

APPENDIX 3

Connectivity Monitoring Workshop Materials



San Diego Management & Monitoring Program San Diego Connectivity Workshop

Date & Location:

Wednesday, 14 April 2010, 9am – 4pm
Ranch House at Los Penasquitos
12020 Black Mountain Road
San Diego, CA 92129
(858) 484-7504

Workshop Organizers (SDMMP):

Ron Rempel
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Jeff A. Tracey
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Yvonne Moore
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Technical Advisory Group:

Amy Vandergast, Landscape Geneticist, US Geological Survey
Rebecca Lewison, Professor of Biology, San Diego State University
Cheryl Brehme, Biologist, US Geological Survey
Clark Winchell, Biomonitor, US Fish and Wildlife Service

Invitees:

Andrew Bohonak, Barbara Kus, Brenda Johnson, Brian Root, Bruce April, Chris Brown, Clark Winchell, Dave Bittner, Doug Deutschman, Elise Watson, Erin Boydston, Grace Chung, Guy Bruyey, Jeff Pasek, Jerre Stallcup, Keith Greer, Kelsey Stricker (Moreno), Kris Preston, Lisa Lyren, Michael Klein, Monica Parisi, Randy Botta, Rebecca Lewison, Robert Fisher, Ron Swain, Rulon Clark, Scott Tremor, Seth Riley, Tom Oberbauer, Winston Vickers

Workshop Goals:

1. Prioritize linkages and species for connectivity monitoring,
2. Identify questions and objectives to be considered for connectivity monitoring of linkages and species, and
3. Identify available methodologies for addressing the questions and objectives

Role of Participants:

Provide their expertise regarding linkage and species priorities, monitoring questions to be addressed, and cost-effective methodologies. The input of the participants will be utilized to develop specific monitoring proposals for funding.

San Diego Connectivity Workshop

AGENDA

9:00-9:20AM

- Introductions & logistics (restrooms, food, exits etc.) - (Jeff)

9:20-10:00AM

- MSCP preserve assembly, cores and linkages, overview maps (Ron)
- Review workshop purpose & objectives, goals, roles of participants (Yvonne)

10:00-10:30AM

- Review selection criteria (Jeff)
 - Linkages
 - Species

10:30 – 10:45AM

BREAK

10:45 – 11:15AM

- Connectivity monitoring in South Coast Ecoregion (Yvonne)
 - CBI and SDTT
 - USGS – mtn lions, bobcats, coyote, herps, & others
 - NPS – mtn lions, bobcats, coyotes
 - UC Davis – mtn lion
 - Roadkill data
 - SDSU – culvert use
 - Others
 - What have we learned?

11:15 AM - 12:00PM

- Group Discussion – Review of Linkage Priorities
 - Conceptual and spatial models of connectivity (Jeff)
 - Core and Linkage Locations (Ron)
 - Condition of Cores and Linkages – size, permeability, habitats, barriers

12:00-12:45PM

LUNCH – to be provided (Rubio's)

12:45-2:15PM

- Species Prioritization: Break-Out Groups (Ron)
 - Large mammals (Doug)
 - Small animals (Becca)
 - Birds (Barbara)

 - What are the Questions specific to the species prioritized?
 - Cost-effective monitoring methodologies to answer questions
 - Need repeatable monitoring that can detect change
 - Basic questions to be answered:
 - Is it working?
 - Are the animals getting across?
 - Are they re-populating or just commuting?
 - Are they exchanging genetic material?
 - Is the use of the linkage changing through time?

2:15-2:30PM

BREAK

2:30-3:45PM

- Re-Group – Integrate Input on Linkages, Species, Questions and Methodologies (Doug)

3:45-4:00PM

WRAP-UP (Ron)

Connectivity Background

In San Diego County, hundreds of millions of dollars have been spent in assembling a regional preserve system. In order for the preserve system to provide the benefits anticipated in the various conservation plans, the plans assumed that core areas would be connected by habitat linkages. Over the past seven years, the assembly of cores and linkages has progressed significantly as has the science regarding how linkages connect core areas. Over the next ten years, tens of thousands of additional acres will be added to conserved core areas and linkages. These cores and linkages are intended to provide for the conservation of hundreds of species, many of them threatened or endangered.

The MSCP Biological Monitoring Plan (Ogden 1996) included provisions for monitoring corridors and all of the subarea plans adopted the monitoring requirements. The MHCP also included requirements to monitor linkages.

MSCP:

- MSCP Plan (Ogden 1998)
 - Generalized Core Biological Resource Areas and Linkages (Fig 2-2)
 - 16 Cores identified
 - 13 Internal Habitat Linkages
 - 11 External Linkages
 - Identified the need for wildlife corridor and dispersal investigations
- Biological Monitoring Plan (Ogden 1996) – Section 4.0 Corridor Monitoring
 - “First necessary to identify a group of focal target species” to evaluate corridors
 - Focal spp. CA gnatcatcher, CA cactus wren, mammalian predators (mtn lion, coyote and bobcat), and mule deer
 - Lists 29 monitoring locations for linkages; recommends looking for **presence** of focal species based on animal sign and visual sightings.
 - Recommended data collected on roadkill in the vicinity of linkages
 - Recommended 3-year cycle (same as for CSS birds)

MHCP:

- Biological Monitoring and Management Plan (CBI 2003) – Sec. 4.1 Wildlife Corridor
 - “It is assumed that the corridors allow both for intergenerational movement and gene flow between populations as well as provide habitat for individual animals.”
 - Focus: riparian corridors
 - Lists 16 monitoring sites within 6 creeks/watersheds
 - Two types of surveys: underpass pinch-point surveys (tracking stations and cameras) and roadkill surveys
 - Focal species: coyotes and smaller mammals, birds, herpetofauna, and invertebrates (e.g., butterflies); assumed mtn lion and deer not a major consideration for reserve design

Summary of Previous Studies in South Coast Ecoregion

- Baldwin Otay Ranch Wildlife Corridor Studies (Ogden 1992)
 - Surveyed use of identified corridors prior to Otay Ranch development
 - Evaluated wildlife corridors constrained by development outside Otay Ranch
 - Focal spp: mtn lion, deer, bobcat
 - Looked at spatial dimensions of 34 road underpasses (on 16 corridors) for animal sign (tracks, track plates, and scat) + roadkill (over 3 month period Apr-Jun 1992)
 - Detected use by target spp. on ~50% of corridors, deer most frequent, mtn lion least
 - Median length of constrained section of corridor for non-used corridor sections was 700ft; and those utilized by target spp. was 500ft

- Robert Fisher, Rulon Clark, Amy Vandergast – Landscape genetics
 - Vandergast et al. (2009) – Examined Jerusalem cricket genetic connectivity in Santa Monica Mtns and Simi Hills.
 - Genetic connectivity disrupted by highways and urban development.
 - Proposed flightless arthropods as sensitive indicator of fragmentation
 - Delaney et al (2010 in prep) – Examined genetic connectivity of 3 lizards and 1 bird (wren-tit) in the Santa Monica Mtn NRA.
 - All four spp. showed similar and significant reductions in gene flow over relatively short geographic and temporal scales; and significant reduction in gene flow from effects of intervening roads and freeways, the degree of patch isolation, and the time since isolation
 - Rulon Clark – SDSU proposal 2009
 - “Our project will provide an in-depth understanding of the degree to which key networks of preserved land in San Diego County are functionally linked”
 - use past tissue samples collected from key fragmented sites, supplemented with additional targeted sampling (pitfall drift-fence array)

- Crooks, Kevin (2002)
 - Examined presence of mammalian carnivores and birds as a function of patch size and isolation at numerous locations in Riverside, Orange, and San Diego Counties
 - Mtn lions need larger connected areas, bobcats need intermediate sized areas, coyotes occur in smaller and more isolated fragments

- Walter Boyce (UC Davis)
 - Pumas in San Diego County – GPS telemetry study
 - Pumas utilize large blocks of habitat but also do move through matrix areas

- Bobcats, coyotes, and pumas in LA and Orange County
 - USGS: Erin Boydston and Lisa Lyren (2006 and 2009) in Orange County – GPS telemetry study
 - Spp. utilized undercrossings, larger blocks and connected smaller fragments
 - Home ranges often delineated by roads and urban edges
 - NPS: Seth Riley (2006) in Santa Monica Mountains and Simi Hills
 - GPS telemetry and genetics
 - Movement occurring but populations show genetic separation

- No young dispersal
- Home range pile-up along freeways
- San Diego Tracking Team
 - Volunteer effort, detect select species presence based on tracking sign
 - Quarterly transects, over multiple years
 - Data analysis in Markovchick-Nicholls et. al. 2007:
 - Fragments of habitat may be important for some species if large enough
 - Coyote and mule deer are fairly adaptable to urbanization and may not be good indicators for determining utility of corridors for other species
 - Cougars, gray foxes, and bobcats are negatively associated with roads
 - No significant correlation was found between species presence or abundance with percent plant cover
- Conservation Biology Institute - Reports (2002, 2003a, 2003b)
 - 2003a - All 29 MSCP linkage monitoring locations field reviewed; included photos, maps, and monitoring and management recommendations
 - 2002 and 2003b:
 - Examined 10 of 29 MSCP linkage monitoring sites, plus 8 other sites, to determine what large mammals and mesopredators use the linkage & core areas
 - Used 3 methods: Track stations, Camera traps, SDTT sign transects – no one method totally reliable to detect presence of all species, need combination
 - Coyote detected at all 18 sites
 - Bobcat detected at 16 of 18 sites
 - Mule deer detected at 15 of 18 sites
 - Gray fox detected at 9 of 18 sites
 - Mtn lion detected at 7 of 18 sites
 - Ground squirrel detected at 7 of 18 sites
 - Also detected domestic dog, house cat, opossum, raccoon, striped skunk, and rabbit
 - Infer that the corridor is functional if demonstrated that a species uses or moves through the chokepoint
 - Included species management recommendations
- Roadkill: County of San Diego, City of San Diego, SDNHM Roadkill Atlas
 - Data collected since permit approval but not analyzed
- Highway widening studies, SR-67 (CBI 2002 draft)
 - Evaluated existing culverts across Hwy 67 between Mapleview at the San Diego River on the south and Dye Road in Ramona on the north
 - Identified conservation goals and objectives

Definitions

Term	Definitions
Core Area	Area generally supporting a high concentration of biological resources which, if lost or fragmented, could not be replaced or mitigated elsewhere (MSCP 1998, p. 2-9)
Linkage	Area of habitat that provides connectivity between core areas and provides breeding and foraging habitat for resident species (MSCP 1998 Biological Opinion, p. 11)
Corridor	Connections that allow for movement and dispersal only and are generally narrower in width than linkages (MSCP 1998 Biological Opinion, p. 11)
Crossing Area	Areas of cores, linkages, or corridors traversed by roads (undercrossings, overcrossings, bridges, etc.)
Chokepoint	“a portion of a wildlife corridor that is constricted, generally due to encroachment of adjacent development or other land uses” (CBI 2003)

Potential Focal Species

- Per Ogden 1996 Biological Monitoring Plan:
 - Coastal cactus wren
 - Coastal California gnatcatcher
 - Southern mule deer
 - Coyote
 - Bobcat

- Other Focal Species of Interest (see Table 1)
 - Large Mammals: Mtn lion, badger, gray fox
 - Small animals: arroyo toad, western toad, orange-throated whiptail, SD horned lizard, SD black-tailed jackrabbit, CA ground squirrel,
 - Birds: burrowing owl, SW willow flycatcher, least Bells' vireo, greater roadrunner

- Considerations
 - Connectivity studies for taxa other than mammals in SD County is lacking
 - Small species with small home ranges should be considered as well as large wide-ranging species
 - Species to be monitored will depend on core/linkage selected

