Midpeninsula Regional Open Space District

PLANNING AND NATURAL RESOURCES COMMITTEE

Report No. 22-31
March 8, 2022

AGENDA ITEM 2

AGENDA ITEM

Electric Bicycle Policy Evaluation

GENERAL MANAGER'S RECOMMENDATIONS

Review the evaluation results of various studies and surveys regarding electric bicycles (e-bikes) use on paved and unpaved trails in open space lands and consider forwarding the following recommendations to the full Board of Directors:

1. Recommend approving Class 1 and 2 e-bike access on limited improved trails at Ravenswood and Rancho San Antonio Open Space Preserves.

2. Based on studies and findings to date, recommend one or more of the following:
   - Approve Class 1 e-bikes access on all District trails where bicycles are allowed.
   - Affirm the prohibition of e-bikes on District trails except for specifically designated trails in recommendation 1.
   - Direct staff to continue the E-bike Study for an additional year.
   - Direct staff to implement an Unpaved E-Bike Pilot Program on select District Preserves to evaluate effects on District lands.

SUMMARY

On November 20, 2019, the Midpeninsula Regional Open Space District (District) Board of Directors (Board) (R-19-155) directed the General Manager to evaluate potential electric bicycle (e-bike) access in District preserves. To guide the evaluation, the Board specified its consideration of potential e-bike access as follows: consideration of Class 1 e-bikes on unpaved, multi-use trails and evaluation of Class 1 and 2 e-bikes on select paved, multi-use trails in two preserves. The e-bike evaluation work conducted over the last year includes various surveys and studies related to a one-year pilot program of Class 1 and Class 2 e-bike use on paved, multi-use trails within Rancho San Antonio and Ravenswood Preserve and intercept surveys on Santa Clara County Parks unpaved, multi-use trails where e-bikes are currently allowed. Additionally, H. T. Harvey and Associates completed an e-bike noise study, focused on potential impacts to birds and bats, and the District Science Advisory Panel (SAP) conducted a literature review of the impacts and benefits of e-bikes. Throughout the evaluation process, public communications received regarding e-bikes were recorded and categorized. In addition, data on violations and accidents for e-bikes and regular bicycles were tracked. At this Planning and Natural Resources Committee (PNR) meeting, the Committee will review studies and findings and public comment received to date and consider forwarding recommendations to the full Board regarding e-bike use on District lands.

BACKGROUND

Over the last few years, public interest in e-bikes for transportation and recreation has grown steadily across the country. This trend has been reflected locally by increased use on public roadways. By ordinance the Midpeninsula Regional Open Space District (District) prohibits the use of e-bikes on District trails and pathways unless they function as an Other Power-Driven Mobility Device for visitors with a mobility disability under the Americans with Disabilities Act. District rangers have reported a rise in illicit e-bike use on District preserves and the District has received extensive public comment on the subject.

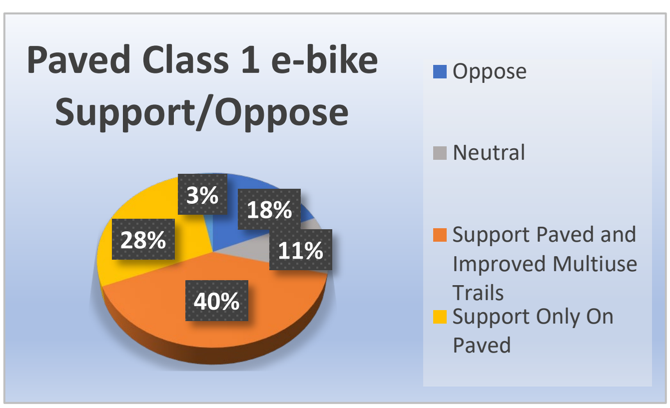
DISCUSION

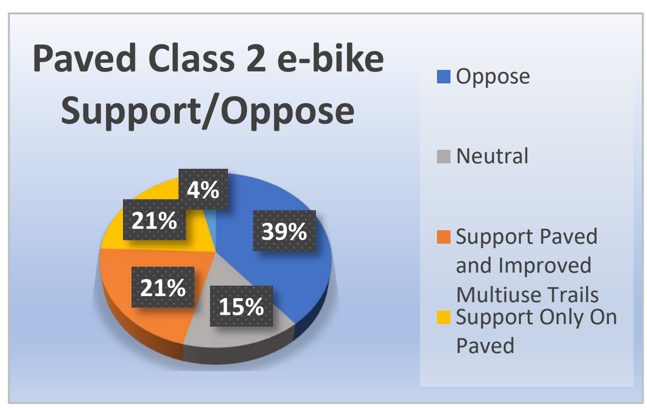
Paved Pilot and Surveys

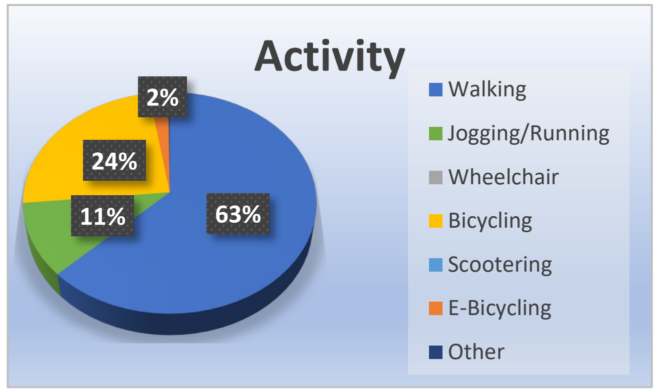
On December 1, 2020, the District began a pilot program of Class 1 and 2 e-bikes on paved or improved multi-use trails within Ravenswood and Rancho San Antonio Preserves. The trails were evaluated by District Land and Facilities staff before the pilot began (baseline conditions) and again this December using photographs (post-pilot conditions). Area Manager Michael Gorman reported that there has been a significant impact from increased visitation during the COVID pandemic that resulted in the widening of some of the trails. However, there is no physical change to the trails over the course of the yearlong pilot that can be attributed specifically to e-bike use.

From April 1, 2021, through June 30, 2021, a total of 556 intercept surveys were conducted along the trails in these pilot preserves. Rancho San Antonio had 14 days of surveys that spanned a total of 56 hours where 398 surveys were completed. Ravenswood had 12 days of surveys, accounting for 48 hours, where 158 surveys were completed. Attachment 1 includes a full report on the paved pilot program.

The intercept survey consisted of 11 questions and a demographics section designed to gauge support or opposition for Class 1 and 2 e-bikes on paved trails within District Preserves. Appendix A includes the results for each question asked on the survey with key takeaways summarized below:







During these intercept surveys, observational data was also collected on the number of e-bikes versus regular bikes observed, the behavior of both groups of bike riders, and the behavior and reactions of wildlife in the area (refer to Appendix D). Key takeaways are as follows:

- Of the total number of bicycles observed (1325):
  - 94.42% were regular bikes (1251 total)
  - 5.58% were e-bikes (3.32% Class 1, 1.58% Class 2, and 0.68% Class 3) (74 total)
- Regular (non-e-bike) bike rider behavior by percentage of regular bikes observed:
  - 3.17% speeding (42 of 1251)
  - 0.38% passing too fast
  - 0.08% rude behavior
- E-bike rider behavior by percentage of e-bikes observed:
  - 5.58% speeding (3 of 74)
  - 1.35% passing too fast
- Wildlife observations
  - 219 wildlife observed
  - 0 wildlife fled as a result of visitor actions or behavior

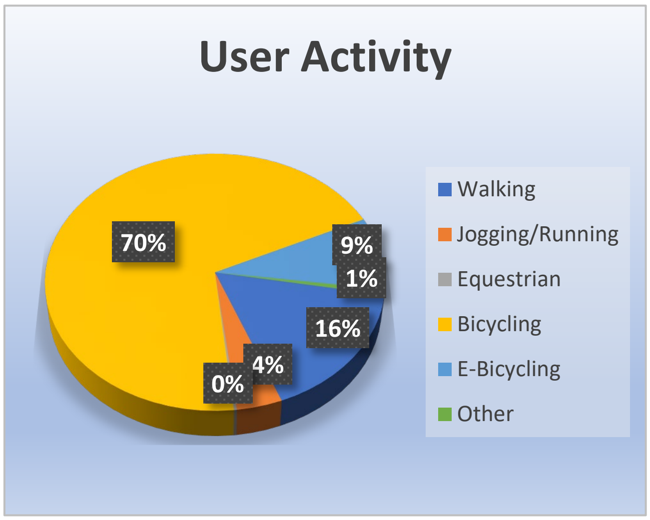
Unpaved Trails - Intercept Surveys

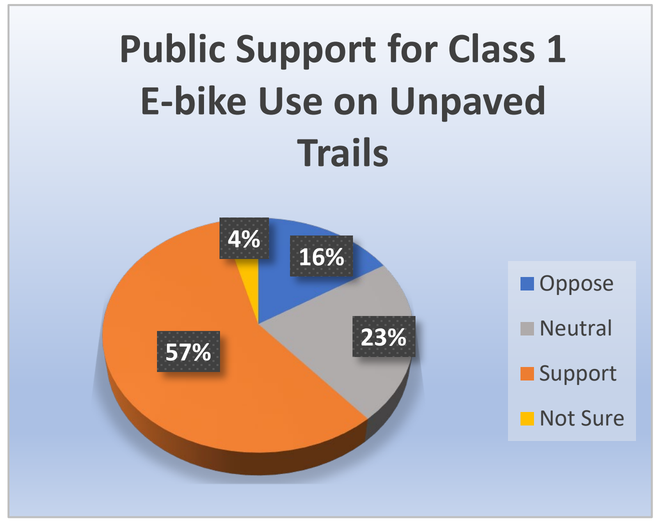
On January 27, 2021, the Board (R-21-13) directed the General Manager to proceed with an unpaved trail intercept survey study on the lands of a partner agency that already allows e-bikes on their unpaved, multi-use trails. Santa Clara County Parks was chosen as the partner agency as their visitor use and trail types are the closest proxy to District preserves and trails. Santa Clara County Parks have allowed Class 1 and 2 e-bikes on all paved and unpaved multi-use trails and pathways, including on approximately 150 miles of unpaved multi-use trails, since 2017.

Two specific unpaved multi-use trails/locations were chosen for the study that closely resemble District trails in environment, use type, and visitation levels. The first location was the junction of the Lisa Killough Trail, Cottle Trail, and North Ridge Trail within the Rancho San Vicente portion of Calero County Park. These three trails are unpaved multi-use trails with high visitation. Equestrians, hikers, dog walkers, and bicyclists use these trails, which compares well to the District's Fremont Older Preserve and Sierra Azul Preserve (Kennedy Area). The second location was along the John Nicholas Trail in Sanborn County Park. This trail is narrow, heavily used by bicyclists, hikers, dog walkers, and occasionally equestrians, and is a segment of the Bay Area Ridge Trail. This trail is similar to segments of the Bay Area Ridge Trail on District preserves.

A total of 1186 intercept surveys and observation reports were conducted from July 1, 2021 through October 31, 2021. The Rancho San Vicente location saw 17 days of surveys for a total of 66.5 hours, yielding 746 surveys. The Sanborn location yielded 440 surveys over 76.25 hours within 20 days. Refer to Attachment 2 for a full report of the unpaved trail study.

The intercept survey consisted of 10 questions and a demographics section designed to gauge support or opposition for Class 1 e-bikes on multi-use trails and to gauge the types and frequency of user conflicts between e-bike users and other trail users. Appendix E includes a copy of the survey questions and the results for each question. Key takeaways are show in the charts below:





During the intercept surveys, observational data was also collected focused on how many e-bikes versus regular bikes were observed, the behavior of bike riders for both groups, and the reactions of wildlife in the area (refer to Appendix H for details). Results of significant data are as follows:

- Of the total amount of bicycles observed (3754):
  - 89.56% were regular bikes (3363 total)
  - 10.42% were e-bikes (9.99% Class 1 and 0.43% Class 2) (391 total)
- Regular (non-e-bike) bike rider behavior by percent of total regular bikes observed:
  - 2.58% speeding
  - 0.03% passing too fast
  - 0.08% rude behavior
  - 0.05% negative interaction
- E-bike rider behavior by percent of total e-bikes observed:
  - 0.024% speeding
  - 0.00% passing too fast

- Wildlife observations
  - 197 wildlife observed
  - 0 wildlife fled as a result of visitor actions or behavior
  - 13 incidents of minimal wildlife reaction[1]

Equestrian Outreach

The trails and parks chosen for the unpaved intercept surveys were selected in part with the expectation of surveying diverse user groups. Because the intercept surveys only yielded minimal data from the equestrian user group due to the small sample size (only three equestrians total), staff also reached out directly to this community for their input. An online survey link was provided to the San Mateo County Horseman's Association, the Los Altos Hill Horseman's Association, Santa Clara County Horseman's Association, and Equestrian Trail Riders Action Committee (ETRAC). Survey respondents were asked to answer the questions based on visits to a Santa Clara County Park where e-bikes are currently allowed.

As this methodology differed from the unpaved intercept surveys, the results are listed here separately. Based on the responses, it is clear that the survey was shared and expanded beyond the equestrian community as intended, with hikers and bicyclists also responding to the survey. Seven of the 69 total surveys received were omitted from the data as the respondents indicated they were not an equestrian, but instead hikers and bikers. The survey focused specifically on e-bike use, however, over 30% of the open-ended questions mentioned "cyclists and bikers" in a holistic manner and did not differentiate between regular bikes and e-bikes.

Reportable data from this outreach is limited due to the wide community sharing of the survey beyond the equestrian groups and the broader responses that included concerns not specific to e-bikes. Key takeaways are as follows:

- Support or oppose Class 1 e-bikes on unpaved, multiuse trails:
  - 70.00% oppose
  - 10.0% are neutral
  - 6.67% support
- User Conflict on the trails:
  - 78.33% had a conflict (23 out of 47 conflicts reported was with an e-bike)
  - 15.0% did not have a conflict on the trails

Public Input Regarding E-bikes

Since the paved pilot began in December of 2020, communication to the District regarding e-bikes has been collected, monitored, and categorized to track public sentiment. This includes public comment received via the general info@openspace.org email address, the public comment form for e-bikes posted on the District project website, through direct email correspondence to Board members, and from comments submitted in Board meetings. The comments are organized into the following categories: Support E-bikes on All Trails, Support E-bikes with Restrictions, Oppose E-bikes, and Undecided. The category of Support E-bikes with Restrictions was further broken down into the following categories: wide trails only, paved trails only, limited trails, and only Class 1 e-bikes.

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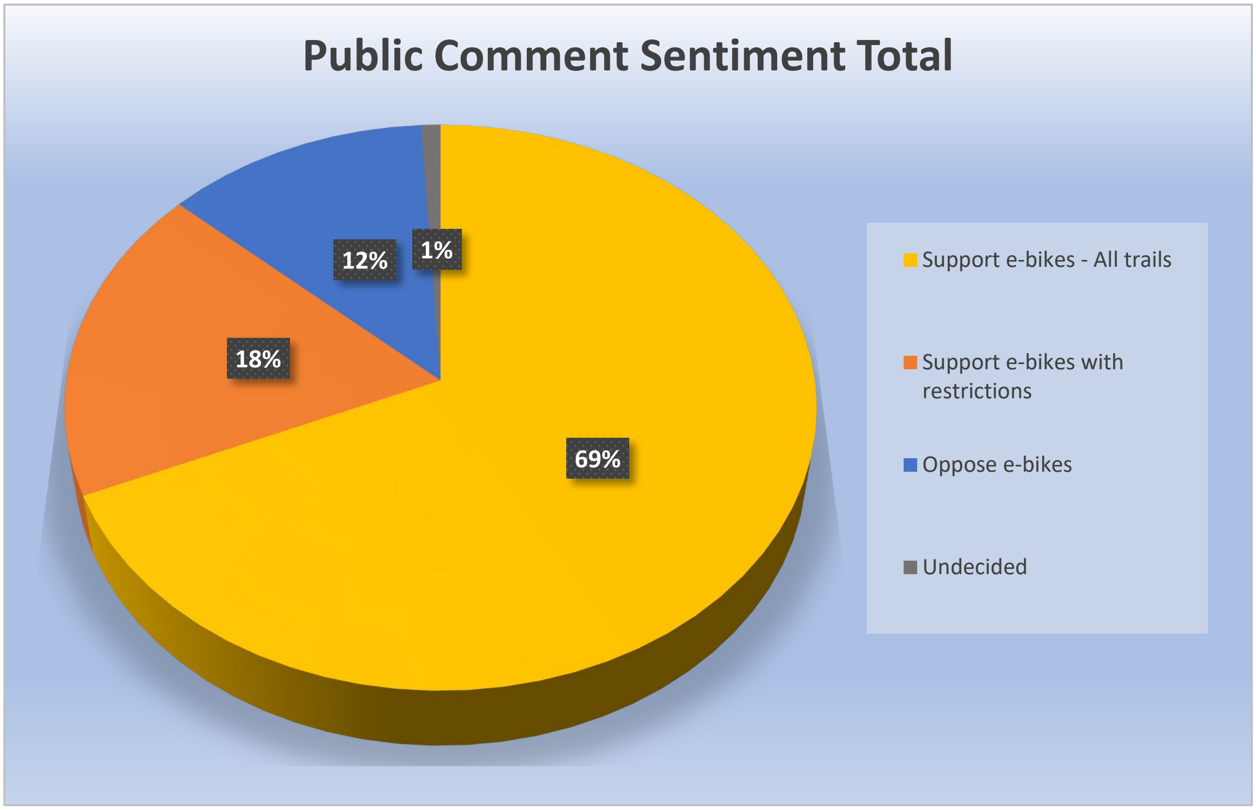
[1] [1]Minimal wildlife reaction was recorded when an animal did not flee but was visibly interrupted from what they were doing. Example: a deer looking up from feeding but then returning to feeding

A detailed analysis of the public comments from December 2020 through December 1, 2021 is provided in Attachment 7. Through all the platforms listed above, a total of 997 comments were received that had a determinable sentiment attached. Some responses only list names and email addresses for inclusion on public notification lists and did not include any comment or indication of opinion on e-bikes; these comments are thus excluded. Results of combined data are shown in the chart below:



Noise Study

The Natural Resources Department was tasked with investigating potential noise impacts to wildlife (specifically birds and bats) from e-bikes. Wildlife Program staff contacted H.T. Harvey & Associates (H.T. Harvey), one of the District's on-call biological consultants, to assist as they have expertise in measuring sound and determining potential noise impacts to these species.

On November 10, 2021, the Board received an FYI detailing the results of this study (see also Attachment 3). The study concluded that both regular bikes and e-bikes generate noise across both low and high frequencies, depending on the model and the type of activity for which the bike is being used. However, regular bikes were generally quieter than the e-bikes. Both types of bikes generated noise in frequencies that are inaudible to most birds and mammals (including humans) but can be heard by bats. Bats are generally more sensitive to the high frequency sounds that were generated by the e-bikes

Noise buffers are currently used by the District during sensitive seasons to reduce potential noise impacts to wildlife where human generated noises may exceed the ambient noise level in site specific areas. The study provided recommended buffer distances for avoiding or reducing impacts to known nesting or roosting sites of certain birds and bats where e-bikes may be allowed. Natural Resources staff reviewed the District's trail system where regular bikes are allowed to identify the potential location of sensitive receptors and determined that there were two known bat boxes located near the Skyline Ridge A-frame house within proximity to an existing multi-use trail. The background noise levels at this location are similar to those generated by e-bikes (as measured in the study), therefore no bat box relocation or seasonal trail closures were recommended. Bat species that use bat boxes are generally more tolerant of disturbance and despite the background noise levels (from the residence, nearby trail, and Skyline field office), bats continue to use these bat boxes. As demonstrated at this site, certain species of bats in certain conditions may have a higher disturbance tolerance and require smaller or no buffers, especially in more heavily disturbed areas. No other known sensitive receptors were identified in proximity to the District's existing bike trails. As future new trails are considered, staff will survey proposed trails alignments for the potential presence of bat roosts or other sensitive receptors to inform changes in the final alignment or the need for other avoidance measures (e.g., seasonal closures, buffers, etc.) to prevent or reduce impacts to sensitive wildlife.

Science Advisory Panel Findings

The Science Advisory Panel (SAP), which consists of the San Francisco Estuary Institute (SFEI) and Point Blue Conservation Science (Point Blue), provided an independent science-based review of scientific literature and practitioner studies about the benefits and impacts of Class 1 electric bike access on multi-use recreational trails in natural areas. The full report is provided as Attachment 4. The SAP determined that of the few studies that have been done to examine the impacts of e-bikes on open space lands, some were too limited to have conclusive statistical analysis. With what research could be found and input from a Technical Advisory Committee (TAC) comprised of resource and recreation management practitioners and scholars, the SAP produced a report that compares the potential impacts from e-bikes to those of regular mountain bikes.

The SAP report identifies six potential e-bike-related impacts within open space lands. These are categorized as Wildlife Disturbance, Noise, Distance and Duration, Soils/Erosion, Vegetation, and Visitor Experience. Of these six categories, literature suggesting a notable difference between e-bikes and regular bikes existed in the Noise category only. This was based on the Noise study performed by H.T. Harvey and Associates. The study showed that e-bikes produce louder sounds in high-frequency ranges audible to certain bat species and in lower-frequency ranges audible to birds (and other wildlife). Other findings also suggest the potential for increased recreational benefits via increased bicycle use in preserves, particularly for people who seek a less challenging means to travel through the preserve. An increase in use, however, may also incrementally increase impacts to natural resources and/or the experience of other visitors if the frequency of bike encounters and/or the interior distance travelled increases with the addition of e-bikes.

Updated Survey of E-bike Policies of Public Land Management Agencies

As with any type of interruptive technology, the increase in e-bike use has not come without controversy and debate among public land managers, trail users, and e-mountain bike (EMTB) advocates. Locally, there is mixed support and varying restrictions on its use. Many policies have not been updated since the California Vehicle Code (CVC) was amended in 2017 to define e-bikes as electric bicycles, separating them from vehicles, motor-driven cycles, and motorized bicycles, and further stipulating that Class 1 or Class 2 e-bikes are allowed on a bicycle path or trail, equestrian trail, or hiking or recreational trail, unless prohibited by ordinance.

In preparation for this report, staff updated the November 2019 survey of local and regional public land management agencies on their e-bike policies. This survey includes information from California State Parks, East Palo Alto, Palo Alto, Menlo Park, San Jose, Santa Clara County Parks, San Mateo County Parks, Marin County Parks and Open Space, Sonoma County Parks, East Bay Regional Parks District, Marin Municipal Water District, Santa Clara Valley Open Space Authority, and CalFire - Soquel Demonstration Forest. As part of the recent update, the list was expanded to include Bureau of Land Management's Cotoni-Coast Dairies National Monument (see Attachment 5). Below is a summary of the key findings:

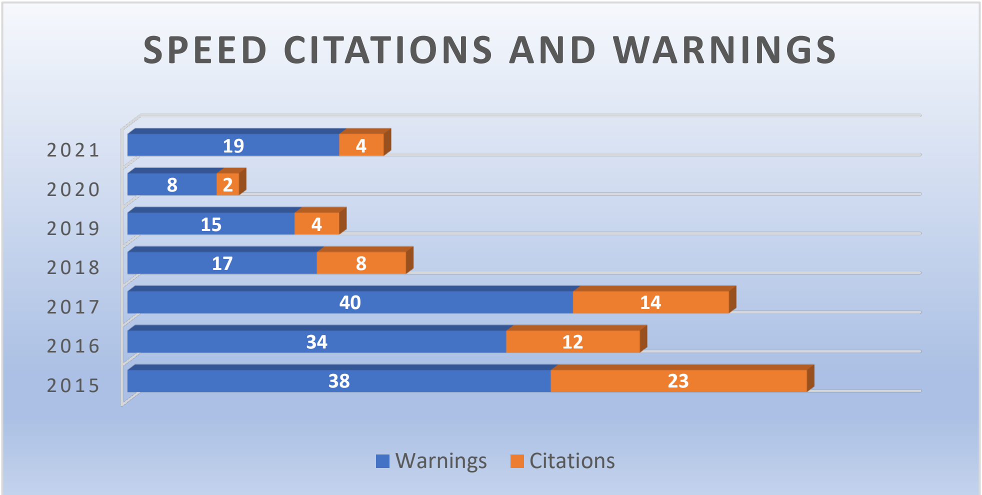
Of the 14 agencies included in the survey:

- Three agencies do not allow e-bikes (Soquel Demonstration Forest, Marin Municipal Water District, Palo Alto)
- Eleven agencies allow e-bikes on paved roadways and paths.
- Eight agencies allow e-bikes on unpaved roads, trails and paths.
- Two agencies treat Class 1 and 2 e-bikes differently.
- Where allowed, Class 3 e-bikes are only permitted on paved paths and roadways. None of the agencies allows Class 3 e-bikes on natural trails.
- Four agencies that do not allow e-bikes or are neutral are either reviewing or considering revising their policies or conducting research.
- Five agencies that allow e-bikes manage lands with local and regional trail connections to District lands.

Enforcement and Accidents

District records of specific e-bike related citations and warnings only consist of the violation of using e-bikes on District lands (as a reminder, e-bikes are currently restricted on District lands). The chart below lists all written warnings and citations for *E-bikes Prohibited* since 2015. District records do not show any citations or warnings issued for e-bikes under other violation codes.

Below is a chart of speeding warnings and violations since 2015 and all were for regular bikes.



Enforcement activity during the Rancho San Antonio and Ravenswood paved pilot program saw one bike related violation in the two Preserves and it was for a *bicycle prohibited* violation in Rancho San Antonio. This violation was for a regular bike and not an e-bike. Looking back to 2015, three e-bike prohibited violations have occurred in Rancho San Antonio Preserve, one each in 2015, 2016, and 2019 (these violations are included in the chart above of all *E-bike Prohibited Violations*). From 2015 to 2021, 24 *Closed Area* Bike violations occurred in Rancho San Antonio, all of these were for regular bikes. Rancho San Antonio also saw two additional bike related violations, both for *riding without a helmet*. Ravenswood only had two bike related violations in the 2015 to 2021 span of time, and one was for a *helmet required* and the other was for *riding with earbuds*.

District records show one e-bike related accident, a solo bicycle accident in Sierra Azul, in the last 2 years. During this same two-year timeframe, the District had 46 bicycle accidents involving regular bikes (27 in 2020 and 19 in 2021).

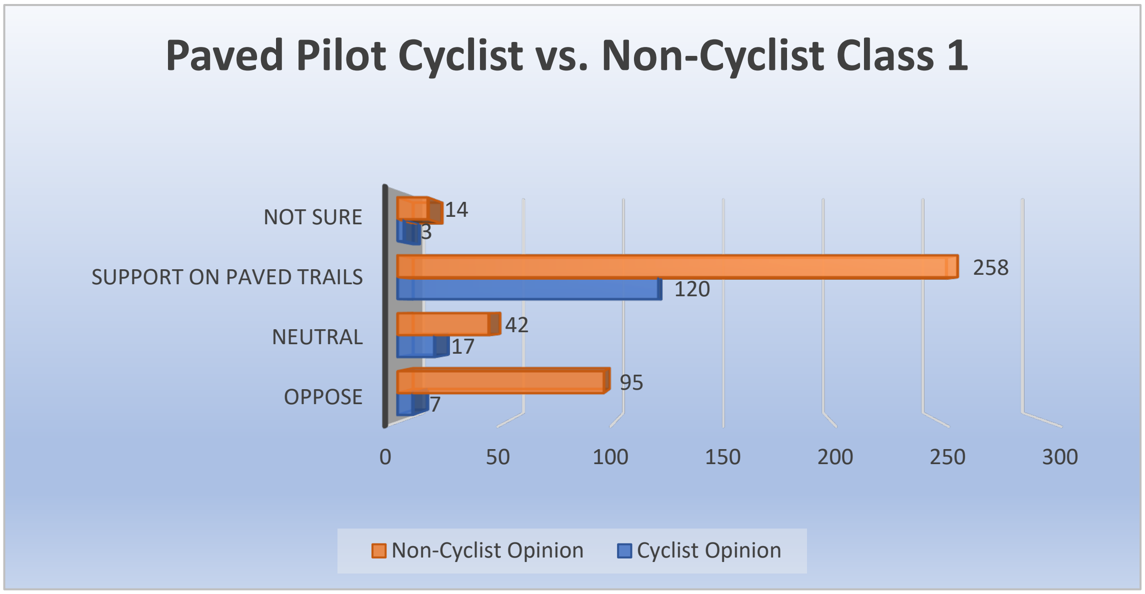
Santa Clara County Parks was contacted and asked about how e-bikes have impacted enforcement activity and the number of accidents involving bicycles. For 2020 and 2021, Santa Clara County Parks reports that no citations were issued for e-bike violations. In 2020, 9 total warnings for Class 3 e-bikes or other e-bikes on non-designated trails were issued. In 2021, 4 total warnings regarding Class 3 e-bikes or other e-bikes on non-designated trails were issued.

In 2020, Santa Clara County Parks reported 79 bicycle accidents with one of these involving an e-bike. In 2021, Santa Clara County Parks had another 61 bicycle accidents with one involving an e-bike.

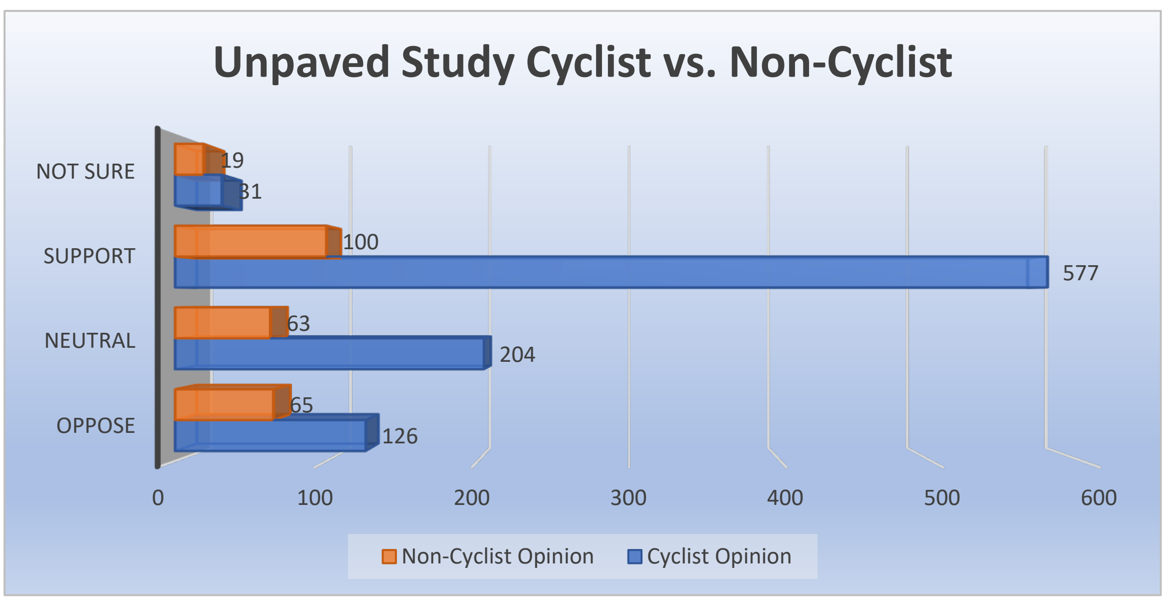
CONCLUSIONS

The paved pilot program and the unpaved intercept survey study both solicited public input on the potential for e-bike use of District lands. The paved pilot survey opinion poll resulted in a total of 556 responses (409 from non-cyclists and 147 from cyclists). Of the total responses, 68% (378 of 556) support allowing Class 1 e-bikes on paved trails. Responses from non-cyclists show 63% (120 of 409) support Class 1 e-bikes on paved trails, while 37% (289 of 409) either oppose (23%), are neutral (10%) or not sure (4%). Responses from cyclists show 81.6% (120 of 147) support Class1 e-bikes on paved trails, while 18.3% (27 of 147) either oppose

(4.8%), are neutral (11.6%) or not sure (2%). The paved pilot program also asked about Class 2 e-bikes. Of all respondents, 42% support Class 2 e-bikes on paved trails while 58% either oppose (39%), are neutral (15%) or not sure (4%) of Class 2 e-bikes on paved/improved trails with more non-cyclists (46%) opposing Class 2 e-bikes.



The unpaved trail study generated 1186 total respondents with a majority (57% or 677) supporting Class 1 e-bike use on unpaved trails. The graph below separates cyclist opinions from non-cyclists. Of the total 247 non-cyclist responses, 100 (40%) support Class 1 e-bikes on unpaved trails while 147 (60%) either oppose (26.3%), are neutral (25.5%), or unsure (7.7%). Of the total 938 cyclist responses, the majority (61.5%) support Class 1 e-bikes on unpaved trails while 361 (38.4%) either oppose (13.4%), are neutral (21.7%), or not sure (3.3%).



Public comment received from December of 2020 through January 31 of 2022 on the subject of e-bikes was also gathered, monitored, and categorized. Of these comments, 87% wrote in support of the use. E-bike use on District land is particularly unpopular with equestrians, with 70% of the equestrian respondents opposing e-bikes.

The SAP report indicates six potential impacts from e-bikes that are largely similar to impacts **from regular bikes,** including potential impacts to trails **and soils, vegetation trampling** and dissemination of invasive seeds and pathogens, wildlife disturbance, and visitor conflict. Ways in which e-bikes could differ from regular bikes include uphill speed, distance traveled per ride, demographics of riders, and noise impacts to wildlife, specifically bats. A study conducted for the District by H. T. Harvey and Associates concluded that both regular bikes and e-bikes generate noise across both low and high frequencies. However, regular bikes were generally quieter than e-bikes in high frequencies that are inaudible to humans and most wildlife but may be disruptive to bats. A staff review found that known bat roousts are sufficiently far from trails that they would not be impacted by e-bike use where bicycles are currently allowed. The SAP findings also suggest the potential for increased recreational benefits via increased bicycle use in preserves, particularly for people with certain mobility challenges or who seek a less challenging means to travel through the preserve; an increase in use, however, may also increase impacts to natural resources and/or the experience of other user groups if the frequency of bike encounters and/or the interior distance travelled increases with the addition of e-bikes.

FISCAL IMPACT

There is no fiscal impact associated with this recommendation.

BOARD AND COMMITTEE REVIEW

A presentation was made to the Board (R-19-155, minutes) on November 20, 2019, to consider options for evaluating a potential e-bike policy for District lands. The Board directed the General Manager to return with an evaluation and process for implementing a phased one-year pilot program for e-bikes on specific paved (Class 1 and 2 e-bikes) trail and a study for unpaved trails (Class 1 e-bikes) to evaluate potential differences in enforcement, use, visitor experience, and impacts to the natural resources. Under this direction, a project was created for Fiscal Year 2020-21 (FY21). As the FY21 budget recommendations were being finalized, the COVID pandemic struck and action plan adjustments were being considered that potentially deferred the e-bike evaluation project to FY22. During the budget hearing on June 10, 2020, the Board expressed concerns about deferring the e-bike project entirely and directed staff to modify the project scope for FY21 to specifically focus on e-bike access on District paved trails and defer the evaluation of e-bike access on unpaved trails to FY22 (minutes). The FY21 project scope was finalized by the Board during the Board meeting on June 24, 2020, to "explore a pilot program for e-bike access on District paved trails" (minutes).

During its regular meeting on August 12, 2020, the Board of Directors (Board) approved a Paved Pilot Program to evaluate select paved and improved trails at Ravenswood Preserve and Rancho San Antonio Preserve and County Park for use by Class 1 and 2 e-bikes (R-20-89, minutes). The Board also directed the General Manager to return with recommendations for an Unpaved Trail Study for Class 1 e-bikes. The Paved Pilot Program began on December 10, 2020. During the December 7, 2020 Board retreat meeting, while discussing potential focus areas for FY22, multiple Board members expressed concern with the timing of the efforts and asked staff to return with options to expedite the Unpaved Trail Study (minutes).

In a special meeting on January 27, 2021, The General Manager presented three options reflecting various deployments of staff resources given limited staff capacities to seek Board direction on how best to proceed with analyzing the potential effects of e-bike use on the visitor experience, trail maintenance and enforcement, and natural resources for paved and unpaved trails (R-21-13, minutes). The Board approved Option 3 (listed below). During the discussion, Director Kersteen-Tucker asked staff to consult the Science Advisory Panel regarding the impacts of e-bikes on the natural resources.

Option 3 – Scale down the Paved Pilot Program and initiate an Unpaved Pilot Program on Partner lands by Summer/Fall of 2021. This option reduced the analysis of the Paved Pilot Program to release staff capacity for initiating a study of unpaved e-bike access on current e-bike trails of partner lands that serve as a proxy to District lands and unpaved bicycle trails. More specifically, under this option:

- The Paved Pilot Program was rescoped by reducing the intercept surveys, observation reports, and speed surveys. Online feedback on the Paved Pilot Program was still captured through the District website. Staff would analyze and present findings to the Board in early 2022 related to use, complaints, enforcement, accidents, and before/after observations to confirm whether to formalize e-bike use on the paved/improved trails.
- Staff would pursue a partnership with a local park/land management agency to conduct a short-term study (intercept surveys and observation reports) on the partner agency's unpaved trails where e-bikes are already permitted during the summer/fall of 2021.
- Staff would present the results of the short-term study to PNR in early 2022 and then forward PNR recommendations to the full Board. Depending on the findings, the Board may consider the following three options:
    i. Determine that the surveys are sufficient to decide whether to allow class 1 e-bikes on unpaved District trails.
        - Final Board decision on e-bike use would occur in Spring 2022.
    ii. Direct staff to continue the partnership study for a full year to include winter and spring use levels and effects.
        - Final Board decision on e-bike use would occur in early 2023.
    iii. Direct staff to implement an Unpaved Pilot Program on select District Preserves to evaluate effects on District lands.
        - Final Board decision on e-bike use would occur in Spring/Summer of 2023.

On December 9, 2020, an FYI on the Paved Pilot Program implementation was provided to the Board (FYI memo, minutes).

On May 12, 2021, an FYI Memorandum was sent to the Board as an update on the e-bike policy evaluation project that included the selection of Santa Clara County Parks as the partner agency to host the unpaved surveys in both Sanborn and Calero County Parks (FYI memo).

On November 10, 2021, an FYI Memorandum was sent to the Board listing the findings and recommendations from the noise study that was conducted by H.T. Harvey and Associates (FYI memo). This noise study was conducted to determine if e-bikes created noise impacts to wildlife, specifically birds and bats.

PUBLIC NOTICE

Public notice was provided as required by the Brown Act.

CEQA COMPLIANCE

The Board's decision on whether to: (a) determine that surveys are sufficient to make a decision on e-bike use, or (b) continue the e-bike study for a full year to include winter and spring use levels and effects, or (c) implement an unpaved e-bike pilot program on select District Preserves is categorically exempt from CEQA as follows:

<u>CEQA Guidelines section 15301. EXISTING FACILITIES</u>
CEQA exempts the operation or minor alteration of existing public or private structures, facilities, or topographical features, which involve negligible or no expansion of existing or former use. The use of e-bikes on paved trails where bicycles are already allowed represents a negligible expansion of use of existing trails.

<u>CEQA Guidelines section 15304. MINOR ALTERATIONS TO LAND</u>
CEQA exempts minor alterations in the condition of land which do not involve removal of healthy, mature, scenic trees and have negligible or no permanent effects on the environment. As stated herein, the limited duration of e-bike use on trails where bicycles are already allowed will have a negligible effect on the environment.

<u>CEQA Guidelines section 15311. ACCESSORY STRUCTURES</u>
CEQA exempts construction, or placement of minor structures accessory to (appurtenant to) existing facilities, such as on-premise signs. As described in this report, signs may be installed or altered in order to notify preserve users of the changes to the trail designation allowing e-bikes during a pilot program.

<u>CEQA Guidelines section 15306. INFORMATION COLLECTION</u>
CEQA exempts information gathering activities or actions that are part of a study leading to an action which the agency has not yet adopted, which do not result in a serious or major disturbance to an environmental resource. Changing the trail designation of certain trails to temporarily allow e-bikes during a pilot program will allow the District to collect information about e-bike use in certain areas. This information will inform future policy decisions about e-bike use on paved and unpaved trails.

NEXT STEPS

Staff will follow up on any clarifications or analysis requests made by the PNR committee. The PNR Committee recommendation will be presented to the full Board later this spring.

Attachments:
Attachment 1 Paved Pilot Program Report
Attachment 2 Unpaved Study
Attachment 3 Noise Study
Attachment 4 Science Advisory Panel Literature Review
Attachment 5 Regional Policies Updated

Attachment 6 Decibel Chart
Attachment 7 Public Comment Sentiment

Responsible Department Head:
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Midpeninsula Regional
Open Space District

Attachment 1

PAVED PILOT PROGRAM AND SURVEYS

BACKGROUND

On November 20, 2019, the Midpeninsula Regional Open Space District (District) Board of Directors (Board) (R-19-155, minutes) considered options for evaluating a potential e-bike policy for District lands. The Board directed the General Manager to return with a process for implementing a phased one-year pilot program for e-bikes on specific paved (Class 1 and 2 e-bikes) and unpaved/multi-use trails (Class 1 e-bikes) to evaluate potential differences in enforcement, use, visitor experience, and impacts to the natural resources. Under this direction, a project was created for Fiscal Year 2020-21 (FY21). As the FY21 budget recommendations were being finalized, the COVID pandemic struck, and action plan adjustments were being considered that potentially deferred the e-bike evaluation project to FY22. During the budget hearing on June 10, 2020, the Board expressed concerns about deferring the e-bike project entirely and directed staff to modify the project scope for FY21 to specifically focus on e-bike access on District paved trails and defer the evaluation of e-bike access on unpaved trails to FY22 (minutes). The FY21 project scope was finalized by the Board on June 24, 2020, to "explore a pilot program for e-bike access on District paved trails" (minutes).

During its regular meeting on August 12, 2020, the Board of Directors (Board) approved a Paved Pilot Program to evaluate select paved and improved trails at Ravenswood Preserve and Rancho San Antonio Preserve and County Park for use by Class 1 and 2 e-bikes (R-20-89, minutes). The Paved Pilot Program began on December 10, 2020. This document presents the detailed results of the Paved Pilot Program.

DISCUSION

<u>Paved Pilot Program and Surveys</u>

On December 10, 2020, a pilot program began allowing Class 1 and 2 e-bikes on paved and improved multi-use trails within Ravenswood and Rancho San Antonio Preserves. Temporary class 1 and 2 e-bike use continues under the pilot program at Ravenswood and Rancho San Antonio County Park and Preserve pending a Board decision on affirming the prohibition of e-bikes or allowing them on designated trails in these preserves. The trails were evaluated by District Land and Facilities staff before the pilot began (baseline conditions) and again this December (post-pilot conditions) using photographs. Area Manager Michael Gorman reports that there has been a significant impact from increased visitation during the COVID pandemic that resulted in the widening of some unpaved trails. However, no physical change to the trails can be attributed specifically to the use of e-bikes during the paved pilot program.

From April 1, 2021 through June 30, 2021, 556 intercept surveys were conducted along the trails in these pilot preserves. Rancho San Antonio had 14 days of surveys that spanned a total of 56 hours where 398 surveys were completed. Ravenswood had 12 days of surveys, accounting for 48 hours, where 158 surveys were completed. Site surveys rather than online polls were collected to ensure that the input received was from people actually visiting each preserve and to solicit relevant feedback about e-bike conflicts experienced at these specific pilot locations.

The survey consisted of 11 questions and a demographics section, designed to gauge support or opposition for allowing Class 1 and 2 e-bikes on paved/improved trails within District Preserves and to record whether visitors experienced any trail conflicts during their visit (refer to Appendix A for detailed results of each survey question).

During these intercept surveys, observational data was also collected that focused on how many e-bikes versus regular bikes were observed, the behavior of e-bike and regular bike riders, and the type of wildlife observed in the area and their reactions if any to the use (details of the observational data is provided under Appendix D).

