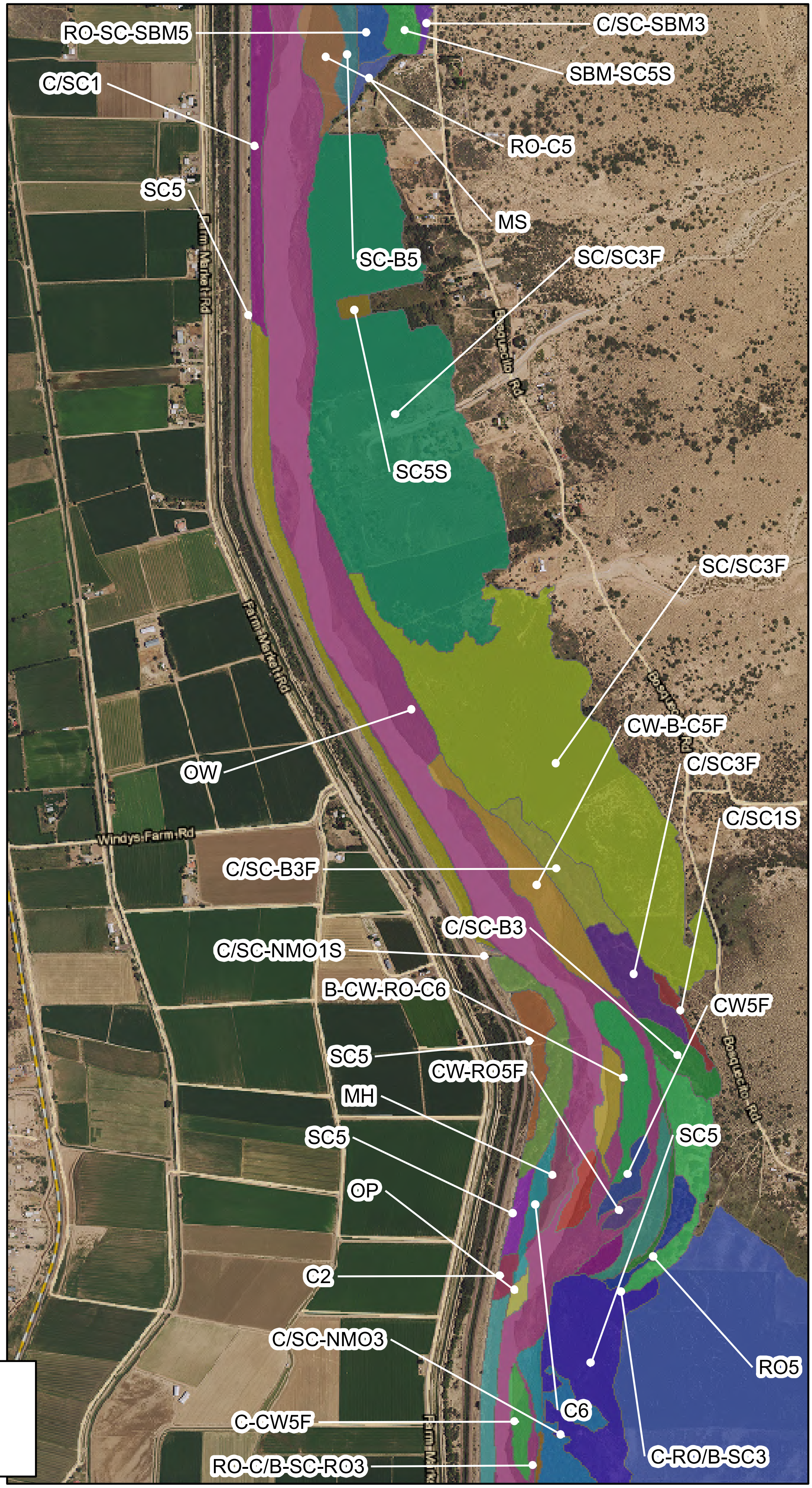


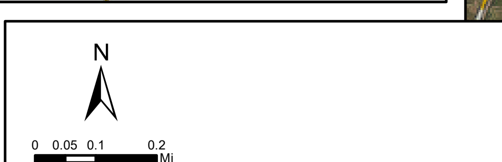
N

0 0.05 0.1 0.2 Mi

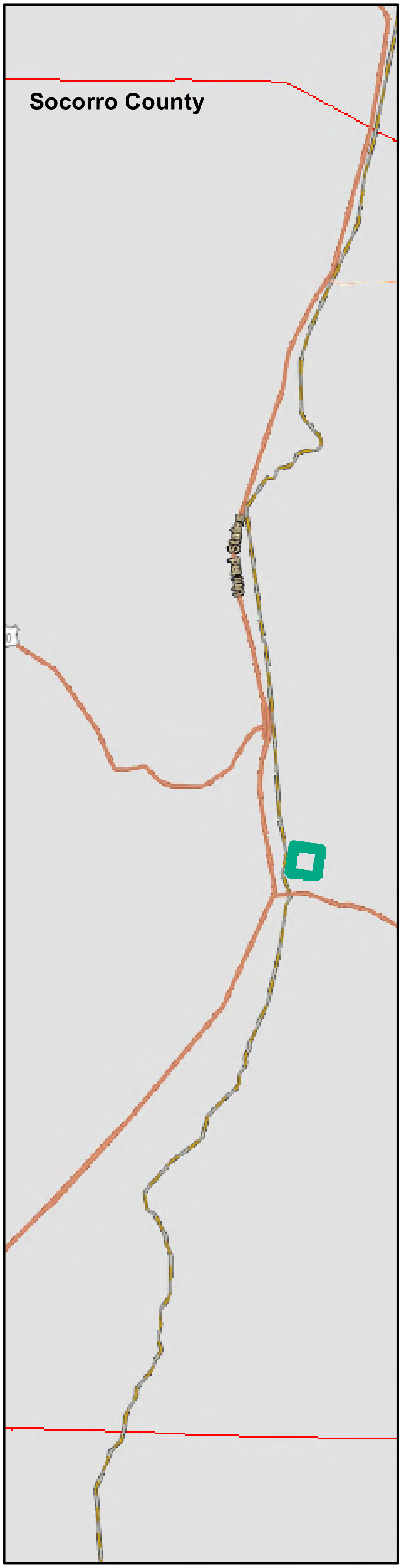
Locator Map

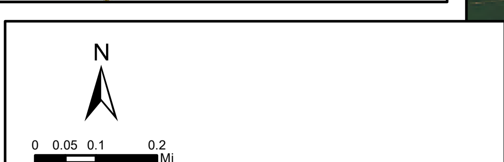

Socorro County


RO-SC-SBM5
C/SC-SBM3
SBM-SC5S
C/SC1
RO-C5
SC5
MS
SC-B5
SC/SC3F
SC5S
SC/SC3F
CW-B-C5F
OW
C/SC3F
C/SC1S
C/SC-B3F
C/SC-B3
C/SC-NMO1S
B-CW-RO-C6
CW5F
SC5
CW-RO5F
MH
SC5
SC5
OP
C2
RO5
C/SC-NMO3
C6
C-CW5F
C-RO/B-SC3
RO-C/B-SC-RO3
Farm Market Rd
Windys Farm Rd

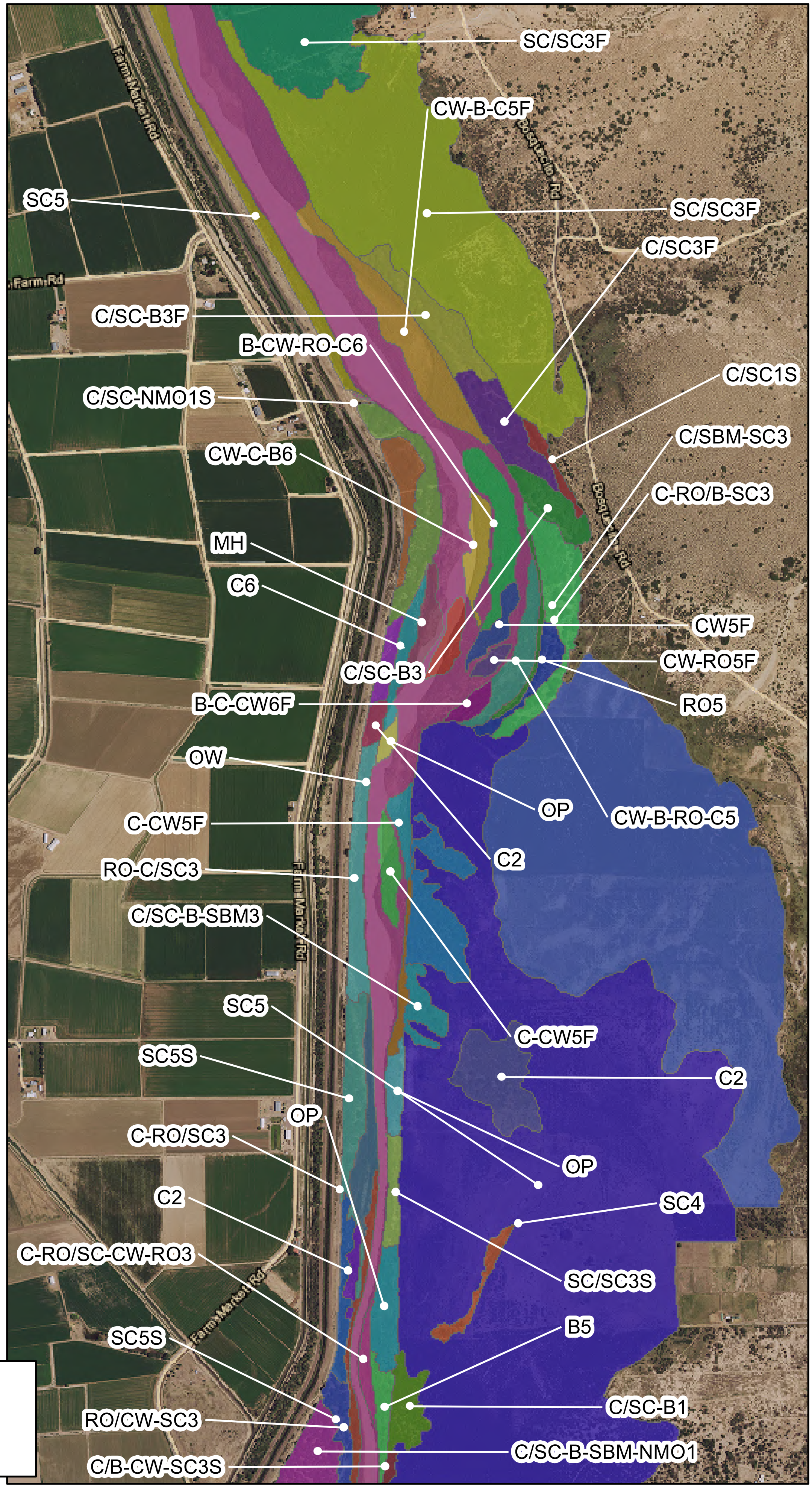

N
0 0.05 0.1 0.2
Mi

Locator Map

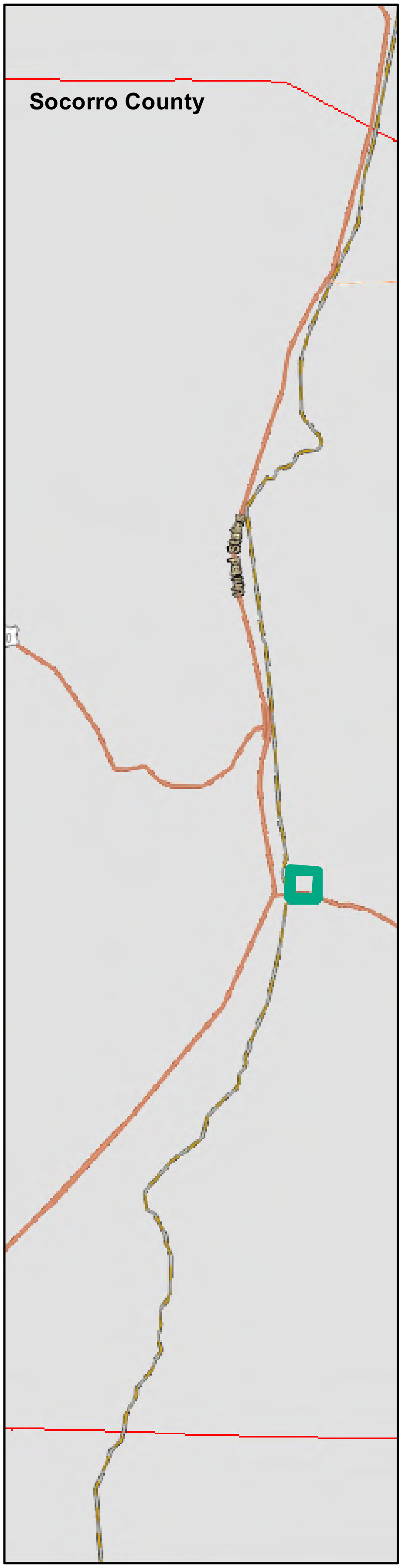




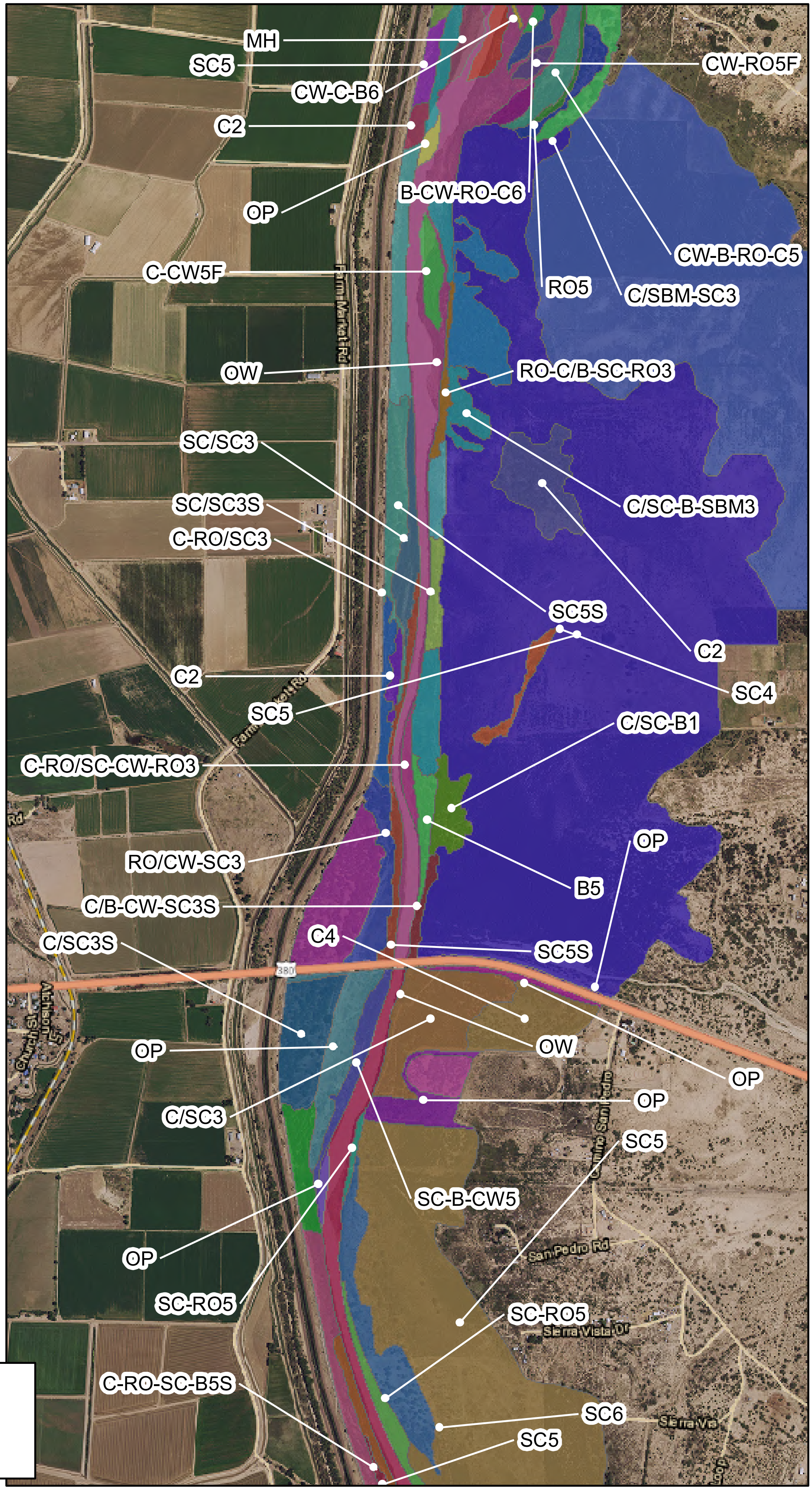
2002
Hink and Ohmart Vegetation Type

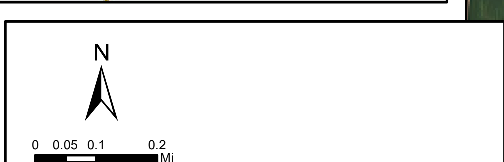


Locator Map



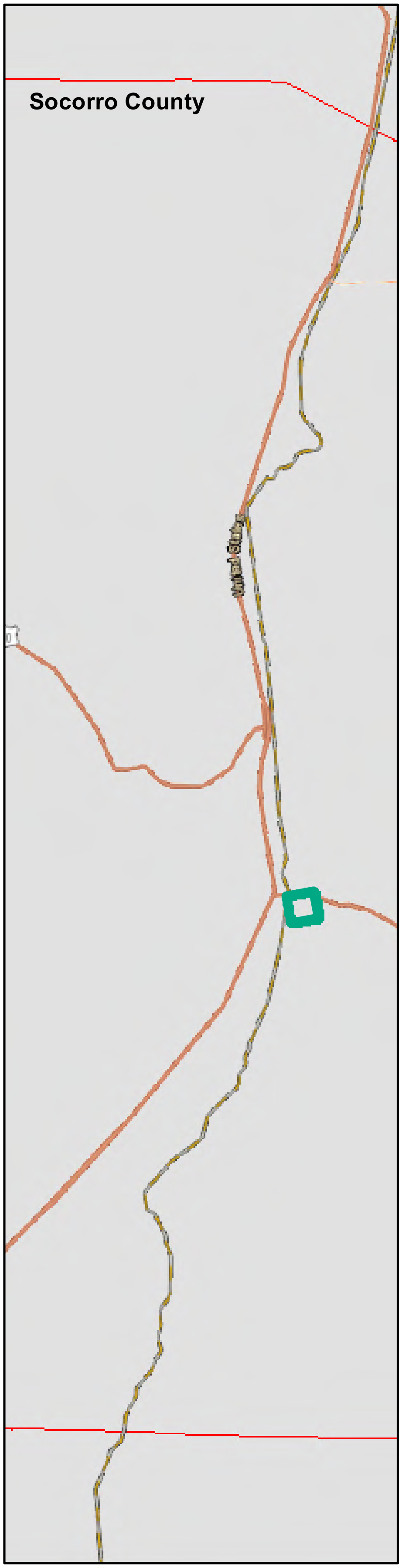
2002
Hink and Ohmart Vegetation Type

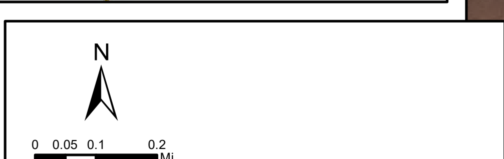


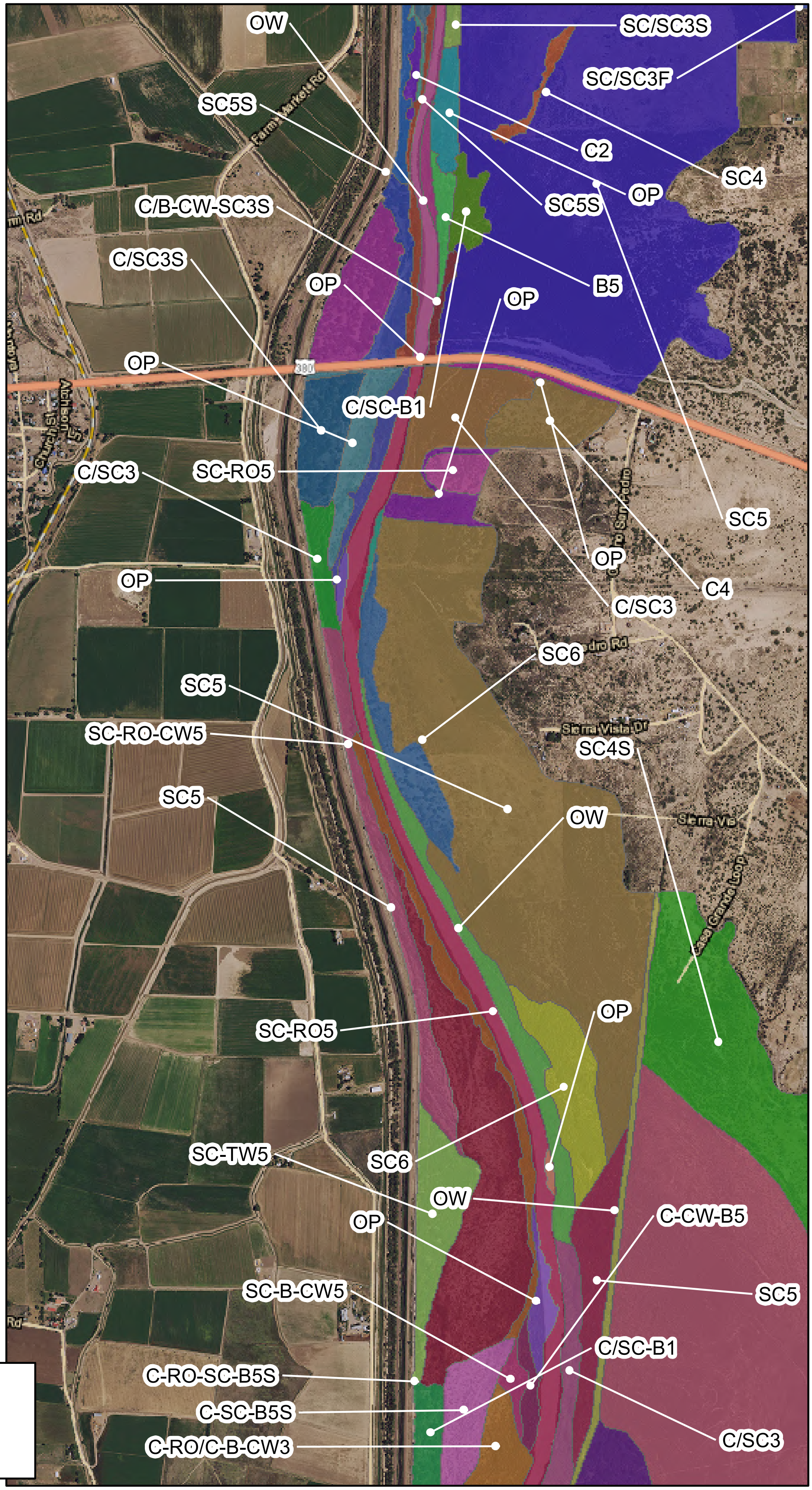


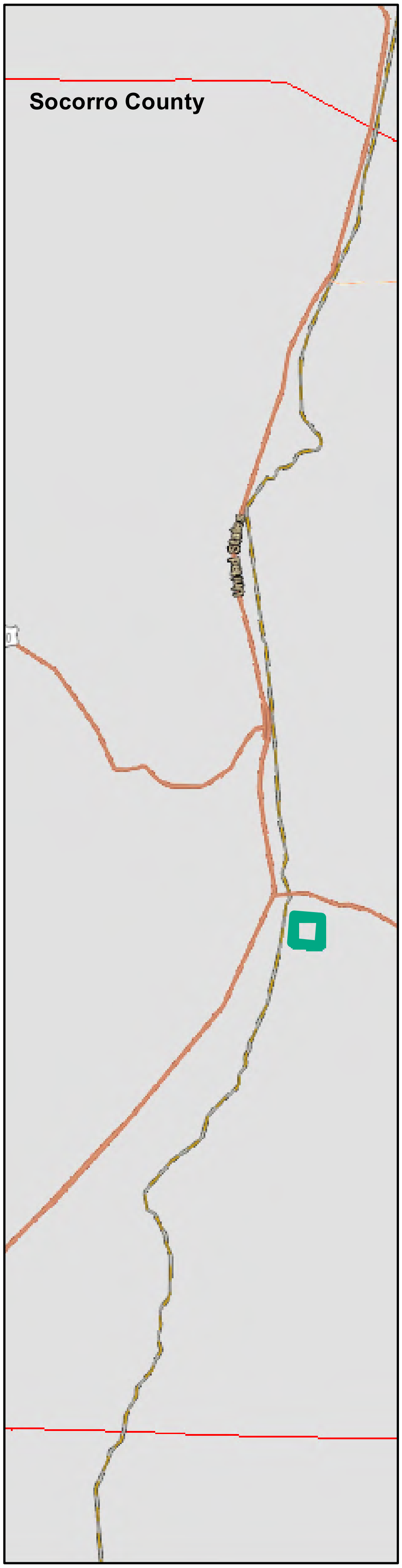
2002
Hink and Ohmart Vegetation Type

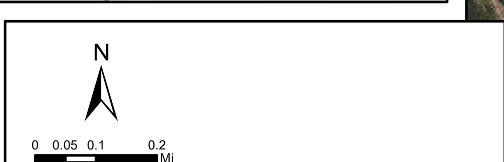
Locator Map

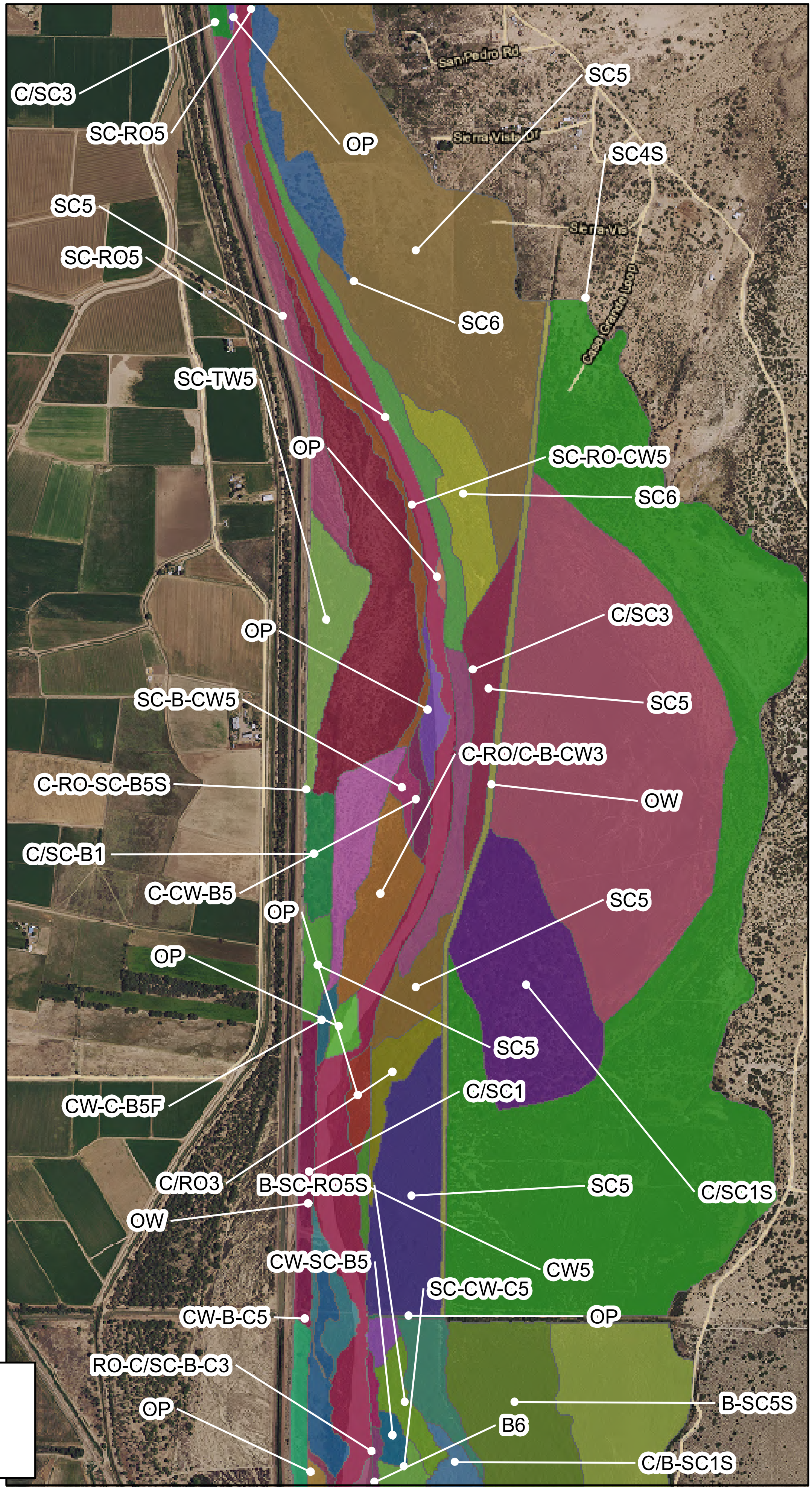






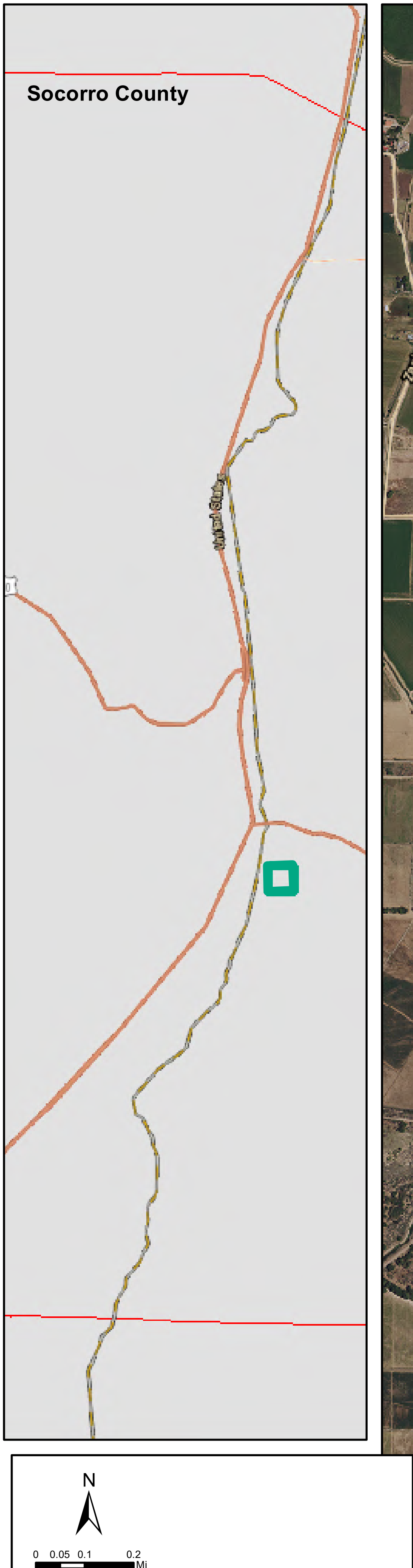

Socorro County

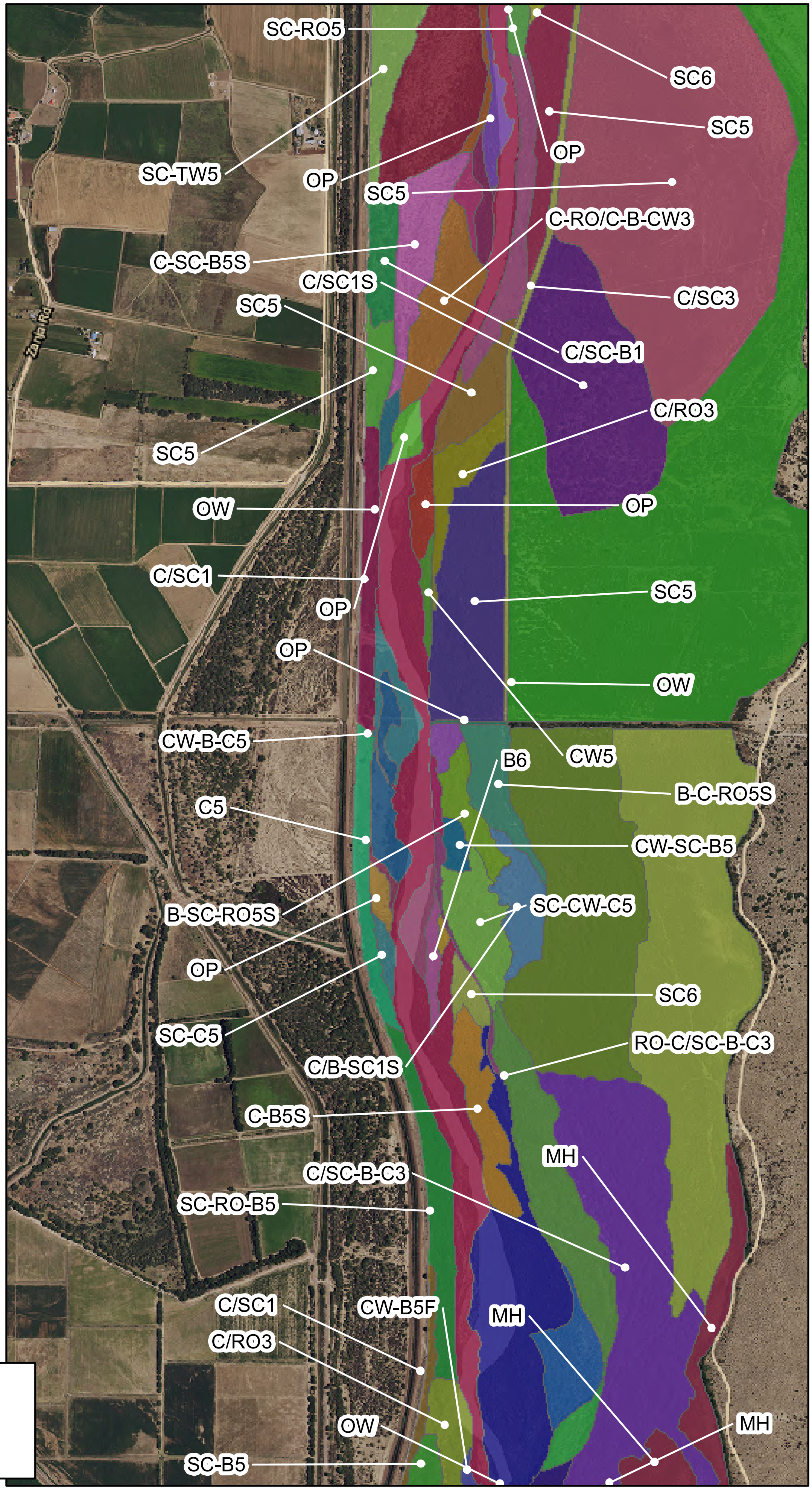

N
0 0.05 0.1 0.2
Mi

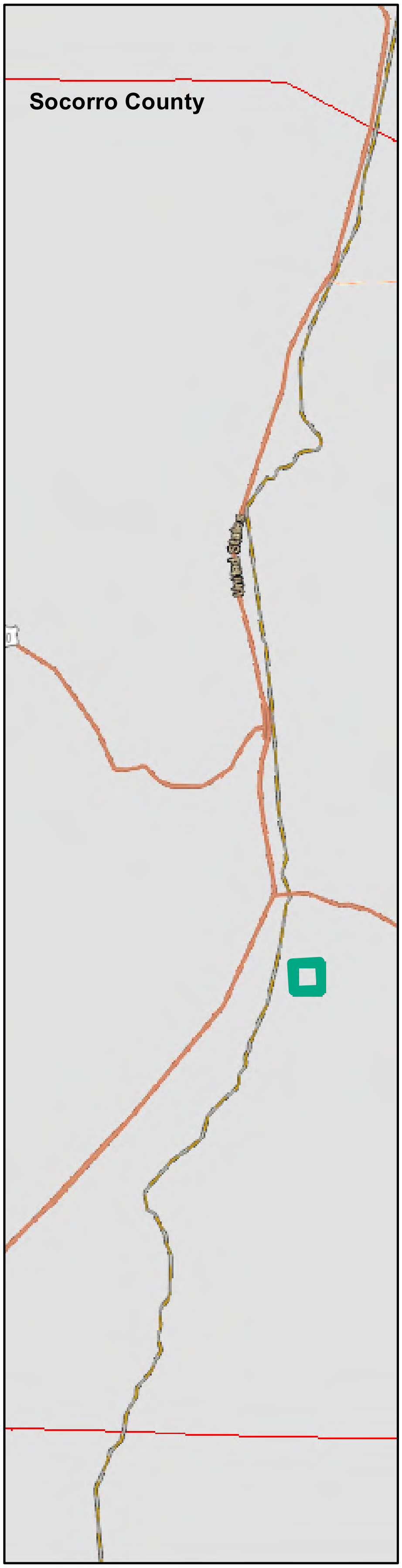

San Pedro Rd
C/SC3
SC-RO5
OP
SC5
SC4S
SC5
SC-RO5
SC6
SC-TW5
OP
SC-RO-CW5
SC6
OP
C/SC3
SC5
SC-B-CW5
C-RO/C-B-CW3
C-RO-SC-B5S
OW
C/SC-B1
C-CW-B5
OP
SC5
OP
SC5
CW-C-B5F
C/SC1
C/RO3
B-SC-RO5S
SC5
C/SC1S
OW
CW5
CW-SC-B5
SC-CW-C5
CW-B-C5
OP
RO-C/SC-B-C3
B-SC5S
OP
B6
C/B-SC1S

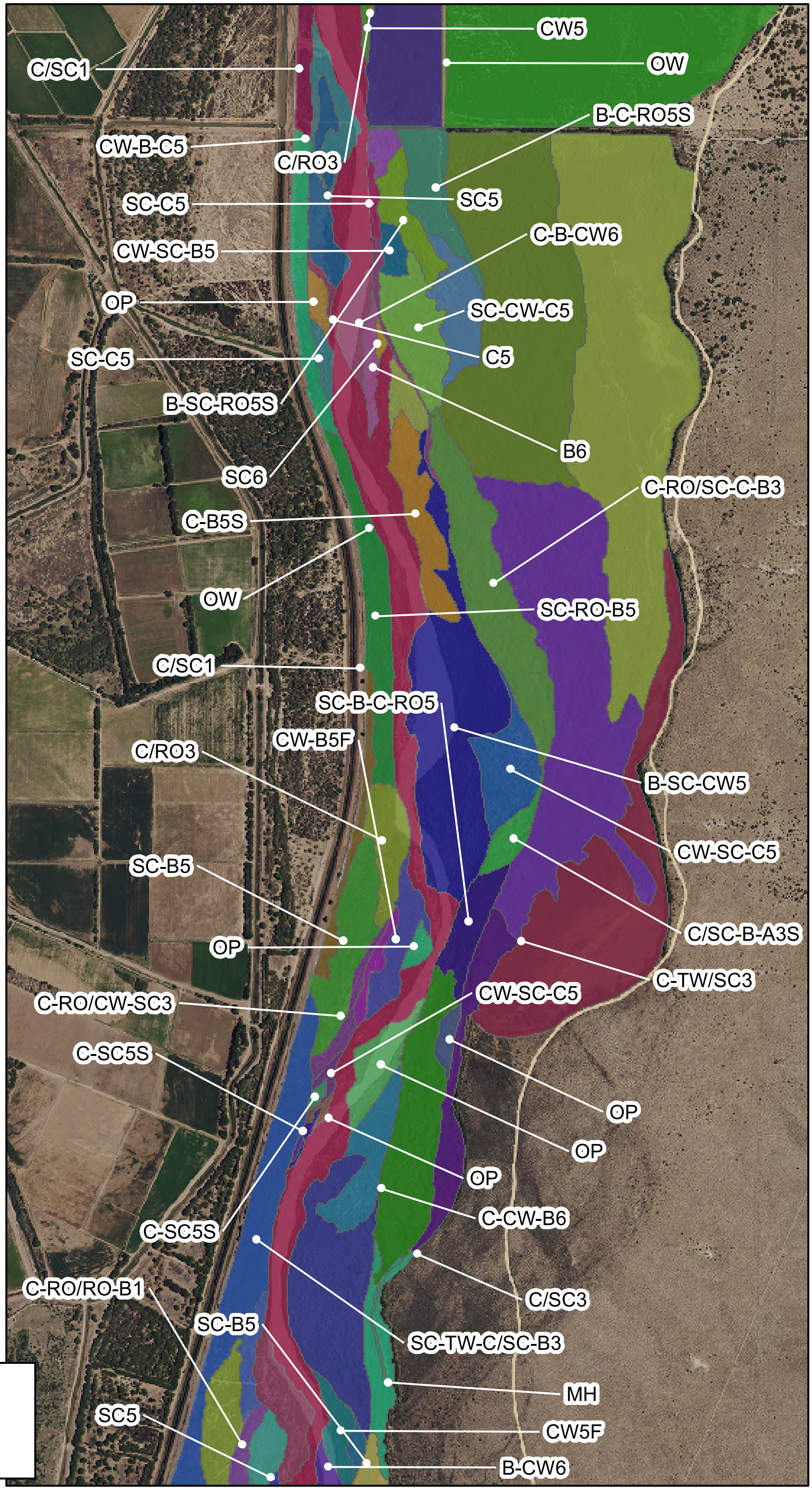
Locator Map

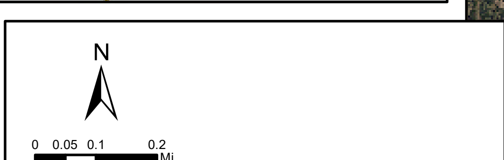
2002
Hink and Ohmart Vegetation Type

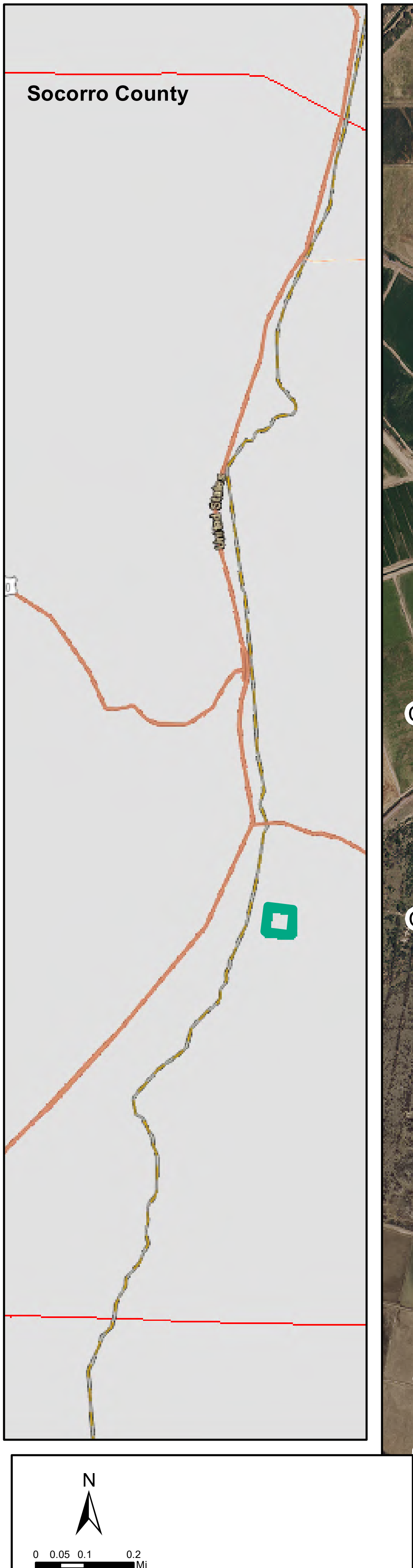


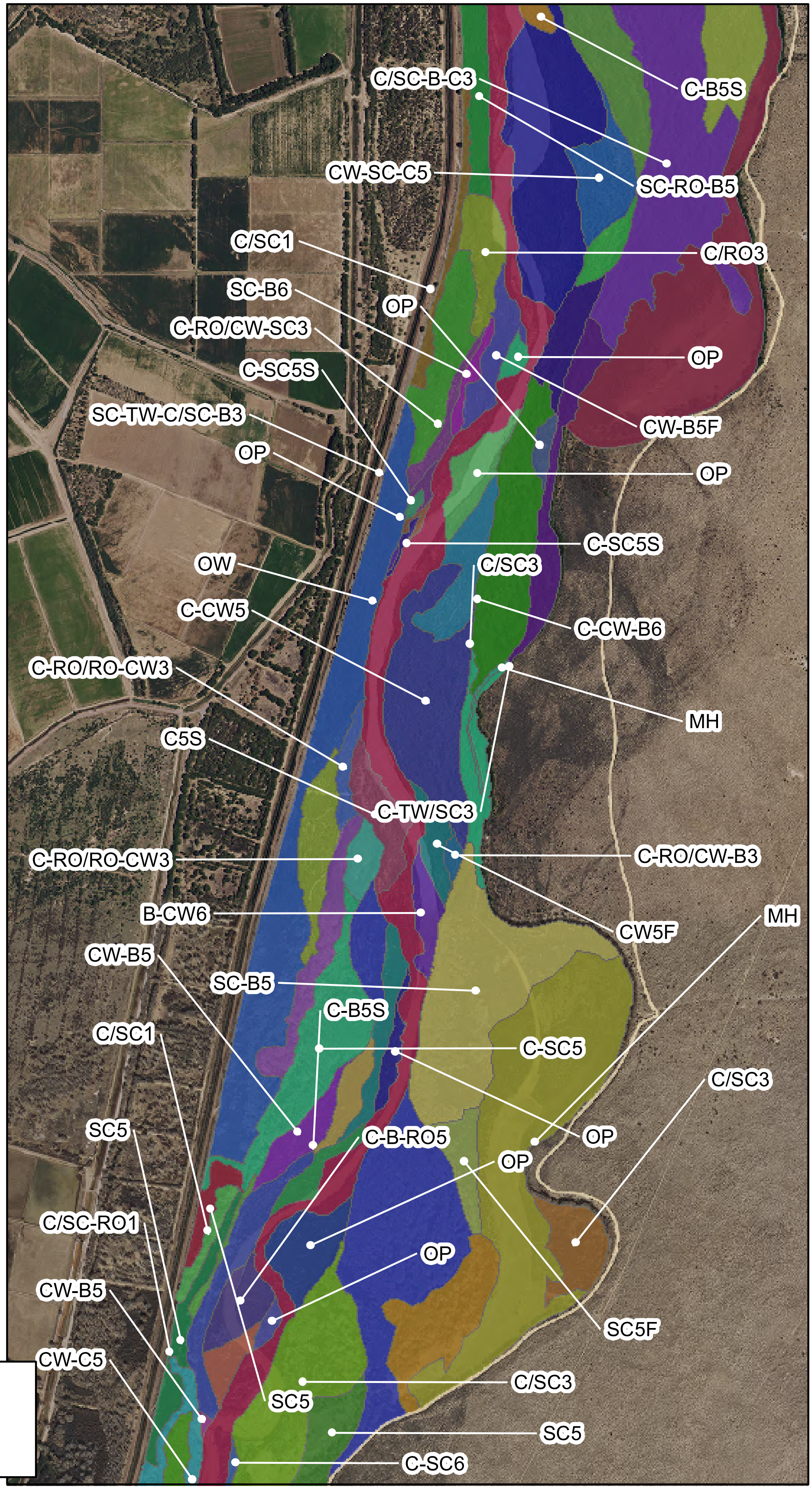



Socorro County

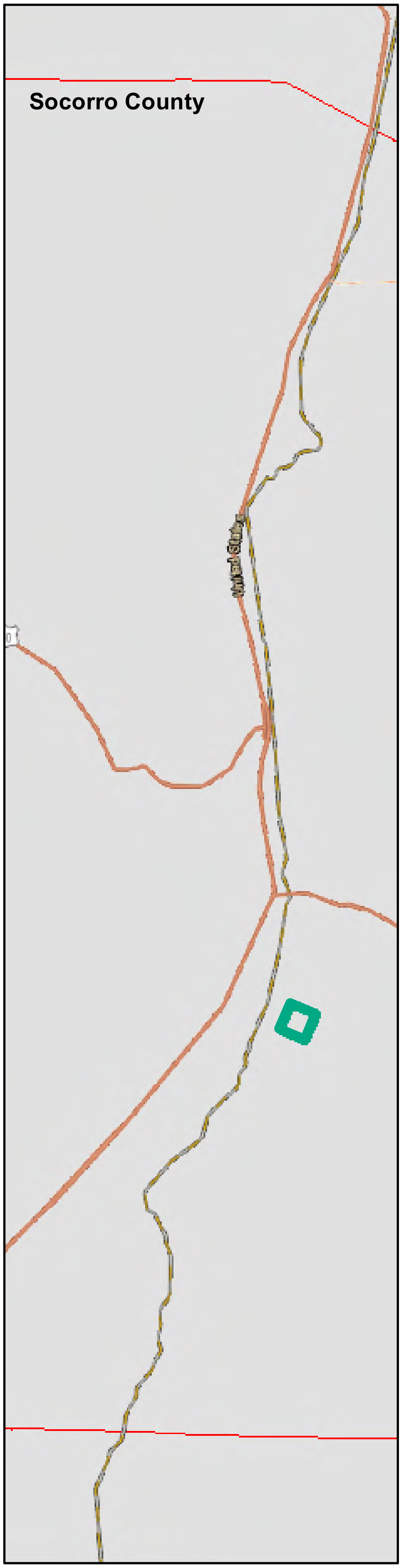

CW5
OW
C/SC1
B-C-RO5S
CW-B-C5
C/RO3
SC5
SC-C5
C-B-CW6
CW-SC-B5
SC-CW-C5
OP
C5
SC-C5
B-SC-RO5S
B6
SC6
C-RO/SC-C-B3
C-B5S
OW
SC-RO-B5
C/SC1
SC-B-C-RO5
CW-B5F
B-SC-CW5
C/RO3
CW-SC-C5
SC-B5
C/SC-B-A3S
OP
C-TW/SC3
C-RO/CW-SC3
CW-SC-C5
C-SC5S
OP
OP
OP
C-CW-B6
C-SC5S
C/SC3
C-RO/RO-B1
SC-TW-C/SC-B3
SC-B5
MH
SC5
CW5F
B-CW6

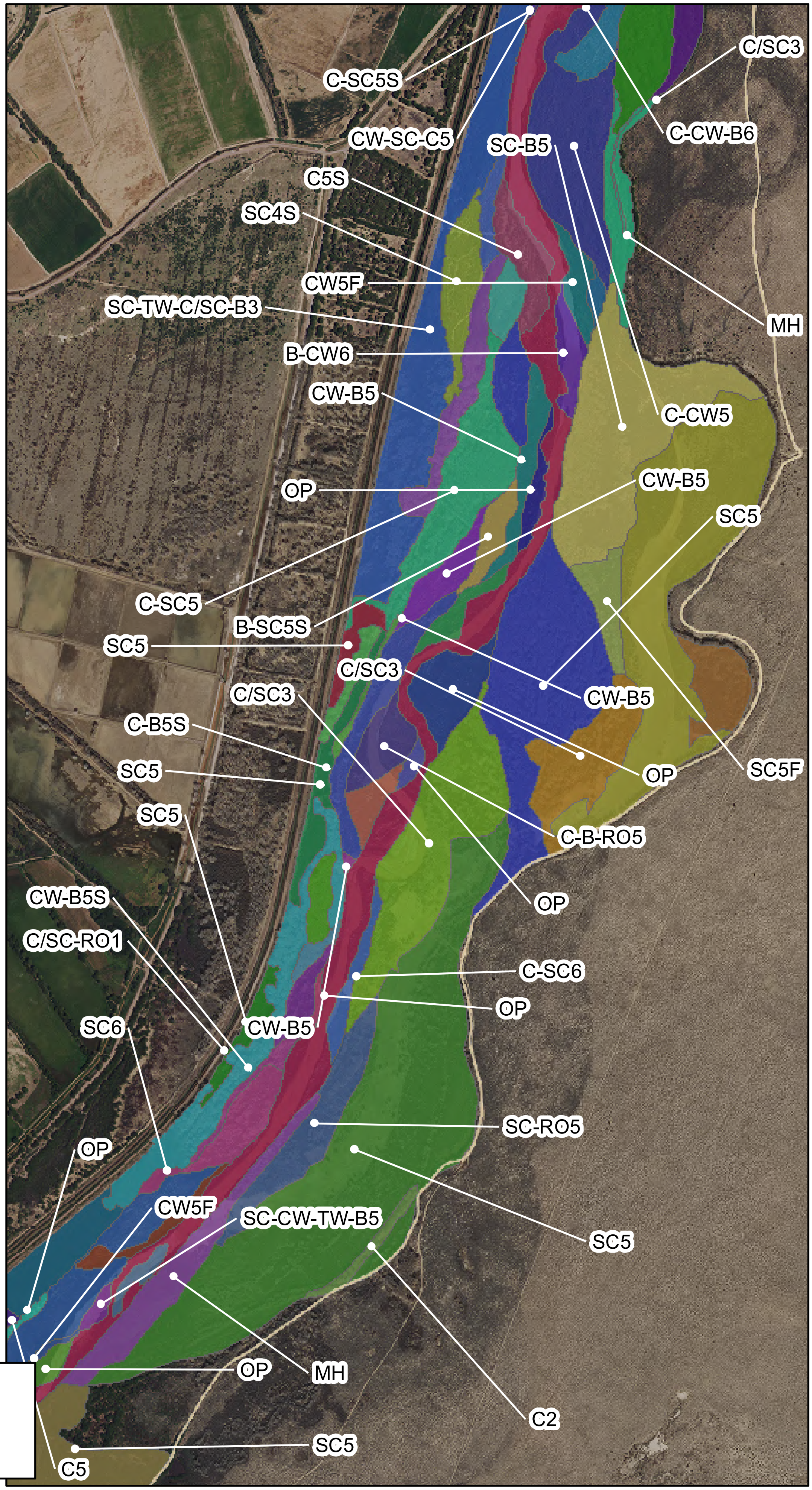

N
0 0.05 0.1 0.2
Mi

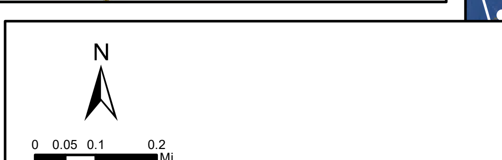

Socorro County
N
0 0.05 0.1 0.2
Mi


C-B5S
C/SC-B-C3
SC-RO-B5
CW-SC-C5
C/RO3
C/SC1
SC-B6
OP
C-RO/CW-SC3
OP
C-SC5S
CW-B5F
SC-TW-C/SC-B3
OP
OP
C-SC5S
C/SC3
OW
C-CW5
C-CW-B6
C-RO/RO-CW3
MH
C5S
C-TW/SC3
C-RO/RO-CW3
C-RO/CW-B3
B-CW6
CW5F
MH
CW-B5
SC-B5
C-B5S
C/SC1
C-SC5
C/SC3
SC5
C-B-RO5
OP
OP
C/SC-RO1
OP
CW-B5
SC5F
CW-C5
SC5
C/SC3
SC5
C-SC6

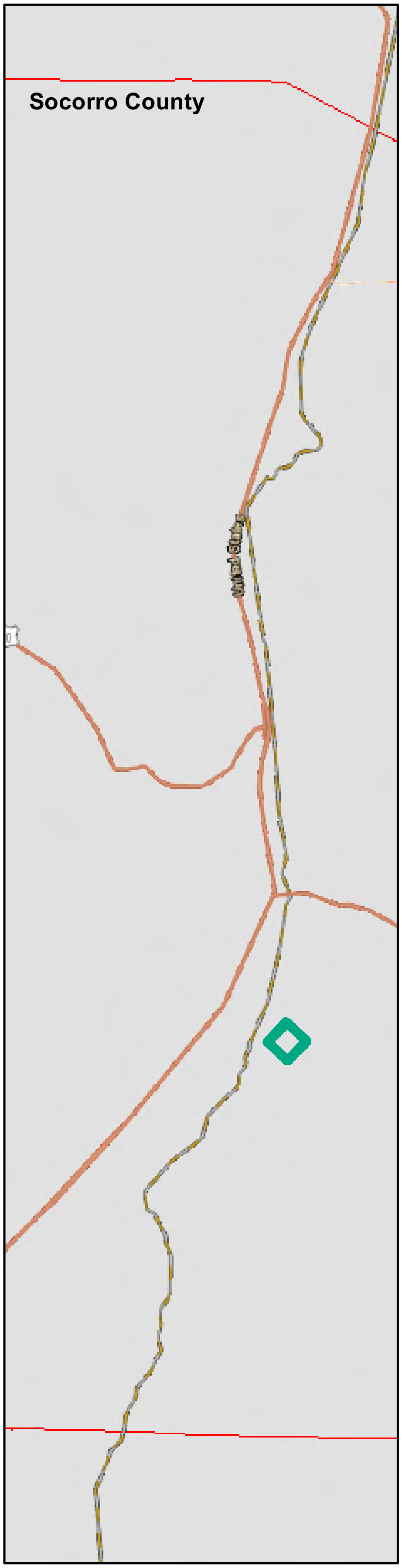
Locator Map

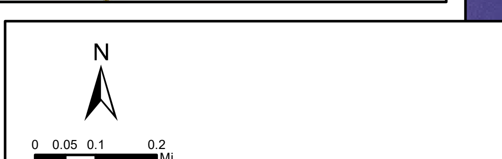

Socorro County

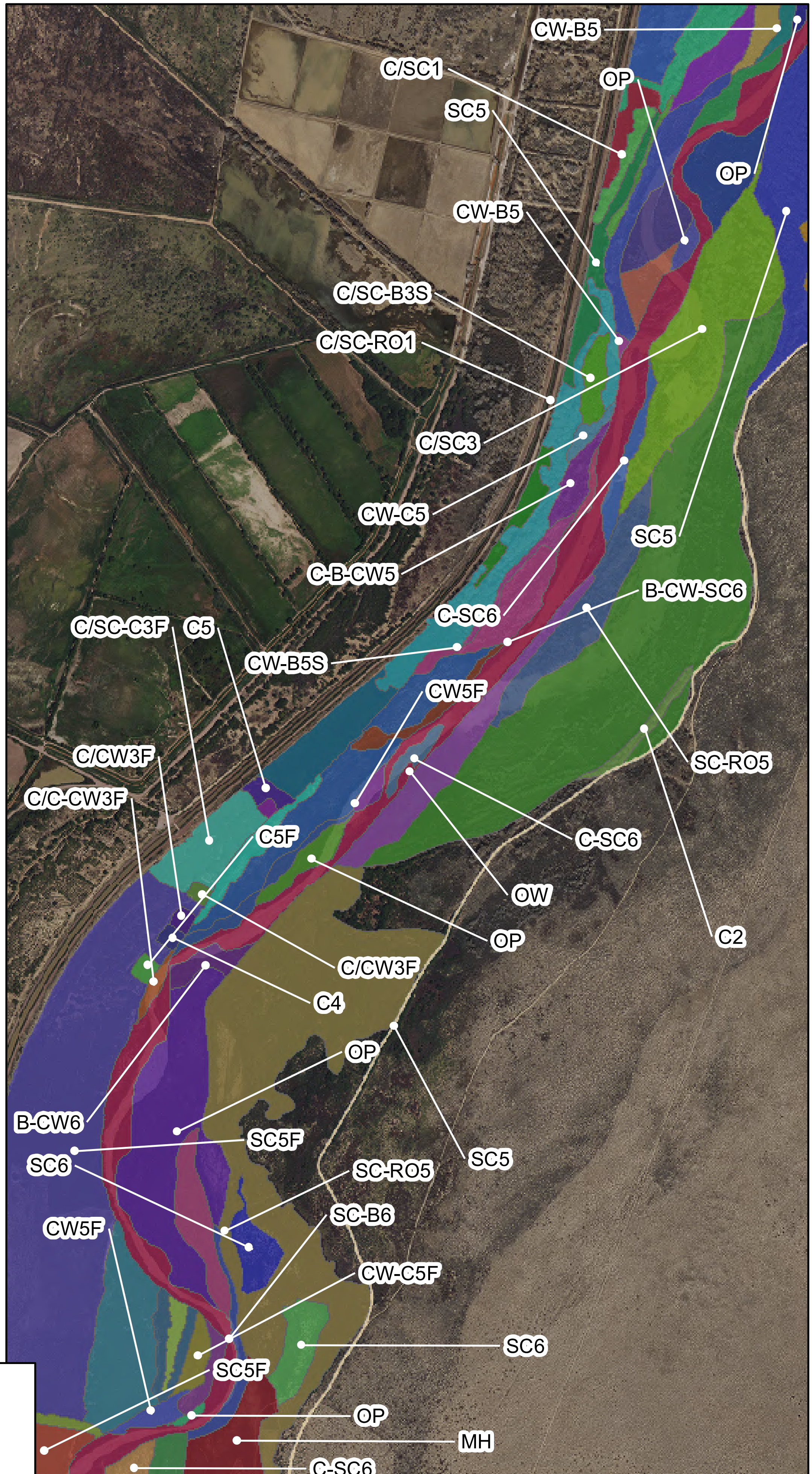

C/SC3
C-SC5S
C-CW-B6
CW-SC-C5
SC-B5
C5S
SC4S
MH
CW5F
SC-TW-C/SC-B3
B-CW6
C-CW5
CW-B5
OP
CW-B5
SC5
C-SC5
B-SC5S
SC5
C/SC3
CW-B5
C/SC3
C-B5S
OP
SC5F
SC5
C-B-RO5
SC5
OP
CW-B5S
C/SC-RO1
C-SC6
OP
SC6
CW-B5
SC-RO5
OP
CW5F
SC-CW-TW-B5
SC5
OP
MH
C2
SC5
C5


N
0 0.05 0.1 0.2
Mi

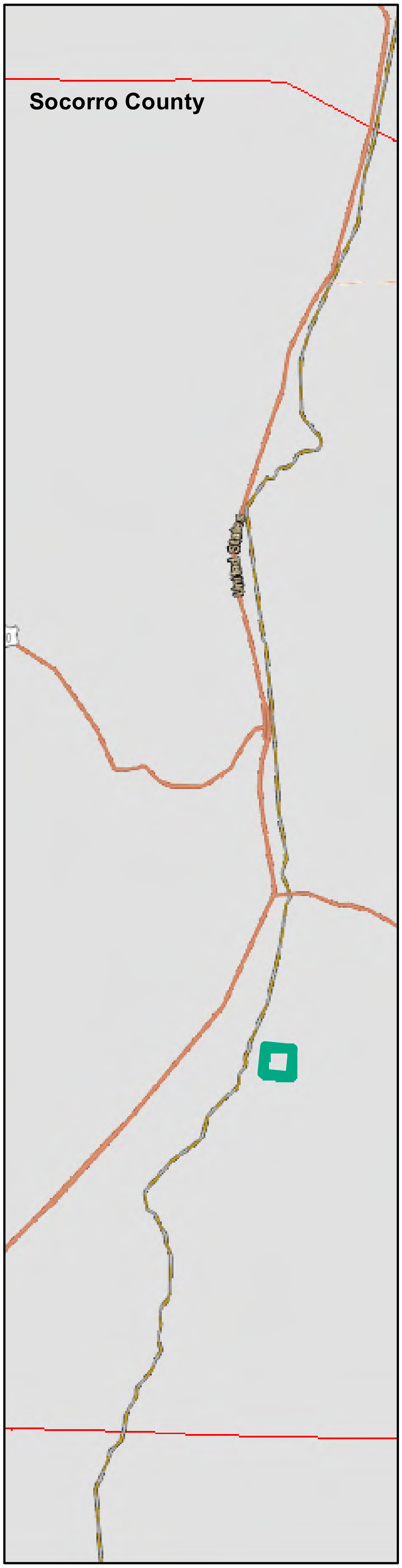
Locator Map

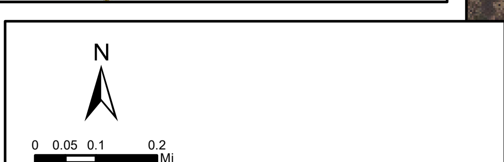

Socorro County

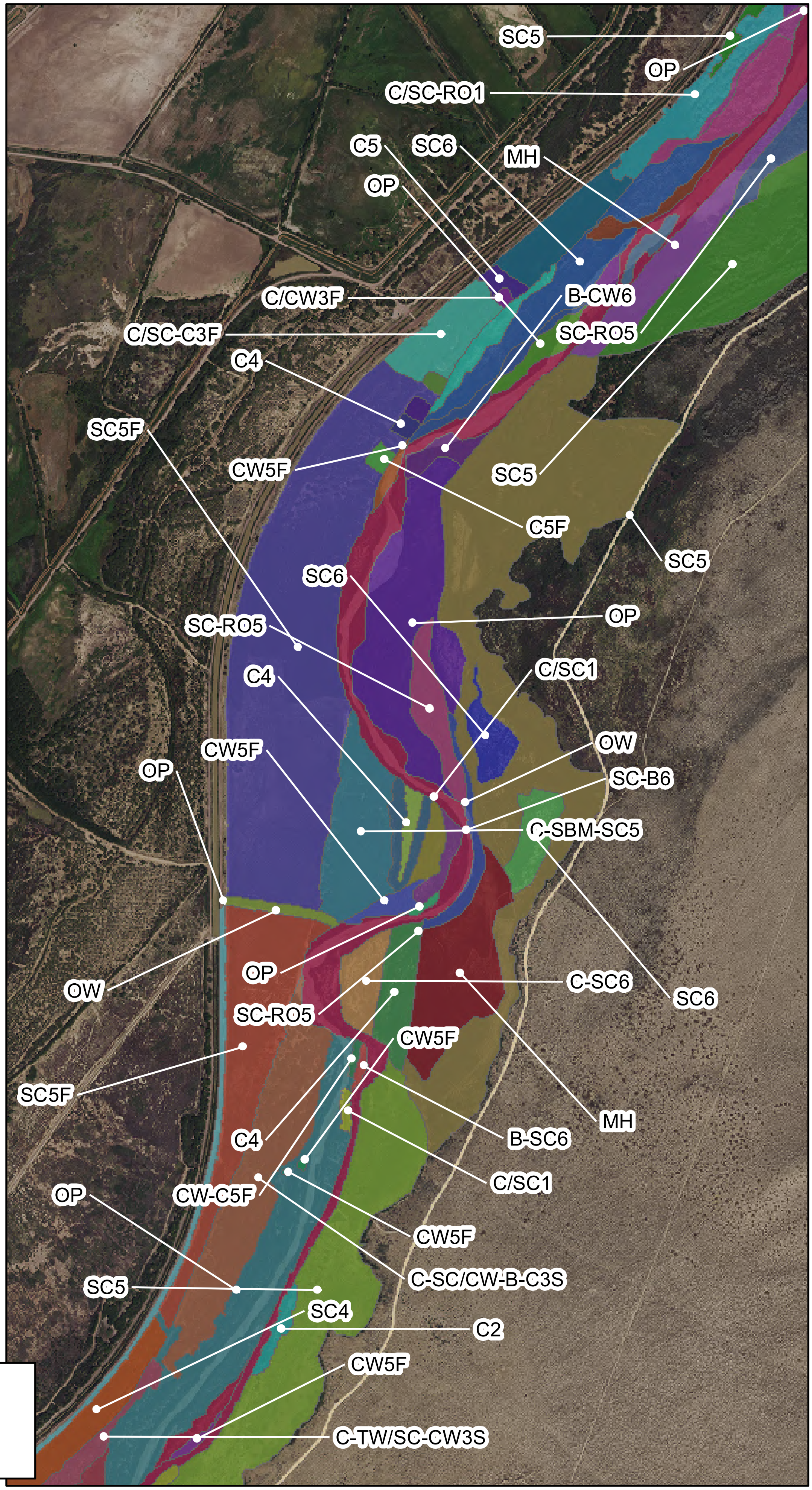

N
0 0.05 0.1 0.2
Mi


CW-B5
C/SC1
OP
SC5
OP
CW-B5
C/SC-B3S
C/SC-RO1
C/SC3
CW-C5
SC5
C-B-CW5
B-CW-SC6
C-SC6
C/SC-C3F
C5
CW-B5S
CW5F
C/CW3F
SC-RO5
C/C-CW3F
C-SC6
C5F
OW
OP
C2
C/CW3F
C4
OP
B-CW6
SC5
SC5F
SC6
SC-RO5
SC-B6
CW5F
CW-C5F
SC6
SC5F
OP
MH
C-SC6

