North Coast Biomass Utilization Regional Assessment: Candidate Site Selection and Feedstock Analysis Memo

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Summary

On behalf of the North Coast Resource Partnership (NCRP) and the Watershed Research and Training Center (WRTC), Tukman Geospatial conducted a set of regional assessments targeted at identifying opportunities for new woody biomass utilization within California's North Coast Region as part of the **North Coast Forest Biomass Strategy**. This work was funded by the North Coast Resource Partnership, with funding from the Governor's Office of Land Use and Climate Innovation.

We used an initial candidate site selection process to locate potentially suitable sites for biomass utilization in the form of wood processing or biomass energy generation. Once we located candidate sites for further investigation, we performed an additional viability check on each site by using Google Street View and aerial imagery to rule out sites with obvious disqualifying factors. Following this initial selection process, we used a network analysis to examine recoverable woody residues within an economically feasible travel time to each selected candidate site, based on estimates of residues generated from a hypothetical 40% thin from below silvicultural treatment. For this analysis, we used outputs from the Schatz Energy Research Center's C-BREC model as the data source for biomass residues. We conducted this feedstock analysis for four scenarios, each representing a unique combination of the proposed use for the site (sawmill versus biomass power plant) and the presence or absence of an additional screen to limit recoverable residues to areas deemed feasible for mechanical treatment. These analyses resulted in a suite of deliverables, including features classes containing the candidate site locations as points and polygons, as well as feature classes and summary tables displaying the results of the feedstock analysis for each scenario. The candidate site selection and feedstock analyses are intended to be part of a larger, ongoing effort to locate opportunities for biomass utilization in the region. They are not meant to be comprehensive, but rather to serve as the first steps in a process involving subsequent regionwide assessments that incorporate other critical considerations such as impacts on equity and forest health.

The NCRP area includes 7 counties of California. This analysis was performed across the entire NCRP region, which is shown in Figure 1.

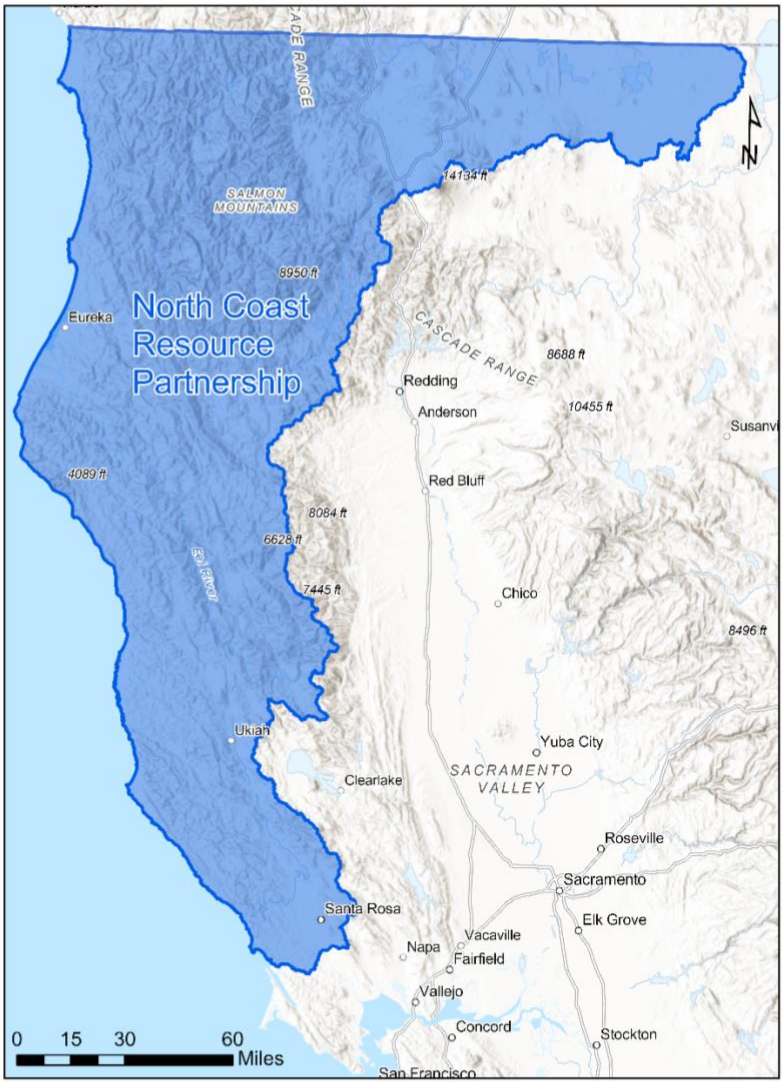

Figure 1. North Coast Resource Partnership Boundary.

Accessing Deliverables

Table 1 lists deliverables from the candidate site selection and feedstock analyses along with their respective links:

Table 1: List of Deliverables and Links for Candidate Site Selection and Feedstock Analyses

Description	Type	Link
File GDB Containing Candidate Site and Feedstock Analysis Feature Classes	File Geodatabase	https://ncrp.online/North_Coast_Biomass_CandidateSites_Feedstock_GDB
Candidate Sites (Parcel Groups)	Feature Service	https://ncrp.online/North_Coast_Biomass_Candidate_Sites_Parcel_Groups
Candidate Sites (Points)	Feature Service	https://ncrp.online/North_Coast_Biomass_Candidate_Sites_Points
Feedstock Analysis Results Summary Table: Biomass Power Plant Scenario	Excel Workbook	https://ncrp.online/North_Coast_Feedstock_Summary_Biomass
Feedstock Analysis Results Summary Table: Biomass Power Plant with Mechanical Treatment Feasibility Screen Scenario	Excel Workbook	https://ncrp.online/North_Coast_Feedstock_Summary_Biomass_Feasible
Feedstock Analysis Results Summary Table: Sawmill Scenario	Excel Workbook	https://ncrp.online/North_Coast_Feedstock_Summary_Sawmill
Feedstock Analysis Results Summary Table: Sawmill with Mechanical Treatment Feasibility Screen Scenario	Excel Workbook	https://ncrp.online/North_Coast_Feedstock_Summary_Sawmill_Feasible
North Coast Biomass Utilization: Data Products and Attribute Definitions	PDF Reference Document	https://ncrp.online/North_Coast_Biomass_Data_Dictionary
North Coast Biomass Utilization: Candidate Site Selection and Feedstock Assessment Memo	PDF Reference Document	https://ncrp.online/North_Coast_Biomass_Candidate_Sites_Feedstock_Memo

Methods

Data Sources and Preprocessing

We obtained input spatial datasets for the candidate site selection analysis from various sources spanning local, state, and federal government agencies; university research centers and cooperative extension programs; non-profit organizations; and private entities. These datasets are outlined in Table 2.

Table 2: List of Input Datasets for Candidate Site Selection and Feedstock Analyses

Dataset Name	Data Type	Source
Parcels	Polygon	County websites and spatial data portals for counties in the North Coast Region
Zoning and Land Use Categories	Polygon	County websites and spatial data portals for counties in the North Coast Region
Closed Wood Processing and Bioenergy Facilities	Point	UC Cooperative Extension California Wood Processing and Bioenergy Facilities Database
Current Wood Processing and Bioenergy Facilities	Point	UC Cooperative Extension California Wood Processing and Bioenergy Facilities Database
TIGER/Line Primary and Secondary Roads	Line	U.S. Census Bureau
Electrical Substations	Point	California Public Utilities Commission
30-Meter Digital Elevation Model for California	Raster	Pyrologix
National Hydrography Dataset Waterbodies	Polygon	U.S. Geological Survey
National Hydrography Dataset Areas	Polygon	U.S. Geological Survey
National Hydrography Dataset Flowlines	Line	U.S. Geological Survey
Primary, Secondary, and Postsecondary Schools	Point	National Center for Education Statistics
Housing Density (100-Acre Hexagons)	Polygon	Microsoft Maps and Tukman Geospatial
California Protected Areas Database Lands	Polygon	GreenInfo Network
Brownfield Locations	Point	U.S. Environmental Protection Agency
Forest Practice Roads	Line	CAL FIRE
30-Meter C-BREC Recoverable Residues Raster (40% Thin from Below Treatment)	Raster	Schatz Energy Research Center
30-Meter Mechanical Treatment Feasibility Raster	Raster	North Coast Resource Partnership and Tukman Geospatial

To ensure consistency in subsequent spatial data processing and analysis steps, we projected all layers into the NAD 1983 (2011) UTM Zone 10N coordinate system, which we selected to minimize distance distortions within the region. We also chose our 30-meter digital elevation model raster as a snap raster to align all raster datasets to a common grid during processing.