Survey Results

The data recorded from the intercept surveys was cross analyzed to quantify information by user group. The first five questions of the survey asked respondents about the activity they were doing at the time of the survey and how familiar they were with e-bikes. The questions also asked about any incidents or conflicts they may have had with other user groups. Below is a summary of the key results:

- The most common activity of all respondents (both preserves) was walking (63%) followed by bicycling (24%). At Rancho San Antonio, the most common activity was walking (81%), while at Ravenswood it was bicycling (72%).
- 2% of all participants and 10% of all cyclists were riding e-bikes.
- Over one-fourth of respondents (28%) had previously ridden an e-bike.
- 85% of respondents did not see any e-bikes on the trails on the day of the survey.
- 5% (30 of 556; includes one non-response) of respondents reporting having a conflict with another visitor; of these, only one (1) was with an e-bike and another was not sure if it was an e-bike. Of the remaining 28 conflicts, 13 were with regular bicycles and 15 were with other visitors other than cyclists.

Below is information pulled from the data that looks deeper into the responses, grouping information by user group/activity and by level of support/opposition.

Level of Support or Opposition

Question 6 of the intercept survey asked about the level of support for Class1 e-bikes on paved/improved multi-use trails. *Thinking about Midpen's paved or improved multiuse trails,*

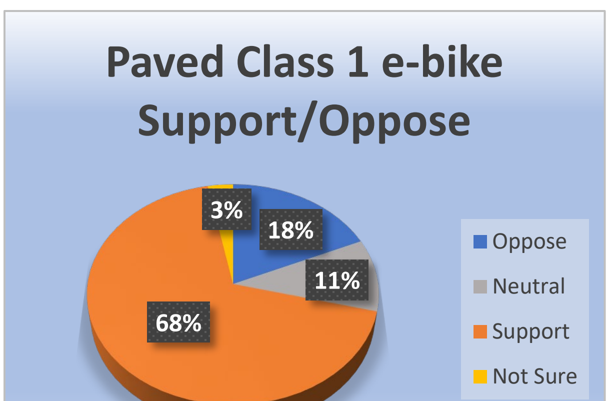

Figure 1

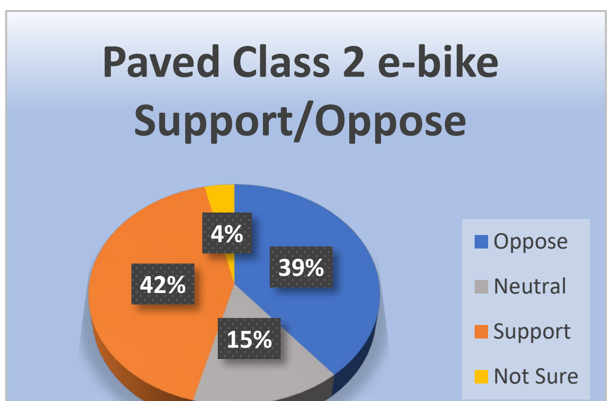

Figure 2

please indicate your level of support or opposition for allowing Class 1 e-bikes on these trails. As a reminder, Class 1 e-bikes provide electrical assistance only while pedaling, up to 20 mph. The majority of respondents (68%) supported Class 1 e-bikes on certain paved trails (Figure 1). The remaining 32% of respondents either oppose (18%), are neutral (11%) or not sure (3%) of the use on paved trails.

Question 8 of the intercept survey asked about the level of support for Class 2 e-bikes on paved/improved multi-use trails. *Thinking about Midpen's paved or improved multiuse trails, please indicate your level of support or opposition for allowing Class 2 e-bikes on these trails. As a reminder, Class 2 e-bikes provide electrical assistance regardless of pedaling, up to 20 mph*. Figure 2 indicates that 42% of respondents support Class 2 e-bikes on paved trails. Of those not directly indicating support, 58% either oppose (39%), are neutral (15%) or not sure (4%) of having Class 2 e-bikes on paved/improved trails.

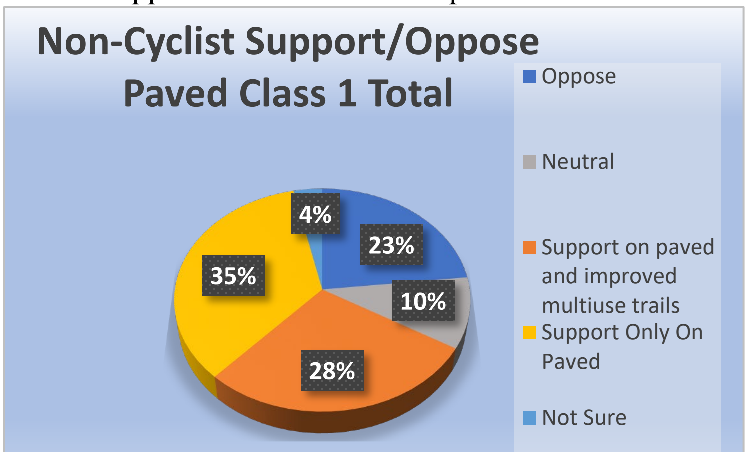

Figure 3

Figure 3 shows the results for the level of support or opposition specifically of non-cyclists (walkers, runners, equestrians) (refer to Appendix B for details). Majority support for Class 1 e-bikes on paved/ improved trails dropped slightly to 63% (35% + 28%) when responses from cyclists were excluded.

For Class 2 e-bikes (Figure 4), when responses from cyclists are excluded, more non-cyclists (46%) oppose Class 2 e-bikes on paved trails. Conversely, the level of support drops to 38%.

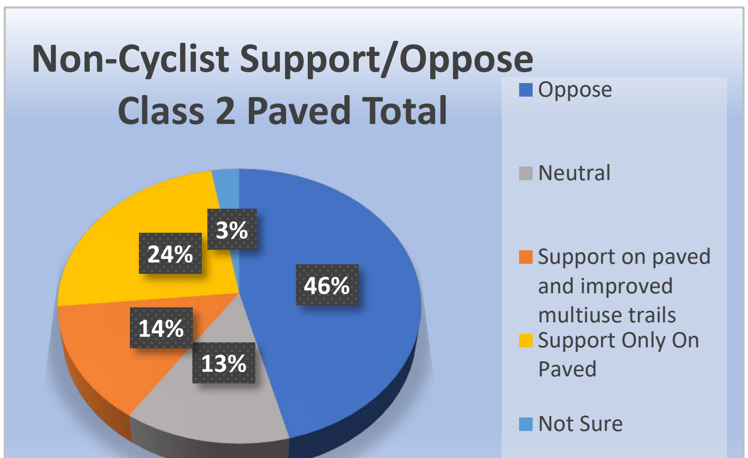

Figure 4

<u>Reasons for Support or Opposition</u>
Questions 7 and 9 asked respondents to give reasons as to why they answered in support or opposition in Questions 6 and 8. The reasons given were narrowed into nine categories; Safety, Circumstantial, Access, Inactive, Erosion, Segregate, Dislike, Indifference, and Other (refer to table).

Categories	Common Answers
Segregate	As long as they are separate from other users, Keep bikes away from hikers, etc.
Safety	Speed concerns, Overcrowding, Poor trail etiquette, Reckless behavior, etc.
Indifference	Don't bother me, Same as a regular bike, Never had an issue, etc.
Inactive	Not exercise, No effort involved, They are not earning it, etc.
Erosion	Less bikes - less damage, Trail damage, etc.

Circumstantial	Only on wide trails, Only if bikes are already allowed, If trail rules are followed, etc.
Access	Allows older people to ride, Allows more people to share preserve, Gets more people on the preserve, etc.
Dislike	Don't like motorized vehicles in preserve, Do not like e-bikes, etc.
Other	Will start fires, Too much like a Harley, Are motorcycles, etc.

Appendix A summarizes the answers to these questions and includes data from all respondents. Shown below in Figure 5, the most common reason for Class 1 e-bike opposition on paved/improved multi-use trails relates to safety concerns while the most common reason for

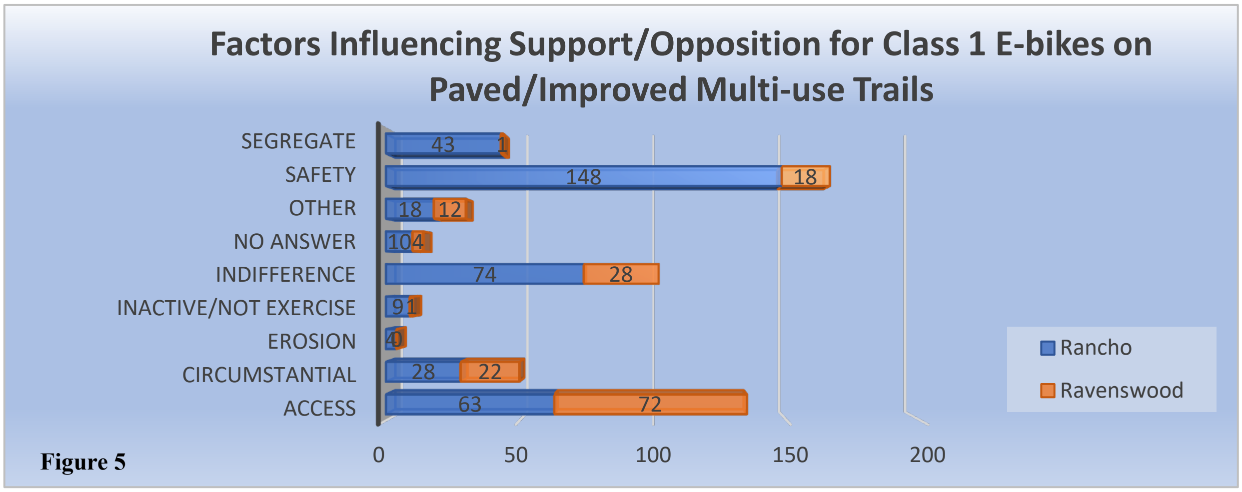

Figure 5

support relates to access.

Appendix C provides a complete breakdown of each reason grouped by opinion (support/opposition). This breakdown is also provided below under Figure 6 by those who indicate support, and Figure 7 by those who indicate opposition to further understand the factors influencing each opinion.

Many different answers were given in the open-ended question portion of the survey. Staff sorted these responses into the same nine categories shown in the table above. 53 responses supporting Class 1 e-bikes on paved/improved trails were categorized as being indifferent to the use (see also Figure 6). 37 of these respondents, or 65%, stated that e-bikes were no different from regular bikes, or close enough to regular bikes. Others who stated an indifference indicated that bikes are already allowed, or not too many bikes are present at the preserve, or never had a problem with bikes.

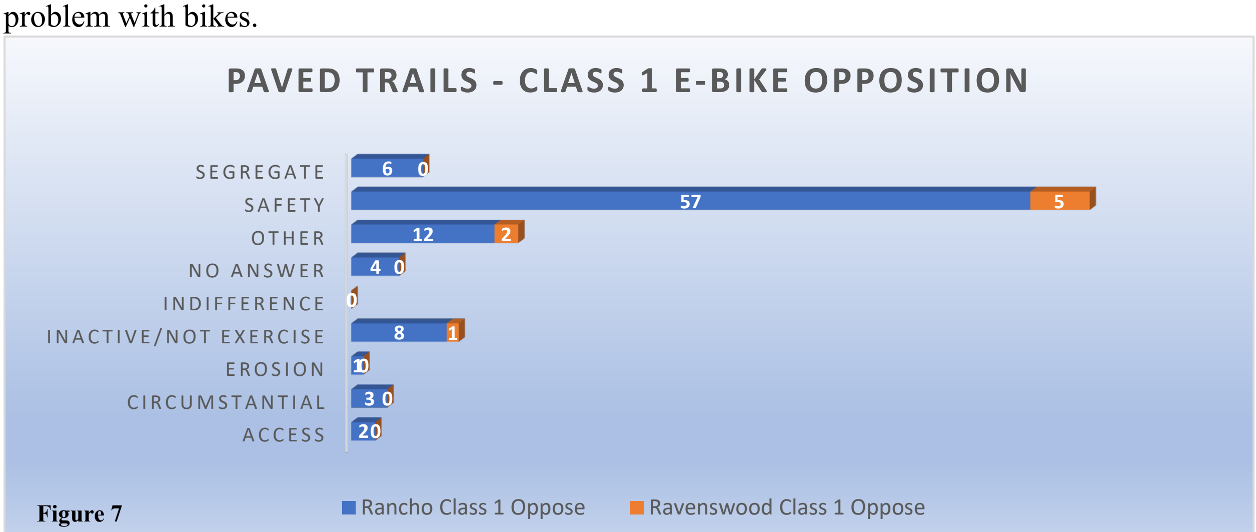

Figure 7

A common theme from the open-ended answers of the respondents who oppose Class1 e-bikes on paved/improved trails relates to safety (61% of respondents) (see Figure 7). Within this 61%, 54% mentioned speed as the reason. The remaining 46% mentioned overcrowding, narrow trails, and the fact that the e-bikes were heavier.

A more in-depth look at respondent opinions for Class 2 e-bikes on paved/improved trails showed similar themes in the reasoning for the level of support or opposition. A majority of respondents oppose Class 2 -e-bikes largely for two reasons: safety and inactivity (i.e., not considered a physical activity/exercise). Figure 8 shows a breakdown by reason for those opposed to Class 2 e-bikes.

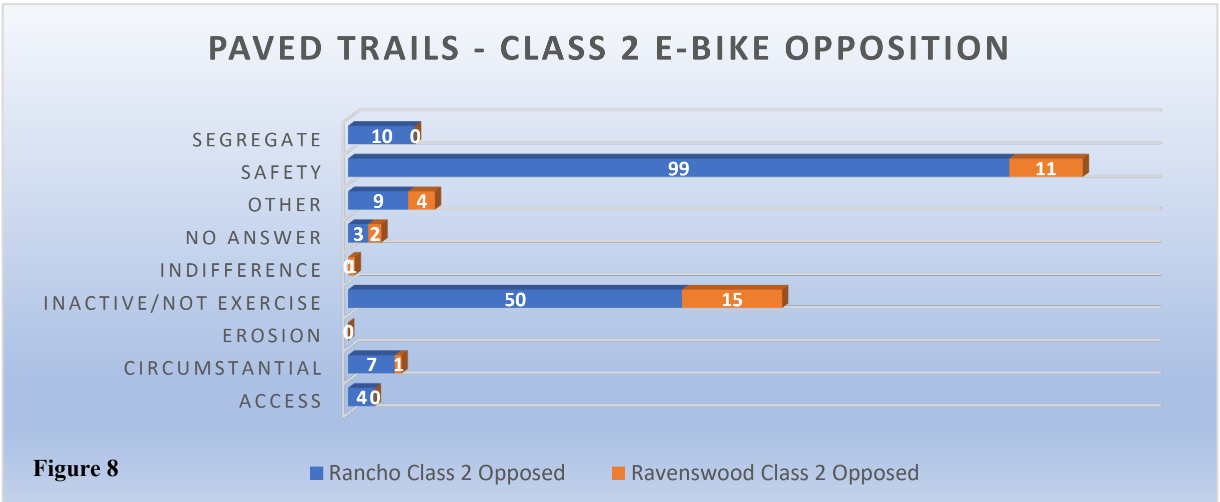

Figure 8

Of the 110 respondents who oppose Class 2 e-bikes on paved/improved trails for safety reasons, 56% of these respondents mentioned speed as the reason. Another 18% of respondents who oppose Class 2 e-bikes for safety reasons mentioned crowding or congestion. The next significant reason for opposing Class 2 e-bikes was inactive/not exercise. Within the 65 respondents in this category, 83% mentioned that it was not exercise. Another 11% of the 65 respondents mentioned that they were too much like a motorcycle.

Observational Data

During the course of each survey period, one staff member was recording observational data of the surrounding area. This data focused on the number of bikes observed and whether they were regular bikes or e-bikes. Other recorded data is on the behavior of those riding each type of bike. Wildlife was also observed, as well as their behavior or reaction, if any, to a bike passing by them. Details of the data can be found in Appendix D.

Observational data showed that e-bikes consisted of only 6% of the total bikes observed during the survey times (refer to Figure 9). When looking at the survey sites independently, e-bikes comprised 6% of total bikes at Rancho and 5% of total bikes at Ravenswood.

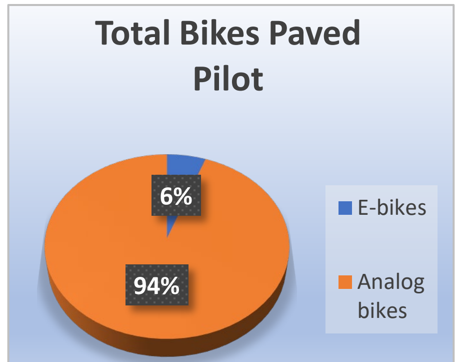

Figure 9

Observations of negative behavior by bicyclists showed a similar outcome. Negative behavior is divided into four categories: speeding, passing too fast, rude behavior, or negative interaction. The sample size of negative behavior from each bike group was small, yet the percentages hold across each group. As a total of e-bike riders from both survey sites, 5% (4 out of 74) of e-bike riders displayed negative behavior and 4% (48 out of 1251) of regular bike riders displayed negative behavior. Speeding was the most common negative behavior observed in both bike groups. Relative speed was estimated and not measured.

Enforcement records during the paved pilot program show one (1) violation between the two preserves for a *bicycle prohibited* violation in Rancho San Antonio. This violation was for a regular bike and not an e-bike. Looking back to 2015, three (3) *e-bike prohibited* violations have occurred in Rancho San Antonio Preserve, one each in 2015, 2016, and 2019. From 2015 to 2021, 24 *Closed Area* bike violations occurred in Rancho San Antonio, all of these were for regular bikes. Rancho San Antonio also saw two (2) additional bike related violations, both for *riding without a helmet*. Ravenswood only had two (2) bike related violations in the 2015 to 2021 span of time, one was for a *helmet required* and the other was for *riding with earbuds*.

Wildlife in the immediate survey areas were counted and placed in categories under common names. Some wildlife was grouped together, such as unidentified birds and rodents. A total of 214 wildlife observations were made during the surveys and of these, 46 were present when bikes were passing. Of these 46 wildlife observations, none reacted to bikes as they passed.

Conclusion

A total of 556 surveys were completed during the paved pilot program at Rancho San Antonio and Ravenswood Preserves accounting for 104 hours of surveys over 26 days. A majority of responses (68%) indicate support Class 1 e-bikes on paved/improved trails (Figure 10), while 32% either oppose (18%), are neutral (11%), or not sure (3%) of the use. Support was lower amongst non-cyclists (63%) but still constituted a majority of these respondents. Support drops

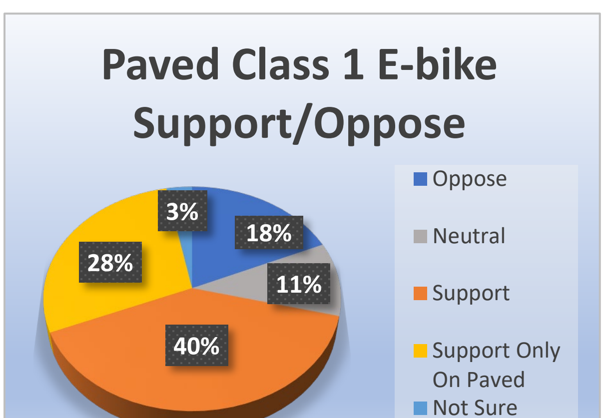

Figure 10

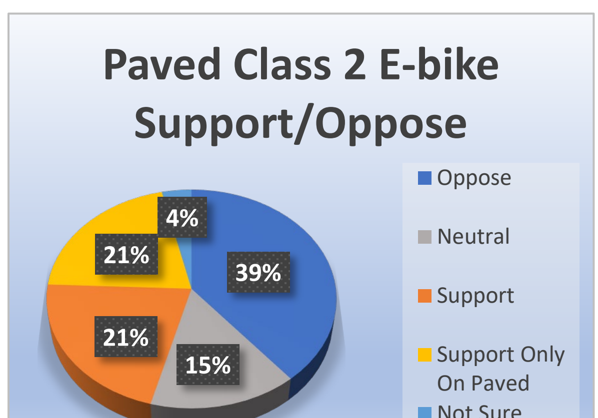

Figure 11

significantly for Class 2 e-bikes on paved/improved trails to 42% (Figure 11), with 58% either opposing (39%), neutral (15%), or not sure (4%) of the use. E-bike use during the pilot study comprised 6% of all the bikes observed and 10% of all the bicyclists surveyed. Trail conflicts were reported by 5% of the respondents, with one instance attributed to e-bikes and about half attributed to regular bikes

The observational data reports 4% negative behavior by e-bike riders and 5% by regular bike riders, demonstrating that in this small sample size study, there was minimal behavioral difference between the two. All of the recorded negative behavior except one instance was related to speed, either speeding or passing to fast. Speed was mentioned in 55.8% of the reasons given for opposing both Class 1 and Class 2 e-bikes. The observational data collected during the surveys show that e-bikes were observed speeding by a slightly higher margin than regular bikes (3.9% versus 3.3%).

Appendices:
Appendix A Paved Pilot Intercept Survey Results
Appendix B Paved Pilot Non-Cyclist Support/Oppose
Appendix C Paved Pilot Opinion by Sentiment
Appendix D Paved Observational Data

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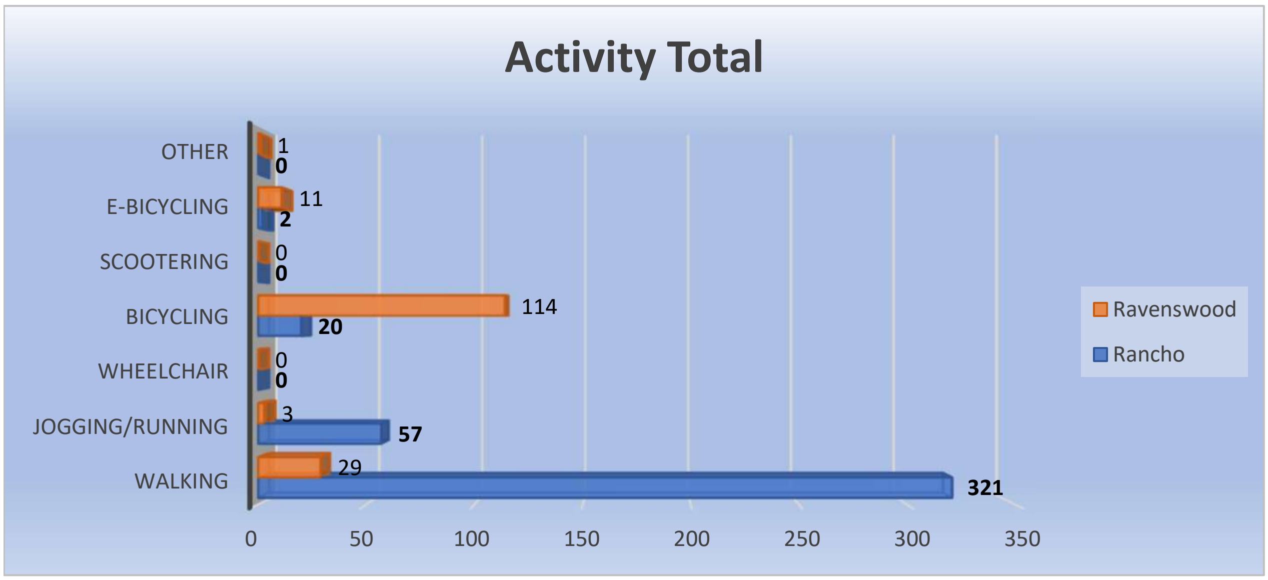
Appendix A

Paved Pilot Survey Results

1. What activity are you participating in while using the paved or improved multiuse trails today?

	Rancho	Ravenswood	TOTAL	% of Total
Walking	321	29	**350**	62.95%
Jogging/Running	57	3	**60**	10.79%
Wheelchair	0	0	**0**	0.00%
Bicycling	20	114	**134**	24.10%
Scootering	0	0	**0**	0.00%
E-Bicycling	2	11	**13**	2.34%
Other	0	1	**1**	0.18%
	398	158	**556**	

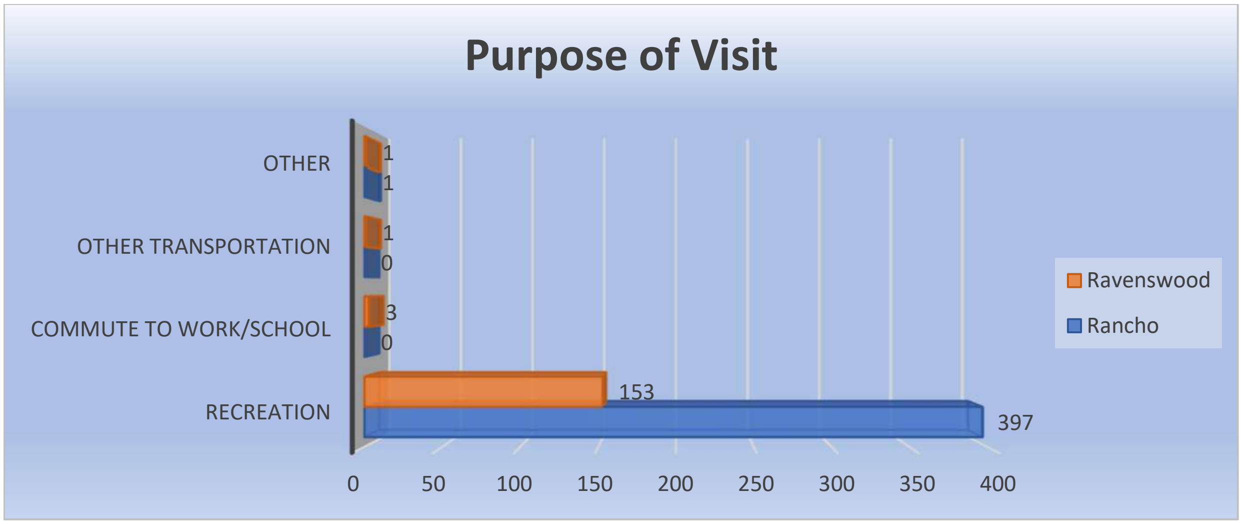


2. What is the purpose of your trip on the paved or multiuse trails today?

	Rancho	Ravenswood	TOTAL	% of Total
Recreation	397	153	**550**	98.92%
Commute to work/school	0	3	**3**	0.54%
Other transportation	0	1	**1**	0.18%
other	1	1	**2**	0.36%
	398	158	**556**	

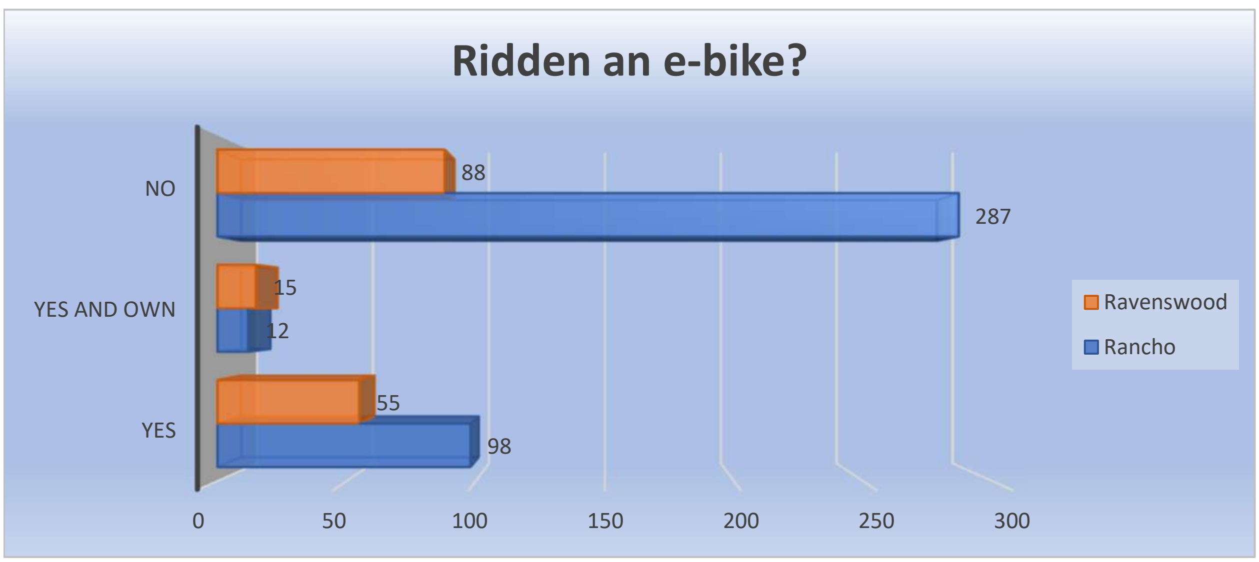
Appendix A

Paved Pilot Survey Results



3. Have you ridden an e-bike?

	Rancho	Ravenswood	TOTAL	% of Total
yes	98	55	**153**	27.57%
yes and own	12	15	**27**	4.86%
no	287	88	**375**	67.57%
	397	158	**555**	

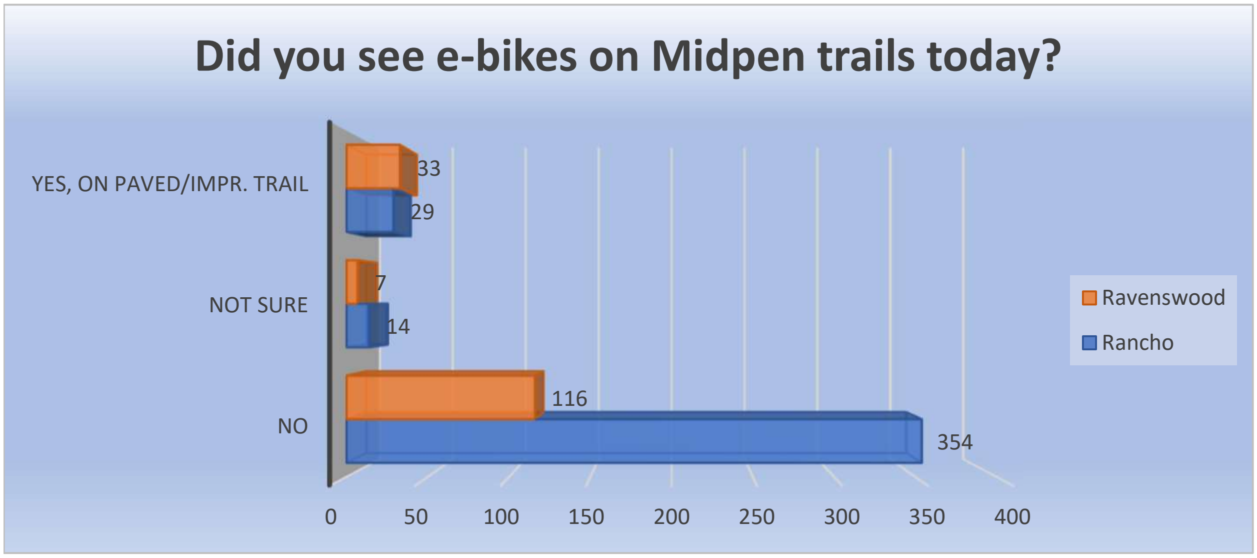


4. Did you see any e-bikes on any Midpen trails today?

	Rancho	Ravenswood	TOTAL	% of Total
No	354	116	**470**	84.99%
Not Sure	14	7	**21**	3.80%
Yes, on paved/Impr. trail	29	33	**62**	11.21%
	397	156	**553**	

Appendix A

Paved Pilot Survey Results



5.Sometimes, trail users interfere with one another's enjoyment of the trail. This is generally referred to as "conflict." Did you experience conflict during your trip on the paved or improved multiuse trails today?

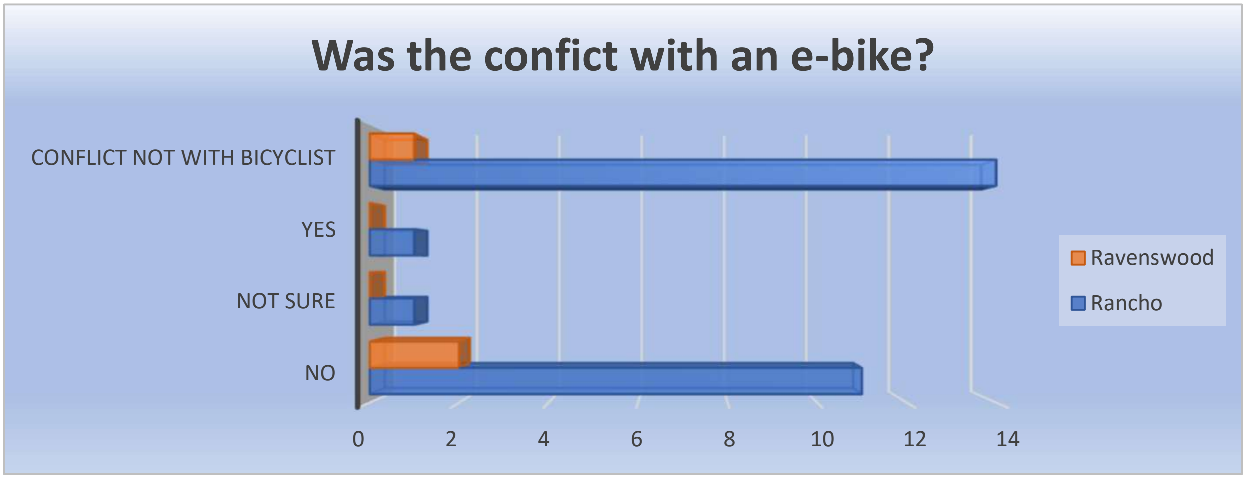
	Rancho	Ravenswood	TOTAL	% of Total
No	368	155	**523**	94.23%
Not Sure	2	0	**2**	0.36%
Yes	27	3	**30**	5.41%
	397	158	**555**	

5b. If you described conflict with someone riding a bike, was it an e-bike?

	Rancho	Ravenswood	TOTAL	% of Total
No	11	2	**13**	44.83%
Not Sure	1	0	**1**	3.45%
Yes	1	0	**1**	3.45%
Conflict not with Bicyclist	14	1	**15**	51.72%
	27	3	**30**	

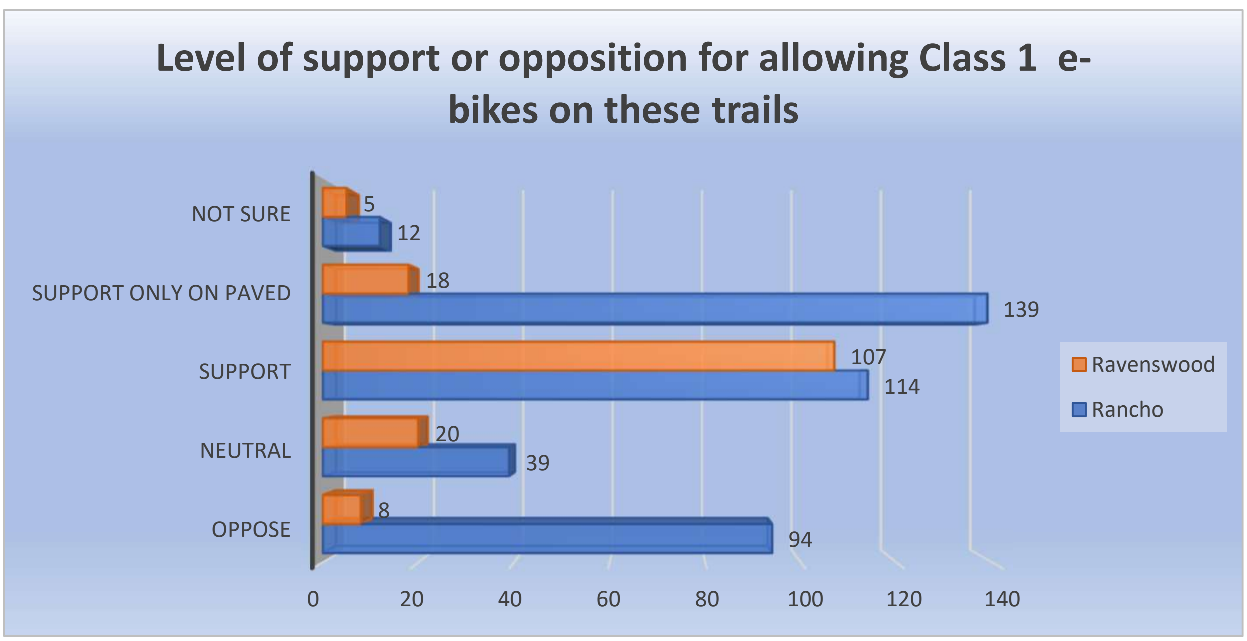
Appendix A

Paved Pilot Survey Results



6. Thinking about Midpen's paved or improved multiuse trails, please indicate your level of support or opposition for allowing Class 1 e-bikes on these trails. As a reminder, Class 1 e-bikes provide electrical assistance only while pedaling, up to 20mph.

	Rancho	Ravenswood	TOTAL	% of Total
Oppose	94	8	**102**	18.35%
Neutral	39	20	**59**	10.61%
Support	114	107	**221**	39.75%
Support Only On Paved	139	18	**157**	28.24%
Not Sure	12	5	**17**	3.06%
	398	158	**556**	



Appendix A

Paved Pilot Survey Results

7. Please briefly explain why you answered that way.

	Rancho	Ravenswood	TOTAL
Access	63	72	**135**
Circumstantial	28	22	**50**
Erosion	4	0	**4**
Inactive/Not exercise	9	1	**10**
Indifference	74	28	**102**
No answer	10	4	**14**
Other	18	12	**30**
Safety	148	18	**166**
Segregate	43	1	**44**
	397	158	**555**

7a. Is your response to the previous question based on an interaction (or experience) or general belief?

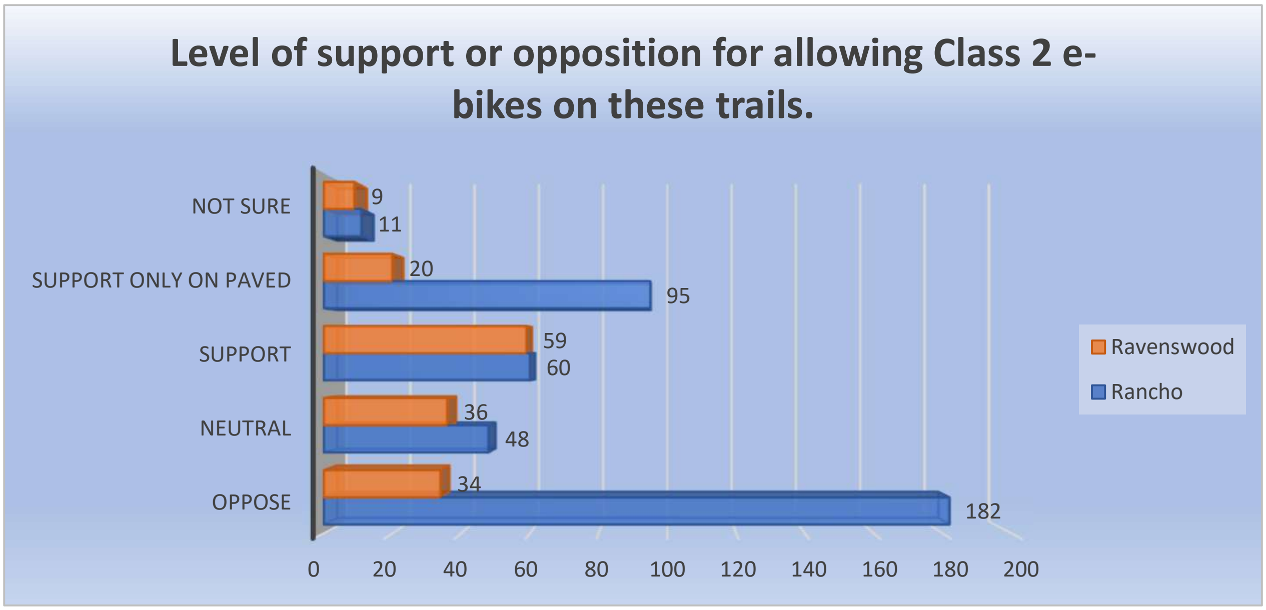
	Rancho	Ravenswood	TOTAL	% of Total
Belief	106	58	**164**	55.22%
Experience	83	50	**133**	44.78%
	189	108	**297**	

8. Thinking about Midpen's paved or improved multiuse trails, please indicate your level of support or opposition for allowing Class 2 e-bikes on these trails. As a reminder, Class 2 e-bikes provide electrical assistance regardless of pedaling, up to 20mph.

Appendix A

Paved Pilot Survey Results

	Rancho	Ravenswood	TOTAL	% of Total
Oppose	182	34	**216**	38.99%
Neutral	48	36	**84**	15.16%
Support	60	59	**119**	21.48%
Support Only On Paved	95	20	**115**	20.76%
Not Sure	11	9	**20**	3.61%
	396	158	**554**	



9. Please briefly explain why you answered that way.

	Rancho	Ravenswood	TOTAL
Access	45	46	**91**
Circumstantial	26	17	**43**
Erosion	2	0	**2**
Inactive/Not exercise	62	22	**84**
Indifference	45	18	**63**
No answer	9	6	**15**
Other	13	14	**27**
Safety	163	35	**198**
Segregate	32	0	**32**
	397	158	**555**

Appendix A

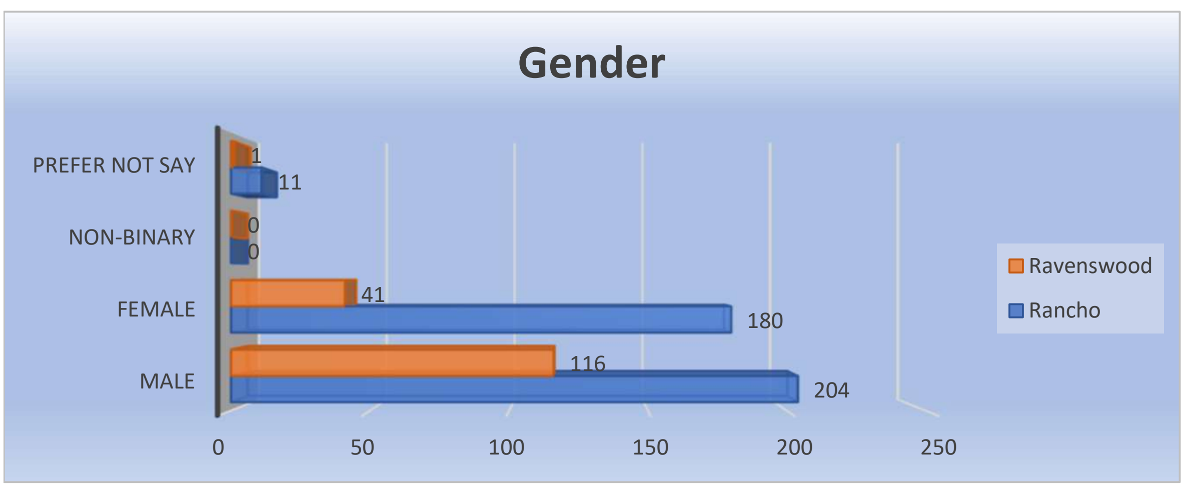
Paved Pilot Survey Results

9a. Is your response to the previous question based on an interaction (or experience) or general belief?

