LANDSMART® FOR VINEYARDS
CARBON FARM PLAN, OUTPOST VINEYARD

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Version 4.0, September 2022

TABLE OF CONTENTS

INTRODUCTION

The Carbon Cycle

The carbon cycle is the exchange of carbon among the earth and its soils, oceans and waterbodies, atmosphere, and living things. As part of the carbon cycle, carbon dioxide (CO_2) from the atmosphere can be captured and stored in soils in the form of organic matter, this is known as carbon sequestration. Increasing soil carbon sequestration is one key strategy for reducing the amount of carbon dioxide in the atmosphere in order to slow global climate change (USGS).

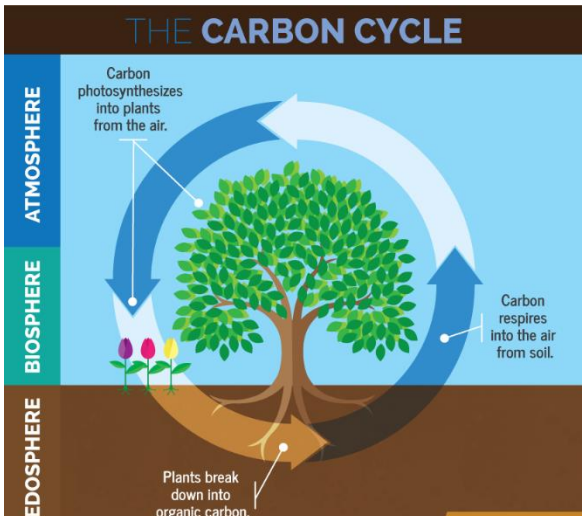


Figure 1. Soil Carbon Cycle

Agricultural activities can lead to increases or decreases in soil carbon and greenhouse gas (GHG) emissions. For example, increasing adoption of practices such as tillage and fossil fuel use by on-farm equipment increases CO_2 emissions. In contrast, reducing soil disturbance (i.e., reduced tillage) and encouraging the growth of long-lasting plant material, above and below ground, can lead to increased carbon sequestration.

Organic carbon is at the center of fundamental physical, biological, and chemical mechanisms in the soil. Increasing soil carbon through carbon farming has the potential to improve soil health, enhance crop production, minimize runoff and erosion, improve soil water-holding capacity, increase water infiltration, increase biodiversity, and build overall climate resiliency. For more detailed information about the benefits of carbon sequestration see "Carbon Sequestration Potential on Agricultural Lands" (Appendix 1).

Steps in the Carbon Farming process

Carbon farm planning helps farmers identify, prioritize, and implement farming practices that help enhance carbon sequestration and reduce GHG emissions on the farm. The first step in the carbon farm planning process involves conducting an inventory of current Natural Resources Conservation Service (NRCS) Conservation Practices and GHG emission sources on the farm to determine a baseline level of carbon sequestration and emissions. Farmers may not be aware that they are already implementing many practices that enhance their soil's ability to capture carbon! The planning process

focuses on farming practices within the area of the property that is actively manipulated by farmers to produce a crop. Only GHG emissions released or sequestered directly on the farm are considered.

The second step is looking at opportunities to enhance carbon sequestration and reduce GHG emissions through implementing additional NRCS Conservation Practices or other conservation measures are identified. A site-specific list of potential practices and their climate mitigation benefits is then developed. The farmer's goals and economic considerations help prioritize practices for implementation from the long list of opportunities that may exist.

The third step is implementation. Resource Conservation Districts (RCDs) work with farmers to identify funding sources to help pay for the practices and provide technical assistance for implementation. Farmers will implement practices as funding, technical assistance, and schedules allow. Over time, the CFP will be reevaluated and updated to meet changing objectives and implementation opportunities.