Closed Facility Points, Parcel Data, and Land Use Compatibility

To determine the potential suitability of candidate sites, we conducted two parallel suitability analyses: one for sites with closed facilities recorded in UC Cooperative Extension's California Wood Processing and Bioenergy Facilities Database (hereafter referred to as "closed sites"), and another for sites without records of closed facilities (hereafter referred to as "new sites"). The locations of closed facilities were provided as points, whereas new site locations were derived by applying suitability screening steps directly to parcel data. Although we ultimately determined the suitability of closed facilities based on facility point locations in the database, we also attached the attributes for each facility point to a corresponding group of nearby parcels to allow us to deliver both new and closed candidate sites in a single polygon feature class.

Parcels and Compatibility

To identify units of land that could be further investigated for possible biomass utilization, we downloaded parcel and zoning/land use data from each county in the North Coast Region (Sonoma, Mendocino, Humboldt, Del Norte, Siskiyou, and Trinity Counties). Modoc County was initially included but was ultimately removed from our analysis due to a lack of available countywide zoning data and a relatively small amount of suitable land area for woody biomass utilization. We started by merging parcel data from all counties into a single feature class and then spatially joined zoning and land use data from each county to the regionwide parcel layer with the Spatial Join geoprocessing tool in ArcGIS Pro 3.2. Then we sorted each zoning or land use category into one of three tiers according to its compatibility with a facility for biomass utilization. In determining compatibility, we used zoning designations when available; however, when zoning categories were missing from the input data, we used land use data as a proxy to determine the acceptable potential use of a parcel. To sort zoning and land use designations by compatibility, we created a list of all of zoning and land use categories present in the data and then divided them into Tier 1 (those deemed most compatible with biomass utilization operations) and Tier 2 (those deemed potentially compatible but not ideal). All classifications that we did not specifically select for Tiers 1 and 2 were assigned to Tier 0 (those deemed incompatible with biomass utilization operations). For new sites, we used only parcels in Tier 1 as inputs for the constraint-based suitability analysis process; we excluded parcels in Tier 2 and Tier 0 from further consideration. The combined list of zoning and land use categories for Tiers 1 and 2 is included in Appendix A. For both new and closed sites, we used the Dissolve Boundaries geoprocessing tool to combine groups of adjacent parcels with shared ownership into a single polygon feature which we refer to as a "parcel group." Parcels without available ownership data were assumed to have different ownership from neighboring parcels and were not combined.

Closed Sites: Joining Point Data to Parcel Groups

For closed sites, we considered parcel data from all zoning/land use categories, as these locations had previously been successfully used for biomass utilization and further filtering by land use designation was unnecessary. Once we determined suitability at each facility point, we joined each point's attributes to all parcel groups within a 100-foot radius to deal with the possibility of slight spatial imprecision in the point locations. This produced a land ownership layer in which each facility's attributes are linked to all parcel groups that might correspond to that facility point.

Site Suitability: Constraints and Opportunities

Each site suitability analysis was based on applying a combination of constraint factors to the landscape to rule out unsuitable areas for biomass utilization facilities. Visual representations of these constraints are shown in Figure 2. For sites with records of closed facilities, we used a more relaxed set of constraints because these areas have previously been successfully used for facilities. Closed site constraints were focused on meeting basic suitability requirements and ensuring that areas had not changed substantially since their last facility closure. New sites, on the other hand, had to be narrowed down from a much broader area and were therefore subject to a more stringent set of constraints aimed at selecting only the most suitable areas within the North Coast Region.

Constraints for Closed Sites

For closed sites, we used the following constraint criteria for site suitability:

- Not within the boundaries of protected lands identified in the California Protected Lands Database (CPAD)
- Not within densely inhabited areas, which were defined as having a structure density of > 1 building per acre
- Not within half a mile of a private, public, or postsecondary school
- On terrain with a slope of ≤ 15%
- Not within 100 feet of a body of water identified in the National Hydrography Dataset (NHD) Waterbody and Area layers (excluding the Pacific Ocean and Humboldt Bay)
- Within 3 miles of a primary or secondary road
- Within 3 miles of an electrical substation

To apply these criteria, we generated a separate polygon layer for each constraint using selected features from the input datasets and the Buffer geoprocessing tool in ArcGIS Pro to create buffer zones around features as necessary. We then converted these polygon layers to rasters and assigned a value of -1 to cells in constrained areas. Finally, we extracted the value of each raster to a separate constraint attribute field for each facility point location with the Extract Values to Points geoprocessing tool.

After joining the facility point attributes to their corresponding parcel groups, we also calculated a version of each constraint field indicating the degree of areal overlap between a parcel group and a given constraint polygon layer (see "New Sites" section for more details). Although we used the point-based constraint fields to select closed sites, we included the area-based counterparts as well to allow for comparison with the area-based constraint values used to select new sites.

Constraints for New Sites

For new sites, we used the following constraint criteria for site suitability:

- Not within the boundaries of protected lands identified in the California Protected Lands Database (CPAD)
- Not within high flood risk zones, which were defined as areas within 1,000 feet of a perennial stream recorded in the National Hydrography Dataset
- Not within densely inhabited areas, which were defined as having a structure density of > 1 building per acre
- On terrain with a slope of ≤ 5%
- Not within 100 feet of a body of water identified in the National Hydrography Dataset (NHD) Waterbody and Area layers (excluding the Pacific Ocean and Humboldt Bay)
- Within 2 miles of a primary or secondary road
- Within 2 miles of an electrical substation

We modified the criteria for new sites from the criteria for closed sites by accounting for flood risk, reducing maximum slope, and decreasing the distance to roads and substations. In contrast to old sites, we included the constraint related to proximity to substations for all new sites to focus only on areas with the potential for grid connections. Additionally, we removed the constraint for proximity to schools because its original purpose was to ensure that schools had not been developed near closed sites since the most recent facility closure, and the proximity to schools may even offer opportunities for local wood utilization (e.g., producing specialized wood products that can be utilized on campuses).

Since new sites did not have associated points, we opted to determine the value of each constraint attribute field for a given site based on the percentage of areal overlap between each constraint layer and the parcel group polygon feature for that site. To do this, our team produced a custom Python script that intersects parcel groups with a single constraint layer at a time and calculates a new field for that constraint layer in the attribute table of the parcel groups feature class. We determined each area-based constraint field value according to one of two methods: majority overlap or complete overlap. We defined the former as having greater than 50% areal overlap between a constraint layer and a parcel group, and the latter as having > 99.5% overlap with a parcel group. We assigned most constraints according to majority overlap, but we determined both the roads and utilities constraints by complete overlap because any portion of a parcel group being within the distance threshold of a major road or substation should be sufficient to allow for transport or grid connection to the site. After calculating constraint values based on areal overlap, we filtered the new sites to keep only parcel groups that had at least 50% suitable area and at least 10 acres of suitable area based on majority overlap constraints, as well as at least 0.5% area based on the complete overlap constraints. Lastly, we used the Dissolve Boundaries geoprocessing tool to dissolve the boundaries of all adjacent parcels (regardless of ownership) after filtering, producing final parcel groups for the new sites.