	Rancho	Ravenswood	TOTAL	% of Total
Belief	110	60	**170**	57.05%
Experience	80	48	**128**	42.95%
	190	108	**298**	

Demographics

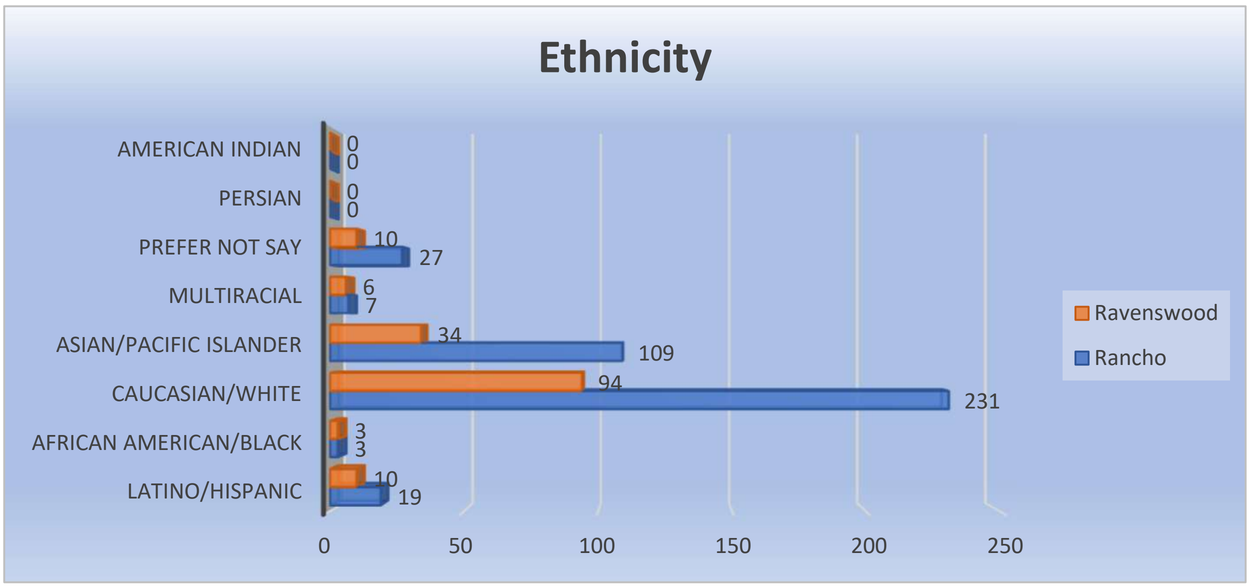
	Rancho	Ravenswood	TOTAL	% of Total
Male	204	116	**320**	57.87%
Female	180	41	**221**	39.96%
Non-binary	0	0	**0**	0.00%
Prefer not say	11	1	**12**	2.17%
	395	158	**553**	



Appendix A

Paved Pilot Survey Results

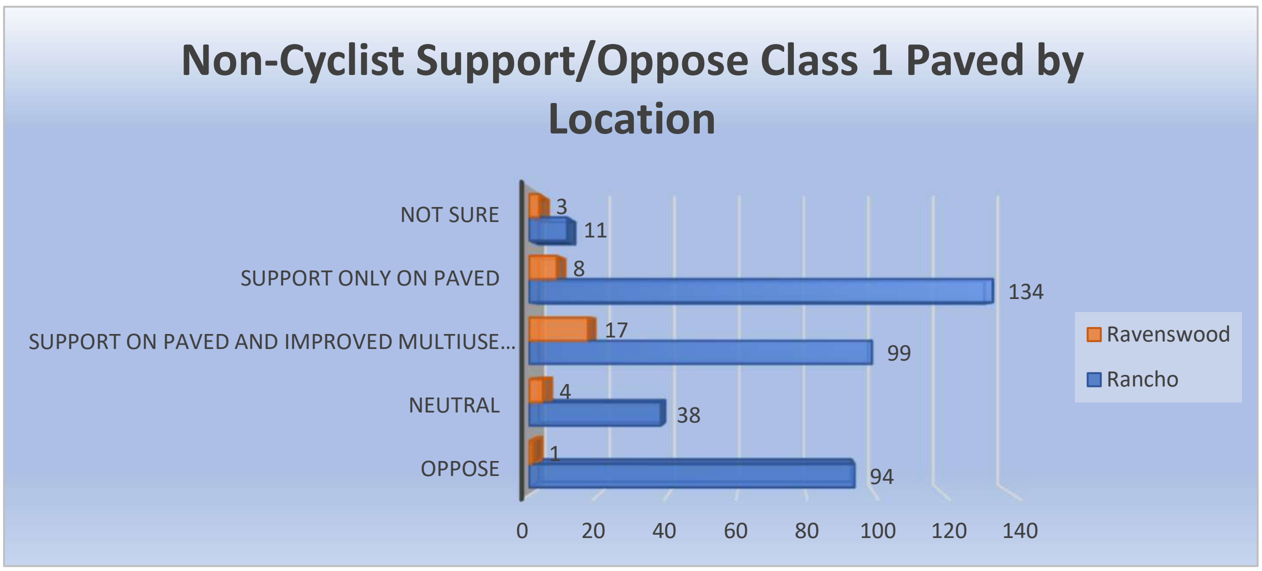
	Rancho	Ravenswood	TOTAL	% of Total
Latino/Hispanic	19	10	**29**	5.22%
African American/Black	3	3	**6**	1.08%
Caucasian/White	231	94	**325**	58.45%
Asian/Pacific Islander	109	34	**143**	25.72%
Multiracial	7	6	**13**	2.34%
Prefer Not Say	27	10	**37**	6.65%
Persian	0	0	**0**	0.00%
American Indian	0	0	**0**	0.00%
	396	157	553	

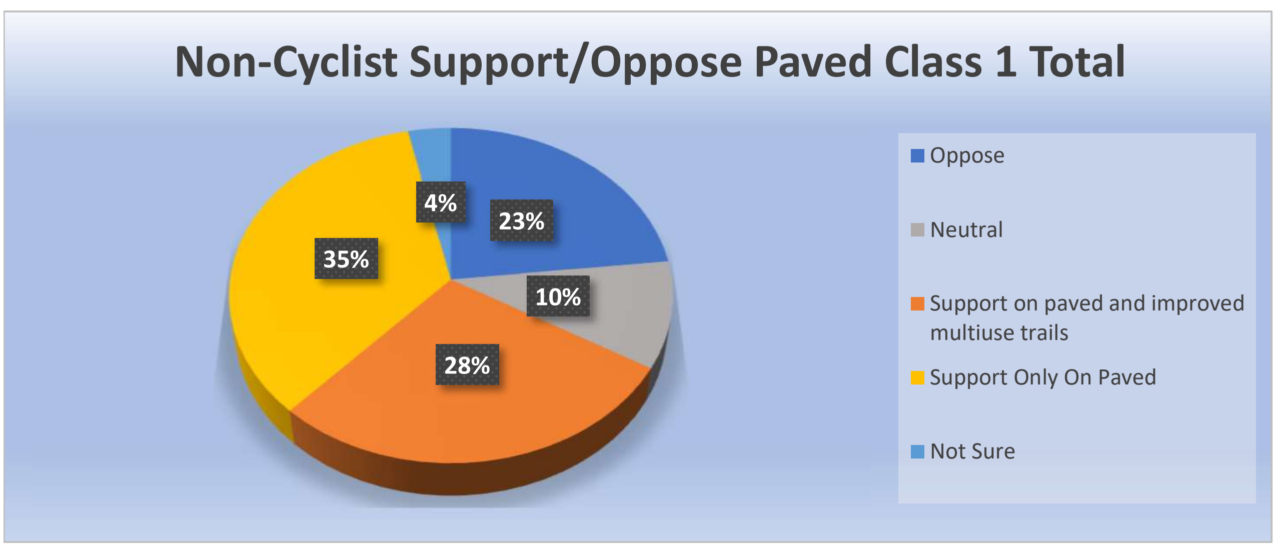


Appendix B

Non-Cyclist Opinion Paved

Non Cyclist Support/Oppose Class 1 Paved							
Rancho			Ravenswood			Total	% Total
Oppose	94	25.00%	Oppose	1	3.03%	95	23.23%
Neutral	38	10.11%	Neutral	4	12.12%	42	10.27%
Support on paved and improved multiuse trails	99	26.33%	Support on paved and improved multiuse trails	17	51.52%	116	28.36%
Support Only On Paved	134	35.64%	Support Only On Paved	8	24.24%	142	34.72%
Not Sure	11	2.93%	Not Sure	3	9.09%	14	3.42%
	376			33		409	

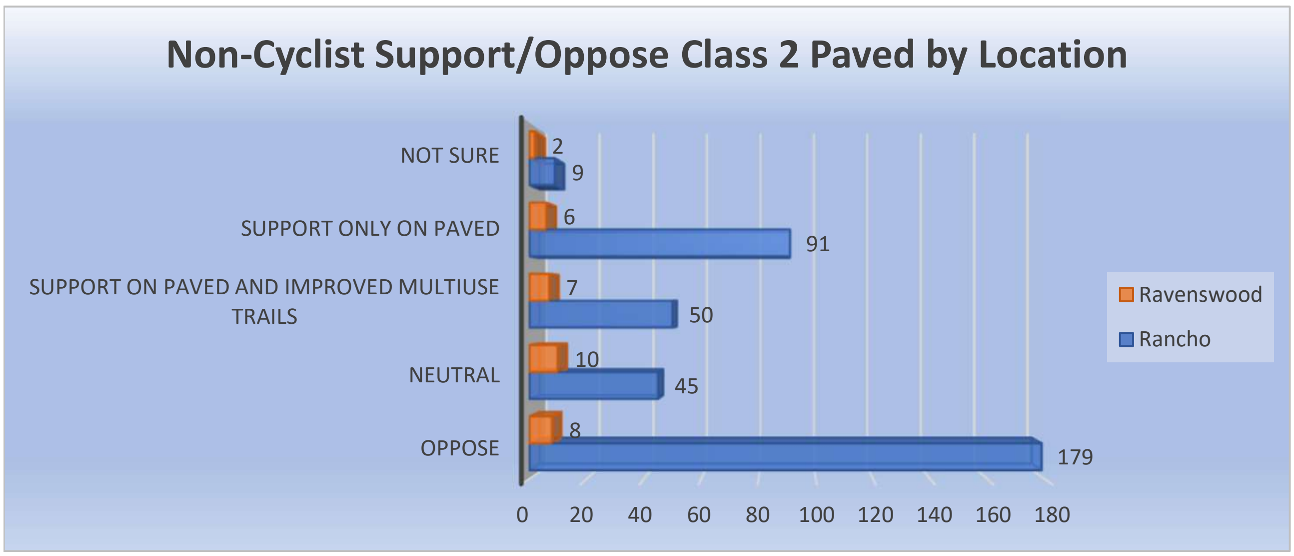


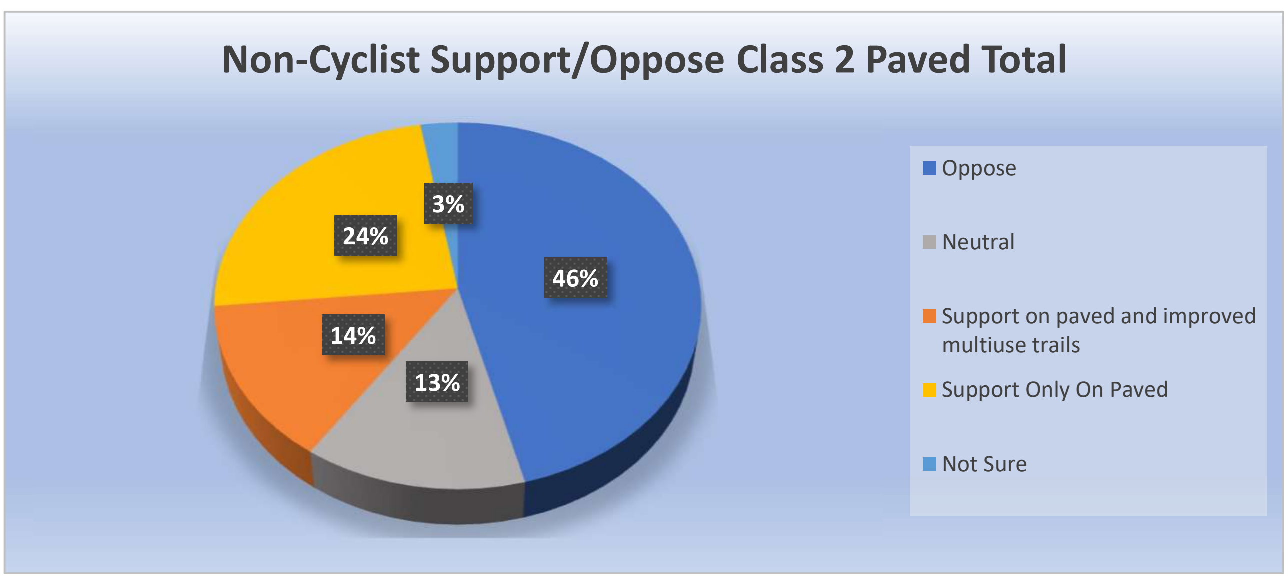


Appendix B

Non-Cyclist Opinion Paved

Non Cyclist Support/Oppose Class 2							
Rancho			Ravenswood			Total	% Total
Oppose	179	47.61%	Oppose	8	24.24%	187	45.95%
Neutral	45	11.97%	Neutral	10	30.30%	55	13.51%
Support on paved and improved multiuse trails	50	13.30%	Support	7	21.21%	57	14.00%
Support Only On Paved	91	24.20%	Support Only On Paved	6	18.18%	97	23.83%
Not Sure	9	2.39%	Not Sure	2	6.06%	11	2.70%
	374			33		407	



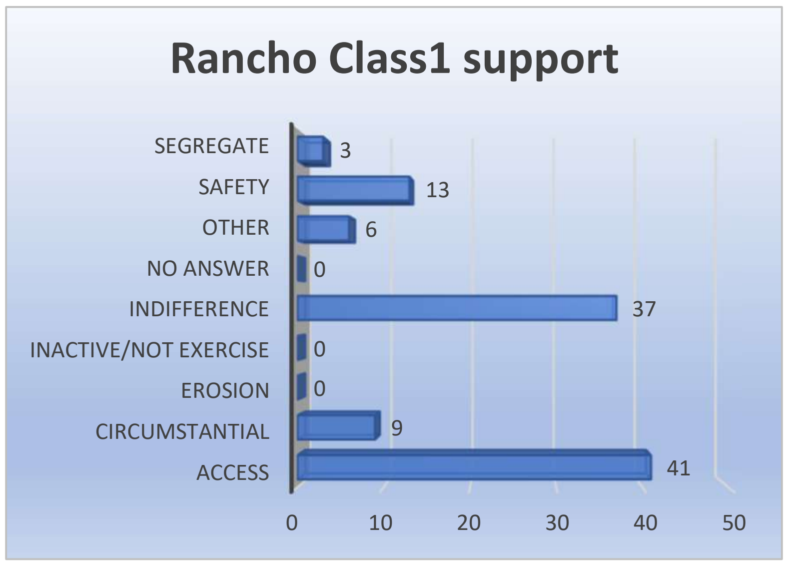


Appendix C

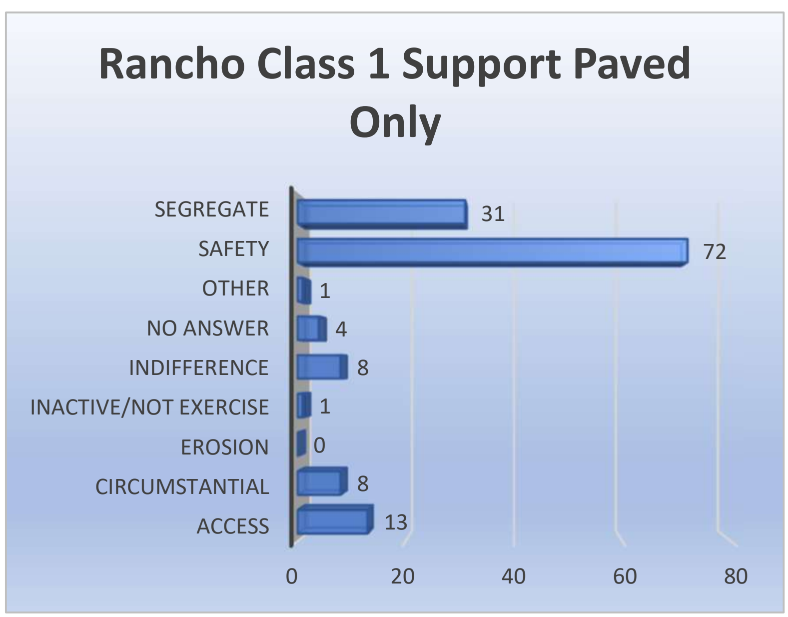
Opinion By Sentiment Paved Pilot

Categories	Common Respondent Answers
Safety	Speed concerns, Overcrowding, Poor trail etiquette, Reckless behavior, etc.
Circumstantial	Only on wide trails, Only if bikes are already allowed, If trail rules are followed, etc.
Access	Allows older people ride, Allows more people to share preserve, Gets more people on the preserve, etc.
Inactive	Not exercise, No effort involved, They are not earning it, etc.
Erosion	Less bikes less damage, Trail damage, etc.
Segregate	As long as they are separate from other users, Keep bikes away from hikers, etc.
Dislike	Don't like motorized vehicles in preserve, Do not like e-bikes, etc.
Indifference	Don't bother me, Same as a regular bike, Never had an issue, etc.
Other	Will start fires, Too much like a Harley, Are motorcycles, etc.

Rancho Class 1 Support	
Access	41
Circumstantial	9
Erosion	0
Inactive/Not exer	0
Indifference	37
No answer	0
Other	6
Safety	13
Segregate	3
	109



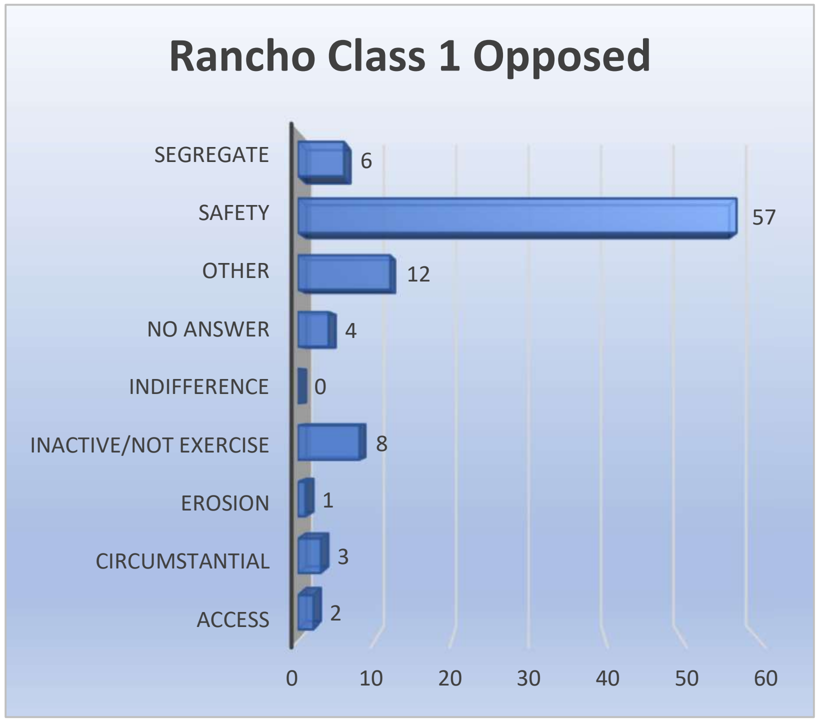
Rancho Class 1 Support Paved Only	
Access	13
Circumstantial	8
Erosion	0
Inactive/Not exer	1
Indifference	8
No answer	4
Other	1
Safety	72
Segregate	31
	138



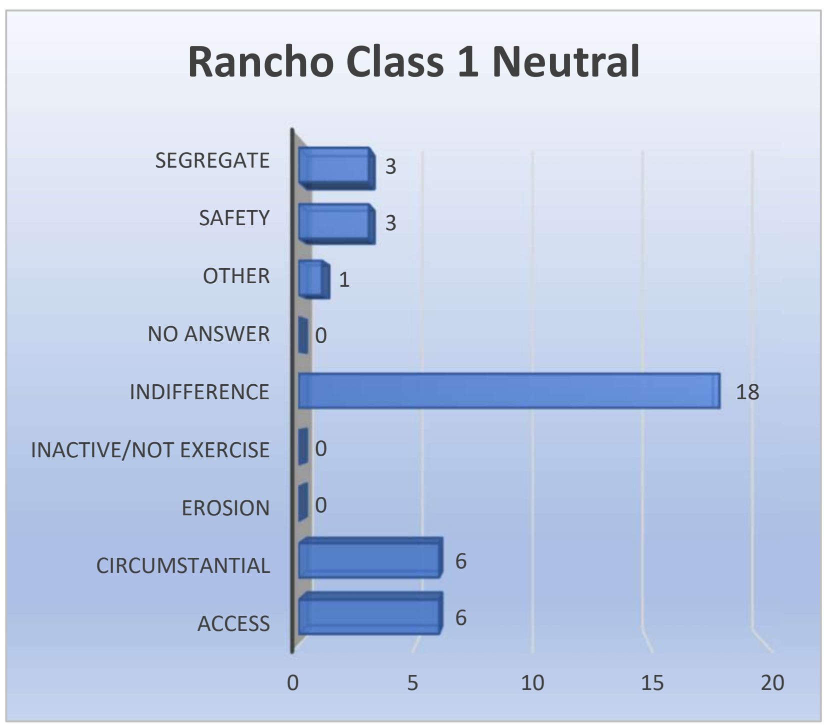
Appendix C

Opinion By Sentiment Paved Pilot

Ramcho Class 1 Opposed	
Access	2
Circumstantial	3
Erosion	1
Inactive/Not exe	8
Indifference	0
No answer	4
Other	12
Safety	57
Segregate	6
	93



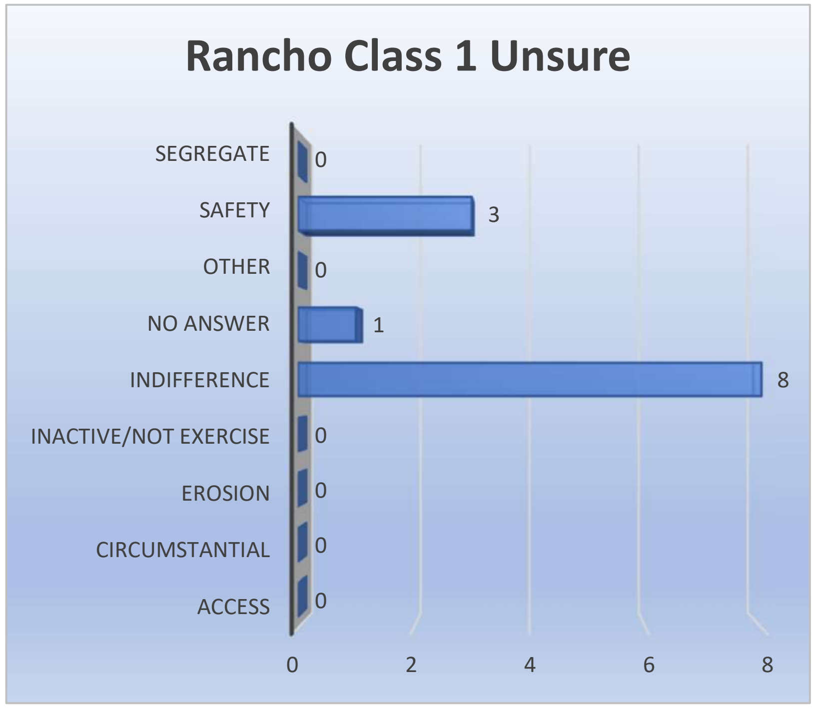
Rancho Class 1 Neutral	
Access	6
Circumstantial	6
Erosion	0
Inactive/Not exe	0
Indifference	18
No answer	0
Other	1
Safety	3
Segregate	3
	37



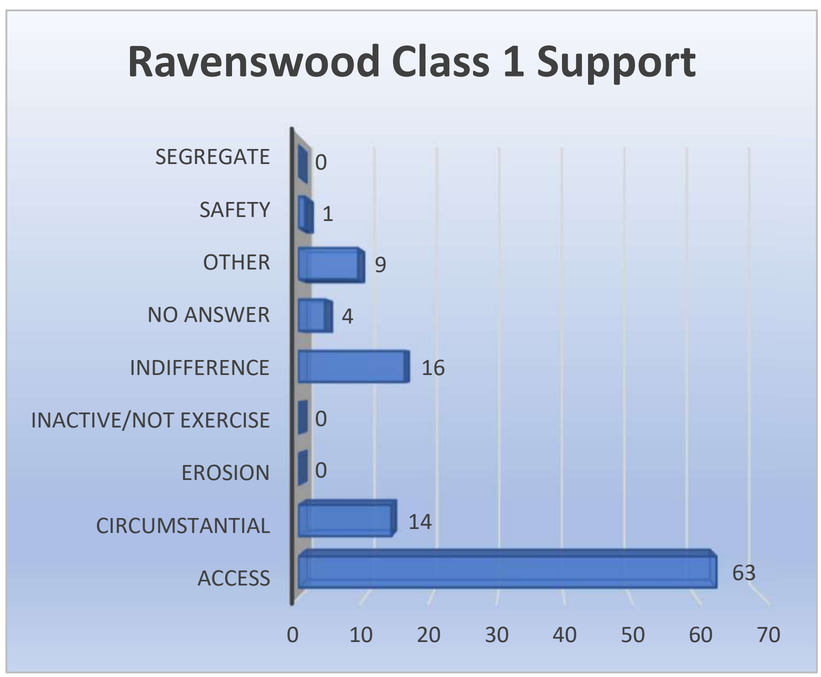
Appendix C

Opinion By Sentiment Paved Pilot

Rancho Class 1 Unsure	
Access	0
Circumstantial	0
Erosion	0
Inactive/Not exe	0
Indifference	8
No answer	1
Other	0
Safety	3
Segregate	0
	12



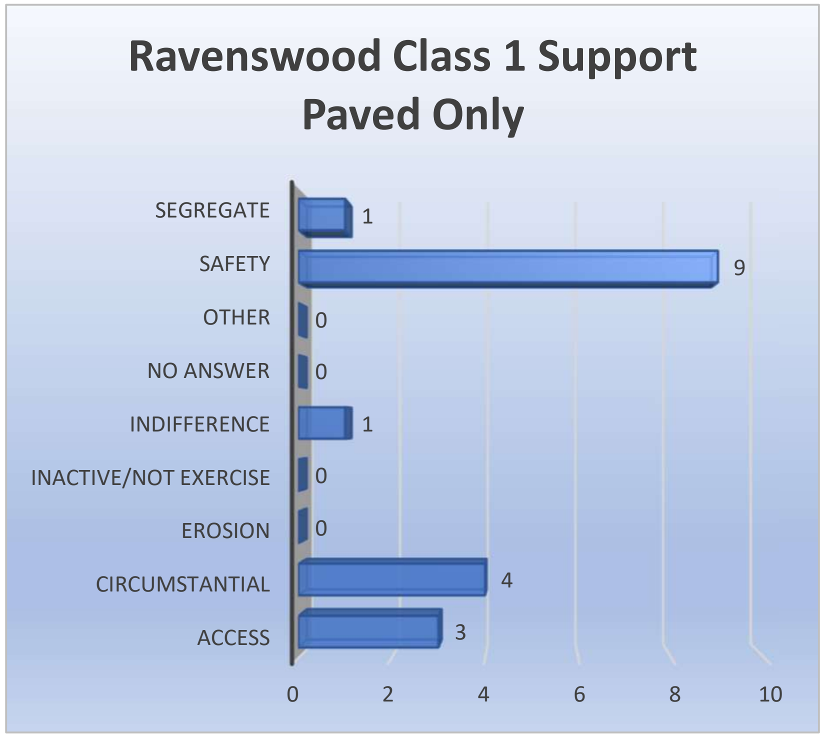
Ravenswood Class1 Support	
Access	63
Circumstantial	14
Erosion	0
Inactive/Not exe	0
Indifference	16
No answer	4
Other	9
Safety	1
Segregate	0
	107



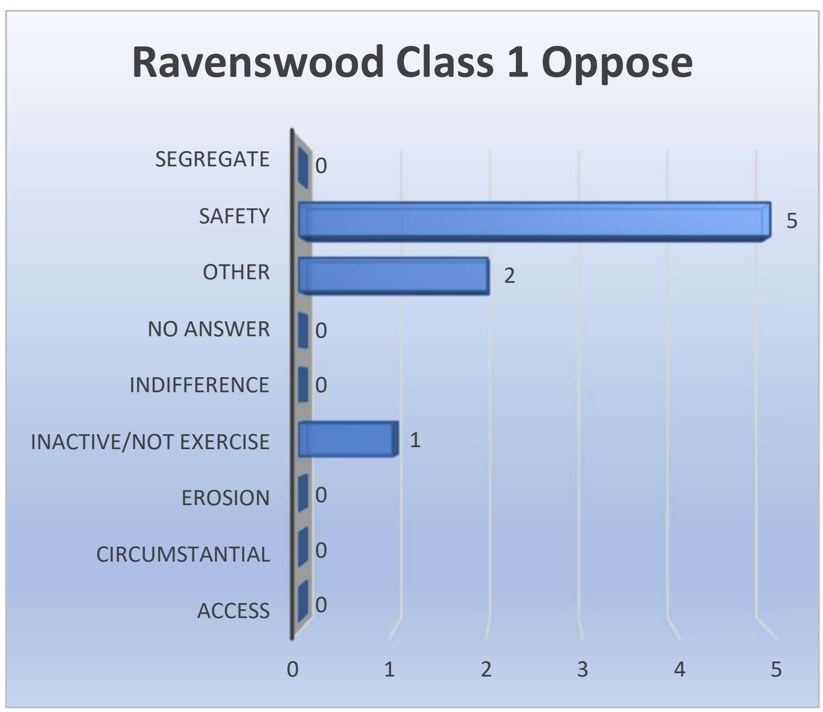
Appendix C

Opinion By Sentiment Paved Pilot

Ravenswood Class 1 Support Paved Only	
Access	3
Circumstantial	4
Erosion	0
Inactive/Not exe	0
Indifference	1
No answer	0
Other	0
Safety	9
Segregate	1
	18



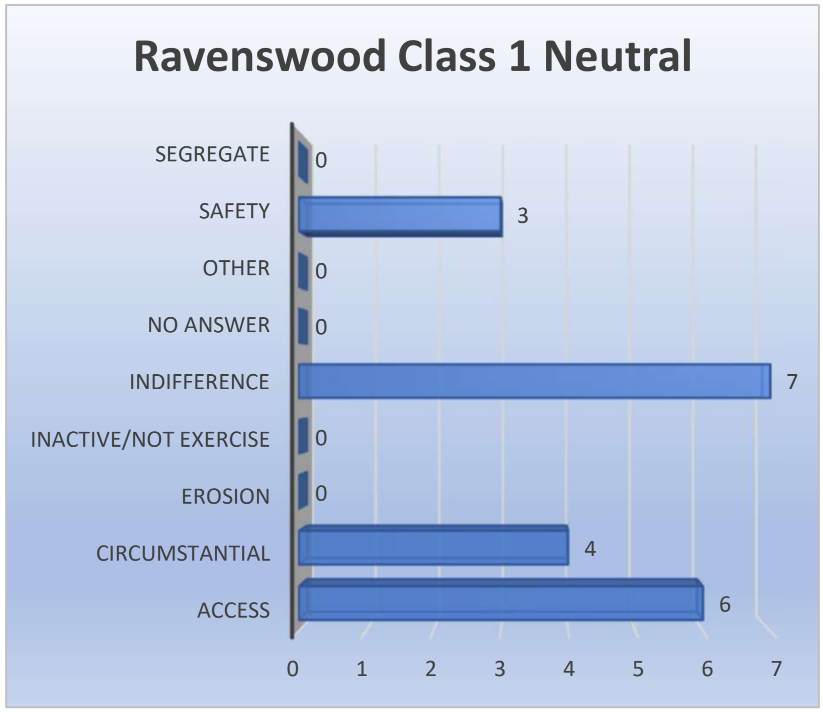
Ravenswood Class 1 Oppose	
Access	0
Circumstantial	0
Erosion	0
Inactive/Not exe	1
Indifference	0
No answer	0
Other	2
Safety	5
Segregate	0
	8



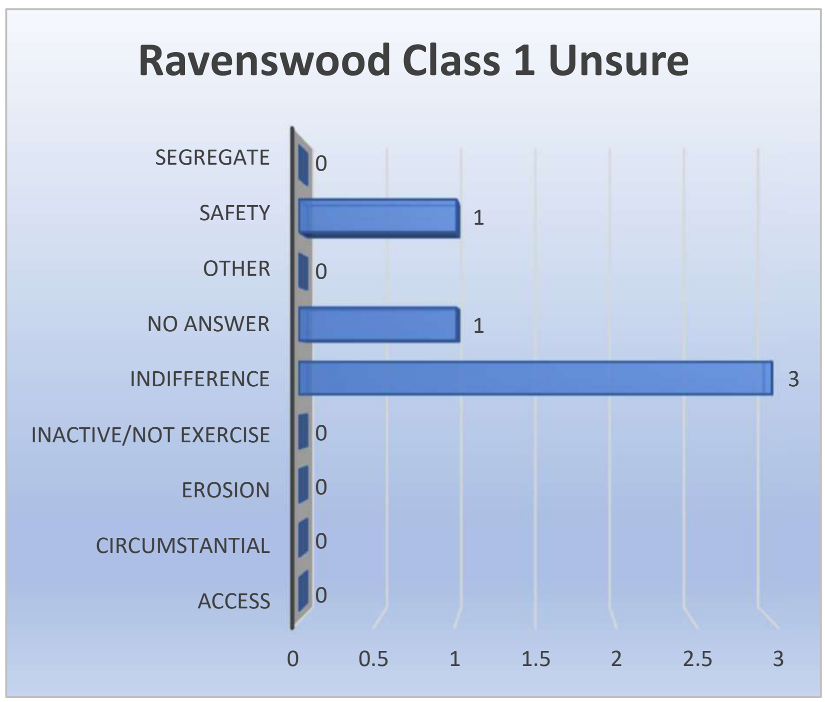
Appendix C

Opinion By Sentiment Paved Pilot

Ravenswood Class 1 Neutral	
Access	6
Circumstantial	4
Erosion	0
Inactive/Not exer	0
Indifference	7
No answer	0
Other	0
Safety	3
Segregate	0
	20



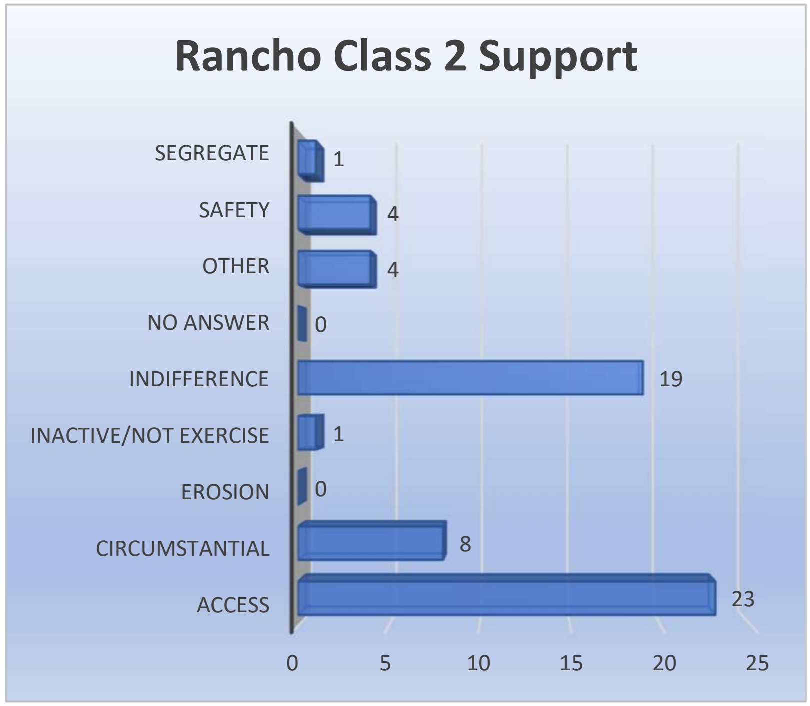
Ravenswood Class 1 Unsure	
Access	0
Circumstantial	0
Erosion	0
Inactive/Not exer	0
Indifference	3
No answer	1
Other	0
Safety	1
Segregate	0
	5



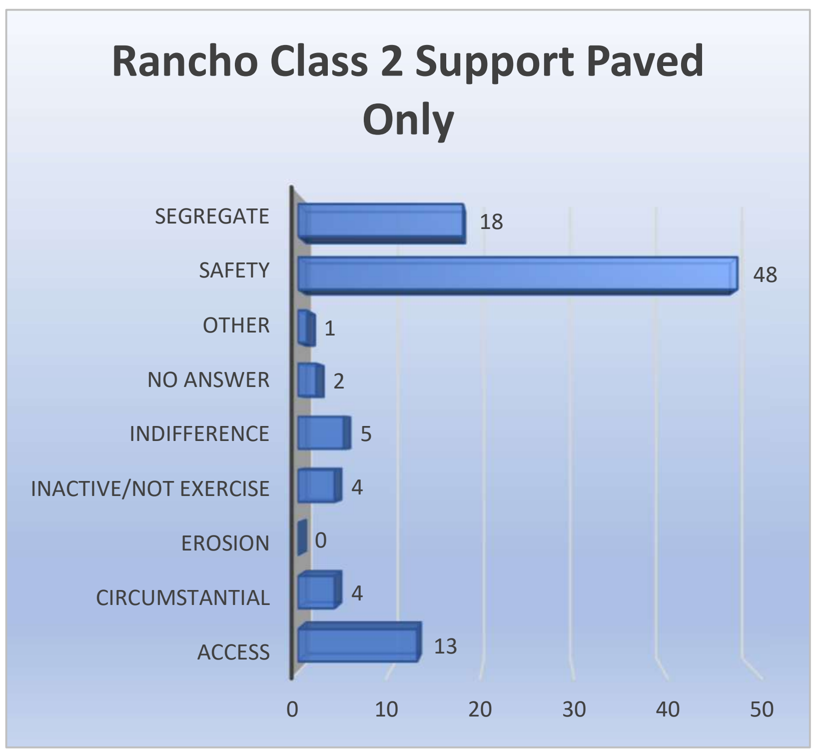
Appendix C

Opinion By Sentiment Paved Pilot

Rancho Class 2 Support	
Access	23
Circumstantial	8
Erosion	0
Inactive/Not exer	1
Indifference	19
No answer	0
Other	4
Safety	4
Segregate	1
	60



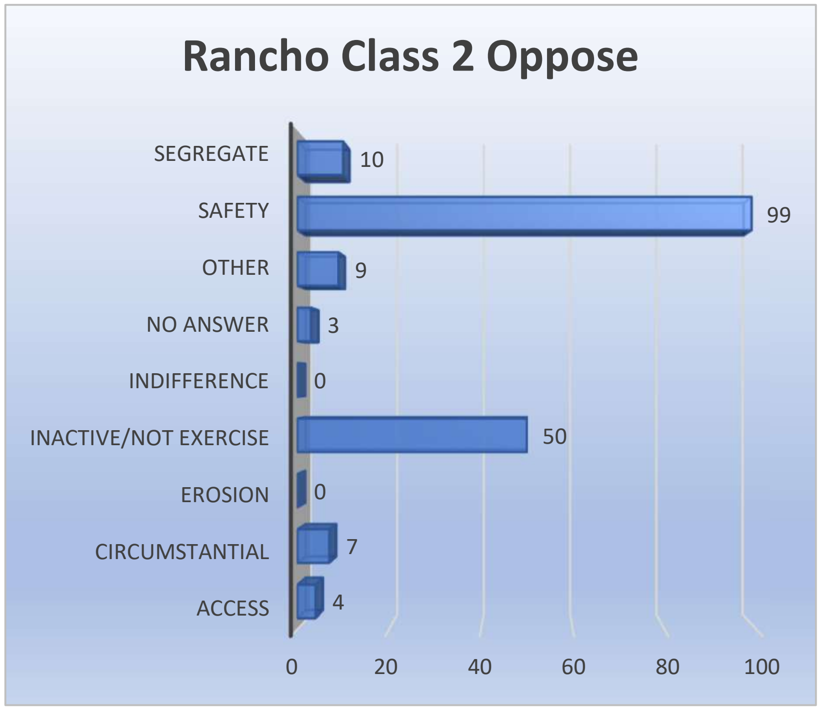
Rancho Class 2 Support Paved Only	
Access	13
Circumstantial	4
Erosion	0
Inactive/Not exercise	4
Indifference	5
No answer	2
Other	1
Safety	48
Segregate	18
	95



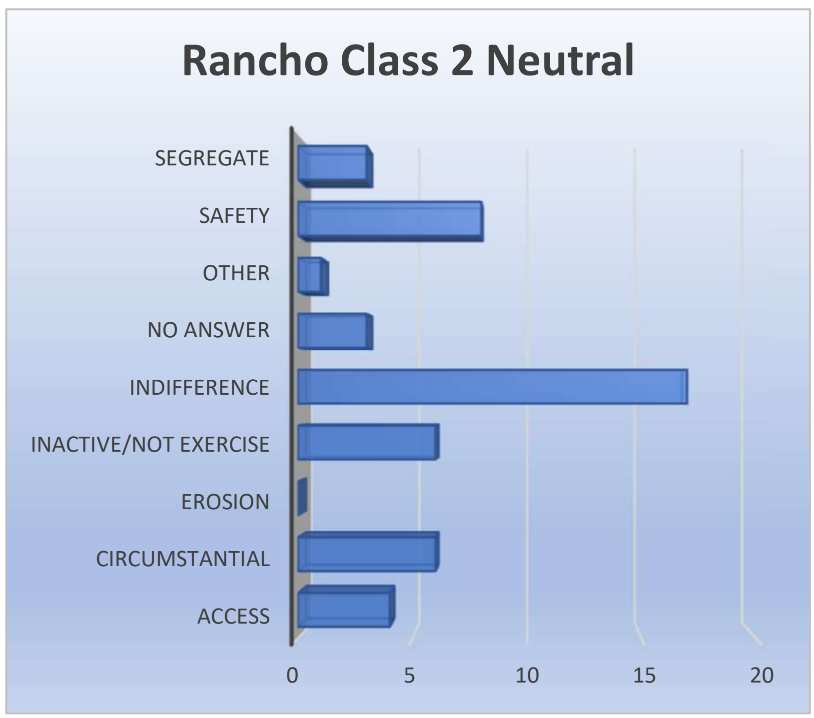
Appendix C

Opinion By Sentiment Paved Pilot

Rancho Class 2 Oppose	
Access	4
Circumstantial	7
Erosion	0
Inactive/Not exe	50
Indifference	0
No answer	3
Other	9
Safety	99
Segregate	10
	182



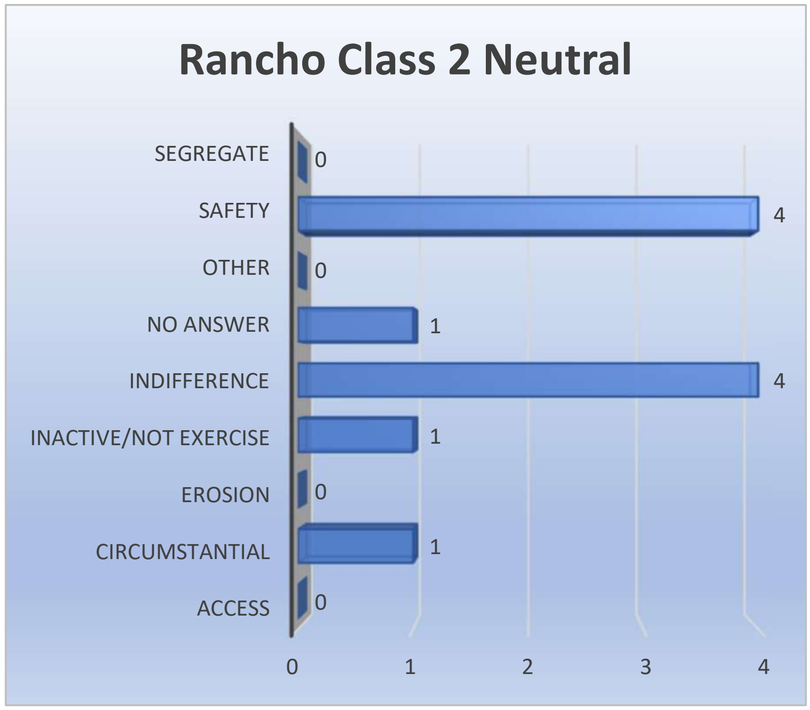
Rancho Class 2 Neutral	
Access	4
Circumstantial	6
Erosion	0
Inactive/Not exe	6
Indifference	17
No answer	3
Other	1
Safety	8
Segregate	3
	48