Carbon sequestration estimates

COMET-Planner CDFA HSP is a model-based tool developed by the USDA's Natural Resource Conservation Service (NRCS) in collaboration with Colorado State University (CSU), and the California Department of Food and Agriculture (CDFA) to quantify net greenhouse gas reductions related to adopting specific agricultural management conservation practices. More specifically, the tool provides approximate greenhouse gas (carbon dioxide (CO_2), nitrous oxide (N_2O), and Methane (CH_4)) mitigation and carbon sequestration potentials from adopting Conservation Practices according to NRCS Standards, and provides estimates based on specific crop type. COMET-Energy is a similar tool used to estimate reductions in greenhouse gas emissions based on anticipated fuel and electricity savings. The numeric estimates provided by these tools are reported in terms of CO_2 equivalents (CO_2eq). CO_2eq is a common measure used to compare the emissions and sequestration from various greenhouse gases, based upon their global warming potential. The tool is regularly updated to reflect current scientific knowledge.

An important consideration when using COMET-Planner CDFA HSP is that this evaluation tool is designed to provide generalized estimates intended to be used to aid initial conservation planning and demonstrate the potential of farms to capture more carbon and reduce emissions. The tool is not designed to provide a comprehensive assessment of property-specific or property-wide GHG fluxes or support claims or

certifications related to “net zero”, “carbon neutrality”, or “climate neutrality”. For a more in depth, site-specific assessment, Colorado State University suggests using the COMET-Farm tool.

IMPLEMENTATION SUMMARY

Table 1. Practices selected by the farmer for implementation.		
NRCS Conservation Practice Standards	Expected implementation date	Notes
422-Hedgerow planting	TBD	Establish at least 1000ft of hedgerows.
Soil analysis	Spring 2023	To conduct soil analysis to determine current organic matter levels along with soil fertility.

These practices were selected by the farmer out of all the identified potential practices discussed in the Proposed Carbon Farming Practices section. These were specifically selected by the farmer, through discussions with RCD staff and are based on feasibility and carbon sequestration potential. See Carbon Farm Plan Implementation Map in Appendix 2 for location of proposed practices

PROPERTY DESCRIPTION

Vineyard Name	Outpost Vineyard
Vineyard Address, County	[redacted]
Assessor's Parcel Number(s)	[redacted]

Owner/Lessee

Name(s)	[redacted]
Phone	[redacted]
Email	[redacted]

Land/Vineyard Manager (if different from above)

Name(s)	[redacted]
Phone	[redacted]
Email	[redacted]

Technical Assistance Advisors/ Plan Preparer

Name(s)	Miguel A. García PhD, CCA		
Organization	Napa Resource Conservation District		
Email	miguel@naparcd.org	**Phone**	707-690-3122

LAND USE

Land Use Activity	Acres	Notes
Total parcel(s) area	42.29	
Vineyard blocks	18.37	
Orchard	0.33	
Forest/Woodland/Chaparral		
Grassland/Open Space/Fallow		
Other Land uses		

VINEYARD AND CARBON FARMING GOALS

Describe the vineyard's goals through the Carbon Farm Planning Process. Elaborate on the desired outcome below.

☐ Carbon sequestration
☐ Address soil loss and/ or erosion
☐ Improve water use efficiency
☐ Enhance wildlife habitat
☒ Improve soil health
☒ Improve vine health
☐ Improve climate resiliency
☐ Attain sustainability certification (Napa Green, etc)
☐ Other- describe below

Describe desired outcome: To increase overall soil and vine health through vineyard improving soil practices such as minimizing tillage, establishing permanent cover, and increasing soil microbial activity through composting.

LAND MANAGEMENT HISTORY

Existing Farming Practices

1. Describe tillage practices for the past 3 years.

Describe: Blocks 8 – 16: Tillage in every other row, undervine tillage (16 inches on each side of vine per 7-foot row), no tillage in every other row. Blocks 1 – 7: No tillage, permanent cover in all rows

2. Describe your cover crop management, seeding practices and seed mix. Please specify if you use legumes in your cover cropping.

