Bay Area Aquatic Resources Inventory (BAARI)

STANDARDS AND METHODOLOGY FOR STREAM NETWORK, WETLAND AND RIPARIAN MAPPING

WETLAND REGIONAL MONITORING PROGRAM (WRMP)
San Francisco Estuary Institute
Contribution No. 756
Revised August 9, 2011

Table of Contents

Purpose

The purpose of this document is to describe the mapping standards and methods used to develop the Bay Area Aquatic Resources Inventory (BAARI). BAARI is a dataset of tidal and non-tidal aquatic systems and riparian functional areas in the San Francisco Bay Region. BAARI was developed as part of the Wetland Regional Monitoring Program (WRMP) at the San Francisco Estuary Institute (SFEI).

The BAARI standards have been developed as part of the WRMP and were funded by the California Coastal Non-point Source Pollution Control Program to demonstrate a comprehensive approach to monitoring and assessment of wetlands and related habitats and projects in the San Francisco Bay Area. This project is being coordinated with a companion project conducted by the Southern California Coastal Water Resources Project (SCCWRP) for the Southern California Bight.

For more information on California wetland mapping projects visit:

- WRMP – www.wrmp.org/prop50
- Southern California Wetlands Mapping Project - www.socalwetlands.com
- California Wetland Tracker – www.californiawetlands.net

This project was established to meet regional needs for wetlands monitoring. One primary objective was to apply standardized monitoring tools to ensure data comparability and consistent, documented quality. These data could help agencies and organizations including the Regional and State Water Boards, Coastal Conservancy, BCDC, local water agencies, watershed stewardship groups and other coastal zone managers assess the extent and condition of wetlands in local watersheds and identify and prioritize opportunities for ecological restoration and enhancement in a watershed context.

Statewide and regional teams of scientists and agency staff have been developing standardized wetland assessment and tracking tools modeled after EPA's three-level framework specifically for the habitats found in California. This pilot applied and advanced the 1-2-3 toolkit to the region's wetlands. This approach is consistent with the California Water Quality Monitoring Council's mandate to standardize water quality monitoring methods across the state.

The 1-2-3 framework is especially useful in that it allows us to look at the answers to questions on multiple scales – from landscape level to site level, general wetland health to detailed function. This approach provides a deeper understanding our resources and can shed light on how best to manage them.

The three levels of the 1-2-3 framework are as follows:

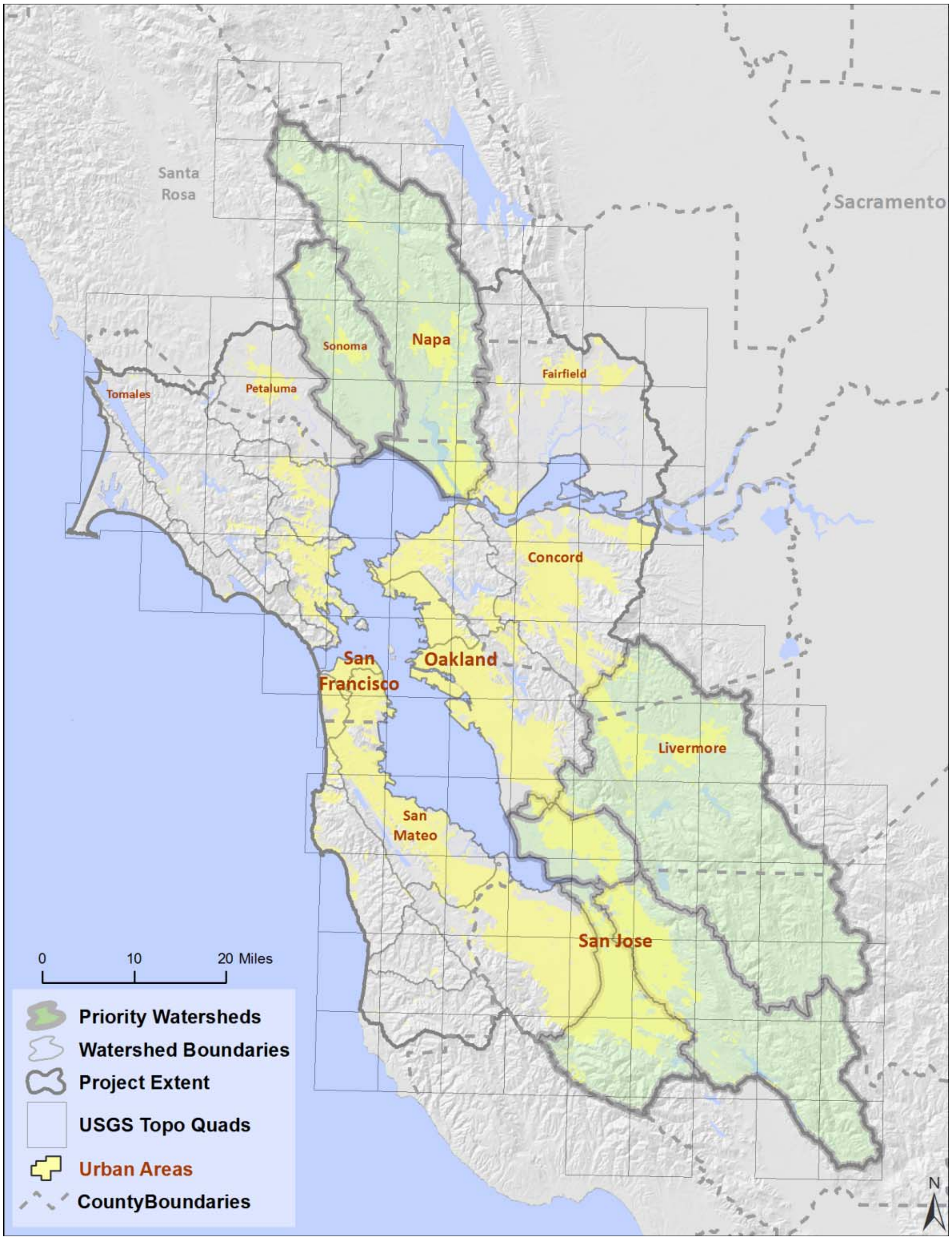
Level 1 involves landscape level analyses of wetlands extent. Geographic information systems (GIS) and remote sensing are used to map and create inventories of existing wetlands (both modern and historical). These inventories quantify the extent of wetland habitats and projects, and can be used for landscape profiles wetlands at the state, regional, watershed, and local scales.

Level 2 entails rapid field assessment of wetland health or condition. In California, the method applied is the California Rapid Assessment Method (CRAM). CRAM is a diagnostic tool that two or more trained practitioners can use to assess the condition of a wetland or riparian site in one half day or less using visual indicators in the field. These field sessions provide an assessment of condition as a CRAM score relative to a wetland's maximum achievable condition. CRAM is applicable to all wetland types and is highly cost-effective.

Level 3 monitoring targets intensive assessment of ecological function or specific aspects of wetland condition. These assessments are intensive quantitative measurements of conditions, stressors, or cause-and-effect relationships. A Level 3 assessment is an in-depth study of a particular attribute of wetland health such as water quality, fish habitat, bird populations, vegetative cover and diversity, or physical processes. Level 3 monitoring can describe the performance of specific ecological functions at the site scale.

These standards pertain only to the level 1 portion of the 1-2-3 framework.

Study Area
The BAARI study area included all watersheds that are contained within the San Francisco Bay Regional Water Quality Control Board (RB2) boundary. This includes all or part of all nine counties in the Bay Area. Within the study area particular priority was given to select watersheds Napa River, Sonoma Creek, Alameda Creek, Coyote Creek, and Guadalupe River.



Mapping Standards

Classification

BAARI classification is an expanded version of the California Rapid Assessment Method (CRAM) for wetlands typology. The BAARI typology is summarized below; it is described more fully in the Manual that is available on the CRAM website (www.cramwetlands.org). To conform to the classification protocols of national datasets, i.e., NHD and NWI, BAARI includes a classification crosswalk to these respective schemes.

Tidal Wetlands

The Baylands consist of the wetlands, aquatic areas, and terrestrial areas open to tidal influence below the topographic contour that corresponds to the maximum possible extent of the tides, which is the tidal boundary that would be observed during the highest tide of the current tidal epoch, if there were no levees, dikes, flood gates, or other unnatural obstructions to the landward flow of tidal water. The boundary is called the "historical high tide line." These wetlands exist along the margins of tidal sloughs, bays, and estuaries. They are subject to daily or twice-daily tidal fluctuations in water height. These fluctuations might be fully natural or muted due to tide gates, culverts, weirs, etc. The water can be a mixture of marine or ocean water and freshwater. Water salinity can range from fresh to hyper-saline (i.e., more saline than the ocean).

Bay Deep (BD): estuarine water (including the greater Bay and other estuarine channels) deeper than 18 feet below Mean Lower Low Water (MLLW).

Bay Shallow (BS): estuarine areas (including the greater Bay and other estuarine channels) entirely between 18 feet below MLLW and MLLW.

Bay Flat (TBF): mostly occur between Mean Tide Level (MTL) and the MLLW tidal datum, based on the current tidal epoch, are not channelized, and support less than 10% cover of vascular vegetation, other than eelgrass.

Lagoon (G): impoundments of water subject to at least occasional or sporadic connection to full or muted tidal action. They can receive tidal action seasonally (S) or perennially (P) depending on management or natural cycles. Lagoons can consist of three habitat areas: open water (OW), unvegetated flat (UF), and vegetated (V). They can also be natural (N) or unnatural (U). Natural features can occur due to barrier beaches or dunes whereas unnatural features are modified with levees with tide gates. For the most part Lagoons in our project area will be perennial and unnatural (GPOWU, GPUFU, GPVU). For a full list of codes see the table at the bottom of this section.

Tidal Vegetated (TV): areas with greater than 10% vascular vegetation cover that exists below the high tide line, commonly referred to as marsh plain. Tidal marsh is vegetated wetland that is subject to tidal action. It occurs throughout much of the Bay from the lowest extent of vascular vegetation to the top of the intertidal zone (at the maximum height of the tides).

Tidal Marsh Flat (TMF): channels within the tidal influence which empty on MLLW. These areas are typically surrounded by tidal marsh or emerging tidal marsh in recently restored areas.

Tidal Ditch (TD): unnatural, man-made ways to convey tidal water or runoff within tidal wetlands and other baylands. Ditches are usually much straighter than channels.

Tidal Panne (TP): areas that store surface water in tidal wetlands during low tide. Marsh pannes are typical features of extensive, well-developed tidal marshes. The term refers to natural ponds that form in the marsh plain. These ponds, usually less than one foot in depth, fill with tidal water only during very high tides. They usually support less than 10% cover of vascular plant growth. They may be hypersaline in late summer, but they do not develop thick deposits of salts as do natural or commercial salt ponds. Most pannes are unvegetated, but some support wigeon grass and green macroalgae. There tend to be fewer but larger pannes in brackish marshes compared to salt marshes (Grossinger 1995).

Non-tidal Wetlands

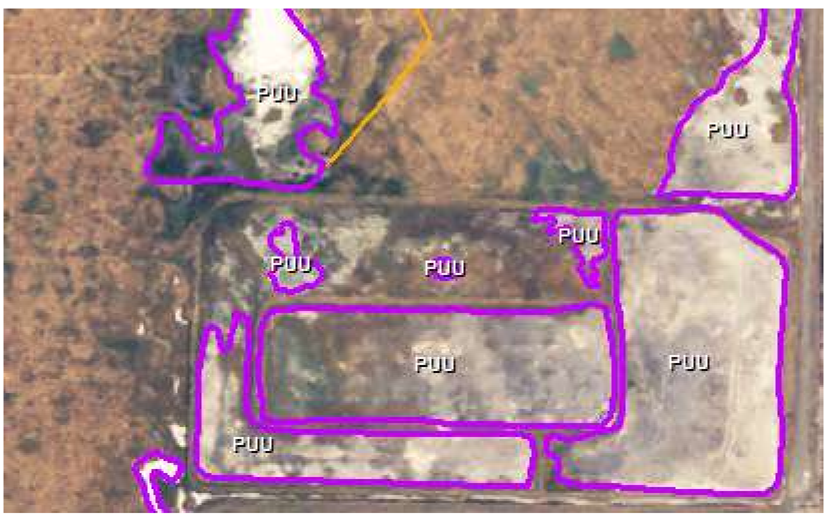
The non-tidal or upland Wetlands consist of all of the wetlands that are not influenced by tidal movements. These features do not need to be outside of the historical bayland boundary and can be created by levees within the baylands which exclude these features from being influenced by tidal activity. Most non-tidal wetlands consist of two habitat elements: open water (OW) and vegetated (V). Open water habitat features are areas that have at least five percent open water. Vegetated habitat features are areas with at least 5% cover of vegetation. A third habitat type, unvegetated (U), is only used in playas. These are areas without standing water during the dry season, less than five percent vegetation cover and usually occur adjacent to open water areas. All these habitat features can be natural (N) or unnatural/man made (U), which is always the last character designation of the code (e.g. PUU refers to Playa Unvegetated Unnatural).

Depressional Wetlands (D): exist in topographic lows that may or may not have outgoing surface drainage. Precipitation and overland flow are their main sources of water. They differ from springs and seeps that depend mainly on groundwater. They differ from lacustrine wetlands by having a perennial body of water at less than 6 feet deep and smaller than 20 acres in area during the dry season. Depressional wetlands can have prominent areas of shallow or seasonally open water (OW) and areas of adjacent vegetation (V). These features can be natural (N) or unnatural (U). They differ from playas by not being strongly alkaline or saline.

Seeps and Springs (S): form due to seasonal or perennial emergence of groundwater into the root zone or onto the ground surface. They usually form on hillsides or along the base of hills or alluvial fans, etc. They can lack well-defined channels. Seeps and springs are almost entirely dependent on groundwater (slope wetlands). Seeps can be naturally occurring (N) or unnatural, existing because of human alteration of the landscape (U).

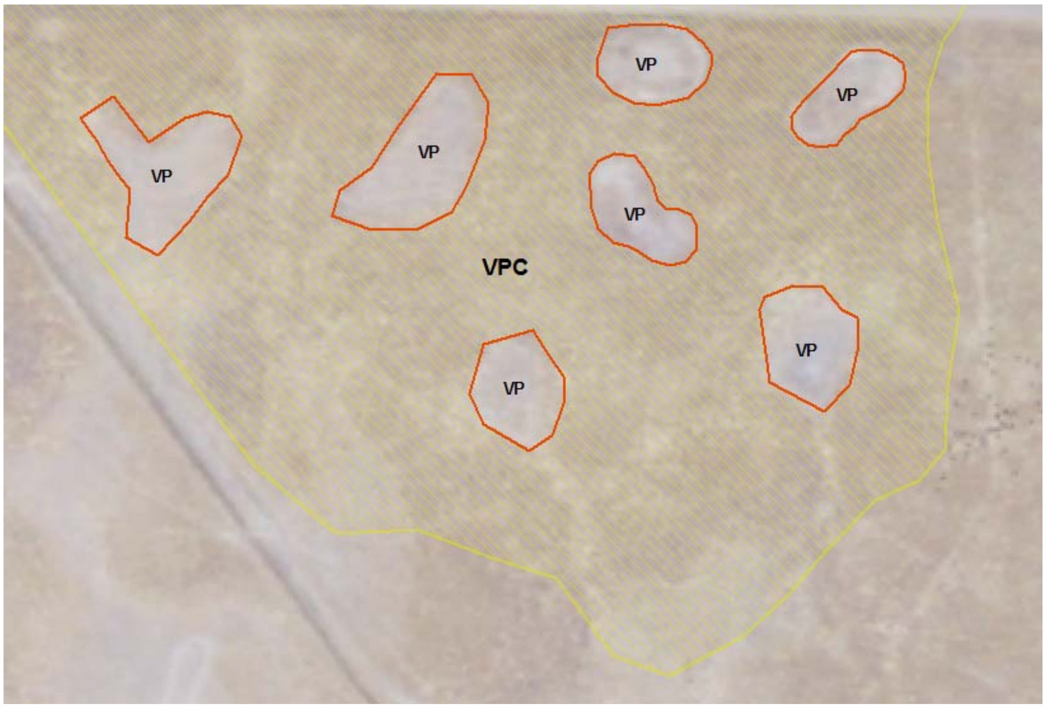
Lacustrine Wetlands (L): are large depressional wetlands that exceed 5 ha (~12.5 acres) in total area with a minimum depth of at least 6 feet during the dry season of most years. Lacustrine wetlands are comprised of two parts; the area of open water and seasonally open water (OW) that is apparent when the lake is full and the area of wetland vegetation (V) that borders the open water area. These wetlands can also be naturally formed (N) or man-made (U). Lacustrine wetlands differ from playas and depressionals by being at least 6 feet deep during the dry season.

Playas (P) are nearly level, shallow, ephemeral (seasonal) or perennial, sodic (i.e., strongly alkaline) or saline water bodies with very fine-grain sediments of clays and silts. Unlike vernal pools, playas have little or no vascular vegetation within the limits of the water body, though they support sparse peripheral vegetation. Playas can consist of open water (OW), associated vegetation (V) and unvegetated areas without standing water (U). These features can be either natural (N) or human modified (U). Unlike lacustrine wetlands, playas are less than 6 ft deep during the dry season, although they can be hundreds of acres in size.



Vernal Pools (VP): a special kind of seasonal depressional wetland having bedrock or an impervious soil horizon close to the surface and supporting a unique vernal pool flora. These depressions fill with rainwater and runoff from small catchment areas during the winter and may remain inundated until spring or early summer, sometimes filling and emptying repeatedly during the wet season. Vernal pools often occur together with vernal swales as vernal pool systems that have many pools of various sizes and shapes, varying floral and faunal composition, and various hydroperiods. Water can move between adjacent pools and swales through the thin soils above the underlying impervious substrate. Individual vernal pools (VP) are mapped at maximum water volume.

Vernal Pool Complex (VPC): several vernal pools that are hydrologically interconnected are mapped as one unit.



Stream Network

Fluvial Channel (FC): natural channels that meander and have variable width due to natural formative processes. These channels may have slight human modification.

Fluvial Unvegetated Flat and Riverine Vegetated (FUF and FV): in-channel habitats including sand, mud, or gravel bars and fresh water marshes that occur in wide fluvial channels draining large watersheds.

Fluvial Ditch (FD): unnatural channels that include any agricultural ditches or roadside ditches. They tend to be uniform in width and straighter than natural channels.

Fluvial Subsurface Drainage (FSD): unnatural, below-ground channels in urban landscapes. Their locations can be indicated in ancillary datasets, including the DRG and local storm drain datasets. When the location of subsurface drainage is not obvious, 3rd order or higher channels are extended beneath roads, buildings, playgrounds, or other man-made, non-agricultural land covers as seen on the NAIP imagery to connect downstream channel network.

Fluvial Engineered Channel (FEC): modified channels that include any extensions to, straightening or rerouting of the natural stream network. These features can include flood control channels as well as canals contributing to the watershed drainage.

Tidal Channel (TC): tidal natural channels that meander and have variable width due to natural formative processes. These channels may have slight human modification.

Tidal Ditch (TD): unnatural, man-made ways to convey tidal water or runoff within tidal wetlands and other baylands. Ditches are usually much straighter than channels. (polygon and linework)

Tidal Engineered Channel (TEC): modified tidal channels that include any extensions to or rerouting of the natural stream network. These features can include flood control channels as well as canals contributing to the watershed drainage.

Classification Crosswalk

Code	Classification	Wetland Tracker Class
TIDAL AND NON-TIDAL WETLANDS		
BD	Bay Deep	Bay Deep
BS	Bay Shallow	Bay Shallow
GPOWN	Lagoon Perennial Open Water Natural	Lagoon
GPOWU	Lagoon Perennial Open Water Unnatural	Lagoon
GPVN	Lagoon Perennial Vegetation Natural	Lagoon
GPVU	Lagoon Perennial Vegetation Unnatural	Lagoon
GPUFN	Lagoon Perennial Unvegetation Flat Natural	Lagoon
GPUFU	Lagoon Perennial Unvegetation Flat Unnatural	Lagoon
GSOWN	Lagoon Seasonal Open Water Natural	Lagoon
GSOWU	Lagoon Seasonal Open Water Unnatural	Lagoon
GSVN	Lagoon Seasonal Vegetation Natural	Lagoon
GSVU	Lagoon Seasonal Vegetation Unnatural	Lagoon
GSUFN	Lagoon Seasonal Unvegetation Flat Natural	Lagoon
GSUFU	Lagoon Seasonal Unvegetation Flat Unnatural	Lagoon
TV	Tidal Vegetation	Marsh
TNV	Tidal Nascent Vegetation	Marsh
TP	Tidal Panne	Panne
TMF	Tidal Marsh Flat	Marsh Flat
TBF	Tidal Bay Flat	Bay Flat

DOWN	Depressional Open Water Natural	Depressional
DOWU	Depressional Open Water Unnatural	Depressional
DVN	Depressional Vegetated Natural	Depressional
DVU	Depressional Vegetated Unnatural	Depressional
SN	Seep or Spring Natural	Seep or Spring
SU	Seep or Spring Unnatural	Seep or Spring
LOWN	Lacustrine Open Water Natural	Lacustrine
LOWU	Lacustrine Open Water Unnatural	Lacustrine
LVN	Lacustrine Vegetated Natural	Lacustrine
LVU	Lacustrine Vegetated Unnatural	Lacustrine
POWN	Playa Open Water Natural	Playa
POWU	Playa Open Water Unnatural	Playa
PVN	Playa Vegetated Natural	Playa
PVU	Playa Vegetated Unnatural	Playa
PUN	Playa Unvegetated Flat Natural	Playa
PUU	Playa Unvegetated Flat Unnatural	Playa
VP	Vernal Pool	Vernal Pool
VPC	Vernal Pool Complex	Vernal Pool
STREAM NETWORK		
FC	Fluvial Channel	Fluvial Natural
FD	Fluvial Ditch	Fluvial Unnatural
FSD	Fluvial Subsurface Drainage	Fluvial Unnatural
FEC	Fluvial Engineered Channel	Fluvial Unnatural
FUF	Fluvial Unvegetated Flat (in-channel)	*not shown*
FV	Fluvial Vegetated (in-channel)	*not shown*
TC	Tidal Channel	Tidal Natural
TD	Tidal Ditch	Tidal Unnatural
TEC	Tidal Engineered Channel	Tidal Unnatural

Scale and Minimum Mapping Unit (mmu)

The BAARI mapping scale and mmu varied based on general habitat type, tidal and non-tidal. The goal was to maximize the detail of the dataset, capturing small, but important habitats, i.e., marsh panes, while producing a consistent dataset for the region. Presence or absence of wetland feature is identified at a standard maximum scale. However, after a wetland feature is located and classified, a larger scale can be appropriate for digitization.

Non-tidal Habitats

Non-tidal wetlands, are mapped and QAQCed at a scale of 1:5000. However, small non-tidal wetlands, including vernal pools and seeps and springs, defined as < 0.01 ha (100 sq m) have a mapping scale of 1:2500.

The minimum mapping unit for all non-tidal polygonal features is 0.01 ha (100 sq m). Non-tidal natural channels have a minimum mapping length of 50m. Non-tidal unnatural channels, including ditches, engineered and subsurface channels, have a minimum mapping length of 25m. However, if an unnatural channel connects a water body, there is no mmu.

Tidal Habitats

Tidal wetlands are mapped and QAQCed at a scale of 1:2500.
The minimum mapping unit for all tidal polygonal features is 0.005 ha (50 sq m). The minimum mapping length of tidal channels, natural and unnatural, is 25m.

Projection and Datum

All data, at all stages of mapping are maintained in the California Teale Albers projection with a North American 1983 Datum (NAD).

Data Sources

Primary Imagery

To establish consistency across the project, the National Agriculture Imagery Program (NAIP) available through the USDA was selected as the base imagery from which all features are mapped. The choice to use NAIP was based on the spatial coverage, year flown and data availability. NAIP imagery is publicly available without cost from the USDA and covers the entire state of California, which is important if these standards are used in other parts of the state to ensure consistency. NAIP datasets are flown periodically for California which helps ensure the aquatic resources inventory is current. For more information visit
http://www.fsa.usda.gov/FSA/

2005 and 2009 National Agricultural Imagery Program (NAIP)
The NAIP images are natural color aerial, 1-m pixel resolution, geo-rectified digital aerial photographs from 2005 and 2009 produced by the US Department of Agriculture (USDA). All wetland features mapped for WRAMP must be consistent with the NAIP imagery.

Watershed Boundary

A watershed geographically defines the unit of land that drains surface run-off to one spot. In the Bay Area, a watershed is usually defined by topography in the upper watershed and dictated by the subsurface drain system in the lower, urbanized watershed. Watersheds, or drainage basins, can vary in size and scale. Standardized methods for delineating watersheds are developed by California Interagency Watershed Mapping Committee (IWMC). The CalWater 2.2.1 watershed dataset, a product of IWMC, was used as a starting point to define BAARI watersheds. BAARI used the CalWater 2.2.1 HUC8 level of watershed. This includes Napa River, Coyote Creek, and Guadalupe River watersheds.

The accuracy of CalWater 2.2.1 varies within a watershed. Some alteration was required to meet the accuracy of BAARI. CalWater 2.2.1 defines a fairly accurate boundary in the upper watershed. Small and infrequent changes were required there. The urbanized areas were more challenging to quality control without a comprehensive storm drain map. In select areas where these data were available and CalWater 2.2.1 had an incorrect boundary, it was modified. In all other areas BAARI relied on CalWater 2.2.1. Watershed boundaries typically exclude the parts of the tidal zone. In BAARI, tidal marshes were included in the watershed as they have a hydrological connection to the upper watershed through surface run-off and sedimentation (Grenier, personal communication). Though, some tidal marshes in the Bay are disconnected from hydrology by levees and other artificial features, for the purposes of BAARI they were not excluded from the watershed. For BAARI purposes the Bay-ward extent of a watershed is the mean sea level (MSL). The Bay-ward extent of tidal marsh can be a proxy for MSL, as *Spartina foliosa*, native to SF Bay, thrives from MSL to mean high tide (MHT) (Faber, 1996). The Bay-ward boundary of a CalWater 2.2.1 watershed seemed to extend to the edge of land including tidal marsh. However, the boundary was not accurate to our primary imagery source and re-mapping of the shoreline was required.

Ancillary Data

Ancillary data are used to augment the primary data sources in areas where identification of aquatic resources are difficult from the aerial imagery. In general, ancillary data is used to understand topography, temporal and seasonal differences, and subsurface drainage. The following specified ancillary data will be used to map BAARI, but additional local data can be included to enhance the interpretation of the landscape:

ArcHydro

ArcHydro is an automated stream network generated from a digital elevation model (DEM) using GIS. Elevation, flow accumulation, and flow direction determine the initiation and location of a stream in ArcHydro. ArcHydro is used as a guide to determine the upstream extent of first order streams and stream density.

National Wetlands Inventory (NWI)

NWI is produced by the US Fish and Wildlife Service (USFWS). These data vary in time and accuracy. They should only be used as an indication of the likely existence, location, and classification of major features.

Digital Raster Graphic (1:24,000 scale DRG from USGS)

The DRG is a scanned image of the 1:24,000 scale Topographic Quadrangle (7.5 minute quadrangle or “quad”) from USGS. These data are used to help view the human environment of major roads and buildings, as well as topography and major water bodies, drainage channels, and ditches. Contour lines are very helpful for estimating flow direction (HINT: choose “Unique Values” for Symbology, and make all values transparent except the first values for blue and brown, to isolate the water features and contour lines).