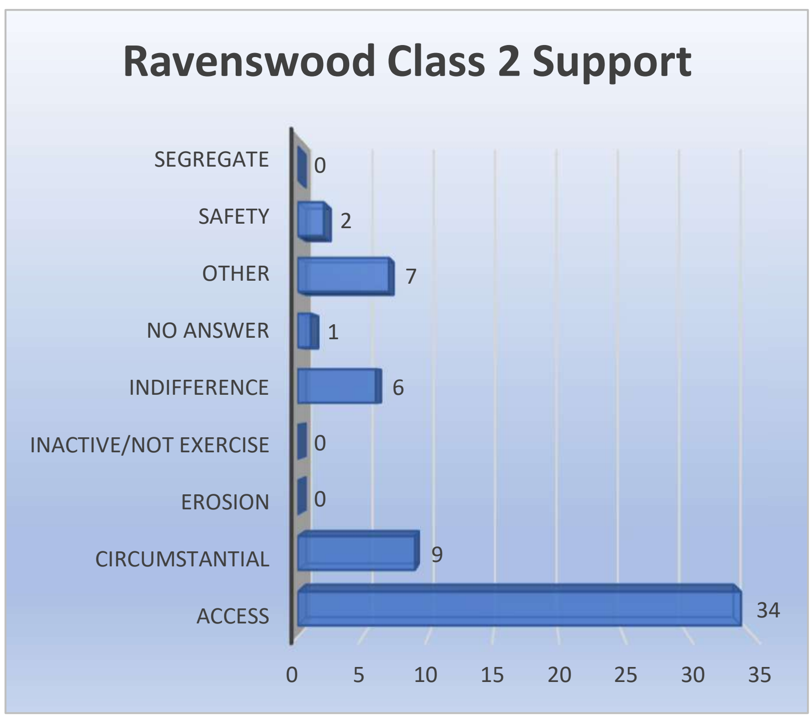
Appendix C

Opinion By Sentiment Paved Pilot

Rancho Class 2 Unsure	
Access	0
Circumstantial	1
Erosion	0
Inactive/Not exer	1
Indifference	4
No answer	1
Other	0
Safety	4
Segregate	0
	11



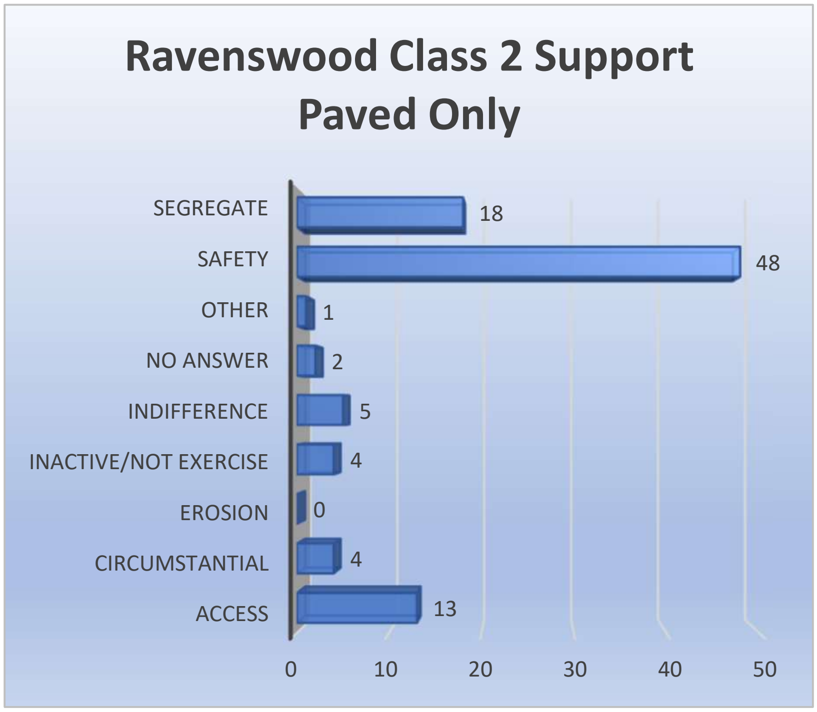
Ravenswood Class 2 Support	
Access	34
Circumstantial	9
Erosion	0
Inactive/Not exer	0
Indifference	6
No answer	1
Other	7
Safety	2
Segregate	0
	59



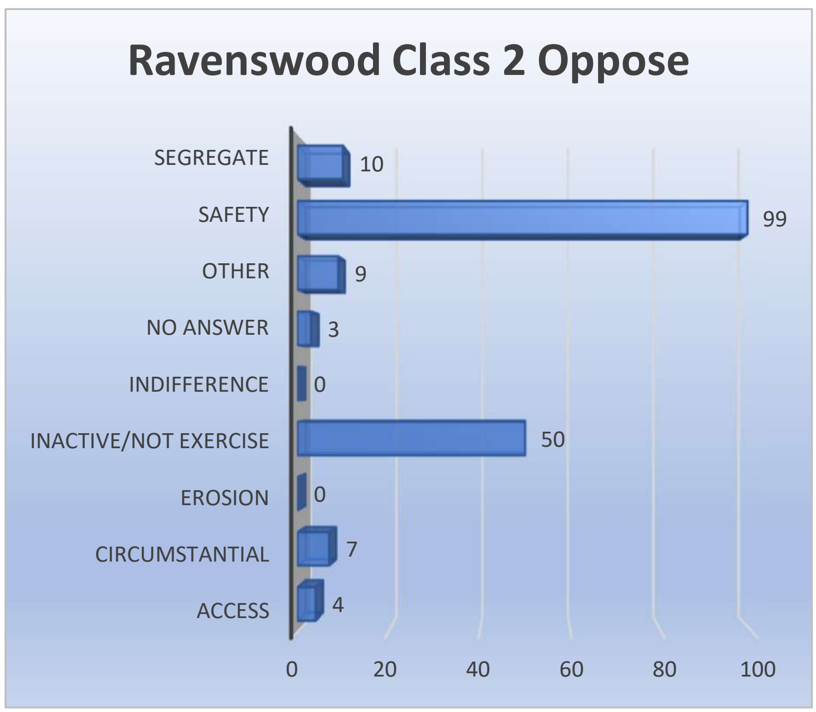
Appendix C

Opinion By Sentiment Paved Pilot

Ravenswood Cl 2 Spprt Paved Only	
Access	2
Circumstantial	2
Erosion	0
Inactive/Not exe	2
Indifference	2
No answer	0
Other	0
Safety	12
Segregate	0
	20



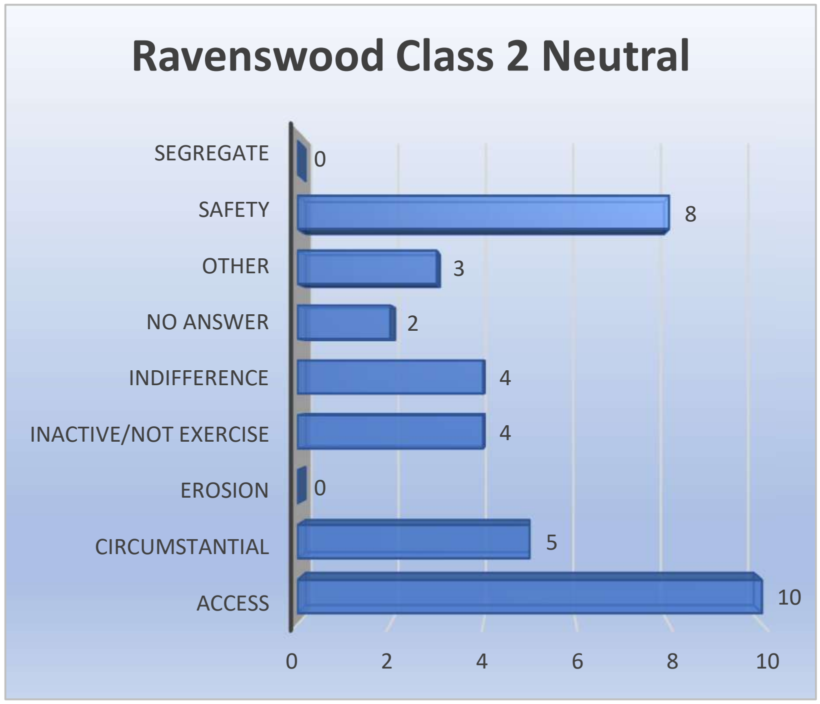
Ravenswood Class 2 Oppose	
Access	0
Circumstantial	1
Erosion	0
Inactive/Not exe	15
Indifference	1
No answer	2
Other	4
Safety	11
Segregate	0
	34



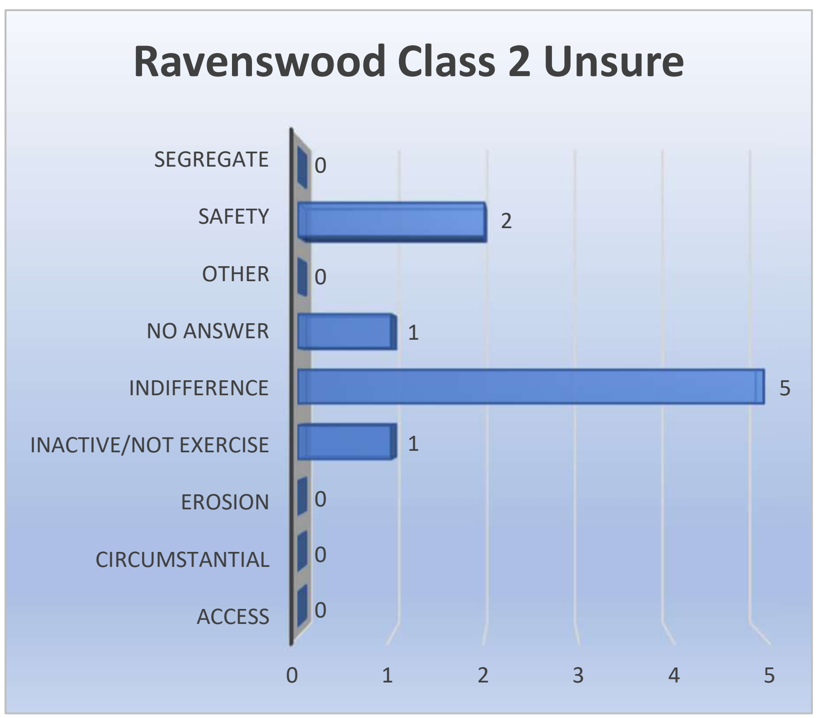
Appendix C

Opinion By Sentiment Paved Pilot

Ravenswood Class 2 Neutral	
Access	10
Circumstantial	5
Erosion	0
Inactive/Not exe	4
Indifference	4
No answer	2
Other	3
Safety	8
Segregate	0
	36



Ravenswood Class 2 Unsure	
Access	0
Circumstantial	0
Erosion	0
Inactive/Not exe	1
Indifference	5
No answer	1
Other	0
Safety	2
Segregate	0
	9



Appendix D

Observational Data Paved Pilot

Rancho San Antonio

Number of e-bikes	Totals	Percent of Total Bikes
Class 1	27	3.86%
Class 2	16	2.29%
Class 3	1	0.14%
Modified	0	0.00%
	44	6.29%

Number of analog bikes		
Counts	655	93.71%
	655	93.71%

E Bike Behavior		
Speeding	3	6.82%
Passing to Fast	1	2.27%
Rude Behavior	0	0.00%
Neg Interaction	0	0.00%
	4	9.09%

Analog Bike Behavior		
Speeding	38	5.80%
Passing to Fast	4	0.61%
Rude Behavior	1	0.15%
Neg Interaction	0	0.00%
	43	6.56%

Wildlife Type and Quantity	
Deer	44
Turkey	89
Rodents	30
Birds	8
Lizard	0
coyote	0
turkey vulture	0
	171

Wildlife Actions	
Fled	
No Reaction	46
Minimal Reaction	
	46

Ravenswood

Number of e-bikes	Totals	Percent of Total Bikes
Class 1	17	2.72%
Class 2	5	0.80%
Class 3	8	1.28%
Modified	0	0.00%
	30	4.79%

Number of analog bikes		
Counts	596	95.21%
	596	95.21%

E Bike Behavior		
Speeding	0	0.00%
Passing to Fast	0	0.00%
Rude Behavior	0	0.00%
Neg Interaction	0	0.00%
	0	0.00%

Analog Bike Behavior		
Speeding	4	0.67%
Passing to Fast	1	0.17%
Rude Behavior	0	0.00%
Neg Interaction	0	0.00%
	5	0.84%

Wildlife Type and Quantity	
Deer	0
Turkey	0
Rodents	0
Birds	43
lizard	0
Coyote	0
Turkey Vulture	0
	43

Wildlife Actions	
Fled	0
No Reaction	0
Minimal Reaction	0
	0

Paved Total

Total	Percent of Total Bikes
44	3.32%
21	1.58%
9	0.68%
0	0.00%
74	5.58%

Total Number of Analog Bikes	
1251	94.42%
1251	94.42%

Total E-Bike Behavior	
3	4.05%
1	1.35%
0	0.00%
0	0.00%
4	5.41%

Total Analog Bike Behavior	
42	3.36%
5	0.40%
1	0.08%
0	0.00%
48	3.84%

Wildlife Totals	
Deer	44
Turkey	89
Rodents	30
Birds	51
Lizards	0
Coyote	0
Turkey Vulture	0
	214

Wildlife Actions Total	
Fled	0
No Reaction	46
Minimal Reaction	0
	46

Midpeninsula Regional
Open Space District

Attachment 2

Unpaved Trails - E-bike Intercept Survey Study

BACKGROUND

During the December 7, 2020 Midpeninsula Regional Open Space District (District) Board of Directors (Board) retreat, while discussing potential focus areas for Fiscal Year 2021-22 (FY22), multiple Board members requested that the General Manager present options to study e-bike use on unimproved/unpaved trails typical of District trails. On January 27, 2021(R-21-13) (minutes) the Board approved reducing the scale of the Paved Pilot Program (refer to Attachment 1) to release staff capacity to partner with a local agency to conduct intercept surveys and complete observation reports on trails that are a good proxy for District trails where e-bikes are already permitted. This document describes the results of the study requested by the Board.

DISCUSION

Intercept Surveys

The General Manager selected Santa Clara County Parks as the partner agency to use for the study since they allow e-bikes and their visitor use and trail types are the closest proxy to District preserves and trails. Santa Clara County Parks have allowed Class 1 and 2 e-bikes on all paved and unpaved bicycle trails and pathways, including on approximately 150 miles of unpaved multi-use trails since 2017.

Two specific trails/locations were chosen for the study that closely resemble District trails in environment, use type, and visitation levels. The first location was the junction of the Lisa Killough Trail, Cottle Trail, and North Ridge Trail within the Rancho San Vicente portion of Calero County Park. These three trails are heavily used multi-use trails. Equestrians, hikers, dog walkers, and bicyclists use these trails, which compares well to the District's Fremont Older Preserve. The second location was along the John Nicholas Trail in Sanborn County Park. This trail is narrow, heavily used by bicyclists, hikers, dog walkers, and occasionally equestrians, and is a segment of the Bay Area Ridge Trail. This trail is similar to segments of the Bay Area Ridge Trail on District preserves.

A total of 1186 intercept surveys and observation reports were conducted from July 1, 2021 through October 31, 2021. Staff conducted 746 surveys at the Rancho San Vicente location over 17 days for a total of 66.5 hours. Staff conducted 440 surveys at Sanborn over 20 days for a total of 76.3 hours.

The survey consisted of 10 questions designed to gauge the level of support or opposition for allowing access to Class 1 e-bikes on unpaved/unimproved multi-use trails and to gauge the types and frequency of user conflicts between e-bike users and other trail users. The first question recorded the activity they were participating in that day to allow cross referencing the other answers with the respondent's activity. (Appendix A provides a copy of the survey questions).

During these intercept surveys, observational data was also collected. The data collected focused on how many e-bikes and regular bikes were observed, the behavior of both types of riders, and the wildlife observed in the area and their reactions, if any, to e-bike use (the details of the observational data results are provided in Appendix D).

Surveys Results

The data recorded from the unpaved intercept surveys was cross analyzed to look at differences in responses based on various factors. Appendix A includes the survey results for each question. The first five questions collected information on what the respondent was doing at the time of the survey and how familiar they were with e-bikes. The questions also asked about any incidents or conflicts they may have experienced with other visitor groups. Below is a summary of the key results:

- The most common activity of respondents was bicycling (70%) followed by walking (16%).
- 35% of respondents had previously ridden an e-bike.
- 50% of respondents said they saw e-bikes on the trails on the day of the survey.
- 5% (62 of 1186 with 6 non-responses) of respondents reported having a conflict with another user group; of these, 57 were with bicyclists of which 14 were e-bikes. There were an additional 5 conflicts that were not with bicyclists.

Below is information pulled from the data that looks deeper into the responses, grouping information by user group/activity and by level of support/opposition.

Level of Support or Opposition

Question 6 of the unpaved trail survey asked respondents for their level of support or opposition for Class 1 e-bikes on unpaved trails with Figure 1 showing the results. The majority of respondents (57%) support Class 1 e-bike access on unpaved trails, while 16% were opposed to class 1 e-bikes.

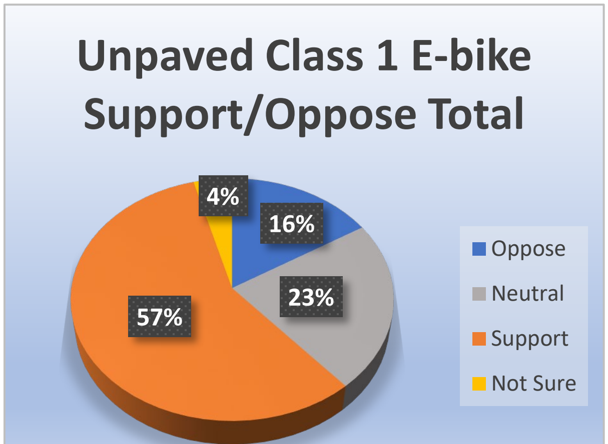


Figure 1

Figure 2 shows the responses from non-cyclists (walkers, runners, and equestrians). Of this group, the percentage of support for Class 1 e-bikes on unpaved trails decreases to 40%. Opposition to Class 1 e-bikes rises to 26%. Appendix B provides a breakdown of this information by survey location and totals.

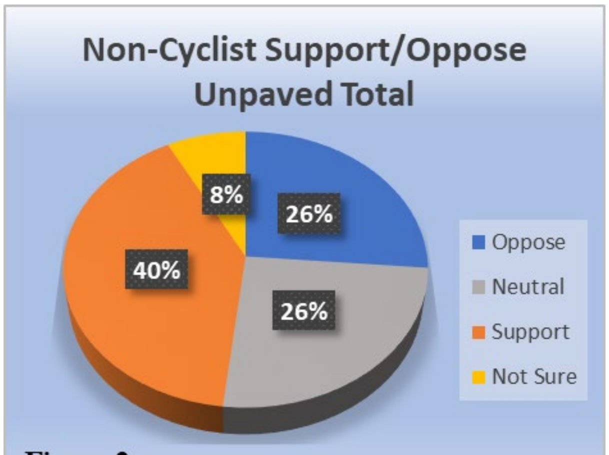


Figure 2

Reasons for Support or Opposition

Question 7 asked respondents to give reasons as to why they support or oppose e-bikes. Staff sorted the responses into nine general categories: Safety, Circumstantial, Access, Inactive, Erosion, Segregate, Dislike, Indifference, and Other. Common answers under each category are provided below.

Categories	Common Respondent Answers
Safety	Speed concerns, Overcrowding, Poor trail etiquette, Reckless behavior, etc.
Circumstantial	Only on wide trails, Only if bikes are already allowed, If trail rules are followed, etc.
Access	Allows older people ride, Allows more people to share preserve, Gets more people on the preserve, etc.
Inactive	Not exercise, No effort involved, They are not earning it, etc.
Erosion	Less bikes less damage, Trail damage, etc.
Segregate	As long as they are separate from other users, Keep bikes away from hikers, etc.
Dislike	Don't like motorized vehicles in preserve, Do not like e-bikes, etc.
Indifference	Don't bother me, Same as a regular bike, Never had an issue, etc.
Other	Will start fires, Too much like a Harley, Are motorcycles, etc.

Figure 3 depicts the total responses at each survey site grouped by the reasons given in support or opposition to Class 1 e-bikes on multi-use/unpaved trails. Access and safety were the primary reasons respondents either supported or opposed e-bike access.

Figure 3

Appendix C contains a breakdown of the reasons provided by each respondent by support or opposition. Figure 4 below shows the combined results for respondents who support Class 1 e-bike use on multi-use/unpaved trails from each survey location. Those who support e-bike access cited "access to trails" as the reason.

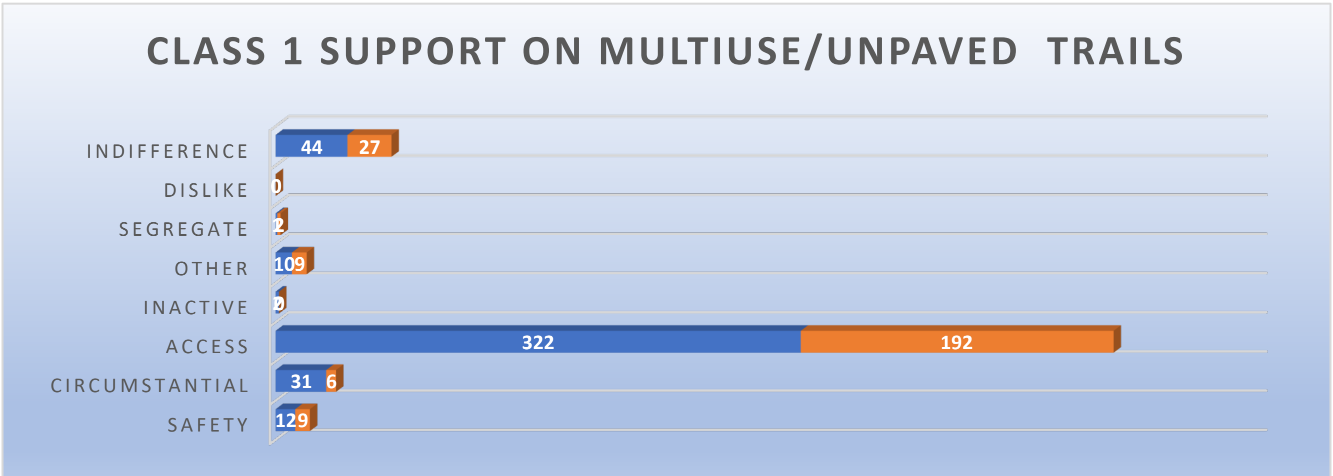


Figure 4

Figure 5 breaks the data down further to look specifically at responses by non-cyclists who support Class 1 e-bike use. Most primarily attribute their support to access.

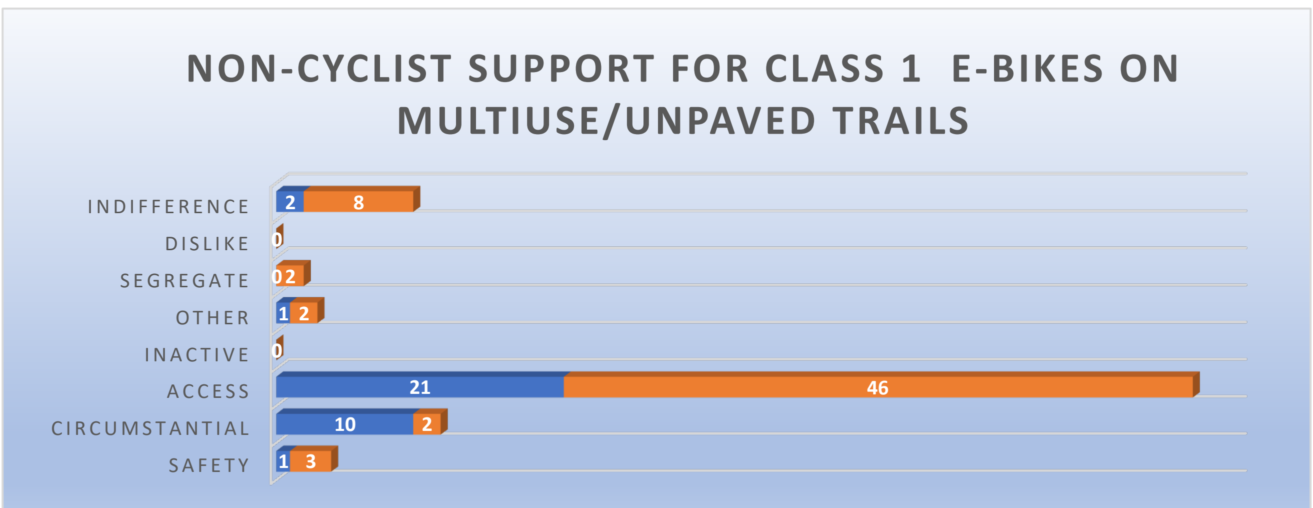


Figure 5

Safety is the most frequent reason given for opposing e-bike access on trails. This is true for all respondents, both for cyclists and non-cyclists. 44% of 185 respondents opposing Class1 e-bikes on multi-use/unpaved trails were cyclists. Figure 6 below gives a break down by reason for all respondents who oppose Class 1 on unpaved trails.

Looking at respondent reasons within the safety category, speed stood out as a common factor. Out of the 123 respondents whose answers fell in the safety category, 64 or 52%, mentioned speed as a factor. Another 24 or 20% of respondents who cited safety concerns mentioned trail etiquette as a reason for opposing Class 1 e-bikes on multi-use/unpaved trails.

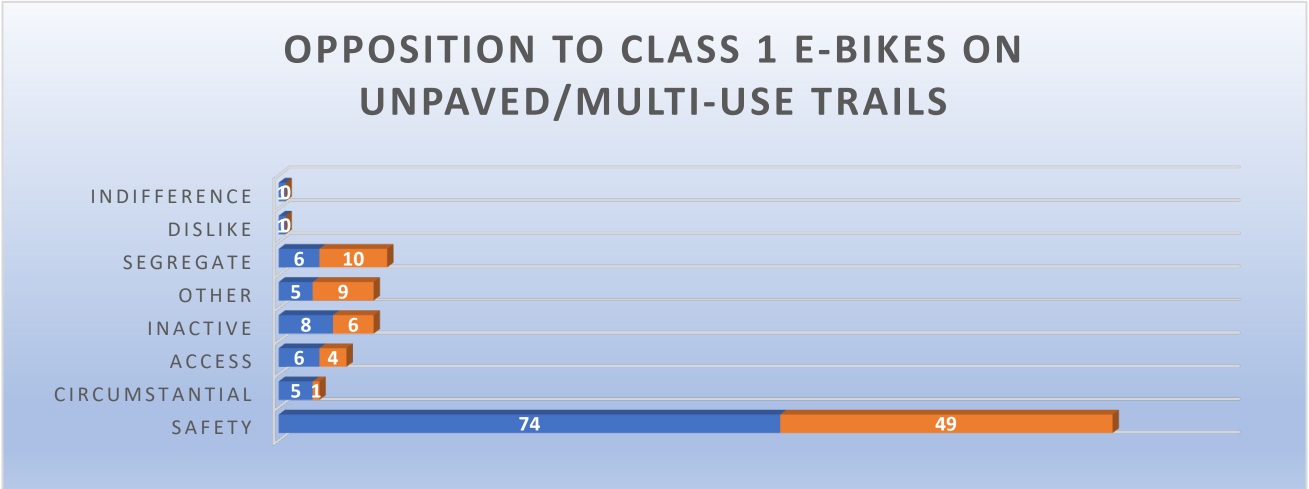


Figure 6

The largest categorical reason for non-cyclist who oppose Class 1 e-bikes on unpaved trails is safety at 59%. Figure 7 gives a break down by reason for all non-cyclist who oppose class 1 on unpaved trails.

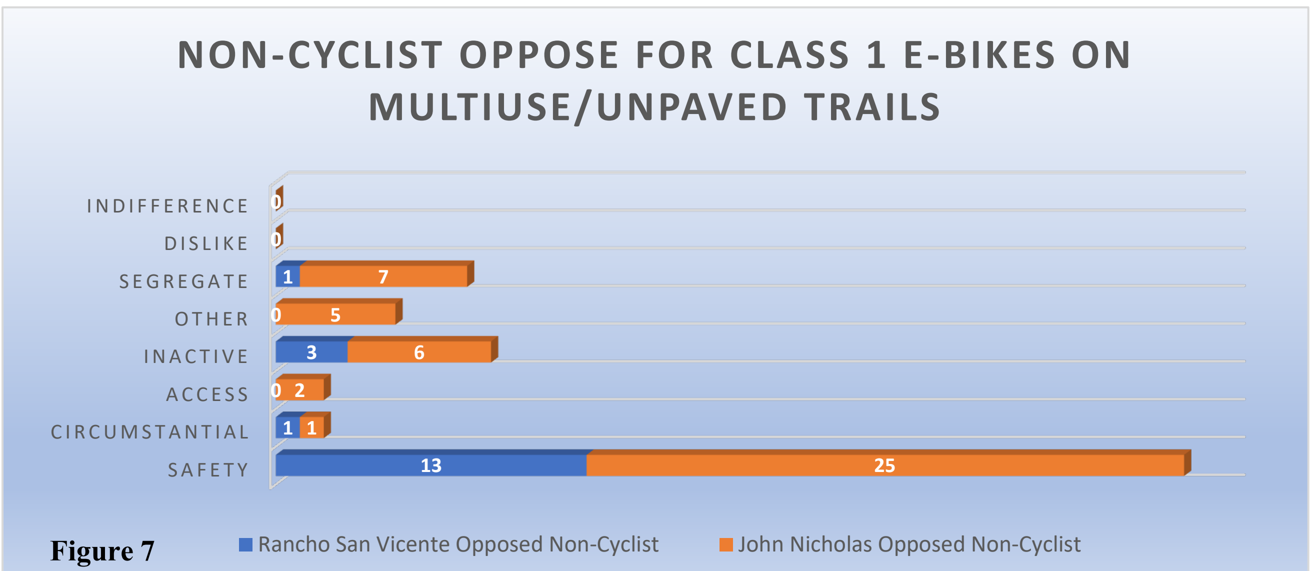


Figure 7

Observational Data

During each survey period, one staff member was recording observational data of the surrounding area. This data focused on the number of bikes and whether they were regular bikes or e-bikes. Other collected data recorded the behavior of those riding each type of bike. Wildlife was also observed and recorded, as well as their behavior in reaction, if any, to a bike passing by them. This data can be found in Appendix D.

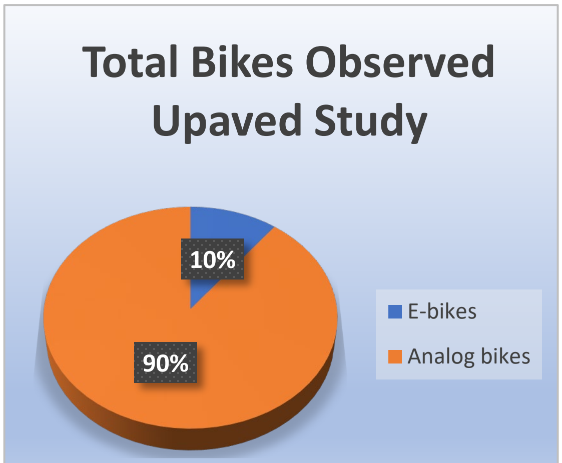


Figure 8

Observational data shows that e-bikes comprised 10% of all bikes observed during the surveys (Figure 8). When looking at the survey sites independently, e-bikes comprised 10% of all bikes at Rancho San Vicente and 12% of all bikes on the John Nicholas Trail. The percentages are close enough from both sites to suggest that this is reflective of the current e-bike usage on these types of trails in this area.

Observations of bicyclist negative behavior showed a similar outcome. Negative behavior was divided into four categories: speeding, passing too fast, rude behavior, or negative interaction. The sample size of negative behavior from e-bike riders was small, yet the percentages do hold across each group. As a total of e-bike riders from both survey sites, 2.3% (9 out of 391 in total for both locations) of e-bike riders observed displayed negative behavior and 3.06% (103 out of 3363 in total for both locations) of regular bike riders displayed negative behavior. The data suggest that a small percentage of each bike riding group engages in negative behavior. Speeding was the most common negative behavior observed in both bike groups. Of the 391 e-bike riders observed, 2.3% were speeding while 2.88% of the 3363 regular bike riders were observed speeding. Relative speed was estimated not measured.

Wildlife in the immediate survey areas were counted and placed in categories under common names. Some wildlife was grouped together such as indiscriminate birds and rodents. A total of 197 counts of wildlife were observed during the surveys and of these only 13 were present when bicycles were passing. Of these 13 wildlife observations, none reacted to bicycles as they passed.

Conclusions

A total of 1186 surveys were completed during the unpaved survey study at Rancho San Vicente in Calero County Park and on the John Nicholas Trail in Sanborn County Park. The data produced during these 142.75 hours of surveys over 37 days includes visitor sentiment supporting or opposing Class 1 e-bikes on multi-use/unpaved trails.

The majority of respondents (57%) support Class 1 e-bike access on multi-use trails, while 43% of respondents were either opposed (16%), neutral (23%) or not sure (4%) of the use.
The percentage of support for Class 1 e-bikes on multi-use/unpaved trails decreases to 40% when looking only at responses from non-cyclists while opposition rises to 26%. In total, 60% of non-cyclists either oppose (26%), are neutral (26%) or not sure (8%) of the use.
Speed was mentioned in 52% of the reasons given in the safety category for opposition to Class 1 e-bikes. Of the 1180 respondents, 14 experienced a prior conflict with e-bikes (1 conflict reported at the John Nicolas Trail, 13 reported at Rancho San Vicente). Of all the reported conflicts, 23% were with e-bikes although they made up only 10% of all observed bikes. The observational data collected during the surveys show that e-bikes were not speeding more than regular bikes, 2.30% of e-bikes were observed speeding and 2.88% of regular bikes were observed speeding. Speed clearly impacts both reported trail conflicts and was an observed

behavior. The survey does not show a difference in those impacts between e-bikes and regular bicycles.

Appendices:
Appendix A Unpaved Study Intercept Survey Results
Appendix B Unpaved Study Non-Cyclist Support/Oppose
Appendix C Unpaved Study Opinion by Sentiment
Appendix D Unpaved Observational Data

Responsible Department Head:
Matt Anderson, Chief Ranger and Manager of Visitor Services Department

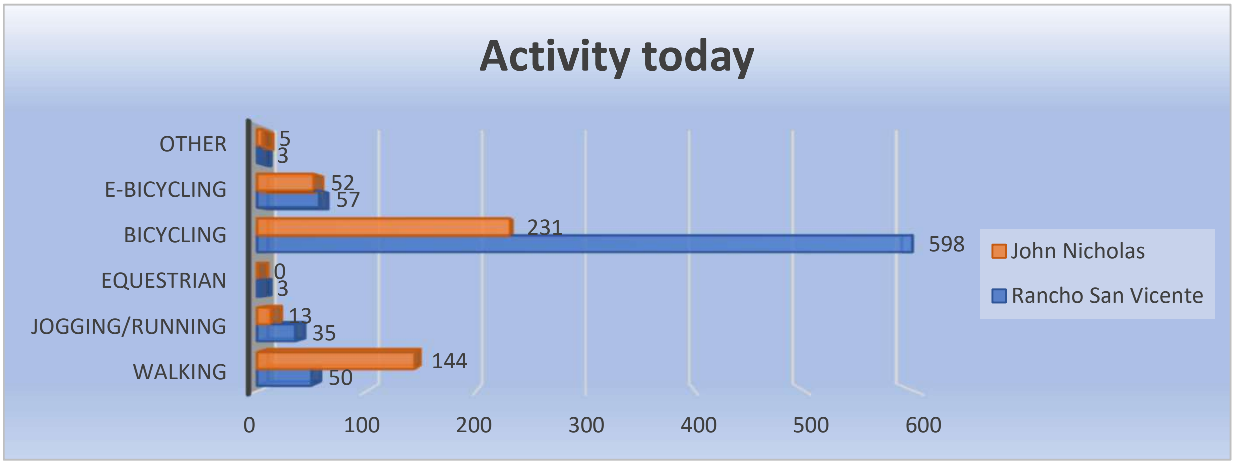
Prepared by:
Brad Pennington, Area Superintendent, Foothills

Appendix A

Unpaved Survey Study Results

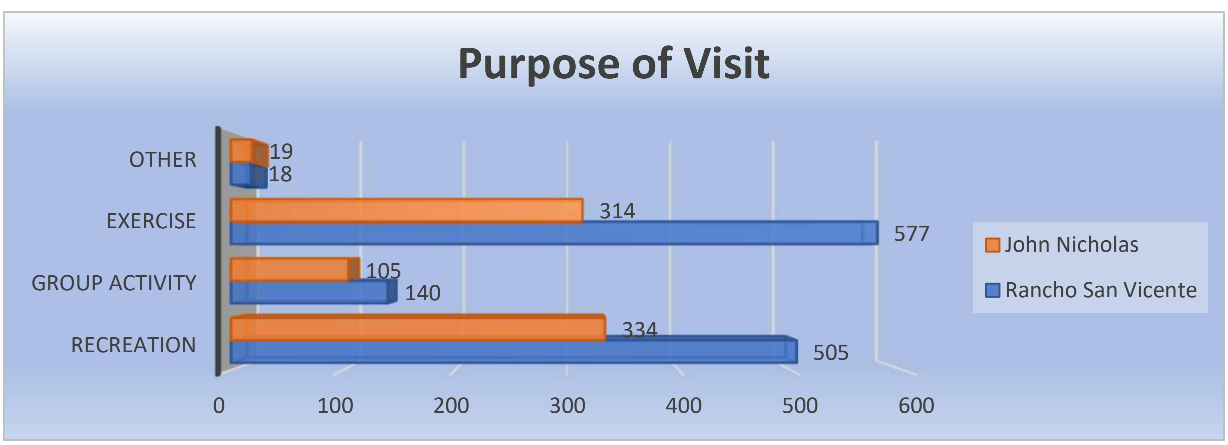
1. What activity are you participating in while using these multiuse trails today?

	Rancho San Vicente	John Nicholas	TOTAL	% of Total
Walking	50	144	**194**	16.29%
Jogging/Running	35	13	**48**	4.03%
Equestrian	3	0	**3**	0.25%
Bicycling	598	231	**829**	69.61%
E-Bicycling	57	52	**109**	9.15%
Other	3	5	**8**	0.67%
	746	445	**1191**	



2. What is the purpose of your trip on this multiuse trail today?

	Rancho San Vicente	John Nicholas	TOTAL	% of Total
Recreation	505	334	**839**	41.70%
Group Activity	140	105	**245**	12.18%
Exercise	577	314	**891**	44.28%
Other	18	19	**37**	1.84%
	1240	772	**2012**	

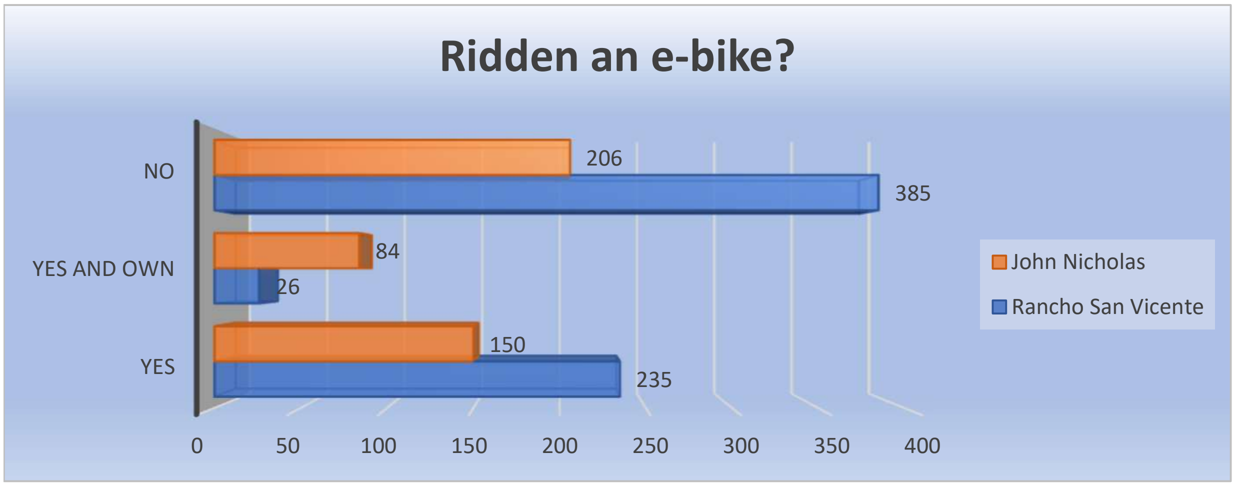


Appendix A

Unpaved Survey Study Results

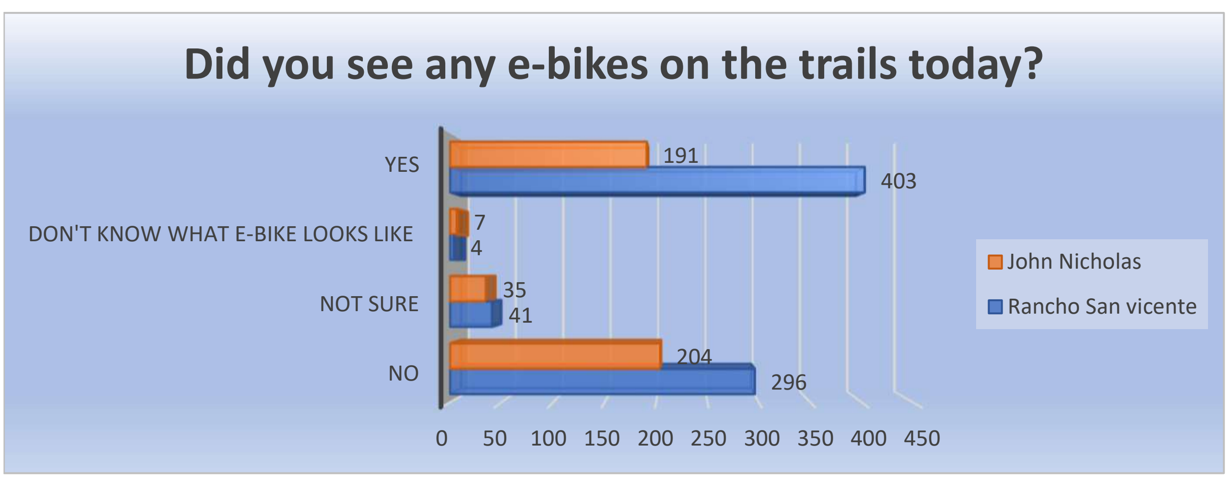
3. Have you ridden an e-bike?

	Rancho San Vicente	John Nicholas	TOTAL	% of Total
Yes	235	150	**385**	35.45%
Yes and own	26	84	**110**	10.13%
No	385	206	**591**	54.42%
	646	440	**1086**	



4. Did you see any e-bikes on the trails today?

	Rancho San Vicente	John Nicholas	TOTAL	% of Total
No	296	204	**500**	42.34%
Not sure	41	35	**76**	6.44%
Don't know what e-bike looks like	4	7	**11**	0.93%
Yes	403	191	**594**	50.30%
	744	437	**1181**	



Appendix A

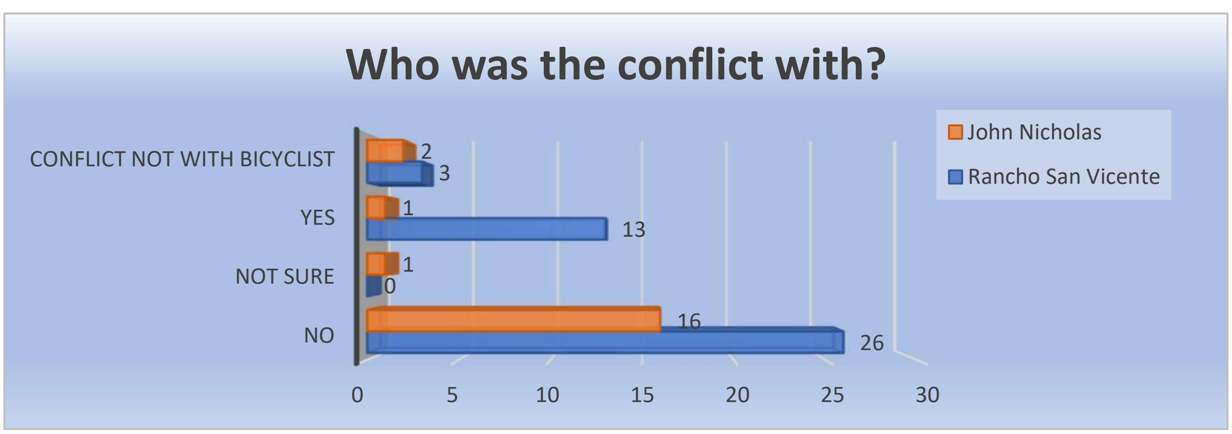
Unpaved Survey Study Results

5. Sometimes, trail users interfere with one another's enjoyment of the trail. This is generally referred to as "conflict." Did you experience conflict during your trip on this multiuse trail today?