Describe: Blocks 8 – 16: Over seeding permanent cover in every other row with Zorro fescue, Blando brome and tetraploid rye. Seeding every other row with bell beans, common vetch, dundale peas, barley mix. Blocks 1 – 7: over seeding permanent cover in all rows with Zorro fescue, Blando brome and tetraploid rye.

3. Describe your soil amendment practices (compost application, mulching, &/or biochar). Describe application method (broadcast, strip, or pile) and rate.

Describe: Compost tea is applied twice a year at a rate of 25 Gallons/Acre through irrigation system. Once during the spring prior to bloom and once following harvest.

4. Do you generate your own soil amendments or purchase them from a supplier? What is the carbon to nitrogen ratio of your soil amendment?

Describe: All amendments are purchased from suppliers. C:N ratios are N/A

5. What type of nitrogen fertilizer do you use? Describe application method (broadcast, strip, pile, or fertigation) and the rate.

Describe: Fish emulsion is applied typically twice a year through fertigation. Rates will vary between 25 – 35 Gallons/Acre

6. Describe the under the vine weed management including herbicide use: number of applications, spot spraying or strip spray width, and/or mechanical removal width.

Describe: Blocks 8 – 16: Mechanical removal/Under vine tillage is performed (16 inches on each side of vine per 7-foot row) Blocks 1 – 7: Undervine mowing/weed eating is performed, all cover is permanent.

7. Describe disposal approach of dead vines upon replant (composting, wood chipping, conventional pile burn, low smoke (conservation) burn).

Describe: Dead vines disposal is completed through conventional pile burns.

Soil Health

8. Describe any soil resource concerns. This may include previous soil lab results, visual observation including cracking, poor cover crop growth, compaction, poor water infiltration after storms, erosion, hard pan, invasive weeds, flooding, etc. Provide existing soil lab data if available.

☐ Soil tests and analysis have been conducted within the past 2 years. Appendix 3 includes recommended soil tests to be taken and past soil test reports.

☒ No soil test and analysis has been done

Describe: No current soil concerns.

9. Develop a report using Web Soil Survey that includes soil type, organic matter, and available water capacity (see soil report in Appendix 4).

Describe major soil types: Major soil types in this vineyard include Aiken loam and Rock outcrop-Kidd complex.

Vine Health

10. Are there any vine nutrient issues that are revealed in petiole or leaf tissue analysis? If so, please describe and provide most recent data.

Describe: No issues detected in tissue analysis.

11. Are there other issues with vine growth (low or excessive vigor, viruses, disease, etc.)?

Describe: Eutypa, nematodes

Fuel and Electric Use

12. Is equipment managed to reduce tractor passes?

☒ Tractor implements are used on both sides of a row.

☒ Conducting more than one soil management practice at once.

☐ Other

Describe: Mowing and undervine tillage during same pass, disking and ring rolling during the same pass, minimizing disking passes, remain on permanent cover when possible.

13. Are alternative fuels/energy sources used (i.e., Biodiesel, Propane Methane, Solar, Marin Clean Energy or Sonoma Clean Power Customer, Other)?

Describe: No, traditional fuels are used.

14. Are all vehicles maintained according to manufacturer's recommendations to ensure maximum fuel efficiency.

☒ Yes

☐ No

Describe:

15. What type of pumps are used on the property (i.e., electric, gas, diesel)? Are the pumps tested for efficiency? When was the last time the pumps were tested for efficiency?

Describe: Electric pump, not regularly tested for efficiency.

16. Are the vineyard pumps equipped with variable frequency drive?

☐ Yes

☒ No

17. Are precision irrigation management tools and techniques used (weekly vine stress monitoring, soil moisture monitoring, ET, NDVI, scheduling software, or other)?

Describe: NDVI's are being used to identify weak areas and help us evaluate the next step that need to be taken in order to identify the issue.

18. Has an irrigation evaluation been conducted in the past three years. Has the system been managed according to recommendations from the evaluation?

Describe: Yes, irrigation evaluation has been conducted. Recommendations are being implemented.