National Elevation Dataset (10m pixel resolution NED from USGS)

The NED is a digital elevation model (DEM) that can be used to generate rasters of hillshade and slope.

Historical Bayland Boundary

This should be used as an aid for judging the extent of the tidal bayland features. As bayland features can only be classified as tidal if they are subject to tidal changes, the boundary should be used solely as a reference.

Google Earth and Google Earth Pro

Google Earth (free) and Google Earth Pro are publically accessible geographic information systems. Google Earth provides high resolution imagery and topography, as well as, photographs and place names. Google Earth Pro provides downloads of the aerial imagery. Digitization of Google Earth imagery is used in areas where major landscape changes have occurred, i.e. tidal marsh restoration or major developments, if the imagery displayed is more current than the primary data sources. High resolution imagery for the altered area is downloaded from Google Earth Pro and georeferenced in ArcGIS to maintain a high spatial accuracy.

EcoAtlas

The Bay Area EcoAtlas is a GIS of past and present local ecology of the bays, baylands, and adjacent habitats of the San Francisco Bay Area. This is used as a reference for habitat classification, particularly when an area has undergone human modification and is still modified according to the most recent data available (Google Earth).

Wetland Tracker

Wetland Tracker is an online resource describing the progress of restoration projects in the San Francisco Bay Area. This should be used to classify polygon features as tidal or non-tidal depending on the status of the restoration area (http://www.californiawetlands.net/tracker/ba/map).

Vernal Pools Layer

This polygon layer, produced by Dr. Bob Holland (USFWS), shows the frequency of vernal pools and should be used to determine the extent of vernal pool complexes and individual vernal pools.

WLA Storm Drains (WLA)

The WLA (William Lettis & Associates) Storm Drain Map documents storm drains 24” in width and greater for limited areas of the Bay Area. Where available, WLA storm drains are used to establish connectivity between urban areas and surface drainages.

Other Local Historical and/or Modern Wetlands Data

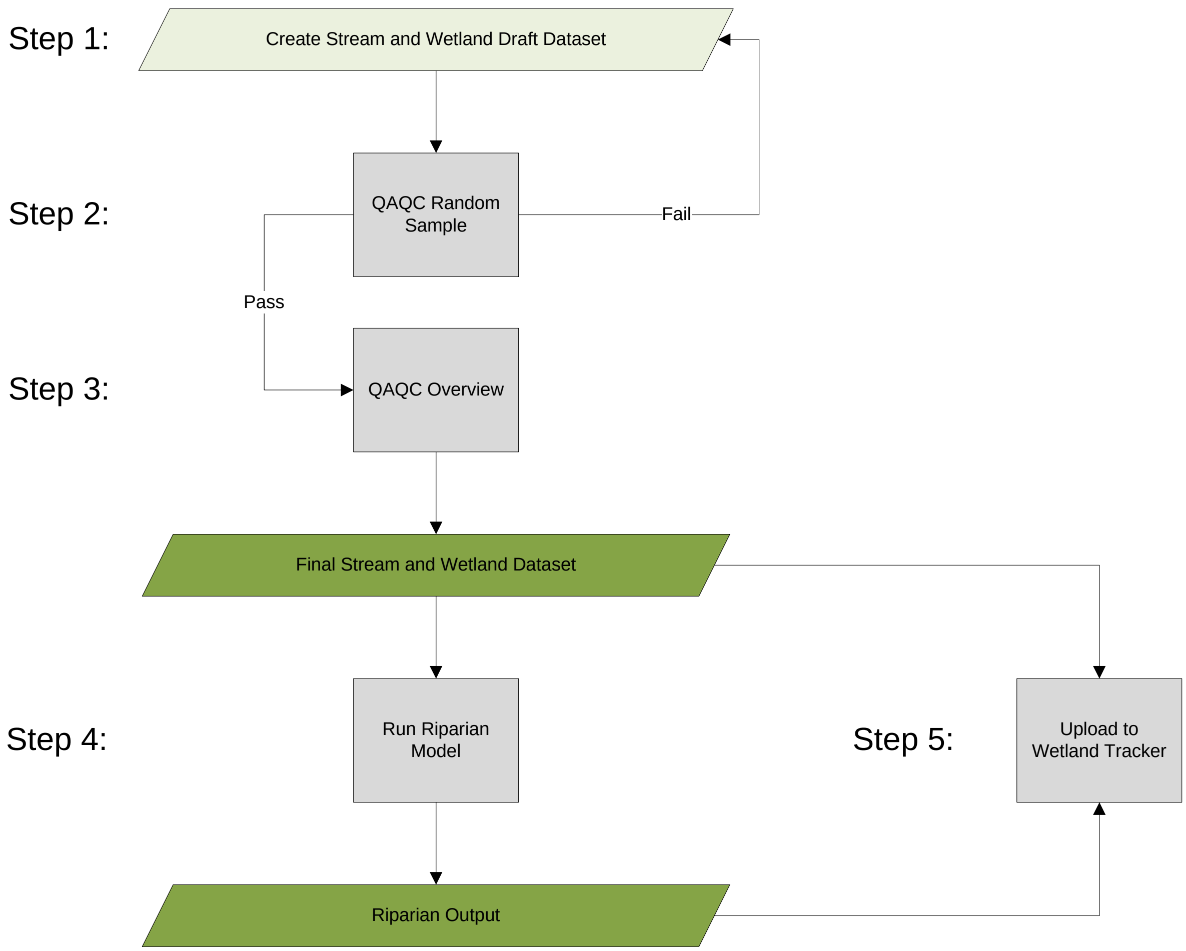
These data can be used to spot-check areas for classification or extent queries. Features may be classified under different criteria, and produced using older imagery, so these data should only be used as a reference.

Data Source Field

The “SourceData” field describes which source dataset or datasets were used to identify and map each feature. Certain areas are digitized with a heavy reliance on ancillary datasets, and others from older images in order to capture the full extent of habitats. For example, NAIP2005 displays a much lower tide than NAIP2009, and much tidal flat, estuarine areas, etc. were digitized from NAIP2005. Additionally, some key restoration areas were digitized from Google Earth imagery that captured the habitat change, springs that were obstructed by vegetation were taken directly from the DRG, and all engineered channels were identified using a ground-truthed dataset from William, Lettis, and Associates (now Fugro WLA) further described in the ancillary data section. See ancillary data for descriptions of the rest of the possible data sources. Expert knowledge was also used to identify features. These were cited with the code “Local_Review”. The “Organization” field is used to attribute the person or agency that provided the local review.

Mapping Procedures

The following describes the BAARI development process in five major steps. All mapping of features must follow the stepwise procedure dictated here. The same individual must map all features for any given 1:24,000 scale quadrangle (i.e., a quad). This ensures traceability for quality control and will help to achieve consistent products.

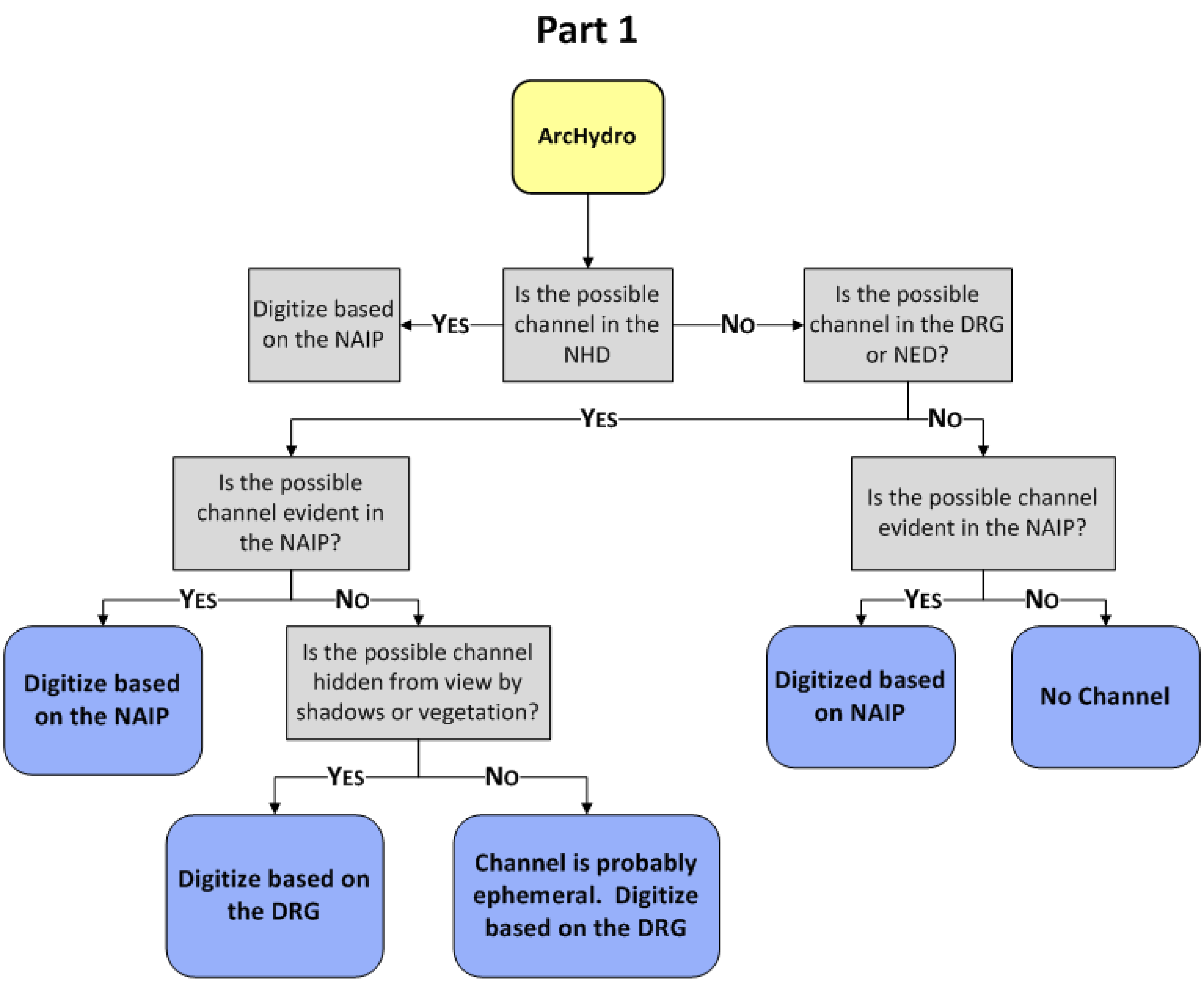

Step 1:
Create Stream and Wetland Draft Dataset
Step 2:
QAQC Random Sample
Fail
Pass
Step 3:
QAQC Overview
Final Stream and Wetland Dataset
Step 4:
Run Riparian Model
Step 5:
Upload to Wetland Tracker
Riparian Output

Step 1: Create Draft Dataset

Stream Network

Mapping Workflow

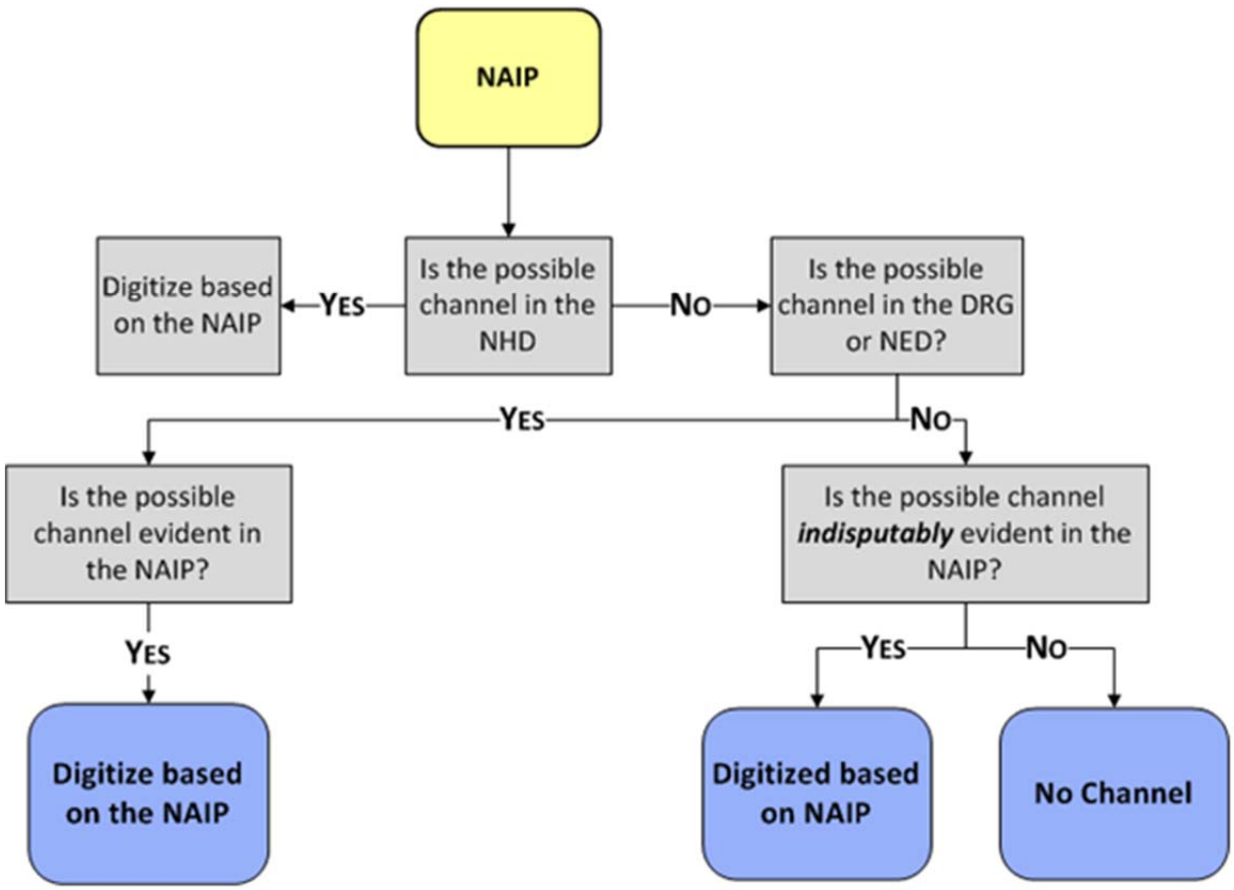
Stream Mapping Procedure



Stream Mapping Procedure

Part 2:

Possible channel is in the NAIP but not the ArcHydro



General considerations:

- Digitize stream segments from upstream to downstream in the direction of flow. Always use "Snapping" to connect segments, particularly the "End" option.
- If stream is clearly visible and appears to fade and fail to connect to the stream network in the image, do not artificially connect it. Instead, digitize only the visually evident portion. Streams may fan out and seep into groundwater.
- Use Google Earth in cases where updated imagery is available for viewing, especially in areas subject to constant change, but only for reference. Attribute [Source_Imagery] field as "GEyyyy", Google Earth and imagery year.

Landscape specific considerations:

In the upper watershed:

1. Using ArcHydro, compare channel segment to the primary imagery.
   a. If channel can be identified in the imagery, digitize based on the imagery and classify.
   b. If there is no evidence of a channel in the imagery, consult the DRG or NED.

2. In the DRG or NED, interpret the contour lines or hillshade to determine whether a channel would form based on lateral slope and longitudinal slope.
   a. If topography indicates a channel would likely form, digitize off the DRG and classify.
   b. If there is no evidence in the DRG or NED of a channel do not digitize.

In urban landscapes:

1. Using ArcHydro, compare channel segment to the primary imagery.
   a. If channel can be identified in the imagery, digitize based on the imagery and classify.
   b. If there is no evidence of a channel (e.g., due to urbanization) in the imagery, consult the storm drain ancillary dataset, if available.

2. In the storm drain dataset check to see if the data identifies a subsurface drain in the area.
   a. If there is a subsurface drain, digitize the segment based on the ancillary data and classify.
   b. If there is no subsurface drain in the storm drain dataset (or no available storm drain dataset) and there is a 3^{rd} order or higher channel entering an urban area then digitize a draft storm drain based on the street grid to connect to the downstream channel. Classify.
   c. If there is no 3^{rd} order or higher channel entering the urban area and no subsurface drain in the ancillary dataset do not digitize channel.

In dry landscapes:

In tidal habitats:

Braided channels:

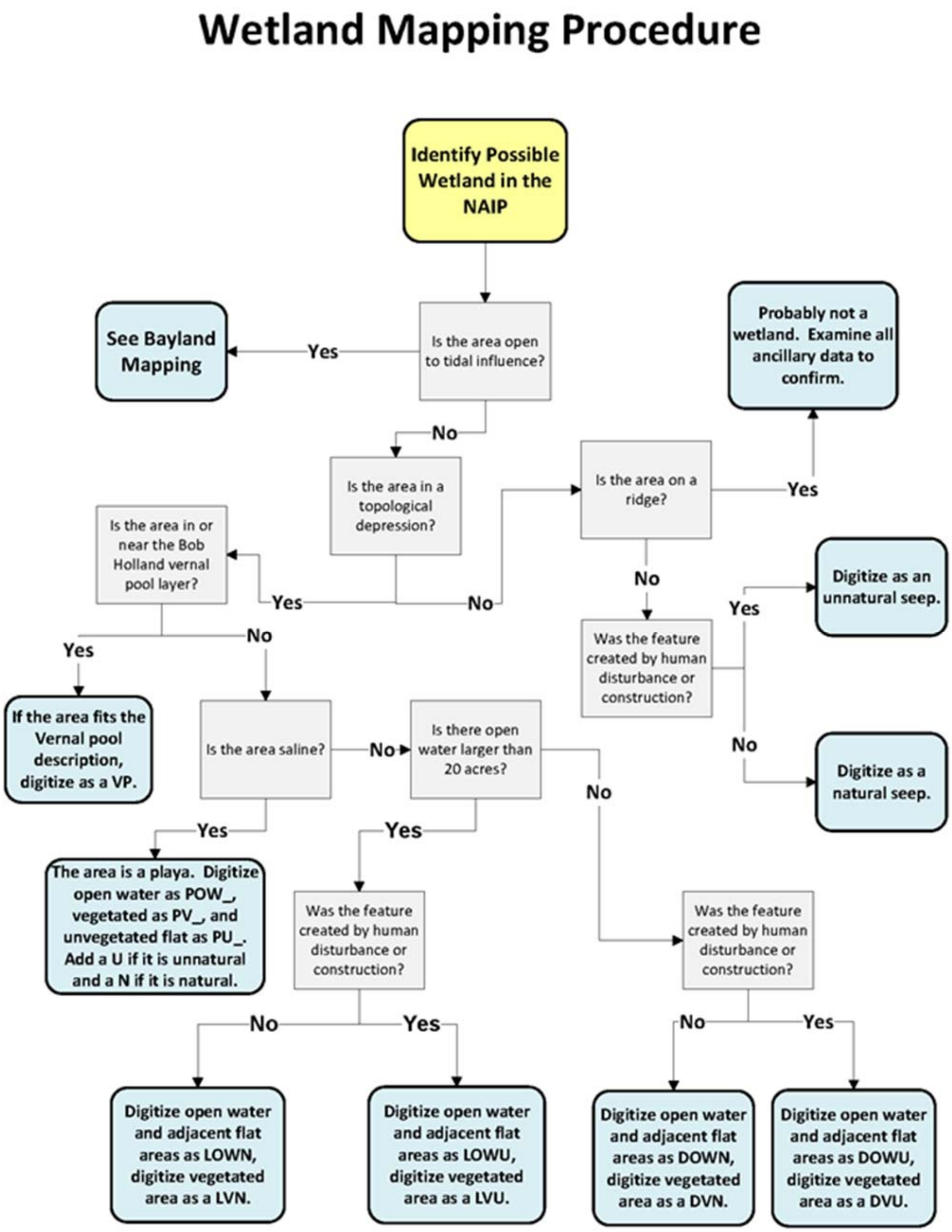
1. If channels are braided, all prominent sub-channels at least 25m long should be digitized.

Wide channels:

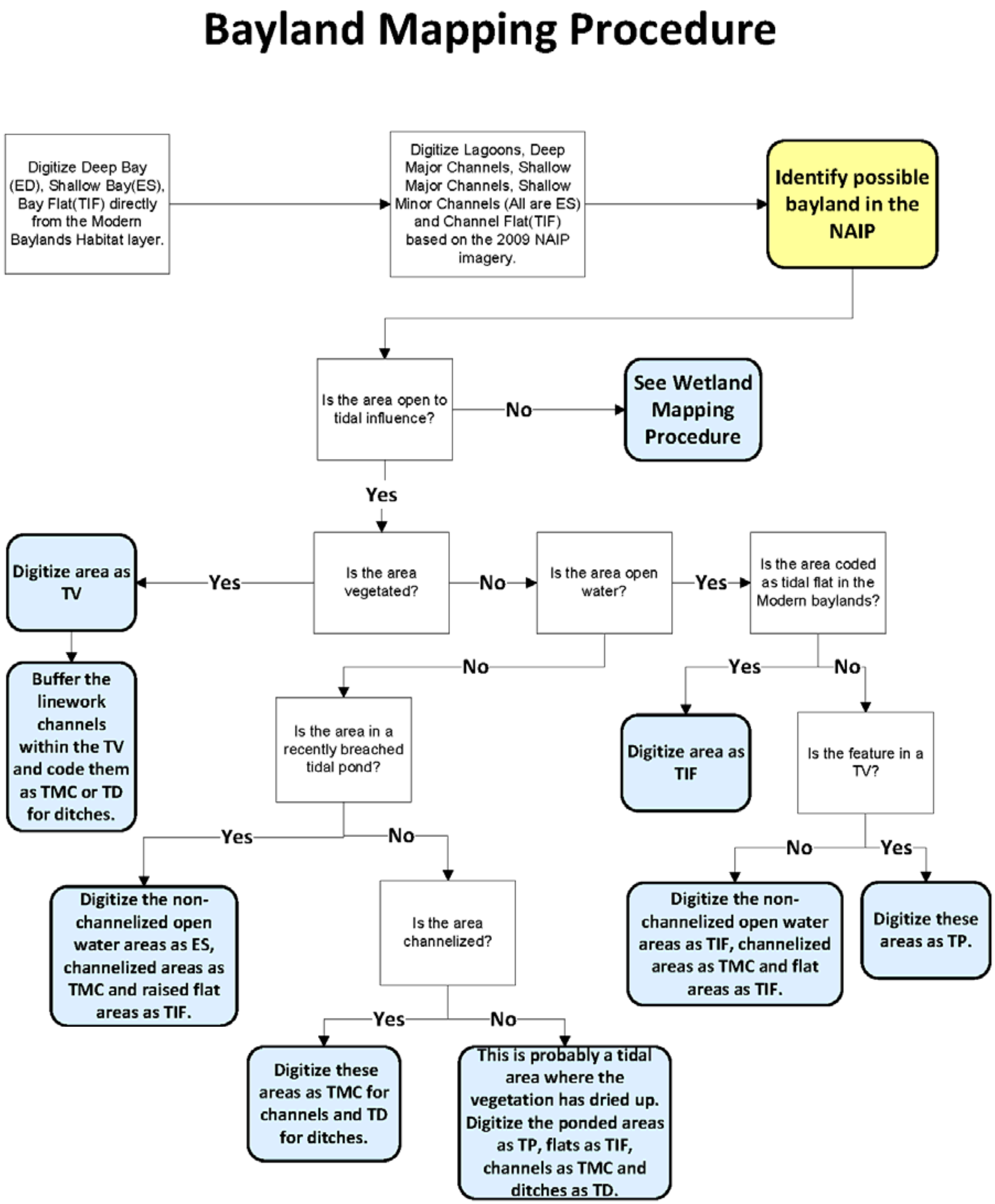
1. If stream banks are apparent in the imagery, digitize the stream from banks to bank as a polygon in the tidal or non-tidal wetland layer and attribute with appropriate channel type.

Wetlands

Non-Tidal Mapping Procedure



Tidal Mapping Procedure



General Considerations:

- Consulting Wetland Mapping Flow Chart, digitize wetland cleanly without any unnecessary vertices (i.e. small spikes, overlapping areas, etc.). When creating new wetland features adjacent to existing ones, always use “Auto-complete Polygon” and “Snapping” to avoid creating small gaps between features.
- Overlay streams layer on the imagery while digitizing wetlands in order to provide clues to flow direction.
- Wetland Tracker should be consulted for each quad to confirm presence of restoration/mitigation projects. Consult the detailed information for projects within quad extent, and if the project has been completed, attribute the feature with its “project completion” attribute (i.e. salt pond: DOWU -> tidal marsh: TV).
- Use Google Earth in cases where updated imagery is available for viewing, especially in areas subject to constant change, but only for reference. Attribute [Source_Imagery] field as “GE”, along with the year of the image. Modern Baylands should be used to define extent of TIF and TCF, along with approximate extents of all major and minor channels.

Feature Specific Considerations

- **Depressional and Lacustrine:**
    - Natural depressional wetlands occupy topographic depressions – low areas on flat ground where rain water and surface runoff collect. Look for natural depressional wetlands along the midline of valleys large and small, on saddles and broad ridge tops, between small hills, and between dunes along estuaries and coastlines.
    - Unnatural depressional wetlands are common as stock ponds and irrigation ponds behind small dams and levees. Any man-made pond that is too small to be a lacustrine wetland should be classified as a depressional unnatural wetland.
    - Habitats within depressional wetlands tend to have indeterminate boundaries where the wetland vegetation blends with the upland vegetation. The boundary can be very difficult to map. Focus on the most distinctive area of the wetland. These are usually darkest green in color, and they occur in the middle portions of the larger areas in question. Extend the boundary outward from the most distinctive area only as far as the imagery provides unequivocal evidence of wetness.
    - Floating or submerged aquatic vegetation in pond and lakes should be labeled and merged with the corresponding “Open Water” (OW) polygon.
    - Unnatural depressional and lacustrine wetlands may not be filled to capacity at time of imagery. In these cases, digitize the boundary of the open water feature as it would appear full.
    -
- **Seeps and Springs**
    - Seeps and springs (SN, SU) always occur uphill from where creeks begin, on slopes where groundwater encounters an impervious geologic stratum, or at the

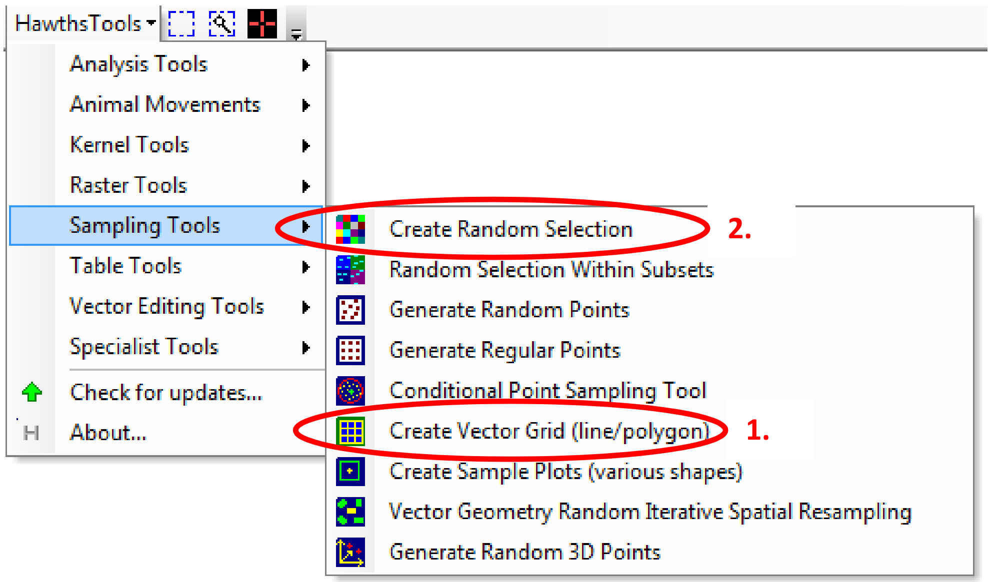
base of slopes where ground water emerges into the root zone of vegetation. Always look for slope wetlands immediately above the upstream end of first-order channels (headwaters), and immediately above or below landslides on grassy hillsides. Check the darker brown and black areas; they are more saturated with water.

