Electric Vehicle Infrastructure PRIORITIZATION STUDY

JUNE 2022

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Study conducted on behalf of Montana Department of Environmental Quality by AECOM

DEQ
Montana Department of Environmental Quality

AECOM

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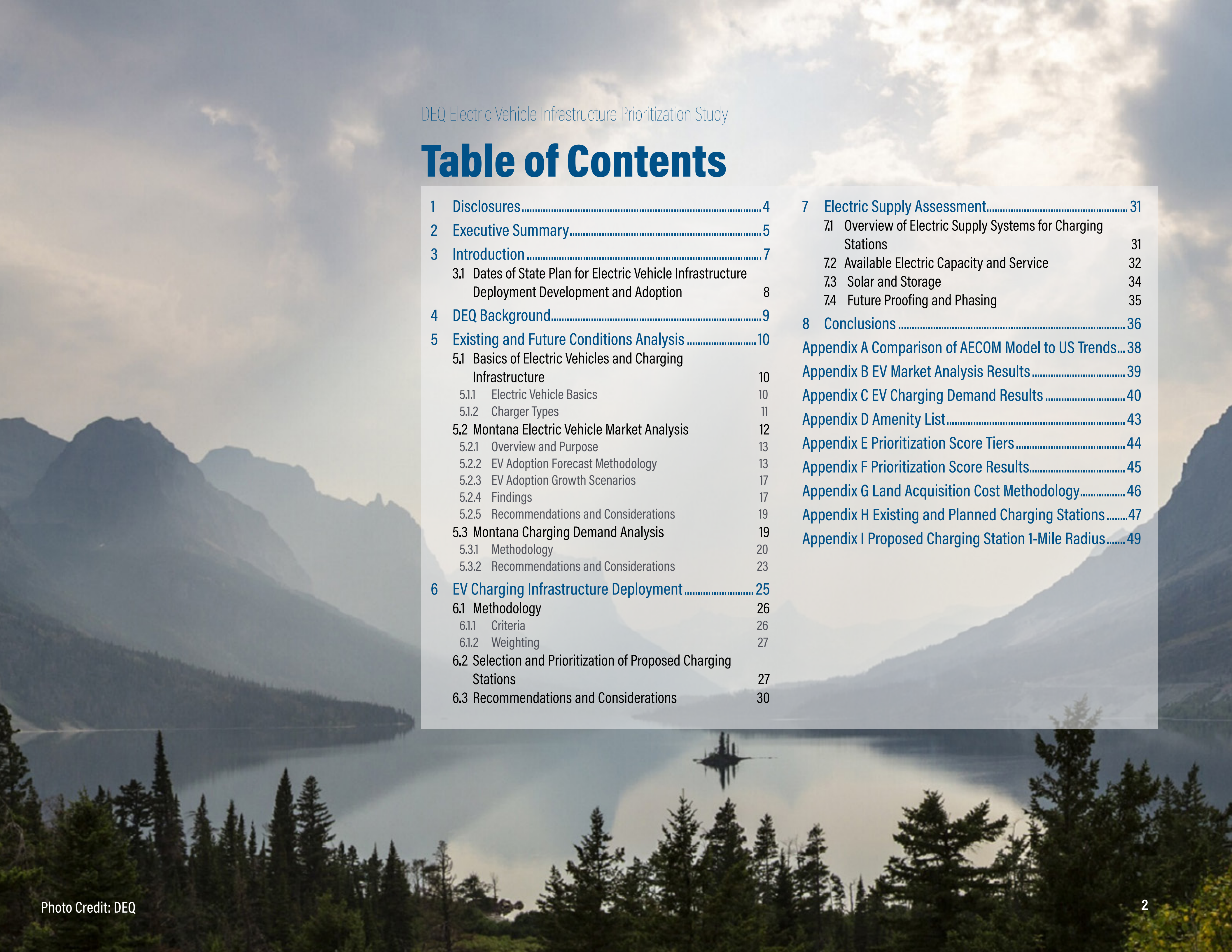

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AFC Alternative Fuel Corridor
DCFC Direct Current Fast Charging Stations (DCFC)
DOE Department of Energy
EPA Environmental Protection Agency
EV Electric Vehicle
GWh Gigawatt-hour (GWh)
ICE Internal Combustion Engine
kWh Kilowatt-hour
DEQ Montana Department of Environmental Quality
MDT Montana Department of Transportation
NEVI National Electric Vehicle Infrastructure
US DOT United States Department of Transportation

Photo Credit: Adobe

1 Disclosures

This material is based upon work supported by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) under the State Energy Program Award Number DE-0008656.

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe on privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.


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2 Executive Summary

The Montana Department of Environmental Quality's (DEQ) Electric Vehicle (EV) Infrastructure Prioritization Study (Study) was developed to identify priority locations along key travel corridors in Montana for optimal deployment of electric vehicle (EV) direct current fast charging stations (DCFC). The Study development was led by DEQ with support from the Montana Department of Transportation (MDT) and funding support from US Department of Energy's State Energy Program[1] to "support alternative transportation planning efforts in Montana and the region" and specifically, "identify high-priority locations for investment in transportation corridor EV charging infrastructure". It is intended that this report will support the development of Montana's Deployment Plan for National Electric Vehicle Infrastructure (NEVI) Formula Program funding along Alternative Fuel Corridors (AFCs), and better inform new public and private investment in EV charging infrastructure throughout the state.

The work conducted to support development of this Study entailed analyzing DCFC needs for battery electric passenger vehicle travel in Montana and subsequently identifying tiered priority locations along key travel corridors in infrastructure deployment over the next five to ten years. To inform siting recommendations, the document includes the results of technical analysis which encompass an assessment of Montana's electric vehicle market, local charging demand, an assessment of costs, and prioritized locations for EV charging infrastructure along key travel corridors. It should be noted that the technical analysis included an assessment of out-of-state travel from key states to ensure that the significant vehicular travel through Montana was accounted for and included in recommendations. The Study is intended to reflect DEQ's commitment to champion a healthy environment for a thriving Montana.

The findings presented in this document are intended to support infrastructure investment

1 US Department of Energy's State Energy Program grant number EE-0008656

decisions and is presented as a baseline guiding document for decision making. The technical analysis included in this Study is intended to support and supplement, rather than replace, nuanced location-specific analysis regarding permitting and costs as implementation decisions become more formalized and actionable under guidance of DEQ and its partners.

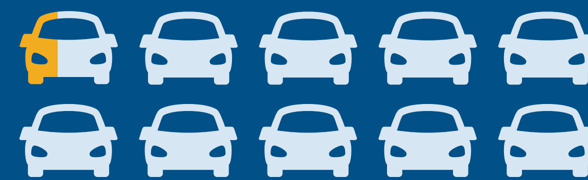
The findings of this document indicate Montana is expected to have about 31,000 (3% of Montana passenger vehicle market) and 88,000 (9% of Montana passenger vehicle market) EVs registered in-state by 2030 and 2040 under a medium growth scenario, respectively. Out-of-state EV adoption will significantly add to the number of EVs requiring charging on Montana roads due to the 12.6 million annual visitors to Montana, estimated at an additional 100,000 EVs in 2030 and 294,000 EVs in 2040[2]. While the anticipated adoption is rapid compared to current rates of EV adoption, the majority of both in- and out-of-state vehicles are likely to continue to be internal combustion engines (ICE), even by 2040.

From the expected growth rates, the amount of energy consumption of the EVs was calculated to quantify the charging demand. The methodology for the calculation considered future traffic patterns, battery fuel economy and range improvements, and cold weather impacts. Results from the medium EV growth scenario indicate 88 GWh of added electricity consumption in 2030. While the added consumption will require utility collaboration, particularly in the vast rural areas of the state, it is less than 1% of the 14,584 GWh consumed annually in Montana[3].

Developing a public charging network is essential to support EV adoption by reducing range anxiety[4] of consumers and providing dedicated charging locations for EV owners who lack access to charging infrastructure or at-home charging. Locations were selected to align with Alternative Fuel Corridor (AFC) requirements, a United States Department of Transportation (DOT) designation to develop sufficient charging infrastructure along highway corridors, and state priorities. A prioritization exercise identified Browning, Custer, Drummond, Forsyth, Havre, Livingston, Miles City, Shelby, and Three Forks as the highest priority for new locations to evaluate and begin expanding the public charging network.

2030 3%

Registered EVs in Montana's passenger vehicle market



2040 9%

Registered EVs in Montana's passenger vehicle market

2 Nonresident reports. Institute for Tourism & Recreation Research. (n.d.). Retrieved January 31, 2022, from http://www.tourismresearchmt.org/index.php?option=com_nonresidentreports&view=nonresidentreports&Itemid=115

3 U.S. Energy Information Administration - EIA - independent statistics and analysis. EIA. (n.d.). Retrieved January 31, 2022, from https://www.eia.gov/electricity/state/Montana/

4 Range anxiety refers to the concern that EVs may not have sufficient battery capacity and/or drivers may not be able to easily access an EV charger in order to cover their desired driving distance or reach their intended destination

Photo Credit: Adobe

3 Introduction

Developing a state-wide charging network can provide access to innovative, clean transportation options for all Montana drivers, including those in underserved areas of the state. New federal funding supports developing such corridors through the NEVI Program, which offers funding to states for planning and deploying charging stations strategically along AFCs. Results from this Study are intended to support development of an application for the NEVI Program and to assist the state in expediting charging station installations to realize the associated benefits for Montana drivers and the state's economy. Transportation is one of the most significant contributors to greenhouse gas emissions in Montana, cited as accounting for about 26% of total emissions within the state in 2018, as shown in **Figure 1**[5]. Transportation electrification, driven by private sector innovation and investment paired with targeted public sector infrastructure support, represents an opportunity for significant emissions reductions.

The implementation of EV charging infrastructure is rapidly evolving, both in terms of available technology and need. Strategic planning should account for technical innovation and identify the level of infrastructure needed to support EV adoption in a manner that is impactful and equitable. By prioritizing EV charging infrastructure along Montana's five primary travel corridors, the Study addresses the needs of local drivers within Montana while enabling drivers from neighboring states to travel by EV without concerns about access to charging.

Similar to many states in the country, tourism is an important part of Montana's economy. In 2019, the estimated 12.6 million visitors to the state contributed an estimated $5.4 billion to the local economy and supported more than 53,000 jobs. Analysis also determined that tourists to Montana spent the greatest

5 U.S. Energy Information Administration (EIA), State Energy Data System and EIA calculations made for this analysis.

share of their dollars on gasoline and diesel fuel[6]. As such, the impact of EV adoption on the broader Montana economy will become a prominent consideration in the near future and accurately articulating the extent to which EV adoption will occur within Montana is not only important from an infrastructure perspective, but for broader impacts as well.

The Study addresses the need for EV infrastructure siting along the five primary corridors that is efficient and effectively deployed to meet Montana's transportation needs[7]. Proposed sites will complement private sector investment by leveraging existing and planned charging station developments while utilizing public funds to fill gaps in the network. This Study is not just a forward-looking document for supporting infrastructure investment decisions, but a document that accounts for broad electrification growth in the region and increases accessibility of EV charging infrastructure to support communities in meeting their targets.

3.1 Dates of State Plan for Electric Vehicle Infrastructure Deployment Development and Adoption

DEQ and MDT intend to submit Montana's NEVI Formula Program Deployment Plan to the Joint Office of Energy and Transportation no later than August 1st, 2022, in accordance with Program requirements. Proposed or upgraded locations are slated to be completed within seven years of approval of the Plan. DEQ aims to have all high traffic volume segments meet the AFC requirements by 2030 and is well positioned with additional federal funding and guidance.

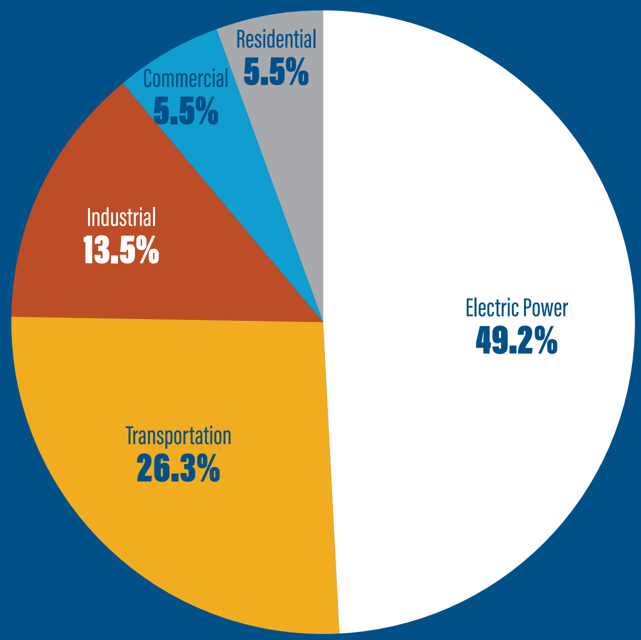


Figure 1: Montana CO2 Emissions by Sector, 2018[5]

6 Preston Parish | February 2021 | Presented by the Montana Budget & Policy Center. (2021, December 3). Montana Budget & Policy Center: Tourism could be an economic driver in Indian country, with focus and Investment. Montana Budget and Policy Center. Retrieved January 31, 2022, from https://montanabudget.org/report/tourism_indiancountry

7 The five primary corridors selected are designated AFC pending routes, which makes these routes eligible for NEVI program funding.


Photo Credit: Adobe

4 DEQ Background

DEQ is a state agency in Montana responsible for numerous environmental issues. DEQ is an executive-branch agency led by a mission to "champion a healthy environment for a thriving Montana." DEQ's Energy Bureau is the state's US Department of Energy-recognized state energy office. DEQ serves many stakeholders and partners with private industry, non-governmental organizations, Tribal and local governments, and the public to advance the DEQ mission and enhance services for those within Montana.

As part of its commitment to a healthy environment, DEQ champions initiatives to reduce emissions and improve air quality, which include innovative approaches to transportation models which significantly contribute to the state's emissions levels. Transportation electrification is a key strategy to achieving improved air quality and DEQ's role in this effort is to provide a high-level assessment of opportunities and strategic plans to do so.

5 Existing and Future Conditions Analysis

This section aims to provide an overview of the existing charger technologies and a forecast of EV adoption in Montana through 2040 with consideration for out-of-state visitors. Based on predicted market uptake, a supplementary charging demand analysis is provided that estimates annual energy consumption based on local traffic patterns, environmental conditions, and EV specifications.

5.1 Basics of Electric Vehicles and Charging Infrastructure

Understanding EVs and their charging needs is key in proper specifications selection, site planning, and effective policy decisions. As a rapidly evolving technology, both EVs and charging stations are offered in many different options, each having their own traits such as cost, power levels, and design.

5.1.1 Electric Vehicle Basics

EVs are powered by electric motors, while internal combustion engines use liquid fuels (typically gasoline or diesel) to power the vehicle. EVs have recently made improvements in range and cost due to improved battery technology and efficiencies in production. Current specifications are shown in **Table 1**. For Montana, DOE estimates a gallon of gasoline to cost $4.90 compared to an equivalent electric "gallon" at $1.00. Lowering cost and increasing vehicle range are expanding the practical use cases for EVs in Montana.

Table 1: Typical EV Technical Specifications

Vehicle Size	Commonly sedans. Beginning to develop SUVs and trucks.
Range[8]	150-300 miles
Efficiency[9]	2.78 mi/kWh
Battery Size	54-108 kWh
Fuel Cost[10]	$1.00 per eGallon
Battery Pack Cost[11]	$157/kWh

5.1.2 Charger Types

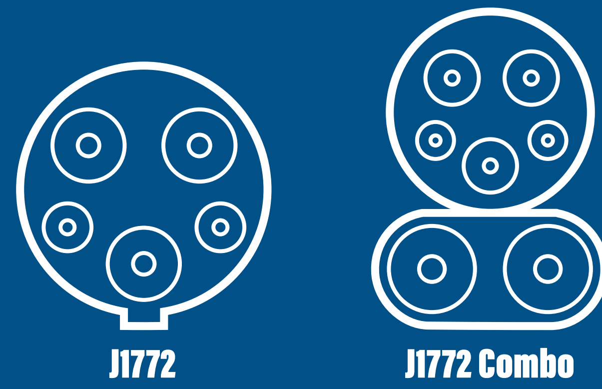
Electric vehicle chargers vary in terms of power output and by the connector type. Power output of a charge is directly linked to vehicle charging time; the higher the power, the quicker the battery is charged. There are three charger power level classifications.

Level 1 chargers use standard 20A, 120-volt outlets typically found in a home. Such chargers are only suitable for home and over-night charging locations due to charging speeds of 2-5 miles of range per hour[12]. Due to larger battery sizes available on the market, Level 1 chargers are becoming less common compared to other levels and generally used as emergency chargers.

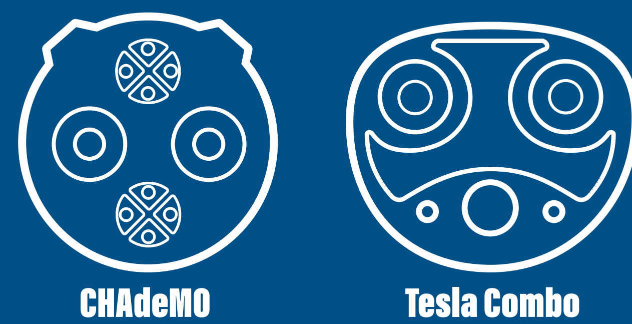
Level 2 chargers use 220-volt outlets, commonly used by clothes dryers. The higher voltage allows these chargers to charge at a rate of 10-20 miles of range per hour. Level 2 chargers are typically found at workplaces, curbside parking spots, or destinations such as hotels or parks.

Level 3, or DCFC, require commercial power levels, which allows for high charging speeds, at around 60-80 miles of range per hour. Power output levels vary between 50kW and 350kW. Due to the high-power demand of level 3 chargers, close collaboration with the local electric utility is necessary for a site owner to ensure proper power capacity and quality are provided to the charger site.

Each charger type is equipped with a connector that transfers power from the grid to the vehicle. In the US, four connector types are used, as shown in **Figure 2**. The connector type refers to the shape of the charging inlet on the vehicle, which needs to be compatible with the EVCS port. It should be noted that for DCFC, as they are the primary charger in this Study, J1172 Combo (CCS) and CHAdeMO are the only cross compatible connectors; Tesla



J1772 and CCS: J1772 primary connector type used for Level 1 and Level 2 charging. A CCS is a J1772 connector with additional ports to enable DC fast charging.



Used on some US cars for DC fast charging only. Vehicles with CHAdeMO will have a second inlet, usually a J1772, for Level 1 or

Used only by Tesla for Level 1, Level 2, and DC fast charging.

Figure 2: Common EV Connector Types

8 "Hybrid and Plug-in Electric Vehicles." Alternative Fuels Data Center: Hybrid and Plug-In Electric Vehicles, https://afdc.energy.gov/vehicles/electric.html.

9 "Alternative Fuels Data Center: Vehicle Cost Calculator Assumptions and Methodology." Afdc.energy.gov, afdc.energy.gov/calc/cost_calculator_methodology.html.

10 "EGallon." Energy.gov, 2019, www.energy.gov/maps/egallon.

11 "FOTW #1206, Oct 4, 2021: DOE Estimates That Electric Vehicle Battery Pack Costs in 2021 Are 87% Lower than in 2008." Energy.gov, www.energy.gov/eere/vehicles/articles/fotw-1206-oct-4-2021-doe-estimates-electric-vehicle-battery-pack-costs-2021.

12 Level 1 electric vehicle charging stations at the ... - energy. (n.d.). Retrieved January 31, 2022, from https://afdc.energy.gov/files/u/publication/WPCC_L1ChargingAtTheWorkplace_0716.pdf

Combo plugs found non-Tesla Super Chargers are only accessible to Tesla EV owners.

5.1.2.1. Public Charging Infrastructure

A public charging network is critical to support EV adoption for the following reasons:

- **Provide alternatives to at-home chargers:** Many populations face barriers in installing chargers at their places of residence (e.g. rental units, multi-family units, installation costs, etc.). An expansive public charging network will enable the purchase of electric vehicles even without a home charger.
- **Reduce driver range anxiety:** The most common reason consumers do not purchase EVs is range anxiety, the concern that a vehicle's battery does not have sufficient range to reach its destination. The availability of public charging infrastructure can mitigate this concern.
- **Inter and intra-state travel:** Developing a charging station network along main highway corridors unlocks the potential for long-distance EV travel across the United States. The DOT's Alternative Fuel Corridor program aims to support development of corridors that have adequate charging infrastructure for such travel.

5.2 Montana Electric Vehicle Market Analysis

Globally the electric vehicle market has been impacted by factors such as an increase in model availability, improved vehicular range, cost competitiveness with internal combustion engines due to maturing battery technology, and availability of tax rebates, and other incentives. Governmental targets to reduce emissions has also increased the focus on expanding use of EVs for different consumer segments. Although Montana does not currently have state EV targets, there has still been increasing investment and attention to strategically siting EV charging stations in the state.

Montana represents a unique sector within the EV market. To date, Montana has not represented a significant market share of EVs and is well below the national average in terms of EV adoption. This slower shift towards EVs in Montana is likely attributed to three primary barriers towards electrification:

- **Initial capital costs:** While studies show that operations and maintenance costs throughout the lifecycle of an EV are significantly lower than those of traditional ICE vehicles, EVs have a higher upfront cost which can be a barrier for some, particularly low-income drivers.[13]
- **Range anxiety:** Many drivers are reluctant to purchase EVs as their primary vehicle due to concerns that their vehicle will not have sufficient battery capacity and/or they will not be able to easily access an EV charger in order to cover their desired driving distance or reach their intended destination.
- **Weather concerns:** Temperature extremes significantly reduce EV range due to electricity consumption for heating and cooling systems. Given that Montana experiences cold temperatures throughout the winter, driver concerns about winter range limitations are a likely barrier to EV adoption. Montana typically has relatively mild summer temperatures, minimizing extreme heat concerns.

These barriers can be resolved with improvements to battery capacity and vehicle range, an expanded network of reliable fast charging infrastructure, and funding to make initial purchases of EVs more accessible. As a state with significant long-distance travel needs, the increase in vehicular range is likely to play a bigger role in encouraging EV adoption compared to other states and regions where regular commuting travel occurs within a smaller radius.

13 https://advocacy.consumerreports.org/wp-content/uploads/2020/10/EV-Ownership-Cost-Final-Report-1.pdf

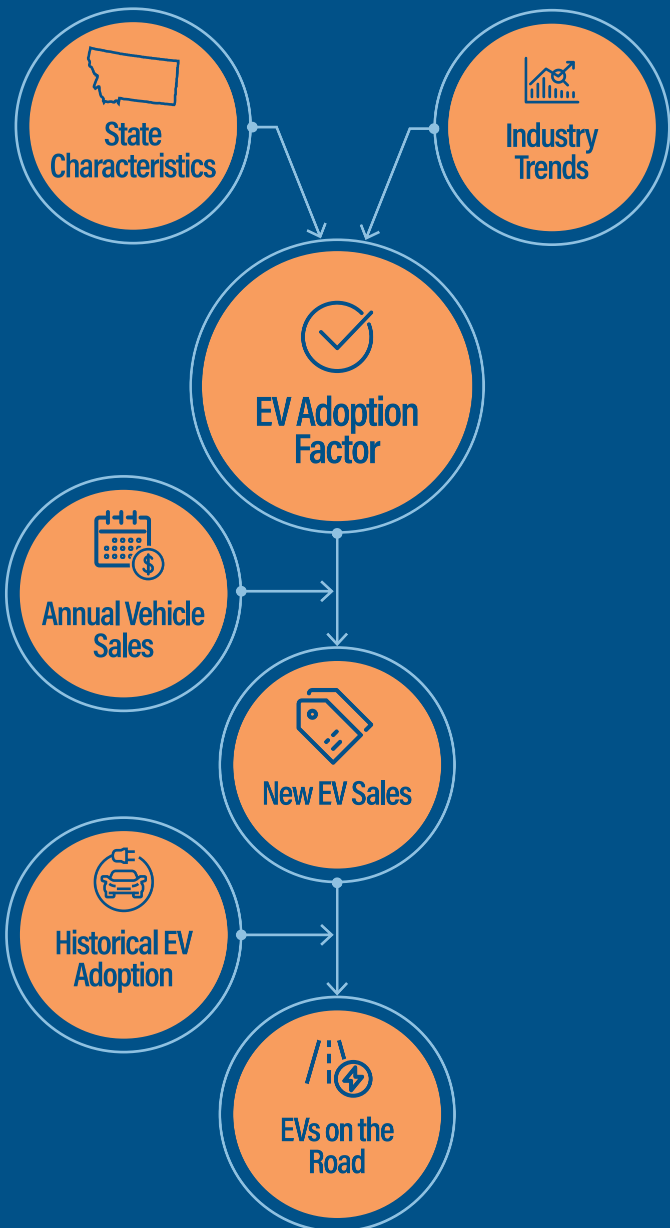


Figure 3: EV Adoption Forecast Methodology Flow Diagram

5.2.1 Overview and Purpose

To support the EV market analysis, an assessment of the current number of light-duty battery electric vehicles both traveling through and registered in Montana was conducted. This analysis was based on current vehicle registration numbers, existing market information, and EV adoption projections. EV adoption projections were conducted for three growth scenarios (low, medium, and high) through the end of 2040. Results from the projections are intended to provide informed infrastructure recommendations for EV charging that can support expected EV adoption on a localized level.

5.2.2 EV Adoption Forecast Methodology

The EV adoption forecast was developed utilizing industry trends, localized EV adoption factors, and historical vehicle trends relative to Montana to determine the anticipated rate of EV adoption and electrified portion of Montana's passenger vehicle market expected over the next 20 years. Adoption was assessed by calculating a projected percentage of vehicle sales expected to be electric in an iterative and annual manner, as shown in **Figure 3**. To provide an accurate depiction of adoption throughout the state, both in-state and out-of-state EV adoption from visitors traveling through the state was accounted for in the modeling of EV adoption. This is important for travel corridors in the state of Montana, as 12.6 million travelers visit annually with 74% traveling by automobile[14]. State policies are not directly included in this analysis; however, they are indirectly included as part of historical adoption trends.

5.2.2.1. EV Adoption Factor

For each year of the model, an EV adoption factor was calculated to represent the percentage of annual vehicle sales expected to be electric each year. The calculation was developed based on two input categories correlated to EV adoption, industry trends and state characteristics. The calculation has been tested and refined to verify the forecasted results align well with historical data and other industry projections. **Appendix A** provides a comparison of actual EV sales across the United States to the model value, demonstrating the accuracy of the tool. Sections 5.2.1.1-5.2.1.2 will present the inputs used to calculate the EV adoption factors used throughout this Study.

5.2.2.1.1. Industry Trends

The EV industry is evolving with battery technology improvements, reduced upfront vehicle costs, and development of a public charging network that further encourages purchase of EVs. These trends are key drivers to provide vehicle buyers the reassurance

14 Nonresident reports. Institute for Tourism & Recreation Research. (n.d.). Retrieved January 31, 2022, from http://www.tourismresearchmt.org/index.php?option=com_nonresidentreports&view=nonresidentreports&Itemid=115

that EVs are as capable, affordable, and accessible as ICEs. The model used in this Study captures industry trends as input factors for EV adoption by examining the model availability and initial capital cost of EV compared to an ICE as well as the density of the public charging network.