CARBON SEQUESTRATION AND GREENHOUSE GAS EMISSIONS ESTIMATES

Current practices

Outpost is an 18.37-acre vineyard in Angwin in the Napa Valley. Currently, 34% of the vineyard middles are under no till management with the rest under alternate row till. The rows under alternate row till are rotated every other year. The undervine area where the middles are under no till are mowed (no till) while the undervine area where the middles are under alternate row till get cultivated (reduced till). A permanent cover crop (conservation cover) is maintained in the no-till areas and a multispecies winter cover crop containing legumes is seeded in the tilled areas. Compost teas and fish emulsion are applied twice a year to the entire vineyard. Currently, COMET-Planner doesn't offer the option to include compost teas and fish emulsion into the carbon sequestration estimates so these are not included in this assessment. Even so, it is recommended to continue application of these materials as they are known to be a great source of nutrients and they do indeed increase soil organic carbon levels. It is hoped that COMET-Planner will incorporate compost teas and fish emulsions in the near future. As a comparison, COMET-Planner estimates that applying compost at a rate of 20 tons per acre will sequester about 4.5 metric tons of CO_2 eq per acre/year. Adjacent to the vineyard is a 0.33-acre apple orchard. Natural vegetation is allowed to grow in the orchard and the soil is not tilled. In 2021 this vineyard used 620 gallons of diesel. Electricity and gasoline usage is unknown at this time. It is recommended to track electricity and gasoline use to get a more comprehensive assessment of the current GHG emissions from this operation. During the assessment conducted for this vineyard it was identified that under the reported current management, and according to the results obtained from the COMET-Planner CDFA HSP and COMET-Energy tools, this vineyard is currently sequestering **31.9** metric tons of CO_2 eq per year and emitting **7.22** metric tons of CO_2 eq per year (emissions from electricity/gasoline use currently missing). This represents a net carbon sequestration of **24.68** metric tons of CO_2 eq per year. To better understand the impact of offsetting these emissions, 24.68 CO_2 eq is equal to **5.2** passenger vehicles not driven in one year or **8.4** tons of waste recycled instead of landfilled according to the EPA GHG Equivalency Calculator.

Table 2. Approximate carbon sequestration and GHG emissions from current farming practices (tons of CO_2 eq per year), including NRCS Conservation Practices occurring in the farm area and emissions generated directly on the farm. Estimates are derived from COMET Planner CDFA HSP, COMET-Energy (results reports shown in Appendix 5) and are not property-specific. This table does not represent a comprehensive GHG assessment of a whole property or farming operation. The COMET-Farm tool is capable of providing more site-specific GHG data for farming practices. Farming practices are only included in this assessment if they are included in the COMET Tools or if there is robust scientific estimation of their climate impact. Positive numbers represent sequestration and negative numbers represent emissions.

Current Practices	Units	CO_2	N_2O	CH_4	Total CO_2eq
Identified NRCS Conservation Practices (carbon sinks)					
327-Conservation cover (acres)	6.12	8.4	0	0	8.4
329-Residue and tillage management-No till (acres)	10.61	3.1	0	0	3.1
340-Cover crop (acres) (legume)	12.58	21	-1	0	20.0
345-Residue and tillage management-Reduced till (acres)	3.59	0.3	0.1	0	0.4
Total Identified Carbon Sinks		**32.8**	**-0.9**	**0**	**31.9**
Identified GHG Emission Sources					
Tillage (acres)	4.49	-1	0	0	-1
Electricity Use (kWh)					
Diesel Use (gal)	620	-6.16	-0.03	-0.03	-6.22
Gasoline Use (gal)					
Other:					
Total Identified Emission Sources		**-7.16**	**-0.03**	**-0.0.**	**-7.22**
Net Carbon Sequestration:					**24.68**

Recommended practices

This identifies carbon beneficial practices that could potentially be implemented in this vineyard. RCD staff will work with the farmer to decide what practices are feasible based on goals, limitations, and finances. See Implementation Table 1 at the beginning of this plan for list of practices selected for implementation by farmer. The following practices are recommended to increase the carbon sequestration potential in Outpost Vineyard.