- **Tidal ecotone**
  - When digitizing wetlands close to Historical Baylands boundary, use best judgment to determine which features are tidal and which non-tidal. Oftentimes, impacted areas of historical baylands do not empty into the Bay and therefore do not participate in tidal function (salt ponds, diked tidal marsh, etc.); these features will be considered non-tidal.
  - All tidal line features must be buffered to encompass the stream width. This buffer is added to the polygon layer and is attributed according to tidal polygon standards.
  - Especially in tidal areas, be careful not to map ghost features. Developed areas of the baylands often have channel scars, and some marshes have vegetated-over pannes that cease to function as pannes.

Step 2: Quality Assurance and Quality Control (QAQC) Random Sample

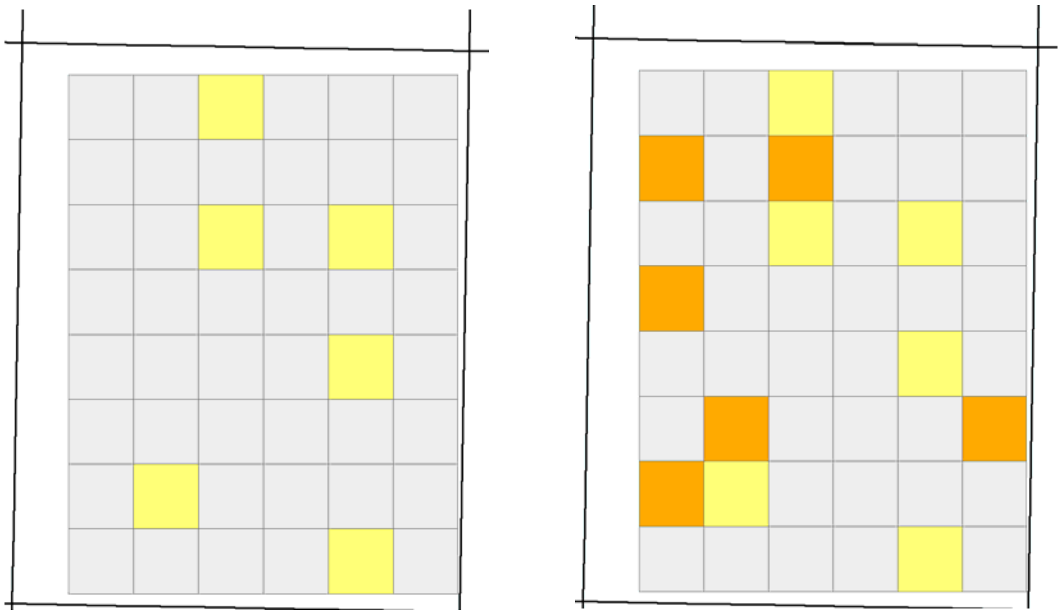
An intensive review of all data is recommended if possible and necessary. If resource restraints limit the amount of ground-truthing or level of review, a QAQC of a random sample of the data is recommended. This method provides an unbiased review of a portion of the map and provides a quantitative score for 4-6 parameters that is representative of the effort as a whole. At least ten percent of the map unit should be reviewed through the random sample QAQC process. Due to the geographic extent of BAARI, 7.5 minute USGS topographic quadrangle (quad) extents were used as a data management unit. QAQC and data management can be done at various scales, i.e., watershed or county, but it is recommended that the unit be manageable at all steps including data creation, QAQC, and storage.

The QAQC of BAARI starts with the generation of 1 square mile cells for the entire project extent. One sq mi cells were chosen because, on average, a quad is roughly 60 sq mi. Choosing 10 cells represents 10% of a quad. The freeware toolset Hawth's Tools was used to create a vector grid of specified size and then perform a random selection. This toolset no longer receives updates but updated new version has been released under a different name and format (http://www.spatialecology.com/gme/index.htm)



Screen Shot of Hawth's Tools GUI

Once the grid is created, the 'create random selection' tool selects a specified portion of the grid. The first random selection is removed from the grid and the random selection process is run again to create the second cell selection. This process is performed 4 times to create 4 unique QAQC cell layers. The multiple, non-duplicating, layers allow new areas of a quad to be QAQCed in subsequent rounds (see next section). No cell is used in more than one iteration. Because QAQC cells must capture 10% of digitized work, cells can be manually selected from the original QAQC grid layer to increase the digitized area.   For example, if 50% of the area is mapped, only 3 cells should be used in the QAQC process, since ten percent of a full quad is approximately 6 QAQC cells. This is done to maintain similar confidence intervals across quads. If the random selection results in a particularly poor representation of classifiable land types (urban, agricultural, forested and water), one may hand-select an appropriate area in order to create a better cross section of the mapping under these land types.



Cells in yellow are the first QAQC round. Cells in orange are the second round.

Stream Network

Ten percent of the draft map is QAQCed in the random sample. For BAARI stream network, that is six random, 1 square mile cells.

1. Organize data in personal geodatabases by mapping unit (BAARI uses quads).
2. Organize versions of QAQC by dataset.
    - Quad_QAQC_1
3. Import draft stream network as a feature class into the dataset.
4. Add the initials of the digitizer and the QAQC round to the feature class name.
    - quad_JD_1
5. Clip the draft stream network to the QAQC cells and rename the feature class "DRAFT", with the initials of the digitizer appended to the name.
    - quad_DRAFT_JD
6. Make a copy of DRAFT feature class in the same geodatabase and renamed "STANDARD", with the initials of the reviewer appended to the name. This STANDARD feature class will be edited for the QAQC process.
    - quad_STANDARD_PQ
7. Edits the STANDARD feature class are done by a wetland mapping professional according to the mapping standards and protocols. The mapping professional did not digitize the draft map.
8. Create a topology for the feature dataset.
    - Apply the following rules: "Must Not Have Dangles", "Must Not Overlap", "Must Not Self-Overlap", "Must Not Intersect", "Must Not Self-Intersect".
    - Dissolve linework by type and source, explode multi-part features, and run the "planarize" tool, found in the topology toolbar, to resegment lines (be sure to remove all domains from the feature before you planarize).

9. Run the First Order Tool. This tool finds all first-order streams and verifies the length is >50m. Lines with a [FirstOrder] field value of 0 are greater than the mmu, and those with a value of 1 are less than the mmu. All first-order streams below the mmu must be checked for adherence to standards on a case-by-case basis. That is, if they are not connected to a water body or touching the cell boundary (a subset of a longer channel), they should be deleted. Be sure to merge the main stem lines where a tributary is deleted.
10. Run the Stream Network QAQC Model. This model will check for differences in the DRAFT and STANDARD layers in alignment, undermapping, overmapping, and feature attribution. A QAQC results table will be exported to the input geodatabase.
11. QAQC Pass or Fail. Quads are considered to have passed if all parameters have an error rate of >15%. They fail if any parameter has an error rate that exceeds 15%.
    - If the quad passes it moves to the QAQC overview step.
    - If the quad fails, repeat QAQC steps 2-9, creating a new feature dataset for the next round of QAQC in the same geodatabase and using a different QAQC cell layer.

Wetlands

1. Organize data in personal geodatabases by mapping unit (BAARI uses quads).
2. Organize versions of QAQC by dataset.
    a. Quad_QAQC_1
3. Import draft stream network as a feature class into the dataset.
4. Add the initials of the digitizer and the QAQC round to the feature class name.
    a. quad_JD_1
5. Clip the draft stream network to the QAQC cells and rename the feature class “DRAFT”, with the initials of the digitizer appended to the name.
    a. quad_DRAFT_JD
6. Make a copy of DRAFT feature class in the same geodatabase and renamed “STANDARD”, with the initials of the reviewer appended to the name. This STANDARD feature class will be edited for the QAQC process.
    a. quad_STANDARD_PQ
7. Edits the STANDARD feature class are done by a wetland mapping professional according to the mapping standards and protocols. The mapping professional did not digitize the draft map.
8. For QAQCed wetlands, merge all polygons by type, then explode multi-part features. Create a topology for the feature dataset and apply the following rules: “Must Not Overlap”, “Must Not Have Gaps”. Also check the Shape_Area field and make sure all wetlands are larger than the minimum mapping area. Compact the geodatabase.
9. Once corrections have been made, the DRAFT and STANDARD layers are fed into the Polygon QAQC Model. This model will check for differences in undermapping, overmapping, feature attribution, and alignment. A table of error parameters will be exported to the geodatabase supplied in the input.

10. Quads are considered to have failed if any of the error parameters exceeds 15%. If the quad fails, repeat the QAQC process, saving a new feature dataset for the next round of QAQC in the same geodatabase.

Step 3: Quality Assurance and Quality Control (QAQC) Overview and Post-processing

Stream Network

- Visually inspect the stream network at 1:10,000 using the USGS quad border and imagery when necessary. This is a general overview used to correct any gross errors.
- Look for streams that cross over ridges and mountain tops.
- Make sure the flow direction is in the correct direction. It helps to symbolize the flow direction by drawing the lines with arrows at the end of each segment.
- Make sure all codes are correct, and no aberrant codes exist.
- Dissolve linework by type and source (and any other attribute field you wish to keep). Then explode multipart features and “planarize” the lines.
- Edge-match features that cross adjacent quads by snapping lines to endpoint. Then merge the lines if they are the same type, and split line segments at ends.
- Calculate Strahler stream order using RivEx or a similar program.
- Check the stream order and make sure that it was calculated correctly. Stream order should build as streams flow into each other. If stream order drops from a high Strahler stream order back to first order then the lines were either not snapped together or have incorrect flow direction. Correct geometric and attribute errors.

Wetlands

- Visually inspect the wetlands network at 1:10,000 using the USGS quad border and imagery when necessary. This is a general overview used to correct any gross errors.
- Look for misidentification errors, particularly tree shadow mistaken for open water, and dark areas mistaken for actual seeps and springs. Vegetation surrounding open water is often overlooked, and this must be attributed separately.
- Make sure all codes are correct, and no aberrant codes exist.
- Dissolve polygons by type and source (and any other attribute field you wish to keep) and explode multipart features.
- Merge adjacent quads by merging polygons of the same type, and make sure no small spikes or overlapping areas exist.

Step 4: Riparian Model

The National Resource Council (NRC) defines riparian as “areas through which surface and subsurface hydrology connect… and significantly influence exchanges of energy and matter”. The riparian model was developed as a cost-effective way to map riparian extent as defined by the NRC. Riparian areas provide valuable flood, pollution, and erosion control as well as habitat food web maintenance. The riparian model estimates the functional areas of two representative riparian processes: vegetation and hillslope. The riparian vegetation process quantifies the extent to which contributions like allochthonous (arising from outside the system) organic matter input, leaves and woody debris, temperature control, and bank stability affect the adjacent water body. The hillslope riparian process quantifies the extent to which sediment input from landslides, etc. would affect the adjacent water body.

The riparian model is modular in design, meaning that additional functions can be built off a foundation of core code. This model does not discriminate between high and low level influences on the adjacent waterbody, nor was it intended to replace on-the-ground empirical evaluations. It is instead intended to display the largest possible extent of riparian function based on the input data.

The riparian model runs in ArcGIS version 9.3x using a Visual Basic for Applications (VBA) script using ArcObjects and standard ESRI geoprocessing tools, and is embedded in a map document (mxd). The model uses BAARI base map data, a DEM, and a vegetation layer as inputs. The vegetation layer used to produce the BAARI riparian outputs was CalVeg 2005 (produced by California Forest Resource and Assessment Program, or FRAP), but any suitable replacement may be used if given the correct fields. The vegetation data input must have fields for vegetation type, tree height and standard buffer distance (SBD). "Tree height" is the height of plants with average heights greater than 6 meters. "SBD" is the height of plants below an average height of 6 meters. Therefore, plants with "tree height" values will have "SBD" values of 0, and vice versa. For a more detailed explanation of the riparian model interface, see the Riparian Model User Guide (http://www.sfei.org/sites/default/files/UserGuide_12202010.pdf).

Step 5: Upload to Wetland Tracker

The data created from these standards were uploaded to the Bay Area Wetland Tracker website (http://www.californiawetlands.net/tracker/ba/map), which is part of the California Wetlands Portal website. This website allows for the data to be viewed and downloaded by watershed or region. In order to get this data on the website, it first needs to be processed.

Four fields need to be added to the datasets: “ClickCode”, “ClickLabel”, “LegLabel” and “LegCode”. The “ClickCode” is identical to “WetlandType”. The “ClickLabel” is a long text full classification description of the code (e.g. “DOWU” = “Depressional Open Water Unnatural”). The “LegLabel” is the code that appears in the Wetland Tracker legend. The “LegCode” is the code version of the “LegLabel”. These are conflated codes based on “WetlandType”, and are generalized from 47 to 18 categories. This allows for a much simpler legend in the wetland tracker field while retaining the full classifications when the user downloads the data. The “LegLabel” and “LegCode” are then associated with specific RGB color values which will symbolize the features on the wetland tracker website.

	Wetland_Type	BAARI full classification	WT Legend Label	WT Legend Code
	ClickCode	**ClickLabel**	**LegLabel**	**LegCode**
Polygons				
	BD	Bay Deep	Bay Deep	BD
	BS	Bay Shallow	Bay Shallow	BS
	GPOWN	Lagoon Perennial Open Water Natural	Lagoon	G
	GPOWU	Lagoon Perennial Open Water Unnatural	Lagoon	G
	GPVN	Lagoon Perennial Vegetation Natural	Lagoon	G
	GPVU	Lagoon Perennial Vegetation Unnatural	Lagoon	G
	GPUFN	Lagoon Perennial Unvegetation Flat Natural	Lagoon	G
	GPUFU	Lagoon Perennial Unvegetation Flat Unnatural	Lagoon	G
	GSOWN	Lagoon Seasonal Open Water Natural	Lagoon	G
Tidal	GSOWU	Lagoon Seasonal Open Water Unnatural	Lagoon	G
	GSVN	Lagoon Seasonal Vegetation Natural	Lagoon	G
	GSVU	Lagoon Seasonal Vegetation Unnatural	Lagoon	G
	GSUFN	Lagoon Seasonal Unvegetation Flat Natural	Lagoon	G
	GSUFU	Lagoon Seasonal Unvegetation Flat Unnatural	Lagoon	G
	TV	Tidal Vegetation	Marsh	TV
	TNV	Nascent Tidal Vegetation	Marsh	TNV
	TP	Tidal Panne	Panne	TP
	TMF	Tidal Marsh Flat	Marsh Flat	TMF
	TBF	Tidal Bay Flat	Bay Flat	TBF
	DOWN	Depressional Open Water Natural	Depressional	D
	DOWU	Depressional Open Water Unnatural	Depressional	D
	DVN	Depressional Vegetated Natural	Depressional	D
	DVU	Depressional Vegetated Unnatural	Depressional	D
	SN	Seep or Spring Natural	Seep or Spring	S
	SU	Seeps or Spring Unnatural	Seep or Spring	S
	LOWN	Lacustrine Open Water Natural	Lacustrine	L
	LOWU	Lacustrine Open Water Unnatural	Lacustrine	L
	LVN	Lacustrine Vegetated Natural	Lacustrine	L
	LVU	Lacustrine Vegetated Unnatural	Lacustrine	L
	POWN	Playa Open Water Natural	Playa	P
Non-tidal	POWU	Playa Open Water Unnatural	Playa	P
	PVN	Playa Vegetated Natural	Playa	P
	PVU	Playa Vegetated Unnatural	Playa	P
	PUN	Playa Unvegetated Flat Natural	Playa	P
	PUU	Playa Unvegetated Flat Unnatural	Playa	P
	VP	Vernal Pool	Vernal Pool	V
	VPC	Vernal Pool Complex	Vernal Pool	V
	FUF	Fluvial Unvegetated Flat (in-channel)	*not shown*	F
	FV	Fluvial Vegetated (in-channel)	*not shown*	F
	FC	Fluvial Channel	*not shown*	F
	FD	Fluvial Ditch	*not shown*	MC
	FEC	Fluvial Engineered Channel	*not shown*	MC
Riparian	RIPVEG	Vegetation Functional Area	Vegetation	RIPVEG
	RIPSLP	Hillslope Functional Area	Hillslope	RIPSLP
Linework				
	FC	Fluvial Channel	Fluvial Natural	F
Non-tidal	FD	Fluvial Ditch	Fluvial Unnatural	MC
	FSD	Fluvial Subsurface Drainage	Fluvial Unnatural	MC
	FEC	Fluvial Engineered Channel	Fluvial Unnatural	MC
	TC	Tidal Channel	Tidal Channel	TC
Tidal	TD	Tidal Ditch	Tidal Unnatural	TMC
	TEC	Tidal Engineered Channel	Tidal Unnatural	TMC

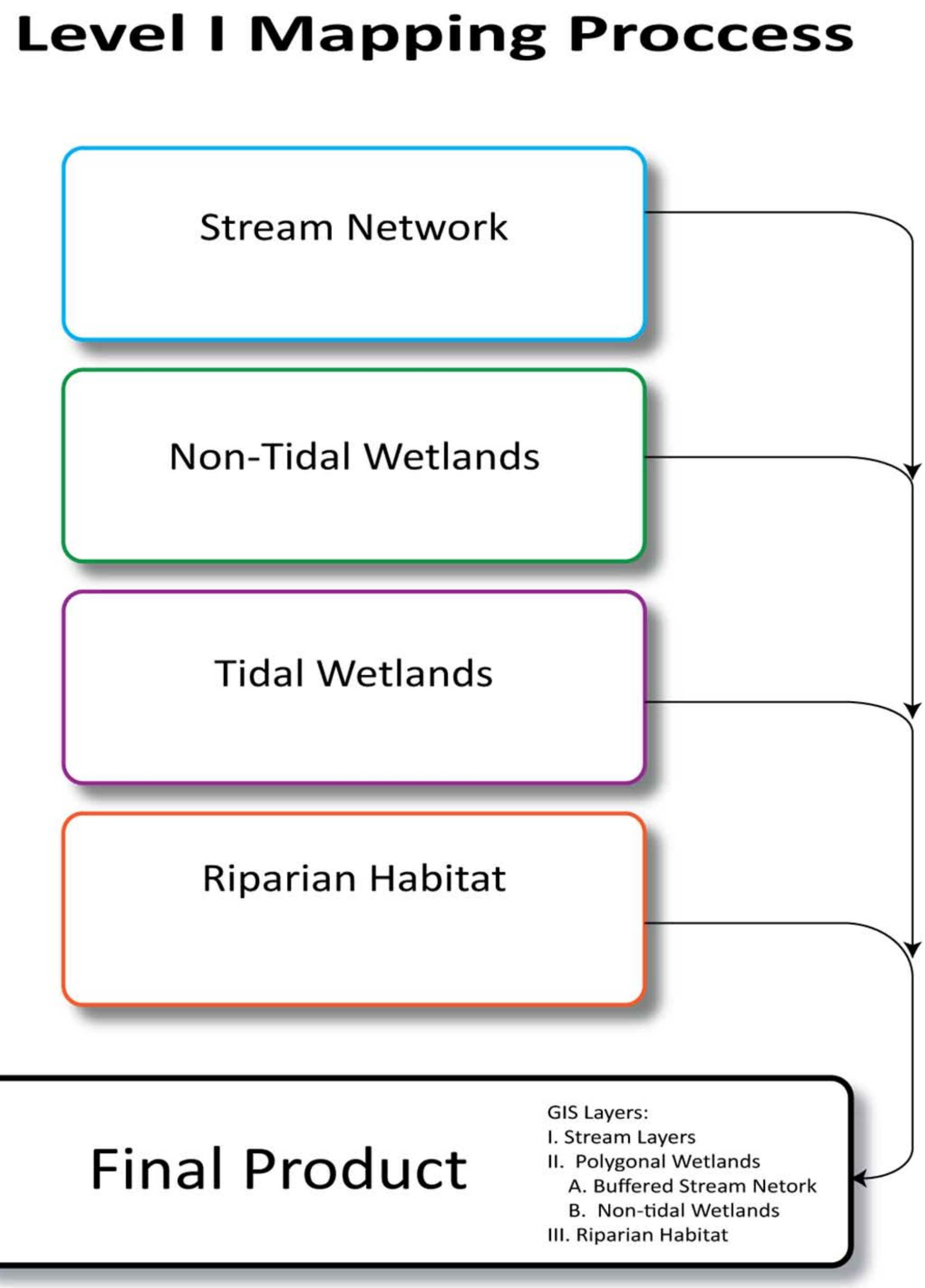
As it will appear in WT legend	
LegCode	**LegLabel**
	Non-Tidal Wetlands
D	Depressional
L	Lacustrine
S	Seep or Spring
V	Vernal Pool
P	Playa
	Tidal Wetlands
TV	Marsh
TMF	Marsh Flat
TBF	Bay Flat
TP	Panne
G	Lagoon
BD	Bay Deep
BS	Bay Shallow
	Channels
FC	Fluvial Natural
MC	Fluvial Unnatural
TC	Tidal Natural
TMC	Tidal Unnatural
	Riparian Functional Areas
RIPVEG	Vegetation
RIPSLP	Hillslope

The data will be served to the web in four different shapefiles:

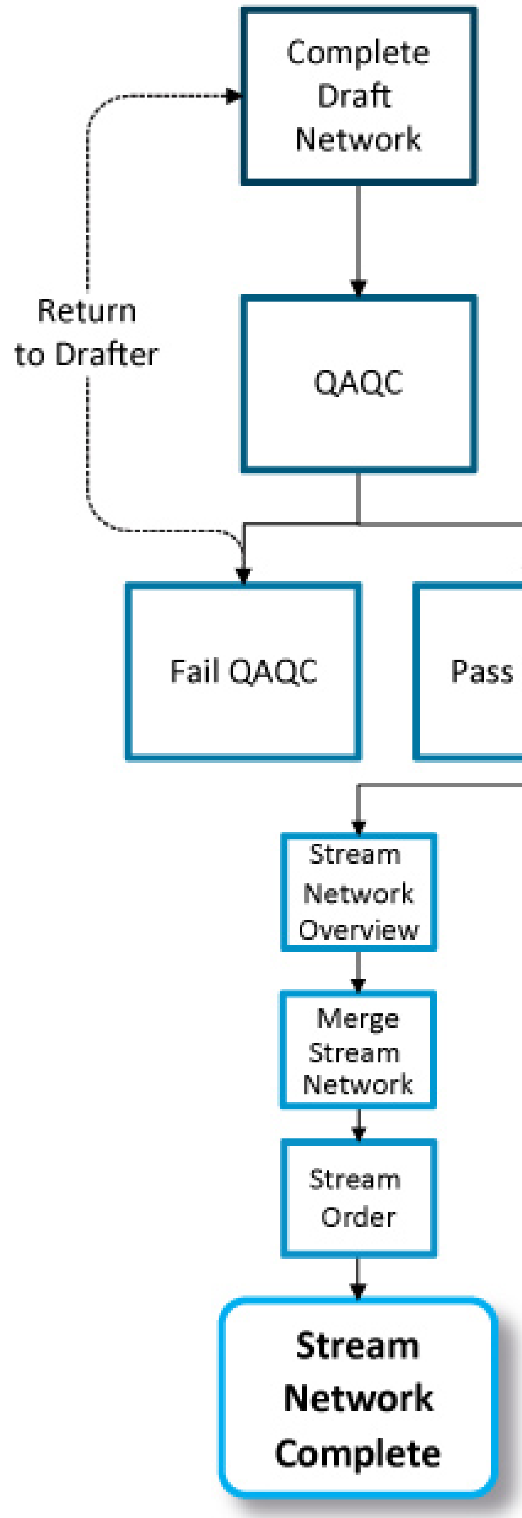
1. Non-tidal wetland features (Polygon)
    - Served by watershed
2. Tidal wetland features (polygon)
    - Served as the entire region
3. Riparian features (polygon)
    - Served by watershed
        - Slope riparian
        - Vegetative riparian
4. Channel Network (Line)
    - Served by watershed

Data prep
Shape conversion
Color selection
Code conflation

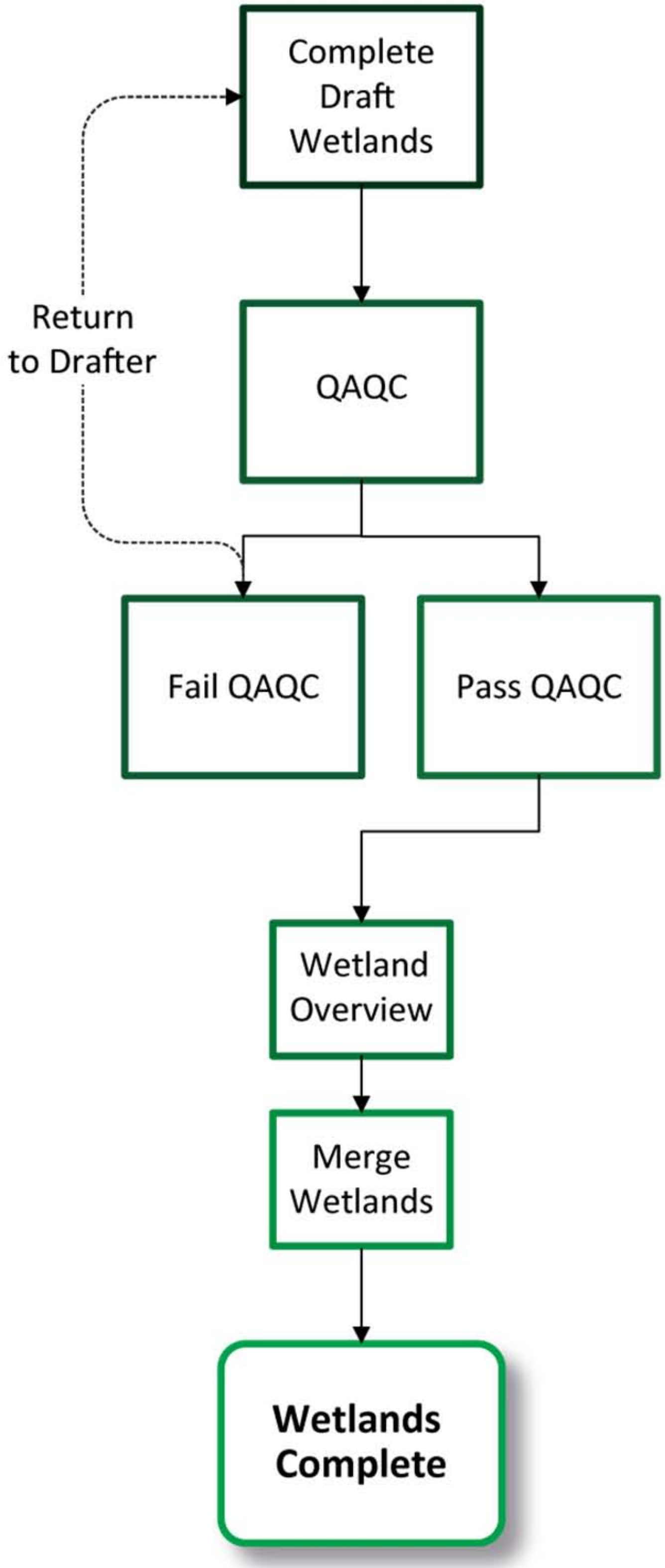
Workflow Charts



Stream Network Mapping Process



Wetland Mapping Process



APPENDIX A

Non-Tidal Polygon Quality Assurance and Quality Control

The draft maps produced by SFEI were verified and accepted by SFEI through the following QAQC process. The QAQC process is conducted for each 1:24,000 scale USGS quadrangle (quad).