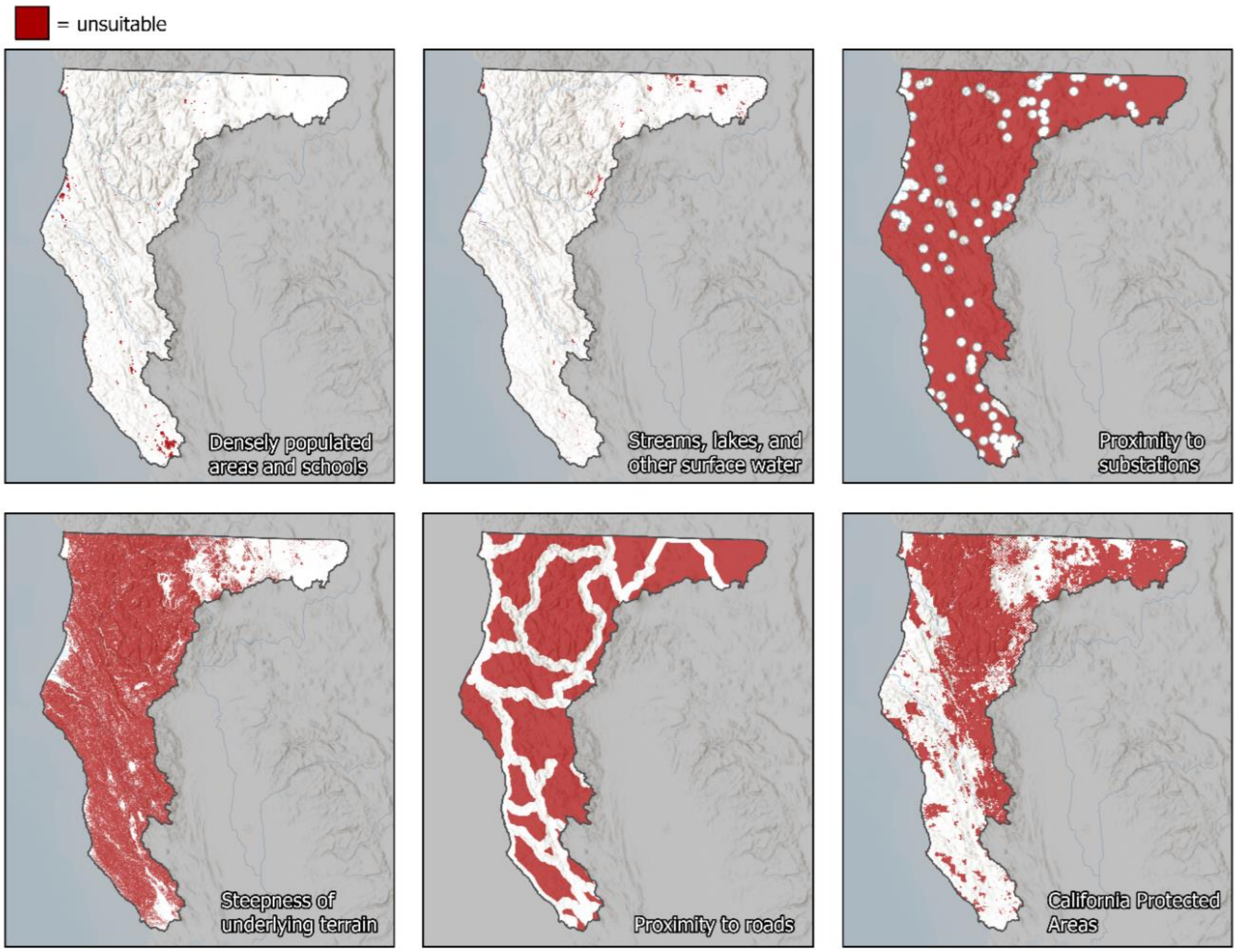

Figure 2. Constraints used in suitability analysis.

Opportunities for Closed and New Sites

For both closed and new sites, we added opportunity fields intended to identify the presence of beneficial factors in the siting of a wood utilization facility. These factors are as follows:

- Within 1,000 feet of a Brownfield site recorded in the US EPA Facility Registry System
- Within 5 miles of a currently operational biomass power plant recorded in the UCCE California Wood Processing and Bioenergy Facilities Database
- Within 5 miles of a currently operational sawmill recorded in the UCCE California Wood Processing and Bioenergy Facilities Database

We calculated opportunity field values in a similar manner to constraint field values. For closed sites, we calculated point-based opportunity fields by using the Buffer geoprocessing tool in ArcGIS

Pro to create polygon buffers around input features, converting these buffer polygons to rasters with a value of 1 in each opportunity cell, and extracting the raster values to the facility points with the Extract Values to Points geoprocessing tool. For both closed and new sites, we calculated area-based opportunity fields according to the principle of any overlap (parcel groups overlapping with an opportunity vector layer in any amount ≥ 0.5% received a value of 1 for the corresponding opportunity field). It is important to note that opportunity fields did not factor into the site selection process. Rather, we included these fields as additional tools that can be used to help prioritize candidate sites that passed the constraints in our screening process.

Figure 3 illustrates the full workflow for screening closed sites, while Figure 4 illustrates the full workflow for screening new sites.

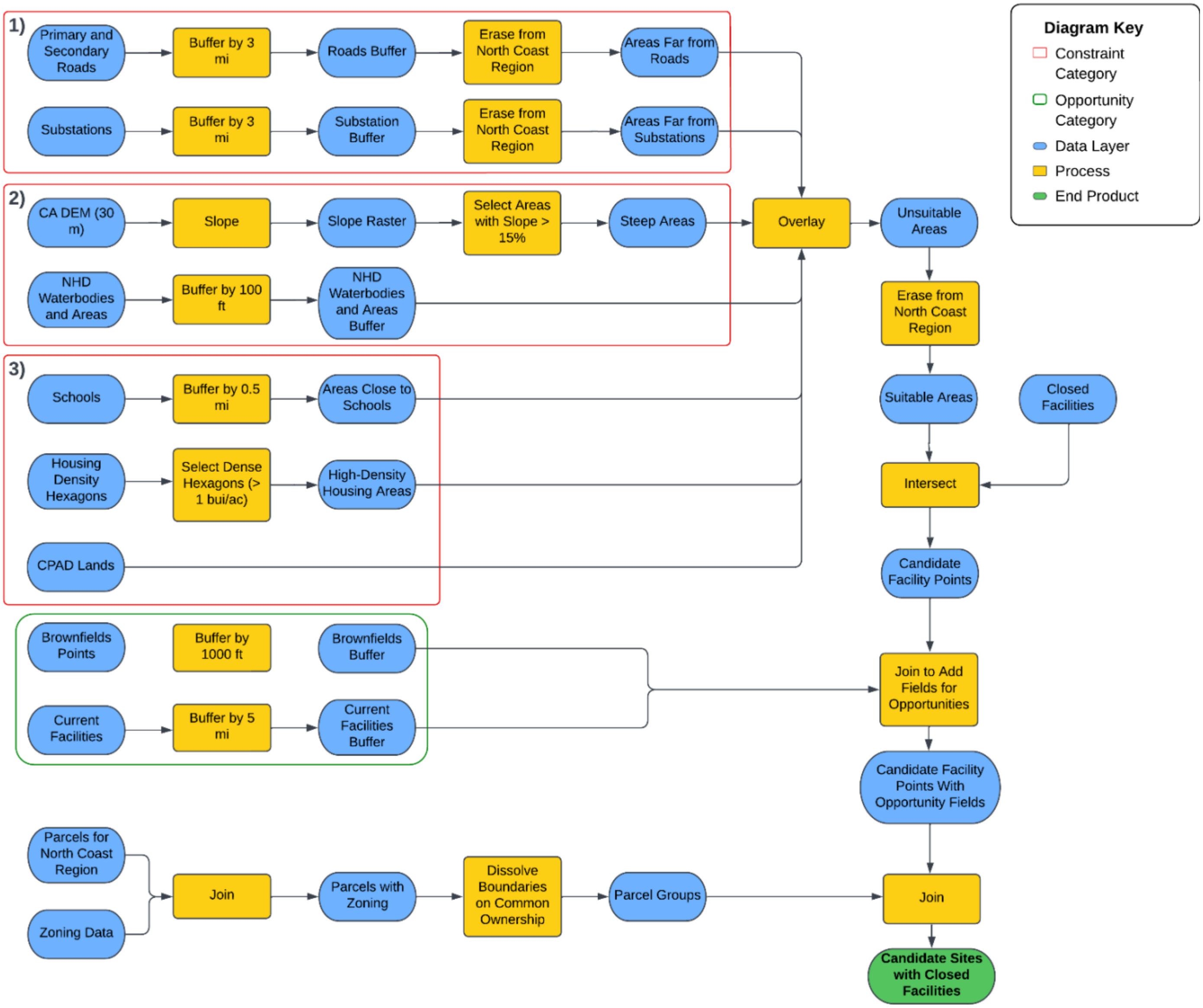

Figure 3. Full Screening Workflow for Closed Sites.