- Transition the tilled and cultivated areas into no till.
- Establish 1000ft of hedgerows/insectaries.
- Continue applications of compost teas and fish emulsions as part of your nutrient management. Always use petiole and soil analysis data to determine appropriate application rate.
- Continue actively seeding a multi-species cover crop in the winter.
- Seed a pollinator cover crop in the apple orchard with as minimum soil disruption as possible.
- Broadcast compost to the entire vineyard.
    - Rate should be determine based on soil needs as indicated in soil analysis.
    - Management may choose to rotate which blocks receive compost in any given year to make sure the entire vineyard receives compost in a 5-year cycle (estimates presented here are valid as long as compost is applied at least every 5 years).

According to estimates from COMET-Planner CDFA HSP, it is expected that this vineyard can sequester an additional **87** metric tons of CO_2 eq per year after implementation of the recommended practices. With these estimates along with those identified in table 2, this vineyard has a collective carbon sequestration potential of **118.9** metric tons of CO_2 eq per year. To better understand the impact of offsetting these emissions, 118.9 CO_2 eq is equal to **25** passenger vehicles not driven in one year or **40** tons of waste recycled instead of landfilled according to the EPA GHG Equivalency Calculator.

Table 3. Approximate carbon sequestration from recommended farming practices (tons of CO_2 eq per year), including NRCS Conservation Practices occurring in the farm area. Estimates are derived from COMET Planner CDFA HSP (results report shown in Appendix 5) and are not property-specific. The COMET-Farm tool is capable of providing more site-specific GHG data for farming practices. Farming practices are only included in this assessment if they are included in the COMET Tools or if there is robust scientific estimation of their climate impact. Positive numbers represent sequestration; negative numbers represent emissions. This table does not represent a comprehensive GHG assessment of a whole property or farming operation.