Locator Map

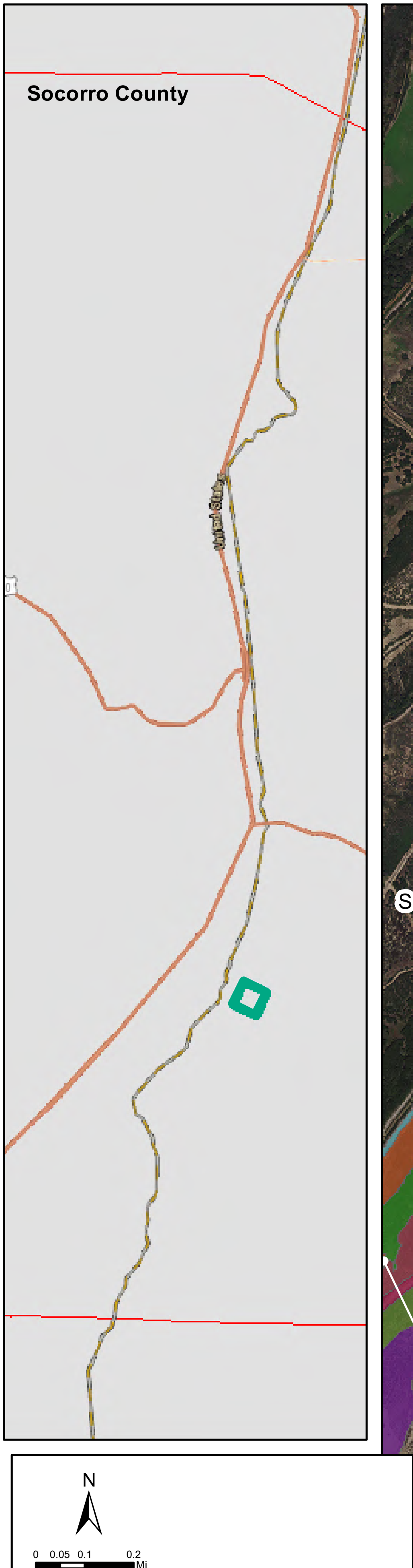

Socorro County

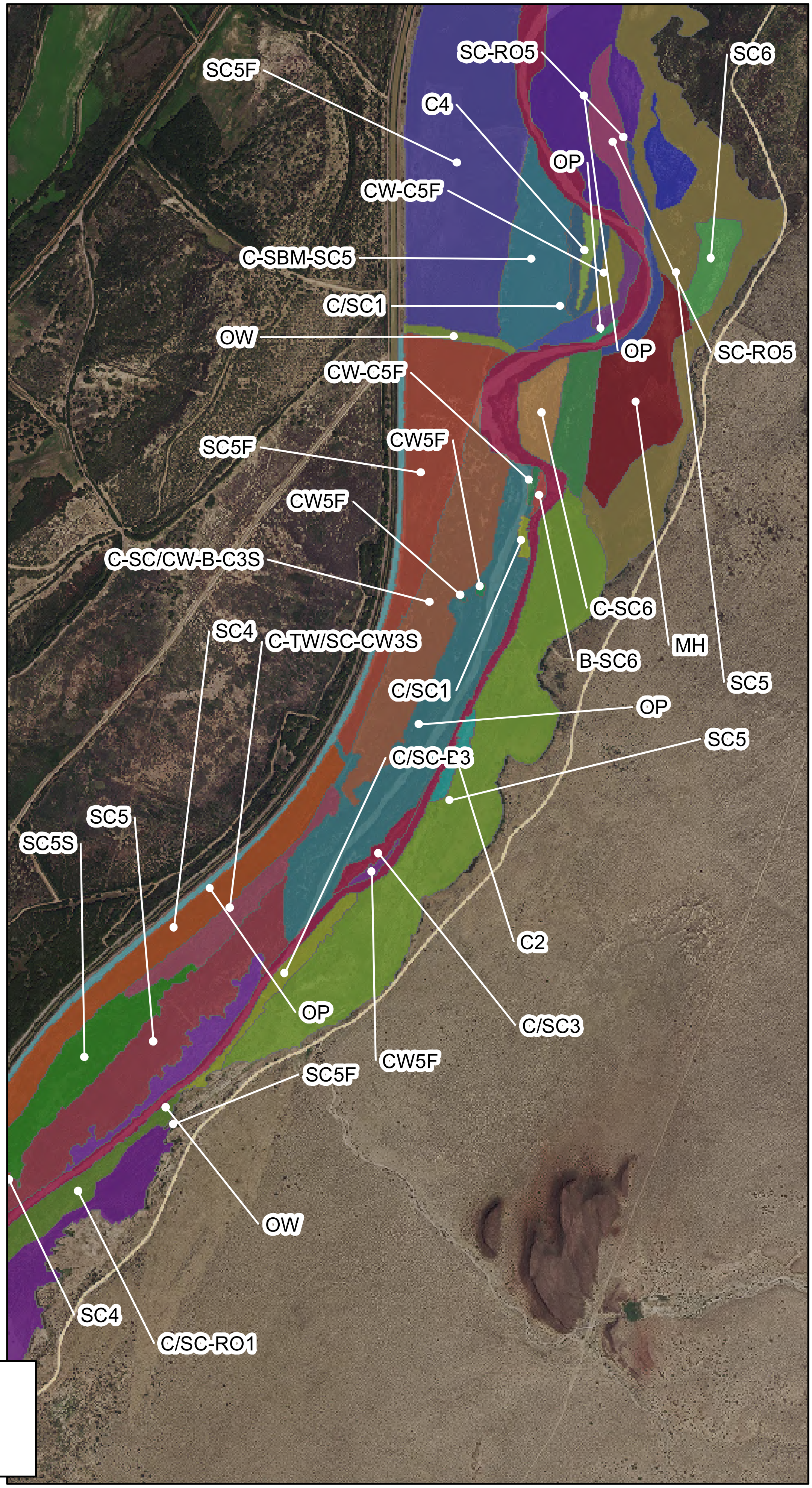

N
0
0.05
0.1
0.2
Mi


SC5
OP
C/SC-RO1
C5
SC6
MH
OP
C/CW3F
B-CW6
C/SC-C3F
SC-RO5
C4
SC5F
CW5F
SC5
C5F
SC5
SC6
OP
SC-RO5
C/SC1
C4
OW
CW5F
SC-B6
OP
C-SBM-SC5
OW
OP
C-SC6
SC6
SC-RO5
CW5F
SC5F
MH
C4
B-SC6
C/SC1
OP
CW-C5F
CW5F
C-SC/CW-B-C3S
SC5
SC4
C2
CW5F
C-TW/SC-CW3S

Locator Map

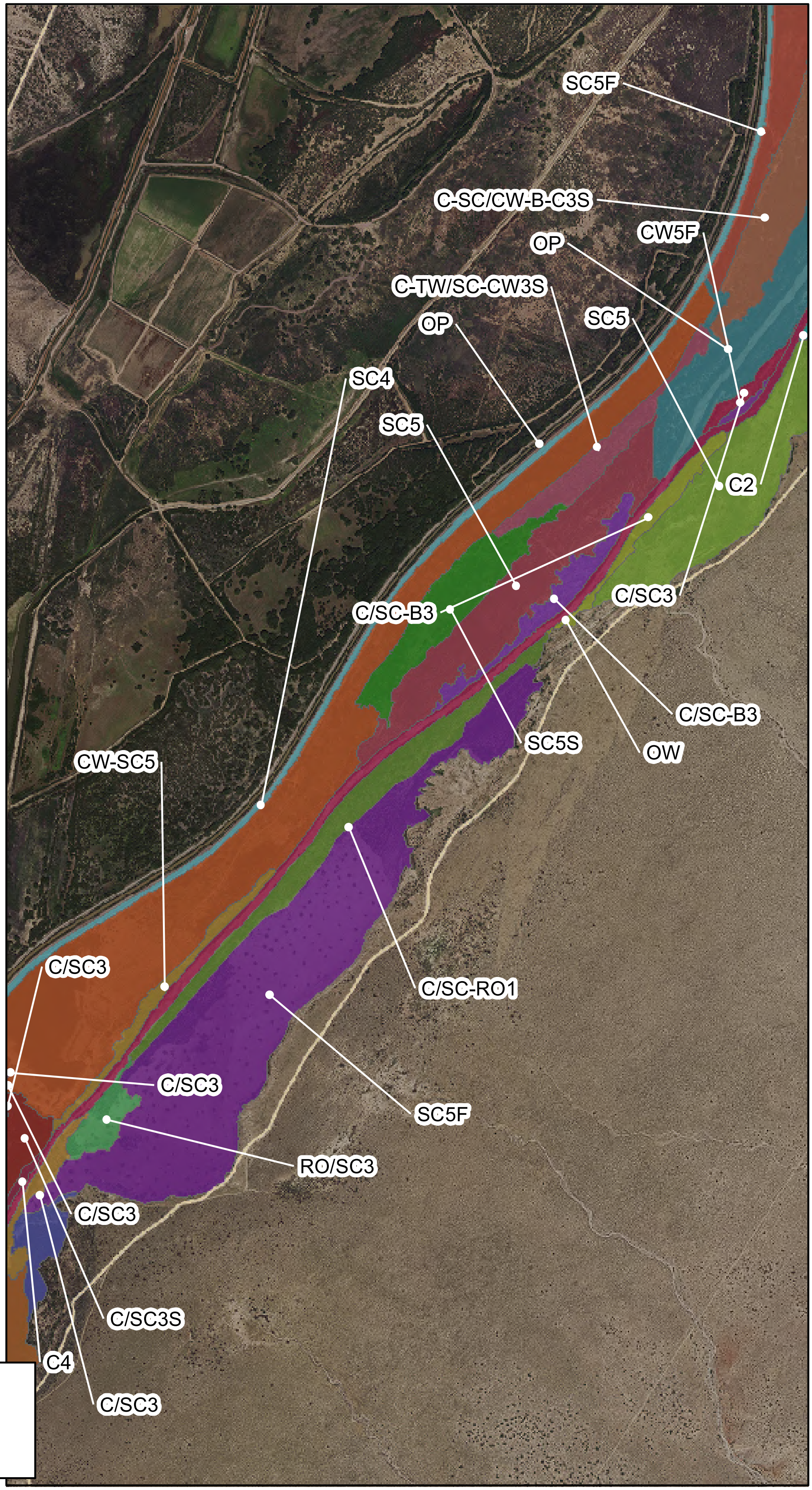
2002
Hink and Ohmart Vegetation Type





Locator Map


Socorro County
N
0 0.05 0.1 0.2
Mi


SC5F
C-SC/CW-B-C3S
CW5F
OP
C-TW/SC-CW3S
SC5
OP
SC4
SC5
C2
C/SC-B3
C/SC3
C/SC-B3
SC5S
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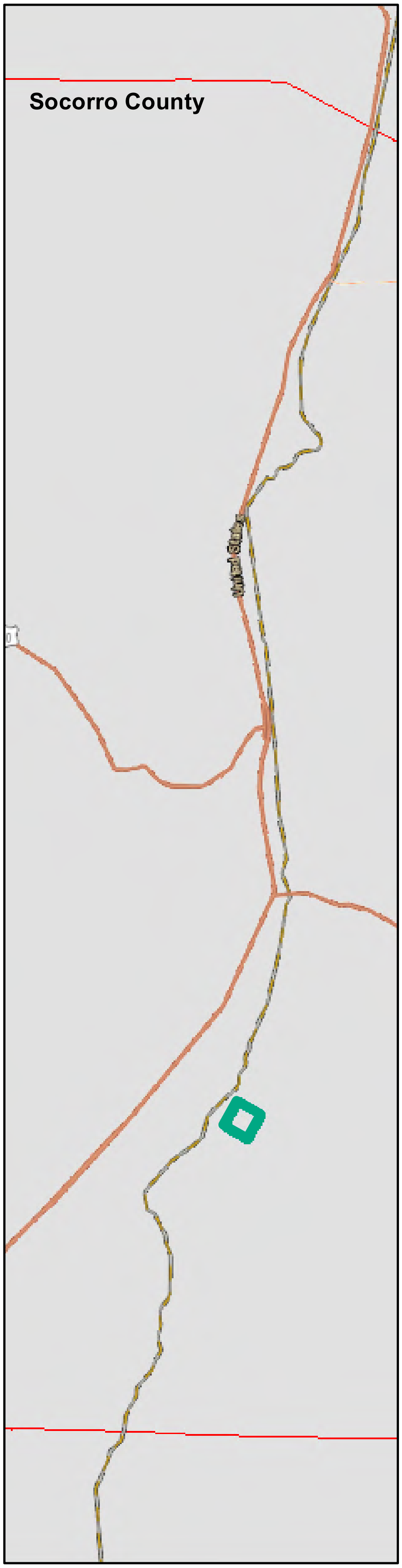
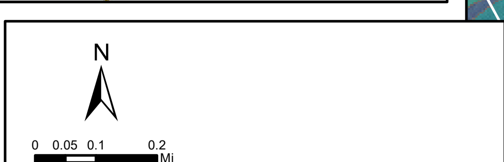
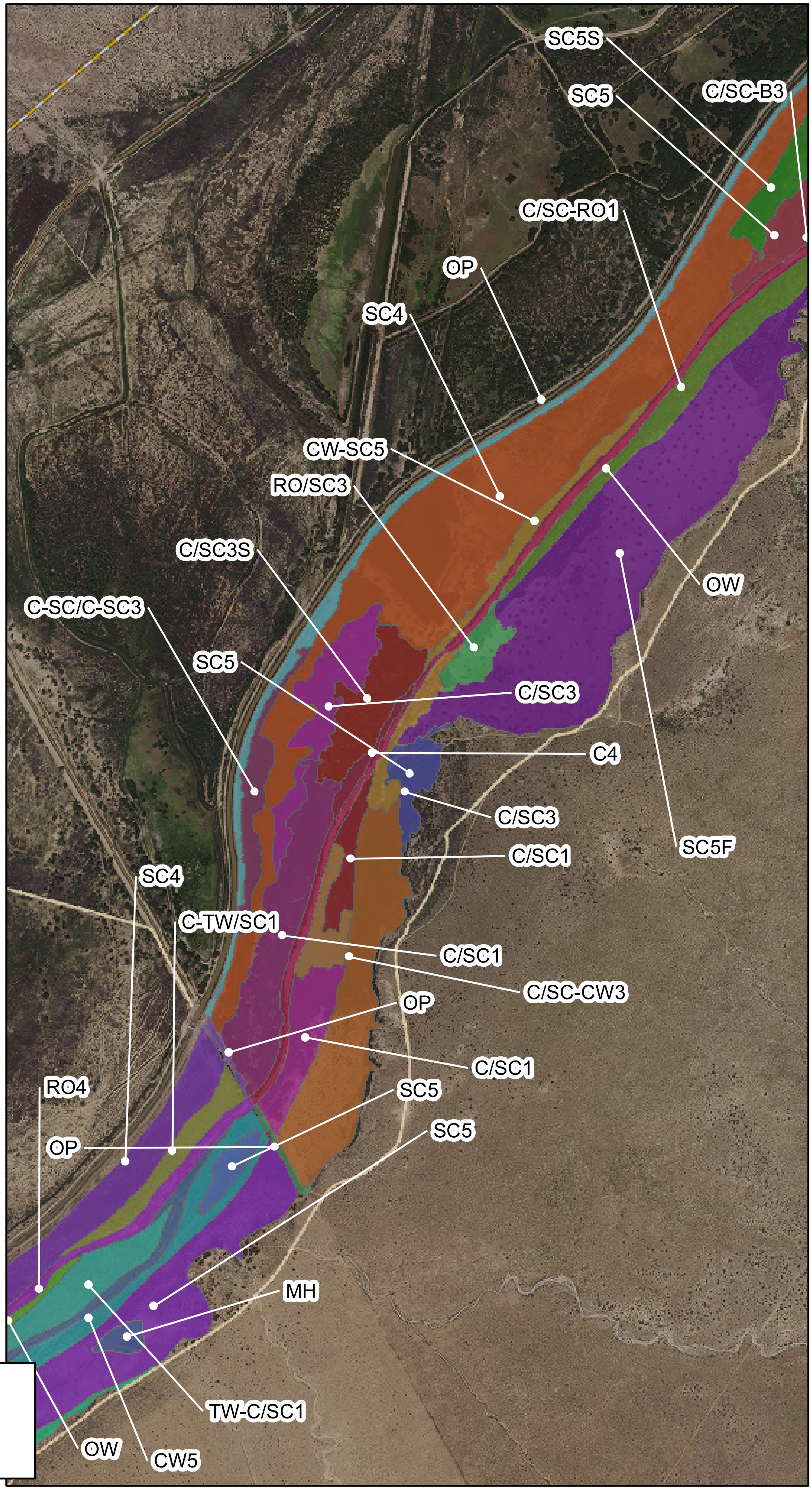
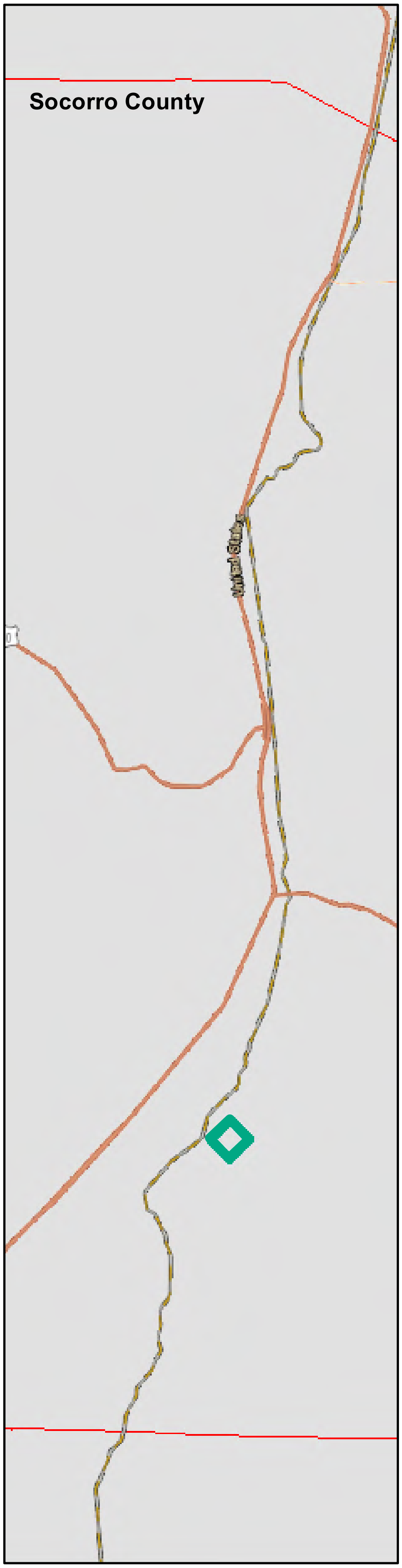
C/SC3S
C4
C/SC3

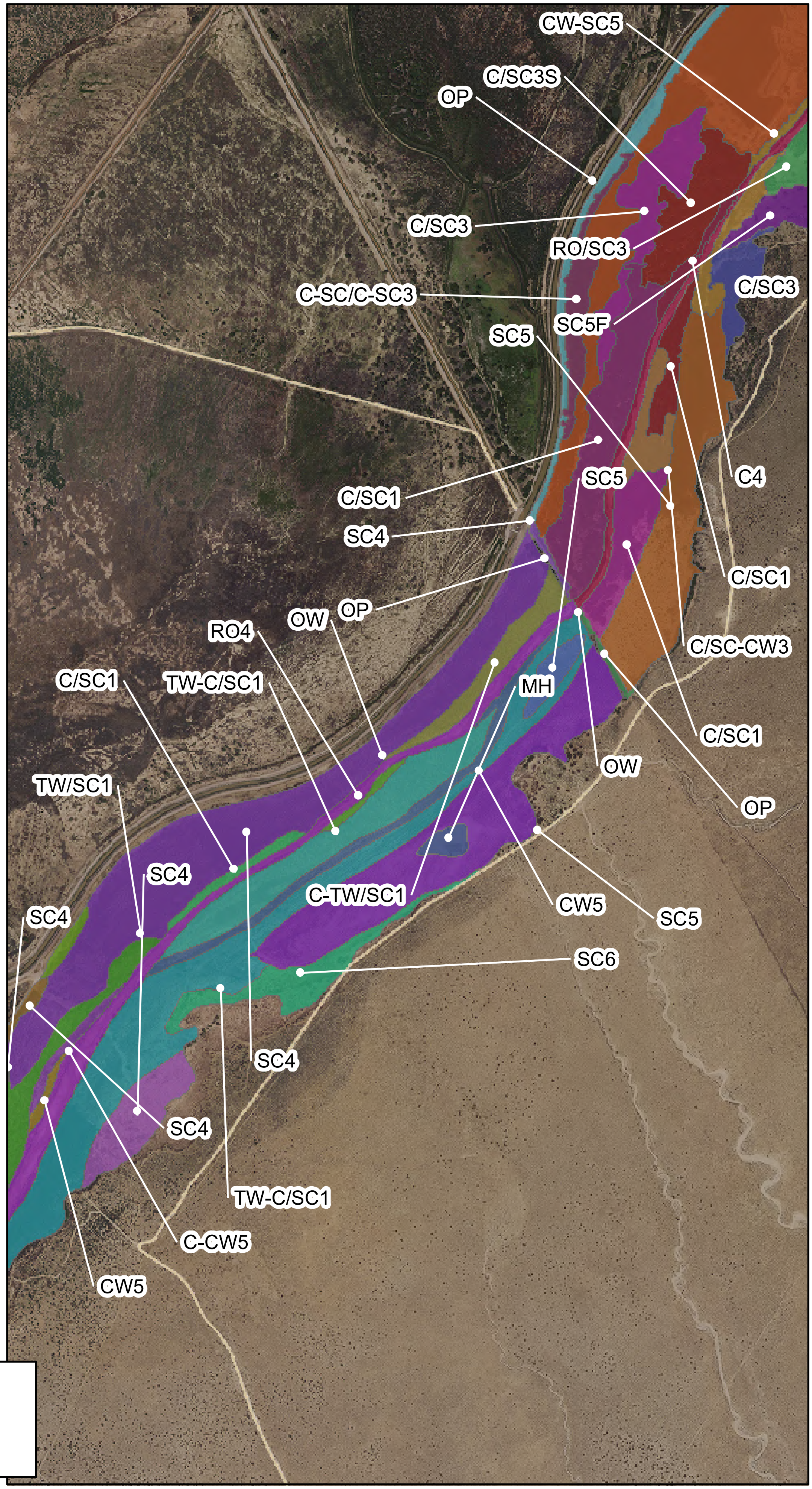

Socorro County

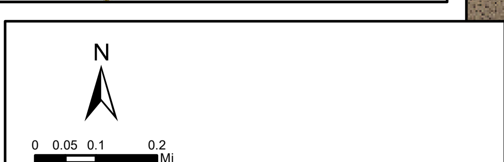

N
0 0.05 0.1 0.2
Mi


SC5S
SC5
C/SC-B3
C/SC-RO1
OP
SC4
CW-SC5
RO/SC3
OW
C/SC3S
C-SC/C-SC3
SC5
C/SC3
C4
C/SC3
C/SC1
SC5F
SC4
C-TW/SC1
C/SC1
C/SC-CW3
OP
C/SC1
SC5
RO4
SC5
OP
MH
TW-C/SC1
OW
CW5

Locator Map

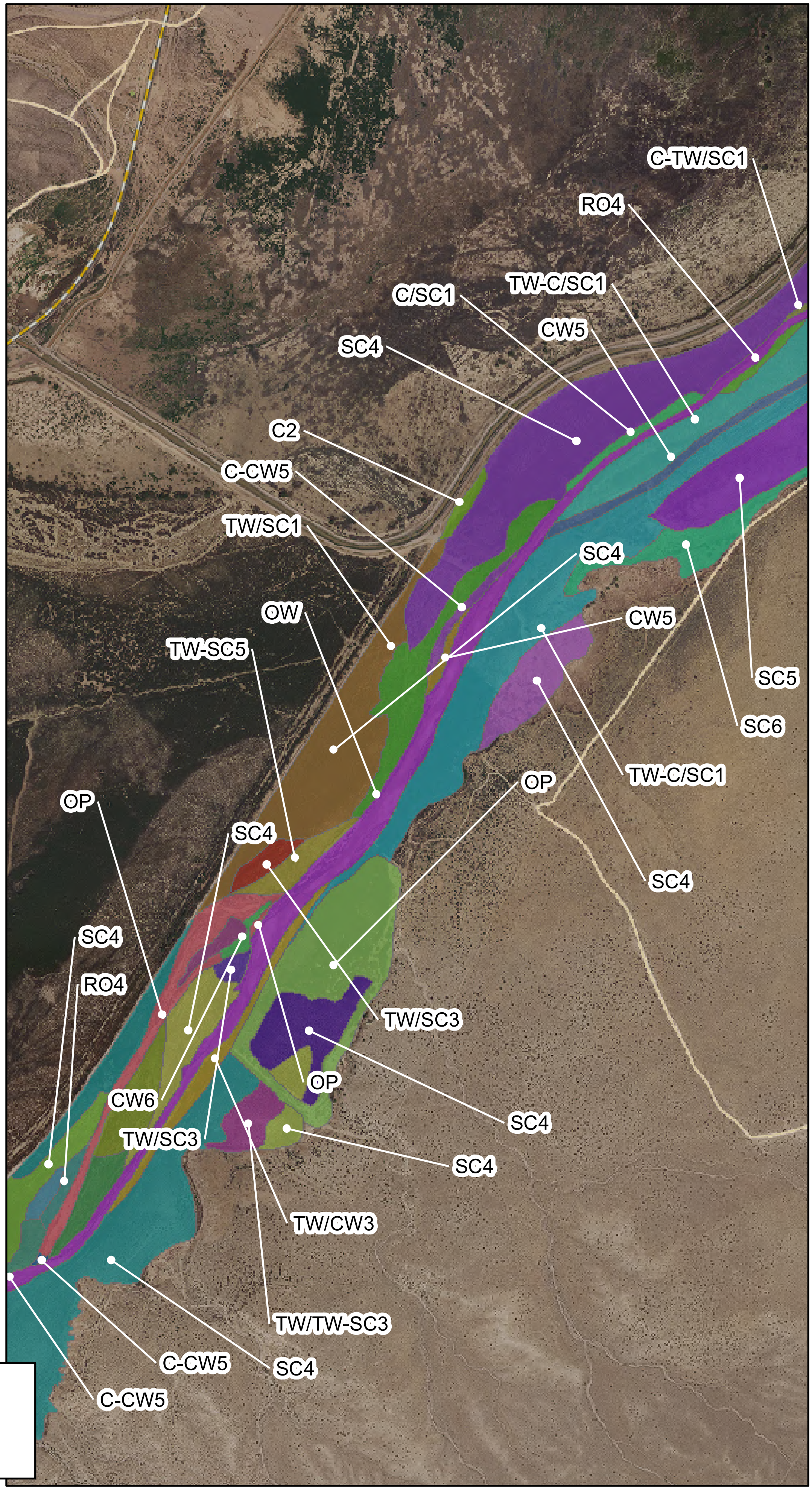

Socorro County


CW-SC5
C/SC3S
OP
C/SC3
RO/SC3
C/SC3
C-SC/C-SC3
SC5F
SC5
C4
C/SC1
SC5
SC4
C/SC1
OW
OP
RO4
C/SC-CW3
C/SC1
TW-C/SC1
MH
C/SC1
OW
TW/SC1
OP
SC4
C-TW/SC1
CW5
SC5
SC4
SC6
SC4
SC4
TW-C/SC1
C-CW5
CW5


N
0
0.05
0.1
0.2
Mi

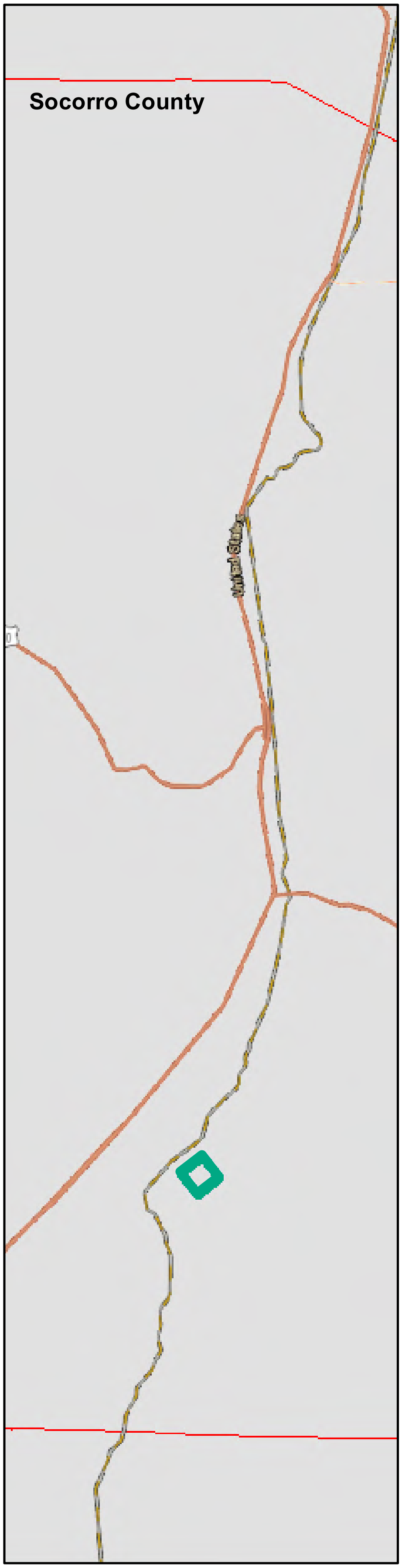
Locator Map

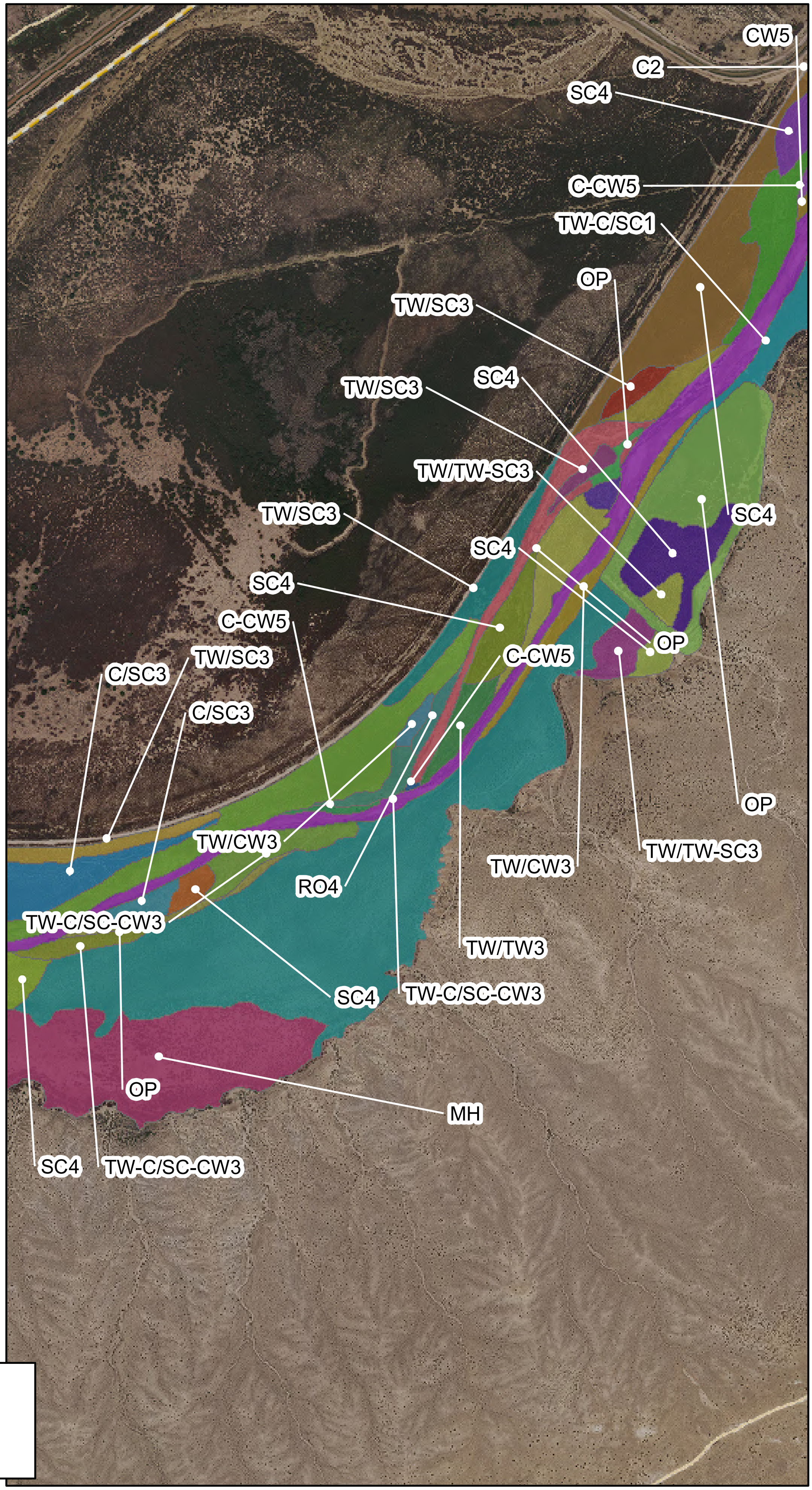

Socorro County
N
0 0.05 0.1 0.2
Mi

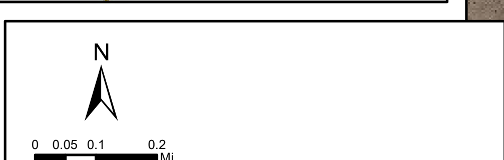

C-TW/SC1
RO4
TW-C/SC1
C/SC1
CW5
SC4
C2
C-CW5
TW/SC1
SC4
OW
CW5
TW-SC5
SC5
SC6
TW-C/SC1
OP
OP
SC4
SC4
SC4
RO4
TW/SC3
OP
CW6
SC4
TW/SC3
SC4
TW/CW3
TW/TW-SC3
C-CW5
SC4
C-CW5

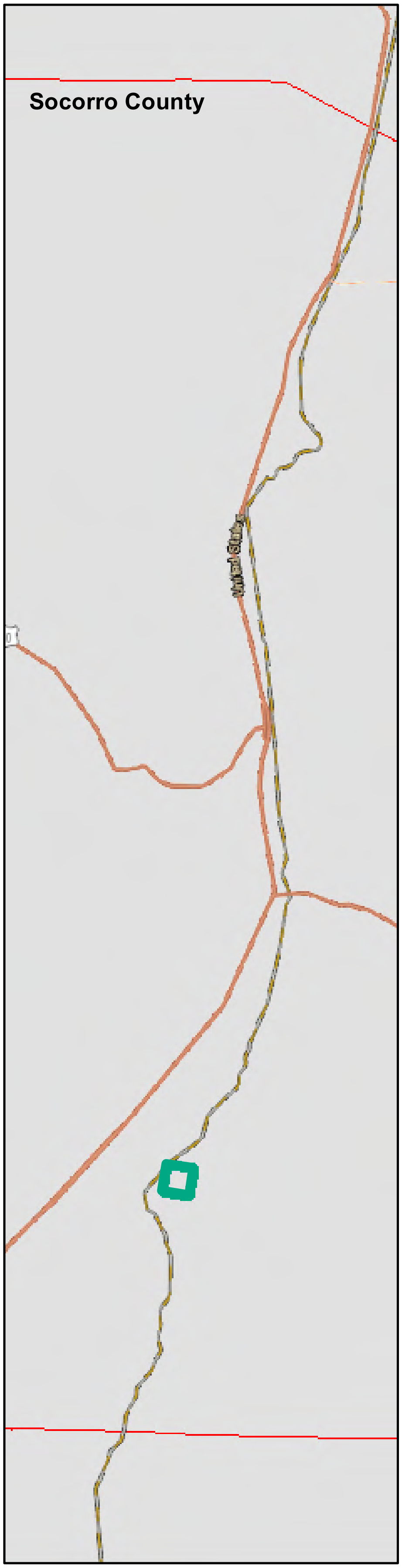
Locator Map

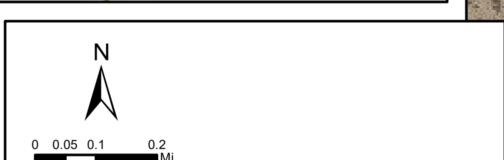
2002
Hink and Ohmart Vegetation Type

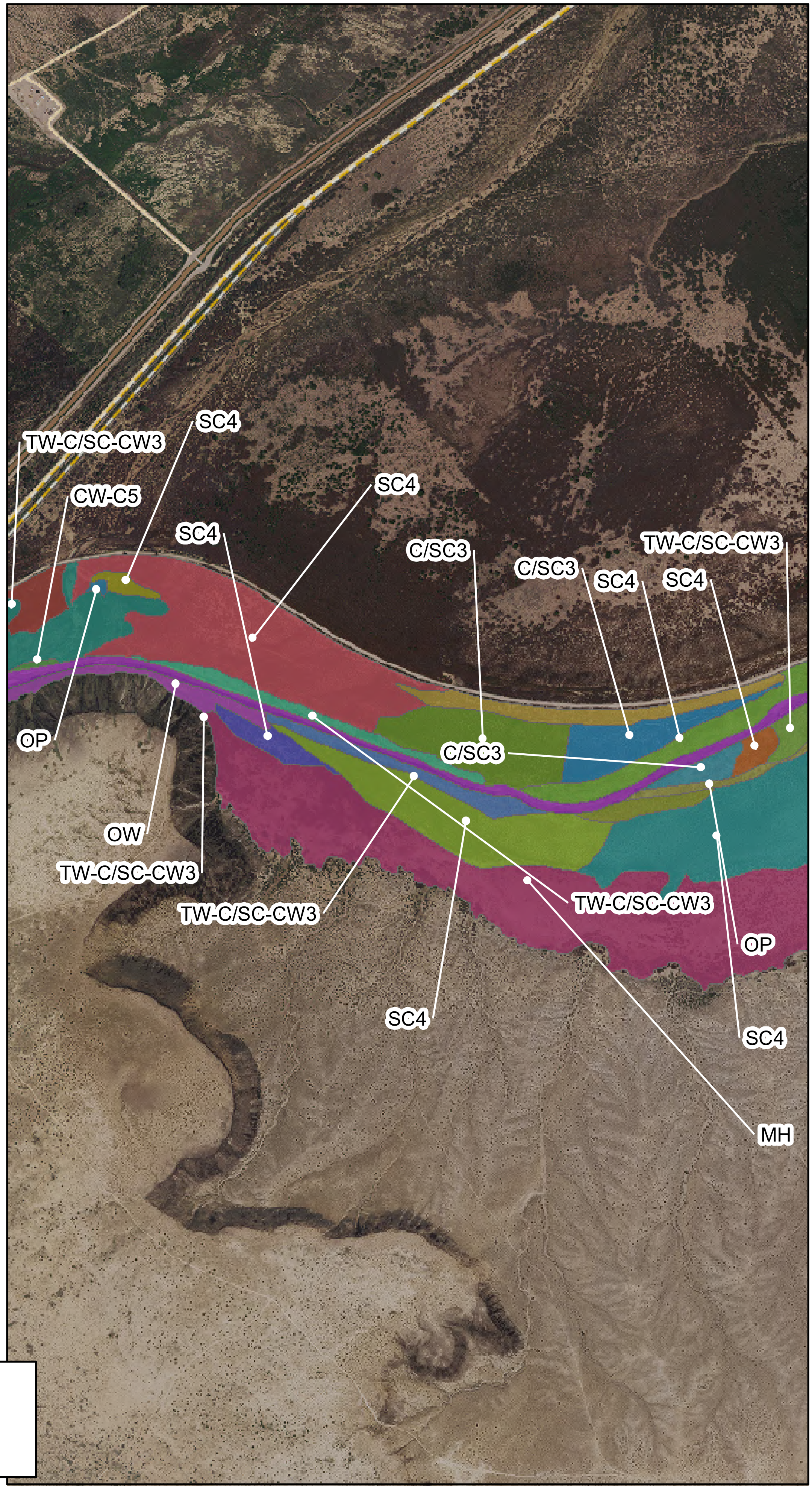






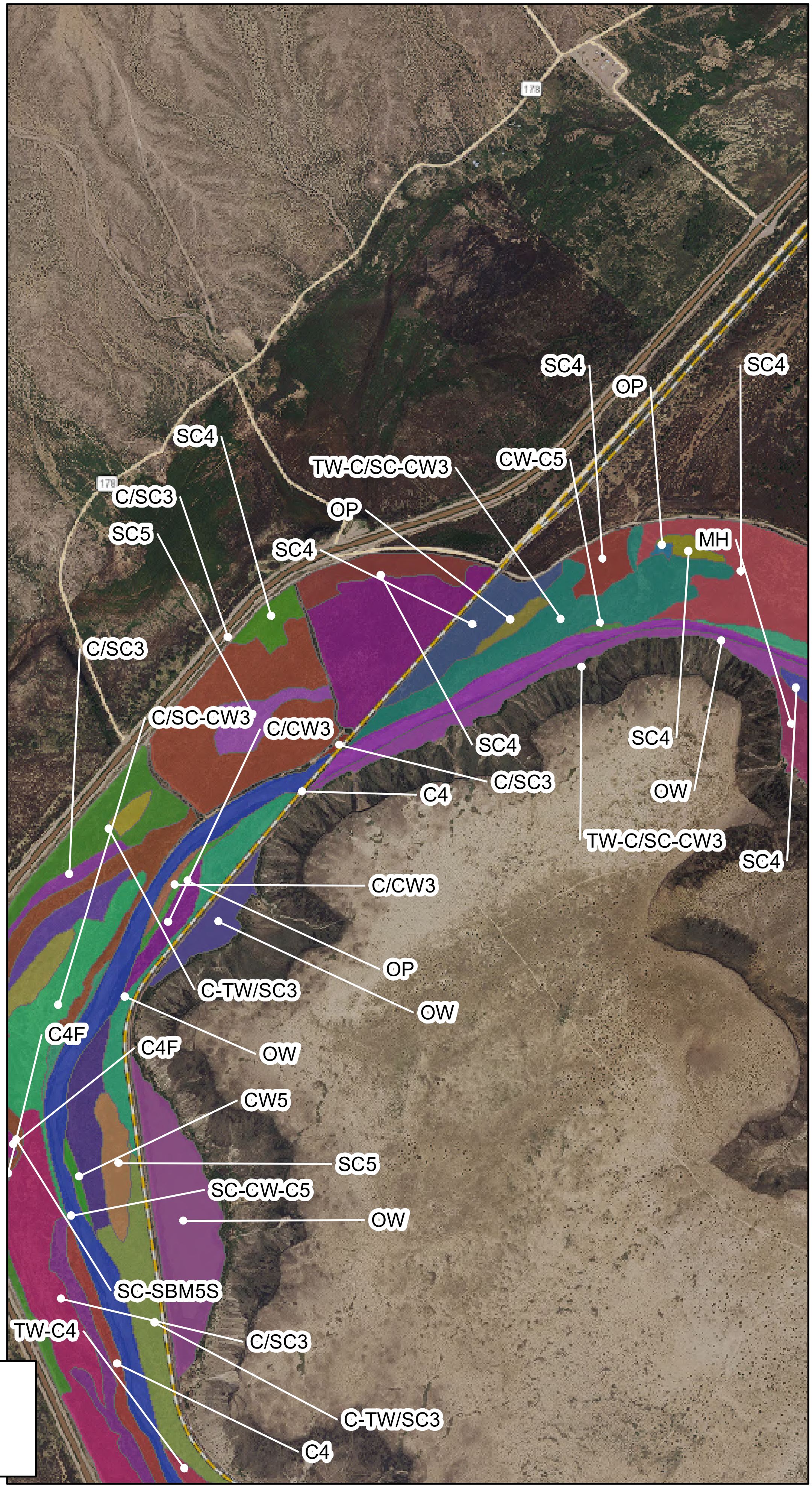

Socorro County


N
0 0.05 0.1 0.2
Mi

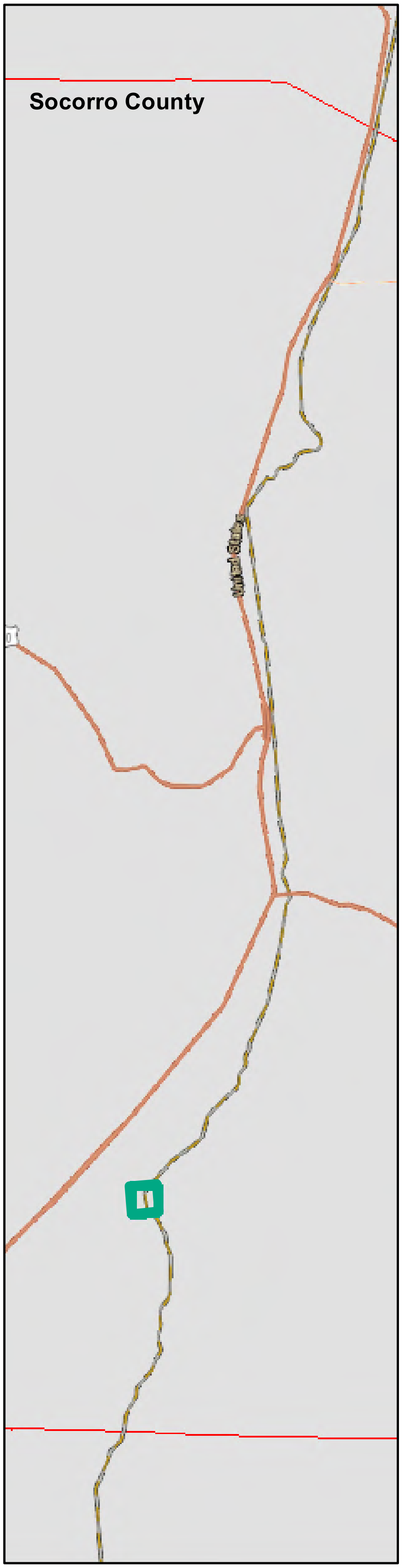

TW-C/SC-CW3
SC4
CW-C5
SC4
SC4
C/SC3
C/SC3
SC4
SC4
TW-C/SC-CW3
OP
C/SC3
OW
TW-C/SC-CW3
TW-C/SC-CW3
TW-C/SC-CW3
OP
SC4
SC4
MH

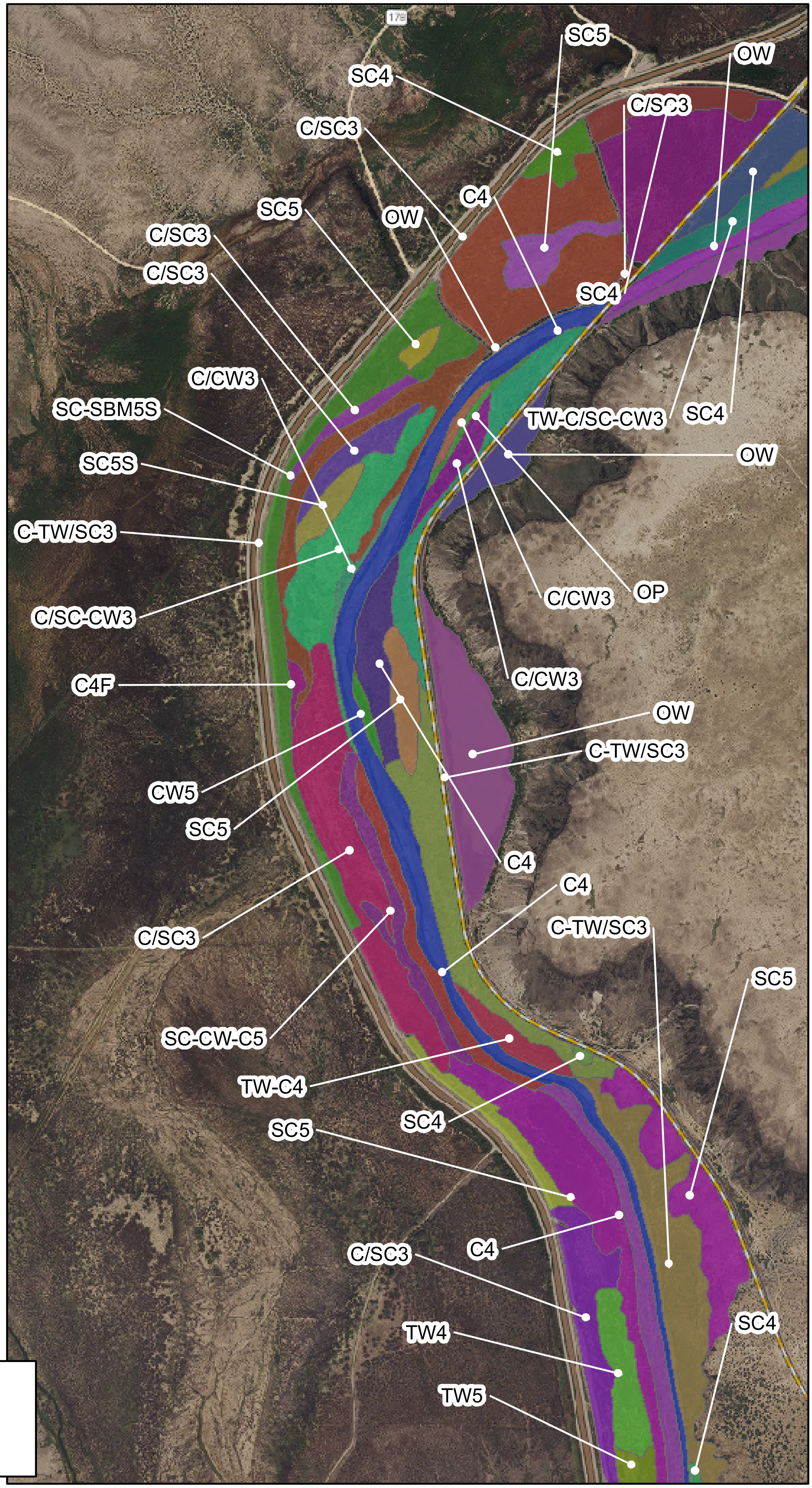
Locator Map

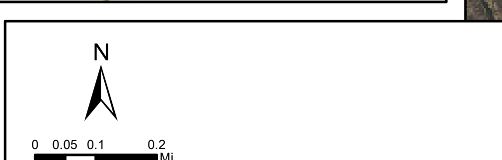
2002
Hink and Ohmart Vegetation Type



Locator Map

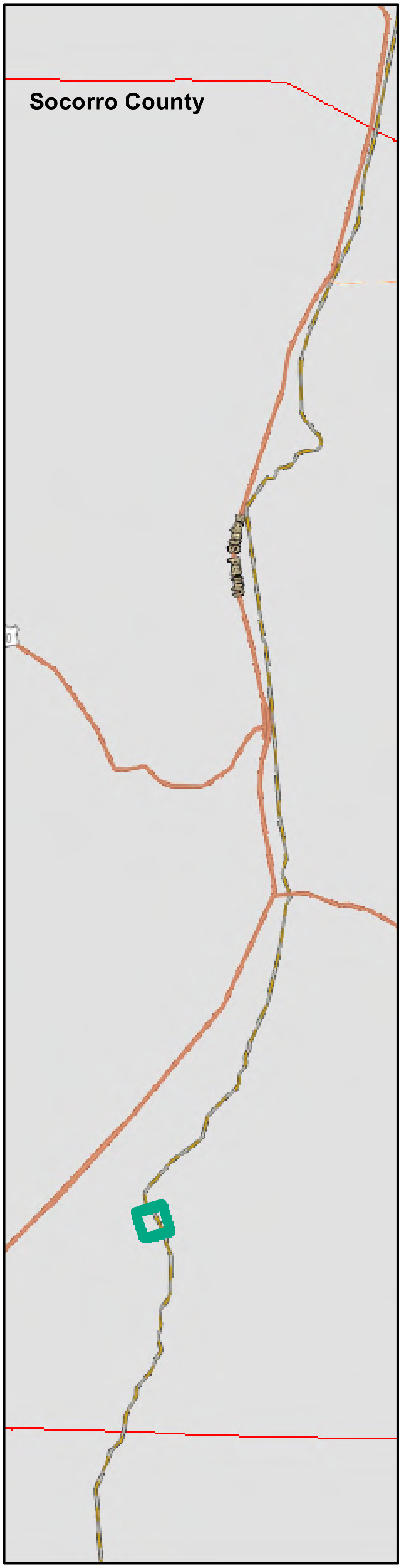

Socorro County

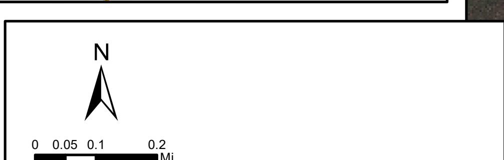

SC5
SC4
OW
C/SC3
C/SC3
C4
SC5
OW
C/SC3
C/SC3
SC4
C/CW3
SC-SBM5S
TW-C/SC-CW3
SC4
OW
SC5S
C-TW/SC3
C/CW3
OP
C/SC-CW3
C/CW3
C4F
OW
C-TW/SC3
CW5
SC5
C4
C4
C-TW/SC3
C/SC3
SC5
SC-CW-C5
TW-C4
SC4
SC5
C/SC3
C4
TW4
SC4
TW5

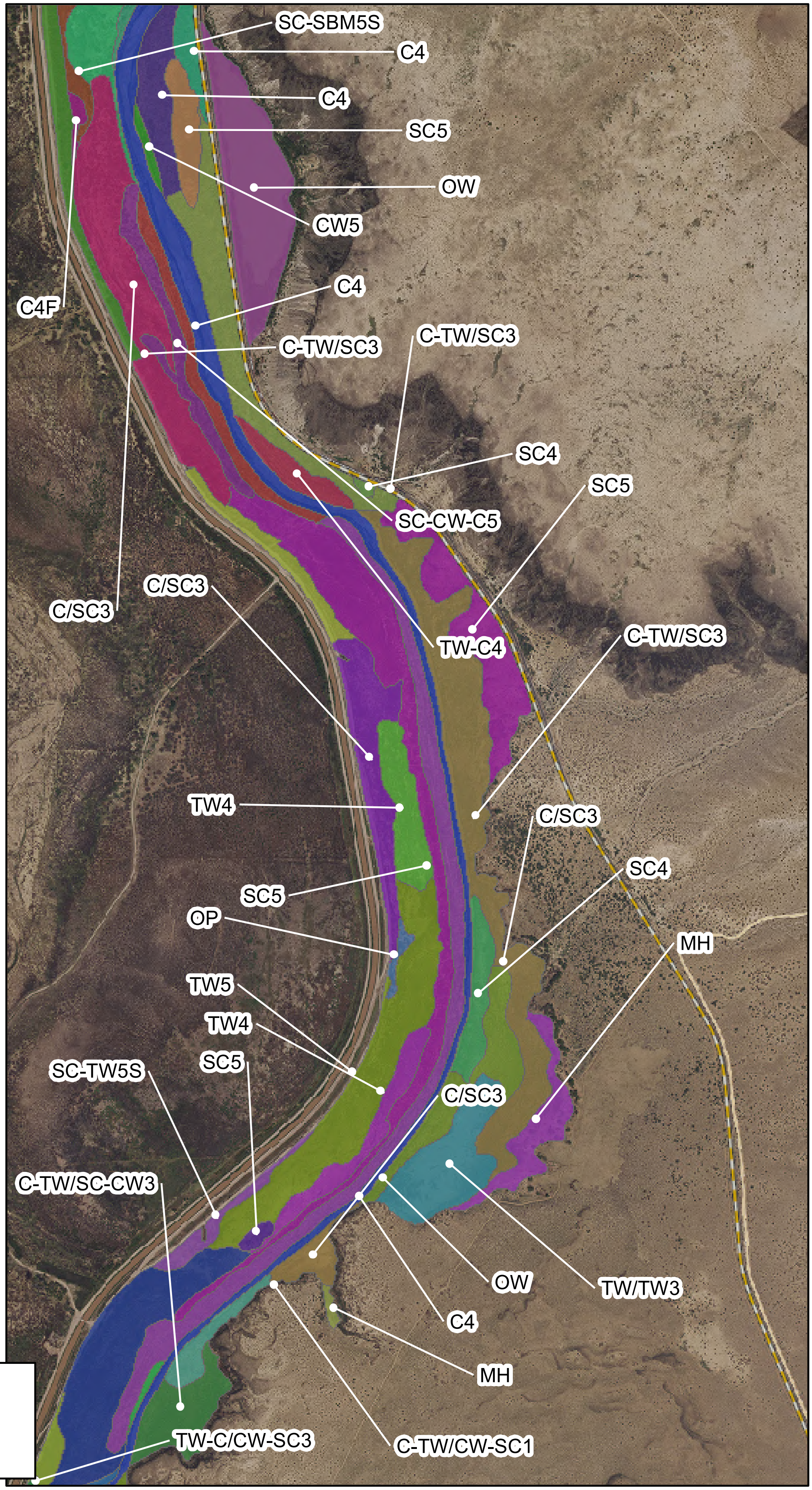

N
0 0.05 0.1 0.2
Mi

Locator Map

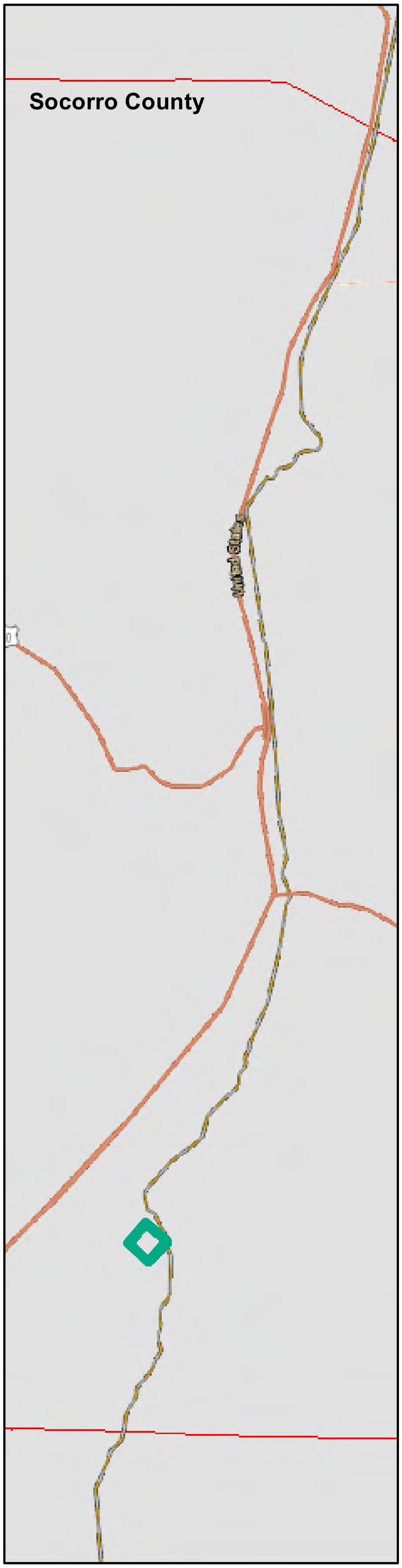
2002
Hink and Ohmart Vegetation Type

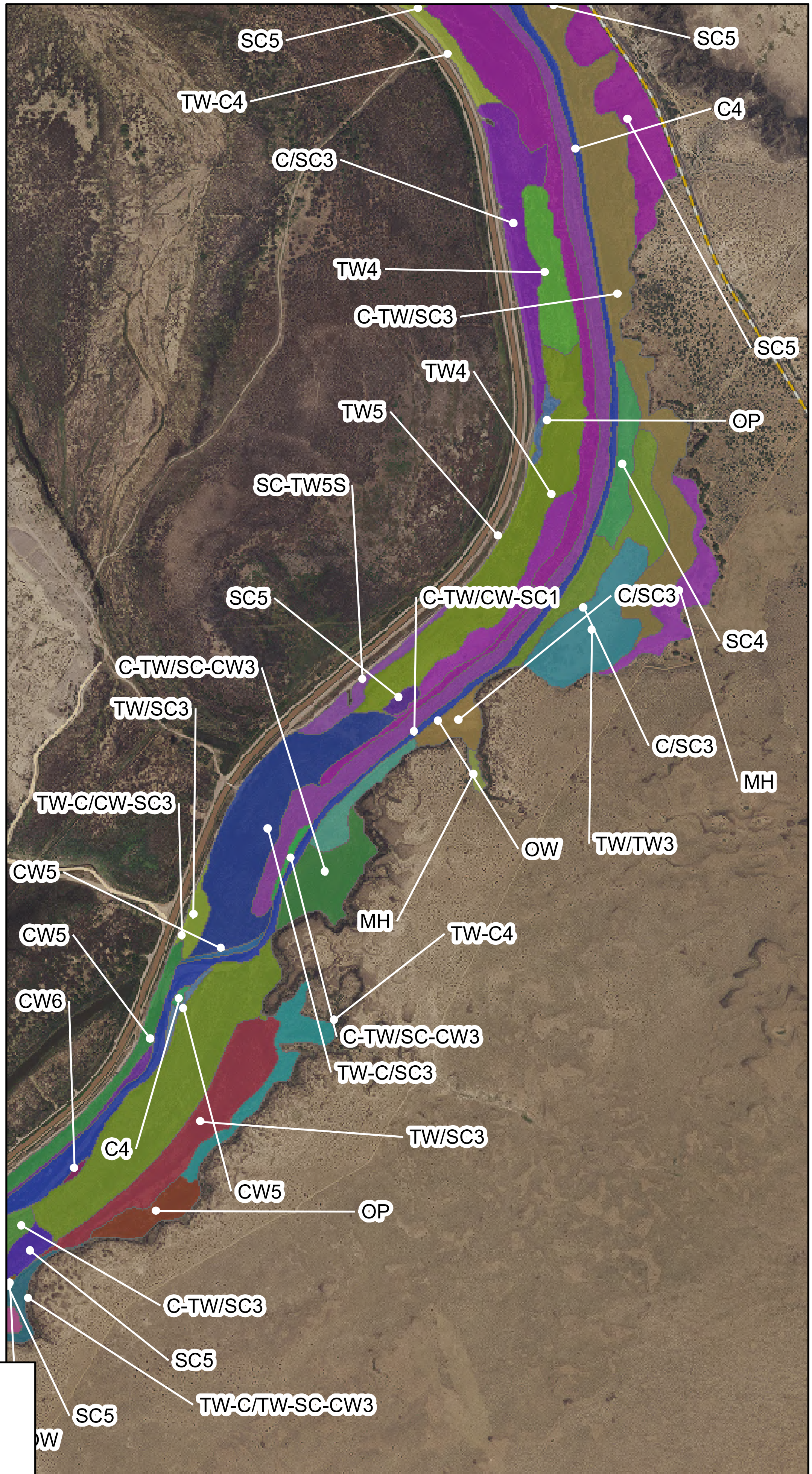


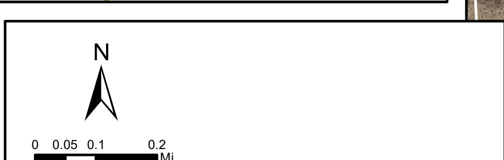




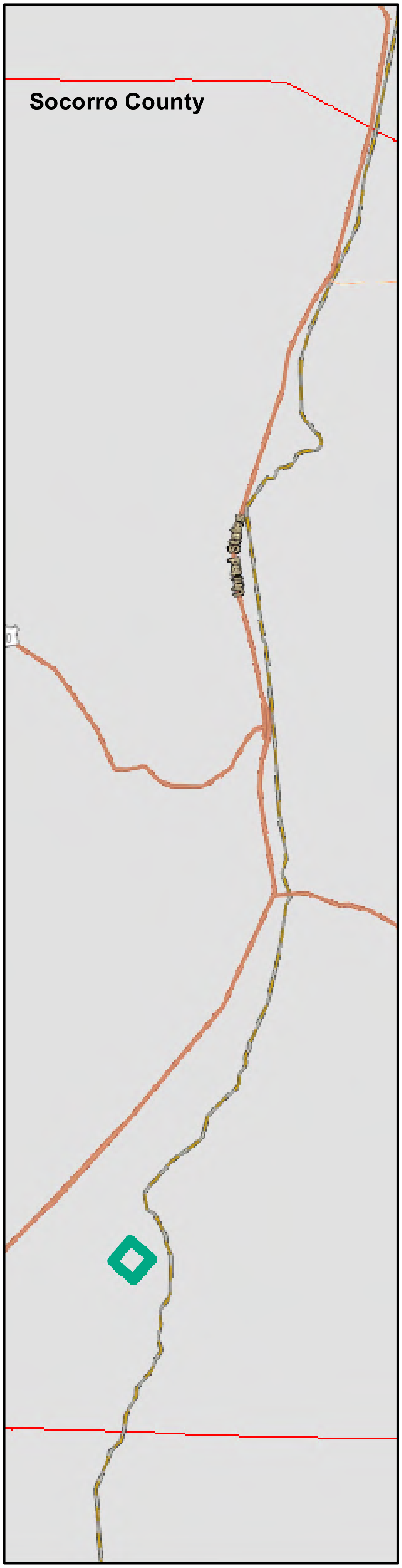
Locator Map


Socorro County

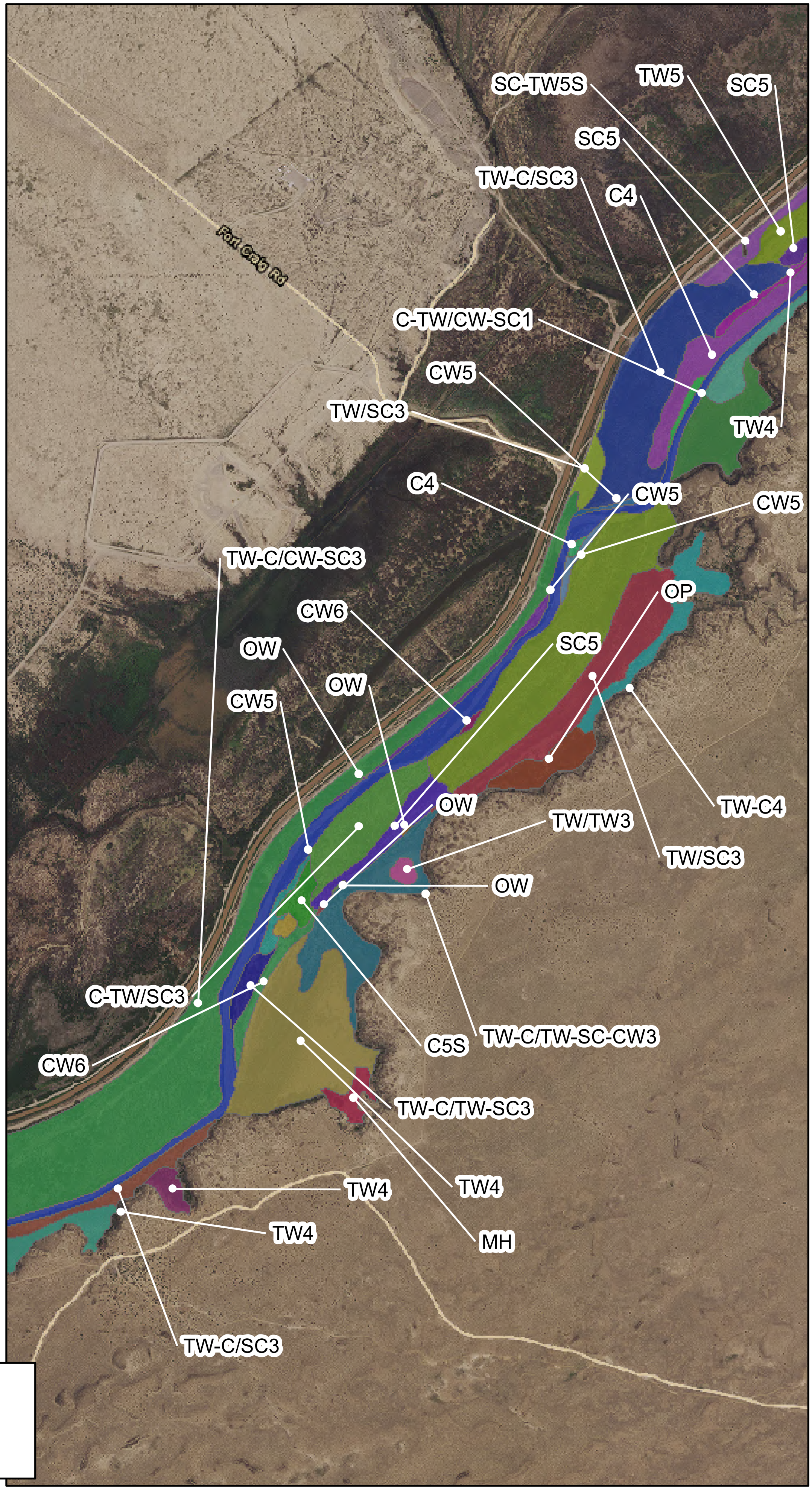

SC5
SC5
TW-C4
C4
C/SC3
TW4
C-TW/SC3
SC5
TW4
TW5
OP
SC-TW5S
SC5
C-TW/CW-SC1
C/SC3
SC4
C-TW/SC-CW3
TW/SC3
C/SC3
MH
TW-C/CW-SC3
OW
TW/TW3
CW5
MH
CW5
TW-C4
CW6
C-TW/SC-CW3
TW-C/SC3
TW/SC3
C4
CW5
OP
C-TW/SC3
SC5
TW-C/TW-SC-CW3
SC5
OW