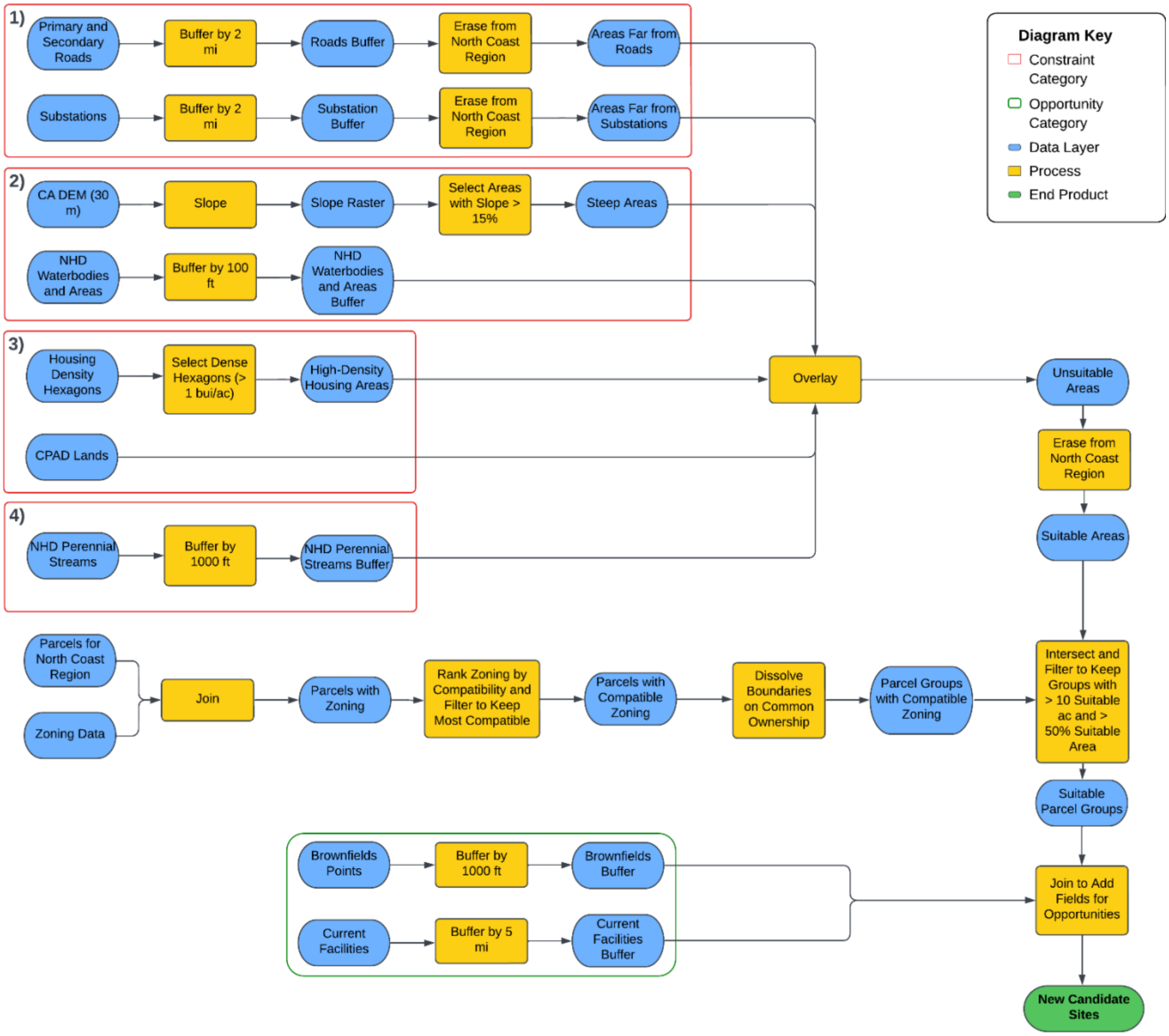

Figure 4. Full Screening Workflow for New Sites.

Additional Steps

After calculating constraint and opportunity fields for all sites and applying the relevant constraint criteria to eliminate unsuitable areas, we performed a few additional steps to obtain our final list of candidate sites. First, we performed an additional viability check on each candidate site that passed the screening process. To do this, we attempted to view the site via Google Street View and/or Esri's World Imagery service and noted any obvious signs that would disqualify a site from further consideration (e.g., a new housing development under construction on most of the area covered by a parcel group would disqualify that parcel group). Next, we calculated the number of acres covered by each candidate parcel group with the Calculate Geometry geoprocessing tool in ArcGIS Pro. After calculating the area of each feature, we used the Spatial Join geoprocessing tool to join subregion designations from the NCRP's 2022 subregions boundary feature class to the candidate parcel groups layer. Lastly, we calculated additional "overall suitability score" fields for closed sawmills, closed biomass power plants, and new sites of all types, respectively. We calculated each of these fields by taking the sum of the relevant constraint field values and all the opportunity field values, providing an overall value that can be used to help prioritize candidate sites within each site type. Selected candidate sites are shown in Figure 5.

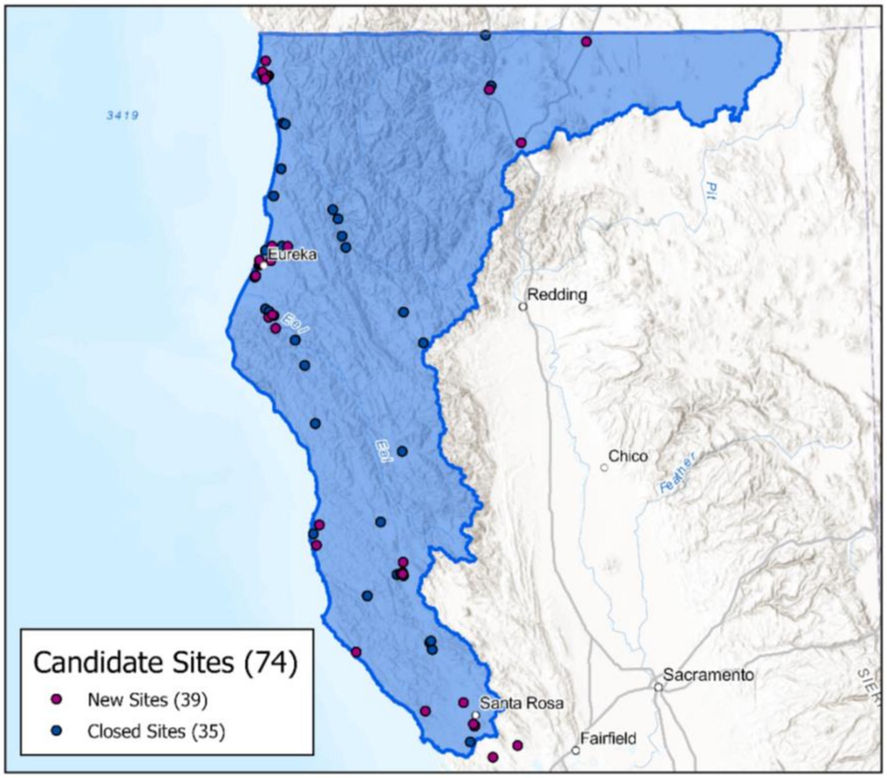

Figure 5. All candidate sites used in analysis.

Feedstock Analysis

Following the selection of candidate sites for further investigation, we analyzed woody feedstock in the vicinity of each site to compare the available residues across sites. To accomplish this, we performed a service area network analysis using ArcGIS Pro 3.2's Network Analyst Tools. The network analysis incorporated several key elements, each of which is summarized below.

Site Locations

The service area network analysis requires point locations to and/or from which travel time may be calculated. To supply point locations for this analysis, we used ArcGIS Pro's Feature to Point geoprocessing tool, which created a new feature class containing a point centered within each candidate parcel group. We chose to use the tool's optional "Inside" parameter to constrain each point to occur within a parcel group polygon when the centroid of a polygon feature occurred outside of the feature's boundaries. These candidate site points retain the attributes from their parcel group counterparts and are provided in a separate feature class (see the "Deliverables" section).

Road Network

Another critical input to the service area analysis is a network along which travel will occur. To construct our network dataset, we downloaded CAL FIRE's Forest Practice Roads dataset and used it as the feature dataset input to ArcGIS Pro's Create Network Dataset geoprocessing tool. We chose the Forest Practice Roads dataset as the basis for our network because it had the most comprehensive coverage of forest roads in comparison to other datasets such as OpenStreetMap and TIGER/Line roads, especially in remote areas. Once the network dataset had been created, we assigned a travel mode value of "Trucking," prohibited U-turns, and prioritized primary and secondary roads over other roads in an effort to emulate woody biomass transport via logging trucks or chip vans. We did not include restrictions for height, travel direction, and turn radius to lack of available data. After assigning these characteristics, we added a maximum speed limit attribute and determined a speed limit value for each road classification based on observation of road conditions on Google Street View in several randomly selected areas and comparison with actual speed limit signage visible in Street View where available (Table 3). We used these speed limit values to determine travel time along each road segment, which we ultimately used as the impedance input for travel cost along the road network.

One limitation of the CAL FIRE Forest Practice Roads layer is that there are a few areas within the NCRP Region without full road coverage. The largest of these areas is in the Klamath Mountains. This limitation could potentially have led to the omission of some sites as candidate locations. If this analysis is to be rurun areas with missing roads in the roads network should be filled in.

Table 3: Maximum Speed Limits by Road Classification for Feedstock Analysis Network Dataset

Road Classification	Maximum Speed (mph)
Primary	55
Secondary	45
Permanent	30
Bridge	25
Historic	25
Road Interchange	20
Seasonal/Temporary	20
4WD	15
Unclassified	15

Recoverable Woody Residues

We used outputs generated by the Schatz Energy Research Center's California Biomass Residues Characterization (C-BREC) model as the source of our estimates of recoverable woody residues. According to the **C-BREC page on the Schatz Energy Research Center website**, the C-BREC model is aimed at "robust, transparent accounting of emissions associated with residual woody biomass energy systems in California" and allows users to estimate recoverable residues from forest treatments by factoring in location, forest treatment type, and the level of biomass removal. The C-BREC model was run to simulate residues generated from a variety of forest treatments using the Landscape Ecology, Modeling, Mapping and Analysis (LEMMA) group's forest state data, which are based on imagery from 2012 and were grown forward to represent forest conditions in 2018 by the Natural Resource Spatial Informatics Group (NRSIG) at University of Washington using Forest Vegetation Simulator (FVS). For our analysis, we chose a recoverable residues raster at 30-meter resolution for a 40% thin from below silvicultural treatment, which is intended to represent a moderate-intensity thinning of small trees that might realistically be applied throughout much of the North Coast Region to reduce wildfire hazard, improve forest health, and generate residues for small log biomass utilization or biomass energy production. Figure 6 shows recoverable residues from the 40% thin from below scenario for the NCRP region. The C-BREC rasters provide separate residue estimates by diameter class. For our biomass power plant scenarios, we calculated residue totals based on the sum of residues across all diameter classes. For the residue totals in our sawlog scenarios, we used only the residues in the class for stems > 9 inches in diameter at breast height.