	Rancho San Vicente	John Nicholas	TOTAL	% of Total
No	699	417	**1116**	94.58%
Not Sure	0	3	**3**	0.25%
Yes	42	19	**61**	5.17%
	741	439	**1180**	

5b. If you described conflict with someone riding a bike, was it an e-bike?

	Rancho San Vicente	John Nicholas	TOTAL	% of Total
No	26	16	**42**	67.74%
Not Sure	0	1	**1**	1.61%
Yes	13	1	**14**	22.58%
Conflict not with Bicyclist	3	2	**5**	8.06%
	42	20	**62**	

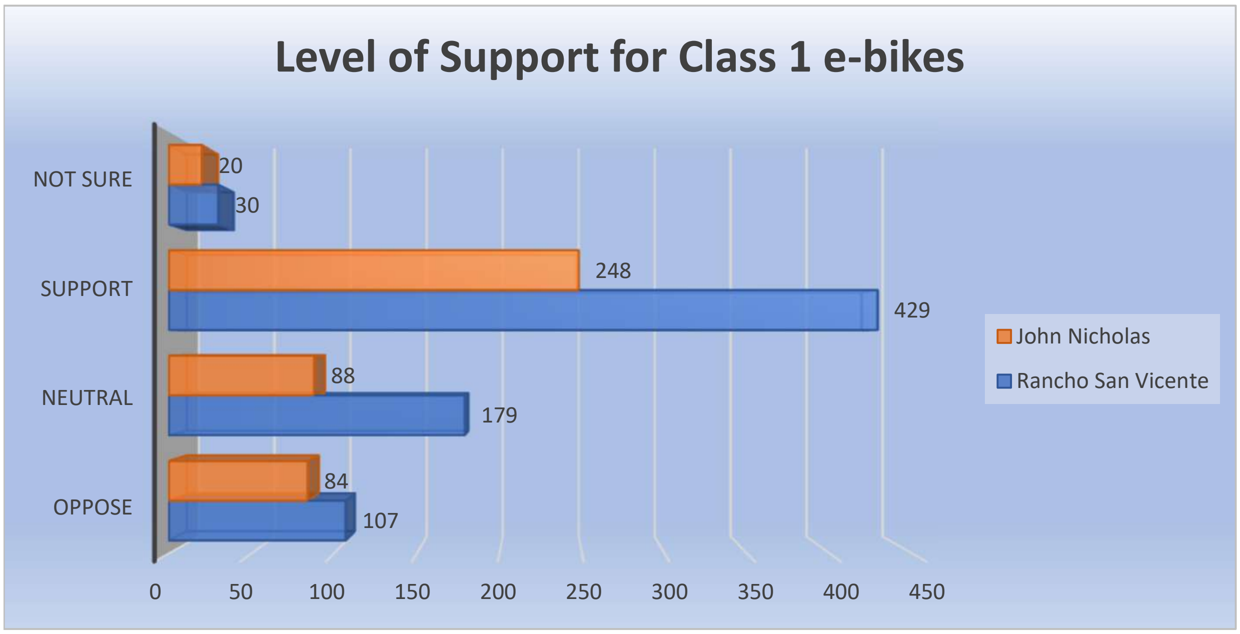


Appendix A

Unpaved Survey Study Results

6. Thinking about multiuse trails, please indicate your level of support for Class 1 e-bikes. As a reminder, Class 1 e-bikes provide electrical assistance only while pedaling, keeping in mind there is a 15mph speed limit on trails for all users.

	Rancho San Vicente	John Nicholas	TOTAL	% of Total
Oppose	107	84	**191**	16.12%
Neutral	179	88	**267**	22.53%
Support	429	248	**677**	57.13%
Not Sure	30	20	**50**	4.22%
	745	440	**1185**	

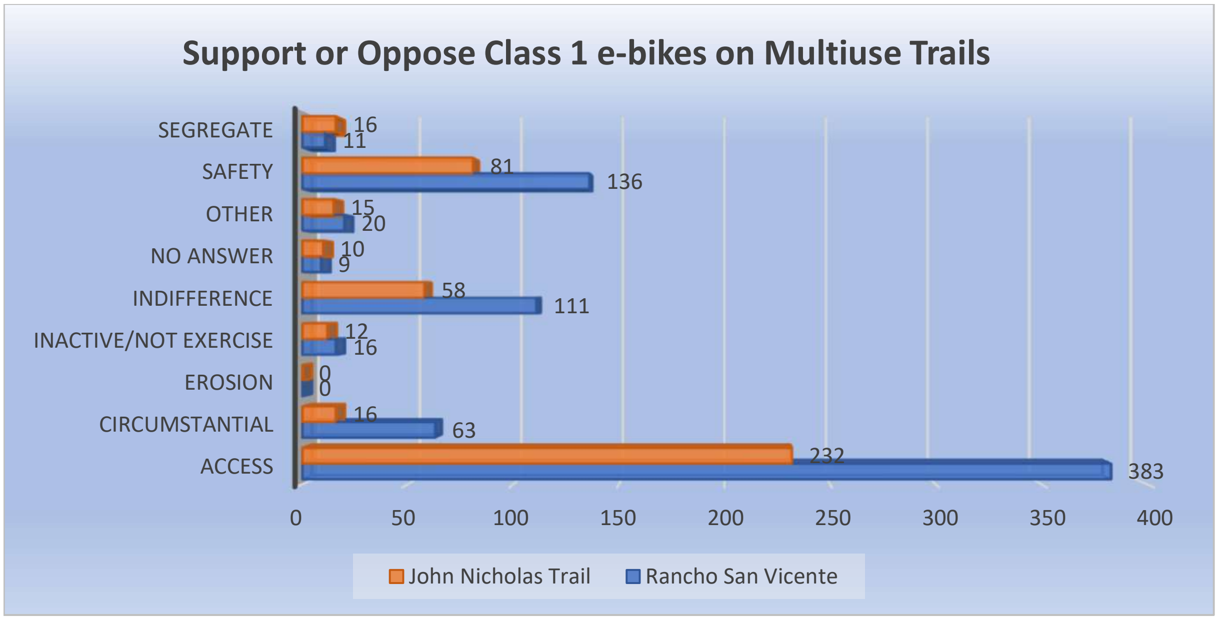


7. Please briefly explain why you answered that way.

	Rancho San Vicente	John Nicholas	TOTAL	% of Total
Access	383	232	**615**	51.72%
Circumstantial	63	16	**79**	6.64%
Erosion	0	0	**0**	0.00%
Inactive/Not exercise	16	12	**28**	2.35%
Indifference	111	58	**169**	14.21%
No answer	9	10	**19**	1.60%
Other	20	15	**35**	2.94%
Safety	136	81	**217**	18.25%
Segregate	11	16	**27**	2.27%
	749	440	**1189**	

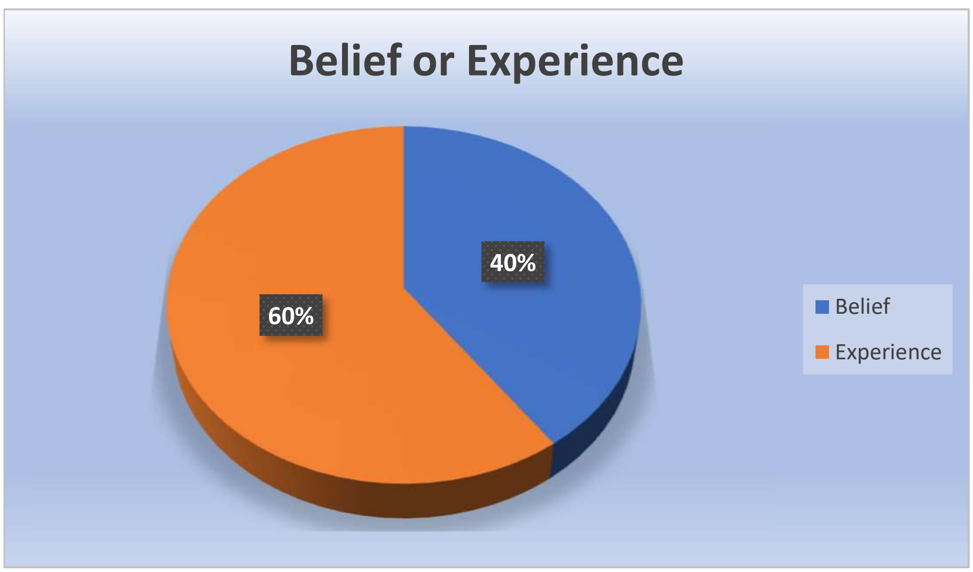
Appendix A

Unpaved Survey Study Results



7a. Is your response to the previous question based on an interaction (or experience) or general belief?

	Rancho San Vicente	John Nicholas	TOTAL	% of Total
Belief	369	204	**573**	40.04%
Experience	525	333	**858**	59.96%
	894	537	**1431**	



8. did you have any wildlife interaction you would like to share with us today?

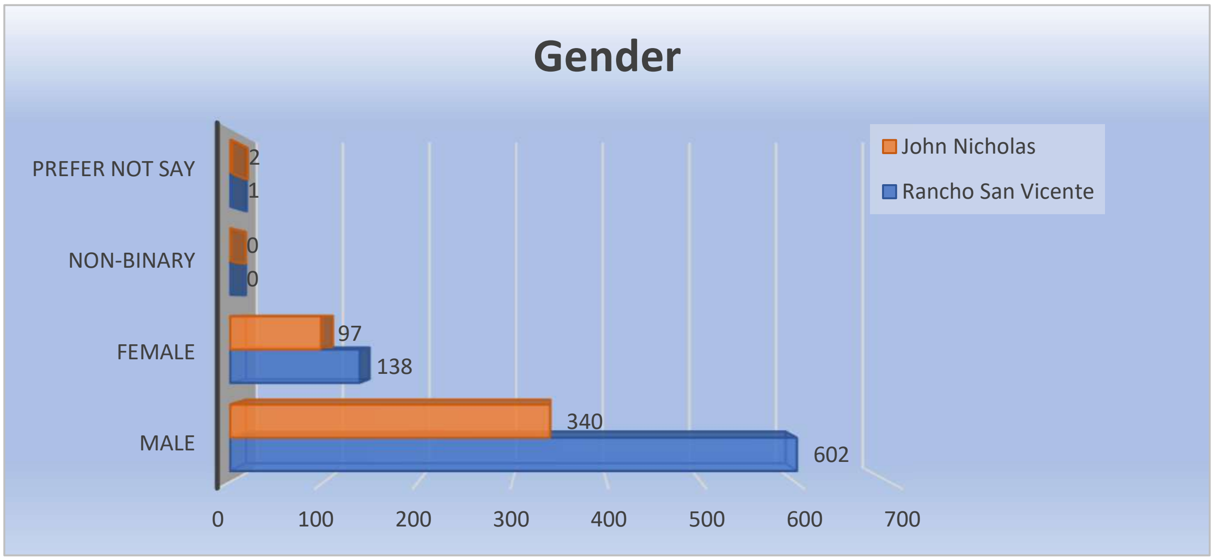
Zero respondents provided an answer to this question at either survey location.

Appendix A

Unpaved Survey Study Results

Demographics

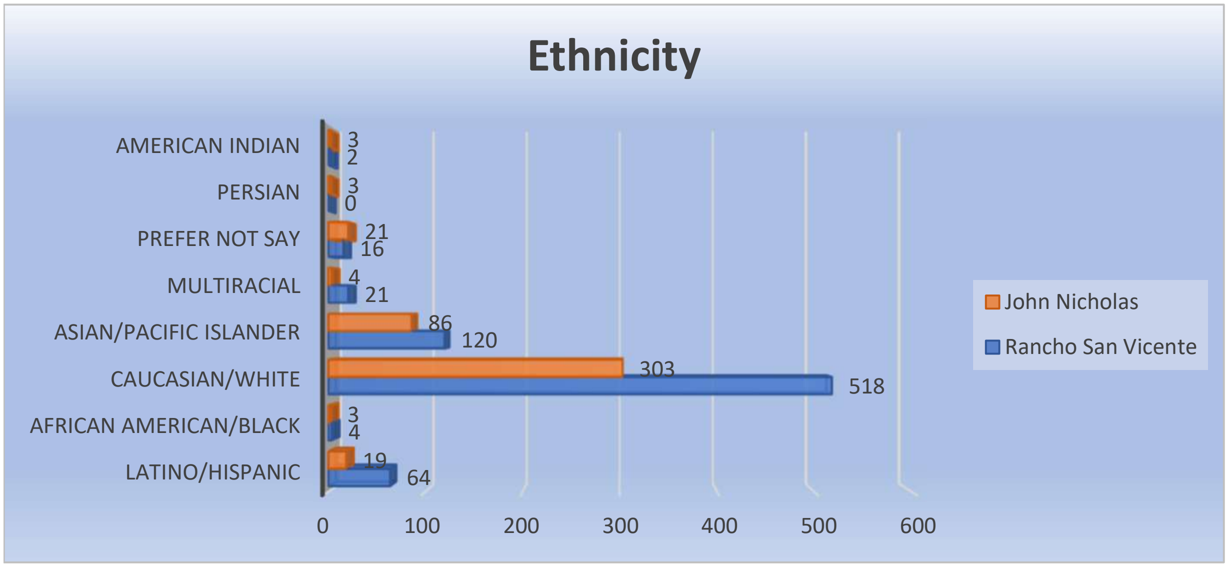
	Rancho San Vicente	John Nicholas	TOTAL	% of Total
Male	602	340	**942**	79.83%
Female	138	97	**235**	19.92%
Non-binary	0	0	**0**	0.00%
Prefer not say	1	2	**3**	0.25%
	741	439	**1180**	



	Rancho San Vicente	John Nicholas	TOTAL	% of Total
Latino/Hispanic	64	19	**83**	6.99%
African American/Black	4	3	**7**	0.59%
Caucasian/White	518	303	**821**	69.17%
Asian/Pacific Islander	120	86	**206**	17.35%
Multiracial	21	4	**25**	2.11%
Prefer Not Say	16	21	**37**	3.12%
Persian	0	3	**3**	0.25%
American Indian	2	3	**5**	0.42%
	745	442	1187	

Appendix A

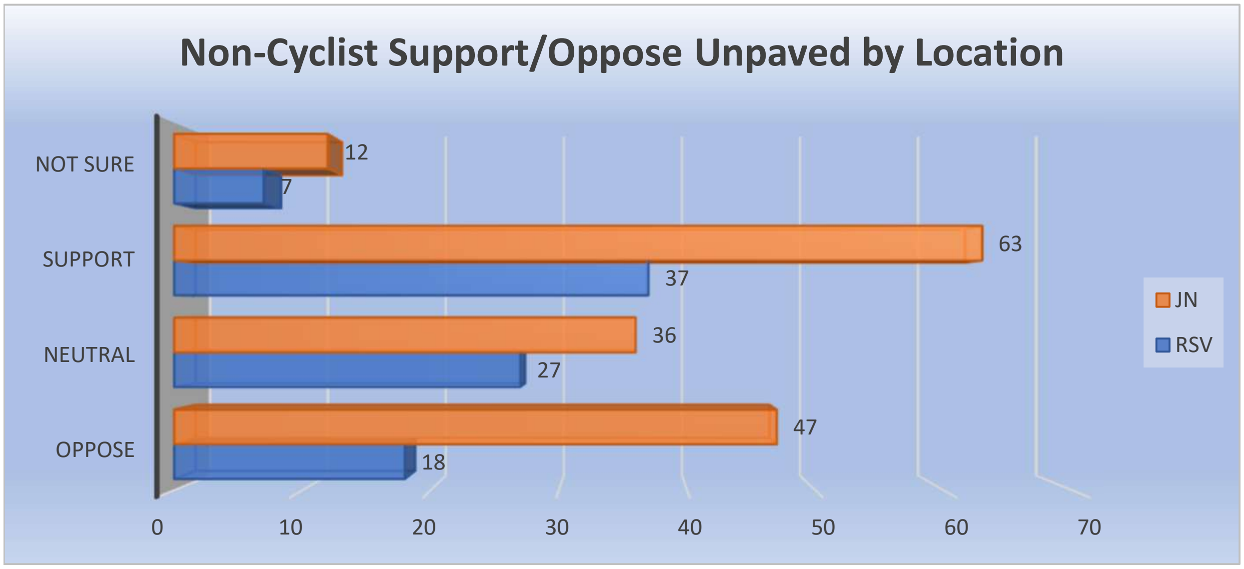
Unpaved Survey Study Results

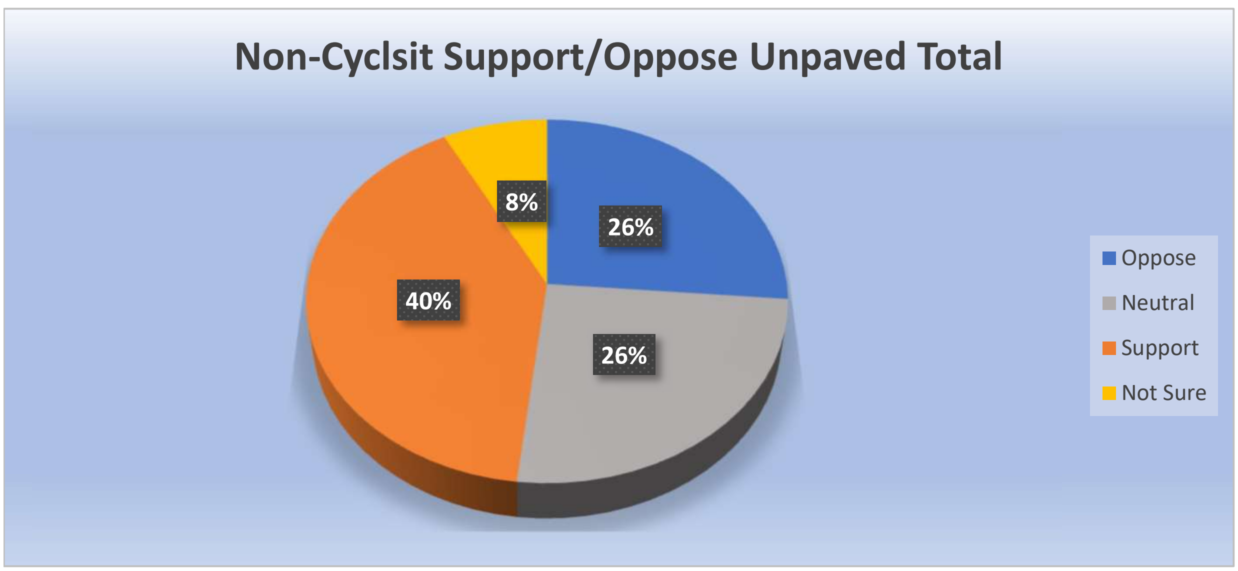


Appendix B

Non-Cyclist Opinion Unpaved

Non Cyclist Support/Oppose Unpaved							
Ranco San Vicente			John Nicholas Trail			Total	% Total
Oppose	18	20.22%	Oppose	47	29.75%	65	26.32%
Neutral	27	30.34%	Neutral	36	22.78%	63	25.51%
Support	37	41.57%	Support	63	39.87%	100	40.49%
Not Sure	7	7.87%	Not Sure	12	7.59%	19	7.69%
	89			158		247	



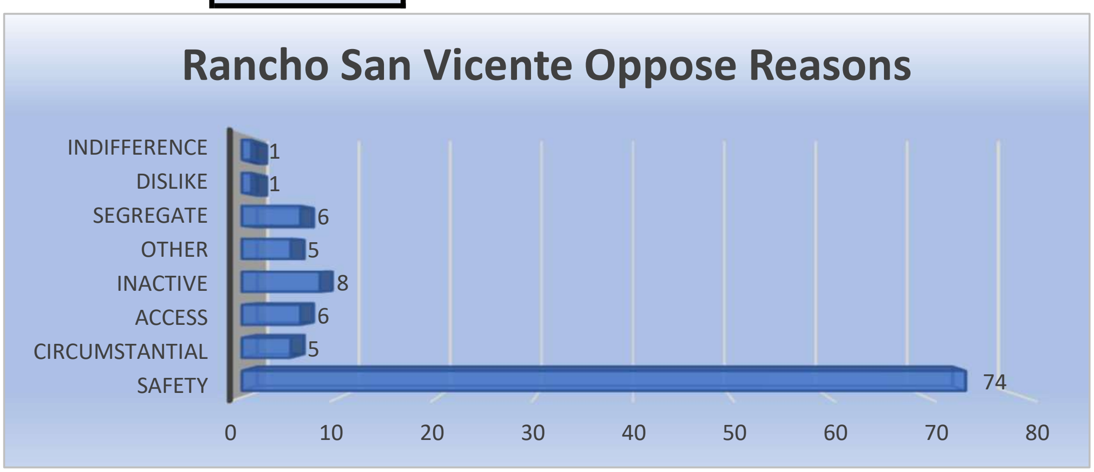


Appendix C

Opinion by Sentiment Unpaved Study

Categories	Common Respondent Answers
Safety	Speed concerns, Overcrowding, Poor trail etiquette, Reckless behavior, etc.
Circumstantial	Only on wide trails, Only if bikes are already allowed, If trail rules are followed, etc.
Access	Allows older people ride, Allows more people to share preserve, Gets more people on the preserve, etc.
Inactive	Not exercise, No effort involved, They are not earning it, etc.
Erosion	Less bikes less damage, Trail damage, etc.
Segregate	As long as they are separate from other users, Keep bikes away from hikers, etc.
Dislike	Don’t like motorized vehicles in preserve, Do not like e-bikes, etc.
Indifference	Don’t bother me, Same as a regular bike, Never had an issue, etc.
Other	Will start fires, Too much like a Harley, Are motorcycles, etc.

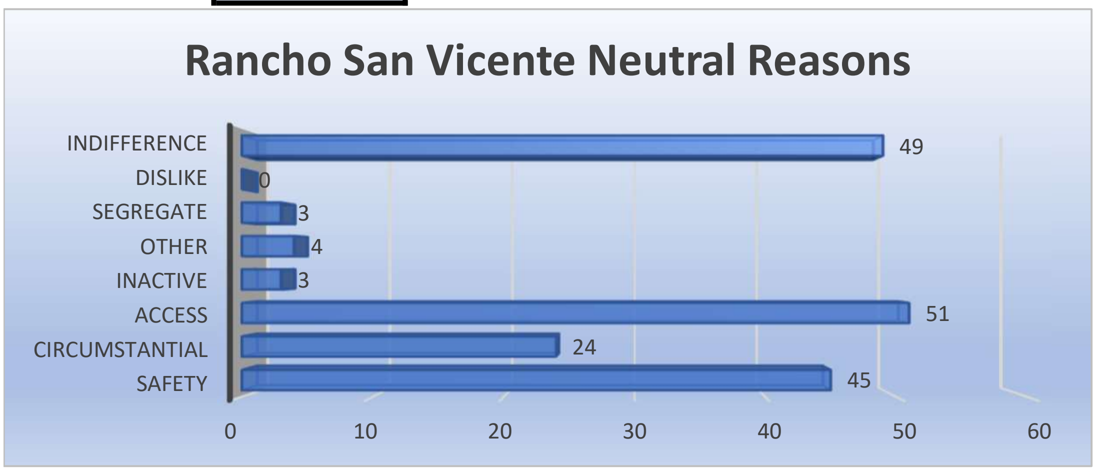
Rancho San Vicente Oppose	
Safety	74
Circumstantial	5
Access	6
Inactive	8
Other	5
Segregate	6
Dislike	1
Indifference	1
	106



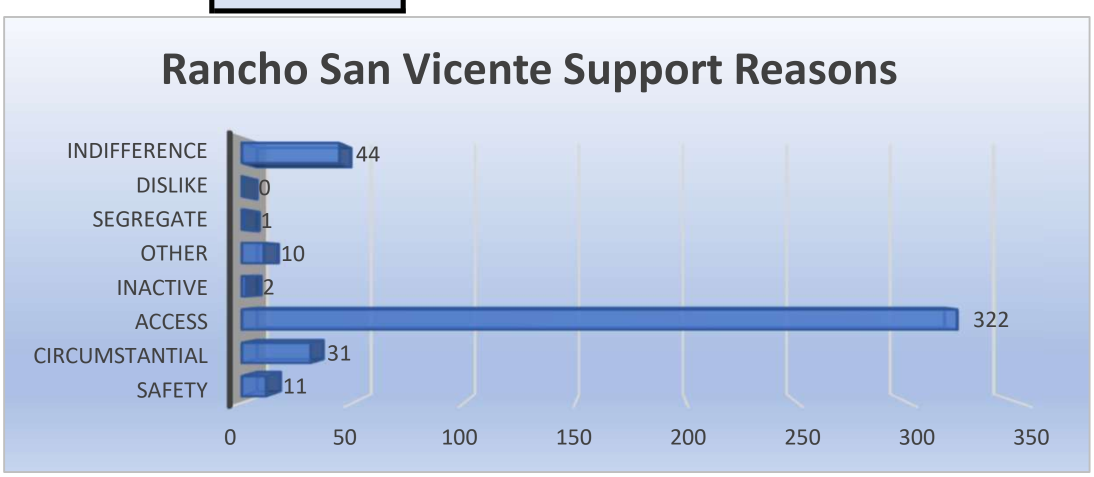
Appendix C

Opinion by Sentiment Unpaved Study

Rancho San Vicente Neutral	
Safety	45
Circumstantial	24
Access	51
Inactive	3
Other	4
Segregate	3
Dislike	0
Indifference	49
	179



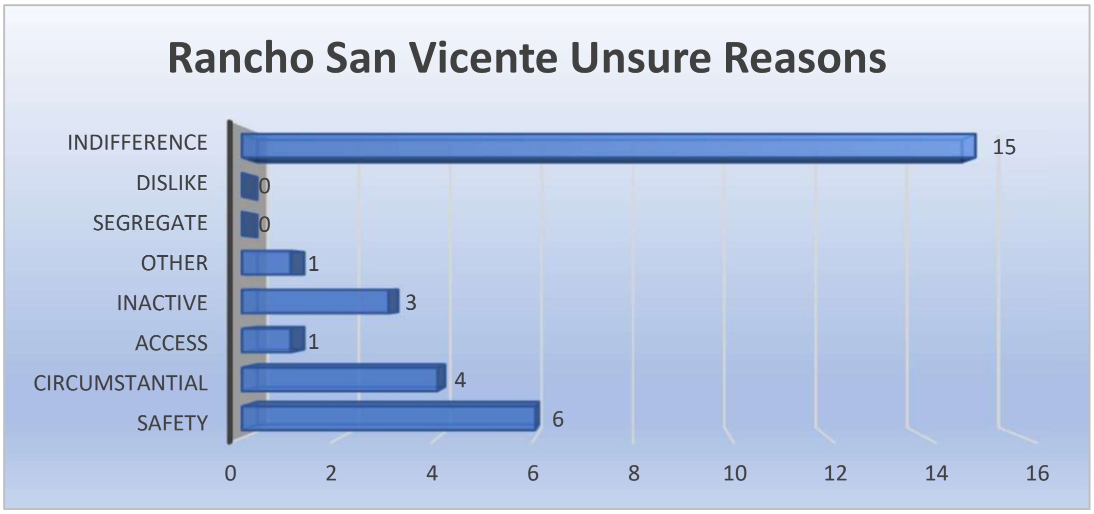
Rancho San Vicente Support	
Safety	12
Circumstantial	31
Access	322
Inactive	2
Other	10
Segregate	1
Dislike	0
Indifference	44
	422



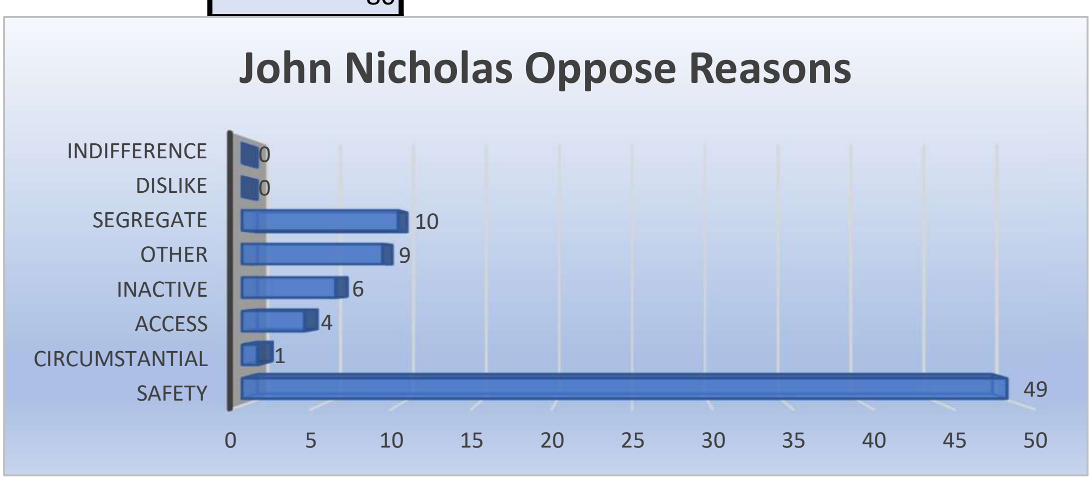
Appendix C

Opinion by Sentiment Unpaved Study

Rancho San Vicente Unsure	
Safety	6
Circumstantial	4
Access	1
Inactive	3
Other	1
Segregate	0
Dislike	0
Indifference	15
	30



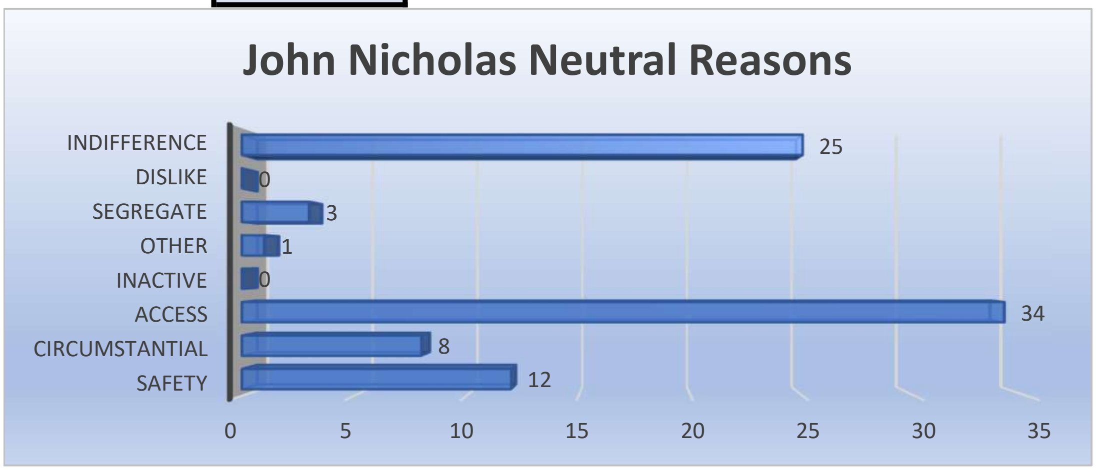
John Nicholas Oppose	
Safety	50
Circumstantial	1
Access	4
Inactive	6
Other	9
Segregate	10
Dislike	0
Indifference	0
	80



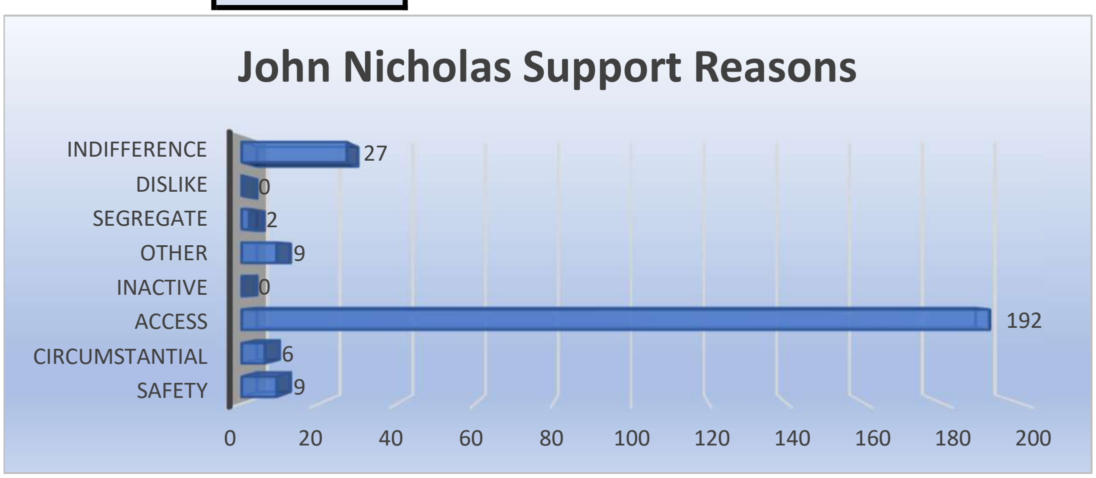
Appendix C

Opinion by Sentiment Unpaved Study

John Nicholas Neutral	
Safety	12
Circumstantial	8
Access	34
Inactive	0
Other	1
Segregate	3
Dislike	0
Indifference	25
	83



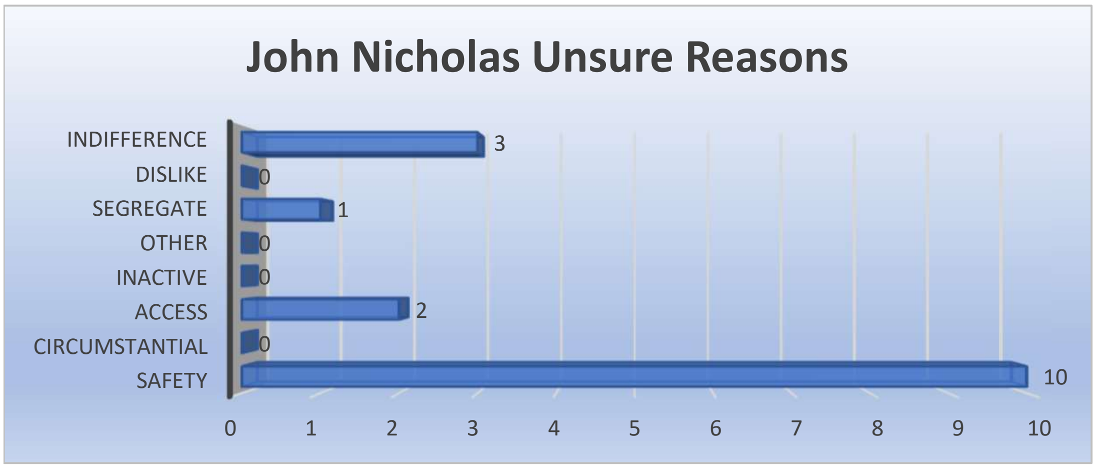
John Nicholas Support	
Safety	9
Circumstantial	6
Access	192
Inactive	0
Other	9
Segregate	2
Dislike	0
Indifference	27
	245



Appendix C

Opinion by Sentiment Unpaved Study

John Nicholas Unsure	
Safety	10
Circumstantial	0
Access	2
Inactive	0
Other	0
Segregate	1
Dislike	0
Indifference	3
	16



Appendix D

Observational Data Unpaved

Rancho San Vicente

Number of e-bikes	Totals	Percent of Total Bikes
Class 1	269	9.50%
Class 2	15	0.53%
Class 3	0	0.00%
Modified	0	0.00%
	284	10.03%

Number of analog bikes		
Counts	2547	89.97%
	2547	89.97%

E Bike Behavior		
Speeding	9	3.17%
Passing to Fast	0	0.00%
Rude Behavior	0	0.00%
Neg Interaction	0	0.00%
	9	3.17%

Analog Bike Behavior		
Speeding	78	3.06%
Passing to Fast	0	0.00%
Rude Behavior	3	0.12%
Neg Interaction	2	0.08%
	83	3.26%

Wildlife Type and Quantity	
Deer	2
Turkey	12
Rodents	73
Birds	35
Lizard	0
coyote	9
turkey vulture	8
	139

Wildlife Actions	
Fled	0
No Reaction	13
Minimal Reaction	0
	13

John Nicholas

Number of e-bikes	Totals	Percent of Total Bikes
Class 1	106	11.48%
Class 2	1	0.11%
Class 3	0	0.00%
Modified	0	0.00%
	107	11.59%

Number of analog bikes		
Counts	816	88.41%
	816	88.41%

E Bike Behavior		
Speeding	0	0.00%
Passing to Fast	0	0.00%
Rude Behavior	0	0.00%
Neg Interaction	0	0.00%
	0	0.00%

Analog Bike Behavior		
Speeding	19	2.33%
Passing to Fast	1	0.12%
Rude Behavior	0	0.00%
Neg Interaction	0	0.00%
	20	2.45%

Wildlife Type and Quantity	
Deer	9
Turkey	0
Rodents	0
Birds	37
lizard	12
Coyote	0
Turkey Vulture	0
	58

Wildlife Actions	
Fled	0
No Reaction	0
Minimal Reaction	0
	0

Unpaved Total

Total	Percent of Total Bikes
375	9.99%
16	0.43%
0	0.00%
0	0.00%
391	10.42%

Total Number of Analog Bikes	
3363	89.58%
3363	89.58%

Total E-Bike Behavior	
9	2.30%
0	0.00%
0	0.00%
0	0.00%
9	2.30%

Total Analog Bike Behavior	
97	2.88%
1	0.03%
3	0.09%
2	0.06%
103	3.06%

Wildlife Totals	
Deer	11
Turkey	12
Rodents	73
Birds	72
Lizards	12
Coyote	9
Turkey Vulture	8
	197

Wildlife Actions Total	
Fled	0
No Reaction	13
Minimal Reaction	0
	13

DATE: November 10, 2021

MEMO TO: Board of Directors

THROUGH: Ana Ruiz, General Manager

FROM: Julie Andersen, Senior Resources Management Specialist

SUBJECT: Update on the Electric Bicycle (e-bike) Noise Study

SUMMARY

In support of the Midpeninsula Regional Open Space District (District's) E-bike Policy Evaluation Project, the Natural Resource Department was tasked with investigating potential noise impacts to wildlife (specifically birds and bats) from electric bikes (e-bikes). Wildlife Program staff contacted H.T. Harvey & Associates (H.T. Harvey), one of the District's on-call biological consultants, to assist as they have expertise in measuring sound and determining potential noise impacts to these species.

BACKGROUND

Most birds are active during the day, primarily hear in low frequencies (sound audible to humans), and are most sensitive to noise when incubating and raising young (nesting). Bats are active at night, primarily hear in high frequencies (sounds not audible to humans), and are acutely sensitive to human-generated noise. They use high frequency sounds to echolocate when hunting prey, to navigate within their surroundings, and to communicate. Different species of bats hear in different frequencies. Bats typically begin hunting at twilight and continue feeding periodically into the night. Human-generated noise within District Preserves occurs mainly during the day and generally does not disrupt foraging bats. However, bats that congregate in colonies to roost (rest or sleep) and to care for and rear young (maternity roosting) can be particularly sensitive to human-generated noise. Potential adverse effects to bats and birds from human-generated noise include roost or nest abandonment, disrupted foraging or feeding, and the interruption of communication between individuals.

In one example provided by H.T. Harvey, big brown bats that appeared tolerant to low-frequency, human-generated noise (chainsaws and graders), were observed abandoning their daytime roost when a high frequency instrument was used. The noise generated was inaudible to humans and the work crew was unaware of the disturbance they were creating for nearby roosting bats. This type of disturbance, especially to a maternity roost may reduce survivorship of some young bats and should be avoided.

DISCUSSION

Study Methods:

H.T. Harvey designed two noise recording sessions to determine the ambient (background environmental) noise level and the noise levels (at both high and low frequencies) generated by the operation of conventional and e-bikes. The study was performed in two representative habitats (redwood forest and grasslands).

Low frequency recordings occurred in May 2021 at Purisima Creek Redwoods Open Space Preserve. This Preserve contains habitat suitable for marbled murrelet, a bird species that requires the use of regulatory agency approved avoidance buffers during their nesting season to avoid impacts from human-generated noise. High frequency recordings occurred in June 2021 at Sierra Azul Open Space Preserve. This Preserve contains typical habitat for both foraging and roosting of pallid bat (*Antrozous pallidus),* which is a California state species of special concern.

Sound from three different types of e-bikes, representative of the types under consideration for access on District trails, and two different types of conventional mountain bikes were measured each day at each site. Each bike was recorded as it was: 1) pedaling slowly uphill (and in power assist mode for e-bikes), 2) pedaling fast uphill (and in power assist mode for e-bikes), 3) coasting, and 4) braking. These were determined to be the most likely modes of use by bicyclists on recreational trails.

Sounds were recorded at different distances from the bikes while they were in operation. The recordings were then sent to a sound laboratory for analysis to determine at what distance sound from both conventional mountain bikes and e-bikes would attenuate (or be reduced) to the ambient noise level. For the purposes of the study, the ambient noise level recorded at each site was 20 decibels (dB).

Decibels are a unit of measurement that describe the intensity, or volume, of noise. Frequency is another unit of measurement that describes the pitch of sounds. Decibel levels were recorded for each bike for each mode, and were calculated and separated into five groups representing the different frequencies in kilohertz (kHz) that are typically audible for bird and bat species that occur within District lands (See H.T. Harvey Table 1).

Table 1. Phonic groups representing birds and bats

Frequency	**1kHz – 5kHz**	**18kHz – 26kHz**	**27kHz – 35kHz**	**36kHz – 44kHz**	**45kHz – 55kHz**
Phonic Groups	Birds	Bats			
Represented Species Examples	Generally, most birds	hoary bat (*Lasiurus cinereus*) Brazilian free-tailed bat (*Tadarida brasiliensis*) Townsend's big-eared bat (*Corynorhinus townsendii*)	pallid bat (*Antrozous pallidus*) big brown bat (*Eptesicus fuscus*) silver-haired bat (*Lasionycteris noctivagans*) Long-eared myotis (*Myotis evotis*) Fringed myotis (*Myotis thysanodes*)	long-legged myotis (*Myotis volans*) little brown bat (*Myotis lucifugus*) western red bat (*Lasiurus frantzii*)	California myotis (*Myotis californicus*) Yuma myotis (*Myotis yumanensis*)

<u>Study Results:</u>
Generally conventional bikes were quieter than e-bikes; at times the sound generated from conventional bikes was too quiet to be recorded. The consistently loudest noises resulted from pedaling slowly or quickly uphill with e-bikes, however, the single loudest noise was generated by braking hard on one of the e-bikes. Recorded sounds were loudest when recorded closest to the microphone, so this set of data was used to visually depict at what frequencies each bike generates noise in each mode (See Appendix A-1 to A-3 of the study). The highest sound pressures occurred between 8 kHz and 70 kHz, which would primarily affect bat species that hear in these ranges. Analysis of the data collected suggests that the amount of sound from e-bikes is far greater in the 40 kHz phonic group than in other phonic groups, suggesting that bats that hear in this range such as the long-legged myotis (*Myotis volans*), little brown myotis (*Myotis lucifugus*), and western red bat (*Lasiurus frantzii*) may be more prone to disturbance from e-bike traffic than other bat species. The human hearing range is typically between 20Hz and 20kHz and is most sensitive between 2 to 5 kHz, so people would not hear most sounds in the range that effect bats.