N
0 0.05 0.1 0.2
Mi

Locator Map

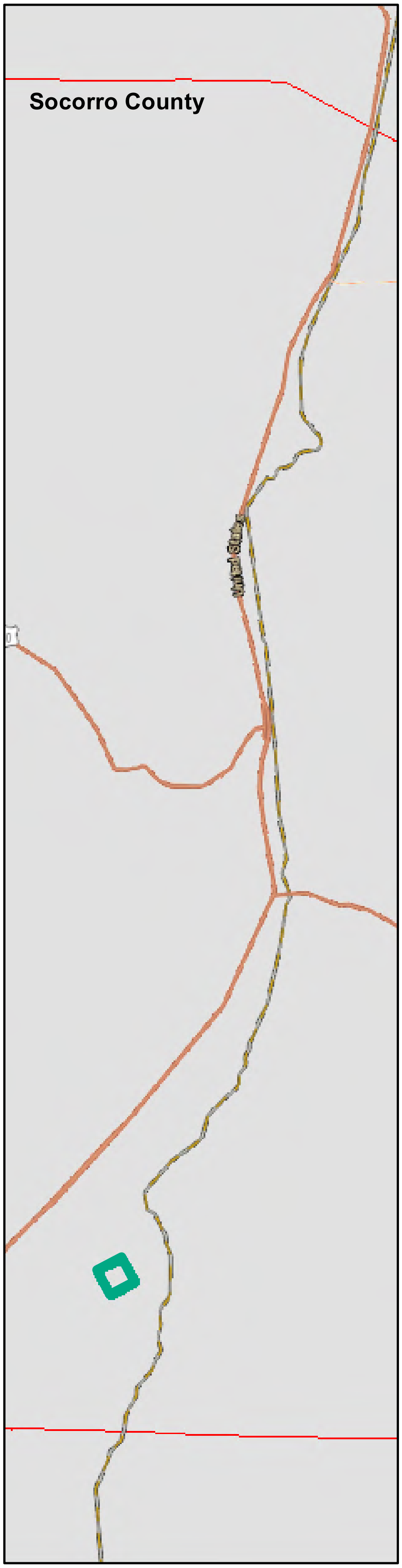


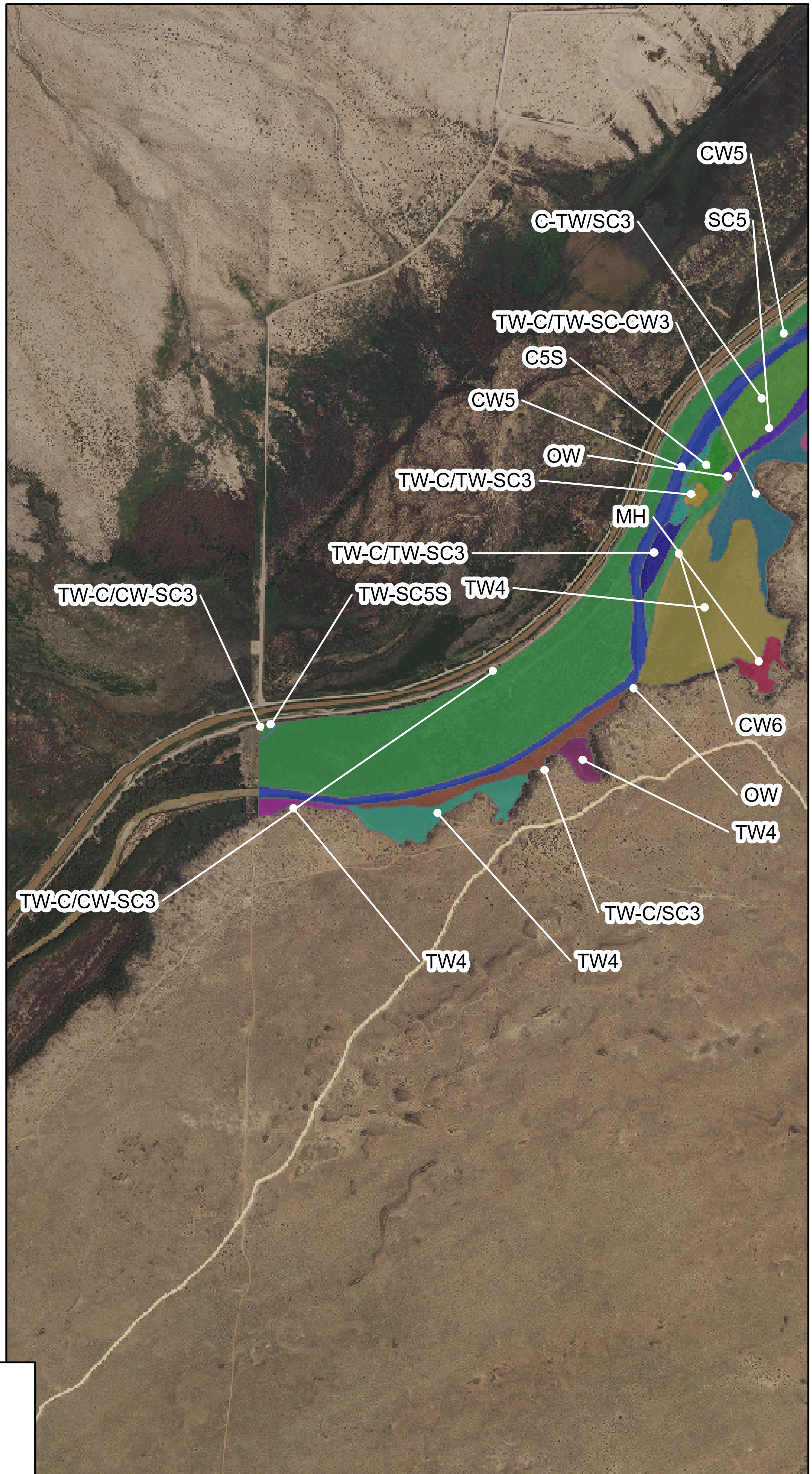
2002
Hink and Ohmart Vegetation Type

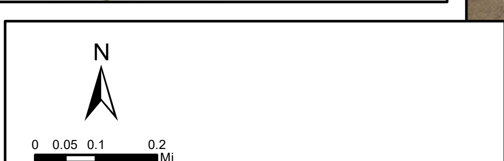


Locator Map

2002
Hink and Ohmart Vegetation Type

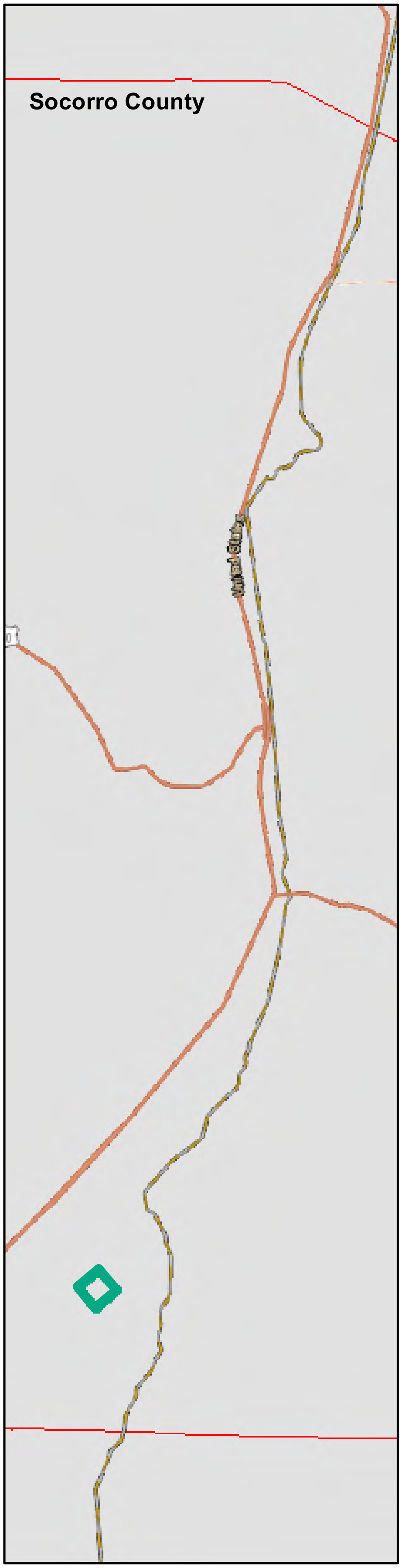


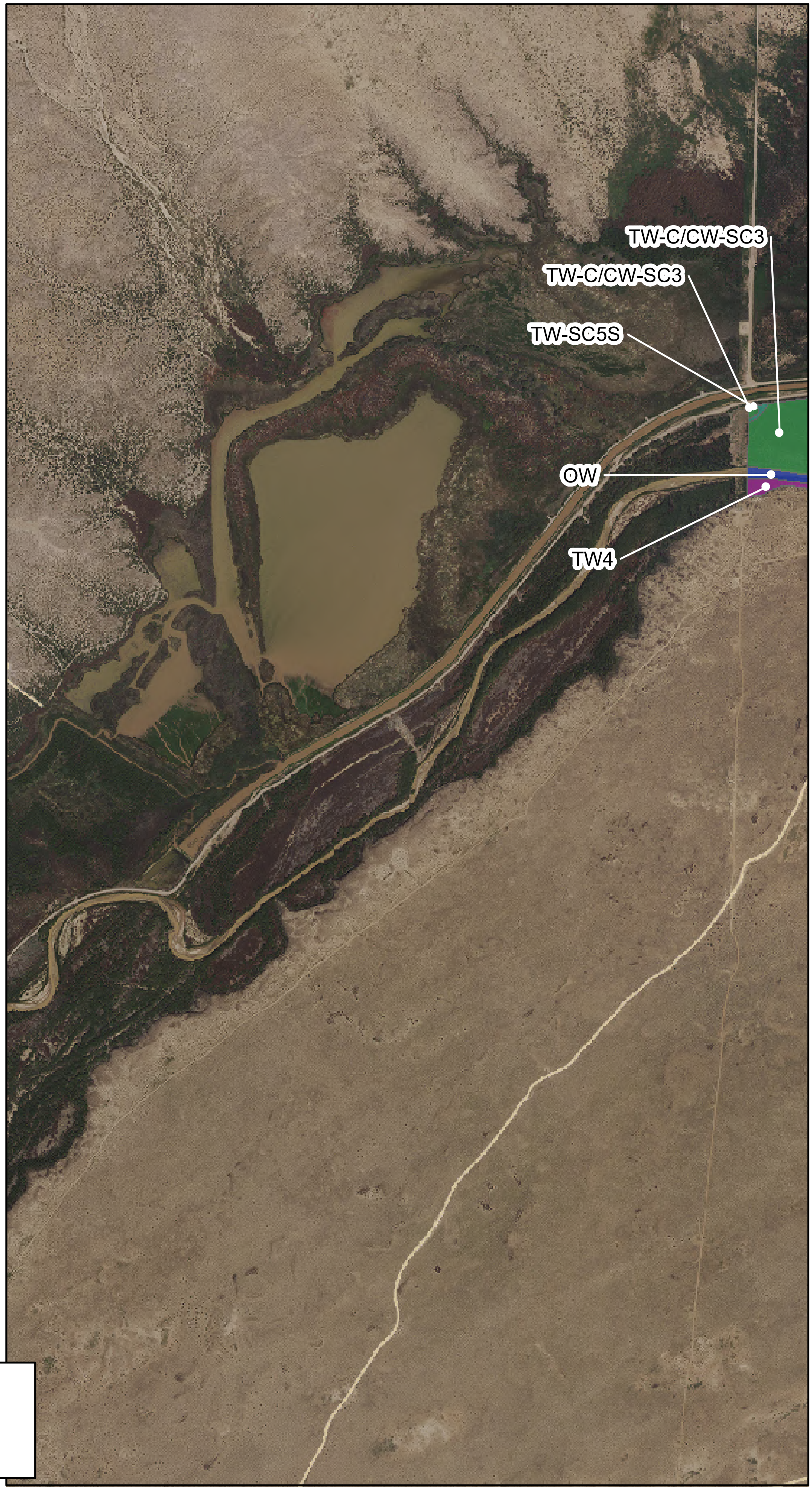


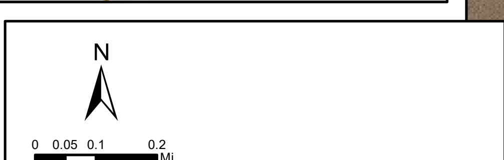


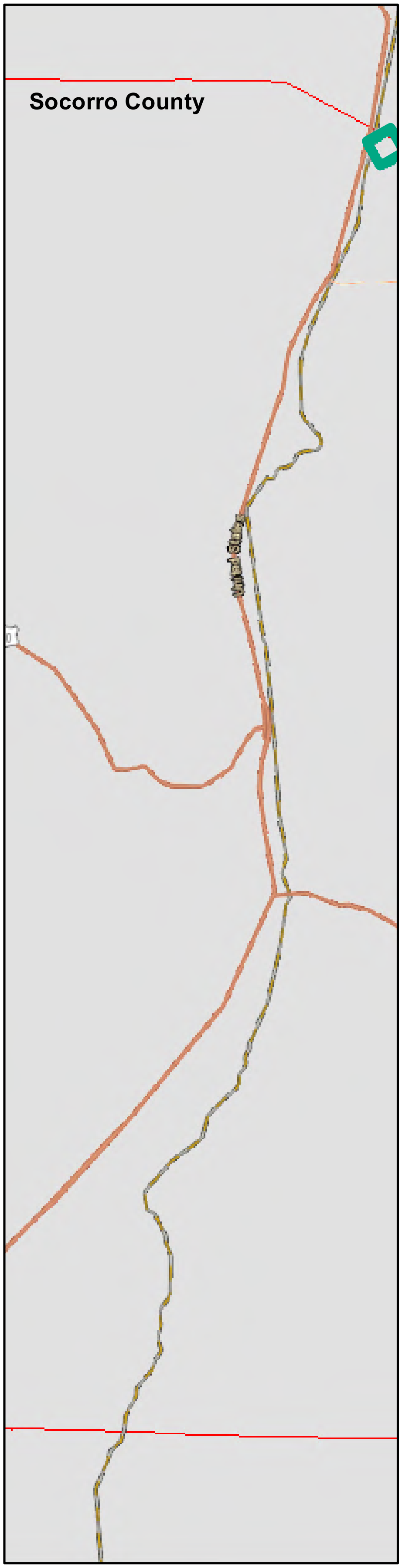
Locator Map

2002
Hink and Ohmart Vegetation Type

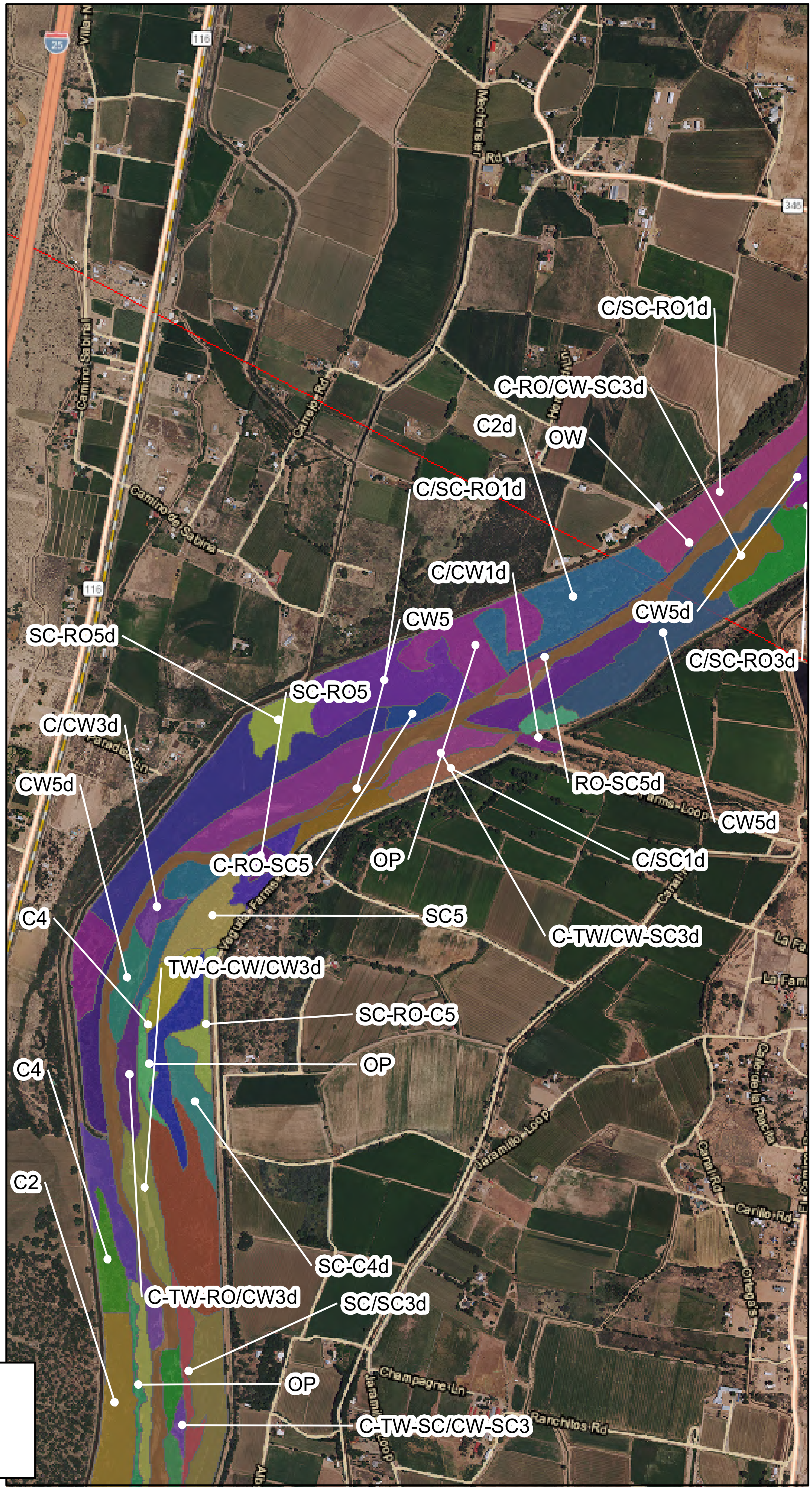






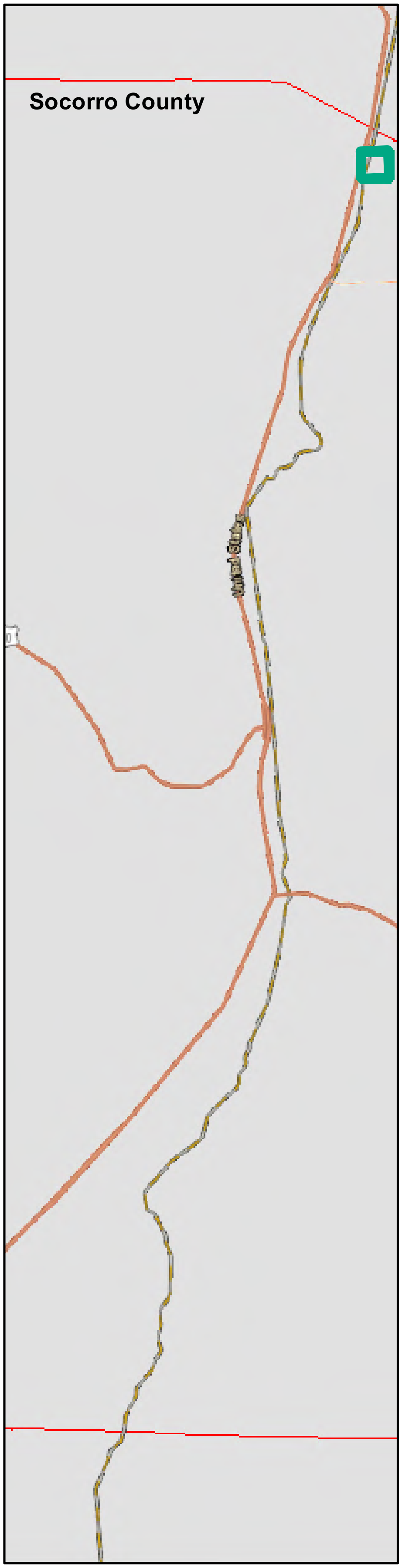


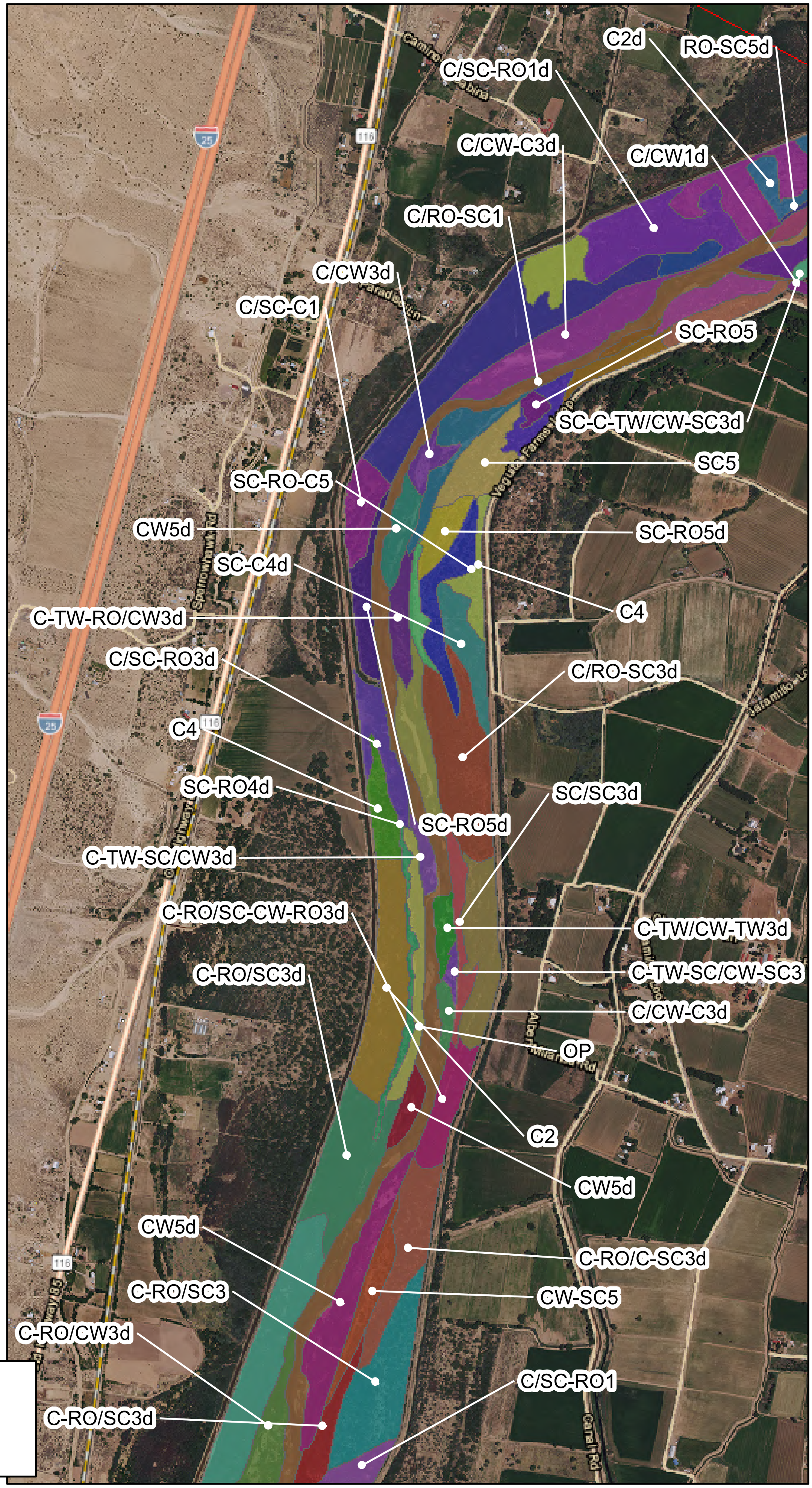
Socorro County

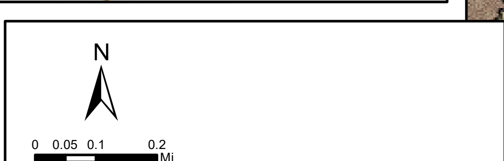


C/SC-RO1d
C-RO/CW-SC3d
C2d
OW
C/SC-RO1d
C/CW1d
CW5
CW5d
C/SC-RO3d
SC-RO5d
SC-RO5
C/CW3d
CW5d
RO-SC5d
CW5d
C-RO-SC5
OP
C/SC1d
SC5
C4
C-TW/CW-SC3d
TW-C-CW/CW3d
SC-RO-C5
C4
OP
C2
SC-C4d
C-TW-RO/CW3d
SC/SC3d
OP
C-TW-SC/CW-SC3
Mechenier Rd
Camino de Sabina
Camino Sabina
Jaramillo Loop
Champagne Ln
Ranchitos Rd
Carillo Rd
Ortegas

N
0 0.05 0.1 0.2
Mi

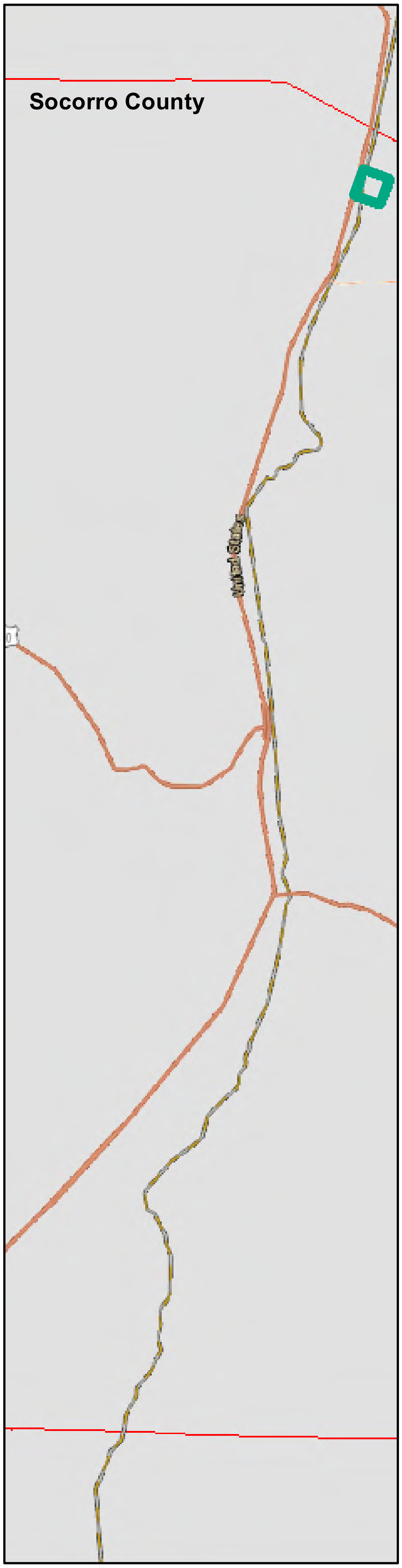

Socorro County

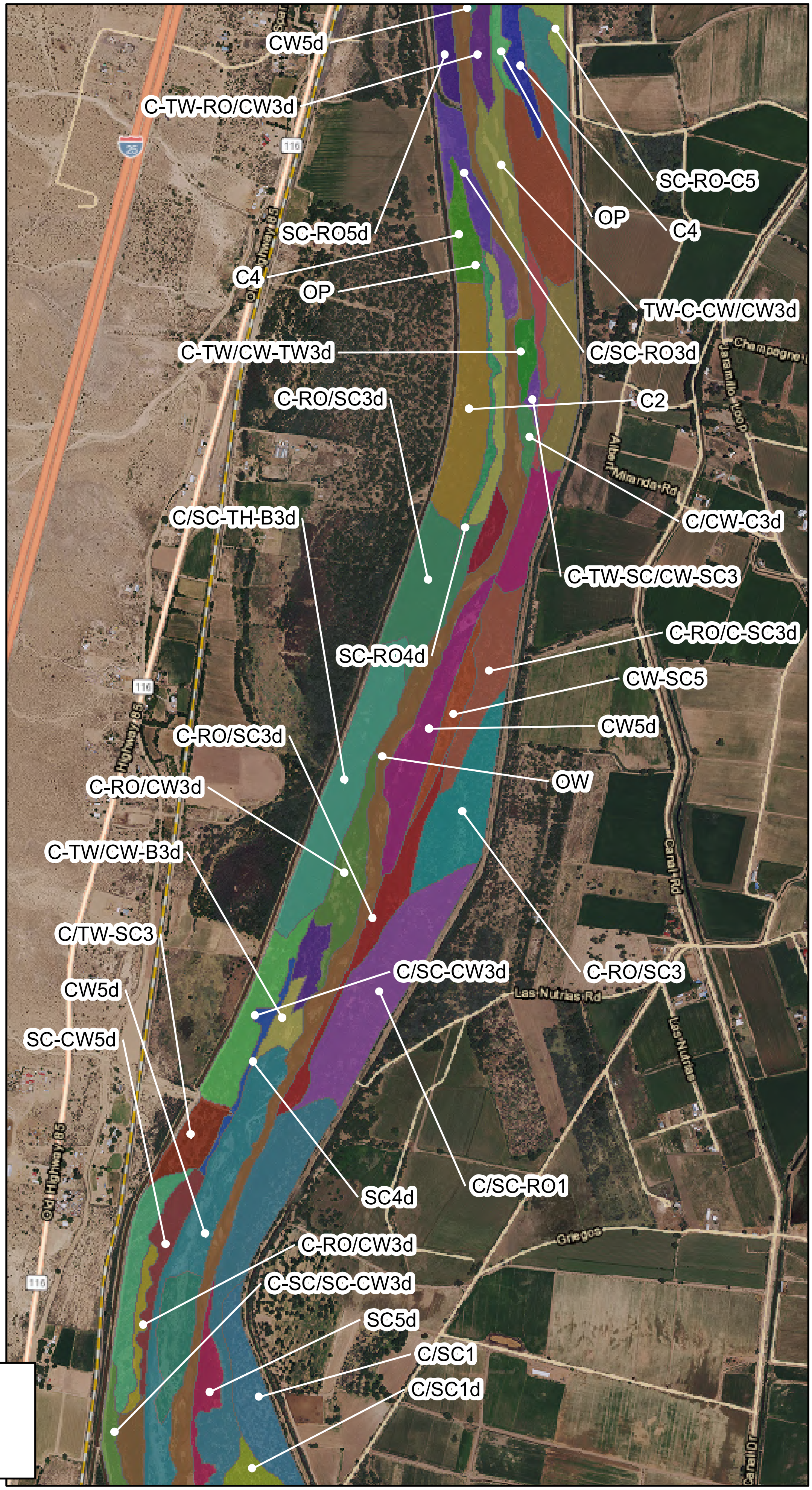

C2d
RO-SC5d
C/SC-RO1d
C/CW-C3d
C/CW1d
C/RO-SC1
C/CW3d
C/SC-C1
SC-RO5
SC-C-TW/CW-SC3d
SC5
SC-RO-C5
CW5d
SC-RO5d
SC-C4d
C4
C-TW-RO/CW3d
C/SC-RO3d
C/RO-SC3d
C4
SC-RO4d
SC/SC3d
SC-RO5d
C-TW-SC/CW3d
C-RO/SC-CW-RO3d
C-TW/CW-TW3d
C-TW-SC/CW-SC3
C-RO/SC3d
C/CW-C3d
OP
C2
CW5d
CW5d
C-RO/C-SC3d
C-RO/SC3
CW-SC5
C-RO/CW3d
C/SC-RO1
C-RO/SC3d

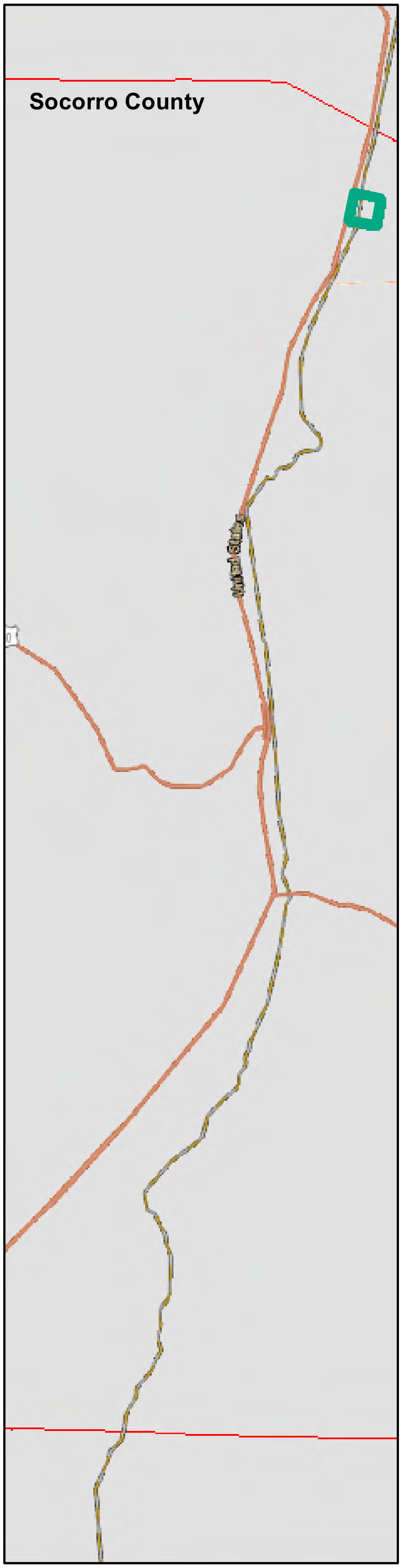

N
0 0.05 0.1 0.2
Mi

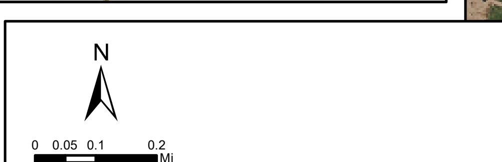
Locator Map

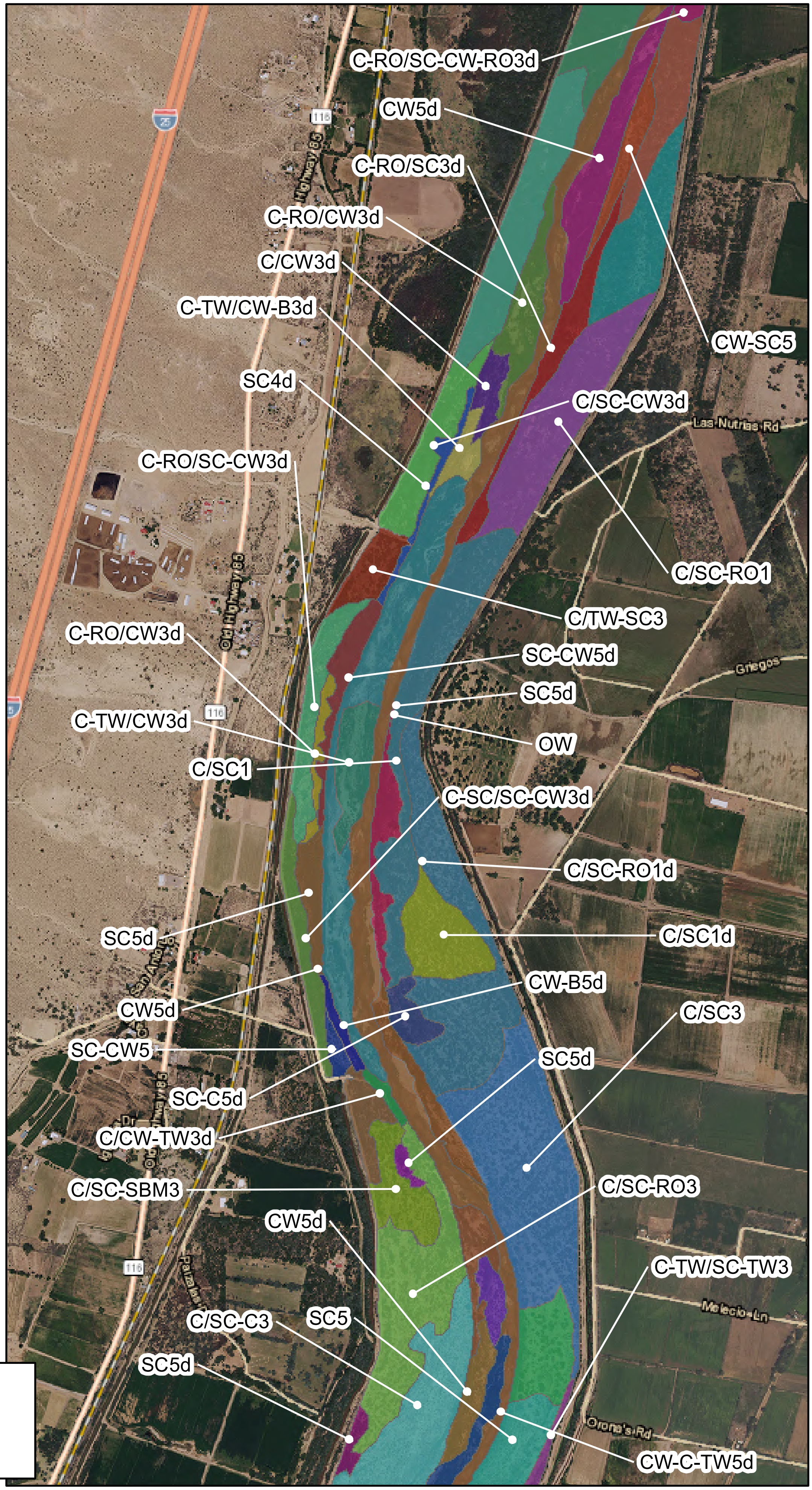
2016
Hink and Ohmart Vegetation Type





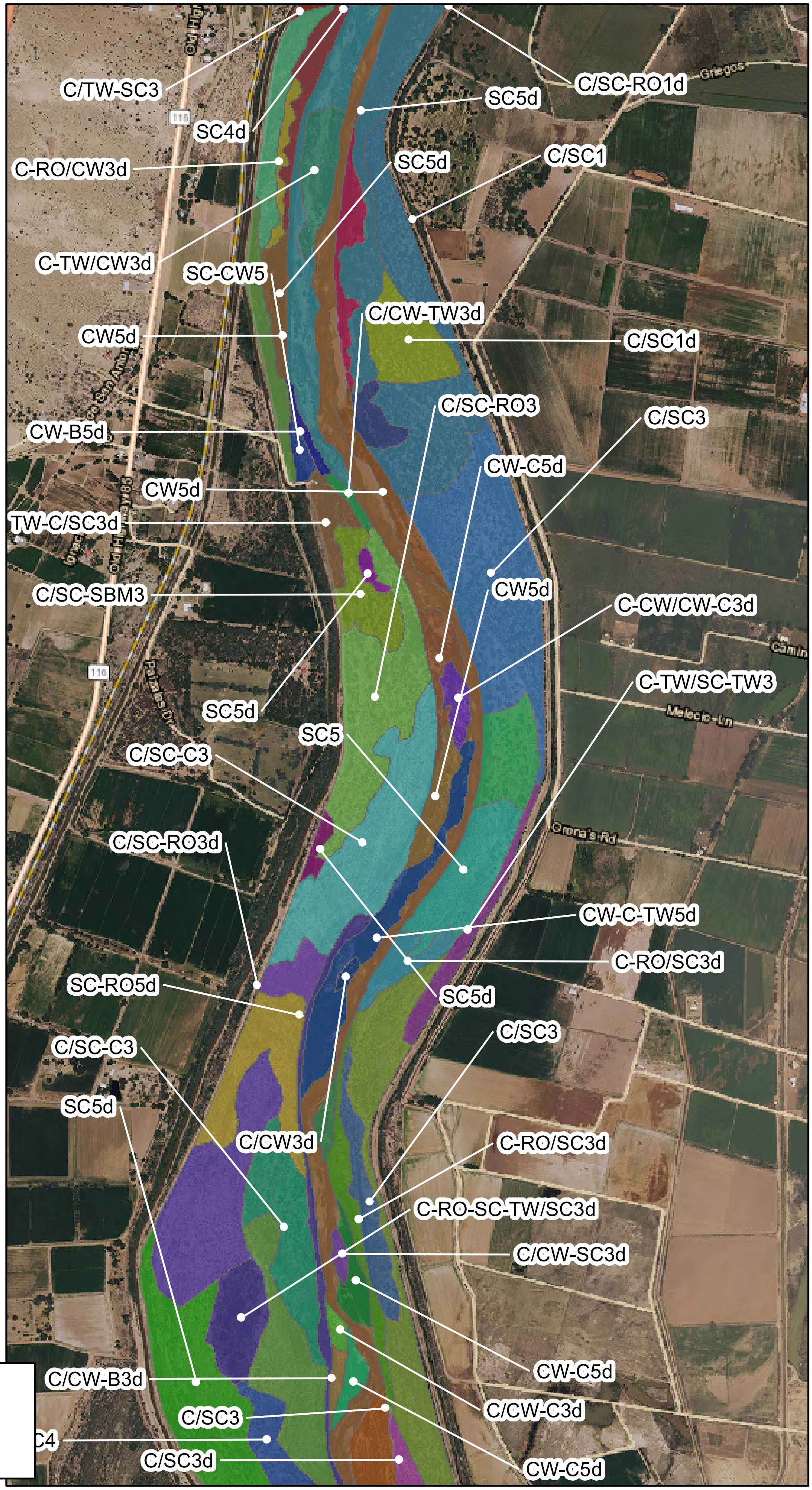

Socorro County


N
0 0.05 0.1 0.2
Mi


C-RO/SC-CW-RO3d
CW5d
C-RO/SC3d
C-RO/CW3d
C/CW3d
C-TW/CW-B3d
CW-SC5
SC4d
C/SC-CW3d
C-RO/SC-CW3d
Las Nutrias Rd
C/SC-RO1
C/TW-SC3
C-RO/CW3d
SC-CW5d
Griegos
SC5d
C-TW/CW3d
OW
C/SC1
C-SC/SC-CW3d
C/SC-RO1d
SC5d
C/SC1d
CW-B5d
CW5d
C/SC3
SC-CW5
SC5d
SC-C5d
C/CW-TW3d
C/SC-SBM3
C/SC-RO3
CW5d
C-TW/SC-TW3
Melecio Ln
C/SC-C3
SC5
SC5d
Orona's Rd
CW-C-TW5d
Old Highway 85
Highway 85
116
25

Locator Map

Socorro County
N
0 0.05 0.1 0.2
Mi



C/TW-SC3
SC4d
C-RO/CW3d
C-TW/CW3d
SC-CW5
CW5d
CW-B5d
CW5d
TW-C/SC3d
C/SC-SBM3
SC5d
C/SC-C3
C/SC-RO3d
SC-RO5d
C/SC-C3
SC5d
C/CW3d
C/CW-B3d
C/SC3
C4
C/SC3d
C/SC-RO1d
SC5d
SC5d
C/SC1
C/CW-TW3d
C/SC1d
C/SC-RO3
C/SC3
CW-C5d
CW5d
C-CW/CW-C3d
C-TW/SC-TW3
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CW-C-TW5d
C-RO/SC3d
SC5d
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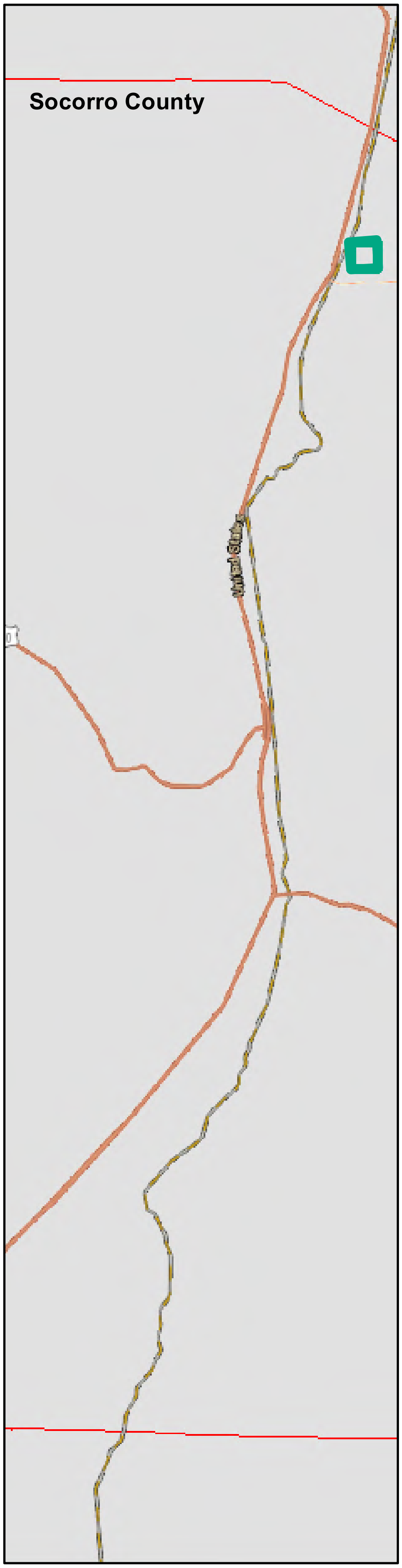
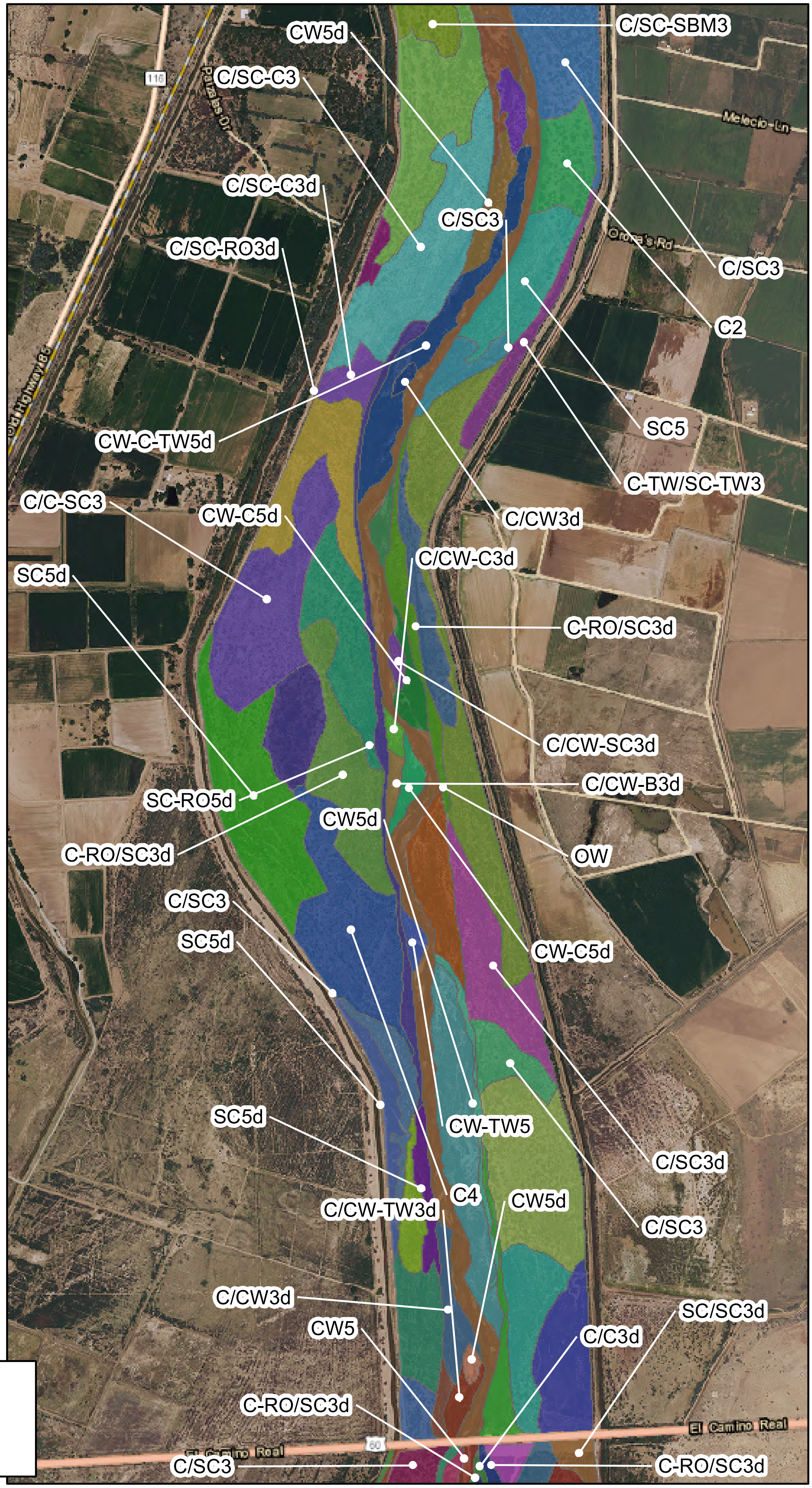
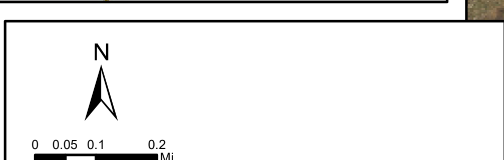
C/CW-C3d
CW-C5d



Socorro County

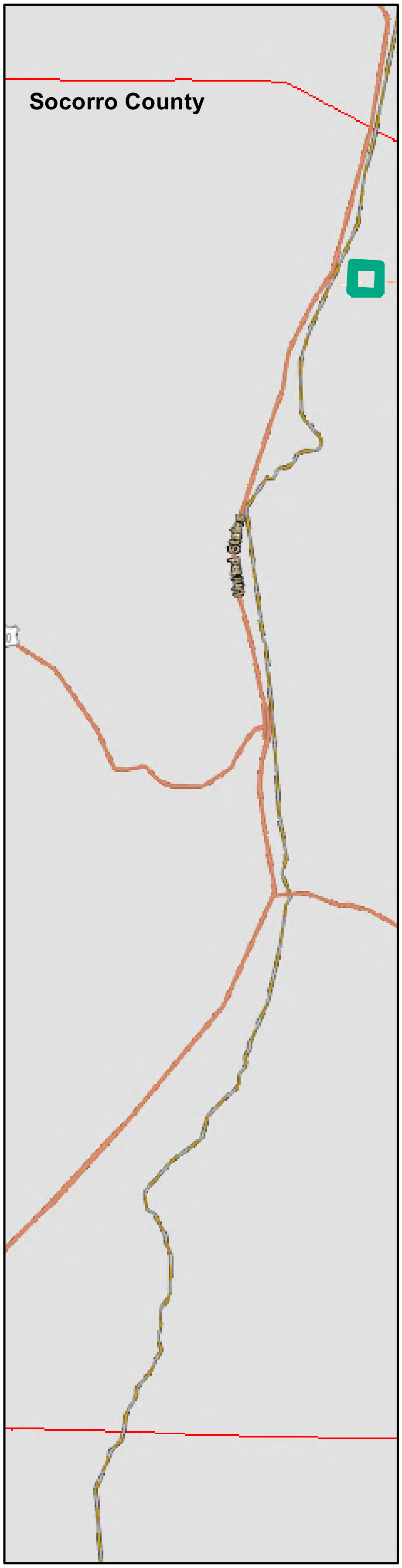


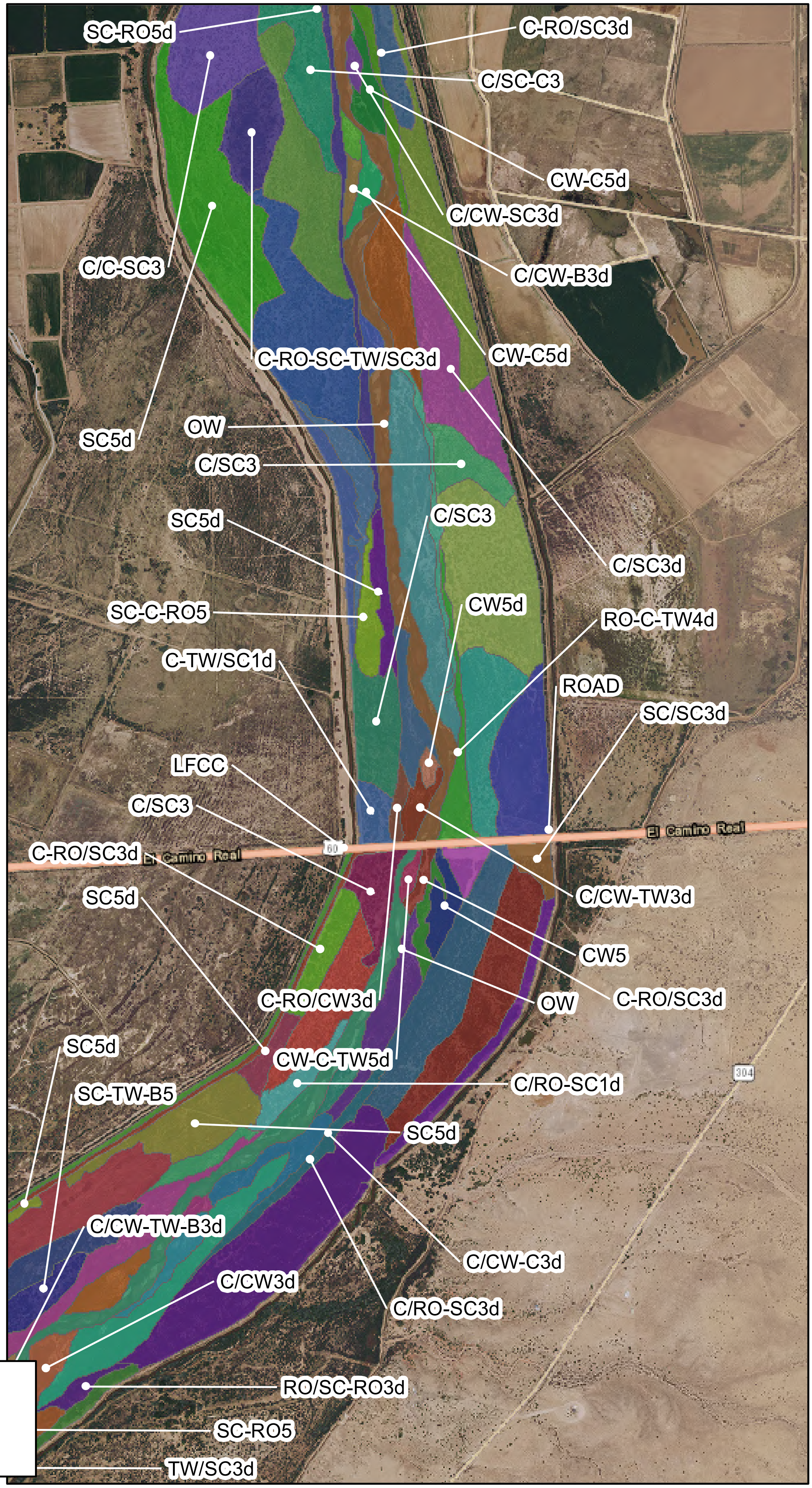
CW5d
C/SC-SBM3
C/SC-C3
C/SC-C3d
C/SC3
C/SC-RO3d
C/SC3
C2
SC5
CW-C-TW5d
C-TW/SC-TW3
C/C-SC3
CW-C5d
C/CW3d
C/CW-C3d
SC5d
C-RO/SC3d
C/CW-SC3d
C/CW-B3d
SC-RO5d
CW5d
OW
C-RO/SC3d
C/SC3
CW-C5d
SC5d
CW-TW5
SC5d
C/SC3d
C4
CW5d
C/CW-TW3d
C/SC3
C/CW3d
SC/SC3d
CW5
C/C3d
C-RO/SC3d
El Camino Real
C/SC3
C-RO/SC3d



N
0 0.05 0.1 0.2
Mi

Locator Map


Socorro County


SC-RO5d
C-RO/SC3d
C/SC-C3
CW-C5d
C/CW-SC3d
C/C-SC3
C/CW-B3d
CW-C5d
C-RO-SC-TW/SC3d
SC5d
OW
C/SC3
SC5d
C/SC3
C/SC3d
CW5d
SC-C-RO5
RO-C-TW4d
C-TW/SC1d
ROAD
SC/SC3d
LFCC
C/SC3
El Camino Real
C-RO/SC3d
C/CW-TW3d
SC5d
CW5
OW
C-RO/SC3d
C-RO/CW3d
SC5d
CW-C-TW5d
C/RO-SC1d
SC-TW-B5
SC5d
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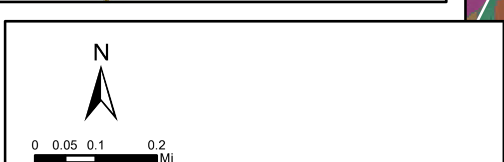
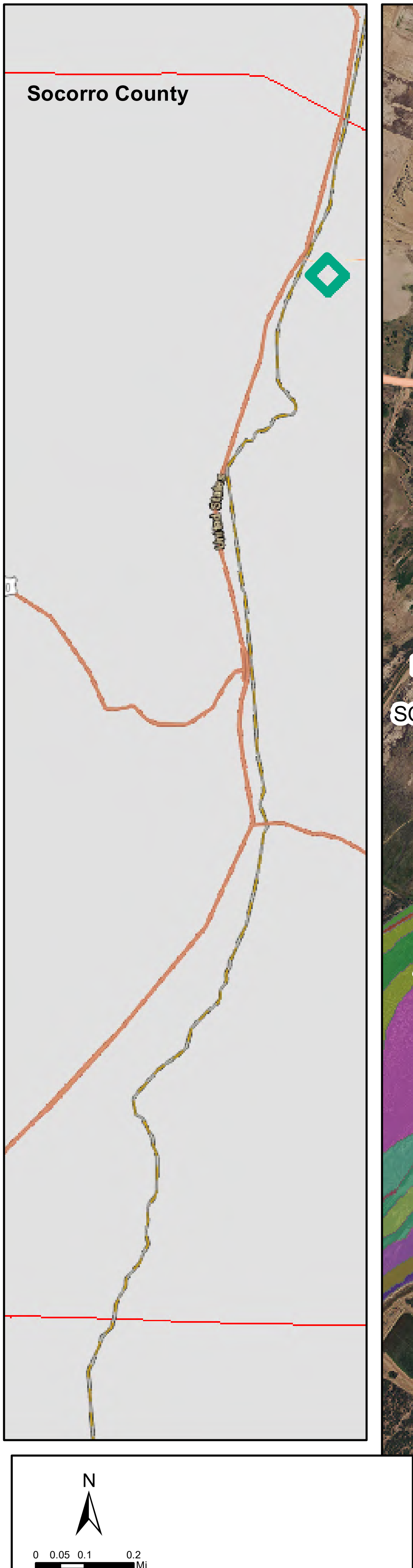
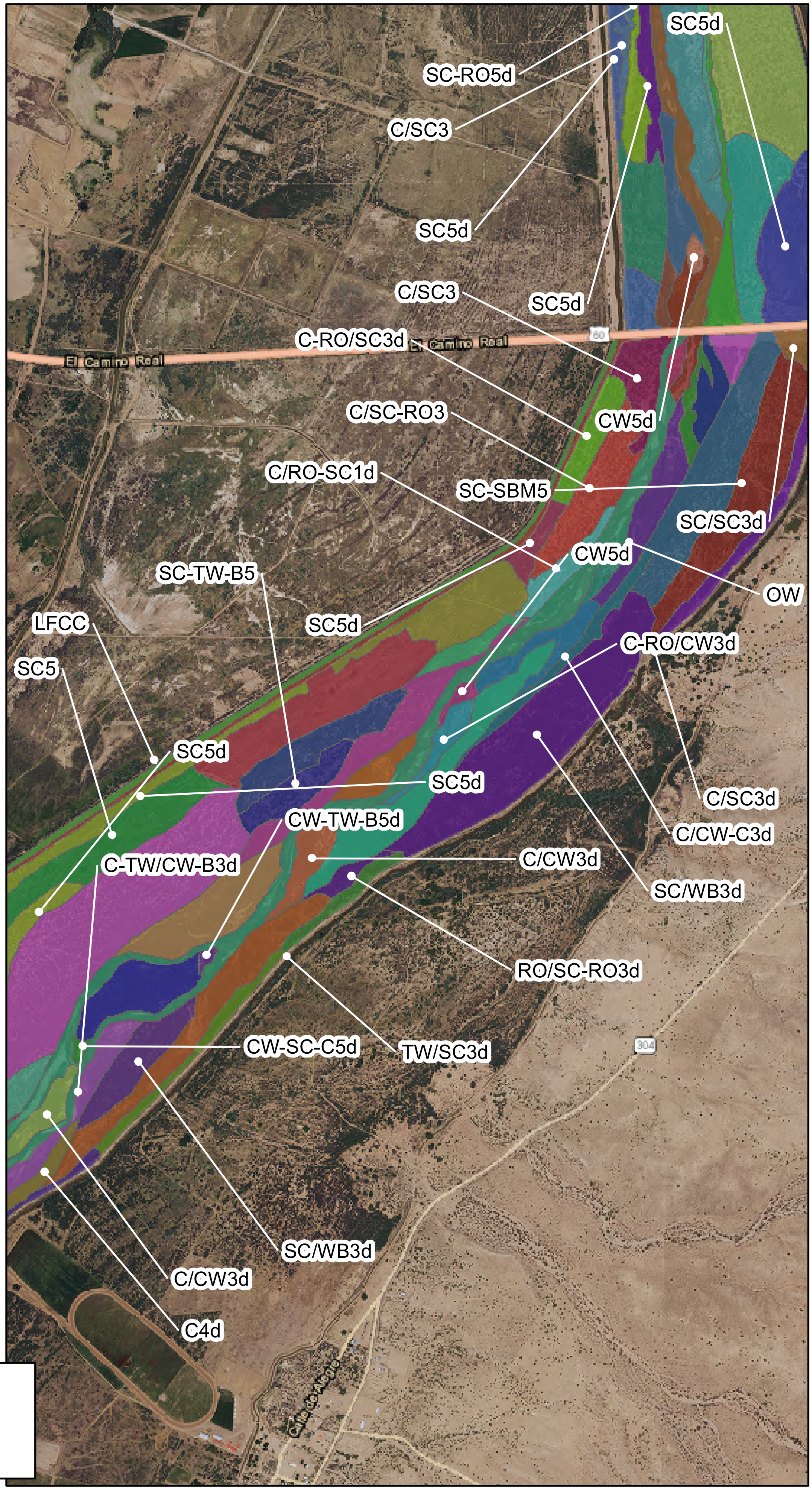
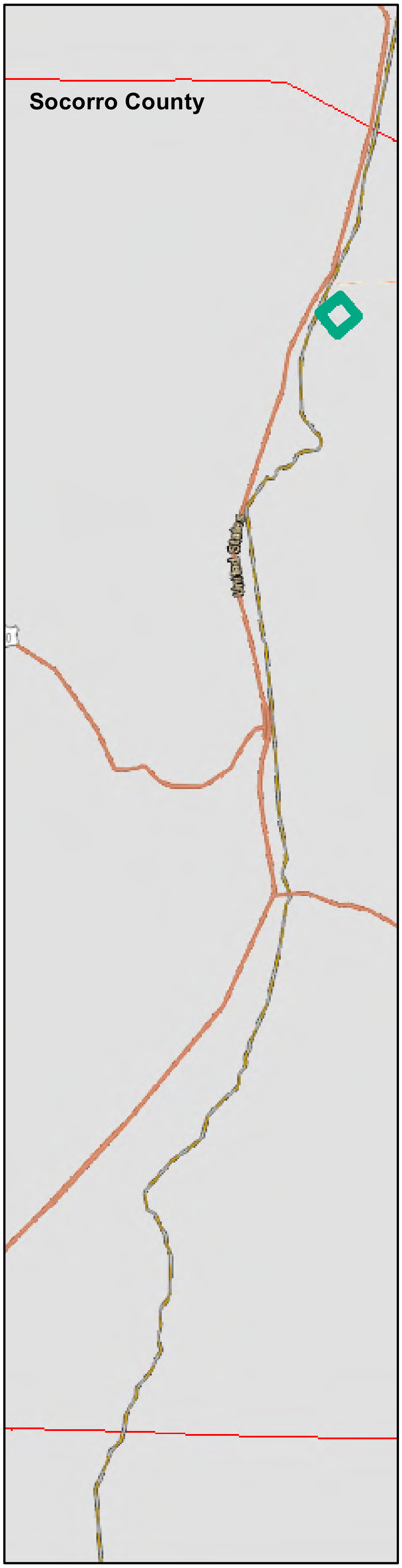
C/CW-C3d
C/CW3d
C/RO-SC3d
RO/SC-RO3d
SC-RO5
TW/SC3d
304

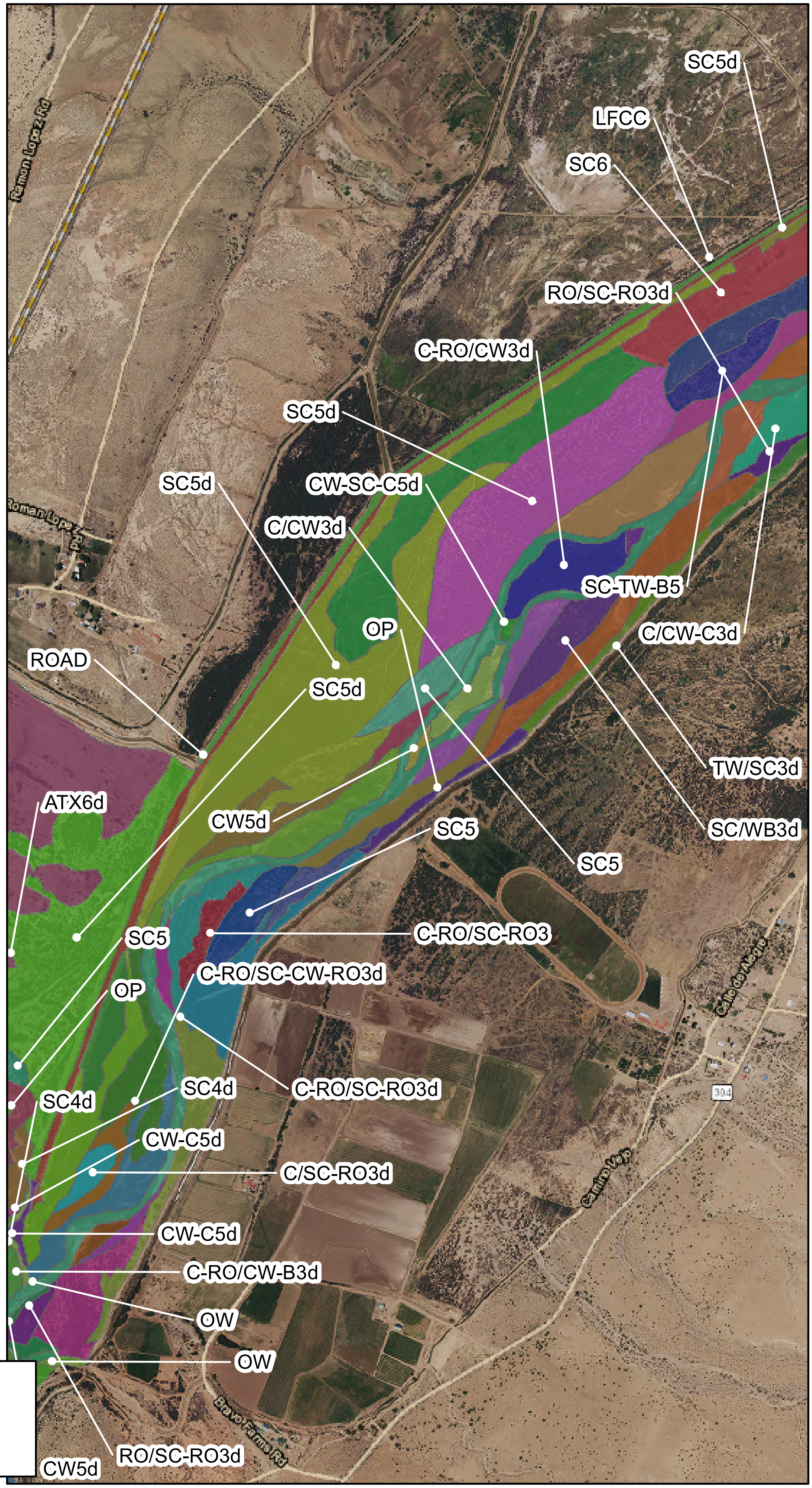

N
0 0.05 0.1 0.2
Mi

Locator Map


Socorro County
N
0 0.05 0.1 0.2
Mi


SC5d
SC-RO5d
C/SC3
SC5d
C/SC3
SC5d
El Camino Real
C-RO/SC3d
C/SC-RO3
CW5d
C/RO-SC1d
SC-SBM5
SC/SC3d
CW5d
OW
SC-TW-B5
SC5d
LFCC
C-RO/CW3d
SC5
SC5d
SC5d
C/SC3d
CW-TW-B5d
C/CW-C3d
C-TW/CW-B3d
C/CW3d
SC/WB3d
RO/SC-RO3d
CW-SC-C5d
TW/SC3d
304
SC/WB3d
C/CW3d
C4d