Model Availability: A larger, more diverse availability of EV models allows drivers the flexibility to select vehicles that align with their preferences, budget, lifestyles, and preferred manufacturer. Model availability is based on the current number of EV models on the market and projected through 2040 using EV model announcements and electrification commitments from major vehicle manufacturers. Industry trends suggest manufacturers will continue to move towards fully electrified lines by 2040 due to public preference and federal targets and commitments to reduce emissions. Model availability inputs for the model are presented in **Figure 4**.

Initial Capital Cost: Upfront costs tend to be a major barrier towards EV adoption. As the parity with ICEs continue to decrease, EV adoption is expected to significantly increase. The model captures the upfront cost difference throughout 2040 as a factor for the assessment. Based on this Study's projections, EVs will be cost competitive with ICEs by 2025 without outside funding sources as shown in **Figure 5**.

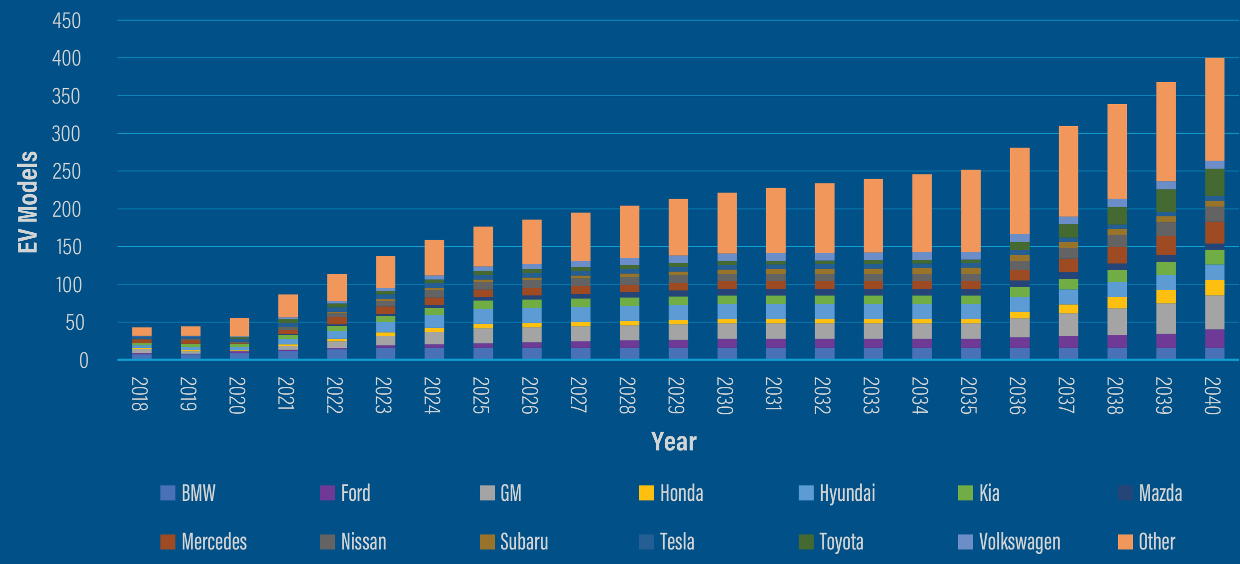


Figure 4: EV Model Availability Forecast

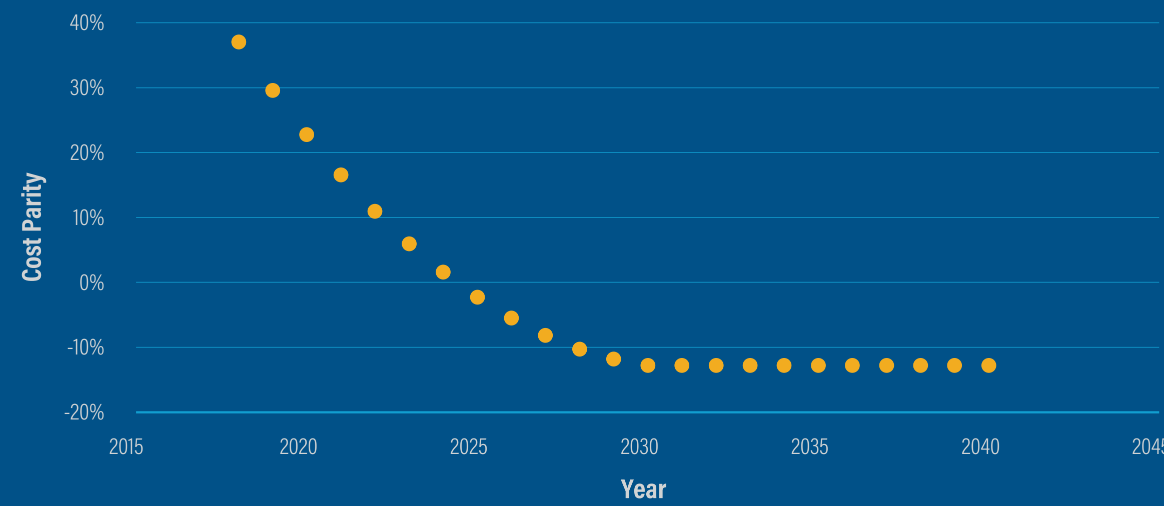


Figure 5: Cost Parity between EVs and ICEs

Charging Infrastructure: EV adoption forecasts often face the paradox of whether charging infrastructure is needed to drive EV adoption or if EV adoption drives the need to develop an EV charging network. The adoption model used in this Study assessed the availability of Level 2 chargers and DCFC in the previous year as a factor of EV adoption for the current year examined. For example, the 2022 adoption calculation utilizes the charging infrastructure installed in 2021. The model adds the necessary charging infrastructure to support the added EVs in 2022, which are then used for the 2023 calculations. This methodology is derived from EV infrastructure planning best practices that illustrate continued charger deployment is essential to encourage EV adoption.

5.2.2.1.2. State Characteristics

EV adoption can vary significantly depending on various indicators including income, educational attainment, environmental concern, home ownership, and the number of vehicles drivers currently own. These factors vary geographically, thus were assessed on a localized level to yield the modeling outputs for Montana.

For the in-state EV adoption component, state level data for Montana residents was gathered from publicly available sources. A description of how each factor was measured is presented in **Table 2** along with the average value for Montana residents and the data source.

Table 2: State Characteristic Factors

State Characteristic	Factor Measurement	Montana Value	Source
Median Household Income	Average income quintile	3.04 Quintile	2020 US Census
Environmental Concern	Statewide election results	41% voted for a platform that supported environmental policies, including EV infrastructure development	2020 Federal Election Results
3 + Car Households	Number of households with 3 or more cars	137,490 households	2020 US Census
College Education Attained	Percentage of residents with a bachelor's degree or higher	32%	2020 US Census
Homeowner Percentage	Percentage of single unit detached households in the state	68%	2020 US Census

5.2.2.2. Vehicle Sales and Historical EV Adoption

Vehicle sales and historical EV adoption can provide great insight into future EV adoption, particularly on a localized level. With the EV adoption factor calculated from industry trend and state characteristic data, a number of new EV sales can be identified. The National Automobile Dealers Association reported that 0.3% of total new vehicle registrations in the US or 51,177 vehicles, were in Montana (Based on 17,059,000 new vehicle sales in the US in 2019)[15, 16]. New EV sales are added to the existing number of EVs to obtain a cumulative EV market quantity. Atlas EV Hub data reported that in 2020 and 2021 there were 1,779 and 2,888 EVs registered in Montana respectively[17]. These existing penetration levels are the baseline adoption levels that future EV sales are added to.

5.2.2.3. Out-of-State EV Adoption

Out-of-state EV adoption was included in this assessment due to the large amount of travel that occurs through the state, including those that tour the state with their personal vehicles and travel through Montana as part of longer road trip efforts. Out-of-state traffic was estimated using 2019 survey data from The University of Montana's Institute for Tourism and Recreation Research[18]. The following

15 Driving Montana's economy - national automobile dealers ... (n.d.). Retrieved January 31, 2022, from https://www.nada.org/WorkArea/DownloadAsset.aspx?id=21474837344

16 New and used passenger car and light truck sales and leases. New and Used Passenger Car and Light Truck Sales and Leases | Bureau of Transportation Statistics. (n.d.). Retrieved January 31, 2022, from https://www.bts.gov/content/new-and-used-passenger-car-sales-and-leases-thousands-vehicles

17 Ruder, A. (2022, January 26). State EV registration data. Atlas EV Hub. Retrieved January 31, 2022, from https://www.atlasevhub.com/materials/state-ev-registration-data/#data

18 Nonresident reports. Institute for Tourism & Recreation Research. (n.d.). Retrieved January 31, 2022, from http://www.tourismresearchmt.org/index.php?option=com_nonresidentreports&view=nonresidentreports&Itemid=115

data from the survey was used to assist in the analysis:

- 12,636,000 annual visitors
- 74% visitors arrive to Montana via passenger vehicle or truck
- 2.18 passengers per passenger vehicle or truck
- 76% repeat visitors within the year

Based on these assumptions, a total of 1,029,428 unique vehicles travel to Montana annually, which includes tourists as well as those who travel to Montana for work. Out-of-state EV adoption was assessed by estimating the EV adoption rates for the five states collectively responsible for the largest amount of traffic through the state of Montana and are indicated in **Table 3**. The five states responsible for the largest number of visitors by passenger vehicle through Montana in the order of greatest to least are Washington, North Dakota, Idaho, Wyoming, and California. The average EV adoption rates of the top five states were applied to all out-of-state vehicles to determine the electrified portion. The same methodology to calculate EV adoption for in-state traffic described in Section 5.2 was applied to estimate adoption for the out-of-state analysis. Inputs were updated to align with localized conditions for each state.

Table 3: Out-of-State Visitors to Montana

State of Origin	Portion of Annual Visitors	Expected Number of Unique Vehicles
Washington	10%	102,943
North Dakota	9%	92,649
Idaho	9%	92,649
Wyoming	7%	72,060
California	6%	61,766
All Other States/ Countries	59%	607,363
Total	**100%**	**1,029,428**

5.2.2.4. EV Adoption Forecast Assumptions

To forecast EV adoption through 2040, key assumptions were made and are presented below:

- **Between 2035 and 2040, car manufacturers will progress beyond EV commitments** and announcements already made by electrifying their full line-up. Some brands have already committed to fully electric line-ups including Cadillac, Lexus, Mercedes-Benz, Audi, and GMC. This includes all sedans, SUVs, and trucks.
- **Operational and maintenance costs are not included** due to the assumption that passenger vehicle owners are primarily focused on the upfront cost and rarely calculate life-cycle costs when determining which vehicle type to purchase.
- **Battery technology will mature by 2030**, leading to upfront cost declines of BEVs. Beyond 2030, costs are assumed to be constant.
- **An optimal amount of charging infrastructure is developed to meet the estimated increase in adoption** using 4 DCFCs per 1,000 EVs, 60 public Level 2 chargers per 1,000 EVs, and at home charging is available for homeowners[19]. In the following year, the expanded charging network infrastructure is used as the input factor for adoption.
- **Vehicle sales are constant throughout 2040**. Total new vehicles sales have remained roughly constant in the United States between 2015-2019; however, impacts from COVID-19 and policy pressure to further encourage EV adoption may impact this assumption in the future[20].
- **Number of out-of-state visitors will remain relatively constant throughout 2040**. This assumption was based on the fact that historic data trends have demonstrated consistency and little fluctuation. Should out-of-state visitors increase slightly throughout the state, the technical analysis will not be significantly impacted.
- **Out-of-state vehicular traffic is primarily using personal vehicles** instead of rental cars.

19 Federal EV policy. Union of Concerned Scientists. (n.d.). Retrieved January 31, 2022, from https://www.ucsusa.org/resources/federal-ev-policy

20 New and used passenger car and light truck sales and leases. New and Used Passenger Car and Light Truck Sales and Leases | Bureau of Transportation Statistics. (n.d.). Retrieved January 31, 2022, from https://www.bts.gov/content/new-and-used-passenger-car-sales-and-leases-thousands-vehicles

5.2.3 EV Adoption Growth Scenarios

Three adoption scenarios were included as part of this analysis to identify potential magnitude of adoption from changes in the EV adoption landscape. Description of the growth scenarios are shown in **Table 4**. The three growth scenarios were solely applied for in-state adoption forecasts to quantify the range of adoption that would be applicable for Montana. For out-of-state adoption, only the medium growth scenario was analyzed to limit potential outcomes but still provide a reasonable EV adoption forecast.

Table 4: EV Market Model Growth Scenarios

Growth Scenario	Description
Low	Reduce model availability by 50% compared to baseline projection. This scenario accounts for supply shortages of EV components and limited EV truck and SUV models, which make up 40% of passenger vehicles in Montana.
Medium	Scale high growth scenario to better align with historical EV adoption trends. This scenario accounts of unique EV adoption factors in Montana that the model may not consider.
High	This scenario reflects an aggressive adoption curve that aligns with average uptake trends across the US but still reflects localized factors in Montana.

5.2.4 Findings

5.2.4.1. In-State EV Adoption

Model generated estimates that were calculated for EV adoption in the state of Montana based on the three growth scenarios can be found in **Figure 6**, **Figure 7**, and **Table 5**. EV adoption estimates for 2030 range between an assumption that 2- 8% of all Montana passenger vehicle market will be electric, with EV sales share between 4- 22%. For comparison the US forecast that 9% of the country's fleet will be electric and 36% of new sales are EVs in the same period, with recent targets made by the federal government for 50% EV sales[21,22]. Montana currently lags behind the national average EV adoption rate which aligns with the results of a lower EV adoption rate than the national average.

Table 5: Expected In-State EV Adoption

	EV Estimate 2030		EV Estimate 2040	
Growth Scenario	EVs on the Road	In-state EV Market %	EVs on the Road	In-state EV Market %
Low	16,500	2%	44,700	4%
Medium	31,350	3%	87,900	9%
High	80,700	8%	231,230	23%

Comparing the different growth scenarios provides insights on the importance of factors that drive EV adoption. First, there is a direct

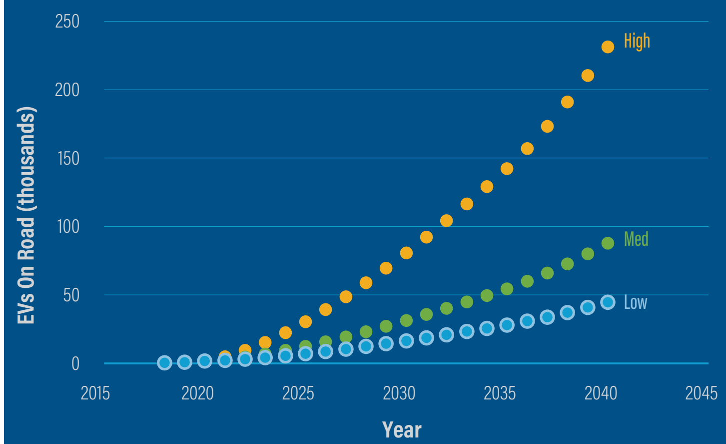


Figure 6: Expected EV Adoption in Montana 2020-2040 by Total Registrations

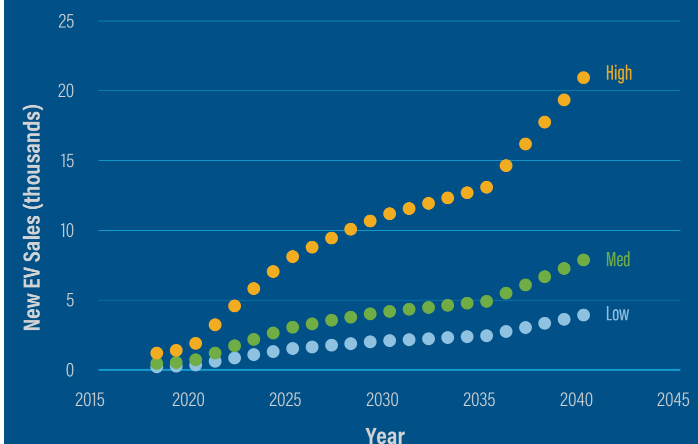


Figure 7: Expected EV Adoption in Montana 2020-2040 by New Sales

21 Charging up America: Assessing the growing need for U.S ... (n.d.). Retrieved January 31, 2022, from https://theicct.org/sites/default/files/publications/charging-up-america-jul2021.pdf

22 The United States Government. (2021, August 5). Fact sheet: President Biden announces steps to drive American leadership forward on clean cars and trucks. The White House. Retrieved January 31, 2022, from https://www.whitehouse.gov/briefing-room/statements-releases/2021/08/05/fact-sheet-president-biden-announces-steps-to-drive-american-leadership-forward-on-clean-cars-and-trucks/

correlation between EV models and the number of EVs on the road. As previously mentioned, the low growth scenario has half of the available models compared to the medium growth scenario and results in nearly half as many EVs on the road. Model availability is expected to play a large role in adoption increases post-2035 as ICE models become rarer and manufacturers begin to solely offer electric options. Second, new EV sales continue to rise in the near-term as the upfront cost continues to reach parity with ICE vehicles. When EVs are the more economical option, sales begin to slow in rate but continue to increase. This is mostly due to a lack of EV model announcements between 2026 and 2035 and the modelling assumption that rapid model development does not begin until 2035. Finally, it should be noted that although EV sales will continue to rise annually it can take a significant amount of time to turnover the current vehicle fleet stock, even in the most aggressive scenario. This is due to low vehicle turnover rates in Montana. Any ICE purchased in the future will postpone its replacement period by the average vehicle life, roughly ten years.

The most likely growth scenario for the state is the medium forecast. While the high scenario is a reasonable target to strive to for emissions reductions, it requires aggressive changes to the EV landscape to support over a 4000% increase in EVs on the road over the next decade. The medium scenario aligns with historical adoption data and reflects the direction federal policies and local governments are pursing to encourage adoption. Therefore, it is recommended that infrastructure investment recommendations operate under a medium growth scenario of expected EV adoption within Montana. It should be noted that this recommendation accounts for current known policies and changes in policy at the state or federal level may alter investment to support a low or high growth scenario.

5.2.4.2. Out-of-state EV Adoption

Results from the out-of-state traffic analysis are shown in **Figure 8**. By 2030, it is expected that of the 1,029,428 unique vehicles that annually travel through Montana nearly 100,000 will be EVs, or around 9.7% of all out-of-state vehicles. Thus, in 2030 the majority of unique EVs on the road will be registered from out-of-state, not Montana. Similar to the Montana resident EV adoption, note the fairly low percentage of out-of-state vehicles that are EVs in 2040. Detailed yearly annual EV market adoption results can be found in **Appendix B**.

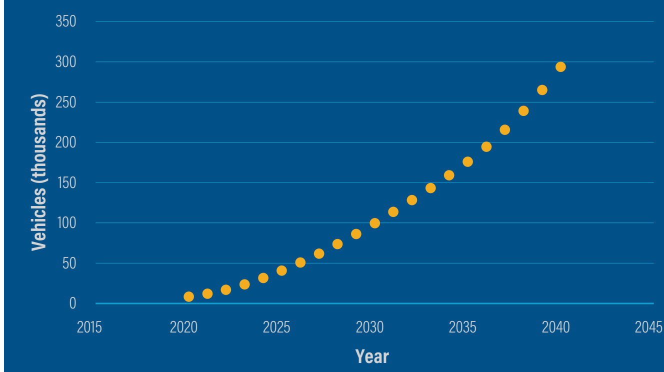


Figure 8: Out-of-state EV Adoption

5.2.5 Recommendations and Considerations

- The medium growth scenario forecasts 31,000 in-state vehicles (3%) and 100,000 out-of-state vehicles (10%) will be EVs by 2030. Overall, 6% of the 2,042,951 unique passenger vehicles that annually travel through Montana are expected to be electric during this period. This is expected to be the most likely forecast as it aligns with historical adoption data and reflects the direction federal policies and local governments are pursuing to encourage adoption. However, aggressive state and federal policies that support EV adoption may align more with the high growth scenario results.
- Montana has a limited number of EVs currently on the road, but under all growth scenarios the number of EVs on the road are expected to at least double from 2020 levels by 2023. The state government may help support this transition by providing local jurisdictions and electric utilities with information on best practices and innovative approaches to accommodate EVs. Initiatives could include developing EV readiness plans, providing educational materials, hosting workshops to encourage cross collaboration, or setting state adoption targets.
- Policies to encourage early vehicle retirements or mandates on new vehicle purchases are levers to accelerate adoption rates and quicken the vehicle stock turnover.
- Potentially half a million trips made by out-of-state residents will be made in an electric vehicle by 2030. To support out-of-state travel, it is essential to provide a cohesive charging network both throughout the state and with neighboring states. Prioritizing charging stations at locations in close proximity to the borders with other states will serve as a site for neighboring states to plan and develop their network.
- It should be noted that the long-term impacts of the COVID-19 pandemic may depress EV adoption due to economic constraint on individual households as well as the global auto market. The impacts of COVID-19 should be considered, along with additional barriers to EV adoption that may be faced, particularly by vulnerable populations. Comprehensive electrification considerations such as incentives, expanded funding sources, partnerships, and streamlined permitting processes can all support reducing barriers to electrification. Even so, the overall trends of EV adoption are expected to remain consistent with projections provided in this Study and point towards an increasingly aggressive trajectory towards electrification nationwide in order to reduce emissions and promote public health. To this point, while the US car market declined about 25% in 2020, the electric car registrations fell less than the overall market.

5.3 Montana Charging Demand Analysis

Forecasting and understanding the charging demand implications of EV adoption can serve as a tool to properly plan for the future. While broad-based EV adoption can bring many benefits to individuals and the environment by significantly reducing emissions, it can also present the significant challenge of ensuring an adequate public charging network that can meet charging demand. Doing so also poses the complexity of ensuring that local electric utilities can continue to provide reliable service with the added electrical load due to vehicle electrification. The impacts of increased electrification on the charging network requirements and impacts to electricity demand can be significant.

To supplement the EV market analysis presented in Section 5, an assessment of the EV charging capacity necessary to accommodate projected EV traffic along the major travel corridors was conducted as part of this Study. Five key traffic corridors in Montana: I-90, I-94, I-15, 94, US-93, and US-2, as shown in **Figure 9**, were analyzed for deployment of EV charging infrastructure. These corridors are strategic routes within Montana as they connect the main population hubs of Billings, Missoula, Great Falls, Bozeman, Butte, and Helena, serve as routes to reach top tourist attractions such as Glacier National Park, and Yellowstone National Park, provide interstate travel to North Dakota, Wyoming, Idaho, and Canada, and account for nearly 20 million miles of vehicle travel annually. I-90, 1-15, and US-93 are National Highway System Routes of the state while US-2 travels through more rural areas of the state.

5.3.1 Methodology

The charging demand analysis was completed by utilizing collected Montana traffic data along the five travel corridors of I-90, I-15, I-94, US-93, and US-2 overlaid with results from the EV market analysis to calculate the expected annual electricity consumption of EVs along the travel corridors through 2040. The assessment accounted for traffic pattern changes, expected battery economy improvements in the future, and the impacts of Montana weather conditions on EV performance. **Figure 10** illustrates the process flow to calculate energy demand that will be detailed in Sections 6.1.1-6.1.3.

5.3.1.1. EV Traffic and Mileage

The Montana Department of Transportation (MDT) records daily passenger vehicular traffic and mileage data for each corridor, as shown in **Table 6**. The data is further categorized into rural and urban segments as well as an

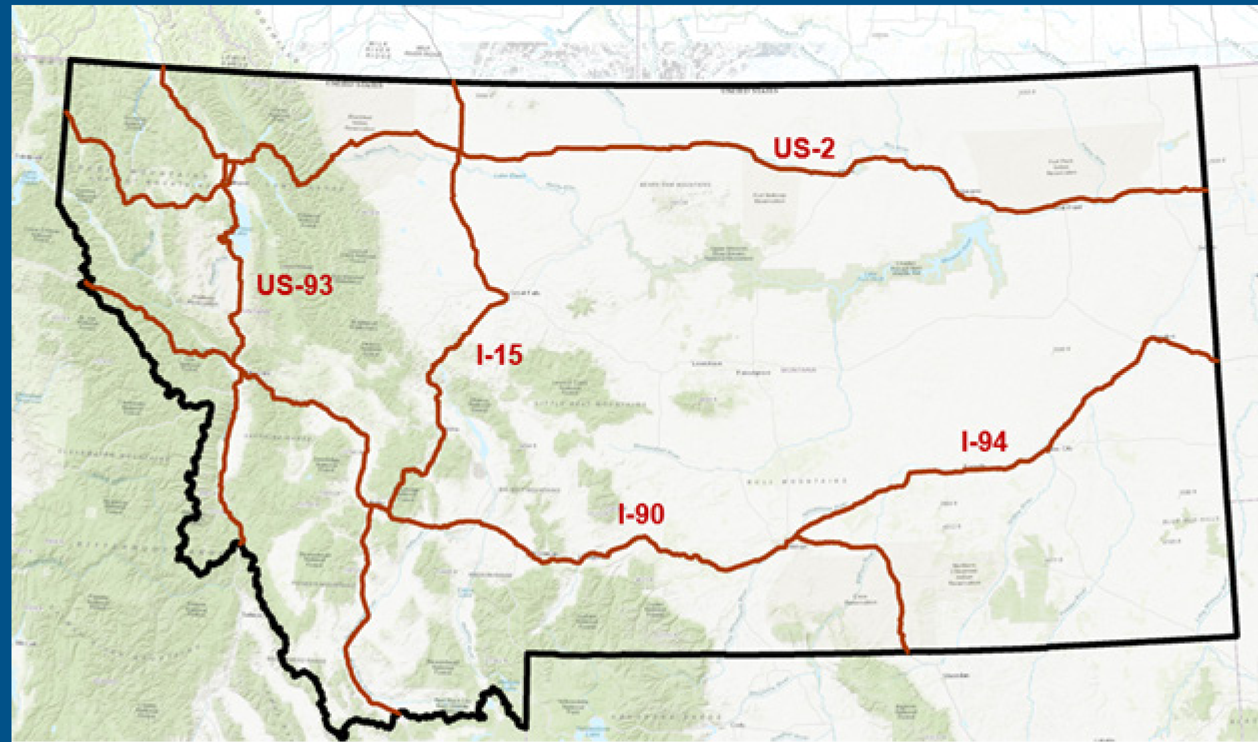


Figure 9: Montana Pending Alternative Fuel Corridors

Figure 10: Charging Demand Methodology

Table 6: Corridor Traffic Data

Corridors	Urban/Rural	Miles	2020 Average Annual Daily Traffic (AADT)	2020 Daily Vehicle Miles Traveled (DVMT)
I-90	Rural	481	6,601	3,174,558
	Urban	64	17,541	1,119,550
	Route Total	**545**	**7,883**	**4,294,108**
I-15	Rural	375	2,780	1,043,654
	Urban	21	10,016	210,194
	Route Total	**396**	**3,163**	**1,253,848**
I-94	Rural	239	2,835	676,878
	Urban	11	4,505	48,987
	Route Total	**250**	**2,908**	**725,865**
US-93	Rural	335	6,608	719,862
	Urban	41	15,900	215,344
	Route Total	**375**	**8,140**	**2,805,617**
US-2	Rural	644	1,810	1,165,279
	Urban	22	12,733	274,836
	Route Total	**665**	**2,164**	**1,440,115**
All Five Corridors	**Routes Total**	**2,231**	**24,258**	**10,519,553**

overall route average of vehicular traffic[23]. Daily vehicle miles traveled (VMT) was determined as the product of the length of the corridor segments in miles and the average annual daily traffic (AADT). To account for increases in traffic through 2040 due to population and economic growth, a 0.72% annual growth rate was assigned to the AADT and VMT[24].