1. SFEI generates the maps of non-tidal wetlands and aquatic systems. All maps are generated based on SFEI standards using collateral data according to the mapping process and standards described above.

2. The QAQC process is conducted by a mapping professional different from the original digitizer.

3. SFEI decides to accept or reject each quad digitized quad based on a quantitative assessment of wetland and aquatic system polygon parameters overlay, over-mapping, under-mapping, and coding. The assessment is based on the differences between the original or draft polygons and an separately produced SFEI map for eight randomly selected 1.0 square mile sample cells (8 cells per quad), representing about 12% of the area of a quad. A quad fails QAQC when one or more parameters have more than a 15% error. The quad is not accepted until it passes QAQC for all wetland types and aquatic systems.

    i. OVERLAY
    The overlay parameter measures the validity of the intersecting draft polygons with the SFEI standard. Overlay is determined using SFEI and draft common areas of interpretation or intersecting regions. Three overlay parameters are measured; overlay alignment, overlay over-mapping, and overlay under-mapping to understand the variation in digitization.

    a. Overlay Alignment
    SFEI will accept the draft quad with regard to overlay alignment if the common area of overlay alignment for all eight sample cells is more than 85% of the SFEI total area.

    b. Overlay Over-mapping
    SFEI will accept the draft quad with regard to overlay over-mapping if the excess draft area mapped with respect to the SFEI standard is less than 15% in the overlay region.

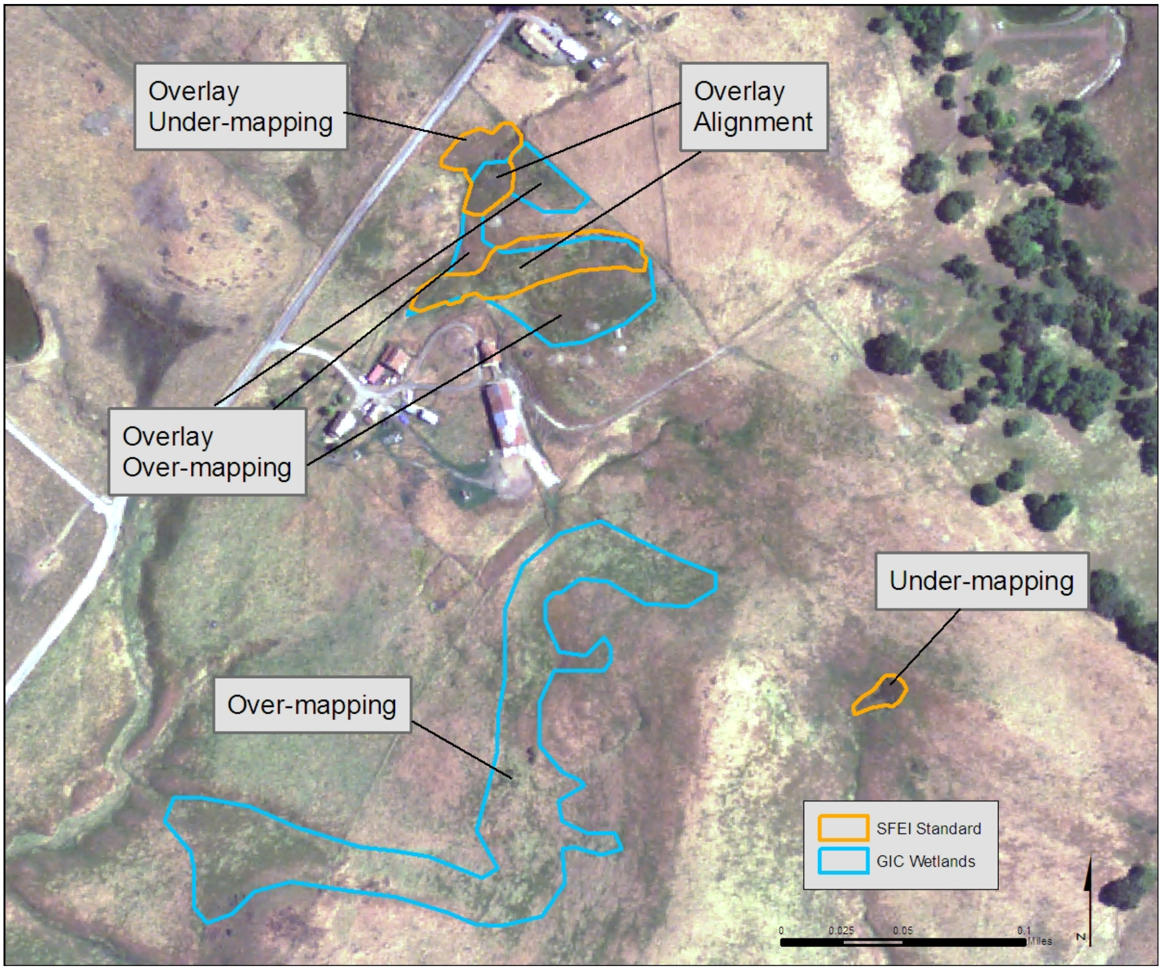
    c. Overlay Under-mapping

SFEI will accept the draft quad for a particular wetland type with regard to overlay under-mapping if the area mapped in the SFEI standard but not draft is less than 15% in the overlay region.

ii. OVER-MAPPING
The over-mapping parameter measures the degree to which draft quad has more polygons than SFEI Standard quad. With regard to over-mapping, SFEI will accept the draft quad for a particular wetland type if the excess area in the draft quad with respect to SFEI standard is than 15%.

iii. UNDER-MAPPING
The under-mapping parameter measures the amount of area not mapped in the draft quad that is mapped in the SFEI standard. With regard to under-mapping, SFEI will accept the draft quad if the area mapped in the SFEI standard but not draft is less than 15%.

iv. CODING
The coding parameter measures the accuracy of draft quad's classification of wetlands and aquatic systems. Coding is only compared in areas where both the standard and the draft have mapped a polygon. With regard to coding, SFEI will accept the draft quad if the amount of misclassification is less than 15%.



Overlay alignment, overlay over-mapping, overlay under-mapping, over-mapping, and under-mapping parameters examples (the Coding parameter is not represented). Not all the wetlands in the example are illustrated.

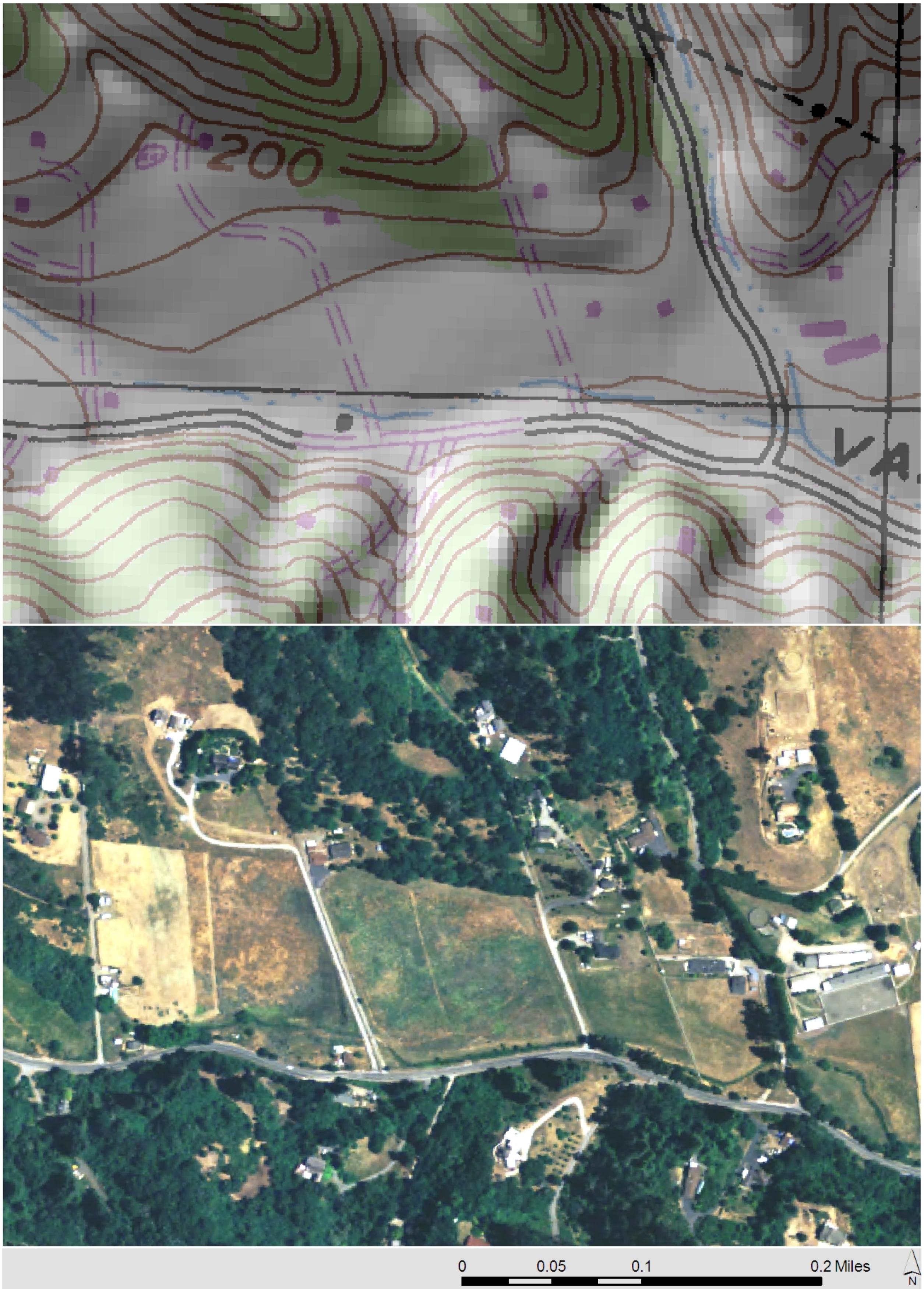
4. If any of the parameters do not meet SFEI standards, the quad will be returned to the original digitizer along with the QAQC results and the digitized polygons for each of the eight sample cells, which the digitizer will use to guide their map revisions. Once the original digitizer is done revising the quad, the quad is returned to reviewer, who will then repeat the QAQC process using a new random set of eight sample cells. The QAQC process will be repeated until the data meets all of the SFEI standards for all QAQC parameters.

5. The last QAQC step features coarse scale overview of the final draft maps at a scale of 1 to 10,000 by mapping and ecology with local knowledge of the area. Any major errors found in the draft maps are resolved during this step in the review.

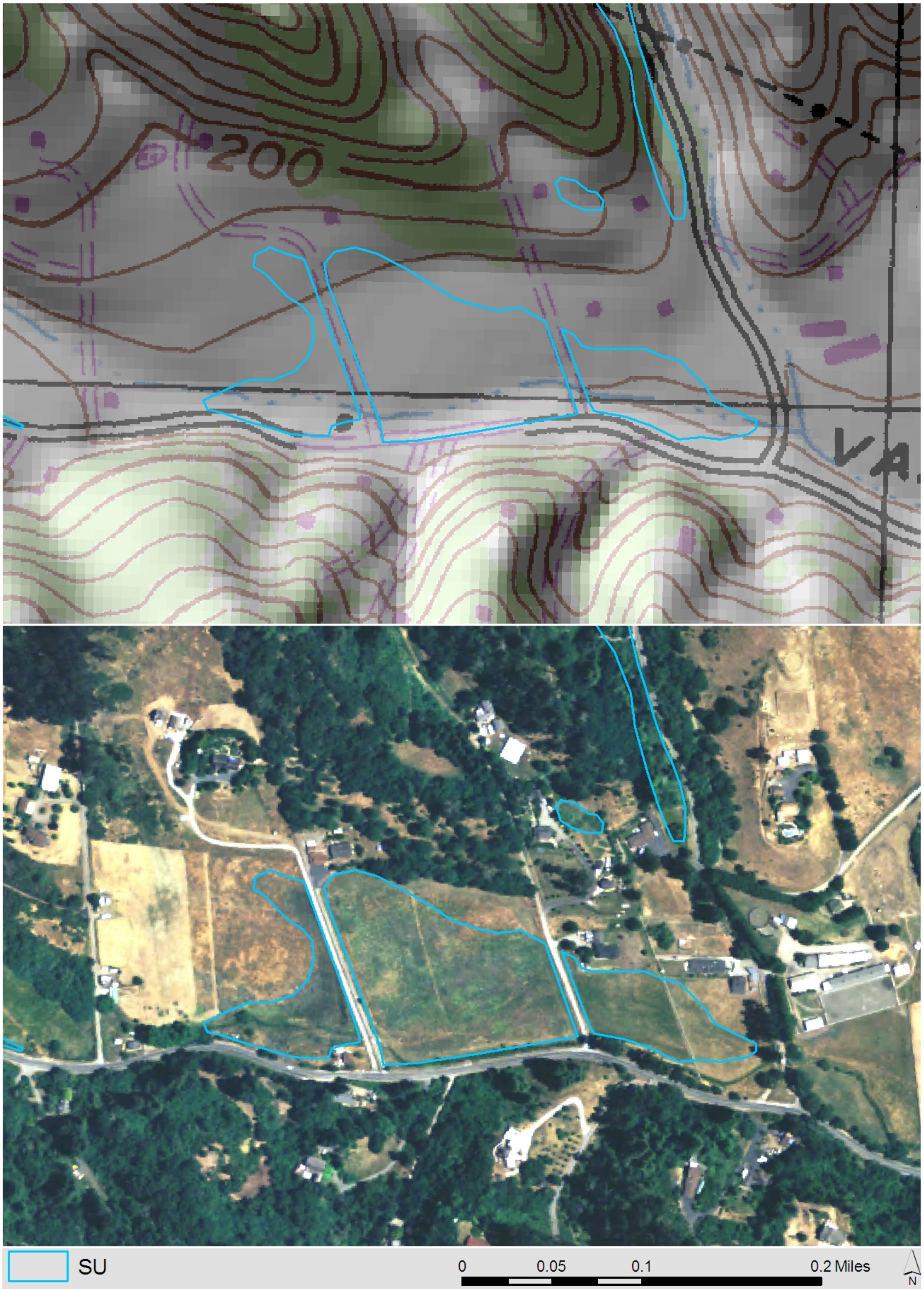
6. The final QAQC results will become a permanent attribute of each quadrangle.

Examples: For each of the examples below a DRG with hillshade image is provided (top) for comparison to a NAIP image with hillshade.

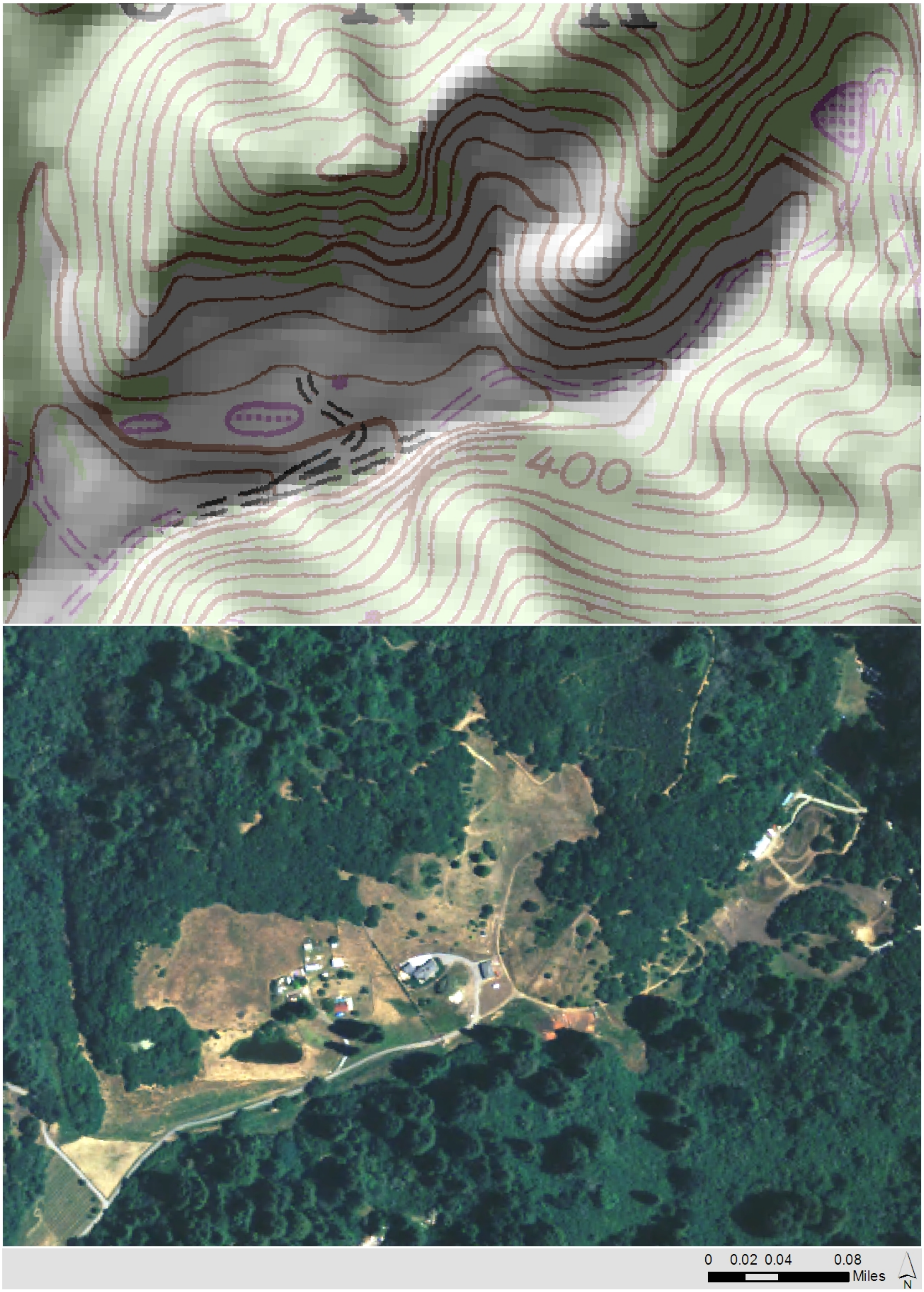
Example 1a



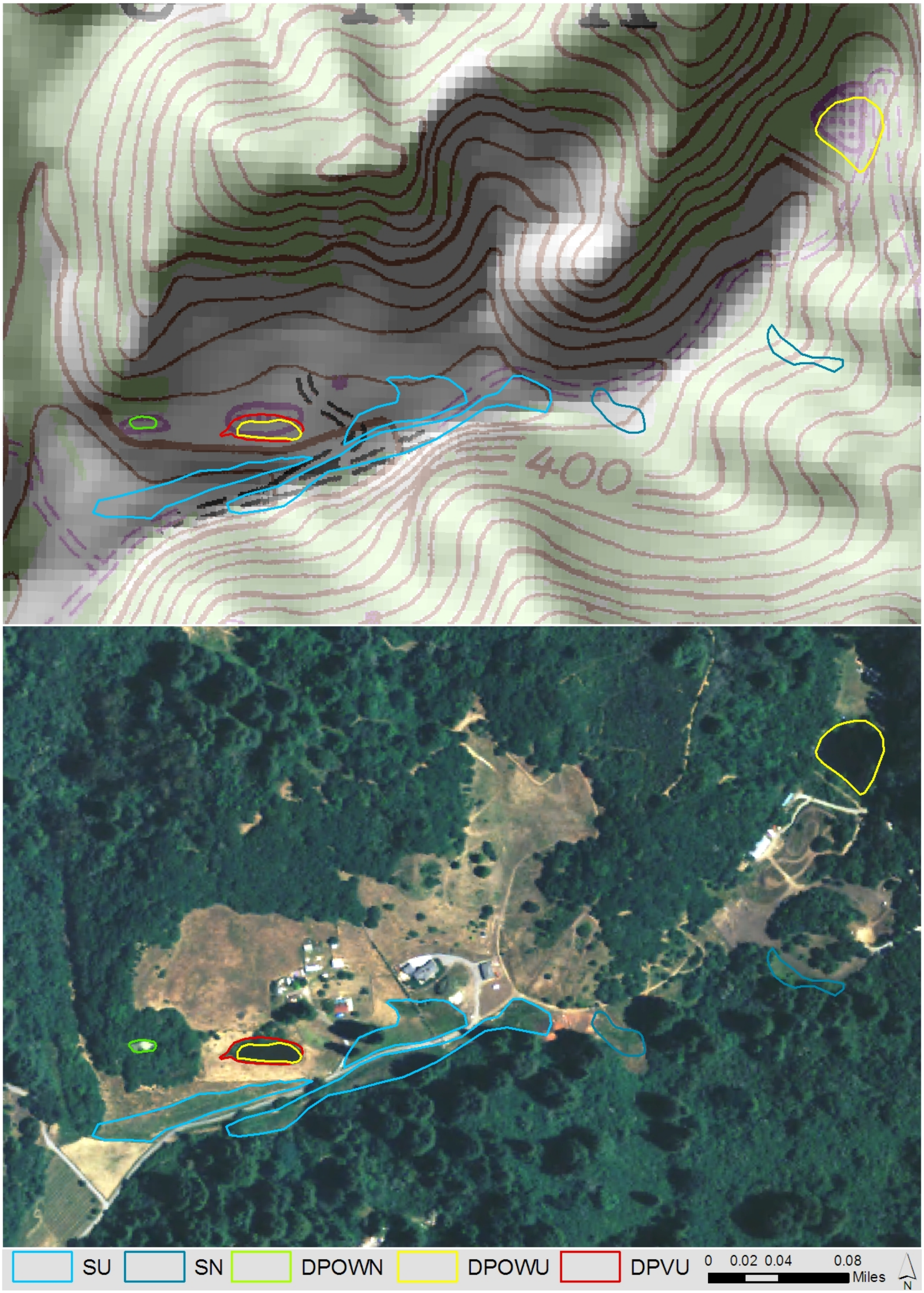
Example 1b



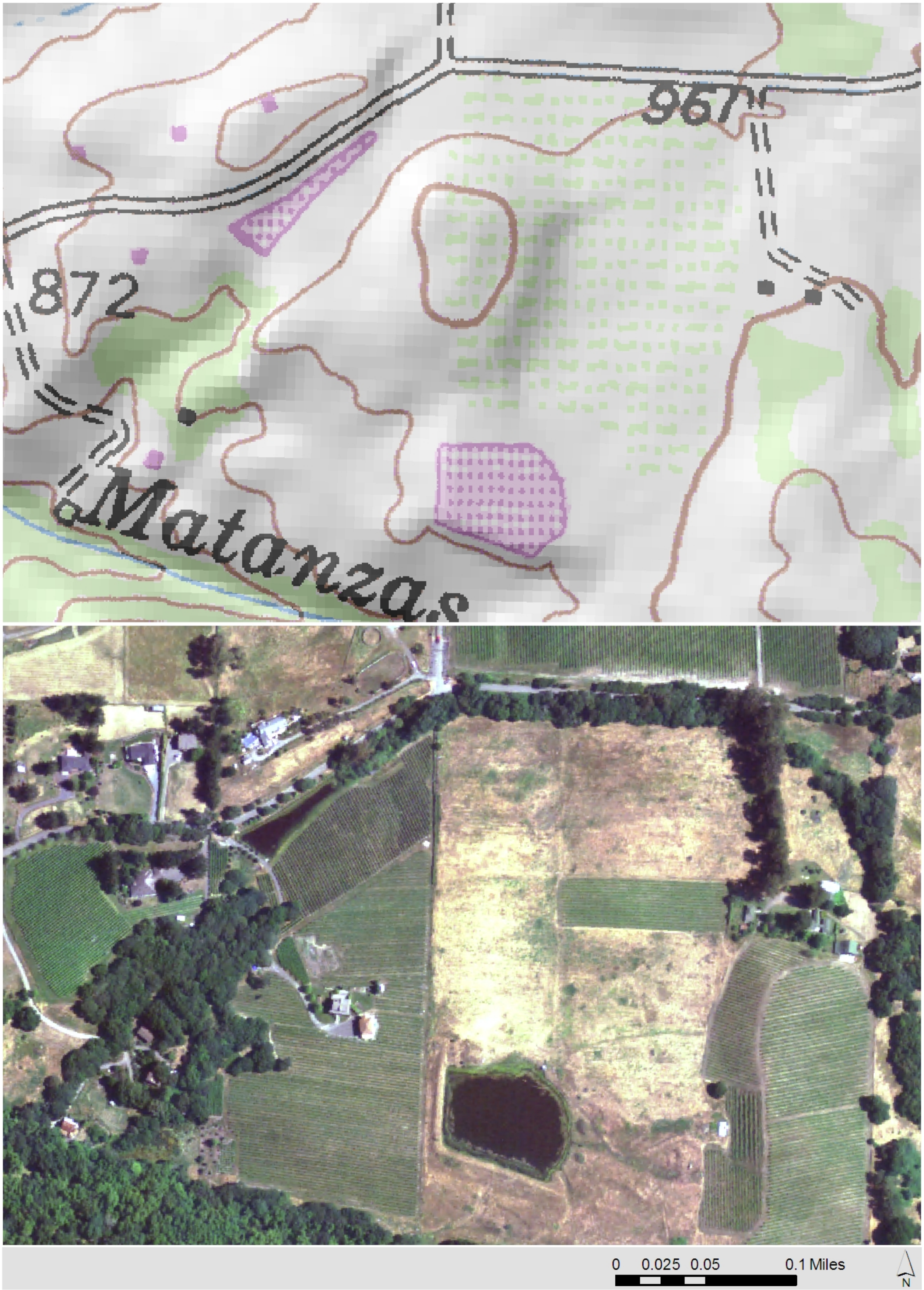
Example 2a



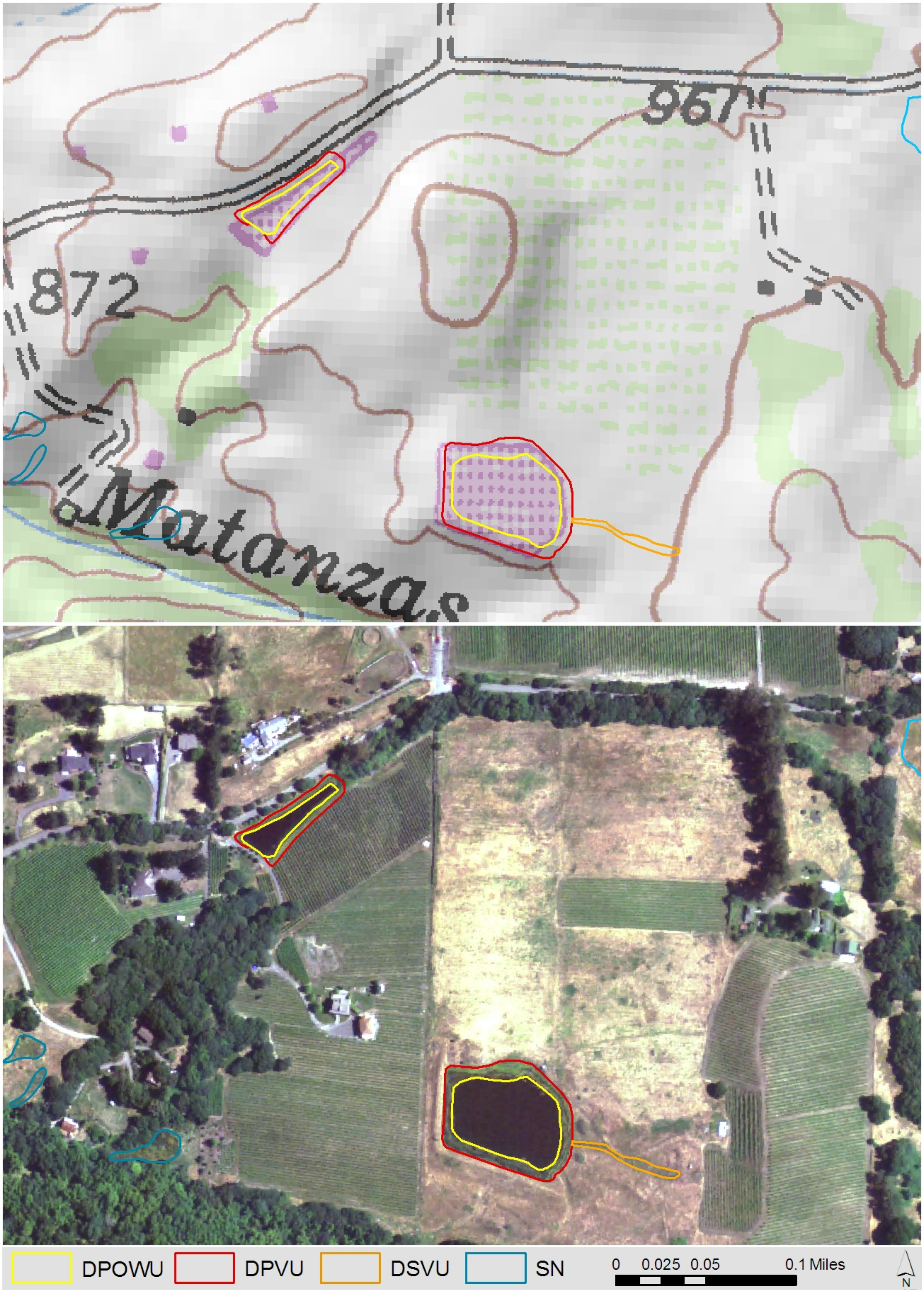
Example 2b



Example 3a



Example 3b



Stream Network Quality Assurance and Quality Control

The first stage in the wetland mapping process is the creation of the linework for the landscape drainage network. This process is done by the Prison Inmate Authority (PIA) and is verified and accepted by SFEI through the following QAQC process. The QAQC process is conducted for each 1:24,000 scale USGS quadrangle (quad).