Table 1. Potential Focal Species and their Presence in Cores

Common Name	Risk Grp	Scientific Name	PRESENCE IN CORES													
			1	2	3	4	5	6	7	8	9	10	11	12	13	
Small Animals																
Arroyo toad	2	<i>Bufo microscaphus californicus</i>	x	x												
Western spadefoot**		<i>Spea hammondi</i>	x		x	x	x	x					x			x
Orange-throated whiptail	3	<i>Cnemidophorus hyperythrus beldingi</i>	x	x	x	x	x		x			x	x			x
San Diego horned lizard	3	<i>Phrynosoma coronatum (blainvillei population)</i>	x	x	x	x	x	x					x			
Dulzura kangaroo rat**		<i>Dipodomys simulans</i>	x	x	x		x	x	x				x			x
San Diego black-tailed jackrabbit**		<i>Lepus californicus bennettii</i>	x	x	x		x		x							x
California ground squirrel**		<i>Spermophilus beecheyi nudipes</i>	x	x				x	x			x	x			x
Birds																
Western burrowing owl	1	<i>Speotyto cunicularia / Athene cunicularia hypugaea</i>	x				x									
Coastal cactus wren	1	<i>Campylorhynchus brunneicapillus sandiegensis</i>	x						x							x
Southwestern willow flycatcher	1	<i>Empidonax traillii extimus</i>														
Coastal California gnatcatcher	2	<i>Polioptila californica californica</i>	x	x		x						x				x
Least Bell's vireo	2	<i>Vireo bellii pusillus</i>	x													
Greater Roadrunner**		<i>Geococcyx californicus</i>	x	x	x	x	x	x	x			x				x
Large Mammals																
Southern mule deer	3	<i>Odocoileus hemionus fuliginata</i>	x	x	x	x	x		x			x	x			x
Mountain lion	3	<i>Puma concolor/felis concolor</i>	x	x		x		x								x
American badger	3	<i>Taxidea taxus</i>	?	x												
Coyote**		<i>Canis latrans</i>	x	x	x	x	x	x	x			x	x			x
Bobcat**		<i>Lynx rufus</i>	x	x	x	x	x	x	x			x				x
Gray fox**		<i>Urocyon cineroargenteus</i>	x	x		x	x	x	x							x

bold = listed as focal species to be monitored at the designated preserve habitat linkages (Ogden 1996)

** = not an MSCP covered species

Gray highlight = information not available at time of table creation

Conceptual Model(s)

Species and Animal Movement Behavior

Species may differ in:

- Basic modes of movement (walk, fly, swim)
- Movement behavior, perceptual and movement capability, and cognitive ability
- Passage species vs. corridor dwellers (Beier and Loe 1992)
- Habitat generalists versus specialists (correlated with geographic range)
- Area-sensitivity, which is related to body size, home range size, and dispersal distance
- Risk of mortality, including risks of human-caused mortality

Movement behavior

- Kinds of movement behaviors
- Characteristics of movement
- Movement response to landscape features

Landscapes

Three alternative approaches to represent landscapes:

- Landscape mosaic
- Gradient
- Network

Risk Factors

Potential Risks:

- Road mortality
- Human-wildlife conflicts
- Increased exposure to pollutants or toxins (e. g., bobcats consuming small mammals that have eaten rodenticides near urban areas)
- Predation (predation risk often higher while moving)
- Starvation
- Exposure

Preserve and Landscape Elements

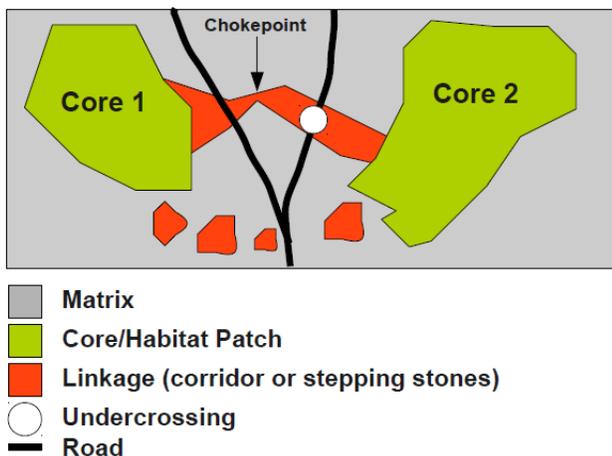


Table 2. Potential Data Collection Methods for Connectivity Monitoring

Method	Summary	Strengths	Weaknesses
Camera Stations	Remotely or time triggered cameras are placed at key locations where info on utilization by focal species is desired	Provides details (sex, age, groups, etc.) that may be missed by other methods, multiple species can be detected including non-targets, relatively low personnel effort after stations are established, volunteers can be utilized for memory card retrieval and battery replacement, pictures can be powerful evidence	Presence only, except possibly when placed at both openings of an undercrossing; may bias detection toward large animals; cameras often triggered by movement of vegetation, etc.; relatively small detection area per camera, equipment theft/vandalism
Track Stations	Tracking substrate (eg. gypsum, smoke plate) applied with or without scent lures to detect animal prints.	Low cost material; data on multiple species; area sampled can be adjusted based on field conditions	Presence only; temporal data not easily obtained; personnel time can be significant (must be checked regularly); tracking substrate can limit ability to detect; requires highly trained professional; limited number of species can be identified; statistical analyses and yr to yr comparisons difficult
Sign Tracking	Animal sign (scat, tracks, etc.) is surveyed for along transects	Low cost – especially if volunteer effort; movement of animals through an area can be detected	Specialized training required; strict protocols needed to ensure consistency; biased toward mammals; limited number of species can be identified; some substrates not suitable; temporal data not easily obtained; trail and road bias
Mark-recapture	Captured animals marked, released, and recaptured through time	Able to mark various-sized animals including very small; well-developed methods for estimating abundance	Low recapture rates; need to coordinate markings to avoid duplication; high effort, low return
Radio telemetry	Transmitters attached to animals and periodically relocated using radio frequency	Able to follow movement of individuals; can be used with smaller organisms than allowed by GPS tracking	Labor intensive; high cost; sometimes methodological difficulties with attaching or implanting transmitters; difficult to use on listed species
GPS telemetry	Transmitters with GPS attached to animals and data is periodically downloaded	Provides good spatial and temporal data, data analysis is straightforward; able to follow movement of individuals, often at high	Capture costs can be significant, downloading of data can be costly; in some cases terrain or vegetation obstruct

Method	Summary	Strengths	Weaknesses
		resolution over long duration; automated data collection and logging reduce human labor to acquire locations; transmitter retrieval is possible	reception and prevent locations from being acquired; collars are typically expensive (but can often be refurbished); in some cases, high rate of transmitter failure
Genetic sampling	Tissue, blood, fecal material is taken from animals and analyzed in the lab	Sample size needed can be pre-determined, data analysis relatively easy; detects relationships in populations over time; samples can often be obtained by passive methods or when animals are captured for other reasons; samples can be acquired from dead animals; investigations into genetics of pathogens may inform connectivity for hosts	For some species requires capturing of animals which can be costly; DNA analysis can be costly and/or slow; does not detect movement an individual; initially, methods need to be developed to process and amplify samples; primers must be developed and tested; slower response to landscape change
Roadkill Surveys	Information about dead animals along roads obtained	Provides positive information on where car/wildlife conflicts are occurring; the public can contribute information; low cost; data on multiple species	Accuracy of data depends on how it is collected; identifies only where animals are killed/injured and found/reported; likely undersamples small animals being killed; only provides information where animals cross roads at grade
Thread/Fluorescent Powder tracking	Animals dipped in fluorescent powder and/or thread attached and then released	Low cost; can be used with smaller organisms; movement of animals can be detected on a small scale	Can only follow animals over short distances; must capture organisms; only applicable for a limited number of species

Potential Near-Term Management Actions:

- CBI 2003 included habitat management recommendations applicable to culvert and bridge locations. A few examples:
 - Provide additional vegetative cover where needed to encourage passage (e.g., between the marsh habitat on either end of the I-5 bridges at Carmel Creek).
 - Maintain irrigation systems to ensure that the culverts do not fill with water.
 - Remove debris in the creek and adjacent to the creek or culvert to decrease flooding of the corridor. Control the abundance of vegetation under bridges to maintain passable areas for wildlife (e.g., Pomerado Road, I-5/I-805 merge).
 - Fence the open space linkage to preclude motor vehicles and bikes and to keep wildlife off roads (e.g., I-5/I-805 merge, Del Mar Mesa, Shaw Valley).
 - Install new wing fencing or ensure that existing wing fencing extends far enough on either side of the underpass or culvert (e.g., Pomerado Road, Scripps-Poway Parkway).
 - Remove fencing that may restrict movement (e.g., Shaw Valley and the eastern, undeveloped portion of Del Mar Mesa).
 - Erect signs that prohibit dumping of trash in the linkage area, and enforce dumping restrictions.

References for Workshop Materials (ftp site to be provided 4/8/2010)

1. Conservation Biology Institute (2002) Wildlife corridor monitoring study for the multiple species conservation program. Prepared for City of Poway City of San Diego, California Department of Fish and Game. Encinitas, CA.
2. Conservation Biology Institute (2003a) Review of regional habitat linkage monitoring locations, Multiple species conservation program. January 2003. Prepared for California Department of Fish and Game NCCP Local Assistance Grant #P0050009. Encinitas, CA.
3. Conservation Biology Institute (2003b) Wildlife Corridor Monitoring Study, Multiple Species Conservation Program. March 2003. Prepared for California Department of Fish and Game NCCP Local Assistance Grant #P0050009. Encinitas, CA.
4. Conservation Biology Institute (2002) Highway widening studies, SR-67. *Draft*
5. Crooks, K. (2002) Relative sensitivities of mammalian carnivores to habitat fragmentation. *Conservation Biology* 16(2): 488-502.
6. Delaney, K.S., S.P.D. Riley, R.N. Fisher (2010) A rapid, strong, and convergent genetic response to urban habitat fragmentation in four divergent and widespread vertebrates. (in prep)
7. Lyren, L. M., R. S. Alonso, K. R. Crooks, and E. E. Boydston. 2009. Evaluation of functional connectivity for bobcats and coyotes across the former El Toro Marine Base, Orange County, California: Administrative report delivered to cooperator Jan. 20, 2009, 179 p. [Administrative Report]
8. Lyren, L. M., G. M. Turschak, E. S. Ambat, C. D. Haas, J. A. Tracey, E. E. Boydston, S. A. Hathaway, R. N. Fisher, and K. R. Crooks. 2006. Carnivore activity and movement in a Southern California protected area, the North/Central Irvine Ranch. U.S. Geological Survey Technical Report, 115 p. [Technical Report]
9. Ogden Environmental and Energy Services (1992) Baldwin Otay Ranch Wildlife Corridor Studies. San Diego, CA
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12. Vandergast, A. E.A. Lewallen, J. Deas, A.J. Bohonak, D.B. Weissman, R.N. Fisher. 2009. Loss of genetic connectivity and diversity in urban microreserves in a southern California endemic Jerusalem cricket (Orthoptera: Stenopelmatidae: *Stenopelmatius* n. sp. "santa monica"). *J Insect Conserv* (13): 329-345.