Appendix C provides the yearly traffic values between 2019 and 2040.

Assessing the portion of traffic and mileage due to EVs utilized the percentage of passenger vehicles traveling in the state that are expected to be electrified by 2040[25]. The obtained values are expected to change on an annual basis due to changes in EV adoption for in-state and out-of-state vehicles. For the purposes of this Study, it was assumed that the percentage of EVs is equal to the percentage of EV AADT. Further analysis on origin and destination of specific EV owners would need to be conducted to identify if specific routes would have higher EV traffic compared to others. Mileage calculations were determined as the product of the EV AADT and route mileage (Equation 1).

Equation 1: EV Mileage Calculation

Annual EV Mileage=VMT*AADT*(EV In State Market %*EV Out of State Market %)*365

5.3.1.2. EV Energy Consumption

EV energy consumption per year was determined by applying an average battery fuel economy for passenger EV vehicles to the known annual mileage of the routes[26]. The resulting value represents the amount of electricity an EV consumes on each designated travel corridor; additional mileage is accumulated traveling to and from the corridor on less trafficked roads.

Figure 11 illustrates the expected average fuel consumption for light-duty passenger vehicles, including sedans, SUVs, and trucks. These values are based on current EV specifications and projected improvements throughout the future. Battery fuel economy is assumed to be

23 Urban segments are defined as traffic within the 19 urban areas of Montana that have a population greater than 5,000. Rural areas are the remaining less populated areas of the state.
24 The 0.72% growth rate is based on historical VMT trends and will fluctuate slightly from year to year.
25 Findings presented in Section 5.4 of the EV Market Analysis.
26 Battery fuel economy refers to the energy consumption rate of the EV and accounts for propulsion, cabin climate control, and other subsystems. It does not include losses during charging.

constant beyond 2030 due to limited insight on standards and technology improvements.

Equation 2: EV Energy Consumption Calculation

$$\text{Annual EV Consumption} = \frac{\text{Annual EV Mileage}}{\text{EV Battery Fuel Economy}}$$

5.3.1.2.1. Localized Weather Impacts

Weather can impact EV performance due to energy from the vehicle's onboard battery being used to support heating and cooling systems (to condition both the vehicle cabin and to maintain battery temperature) in addition to standard propulsion, leading to decreases in travel range. Studies show that ambient 25.2°F temperature results in a 46% decrease in driving range and 18.4°F temperature results in a 48% reduction[27]. Localized Montana minimum monthly average temperatures from the National Oceanic and Atmospheric Administration were utilized to identify months in which EV performance could be expected to be significantly impacted by cold weather and low temperatures[28]. The data indicated that the average observed minimum temperatures in Montana for the shoulder months (March, April, October, and November) were 25.6°F. A 46% decrease in battery fuel economy was factored for these months. Similarly, the Montana average minimum temperatures in the peak winter months of December, January, and February were 12.6°F and assigned a 48% reduction. A monthly comparison of standard and degraded battery economy due to cold weather is shown in **Figure 12**. The monthly average cold weather economy impacts articulate seasonal traffic variance for the purpose of this Study.

Hot temperatures and changes in elevation impacts were investigated and determined to not have significant considerations for the state of Montana. Range decline associated with using cooling systems is found to be significant at monthly maximum average temperatures above 90°F, and the highest average monthly temperature in Montana was determined to be 84°F in August. Changes in elevation were also determined to be insignificant for passenger vehicles regardless of topography and local elevation changes. While EVs consume additional energy when traveling uphill, energy regeneration can restore much of the energy consumption when the vehicle goes downhill. Additionally, passenger vehicles require little torque and minimal battery discharge needed to support elevation changes. While these impacts are more significant for heavier vehicle classes and should be considered for those vehicles, this Study was limited to passenger vehicles. Additional factors, such as headwinds can

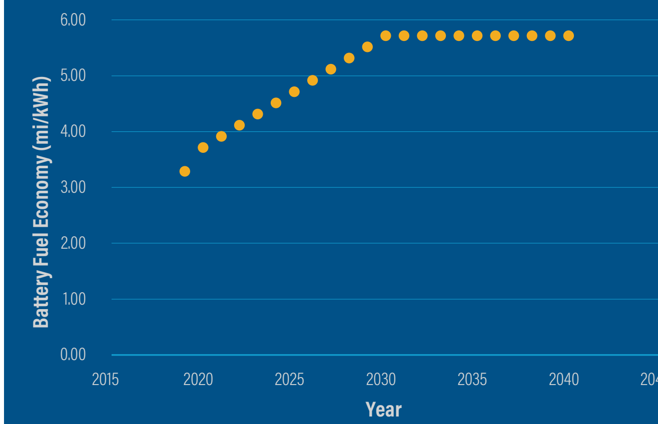


Figure 11: EV Battery Fuel Economy Projections

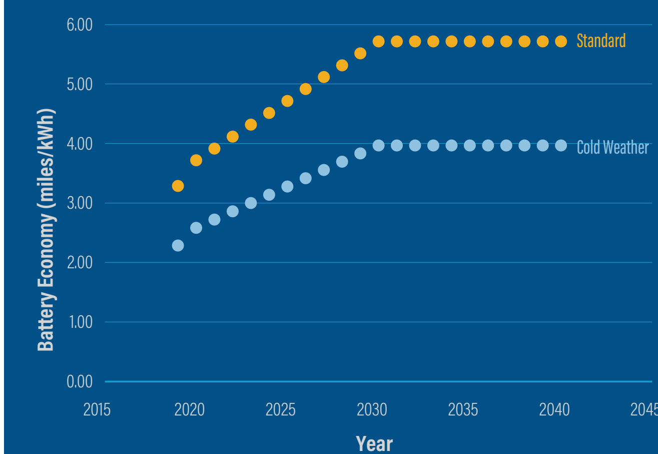


Figure 12: EV Battery Economy Comparison, Standard & Cold Weather

27 AAA Electric Vehicle Range Testing. (n.d.). Retrieved January 31, 2022, from https://www.aaa.com/AAA/common/AAR/files/AAA-Electric-Vehicle-Range-Testing-Report.pdf

28 NCEI.Monitoring.info@noaa.gov. (n.d.). Climate at a glance. National Climatic Data Center. Retrieved January 31, 2022, from https://www.ncdc.noaa.gov/cag/county/mapping/24/tavg/191712/12

further undermine vehicle range due to an increase in resistive force opposing the propulsion direction. Other environmental impacts such as snowfall and wind can affect vehicle range.

Findings for this section are presented using the medium EV growth scenario as is it aligns with historical adoption trends. By 2030, over 519,000 rural trips and 1.5 million urban trips will be made by EVs annually. Variation in findings will occur using the low and high growth scenarios. Results from the EV traffic assessment is shown in **Figure 13** by route and **Figure 14** by segment. Over 66% of EV traffic is expected along the National Highway System Routes of the state, I-90 and US-93, as they have more overall traffic.

Expected electricity consumed by EVs traveling along these main corridors in standard conditions is expected to reach 61 GWh in 2030[29]. For comparison, Montana electricity sales totaled 14,584 GWh in 2019[30]. For cold weather conditions (below 32°F average minimum monthly temperature), a higher amount of energy is consumed due to impacts of weather on battery economy. As shown in **Figure 15**, consumption can reach 88 GWh for monthly cold weather conditions in Montana by 2030, an increase of 27 GWh compared to 75 degree standard conditions.

While most charging, particularly intra-city trips, is likely to occur at home, a portion of the electricity consumption will occur at proposed public charging stations along these corridors. Additionally, a large portion of consumption is along rural segments of the routes as they are longer distances. This demonstrates the need for rural charging station installations, which are typically less prioritized over heavily trafficked urban segments that are expected to have higher utilization rates. However, in order to have equitable EV charger installation, it is vital to consider rural accessibility.

5.3.2 Recommendations and Considerations

- A transition to electric vehicles is expected to increase electricity consumption nearly 88 GWh by 2030 at a 6% EV market penetration (but still less than 1% of Montana's 2019 energy consumption). The actual total statewide EV-related energy consumption will be higher since this value is solely for consumption along the main corridors. Coordinating with local utility companies will be paramount to ensure expected load is properly met and managed as localized grid constraints may be realized.
- While the majority of EV adoption is expected to be concentrated in urban areas, 72% of energy will be consumed along rural

29 Standard conditions assumed to be an average of 68F and 60 mph speeds.
30 U.S. Energy Information Administration - EIA - independent statistics and analysis. EIA. (n.d.). Retrieved January 31, 2022, from https://www.eia.gov/electricity/state/Montana/

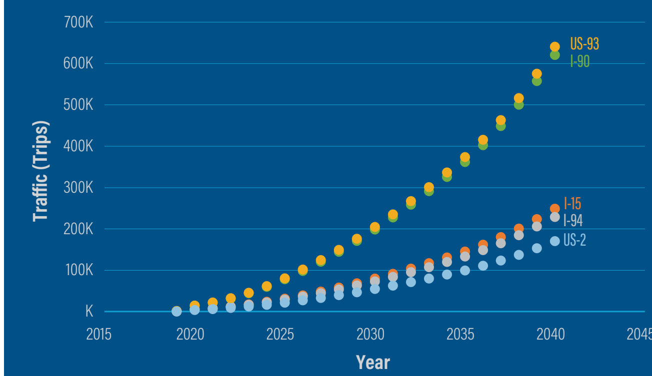


Figure 13: EV Annual Traffic by Route

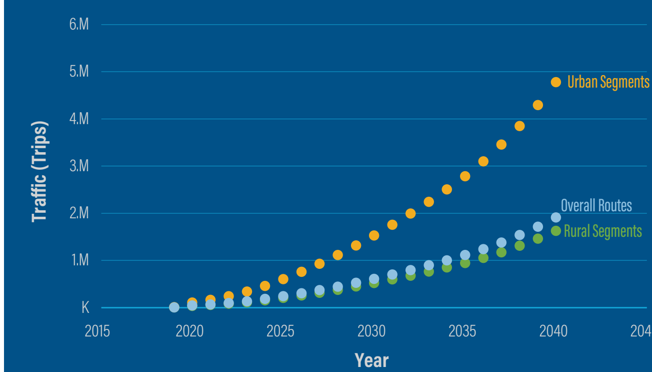


Figure 14: EV Annual Traffic by Segment

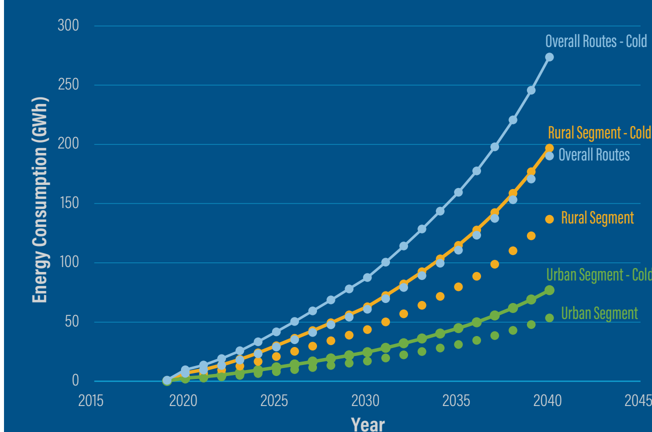


Figure 15: EV Energy Consumption

segments of the highway corridors due to their length. Building out a rural charging network will not only ensure that charging stations are accessible during long distance travel but also encourage EV adoption throughout the state.

- Cold weather conditions can impact EV range due to vehicle heating requirements; as such, EV charging networks in Montana should be structured to account for reduced range during winter months. Due to reduced range, charging stations should be placed in 50-mile increments where possible to ensure travelers have adequate, charging options along the route.

Photo Credit: DEQ

Photo Credit: DEQ

6 EV Charging Infrastructure Deployment

A nationwide public EV charging network is key to enabling widespread EV adoption. The Federal Highway Administration's Alternative Fuel Corridor (AFC) program designates highway corridors that are eligible for NEVI Formula Program funding. In order to be eligible for NEVI funding, EV charging station deployments must be located along a designated AFC, and must meet the following additional requirements:[31]

- Public DCFC separated by no more than 50 miles. Tesla Superchargers are currently unable to be qualified as part of this network as they are proprietary.
- Charging stations cannot be more than 1 mile from a highway intersection or interstate exit.
- Site power capability should be no less than 600kW to support at least 150 kW per charging port simultaneously across 4 ports.
- Each DCFC station must be equipped with a CCS connector.

The five corridors included in this Study have all received AFC designation by the US DOT and are eligible for EV charging infrastructure installation. With anticipated private investment and federal funding, Montana is well positioned for all of the high traffic volume segments of currently designated AFCs to

31 "Bipartisan Infrastructure Law - National Electric Vehicle Infrastructure (NEVI) Formula Program Fact Sheet | Federal Highway Administration." www.fhwa.dot.gov, www.fhwa.dot.gov/bipartisan-infrastructure-law/nevi_formula_program.cfm.

meet AFC requirements by 2030. Under the Infrastructure Investment and Jobs Act (IIJA), Montana is slated to receive $43 million over five years starting in fiscal year 2022 to expand the state's EV charging network[32,33]. For this Study, a list of proposed charging stations in strategic locations have been recommended along each of the five travel corridors to meet the AFC and NEVI funding requirements.

6.1 Methodology

Proposed charging station locations were identified by first investigating areas of 50-mile gaps in the existing and planned network. A list of proposed locations was identified based on site-specific criteria that would make a charging station installation impactful and beneficial. A weighting system was created that prioritizes locations for charging station development according to the needs of EV drivers and guidance of public funding sources.

6.1.1 Criteria

The following location criteria were selected to perform the charging location analysis and include location traits that would support a utilized, efficient, equitable charging network. Scores were calculated for each location to identify a shortlist of locations that would meet AFC requirements or that are close to bordering states. Description and data sources for each criterion are as follows. Scoring tiers for each criterion are in **Appendix E**.

Amenity Count: Locations with amenities, such as restrooms and food services are optimal features of sites for DCFC stations as they are common layover spots during long-duration and daily trips[34]. Locations with a higher amenity count within two miles of the highway were selected as there are more potential charger sites[35]. Amenity count is determined by mapping amenity locations within a two-mile driving distance of the highway corridor. Amenities are pulled from ESRI Business Analyst 2020 and filtered based on NAICS codes that would be an optimal site for DCFC. These NAICS codes include grocery stores, museums, gas stations, hotels, and restaurants. A full list of amenities counted in this analysis is included in **Appendix D**.

Connection Hub: Siting charging stations at the intersections of major highways is an effective strategy for cost-effectively building a charging network. Similarly, siting chargers close to the Montana border is useful in developing a cohesive charging network for interstate and long-distance travel.

Cost: Lower cost locations are preferrable as they provide the opportunity to utilize resources to support additional network sites. For the purpose of this analysis, cost estimates for charger locations include the charger station, installation, electrical upgrade, and land acquisition. Based on NEVI requirements, four 150kW charging stations are proposed at each site. These chargers have rapid charging speeds that allow EVs to conveniently charge in a matter of minutes and are expected to be compatible with every new EV model. Charger installations costs are shown in **Table 7**. Utility cost estimates were based on engagement with local utilities as detailed in Section 6 to determine which locations have adequate electric capacity. **Appendix G** provides additional information on the methodology used to estimate land acquisition costs at each location.

32 The United States Government. (2021, April 22). Fact sheet: Biden Administration Advances Electric Vehicle Charging Infrastructure. The White House. Retrieved January 31, 2022, from https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-biden-administration-advances-electric-vehicle-charging-infrastructure/

33 The Infrastructure Investment and Jobs Act ... - leg.mt.gov. (n.d.). Retrieved January 31, 2022, from https://leg.mt.gov/content/publications/fiscal/2023-Interim/IBC-F/MONTANA_Infrastructure-Investment-and-Jobs-Act-State-Fact-Sheet.pdf

34 Rest stops are not included as an amenity due to federal regulations prohibiting fueling stations at such locations.

35 The amenity count screening was conducted using a 2-mile radius as this was performed prior to the AFC requirement decreasing to 1-mile radius on February 10, 2022.

Table 7: DCFC Costs

Level 3 Charger (DCFC) Cost Component	Cost Estimate
Charging Station (50kW)	$33,000
Installation and Utility Upgrades (50kW)	$25,000
Total 50kW Charger	**$58,000**
Charging Station (150kW)	$94,000
Installation and Utility Upgrades (150kW)	$40,000
Total 150kW Charger	**$134,000**
Charging Station ((4) 150kW)	$376,000
Installation and Utility Upgrades (600kW)	$80,000
Total (4) 150kW Charger	**$456,000**
Charging Station (350kW)	$150,000
Installation and Utility Upgrades (350kW)	$50,000
Total 350kW Charger	**$200,000**

Gap Filled: The AFC currently requires a 50-mile distance between stations to create an optimized network. Only locations that were not already covered or planned to be covered by the existing charging network were considered. Locations with planned and existing Tesla Supercharging stations are still considered unfilled in this analysis as the stations are currently only accessible to Tesla drivers and do not qualify for the AFC requirements[36]. Locations of existing and planned charging stations were provided by DEQ and taken from the Department of Energy's Alternative Fuels Data Center; however, Tesla is currently implementing pilots internationally and is planning on implementing similar pilots within the US to make their charging network accessible to non Tesla electric vehicles[37].

Traffic: Locations with higher localized traffic are likely to have more EVs traveling through the site and thus higher utilization rates. Montana's traffic flow map was used to gather the necessary data.

Route: Only locations along I-90, I-15, I-94, US-93, and US-2 were considered. The AFC requirements recommend prioritizing national interstate systems followed by higher AADT U.S highway systems.

Vulnerability Index: Vulnerable communities, or areas that face disproportionate social, economic, and environmental impacts, are often the locations that receive the least investment yet could benefit significantly from access to public charging. This criterion utilizes Argonne National Lab's Justice40 tool to identify disadvantaged communities and tribal lands, which would be the highest priority locations. The index calculates vulnerability using several factors including poverty, access to transportation, health conditions, minority status, and climate hazards. This methodology aligns with NEVI Formula Program guidance that requires consideration of under-served communities.

6.1.2 Weighting

While all of the proposed locations will eventually be needed to meet AFC requirements, a phased approach is useful in supporting staged implementation of the charging network, understanding potential barriers, developing best practices, and aligning with available funding periods. The same criteria used to identify proposed locations was referenced for the recommended prioritization process. Each criterion was assigned an appropriate weight based on DEQ priorities, as shown in **Table 8**. The proposed weighting system focuses primarily on meeting the 50-mile gap and installing charging stations that will be utilized.

Table 8: Proposed EV Charging Location Criteria Weight

Criteria	Weight
Gap Filled Tier	30.0%
Traffic Tier	27.5%
Route Tier	10.0%
Amenity Count Tier	12.5%
Charger Cost Tier	2.5%
Vulnerability Index Tier	5.0%
Connection Hub Tier	12.5%

36 Tesla is currently piloting opening their Supercharger network to all EVs in the Netherlands which may lead Super Charger stations as an AFC qualified installation in the future.
37 Alternative fueling station locator. Alternative Fuels Data Center: Alternative Fueling Station Locator. (n.d.). Retrieved January 31, 2022, from https://afdc.energy.gov/stations/#/find/nearest

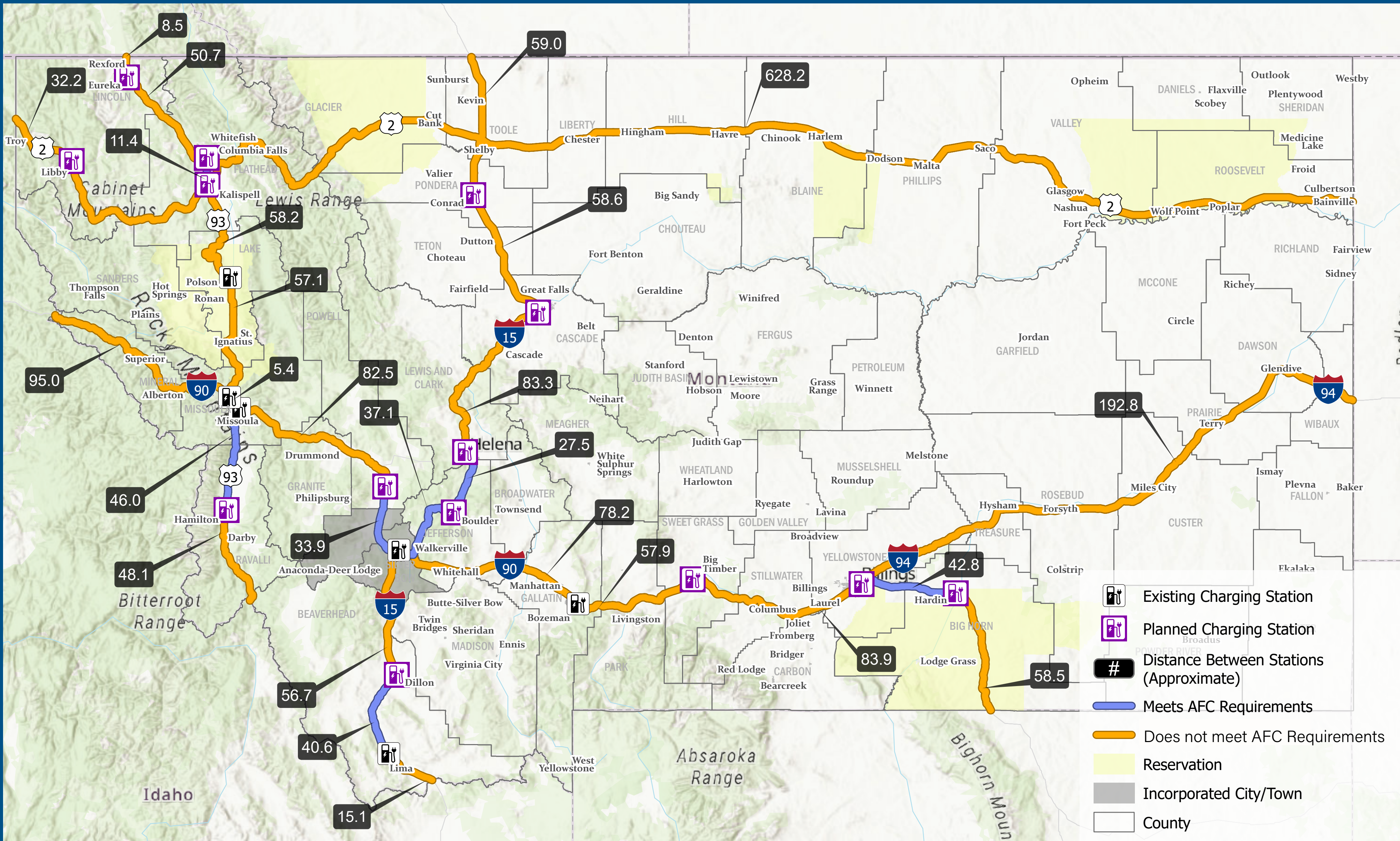


Figure 16: Current Montana EV Charging Network

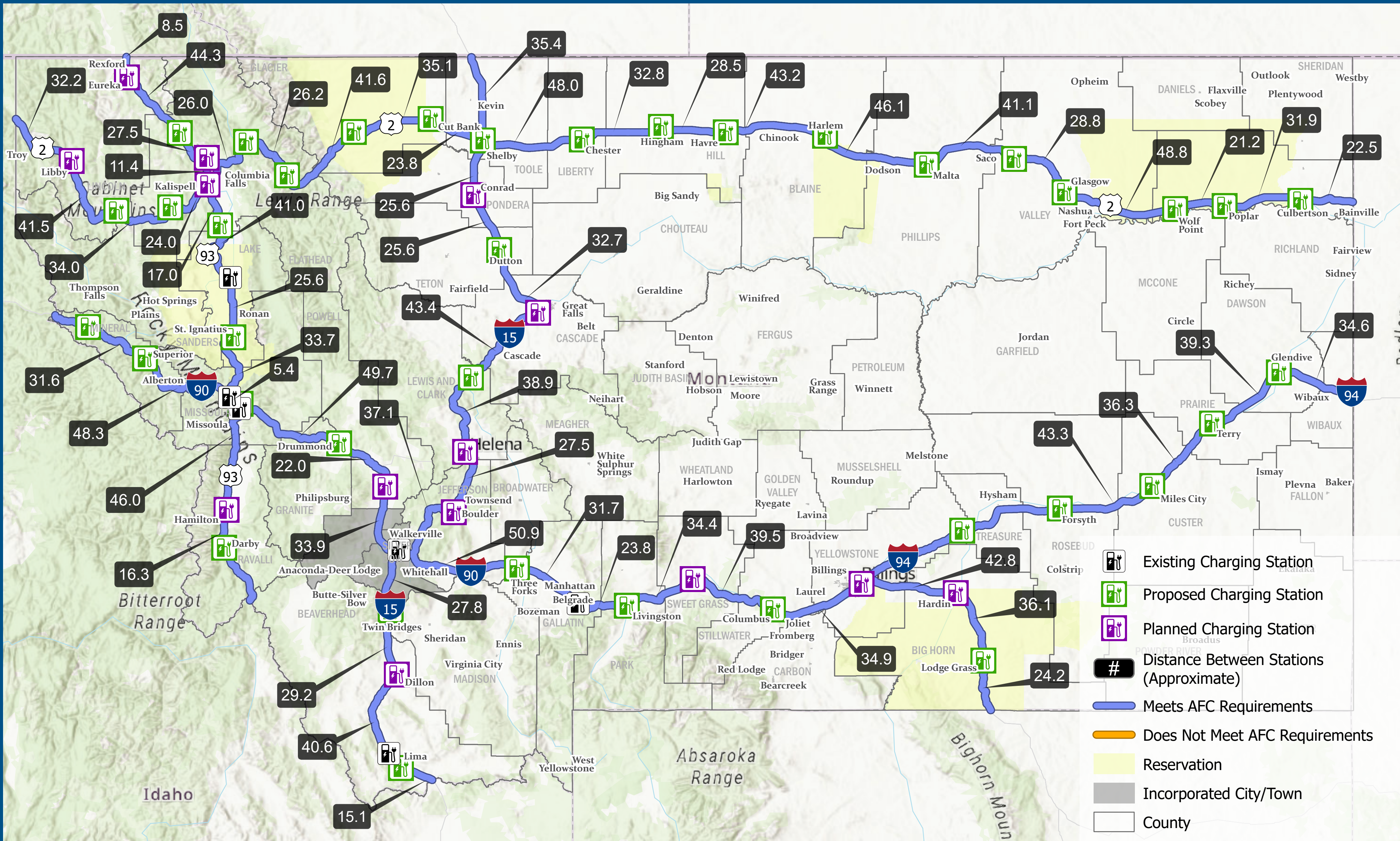


Figure 17: Proposed Charging Locations Map

To fill these gaps, the 36 locations listed in **Table 9** are proposed for future charging installations. Results of the prioritization analysis for each of these locations can be found in **Appendix F**. It should be noted that in **Figure 17** all of the corridors meet AFC requirements with the proposed locations incorporated into the network.