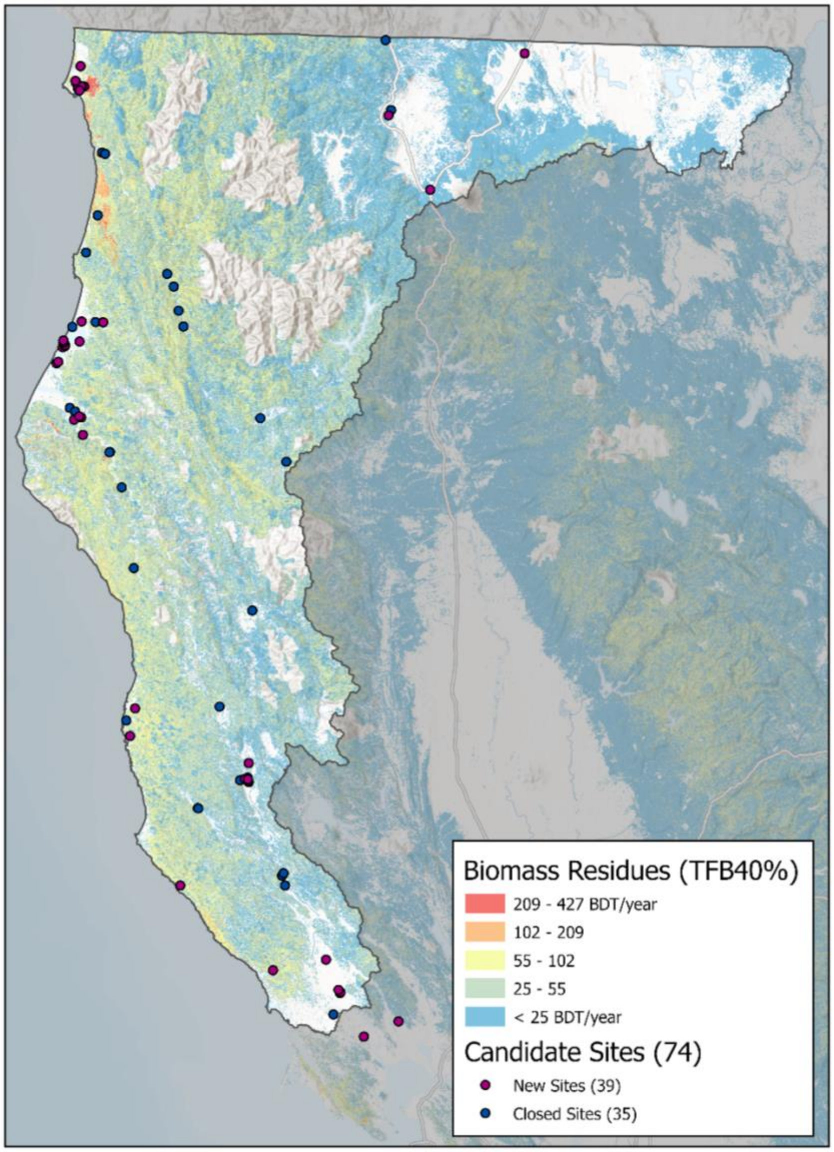

Figure 6. Recoverable Biomass Residues (C-BREC). Values reflect a thin from below 40% (TFB40%) treatment.

Mechanical Treatment Feasibility

The final input for the feedstock analysis was a **mechanical treatment feasibility** raster developed by Tukman Geospatial for the North Coast Resource Partnership in 2022. This 30-meter raster, shown in Figure 7, designates areas as infeasible for mechanical treatments requiring equipment such as chainsaws, chippers, and/or larger machinery using the following criteria: designated wilderness, slope > 40%, no treatable vegetation, within 100 feet of perennial streams or 50 feet of intermittent streams, and greater than 1,000 feet from a road or trail. These criteria are applied to filter the landscape in a stepwise fashion, with areas receiving a score based on the step in which they are eliminated. When applying this raster as a filter in our analysis, we chose to retain only areas receiving the highest score, which are areas deemed feasible for mechanical treatment. We used the mechanical treatment feasibility raster in two out of the four feedstock analysis scenarios (one for a sawmill and another for a bioenergy facility) to offer a conservative estimate of the residues that might be recoverable via mechanical treatment methods. When paired with estimates that exclude this additional treatment feasibility screen, the outputs for the different scenarios provide a range of estimates for total woody residues (in tons) able to be utilized by each facility type.

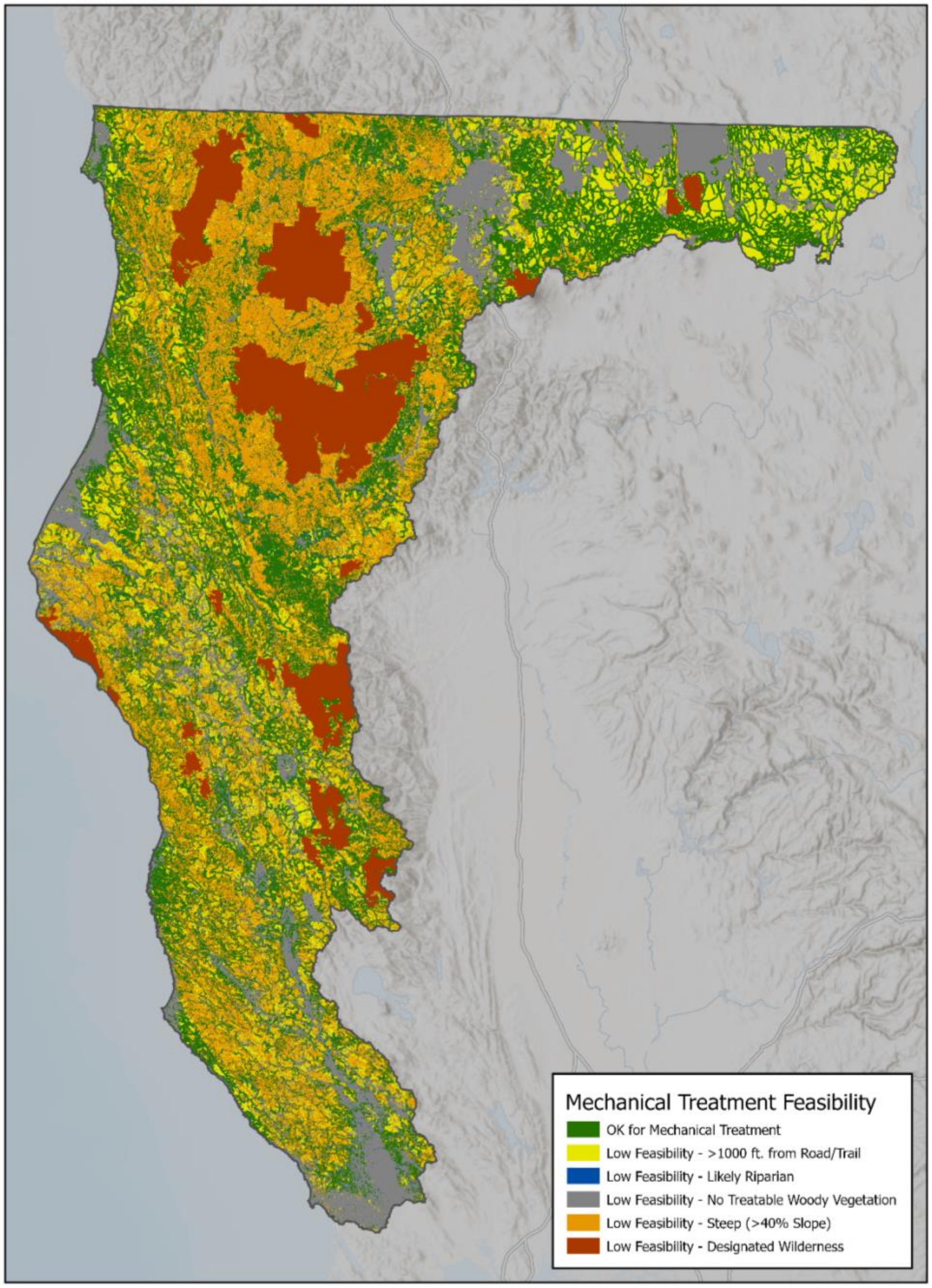

Figure 7. Mechanical treatment feasibility within the NCRP boundary.