Other Relevant Literature

- Beier and Loe (1992) A checklist for evaluating impacts to wildlife movement corridors. *Wildlife Society Bulletin* 30: 434 – 440.
- Beier, P and R. F. Noss (1998) Do habitat corridors provide connectivity? *Conservation Biology* 12(6): 1241 – 1252.
- Crooks, K R and M Sanjayan (2006) Connectivity conservation: maintaining connections for nature. In *Conservation Connectivity*. Crooks and Sanjayan eds. Cambridge.
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- Krebs, C (1994) *Ecology: The Experimental Analysis of Distribution and Abundance*. Harper Collins.
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San Diego Connectivity Science Forum



*San Diego Management &
Monitoring Program*

SDMMP Connectivity Monitoring

Goals of Connectivity Monitoring

- **Basic questions to be answered:**
 - **Is it working? [i.e. core areas, linkages]**
 - **Are the animals getting across?**
 - **Are they re-populating or just commuting?**
 - **Are they exchanging genetic material?**
 - **Is the use of the linkage changing through time?**

Monitoring Connectivity

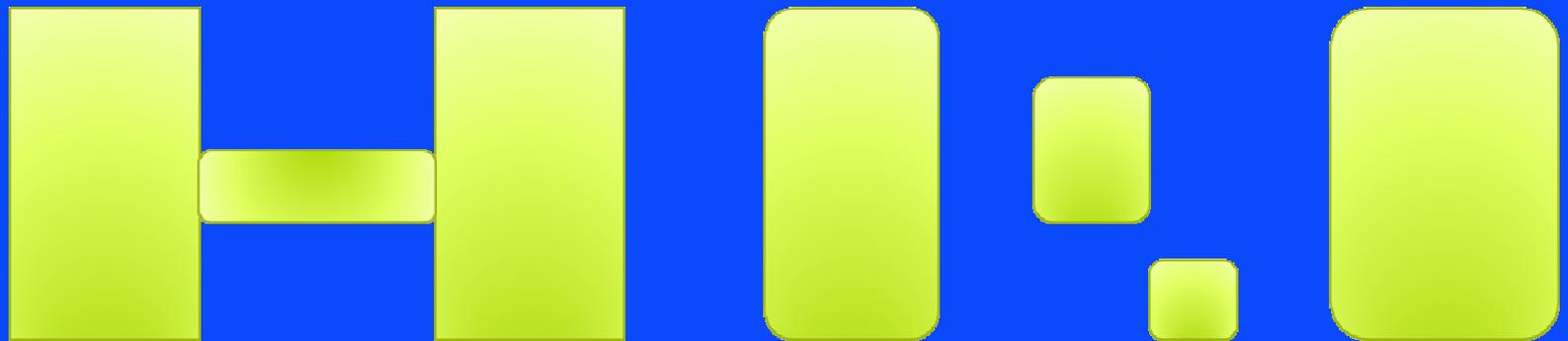
Geographic Area- San Diego County

Current Resources - \$300K

- **Design and Implement Monitoring**
- **Research/Studies**
 - **Test methodologies**
 - **Identification of crossing issues**
 - **Other**
- **Crossing Improvements**
 - **Fencing**
 - **Culvert clearing/cover establishment**
 - **other**

Linkages, corridors and Crossings

- Linkages



Cores, Linkages and Crossings

- Corridor



Cores, Linkages and Crossings

- Crossing

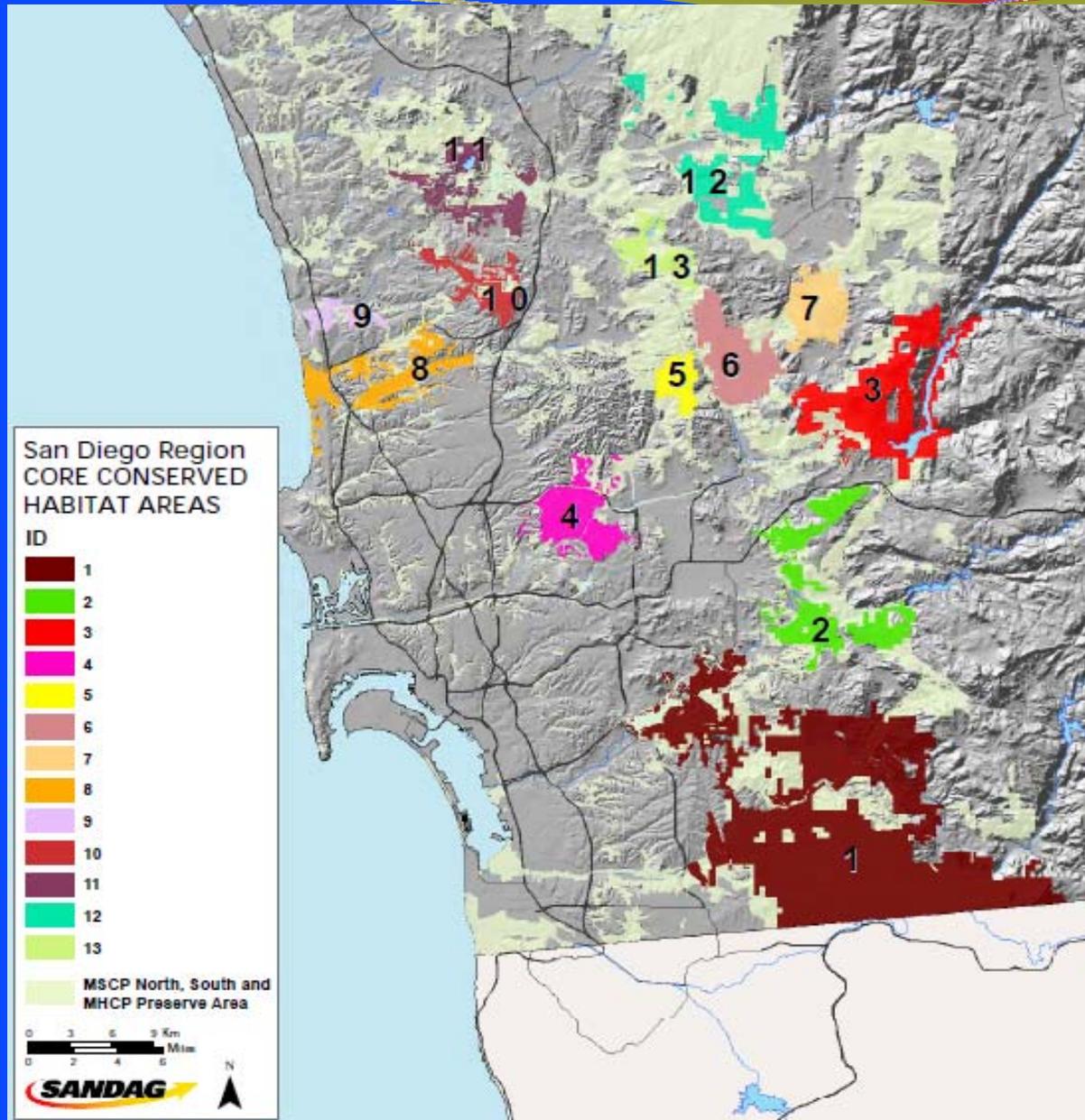


Why Connected?

- Ecosystem Function
- Resilience to stochastic events
- Gene flow
- Resilience to climate change
- Daily and annual habitat requirements
- Dispersal/population maintenance

Existing Cores

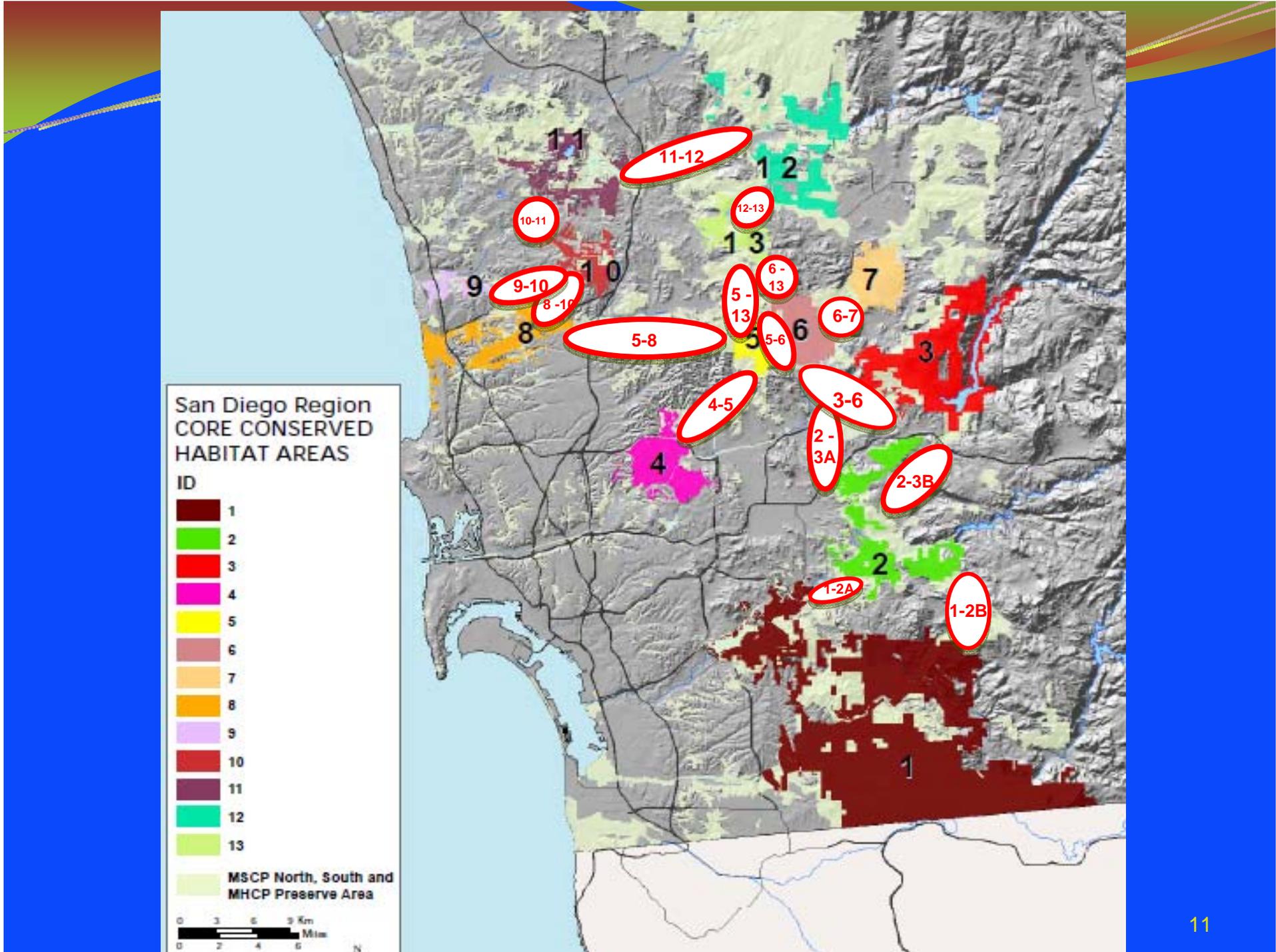
- Maps
 - Core
 - Linkages
- Plans determined that they must be linked



SDMMP Linkage Monitoring

Currently Conserved Acres- Core Areas

Core Area	Acreage	Core Area	Acreage
1	57,060	8	6,730
2	9,606	9	1,422
3	15,483	10	3,530
4	6,264	11	5,182
5	2,295	12	8,244
6	7,203	13	3,228
7	5,199	Total	131,452



Core Areas

- Connected or
- Not Connected?
- That is the question
- Answers vary by species and core area

Which corridors and/or crossings are most important/critical?

- Why?
 - Importance of cores they connect
 - What species are present
 - Potential for stressor impacts
 - Fire
 - Drought
 - Development
 - Existing, new and expanded roads

Most Important Linkages

- **Diversity of species and habitats within Cores connected by a linkage**
- **Level of conservation in connected cores**
- **Level of conservation within linkage area**
- **Elevational gradient connected**
- **Threats to linkage**
 - **Immediacy**
 - **severity**

Which Species and Why?