Table 9: Proposed Charging Locations List (Listed Alphabetically)

Route	Locations
I-90	Columbus, Drummond, Haugan, Livingston, Lodge Grass, Superior, Three Forks
I-15	Craig, Dutton, Melrose, Shelby
I-94	Custer, Forsyth, Glendive, Miles City, Terry
US-93	Darby, Lakeside, Olney, St. Ignatius
US-2	Browning, Chester, Culbertson, Cut Bank, Essex, Gildford, Glasgow, Happy's Inn, Harlem, Havre, Hinsdale, Malta, Marion, Poplar, West Glacier, Wolf Point

Table 10 presents the results of the prioritization exercise. Locations have been grouped into four tiers, with the highest-ranking tier correlating with the highest priority consideration for installing a charging station. This prioritization may be used as a the basis of future, phased funding opportunities. Priority levels are well distributed around the state in both rural and urban locations. These recommendations avoid installation of concentrated segments of charging stations and favor a more distributed approach to EV charger installation throughout the state.

Table 10: Proposed Charging Location Prioritization Tiers (Listed Alphabetically)

Tier 1	Tier 2	Tier 3	Tier 4
Browning	Columbus	Craig	Chester
Custer	Cut Bank	Dutton	Culbertson
Drummond	Glendive	Glasgow	Darby
Forsyth	Happy's Inn	Harlem	Essex
Havre	Haugan	Marion	Gildford
Livingston	Lakeside	Melrose	Hinsdale
Miles City	Lodge Grass	Olney	Malta
Shelby	St. Ignatius	Poplar	Superior
Three Forks	West Glacier	Terry	Wolf Point

Another focus for DEQ was identifying charging stations locations in underserved or vulnerable communities that also serve to build out a complete charging network. Charging stations may help to reduce transportation costs and bring in local income in areas that need it most. Sixteen of the 36 proposed charging station locations, or 44%, are in areas identified as vulnerable communities based on Argonne National Lab's Justice40 tool.

6.3 Recommendations and Considerations

- Thirty-six locations are proposed in this Study to enhance the public charging network along the five main corridors in Montana (I-90, I-15, I-94, US-93, and US-2) to qualify for an approved AFC segment. It is recommended that each location be within 1-mile of the interstate or highway and have four 150kW DCFC chargers that can simultaneously charge (600kW total) with a J1772 combo (CCS) connector. Typical next steps in this process are to issue proposals to pursue development the site. **Appendix I** illustrates each proposed location with a 1-mile radius from a highway exist or intersection.
- This section has outlined a methodology to identify, select, and rank the prioritization of charging station installation locations in the state. This methodology can be applied for future AFC corridors to fully develop the necessary public charging network across Montana. It is recommended the model be updated to account for technology advancements, EV adoption targets, best practices, and changes to AFC requirements. There are no foreseen changes to AFC requirements issued on February 10, 2022; however, as EV ranges continue to increase an incremental 50-mile network may become less utilized for intra-state travel. Additionally, Tesla Supercharging stations may become qualified, publicly accessible charging stations[38].

38 Non-tesla supercharger pilot. Tesla. (2021, December 3). Retrieved January 31, 2022, from https://www.tesla.com/support/non-tesla-supercharging

Photo Credit: DEQ

7 Electric Supply Assessment

While the rapid charging time of high power DCFC stations is an important benefit to EV drivers, fast charging stations can create localized grid capacity constraints and demand spikes if they are installed without appropriate planning and coordination between charging station developers and utilities. Proper assessment of the available electric infrastructure is critical in planning DCFC deployments to ensure a reliable, cost-effective grid is maintained. To understand the current electric supply conditions at the proposed and existing locations, DEQ engaged numerous utilities to understand the existing available grid capacity, electric service conditions, utility costs and timelines to provide EV infrastructure, and identify whether charging station locations could benefit from the addition of distributed energy resources (DERs)[39]. It should be noted that the findings of these consultations with utilities were maintained at a higher level for the purpose of this Study and should not substitute full assessments once charging locations have been more specifically selected in order to accurately depict existing conditions.

7.1 Overview of Electric Supply Systems for Charging Stations

Electric transmission systems connect power generation sources to substations, which are typically sited close to utility customer load centers. Power is delivered to customers from those substations via utility distribution systems. Transformers are placed at the customer location to provide the applicable capacity and electric service needed to meet the desired load. A diagram of a typical EV

39 DEQ was unable to hold meetings with utilities serving four proposed locations. Future engagement efforts with these utilities is recommended to confirm existing conditions and identify any barriers.

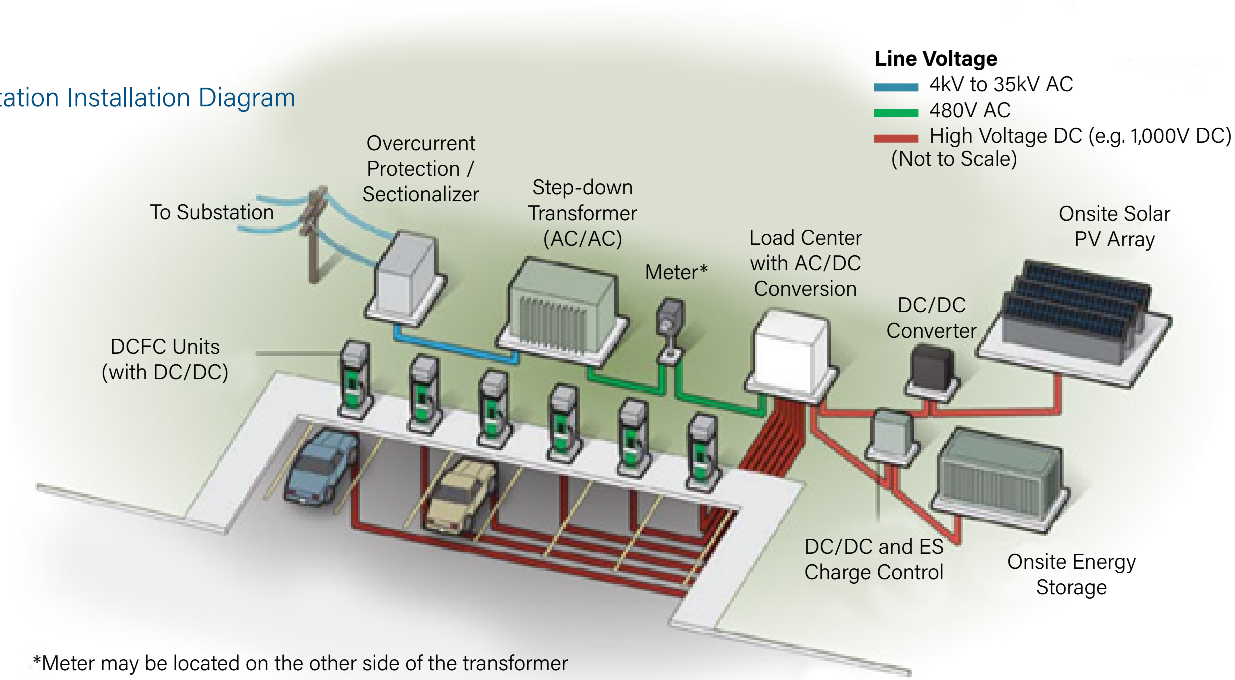
charging station electric system is shown in **Figure 18**.

Utility transmission and distribution systems are designed to withstand a defined threshold of electrical load. If the addition of EV charging stations (for example, 600kW of capacity required for compliance with NEVI funding guidelines) overloads that segment of the distribution system, upgrades to the network would be needed, which could include installing new distribution lines rated at higher capacities, increasing the customer's transformer size, or adding capacity to a nearby substation. DCFC stations also require three-phase electric service to operate, which may not be available at every location. Similarly, new distribution lines would be needed to provide the three-phase service at the proposed location. Through engagement with six utilities, each location was evaluated for the available capacity and the presence of 480V three-phase service to identify where grid upgrades may be needed.

7.2 Available Electric Capacity and Service

With input from local utilities, DEQ assessed the community-level capacity for each recommended charging station location. Further assessment at specific locations is required to confirm the available grid capacity in greater granularity. Based on engagement with utilities, it was determined that many locations (55%) have sufficient existing capacity to support 600kW of load and have adequate service conditions for

Figure 18: EV Charging Station Installation Diagram



*Meter may be located on the other side of the transformer

Source: NREL - https://www.nrel.gov/transportation/medium-heavy-duty-vehicle-charging.html

EV charging stations as shown in **Table 11**. Locations where upgrades may be required will depend upon each specific location to confirm available infrastructure. It is assumed that locations with existing DCFC stations have adequate distribution system capacity for standard operations but would require a new transformer to meet the additional demands of 600 kW of charging capacity. At the time of the writing of this report, utilities are experiencing significant delays with transformer deliveries due to supply chain constraints. Gildford and Hinsdale were identified as locations that will likely require substation level upgrades to support 600kW of charging capacity.

Table 11: Proposed Locations Existing Electric Capacity

Available Capacity and Service	Upgrade May Be Required	Upgrades Required	No Utility Input Received
Browning	Chester	Gildford	Forsyth
Craig	Columbus	Hinsdale	Lodge Grass
Culbertson	Darby		Shelby
Custer	Dutton		St. Ignatius
Cut Bank	Essex		
Drummond	Glasgow		
Glendive	Happy's Inn		
Harlem	Malta		
Haugan	Superior		
Havre			
Lakeside			
Livingston			
Marion			
Melrose			
Miles City			
Olney			
Poplar			
Terry			
Three Forks			
West Glacier			
Wolf Point			

Numerous utilities consulted in the course of this Study recommended the following strategies to lower costs and streamline installation timelines:

- **Early Customer Engagement:** Customers are required to submit a service application to the local utility in order to interconnect to the grid. Completing this step early in the design process is critical to allow utilities proper time to evaluate the proposed location and determined needed upgrades. On average, utilities can review service applications in one month to determine specific grid capacity available and provide a cost estimate. Locations with available capacity can have a transformer placed anywhere between 2 months and 3 years. Many utilities commonly referenced transformer lead times as a major constraint in the timeline due to supply chain shortages[40]. Locations that require upgrades are estimated to require an additional year depending on the exact location.
- **Siting Chargers Near Existing Electric Infrastructure:** Siting chargers near substations along the highway right of way and on the same side of the road as existing electric lines improves the likelihood of available electric capacity. By doing so, the scale of upgrades is minimized. Additionally, grid upgrades are more difficult to complete

40 Yellowstone Valley Electric Cooperative noted that as of May, 2022 had a 1500 kVa and 750 kVa transformer in stock.

in areas with distribution infrastructure that pass through National Parks or other federal land due to lengthy environmental review processes, Essex is a specific location that potentially poses this difficulty.

Costs to perform the necessary upgrades vary widely based on the proposed location and whether environmental review is needed. Some utilities were hesitant to provide cost estimates without a specific location selected and given the variability of supply chain impacts on cost; however, order of magnitude of costs are displayed in **Table 12**. Based on the utility cost structure, a customer is responsible for upfront costs or upgrades are deemed recoverable by the utility. Early collaboration with the utility is essential to understand associated utility costs.

Table 12: DCFC Utility Cost Components

Component	Cost
Transformer (750kVa)	$20,000+
Service	$10,000
Distribution Upgrades	$50,000 - $250,000 per mile

7.3 Solar and Storage

NEVI guidance states that funding may be utilized to install distributed energy resources at locations that improve reliability, mitigate grid impacts, provide high speed charging times, or minimize charging costs. Examples of DERs that could benefit charging station operations include on-site battery storage and solar photovoltaic arrays in certain cases. Utility input regarding local grid constraints and utility interest in installing DERs to mitigate charging costs or distribution system upgrade costs informed the following prioritization of locations for DER deployment (**Table 13**). Locations were assigned scores as follows:

Preferred: The location experiences numerous grid outages and could greatly benefit from DERs.

Fair: The utility has expressed the desire to add certain DERs to help minimize grid impacts in the future.

Not Recommended: The local utility does not have a preference on whether chargers are co-located with DERs.

Table 13: Potential for Solar and/or Battery Storage

Preferred	Fair	Not Recommended	No Utility Input Received
West Glacier	Chester	Browning	Forsyth
	Columbus	Custer	Lodge Grass
	Craig	Cut Bank	Shelby
	Culbertson	Essex	St. Ignatius
	Darby	Happy's Inn	
	Drummond	Lakeside	
	Dutton	Marion	
	Gildford	Melrose	
	Glasgow	Olney	
	Glendive		
	Harlem		
	Haugan		
	Havre		
	Hinsdale		
	Livingston		
	Malta		
	Miles City		
	Poplar		
	Superior		
	Terry		
	Three Forks		
	Wolf Point		

Overall, many of the locations were deemed as suitable candidates for DERs (solar and energy storage) particularly as EV adoption rates grow and the demand for the stations increase. Locations where certains DERs are "not recommended" are based on current conditions but may be ideal candidates in the future if utility programs provide substantial compensation for DER services or to mitigate increases in demand charges. It should be noted that West Glacier received a preferred rating as it experiences frequent power outages from severe weather; to help minimize grid outages, the local electric cooperative is considering installing a microgrid at this location in the coming years. Combination or incorporation of the EV charging station with the microgrid may be an attractive option to pursue at this location.

7.4 Future Proofing and Phasing

Planning for future EV charger expansion due to growing demand and higher charger power levels is critical in preventing the utility from returning to a location to provide upgrade, adding to the cost and timeline of a project. Alternatively, electric grid constraints and long lead times for high-capacity transformers may also lead to the conclusion to install fewer than four 150 kW chargers now and upsize if constraints are eased. **Table 14** establishes a phasing plan on the number of chargers based on the following criteria:

Two Chargers: Two chargers are recommended initially based on limited grid capacity and expected minimal utilization based on AADT data (below 3,000). If chargers continue to be underutilized throughout the future DEQ may request an exemption from the NEVI guidance to install four 150 kW chargers at each NEVI-funded location.

Four Chargers: Four chargers are recommended based on available grid capacity but expected utilization may be low until EV adoption rates increase (AADT between 3,000 and 10,000). This is a make-ready approach that allows for simplified addition of chargers as utilization increases while keeping upfront costs more manageable. Locations that may require upgrades are also recommended to have the transformer capacity for four chargers but will depend on the specific location.

Future Proof: It is recommended that the location initially plan to host up to 1 MW of charging station capacity to accommodate high utilization rates. These locations have 1 MW of grid capacity available and high AADT levels (above 10,000).

Table 14: Charging Phasing and Future Proofing Plan

Two Chargers	Four Chargers	Future Proof	No Utility Input Received
Marion	Browning	Livingston	Forsyth
Olney	Columbus		Lodge Grass
Poplar	Craig		Shelby
Harlem	Custer		St. Ignatius
Essex	Cut Bank		
Hinsdale	Darby		
Culbertson	Drummond		
Malta	Dutton		
Gildford	Glasgow		
Chester	Glendive		
	Happy's Inn		
	Haugan		
	Havre		
	Lakeside		
	Melrose		
	Miles City		
	Superior		
	Terry		
	Three Forks		
	West Glacier		
	Wolf Point		


Photo Credit: Adobe

8 Conclusions

The Montana Electric Vehicle Infrastructure Prioritization Study provides insights on EV adoption rates in the state, expected EV charging demand needs along the five main highway corridors, and proposed charger siting locations to meet NEVI requirements. Additionally, a prioritization methodology was developed to identify locations that should be prioritized for charging station installations.

This Study utilized historic data and industry reports to project future conditions for the assessment; however, numerous limitations should be noted that could impact forecasted conditions. Of particular note, the ongoing impacts of the COVID-19 pandemic, war in Ukraine, and supply-chain shortages are likely to impact EV adoption and the cost and timeline to implement EV charging infrastructure.

The findings of this document indicate that Montana is expected to have between 16,000 (2% of Montana passenger vehicle market) and 86,000 (8% of Montana passenger vehicle market) electric vehicles registered in-state by 2030 with expected growth of up to 24% of the Montana passenger market by 2040. The medium growth scenario, which is believed to reflect adoption most likely in the future, expects 31,000 EVs in 2030 and 88,000 EVs by 2040. Out-of-state EV adoption will significantly add to the number of EVs on Montana roads due to the 12 million annual visitors, estimated at an additional 100,000 EVs in 2030 and 294,000 EVs in 2040. Shifts in tourism or preferred travel mode could significantly change out-of-state projections. While the anticipated EV adoption rate is rapid compared to currently observed rates, the majority of vehicles continue to be internal combustion engines, even by 2040.

Based on projected growth rates, the annual energy consumption of EVs operating in Montana was quantified. The methodology for the calculation considered future traffic patterns, battery economy advancements, and cold weather impacts. Results from the medium EV growth scenario indicate 88 GWh of added electricity consumption in 2030. While the added load will require utility planning, particularly in the vast rural areas of that state, it is less than 1% of the 14,000 GWh Montana consumes annually.

Thirty-six new charger locations are proposed in this Study for alignment with NEVI guidance, state priorities, and EV manufacturer recommendations. A prioritization exercise identified Browning, Custer, Drummond, Forsyth, Havre, Livingston, Miles City, Shelby, and Three Forks as the highest priority locations to begin expanding the public charging network. With input from Montana utilities, this Study found that over half of the proposed locations likely have adequate electric service to support 600 kW of charging capacity which can greatly reduce the cost and timeline to install the stations. Knowledge of the precise locations is needed to confirm actual existing grid conditions; however, utilities recommended siting chargers on the same side of the road as existing transmission systems and closer to electric substations to minimize needed upgrades.

This Study is intended to support DEQ in its efforts to enhance the state's public charging network and improve the understanding around projected EV infrastructure needs. This includes leveraging available federal funding from the NEVI program to pursue EV charging station installations. Additional work to apply for NEVI funding includes stakeholder engagement efforts to confirm proposed locations and identify specific sites, understanding workforce considerations, and developing an implementation method.

APPENDIX A Comparison of AECOM Model to US Trends

Figure 19 illustrates the results of the EV Adoption market model described in Section 5 compared to other DOE projections. The model utilizes nationwide inputs for the analysis. Based on the figure, MDEQ's model closely aligns to the DOE's medium forecast and within the upper and lower tiers of the high and low forecast.

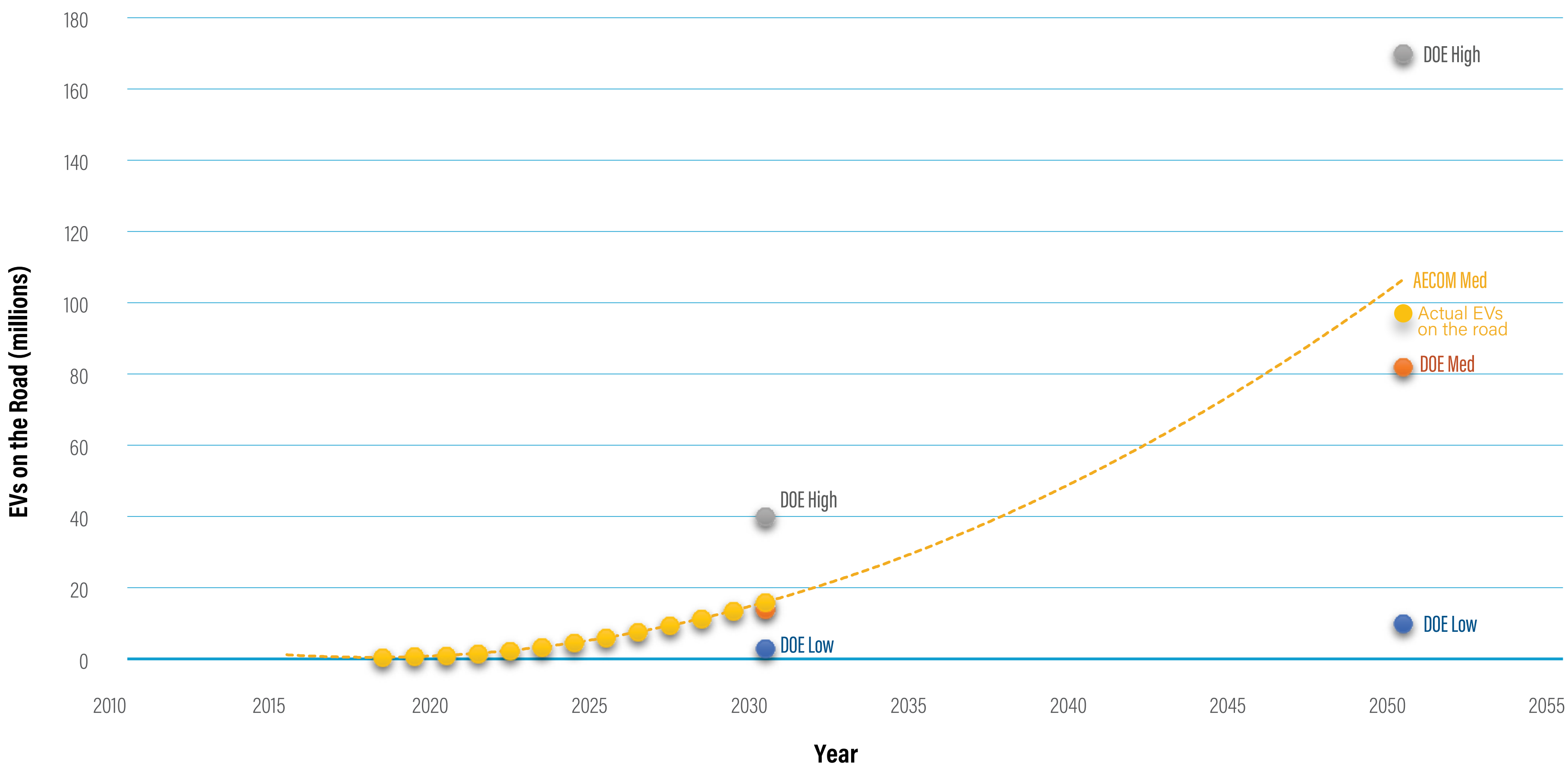


Figure 19: Comparison of AECOM's EV Adoption Model to DOE Projections of US EV Adoption

APPENDIX B EV Market Analysis Results

Table 15 presents the annual results from the EV Market Assessment in Section 5.4. Results are presented for both in and out-of-state traffic. The total percentage of unique vehicles that are electric are presented which are used for the EV Charging Demand analysis.

Table 15: In and Out-of-state EV Adoption Results in Montana through 2040

Montana Analysis Results

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
EVs on Road (Thousands) - HIGH	0.40	0.92	1.78	5.23	10.12	16.33	23.84	32.48	41.85	51.92	62.66	74.03	85.93	98.24	110.95	124.06	137.58	151.51	167.08	184.30	203.18	223.75	246.01
EVs on Road (Thousands) - MED	0.40	0.92	1.78	3.00	4.72	6.91	9.56	12.61	15.92	19.47	23.26	27.27	31.48	35.82	40.30	44.93	49.70	54.62	60.11	66.19	72.85	80.11	87.97
EVs on Road (Thousands) - LOW	0.40	0.92	1.78	2.39	3.25	4.35	5.67	7.20	8.85	10.63	12.52	14.53	16.63	18.80	21.04	23.35	25.74	28.20	30.94	33.98	37.32	40.94	44.87

Out of State Traffic Analysis

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Percentage of Out of State Vehicle Market		1%	1%	1%	2%	3%	3%	4%	5%	7%	8%	9%	11%	12%	13%	15%	16%	18%	20%	22%	24%	26%	29%
EVs on Road (Thousands)			8	12	17	24	32	41	51	62	74	86	100	114	128	143	159	176	195	216	239	265	294

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Total EVs (% of In and Out of State Market) - HIGH		0%	0%	1%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	12%	13%	15%	16%	18%	20%	22%	24%	26%
Total EVs (% of In and Out of State Market) - MED		0%	0%	1%	1%	1%	2%	3%	3%	4%	5%	6%	6%	7%	8%	9%	10%	11%	12%	14%	15%	17%	19%
Total EVs (% of In and Out of State Market) - LOW		0%	0%	1%	1%	1%	2%	2%	3%	4%	4%	5%	6%	6%	7%	8%	9%	10%	11%	12%	14%	15%	17%

APPENDIX C EV Charging Demand Results

Tables 16-19 present a step-by-step calculation of the methodology described in Section 6.1.1. The calculations use traffic and vehicle miles traveled from MDQ in combination with results from the EV market assessment to determine EV traffic, EV mileage, and annual EV energy consumption.