H.T. Harvey used the sound data collected to compute noise attenuation rates for the loudest bike (an e-bike) to provide recommended buffer distances from recreational trails and facilities to reduce potential noise impacts to bird and bat species. See H.T. Harvey Table 4 below:

Table 4. Computed distances for e-bike sound to attenuate to ambient levels of 20 dB for different frequency ranges

	1 kHz - 5 kHz	18 kHz - 26 kHz	27 kHz - 35 kHz	36 kHz - 44 kHz	45 kHz - 55 kHz
Distance to ambient (ft)	45	100	107	231	134*

*Drop in distance is due to how sound in this frequency travels and attenuates as well as at what level sounds are generated by e-bikes (loudest noises generated were in the 36kHz -44kHz levels)

The noise generated by e-bikes occurs in both low and high frequencies. Like humans, birds cannot hear high frequency sound and are not likely to be affected by e-bike high frequency noise. Instead, low frequency sound generated in the audible range (1kHz to 5kHz) may affect birds. Additionally, and specific to marbled murrelet, the District currently follows regulatory agency regulations that restrict noise-producing activities by creating dB limits and distance buffers based on ambient and action noise levels. These regulations define ambient noise levels at 50 dB or less which inherently makes H.T. Harvey's recommended buffers more conservative than agency standards. H.T. Harvey's study finds that e-bike noise attenuation will occur over a reasonably short distance (45 feet) and to an ambient level (20 dB).

<u>Recommendations:</u>
Buffer Distances: any trail that allows e-bikes should have:

- A minimum 45-foot distance from any known nesting bird site.
- A minimum 100-foot distance from any roost site of bats that hear in the 18kHz – 26kHz range, including Brazilian free-tailed bats (*Tadarida brasiliensis*), Townsend's big-eared bats (*Corynorhinus townsendii*), or hoary bats (*Lasiurus cinereus*).
- A minimum 107-foot distance from any roost site of bats that hear in the 27kHz – 35kHz range, including pallid bats, big brown bats (*Eptesicus fuscus*), silver-haired bats (*lasionycteris noctivagans*), long-eared myotis (*Myotis evotis*), and fringed myotis (*Myotis thysanodes*).
- A minimum 231-foot distance from any roost site of bats that hear in the 36kHz – 44kHz range, including long-legged myotis, little brown myotis, and western red bat.

- A minimum 134-foot distance from any roost site of bats that hear in the 45kHz – 55kHz range, including California myotis (*Myotis californicus*) and Yuma myotis (*Myotis yumanensis*).

For any trail that allows conventional and/or e-bikes:

- Maternity colonies of pallid bats and Townsend's big-eared bats are extremely sensitive, and Townsend's big-eared bats are known to abandon young because of disturbances. Therefore, for a maternity colony of either of these species, a minimum buffer of 200 feet to any trail allowing any bike traffic is recommended.

Management Considerations:
Guided by the District's mission, Natural Resources staff utilize best available science to determine best management practices when developing public access and managing recreational uses in the Preserves. This study provides recommended avoidance buffers for sensitive natural resources that are being reviewed and incorporated in the current e-bike evaluation work. Based on the location of known sensitive resources, there are no recommended changes to existing recreational trail uses, including conventional bike use. The evaluation of e-bike use will need to consider the sensitivity of bat populations for high frequency noise that is not audible to humans yet known to be generated by e-bike electric motors. See "Next Steps" below for information on how the Science Advisory Panel will consider these findings as part of their e-bike evaluation.

Seasonal trail closures and/or avoidance buffers are a current District practice utilized when warranted by the conditions (such as weather, noise, hazards etc.) and/or observable impacts to species. See situational evaluation section below for methodology and examples of when modifications to trail use may be warranted based on noise generated by recreational trail users. This information will continue to be used during future site planning for trails or other recreational facilities.

Situational Evaluation:
District staff will continue to evaluate sensitive resources like bird nests and bat maternity roosts on a situational basis and adjust protections based on species needs. Breeding birds have substantial variation in their behavior, sensitivity, and ability to acclimate to environmental stressors during the breeding season. The District implements nest protections for nests that are found incidentally or during surveys for project work. Seasonal nesting bird surveys would not be required just for trail use. Protections around bird nests should remain flexible to suit the ambient noise levels and activity in each particular location, using the distances described above as a suggested starting point if buffers are determined to be needed.

For example, nesting great-horned owls at Rancho San Antonio are acclimated to louder ambient noise levels and more frequent recreation activity. Each year perimeter flagging is placed around the tree that stands less than 25 feet from the paved trail, and the trail remains open while owls continue nesting successfully. Woodpeckers nesting at Bear Creek Redwoods during project work were monitored for disturbance and were determined to require no buffer at all; project work was therefore allowed to continue without negative impacts to the woodpeckers.

The majority of known bat maternity roosts in District preserves are located within buildings with low occupancy or use (e.g., barns), and in bat structures (e.g., bat boxes). Bats also nest in natural habitat, but such nesting sites are more dispersed and often go undocumented. Only two potential roost sites are known to be located in proximity to existing District bike trails – two bat boxes located on a spur access trail to the Skyline Ridge A-frame house. Temporary seasonal trail closures should be evaluated on an individual basis if new bat roost sites are identified within proximity to bike trails. Bats may also have a higher disturbance tolerance and therefore smaller buffer size in more heavily visited areas (e.g., Skyline Field Office area).

Buffers would only be explored during the bird and bat breeding seasons, resulting in potential seasonal and temporary trail closures. Most bird nest sites that require temporary seasonal trail closures would be considered so sensitive (e.g., marbled murrelet) that the closure would apply for all forms of recreation and project work, and follow District resource protection practices.

Conclusion:
Both conventional bikes and e-bikes generate noise across both low and high frequencies depending on the model and the type of activity for which the bike is being used. Generally, conventional bikes are quieter than e-bikes and e-bikes generate noise in ranges that may be more impactful to bats.

An existing District best management practice is to avoid locating recreational trails and facilities in proximity to sensitive noise receptors (including known bird nests and bat roosts). However, both birds and/or bats may establish nests or roosts in proximity to a trail or other facility after it has been in place for some time. In these instances, during nesting and roosting seasons, when human generated noise is expected to exceed the ambient noise level, avoidance buffers can be considered to reduce potential impacts. Through this study, H.T. Harvey has provided recommended avoidance buffers that may be used to reduce impacts to both bird and bat species from bike and e-bike use on District trails.

NEXT STEPS

As part of the District's E-bike Policy Evaluation Project, the District's Scientific Advisory Panel (SAP) is reviewing the state of the science and practitioner knowledge on impacts and management of e-bike recreation on unpaved trails. This study has been provided to the SAP for review and to augment the existing literature on noise impacts from both conventional and e-bike use. It has also been shared with the SAP's Technical Advisory Committee, made up of researchers and practitioners for whom the information may be relevant. Since e-bikes have an electric motor, they produce sounds in the high frequency ranges. There appear to be few studies investigating e-bike noise impacts to wildlife and the few that exist often assume that e-bike impacts would be very similar to conventional bikes in terms of noise. This may be one of the first studies to look at potential impacts of high frequency sound emitted by e-bikes. H.T. Harvey will be presenting this study and findings at the Western Section of the Wildlife Society Conference in February of 2022. The study has been provided to the District e-bike team for review to inform the development of a potential e-bike policy. A copy of the final H.T. Harvey report and its appendices can be found on the District website.

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H. T. HARVEY & ASSOCIATES
Ecological Consultants
50 years of field notes, exploration, and excellence

Memorandum

September 17, 2021 **Project #4505-01**

To: **Julie Andersen, Senior Resource Management Specialist; Karine Tokatlian, Resource Management Specialist II; and Brad Pennington, Area Superintendent (Midpeninsula Regional Open Space District)**

From: **Dave Johnston, Ph.D. Associate Ecologist and Bat Biologist and Steve Rottenborn, Ph.D. Vice-President and Wildlife Ecologist (H. T. Harvey & Associates)**

Subject: **Analysis of E-bike Noise and Recommendations for Buffer Distances between Bike Trails and Bat Roosts/Nesting Birds**

Midpeninsula Regional Open Space District (MROSD) contacted H. T. Harvey & Associates to provide an analysis of high and low-frequency noises generated by e-bikes to help predict potential impacts to roosting bats and nesting birds in proximity of bike trails. Based on MROSD guidance, H. T. Harvey & Associates designed recording sessions of operating bicycles to determine what high-frequency noises are generated by three examples of e-bikes and two conventional bikes and to assess which bat species, if any, might be disturbed by these noises. Based on our subsequent communications with you, we have added the task of recording these noises on low-frequency recording devices as well, to help determine potential impacts to nesting birds. This memorandum provides the methods, results, and recommendations for establishing appropriate "buffer" distances between bike trails and roosting bats. We have also indicated the distances needed for e-bike and conventional bike (bike) sounds to attenuate to 20 decibels (dB), the approximate ambient noise level we recorded during our study, for purposes of determining the distance away from operating e-bikes and conventional bikes to reach this sound pressure, and to suggest "buffer" distances between all bike sounds and nesting birds in general. We are not prescribing a specific distance from trails to nesting marbled murrelets (*Brachyramphus marmoratus*) given the lack of consistent information on marbled murrelet disturbance tolerances. However, we recommend that site specific distances for marbled murrelets and other birds be explored and developed during the planning of trails.

Introduction

Sound pressure is reported in decibels (dB). Decibels are units based on human hearing; 1 dB is the lowest level of sound a human can hear, and each dB unit is the smallest increment in which humans can detect a difference in loudness. Kilohertz (kHz) is a unit of measurement for the frequency of sounds; higher frequencies correspond to higher pitches. While adult humans can detect sounds between approximately 0.015–18 kHz, most bats' hearing ranges from about 0.1–200 kHz (Altringham 2014). Avian hearing is similar to human hearing; birds are most sensitive to sounds from about 1 to 4 kHz although they can typically hear higher and lower frequencies (Beason 2004). No species of birds has shown sensitivity to high frequency sounds above 20 kHz (Beason 2004).

Bats typically have different roost sites for different activities. During the daytime, bats roost in crevices, caves, or foliage depending upon the species of bats, and sleep during this period. Usually at dusk or as early as just prior to sunset, bats leave their day roost, drink water, forage on insects, and night roost in an area that is typically warmer than ambient temperature. After night roosting for several hours, bats typically drink water again, forage again, and then return to their day roosts to sleep during the day. Bats are most sensitive to disturbance while day roosting during the maternity season when they are raising young.

Bats are acutely sensitive to changes in their sound environment and can react to even relatively quiet noise if it is foreign to them and stimulates a stress response (Altringham and Kerth 2016). Additionally, the frequency of the noise is also important because individual species of bats have different sensitivities to various noise frequencies (Johnston et al. 2019). Nearly all of California's bats are insectivorous, and with the exception of a few species such as the pallid bat (*Antrozous pallidus*), use high-frequency echolocation to detect prey and orient themselves within the landscape. Bats also use sound to communicate, especially while flying (Gillam and Fenton 2016). Different species of bats will respond differently to human-induced noise, and noise will affect certain bat behaviors, such as foraging versus roosting, differently (Caltrans 2016).

Potential adverse effects on bats from noise disturbances include roost abandonment and the interruption or impediment of bats' abilities to use echolocation for foraging or navigation. Noise disturbance and displacement of bats from roosts or important foraging areas can potentially result in reduced survivability of individuals from increased susceptibility to predation, reduced quality of thermal and social environments, and decreased foraging efficiencies. Although bicycling may generate a multitude of low and high frequencies to disrupt bats' foraging ability, and bats frequently use trails as foraging routes, bicycles and foraging bats are not usually operating at the same time. Bicycling is typically diurnal whereas bats forage during the twilight (crepuscular foraging) and at night (nocturnal foraging). Therefore, bicycling is not expected to disrupt bats foraging unless bicycles operate during twilight and nighttime hours.

On the other hand, bats are particularly sensitive to noise in proximity to maternity colonies. At a daytime construction project in a large urban park, a maternity colony of big brown bats (*Eptesicus fuscus*) tolerated high decibel (dB) levels of low frequency sounds (audible to humans) generated by chain saws (75–86 dB) and large graders (85–89 dB) within 100 feet of their maternity roost, but the colony abandoned their roost when workers used a high-frequency (19–28 kilohertz [kHz]) laser surveying instrument, inaudible to the human ear (Johnston et al. 2017). Such a disturbance so great as to cause a maternity colony to abandon its roost site likely reduces the survivorship of some of the young. Although high frequencies attenuate to ambient sound in shorter distances than lower frequencies, the noise from equipment should be measured for corresponding frequencies to which the bat species involved are most sensitive (Figure 1). For example, in order to determine appropriate buffer zones for operating equipment near an active big brown bat roost, it would be necessary to measure the dB of the 20-kHz frequency noise (the frequency that the big brown bat is most sensitive to) and the distance over which the noise would attenuate to ambient levels.

While adult humans can detect sounds between approximately 0.015–18 kHz, most bats' hearing ranges from about 0.1–200 kHz (Altringham 2014). Additionally, bats' sensitivity to noise is usually greatest at frequencies similar to those used for foraging. For example, the big brown bat's peak hearing sensitivity is at about 20 kHz (Figure 1), which represents the frequency of the bats' search calls with the most energy (Koay et al. 1997).

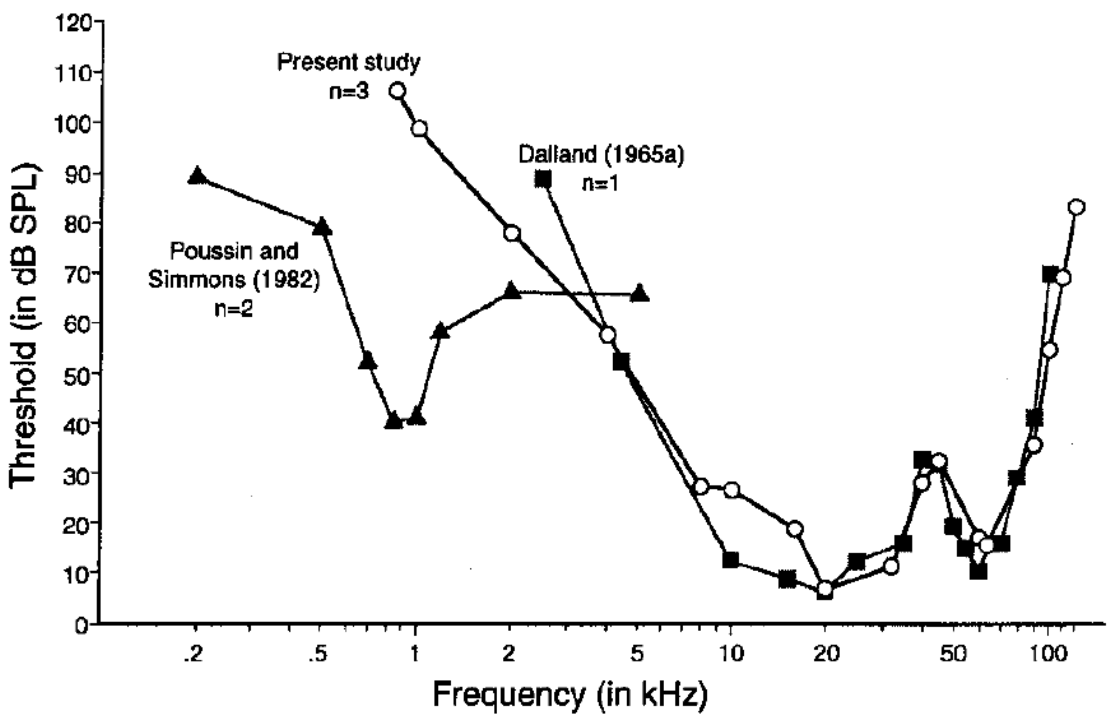


Figure 1. Hearing sensitivity in big brown bats (*Eptesicus fuscus*) as measured in three studies (Koay et al. 1997). Values shown depict the threshold of hearing for big brown bats for sounds up to 100 kHz.

Because bats' hearing is not as sensitive at lower frequencies compared to human hearing, the sound frequencies that disturb humans do not necessarily have a corresponding effect on most bat species, and vice versa. Humans may not be able to hear frequencies detected by bats. Therefore, we have used the frequency range of bats foraging calls to help determine which bats are sensitive to which frequencies.

Like bats, birds are most sensitive to noise disturbance when they are raising young. Birds' nesting season includes nest building, egg laying, egg incubating, and raising chicks until they have fledged. Birds have many different life histories, but most songbirds on MSORD lands nest in trees, shrubs, and grasslands; they are active during daylight hours and are sleeping during nighttime hours.

There has been much debate and controversy over the potential disturbance thresholds to marbled murrelets and what constitutes disturbance impacts to this species. While Hammer and Nelson (1998) recommended buffers greater than 100-meters between nesting marbled murrelets and any human activity, Long and Ralph (1998) reported that adult murrelets located in trees 10 and 25 meters from heavily used hiking trails showed "no visible reaction to loud talking near a nest tree." Hebert and Golightly (2006) later suggested that prolonged noise disturbance at nest sites could have unknown consequences. Additionally, the base ambient noise levels varied from one study to another, with some studies using 70 dB as the ambient noise level. We used a conservative 20 dB for the low frequency recordings because this was the measured ambient noise level at our recording sites. Therefore, we have determined the distance needed for the various noises generated by e-bikes and conventional bikes to attenuate to 20 dB, the approximate ambient noise levels determined during our low-frequency and high-frequency recording sessions.

Methods

On May 17, 2021 we positioned two low frequency sound recorders (Song Meter Mini recorders; Wildlife Acoustics, Concord, Massachusetts, United States) to record sounds in the low frequency (1 kHz – 10 kHz) range (Figure 2). One microphone was placed 10 feet and another 20 feet away from the Purisima Creek Trail at the Purisima Creek Redwoods Open Space Preserve in San Mateo County. We used this trail to record low frequency sounds because it was fairly typical of marbled murrelet nesting habitat. We recorded a Gary Fischer and a Specialized Rock Hopper to represent conventional bicycles and a Specialized 2020 Levo SL, a Santa Cruz 2018 Heckler, and a Specialized 2019 Levo to represent e-bikes. We recorded each e-bike and conventional bike as it was: 1) in power assist mode peddling slowly uphill, 2) in power assist mode peddling fast uphill, 3) coasting, and 4) braking.

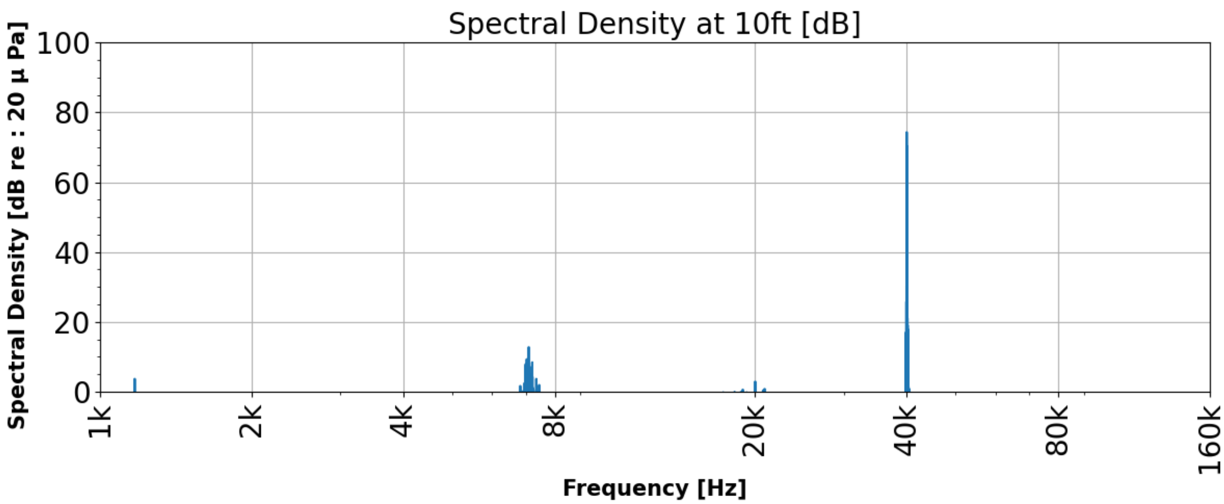
Figure 2. Song Meter Mini used to record low frequency sounds propagated by e-bikes and conventional bikes.

On June 15, 2021 we set out four Song Meter bat detectors (Song Meter SM4 BAT recorders; Wildlife Acoustics, Concord, Massachusetts, United States) (Figure 3) to record high frequency sounds at distances 10 feet, 20 feet, 40 feet, and 80 feet from a trail located in mostly open grassland habitat at the Sierra Azul Open Space Preserve unit in Santa Clara County. We used this trail to record high frequency sounds because it was fairly typical of pallid bat foraging and roosting habitat. . We recorded a Gary Fischer and a Specialized Rock Hopper to represent conventional bicycles and a Specialized 2020 Levo SL, a Santa Cruz 2018 Heckler, and a Specialized 2019 Levo to represent e-bikes. We recorded each e-bike and conventional bike as it was: 1) in power assist mode peddling slowly uphill, 2) in power assist mode peddling fast uphill, 3) coasting, and 4) braking (Figure 4).

Figure 3. Song Meter SM4 Bat Detector used to record sound pressures from bikes.

Figure 4. Field recording of e-bikes. A Specialized 2019 Levo ridden by Jeff Smith (MROSD) while Dr. Dave Johnston (H. T. Harvey & Associates) notes the timing of each recording at the Sierra Azul Open Space Preserve.

We determined the specific sensitivity of each microphone and confirmed that all microphones' sensitivities did not vary by more than about 1% from the others. Further, the sound levels analyzed were calibrated using a recording of a "chirp" tone at 40 kHz generated by a Song Meter SM4 calibrator for each of the four deployed microphones. Based on the user guide for the SM4 calibrator, the chirp mode emits a 100-millisecond (ms) long, 40 kHz (±10 Hz) tone every 500 ms. The amplitude of this chirp is 104 dB sound pressure level (SPL) (±3 dB) at 10 centimeters. Using the recordings made at 10 feet (3.048 meters), the amplitude of the chirp is calculated to be 74 dB in amplitude using a standard geometric spherical spreading loss of 6 dB per doubling of distance. Figure 5 shows the spectral density and spectrogram of the calibration chirps used to analyze the conventional bike and e-bike recordings. All e-bike and conventional bike recordings made were typically 2 seconds in duration for the coast and brake modes of operation and about 8 to 10 seconds for the pedal fast/pedal slowly uphill modes. The difference in the duration times was due to the speed of the bike as it passed the microphones; bikes simply took more time to pedal uphill than they did to coast or coast and brake going downhill.



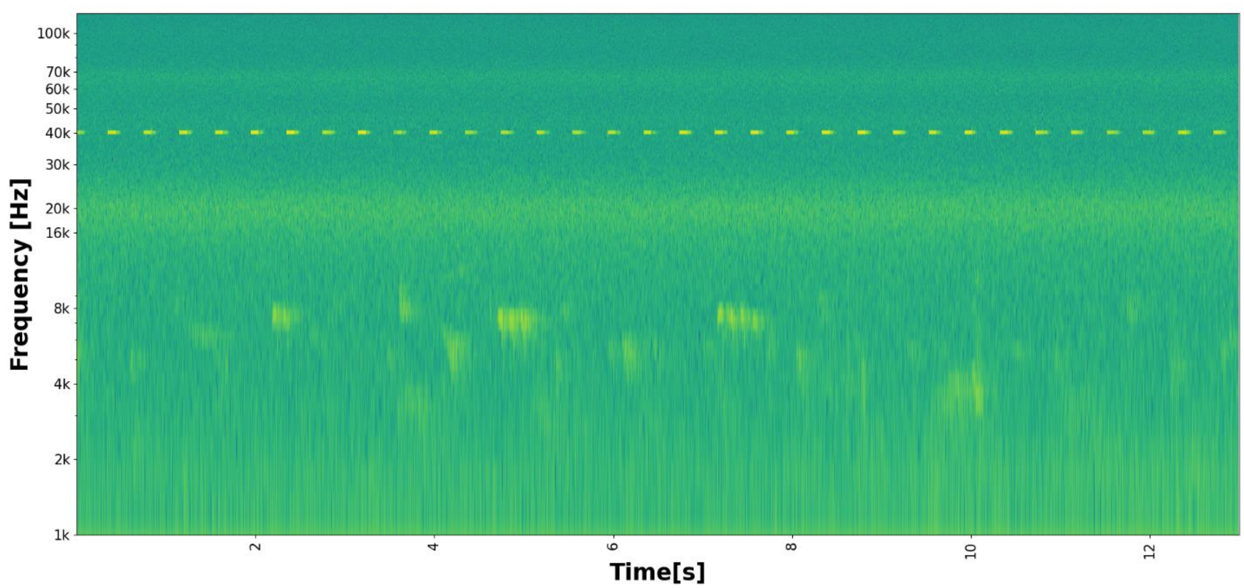


Figure 5: Spectral density plot and spectrogram for the calibration 'chirp' measured at 10 feet

A sound laboratory, Illingworth & Rodkin, Inc., analyzed recordings and was tasked with determining the distance-based rate of noise attenuation. For a generalized summary of all recordings, sound pressure levels in decibels were calculated for each bicycle and for each trial and separated into three frequency groups: all frequencies (1 – 128 kHz), medium and high frequencies (8 – 128 kHz) and high frequencies (16 – 128 kHz) (Table 1). For this summary, all frequencies were first combined and then reduced in a step-wise procedure when going from all frequencies to only high frequencies. For purposes of determining the distance-based noise attenuation for birds and each phonic group of bat species, noises were further grouped into categories representing species that are expected to regularly occur within the MROSD's geographic area. Therefore, we grouped the noise levels and attenuation rates into five phonic groups (Table 2). Illingworth & Rodkin, Inc. staff then computed the transmission loss rates for the loudest sounds propagating from the e-bikes for each phonic group to determine the distance for the sound to level off to ambient levels (20 dB).

Table 1. Phonic groups representing birds and bats

Frequency	1kHz – 5kHz	18kHz – 26kHz	27kHz – 35kHz	36kHz – 44kHz	45kHz – 55kHz
Phonic Group Name	Birds	20 kHz bats	30 kHz bats	40 kHz bats	50 kHz bats
Species Represented	Birds	hoary bat (*Lasiurus cinereus*) Brazilian free-tailed bat (*Tadarida brasiliensis*) Townsend's big-eared bat (*Corynorhinus townsendii*)	pallid bat (*Antrozous pallidus*) big brown bat (*Eptesicus fuscus*) silver-haired bat (*Lasionycteris noctivagans*) Long-eared myotis (*Myotis evotis*) Fringed myotis (*Myotis thysanodes*)	long-legged myotis (*Myotis volans*) little brown bat (*Myotis lucifugus*) western red bat (*Lasiurus frantzii*)	California myotis (*Myotis californicus*) Yuma myotis (*Myotis yumanensis*)

Results

Spectral Densities of the Different Modes for Representative Bicycles

The sound pressure levels for different modes of operation for each of the e-bikes and conventional bicycles are summarized in Table 2. No values are reported for pedaling slowly or pedaling fast for the Gary Fischer conventional bicycle, or pedaling fast for the Specialized Rock-Hopper conventional bicycle, because the sound pressures generated from these modes and models were likely too low to be recorded by the microphones. Generally, conventional bicycles were quieter. Note also that the loudest noises were propagated by pedaling slowly or fast uphill with the e-bikes. The loudest consistent noise, 90 dB, was generated by pedaling slowly uphill in the Specialized 2020 Levo SL e-bike, although the loudest sound recorded, 96 dB, was generated by braking hard in the Specialized 2019 Levo e-bike. Because braking hard generated very inconsistent results and is not a commonly occurring event for e-bike riders, we did not use this single 96-dB data point to help determine buffer distances. Likewise, we found inconsistent results from recordings of e-bikes pedaling slowly uphill, so we decided to determine appropriate buffer distances based on pedaling fast uphill.

Table 2: Summary of sound pressure levels for different modes of operation – conventional bikes and e-bikes measured at a distance of 10 feet

Bike name & type	Mode of operation	SPL dB* (1 kHz - 128kHz)	SPL dB* (8 kHz - 128kHz)	SPL dB* (16 kHz - 128kHz)
Gary Fischer - Conventional	Coast	52	52	52
	Brake	66	66	66
Specialized Rock Hopper - Conventional	Coast	61	61	61
	Pedal slowly uphill	83	81	81
	Brake	64	64	62
	Hard Brake	70	70	70
Specialized 2020 Levo SL - E-bike	Pedal fast uphill	81	81	81
	Coast	64	64	64
	Pedal slowly uphill	90	90	90
	Brake	82	82	82
Santa Cruz 2018 Heckler - E-bike	Pedal fast uphill	76	76	76
	Pedal slowly uphill	88	88	87
	Brake	54	54	54
Specialized 2019 Levo - E-bike	Pedal fast uphill	72	72	72
	Coast	88	87	86
	Pedal slowly uphill	41	38	38
	Brake	71	70	70
	Hard Brake	96	94	94

*SPL dB = sound pressure levels in decibels

Because sounds were loudest and more intact in their structure at 10 feet, Illingworth & Rodkin staff prepared spectral density graphs with dB for the continuum of frequencies along with frequency/time spectrograms based on the recordings made at 10 feet (Appendix A). Figure 6 shows spectral density plots on the left along with the corresponding spectrograms for the three e-bikes measured when the e-bike is operating in the 'pedal fast uphill' mode. For the Specialized Levo e-bikes, the frequency spectrum is relatively broadband as compared to the Santa Cruz Heckler e-bike, which has peaks between 16 kHz to 60 kHz. As seen from table 1 above, the Specialized 2020 Levo SL e-bike is the loudest of the three when operating in this mode, measuring at 81 dB when summed up logarithmically across the different frequency ranges taken into consideration.

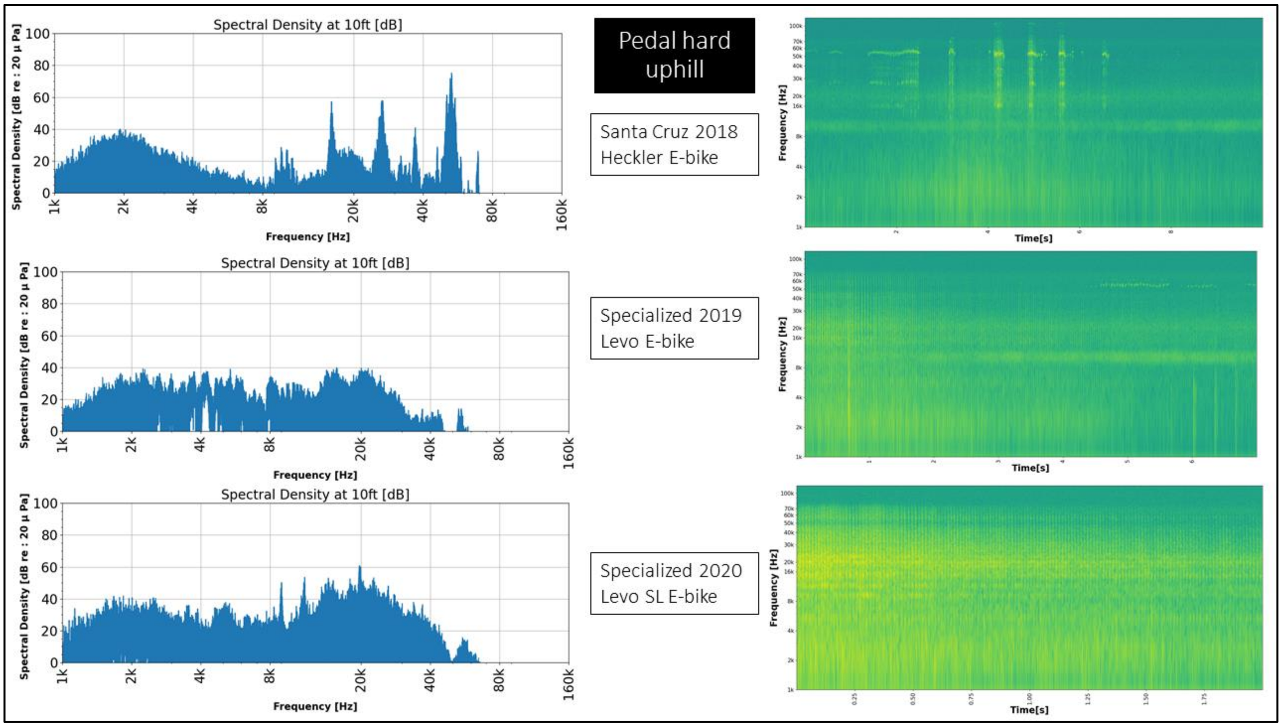


Figure 6. Spectral Densities of sound pressures and spectrograms of conventional bikes and e-bikes in pedaling fast uphill mode. This mode was chosen to determine appropriate buffers for various phonic groups of bats and birds as its own 1 kHz – 5 kHz group.

The 'coast' mode spectral density plots and spectrograms suggest that conventional bikes are quieter as compared to the e-bikes when coasting and the highest sound pressures were from between 8 kHz and 70 kHz (Appendix A1). The 'pedal slowly uphill' mode spectral density plots and spectrograms suggest that both the conventional bikes and e-bikes have substantial sound pressure from between 50 kHz and 70 kHz and the Specialized 2019 Levo e-bike is the quietest of all the bikes in this mode (Appendix A2). The brake mode spectral density plots and spectrograms suggest that the Specialized Levo e-bike showed the loudest levels while the quietest bike was the Santa Cruz Heckler e-bike (Appendix A3)

Recommendations

Buffer Distances

The Specialized 2020 Levo SL appeared to be the overall loudest e-bike out of the bikes measured; hence, sounds measured from this bike in the 'pedal fast uphill' mode were further analyzed to compute a sound transmission loss (attenuation) rate. A recommended buffer distance would therefore be based on the estimated distance from this operating e-bike needed in order to attenuate to an ambient noise level of 20 dB, the estimated ambient sound level of the environment at the time of recording. Figures 7 and 8 below show the spectral density and the spectrograms corresponding to the 2020 Levo SL e-bike operating in the 'pedal fast uphill' mode at distances of 10, 20, 40 and 80 feet captured by the Song Meter SM4 microphone.

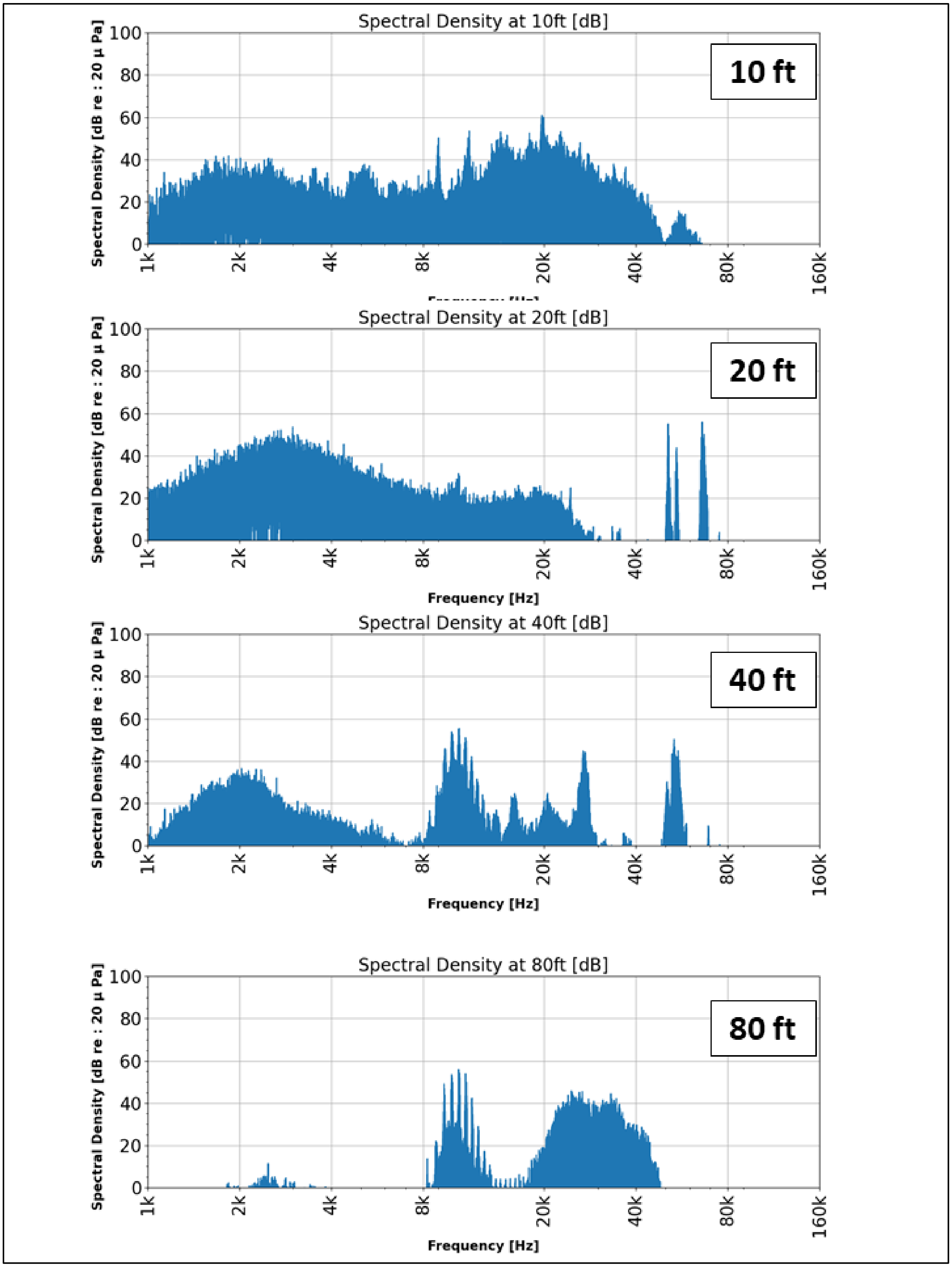


Figure 7: Spectral density plots for Specialized 2020 Levo SL e-bike in 'pedal fast uphill' mode of operation at different measurement distances from the source

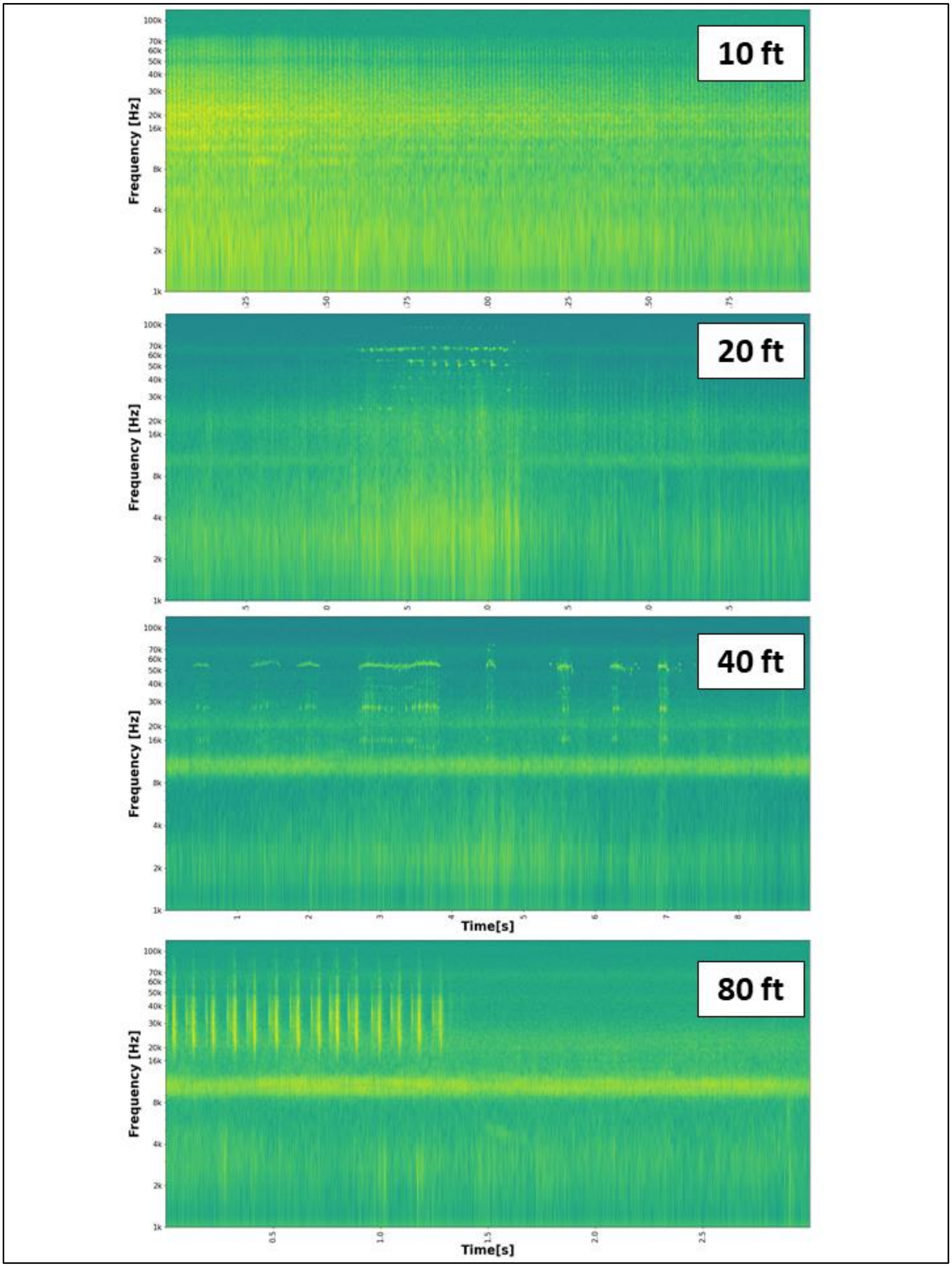


Figure 8: Spectrograms for Specialized 2020 Levo SL e-bike in 'pedal fast uphill' mode of operation at different measurement distances from the source

Calibration chirps at 40 kHz were also recorded at 10, 20, 40 and 80 foot distances along with e-bike sounds. The data from the above measurements for the Specialized 2020 Levo SL are summarized in Table 3 below. The sound levels shown in the table below have been summed up logarithmically between the phonic groups as previously described (Table 1).

Table 3: Summary of sound pressure levels summed for different frequency ranges along with computed sound transmission loss rates

Specialized 2020 Livo SL - E-bike	Sound Pressure Level, dB					
Distance (ft)	**Calibration chirp (40 kHz)**	**1kHz to 5khz**	**18kHz to 26kHz**	**27kHz to 35kHz**	**36kHz to 44kHz**	**45kHz to 55kHz**
10	74	61	66	73	78	72
20	47	48	61	51	50	46
40	61	8	57	42	37	33
80	No chirps in recordings	11	22	71	40	30
Transmission loss rate	-13.5 dB per doubling	-18.8 dB per doubling	-13.9 dB per doubling	-15.5 dB per doubling*	-12.8 dB per doubling	-13.9 dB per doubling

*using only 10, 20, 40 ft measurements

Using the transmission loss rates computed for the above frequency ranges, Table 4 below shows the computed distances required for sound to attenuate to an ambient level of 20 dB. As presented, the data suggest that the amount of sound pressure from e-bikes is not even across each of the phonic groups; rather, the amount of sound pressure is far greater in the 40 kHz phonic group than in other groups suggesting that bats such as the long-legged myotis, little brown bat, and western red bat may be more prone to disturbance from e-bike traffic than other bat species.

Table 4: Computed distances for e-bike sound to attenuate to ambient levels of 20 dB for different frequency ranges

	1 kHz to 5 kHz	**18 kHz to 26 kHz**	**27 kHz to 35 kHz**	**36 kHz to 44 kHz**	**45 kHz to 55 kHz**
Distance to ambient (ft)	45	100	107	231	134

We therefore recommend any bike (conventional bike and e-bike) trail that allows e-bike traffic, to have a minimum 100-foot distance from any roost site of Brazilian free-tailed bats, Townsend's big-eared bats, or hoary bats, although the latter is transient and does not produce young on MROSD lands. Active roosts of the 30 kHz phonic group of bats, which include pallid bats, big brown bats, silver-haired bats, long-eared myotis, and fringed myotis, should have a minimum buffer zone of 107 feet between an active roost and any bike trail; active roosts of the 40 kHz phonic group of bats, which include long-legged myotis, little brown bat, and western red bat should have a minimum buffer zone of 231 feet between an active roost and any bike trail; and active roosts of the 50 kHz phonic group of bats, which include California myotis and Yuma myotis, should have a minimum buffer zone of 134 feet between an active roost and any bike trail. Maternity colonies of pallid bats and Townsend's big-eared bats are extremely sensitive, and Townsend's big-eared bats are known to abandon young because of disturbances. Therefore, for a maternity colony of either of these species, we recommend a minimum buffer of 200 feet to any trail allowing any bike traffic.