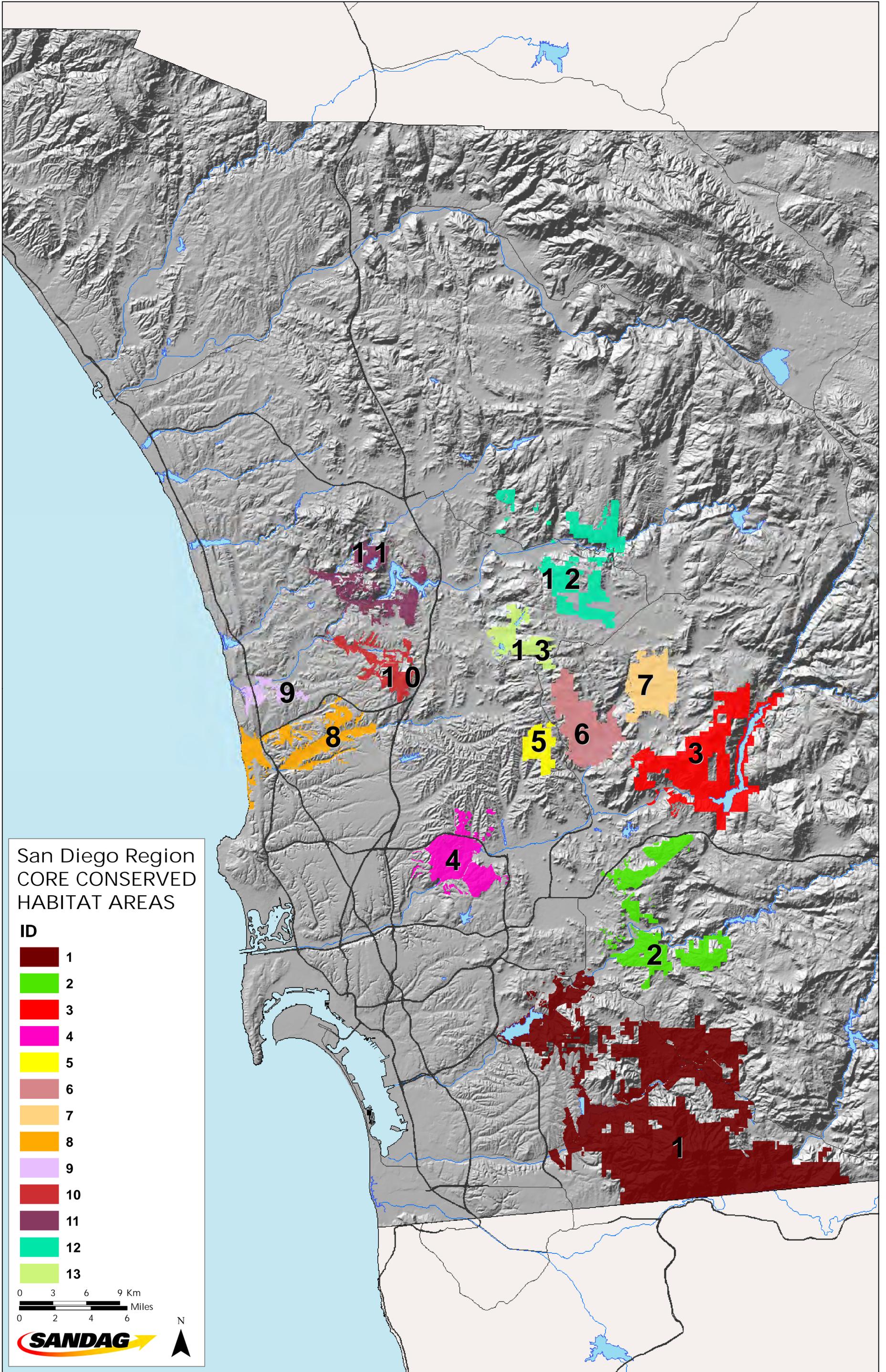
- **Ecosystem services**
- **Listed**
- **Vulnerability to change**
- **Umbrella for others**
- **Facilitates implementation of specific monitoring protocol**
 - **Little to no permitting requirements**
 - **Sample size**
 - **Etc.**

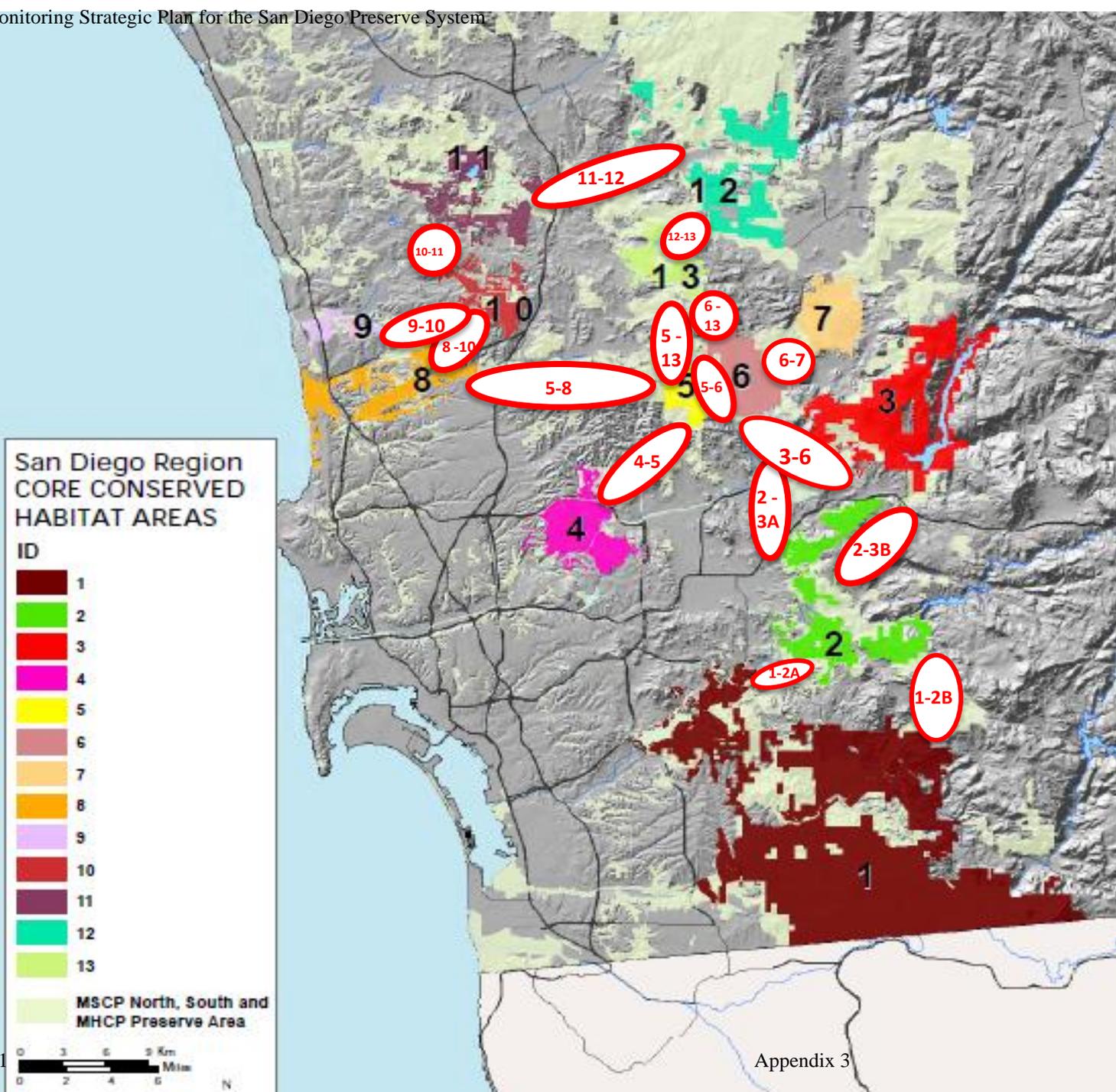
What are the specific questions?

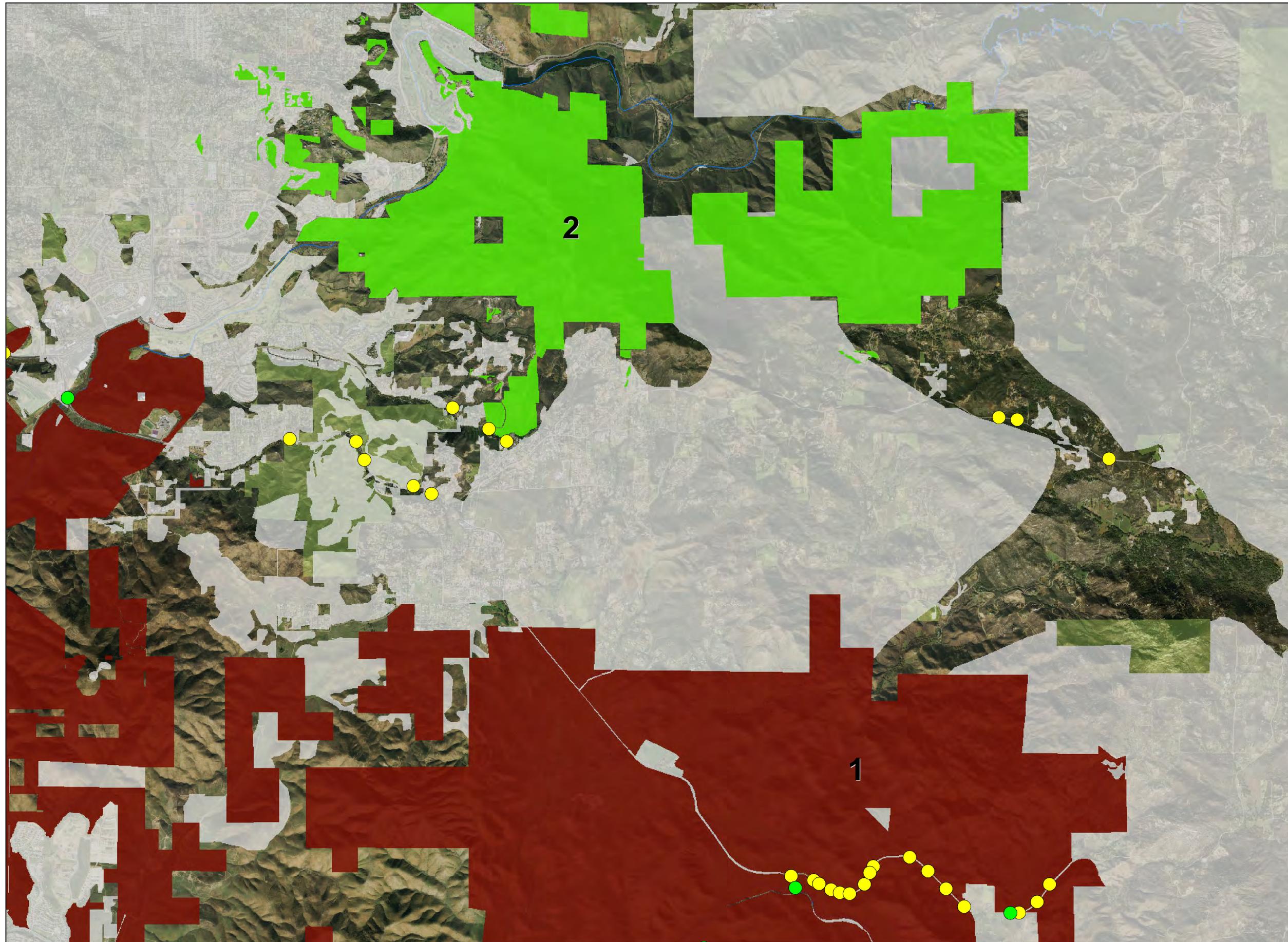
- **Today**
- **Tomorrow**
- **Next 5 Decades**

What Methodologies to Answer the Question(s), Cost/Value?