1. PIA generates the stream network based on SFEI standards using collateral data according to the 4-step mapping process and standards described above.

2. SFEI decides to accept or reject PIA's drainage network map. The decision is based on SFEI's quantitative assessment of alignment, over-mapping, under-mapping, and coding. The assessment is based on the differences between the PIA map and an independently produced SFEI map for six randomly selected 1.0 square mile sample cells of the PIA map. The six sample sections represent about 10% of the area of a quad.
   i. ALIGNMENT
   The alignment parameter measures the degree to which the PIA drainage network map meets SFEI standards for channel alignment. SFEI will accept any length of a PIA channel that is within 7.5 meters of an SFEI channel. The length of a PIA channel that exists within this area will be considered correctly aligned. For all the six sample cells, the average amount of misalignment between the PIA drainage network map and the comparable SFEI map should be less than 15% of the SFEI map.

   ii. OVER-MAPPING
   The over-mapping parameter measures the amount of the PIA drainage network map that extends beyond the SFEI map. The total length of the PIA drainage network is compared to the total length of the SFEI drainage network, discounting the area of misalignment. The difference between the length of PIA network and the length of the SFEI network cannot have a positive value greater than 15% of the length of the SFEI network.

   iii. UNDER-MAPPING
   The under-mapping parameter measures the amount of the SFEI drainage network map that extends beyond the PIA map. The total length of the PIA drainage network is compared to the total length of the SFEI drainage network, discounting the area of misalignment. The average difference between the length of PIA network and the length of the SFEI network cannot have a negative value greater than 15% of the length of the SFEI network.

   iv. CODING

The coding parameter measures the accuracy of PIA classification of the drainage network. With regard to coding, SFEI will accept the quad for a particular stream type if the amount of misclassification by PIA is less than 15%.

3. If any of the parameters do not meet SFEI standards, the quad will be returned to PIA along with the SFEI drainage network maps for each of the six sample cells, which PIA will use to guide their revisions of the PIA drainage network map. Once PIA is done the quad will be send back to SFEI where the QAQC process will be repeated. The QAQC process will be repeated until the PIA map meets all of the SFEI standards. Each QAQC process will be conducted using a different set of six randomly selected QAQC cells.

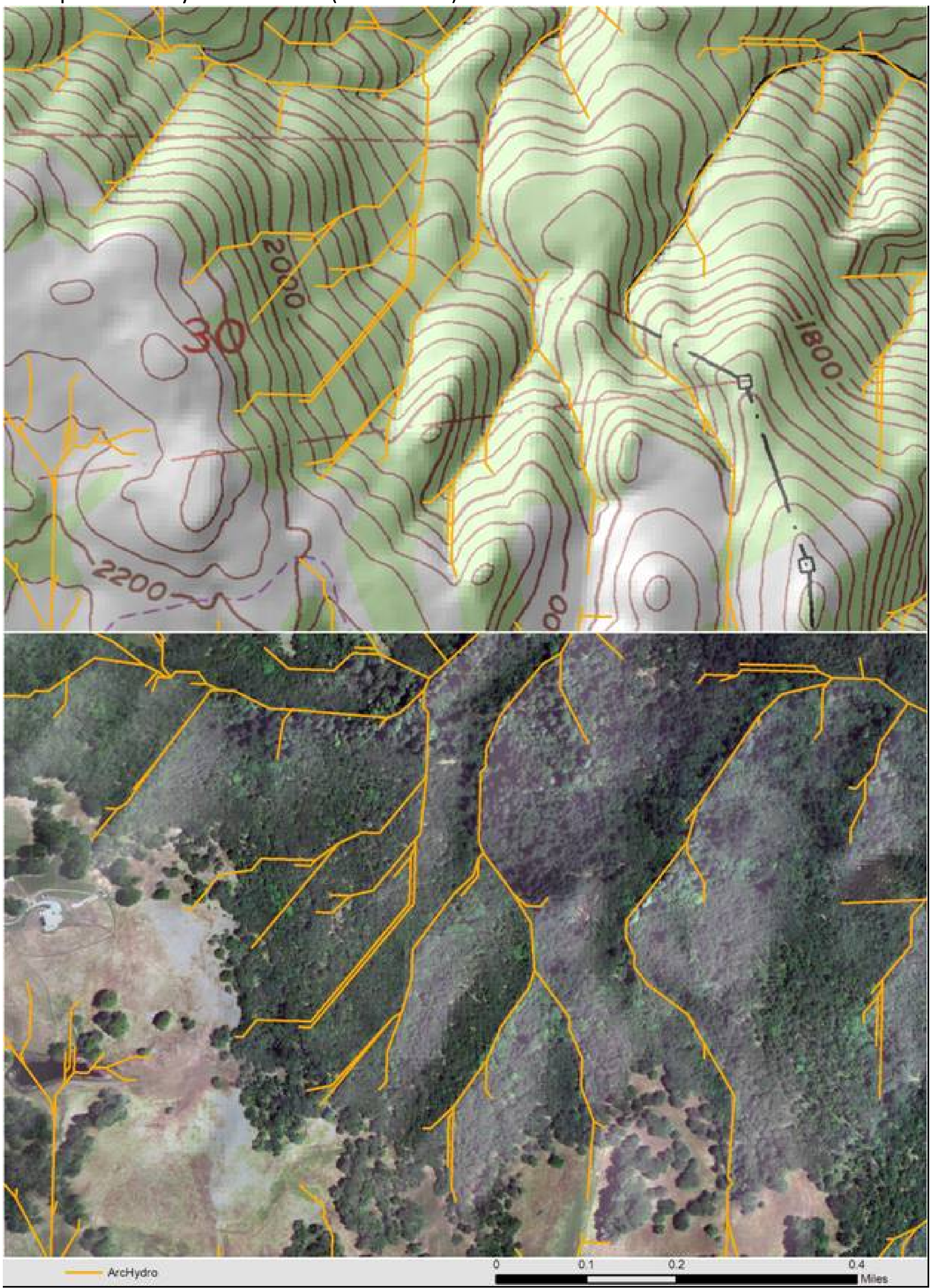
4. The last QAQC step features coarse scale overview of the final draft maps at a scale of 1 to 10,000 by mapping and ecology with local knowledge of the area. Any major errors found in the draft maps are resolved during this step in the review.

5. The final QAQC cells and their final QAQC results will become a permanent attribute of each quadrangle.

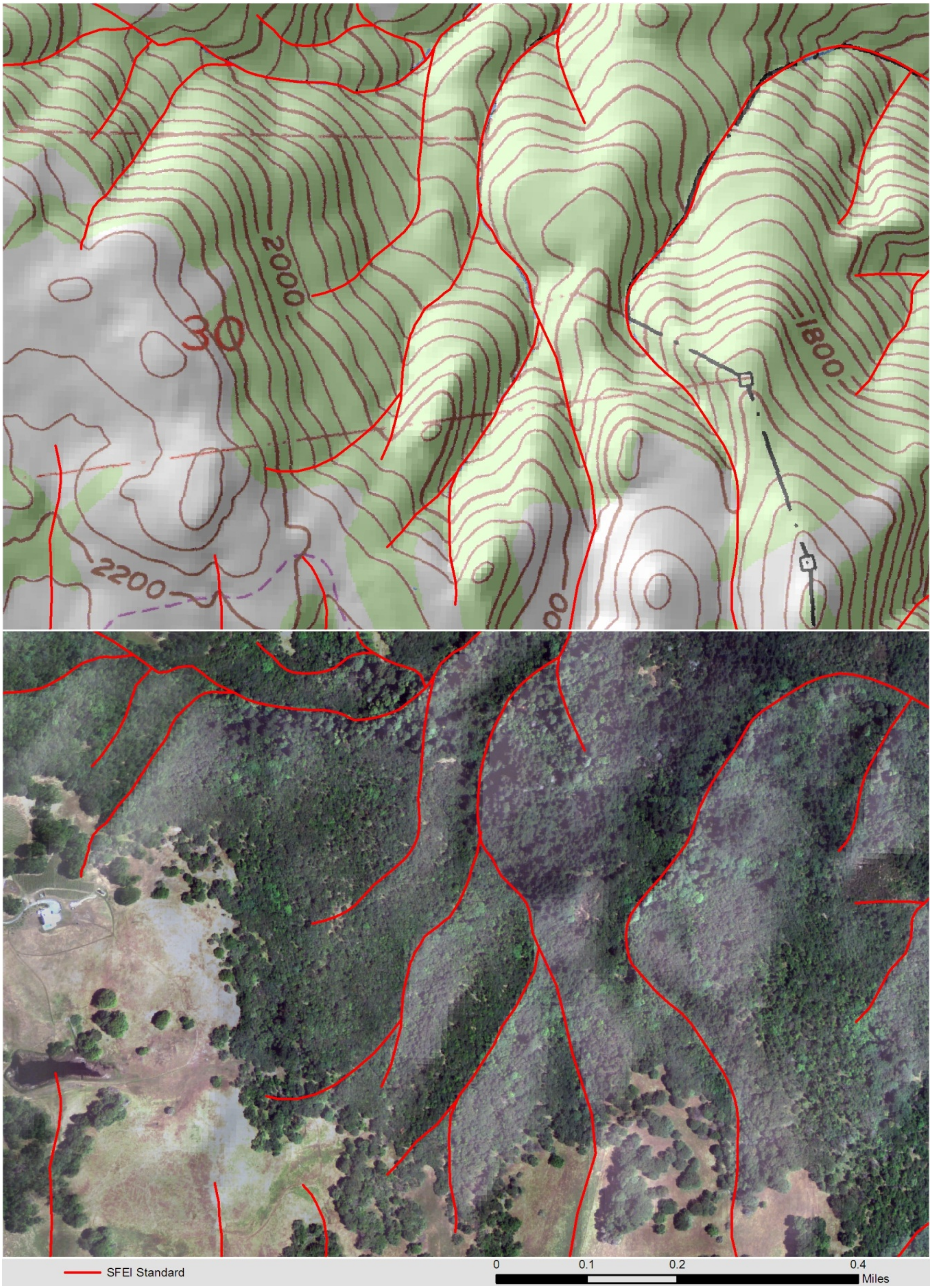
Examples: For each of the examples below a DRG with hillshade image is provided (top) for comparison to a NAIP image with hillshade.

Mountains

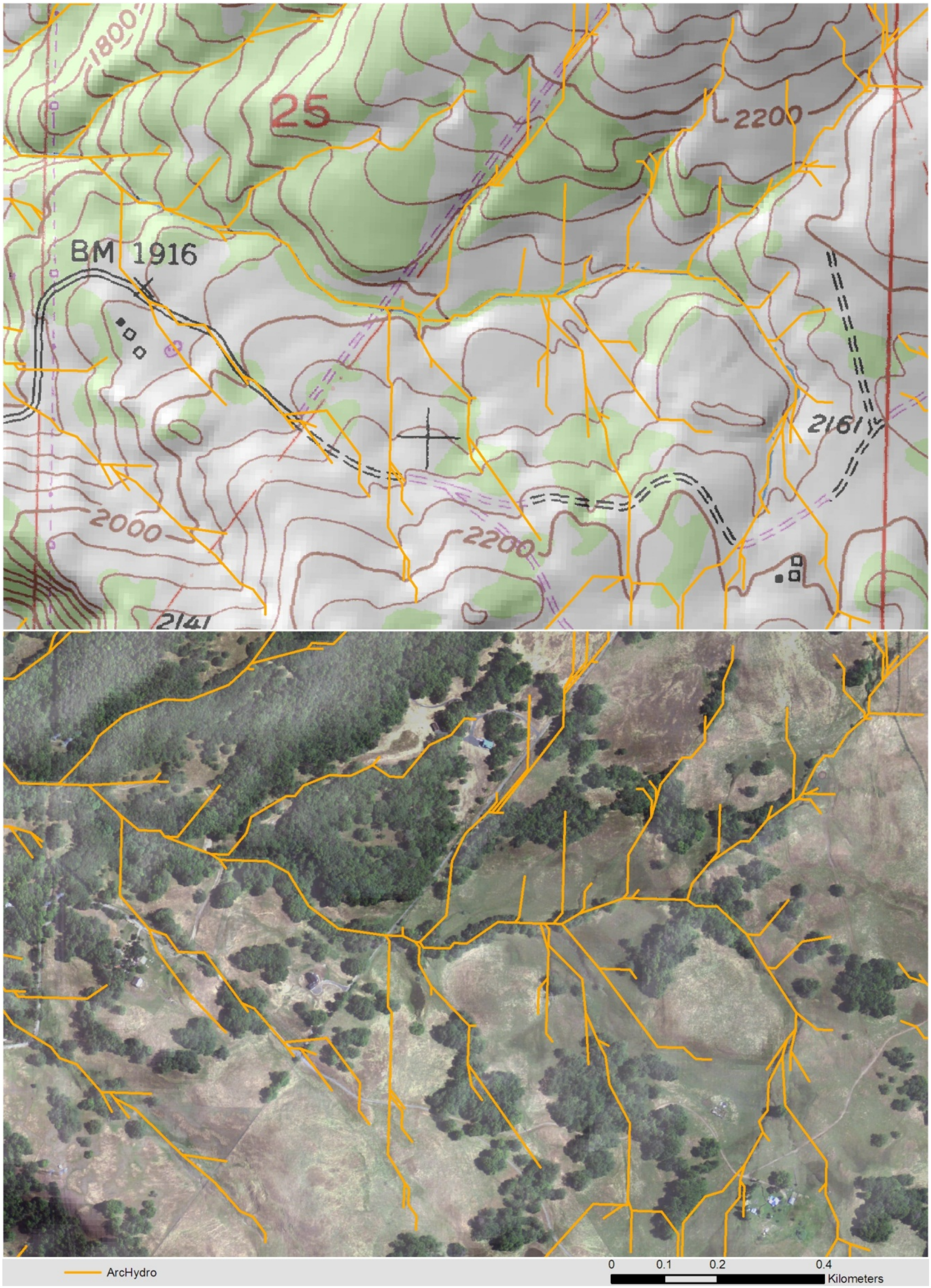
Example 1a ArcHydro linework (Mountains)



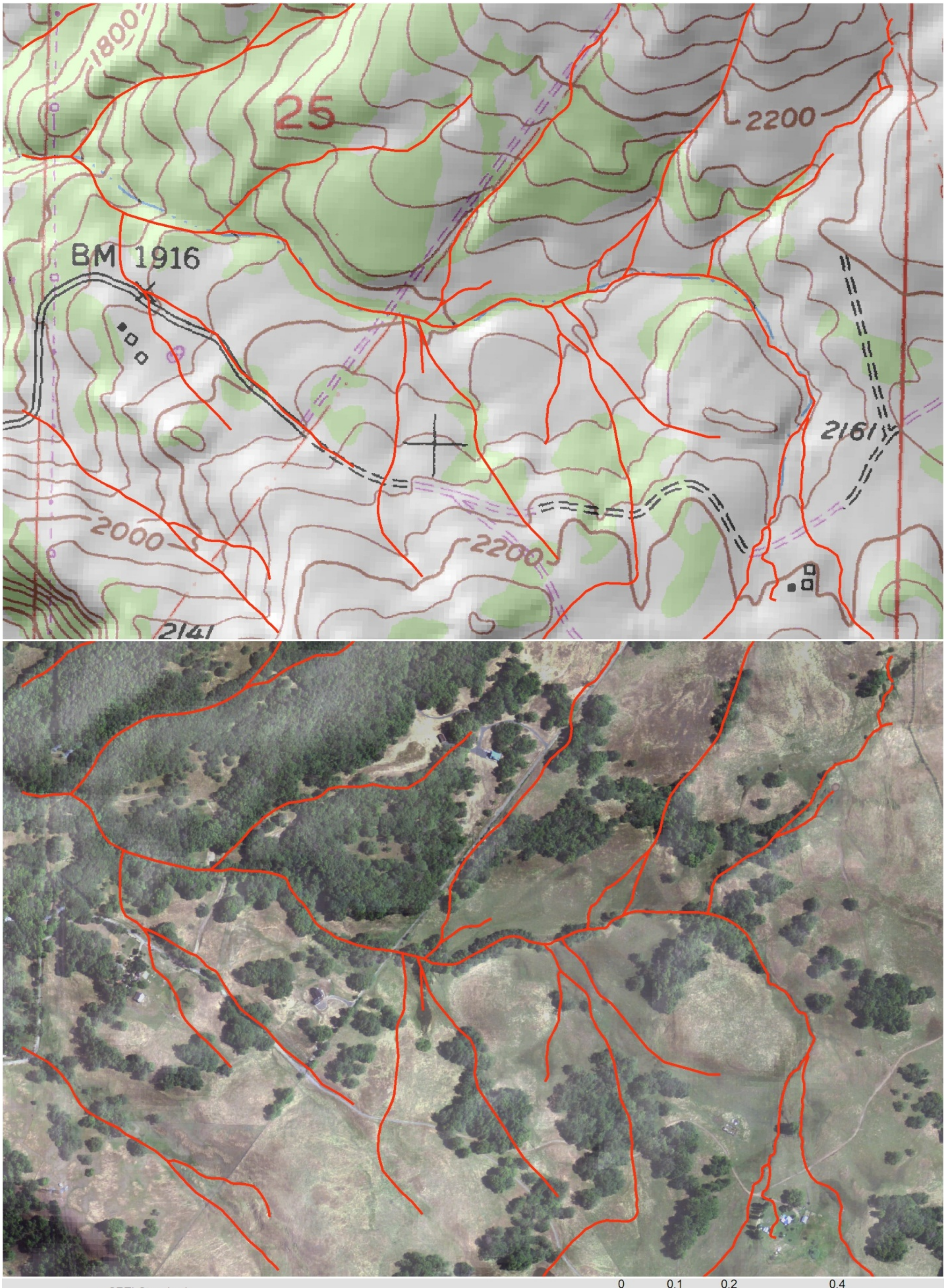
Example 1b SFEI standard linework (Mountains)



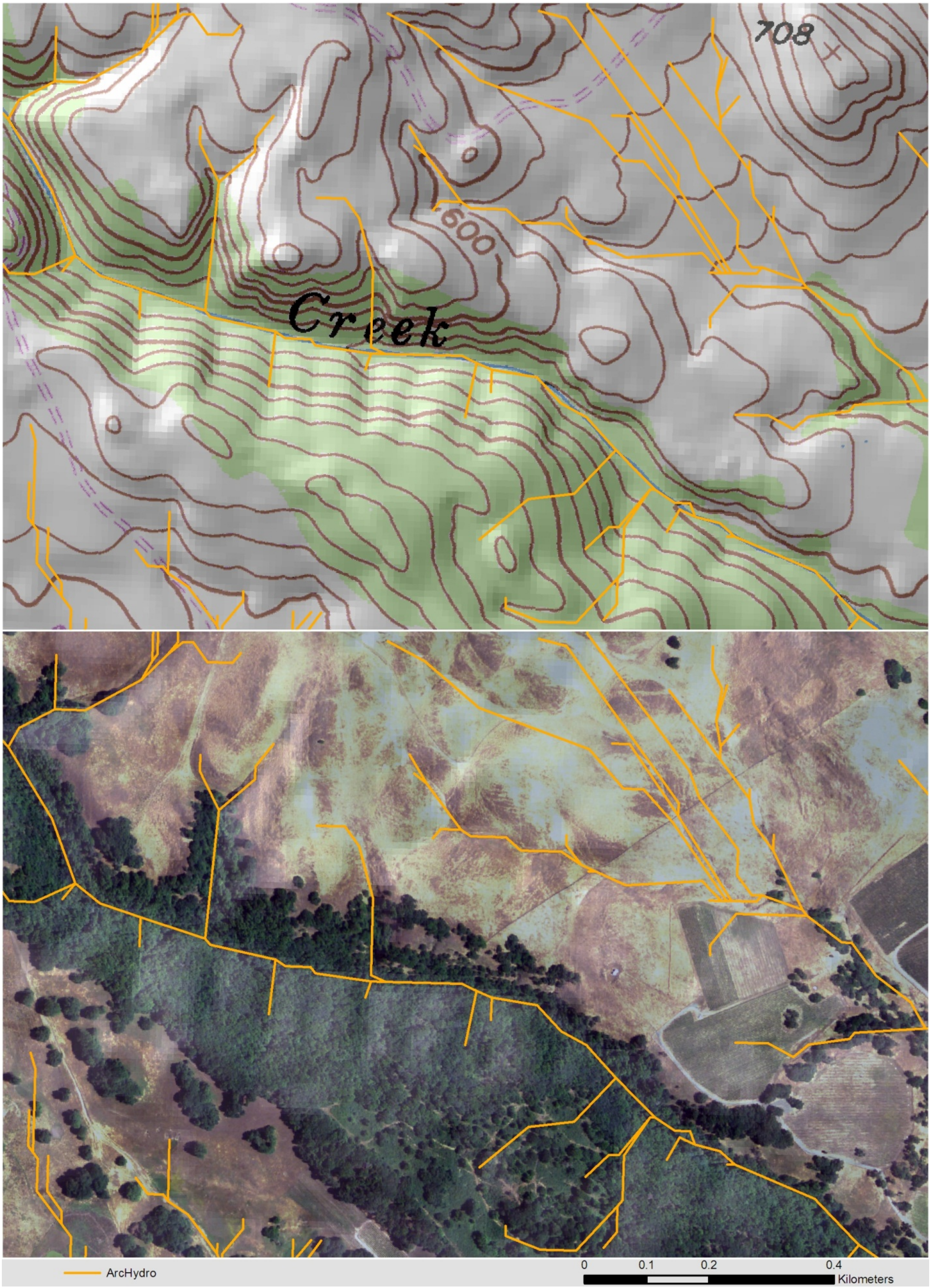
Example 2a ArcHydro linework (Mountains)



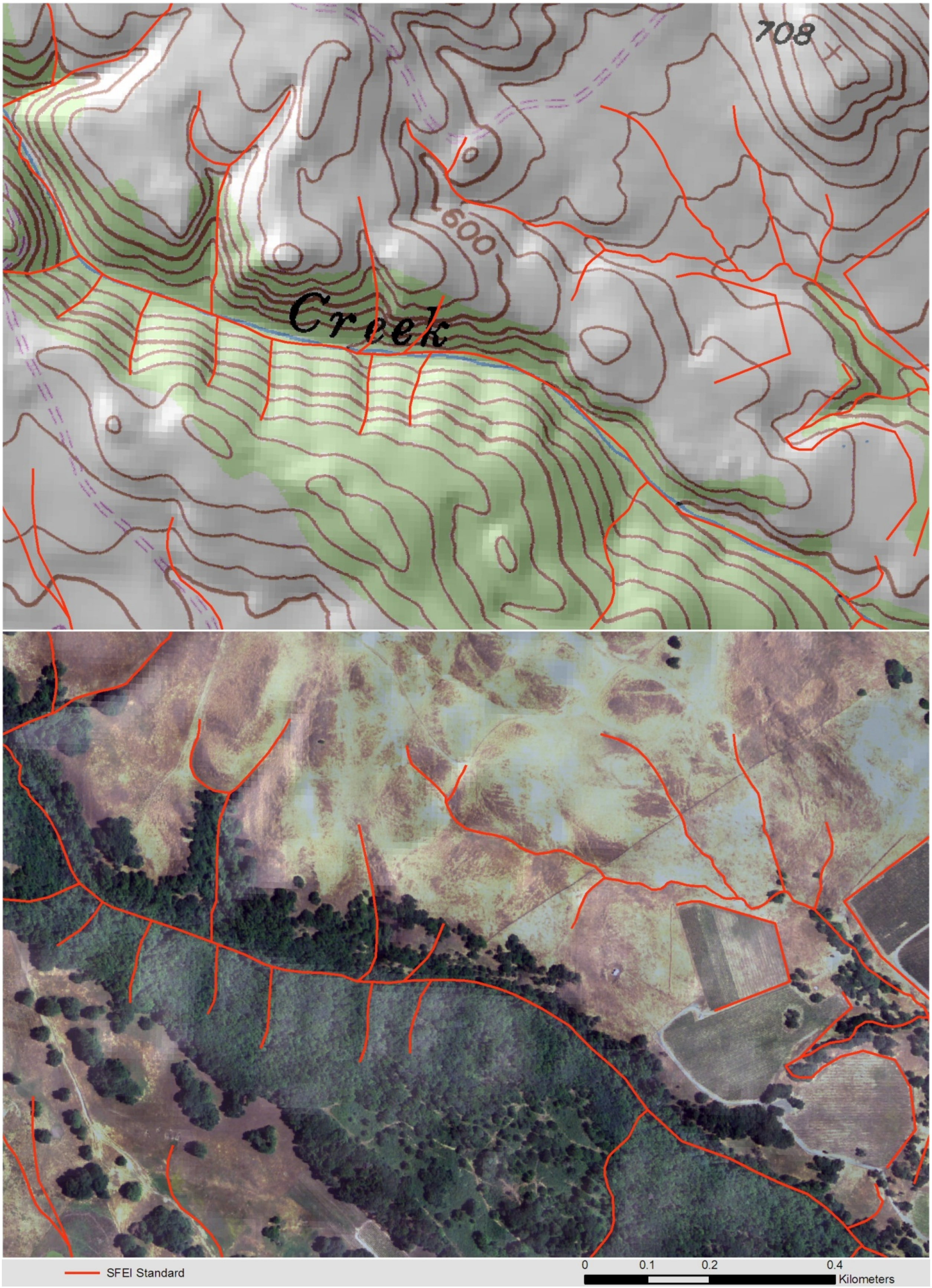
Example 2b SFEI Standard linework (Mountains)