Socorro County


SC5d
LFCC
SC6
RO/SC-RO3d
C-RO/CW3d
SC5d
SC5d
CW-SC-C5d
C/CW3d
SC-TW-B5
OP
C/CW-C3d
ROAD
SC5d
TW/SC3d
ATX6d
CW5d
SC5
SC/WB3d
SC5
SC5
C-RO/SC-RO3
OP
C-RO/SC-CW-RO3d
C-RO/SC-RO3d
SC4d
SC4d
CW-C5d
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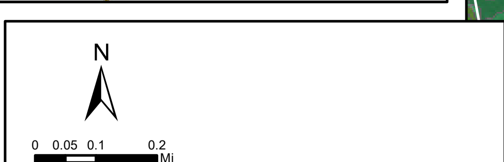
CW-C5d
C-RO/CW-B3d
OW
OW
RO/SC-RO3d
CW5d
Ramon Lopez Rd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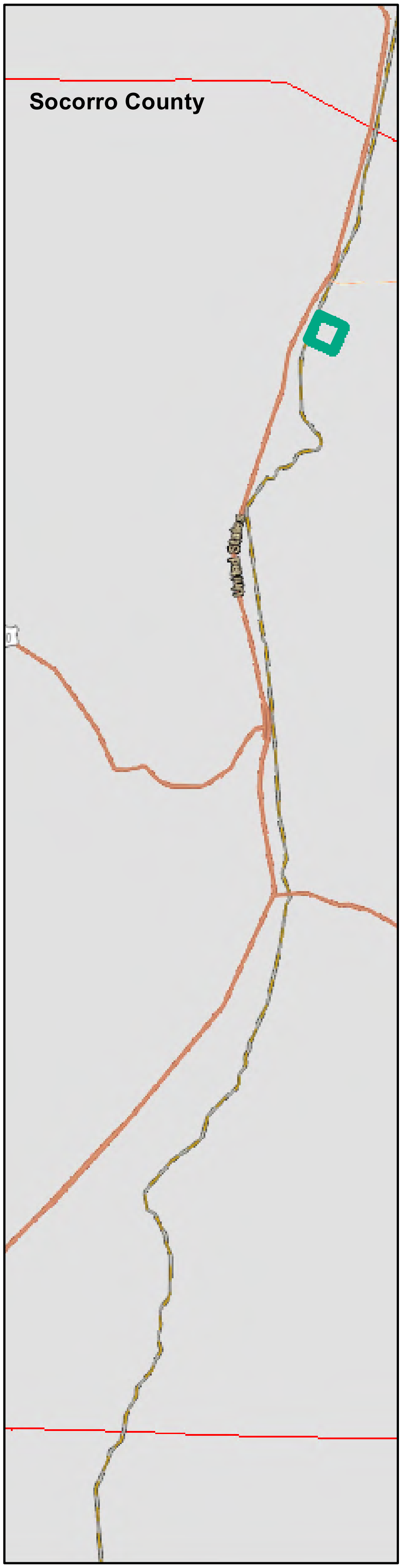
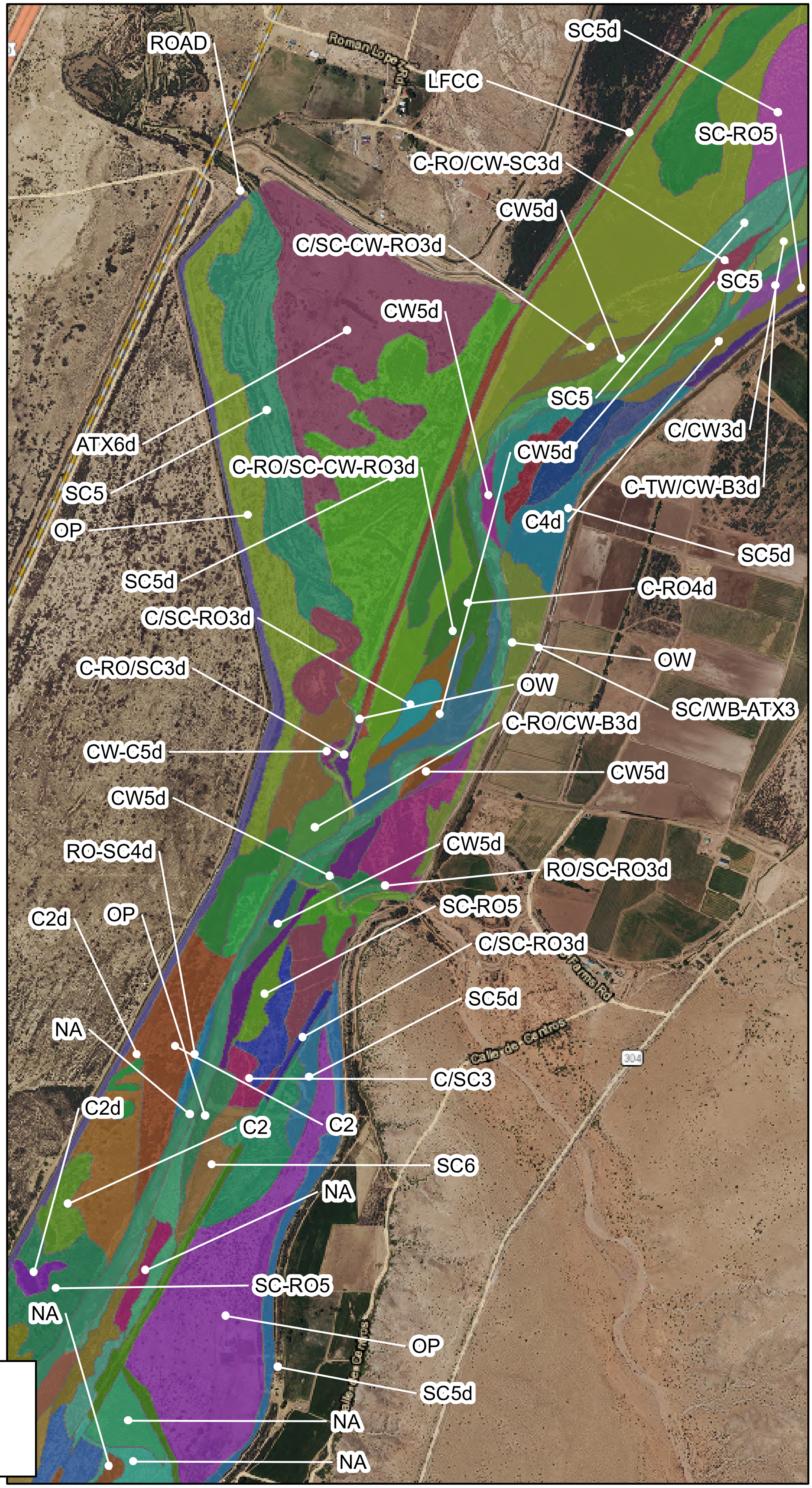
Mi

Locator Map


Socorro County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CW5d
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SC5
CW5d
SC5
ATX6d
C/CW3d
CW5d
C-RO/SC-CW-RO3d
SC5
C-TW/CW-B3d
OP
C4d
SC5d
SC5d
C-RO4d
C/SC-RO3d
OW
C-RO/SC3d
OW
SC/WB-ATX3
C-RO/CW-B3d
CW-C5d
CW5d
CW5d
CW5d
RO-SC4d
RO/SC-RO3d
SC-RO5
C2d
OP
C/SC-RO3d
SC5d
NA
Calle de Centros
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C2
C2
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SC-RO5
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OP
SC5d
NA
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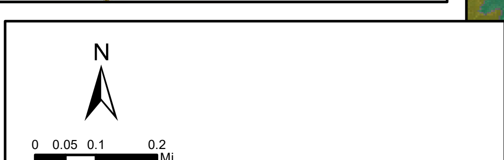
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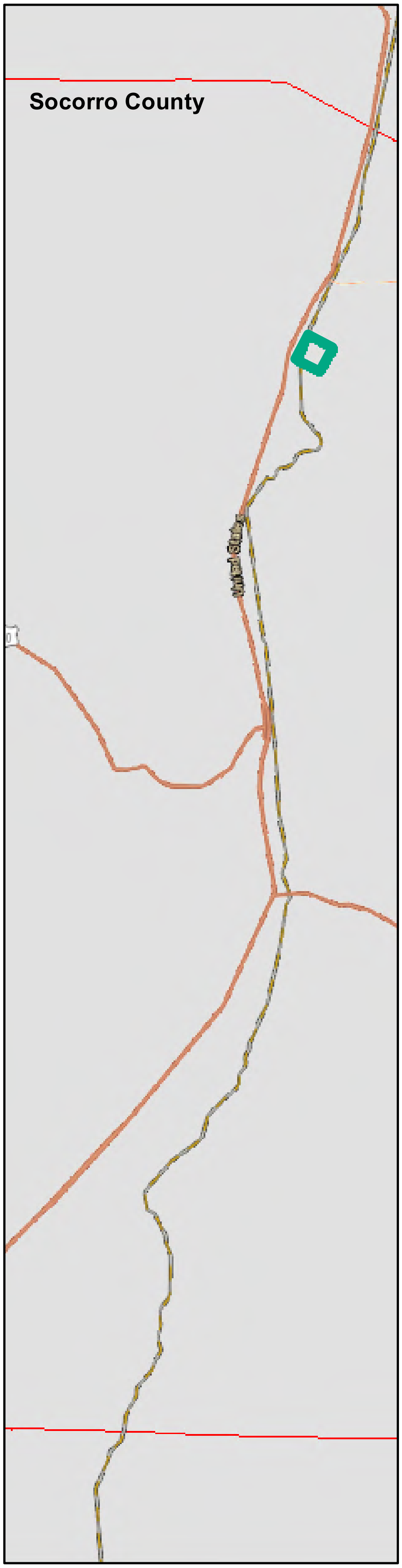
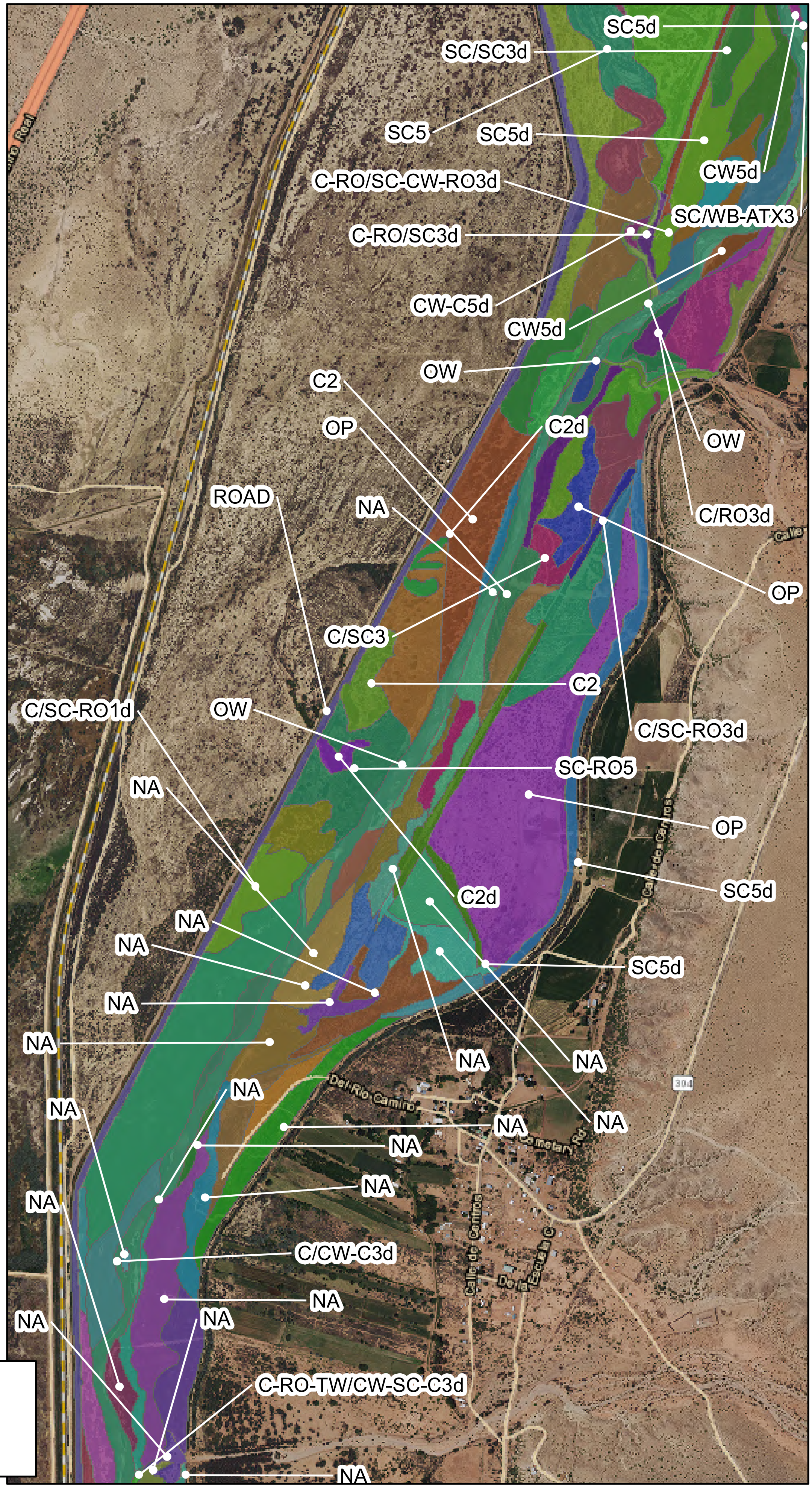
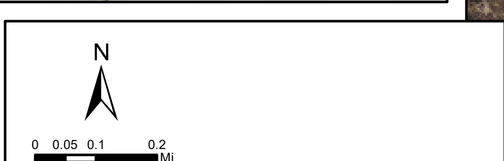
Mi

Locator Map

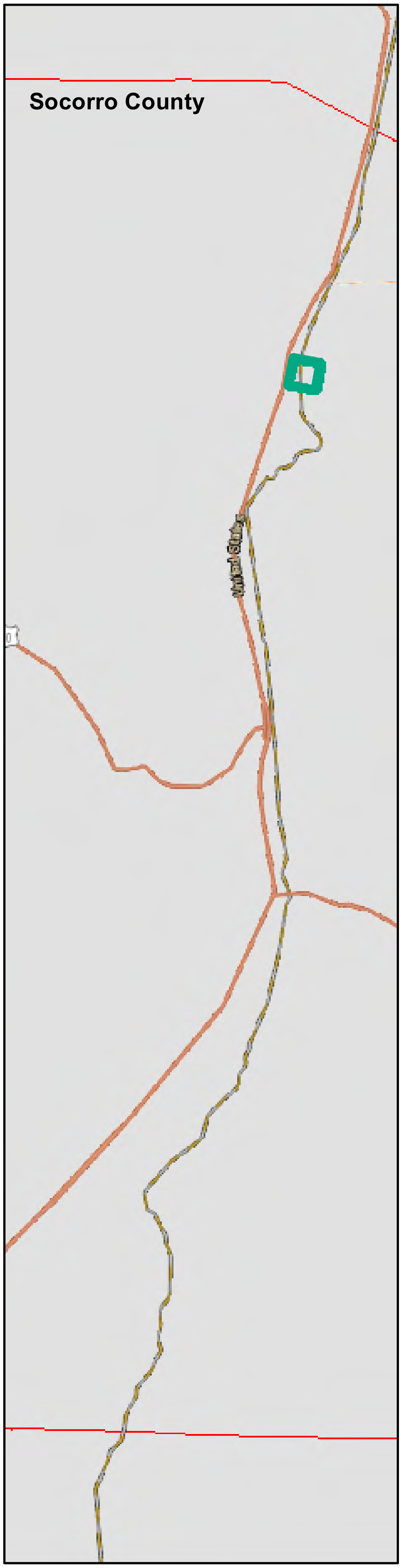
2016
Hink and Ohmart Vegetation Type



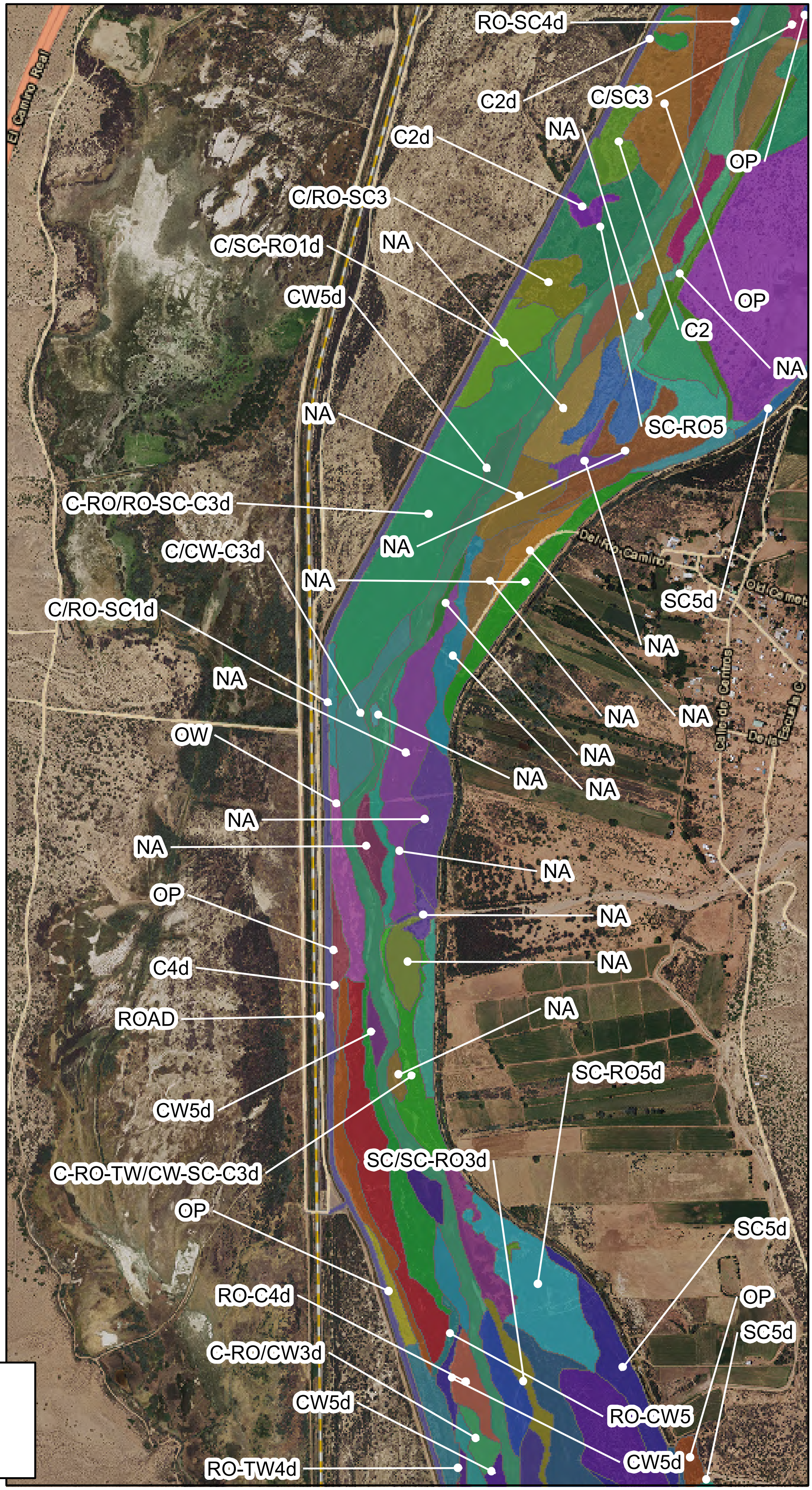


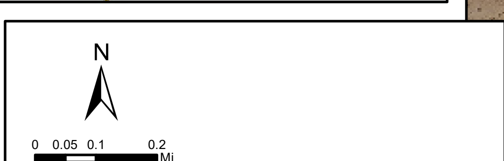


Locator Map



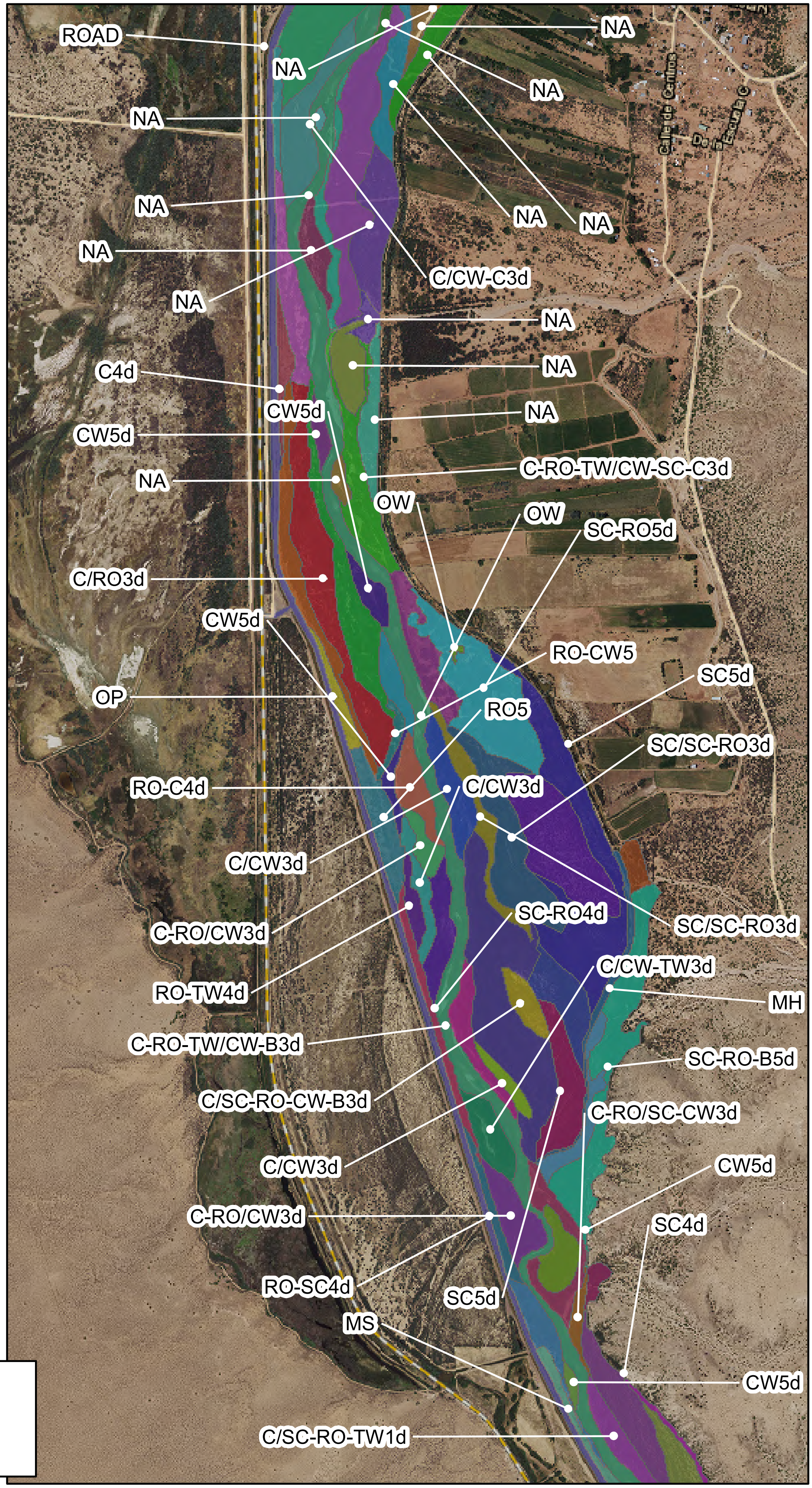
2016
Hink and Ohmart Vegetation Type





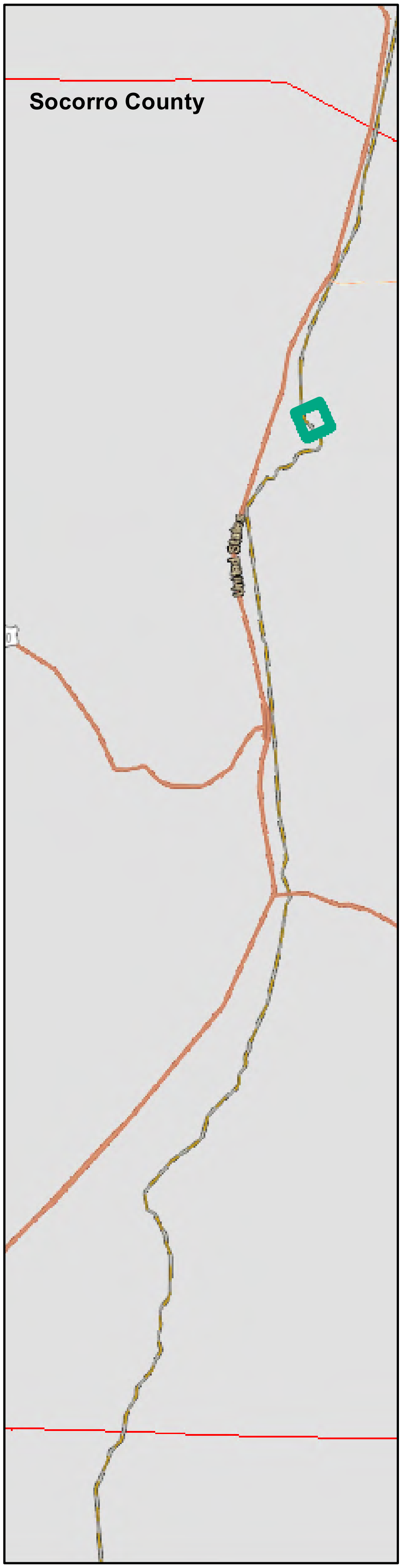
Locator Map

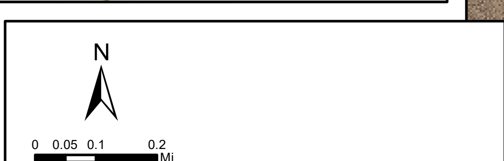
2016
Hink and Ohmart Vegetation Type

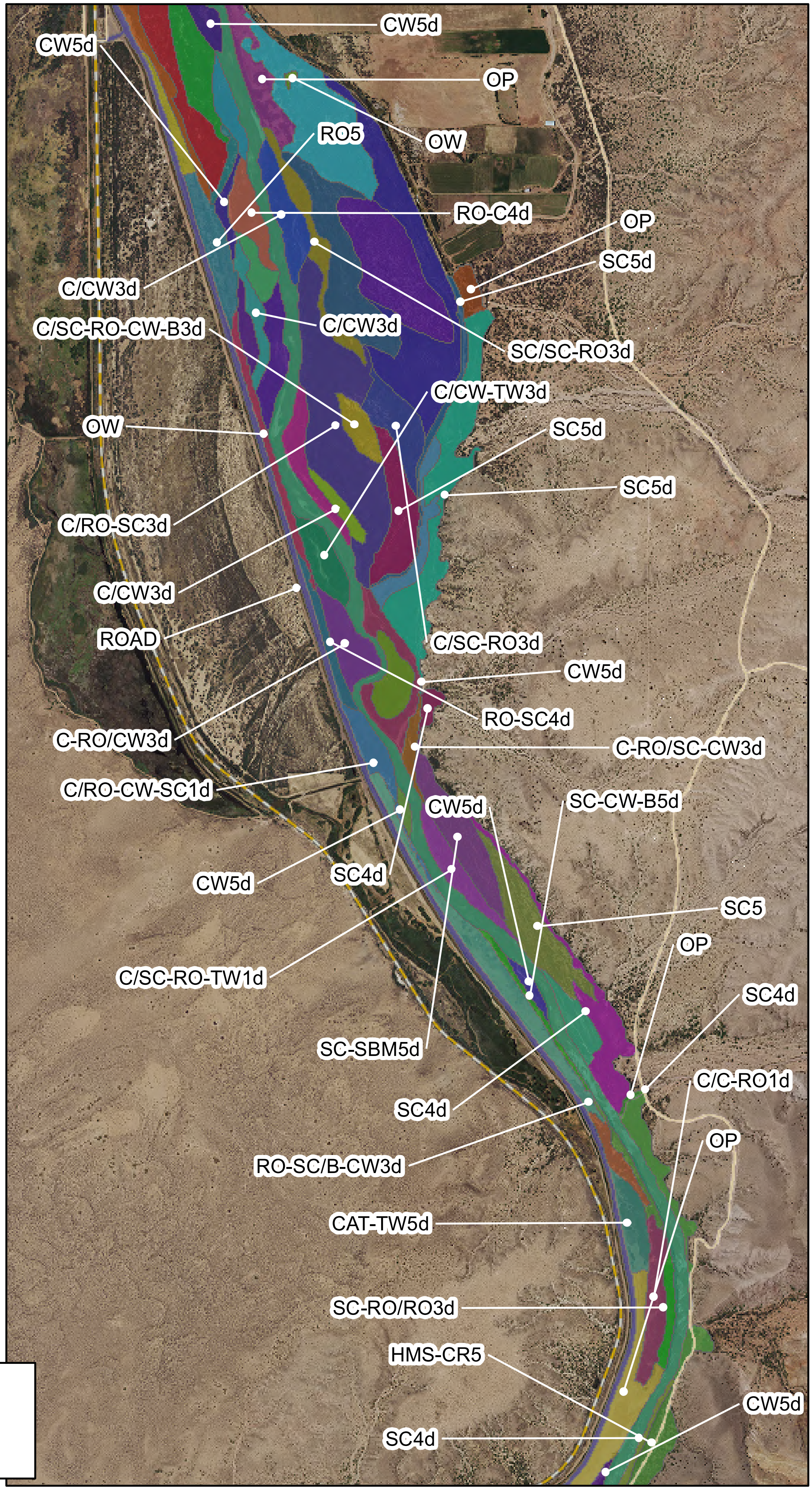


Locator Map

2016
Hink and Ohmart Vegetation Type

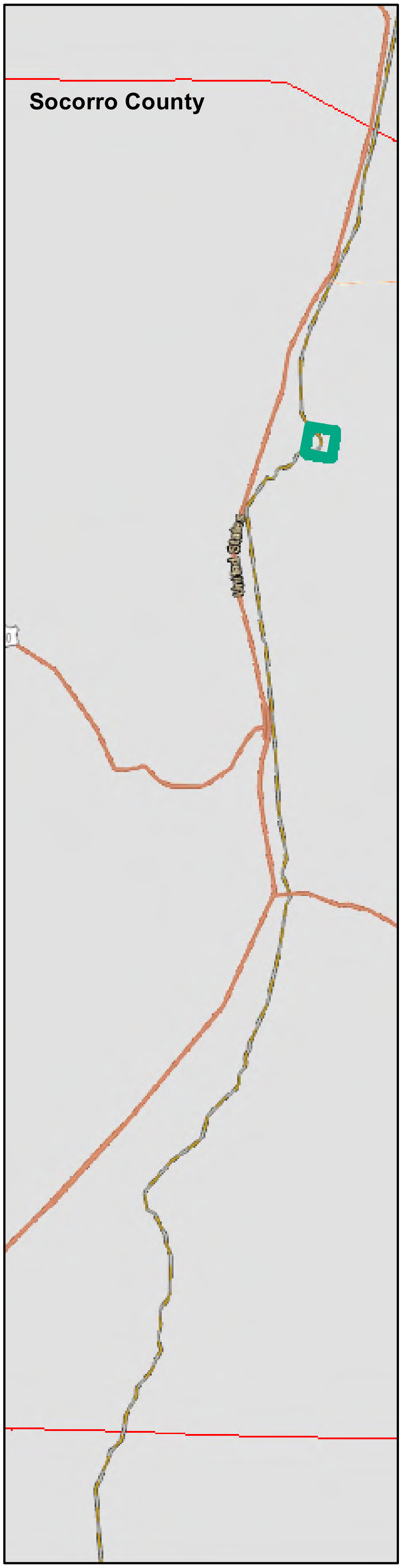


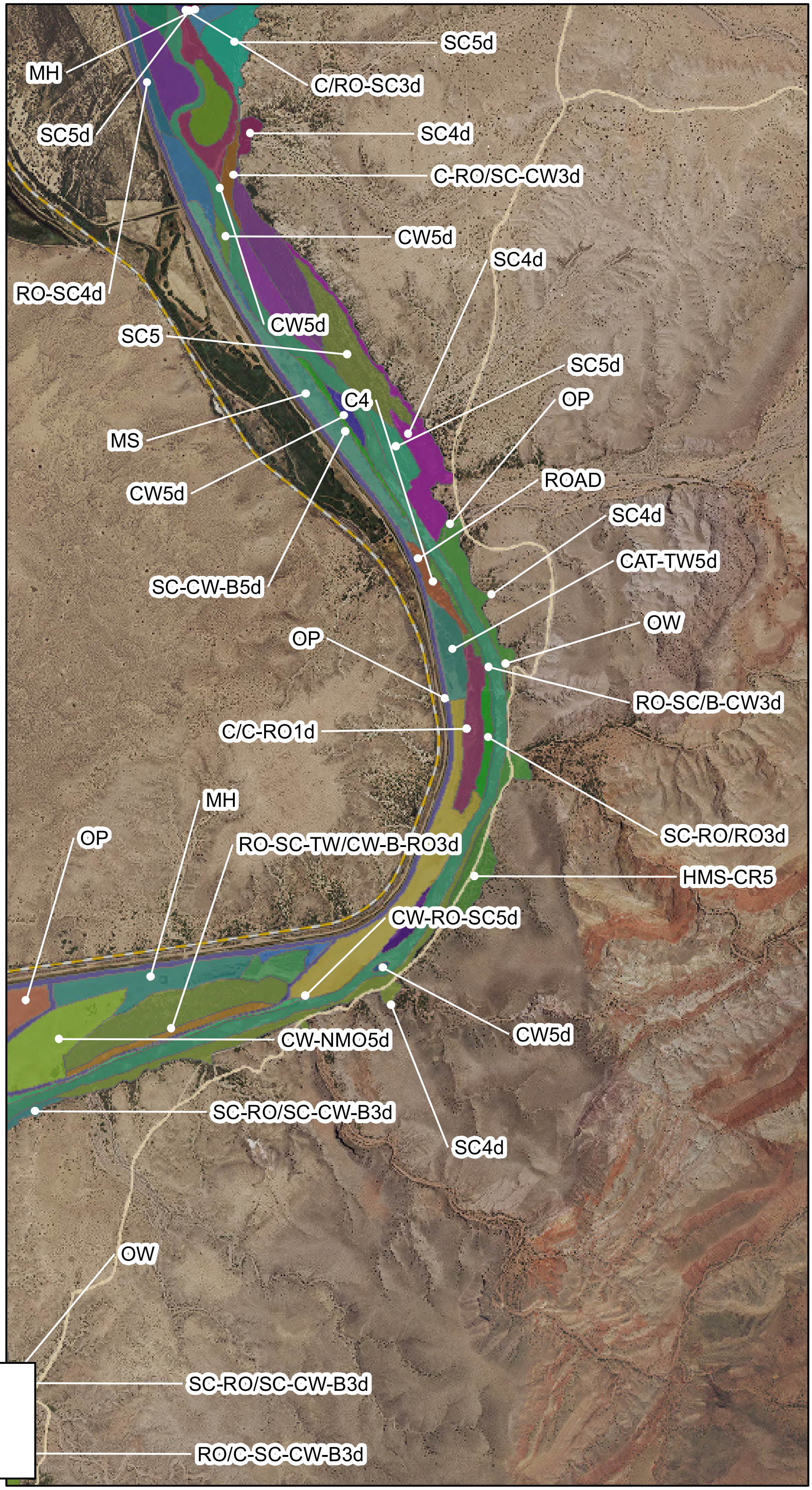


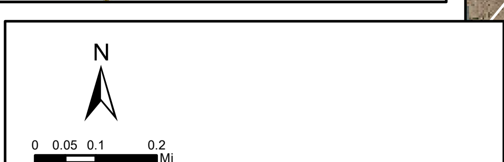


Locator Map

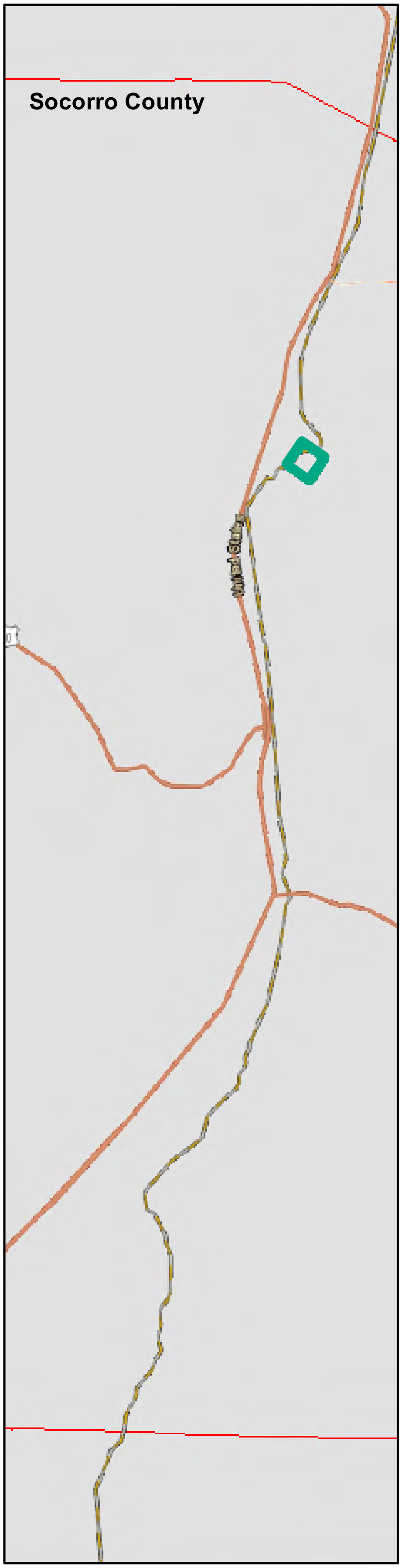
2016
Hink and Ohmart Vegetation Type

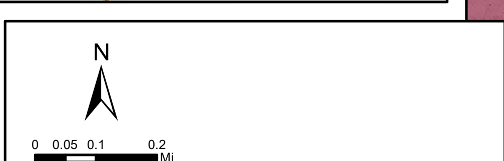






Locator Map


Socorro County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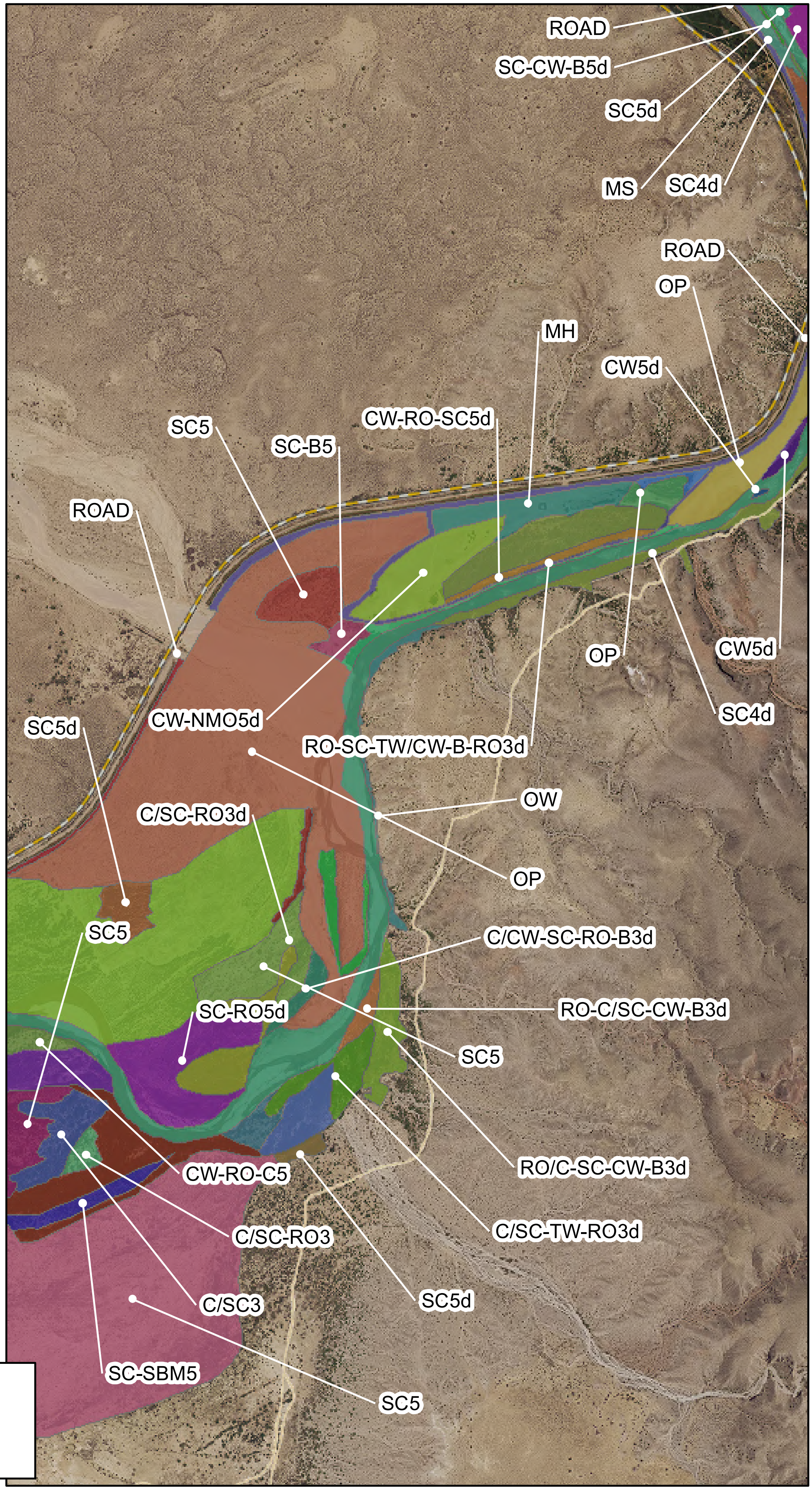
Mi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SC5d
MS
SC4d
ROAD
OP
MH
CW5d
CW-RO-SC5d
SC5
SC-B5
ROAD
OP
CW5d
SC5d
CW-NMO5d
RO-SC-TW/CW-B-RO3d
SC4d
OW
C/SC-RO3d
OP
SC5
C/CW-SC-RO-B3d
SC-RO5d
RO-C/SC-CW-B3d
SC5
RO/C-SC-CW-B3d
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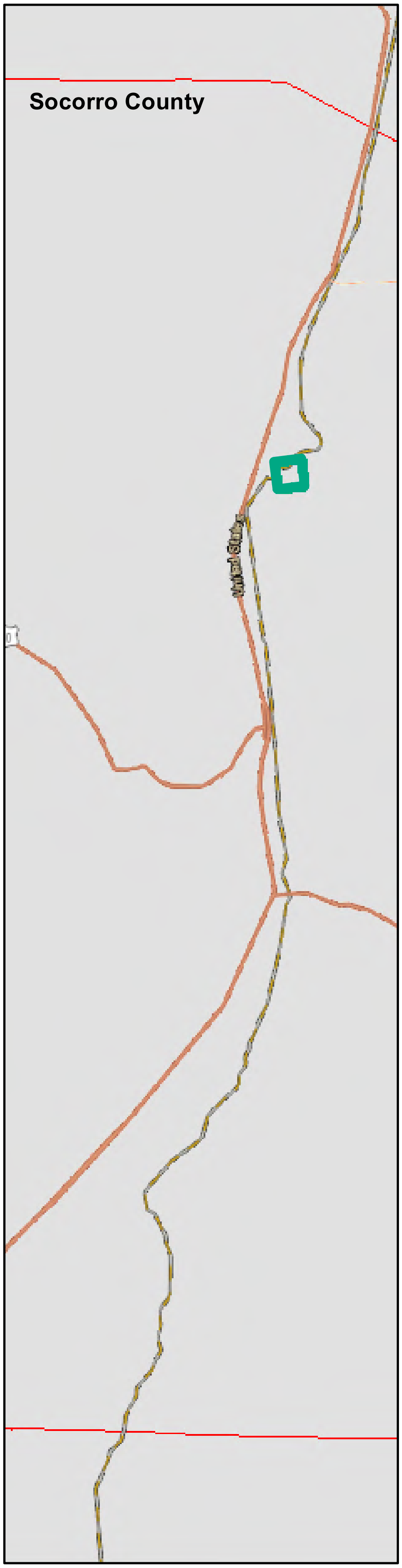
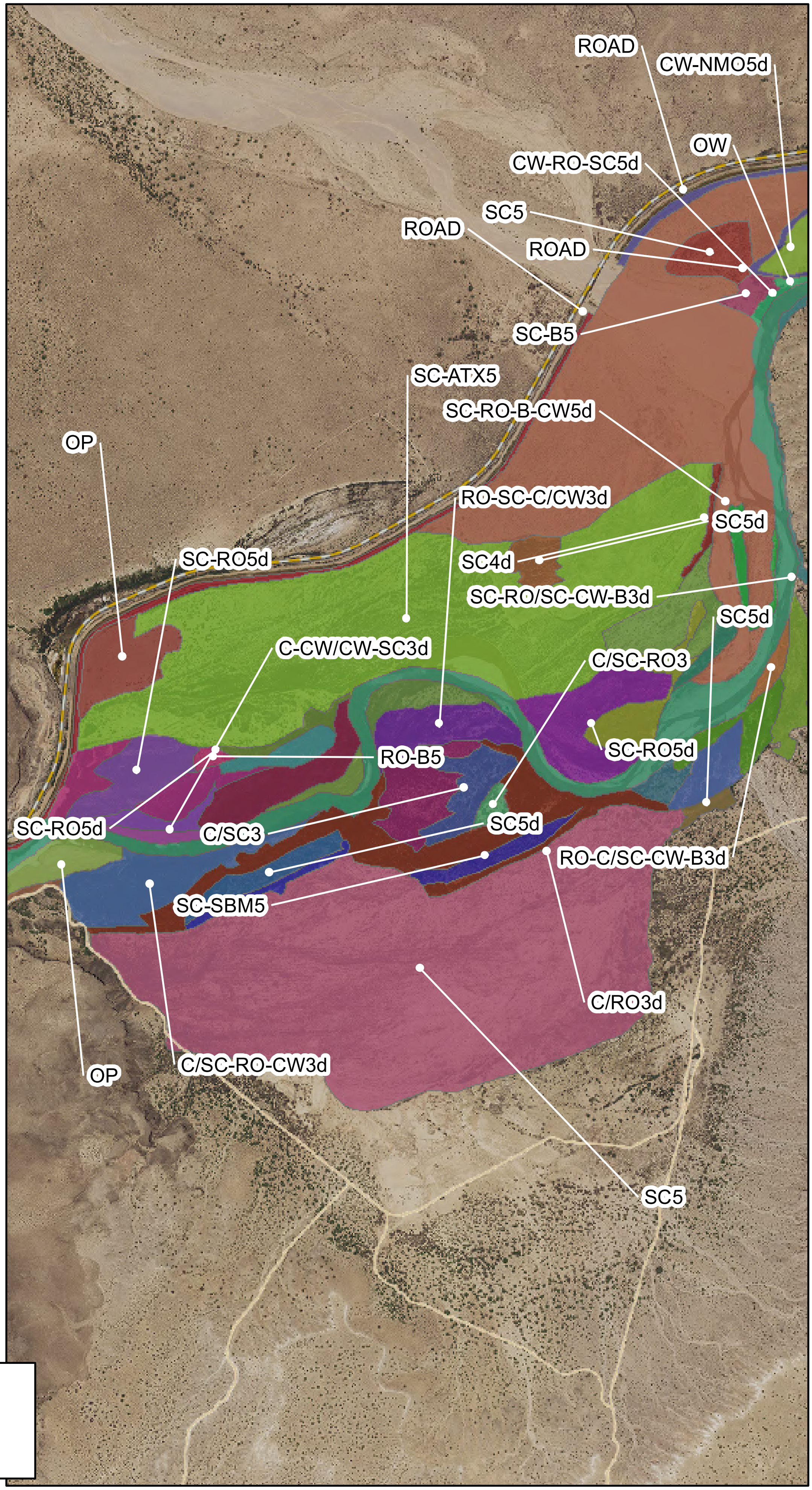
C/SC-RO3
SC5d
C/SC3
SC-SBM5
SC5

Locator Map


Socorro County


ROAD
CW-NMO5d
OW
CW-RO-SC5d
SC5
ROAD
ROAD
SC-B5
SC-ATX5
SC-RO-B-CW5d
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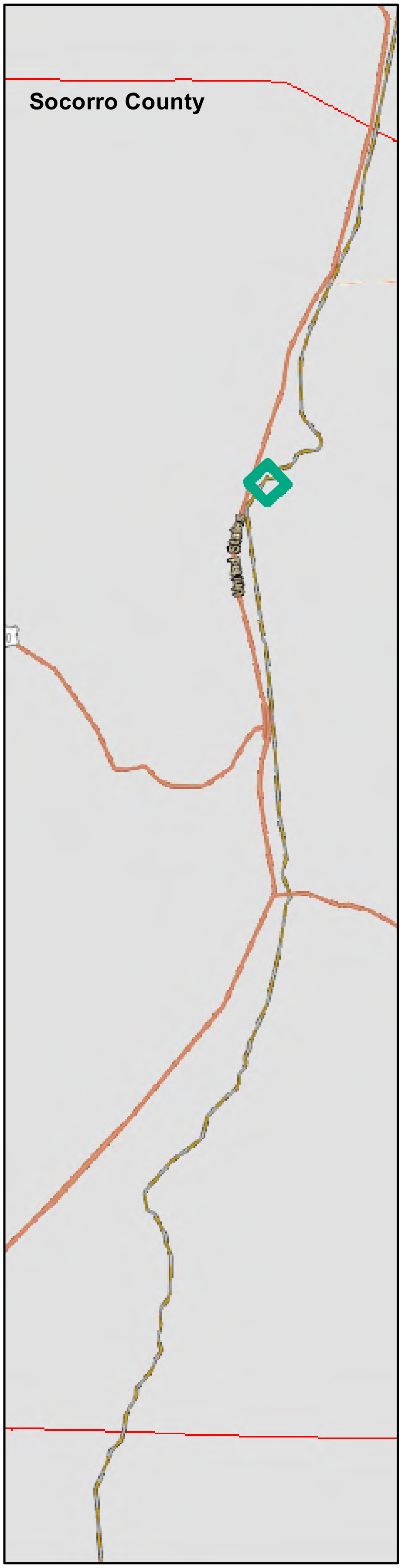
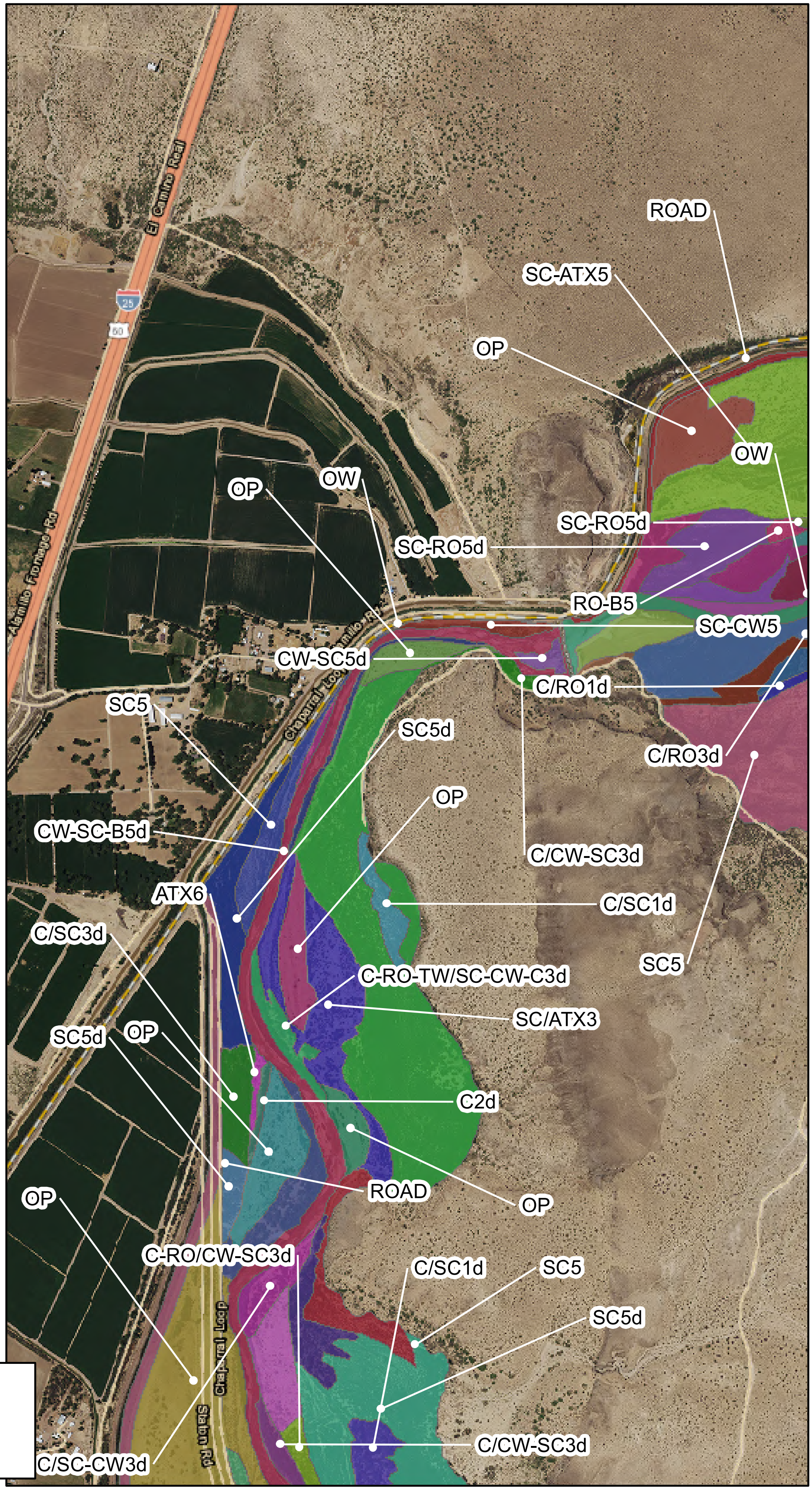
RO-SC-C/CW3d
SC5d
SC4d
SC-RO5d
SC-RO/SC-CW-B3d
SC5d
C-CW/CW-SC3d
C/SC-RO3
SC-RO5d
RO-B5
SC-RO5d
C/SC3
SC5d
RO-C/SC-CW-B3d
SC-SBM5
C/RO3d
OP
C/SC-RO-CW3d
SC5


N
0 0.05 0.1 0.2
Mi

Locator Map

2016
Hink and Ohmart Vegetation Type

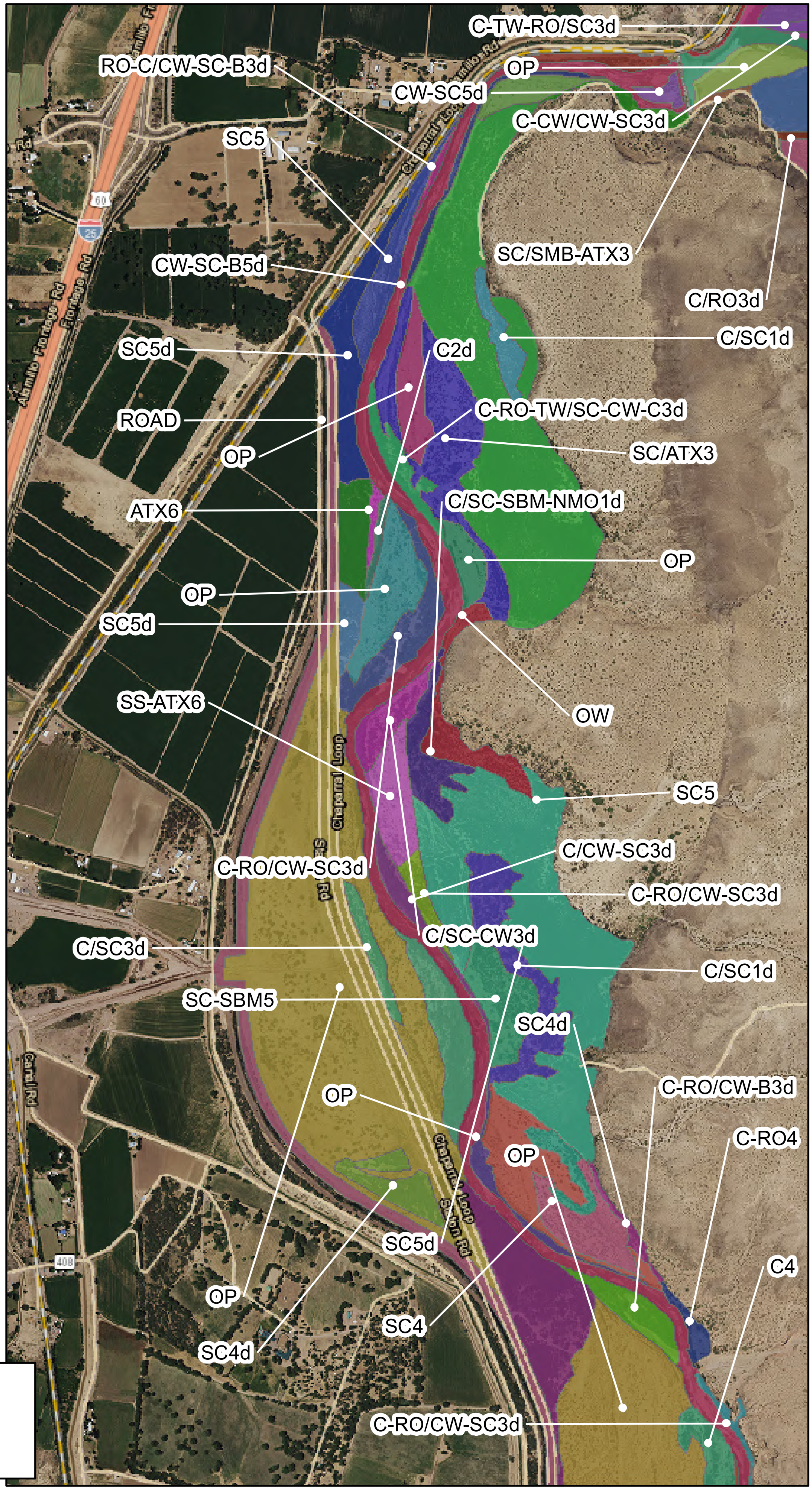




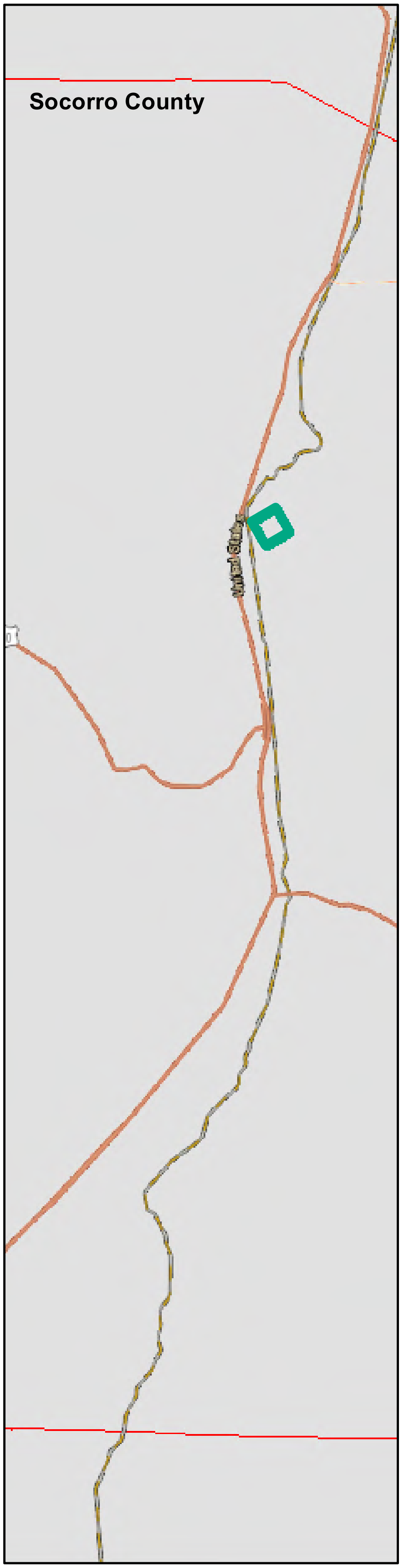
N
0 0.05 0.1 0.2 Mi

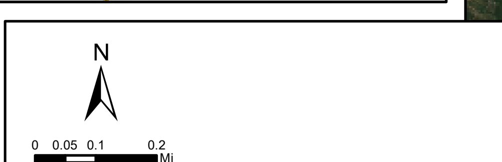
Locator Map


Socorro County
N
0 0.05 0.1 0.2
Mi

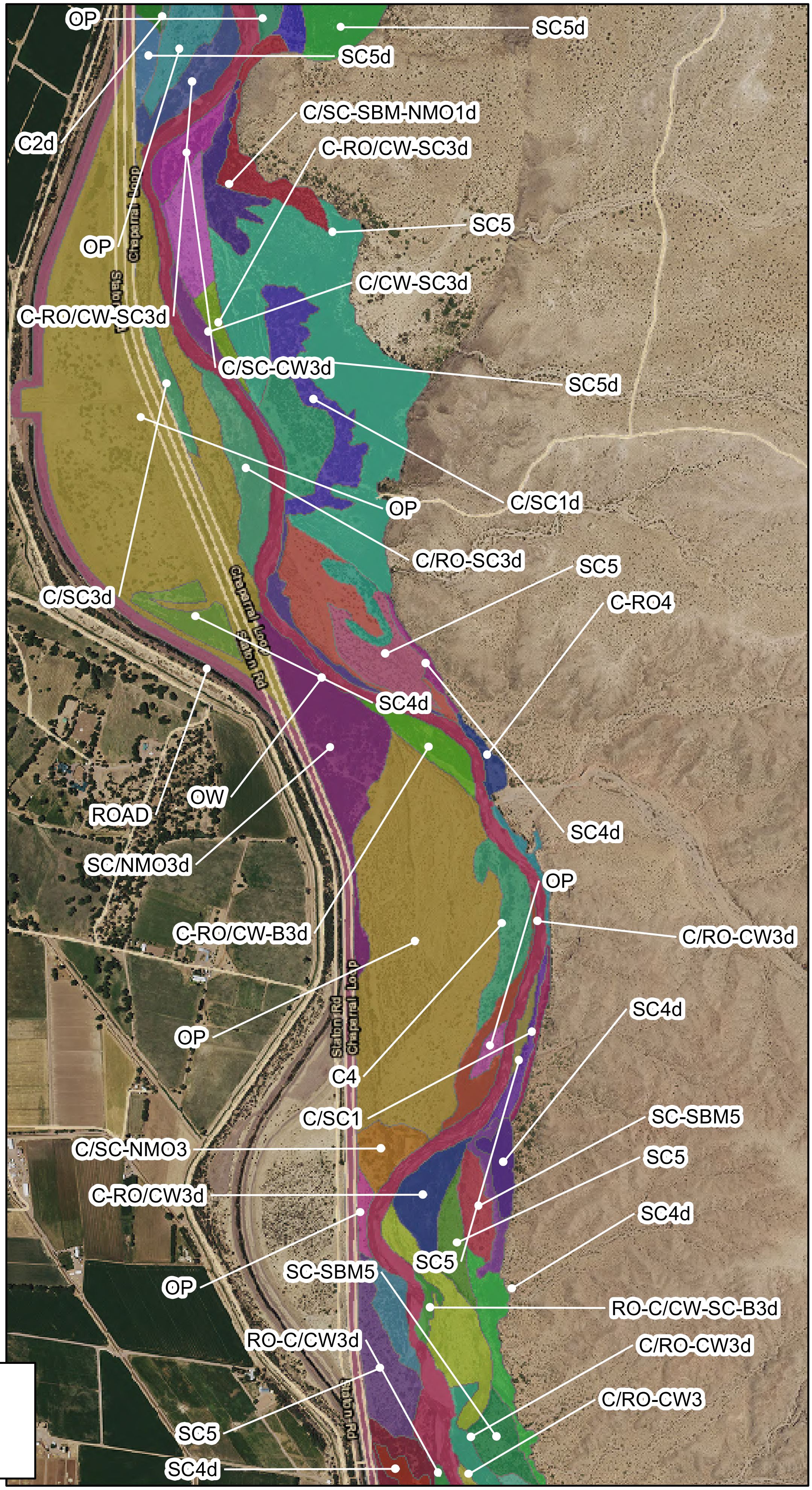

C-TW-RO/SC3d
RO-C/CW-SC-B3d
OP
CW-SC5d
C-CW/CW-SC3d
SC5
SC/SMB-ATX3
CW-SC-B5d
C/RO3d
C/SC1d
SC5d
C2d
C-RO-TW/SC-CW-C3d
ROAD
SC/ATX3
OP
C/SC-SBM-NMO1d
ATX6
OP
OP
SC5d
OW
SS-ATX6
SC5
C/CW-SC3d
C-RO/CW-SC3d
C-RO/CW-SC3d
C/SC-CW3d
C/SC3d
C/SC1d
SC-SBM5
SC4d
C-RO/CW-B3d
OP
OP
C-RO4
SC5d
C4
OP
SC4
SC4d
C-RO/CW-SC3d
Chaparral Loop
Sexton Rd
Alamillo Frontage Rd
Frontage Rd
Canal Rd