Table 16: Passenger Vehicle AADT and DVMT through 2040

AADT

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
I-90 (rural)		6,553	6,601	6,649	6,696	6,745	6,793	6,842	6,891	6,941	6,991	7,041	7,092	7,143	7,194	7,246	7,298	7,351	7,404	7,457	7,511	7,565	7,619
I-90 (urban)		17,415	17,541	17,667	17,794	17,923	18,052	18,182	18,313	18,444	18,577	18,711	18,846	18,981	19,118	19,256	19,394	19,534	19,675	19,816	19,959	20,103	20,247
I-90 (total)		7,826	7,883	7,940	7,997	8,055	8,112	8,171	8,230	8,289	8,349	8,409	8,469	8,530	8,592	8,654	8,716	8,779	8,842	8,906	8,970	9,034	9,099
I-15 (rural)		2,760	2,780	2,800	2,820	2,840	2,861	2,882	2,902	2,923	2,944	2,965	2,987	3,008	3,030	3,052	3,074	3,096	3,118	3,141	3,163	3,186	3,209
I-15 (urban)		9,944	10,016	10,088	10,161	10,234	10,308	10,382	10,457	10,532	10,608	10,684	10,761	10,838	10,916	10,995	11,074	11,154	11,234	11,315	11,397	11,479	11,561
I-15 (total)		3,140	3,163	3,186	3,209	3,232	3,255	3,279	3,302	3,326	3,350	3,374	3,398	3,423	3,447	3,472	3,497	3,522	3,548	3,573	3,599	3,625	3,651
I-94 (rural)		2,815	2,835	2,855	2,876	2,897	2,918	2,939	2,960	2,981	3,002	3,024	3,046	3,068	3,090	3,112	3,135	3,157	3,180	3,203	3,226	3,249	3,272
I-94 (urban)		4,473	4,505	4,537	4,570	4,603	4,636	4,670	4,703	4,737	4,771	4,805	4,840	4,875	4,910	4,945	4,981	5,017	5,053	5,089	5,126	5,163	5,200
I-94 (total)		2,887	2,908	2,929	2,950	2,971	2,993	3,014	3,036	3,058	3,080	3,102	3,124	3,147	3,169	3,192	3,215	3,238	3,262	3,285	3,309	3,333	3,357
US-93 (N-7, N-92, N-5) (rural)		6,561	6,608	6,656	6,704	6,752	6,801	6,850	6,899	6,949	6,999	7,049	7,100	7,151	7,202	7,254	7,307	7,359	7,412	7,466	7,519	7,573	7,628
US-93 (N-7, N-92, N-5) (urban)		15,786	15,900	16,015	16,130	16,246	16,363	16,481	16,600	16,719	16,840	16,961	17,083	17,206	17,330	17,455	17,580	17,707	17,834	17,963	18,092	18,222	18,354
US-93 (N-7, N-92, N-5) (total)		8,081	8,140	8,199	8,258	8,317	8,377	8,437	8,498	8,559	8,621	8,683	8,745	8,808	8,872	8,936	9,000	9,065	9,130	9,196	9,262	9,329	9,396
US-2 (N-1) (rural)		1,797	1,810	1,823	1,836	1,849	1,863	1,876	1,890	1,903	1,917	1,931	1,945	1,959	1,973	1,987	2,001	2,016	2,030	2,045	2,059	2,074	2,089
US-2 (N-1) (urban)		12,641	12,733	12,825	12,917	13,010	13,104	13,198	13,293	13,389	13,485	13,582	13,680	13,779	13,878	13,978	14,078	14,180	14,282	14,385	14,488	14,592	14,698
US-2 (N-1) (total)		2,148	2,164	2,180	2,195	2,211	2,227	2,243	2,259	2,275	2,292	2,308	2,325	2,342	2,359	2,376	2,393	2,410	2,427	2,445	2,462	2,480	2,498
Total		104,827	105,588	106,348	107,114	107,885	108,662	109,444	110,232	111,026	111,825	112,630	113,441	114,258	115,081	115,909	116,744	117,584	118,431	119,284	120,142	121,007	121,879

DVMT

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
I-90 (rural)		3,151,701	3,174,558	3,197,415	3,220,436	3,243,623	3,266,977	3,290,500	3,314,191	3,338,053	3,362,087	3,386,294	3,410,676	3,435,233	3,459,966	3,484,878	3,509,969	3,535,241	3,560,695	3,586,332	3,612,153	3,638,161	3,664,356
I-90 (urban)		1,111,489	1,119,550	1,127,611	1,135,730	1,143,907	1,152,143	1,160,438	1,168,794	1,177,209	1,185,685	1,194,222	1,202,820	1,211,480	1,220,203	1,228,988	1,237,837	1,246,750	1,255,726	1,264,767	1,273,874	1,283,046	1,292,284
I-90 (total)		4,263,190	4,294,108	4,325,026	4,356,166	4,387,530	4,419,120	4,450,938	4,482,985	4,515,262	4,547,772	4,580,516	4,613,496	4,646,713	4,680,169	4,713,867	4,747,806	4,781,991	4,816,421	4,851,099	4,886,027	4,921,206	4,956,639
I-15 (rural)		1,036,140	1,043,654	1,051,168	1,058,737	1,066,360	1,074,037	1,081,770	1,089,559	1,097,404	1,105,305	1,113,264	1,121,279	1,129,352	1,137,484	1,145,673	1,153,922	1,162,231	1,170,599	1,179,027	1,187,516	1,196,066	1,204,678
I-15 (urban)		208,681	210,194	211,707	213,232	214,767	216,313	217,871	219,439	221,019	222,611	224,214	225,828	227,454	229,091	230,741	232,402	234,076	235,761	237,458	239,168	240,890	242,625
I-15 (total)		1,244,820	1,253,848	1,262,876	1,271,968	1,281,127	1,290,351	1,299,641	1,308,999	1,318,423	1,327,916	1,337,477	1,347,107	1,356,806	1,366,575	1,376,414	1,386,325	1,396,306	1,406,360	1,416,485	1,426,684	1,436,956	1,447,302
I-94 (rural)		672,004	676,878	681,752	686,660	691,604	696,584	701,599	706,651	711,738	716,863	722,024	727,223	732,459	737,733	743,044	748,394	753,783	759,210	764,676	770,182	775,727	781,312
I-94 (urban)		48,634	48,987	49,340	49,695	50,053	50,413	50,776	51,142	51,510	51,881	52,254	52,631	53,010	53,391	53,776	54,163	54,553	54,946	55,341	55,740	56,141	56,545
I-94 (total)		720,639	725,865	731,091	736,355	741,657	746,997	752,375	757,792	763,248	768,744	774,279	779,854	785,468	791,124	796,820	802,557	808,335	814,155	820,017	825,921	831,868	837,858
US-93 (N-7, N-92, N-5) (rural)		714,679	719,862	725,045	730,265	735,523	740,819	746,153	751,525	756,936	762,386	767,875	773,404	778,972	784,581	790,230	795,919	801,650	807,422	813,235	819,091	824,988	830,928
US-93 (N-7, N-92, N-5) (urban)		213,794	215,344	216,894	218,456	220,029	221,613	223,209	224,816	226,435	228,065	229,707	231,361	233,027	234,704	236,394	238,096	239,811	241,537	243,276	245,028	246,792	248,569
US-93 (N-7, N-92, N-5) (total)		2,785,417	2,805,617	2,825,817	2,846,163	2,866,656	2,887,296	2,908,084	2,929,022	2,950,111	2,971,352	2,992,746	3,014,294	3,035,997	3,057,856	3,079,872	3,102,047	3,124,382	3,146,878	3,169,535	3,192,356	3,215,341	3,238,491
US-2 (N-1) (rural)		1,156,889	1,165,279	1,173,669	1,182,119	1,190,631	1,199,203	1,207,837	1,216,534	1,225,293	1,234,115	1,243,001	1,251,950	1,260,964	1,270,043	1,279,188	1,288,398	1,297,674	1,307,017	1,316,428	1,325,906	1,335,453	1,345,068
US-2 (N-1) (urban)		272,857	274,836	276,815	278,808	280,815	282,837	284,874	286,925	288,991	291,071	293,167	295,278	297,404	299,545	301,702	303,874	306,062	308,266	310,485	312,721	314,972	317,240
US-2 (N-1) (total)		1,429,746	1,440,115	1,450,484	1,460,927	1,471,446	1,482,040	1,492,711	1,503,459	1,514,284	1,525,186	1,536,168	1,547,228	1,558,368	1,569,588	1,580,889	1,592,272	1,603,736	1,615,283	1,626,913	1,638,627	1,650,425	1,662,308
Total		19,030,680	19,168,695	19,306,709	19,445,718	19,585,727	19,726,744	19,868,777	20,011,832	20,155,917	20,301,040	20,447,207	20,594,427	20,742,707	20,892,054	21,042,477	21,193,983	21,346,580	21,500,275	21,655,077	21,810,993	21,968,033	22,126,202

APPENDIX C EV Charging Demand Results

Table 17: EV AADT and DVMT through 2040

Expected Yearly EV Traffic - LOW RURAL

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
I-90		1,082	11,951	17,813	26,170	36,921	50,060	65,425	82,383	100,952	121,137	142,932	166,221	190,784	216,672	243,935	272,629	302,812	337,076	375,641	418,751	466,676	519,714
I-15		456	5,033	7,502	11,021	15,549	21,083	27,554	34,696	42,516	51,017	60,196	70,004	80,349	91,251	102,733	114,817	127,529	141,959	158,200	176,356	196,540	218,877
I-94		465	5,133	7,651	11,239	15,857	21,500	28,099	35,382	43,357	52,026	61,386	71,389	81,938	93,056	104,765	117,089	130,052	144,767	161,330	179,845	200,428	223,207
US-93 (N-7, N-92, N-5)		1,083	11,964	17,833	26,199	36,962	50,116	65,498	82,475	101,064	121,271	143,091	166,406	190,996	216,912	244,206	272,932	303,148	337,450	376,058	419,216	467,194	520,291
US-2 (N-1)		297	3,277	4,884	7,176	10,124	13,727	17,940	22,590	27,681	33,216	39,192	45,578	52,313	59,412	66,887	74,755	83,031	92,426	103,001	114,822	127,963	142,506
Total		3,382	37,358	55,684	81,806	115,411	156,486	204,514	257,526	315,570	378,666	446,797	519,598	596,381	677,302	762,525	852,222	946,572	1,053,679	1,174,231	1,308,990	1,458,800	1,624,595

Expected Yearly EV Traffic - HIGH URBAN

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
I-90		2,875	31,758	47,336	69,542	98,110	133,027	173,855	218,919	268,262	321,900	379,817	441,704	506,976	575,767	648,214	724,464	804,669	895,720	998,199	1,112,756	1,240,108	1,381,049
I-15		1,642	18,134	27,029	39,709	56,021	75,959	99,272	125,004	153,179	183,806	216,877	252,215	289,486	328,766	370,133	413,672	459,470	511,461	569,977	635,390	708,108	788,586
I-94		738	8,156	12,157	17,860	25,197	34,165	44,651	56,224	68,897	82,672	97,547	113,441	130,205	147,872	166,479	186,062	206,661	230,045	256,364	285,786	318,493	354,690
US-93 (N-7, N-92, N-5)		2,606	28,787	42,909	63,037	88,933	120,584	157,594	198,443	243,171	291,791	344,291	400,390	459,557	521,913	587,584	656,702	729,406	811,940	904,835	1,008,677	1,124,117	1,251,875
US-2 (N-1)		2,087	23,053	34,361	50,480	71,218	96,564	126,201	158,913	194,731	233,667	275,709	320,633	368,014	417,949	470,538	525,888	584,109	650,202	724,592	807,749	900,194	1,002,502
Total		9,948	109,888	163,793	240,629	339,480	460,299	601,574	757,505	928,241	1,113,837	1,314,241	1,528,383	1,754,238	1,992,266	2,242,948	2,506,788	2,784,316	3,099,368	3,453,967	3,850,357	4,291,020	4,778,702

Expected Yearly EV Traffic - Total Route

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
I-90		1,292	14,272	21,273	31,252	44,091	59,783	78,131	98,383	120,558	144,663	170,691	198,504	227,837	258,752	291,310	325,577	361,622	402,540	448,595	500,077	557,310	620,649
I-15		518	5,727	8,536	12,540	17,691	23,987	31,350	39,476	48,373	58,045	68,489	79,648	91,418	103,822	116,886	130,636	145,098	161,517	179,996	200,653	223,617	249,031
I-94		477	5,265	7,848	11,529	16,265	22,054	28,822	36,293	44,473	53,366	62,967	73,227	84,048	95,452	107,463	120,104	133,401	148,495	165,485	184,476	205,589	228,954
US-93		1,334	14,737	21,967	32,271	45,528	61,732	80,679	101,591	124,489	149,379	176,256	204,975	235,265	267,188	300,807	336,191	373,411	415,664	463,220	516,381	575,479	640,883
US-2		355	3,918	5,840	8,579	12,104	16,411	21,448	27,008	33,095	39,712	46,857	54,492	62,545	71,031	79,969	89,376	99,271	110,503	123,146	137,279	152,990	170,377
Total		3,976	43,919	65,463	96,172	135,679	183,967	240,430	302,751	370,989	445,165	525,261	610,846	701,113	796,246	896,435	1,001,884	1,112,803	1,238,719	1,380,441	1,538,866	1,714,985	1,909,896

Expected EV Daily Miles - RURAL

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
I-90		520,269	5,747,153	8,566,389	12,584,944	17,754,875	24,073,739	31,462,452	39,617,677	48,547,240	58,253,944	68,735,145	79,934,827	91,747,112	104,196,028	117,306,743	131,105,641	145,620,412	162,097,719	180,643,365	201,374,657	224,421,451	249,927,327
I-15		219,110	2,420,404	3,607,720	5,300,128	7,477,436	10,138,614	13,250,358	16,684,918	20,445,588	24,533,550	28,947,690	33,664,417	38,639,141	43,881,981	49,403,537	55,214,919	61,327,791	68,267,181	76,077,648	84,808,597	94,514,715	105,256,472
I-94		223,445	2,468,289	3,679,096	5,404,986	7,625,371	10,339,199	13,512,506	17,015,015	20,850,087	25,018,926	29,520,396	34,330,440	39,403,585	44,750,150	50,380,945	56,307,301	62,541,110	69,617,790	77,582,781	86,486,465	96,384,611	107,338,884
US-93 (N-7, N-92, N-5)		520,847	5,753,537	8,575,906	12,598,925	17,774,600	24,100,483	31,497,405	39,661,690	48,601,174	58,318,661	68,811,506	80,023,630	91,849,038	104,311,784	117,437,064	131,251,292	145,782,188	162,277,801	180,844,049	201,598,373	224,670,771	250,204,982
US-2 (N-1)		142,658	1,575,874	2,348,911	3,450,803	4,868,402	6,601,040	8,627,032	10,863,202	13,311,696	15,973,283	18,847,237	21,918,200	25,157,139	28,570,642	32,165,612	35,949,282	39,929,245	44,447,337	49,532,569	55,217,108	61,536,559	68,530,293
Total		1,626,329	17,965,257	26,778,023	39,339,786	55,500,684	75,253,075	98,349,752	123,842,502	151,755,786	182,098,364	214,861,975	249,871,513	286,796,015	325,710,585	366,693,901	409,828,434	455,200,746	506,707,828	564,680,412	629,485,198	701,528,106	781,257,957

Expected EV Daily Miles - URBAN

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
I-90		183,491	2,026,930	3,021,231	4,438,512	6,261,865	8,490,429	11,096,312	13,972,531	17,121,848	20,545,249	24,241,804	28,191,755	32,357,763	36,748,299	41,372,242	46,238,896	51,358,028	57,169,315	63,710,072	71,021,672	79,149,914	88,145,435
I-15		104,774	1,157,387	1,725,138	2,534,413	3,575,557	4,848,078	6,336,050	7,978,386	9,776,662	11,731,442	13,842,193	16,097,635	18,476,447	20,983,465	23,623,760	26,402,644	29,325,694	32,643,969	36,378,774	40,553,735	45,195,002	50,331,491
I-94		47,125	520,570	775,933	1,139,929	1,608,215	2,180,570	2,849,831	3,588,521	4,397,350	5,276,572	6,225,946	7,240,400	8,310,343	9,437,950	10,625,503	11,875,391	13,190,121	14,682,616	16,362,458	18,240,273	20,327,824	22,638,116
US-93 (N-7, N-92, N-5)		166,328	1,837,345	2,738,645	4,023,363	5,676,173	7,696,291	10,058,437	12,665,635	15,520,386	18,623,585	21,974,389	25,554,889	29,331,236	33,311,112	37,502,562	41,914,022	46,554,345	51,822,083	57,751,062	64,378,785	71,746,766	79,900,906
US-2 (N-1)		133,196	1,471,347	2,193,109	3,221,913	4,545,484	6,163,196	8,054,805	10,142,651	12,428,738	14,913,783	17,597,109	20,464,376	23,488,478	26,675,565	30,032,083	33,564,783	37,280,757	41,499,167	46,247,098	51,554,584	57,454,869	63,984,711
Total		634,914	7,013,580	10,454,056	15,358,129	21,667,293	29,378,565	38,395,435	48,347,725	59,244,983	71,090,631	83,881,442	97,549,056	111,964,266	127,156,392	143,156,150	159,995,737	177,708,945	197,817,149	220,449,464	245,749,049	273,874,375	305,000,659

Greand Total		2,261,243	24,978,838	37,232,080	54,697,915	77,167,977	104,631,640	136,745,187	172,190,227	211,000,769	253,188,995	298,743,416	347,420,568	398,760,281	452,866,977	509,850,051	569,824,170	632,909,691	704,524,977	785,129,876	875,234,248	975,402,481	1,086,258,616

Table 18: Annual EV Energy Consumption Under Standard Conditions

Expected EV Energy - RURAL

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
I-90		158343	1547310	2188494	3058841	4115368	5332790	6673853	8061737	9492477	10961764	12464923	13988595	16055745	18234305	20528680	22943487	25483572	28367101	31612589	35240565	39273754	43737282
I-15		66686	651647	921680	1288226	1733180	2245896	2810682	3395187	3997741	4616528	5249581	5891273	6761850	7679347	8645619	9662611	10732363	11946757	13313588	14841504	16540075	18419883
I-94		68005	664539	939915	1313712	1767470	2290329	2866289	3462358	4076833	4707862	5353440	6007827	6895627	7831276	8816665	9853778	10944694	12183113	13576987	15135131	16867307	18784305
US-93 (N-7, N-92, N-5)		158519	1549029	2190925	3062239	4119940	5338715	6681268	8070693	9503023	10973942	12478770	14004135	16073582	18254562	20551486	22968976	25511883	28398615	31647709	35279715	39317385	43785872
US-2 (N-1)		43418	424274	600087	838737	1128438	1462256	1829976	2210535	2602846	3005725	3417893	3835685	4402499	4999862	5628982	6291124	6987618	7778284	8668200	9662994	10768898	11992801
Total (GWH)		0	5	7	10	13	17	21	25	30	34	39	44	50	57	64	72	80	89	99	110	123	137

Expected EV Energy - URBAN

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
I-90		55845	545712	771847	1078805	1451426	1880791	2353763	2843248	3347847	3866042	4396182	4933557	5662608	6430952	7240142	8091807	8987655	10004630	11149263	12428793	13851235	15425451
I-15		31888	311604	440729	616003	828771	1073941	1344011	1623509	1911638	2207529	2510242	2817086	3233378	3672106	4134158	4620463	5131997	5712695	6366285	7096904	7909125	8808011
I-94		14342	140154	198231	277066	372765	483038	604510	730222	859817	992903	1129058	1267070	1454310	1651641	1859463	2078193	2308271	2569458	2863430	3192048	3557369	3961670
US-93 (N-7, N-92, N-5)		50622	494670	699654	977901	1315669	1704875	2133608	2577309	3034712	3504438	3984993	4472106	5132966	5829445	6562948	7334954	8147010	9068865	10106436	11266287	12555684	13982659
US-2 (N-1)		40538	396132	560283	783104	1053589	1365265	1708595	2063912	2430200	2806357	3191186	3581266	4110484	4668224	5255614	5873837	6524133	7262354	8093242	9022052	10054602	11197325
Total (GWh)		0	2	3	4	5	7	8	10	12	13	15	17	20	22	25	28	31	35	39	43	48	53

Grand Total		1	7	10	13	18	23	29	35	41	48	54	61	70	79	89	100	111	123	137	153	171	190

Table 19: Annual EV Energy Consumption Under Standard Conditions

Expected EV Energy - RURAL COLD

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
I-90		228025	2228236	3151584	4404945	5926420	7679592	9610817	11609467	13669834	15785709
I-15		96032	938418	1327284	1855135	2495902	3234247	4047580	4889307	5757027	6648125
I-94		97932	956983	1353544	1891838	2545281	3298234	4127658	4986038	5870925	6779652
US-93 (N-7, N-92, N-5)		228278	2230711	3155086	4409839	5933003	7688124	9621494	11622364	13685020	15803246
US-2 (N-1)		62525	610984	864167	1207840	1625029	2105751	2635295	3183326	3748280	4328455
Total (GWH)		0.71	6.97	9.85	13.77	18.53	24.01	30.04	36.29	42.73	49.35

	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
I-90	17950364	20144558	23121400	26258679	29562741	33040232	36698133	40850617	45524347	50748888	56556963	62984757
I-15	7559765	8483847	9737538	11058798	12450298	13914838	15455357	17204168	19172502	21372808	23818869	26525924
I-94	7709329	8651693	9930188	11277588	12696617	14190132	15761128	17544539	19551814	21795652	24290106	27050718
US-93 (N-7, N-92, N-5)	17970306	20166938	23147086	26287851	29595583	33076938	36738903	40896000	45574922	50805267	56619795	63054730
US-2 (N-1)	4922006	5523656	6339908	7200153	8106129	9059661	10062660	11201275	12482816	13915390	15507969	17270476
Total (GWH)	56.11	62.97	72.28	82.08	92.41	103.28	114.72	127.70	142.31	158.64	176.79	196.89

Expected EV Energy - URBAN COLD

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
I-90		80421	785864	1111514	1553555	2090155	2708471	3389584	4094476	4821135	5567371
I-15		45921	448732	634680	887088	1193489	1546551	1935470	2337967	2752893	3178997
I-94		20654	201831	285467	398995	536808	695608	870536	1051571	1238197	1429850
US-93 (N-7, N-92, N-5)		72899	712359	1007551	1408246	1894656	2455139	3072545	3711507	4370199	5046637
US-2 (N-1)		58377	570458	806847	1127724	1517242	1966078	2460497	2972178	3499659	4041351
Total (GWH)		0	3	4	5	7	9	12	14	17	19

	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
I-90	6330811	7104669	8154554	9261023	10426313	11652770	12942854	14407370	16055721	17898334	19946751	22213733
I-15	3614925	4056802	4656292	5288091	5953478	6653791	7390435	8226681	9167898	10220040	11389696	12684154
I-94	1625922	1824670	2094308	2378479	2677757	2992744	3324073	3700200	4123540	4596773	5122861	5705083
US-93 (N-7, N-92, N-5)	5738670	6440146	7391832	8394809	9451106	10562849	11732267	13059802	14553977	16224245	18081066	20136010
US-2 (N-1)	4595531	5157274	5919385	6722570	7568454	8458738	9395209	10458300	11654837	12992389	14479333	16124933
Total (GWH)	22	25	28	32	36	40	45	50	56	62	69	77

Expected EV Energy - Total

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
I-90		308445	3014099	4263099	5958500	8016574	10388064	13000401	15703943	18490969	21353081
I-15		141953	1387150	1961965	2742223	3689391	4780798	5983049	7227274	8509920	9827122
I-94		118586	1158814	1639010	2290832	3082089	3993842	4998194	6037610	7109122	8209503
US-93		301177	2943070	4162636	5818085	7827659	10143263	12694040	15333871	18055219	20849883
US-2		120902	1181442	1671015	2335564	3142271	4071828	5095791	6155504	7247939	8369806
Greand Total		1	10	14	19	26	33	42	50	59	69

	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
I-90	24281175	27249227	31275953	35519702	39989054	44693002	49640987	55257987	61580068	68647222	76503714	85198490
I-15	11174690	12540649	14393830	16346889	18403776	20568629	22845792	25430849	28340400	31592848	35208565	39210078
I-94	9335251	10476362	12024496	13656067	15374374	17182876	19085201	21244738	23675355	26392425	29412968	32755801
US-93	23708975	26607084	30538918	34682660	39046690	43639787	48471169	53955801	60128900	67029512	74700861	83190740
US-2	9517537	10680930	12259293	13922723	15674583	17518399	19457869	21659575	24137653	26907778	29987302	33395409
Greand Total	78	88	100	114	128	144	160	178	198	221	246	274

APPENDIX D Amenity List

The following amenities, based on NAICS codes, were included in the analysis to identify the amenity count at each of the proposed locations. The amenity count was used as part of the prioritization process:

- Grocery Stores
- Supermarkets and Other Grocery (except Convenience) Stores
- Convenience Stores
- Beer, Wine, and Liquor Stores
- Pharmacies and Drug Stores
- Gasoline Stations and Gasoline Stations with Convenience Stores
- Other Gasoline Stations
- General Merchandise Stores, including Warehouse Clubs and Supercenters
- All Other General Merchandise Stores
- Museums, Historical Sites, and Similar Institutions
- Zoos and Botanical Gardens
- Nature Parks and Other Similar Institutions
- Amusement, Arcades, and Theme Parks
- Traveler Accommodation
- Hotels, Casino Hotels, and Motels
- Casino Hotels
- Bed-and-Breakfast Inns
- All Other Traveler Accommodation
- RV (Recreational Vehicle) Parks and Campgrounds
- Recreational and Vacation Camps (except Campgrounds)
- Rooming and Boarding Houses, Dormitories, and Workers' Camps
- Mobile Food Services
- Drinking Places (Alcoholic Beverages)
- Restaurants and Other Eating Places
- Full-Service Restaurants
- Limited-Service Restaurants
- Cafeterias, Grill Buffets, and Buffets
- Snack and Nonalcoholic Beverage Bars

APPENDIX E Prioritization Score Tiers

Score tiers for each of the location criterion described in Section 7.1.1 are listed in **Table 20**. Lower scores represent preferable traits of location to install a proposed charging station. Scores for each criterion at each location are shown in Appendix 9.6.

Table 20: Location Criteria Scoring Tiers

Criteria	Score	Score Description
Amenity Count	1	More than 50 amenities
	2	Between 25 and 50 amenities
	3	Less than 25 amenities
Connection Hub	1	Locations at the intersection of two or more major highways
	2	Locations along the Montana border that could connect to the regional network
	3	Locations solely along the main highway corridors in this Study
Cost (Average of installation and utility costs)	1	Bottom third of locations with the lowest charger installation cost
	2	Middle third of locations based on charger installation costs
	3	Top third of locations with the highest charger installation cost
	1	Location has adequate electric supply for 600kW of charging power.
	2	Location may need grid upgrades depending on the specific site to host 600kW of charging power. Sites where the local utility was not engaged are also included in this score.
	3	Sites will require grid level upgrades to support 600kW of charging power.
Gap Filled	1	Locations that fill a 50-mile gap in the charging network
	2	Locations that enhance the network beyond a 50-mile network
	3	Locations with a planned Tesla Supercharger
Traffic	1	Locations with an AADT over 5000
	2	Locations with an AADT between 2000 and 5000
	3	Locations with an AADT under 2000
Route	1	Interstate highway routes.
	2	United States highway routes with an AADT higher than the Interstate highway routes.
	3	United States highway routes with an AADT lower than the Interstate highway routes.
Vulnerability Index	1	A designated DAC or tribal community in the EVJustice40 Mapping Tool
	2	Not applicable for this criterion
	3	Neither a designated DAC nor tribal community in the EVJustice40 Mapping Tool

APPENDIX F Prioritization Score Results

Scores using the tiers shown in Appendix E at each location are shown in **Table 21.** Lower scores are preferred locations for charger installations.