- **Genetics**
- **Camera stations**
- **Tracking**
- **Telemetry**
- **Banding**
- **Stable Isotopes**
- **Others/Combinations**

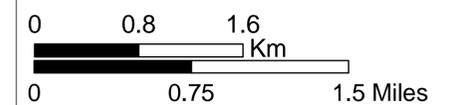


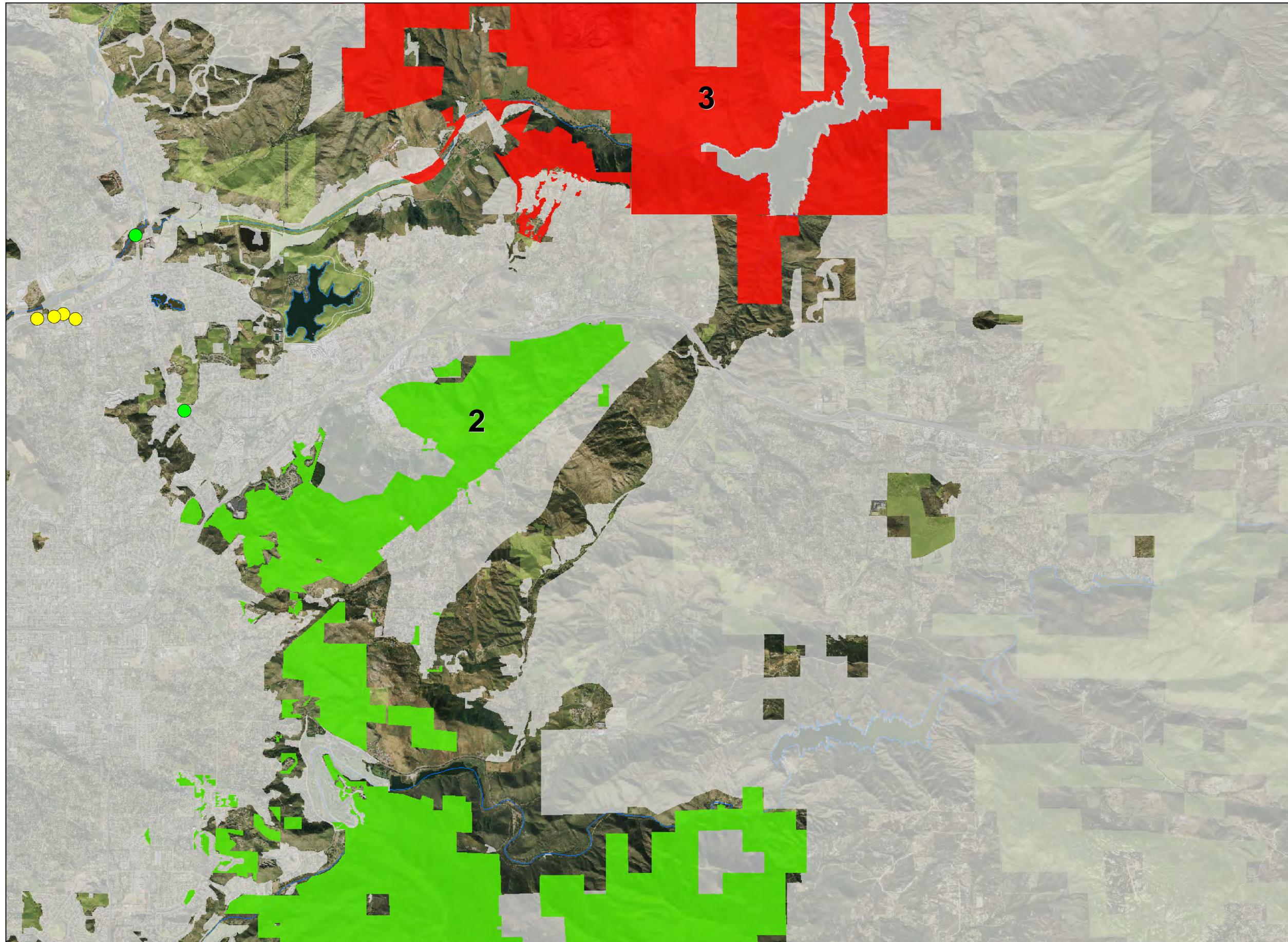




San Diego Region
Conserved Habitat Linkage:
Core Areas 1 and 2

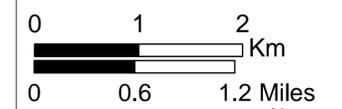
- Bridges
- Culverts
- Core Area 1
- Core Area 2
- Outside MSCP North, South, or MHCP Preserve Area
- Conserved Land

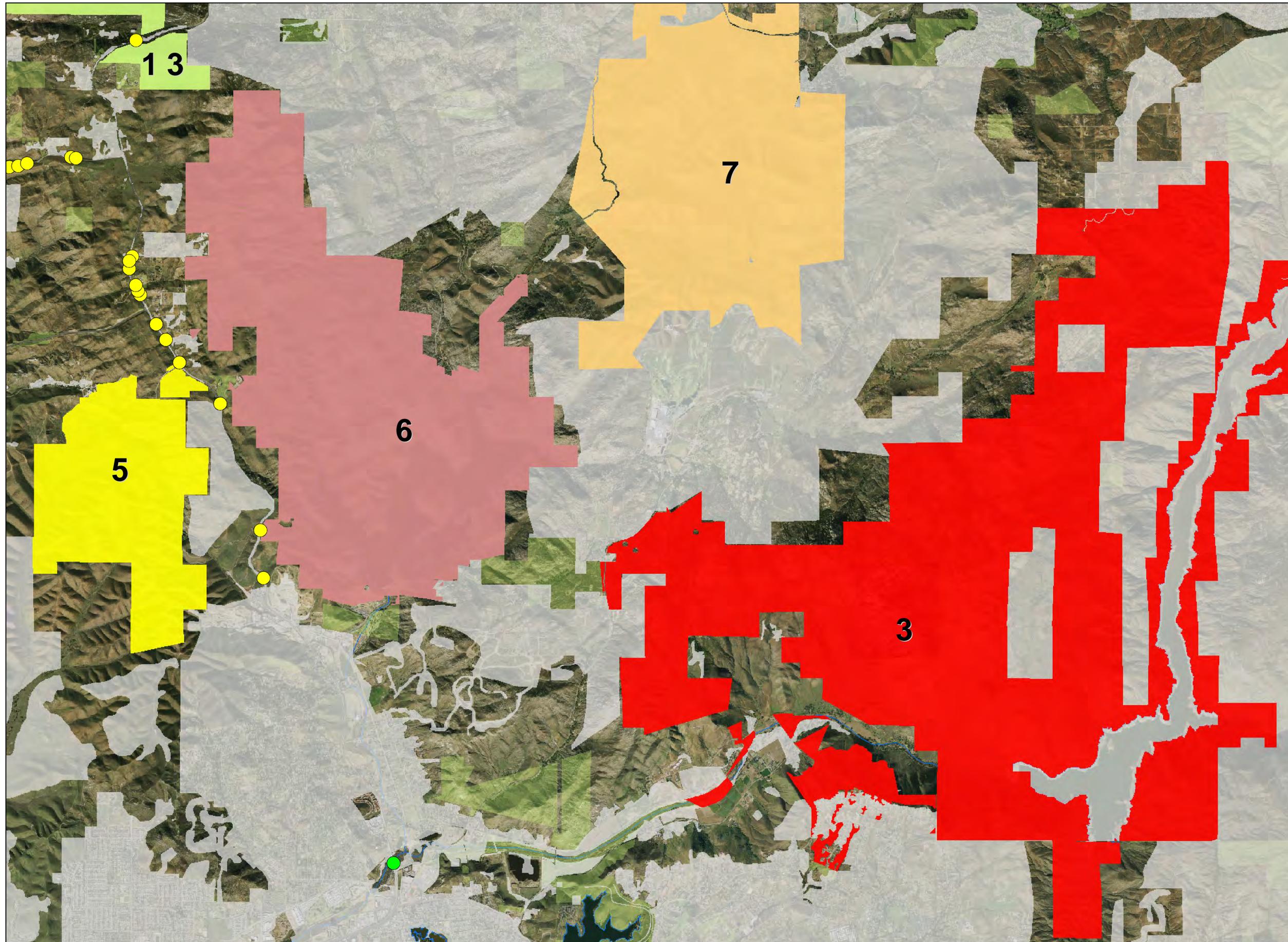




San Diego Region
Conserved Habitat Linkage:
Core Areas 2 and 3

- Bridges
- Culverts
- Core Area 2
- Core Area 3
- Outside MSCP North, South, or MHCP Preserve Area
- Conserved Land



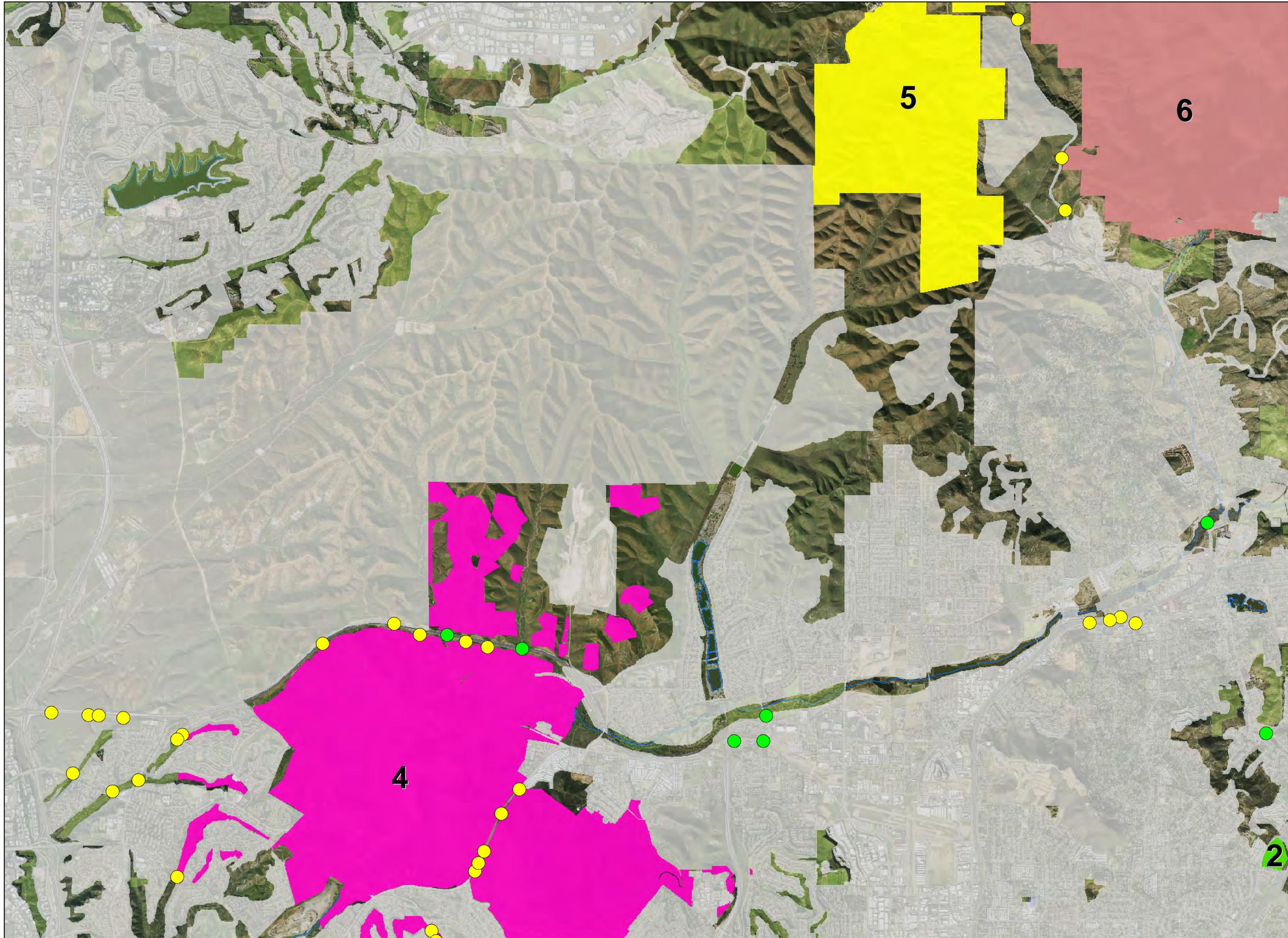


San Diego Region
Conserved Habitat Linkage:
Core Areas 3, 5, 6, and 7

- Bridges
- Culverts
- Core Area 3
- Core Area 5
- Core Area 6
- Core Area 7
- Outside MSCP North, South, or MHCP Preserve Area
- Conserved Land