Birds' sensitivities to noise disturbances are varied, and little is known about the tolerance of many species to noise disturbance; however, based on our data, these low frequency e-bike sounds attenuate to about 20 dB, the ambient noise level recorded, at 45 feet from the operating e-bike. The noises e-bikes make are primarily high frequency, so like humans, birds cannot hear these high energy, high frequency sounds and are not likely affected much from them. For reference, the United States Fish and Wildlife Service (USFWS) (2020) has recently published guidelines on the estimated disturbance distance (in feet) due to elevated action-generated sound levels affecting the northern spotted owl and marbled murrelet, by sound level (Appendix B). On the other hand, bats are going to be quite sensitive to e-bike noises. For a review of noise impacts on wildlife, see Blickley and Patricelli (2010).

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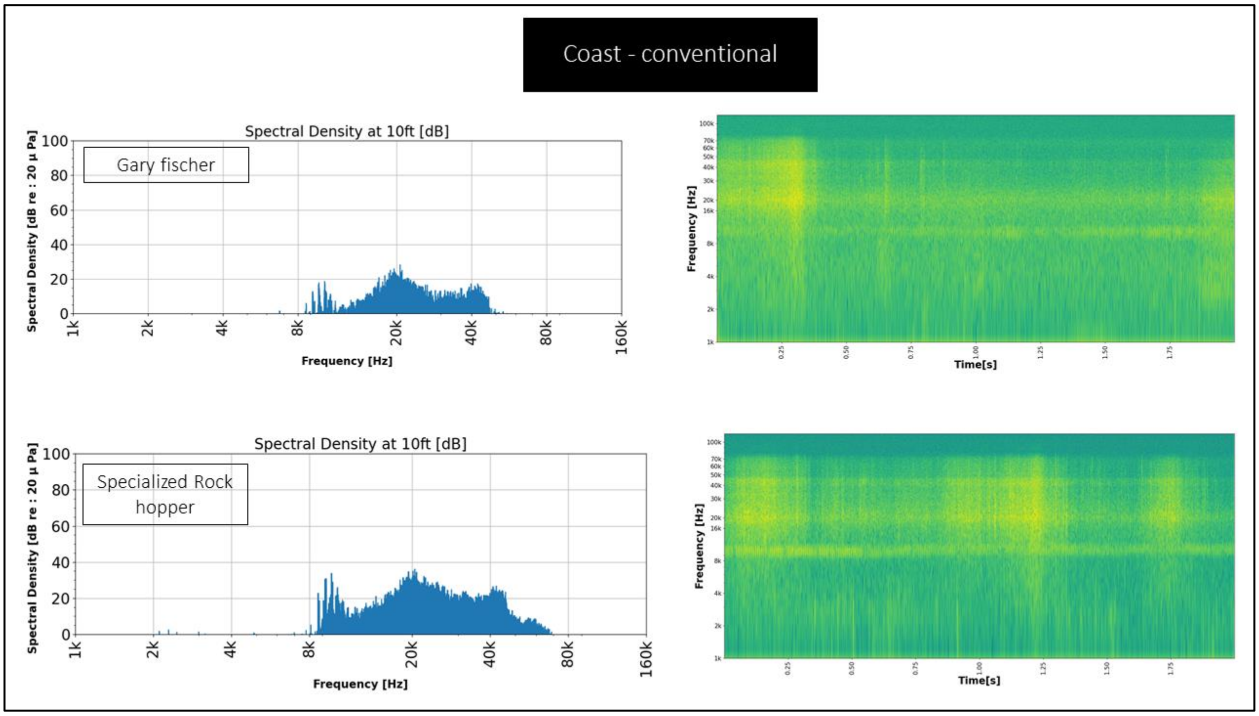
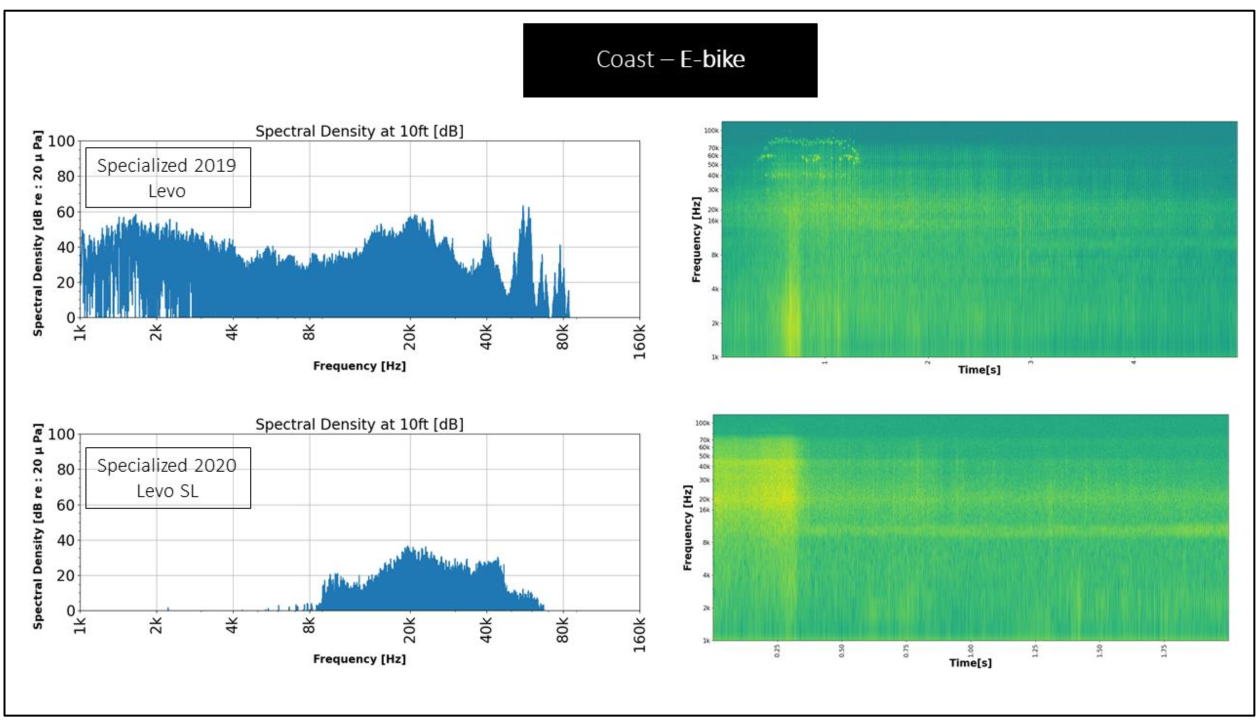
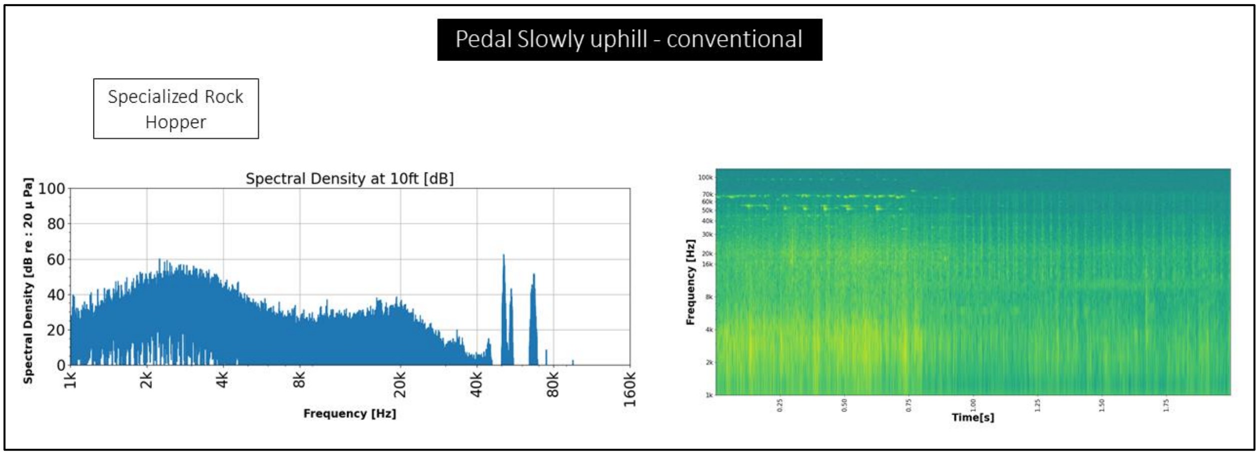
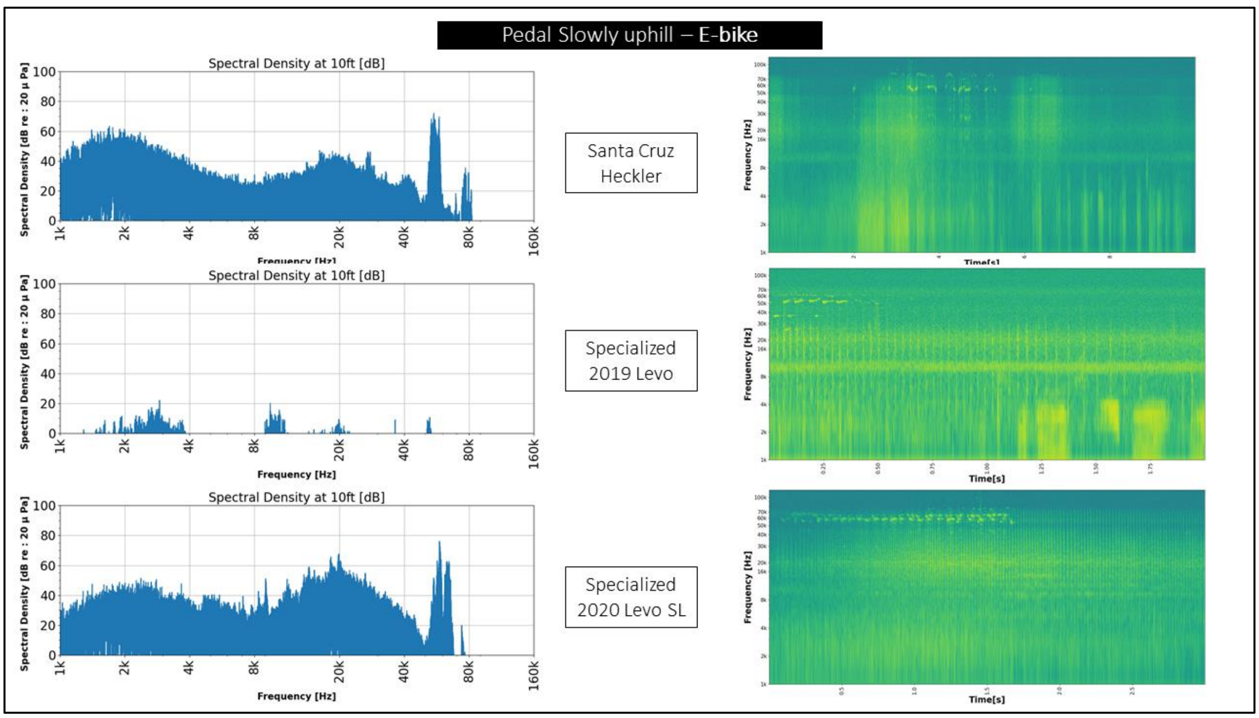
Appendix A1. Spectral density plots and spectrograms for conventional bikes and e-bikes when operating in the 'coast' mode



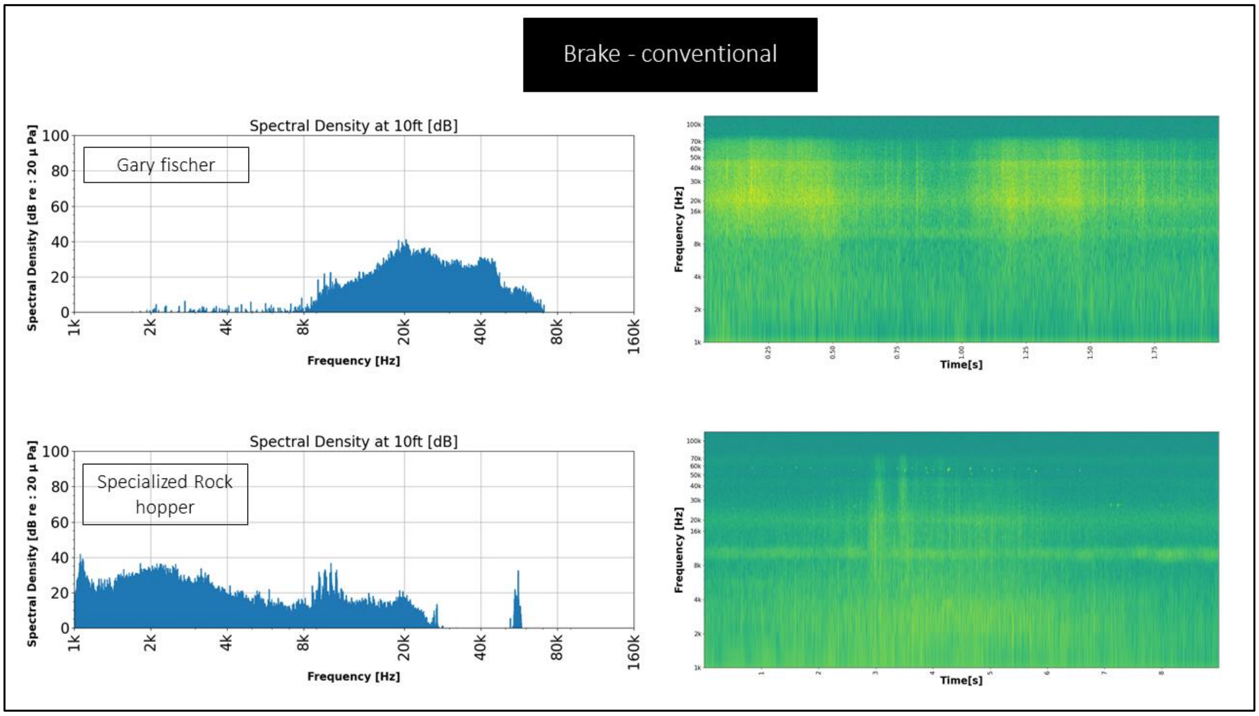


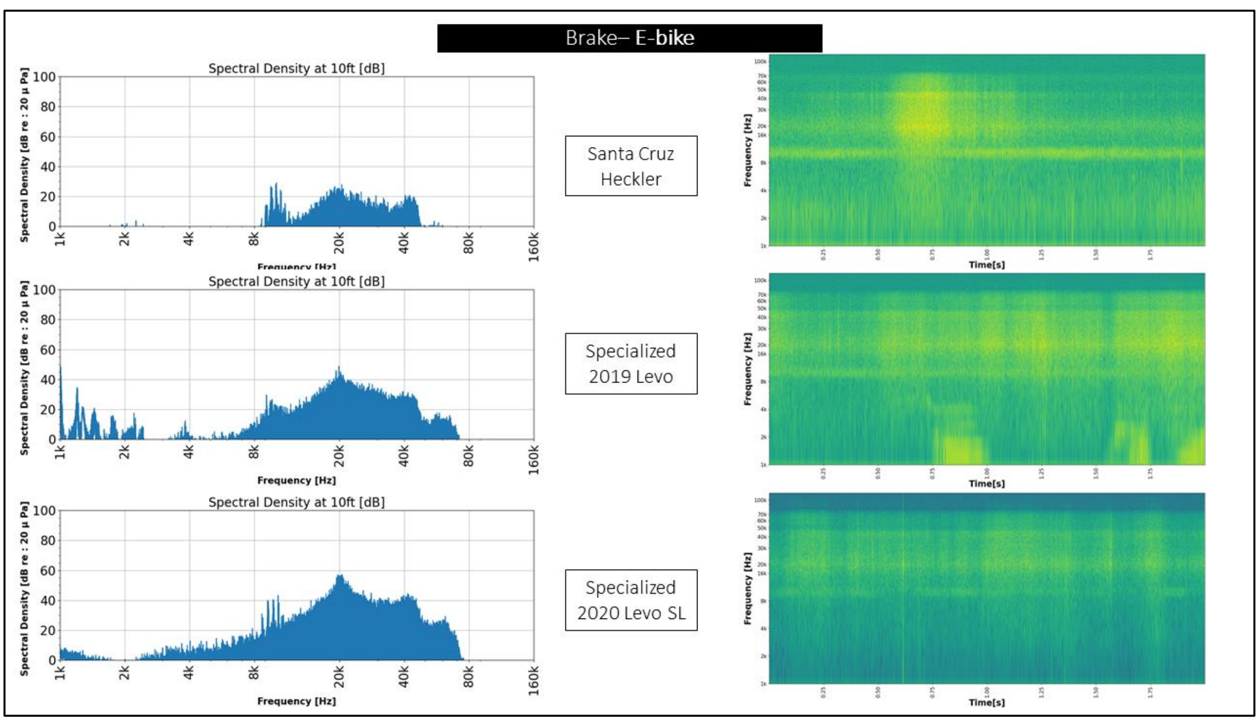
Appendix A2. Spectral density (left) and spectrogram (right) plots for conventional bikes and e-bikes in 'pedal slowly uphill' mode of operation





Appendix A3. Spectral density plots and spectrograms for conventional bikes and e-bikes when operating in the 'brake' mode.





Appendix B. USFWS guidelines for disturbance distances

Table 1. Estimated disturbance distance (in feet) due to elevated action-generated sound levels affecting the northern spotted owl and marbled murrelet, by sound level.

Existing (Ambient) Pre-Project Sound Level (dB) [1, 2]	Anticipated Action-Generated Sound Level (dB) [2, 3]			
	Moderate (71-80)	High (81-90)	Very High (91-100)	Extreme (101-110)
"Natural Ambient" [4] (< = 50)	50 (165)[5,6]	150 (500)	400 (1,320)	400 (1,320)
Very Low (51-60)	0	100 (330)	250 (825)	400 (1,320)
Low (61-70)	0	50 (165)	250 (825)	400 (1,320)
Moderate (71-80)	0	50 (165)	100 (330)	400 (1,320)
High (81-90)	0	50 (165)	50 (165)	150 (500)

1 Existing (ambient) sound level includes all natural and human-induced sounds occurring at the project site prior to the proposed action, and are not causally related to the proposed action.

2 See text for full description of sound levels.

3 Action-generated sound levels are given in decibels (dB) experienced by a receiver, when measured or estimated at 50 ft from the sound source.

4 "Natural Ambient" refers to sound levels generally experienced in habitats not substantially influenced by human activities.

5 All distances are given in meters, with rounded equivalent feet in parentheses.

6 For murrelets, activities conducted during the dawn and dusk periods have special considerations for ambient sound level. Refer to page 7 for details.


Photo by Karl Gohl, courtesy of Midpeninsula Regional Open Space District

E-BIKES AND OPEN SPACE:

THE CURRENT STATE OF RESEARCH AND MANAGEMENT RECOMMENDATIONS

ATTACHMENT 4

PREPARED BY
San Francisco Estuary Institute

PREPARED FOR
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E-bikes and open space: the current state of research and management recommendations

Prepared for Midpeninsula Open Space District by the San Francisco Estuary Institute

Executive Summary

Electric bikes (hereafter "e-bikes") are a new technology that is growing in popularity. There are three classes of e-bike, all of which have a battery-powered motor that assists the rider. Classes 1 and 3 require the rider to pedal to engage the motor, while class 2 can use the motor exclusively to propel the bike.

As e-bikes have risen in popularity and other land managers have begun allowing e-bikes on trails and roads within parks and preserves, the Midpeninsula Regional Open Space District (hereafter "Midpen") has received many public comments expressing interest in riding e-bikes in its preserves. Currently, two-thirds of Midpen's trail system allows traditional non-motorized bicycles, but their regulations prohibit e-bikes. Little information is available to predict whether e-bikes, relative to traditional bikes, would have different ecological and social impacts. Like many other agencies, Midpen is looking to emerging scientific studies to better understand the potential impacts of e-bikes on the natural resources and ecosystem functions in public open space. This information will help Midpen evaluate whether e-bike use is compatible with its mission for the management of the preserves, part of which is to "protect and restore the natural environment, and provide opportunities for ecologically sensitive public enjoyment and education." If Midpen determines that e-bikes are compatible with its goals, the science will also help in crafting a policy that allows for e-bike use in a way that serves the interests of both users and the environment.

This report is part of Midpen's effort to gain a deeper understanding of the range of possible outcomes of allowing e-bike use in the preserves. For this science synthesis, over 75 papers were reviewed, and a committee of advisors (see Introduction) contributed their knowledge and expert opinions. The goals of this report are to summarize the impacts of traditional mountain bikes, identify how e-bike impacts are likely to be similar or different, and provide recommendations for managing e-bike use if Midpen decides to allow it. The literature review revealed a number of key themes:

1. **Very few studies have been published about e-bike use in public open space.**

   Most studies are about e-bikes for commuter use. Much of this information will be relevant only to urban settings, though some portion may translate to open space settings. In addition, among the few studies conducted in open space settings, some did not yield statistically meaningful results due to small sample sizes. More research is needed to understand e-bike use in open space and its potential impacts to trails, wildlife, and other visitors. Regular reviews of new research and ongoing collaboration between Midpen and other recreation land managers would help ensure that Midpen's e-bike policy continues to be guided by the most recent science and expertise.

2. **Noise pollution is likely to be an important impact of e-bikes, leading to disturbances to some wildlife species.**

   Noise emitted by the motor has the potential to disturb some wildlife species. E-bikes emit both high- and low- frequency sounds in the audible range of many bird and bat species. Other species that hear in these frequencies are likely to experience some disturbance as well when using trail-adjacent habitat. Continued research on sounds from e-bike motors and wildlife disturbance will be valuable. If allowing e-bikes, Midpen should use buffer distances based on the best available research to separate trails from sensitive nesting and roosting sites.

3. **Potential areas of difference between e-bikes and traditional bikes include uphill speed, trail degradation, distance traveled and number of users.**

   At this time, the limited amount of available research is insufficient for drawing general conclusions about the trends or impacts related to e-bike use in open space settings. Surveys of e-bike users highlight their motivations to use e-bikes, including extending their ability to ride into older age (thus increasing the number of users) and being able to travel longer distances. Surveys of other visitors identified speed of e-bikes to be a major concern, for reasons related to safety and environmental degradation. More quantitative research is needed to understand whether these motivations and concerns are reflected in reality in open space settings where e-bikes are allowed.

4. **As more e-bike research becomes available, an adaptive management strategy would facilitate future adjustments to management practices. Many of the management strategies used for mountain bikes are likely to apply to e-bikes as well.**

   Education and outreach, including signage and education programs, are key tools for promoting responsible cyclist behavior as well as reducing conflicts between visitors. Sustainable trail design and other on-trail management strategies can help to minimize traditional mountain bike impacts to natural resources while maintaining high quality recreation experiences. These strategies are likely to continue to be effective for managing potential trail impacts of e-bikes, but continued monitoring and research will be critical to increasing knowledge and improving management of e-bikes in Midpen preserves over time.

Finally, many agencies that manage open space face a challenge in developing a policy for e-bikes based on a very limited amount of information. For instance, a 2016 survey of land management agencies found that the vast majority of land managers (91%) are concerned about possible environmental impacts of e-bikes and would find more research to be useful *(Trail Use and Management of Electric Mountain Bikes: Land Manager Survey Results,* 2016). Given the lack of information, if Midpen proceeds with a policy allowing e-bikes, an adaptive management approach is highly recommended. As new studies are published and as e-bikes continue to evolve, Midpen should be prepared to review the new information and potentially integrate it into a revised policy to ensure that e-bike use will remain compatible with its mission.

Introduction

Electric bicycles, hereafter "e-bikes," are a relatively new technology that is growing in popularity in the United States (MacArthur et al., 2018). E-bikes are equipped with a battery-powered motor that assists the rider in propelling the bike forward. Around the world, urban residents are rapidly adopting e-bikes for their commutes, and therefore most scientific research on e-bikes focuses on urban settings and outcomes like greenhouse gas emissions, urban noise pollution, and traffic collisions (e.g., McQueen et al., 2020; Schepers et al., 2014; Weiss et al., 2015). However, e-bikes are becoming increasingly popular in natural areas as well. For instance, a survey of Colorado e-bike users found that most (93%) intend to use their e-bikes on public lands and a substantial portion of e-bike users (34%) are interested in using their e-bikes for mountain biking (Perry and Casey, 2020). Given that e-bikes are fairly new technology, available studies on e-bikes are limited. Nonetheless, many open space agencies are pressed to establish an e-bike policy as public interest in e-bike use grows. By default, California Vehicle Code Section 21207.5 allows some types of e-bikes on unpaved trails unless the managing agency's policy specifically prohibits them. A survey of land managers found that the vast majority (91%) are concerned about possible environmental impacts of electric mountain bikes and would find studies on these and other impacts useful (*Trail Use and Management of Electric Mountain Bikes: Land Manager Survey Results*, 2016).

The Midpeninsula Regional Open Space District (hereafter "Midpen") is one of many agencies seeking to establish an e-bike policy. In Santa Clara, San Mateo and Santa Cruz counties, Midpen has preserved approximately 65,000 acres of land, more than half of which is open to the public. Many people in the region visit Midpen's preserves to participate in various activities, such as hiking, mountain biking, horseback riding, and other more leisurely activities like bird-watching and nature photography. Approximately two-thirds of Midpen's trail system is multi-use and allows bicyclists. Currently, Midpen does not allow e-bike use on preserves except under an e-bike pilot program at two preserves and primarily on paved trails, as well as for people with mobility disabilities under the Other Power-Driven Mobility Devices policy in conformity with federal land management laws and regulations. Recently, Midpen has received many public comments expressing interest in riding e-bikes in the preserves, prompting this literature review and other efforts to evaluate the feasibility and potential impacts of introducing e-bike use on trails.

Like many other agencies, Midpen is looking to existing scientific studies to better understand the potential impacts of e-bikes on natural resources in public open space. This information will help Midpen evaluate whether e-bike use is compatible with its mission to "protect and restore the natural environment, and provide opportunities for ecologically sensitive public enjoyment and education." This report presents a synthesis of the current body of scientific literature and aims to achieve the following:

- Summarize the impacts of traditional mountain bikes
- Identify potential impacts that may be unique to e-bikes
- Identify which traditional mountain bike impacts are likely to also be true of e-bikes
- Provide management recommendations to reduce potential negative impacts of e-bikes

In addition to this study, Midpen has collaborated with partners on a study of motor noise emissions and the potential to disturb wildlife (discussed in this report), and an ongoing study of visitor perceptions of e-bikes. The broader literature on e-bikes includes several other topics that this report will not address, because these topics are likely to not be relevant to public open space settings. Such topics are more relevant to urban areas and include greenhouse gas emissions reductions (i.e., when replacing a gas-powered vehicle with an e-bike), urban noise pollution reduction, and traffic collisions.

Additionally, this report has benefited from the involvement of a committee of six advisors, representing a range of relevant areas of expertise. They contributed their knowledge and expert opinion during two workshop meetings and through review of this report. The advisors were Mary Ann Bonnell (Jefferson County Open Space), Peter Cowan (Peninsula Open Space Trust), Natalie Dayal (National Park Service, Golden Gate National Recreation Area), Mia Monroe (National Park Service, Golden Gate National Recreation Area), Jennifer Thomsen (University of Montana), and Lynne Trulio (San Jose State University).

Electric bicycle near trail. (photo by Fabrice Florin, courtesy of CC BY 2.0)

CLASSES OF E-BIKES

California Vehicle Code Section 312.5(a) defines an "electric bicycle" as "a bicycle equipped with fully operable pedals and an electric motor of less than 750 watts." The section also defines the three classes of electric bicycle as follows:

- "A "class 1 electric bicycle," or "low-speed pedal-assisted electric bicycle," is a bicycle equipped with a motor that provides assistance only when the rider is pedaling, and that ceases to provide assistance when the bicycle reaches the speed of 20 miles per hour."
- "A "class 2 electric bicycle," or "low-speed throttle-assisted electric bicycle," is a bicycle equipped with a motor that may be used exclusively to propel the bicycle, and that is not capable of providing assistance when the bicycle reaches the speed of 20 miles per hour."
- "A "class 3 electric bicycle," or "speed pedal-assisted electric bicycle," is a bicycle equipped with a motor that provides assistance only when the rider is pedaling, and that ceases to provide assistance when the bicycle reaches the speed of 28 miles per hour, and is equipped with a speedometer."

At the time of writing, Midpen is only considering allowing class 1 e-bikes on unpaved trails and classes 1 and 2 e-bikes on limited paved trails.

ABOUT THE LITERATURE

This literature review primarily focused on peer-reviewed studies. The peer review system among academic journals gives other scientists a chance to critique the paper to ensure the research is of high quality before it is accepted for publication. Because peer-reviewed studies on both traditional mountain bikes and e-bikes are limited in number, to gather as much evidence as possible this review also includes studies that have not been peer reviewed. Whether or not a resource is peer-reviewed, when very few studies are available on a particular topic, it is important to note that additional research is necessary to build more evidence before broad conclusions may be drawn.

Studies that are not peer-reviewed fall into two categories: student research and white papers. Student research (e.g., master's theses and Ph.D. dissertations) is overseen by university faculty to ensure that the student develops a rigorous study design and produces a high quality report. A white paper is a report or guide that is independently produced by a company or organization. Some white papers in this report were produced by government agencies (e.g., Boulder County Parks and Open Space) and others by non-profit organizations (e.g., PeopleForBikes and International Mountain Biking Association). Some caution regarding literature that has not been peer reviewed is warranted. Non-peer-reviewed works were included as long as the authors provided clearly stated methods and results, and their interpretation did not overstate the results. The latter is particularly important when the sample size is too low to yield a statistically powerful result.

Impacts of traditional mountain bikes

Because traditional mountain bikes have been around since the 1970s, more is known about the ecological impacts of mountain bikes in open space than e-bikes. In the broader body of literature on recreation outcomes, mountain biking has received less attention than hiking, which is by far the most studied activity (Larson et al., 2016; Thomsen et al., 2018).

This chapter summarizes the impacts of mountain biking on the four major landscape components that are affected by recreation: wildlife, soil, vegetation and water (Cole, 1993). A brief section on visitor experience addresses the benefits received by participants in the sport and the potential for negative interactions between user groups on multi-use trails.

WILDLIFE

Mountain biking, as with other forms of recreation, can cause both short term and longer term disturbance to wildlife. Wildlife may respond to the presence of bicyclists through increased alertness or fleeing, as well as longer term avoidance of areas around trails. A recent review indicates that the level of disturbance varies widely depending on taxonomic group, frequency of recreational use, environmental characteristics, and other factors, making it difficult to draw generalizations (Marion, 2019).

Wildlife species that are disturbed by human presence may decrease in abundance at a site, or a species may no longer occupy the site at all. Some studies have reported reduced abundance of small mammals and mesocarnivores (small to medium sized predators), such as coyotes and bobcats, in response to recreational use (biking, hiking, and horseback riding) and human-modification in open space (Reed

Bobcat near Mount Hamilton. (photo by Don DeBold, courtesy by CC BY 2.0)

and Merenlender, 2011, 2008; Sauvajot et al., 1998), while other studies have found little relationship between mesocarnivore habitat occupancy and recreational use (Reilly et al., 2017; Townsend et al., 2020). These contradictory findings may be explained in part by different methodologies, such as the use of scat as a proxy for occupancy, which can be less accurate due to domestic dogs consuming scat and humans having low visual detection ability for scat (Townsend et al., 2020). Mountain lions are especially sensitive to humans, and have been observed in the Santa Cruz Mountains using GPS trackers to avoid areas where they perceive human presence by sound (Suraci et al., 2019). Their reduced occupancy led to a secondary effect of small mammals using more habitat area. After the opening of a new multi-use (biking, hiking, and horseback riding) trail in Sonoma County, mountain lions disappeared from the site and nine months of surveys post-opening did not observe any individuals returning to the site (Townsend et al., 2020). In some contexts, some wildlife species may habituate to recreational use and rebound to occupancy levels observed prior to the introduction of recreation (Townsend et al., 2020). For example, Townsend et al. (2020) found that detection of black-tailed deer around trails in North Sonoma Mountain Regional Park and Open Space Preserve decreased for two years after trail opening but then returned to pre-opening levels.

Literature regarding the impacts of mountain biking on wildlife relative to other forms of recreation is limited, and findings are mixed. In addition, much of the research has been conducted in other regions and is not focused on local species of interest in Santa Clara and San Mateo counties. (Taylor and Knight, 2003) found that bison, pronghorn antelope, and mule deer on Antelope Island, UT, responded similarly to hiking and mountain biking, and exhibited a 70% probability of flushing from on-trail visitors within 100 m of trails regardless of the type of activity. However, the potential for mountain bikers to disturb more wildlife within a given time period due to greater distance traveled was not examined. (Papouchis et al., 2001) found that desert bighorn sheep in Canyonlands National Park, UT, were much more likely to respond behaviorally to hikers than to mountain bikers; the authors hypothesize that this was due to the less predictable activity of hikers. In contrast, a study by (Naidoo and Burton, 2020) in British Columbia found that the timing of wildlife activity was affected more by mountain biking and motorized recreation than by hikers or horse riders. Townsend et al. (2020) found in Sonoma County that in the same four seasons post-trail opening, some wildlife species' occupancy levels rebounded and mountain biking rates decreased, both to pre-trail opening levels; the authors suggest that some wildlife may tolerate high hiking levels but low rates of bicycle use.

SOIL

Studies on soil-related impacts of recreation typically focus on forms of trail degradation. While type of use does influence trail degradation (Svajda et al., 2016), it is not as significant as certain aspects of trail design. The two primary drivers of trail sustainability are low trail slope alignment and low trail grade (Marion and Wimpey, 2017). Trail slope alignment (TSA) is the difference between the trail and the slope of the land. On more sustainable “side-hill” trails, TSA is low and the trail ascends more gradually, whereas a less sustainable “fall-line” trail is highly aligned with the slope and ascends the slope more directly. Studies conducted in the Southwestern US and on the Appalachian Trail have found that the steepest trail sections experienced the most soil loss, as measured by the amount of trail incision or change in trail depth (Meadema et al., 2020; White et al., 2006).

Mountain bikes can cause trail degradation through skidding and the construction of informal trails, jumps and bridges (Pickering et al., 2010). The riding style (speed, control) and trail conditions (grade and moisture) influence the severity of mountain bike impacts (Pickering et al., 2010). Another factor is the bike’s contact patch (the area of the tire that touches a surface) which is determined by tire width and pressure. In comparison to a cyclocross bike with 35mm wide tires inflated to higher pressure, a mountain bike with 60mm wide tires inflated to lower pressure had less impact on soil compaction (Martin et al., 2018).

Generally, impacts of mountain biking are mostly confined to the main tread (the surface of the trail where people walk or ride; (White et al., 2006). Mountain biking causes a very similar but slightly higher rate of soil loss compared to hiking (Evju et al., 2021; Olive and Marion, 2009). Mountain biking can cause soil compaction at similar rates as hiking (Martin et al., 2018). Studies of trail width expansion have found mountain bikes to have a relatively low effect that is comparable or greater relative to hiking (Evju et al., 2021; White et al., 2006). Wet conditions on natural-surface trails can exacerbate degradation caused

Mountain biking in the forest. (photo by TJ N, courtesy of Midpeninsula Regional Open Space District and CC BY 2.0) by mountain bikers and other recreationists (Evju et al., 2021; Landsberg et al., 2001). The contribution of mountain bikes to trail widening is relatively small compared to horse riding and off-highway vehicles (White et al., 2006).

Mountain bikers cause negative impacts through the unauthorized construction of trails (Pickering et al., 2010). Compared to trails carefully planned and constructed by land management staff, the unplanned nature of informal trails typically means that sustainability is not factored into their creation. Informal trails are more susceptible to degradation because they tend to feature higher trail grade and greater trail slope alignment (Wimpey and Marion, 2011).

VEGETATION

As with soil, vegetation impacts of mountain bikes stem from skidding, creation of informal trails, and addition of other unauthorized features like jumps (Pickering et al., 2010). Vegetation trampling is a well-studied impact of recreation, and is particularly problematic where users go off trail and create informal trails. In previously untrampled areas, after just 400 passes by a mountain bike (or a hiker), at least 50% of vegetation cover may be lost (Martin et al., 2018). Compared across recreational activities, mountain biking has a greater impact on vegetation cover than either hiking or running (Havlick et al., 2016). Within mountain biking, more vegetation loss occurs when riding uphill than downhill (Havlick et al., 2016). As mentioned earlier, wet trail conditions can lead mountain bikers and hikers to move around the muddy section, contributing to trail widening (Evju et al., 2021), which results from the trampling of trail-adjacent vegetation. Vegetation trampling also occurs when bikers move off trail to yield to hikers on multi-use trails where equestrians yield to bikers, who yield to hikers.

Mountain biking may also lead to human-mediated dispersal of pathogens. Pathogens may be accidentally spread on contaminated footwear, clothing, bike tires, or other objects (Kolby and Daszak, 2016). In the case of sudden oak death, a disease that affects oak trees in coastal California, spores of the fungus that causes the disease can stick to bike tires and thus travel between recreation sites (Davidson et al., 2005).

Similarly, mountain biking can also facilitate the dispersal of non-native plants. Especially in wet conditions, mountain biking can disperse plant seeds up to 500m (Weiss et al., 2016).

WATER

Mountain biking impacts to water quality have not been a major focus of scientific research. A review in 2010 found no published studies specific to mountain bike impacts on water (Quinn and Chernoff, 2010); more recent reviews have confirmed the lack of studies (Claussen, 2021). Potential impacts of mountain biking may be inferred from the broader body of literature on recreation impacts to water quality, although water quality impacts from recreation are not as well studied as wildlife, vegetation and soil impacts (Marion et al., 2016).

Recreation impacts to water quality often occur via impacts to soil. Except during wet conditions, well-designed trails are rather resilient to recreation impacts like soil compaction, widening and soil loss (Evju et al., 2021; Landsberg et al., 2001). Soil erosion may be higher where trails cross streams, especially where best management practices for trails are not implemented, and the soil enters the water (Kidd et al., 2014). The extra input of sediment and nutrients increases turbidity, reduces dissolved oxygen, and may promote algal blooms (Hammitt et al., 2015). Some algae produce toxins, and these harmful algal blooms (often referred to as “HABs”) can make water unsafe for recreation or drinking (Wurtsbaugh et al., 2019). Deaths as a result of algal toxins have been recorded for livestock and birds (Wurtsbaugh et al., 2019). Extra input of sediment also reduces habitat quality for protected salmonids, which are present in several of the watersheds on Midpen lands. Excessive sedimentation reduces the quality of salmonid spawning gravels and egg survival rates (Wood and Armitage, 1997). Juvenile salmonids also experience decreased growth and survival rates as a result of fine sediment deposition according to a study in Northern California (Suttle et al., 2004).

VISITOR EXPERIENCE

People who participate in mountain biking receive physical and mental health benefits. Studies have found that mountain biking can be as healthful an activity as road cycling (Dillard, 2017), which imparts many health benefits like cardiorespiratory fitness, lower risk of heart disease, lower risk of stroke, improved muscular fitness, and reduced depression (Oja et al., 2011). Beyond physical fitness benefits, participation in mountain biking helps people feel more connected to nature, which plays a significant role in supporting general well-being (Mayer and Frantz, 2004; Roberts et al., 2018; Shanahan et al., 2016). Mountain bikers also report stress reduction, improved self-esteem, and greater life satisfaction as a result of participation (Hill and Gómez, 2020; Roberts et al., 2018).

When different types of recreationists interact on the trail, there is a possibility for a negative experience or conflict. One study conducted in Montana received survey responses from 161 recreationists who were a mix of bicyclists and non-bicyclists to understand their perspectives of each other (Watson et al., 1991). The survey revealed that the perceived conflict was asymmetrical, with about 60% of hikers reporting issues with mountain bikers ("Bicycles traveling too fast or too many bicycles"), whereas 25-30% of bicyclists reported issues with hikers. Conflict can manifest in the form of negative interpersonal interactions, such as mountain bikers traveling too fast or passing too closely from the perspective of hikers (Carothers et al., 2001). High speeds of mountain bikers can also startle horses, leading some equestrians to report conflict (Napp and Longsdorf, 2005). Hikers may also perceive mountain biking as in conflict with their social values (e.g., causing more environmental degradation or increasing safety concerns; Carothers et al., 2001). A survey of 270 people living within 4 km of two national parks in Australia found that primary concerns about mountain bikes include the potential for collisions and environmental impacts (e.g., damage to plants and animals; (Rossi et al., 2014).

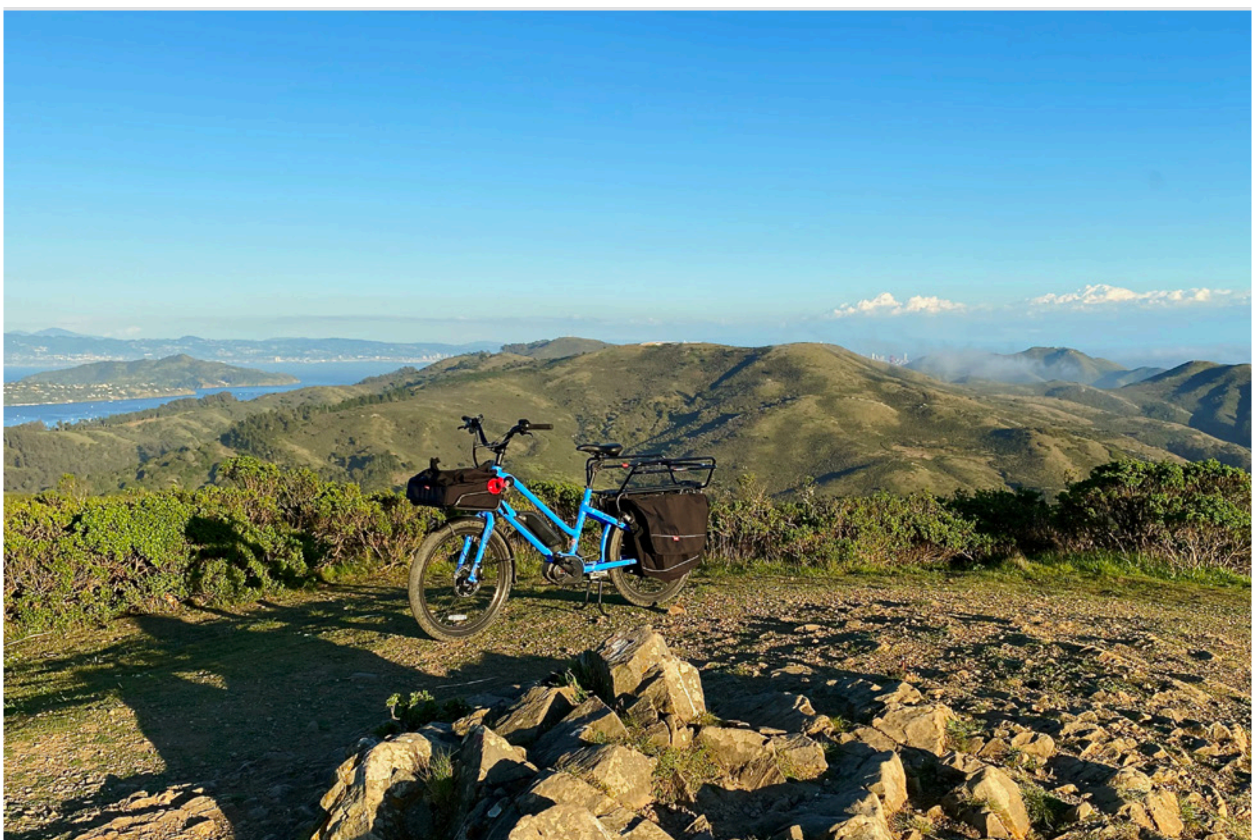
Mountain biking in the forest. (photo by TJ N, courtesy of Midpeninsula Regional Open Space District and CC BY 2.0)

Unique considerations of e-bikes

While many of the impacts from the use of e-bikes in natural areas are likely to be similar to the impacts from traditional mountain bikes discussed above, there are some areas in which the impacts from e-bikes may differ. Some of these potential differences are associated with the technology itself, such as noise produced by the e-bike motor. Other potential differences are associated with changes in visitor behavior or perceptions — such as increased number of unique visitors or distance traveled — that might result from land managers establishing a policy allowing the use of e-bikes. Very little empirical research has been conducted directly comparing the impacts of e-bikes and traditional mountain bikes in natural areas, and thus the focus of this chapter is on identifying the ways in which e-bike impacts are most likely to be similar to or different from traditional mountain bike impacts and summarizing the minimal amount of literature currently available on e-bike impacts in natural areas.