Locator Map



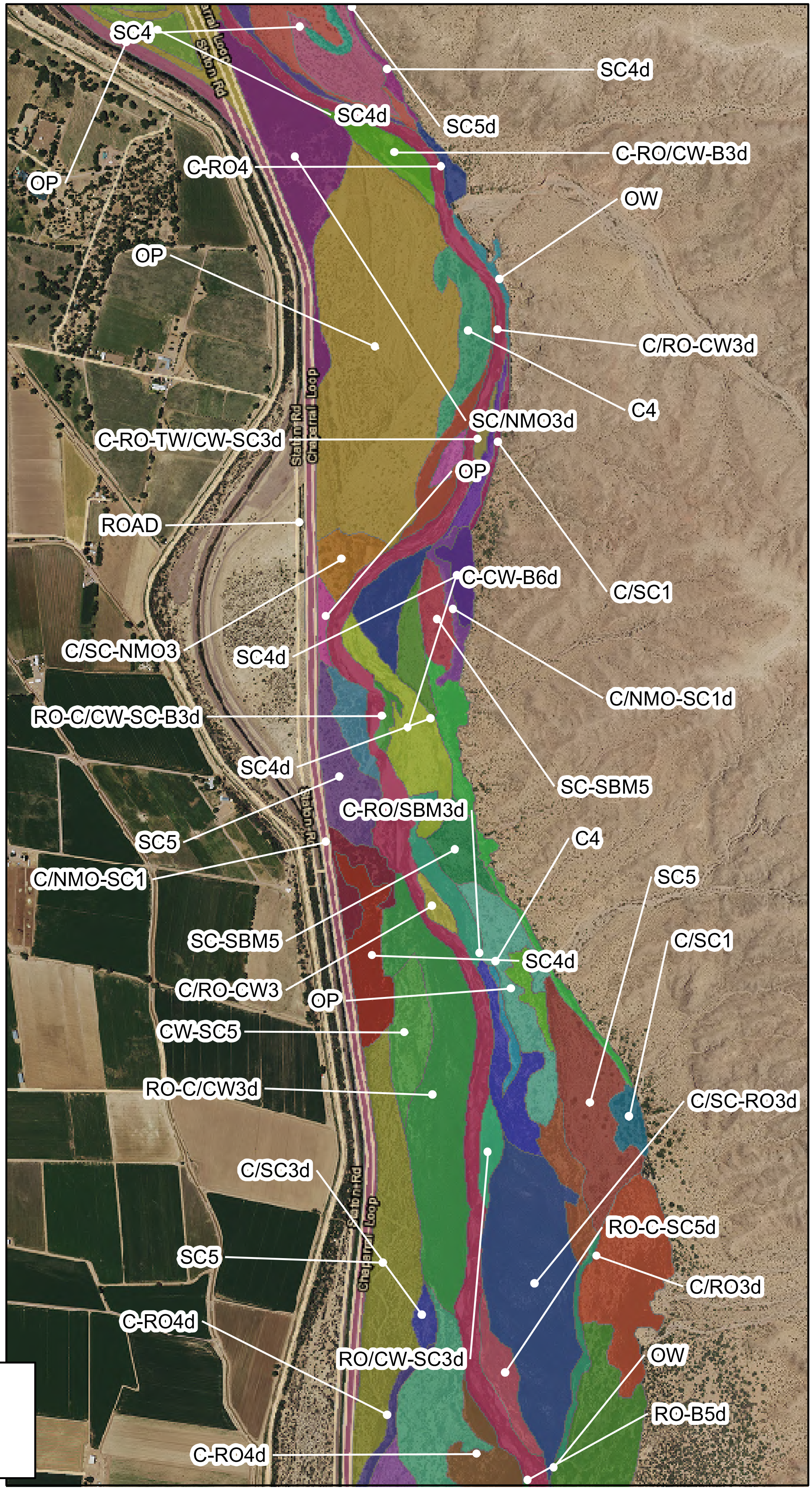


2016
Hink and Ohmart Vegetation Type



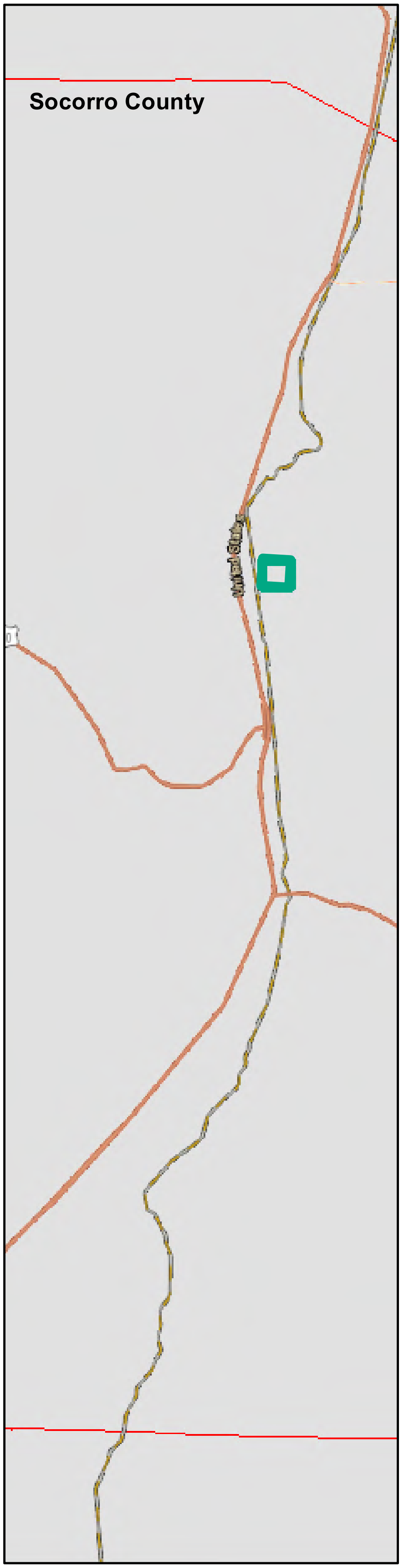
Locator Map

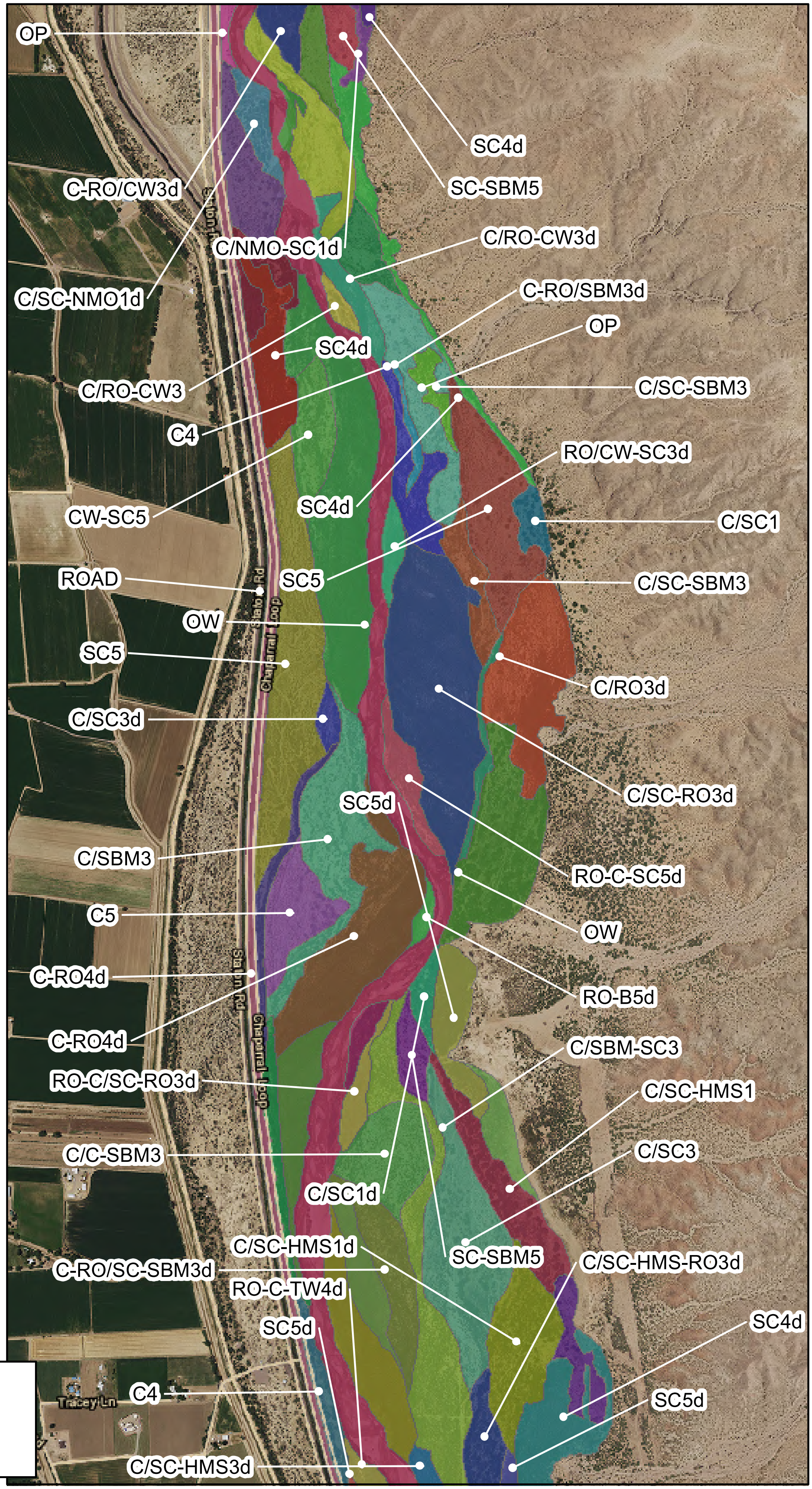
2016
Hink and Ohmart Vegetation Type

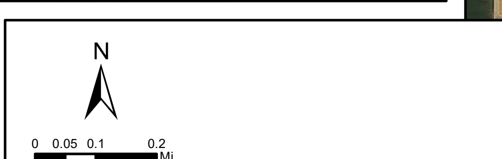


Locator Map

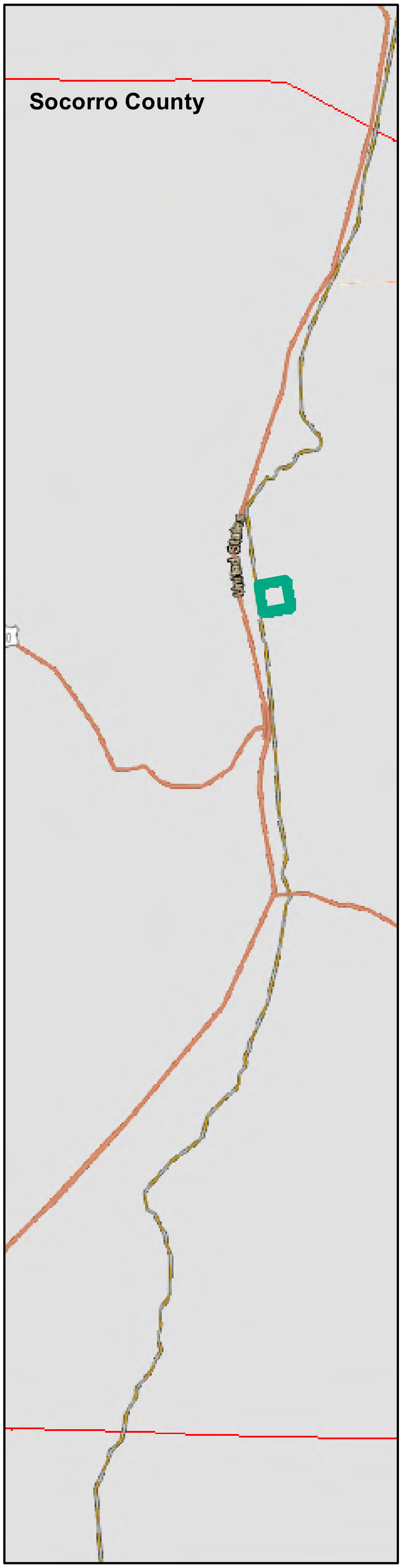
2016
Hink and Ohmart Vegetation Type

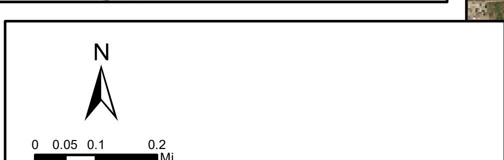






Locator Map


Socorro County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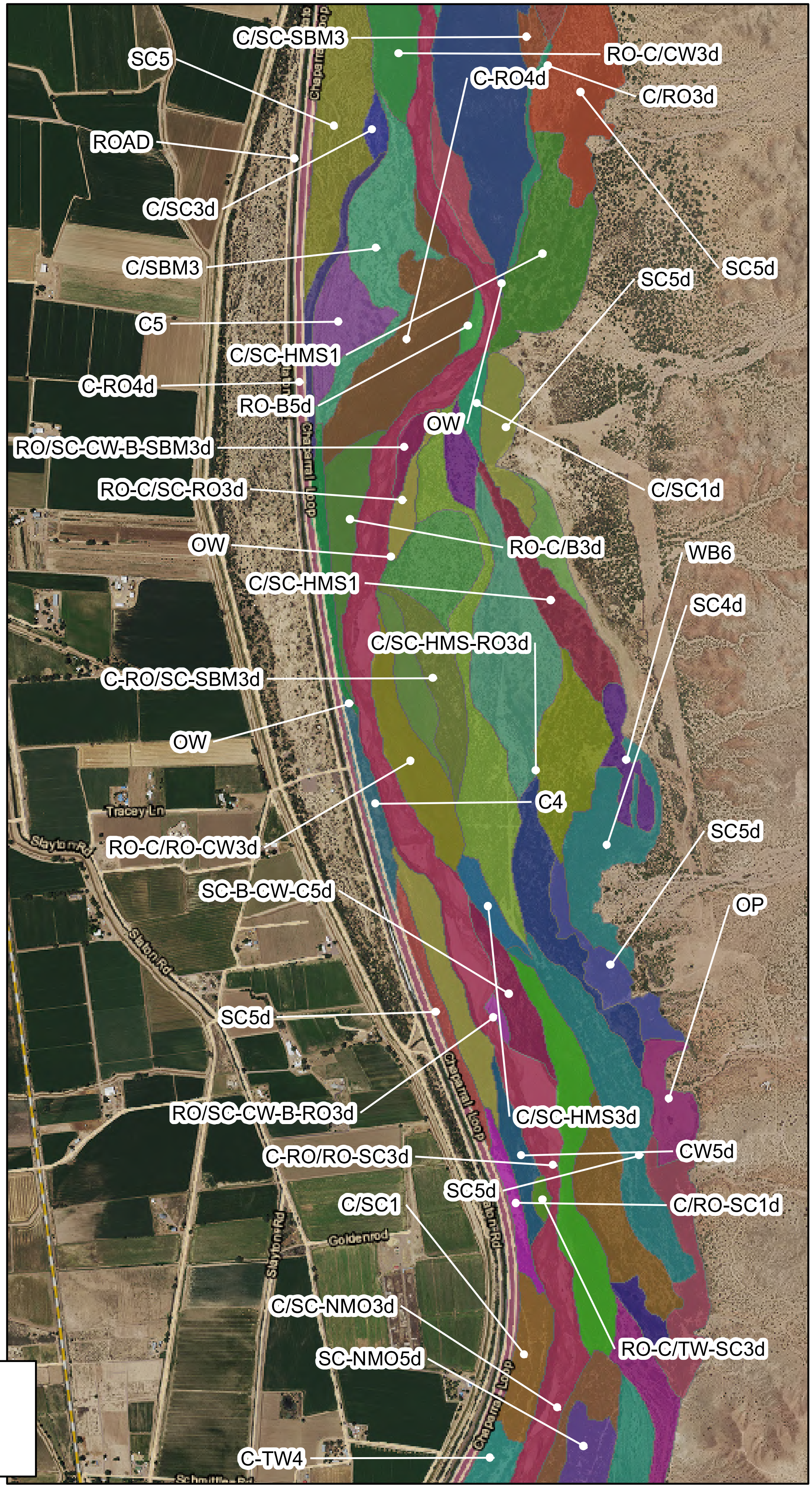
Mi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RO-C/CW3d
SC5
C-RO4d
C/RO3d
ROAD
C/SC3d
C/SBM3
SC5d
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C5
C/SC-HMS1
C-RO4d
RO-B5d
OW
RO/SC-CW-B-SBM3d
RO-C/SC-RO3d
C/SC1d
OW
RO-C/B3d
WB6
C/SC-HMS1
SC4d
C/SC-HMS-RO3d
C-RO/SC-SBM3d
OW
C4
RO-C/RO-CW3d
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CW5d
SC5d
C/SC1
C/RO-SC1d
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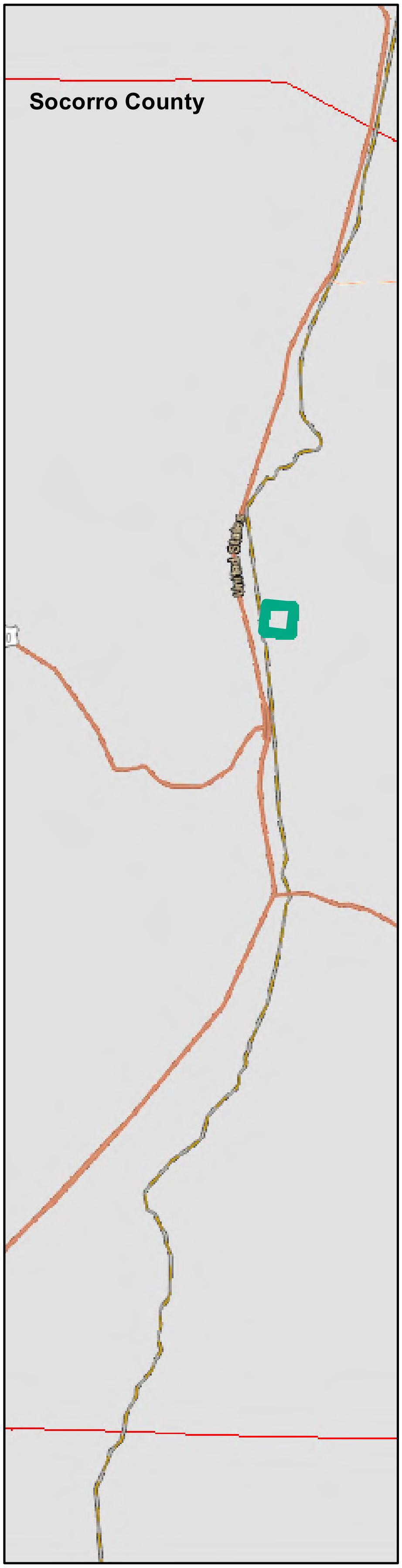
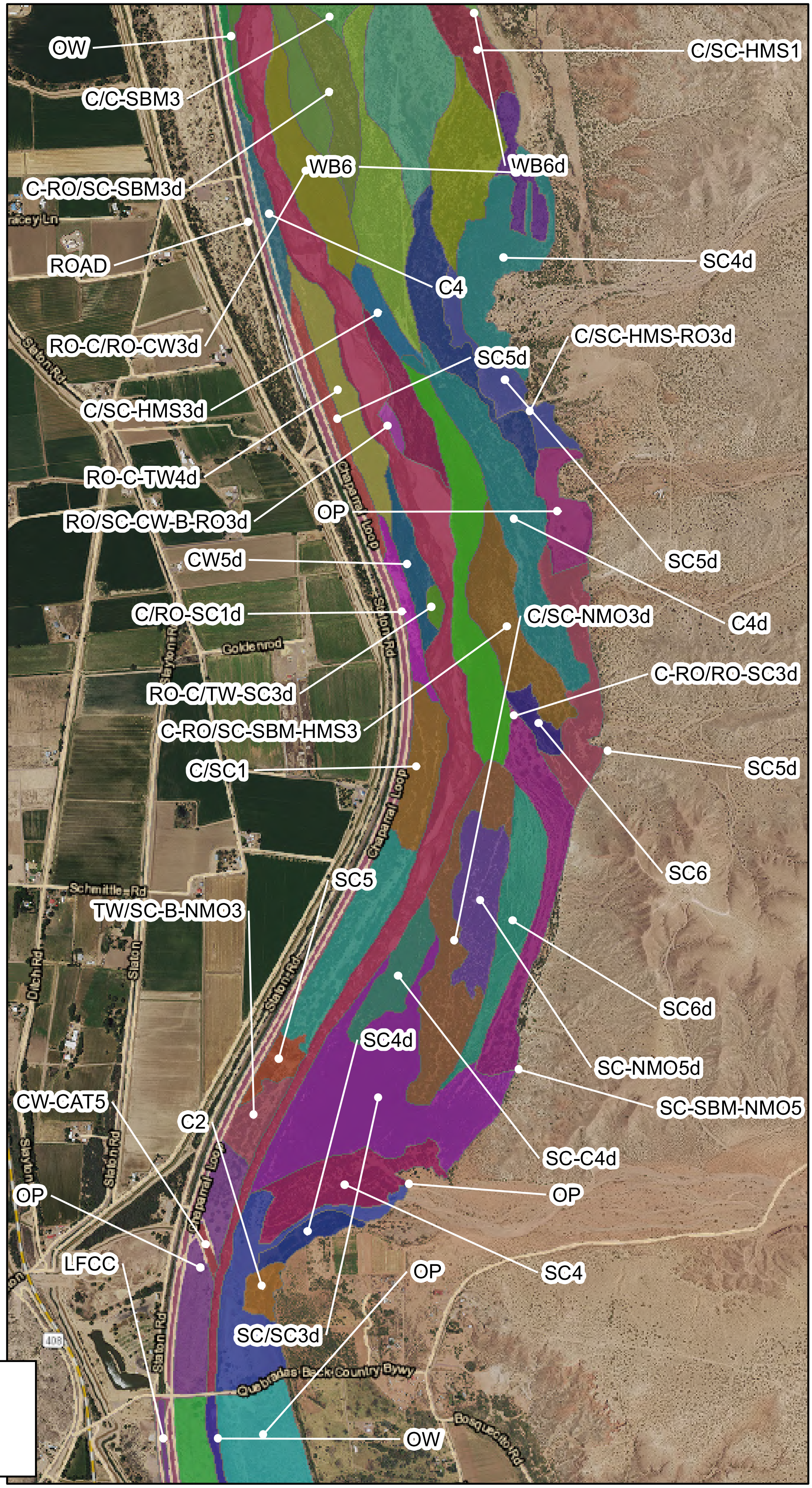
C-TW4
Tracey Ln
Slayton Rd
Chaparral Loop
Goldenrod


Socorro County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ROAD
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RO-C-TW4d
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CW5d
C/RO-SC1d
RO-C/TW-SC3d
C-RO/SC-SBM-HMS3
C/SC1
TW/SC-B-NMO3
CW-CAT5
C2
OP
LFCC
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WB6
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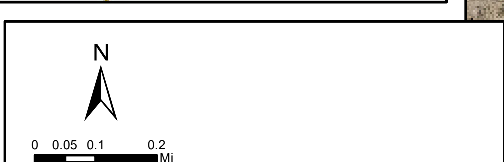
SC4d
C/SC-HMS1
WB6d
SC4d
C/SC-HMS-RO3d
SC5d
C4d
C/SC-NMO3d
C-RO/RO-SC3d
SC5d
SC6
SC6d
SC-NMO5d
SC-SBM-NMO5
SC-C4d
OP
SC4
OP
OW
Schmittle Rd
Goldenrod
Chaparral Loop
Slaton Rd
Ditch Rd
Quebradas Back Country Byway
Bosquecito Rd
408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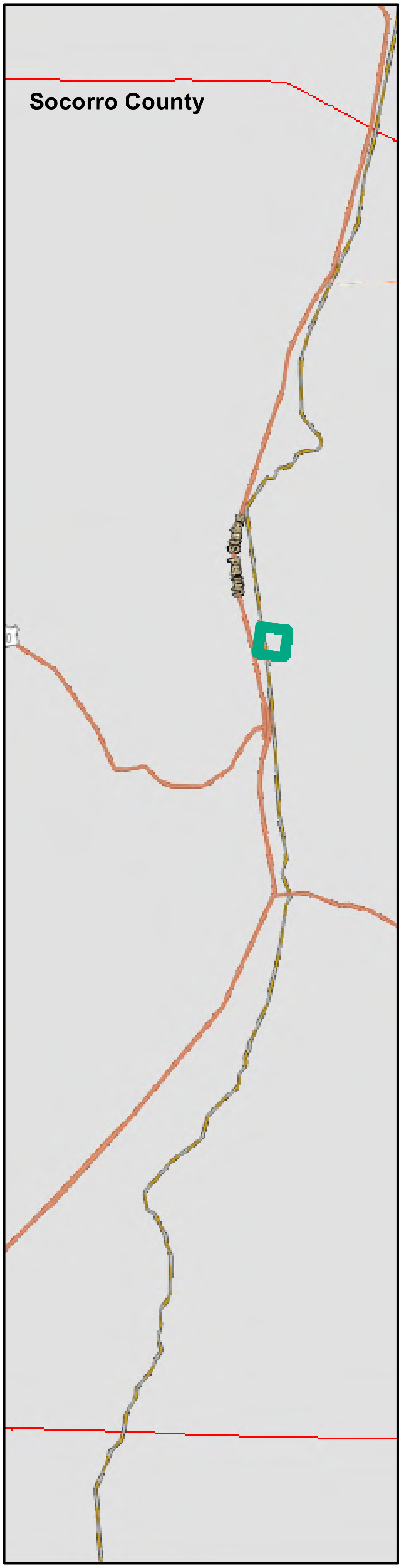
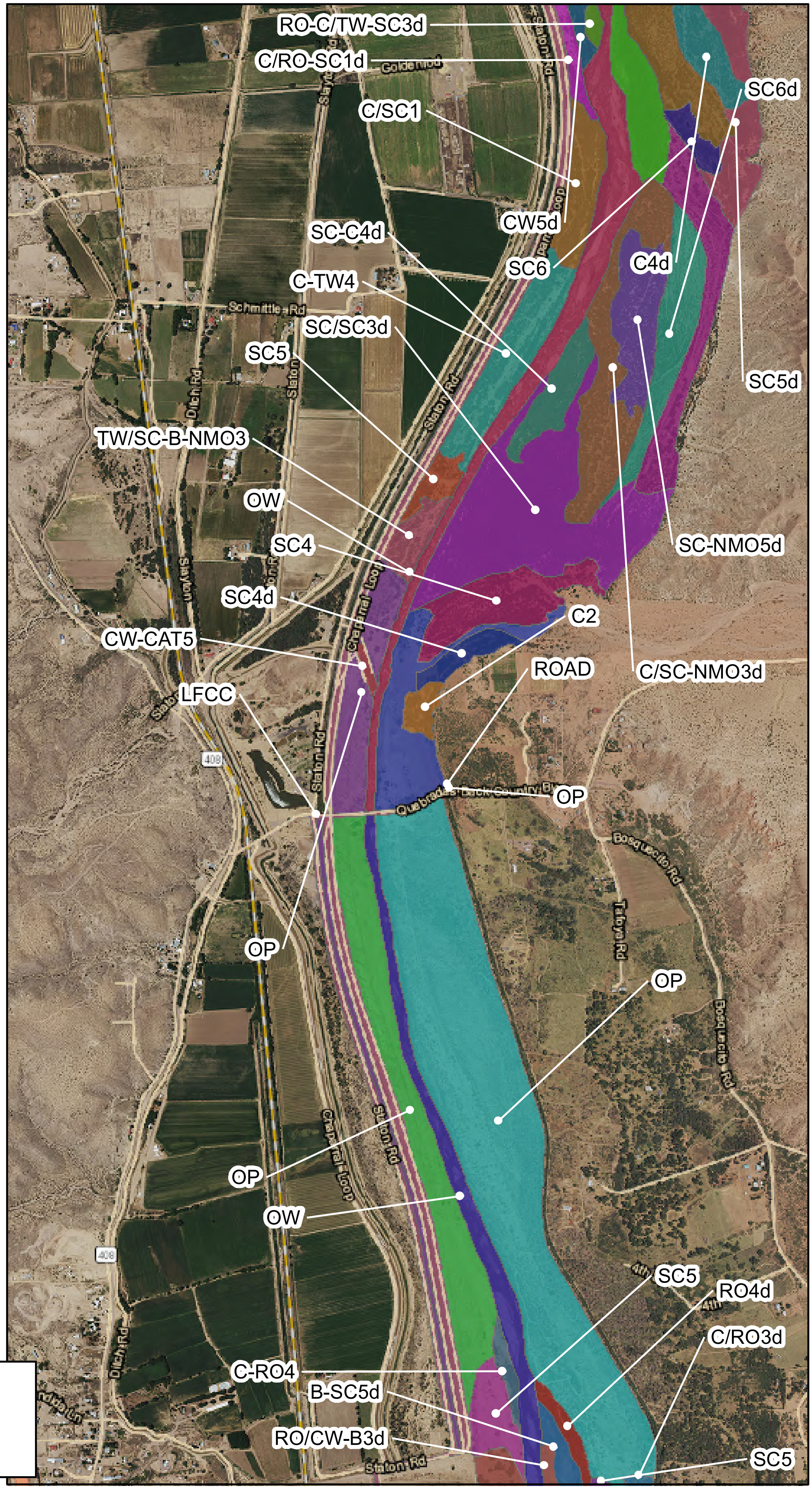

Socorro County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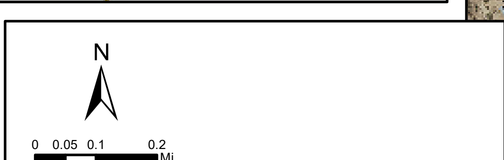
C/RO-SC1d
C/SC1
SC6d
CW5d
SC-C4d
SC6
C4d
C-TW4
SC/SC3d
SC5
SC5d
TW/SC-B-NMO3
OW
SC4
SC-NMO5d
SC4d
C2
CW-CAT5
ROAD
C/SC-NMO3d
LFCC
OP
OP
OP
OP
OW
SC5
RO4d
C/RO3d
C-RO4
B-SC5d
RO/CW-B3d
SC5
Golden Rd
Schmittle Rd
Slaton Rd
Ditch Rd
Chaparral Loop
Quebradas Back Country Byway
Bosquecito Rd
Tafoya Rd
Staton Rd


N
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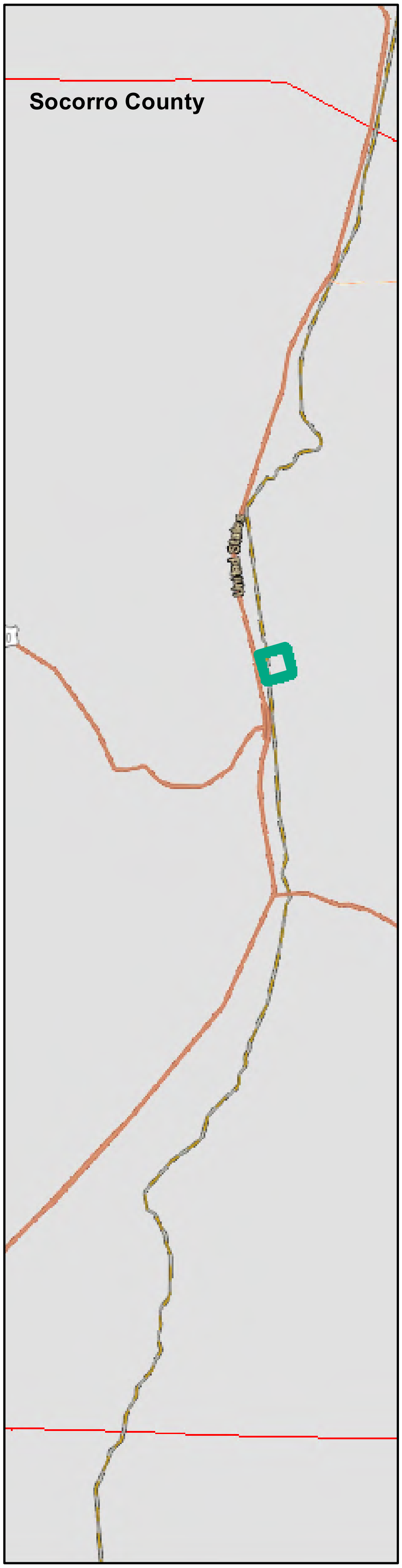
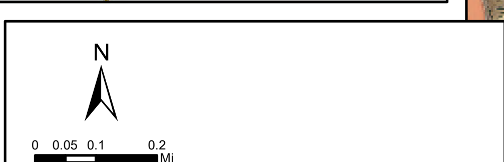
Mi

Locator Map


Socorro County


N
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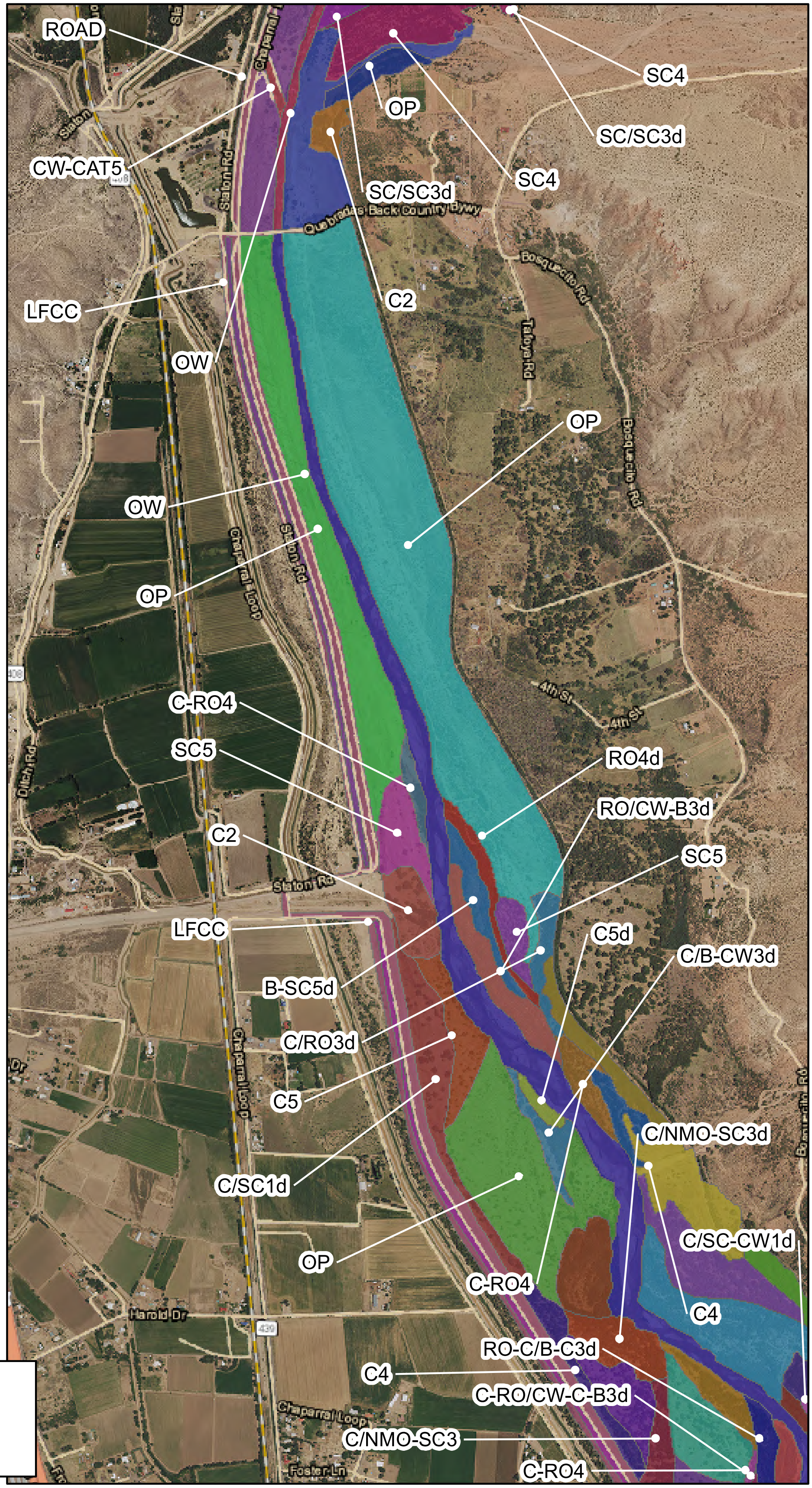
Mi


ROAD
CW-CAT5
LFCC
OW
OP
SC/SC3d
SC4
SC/SC3d
SC4
OP
C2
OP
OW
OP
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SC5
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C5
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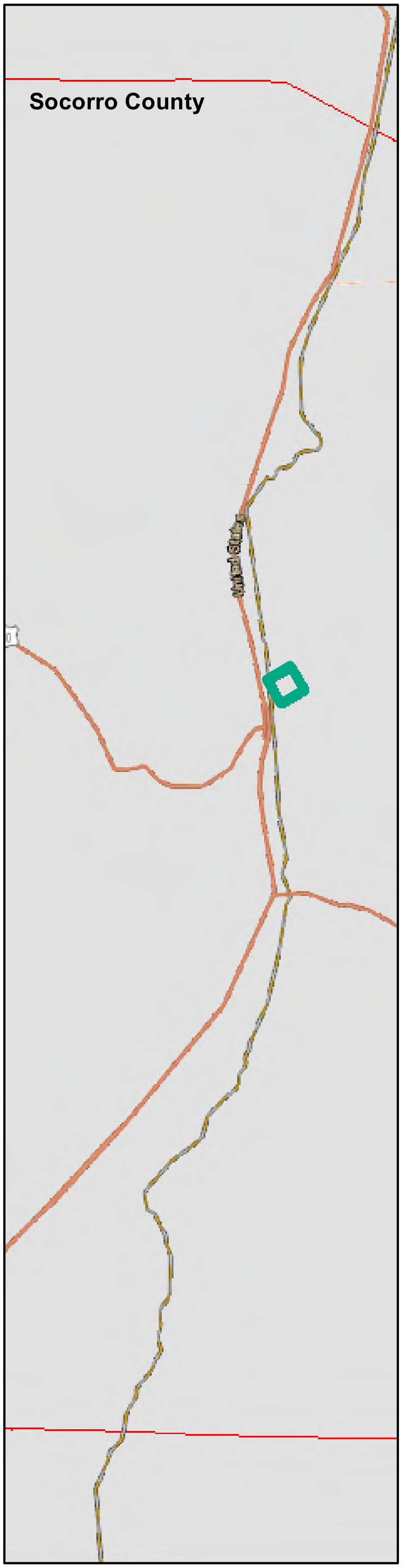
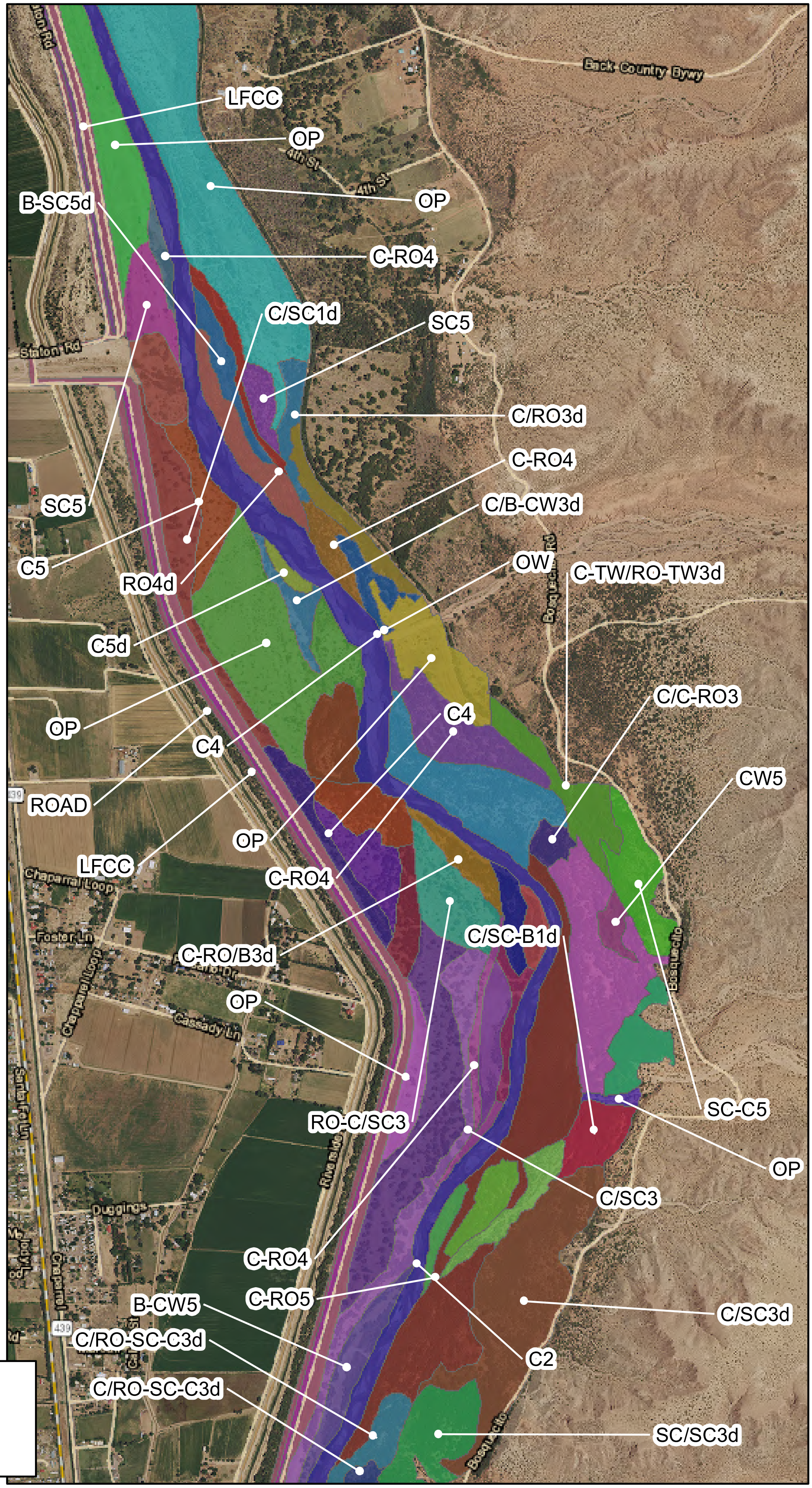
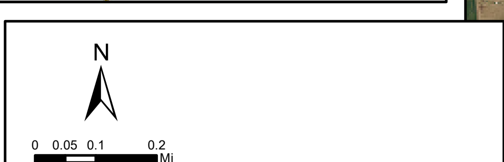
C/SC1d
C/SC-CW1d
OP
C-RO4
C4
RO-C/B-C3d
C4
C-RO/CW-C-B3d
C/NMO-SC3
C-RO4
Quebradas Back Country Bywy
Bosquecito Rd
Tafoya Rd
Chaparral Loop
Staton Rd
4th St
Harold Dr
Foster Ln

Locator Map

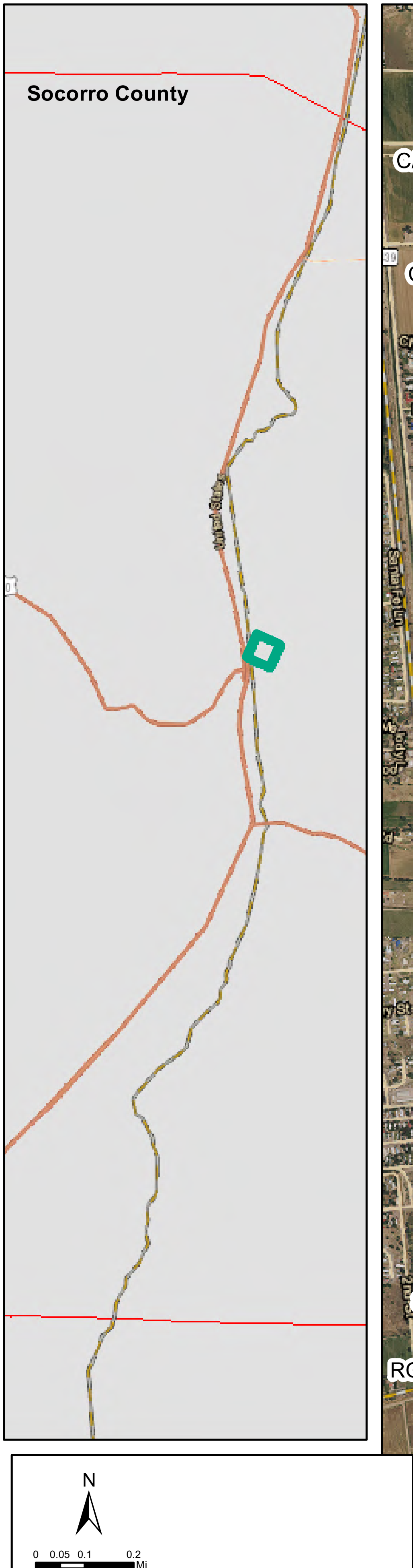
2016
Hink and Ohmart Vegetation Type



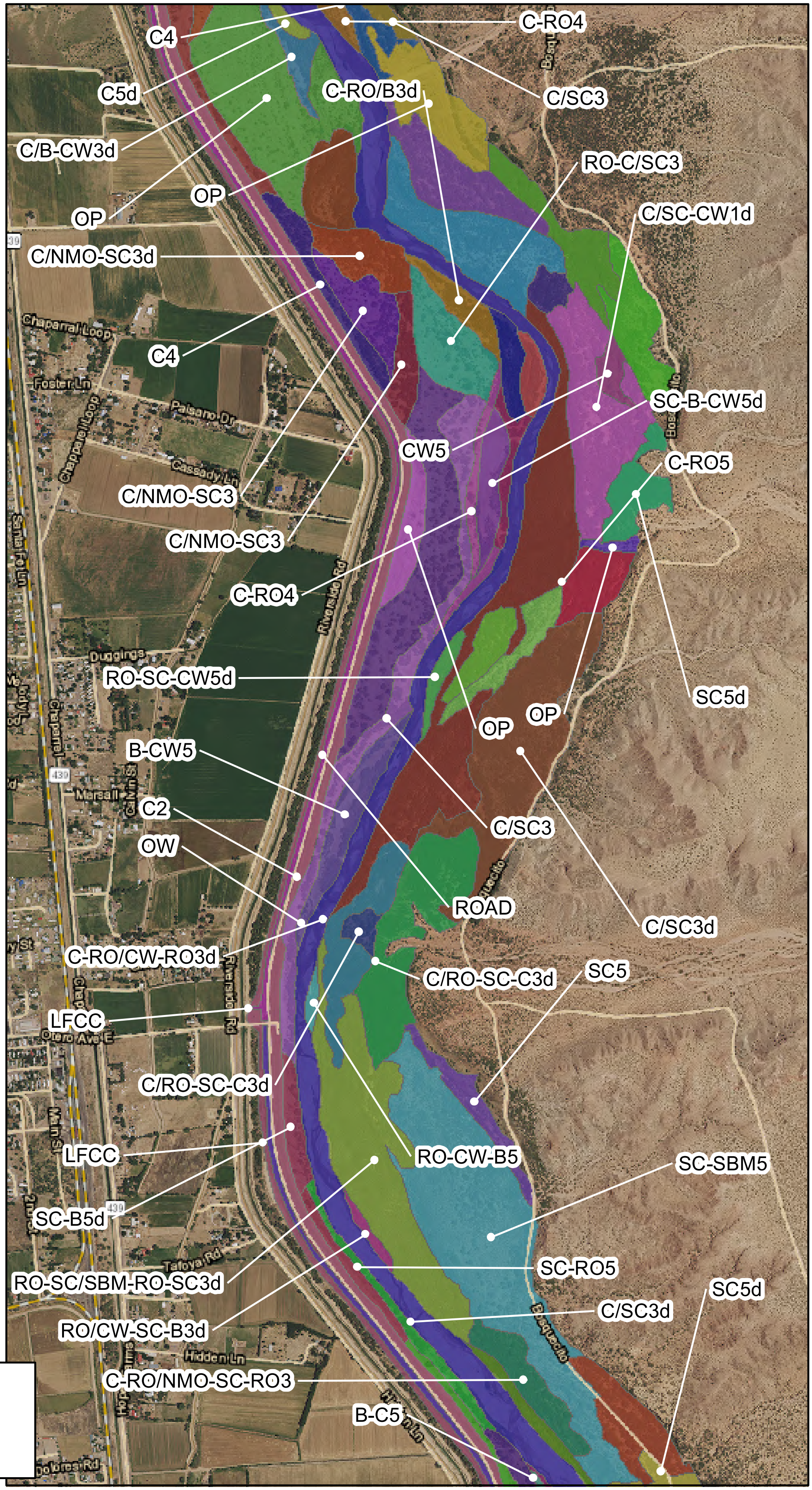




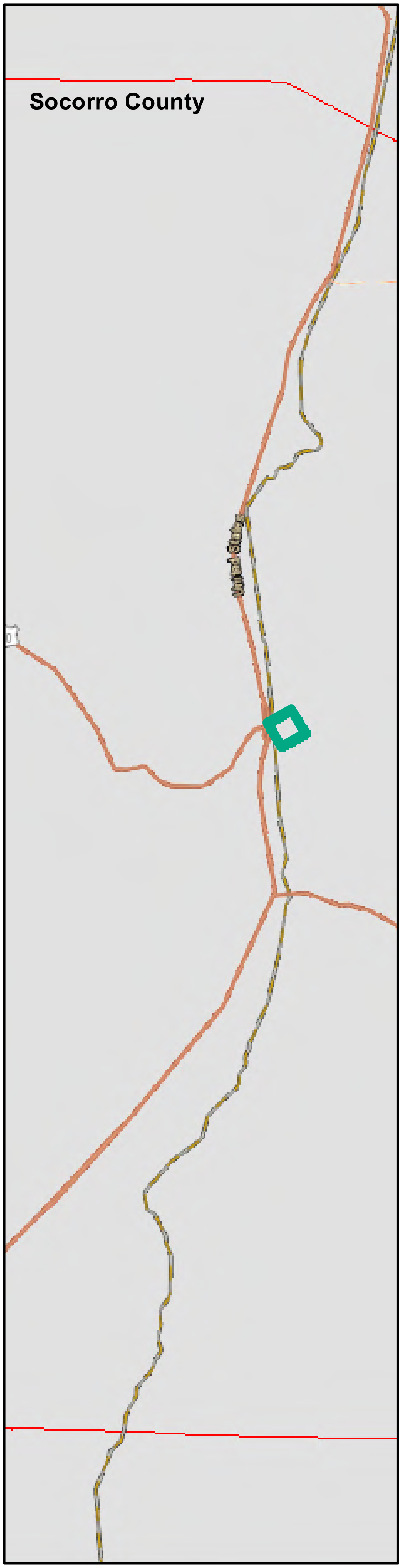
Locator Map

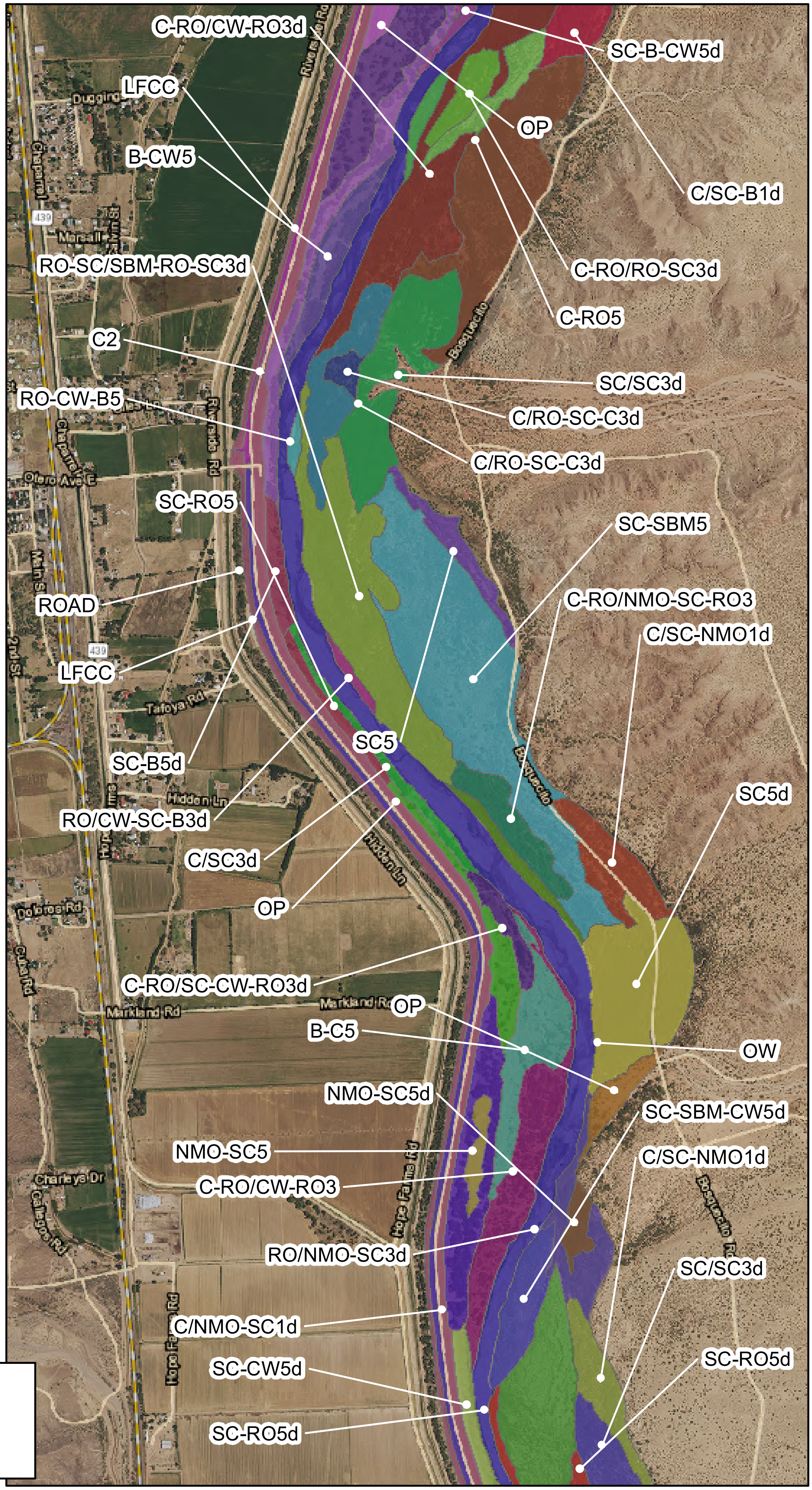


2016
Hink and Ohmart Vegetation Type



Locator Map


Socorro County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SC-B-CW5d
LFCC
OP
B-CW5
C/SC-B1d
RO-SC/SBM-RO-SC3d
C-RO/RO-SC3d
C-RO5
C2
SC/SC3d
RO-CW-B5
C/RO-SC-C3d
C/RO-SC-C3d
SC-RO5
SC-SBM5
C-RO/NMO-SC-RO3
ROAD
C/SC-NMO1d
LFCC
SC5
SC-B5d
SC5d
RO/CW-SC-B3d
C/SC3d
OP
C-RO/SC-CW-RO3d
OP
B-C5
OW
NMO-SC5d
SC-SBM-CW5d
C/SC-NMO1d
NMO-SC5
C-RO/CW-RO3
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C/NMO-SC1d
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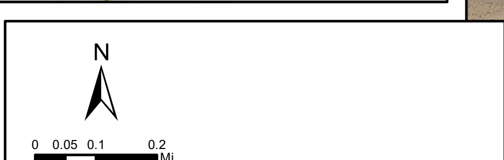
SC-RO5d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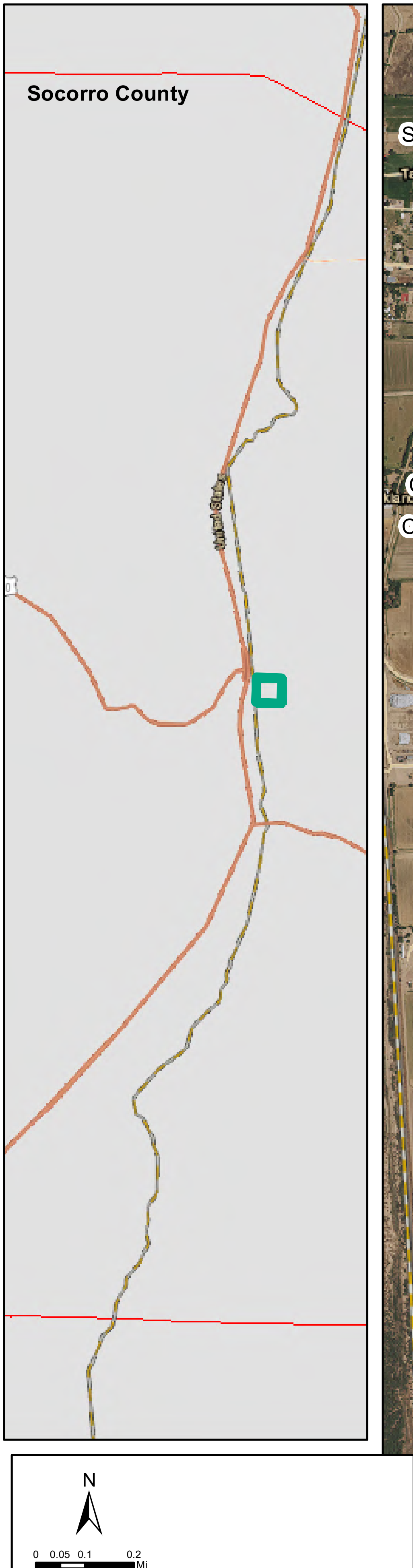
Mi

Locator Map


Socorro County
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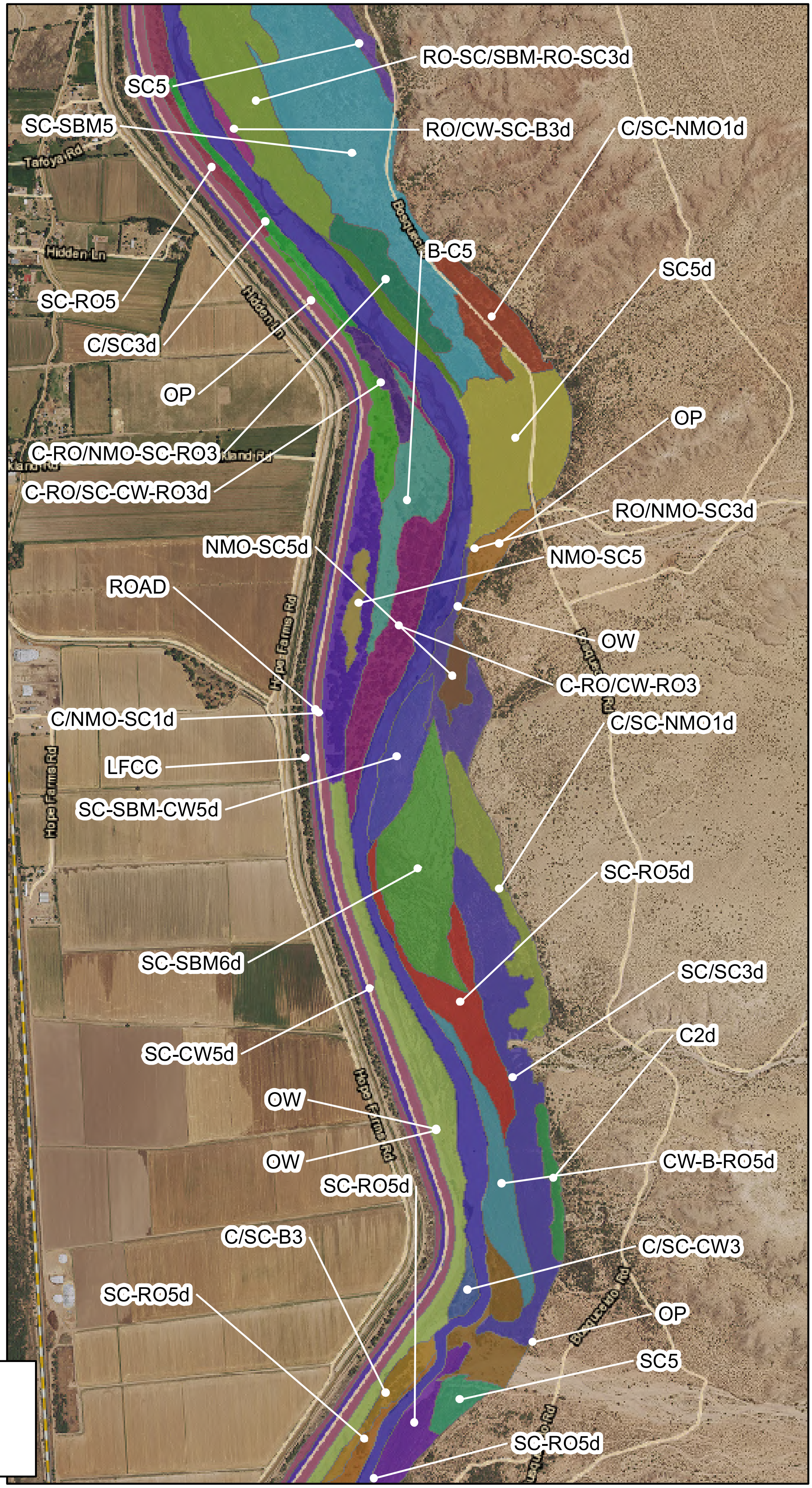
Mi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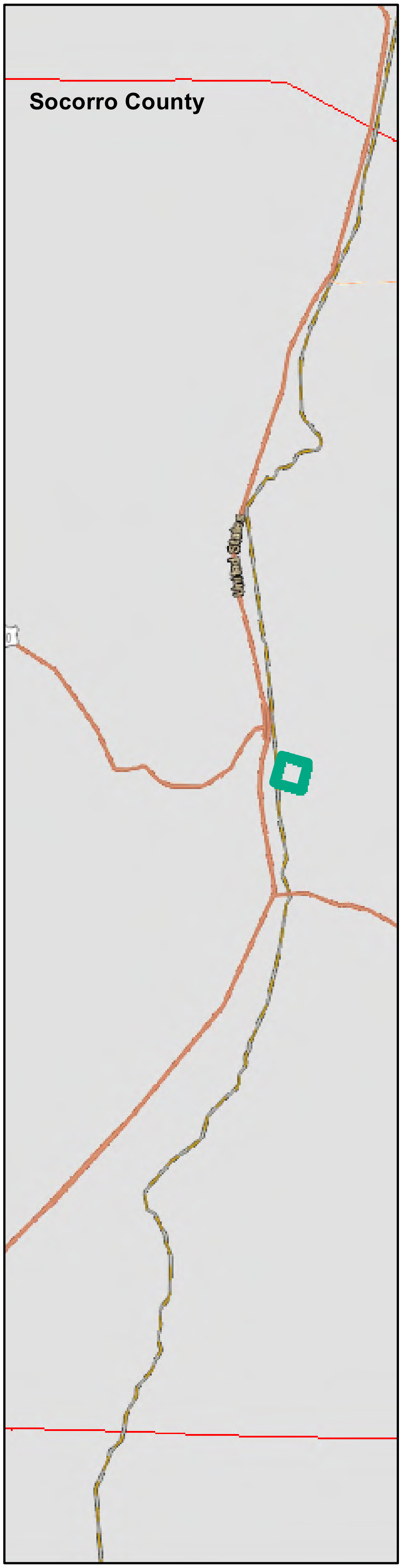
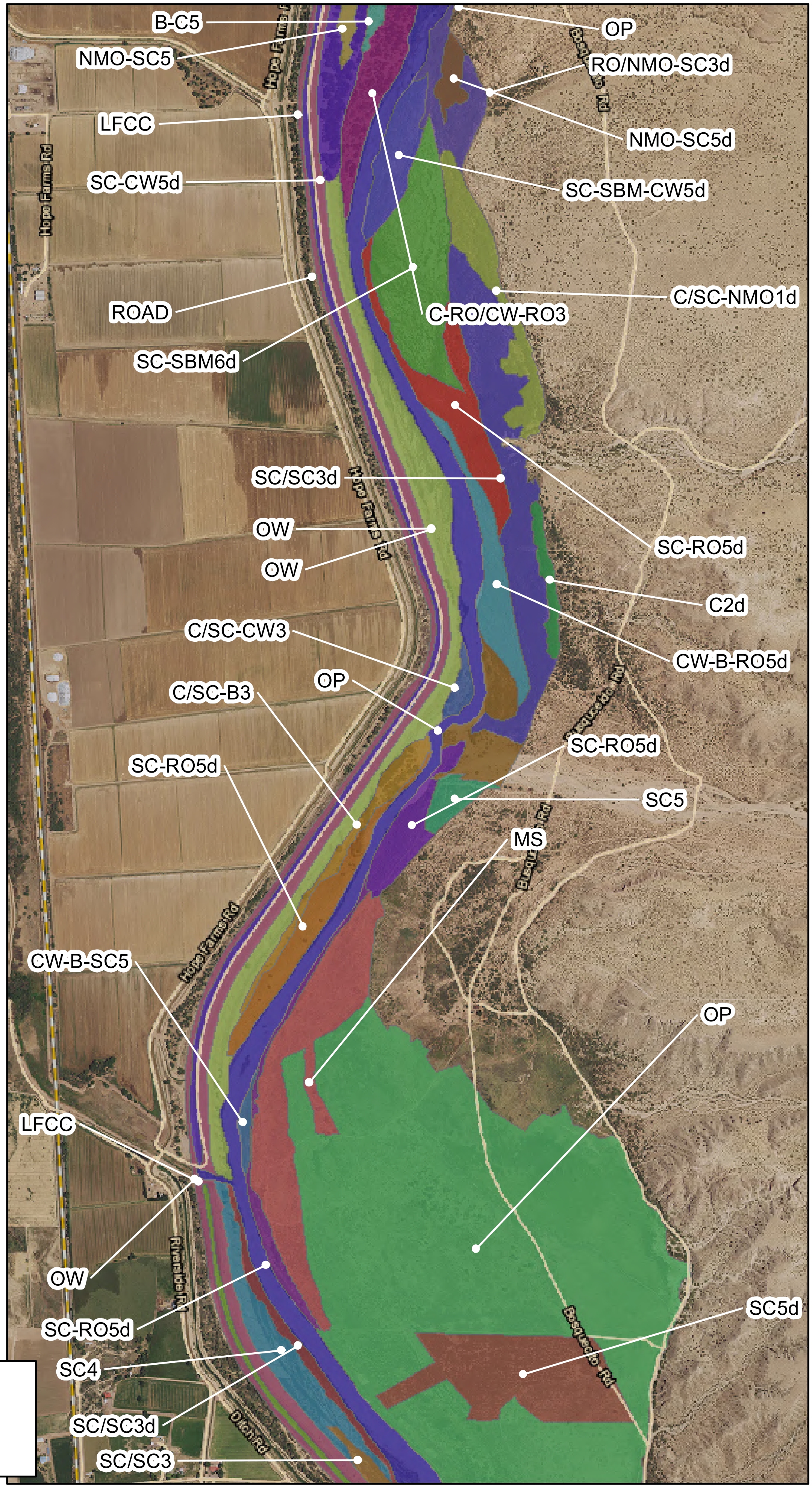
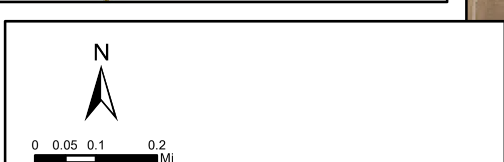
SC5
SC-SBM5
RO/CW-SC-B3d
C/SC-NMO1d
Tafoya Rd
Hidden Ln
B-C5
SC5d
SC-RO5
C/SC3d
OP
OP
C-RO/NMO-SC-RO3
C-RO/SC-CW-RO3d
RO/NMO-SC3d
NMO-SC5d
NMO-SC5
ROAD
OW
Hope Farms Rd
C-RO/CW-RO3
C/NMO-SC1d
C/SC-NMO1d
LFCC
SC-SBM-CW5d
SC-RO5d
SC-SBM6d
SC/SC3d
SC-CW5d
C2d
OW
OW
CW-B-RO5d
SC-RO5d
C/SC-B3
C/SC-CW3
SC-RO5d
OP
SC5
SC-RO5d

Locator Map


Socorro County


B-C5
NMO-SC5
LFCC
SC-CW5d
ROAD
SC-SBM6d
SC/SC3d
OW
OW
C/SC-CW3
C/SC-B3
OP
SC-RO5d
CW-B-SC5
LFCC
OW
SC-RO5d
SC4
SC/SC3d
SC/SC3
OP
RO/NMO-SC3d
NMO-SC5d
SC-SBM-CW5d
C/SC-NMO1d
C-RO/CW-RO3
SC-RO5d
C2d
CW-B-RO5d
SC-RO5d
SC5
MS
OP
SC5d
Hope Farms Rd
Hope Farms Rd
Hope Farms Rd
Hope Farms Rd
Riverside Rd
Ditch Rd
Bosquecito Rd