Table 21: Location Prioritization Scoring Results

Locations	Gap Filled Tier	Traffic Tier	Route Tier	EV Traffic Tier	Amenity Count Tier	Charger Cost Tier	Vulnerability Index Tier	Connection Hub Tier	Utility Capacity Tier
Livingston	1	1	1	0	1	2.0	3	1	1
Drummond	1	1	1	0	3	1.0	3	3	1
Hauve	1	1	3	0	1	2.0	1	1	1
Haugan	2	1	1	0	3	2.0	1	2	1
Superior	3	1	1	0	3	2.5	1	3	2
West Glacier	1	1	3	0	3	1.5	1	3	1
St. Ignatius	1	1	2	0	3	2.5	1	3	2
Lakeside	1	1	2	0	3	2.0	3	3	1
Custer	1	1	1	0	3	1.0	3	3	1
Miles City	3	1	1	0	1	1.0	1	1	1
Glendive	3	1	1	0	1	1.0	3	1	1
Happy's Inn	1	1	3	0	3	2.0	1	3	2
Columbus	1	1	1	0	3	1.5	3	3	2
Browning	1	1	3	0	3	1.5	1	1	1
Forsyth	1	1	1	0	3	1.5	3	1	2
Glasgow	1	2	3	0	2	2.0	3	1	2
Terry	1	2	1	0	3	1.0	3	3	1
Craig	1	2	1	0	3	2.0	3	3	1
Lodge Grass	1	2	1	0	3	1.5	1	2	2
Dutton	1	2	1	0	3	2.5	3	3	2
Darby	2	2	2	0	3	2.5	1	2	2
Three Forks	1	2	1	0	2	1.0	3	1	1
Malrose	1	2	1	0	3	2.0	3	3	1
Cut Bank	1	2	3	0	2	1.5	1	1	1
Wolf Point	1	2	3	0	3	2.0	1	3	1
Shelby	1	2	1	0	2	2.5	3	1	2
Marion	1	2	3	0	3	1.5	1	3	1
Olney	1	2	2	0	3	2.0	1	3	1
Poplar	1	2	3	0	3	1.5	1	3	1
Harlem	1	2	3	0	3	1.5	3	1	1
Essex	1	2	3	0	3	2.5	1	3	2
Hinsdale	1	3	3	0	3	1.5	3	3	1
Culbertson	1	3	3	0	3	1.5	3	1	1
Maka	1	3	3	0	3	2.0	3	1	2
Gildford	1	3	3	0	3	2.0	3	3	1
Chester	1	3	3	0	3	2.0	3	3	2

APPENDIX G Land Acquisition Cost Methodology

Land acquisition costs were determined for each proposed charging location based on the following methodology:

- Used a historical database of commercial land sales from research provider, Costar
- Sales data was assessed within a 2-mile radius of major highway corridors included in this Study
- The five nearest sales groups were averaged for each proposed site

Table 22: Land Acquisition Cost Summary

Type	Per Acre
Rural	$193,105
Ski	$238,000
Urban	$195,818

Tier	Per Acre
1	$159,500
2	$189,667
3	$255,545

APPENDIX H Existing and Planned Charging Stations

The tables below are the existing and planned DCFC station in Montana provided by DEQ. For the gap analysis, only publicly available chargers along the main corridors that meet AFC requirements were considered.

Table 23: Existing DCFC Locations in Montana

Station Name	City	EV DC Fast Count	EV Network
The Fort - Tesla Supercharger	Big Timber	4	Tesla
Billings Big Horn Resort - Tesla Supercharger	Billings	4	Tesla
Hilton Garden Inn Bozeman - Tesla Supercharger	Bozeman	4	Tesla
Best Western Plus Butte Plaza Inn - Tesla Supercharger	Butte	6	Tesla
S&S Foods - Tesla Supercharger	Superior	4	Tesla
Jan's Cafe - Tesla Supercharger	Lima	8	Tesla
Best Western Plus Grant Creek Inn - Tesla Supercharger	Missoula	6	Tesla
Grizzly & Wolf Discovery Center - Tesla Supercharger	West Yellowstone	8	Tesla
Walmart 3259 Missoula	Missoula	4	Electrify America
Dell Mercantile	Dell	4	Electrify America
Cenex - Tesla Supercharger	Miles City	8	Tesla
Holiday Inn Express - Tesla Supercharger	Glendive	8	Tesla
Super1 Foods - Tesla Supercharger	Helena	8	Tesla
Great Falls Hampton Inn - Tesla Supercharger	Great Falls	8	Tesla
Big Sky Town Center - Tesla Supercharger	Big Sky	8	Tesla
Audi of Bozeman	Bozeman	4	EV Connect
Flying J Town Pump	Butte	4	Electrify America
Taco Bell - Missoula	Missoula	1	Non-Networked
Taco Bell - Polson	Polson	1	Non-Networked

APPENDIX H Existing and Planned Charging Stations

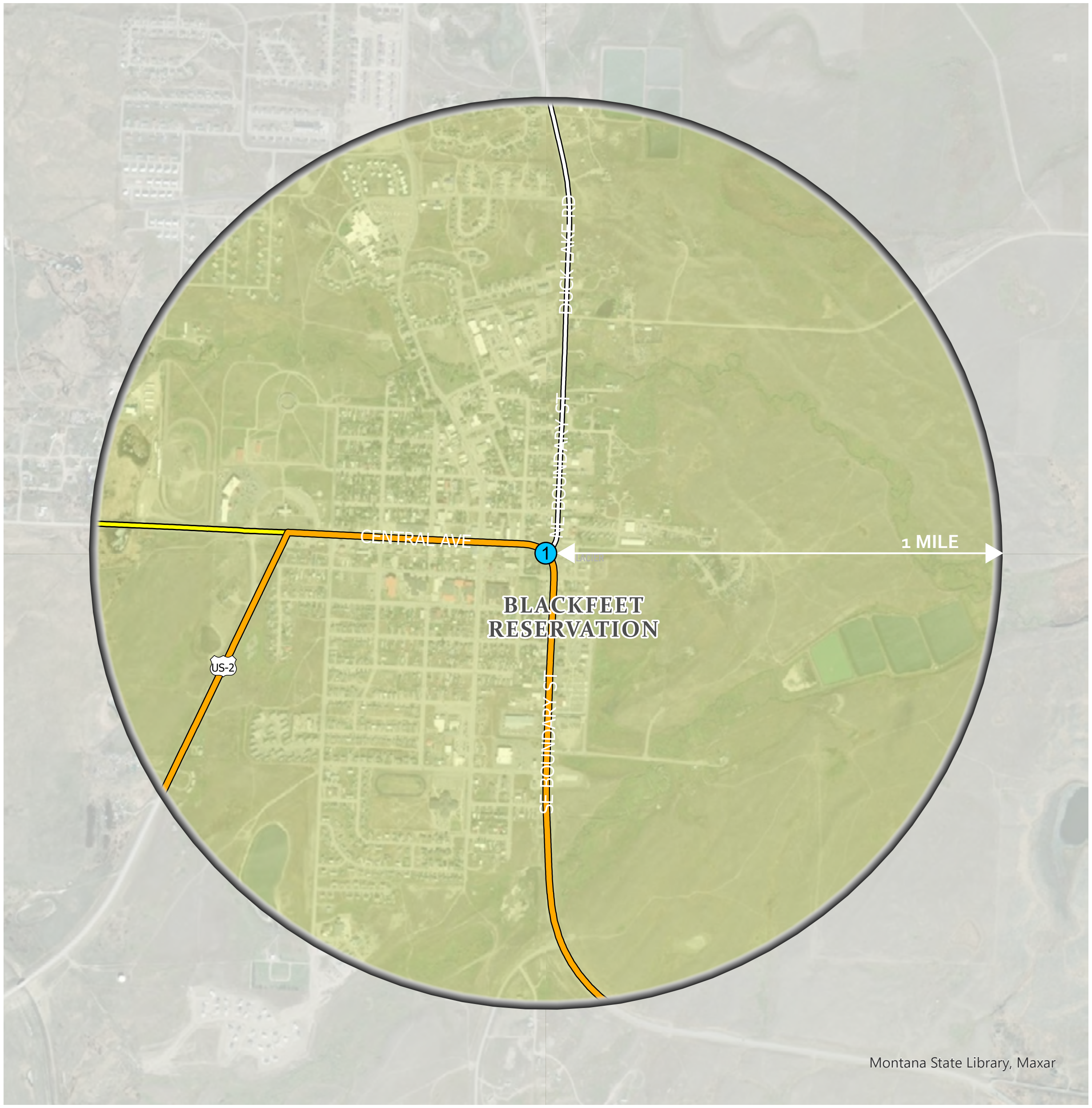
Table 24: Planned DCFC Locations in Montana

Station Name	City	Access	EV DC Fast Count	Charging Speed (kW)
Town Pump - NWE	Billings	Public	2	62.5
Sinclair	Gardiner	Public	2	62.5
Town Pump - NWE	Helena	Public	2	62.5
Town Pump - NWE	Hardin	Public	2	62.5
Town Pump - NWE	Big Timber	Public	2	62.5
Town Pump - NWE	Deer Lodge	Public	2	62.5
Town Pump - NWE	Dillon	Public	2	62.5
Town Pump - NWE	Great Falls	Public	2	62.5
Town Pump - NWE	Hamilton	Public	2	62.5
Town Pump	Kalispell	Public	2	62.5
Town Pump	Eureka	Public	2	62.5
Town Pump - NWE	Conrad	Public	2	62.5
Town Pump	Libby	Public	2	62.5
Seeley Lake Community Foundation	Seeley Lake	Public	2	50
Town Pump	Boulder	Public	2	62.5
Town Pump	Whitefish	Public	2	62.5
Electrify America	Billings	Public	TBD	TBD

APPENDIX I Proposed Charging Station 1-Mile Radius

The maps on the following pages illustrate the 36 proposed locations with a 1-mile radius from a highway exit or intersection. Locations within the circle would be eligible to site a charging station to meet AFC requirements. The numbered dot icons on each map indicate the center of a 1-mile radius area, but do not identify specific recommended charging station sites.

APPENDIX I Proposed Charging Station 1-Mile Radius



Browning

Priority Tier 1

Proposed Charging Locations (Hwy Exit or Intersection)

- 1 Tier 1
- 2 Tier 2
- 3 Tier 3
- 4 Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 20: Browning Proposed Charging Station Location

APPENDIX I Proposed Charging Station 1-Mile Radius

Chester

Priority Tier 4

Proposed Charging Locations (Hwy Exit or Intersection)

- 1 Tier 1
- 2 Tier 2
- 3 Tier 3
- 4 Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 21: Chester Proposed Charging Station Location

Columbus

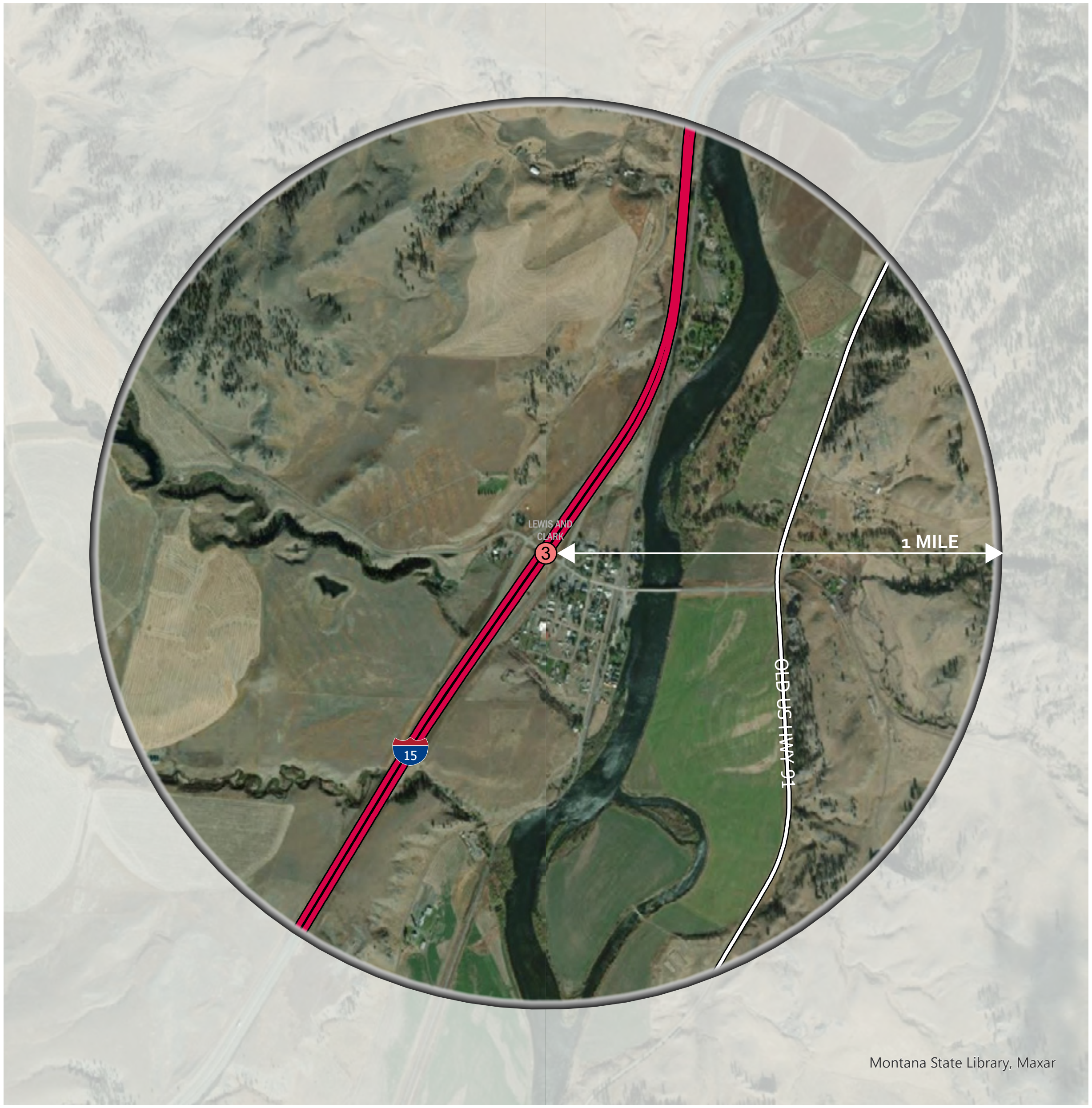
Priority Tier 2

Proposed Charging Locations (Hwy Exit or Intersection)

- 1 Tier 1
- 2 Tier 2
- 3 Tier 3
- 4 Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 22: Columbus Proposed Charging Station Location

APPENDIX I Proposed Charging Station 1-Mile Radius



Craig

Priority Tier 3

Proposed Charging Locations (Hwy Exit or Intersection)

- 1 Tier 1
- 2 Tier 2
- 3 Tier 3
- 4 Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 23: Craig Proposed Charging Station Location

Culbertson

Priority Tier 4

Proposed Charging Locations (Hwy Exit or Intersection)

- 1 Tier 1
- 2 Tier 2
- 3 Tier 3
- 4 Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 24: Culbertson Proposed EV Charging Station Location

APPENDIX I Proposed Charging Station 1-Mile Radius

Figure 25: Custer Proposed Charging Station Location

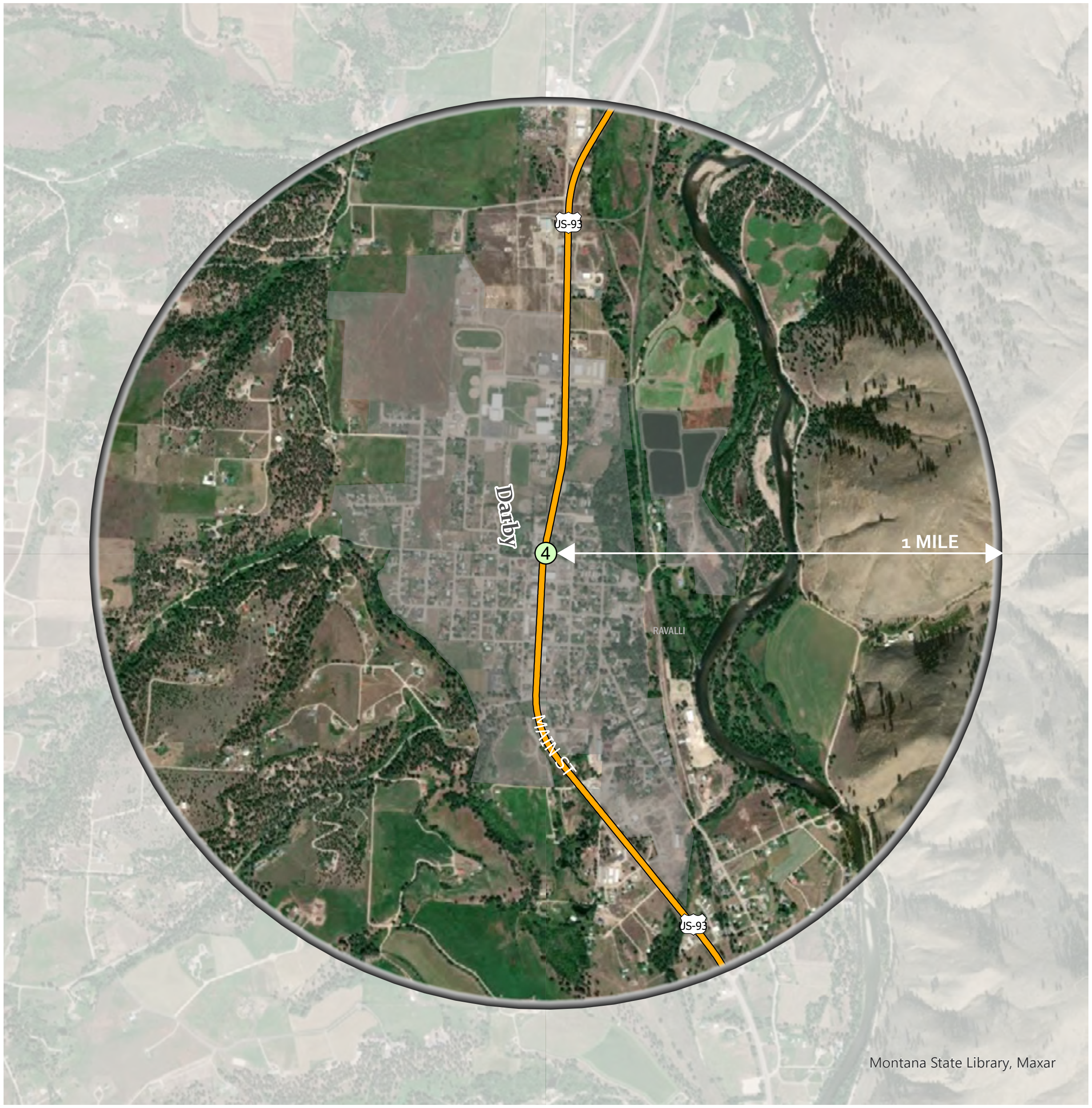
Cut Bank

Priority Tier 2

Proposed Charging Locations (Hwy Exit or Intersection)
- 1 Tier 1
- 2 Tier 2
- 3 Tier 3
- 4 Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 26: Cut Bank Proposed Charging Station Location

APPENDIX I Proposed Charging Station 1-Mile Radius



Darby

Priority Tier 4

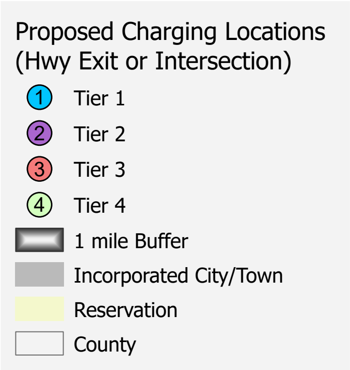
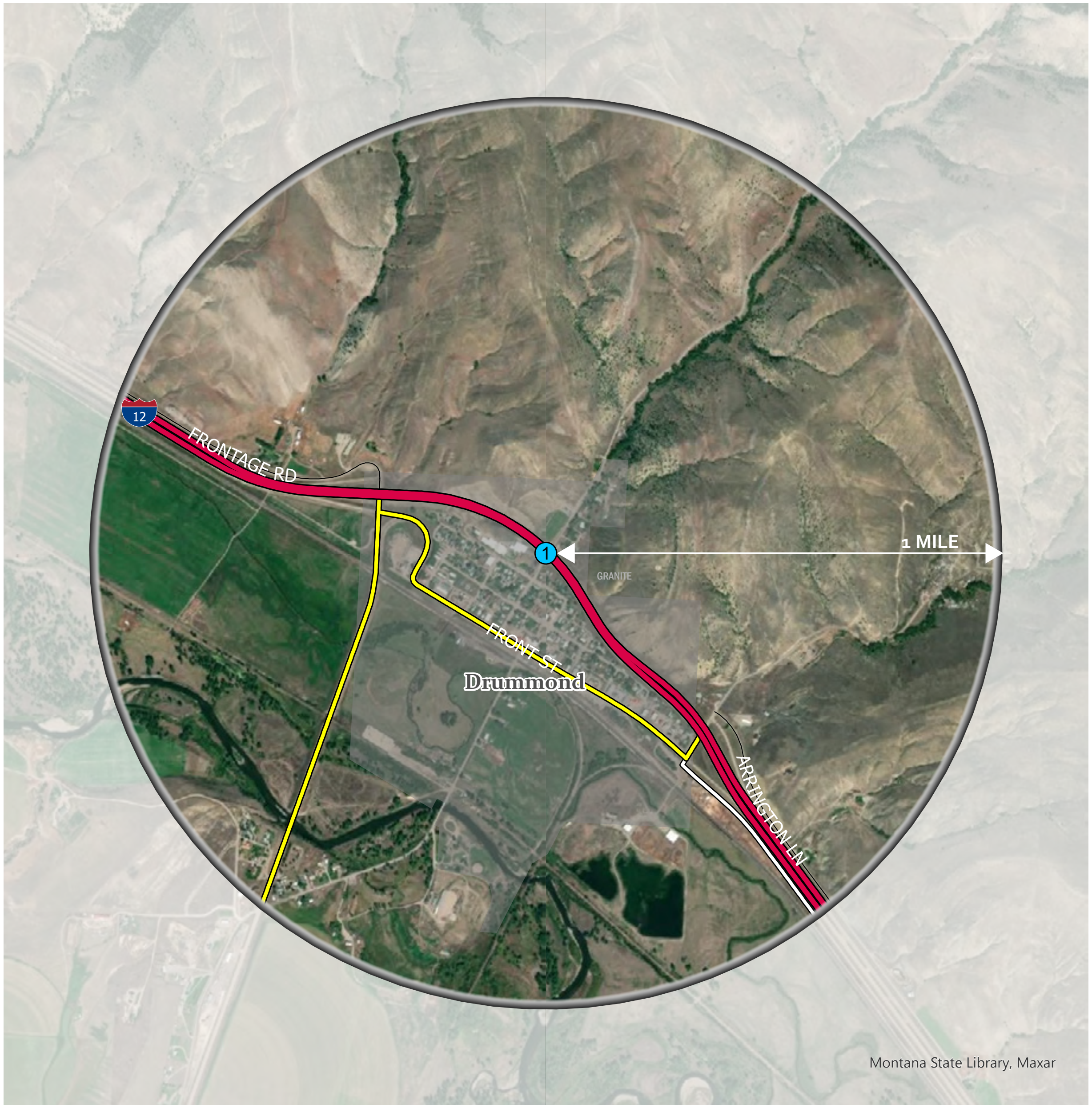


Figure 27: Darby Proposed Charging Station Location



Drummond

Priority Tier 1

Proposed Charging Locations (Hwy Exit or Intersection)

- 1 Tier 1
- 2 Tier 2
- 3 Tier 3
- 4 Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 28: Drummond Proposed Charging Station Location

Dutton

Priority Tier 3

Proposed Charging Locations (Hwy Exit or Intersection)

- 1 Tier 1
- 2 Tier 2
- 3 Tier 3
- 4 Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 29: Dutton Proposed Charging Station Location

Essex

Priority Tier 4

Proposed Charging Locations (Hwy Exit or Intersection)
- 1 Tier 1
- 2 Tier 2
- 3 Tier 3
- 4 Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 30: Essex Proposed Charging Station Location

APPENDIX I Proposed Charging Station 1-Mile Radius

Forsyth

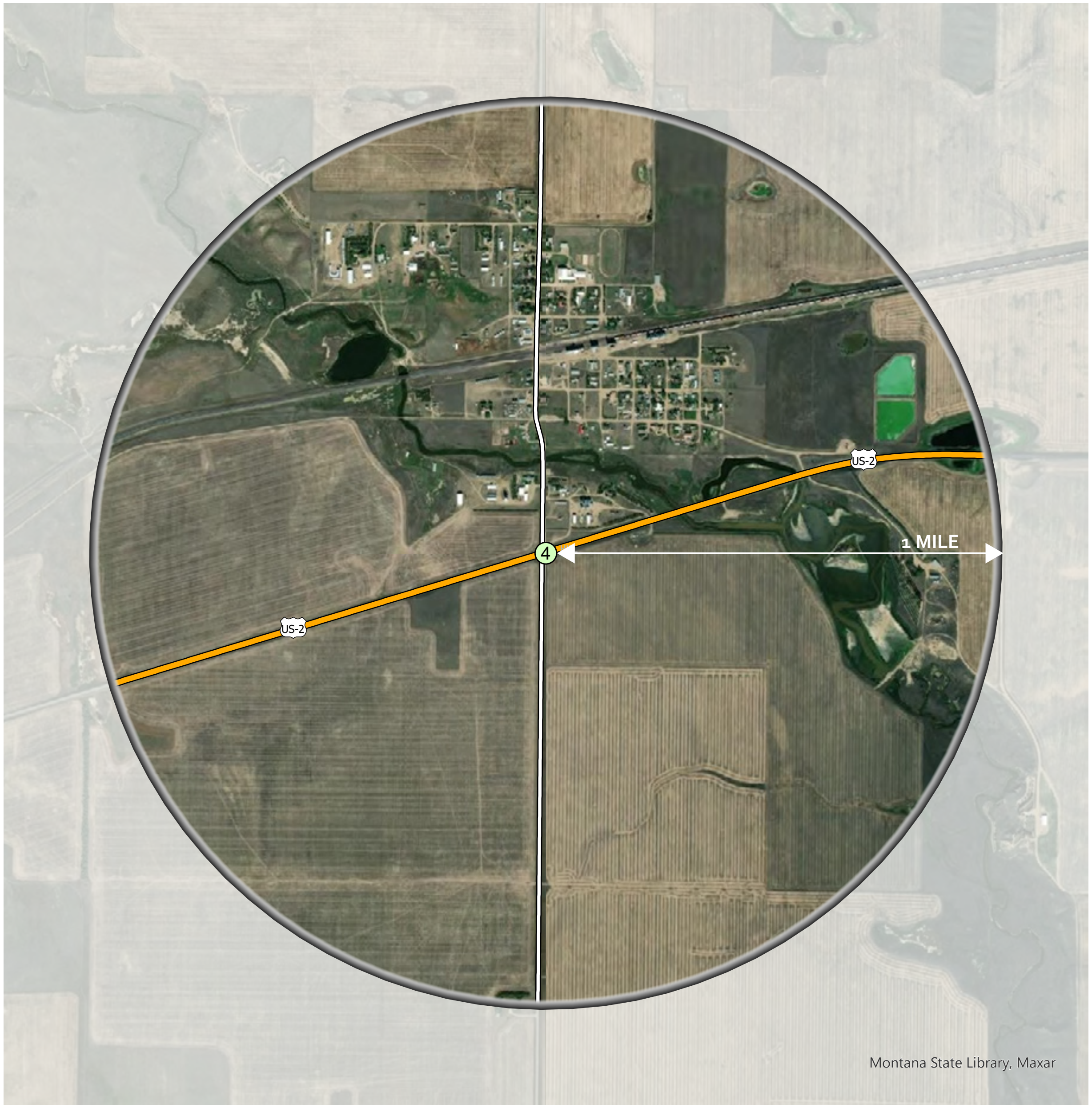
Priority Tier 1

Proposed Charging Locations (Hwy Exit or Intersection)