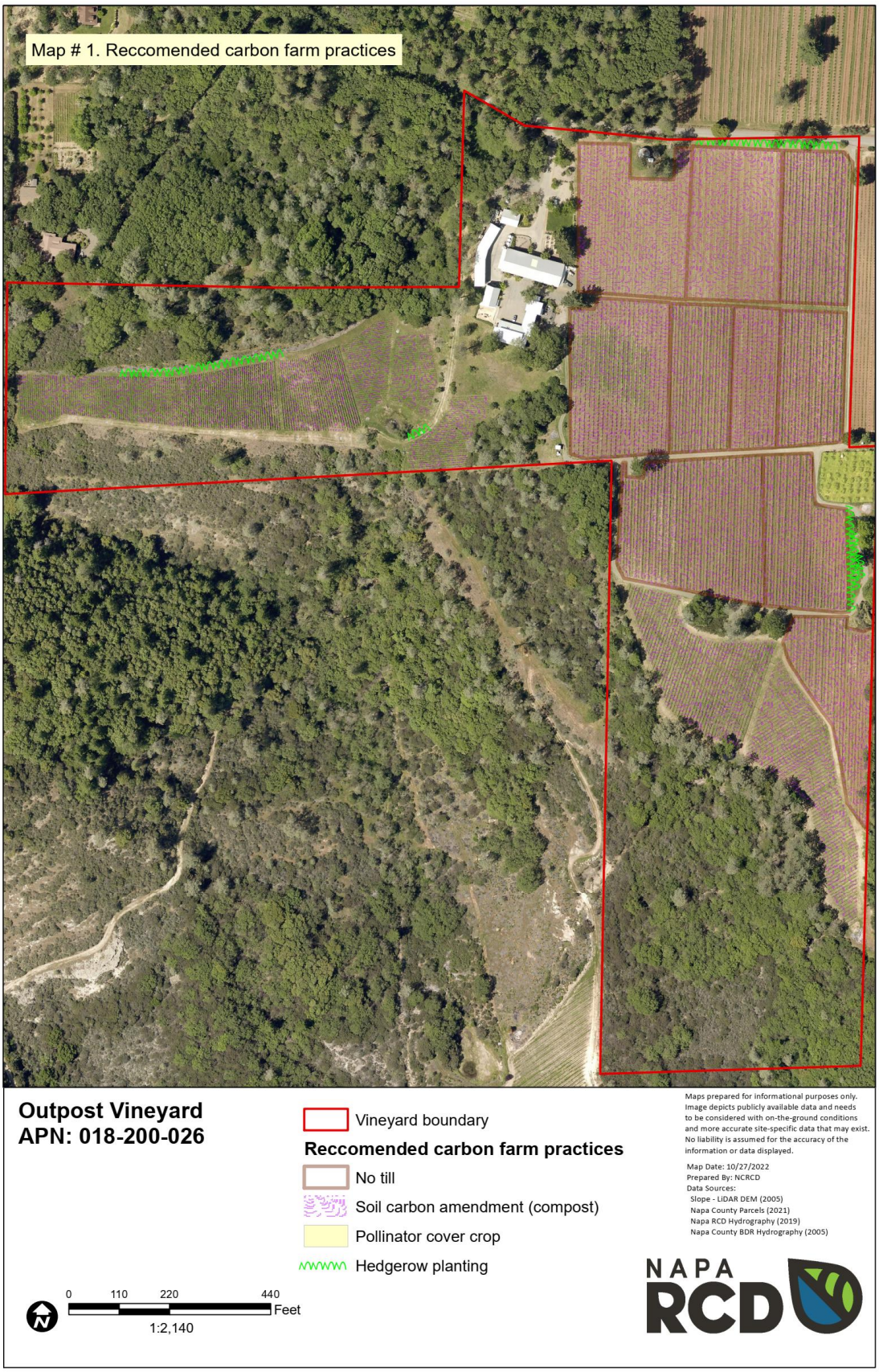
NRCS Conservation Practice Standards	Units	CO_2	N_2O	CH_4	Total CO_2eq
Identified NRCS Conservation Practices (carbon sinks)					
329-Residue and tillage management-No till (acres)	8.08	3	0	0	3
422-Hedgerow planting (linear feet)	1000	2	0	0	2
808-Soil carbon amendment (compost/biochar) (acres)	18.37	85	-3	0	82
Total Identified Carbon Sinks		**90**	**-3**	**0**	**87**

FUNDING

Describe the funding needs to implement the Carbon Farm Plan. RCD will work with farmer to help secure funding for implementation of the plan.

☐ Farmer needs full funding
☒ Farmer needs partial funding
☐ Farmer is working with NRCS to acquire funding through the EQIP program
☒ Farmer is willing to collaborate on grant application with RCD (such as the CDFA Healthy Soils Program, CDFA SWEEP Program, or Zero Foodprint).
☒ Farmer needs only technical assistance for plan implementation
☐ Farmer has knowledge/funding to implement the Carbon Farm Plan independently

Describe: Farmer would like to collaborate with the Napa RCD to establish pollinator habitat in the form of hedgerows and insectaries.


Map # 1. Reccomended carbon farm practices
Outpost Vineyard
APN: 018-200-026
Vineyard boundary
Reccomended carbon farm practices
No till
Soil carbon amendment (compost)
Pollinator cover crop
Hedgerow planting
0 110 220 440
Feet
1:2,140
Maps prepared for informational purposes only.
Image depicts publicly available data and needs to be considered with on-the-ground conditions and more accurate site-specific data that may exist.
No liability is assumed for the accuracy of the information or data displayed.
Map Date: 10/27/2022
Prepared By: NCRCD
Data Sources:
Slope - LiDAR DEM (2005)
Napa County Parcels (2021)
Napa RCD Hydrography (2019)
Napa County BDR Hydrography (2005)
NAPA RCD