N
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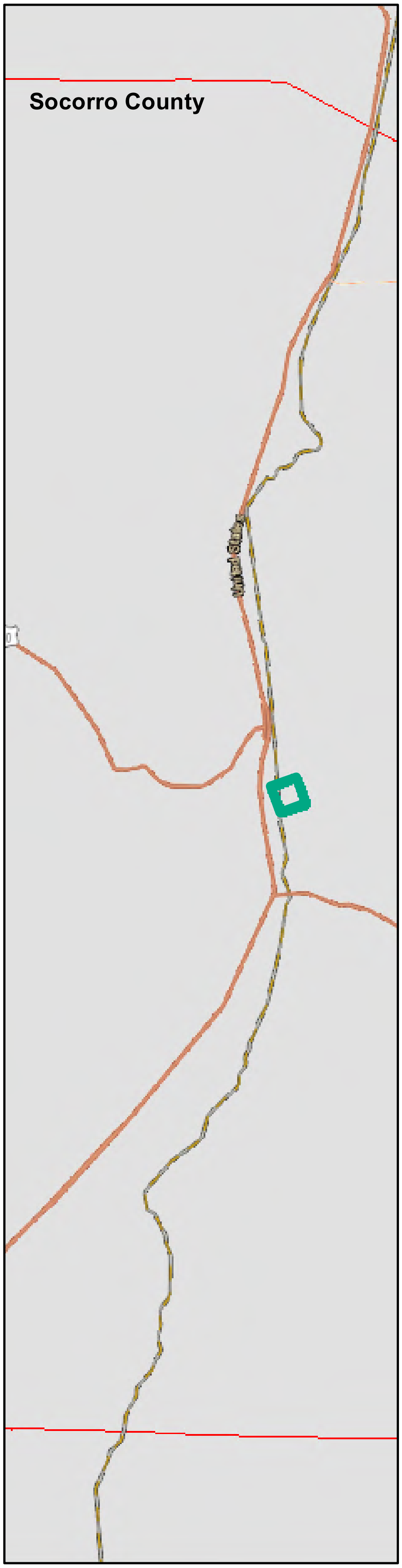
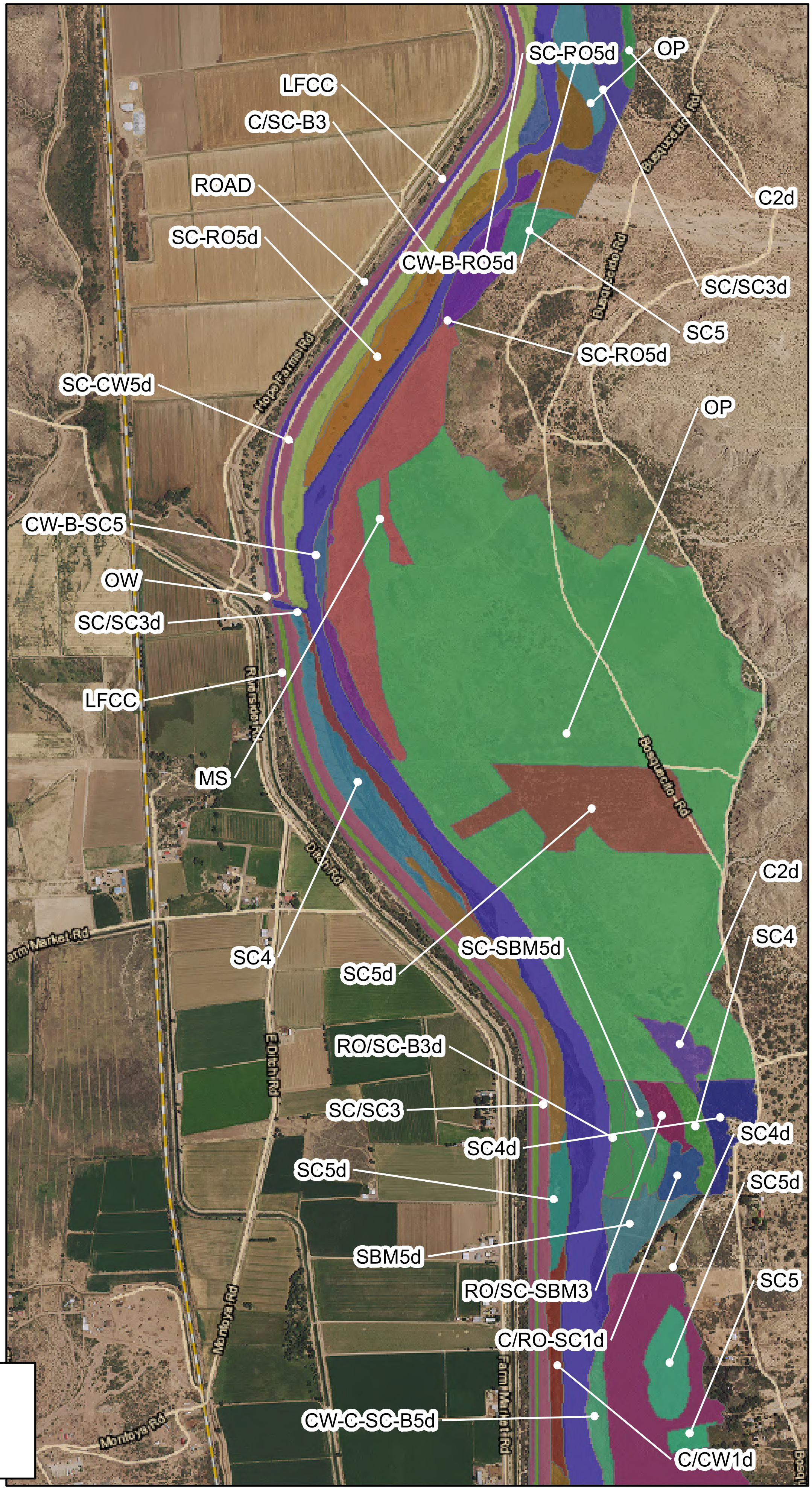
Mi

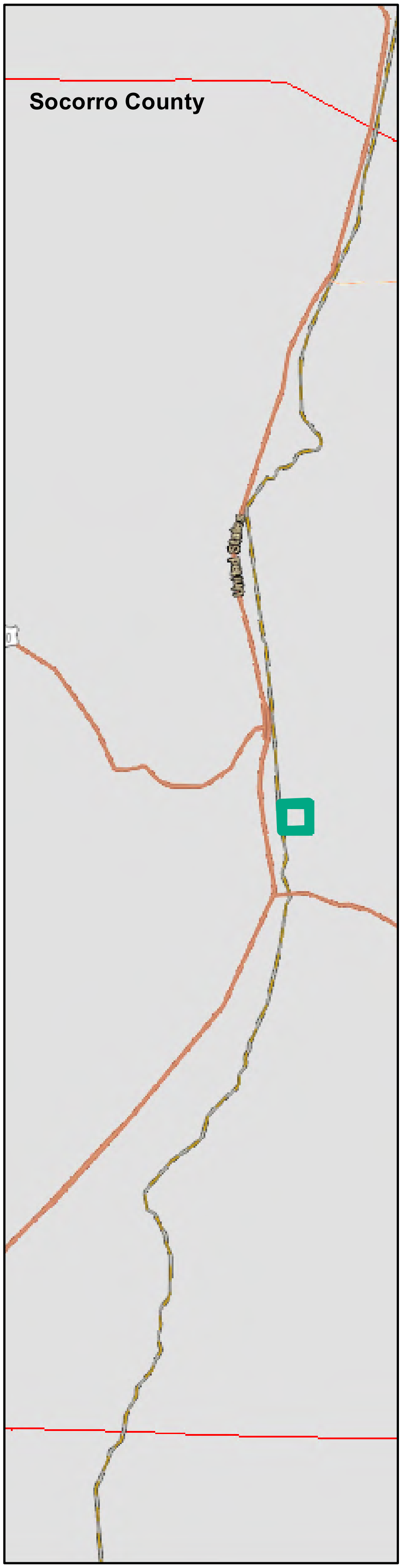
Locator Map

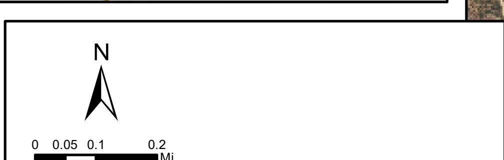

Socorro County


SC-RO5d
OP
LFCC
C/SC-B3
ROAD
SC-RO5d
CW-B-RO5d
C2d
SC/SC3d
SC5
SC-RO5d
SC-CW5d
OP
CW-B-SC5
OW
SC/SC3d
LFCC
MS
C2d
SC4
SC4
SC5d
SC-SBM5d
RO/SC-B3d
SC/SC3
SC4d
SC4d
SC5d
SC5d
SBM5d
RO/SC-SBM3
SC5
C/RO-SC1d
CW-C-SC-B5d
C/CW1d
Hope Farms Rd
Bosquecito Rd
Rivers Ditch
Ditch Rd
Farm Market Rd
E Ditch Rd
Montoya Rd

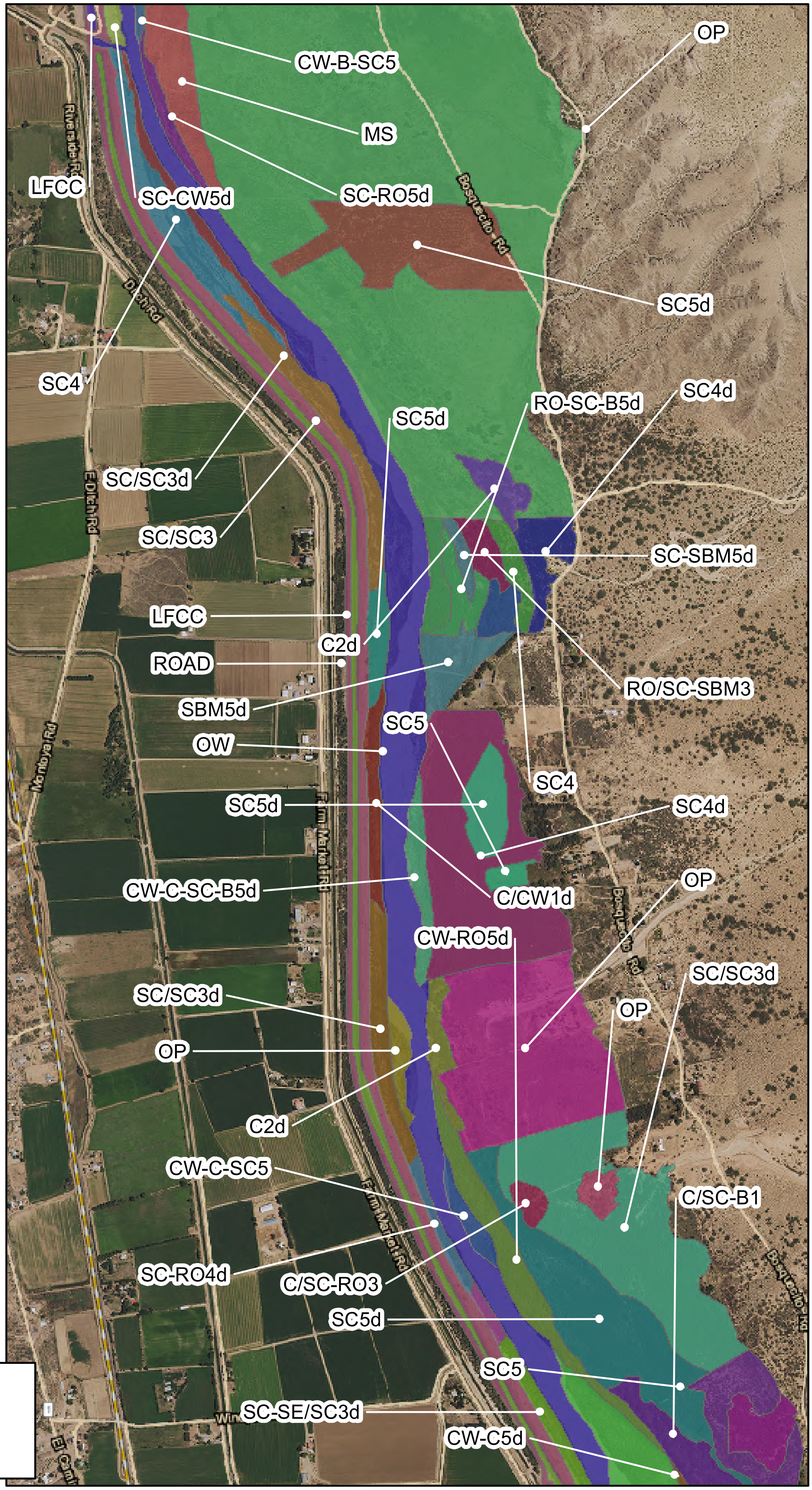

N
0 0.05 0.1 0.2
Mi

Locator Map

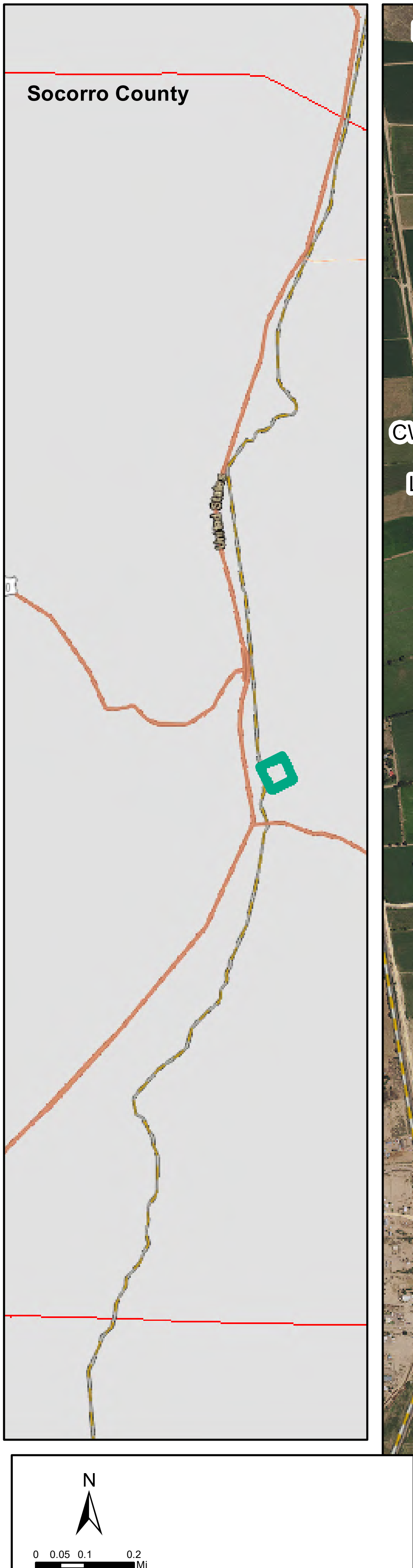




2016
Hink and Ohmart Vegetation Type



Locator Map


Socorro County
N
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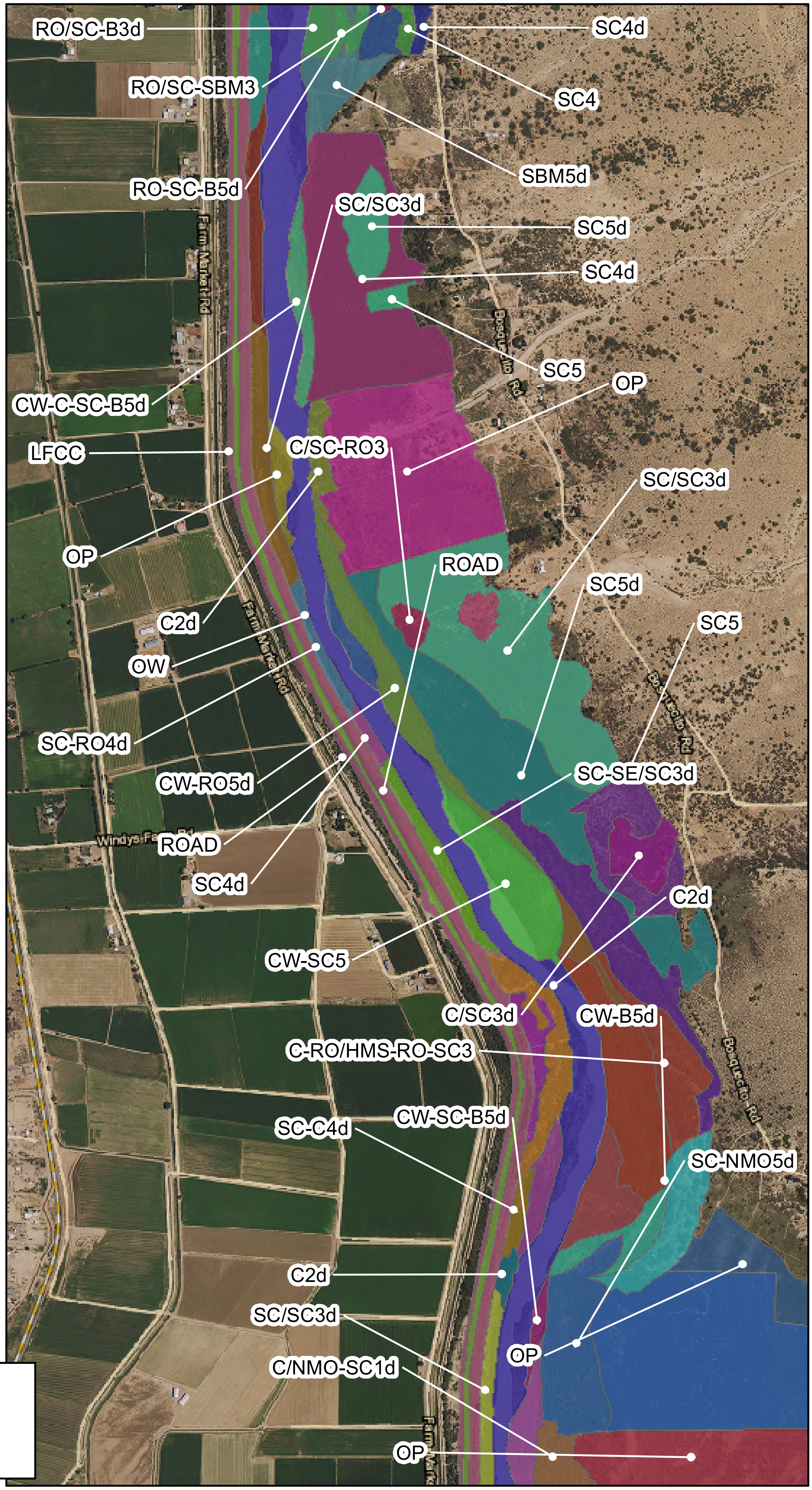
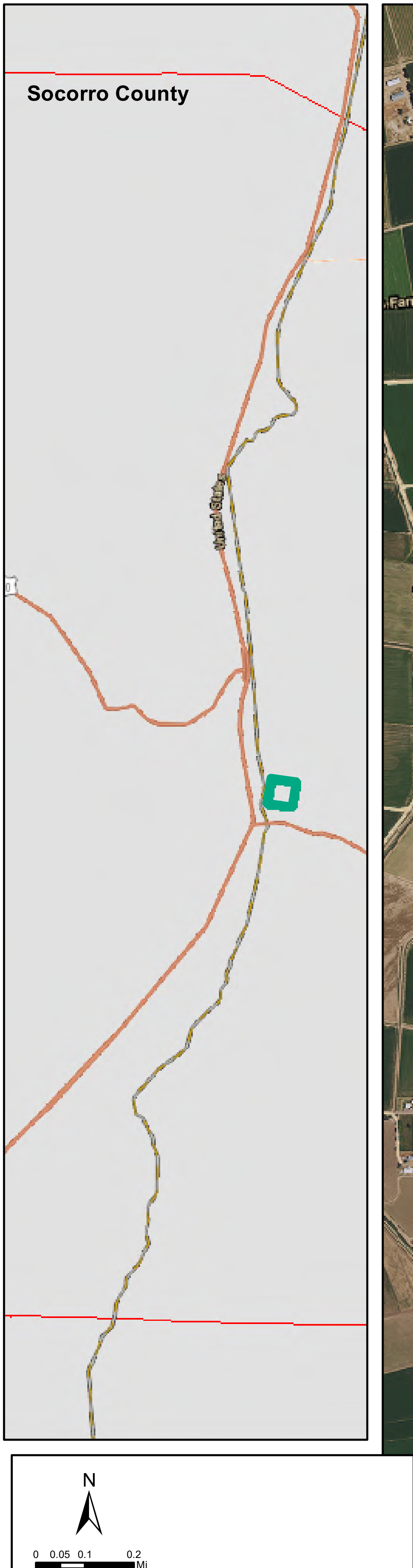
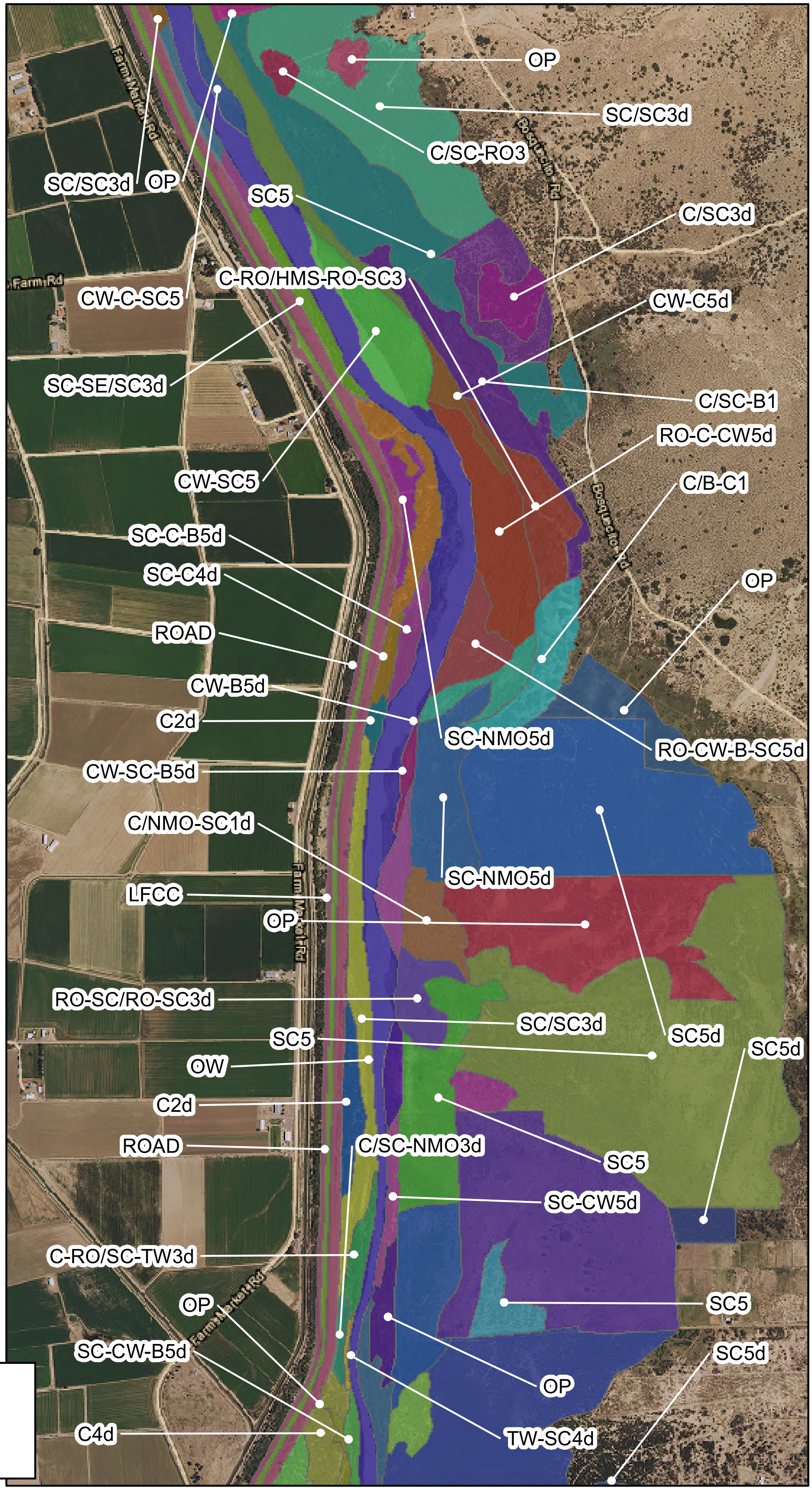
Mi

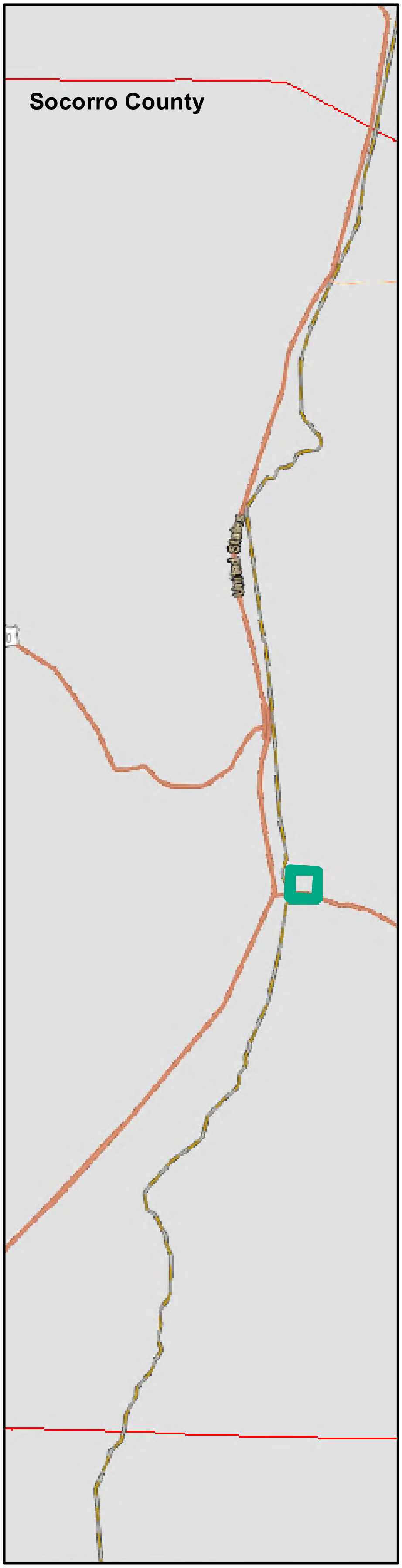

RO/SC-B3d
SC4d
RO/SC-SBM3
SC4
SBM5d
RO-SC-B5d
SC/SC3d
SC5d
SC4d
SC5
OP
CW-C-SC-B5d
LFCC
C/SC-RO3
SC/SC3d
OP
ROAD
SC5d
C2d
SC5
OW
SC-RO4d
CW-RO5d
SC-SE/SC3d
ROAD
SC4d
C2d
CW-SC5
C/SC3d
CW-B5d
C-RO/HMS-RO-SC3
SC-C4d
CW-SC-B5d
SC-NMO5d
C2d
SC/SC3d
OP
C/NMO-SC1d
OP

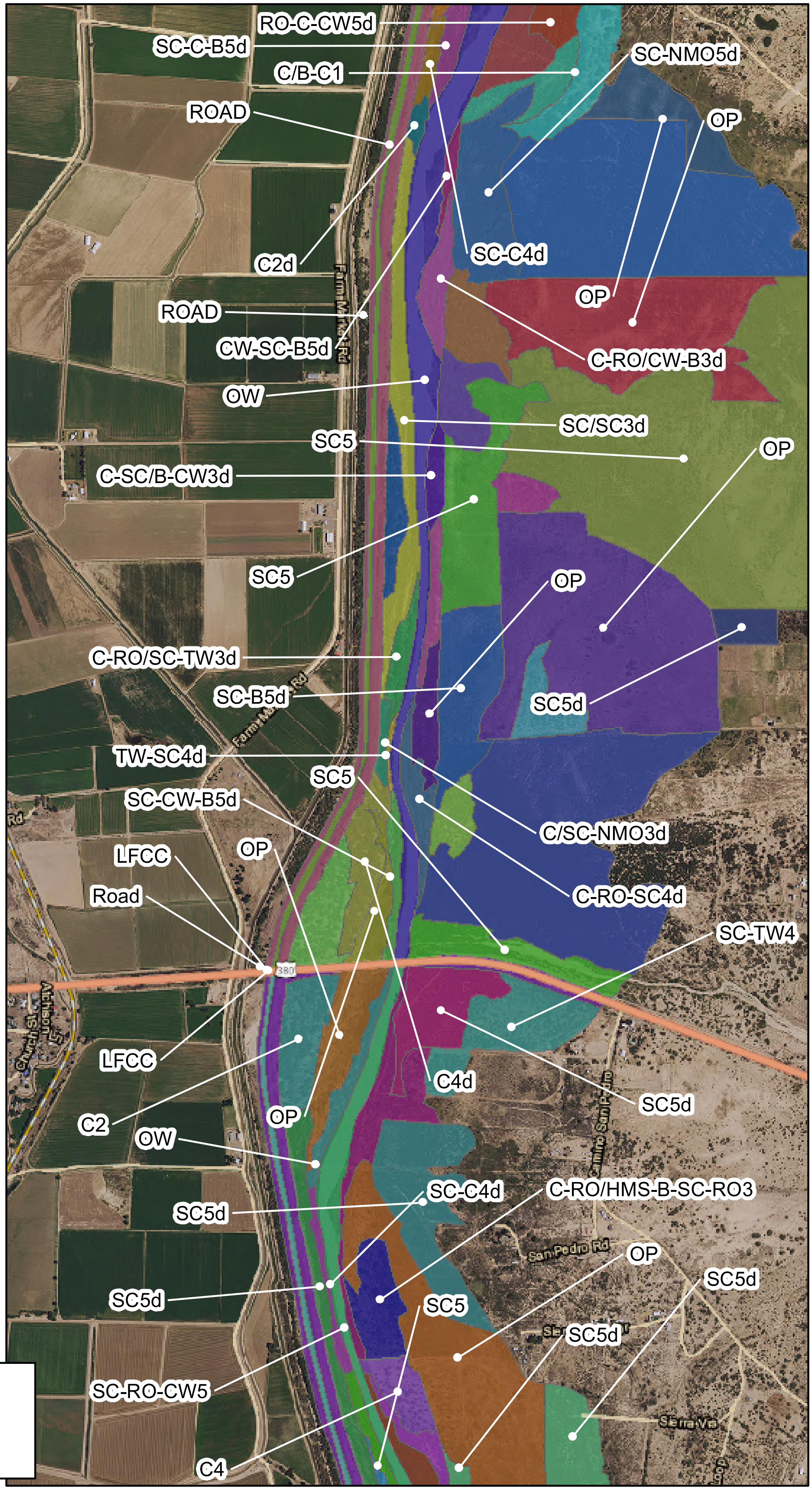
Locator Map

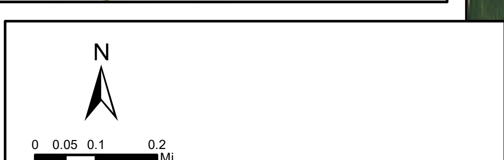
2016
Hink and Ohmart Vegetation Type






Socorro County


RO-C-CW5d
SC-C-B5d
C/B-C1
SC-NMO5d
ROAD
OP
C2d
SC-C4d
OP
ROAD
CW-SC-B5d
C-RO/CW-B3d
OW
SC/SC3d
SC5
OP
C-SC/B-CW3d
SC5
OP
C-RO/SC-TW3d
SC-B5d
SC5d
TW-SC4d
SC5
SC-CW-B5d
C/SC-NMO3d
LFCC
OP
Road
C-RO-SC4d
SC-TW4
LFCC
C4d
SC5d
C2
OP
OW
SC-C4d
C-RO/HMS-B-SC-RO3
SC5d
OP
SC5d
SC5
SC5d
SC-RO-CW5
C4


N
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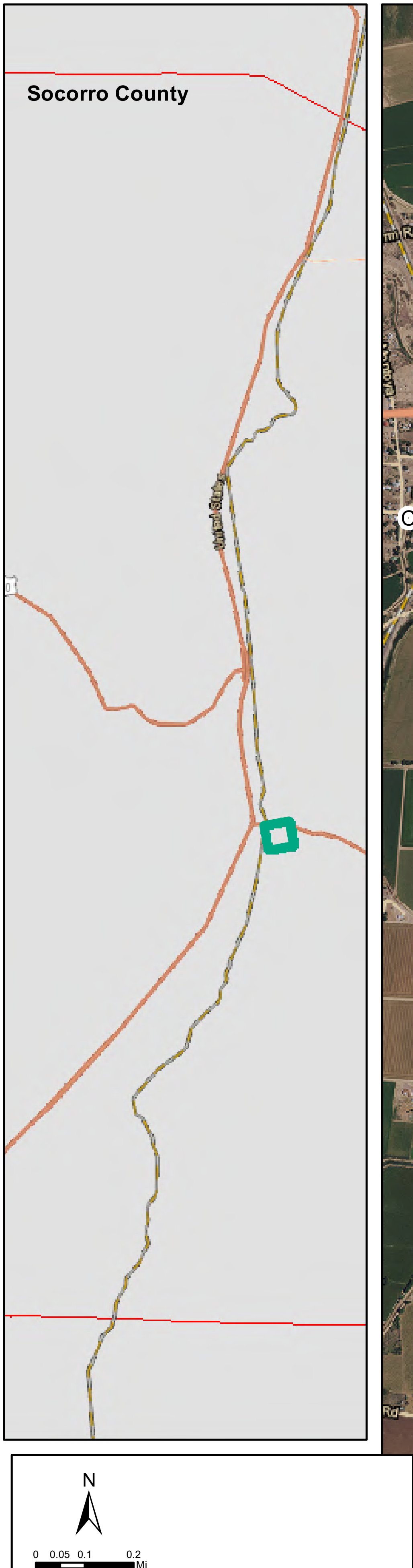
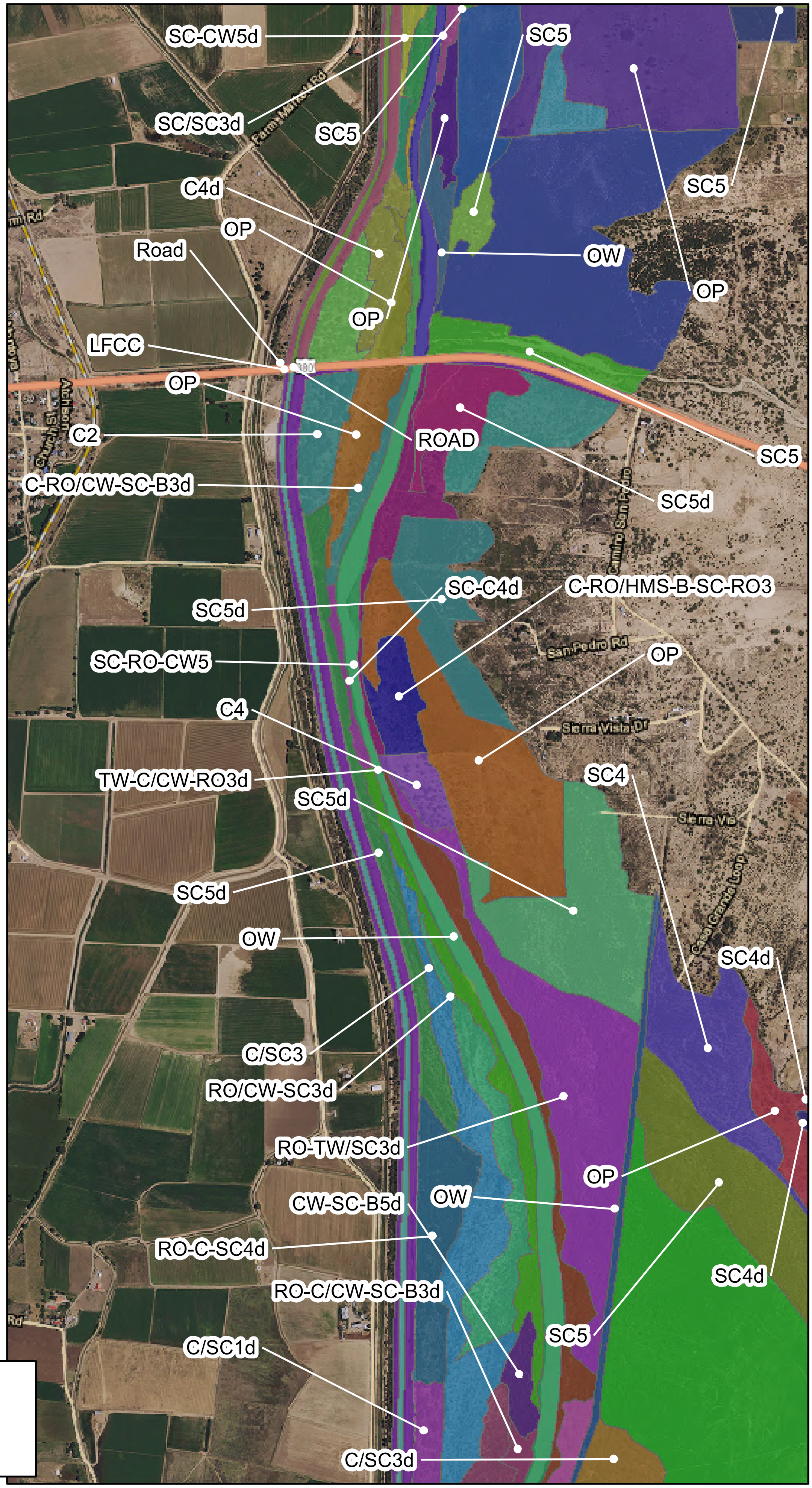
Mi


Socorro County
N
0 0.05 0.1 0.2
Mi


SC-CW5d
SC/SC3d
SC5
SC5
C4d
OP
Road
OP
LFCC
OP
C2
C-RO/CW-SC-B3d
OW
OP
SC5
ROAD
SC5d
SC5
SC-C4d
C-RO/HMS-B-SC-RO3
SC5d
SC-RO-CW5
OP
C4
TW-C/CW-RO3d
SC5d
SC4
SC5d
OW
SC4d
C/SC3
RO/CW-SC3d
RO-TW/SC3d
OP
CW-SC-B5d
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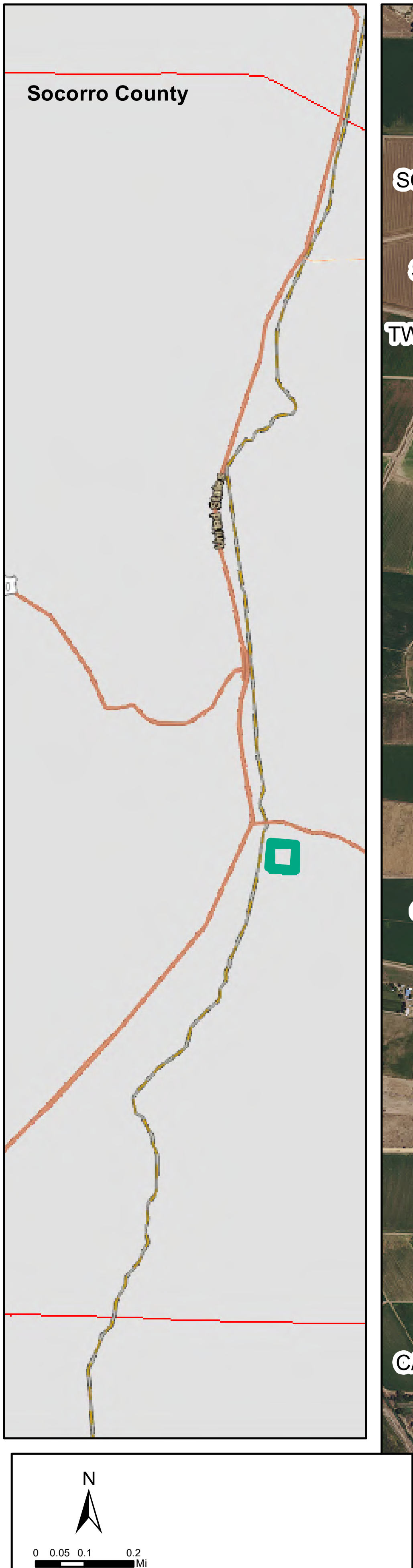
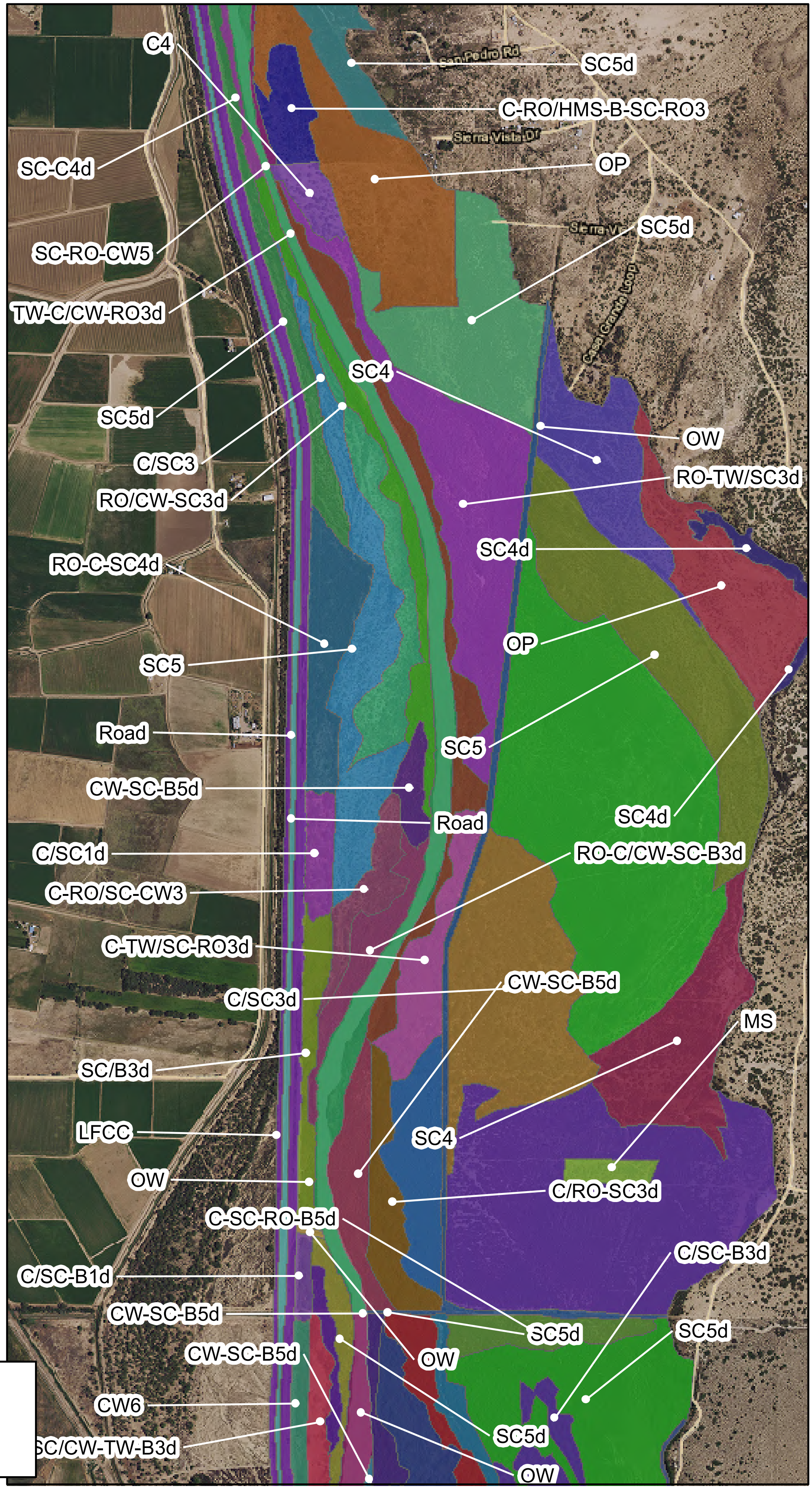
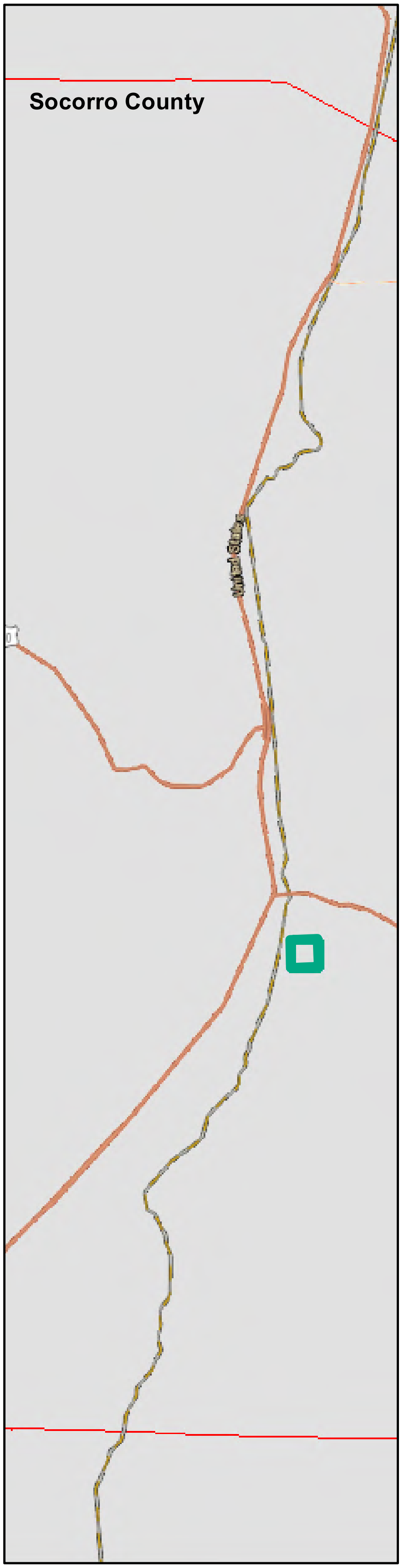
RO-C-SC4d
SC4d
RO-C/CW-SC-B3d
SC5
C/SC1d
C/SC3d

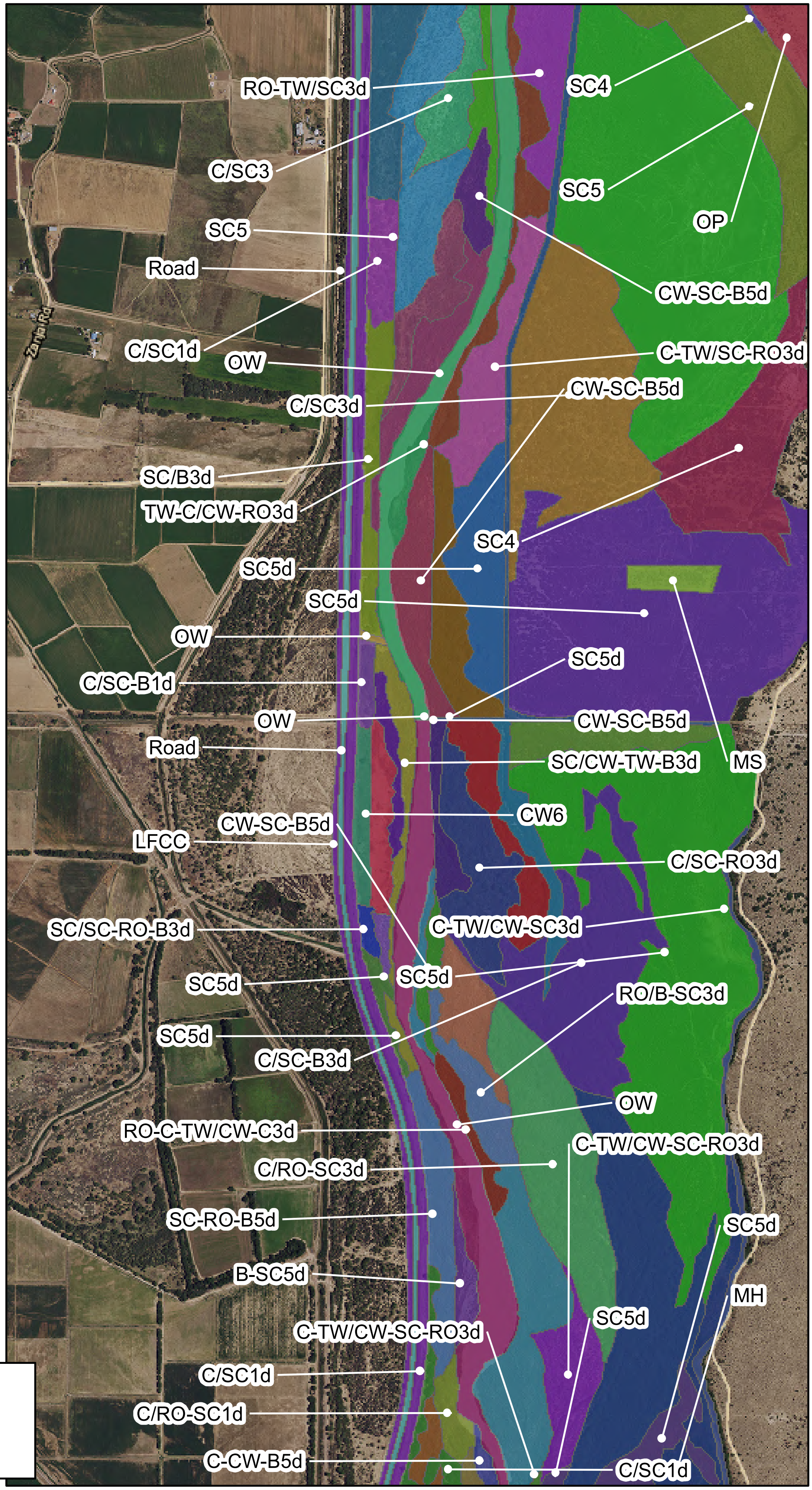
Locator Map


Socorro County
N
0 0.05 0.1 0.2
Mi


C4
SC5d
C-RO/HMS-B-SC-RO3
SC-C4d
OP
SC5d
SC-RO-CW5
TW-C/CW-RO3d
SC4
SC5d
OW
C/SC3
RO-TW/SC3d
RO/CW-SC3d
SC4d
RO-C-SC4d
OP
SC5
Road
SC5
CW-SC-B5d
SC4d
Road
C/SC1d
RO-C/CW-SC-B3d
C-RO/SC-CW3
C-TW/SC-RO3d
CW-SC-B5d
C/SC3d
MS
SC/B3d
LFCC
SC4
OW
C/RO-SC3d
C-SC-RO-B5d
C/SC-B3d
C/SC-B1d
CW-SC-B5d
SC5d
SC5d
CW-SC-B5d
OW
CW6
SC5d
SC/CW-TW-B3d
OW
San Pedro Rd
Sierra Vista Dr

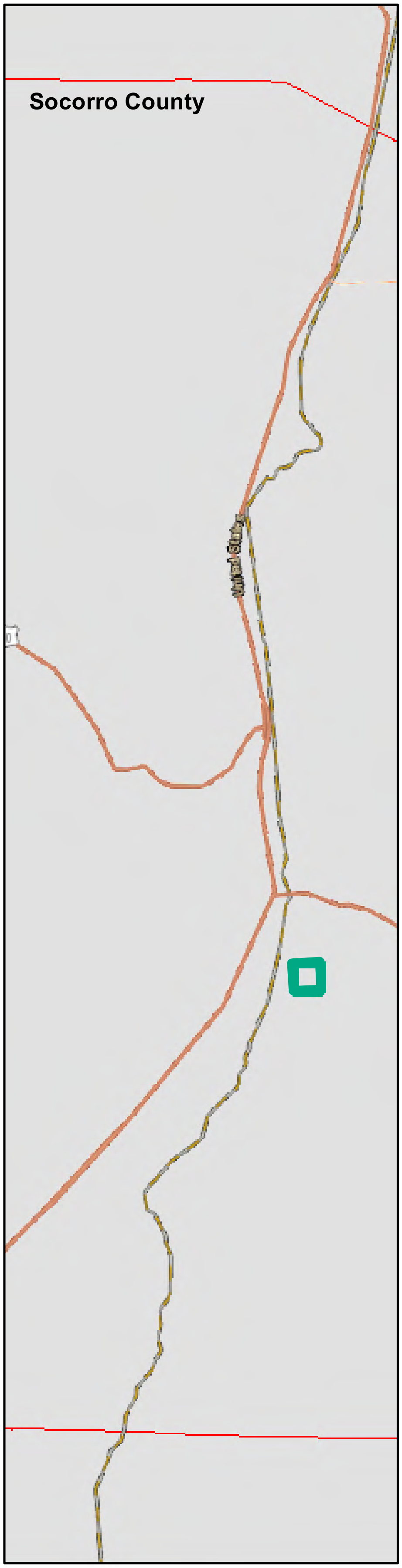
Locator Map

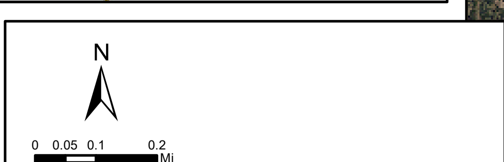

Socorro County


RO-TW/SC3d
SC4
C/SC3
SC5
OP
SC5
Road
CW-SC-B5d
C/SC1d
C-TW/SC-RO3d
OW
CW-SC-B5d
C/SC3d
SC/B3d
TW-C/CW-RO3d
SC4
SC5d
SC5d
OW
SC5d
C/SC-B1d
OW
CW-SC-B5d
Road
SC/CW-TW-B3d
MS
CW6
CW-SC-B5d
LFCC
C/SC-RO3d
SC/SC-RO-B3d
C-TW/CW-SC3d
SC5d
SC5d
RO/B-SC3d
SC5d
C/SC-B3d
OW
RO-C-TW/CW-C3d
C-TW/CW-SC-RO3d
C/RO-SC3d
SC-RO-B5d
SC5d
MH
B-SC5d
SC5d
C-TW/CW-SC-RO3d
C/SC1d
C/RO-SC1d
C-CW-B5d
C/SC1d


N
0 0.05 0.1 0.2
Mi

Locator Map


Socorro County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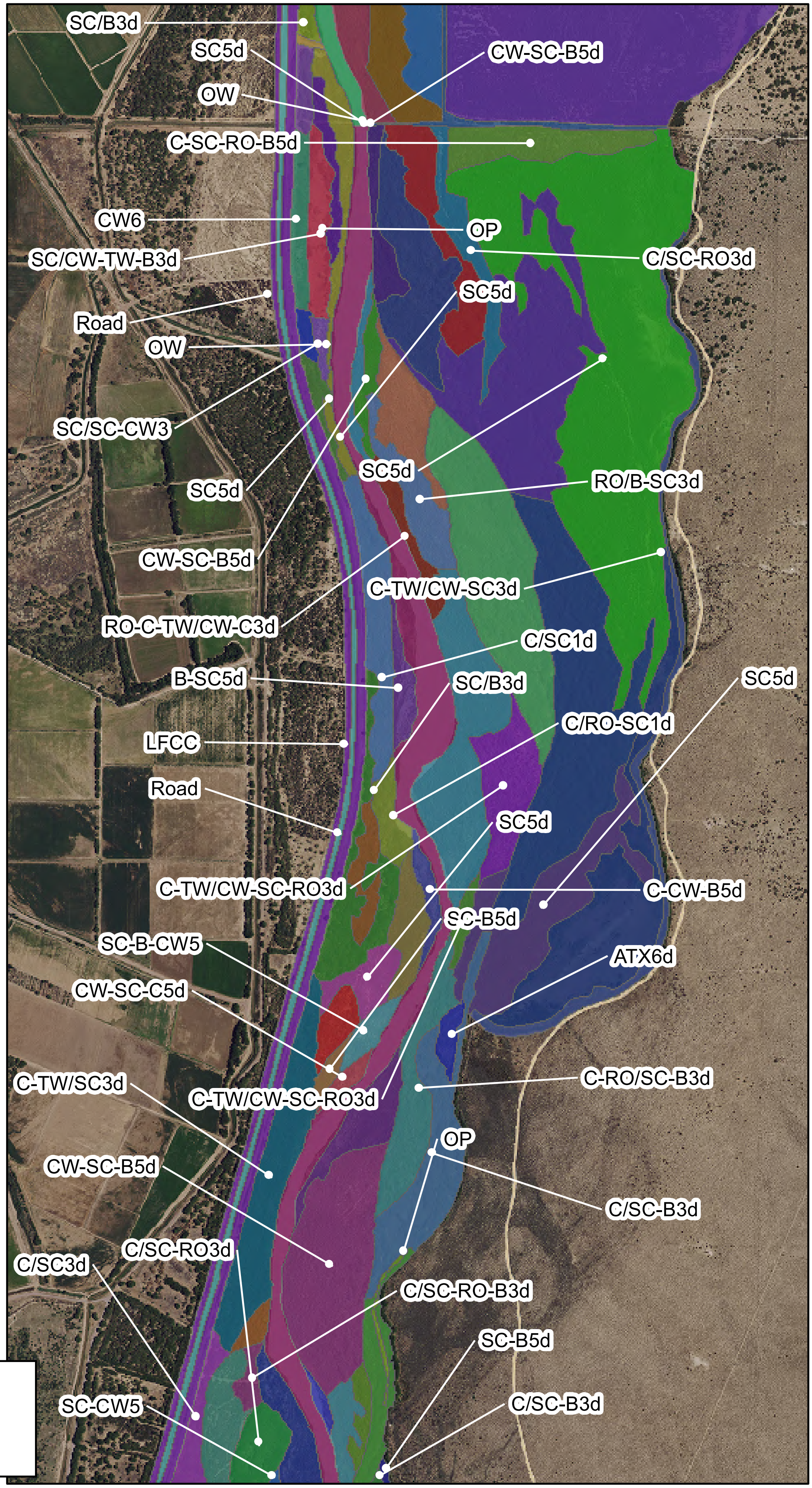
Mi


SC/B3d
SC5d
CW-SC-B5d
OW
C-SC-RO-B5d
CW6
OP
SC/CW-TW-B3d
C/SC-RO3d
SC5d
Road
OW
SC/SC-CW3
SC5d
RO/B-SC3d
SC5d
CW-SC-B5d
C-TW/CW-SC3d
RO-C-TW/CW-C3d
C/SC1d
B-SC5d
SC/B3d
SC5d
C/RO-SC1d
LFCC
Road
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C-CW-B5d
SC-B5d
SC-B-CW5
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CW-SC-C5d
C-RO/SC-B3d
C-TW/SC3d
C-TW/CW-SC-RO3d
OP
CW-SC-B5d
C/SC-B3d
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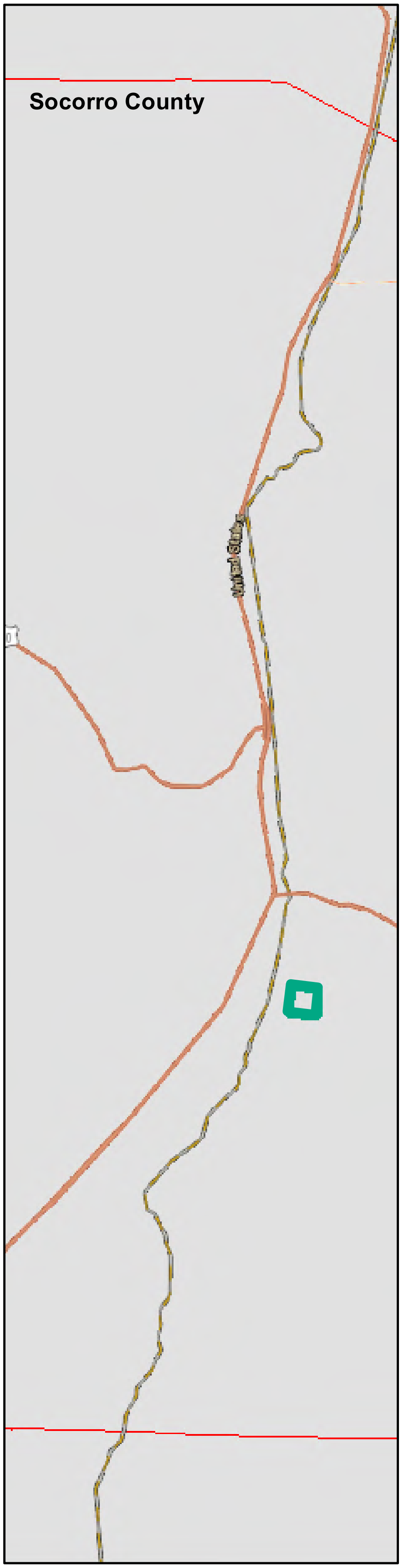
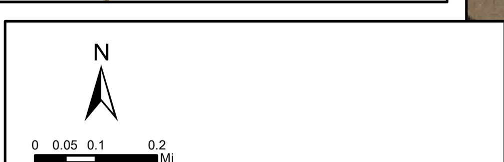
SC-CW5
C/SC-B3d

Locator Map


Socorro County


N
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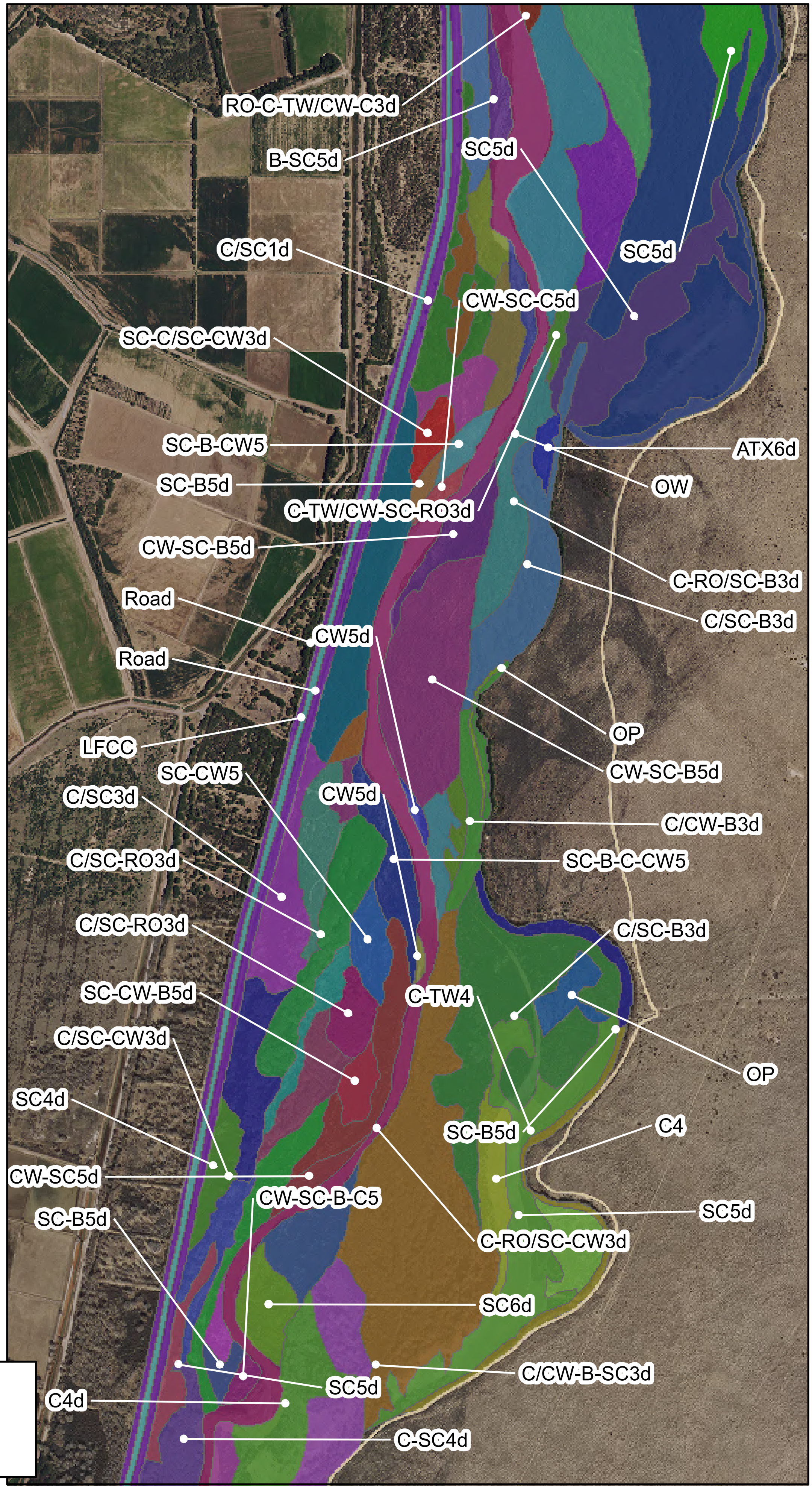
Mi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B-SC5d
SC5d
SC5d
C/SC1d
CW-SC-C5d
SC-C/SC-CW3d
SC-B-CW5
ATX6d
OW
SC-B5d
C-TW/CW-SC-RO3d
CW-SC-B5d
C-RO/SC-B3d
C/SC-B3d
Road
CW5d
Road
OP
LFCC
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C/SC3d
CW5d
C/CW-B3d
C/SC-RO3d
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C/SC-RO3d
C/SC-B3d
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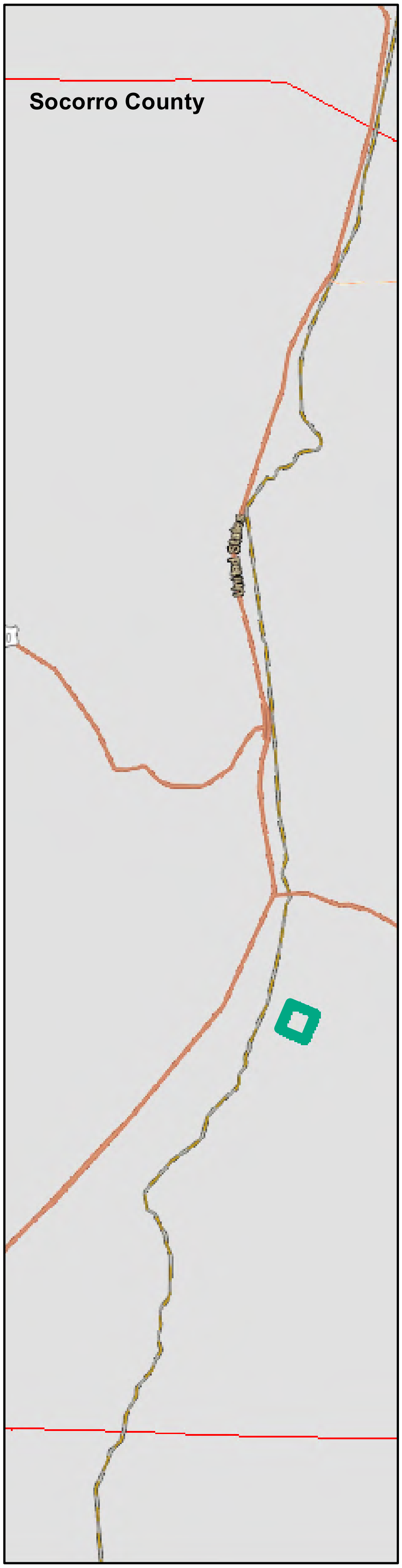
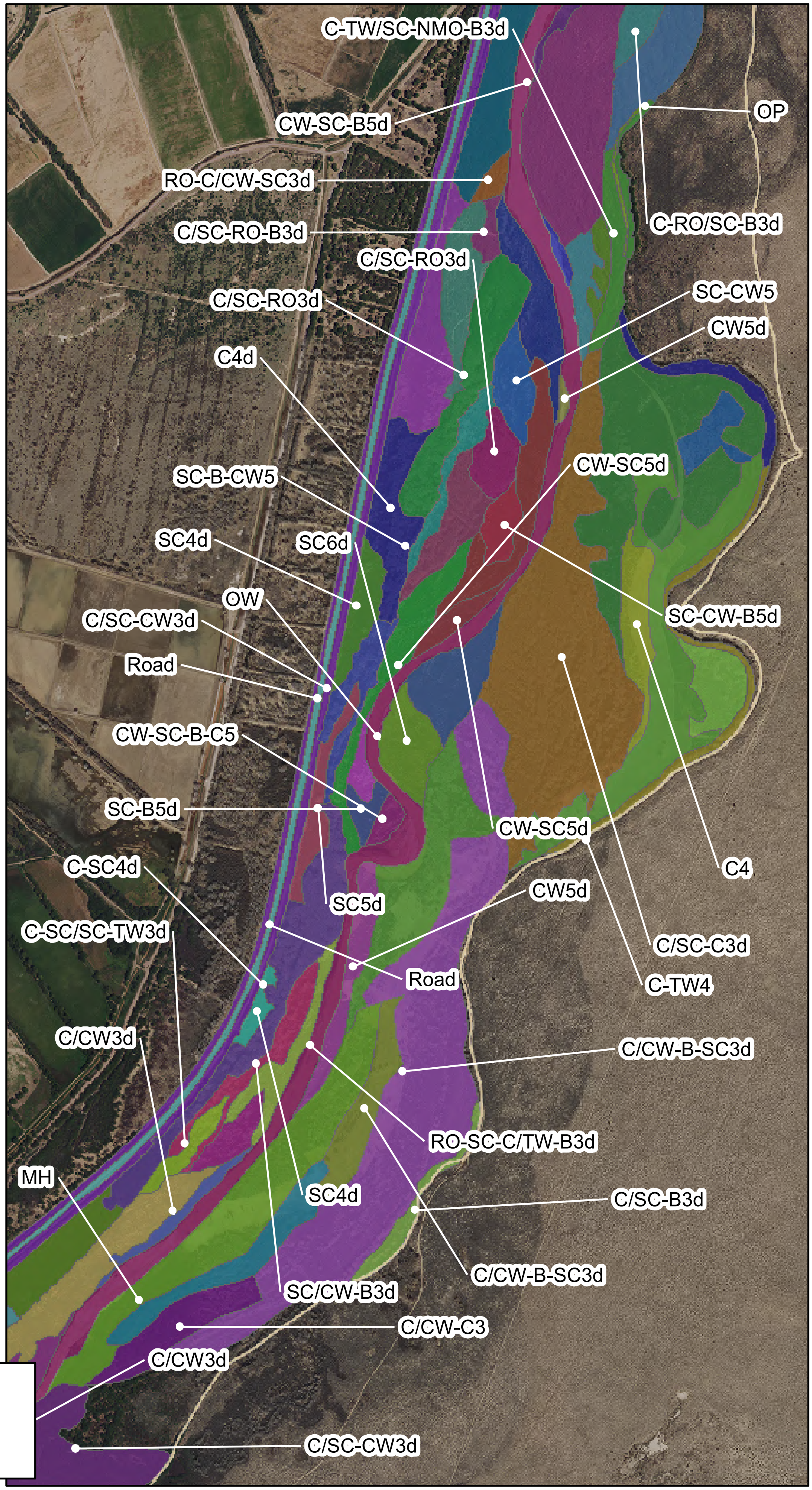
C4d
C-SC4d