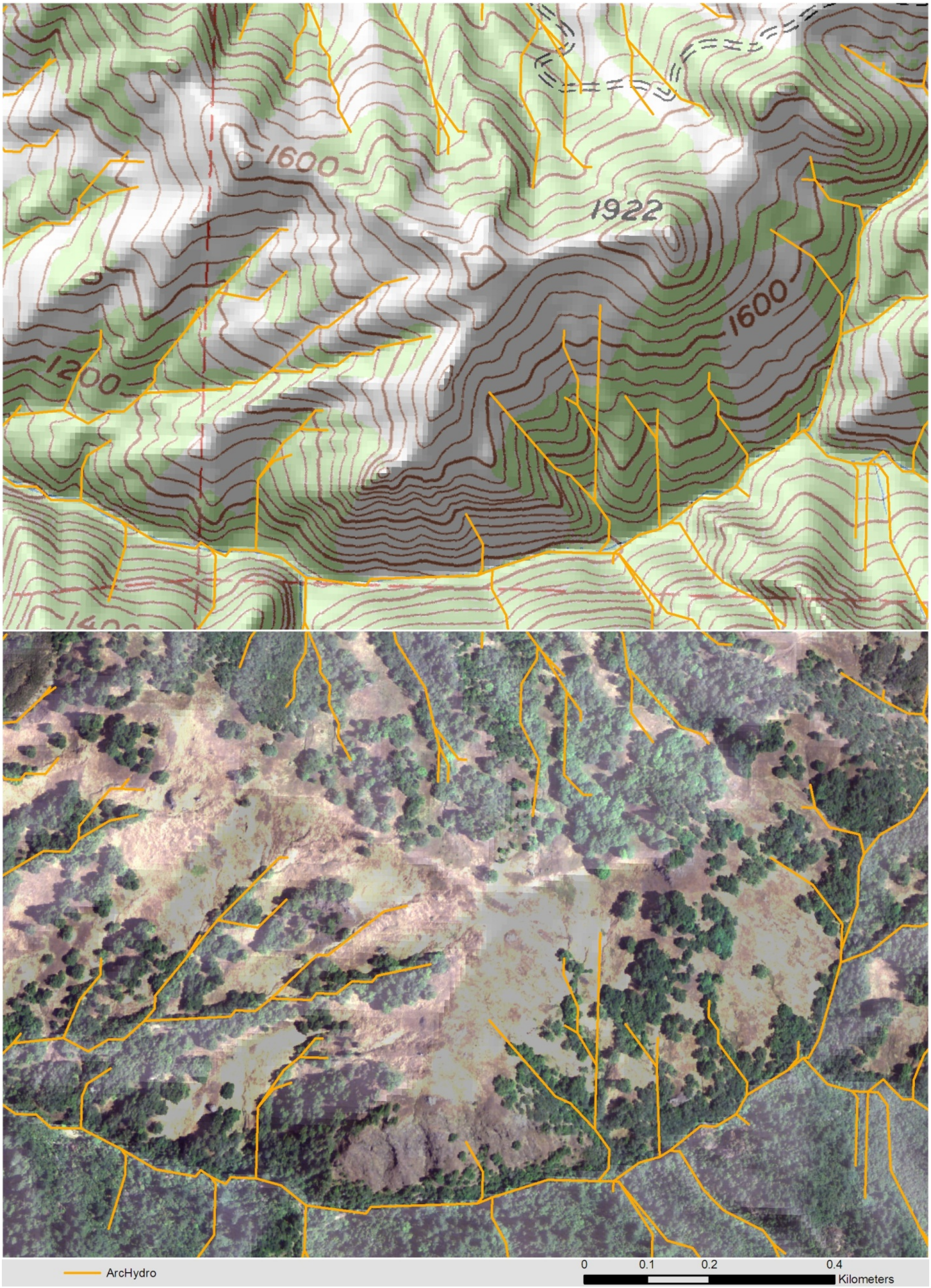
Example 3a ArcHydro linework (Mountains)



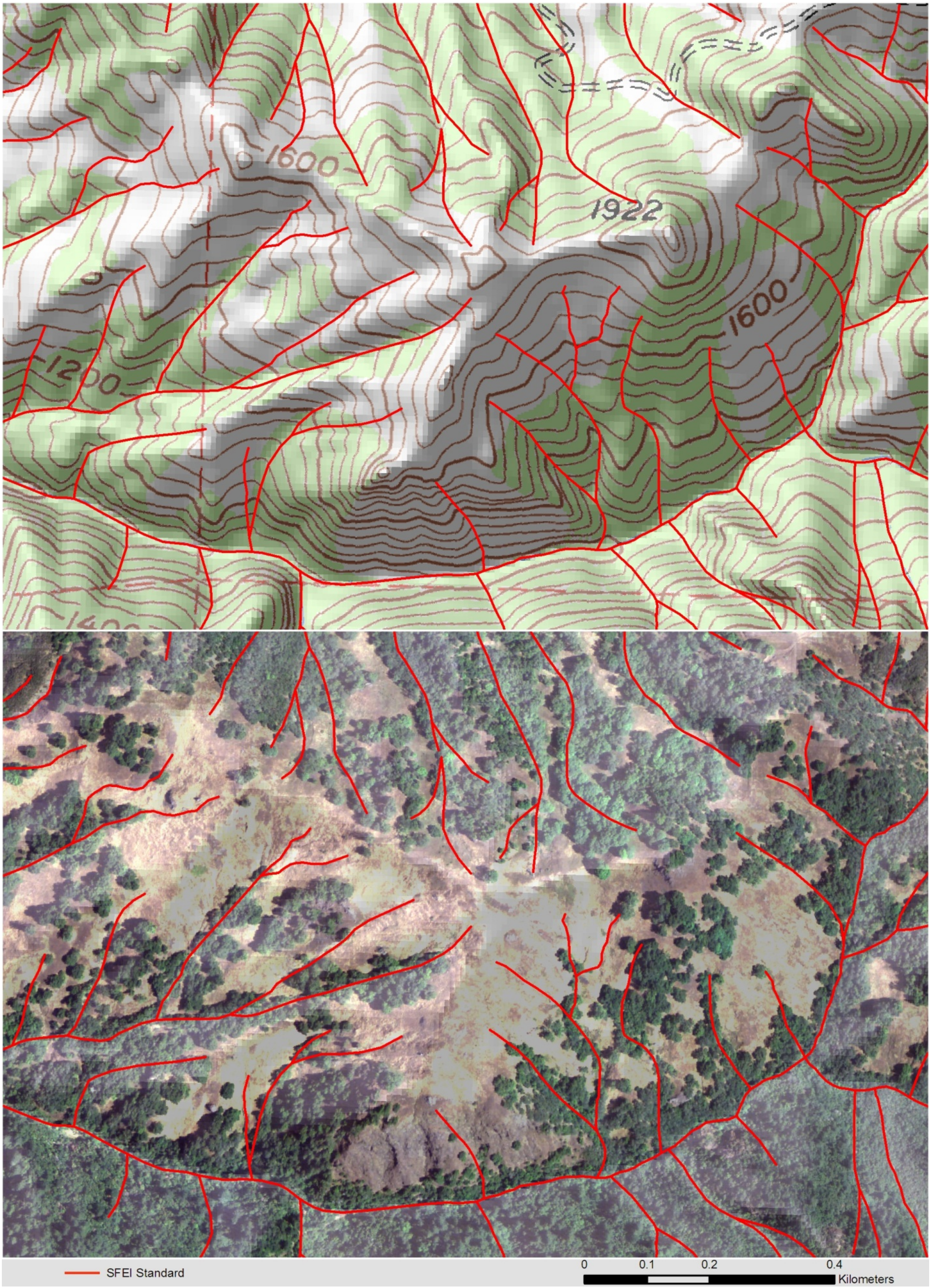
Example 3b SFEI standard linework (Mountains)



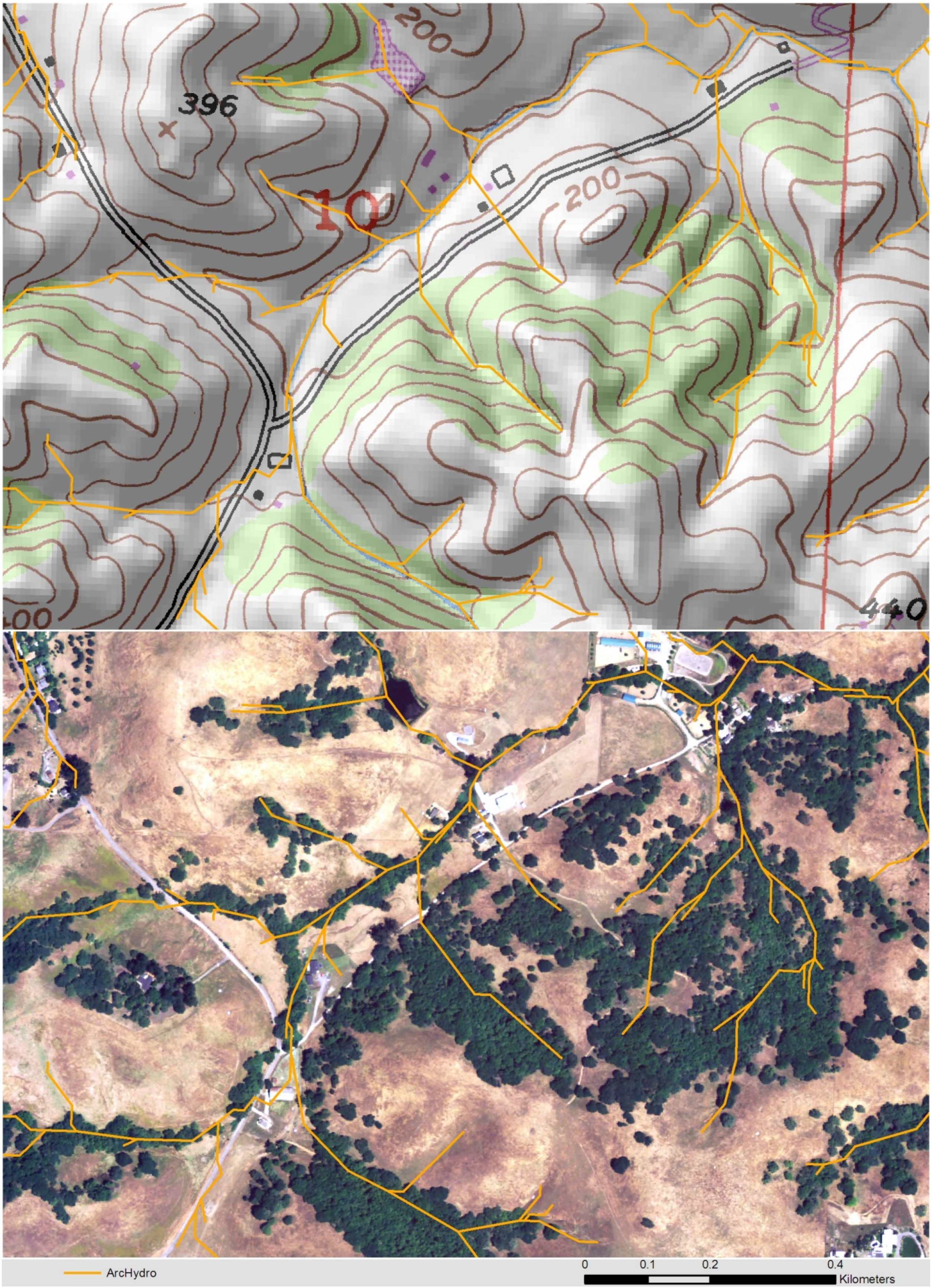
Example 4a ArcHydro linework (Mountains)



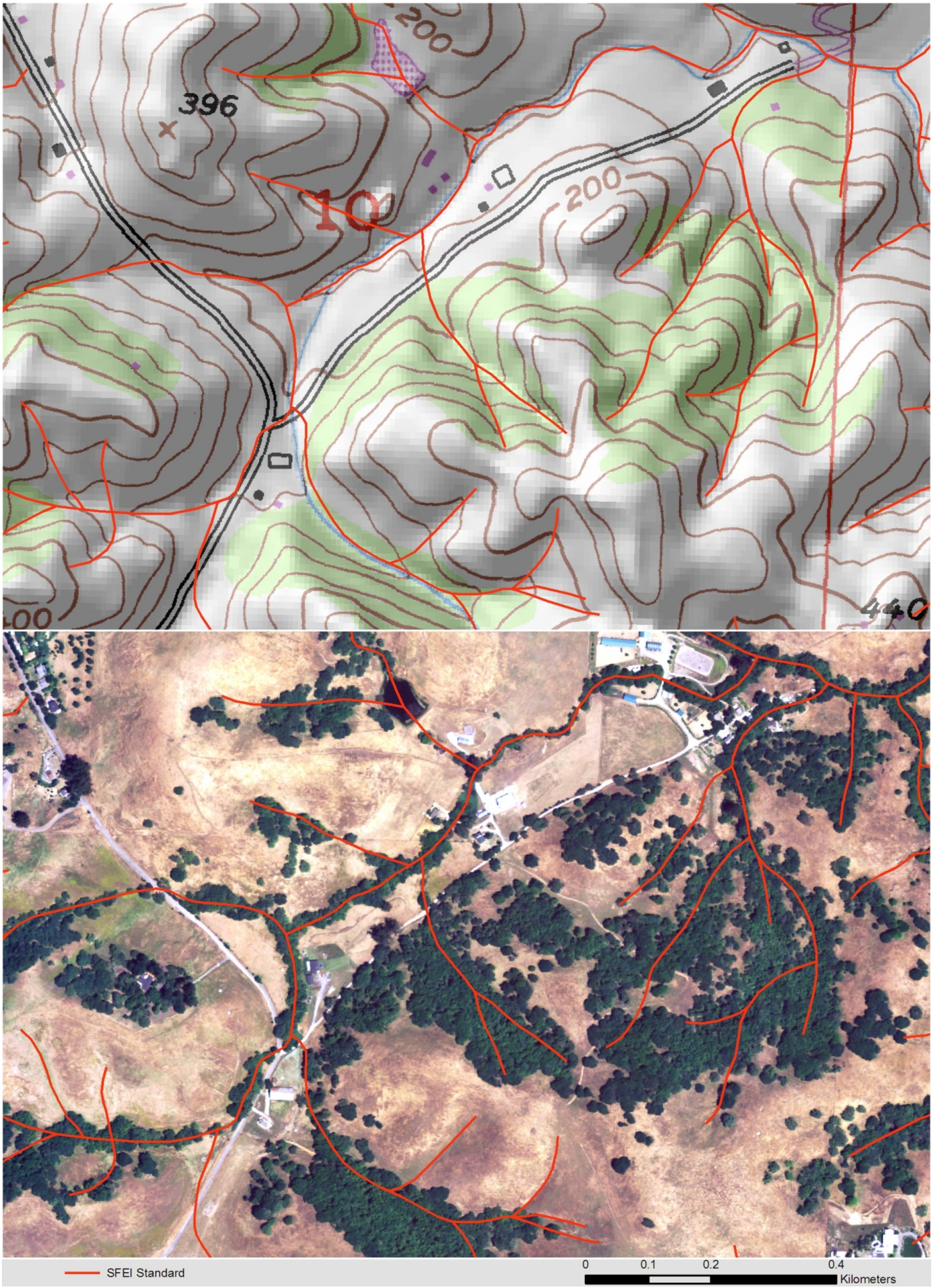
Example 4b SFEI standard linework (Mountains)



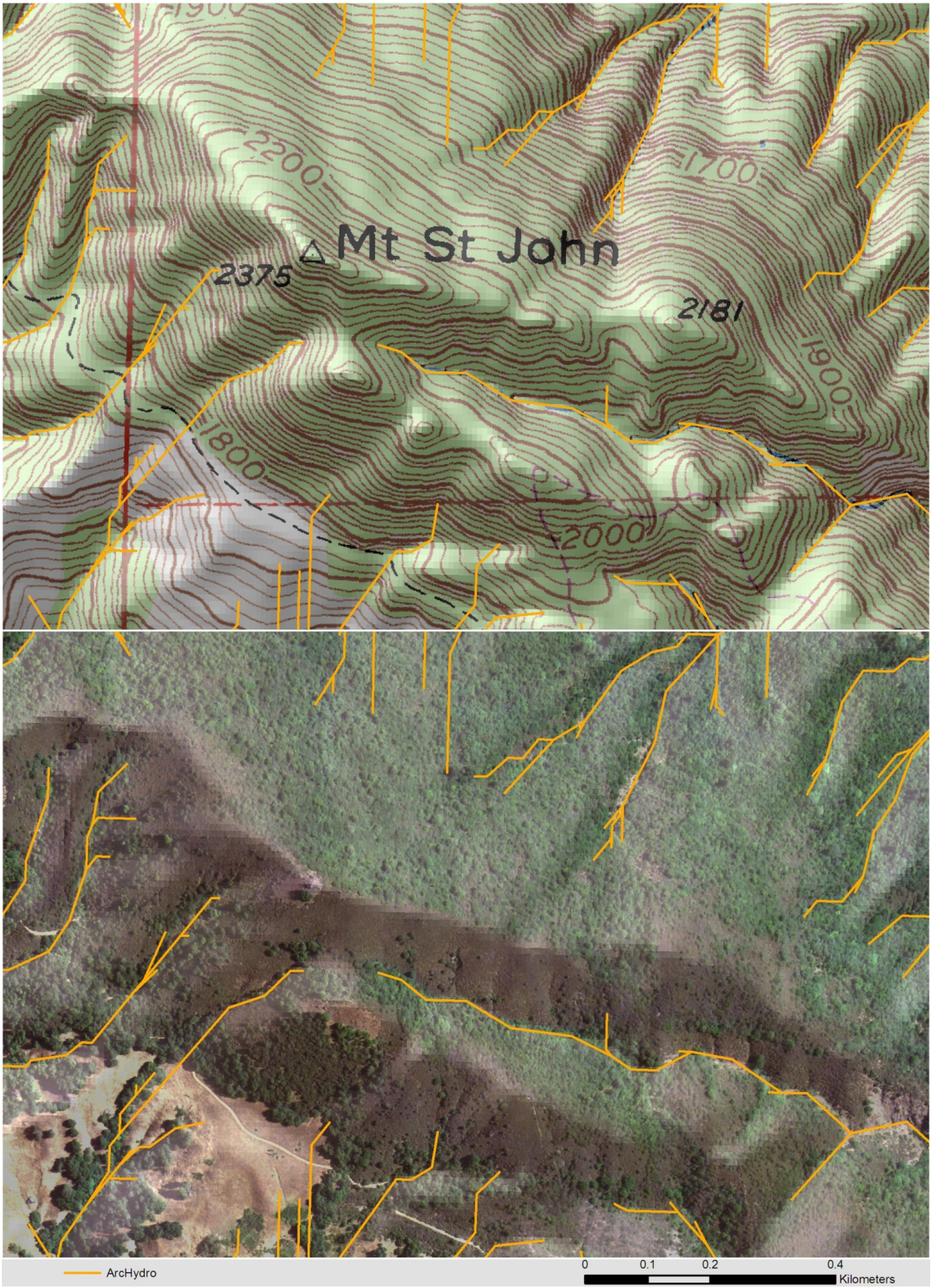
Example 5a ArcHydro linework (Mountains)



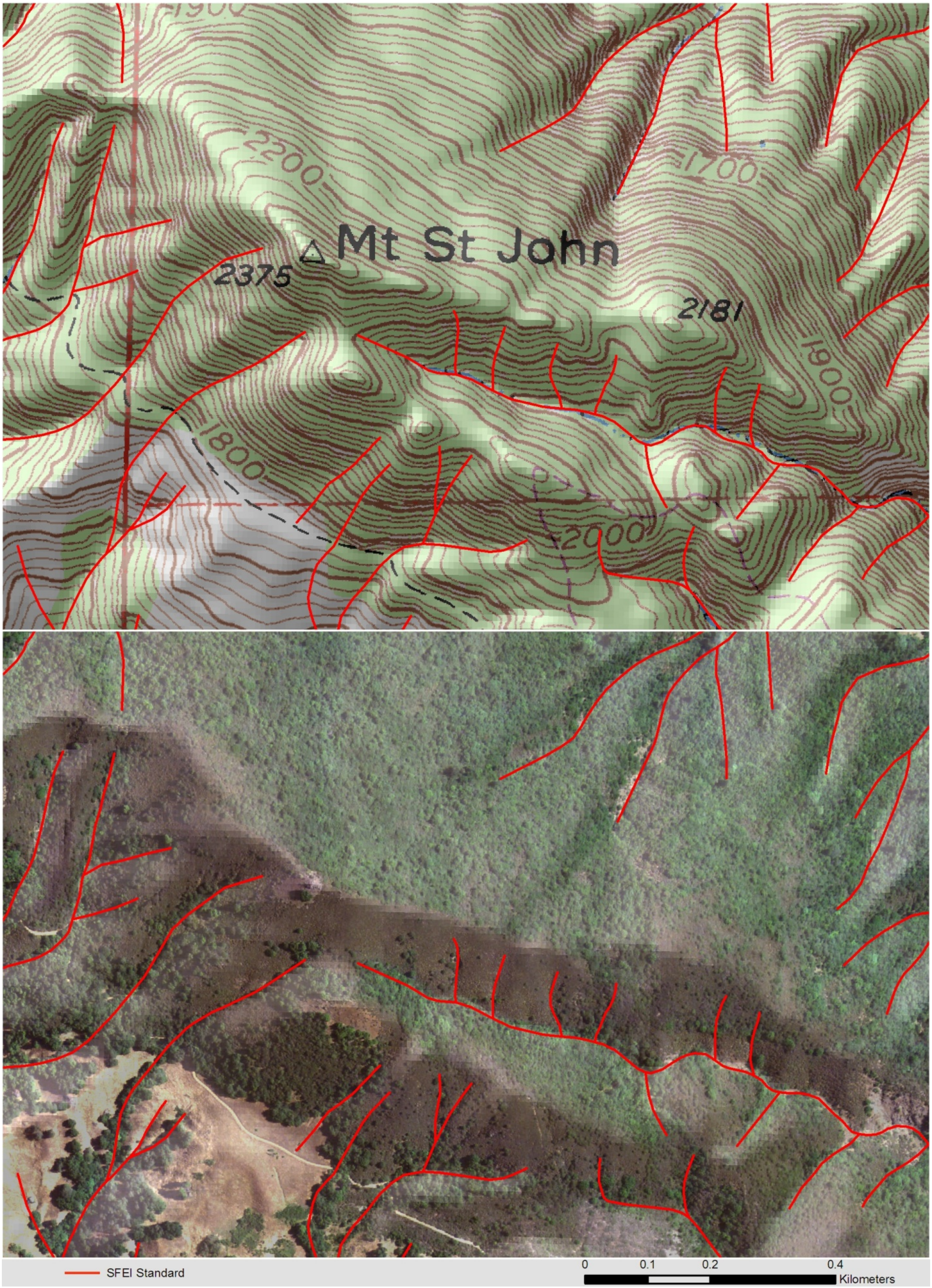
Example 5b SFEI standard linework -(Mountains)



Example 6a ArcHydro linework (Mountains)

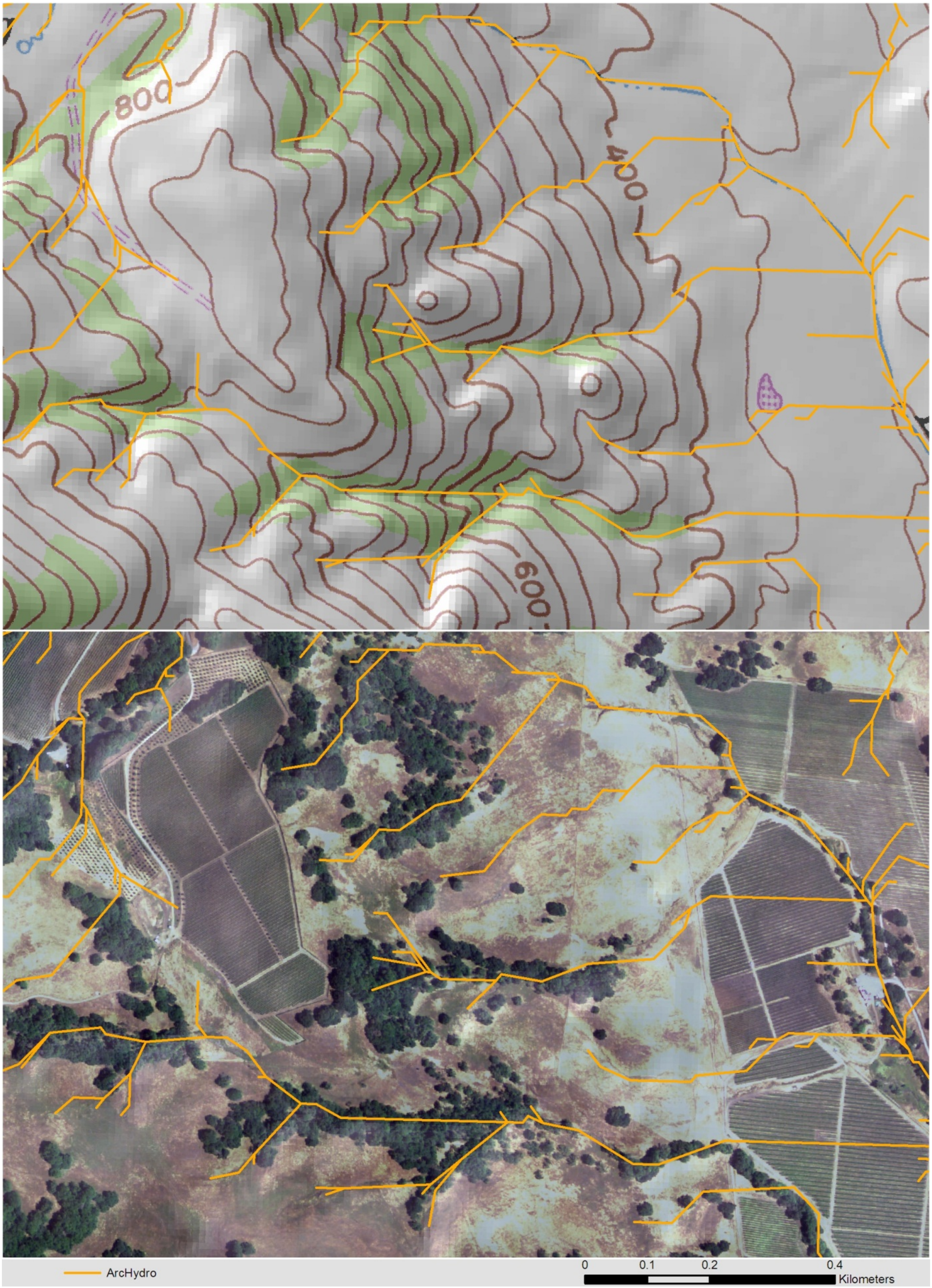


Example 6b SFEI standard linework -(Mountains)