Feedstock Analysis Workflow

To automate the feedstock analysis, our team created a Python script using the ArcPy package. With this script, we generated service areas in 30-minute travel time increments out to a maximum of 120 minutes for the road network derived from CAL FIRE's Forest Practice Roads and the selected candidate site point locations. 120 minutes represents the maximum economically feasible one-way travel time distance for the transport of woody residues to a facility, and the 30-minute increments allow for some flexibility in adjusting the outer boundary for woody residue procurement. Once the service areas had been generated, we intersected them with the mechanical treatment feasibility raster in the appropriate scenarios and then dissolved all service area polygons by their outermost travel time value to ensure a single polygon per 30-minute time increment. We then used these dissolved service areas as zones to summarize residues from the C-BREC recoverable residues raster with ArcGIS Pro's Zonal Statistics as Table geoprocessing tool and joined the resulting summary table to the dissolved service areas feature class. This produced two deliverables: a service area feature class with residue totals for each service area polygon and an Excel table that summarizes these totals, allowing the user to sort totals by subregion if desired. We also added a field for the average one-way transportation cost to a facility within a given travel time break, which we calculated as follows (using transportation costs of $150 for sawlogs and $160 for biomass):

Average transportation cost = [Total number of loads within given time break] * [Price to transport one load] / [Total tons of residue within given time break]

Figure 8 illustrates the full feedstock analysis workflow.

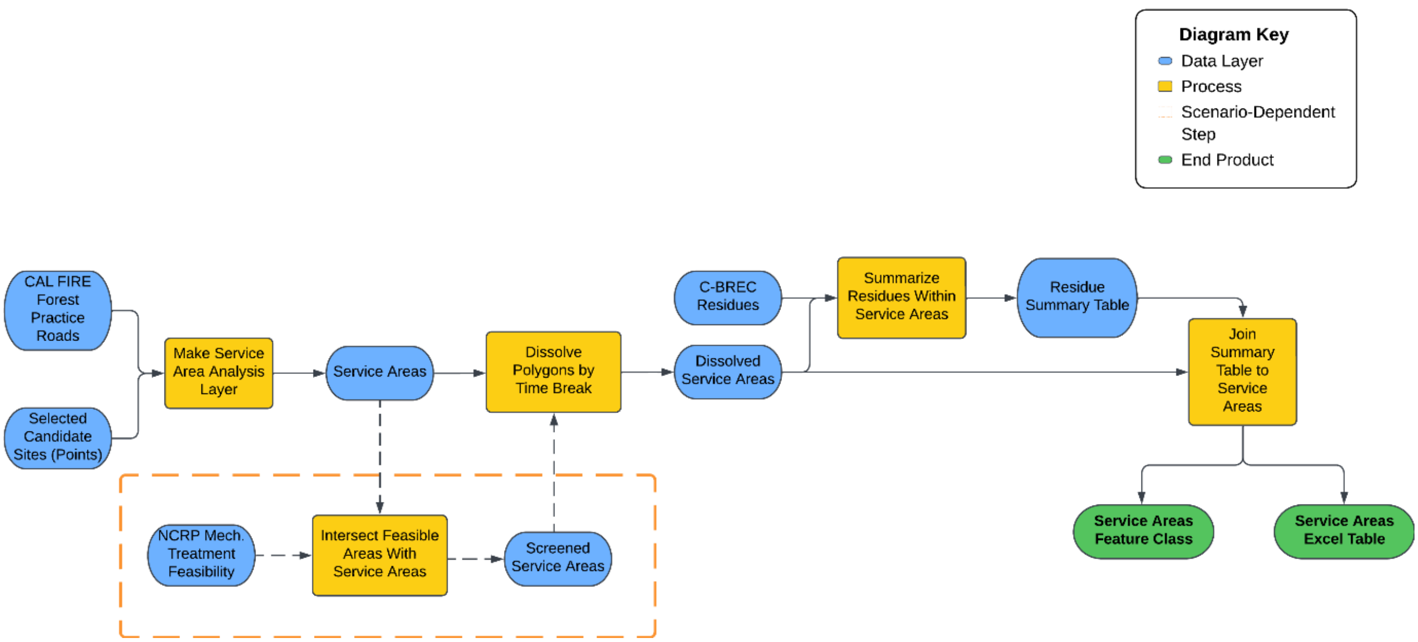

Figure 8. Full Feedstock Analysis Workflow.

Results and Deliverables

In total, the candidate site selection process selected 74 candidate sites (35 closed sites and 39 new sites) for further consideration. Of the closed sites, only two were formerly biomass power plants, with the remainder being sawmills. Closed sites were spread throughout the North Coast Region but were especially prevalent in Del Norte, Humboldt, Mendocino, and Sonoma Counties. New sites were largely clustered in and around major cities including Eureka, Arcata, Crescent City, Ukiah, Cloverdale, and Santa Rosa, as well as in a few other areas across Sonoma County. Several closed and new candidate sites were also identified in the northeastern portion of the North Coast Region within Siskiyou County.

It is important to note that these sites have not been officially selected for the pursuit of biomass utilization operations. Rather, the distinction of “selected” in this context means that they have been selected by our preliminary, regionwide screening process for further investigation that will require the acquisition of more detailed information at the local scale. Due to the inherent limitations of this regionwide screening approach, it is likely that many of these candidate sites will end up being unsuitable for biomass utilization based on factors beyond the scope of this analysis. However, this approach offers a starting point to help narrow down the range of possibilities for subsequent investigation.

For the selected candidate sites, we produced a feature class and Excel summary table displaying the results of each of our four scenarios (biomass power plant without mechanical treatment feasibility screen, biomass power plant with mechanical treatment feasibility screen, sawmill without mechanical treatment feasibility screen, and sawmill with mechanical treatment feasibility screen). The Excel summary tables (see Table 1 for links) show the results in two configurations: unsorted and sorted by greatest residue totals within each site type and subregion. Visualizations of the four scenarios as maps are shown in Figures 9-12.

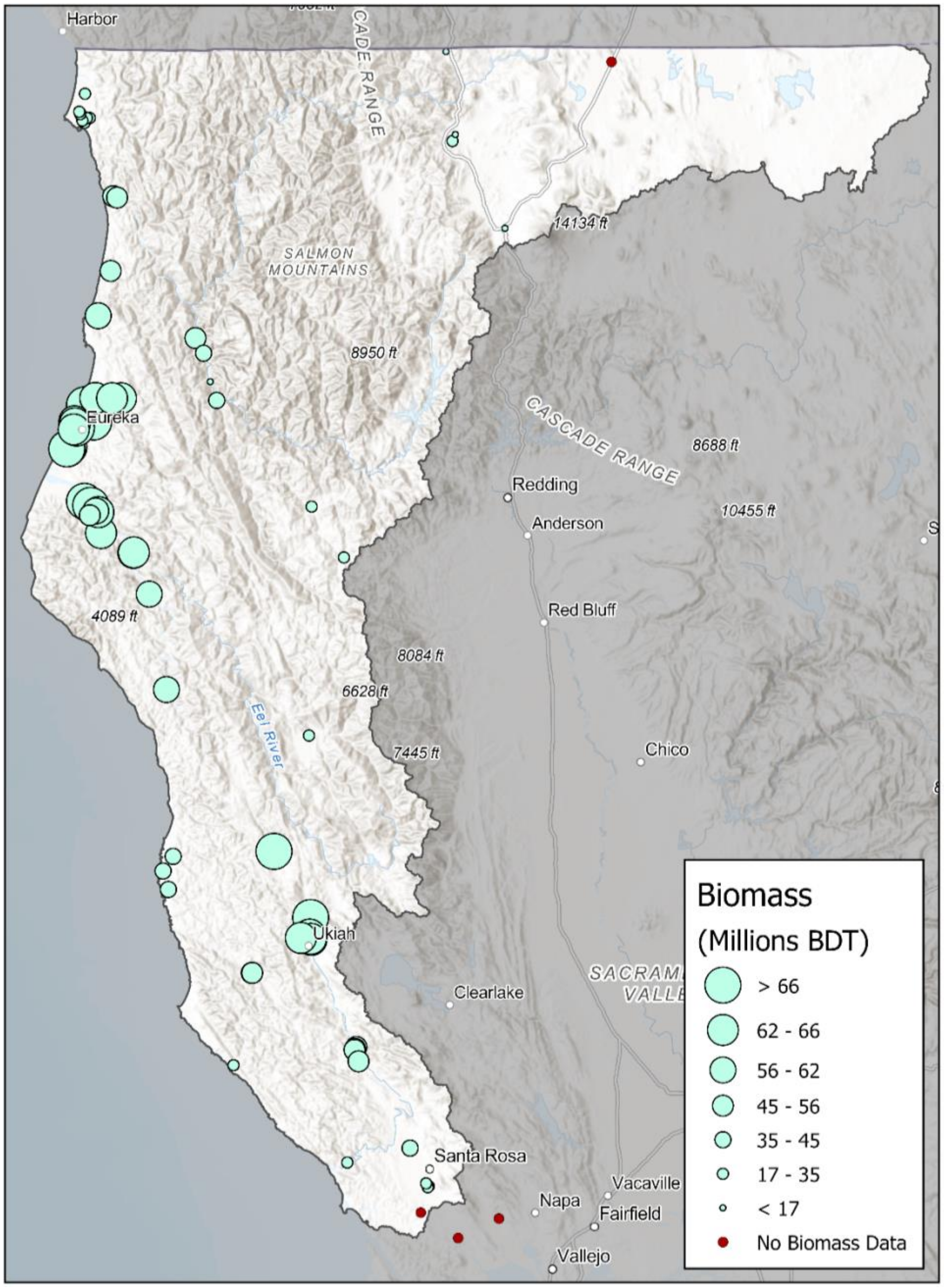

Figure 9. Biomass available to each candidate site.