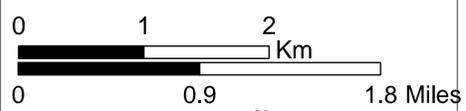
0 1 2 Km
0 0.8 1.6 Miles

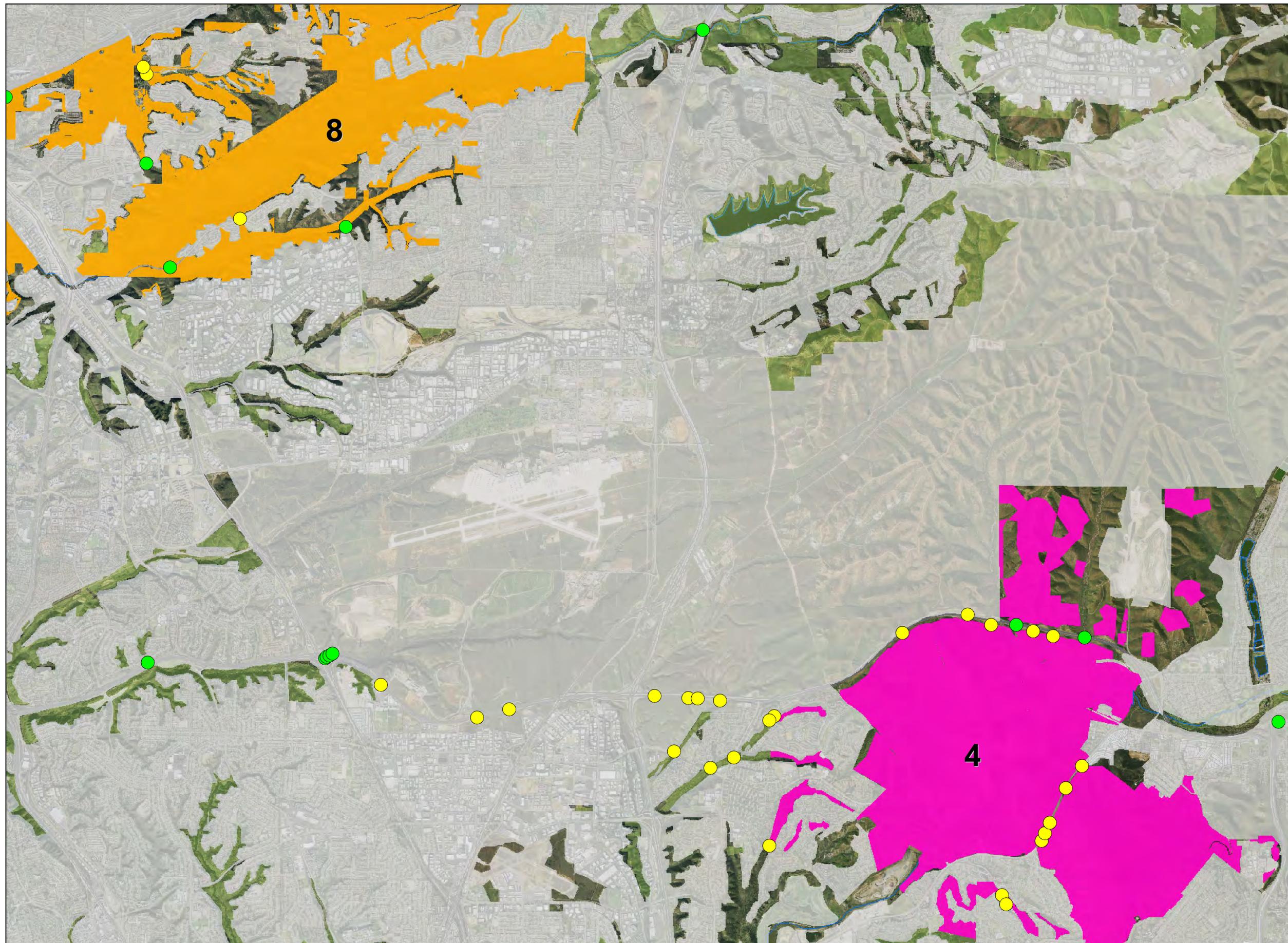
SANDAG N



San Diego Region
Conserved Habitat Linkage:
Core Areas 4, 5, and 6

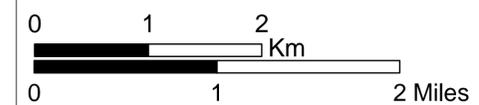
- Bridges
- Culverts
- Core Area 4
- Core Area 5
- Core Area 6
- Outside MSCP North, South, or MHCP Preserve Area
- Conserved Land

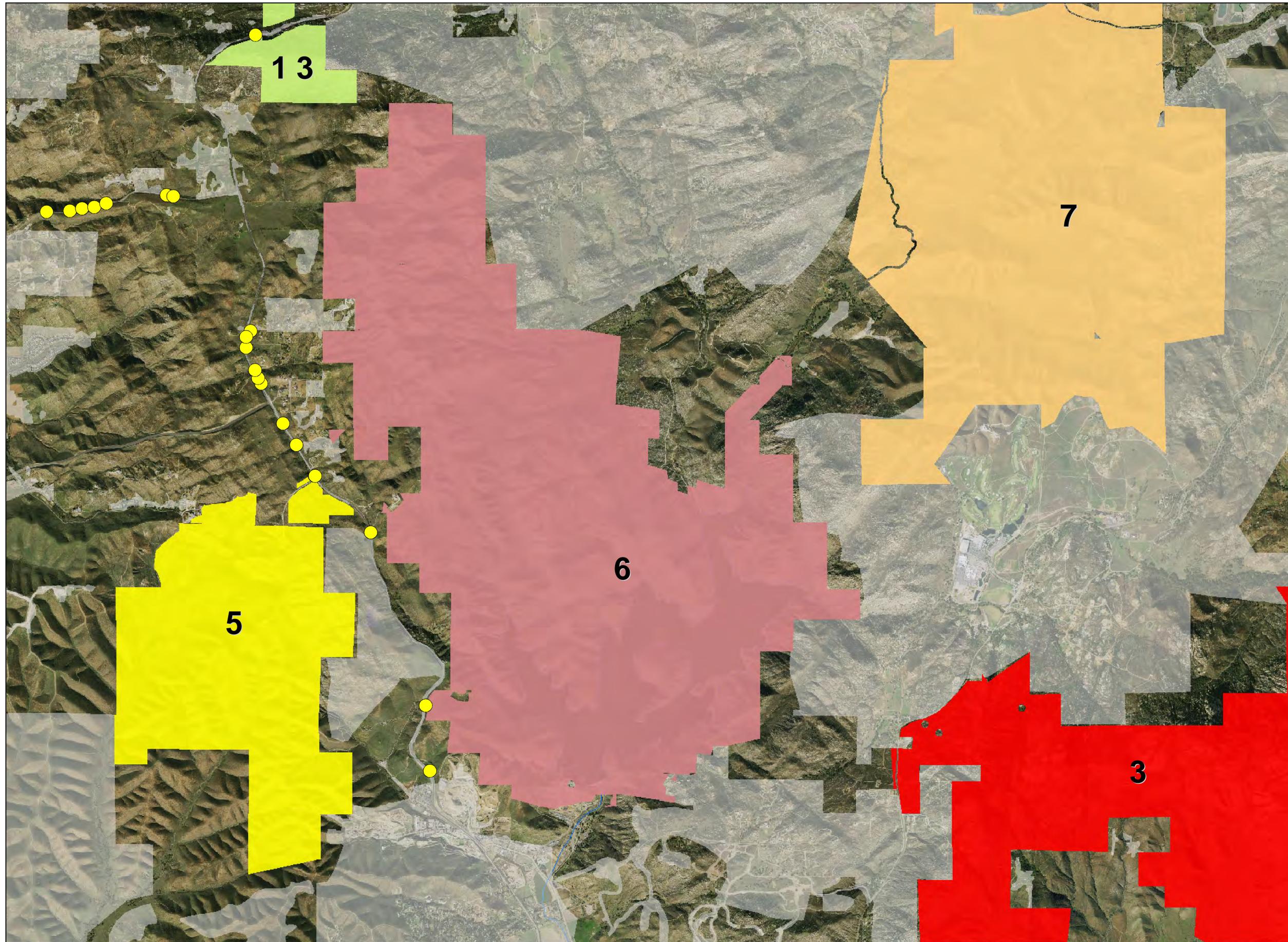




San Diego Region
Conserved Habitat Linkage:
Core Areas 4 and 8

- Bridges
- Culverts
- Core Area 4
- Core Area 8
- Outside MSCP North, South, or MHCP Preserve Area
- Conserved Land