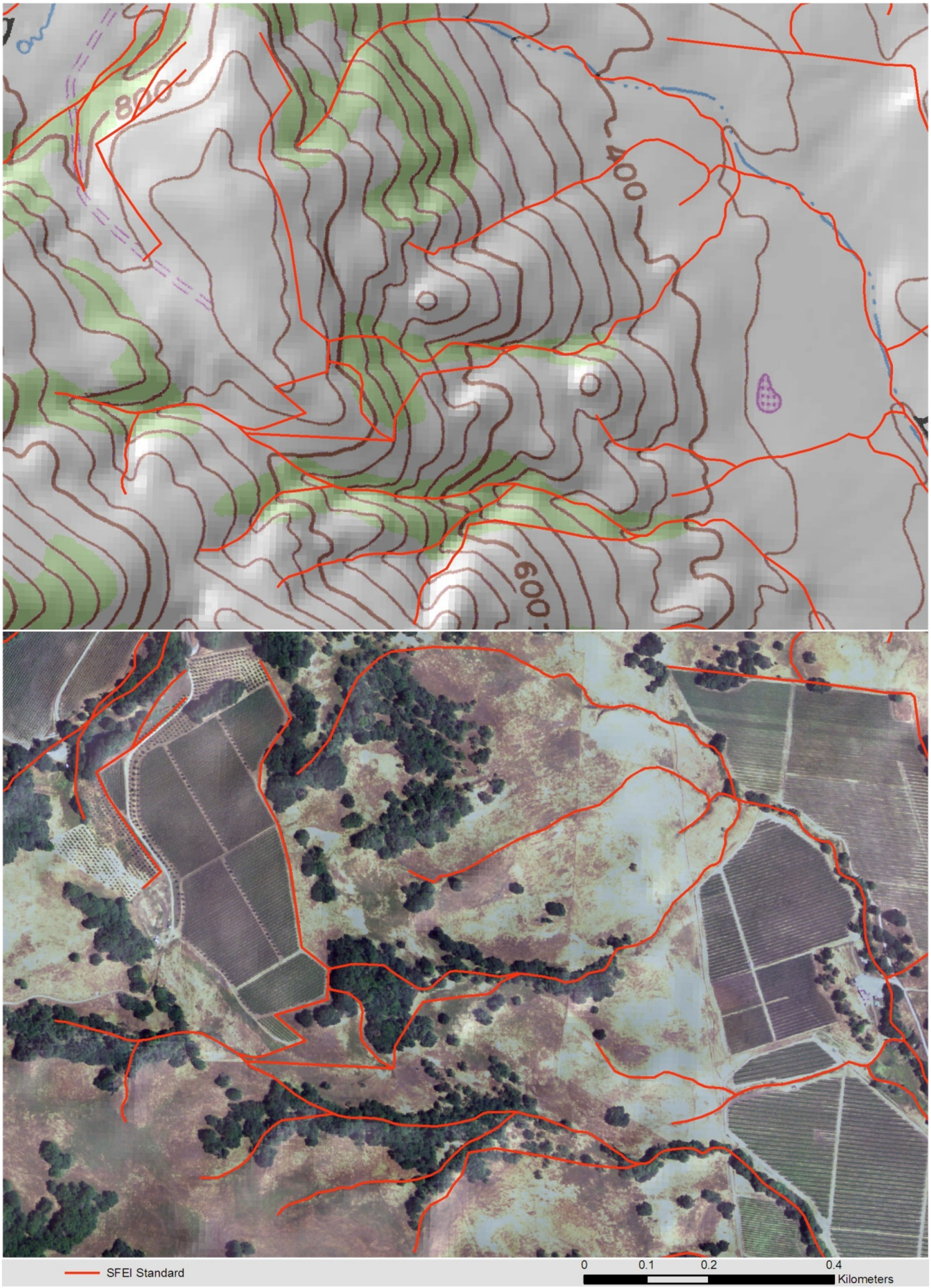


Agricultural Areas

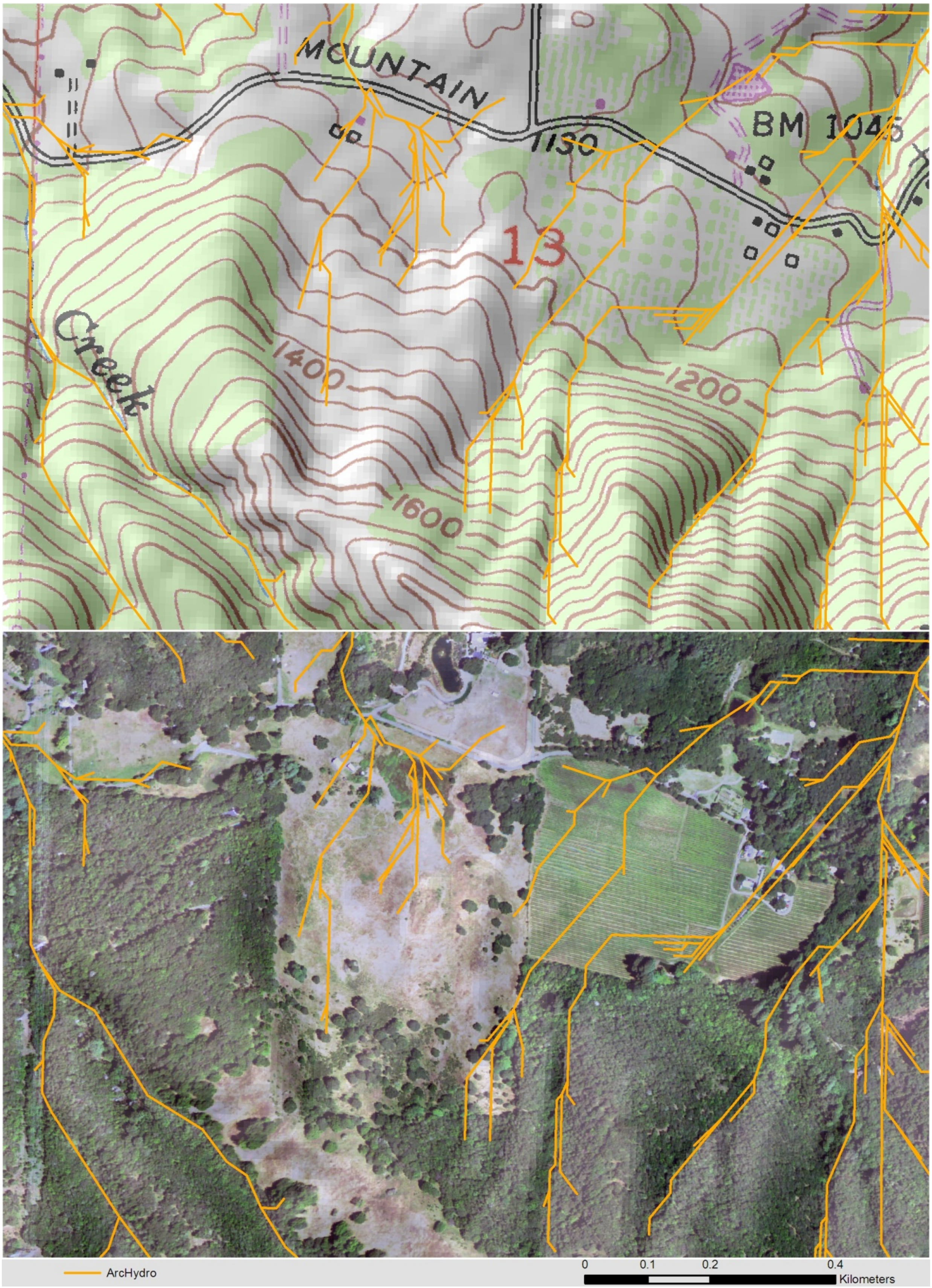
Example 7a- ArcHydro linework (Agricultural Areas)



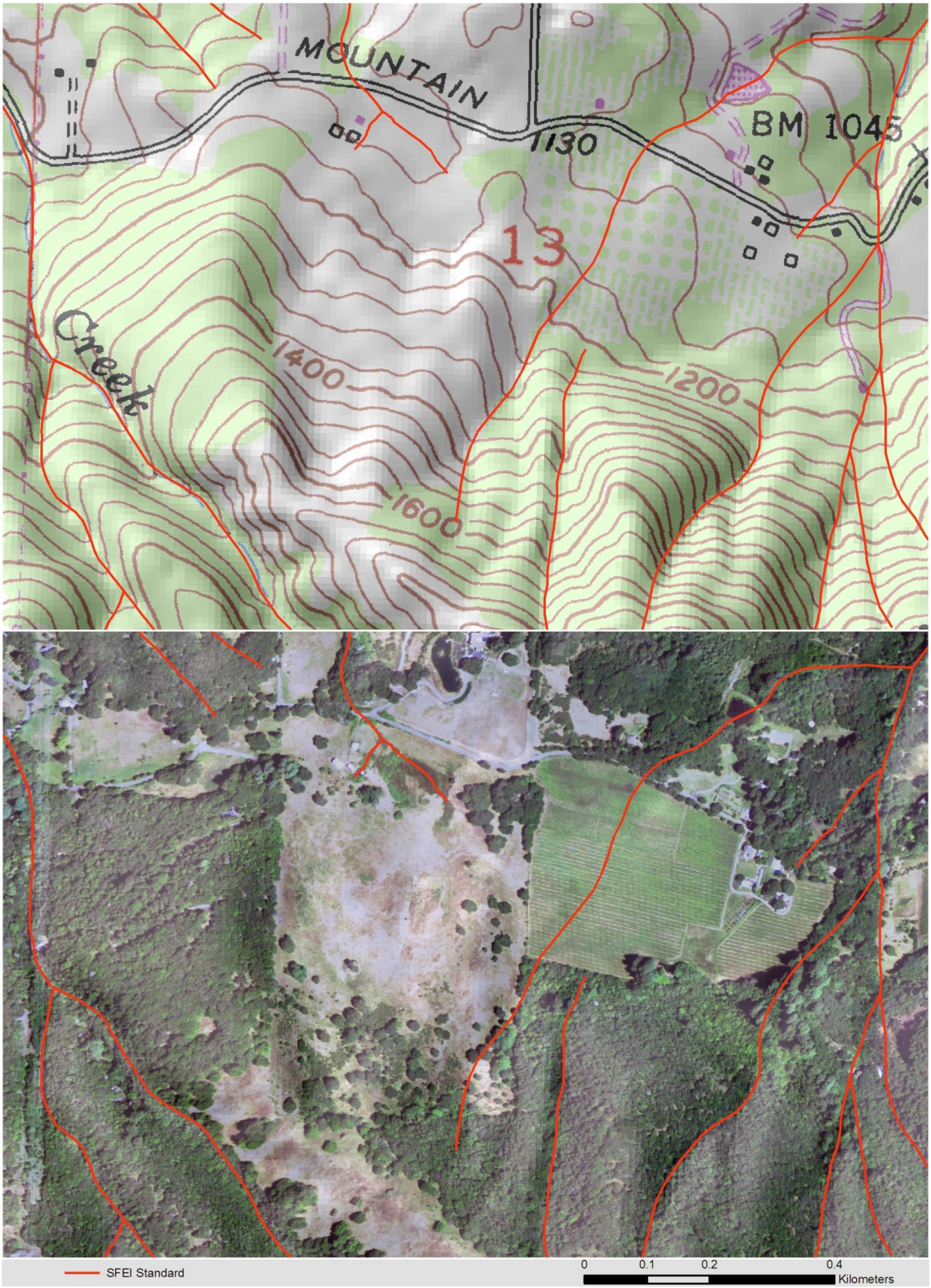
Example 7b SFEI standard linework (Agricultural Areas)



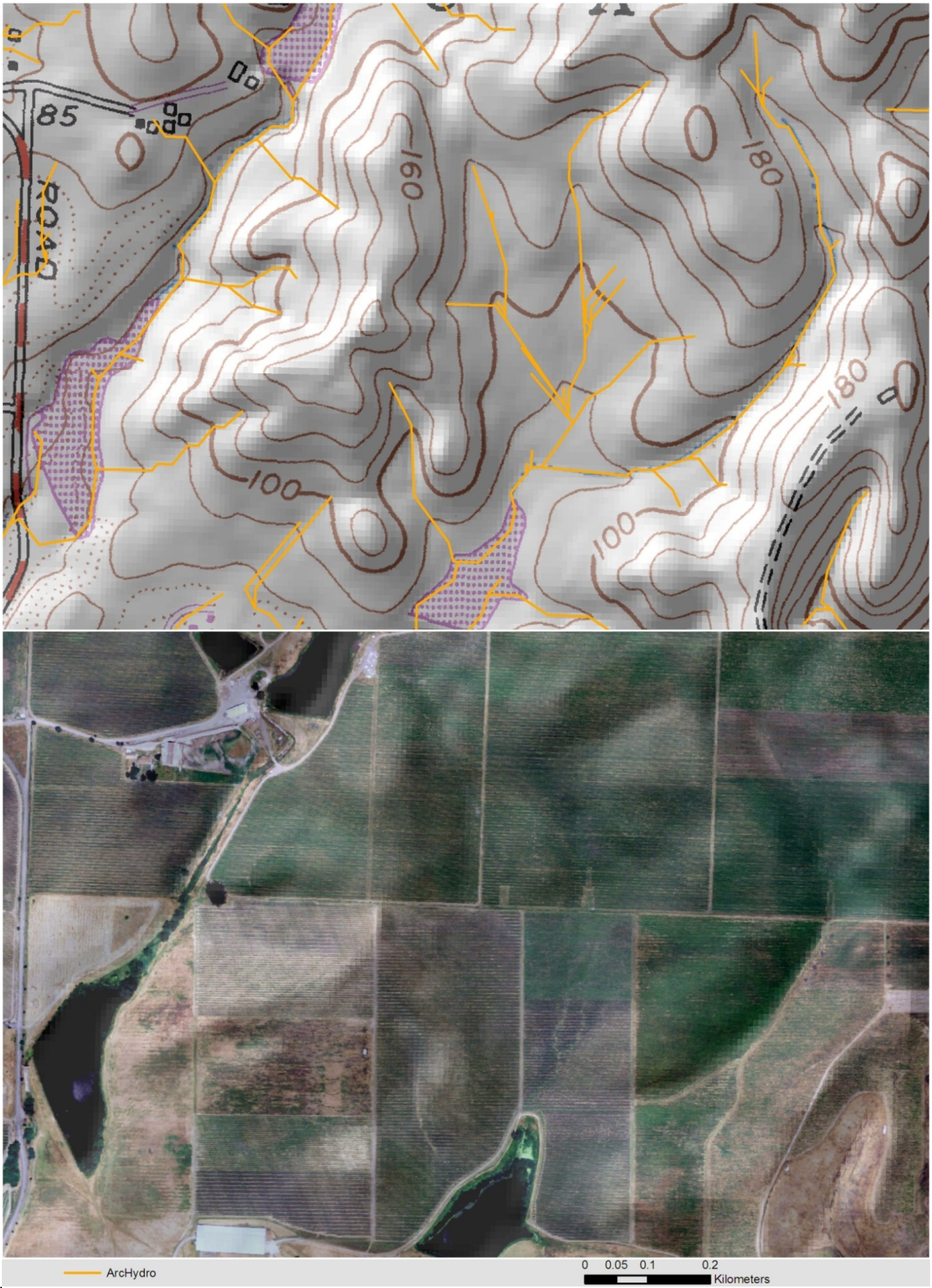
Example 8a ArcHydro linework (Agricultural Areas)



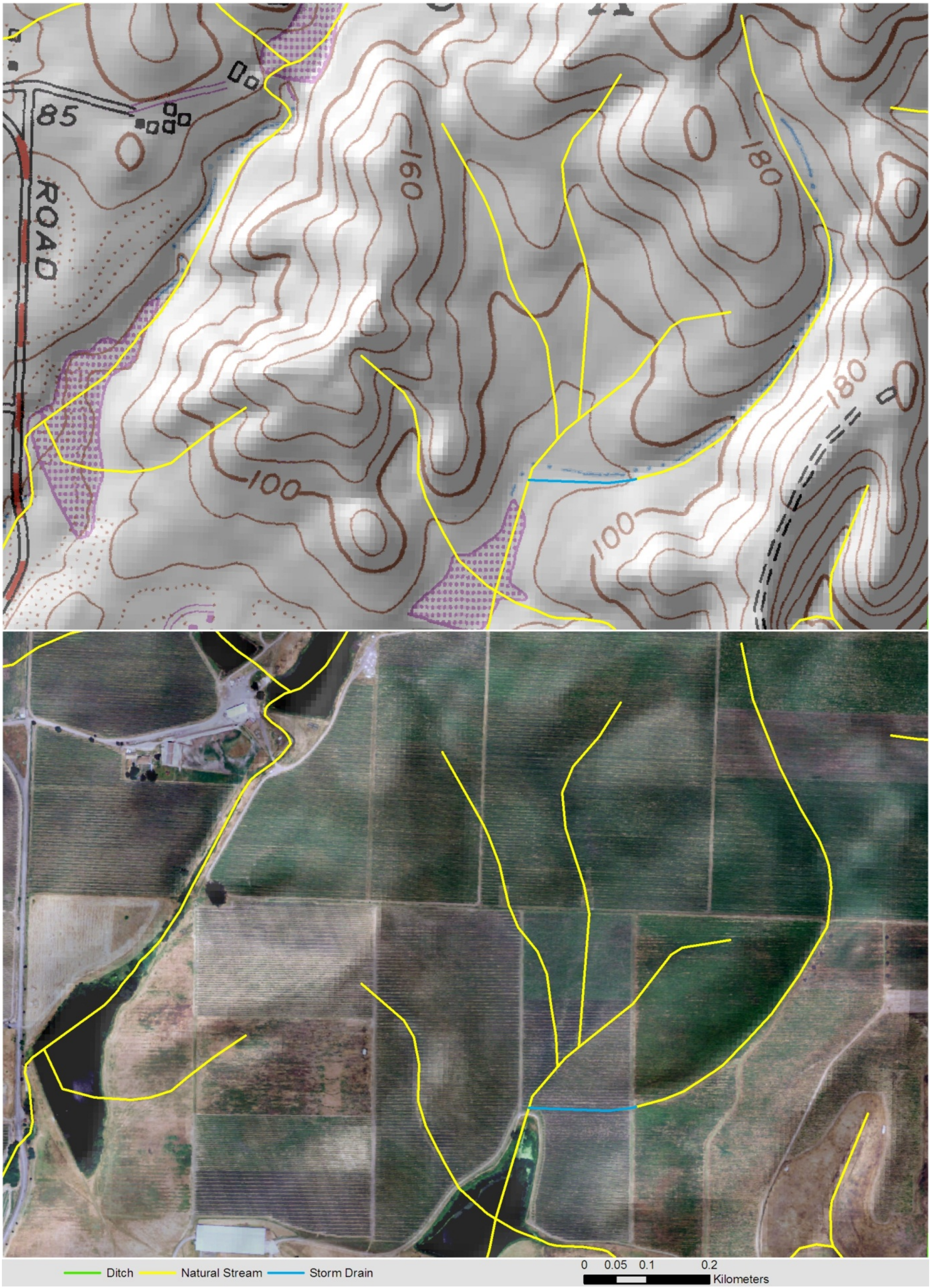
Example 8b SFEI standard linework (Agricultural Areas)



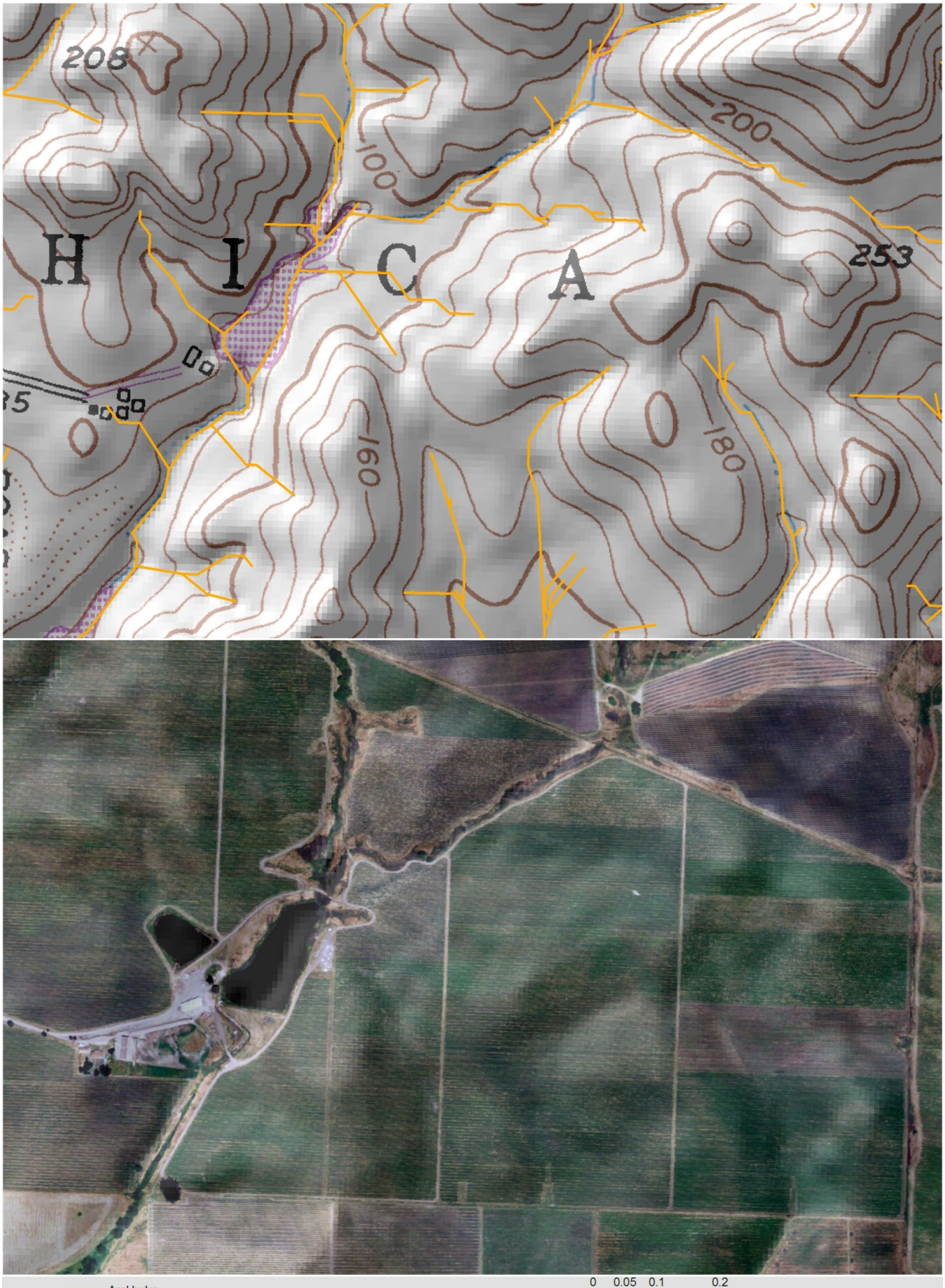
Example 9a ArcHydro linework (Agricultural Areas)


85
160
180
180
100
100
ArcHydro
0 0.05 0.1 0.2
Kilometers

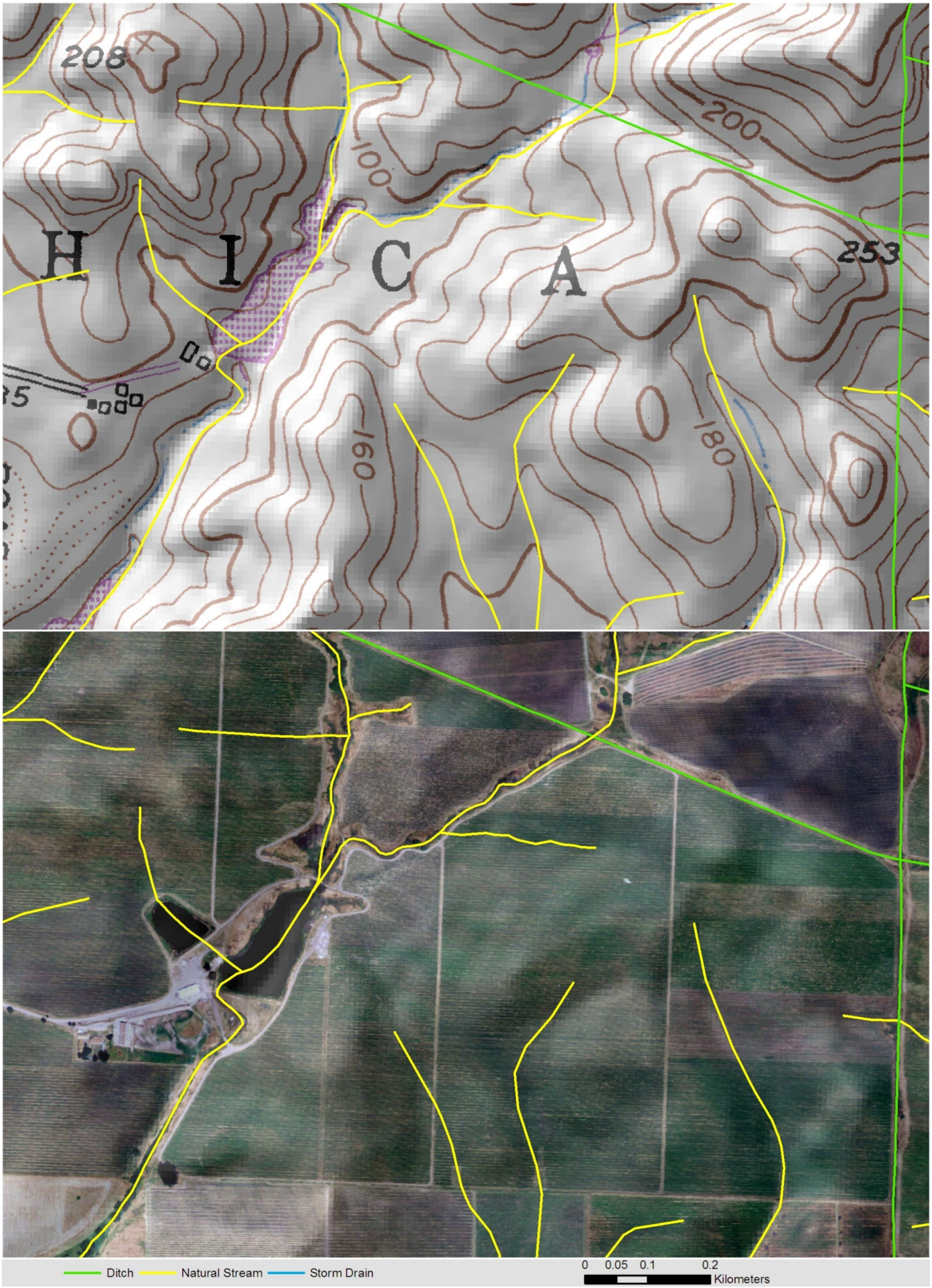
Example 9b SFEI standard linework (Agricultural Areas)