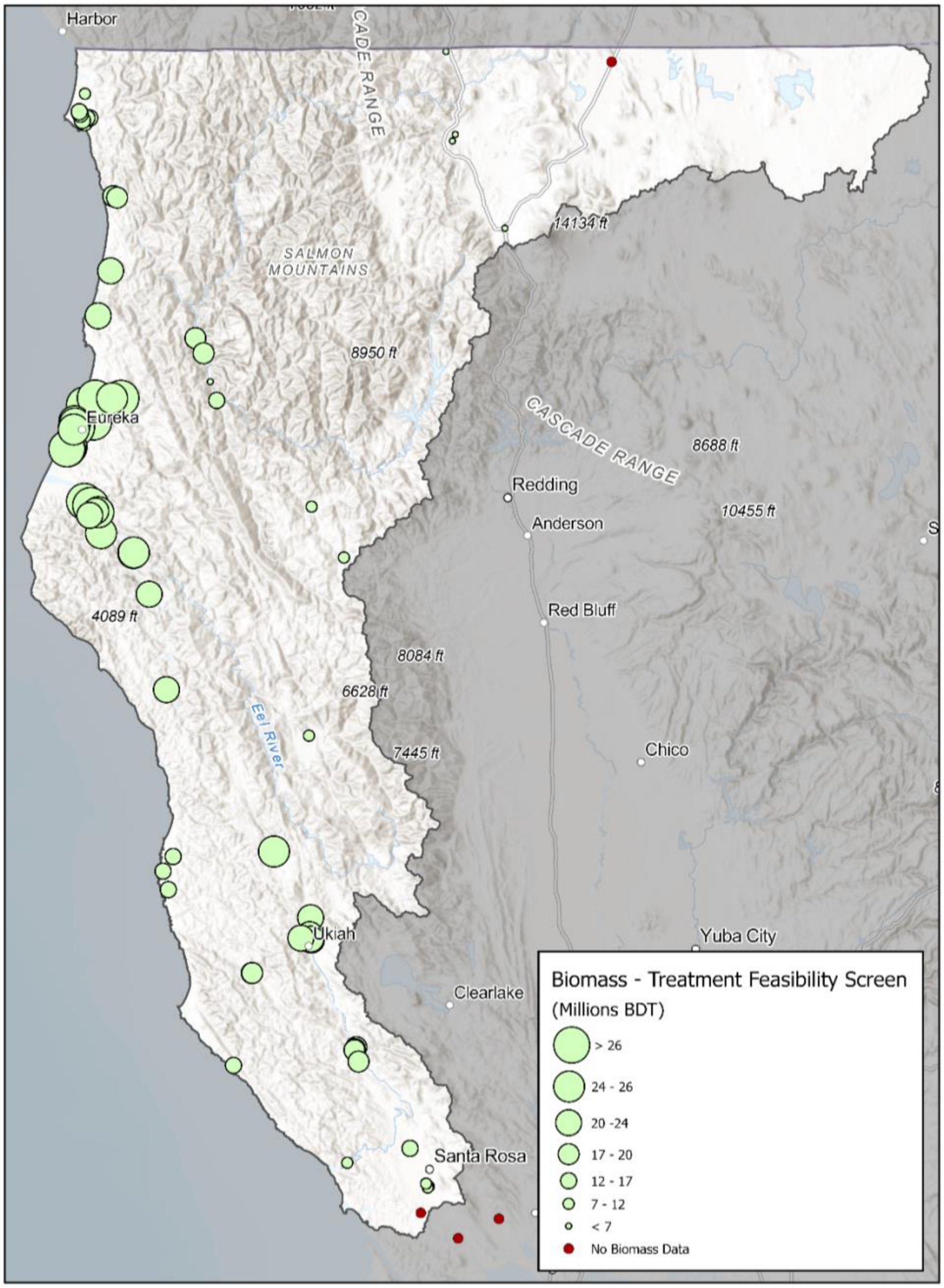

Figure 10. Biomass available to each candidate site with the treatment feasibility screen applied.

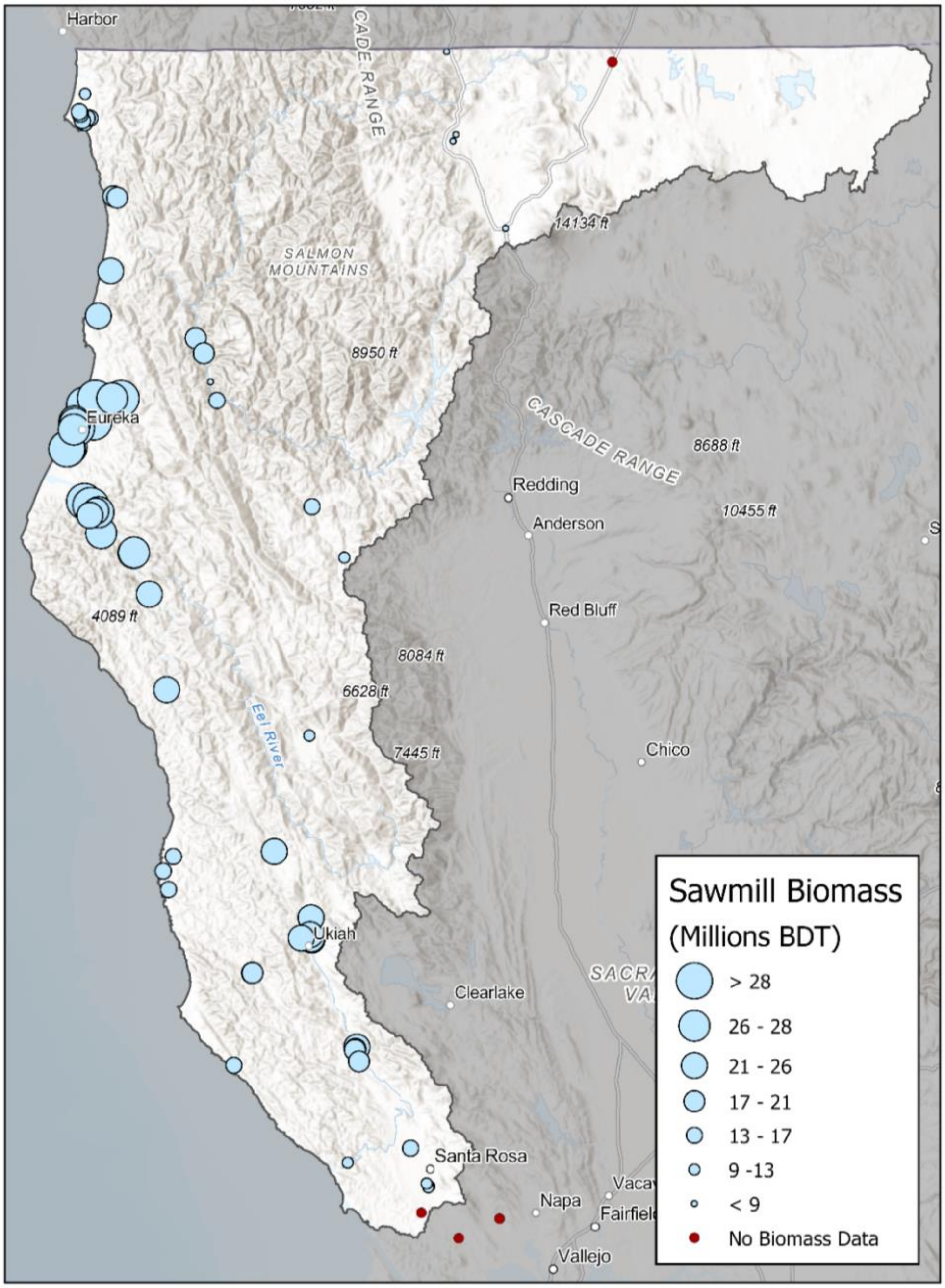

Figure 11. Sawmill biomass available to each site.