DEMOGRAPHICS

One of the potential effects of allowing e-bikes in open space is an increase in the total number of bicycles on trails. If riders are switching to e-bikes to extend their mountain biking careers as they reach older age, this would increase the overall number of mountain bikers, assuming new people continue to take up mountain biking at similar rates. This concept is supported by recent surveys conducted among bicycle riders on public lands in Colorado: the average age of e-bike riders (58 years old) is higher than that of traditional mountain bike riders (32 years old), and the average e-bike user had ridden bicycles on public lands for over 18 years (Perry and Casey, 2020).



Electric bicycle on trail. (photo by Fabrice Florin, courtesy of CC BY 2.0)

The attraction of new users to the sport due specifically to e-bikes may also increase the total number of bicycles on trails. Recent surveys in North America have found that demographic trends among e-bike users (predominantly older, highly educated, higher-income white males) are similar to trends among traditional bicycle users (Ling et al., 2017; MacArthur et al., 2018, 2014). These surveys have focused on early adopters (Ling et al., 2017), and therefore the demographics among e-bike users may change over time as technology becomes more broadly adopted. The current socioeconomic disparity among e-bike users may be in part due to the high cost of e-bikes, which has been identified as a significant barrier to e-bike adoption (Ling et al., 2017; Perry and Casey, 2020). Furthermore, new users may join the sport because e-bikes lower the physical fitness level necessary to participate. In North America, the use of e-bikes for recreation and exercise (as opposed to utilitarian purposes) is particularly common not only among older riders, but also among those with physical limitations (e.g., limitations related to mobility, respiratory disease, weight, or dexterity; MacArthur et al., 2018). These survey results are supported by other studies that found that study participants perceive their exertion to be lower on an e-bike than a traditional bike (Hall et al., 2019). Despite this perception and the pedal assistance, a comparison of measured heart rates found e-bike riding to provide many of the same health benefits as traditional bike use (Hall et al., 2019; Hoj et al., 2018).

Another potential effect of allowing e-bikes in open space is an increase in the frequency of bicycle use. Survey responses from 553 e-bike users across North America found that e-bikes can result in more frequent participation, increasing from only 31% to 89% of users riding weekly or daily after the purchase of an e-bike (MacArthur et al., 2018). This survey was more focused on urban and suburban settings, and could feasibly translate to the open space setting; however, more research is needed to determine whether this trend of increasing frequency of bicycle use will hold true in open space.

UPHILL SPEED

The electric assistance provided by e-bike motors may allow them to travel faster than traditional bicycles, particularly when traveling uphill. Surveys have shown that visitors may have safety concerns related to speed, especially on narrow trails or around blind corners (Chaney et al., 2019; Schachinger, 2020). However, very few studies have quantified e-bike speeds in open space settings, and the limited data are insufficient for drawing general conclusions. A pilot study in Boulder County conducted by Boulder County Parks & Open Space (Nielsen et al., 2019b) observed the speeds of 492 conventional bikes and 12 e-bikes on open space trails, and found that on average e-bike speed (13.8 mph) was slightly lower than conventional bike speed (14.9 mph). E-bikes traveled faster than conventional bikes in uphill settings (13.8 vs. 12.9 mph) and slower in downhill settings (13.5 vs. 15 mph). Statistical tests were not conducted due to the low number of e-bike observations. An undergraduate project from the Worcester Polytechnic Institute, which used trail cameras to compare the speeds of 152 conventional bikes and 3 e-bikes in Acadia National Park, similarly found that e-bikes traveled faster on average than conventional bikes in uphill settings (7 mph vs. 4.5 mph; Williams et al., 2020). In this study the maximum speed observed was 16 mph, but the authors did not state which type of bicycle achieved this speed.

The small sample size of e-bikes in both studies limits the utility of these findings, and further study is needed. If new research provides sufficient evidence of significant differences in speed between e-bikes and traditional bikes, then negative impacts to the trail may become a concern. This may be especially true in combination with the heavier weight of e-bikes; although the combined weight of a rider and their bike ranges widely, the additional weight of the motor and battery will shift the average weight, and thus cumulative impacts could be greater. Faster speeds may also contribute to increased safety concerns or conflicts with other visitors. For example, Pickering et al. (2010) state that impacts from mountain biking "are likely to be greater when riding is faster, less controlled, occurs on steeper slopes and in wetter conditions."

SOIL IMPACTS

There is a lack of data about the specific impacts of e-bikes on trails and soils. To date, only one study, conducted by the International Mountain Bicycling Association in 2015, has directly measured the trail impacts of electric mountain bikes compared with traditional mountain bikes (IMBA (International Mountain Bicycling Association), 2016). This study, conducted on a test trail in northwestern Oregon, measured soil displacement from class 1 electric mountain bikes, traditional mountain bikes, and off-road motorcycles, controlling for variables such as trail grade, tread texture, and soil moisture. Soil displacement was quantified by measuring trail cross sectional area following a set number of laps by each bicycle type. The study found no significant difference between the impacts of electric mountain bikes and traditional mountain bikes on trail cross sectional area, while motorcycles resulted in significantly more soil displacement than either electric or traditional mountain bikes. (Midpen does not allow visitors to ride motorcycles on trails, and is not considering doing so.) The study authors caution against drawing general conclusions from this limited study, as similar research has not yet been conducted in other study locations.

CONFLICTS BETWEEN VISITORS

The presence of e-bikes in preserves may cause concern among other user groups for similar reasons as traditional mountain bikes. Surveys have shown that visitors may have safety concerns related to speed, and may disapprove of perceived increased environmental damage or heightened noise pollution from e-bikes (Chaney et al., 2019; Schachinger, 2020). General disapproval is directed at all riders, whether on an e-bike or traditional bike, as some participants indicated in a Jefferson County, Colorado survey (Jefferson County Open Space, 2017).

In addition, e-bikes may spark new concerns. A common perception among traditional mountain bikers is that electric mountain bikers are "cheating" (Chaney et al. 2019, Jefferson County 2017, Nielsen et al.), and potential e-bike users have indicated that shaming, especially from other cyclists, poses a barrier to use (Mayer, 2020). The motorized aspect of e-bikes is a great concern (Baechle and Kressler, 2020), and has led participants in two surveys to raise the idea of a "slippery slope," meaning that if motorized e-bikes are allowed on trails not previously open to motorized recreational vehicles, then other uses that conflict with visitors' values and expectations for open space recreation may be allowed as well (Baechle and Kressler, 2020; Jefferson County Open Space, 2017). Despite these concerns, surveys have found that in practice the ability of trail users to distinguish e-bikes from traditional mountain bikes is relatively low (Jefferson County Open Space, 2017). In addition, trail users may be more likely to approve of e-bikes if they have experience with them. A study in which participants shared their perceptions before and after test riding an e-bike revealed the experience led to an increase in approval of e-bikes (Jefferson County Open Space, 2017).

Currently, Midpen is collaborating with Santa Clara County Parks (SCCP), which allows e-bike classes 1 and 2 where traditional bikes are allowed, on a study of perceptions of e-bikes among other user groups. The results (anticipated for release in 2022) will be a valuable addition to the literature on e-bikes.

NOISE POLLUTION

In the first study of its kind, H.T. Harvey and Associates (2021) measured the noise output from both traditional bikes and e-bikes in Midpen preserves to predict impacts of e-bike noise on bats and birds. Bats and birds hear in the high and low frequency range, respectively, and therefore both ranges were measured. In general, terrestrial wildlife responds to sound levels of 40 dB and greater (Shannon et al., 2016), and the loudest measurements in the study were 90-96 dB, generated by pedaling uphill (when the motor is engaged for pedal-assist) and braking. (Note that decibels are a logarithmic scale. For comparison, the sound level of a motorcycle 25 ft away is about 90 dB, and bird calls are around 44 dB (IAC Acoustics, 2021).) The researchers calculated the distance at which the noise output would attenuate to ambient noise levels of 20 decibels. Low and high frequency noise from e-bikes sufficiently attenuated around 45 ft and 100-231 ft, respectively. The attenuation distance for sounds in the high frequency range depends on the exact frequency. To protect known locations of nesting birds and roosting bats, land managers can use these attenuation distances as the minimum buffer distance required to prevent human-generated noise disturbance. Other wildlife species with similar auditory ranges may also be affected by e-bike noise output when using trail-adjacent habitat.

A recent literature review found no other studies of noise output from e-bikes, and in lieu reviewed wildlife impacts of drones as a proxy for e-bike motor noise (Nielsen et al., 2019a). Like e-bikes, drones are an emerging technology, and therefore the scientific literature is also emerging and limited. Drones can cause disturbance to wildlife when they are visibly and audibly detected by wildlife. Evidence indicates that drones can elicit behavioral changes including alertness, escape or attack (Barr et al., 2020; Rebolo-Ifrán et al., 2019). Therefore, it is plausible given the evidence from drone research and the new evidence from H.T. Harvey that e-bike motor noise can disturb and elicit behavioral responses from wildlife.

LONGER DISTANCE TRAVELED

E-bikes enable riders to travel longer distances. Surveys conducted in Sacramento and across North America have found that traveling longer distances is a motivation for e-bike users, and that e-bikes enable users to travel longer distances that might not have been possible for them on a traditional bike (MacArthur et al., 2014; Perry and Casey, 2020). These surveys were broadly focused on e-bike use, including urban and suburban settings. The findings could feasibly translate to open space settings; however, more research is needed to determine whether this trend of increasing distance traveled will hold true in open space.

The ability to travel longer distances may have implications for wildlife. If e-bike use results in increased traffic on more remote trails, wildlife may encounter more frequent disturbance. Depending on the frequency, as well as the wildlife species, wildlife response may intensify or wildlife may habituate. With infrequent disturbance, wildlife tend to have greater behavior response (e.g., alert distance, flight; (Marion, 2019). The habituation of wildlife may be more likely with greater predictability and greater frequency of visitors (Miller et al., 2001; Trulio et al., 2013; Westekemper et al., 2018).

FIRE RISK

While not common, there are a number of documented cases of the lithium-ion batteries used on e-bikes catching fire or exploding. Most of the reported incidents involved damaged batteries that caught fire while being charged or stored; fires may also be more likely to occur in aftermarket batteries (NBC New York, 2021; Roe, 2019). Fires that ignite mid-ride appear to be much less common, although there are documented cases (Pagones and Meyer, 2019; Tremblay, 2019).

Management recommendations

Similar to many other agencies who manage open space areas, Midpen will need to establish a policy on e-bikes in response to growing interest from the public. (At the time of writing, Midpen is only considering e-bikes of classes 1 and 2. Midpen is not considering class 3 e-bikes, which can travel at speeds up to 28 mph.) The decision depends on careful consideration of both the health and accessibility benefits to e-bike users and the potential negative impacts to natural resources and other visitors. Many agencies have already created policies on e-bikes (Table 1), and Midpen has interviewed staff at local agencies to understand their decision-making process, justifications, approach to rolling out the policy, and enforcement of the policy. Agencies interviewed by Midpen staff did not report major management challenges unique to e-bikes beyond those associated with traditional mountain bikes (B. Malone pers. comm.). Most local agencies that allow e-bikes did so after a classification system was adopted by the state and after California Vehicle Code was amended to allow e-bike trail use unless specifically prohibited. Similar action followed at the Federal level for land management agencies under the U.S. Department of the Interior. The existing policies represent a range of approaches across the three class types of e-bike and types of trail (paved or unpaved). Notably, only Marin Municipal Water District mentioned aftermarket kits (which are used to retrofit a traditional bike with a motor and battery), banning their use while allowing class 1 e-bikes with a special use permit. Given the potential fire hazard associated with aftermarket kits, Midpen may consider a similar stipulation in its future e-bike policy.

Short of allowing e-bikes on all trails currently open to traditional bikes, there are a number of intermediate policies that Midpen could consider. Midpen could establish a temporary pilot program in which e-bikes are allowed for a finite time period on a subset of trails. During this trial period, information about e-bike use, environmental impacts, impacts to visitor experience, and noise output can be collected. If findings from the pilot program are favorable, Midpen could permit e-bikes on a subset of trails where impacts are expected to be minimal, based on a review of ecological conditions that would inform the resiliency and durability of the vegetation, soil and wildlife (see sections on sustainable trail design and on-trail management below). Alternatively, Midpen could require e-bike riders to obtain a special use permit. A fee to obtain a special use permit (or any other approach to gain access) may have implications to equitable access, which should be considered because cost is often recognized as a barrier to participation (Gibson et al., 2019).

One factor to consider is the potential difficulty in enforcing a given e-bike policy that separates e-bikes from traditional bikes or divides use by area, trail type, or requires a greater level of oversight, such as a permit system. Detection may pose another challenge to policy enforcement. To the casual observer, e-bikes may be difficult to differentiate from traditional, and surveys have found that other recreationists in open spaces are often unable to distinguish e-bikes from traditional bikes (Jefferson County Open Space, 2017). E-bikes may be more easily identifiable to trained rangers; education and training of Midpen Rangers should be continued as new models are introduced.

In the event that Midpen decides to proceed with a policy that allows e-bikes, this chapter presents a compilation of management strategies and recommendations drawn from the scientific literature, guidance documents and advisors to this project. Management recommendations are grouped under education and outreach, sustainable trail design, on-trail management, and monitoring and research.

Table 1. E-bike policies at various agencies in the U.S. This table is not an exhaustive list of agencies with existing e-bike policies or policies in development.

AGENCY	POLICY
Agencies in California	
California State Parks	**"State recreation areas:** Except for public roadways, only class 1 e-bikes shall be allowed by Superintendent's Order on controlled-access roads and trails. Except for public roadways, class 2 or 3 e-bikes are not allowed. Class 1 e-bikes may be designated for use only on trails and controlled-access roads that already allow traditional (non-electric) bicycles. **State vehicular recreation areas:** Class 1, 2 and 3 e-bikes may be allowed by Superintendent's Order for use on trails and controlled-access roads. **All other park unit classifications:** Class 1 e-bikes may be temporarily allowed by Superintendent's Order for use on trails and nonpublic, controlled-access roads for research and demonstration purposes. Except for public roadways, class 2 or 3 e-bikes are not allowed."
City of East Palo Alto	In the process of amending their municipal code to allow e-bikes on paved bicycle paths, which includes a section of the Bay Trail south of Bay Rd which is managed by the City of Palo Alto.
City of Menlo Park	All e-bikes are allowed on paved trails, including Bay Trail.
City of Palo Alto	E-bikes are allowed under ADA, but the City will consider amending ordinance to be consistent with neighboring agencies for Bay Trail management.
City of San Jose	Class 1 and 2 only are allowed where bikes are permitted.
East Bay Regional Parks District	"Class I and II eBikes are allowed on select park trails"
Golden Gate National Recreation Area	"Allow e-bikes on all routes open to traditional bicycles" "The motor may not be used to propel an e-bike without the rider also pedaling. Motorbikes with a throttle are not e-bikes. The operator of an e-bike must also comply with speed limits that apply to traditional bikes (15 mph in most places and 5 mph in high-congestion areas) and obey state traffic laws."
Marin County	"Marin's updated ordinance allows Class 1 and Class 2 e-bikes on public roads and parking lots within Marin County Parks facilities, and on County paved bicycle and multiuse pathways. Class 1 and Class 2 e-bikes also would be allowed in other areas when specifically signed to permit them. Class 3 e-bikes are prohibited within Parks facilities except upon public roadways and parking lots or when specifically signed to permit them."
Marin Municipal Water District	E-bikes are currently prohibited. A Community Advisory Committee (CAC) was assembled to investigate and develop recommendations. The recommendation is to allow riders with class 1 e-bikes to apply for a special use permit (good for 3 years) and prohibit classes 2 and 3 and after market e-bike kits.

AGENCY	POLICY
Pt. Reyes National Seashore	"E-bike usage is limited to Class I e-bikes where traditional bikes are allowed and as listed below, except as noted (Abbotts Lagoon Trail). Only class I e-bikes are permitted; class II and class III e-bikes are prohibited. E-bikes are prohibited where traditional bikes are prohibited. Except where uswe of motor vehicles by the public is allowed, using the electric motor to move an e-bike without pedaling is prohibited."
San Mateo County Parks	Class 1 and 2 only where bikes are allowed. However, allowed bicycle use is limited.
Santa Clara County Parks	Class 1 and 2 only where bikes are permitted, paved and unpaved.
Santa Clara Valley OSA	Gathering more information, no formal policy for or against ebikes.
Sonoma County Parks	Class 1 and 2 only where bikes are permitted.
Soquel State Demonstration Forest (CalFire)	"Electric bicycles (including all classes) are not allowed."
Tahoe Donner	"Class 1 ebikes (pedal assist bikes) are allowed on Tahoe Donner fire access roads and doubletrack trails"
Town of Mammoth Lakes	"All e-bikes are allowed on roads and streets" "Class 1 e-bikes are allowed on all paved multi-use pathways and in the Mammoth Mountain Bike Park" "E-bikes are not allowed on any trail designated as non-motorized"
Agencies nation-wide	
Jefferson County Open Space (Colorado)	“Class 1 e-bikes are allowed on natural surface trails within the parks. Class 1 and Class 2 e-bikes are allowed on paved trails within the parks.”
Oregon Parks and Recreation Department	"A person may operate an electric assisted bicycle on roads and trails eight feet or wider unless otherwise posted to restrict or permit such activity."
Washington State Parks	Class 1 and 3 e-bikes are allowed on natural surface trails.
King County Parks	E-bikes are prohibited.
U.S. National Park Service	Superintendents may establish their own e-bike policy for their park.
Cuyahoga Valley National Park	"Allow class 1 and class 2 e-bikes on all routes open to traditional bicycles"
Arches National Park	"You can ride your bike or e-bike on all paved and unpaved roads in the park. You may not ride your bike on trails or anywhere off a road."
Acadia National Park	"Only Class-1 e-Bikes are allowed on park Carriage Roads." "Class 2 & 3 e-Bikes are prohibited."
U.S. Bureau of Reclamation	E-bikes are allowed only where traditional bicycles are allowed.
U.S. Fish and Wildlife Service	E-bikes are allowed only where traditional bicycles are allowed.
U.S. Bureau of Land Management	E-bikes are allowed only where traditional bicycles are allowed.
U.S. Forest Service	“Class 1, 2, and 3 e-bikes and electric mountain bicycles (eMTBs) are allowed on approximately 60,000 miles or nearly 40 percent of trails on national forests and grasslands. These vehicles are also allowed on thousands of miles of roads on national forests and grasslands at maintenance level 2, 3, or 4.”

EDUCATION AND OUTREACH

As with any policy change, efforts to educate and inform visitors about the reasons for, and the effects of, allowing e-bikes on trails are likely to increase both behavioral compliance and levels of acceptance, and thus ultimately reduce both environmental impacts and visitor conflicts. For instance, a number of studies have found that education is an effective tool for reducing conflict between hikers and mountain bikers (e.g., Carothers et al., 2001; Watson et al., 1991), and the same is likely to be true for e-bikes as well.

Education and outreach can help promote responsible, lower-impact behavior among e-bike riders, such as staying on trails, slowing down in crowded areas or at trail intersections, wearing bright colored or reflective clothing to increase visibility, and cleaning bicycle equipment before and after rides to reduce the spread of pathogens or invasive species. Signage or education programs could be paired with the tools to enact behavior changes, such as shoe brushes and bike cleaning supplies at the trailhead. Midpen currently provides boot and wheel brushes at trailheads for hikers and bikers to remove dirt both before and after recreating (S. Christel pers. comm.).

Education can also help visitors understand what e-bikes are, and what to expect if they encounter them on trails. Studies have found that there is a general lack of understanding — and some prevalent misconceptions — about the nature of e-bikes among other trail users, and in particular among traditional mountain bikers (Chaney et al., 2019). This lack of familiarity can sometimes lead to conflicts or negative perceptions. Concerns about e-bikes tend to decrease once visitors become more familiar with the technology (Nielsen et al., 2019a), and thus education and outreach is likely to be a critical tool for reducing visitor conflict.

SUSTAINABLE TRAIL DESIGN

As with other recreational activities such as hiking and traditional mountain biking, a number of the impacts from e-bikes — such as soil erosion or vegetation trampling — can be partially mitigated through sustainable trail design. While further research is needed to better understand the potential for unique soil impacts associated with e-bikes, such as increased erosion resulting from greater uphill speeds, overall the recommendations and best management practices pertaining to traditional mountain bikes are also likely to be appropriate for e-bikes on trails.

The scientific literature, as well as existing guidance documents from land management agencies and bicycling industry/advocacy groups, identify a number of best practices for sustainable trail design. Midpen's existing trail design best practices are similar to those of other agencies including California State Parks. Additionally, Midpen made improvements to 24 miles of trail in El Corte de Madera Creek Preserve, which is a popular preserve for mountain bikers, and a study showed a 63% reduction in sedimentation in the creek as a result (Midpeninsula Regional Open Space District, 2020). While an exhaustive treatment of trail design is beyond the scope of this study, several key considerations are provided below:

- **Trail grade.** In general, lower grade trails are less susceptible to erosion (Meadema et al., 2020; White et al., 2006), though very flat trails are prone to muddiness, which can result in trail widening if users go off-trail to avoid muddy sections (Marion and Wimpey, 2017). Marion and Wimpey (2017) recommend trail grades of 3-10% with periodic grade reversals (or dips) that promote the drainage of water off of the trail.
- **Trail slope alignment.** "Side-hill" trails (i.e., trails aligned more closely with local topography) tend to drain water more effectively than "fall-line" trails that ascend slopes more directly, and thus are more resistant to soil erosion and trail degradation (Marion and Wimpey, 2017).

- **Water diversion structures.** Where sufficient drainage cannot be achieved through trail grade and trail slope alignment, water diversion structures may be useful in reducing soil loss (Salesa and Cerdà, 2020).
- **Armoring substrate.** High traffic trails can be hardened, or armored, with embedded rock or crushed gravel to reduce trail degradation. Armoring may be particularly effective on steep trail segments or in wet areas (Marion and Wimpey, 2017). Land managers should consider the siting of armor, as armoring may have tradeoffs (e.g., downhill displacement problems, extra maintenance required) where the trail grade is too steep and receives heavy traffic.
- **Trail siting.** Where possible, trails should be sited in areas with dense and resistant vegetation cover and stable, well-drained soils. Trail creation should be avoided around streams, wetlands, and waterbodies; in large patches of unfragmented habitat; and in areas with sensitive soils, flora or fauna (Salesa and Cerdà, 2020).
- **Barriers.** Physical barriers or borders like boulders can be used to indicate the trail location and prevent trail widening (PeopleForBikes et al., 2017).
- **Maintenance.** Regular trail maintenance is important to ensure that features like water diversion structures continue to function properly and that trail degradation does not occur over time (Salesa and Cerdà, 2020).

Existing and planned trails should be evaluated using the Trail Sustainability Rating system (Marion and Wimpey, 2017) or other standardized methods, and unsustainable trails should be closed or rerouted if suitable alternatives exist (Evju et al., 2021). Midpen works with consultants to evaluate trails and roads that are not built to Midpen's specifications (e.g. ranch or logging roads inherited when Midpen purchases a new property) and determine if treatment, rerouting, or closure is necessary (S. Christel pers. comm.). When assessing trails and implementing sustainable trail design, if necessary, certain trail segments can be prioritized based on need and/or level of use. For trails specifically intended for mountain biking, principles of sustainable trail design may also need to be balanced with incorporation of features and experiences desired by mountain bike users (PeopleForBikes et al., 2017). Additionally, Midpen should assess its current trail network to identify more remote trail segments that may be most likely to experience a substantial increase in bicycle use if e-bikes are permitted (given the potential for e-bikes to travel longer distances than traditional mountain bikes).

ON-TRAIL MANAGEMENT

In combination with sustainable trail design, a variety of on-trail management strategies can be employed to reduce impacts from both e-bikes and traditional mountain bikes, improve on-trail safety for all visitors, and minimize the potential for conflicts between visitors:

- Post speed limits at the trailhead and at the top and bottom of hills. Use a lower speed limit (e.g., 5 mph) on trail sections with greater use or limited line of sight. Current practice at Midpen is to post the speed limit (15 mph) at all trailheads. The speed limit is reduced to 5 mph on blind curves and when passing. Trails with steep slopes where bicycle accidents or speed issues have occurred have the speed limit posted.
- Encourage positive trail behavior by posting yield signs on multi-use trails, especially at intersections (Figure 1). Signage specifically targeting e-bike riders or other user groups is not recommended, as singling out certain user groups can foster resentment or conflict between groups. Midpen has limited use of yield signs to a few locations where conflicts have occurred.

- Close trails during wet and semi-wet conditions to prevent trail degradation and potential spread of non-native plant seeds and pathogens (Weiss et al., 2016). Midpen's existing policy is to seasonally close some trails to mountain bikers and equestrians during the rainy season, when soil moisture is higher.
- Restrict bicycle use around waterbodies and streams (if trails are permitted at all), particularly during amphibian migration season. Midpen closes sensitive areas, such as habitat for endangered species, to all use. Creek fords are changed to culvert or bridge crossings when feasible.
- Take measures to prevent informal trail creation, such as posting signage, developing educational programs, creating physical or visual barriers along trail margins, and monitoring off-trail usage (Barros and Pickering, 2017). Midpen currently prohibits the construction of informal trails, as well as off-trail use by bicyclists and equestrians. Pedestrians are allowed off-trail except for specific closure areas. Midpen monitors and closes informal trails if impacts like erosion are apparent.
- Consider zoning or designating certain trails as single-use. The single-use approach may be particularly appropriate for trails where more visitor conflict has been reported or trails that are too narrow to accommodate both hiking and mountain biking. Deciding where and which user groups share trails depends on the local context, as well as conflicts reported to and observed by management staff. For example, some researchers have reported conflict when horses and bikers share trails (Koemle and Morawetz, 2016; Napp and Longsdorf, 2005), or when hikers and bikers share trails (Carothers et al., 2001). Separating e-bike and traditional mountain bike users is unlikely to be necessary or effective. Midpen currently designates about 60% of trails as multi-use, including equestrians, bicyclists and hikers. Trade-offs of shifting toward more single-use trails may include restriction of access or an increase in negative impacts if new trails are built to accommodate separate user groups.
- Similarly, consider designating certain trails as uni-directional. Directional trails reduce the frequency of visitor interactions, and can thus reduce the potential for conflict among or between user groups (PeopleForBikes et al., 2017).
- Caution signs in advance of rough terrain can inform riders and remind them not to exceed their ability level (Napp and Longsdorf, 2005).

Right-of-way signs (Forest Service sign (left) and Bureau of Land Management sign (right) courtesy of CC BY 2.0)

MONITORING AND RESEARCH

Given the lack of information about e-bike use and impacts, a key element of any policy change allowing e-bikes in Midpen's preserves will be a robust monitoring and research program to evaluate how e-bikes are being used and the impacts of e-bike use over time. Some of the high priority areas for further research on e-bike use and impacts may include soil displacement and loss in different settings (uphill, downhill, different trail grades), speed, rates of e-bike use, distance traveled within preserves, demographic make-up of e-bike users, and visitor conflicts related to e-bike use. Sharing research findings would be a benefit to other land management agencies considering policy changes or seeking to assess the impacts of e-bike use.

A report prepared for Midpen by the (San Francisco Estuary Institute, 2021), titled *An Examination of the Costs and Benefits of Visitation and Recreational Use of Public Open Space*, summarizes monitoring techniques and metrics to measure the impacts from mountain biking and other recreational activities. There are a number of established techniques for measuring mountain bike use and impacts that can be applied to e-bikes as well. For example, trail cams can be deployed to document rates of e-bike use and measure speed. Soil incision and erosion can be measured by systematically sampling trail depth or cross-sectional area. In many cases, it may not be possible to separate e-bike impacts from the impacts of other forms of trail use. Partnering with researchers to run a designed experiment would enable Midpen to isolate and measure impacts from each type of trail use and to compare across use types. Partnerships with local scientists and students could be a mutually beneficial, cost-effective way to conduct monitoring and research on e-bike impacts. Certain collaborators may be willing to share research costs. Whether studies are conducted by university research groups or even by volunteer community scientists, proper training and oversight by expert scientists or university faculty would help to ensure high quality of data to inform decisions.

Conclusion

As Midpen evaluates whether e-bike use is compatible with its mission for the management of its preserves, factors to consider include challenges to policy enforcement, potential physical and ecological impacts, the potential for visitor conflicts or changes to the visitor experience, as well as the health benefits of recreational e-bike use. While the scientific literature pertaining to e-bike impacts in open space is quite limited, insights from research on traditional mountain bike impacts provide an important foundation for decision making. Survey-based research shows that land managers and other visitors suspect there are a number of areas in which e-bike use and impacts may differ from those of traditional mountain bikes, including demographics, uphill speed, soil displacement, conflicts between visitors, noise, and distance traveled. At this time, the very limited research on e-bikes provides a basis for drawing tentative conclusions about some of these impacts, but further research is needed to provide a more robust understanding and address unresolved questions. Until additional information becomes available, the existing research seems to indicate that many of the same management strategies used for traditional mountain bikes will apply to e-bikes as well. If Midpen decides to establish a policy allowing e-bikes on some of its trails, there are a number of practical management strategies Midpen can use, and others already in place that can be continued, to educate e-bike riders and other visitors, ensure sustainable trail design, manage on-trail use, and contribute to the knowledge base around e-bike use through monitoring and research.

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Appendix I

Regional Policies
Updated 1/19/2022

Fourteen local and regional, public land management agencies were surveyed: California State Parks, Cities of East Palo Alto, Palo Alto, Menlo Park, and San Jose. Counties of Santa Clara, Marin, Sonoma. East Bay Regional Parks District, Marin Municipal Water District, Santa Clara Valley Open Space Authority, CalFire - Soquel Demonstration Forest and the Bureau of Land Management – Cotoni Coast Dairies National Monument.

11 of the agencies allow e-bikes on paved roadways and paths, 3 do not. 8 agencies allow them on natural roads, trails and paths, 6 do not.

Agency	Allow on Paved Trails	Allow on Unpaved Trails	Comments
California State Parks	Yes	Yes	Overarching State Parks Policy: E-bike use on trails and nonpublic, controlled access roads shall be allowed only where designated by Superintendent's Order in the following park unit classifications: **State Recreation Areas** – Class 1 on controlled-access roads and trails that already allow traditional bikes. Class 2 and 3 not allowed except for public roadways. **State Vehicular Recreation Areas** – Class 1, 2, and 3 may be allowed on trails and controlled access roads. In all other areas class-1 e-bikes may be allowed by Superintendent's order for research or demonstration purposes. Except for public roadways, class 2 or 3 e-bikes are not allowed. **Local State Parks where class 1 e-bikes are allowed under Superintendent's Order.** Half Moon Bay SB – Coastal Trail (paved) Henry Coe SP – all trail routes currently open to traditional bikes - 200+ miles of roads and trails. The Forest of Nisene Marks SP- all trail routes currently open to traditional bikes – approx. 20 miles of dirt single track and 13 miles of fire road.

Appendix I

			Wilder Ranch SP - all trail routes currently open to traditional bikes – 35 miles of paved and dirt multi use trails.
City of East Palo Alto*	Yes	Yes	A section of the Bay Trail south of Bay Rd is managed by the City of Palo Alto. In 2017, the City of East Palo Alto adopted the Bicycle Transportation Plan to improve the bicycling environment in East Palo Alto. The Plan provides for a recommended citywide network of bicycle paths, lanes, and routes, along with bicycle-related programs and support facilities. In June 2019, the City of East Palo Alto along with Eden Housing, EPA CAN DO, and San Mateo County Transit District (SamTrans) were awarded an AHSC grant that is expected to fund up to 8.6 miles (1.5 miles of Class II and 7.1 miles of Class III) of bikeways per the City's Bicycle Transportation Plan (See Figure 42) along with other projects including affordable housing, transit infrastructure improvements, and new electric buses for a future express bus route linking East Palo Alto with the San Bruno BART. The new bicycle facilities will provide connectivity to existing bike trails and a safe bikeway system throughout the city. Construction on the bikeway improvements is anticipated to begin in 2021 and conclude in 2023. Presently they have no specific restriction to e-bikes on city bicycle paths, lanes or routes. Default would be the CVC. Class 3 e-bikes are not allowed on paths and trails unless adjacent to a roadway or permitted by local ordinance. Class 1 and 2 are allowed unless prohibited by ordinance. 21207.5. (a) Notwithstanding Sections 21207 and 23127 of this code, or any other law, a motorized bicycle or class 3 electric bicycle shall not be operated on a bicycle path or trail, bikeway, bicycle lane established pursuant to Section 21207, equestrian trail, or hiking or recreational trail, unless it is within or adjacent to a roadway or unless the local authority or the governing body of a public agency having jurisdiction over the path or trail permits, by ordinance, that operation. (b) The local authority or governing body of a public agency having jurisdiction over a bicycle path or trail, equestrian trail, or hiking or recreational trail, may prohibit, by ordinance, the operation of a class 1 or class 2 electric bicycle on that path or trail.

Appendix I

City of Palo Alto*	No	No	Currently don't allow on any trails including Bay Trail, except under ADA. However, their Parks and Recreation Commission is interested in creating an e-bike policy and would consider amending ordinance to be consistent with neighboring agencies for Bay Trail management.
City of Menlo Park*	Yes	yes	Their Municipal Ordinance does not address e-bikes however by practice all classes of e-bikes are allowed on paved bicycle pathways and trails, including Bay Trail.
City of San Jose	Yes	Some	Class 1 and 2 only where bikes are permitted
East Bay Regional Parks District	Yes	No	In 2019, the Park District Board of Directors, after a pilot program showed e-bikes were a compatible use, amended the District's rules and regulations to allow Class 1 and 2 e-bikes on select paved regional trails.
Marin County Parks and Open Space	Yes	No	Parks: The Marin County Parks code (MCC Title 10) was updated in 2019 and allows class 1 and class 2 electric bicycles on paved roads, paved designated bicycle and multi-use pathways and public roads not signed against such use. Class 3 electric bicycles are only allowed on public roads or parking lots. Open Space: Electric bicycles are not permitted within Marin County Open Space District preserves except when used as Other Power-driven Mobility Devices (OPDMD) by individuals with mobility disabilities. OPDMD use is subject to limitations and regulations of the Marin County Open Space District Inclusive Access Plan. One such limitation specified in the Plan is a 6-mph speed limit. Not currently considering e-bike access to unpaved trails but are monitoring other agencies.

Appendix I

Marin Municipal Water District	No	No	• Marin Water concluded the Citizens Advisory Committee and summarized the process in a summary report, • Staff proposed a 1-year trial program that would have allowed for Class 1 e-bikes to be used on fire roads for one year to allow staff to collect information relating to their use on the watershed (Board did not approve), • Last month (December 2021) staff proposed an Other Power-Driven Mobility Device (OPDMD) policy which would have allowed Class 1 e-Bikes to be used as an ADA OPDMD as long as they were registered with the District (Board did not approve). Their Board did provide direction to staff to begin developing a Watershed Recreation Management Plan and to continue to review e-bikes as part of this larger planning process. So, in short no formal changes have been made and they are continuing to review the issues as part of a larger recreation planning process.
San Mateo County Parks *	Yes	No	Allow class 1 and 2 only where bikes are allowed (primarily paved or improved surfaces). No formal ordinance or policy
Santa Clara County Parks*	Yes	Yes	Class 1 and 2 where conventional bikes are permitted Total miles of trails open to MTB/EMTB is ~190. 35.6 paved and 154.2 natural.
Santa Clara Valley OSA *	Yes	Yes	No formal policy for or against, do not see a lot of them. Gathering more info to make policy recommendation. Considering class 1, possibly 2. No class 3. Will most likely take what we do to their Board to be consistent.
Sonoma County Parks	Yes	Yes	Class 1 e-bikes permitted on all trails (not just class 1 trails) where conventional bikes are allowed.
CalFire - Soquel State Demonstration Forest	No	No	Does not allow any e-bikes.
Bureau of Land Management (BLM) Department of Interior Cotoni-Coast Dairies (North Santa Cruz County coast)	Yes	Yes	Began developing the initial 19 miles of multi-use trails (hiking, horseback riding, dog walking and biking trails) in December 2021. The first nine miles anticipated to be available to the public in approx.1 year. Class 1 and 2 e-bikes will be allowed on all trails where bikes are permitted.

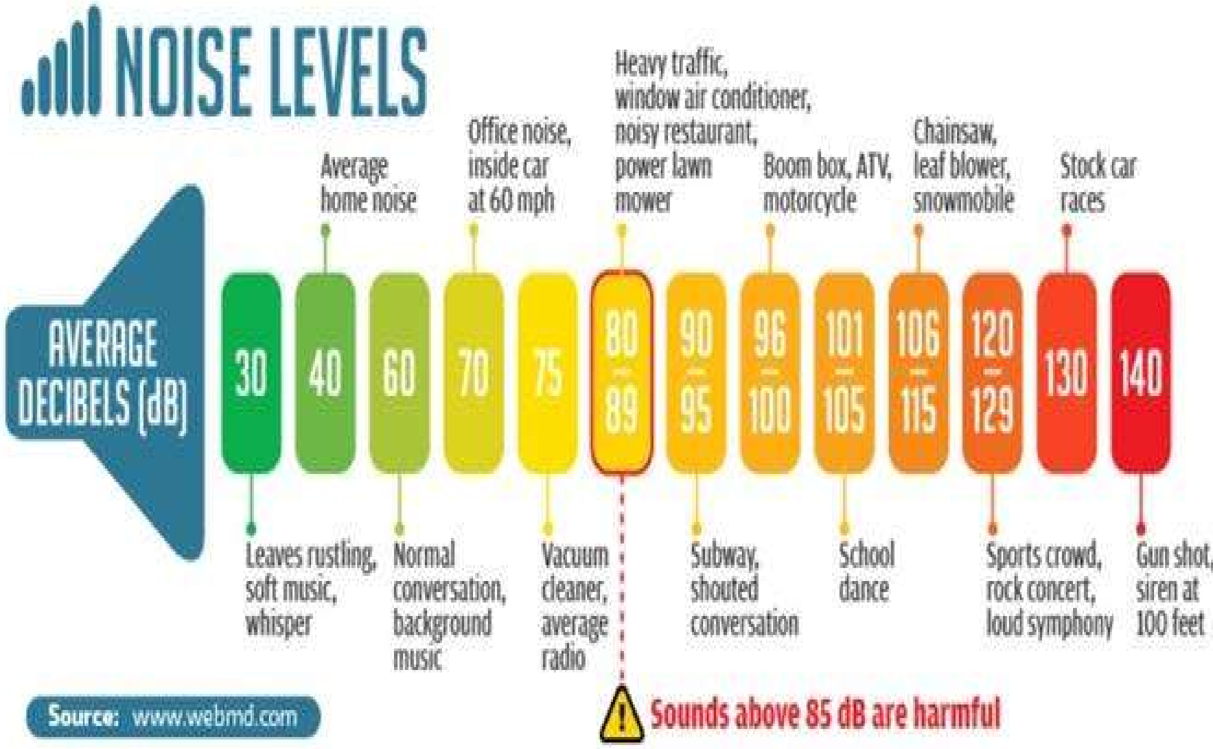
ATTACHMENT 5

Appendix I

* These agencies manage lands with local and regional trail connections to District lands

ATTACHMENT 6

Decibel Chart



Public Comment Sentiment

Web Page Comments

Totals	
612	Support e-bikes - All trails
162	Support e-bikes with restrictions
75	Oppose e-bikes
3	Undecided
852	TOTAL

"with restrictions" details:	
0	Support e-bikes - Class 1 and 3 only
1	Support e-bikes - Limited trails
2	Support e-bikes - Wide trails only
5	Support e-bikes - Paved only
0	Support e-bikes - Paved pilot
154	Support e-bike - Class 1

Oppose e-bikes details:	
4	Oppose e-bikes
71	Oppose e-bikes - ADA only

Percentage of Totals	
71.83%	Support e-bikes - All trails
19.01%	Support e-bikes with restrictions
90.85%	Support e-bikes Total
8.80%	Oppose e-bikes
0.35%	Undecided
With Restrictions	
18.08%	Support e-bike - Class 1
0.59%	Support e-bikes - Paved only
0.12%	Support e-bikes - Limited Trails
0.23%	Support e-bikes - Wide trails only

Board Meeting Comments

Totals	
54	Support e-bikes - All trails
12	Support e-bikes with restrictions
7	Oppose e-bikes
6	Undecided
79	TOTAL

"with restrictions" details:	
0	Support e-bikes - Class 1 and 3 only
0	Support e-bikes - Limited trails
0	Support e-bikes - Wide trails only
0	Support e-bikes - Paved only
0	Support e-bikes - Paved pilot
12	Support e-bike - Class 1

Oppose e-bikes details:	
0	Oppose e-bikes
7	Oppose e-bikes - ADA only

Percentage of Totals	
68.35%	Support e-bikes - All trails
15.19%	Support e-bikes with restrictions
83.54%	Support e-bikes Total
8.86%	Oppose e-bikes
7.59%	Undecided
With Restrictions	
15.19%	Support e-bike - Class 1
0.00%	Support e-bikes - Paved only
0.00%	Support e-bikes - Limited Trails
0.00%	Support e-bikes - Wide trails only

ATTACHMENT 7

Public Comment Sentiment

Board Direct Comments

Totals	
17	Support e-bikes - All trails
7	Support e-bikes with restrictions
42	Oppose e-bikes
0	Undecided
66	TOTAL

"with restrictions" details:	
0	Support e-bikes - Class 1 and 3 only
2	Support e-bikes - Limited trails
0	Support e-bikes - Wide trails only
1	Support e-bikes - Paved only
0	Support e-bikes - Paved pilot
4	Support e-bike - Class 1

Oppose e-bikes details:	
0	Oppose e-bikes
42	Oppose e-bikes - ADA only

Percentage of Totals	
25.76%	Support e-bikes - All trails
10.61%	Support e-bikes with restrictions
36.36%	Support e-bikes Total
63.64%	Oppose e-bikes
0.00%	Undecided
With Restrictions	
6.06%	Support e-bike - Class 1
1.52%	Support e-bikes - Paved only
3.03%	Support e-bikes - Limited Trails
0.00%	Support e-bikes - Wide trails only

All Comments

Totals	
683	Support e-bikes - All trails
181	Support e-bikes with restrictions
124	Oppose e-bikes
9	Undecided
997	TOTAL

"with restrictions" details:	
0	Support e-bikes - Class 1 and 3 only
3	Support e-bikes - Limited trails
2	Support e-bikes - Wide trails only
6	Support e-bikes - Paved only
0	Support e-bikes - Paved pilot
170	Support e-bike - Class 1

Oppose e-bikes details:	
4	Oppose e-bikes
120	Oppose e-bikes - ADA only

Percentage of Totals	
68.51%	Support e-bikes - All trails
18.15%	Support e-bikes with restrictions
86.66%	Support e-bikes Total
12.44%	Oppose e-bikes
0.90%	Undecided
With Restrictions	
17.05%	Support e-bike - Class 1
0.60%	Support e-bikes - Paved only
0.30%	Support e-bikes - Limited Trails
0.20%	Support e-bikes - Wide trails only

Public Comment Sentiment

Combined Public Comment Totals