Locator Map


Socorro County


C-TW/SC-NMO-B3d
CW-SC-B5d
OP
RO-C/CW-SC3d
C/SC-RO-B3d
C-RO/SC-B3d
C/SC-RO3d
SC-CW5
C/SC-RO3d
CW5d
C4d
CW-SC5d
SC-B-CW5
SC4d
SC6d
OW
SC-CW-B5d
C/SC-CW3d
Road
CW-SC-B-C5
SC-B5d
CW-SC5d
C-SC4d
C4
SC5d
CW5d
C-SC/SC-TW3d
C/SC-C3d
Road
C-TW4
C/CW3d
C/CW-B-SC3d
RO-SC-C/TW-B3d
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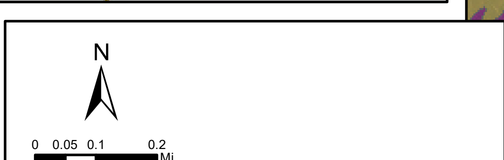
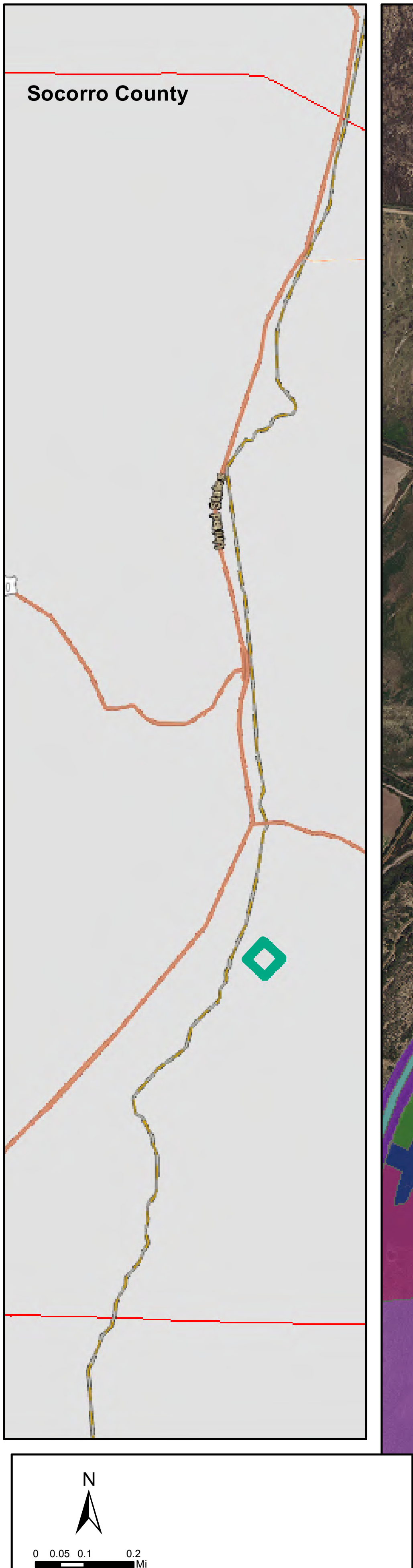
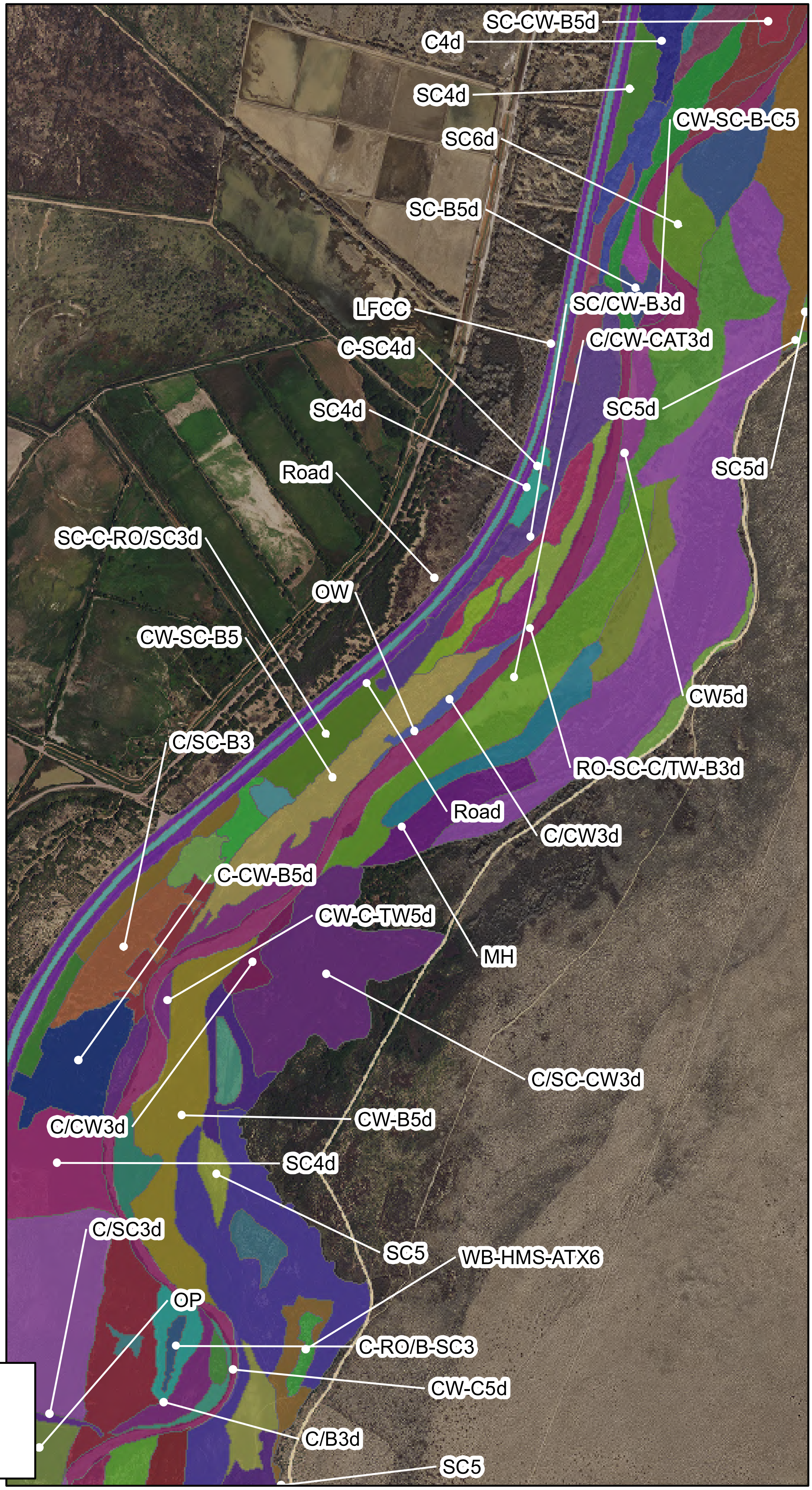
C/CW3d
C/SC-CW3d


N
0 0.05 0.1 0.2
Mi

Locator Map


Socorro County
N
0 0.05 0.1 0.2
Mi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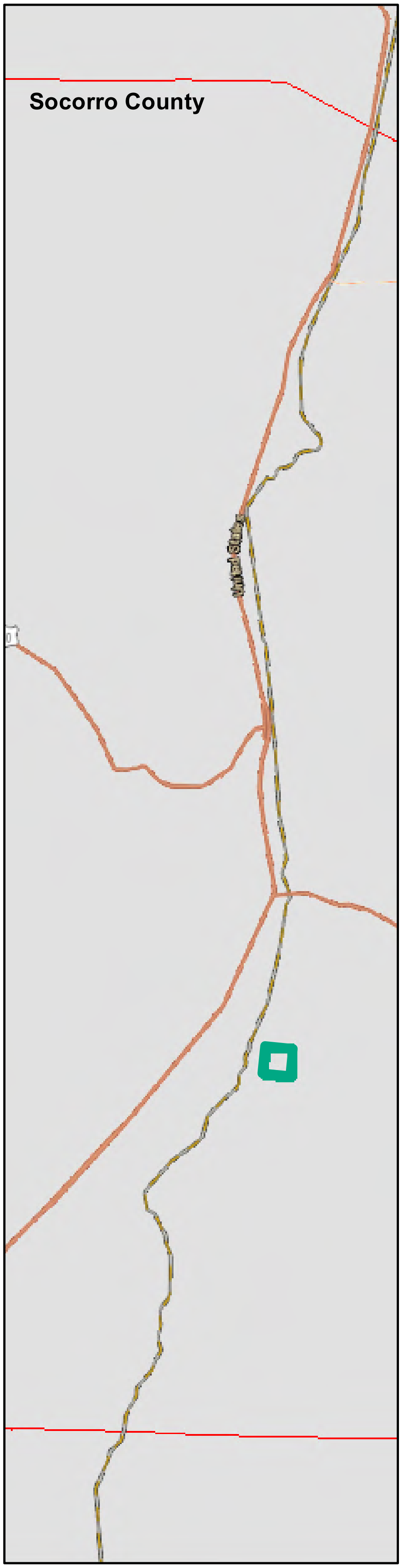
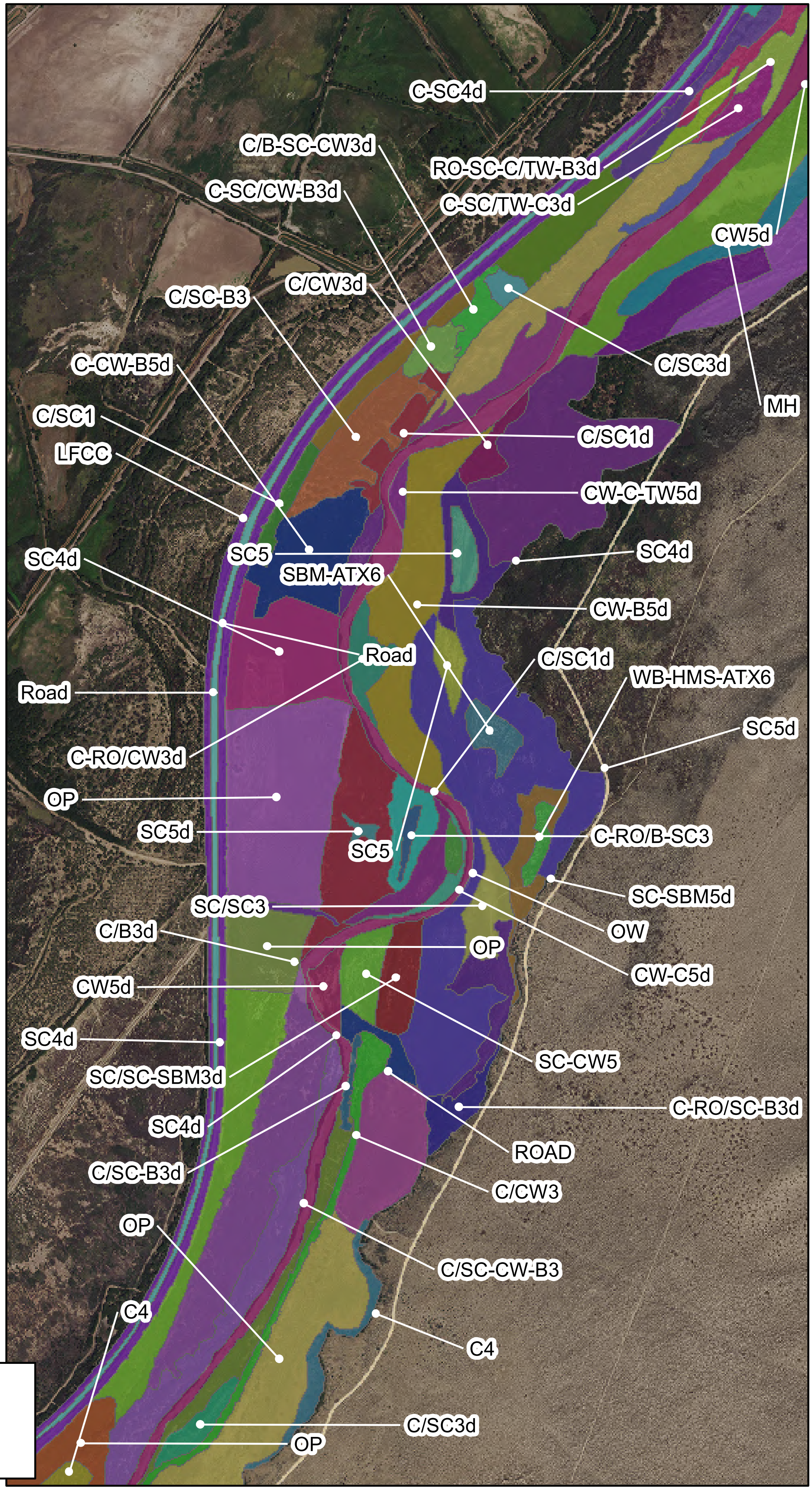
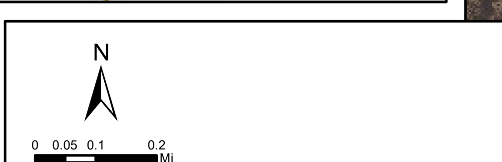
C4d
SC4d
CW-SC-B-C5
SC6d
SC-B5d
SC/CW-B3d
LFCC
C/CW-CAT3d
C-SC4d
SC5d
SC4d
SC5d
Road
SC-C-RO/SC3d
OW
CW-SC-B5
CW5d
C/SC-B3
RO-SC-C/TW-B3d
Road
C/CW3d
C-CW-B5d
CW-C-TW5d
MH
C/SC-CW3d
CW-B5d
C/CW3d
SC4d
C/SC3d
SC5
WB-HMS-ATX6
OP
C-RO/B-SC3
CW-C5d
C/B3d
SC5

2016
Hink and Ohmart Vegetation Type

Locator Map







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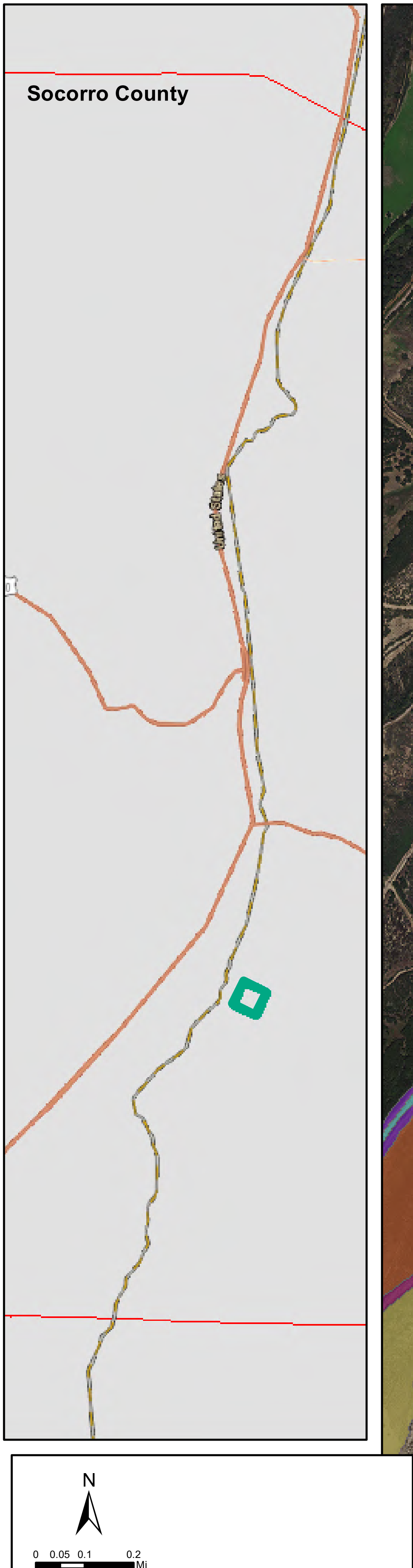
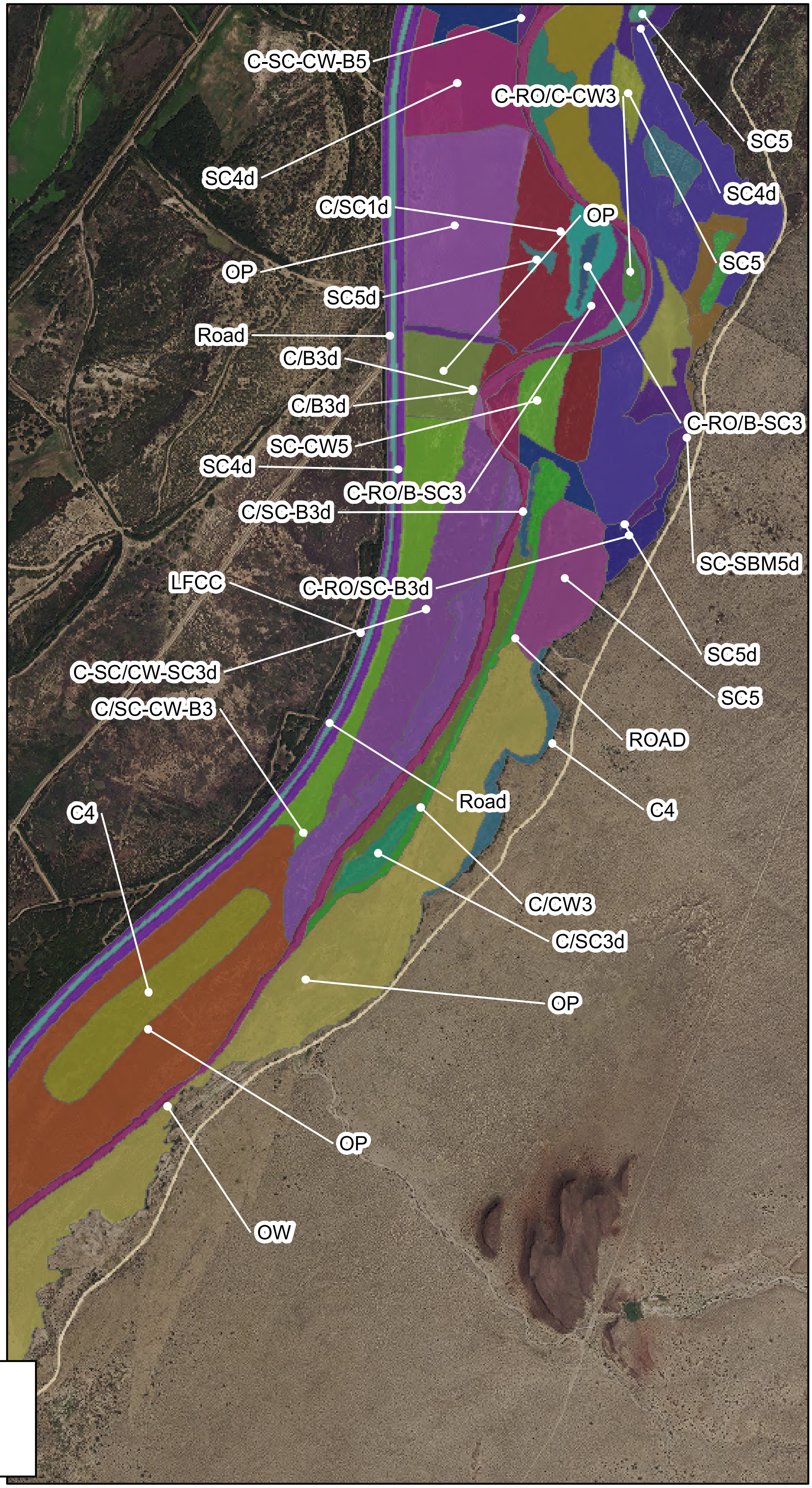
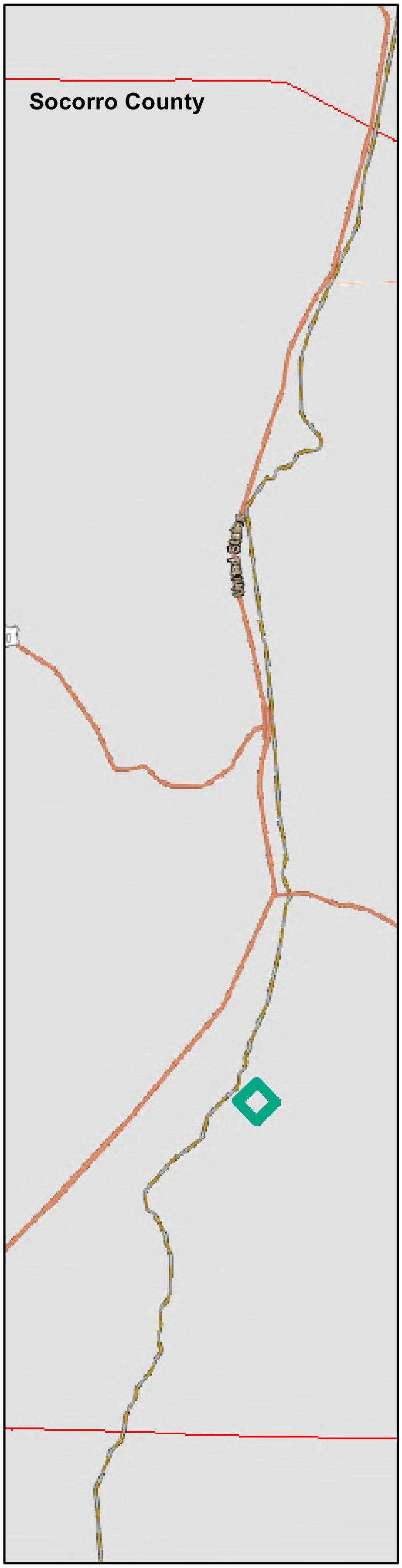
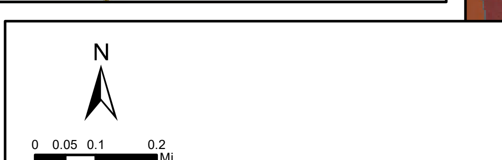


2016
Hink and Ohmart Vegetation Type



Locator Map


Socorro County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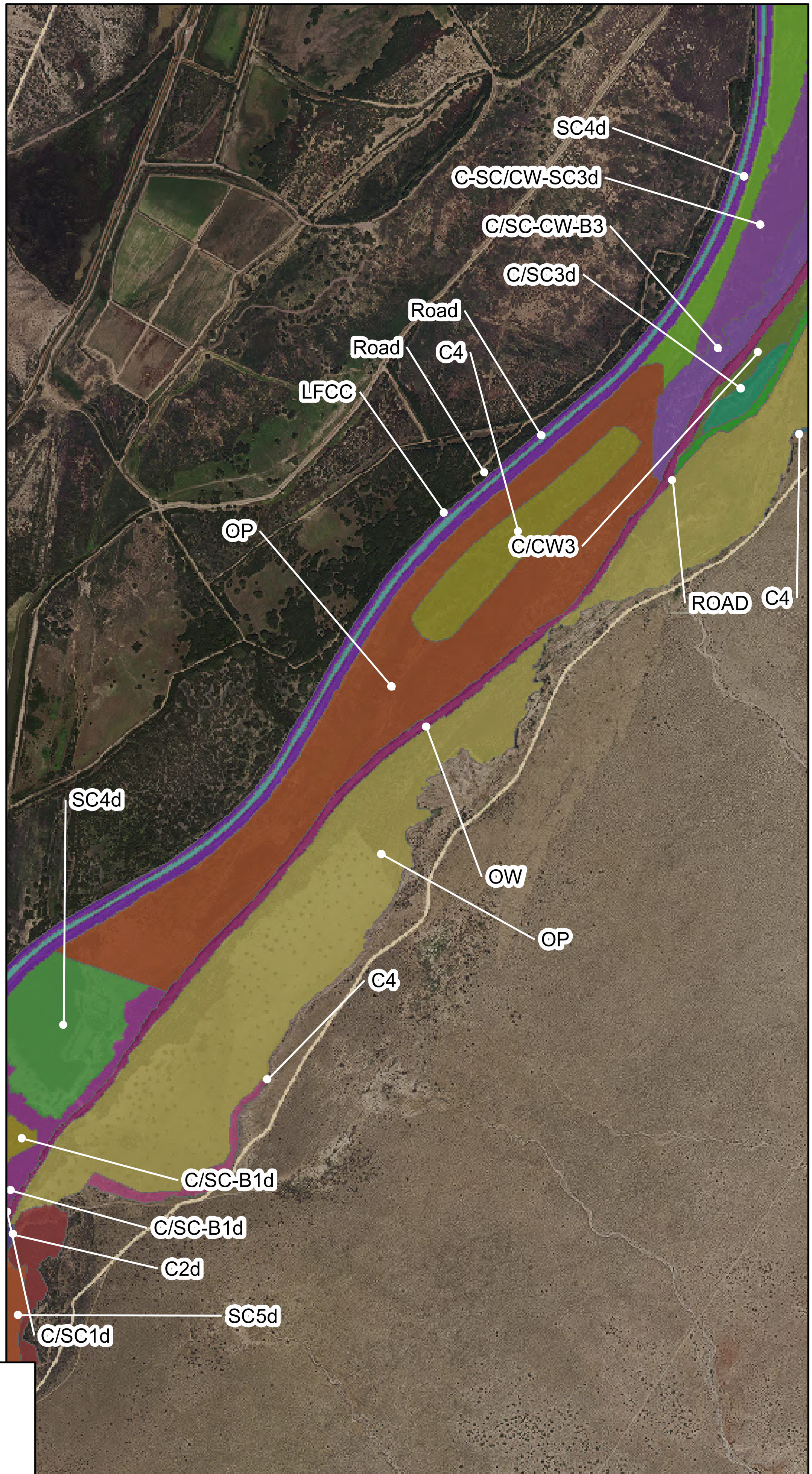
Mi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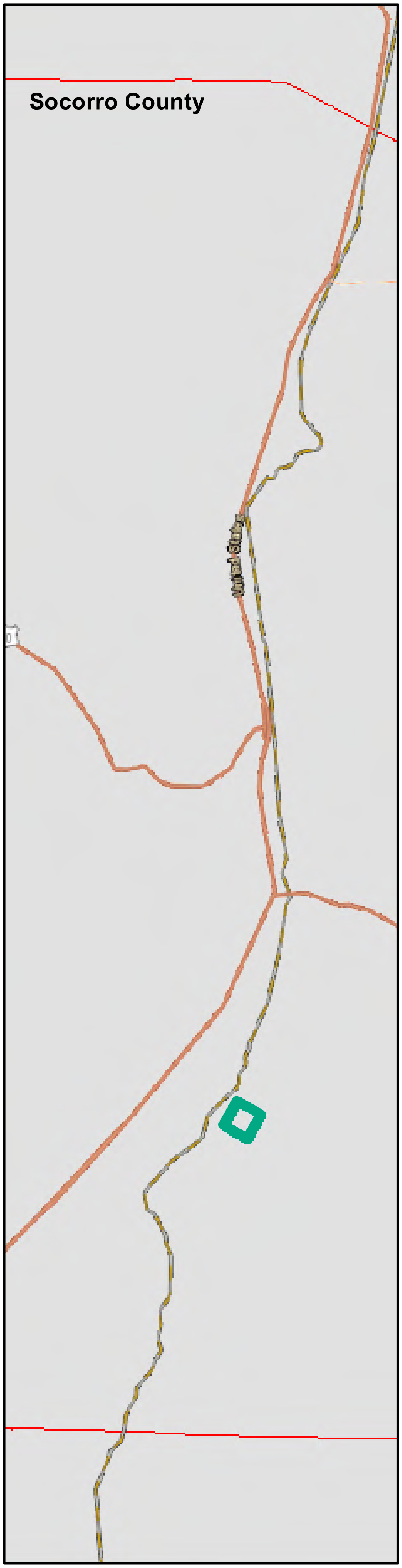
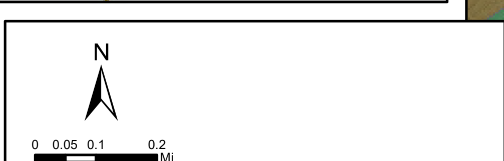
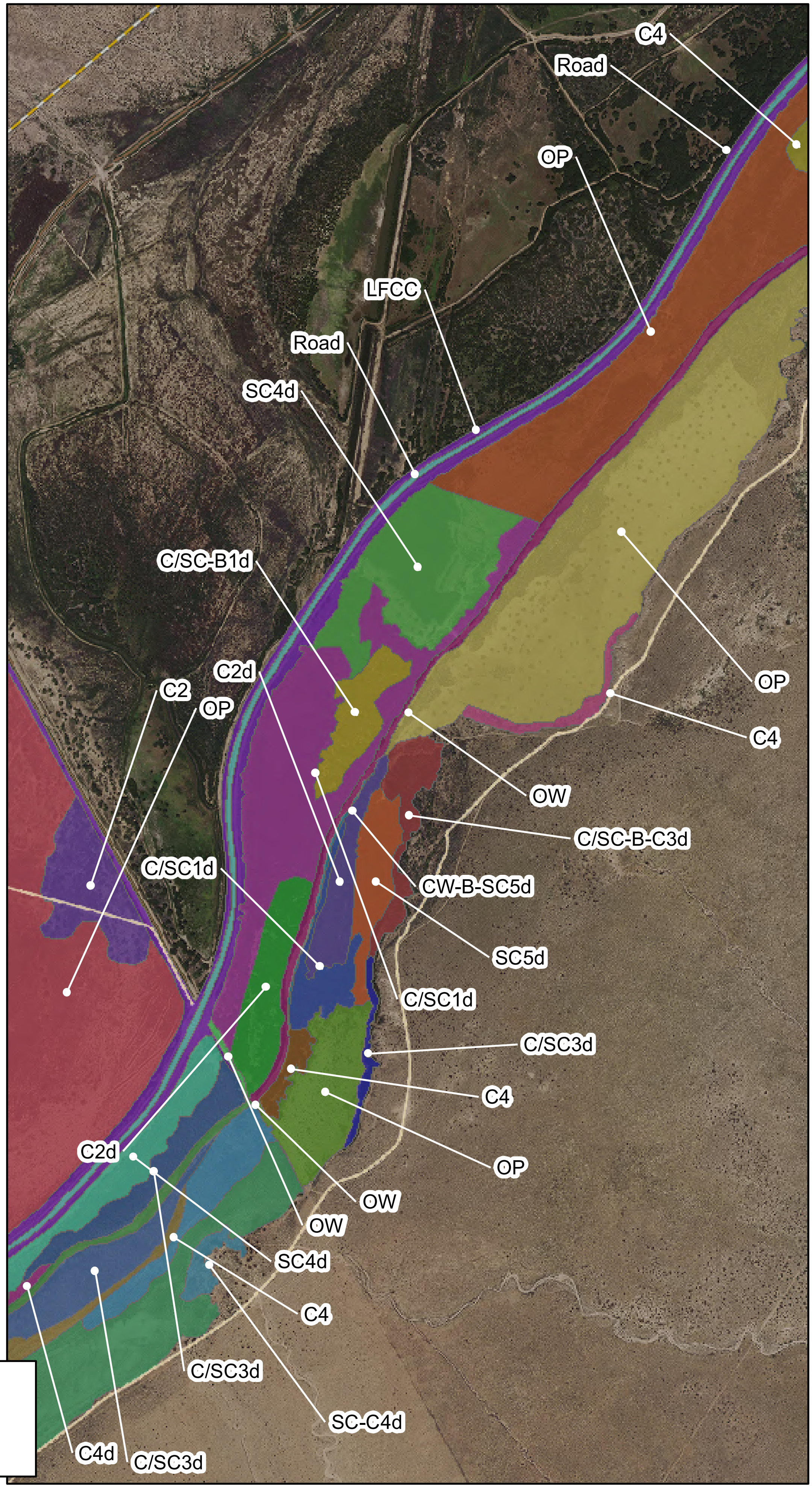
C-SC/CW-SC3d
C/SC-CW-B3
C/SC3d
Road
Road
C4
LFCC
OP
C/CW3
ROAD
C4
SC4d
OW
OP
C4
C/SC-B1d
C/SC-B1d
C2d
SC5d
C/SC1d

Locator Map

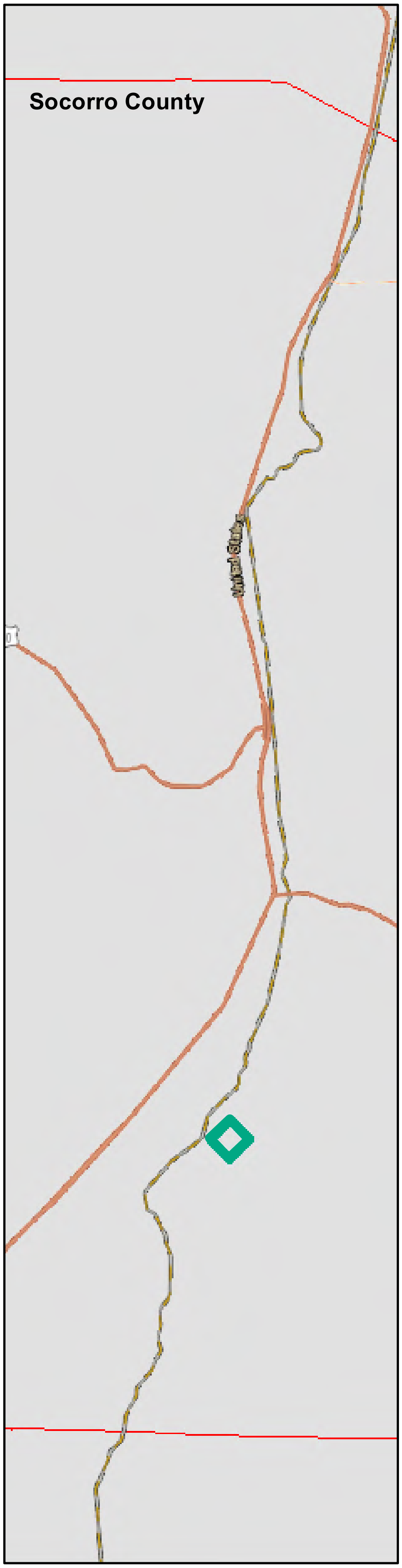
2016
Hink and Ohmart Vegetation Type

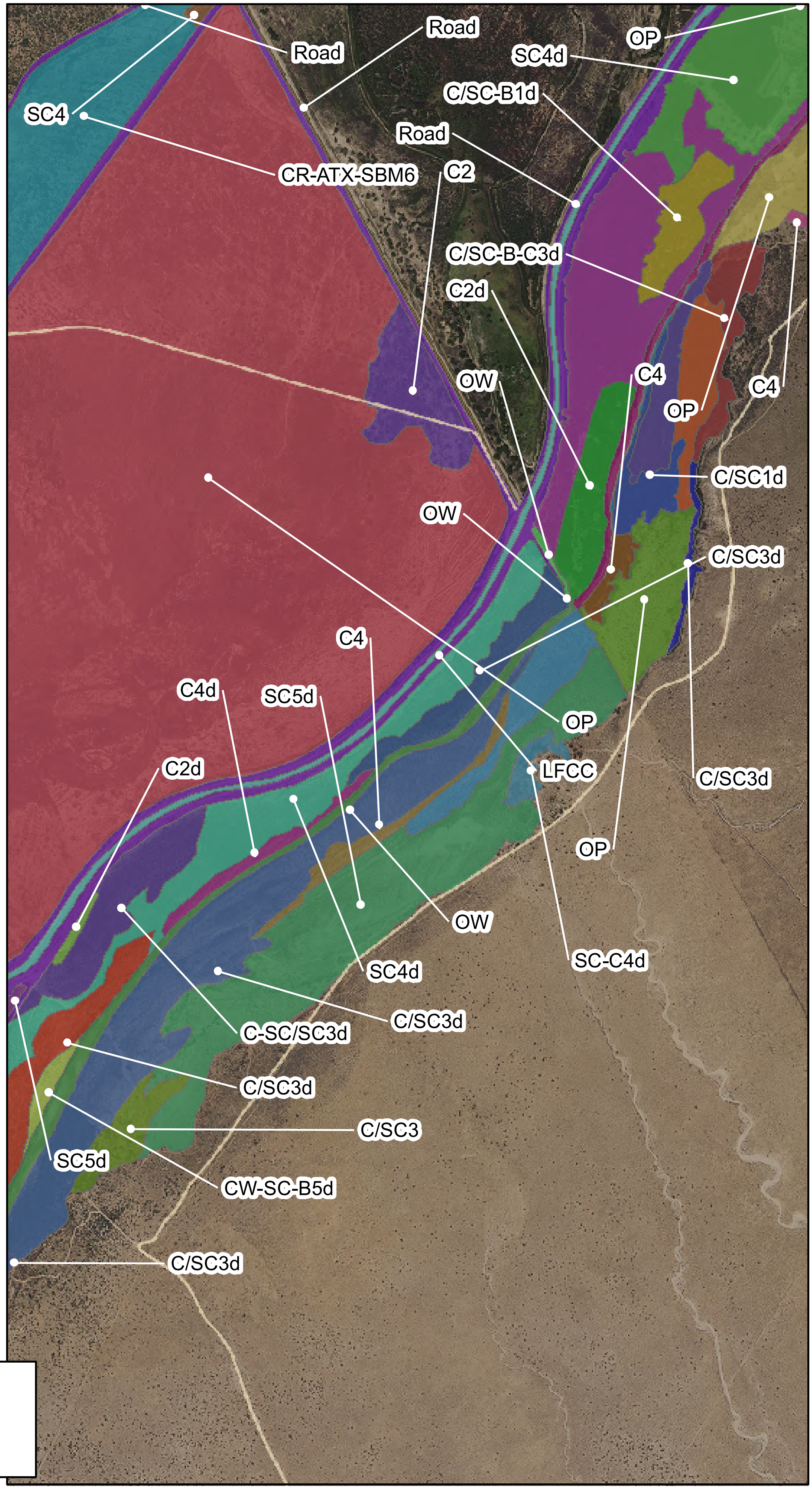






Locator Map


Socorro County


Road
OP
Road
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C/SC-B1d
SC4
Road
CR-ATX-SBM6
C2
C/SC-B-C3d
C2d
C4
OW
C4
OP
C/SC1d
OW
C/SC3d
C4
C4d
SC5d
OP
C2d
LFCC
C/SC3d
OP
OW
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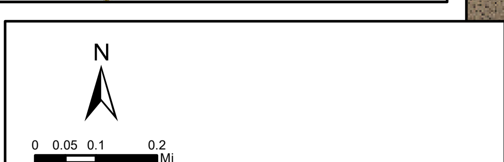
CW-SC-B5d
C/SC3d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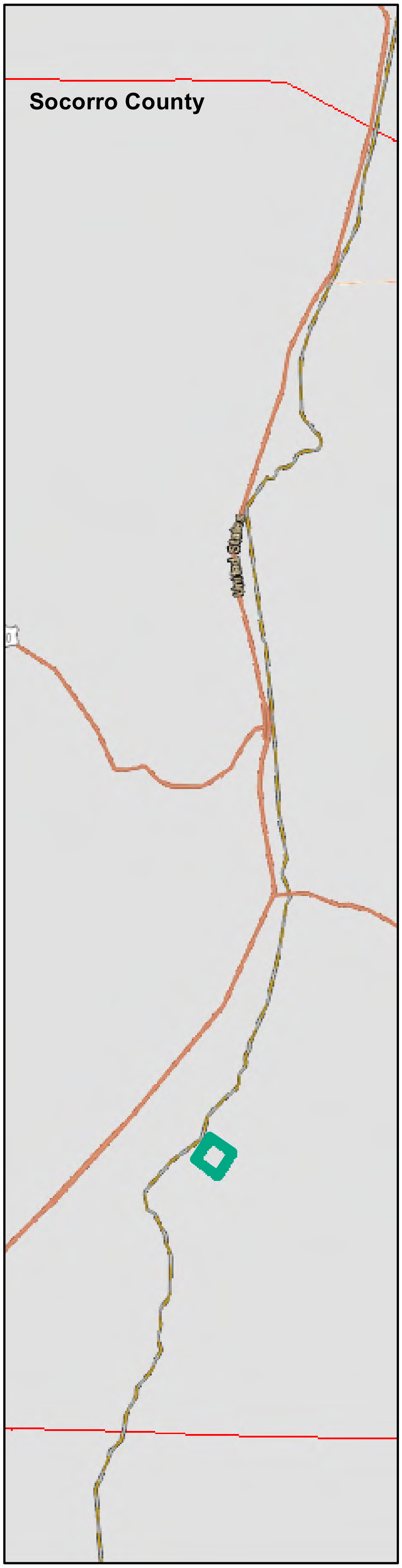
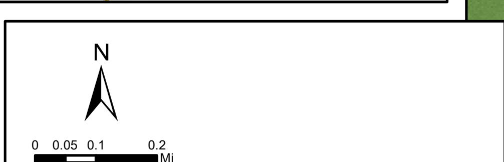
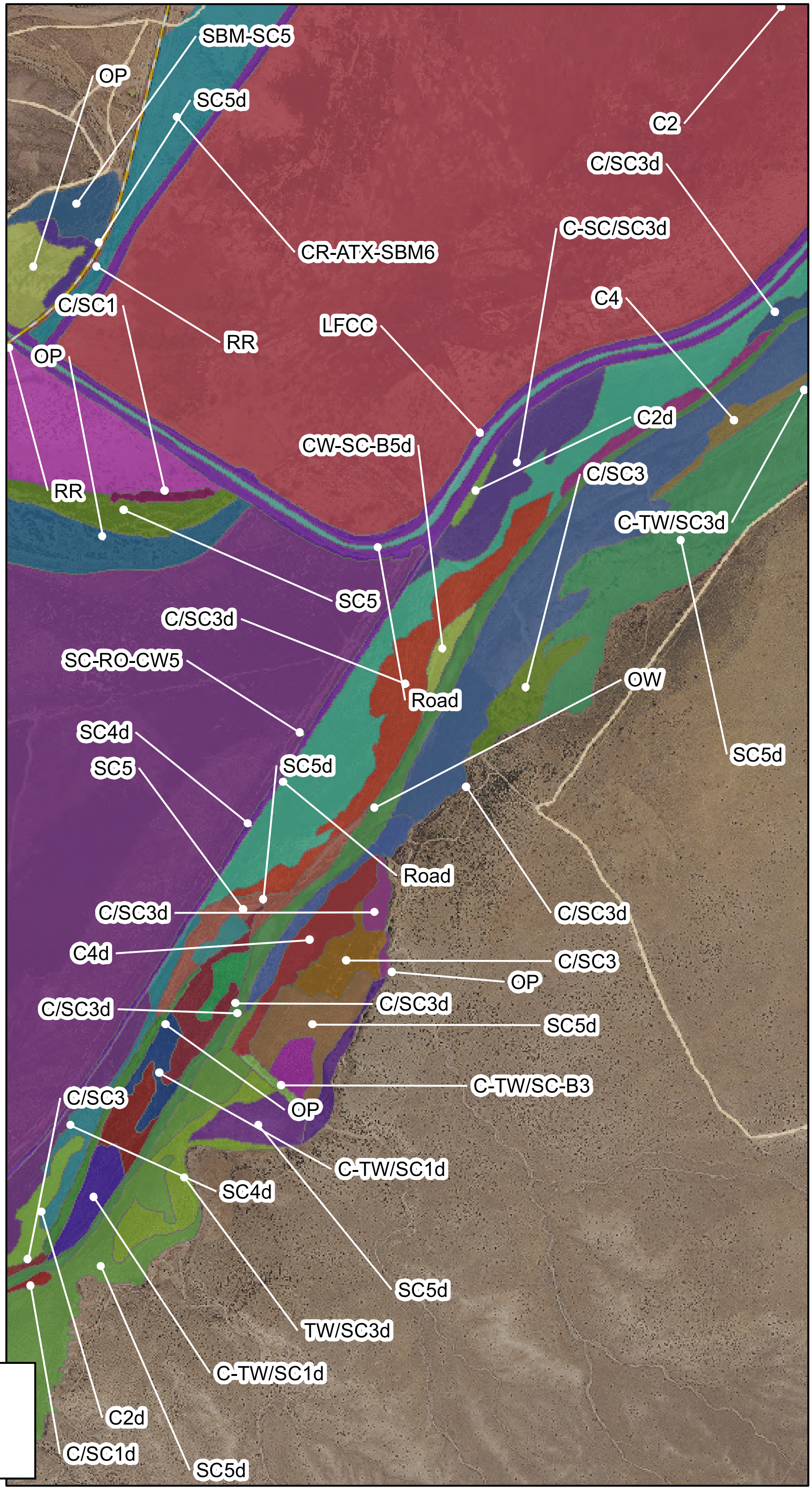
Mi

Locator Map

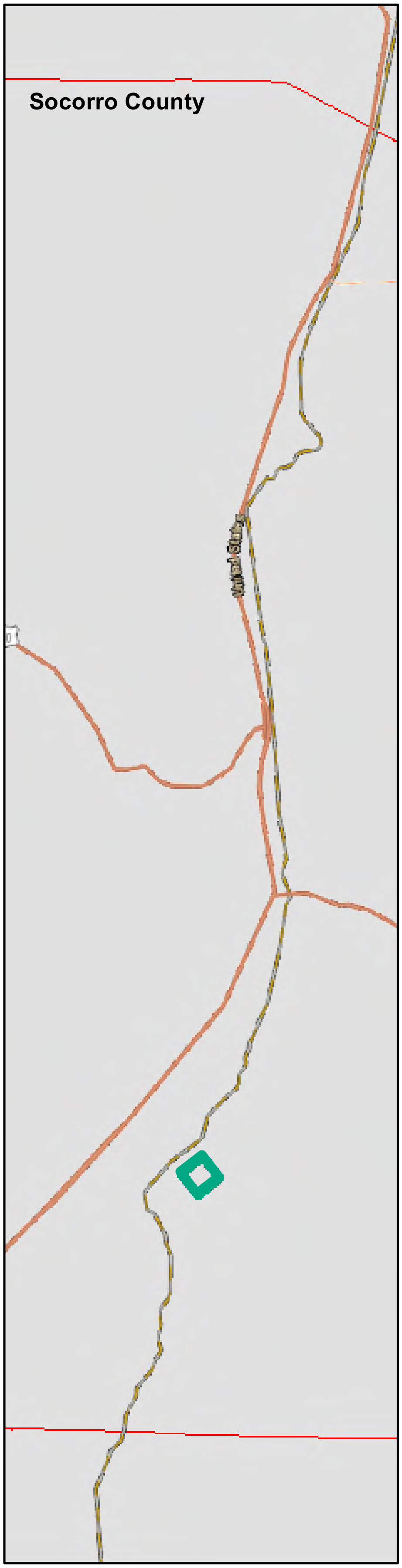


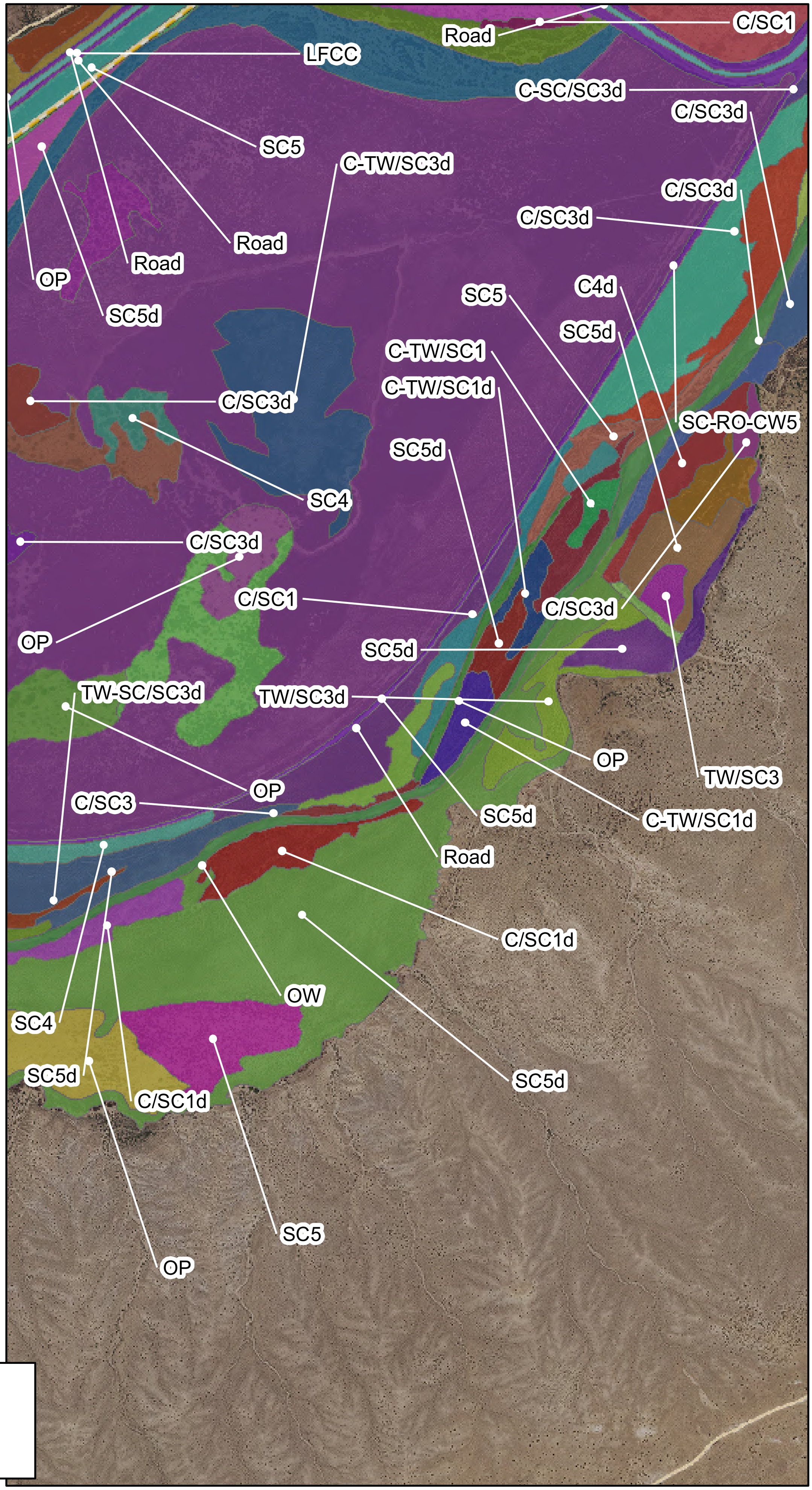


2016
Hink and Ohmart Vegetation Type



Locator Map


Socorro County


Road
C/SC1
LFCC
C-SC/SC3d
C/SC3d
SC5
C-TW/SC3d
C/SC3d
C/SC3d
Road
Road
OP
SC5d
SC5
C4d
SC5d
C-TW/SC1
C-TW/SC1d
C/SC3d
SC-RO-CW5
SC5d
SC4
C/SC3d
C/SC1
C/SC3d
OP
SC5d
TW-SC/SC3d
TW/SC3d
OP
TW/SC3
OP
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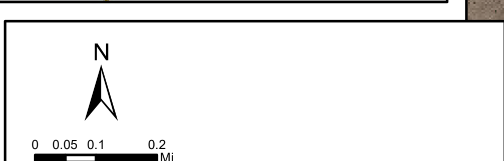
SC5d
SC5
OP


N
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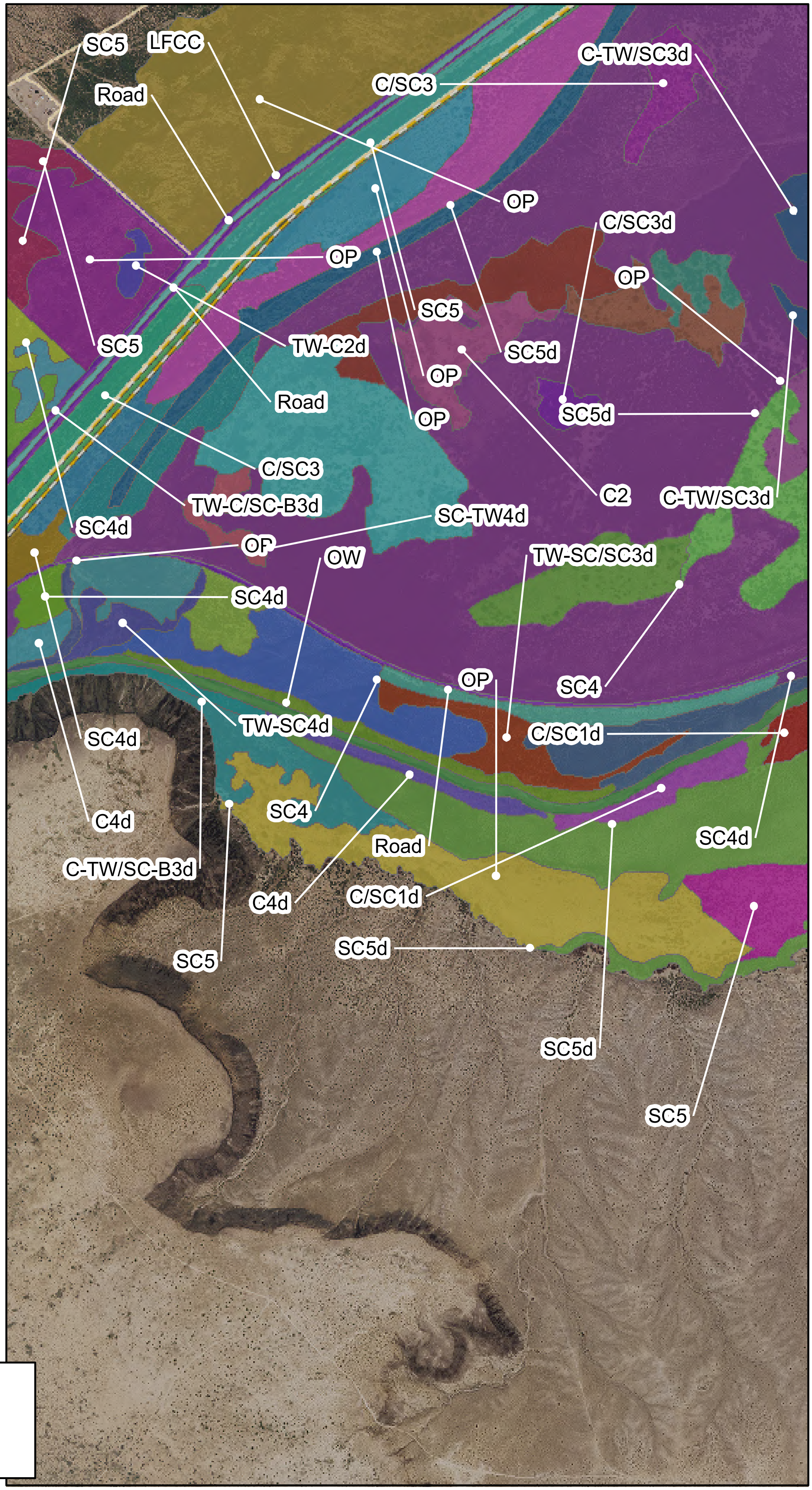
Mi

Locator Map


Socorro County
N
0 0.05 0.1 0.2
Mi


SC5
LFCC
Road
C/SC3
C-TW/SC3d
OP
C/SC3d
OP
OP
SC5
TW-C2d
SC5d
OP
Road
OP
SC5d
C/SC3
C2
C-TW/SC3d
TW-C/SC-B3d
SC-TW4d
SC4d
OP
OW
TW-SC/SC3d
SC4d
OP
SC4
TW-SC4d
C/SC1d
SC4d
SC4
C4d
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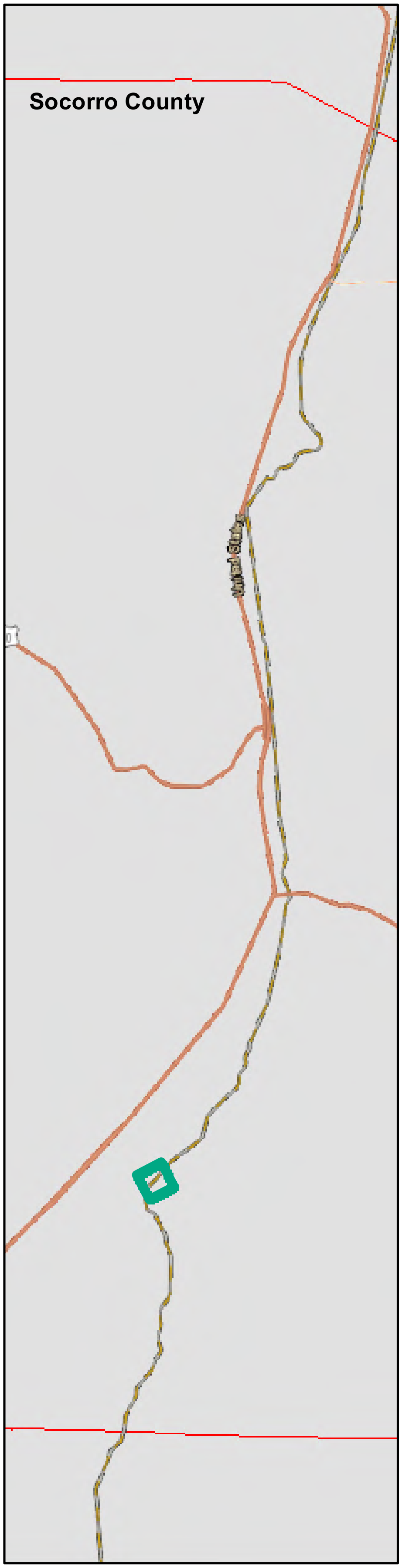
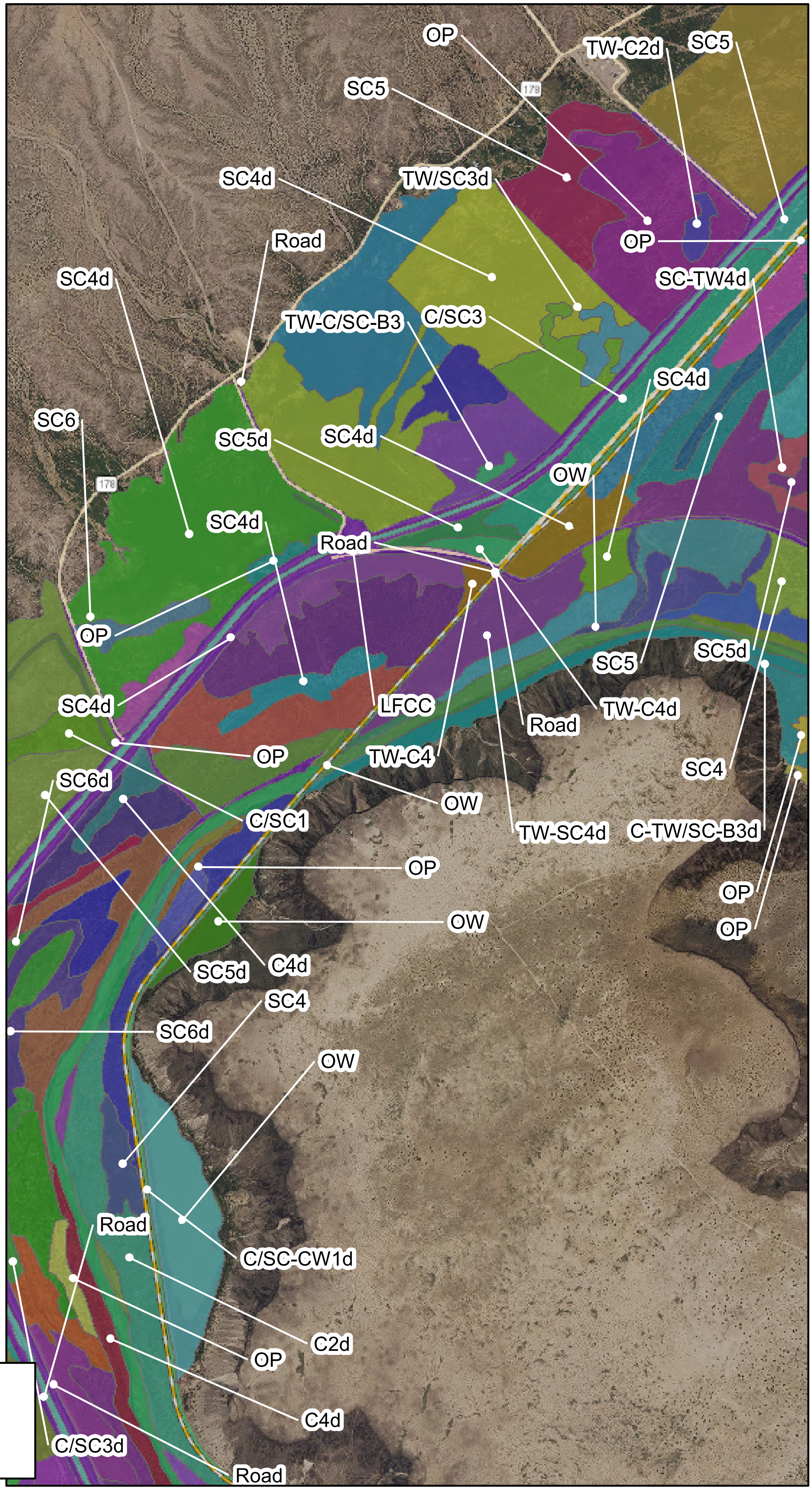
C-TW/SC-B3d
C/SC1d
C4d
SC5d
SC5
SC5d
SC5

Locator Map


Socorro County


OP
TW-C2d
SC5
SC5
SC4d
TW/SC3d
OP
Road
SC4d
SC-TW4d
TW-C/SC-B3
C/SC3
SC4d
SC6
SC5d
SC4d
OW
SC4d
Road
OP
SC5
SC5d
SC4d
LFCC
Road
TW-C4d
OP
TW-C4
SC4
SC6d
OW
C/SC1
TW-SC4d
C-TW/SC-B3d
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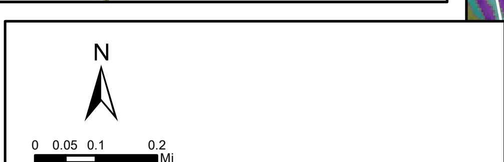
C4d
C/SC3d
Road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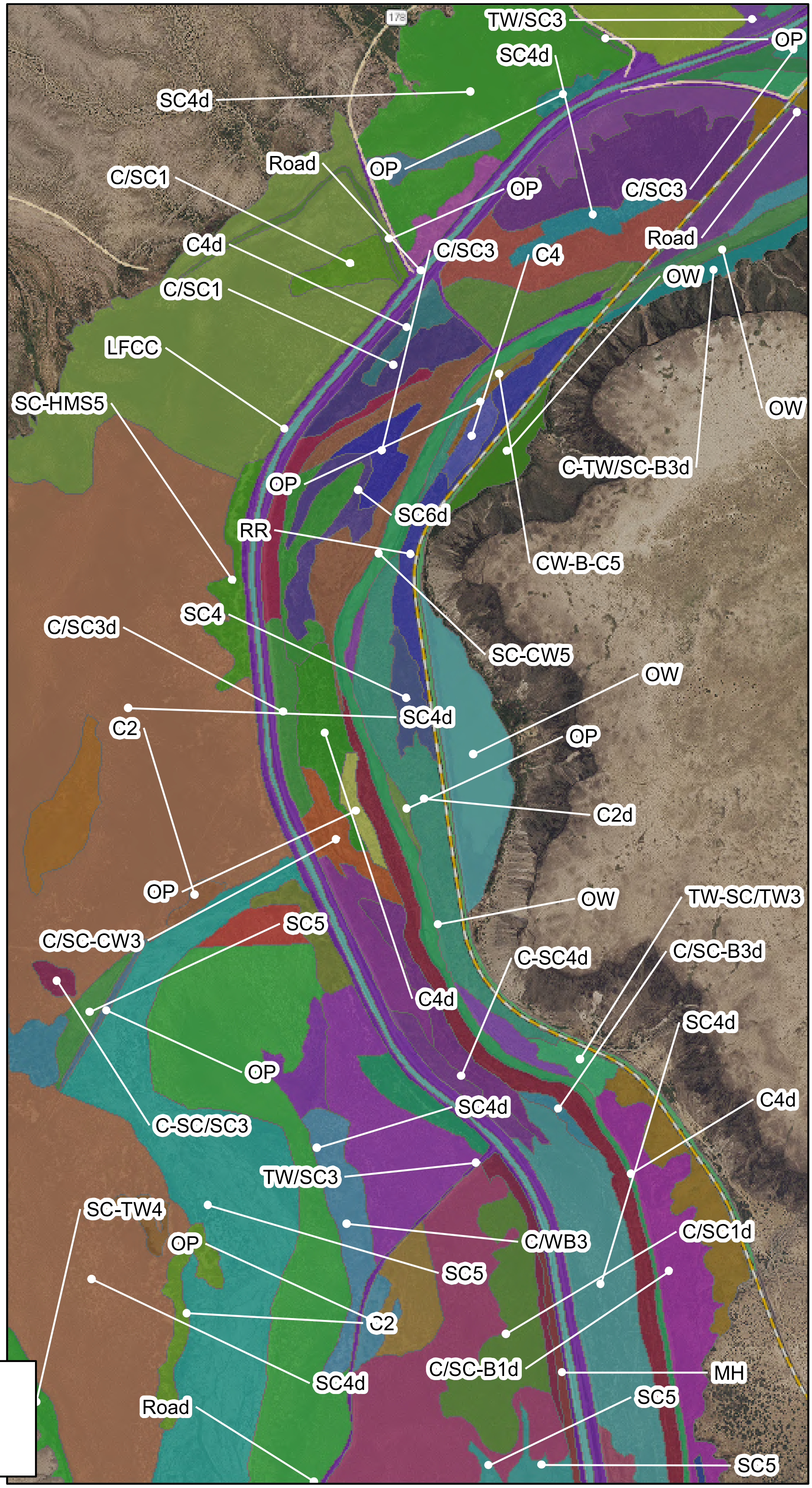
Mi