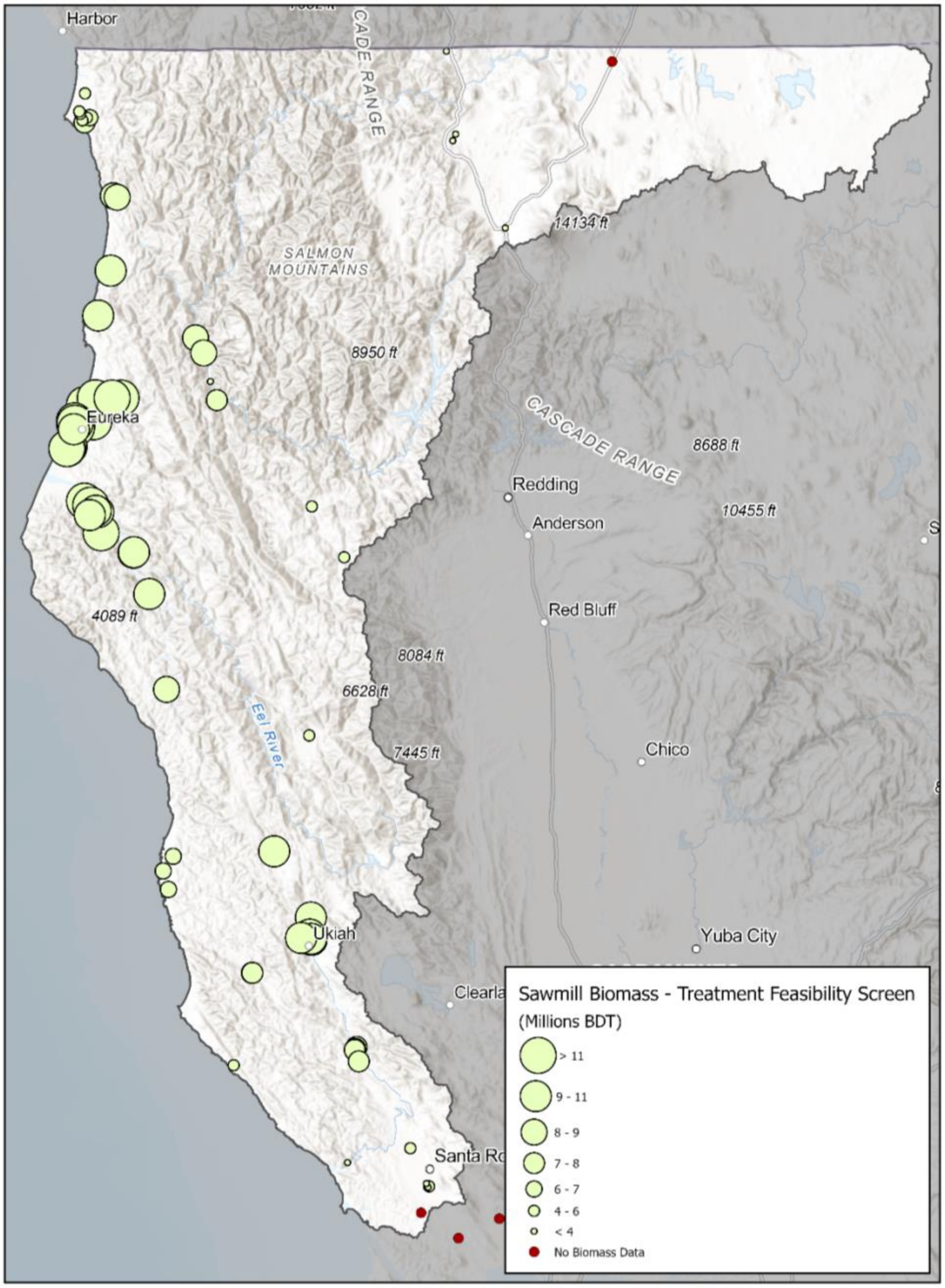

Figure 12. Sawmill biomass available to each site with the treatment feasibility screen applied.

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Appendix A: List of Zoning and Land Use Category Descriptions in Compatibility Tiers 1 and 2

Note: Land use categories are italicized.

Tier 1: Most Compatible with Biomass Utilization Operations

- **Del Norte County**
    - **'Manufacturing and Indus'**
    - **'Manufacturing Performance'**
    - **'Coastal Timber'**
    - **'Manufacturing'**
- **Humboldt County**
    - **'100% TPZ, Rdwd & Wwd, Improved'**
    - **'100% TPZ, Rdwd & Wwd, Vacant'**
    - **'100% TPZ, Rdwd, Improved'**
    - **'100% TPZ, Rdwd, Vacant'**
    - **'100% TPZ, Wwd, Improved'**
    - **'Heavy Industrial, Electrical Co-Gen'**
    - **'Heavy Industrial, Wood Product'**
    - **'Industrial - Heavy'**
    - **'Light Industrial, Wood Product'**
    - **'Portion TPZ, Mix Rdwd&Wwd, Improved'**
    - **'Portion TPZ, Mix Rdwd, Wwd, Vacant'**
    - **'Portion TPZ, Rdwd, Improved'**
    - **'Portion TPZ, Rdwd, Vacant'**
    - **'Portion TPZ, Wwd, Improved'**
    - **'Portion TPZ, Wwd, Vacant'**
    - **'Vacant, Industrial'**
    - **'Vacant Industrial with Paving/Concrete'**
    - **'100% TPZ, Wwd, Vacant' 'Industrial - Vacant'**
- **Mendocino County**
    - **'Forest Land District '**
    - **'Gualala Industrial District'**
    - **'Industrial District'**
    - **'General Industrial District'**
    - **'Mendocino Forest Lands District'**
    - **'Pinoleville Industrial District'**
    - **'Timberland Production District'**
- **Siskiyou County**

  - **'Heavy Industrial'**
  - **'Timberland Production'**
- **Sonoma County**
  - **'Heavy Industrial District'**
  - **'Limited Rural Industrial District'**
  - **'Resources and Rural Development'**
  - **'Timberland Production District'**
- **Trinity County**
  - ***'Restricted - vacant timber production zone (TPZ)'***
  - ***'Restricted - improved timber production zone (TPZ)'***

Tier 2: Potentially Compatible with Biomass Utilization Operations

- **Del Norte County**
  - **'Agricultural General District'**
  - **'Agriculture Exclusive District'**
  - **'Agriculture Industrial District'**
  - **'General Commercial District'**
  - **'Harbor Related Commerc/Industrial'**
  - **'Public Facility District'**
  - **'Rural Residential 1'**
  - **'Rural Residential Agriculture'**
  - **'Timberland Preserve'**
  - **'Agricultural'**
  - **'Agricultural Exclusive'**
  - **'Agricultural Forestry'**
  - **'Public Ownership'**
  - **'Residential Agriculture 1'**
  - **'Residential Agriculture 2'**
  - **'Rural Residential 1'**
  - **'Rural Residential 2'**
  - **'Rural Residential 3'**
  - **'Timberland Preserve'**
- **Humboldt County**
  - **'Heavy Industrial, Petroleum Products'**
  - **'Industrial - Light'**
  - **'Misc Light Industrial'**
  - **'Rural - Improved'**
  - **'Rural - Vacant'**
  - **'Rural w/ Timber Infl - Improve'**

   - **'Rural, Agricultural, Misc Imps, Unrestricte'**
   - **'Rural w/ Timber Infl - Vacant'**
   - **'Rural, Agricultural, Residence, Unrestricte'**
   - **'Vacant Rural Residential, 1-5 ac'**
   - **'Vacant, Rural Residential, 10+ to 20 ac'**
   - **'Vacant, Rural Residential, 20+ to 40 ac'**
   - **'Vacant, Rural Residential, 40+ ac'**
   - **'Vacant, Rural Residential, 5+ to 10 ac'**
   - **'Vacant, Rural Residential, to .99ac'**
   - **'Vacant, Rural, Agricultural, Unrestricted'**
   - **'Vacant Land, Subject to Exemption'**
- **Mendocino County**
   - **'Agricultural District'**
   - **'Limited Industrial District'**
   - **'Mendocino Public Facilities'**
   - **'Mendocino Rural Residential'**
   - **'Public Facilities District'**
   - **'Rural Community District'**
   - **'Rangeland District'**
   - **'Rural Mountainous Residential'**
   - **'Residential Rural District'**
   - **'Residential Rural District'**
   - **'Rural Village'**
- **Siskiyou County**
   - **'Light Industrial'**
   - **'Limited Industrial'**
   - **'Non-Prime Agriculture'**
   - **'Prime Agriculture'**
   - **'Rural Residential Agricultural'**
- **Sonoma County**
   - **'Agriculture and Residential District'**
   - **'Agricultural Services District'**
   - **'Retail Business and Service District'**
   - **'General Commercial District'**
   - **'Commercial Rural District'**
   - **'Diverse Agriculture District'**
   - **'Limited Commercial District'**
   - **'Land Extensive Agriculture District'**
   - **'Land Intensive Agriculture District'**
   - **'Limited Urban Industrial District'**

  - **'Industrial Park District'**
  - **'Public Facilities District'**
- **Trinity County**
  - ***'Restricted - vacant agricultural preserve zone (APZ)'***
  - ***'Restricted - improved agricultural preserve zone (APZ)'***
  - ***'Federal'***
  - ***'Vacant land – industrial'***