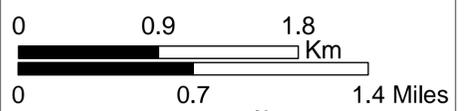


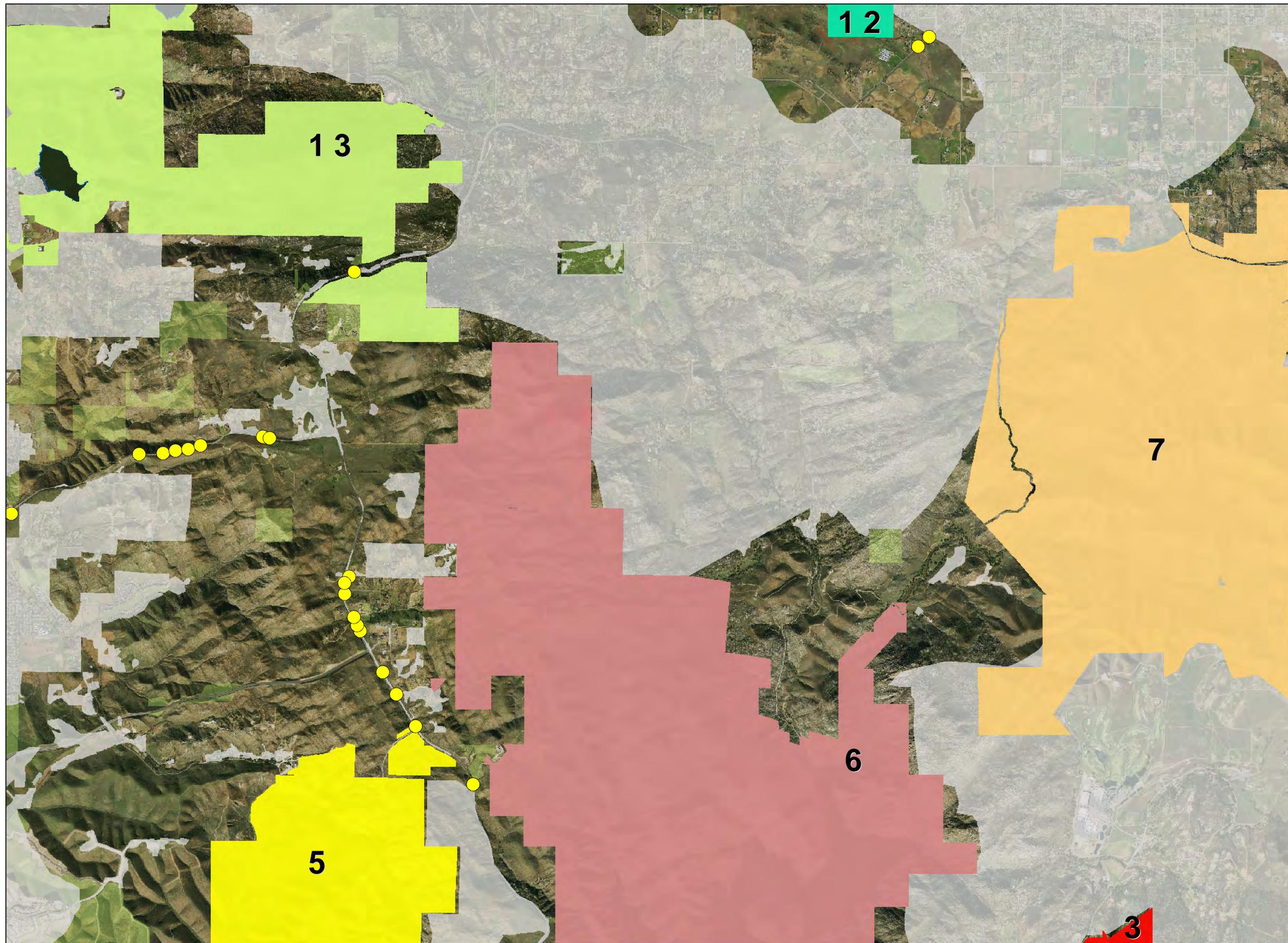


San Diego Region
Conserved Habitat Linkage:
Core Areas 5, 6, and 7

- Bridges
- Culverts
- Core Area 3
- Core Area 5
- Core Area 6
- Core Area 7
- Core Area 13

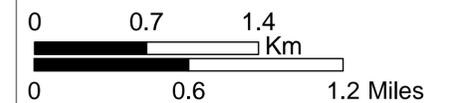
■ Outside MSCP North, South,
or MHCP Preserve Area

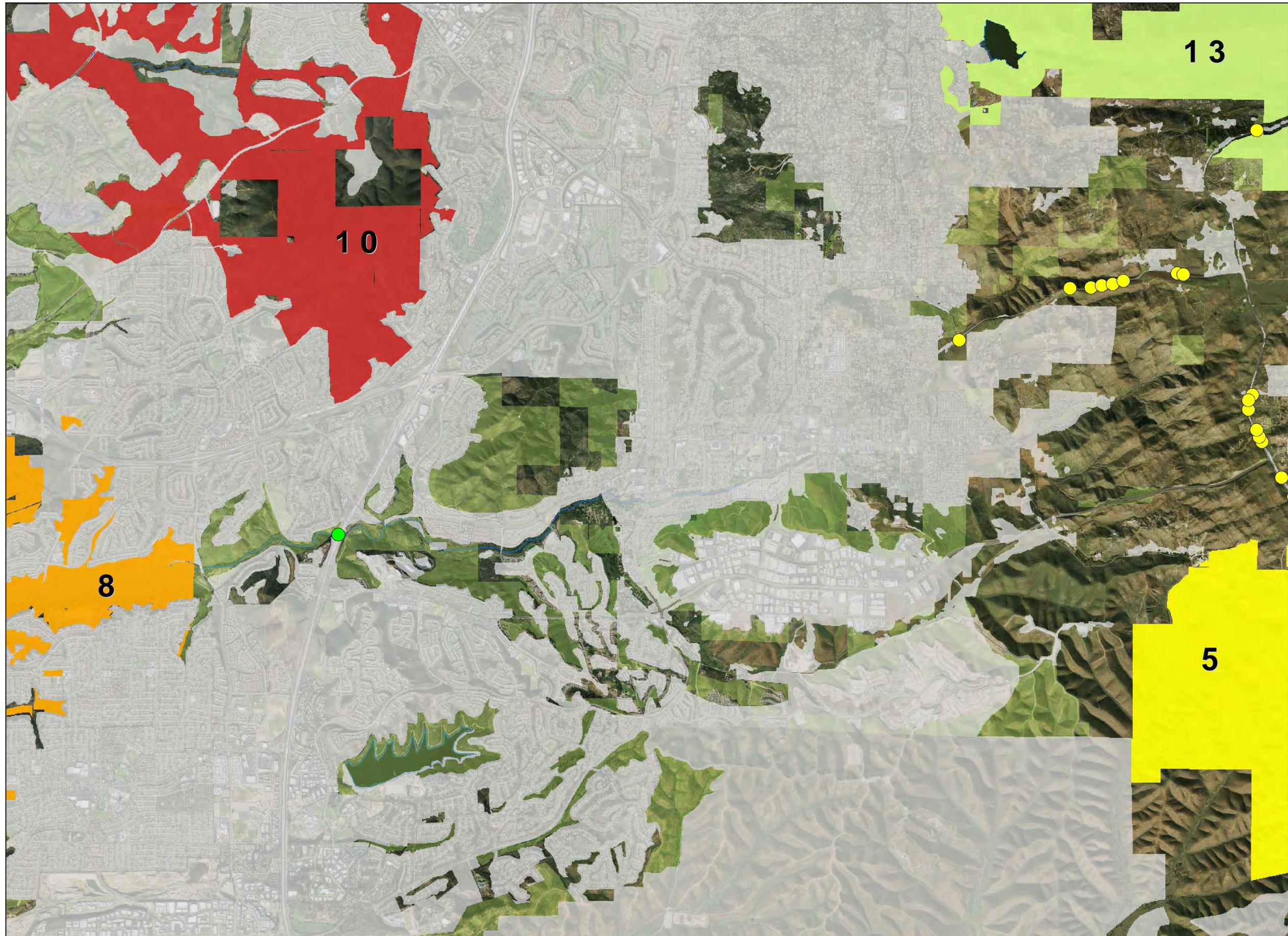




San Diego Region
Conserved Habitat Linkage:
Core Areas 5, 6, 7, and 13

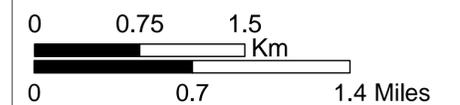
-  Bridges
-  Culverts
-  Core Area 5
-  Core Area 6
-  Core Area 7
-  Core Area 13
-  Outside MSCP North, South, or MHCP Preserve Area
-  Conserved Land

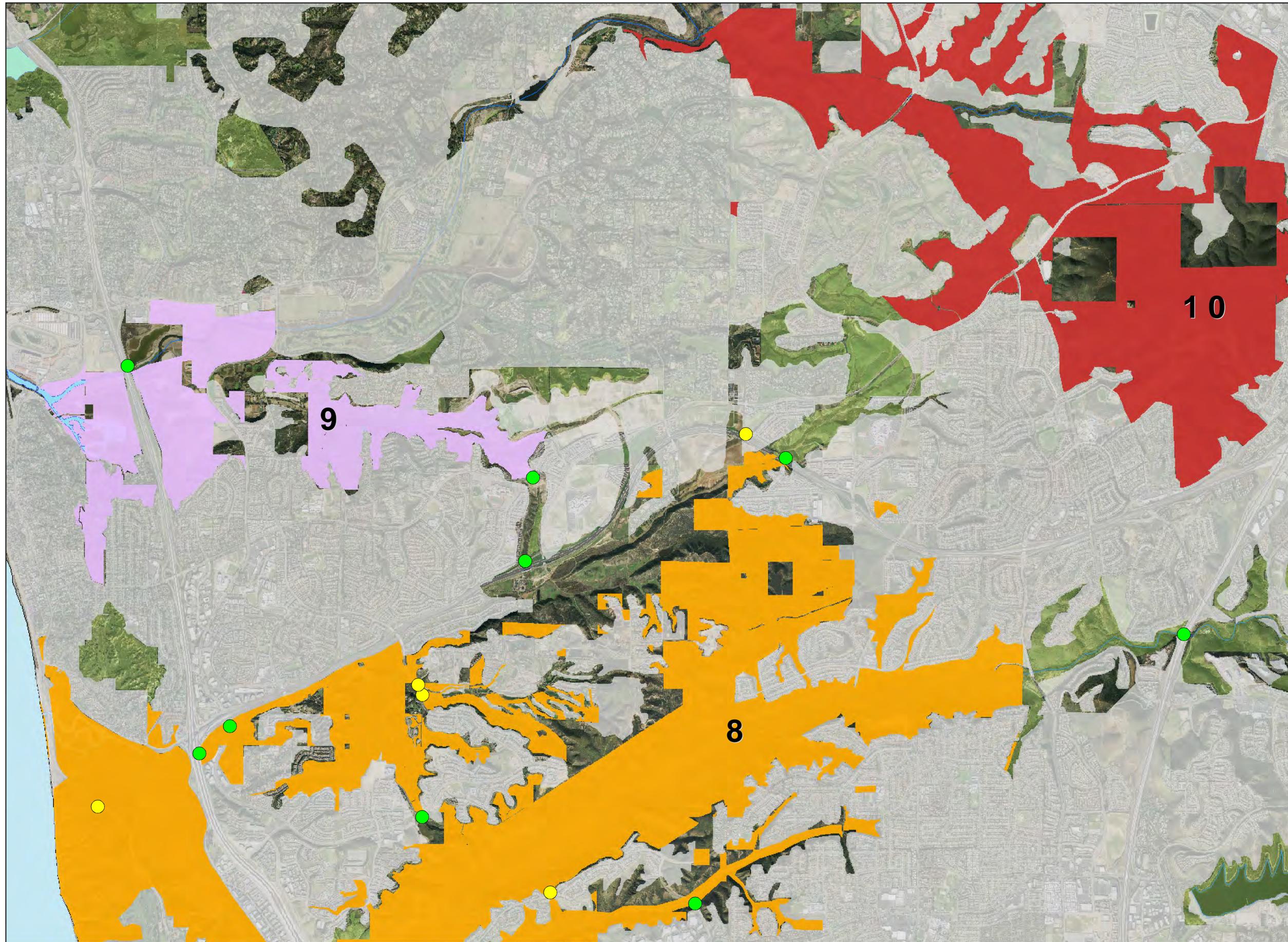




San Diego Region
Conserved Habitat Linkage:
Core Areas 5, 8, 10, and 13

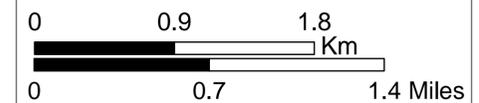
- Bridges
- Culverts
- Core Area 5
- Core Area 8
- Core Area 10
- Core Area 13
- Outside MSCP North, South, or MHCP Preserve Area
- Conserved Land