Locator Map

2016
Hink and Ohmart Vegetation Type



Locator Map


Socorro County
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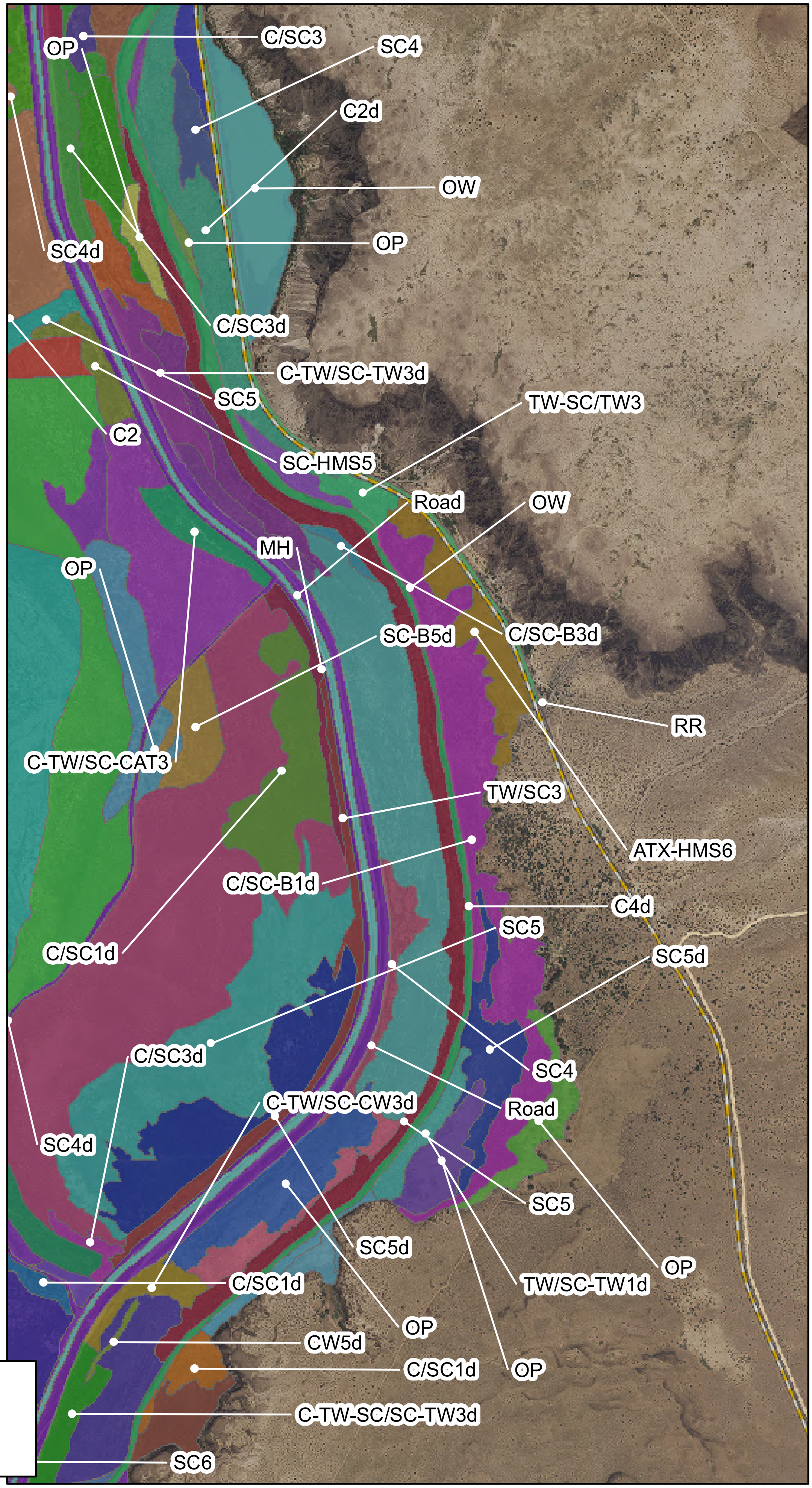
Mi


OP
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SC4
C2d
OW
OP
SC4d
C/SC3d
C-TW/SC-TW3d
SC5
TW-SC/TW3
C2
SC-HMS5
Road
OW
MH
OP
C/SC-B3d
SC-B5d
RR
C-TW/SC-CAT3
TW/SC3
ATX-HMS6
C/SC-B1d
C4d
SC5
C/SC1d
SC5d
C/SC3d
SC4
C-TW/SC-CW3d
Road
SC4d
SC5
SC5d
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TW/SC-TW1d
OP
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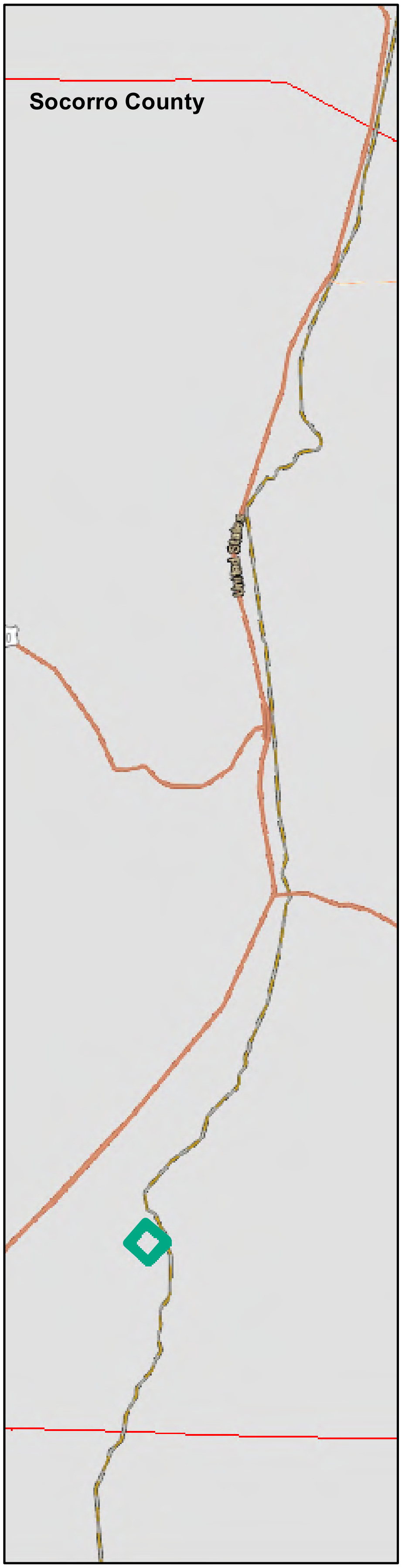
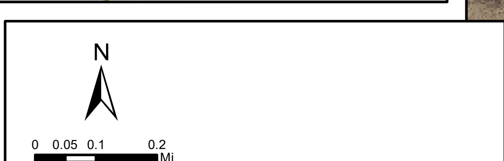
C/SC1d
OP
C-TW-SC/SC-TW3d
SC6

Locator Map


Socorro County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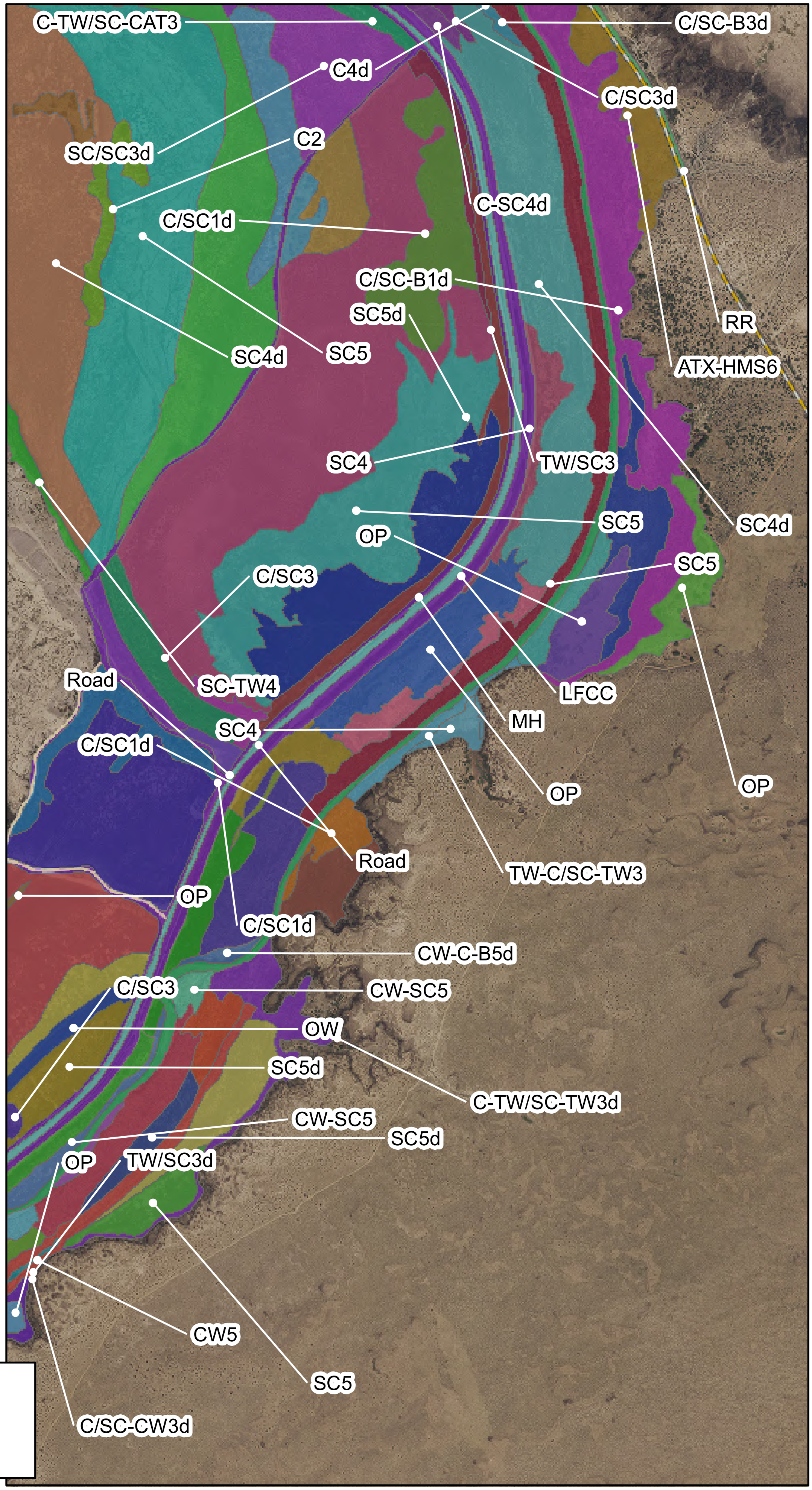
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C/SC3d
SC/SC3d
C2
C-SC4d
C/SC1d
C/SC-B1d
RR
SC5d
ATX-HMS6
SC4d
SC5
SC4
TW/SC3
SC5
SC4d
OP
SC5
C/SC3
LFCC
SC-TW4
Road
MH
SC4
C/SC1d
OP
OP
Road
TW-C/SC-TW3
OP
C/SC1d
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C/SC3
CW-SC5
OW
SC5d
C-TW/SC-TW3d
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SC5d
OP
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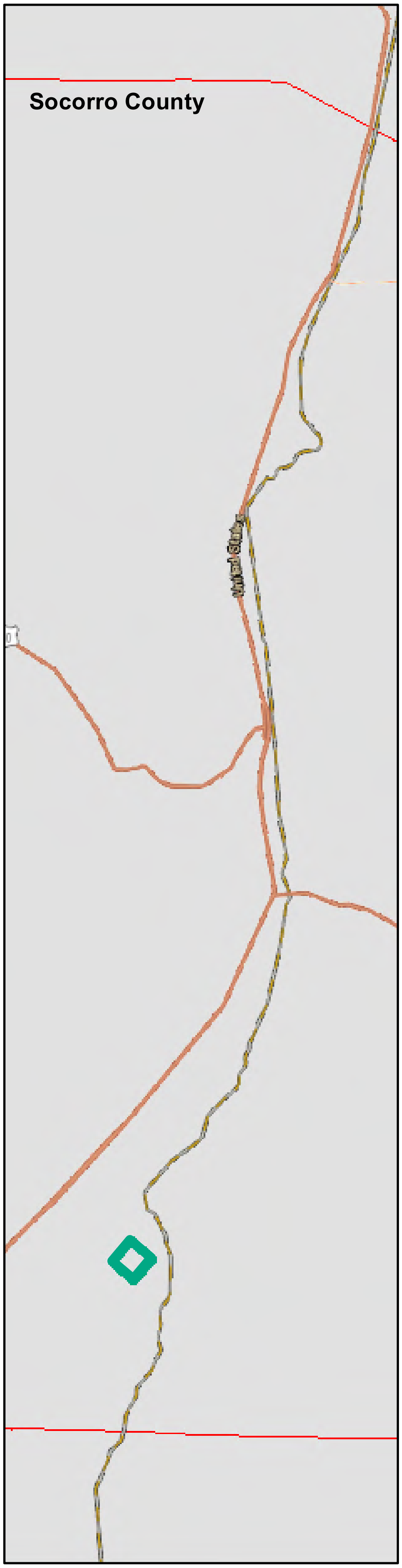
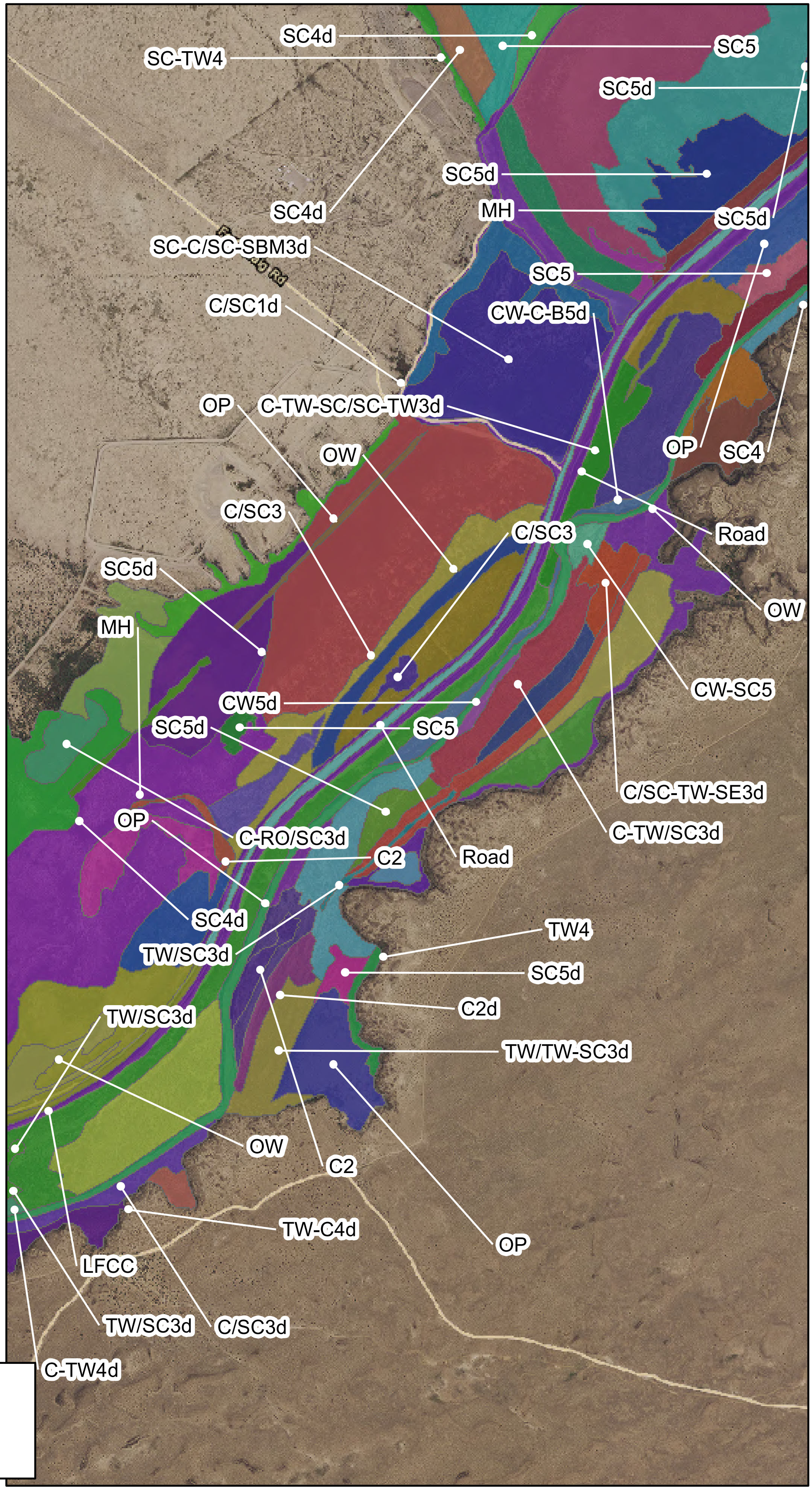
CW5
SC5
C/SC-CW3d

Locator Map


Socorro County


SC4d
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SC5
SC5d
SC5d
SC4d
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SC5d
SC-C/SC-SBM3d
SC5
C/SC1d
CW-C-B5d
OP
C-TW-SC/SC-TW3d
OW
OP
SC4
C/SC3
Road
C/SC3
SC5d
OW
MH
CW-SC5
CW5d
SC5d
SC5
C/SC-TW-SE3d
OP
C-TW/SC3d
C-RO/SC3d
C2
Road
SC4d
TW4
TW/SC3d
SC5d
C2d
TW/SC3d
TW/TW-SC3d
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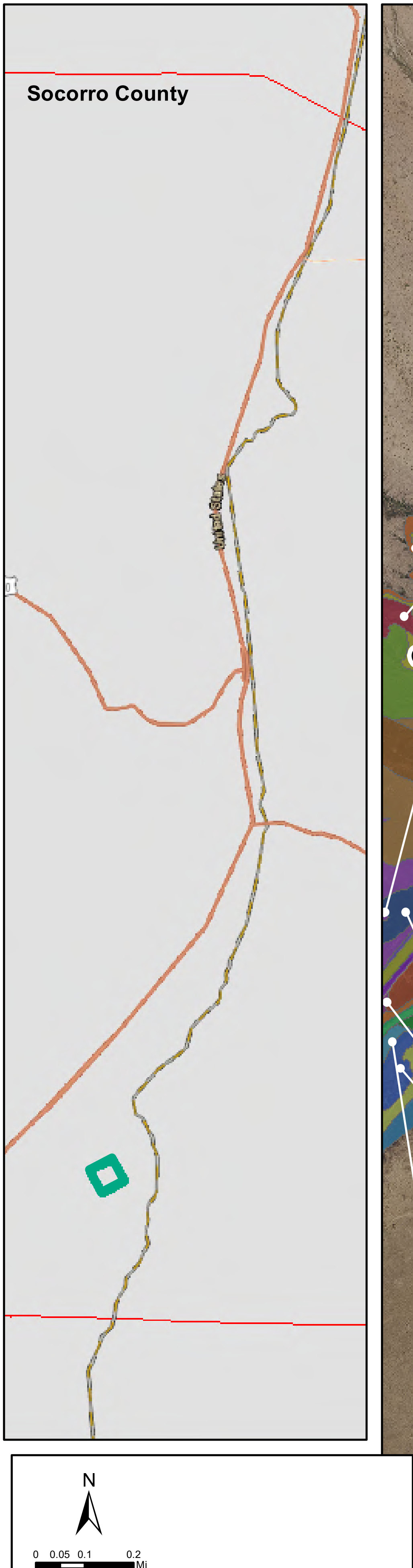
TW-C4d
OP
LFCC
TW/SC3d
C/SC3d
C-TW4d


N
0 0.05 0.1 0.2
Mi



Socorro County
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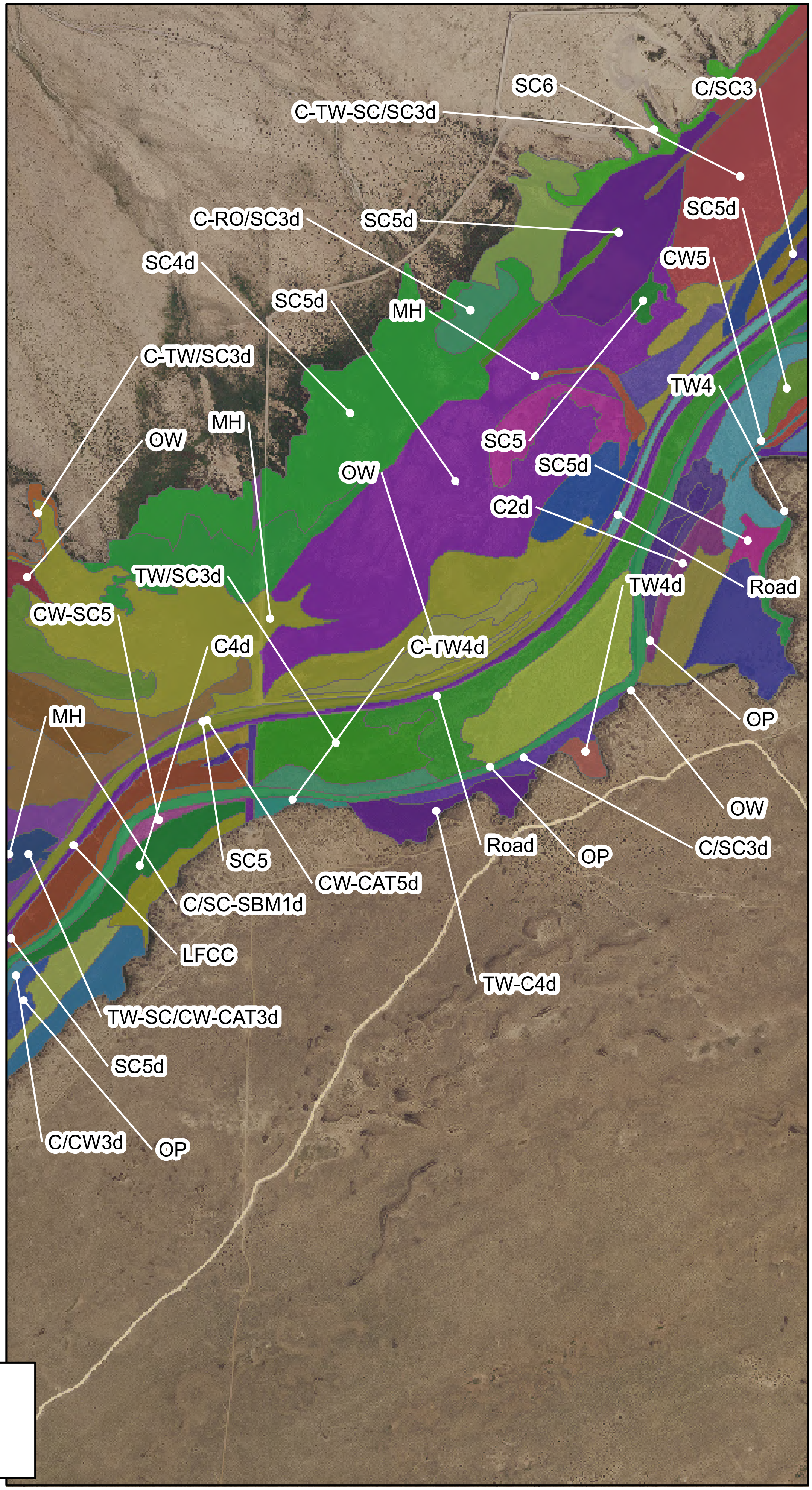

SC6
C/SC3
C-TW-SC/SC3d
SC5d
C-RO/SC3d
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SC4d
SC5d
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SC5d
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OP
C/SC3d
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TW-SC/CW-CAT3d
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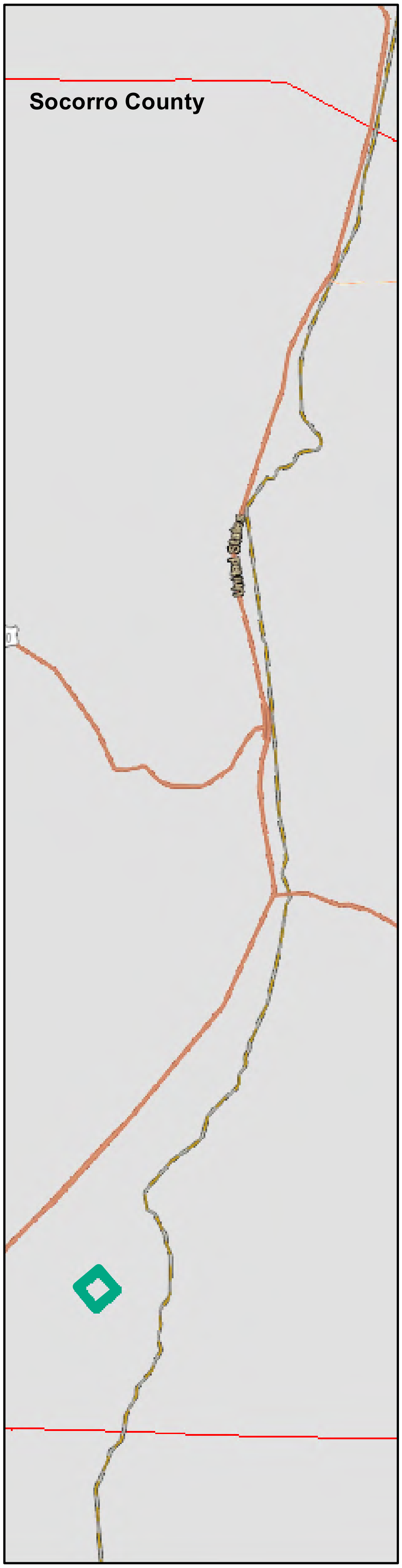
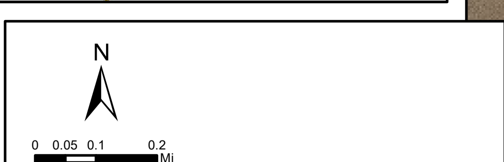
C/CW3d
OP

Locator Map


Socorro County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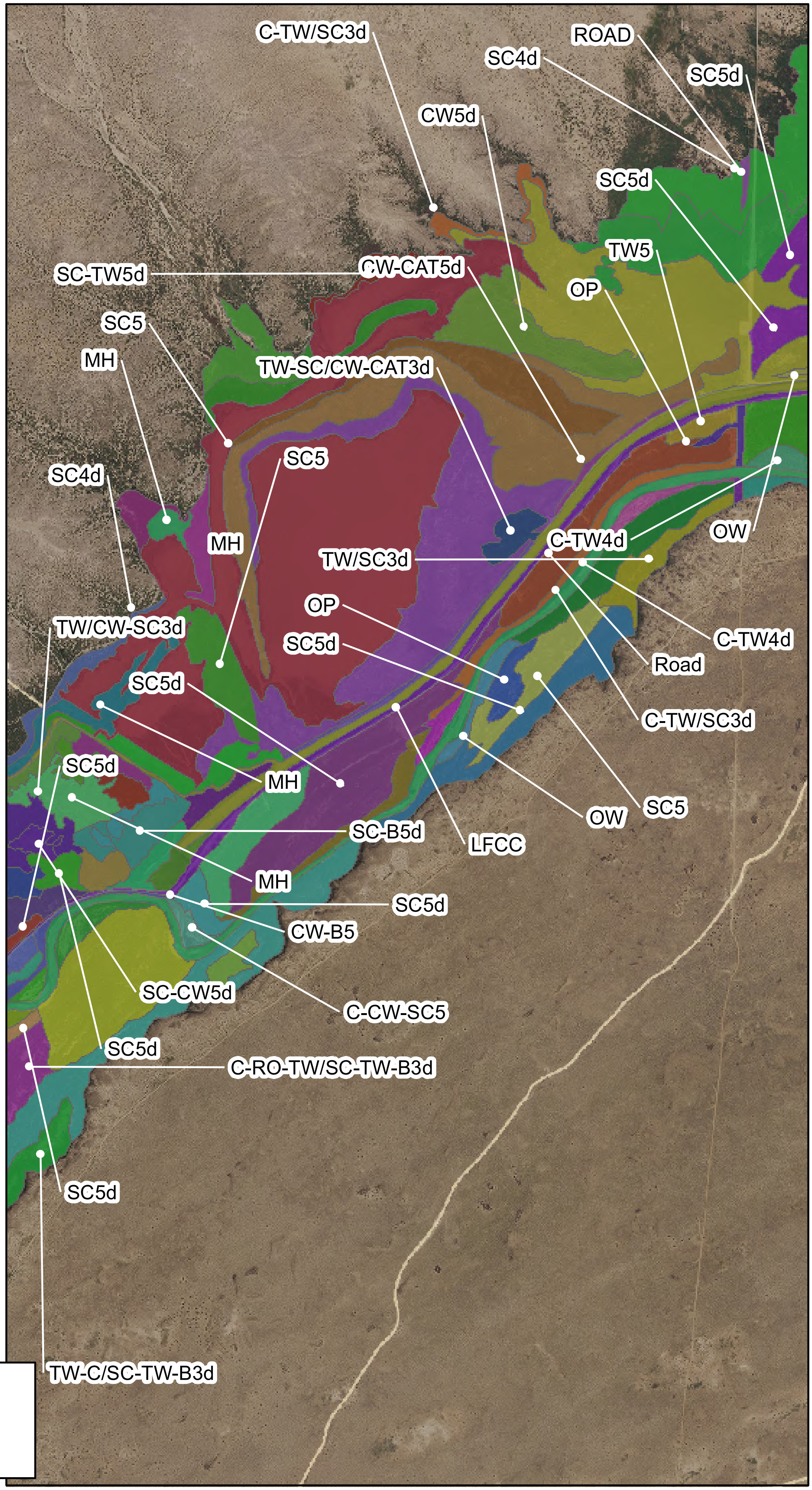
C-TW/SC3d
ROAD
SC4d
SC5d
CW5d
SC5d
TW5
SC-TW5d
CW-CAT5d
OP
SC5
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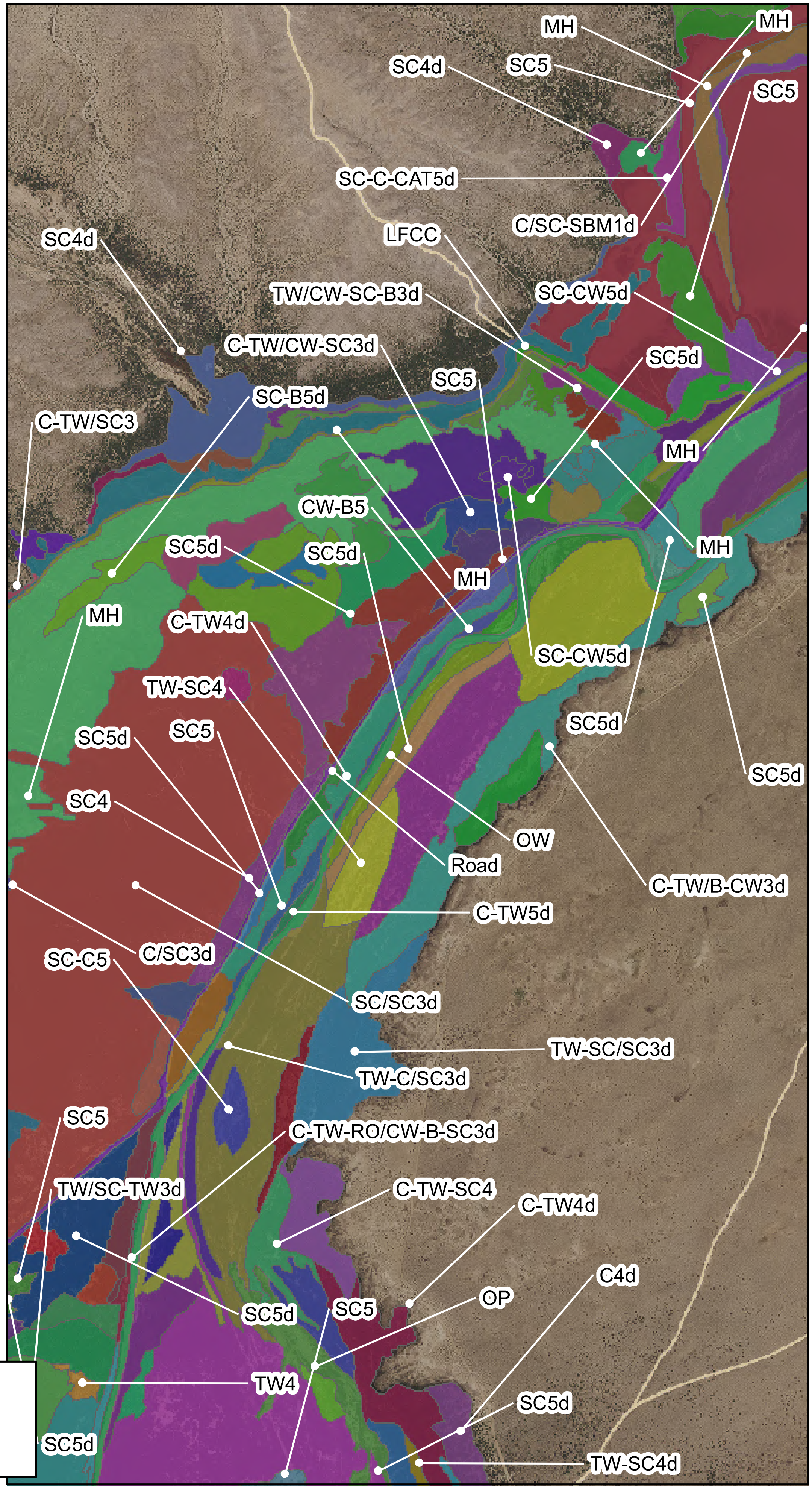
C-TW4d
Road
SC5d
C-TW/SC3d
SC5d
MH
SC5
OW
SC-B5d
LFCC
MH
SC5d
CW-B5
SC-CW5d
C-CW-SC5
SC5d
C-RO-TW/SC-TW-B3d
SC5d
TW-C/SC-TW-B3d

Locator Map


Socorro County
N
0 0.05 0.1 0.2
Mi


MH
MH
SC4d
SC5
SC5
SC-C-CAT5d
C/SC-SBM1d
LFCC
SC4d
TW/CW-SC-B3d
SC-CW5d
C-TW/CW-SC3d
SC5d
SC5
SC-B5d
C-TW/SC3
MH
CW-B5
MH
SC5d
SC5d
MH
MH
C-TW4d
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TW-SC4
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SC5d
SC4
OW
Road
C-TW/B-CW3d
C-TW5d
C/SC3d
SC-C5
SC/SC3d
TW-SC/SC3d
TW-C/SC3d
SC5
C-TW-RO/CW-B-SC3d
TW/SC-TW3d
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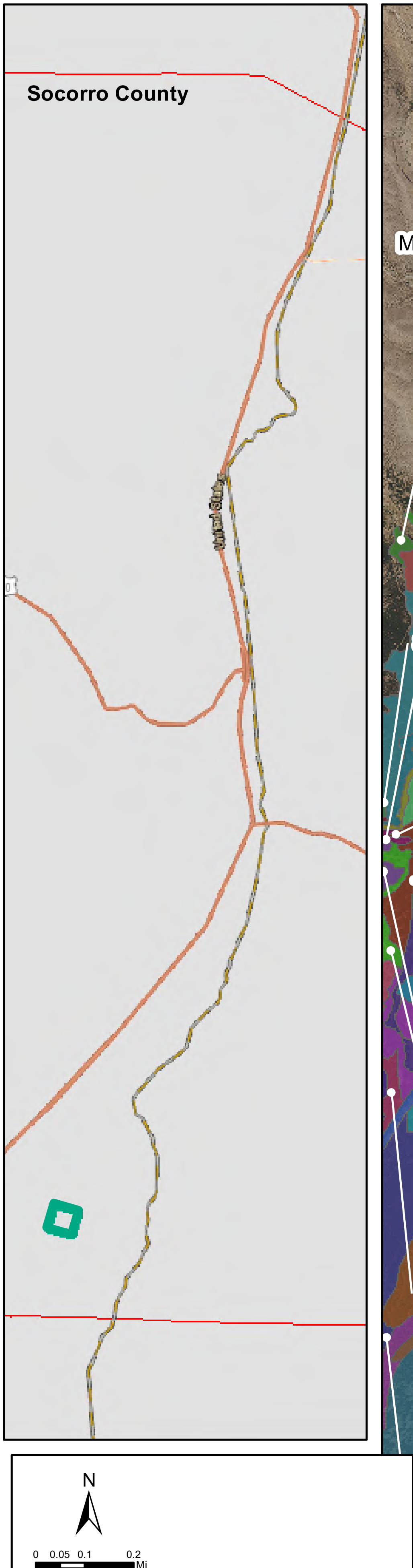
SC5d
SC5d
TW-SC4d

Locator Map


Socorro County
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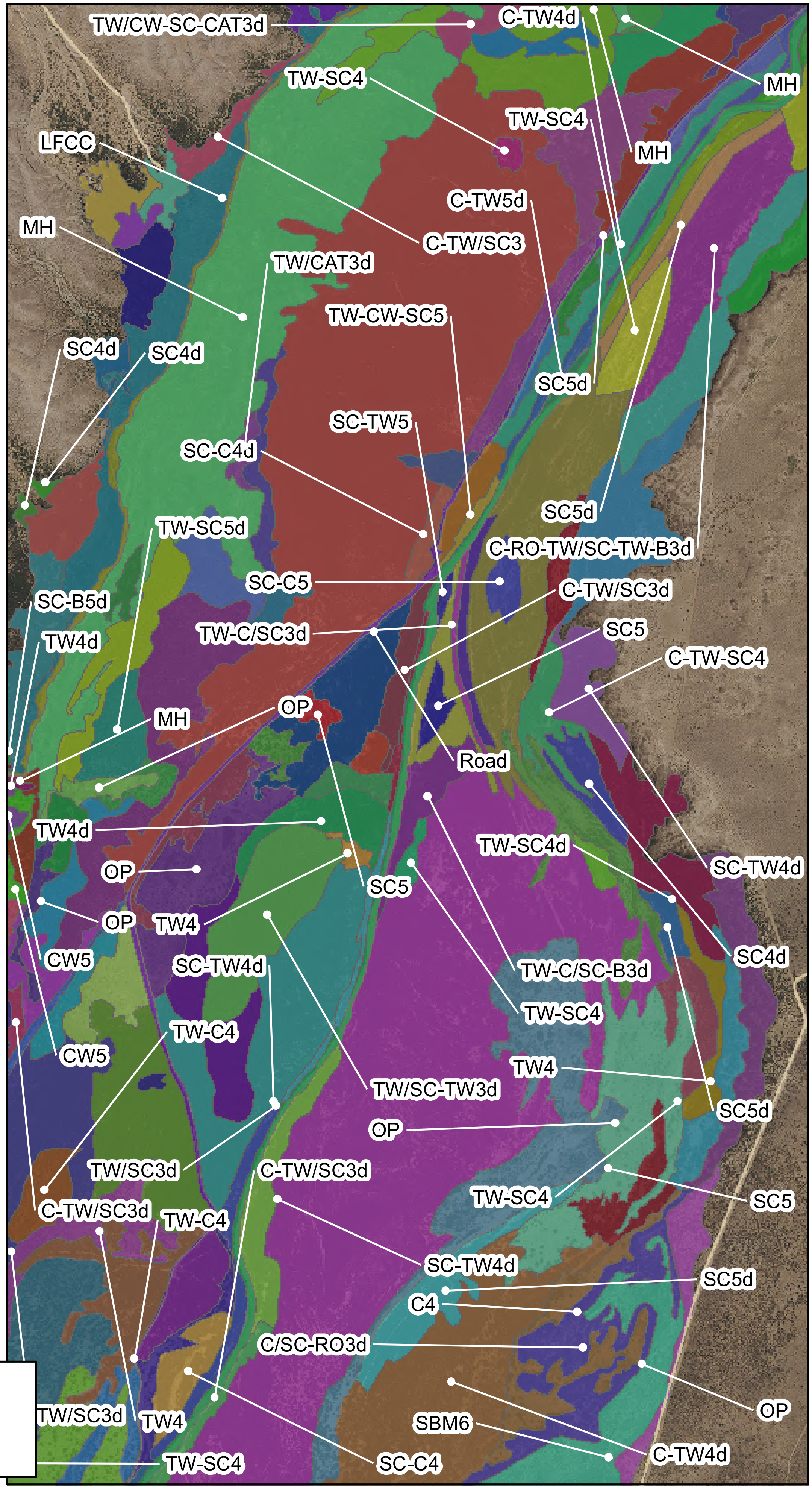
0 0.05 0.1 0.2
Mi


TW/CW-SC-CAT3d
C-TW4d
MH
TW-SC4
TW-SC4
MH
LFCC
C-TW5d
MH
C-TW/SC3
TW/CAT3d
TW-CW-SC5
SC4d
SC4d
SC5d
SC-TW5
SC-C4d
SC5d
TW-SC5d
C-RO-TW/SC-TW-B3d
SC-C5
C-TW/SC3d
SC-B5d
TW-C/SC3d
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TW4d
C-TW-SC4
OP
MH
Road
TW4d
TW-SC4d
SC-TW4d
OP
SC5
OP
TW4
SC4d
CW5
SC-TW4d
TW-C/SC-B3d
TW-SC4
TW-C4
CW5
TW4
TW/SC-TW3d
SC5d
OP
TW/SC3d
C-TW/SC3d
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TW-C4
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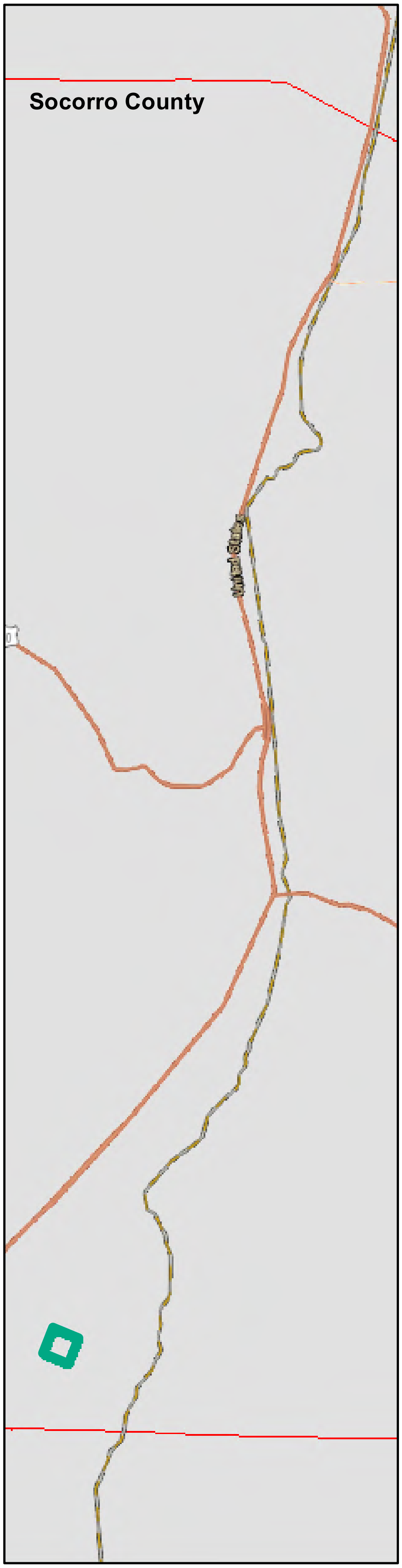
Locator Map


Socorro County
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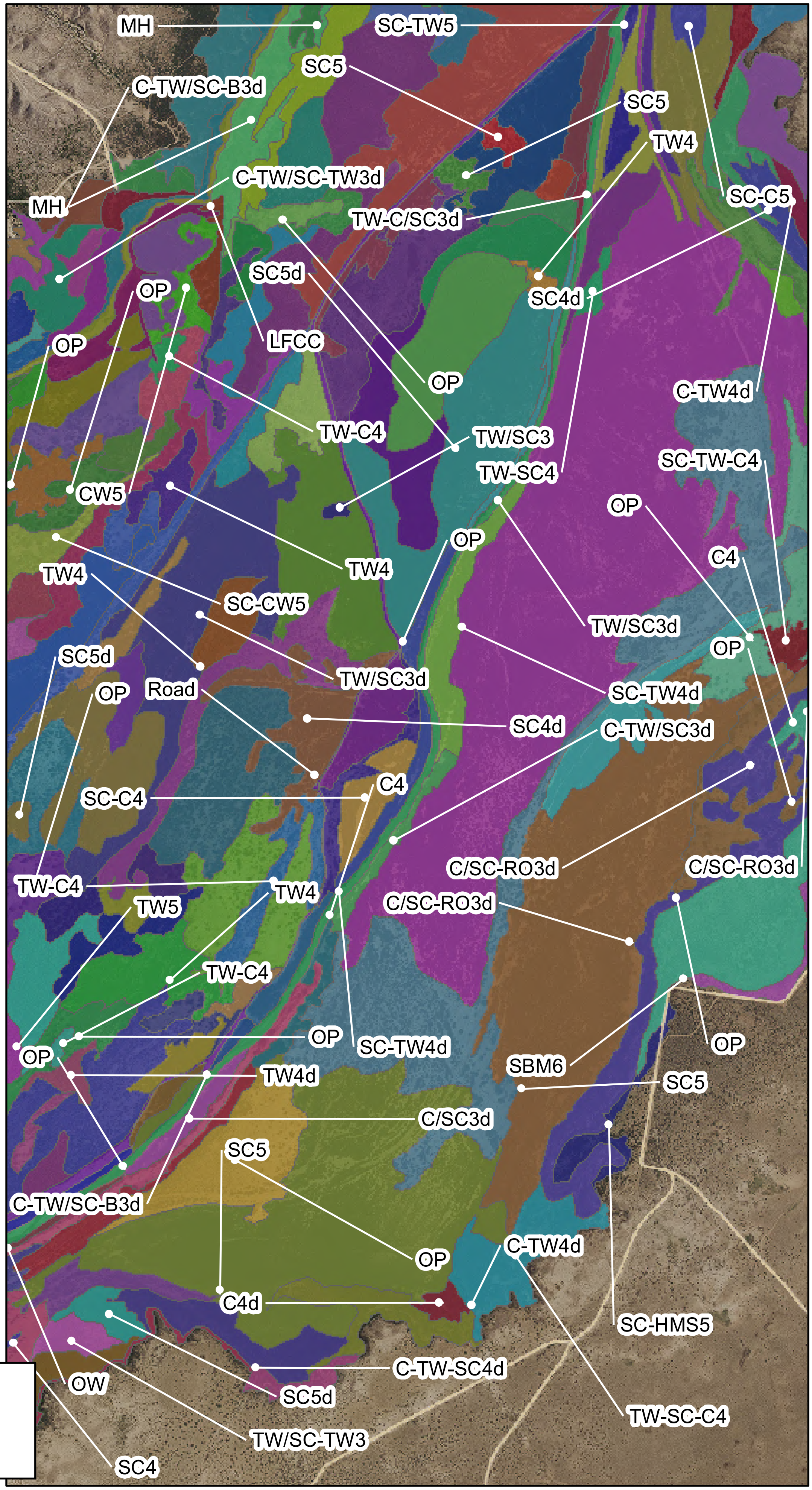
Mi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SC5
TW4
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MH
SC-C5
TW-C/SC3d
SC5d
OP
SC4d
OP
LFCC
OP
C-TW4d
TW-C4
TW/SC3
SC-TW-C4
TW-SC4
CW5
OP
OP
TW4
C4
TW4
SC-CW5
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TW/SC3d
SC-TW4d
OP
Road
SC4d
C-TW/SC3d
C4
SC-C4
C/SC-RO3d
C/SC-RO3d
TW-C4
TW4
C/SC-RO3d
TW5
TW-C4
OP
SC-TW4d
OP
OP
SBM6
TW4d
SC5
C/SC3d
SC5
C-TW/SC-B3d
OP
C-TW4d
C4d
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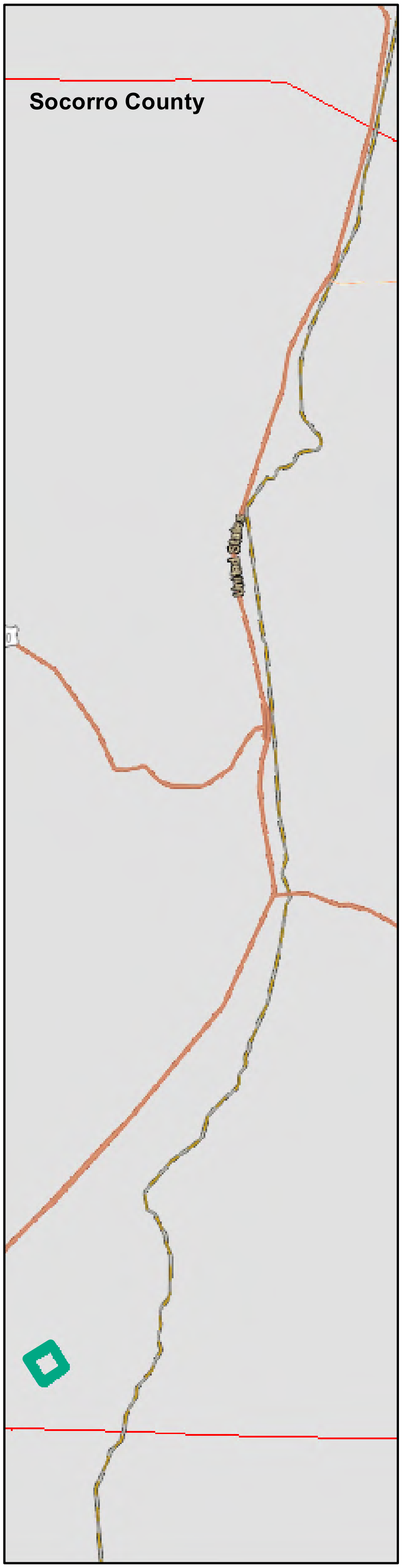
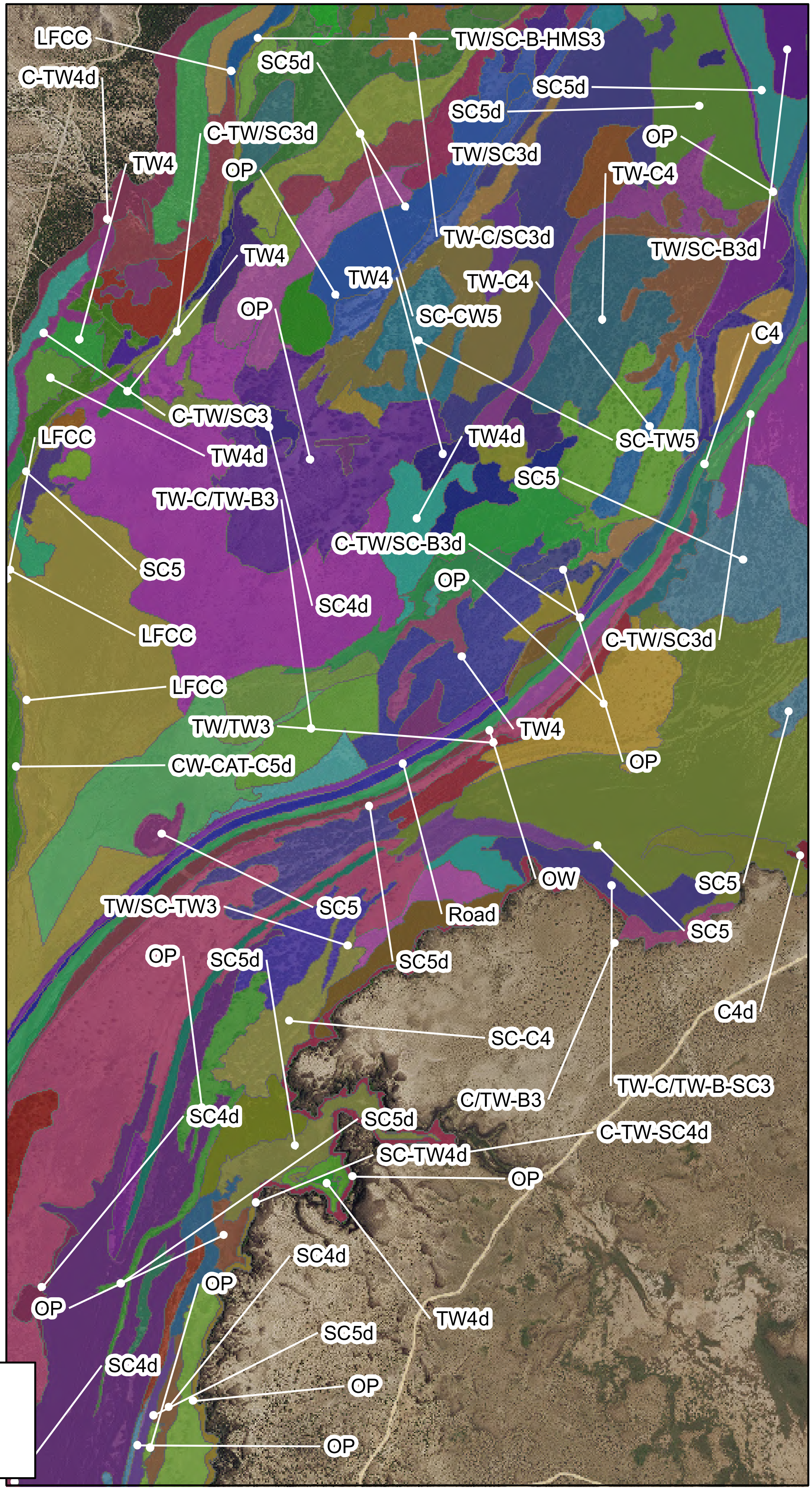
TW/SC-TW3
SC4

Locator Map

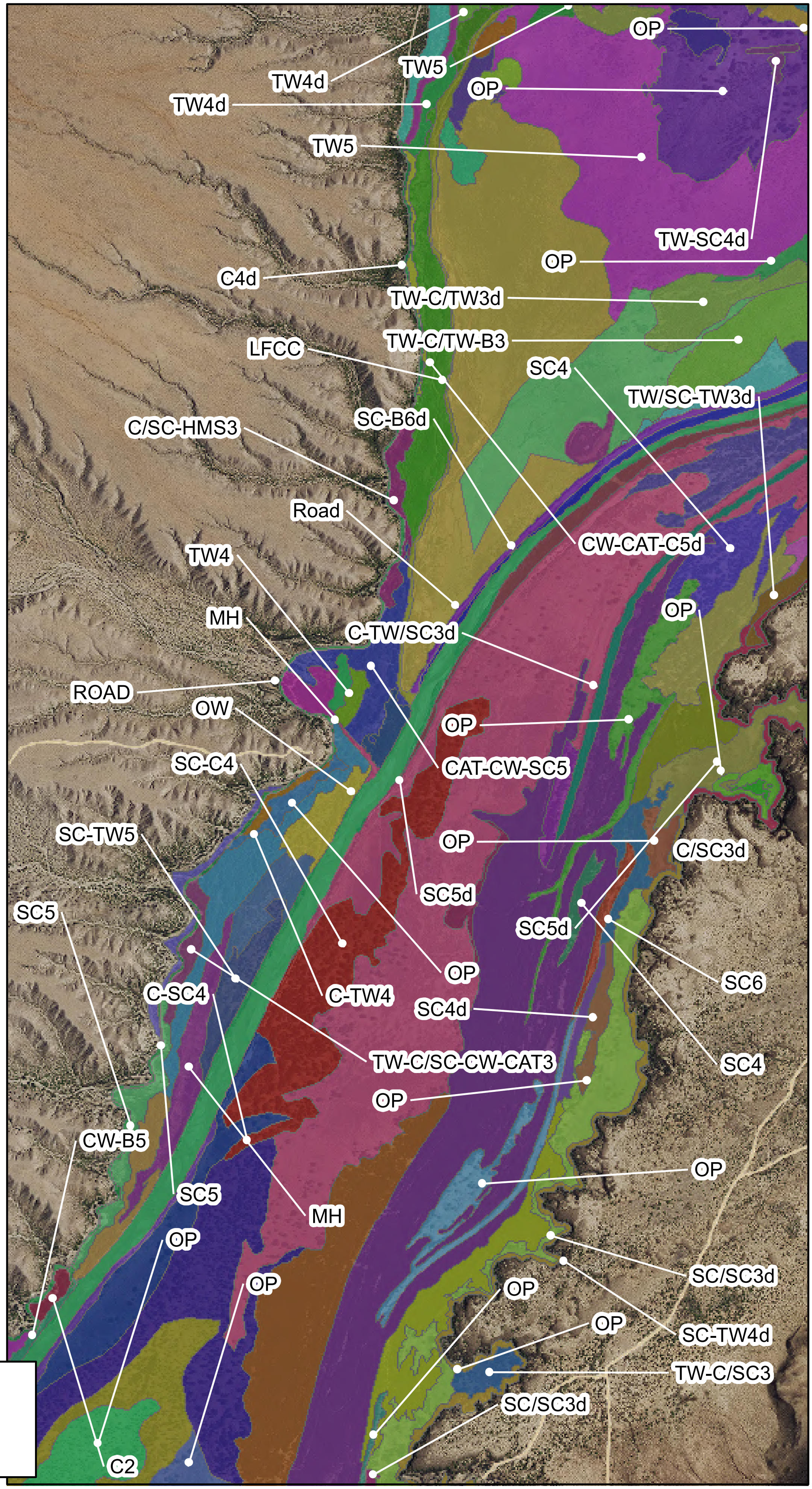
2016
Hink and Ohmart Vegetation Type





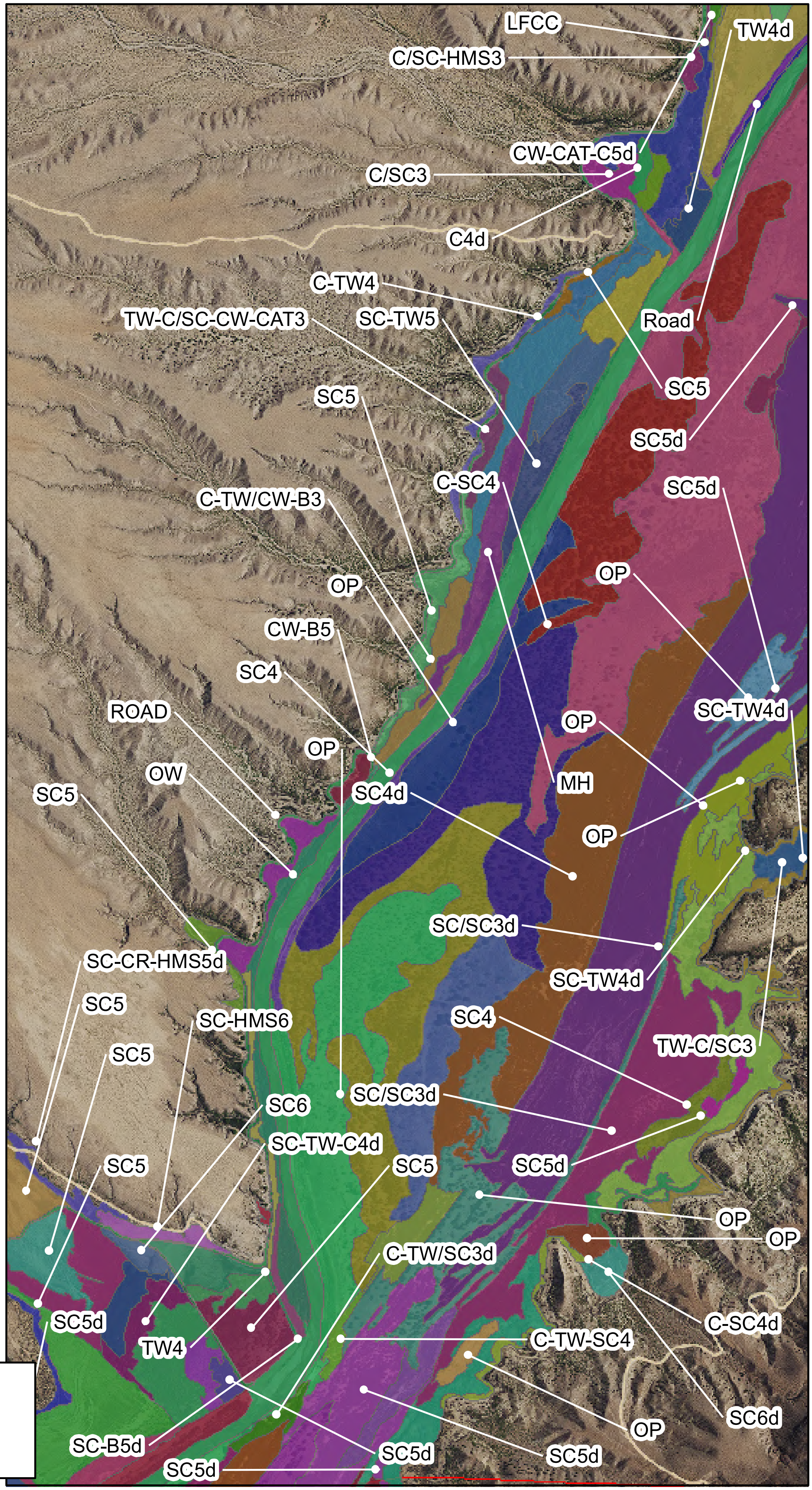
Locator Map

2016
Hink and Ohmart Vegetation Type

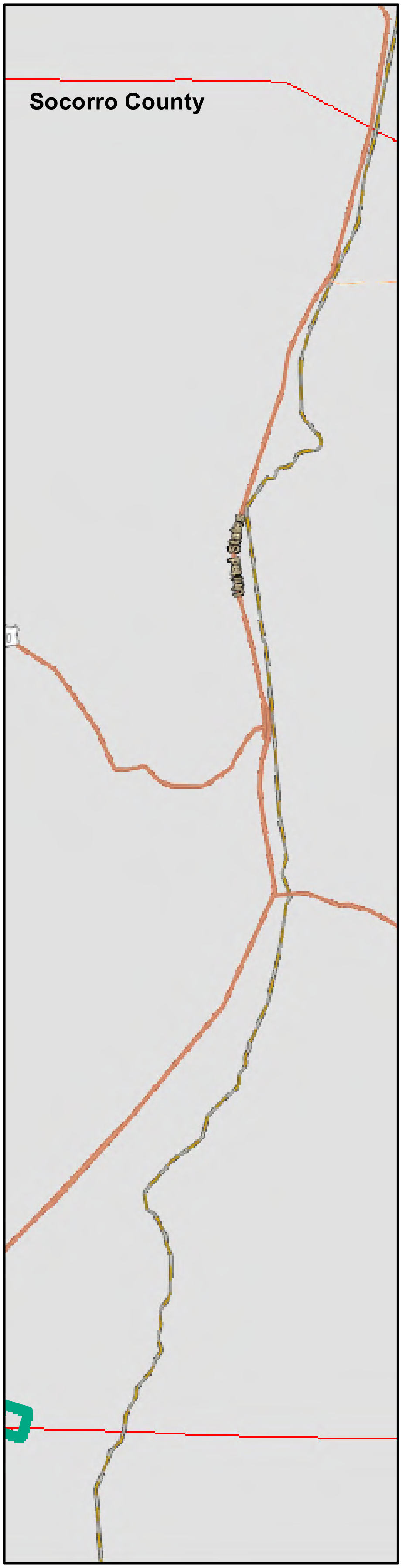


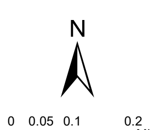
Locator Map

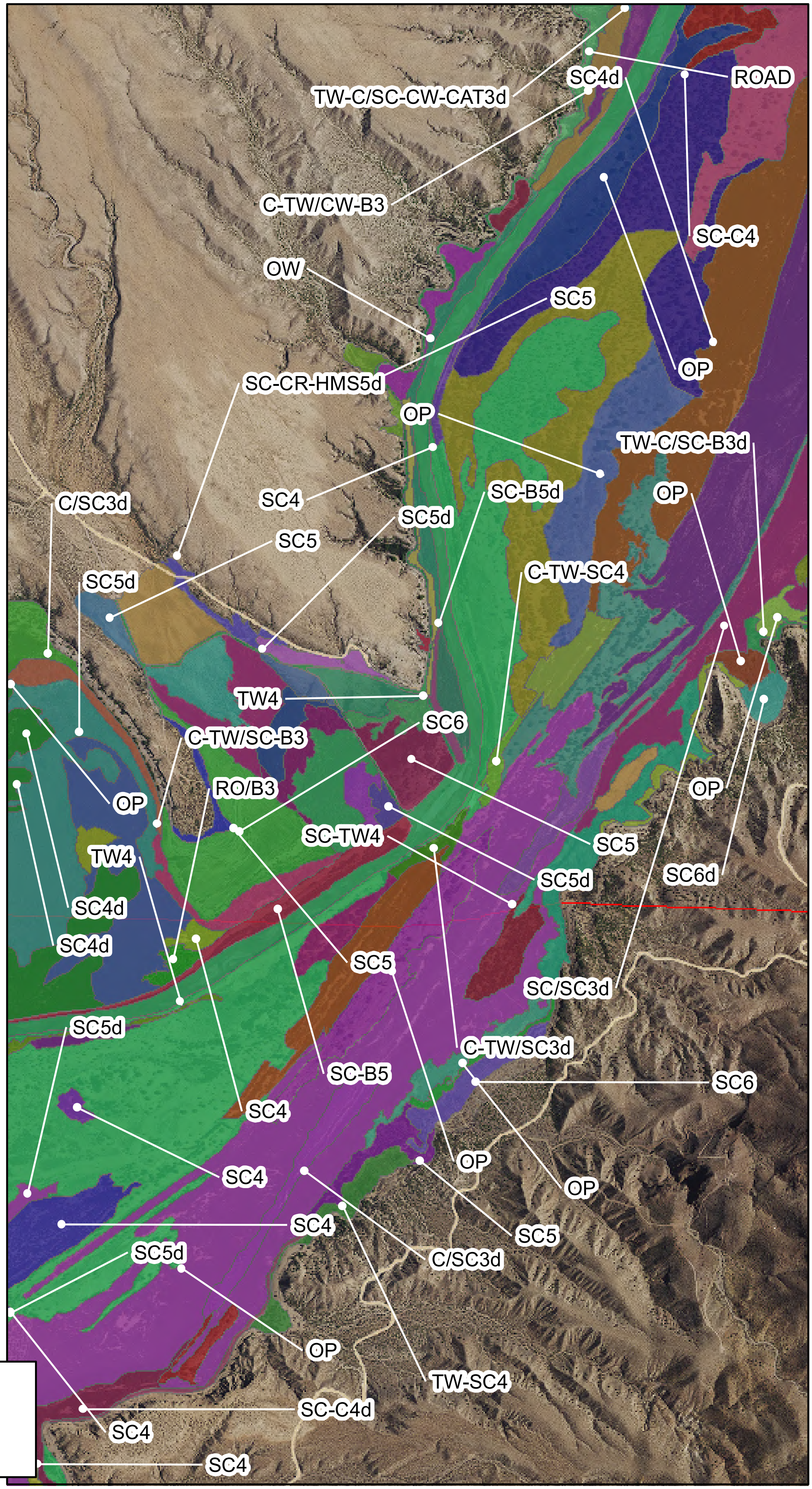
2016
Hink and Ohmart Vegetation Type



Locator Map


Socorro County


N
0 0.05 0.1 0.2
Mi


SC4d
ROAD
TW-C/SC-CW-CAT3d
C-TW/CW-B3
SC-C4
OW
SC5
OP
SC-CR-HMS5d
OP
TW-C/SC-B3d
SC4
SC-B5d
OP
C/SC3d
SC5d
SC5
C-TW-SC4
SC5d
TW4
SC6
C-TW/SC-B3
RO/B3
OP
OP
SC5
SC-TW4
TW4
SC5d
SC6d
SC4d
SC4d
SC5
SC/SC3d
SC5d
C-TW/SC3d
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SC6
SC4
OP
SC4
OP
SC4
SC5
C/SC3d
SC5d
OP
TW-SC4
SC-C4d
SC4
SC4