- 1 Tier 1
- 2 Tier 2
- 3 Tier 3
- 4 Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 31: Forsyth Proposed Charging Station Location

APPENDIX I Proposed Charging Station 1-Mile Radius



Gildford

Priority Tier 4

Proposed Charging Locations (Hwy Exit or Intersection)

- 1 Tier 1
- 2 Tier 2
- 3 Tier 3
- 4 Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 32: Gildford Proposed Charging Station Location

APPENDIX I Proposed Charging Station 1-Mile Radius

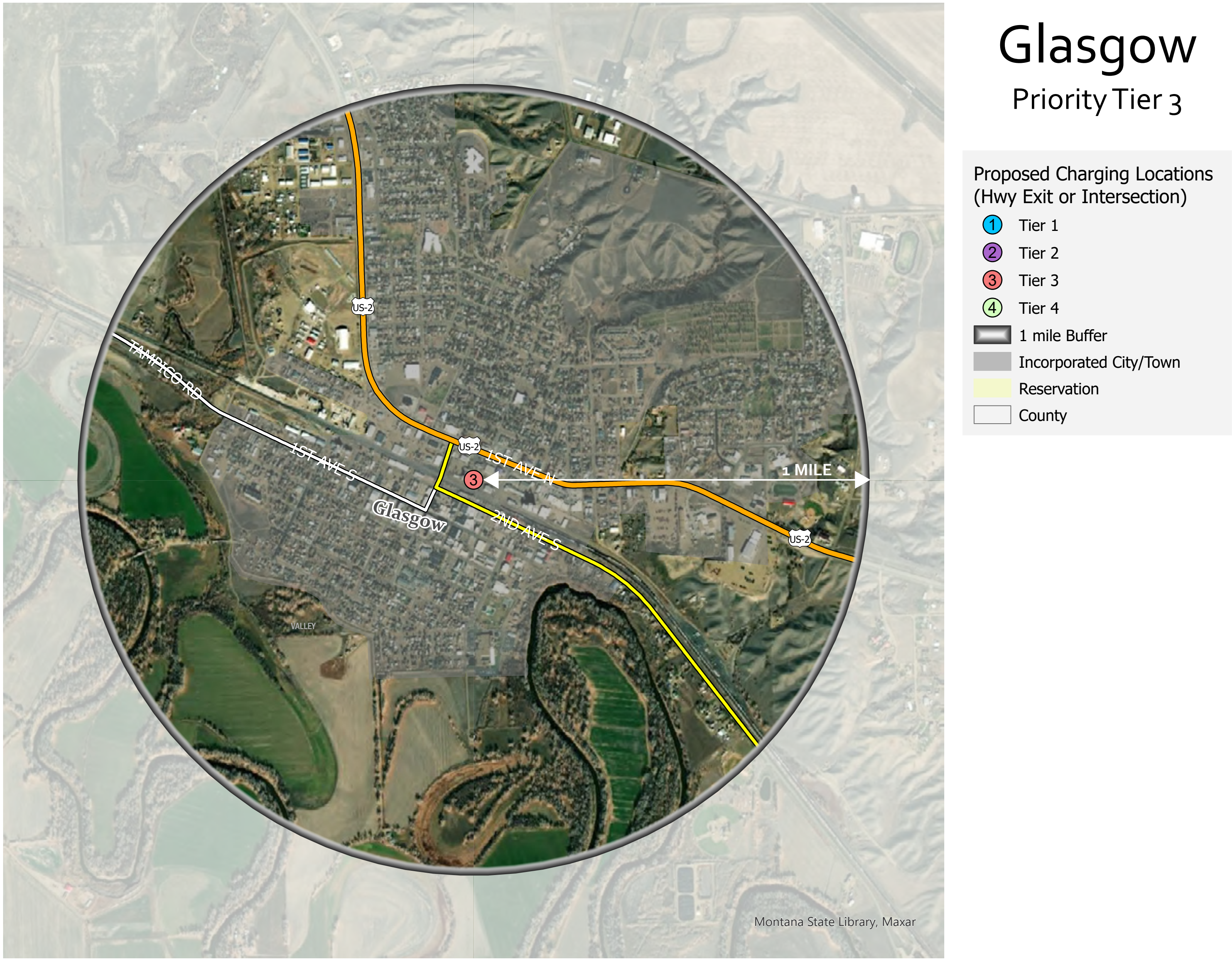


Figure 33: Glasgow Proposed Charging Station Location

APPENDIX I Proposed Charging Station 1-Mile Radius

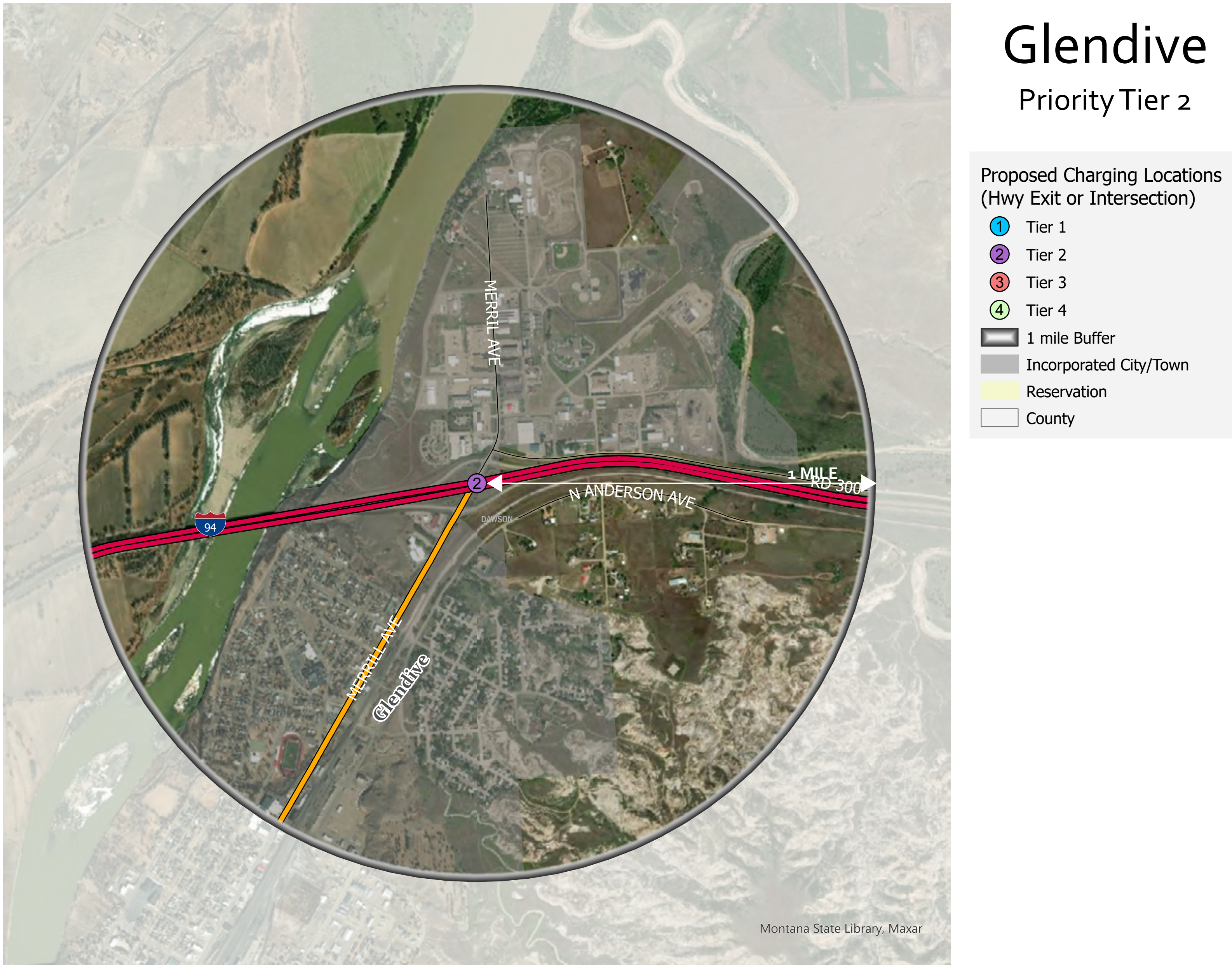


Figure 34: Glendive Proposed Charging Station Location

APPENDIX I Proposed Charging Station 1-Mile Radius

Happy's Inn

Priority Tier 2

Proposed Charging Locations (Hwy Exit or Intersection)

- 1 Tier 1
- 2 Tier 2
- 3 Tier 3
- 4 Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 35: Happy's Inn Proposed Charging Station Location

Harlem

Priority Tier 3

Proposed Charging Locations (Hwy Exit or Intersection)

- 1 Tier 1
- 2 Tier 2
- 3 Tier 3
- 4 Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 36: Harlem Proposed Charging Station Location

Haugan

Priority Tier 2

Proposed Charging Locations (Hwy Exit or Intersection)
- 1 Tier 1
- 2 Tier 2
- 3 Tier 3
- 4 Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 37: Haugan Proposed Charging Station Location

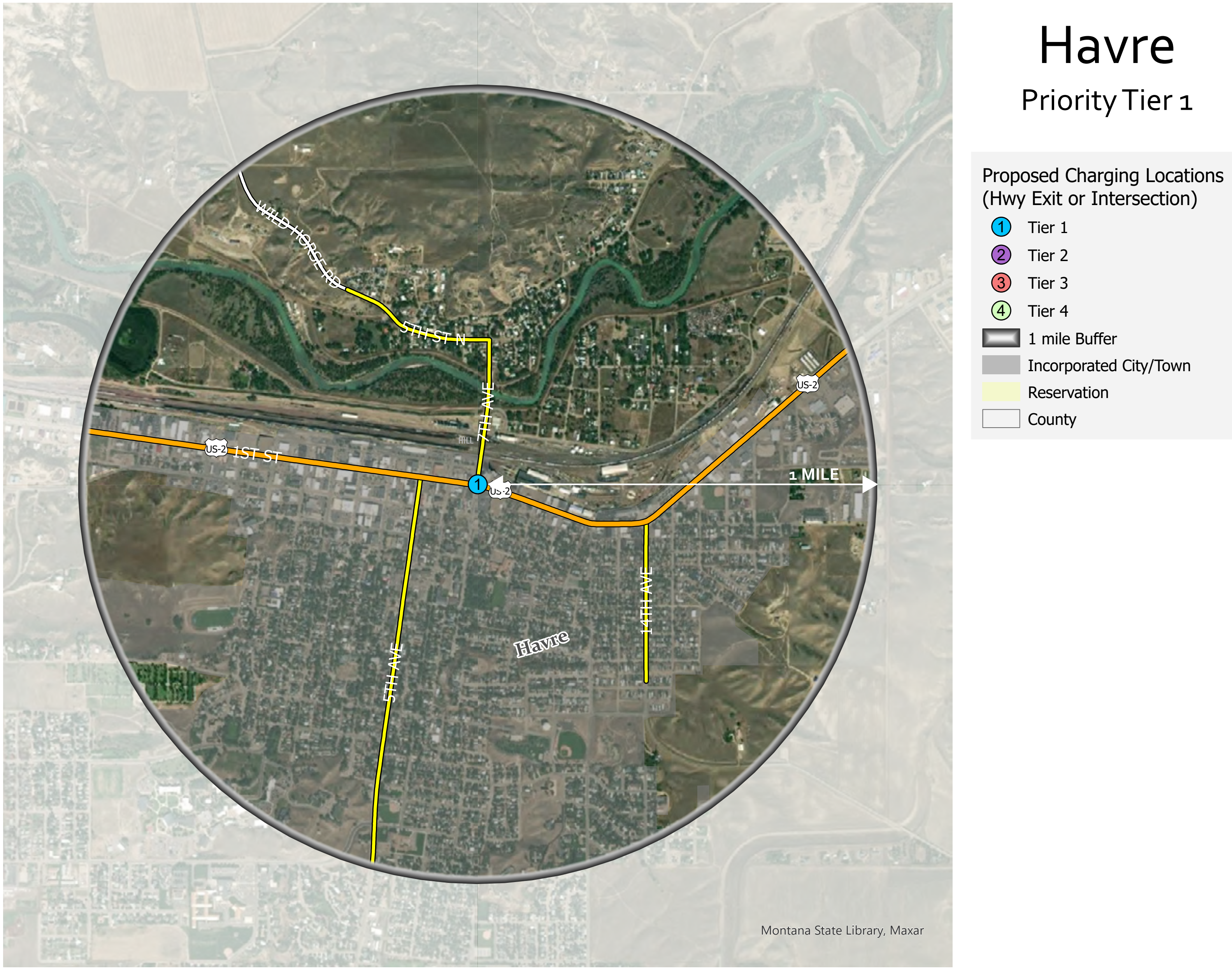


Figure 38: Havre Proposed Charging Station Location

Hinsdale

Priority Tier 4

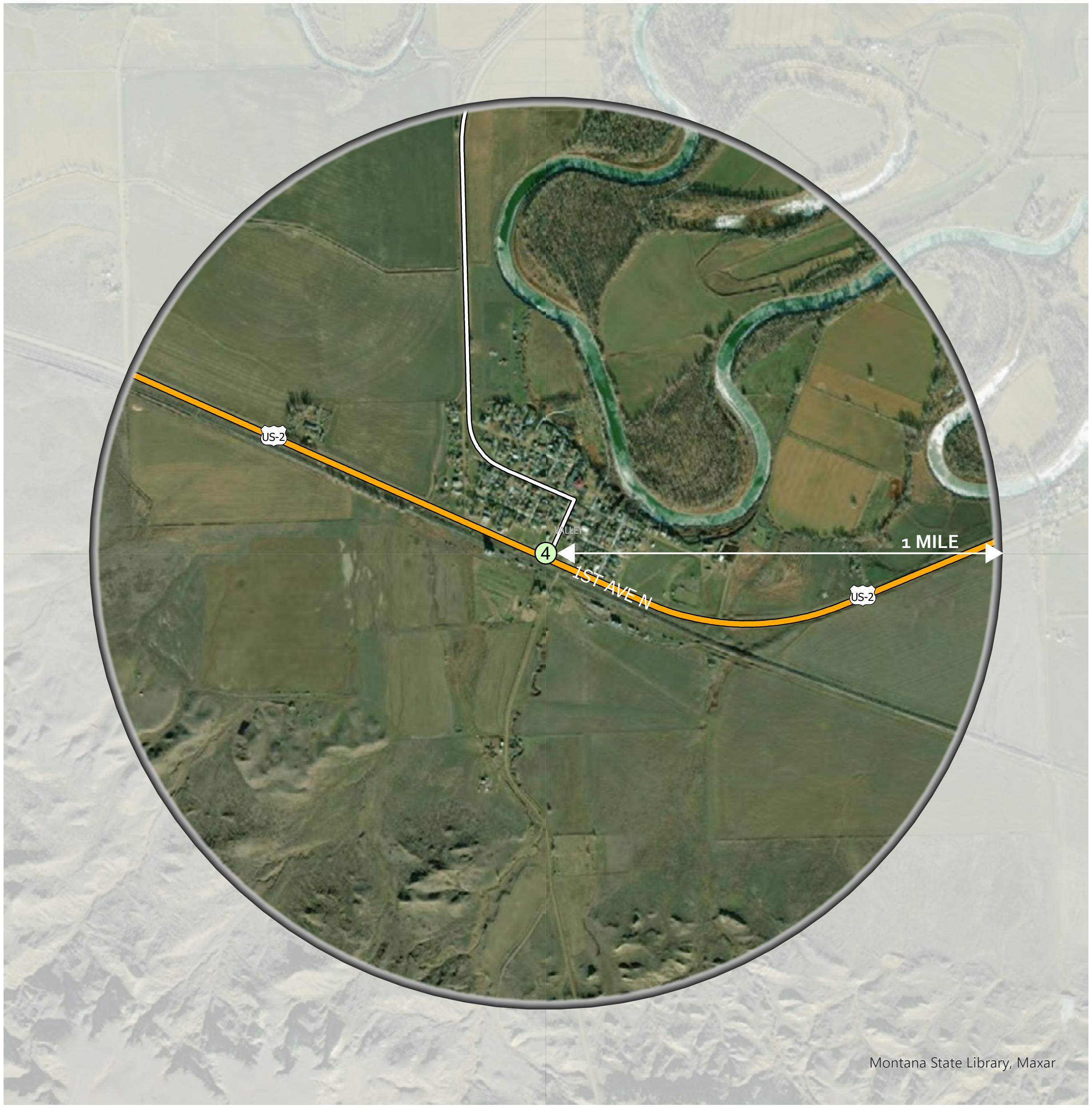


Figure 39: Hinsdale Proposed Charging Station Location

APPENDIX I Proposed Charging Station 1-Mile Radius

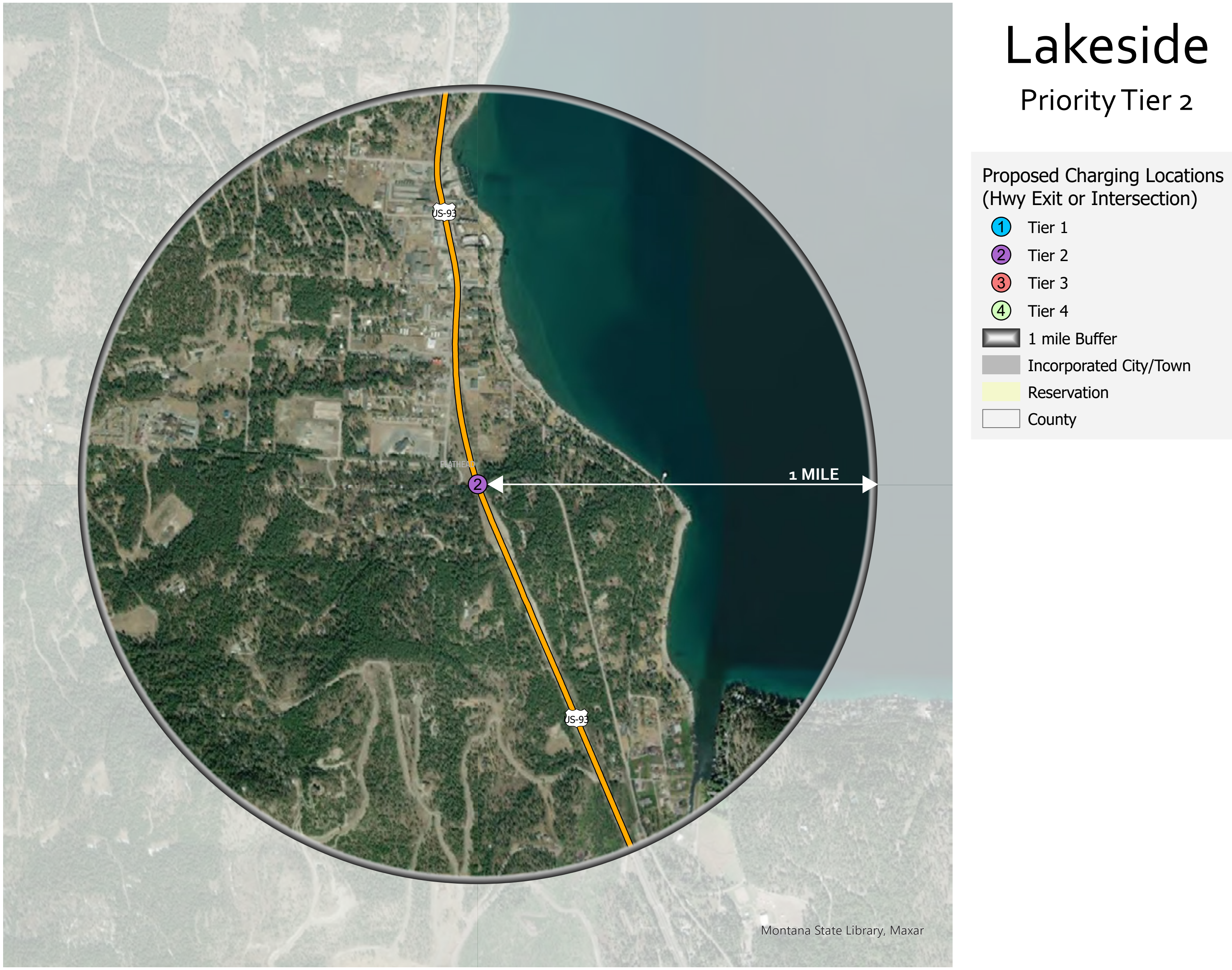


Figure 40: Lakeside Proposed Charging Station Location

Livingston

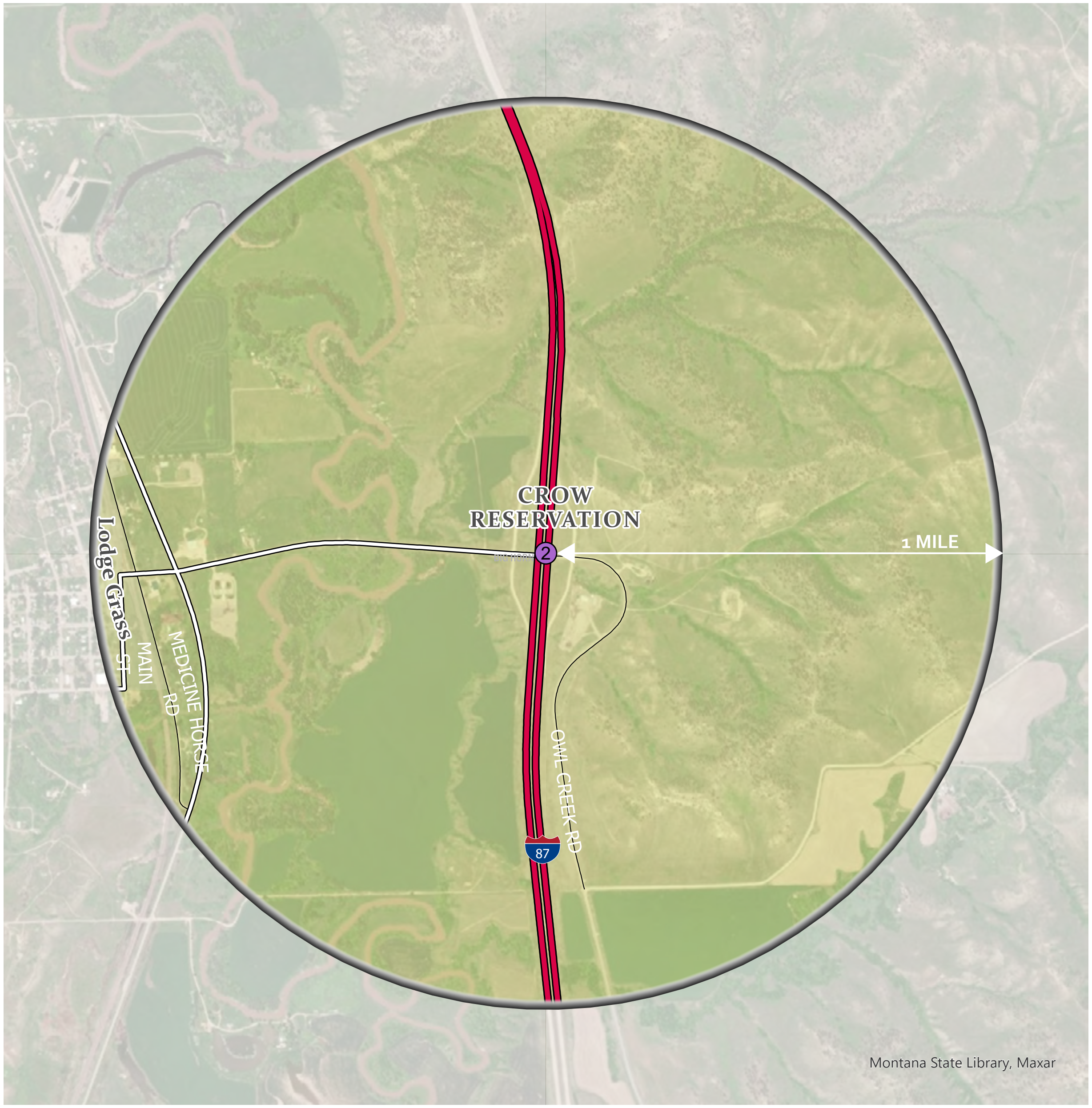
Priority Tier 1

Proposed Charging Locations (Hwy Exit or Intersection)

- 1 Tier 1
- 2 Tier 2
- 3 Tier 3
- 4 Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 41: Livingston Proposed Charging Station Location

APPENDIX I Proposed Charging Station 1-Mile Radius



Lodge Grass

Priority Tier 2

Proposed Charging Locations (Hwy Exit or Intersection)
- 1 Tier 1
- 2 Tier 2
- 3 Tier 3
- 4 Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 42: Lodge Grass Proposed Charging Station Location

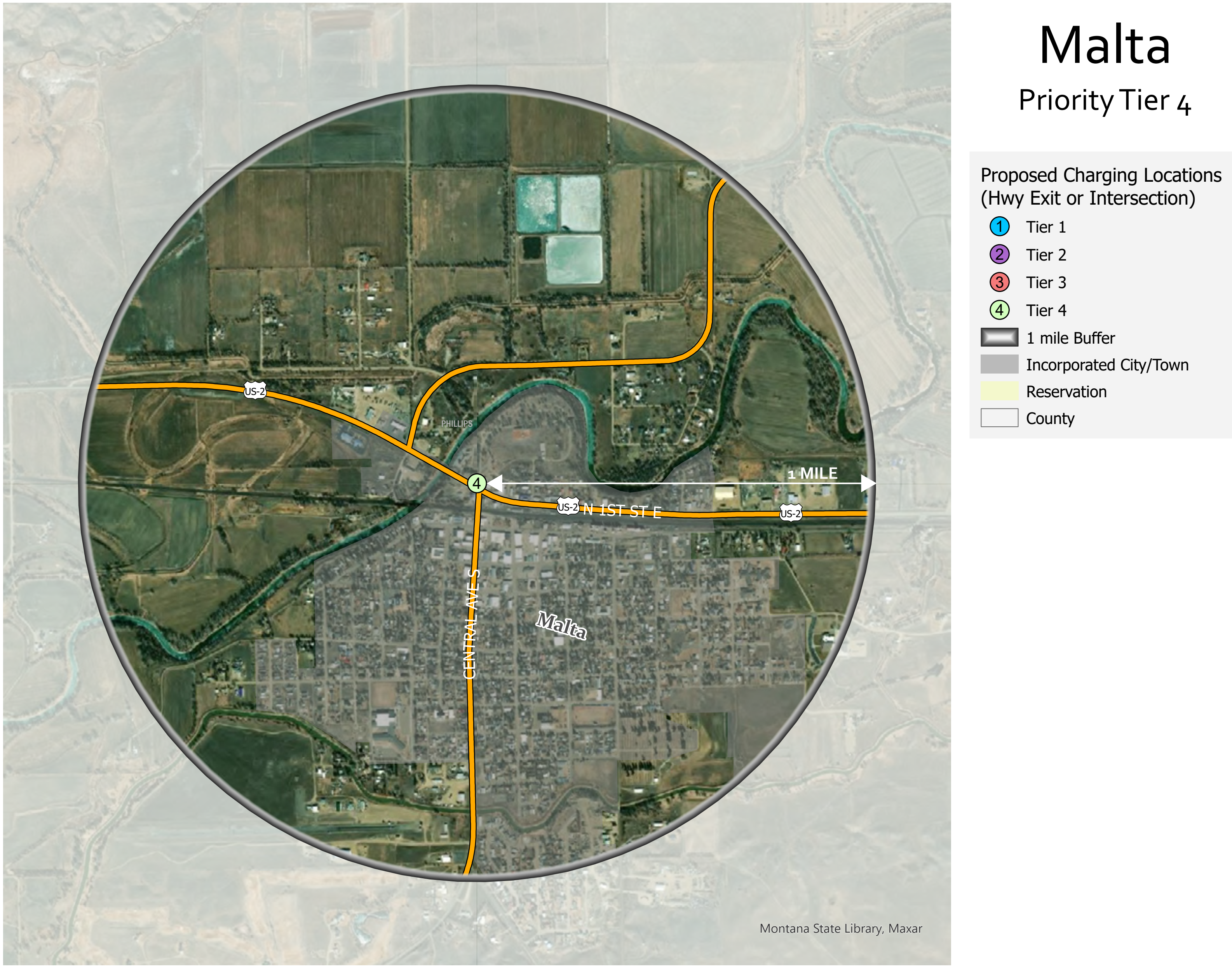


Figure 43: Malta Proposed Charging Station Location

Marion

Priority Tier 3

Proposed Charging Locations (Hwy Exit or Intersection)