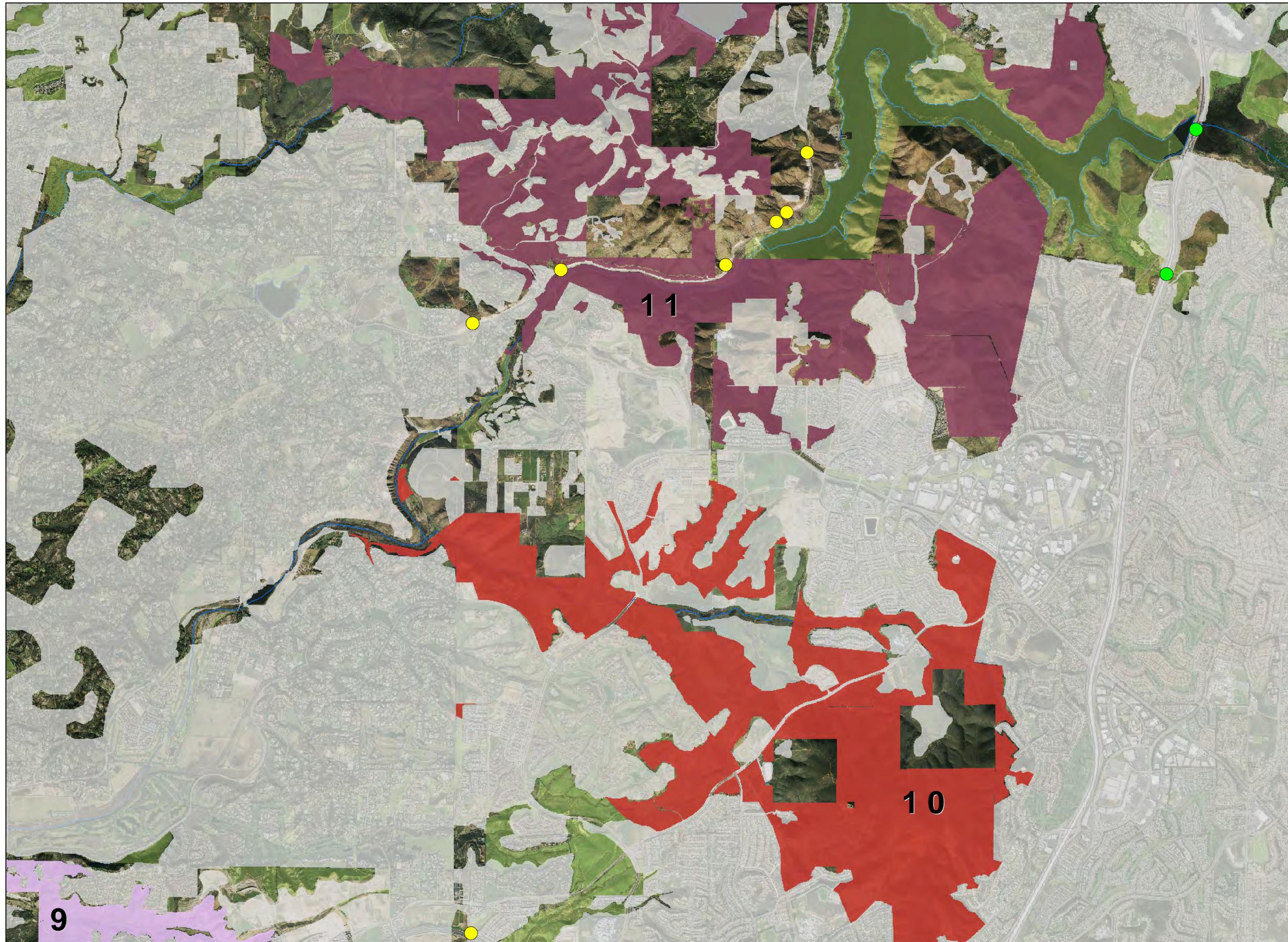




San Diego Region
Conserved Habitat Linkage:
Core Areas 8, 9 and 10

- Bridges
- Culverts
- Core Area 10
- Core Area 9
- Core Area 8
- Outside MSCP North, South, or MHCP Preserve Area
- Conserved Land

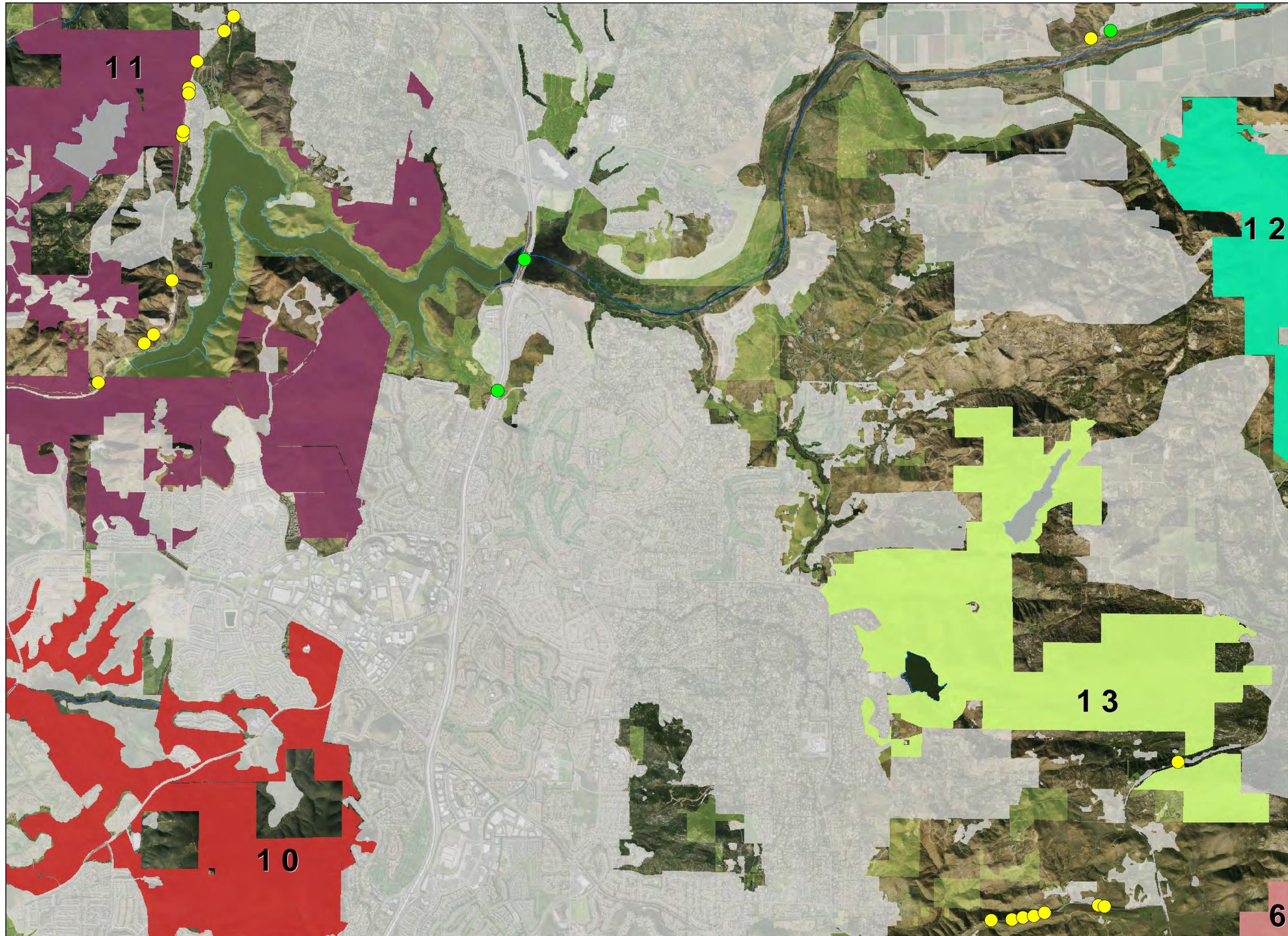




San Diego Region
Conserved Habitat Linkage:
Core Areas 10 and 11

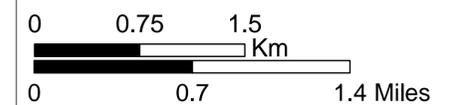
- Bridges
- Culverts
- Core Area 10
- Core Area 11
- Outside MSCP North, South, or MHCP Preserve Area
- Conserved Land

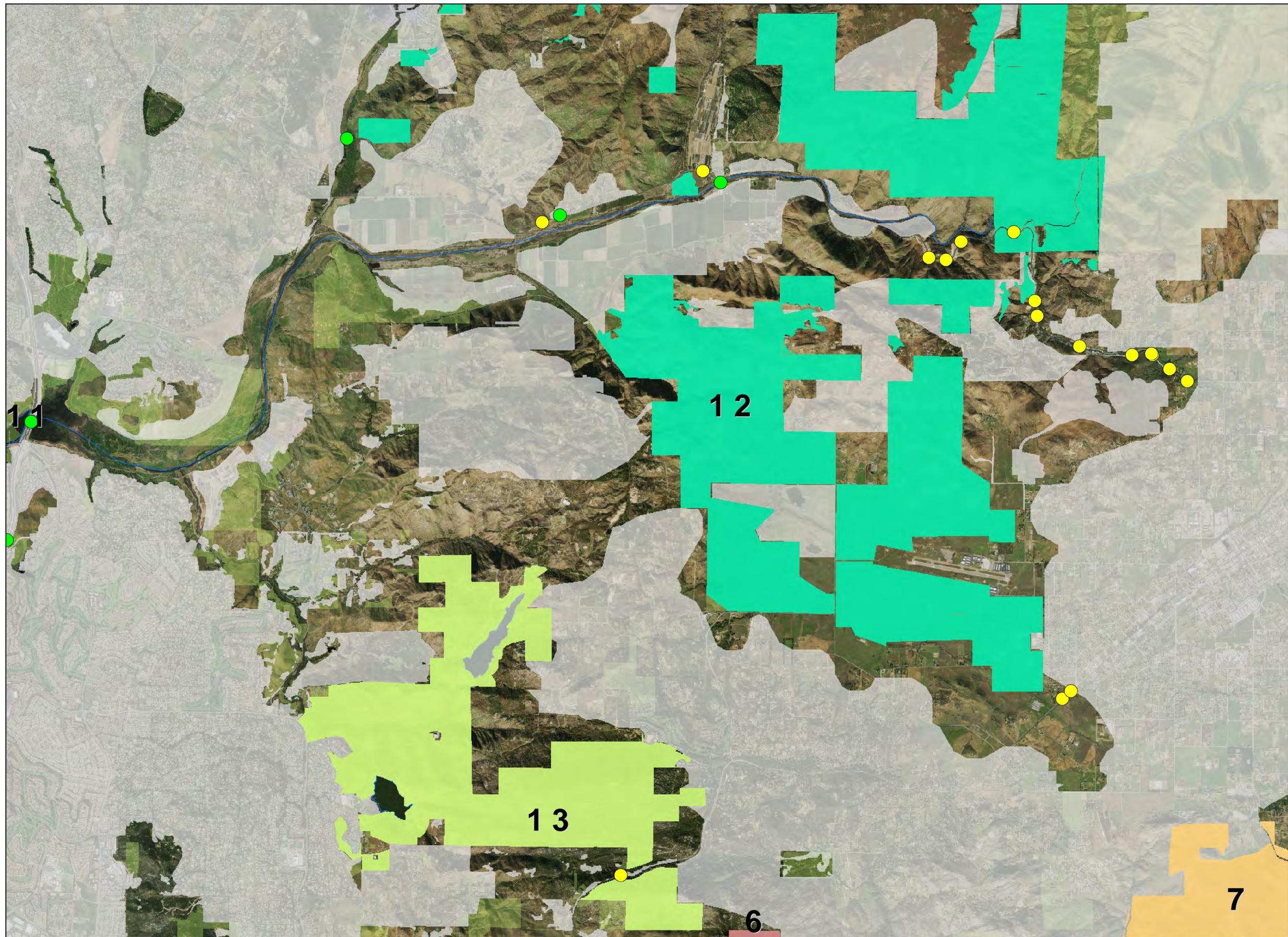




San Diego Region
Conserved Habitat Linkage:
Core Areas 10, 11, 12, and 13

-  Bridges
-  Culverts
-  Core Area 10
-  Core Area 11
-  Core Area 12
-  Core Area 13
-  Outside MSCP North, South, or MHCP Preserve Area
-  Conserved Land





San Diego Region
Conserved Habitat Linkage:
Core Areas 12 and 13

- Bridges
- Culverts
- Core Area 12
- Core Area 13
- Outside MSCP North, South, or MHCP Preserve Area
- Conserved Land