Example 10a ArcHydro linework (Agricultural Areas)

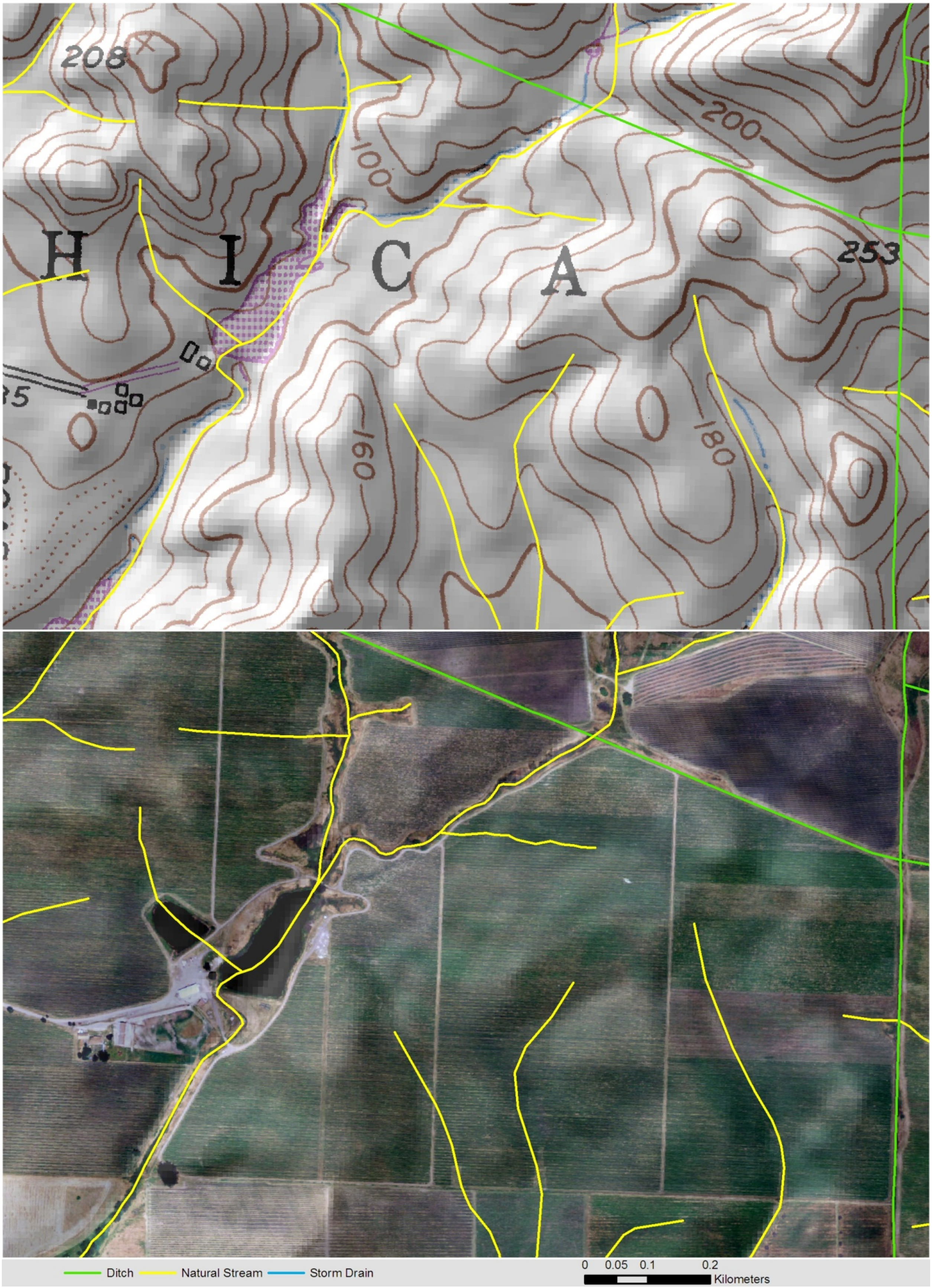


Example 10b SFEI standard linework (Agricultural Areas)

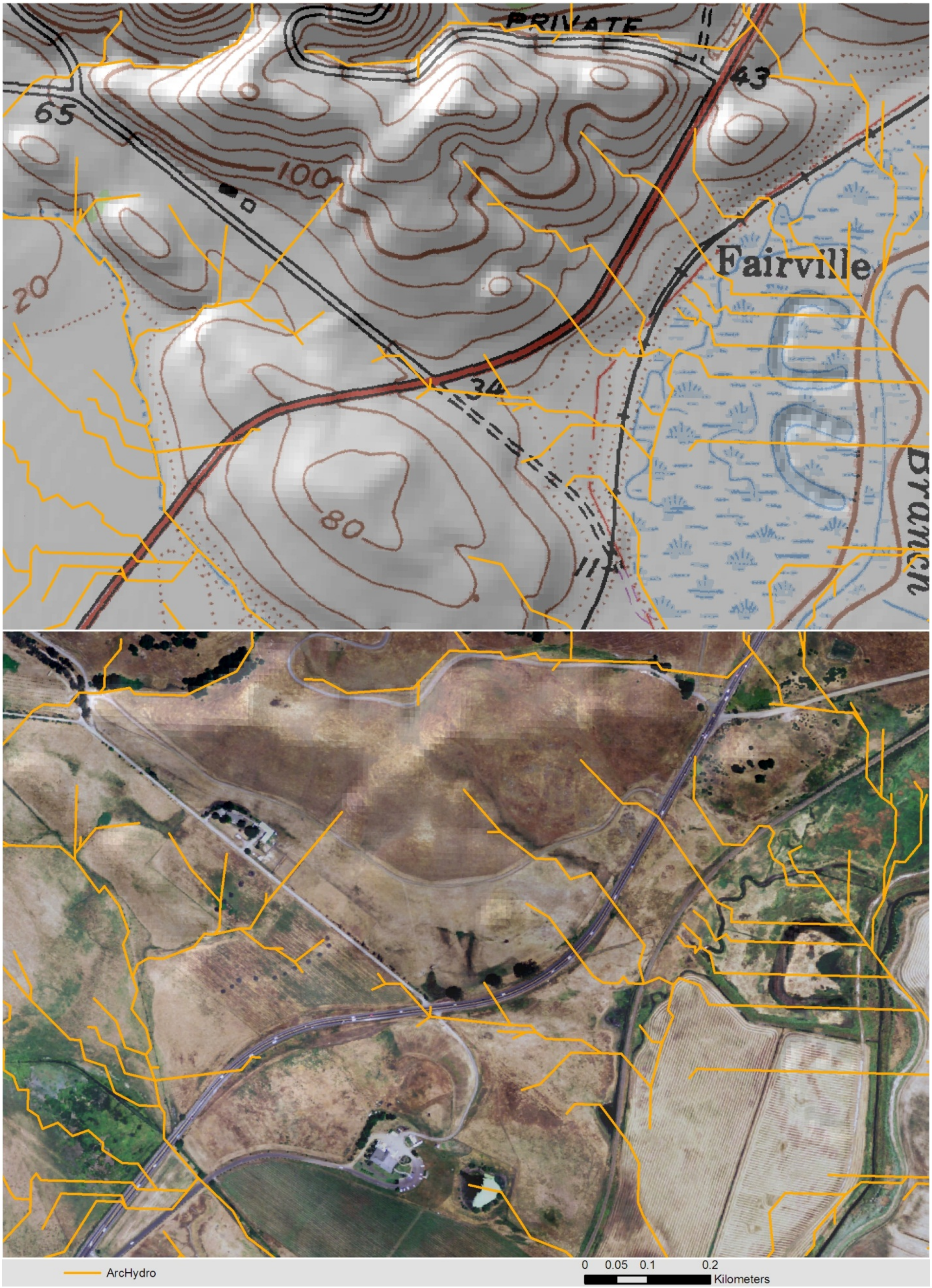


Example 11a ArcHydro linework (Agricultural Areas)

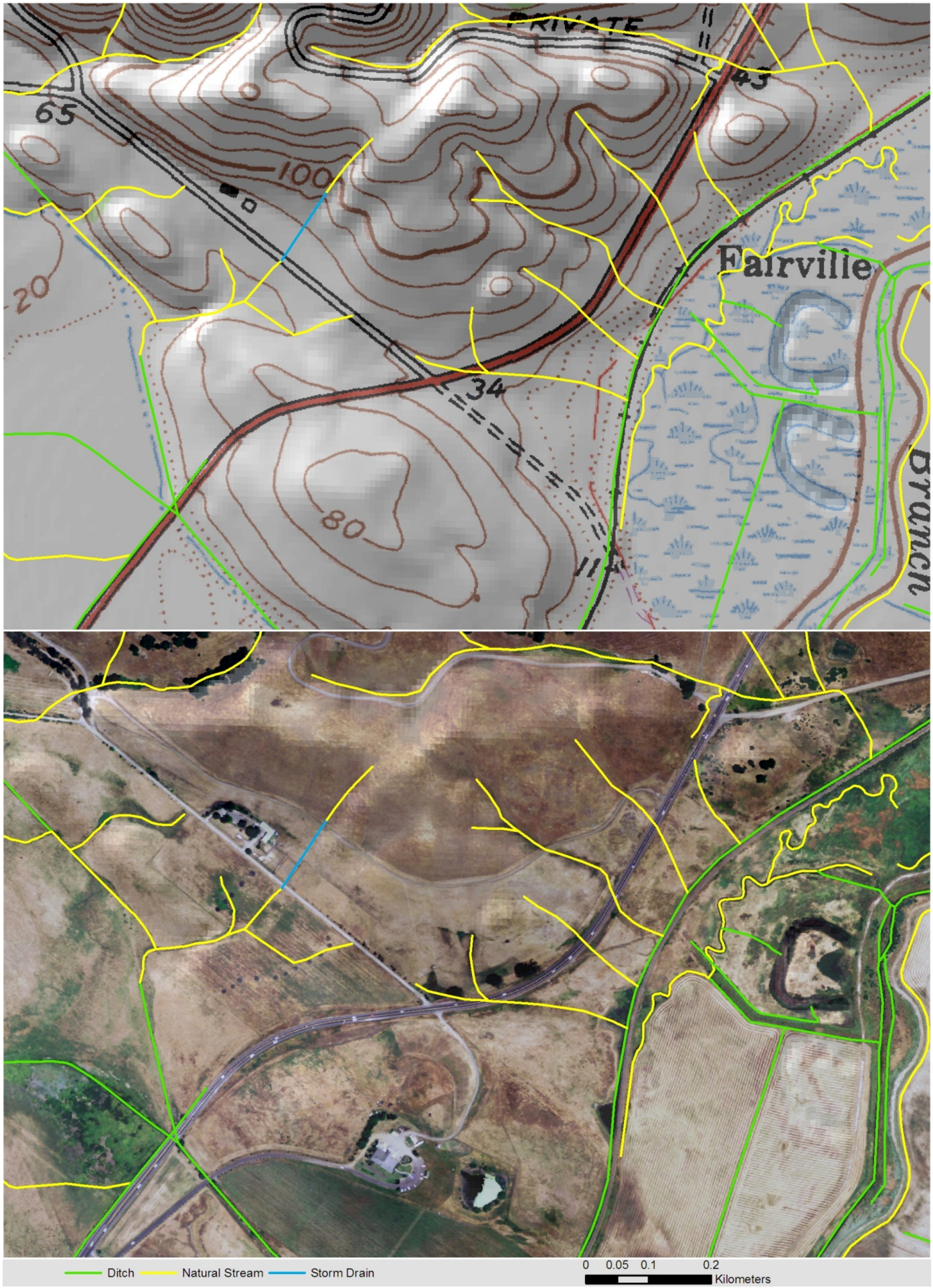
Example 11b SFEI standard linework (Agricultural Areas)



Example 12a ArcHydro linework (Agricultural Areas)

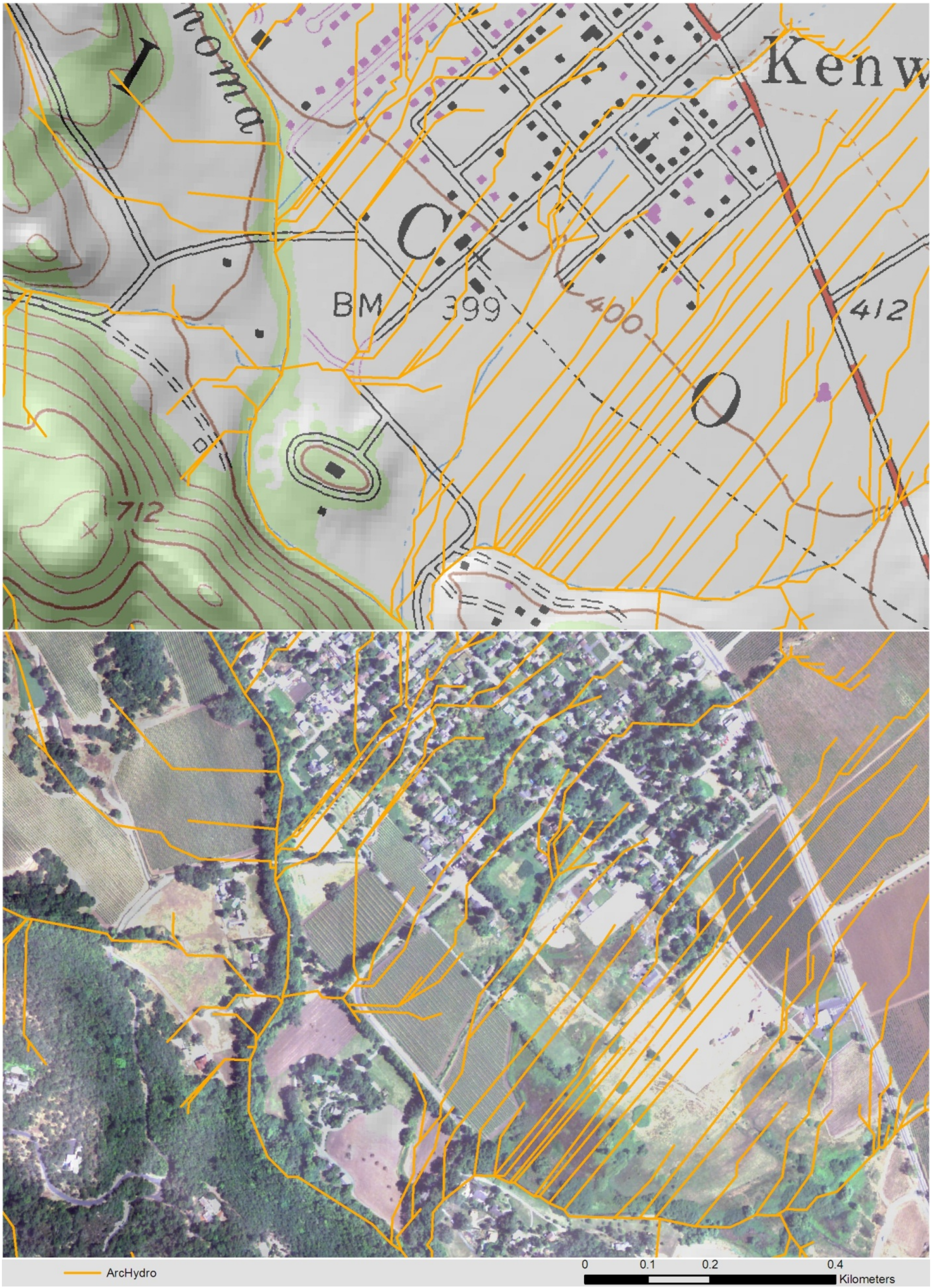


Example 12b SFEI standard linework (Agricultural Areas)

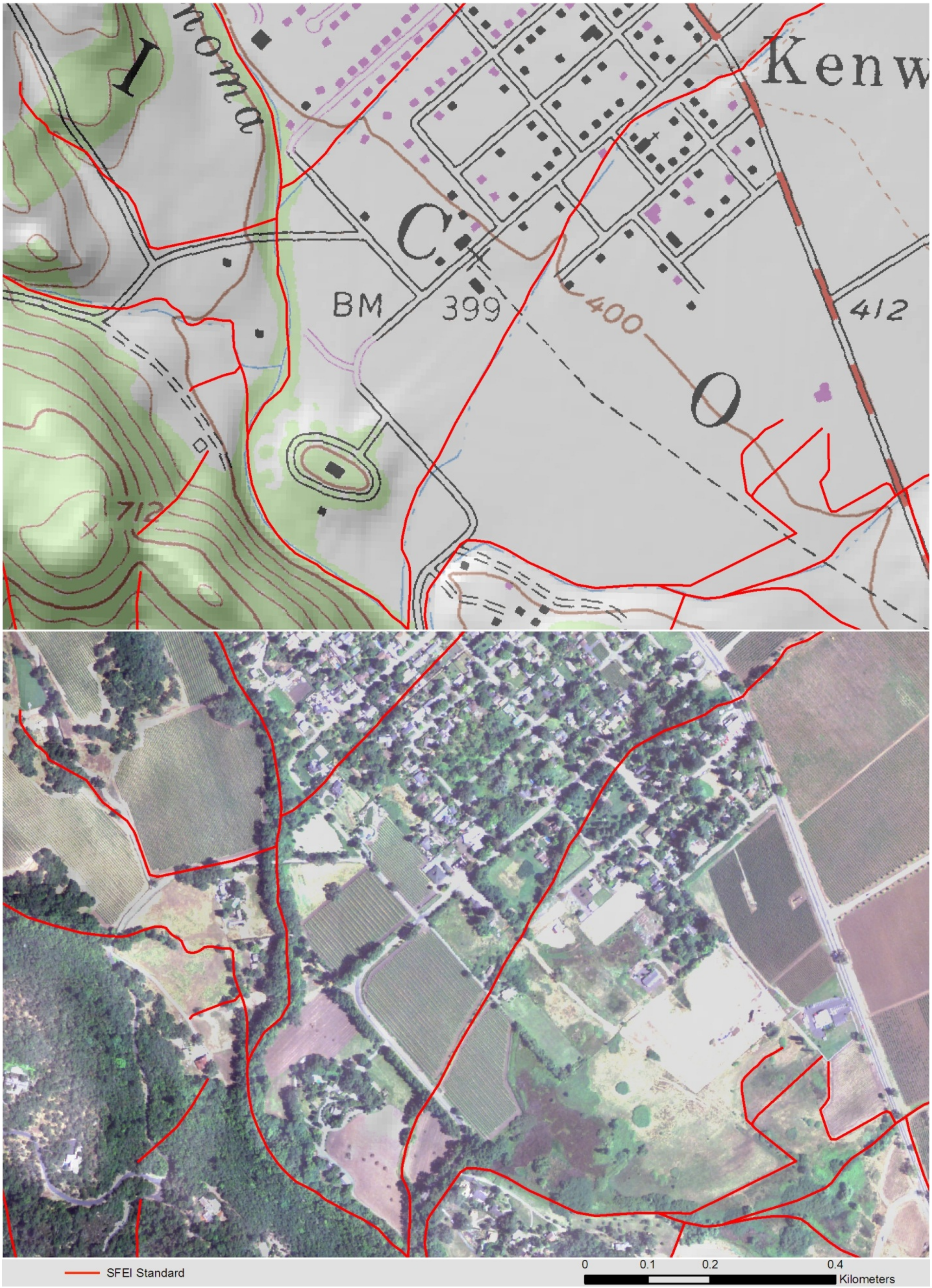


Transitional areas (Urban-Rural Areas)

Example 13a ArcHydro linework (Urban-Rural Areas)



Example 13b SFEI Standard linework (Urban-Rural Areas)



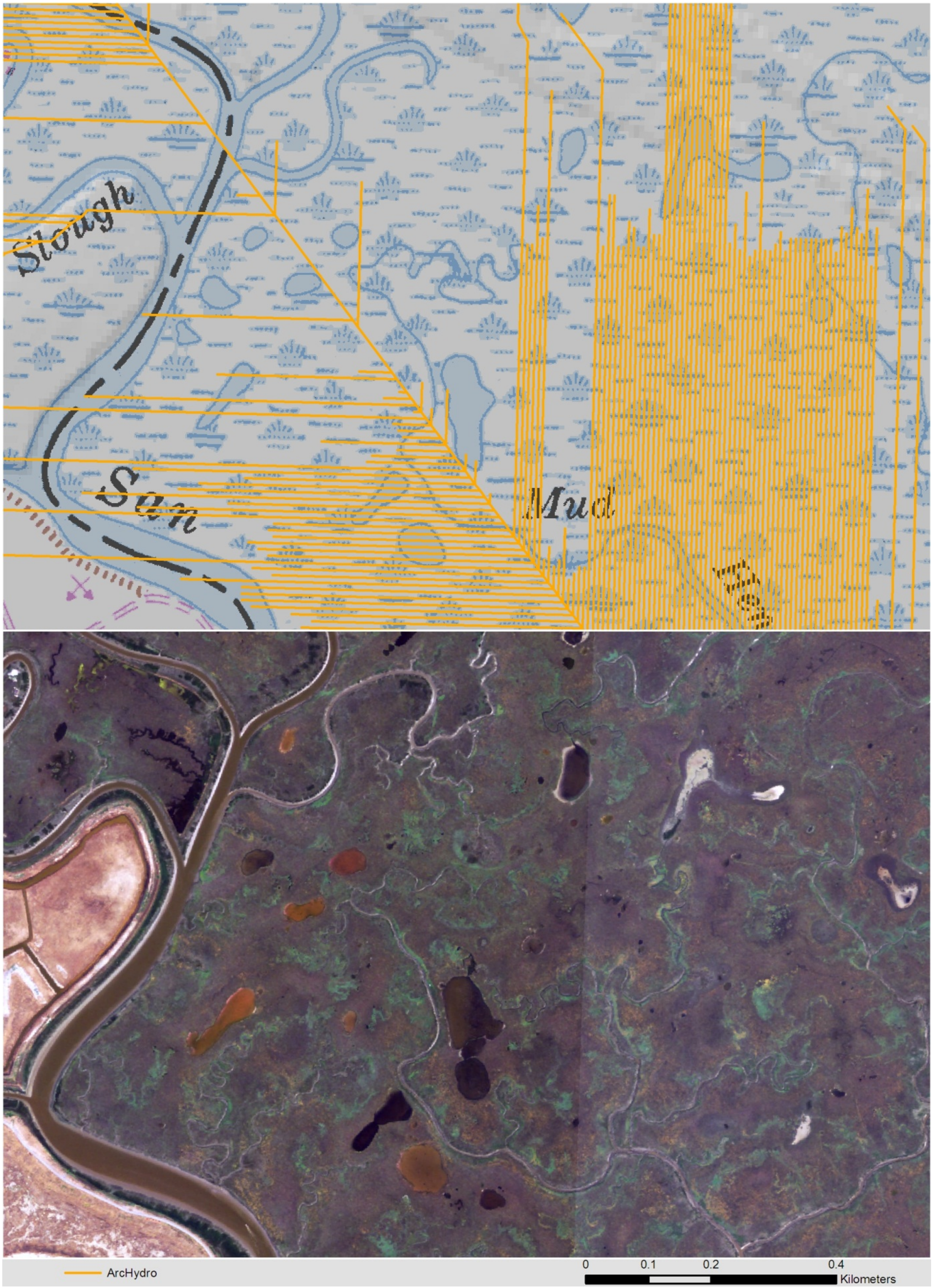
Vernal Pools

Example 14a ArcHydro linework (Vernal Pools)

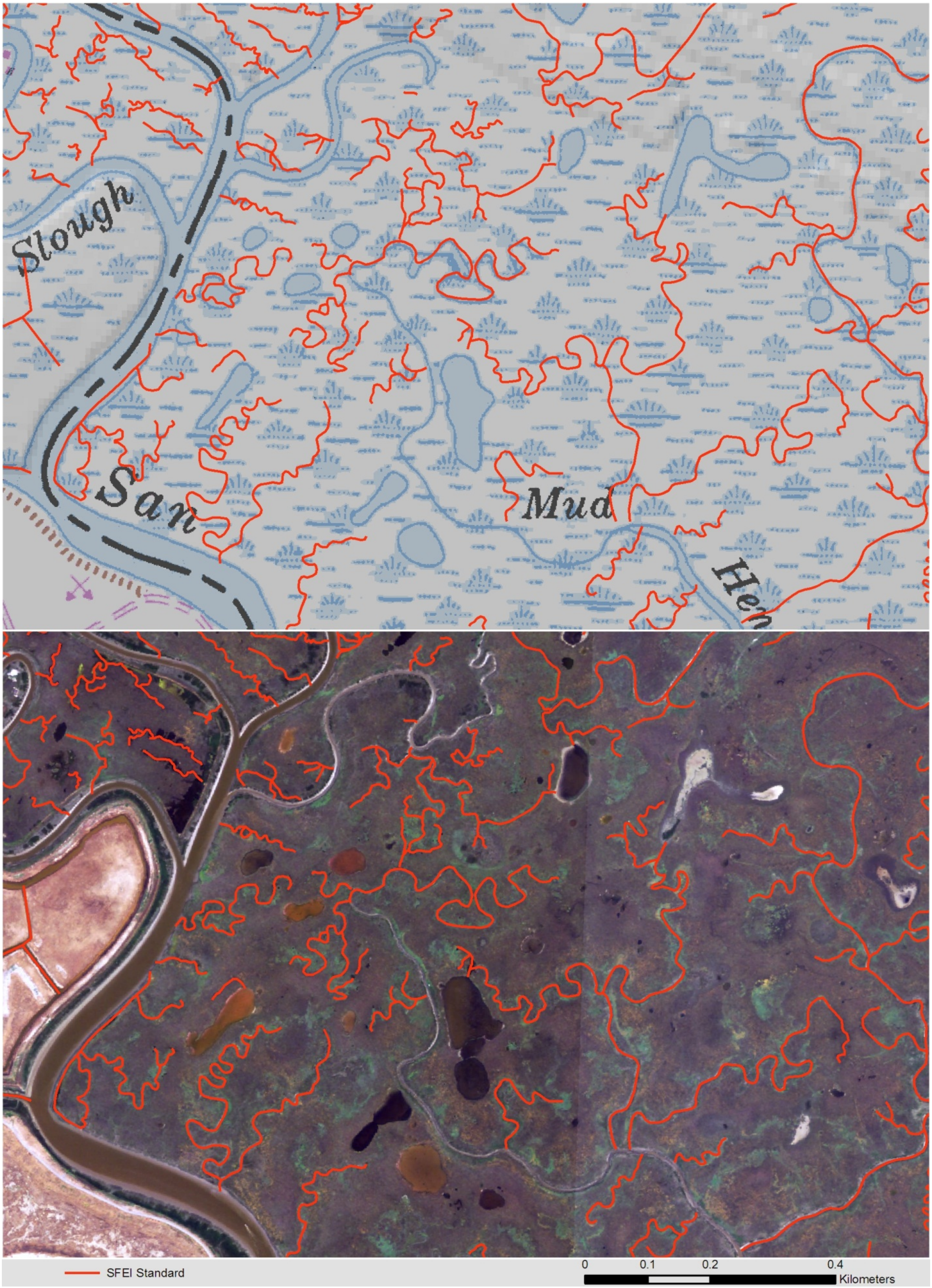
Example 14b SFEI Standard linework (Vernal Pools)

Marsh Areas

Example 15a ArcHydro linework (Marsh Areas)



Example 15b SFEI Standard linework (Marsh Areas)



Example 16a ArcHydro linework (Marsh Areas)

Example 16b SFEI Standard linework (Marsh Areas)