- 1 Tier 1
- 2 Tier 2
- 3 Tier 3
- 4 Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 44: Marion Proposed Charging Station Location

Figure 45: Melrose Proposed Charging Station Location

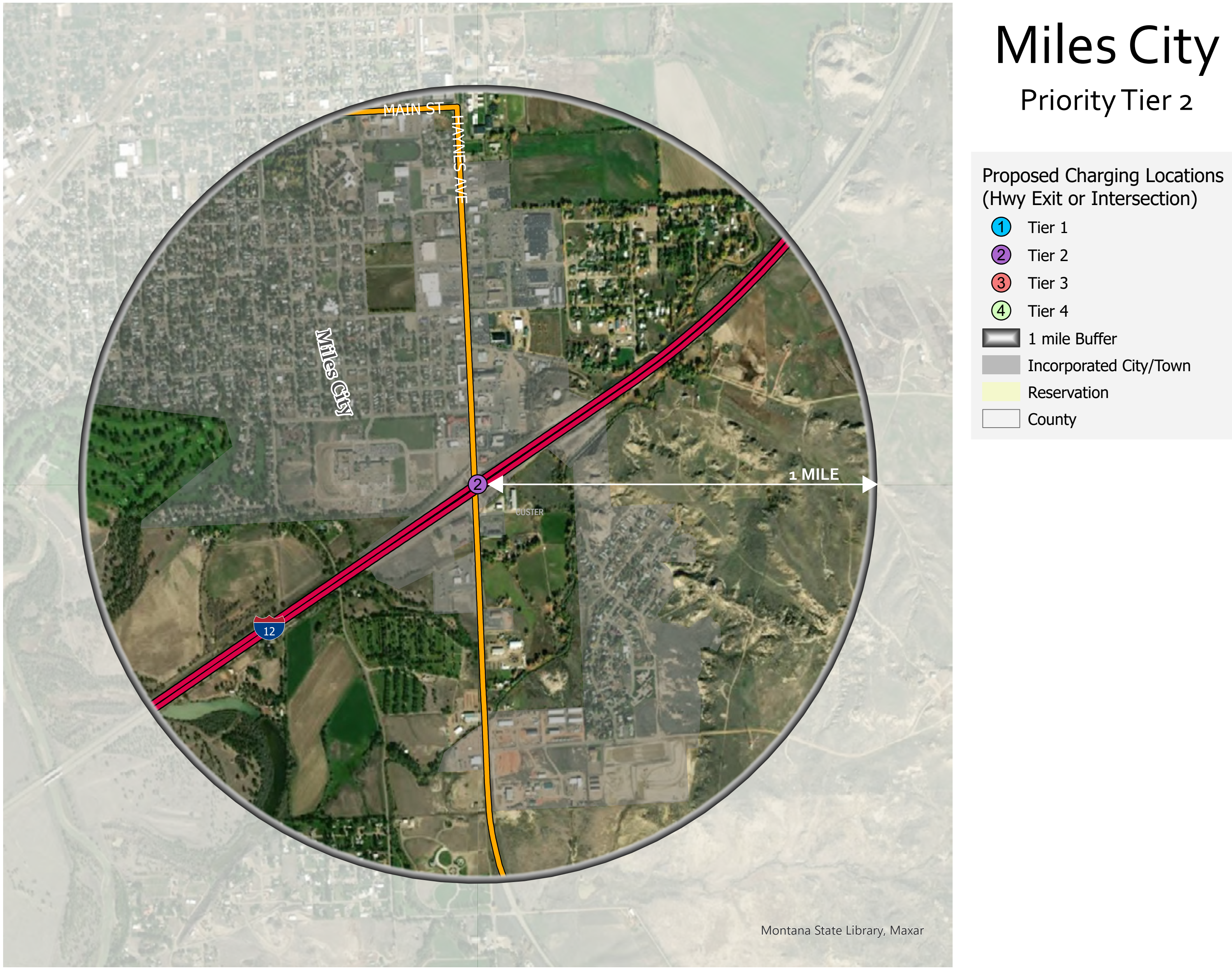
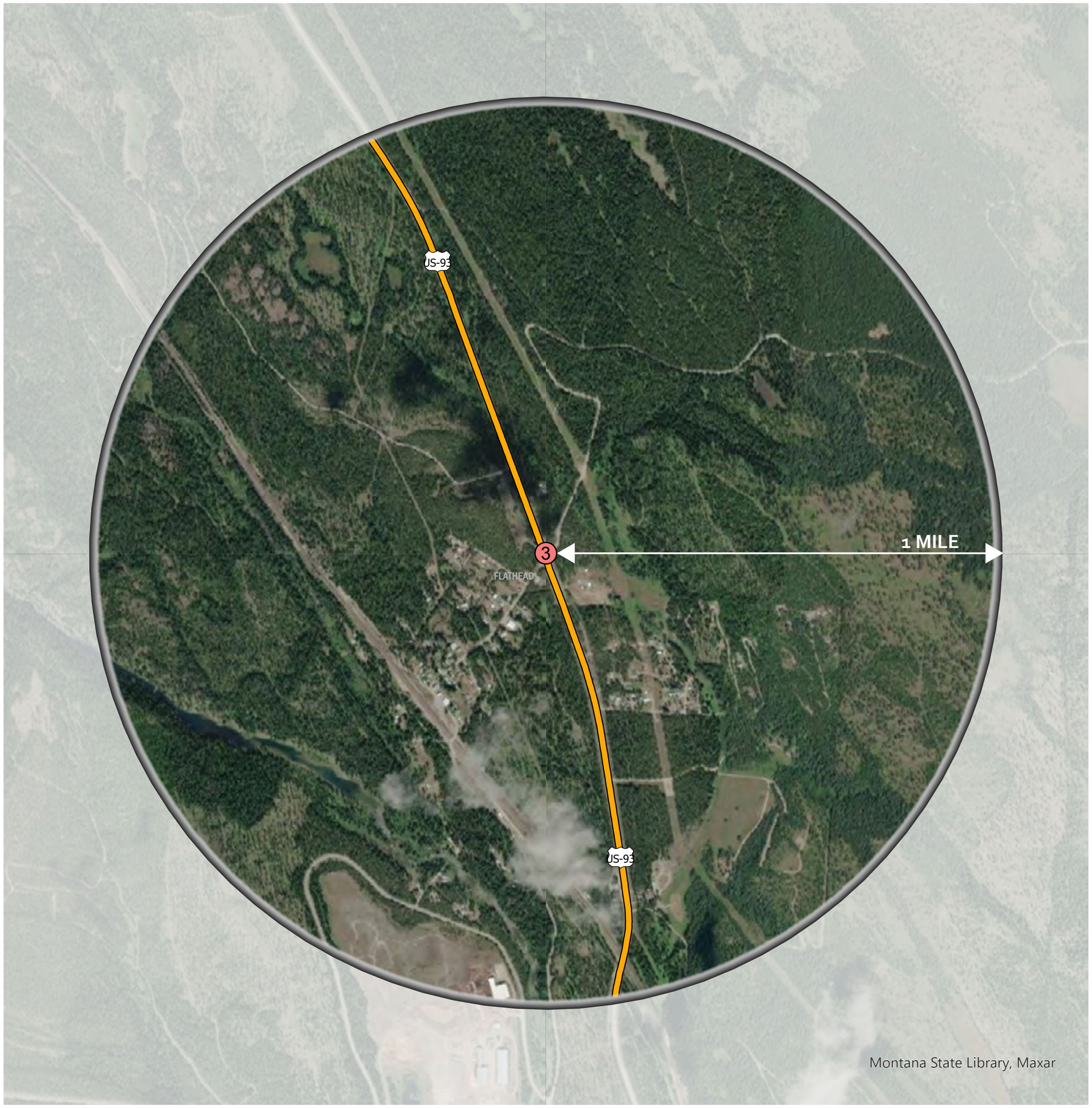


Figure 46: Miles City Proposed Charging Station Location

APPENDIX I Proposed Charging Station 1-Mile Radius

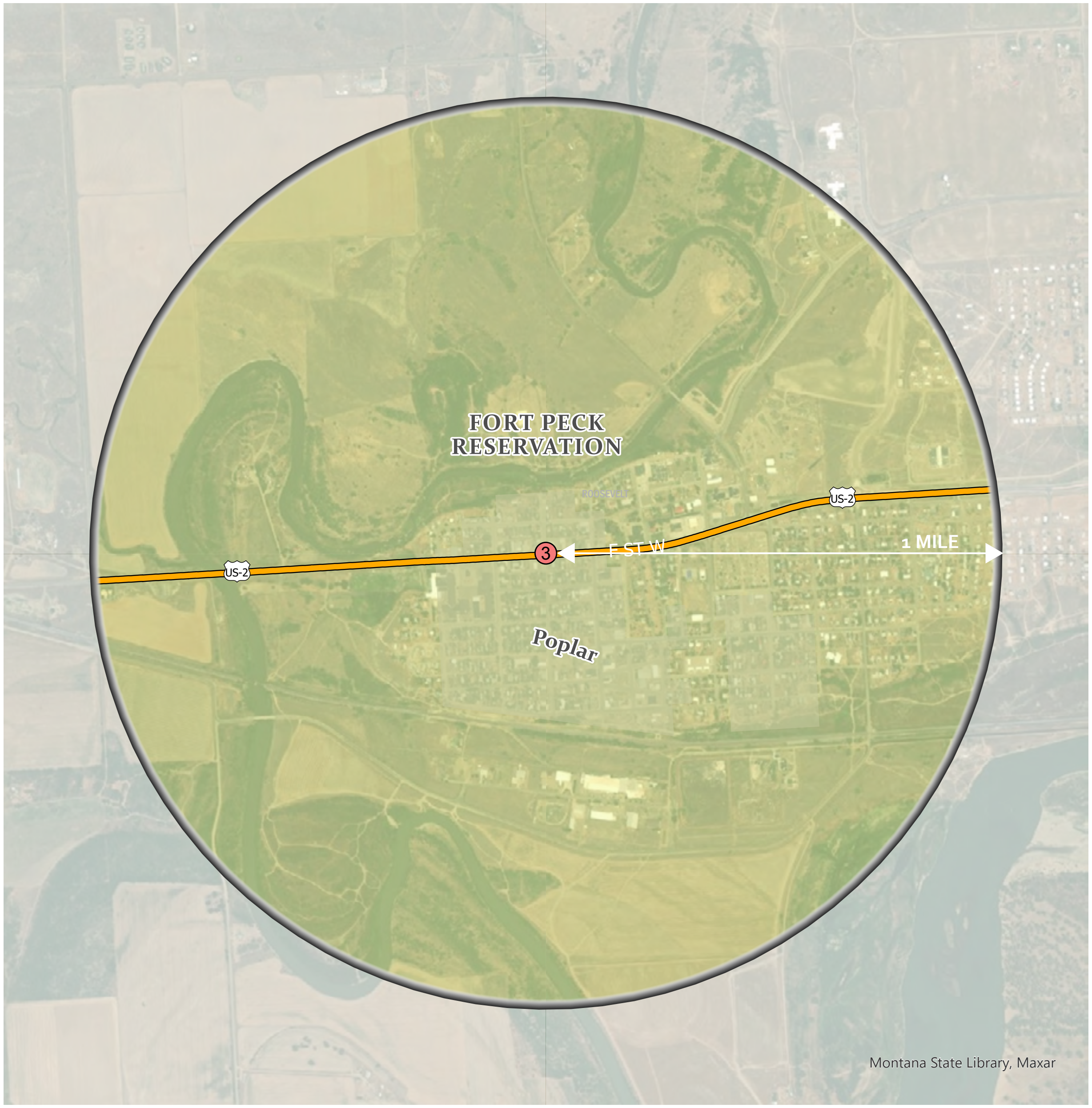


Olney

Priority Tier 3

Figure 47: Olney Proposed Charging Station Location

APPENDIX I Proposed Charging Station 1-Mile Radius



Poplar

Priority Tier 3

Proposed Charging Locations (Hwy Exit or Intersection)

- 1 Tier 1
- 2 Tier 2
- 3 Tier 3
- 4 Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 48: Poplar Proposed Charging Station Location

APPENDIX I Proposed Charging Station 1-Mile Radius

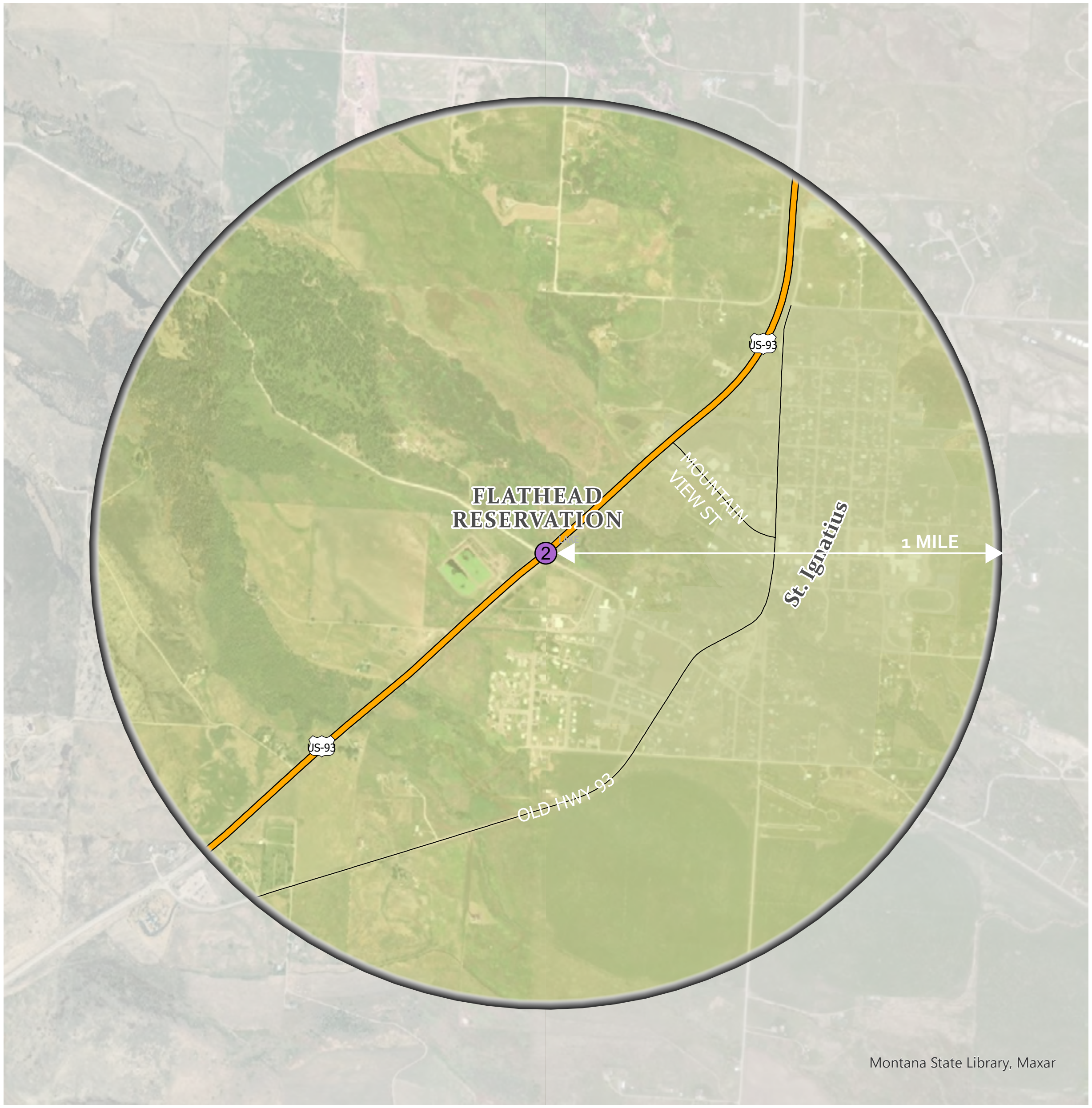
Shelby

Priority Tier 1

Proposed Charging Locations (Hwy Exit or Intersection)

- 1 Tier 1
- 2 Tier 2
- 3 Tier 3
- 4 Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 49: Shelby Proposed Charging Station Location



St. Ignatius

Priority Tier 2

Proposed Charging Locations (Hwy Exit or Intersection)

- 1 Tier 1
- 2 Tier 2
- 3 Tier 3
- 4 Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 50: St. Ignatius Proposed Charging Station Location

Superior

Priority Tier 4

Proposed Charging Locations (Hwy Exit or Intersection)

- 1 Tier 1
- 2 Tier 2
- 3 Tier 3
- 4 Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 51: Superior Proposed Charging Station Location

APPENDIX I Proposed Charging Station 1-Mile Radius

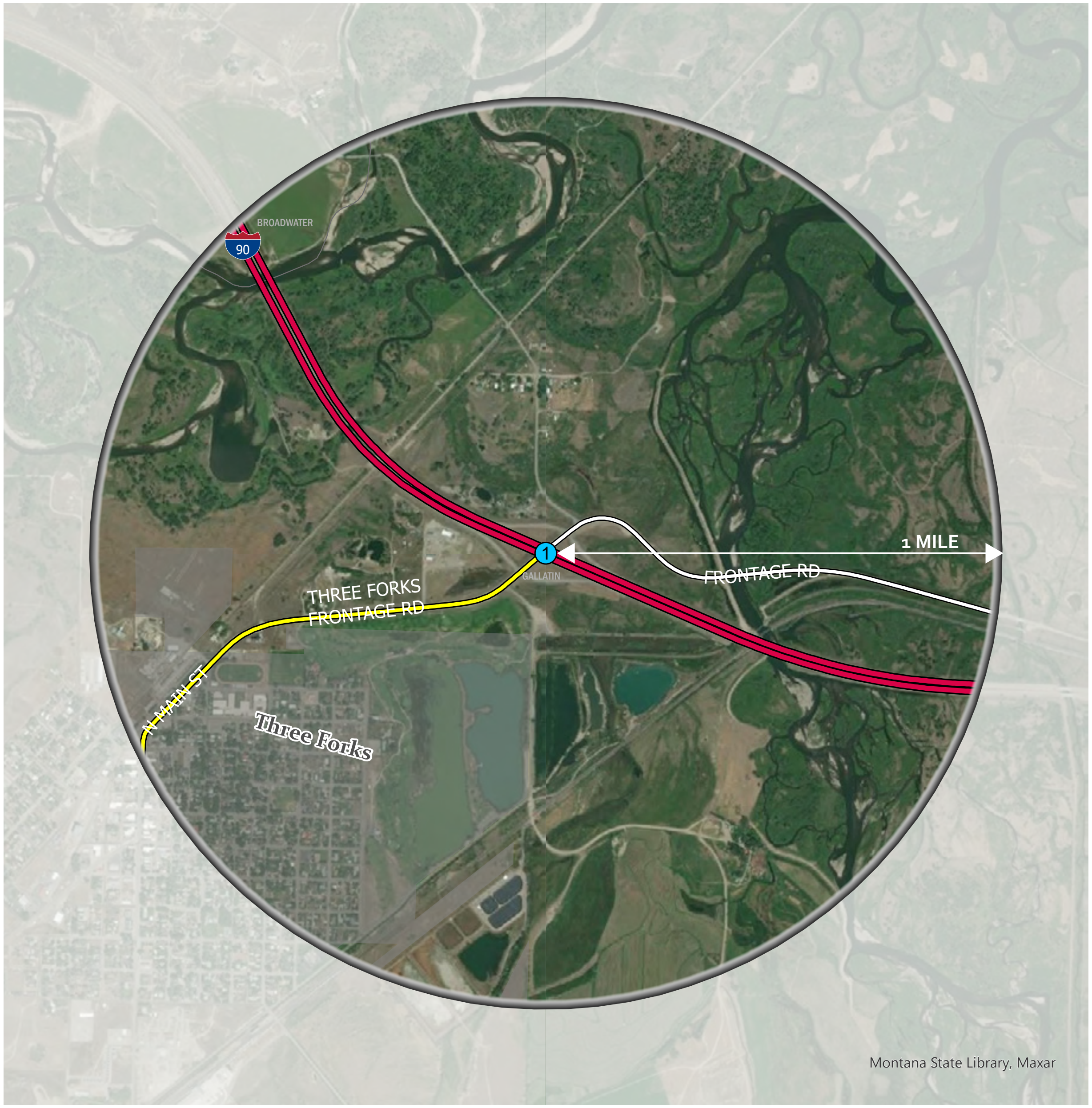
Terry

Priority Tier 3

Proposed Charging Locations (Hwy Exit or Intersection)

- Tier 1
- Tier 2
- Tier 3
- Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 52: Terry Proposed Charging Station Location



Three Forks

Priority Tier 1

Proposed Charging Locations (Hwy Exit or Intersection)
- Tier 1
- Tier 2
- Tier 3
- Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 53: Three Forks Proposed Charging Station Location

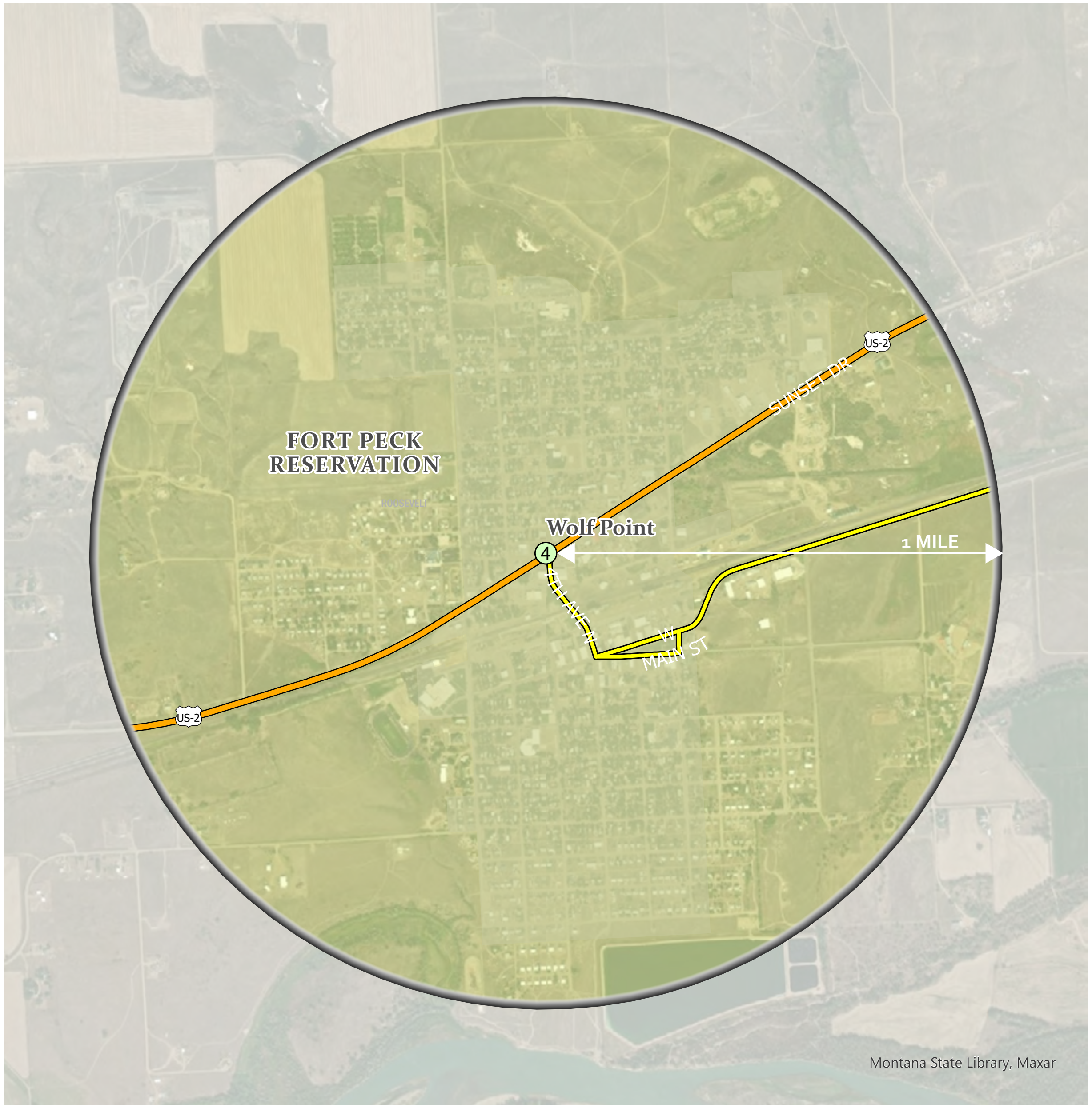
West Glacier

Priority Tier 2

Proposed Charging Locations (Hwy Exit or Intersection)

- 1 Tier 1
- 2 Tier 2
- 3 Tier 3
- 4 Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 54: West Glacier Proposed Charging Station Location



Wolf Point

Priority Tier 4

Proposed Charging Locations (Hwy Exit or Intersection)

- 1 Tier 1
- 2 Tier 2
- 3 Tier 3
- 4 Tier 4
- 1 mile Buffer
- Incorporated City/Town
- Reservation
- County

Figure 55: Wolf Point Proposed Charging Station Location

Study conducted on behalf of Montana Department of Environmental Quality by AECOM

DEQ
Montana Department of Environmental Quality

AECOM