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OPDR Supplemental Information

Part III: OPO and APD Information

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Part V. Project Offset Area

Species (tree) composition;

Species	BA/Acre	%
yellow poplar	18.7	16.4%
sugar maple	14.3	12.6%
eastern redcedar	12.3	10.8%
chestnut oak	11.5	10.1%
red maple	10.4	9.2%
northern red oak	6.2	5.5%
white oak	4.8	4.2%
chinkapin oak	4.0	3.5%
pignut hickory	3.5	3.1%
black oak	2.8	2.5%
Virginia pine	2.8	2.5%
American beech	2.4	2.1%
white ash	2.3	2.1%
sycamore	2.0	1.7%
blackgum	1.8	1.6%
American basswood	1.4	1.3%
sassafras	1.4	1.2%
black cherry	1.1	1.0%
sourwood	0.9	0.8%
bitternut hickory	0.8	0.7%
yellow buckeye	0.6	0.6%
redbud	0.6	0.5%
blue ash	0.6	0.5%
black walnut	0.6	0.5%
boxelder	0.5	0.5%
dogwood spp.	0.5	0.4%
shagbark hickory	0.5	0.4%
scarlet oak	0.5	0.4%

slippery elm	0.4	0.3%
black locust	0.4	0.3%
green ash	0.3	0.3%
American elm	0.3	0.3%
musclewood (Carpinus)	0.3	0.3%
pawpaw	0.3	0.2%
hackberry	0.2	0.2%
swamp chestnut oak	0.2	0.2%
honeylocust	0.2	0.1%
pin cherry	0.2	0.1%
bigtooth aspen	0.1	0.1%
Ohio buckeye	0.1	0.1%
shellbark hickory	0.1	0.1%
cucumbertree	0.1	0.1%
shingle oak	0.1	0.1%
serviceberry spp.	0.1	0.1%
rock elm	0.1	0.1%
Alianthus (tree of heaven)	0.1	0.1%
mockernut hickory	0.1	0.1%
commercial hardwoods	0.1	0.0%
ironwood (Ostrya)	0.1	0.0%
common persimmon	0.1	0.0%
catalpa spp.	0.0	0.0%
bur oak	0.0	0.0%
quaking aspen	0.0	0.0%
alder spp.	0.0	0.0%
black ash	0.0	0.0%
paulownia	0.0	0.0%
apple spp.	0.0	0.0%
sweetgum	0.0	0.0%
flowering dogwood	0.0	0.0%
blackjack oak	0.0	0.0%
mulberry spp.	0.0	0.0%

*Total may not sum to 100% due to rounding.

Composition of Native Species;

Assessment Area	Site Class	Acres	%	Species Diversity Index
Southern Allegheny Plateau Lowland Hardwoods	All	-	0%	60%
Southern Allegheny Plateau Mixed Pine-Hardwoods	All	-	0%	65%
Southern Allegheny Plateau Northern Conifer	All	-	0%	75%
Southern Allegheny Plateau Oak-Hickory	High	-	0%	70%
Southern Allegheny Plateau Oak-Hickory	Low	-	0%	70%
Southern Allegheny Plateau Upland Hardwoods	High	1,224.1	9%	65%
Southern Allegheny Plateau Upland Hardwoods	Low	4,546.6	35%	65%
Central Interior Broadleaf Forest Eastern Low Plateau Cove Forest	High	75.8	1%	70%
	Low	334.8	3%	70%
Central Interior Broadleaf Forest Eastern Low Plateau Lowland Hardwoods	All	154.5	1%	60%
Central Interior Broadleaf Forest Eastern Low Plateau Mixed Upland Hardwoods	High	631.3	5%	70%
	Low	2,812.8	21%	70%
Central Interior Broadleaf Forest Eastern Low Plateau Northern Hardwoods	High	236.9	2%	65%
	Low	90.6	1%	65%
Central Interior Broadleaf Forest Eastern Low Plateau Oak-Hickory	High	-	0%	70%
	Low	-	0%	70%
Central Interior Broadleaf Forest Eastern Low Plateau Oak-Pine	All	2,985.2	23%	70%
Central Interior Broadleaf Forest Eastern Low Plateau Pine	All	-	0%	75%
Total		13,092.7	100%	67.6%

Age class distribution;

An analysis of age class on HUC10 watersheds shows that the project meets the age class requirements on a watershed-scale. Histogram distributions were created for each watershed using COLE 1605(b) Report for Ohio filtered for Forest Type: Oak / pine group, Loblolly pine / hardwood, Other pine / hardwood, Oak / hickory group, Chestnut oak, White oak / red oak / hickory, Yellow-poplar /white oak / northern red oak, Yellow-poplar, Red maple / oak, Mixed upland hardwoods. The watersheds overlapping the project area and corresponding percentage of the project area less than 20 years old based on this analysis are:

Age	Acres	%
<10	266	2.0%
11-20	160	1.2%
21-30	213	1.6%
31-40	426	3.3%
41-50	692	5.3%
51-60	266	2.0%
61-70	1,064	8.1%
71-80	639	4.9%

81-90	532	4.1%
91-100	426	3.3%
>100	8,409	64.2%
Total	13,093	

*Acres are rounded

Potential Pests/ Diseases
A review on April 24, 2019 of the Ohio Department of Natural Resources website page Trees > Tree Health > Insects & found that there are a few pests and diseases potentially present on the property. Potential pests include, Asian Longhorned Beetle, Emerald Ash Borer, Gypsy Moth, and Hemlock Wooly Adelgid. Potential diseases include Beach Leaf Disease and Thousand Cankers Disease.

No significant presence of pest or disease occurs throughout the Project Area.

Part VII. Carbon Stock Inventory

Projected Growth

The Northeast Variant of the Forest Vegetation Simulator (Keyser 2010) was used to model forest growth, mortality and harvest over 100 years. Plot data and tree data was entered into a database readable by FVS, with each plot entered as an individual stand and each tree record multiplied by the appropriate factor to determine trees per acre. TPA, species, height, and DBH were used as inputs for the TreeInIt input file. After entry into FVS, the "forest" was grown 100 years and the resulting tree list used to calculate biomass.

Upon future re-measurements of plots, the calculated annual growth will be input into the FVS TreeInit file in the DG column (diameter increment growth). As Essential FVS notes," If increment data are provided with the tree records, the large-tree diameter increment model and the small-tree height increment model will be scaled to reflect local deviations from the regional growth trends represented in the models." Thus, incorporating the measured growth rates will calibrate the growth models in FVS.

For newly added plots, the READCORD (READjust CORrection for Diameter) and READCORR (READjust CORrection for Regeneration) keywords may be used to alter the increment growth models for these plots to reflect the growth rates from similar plots.

Adjustments for Start Date

To determine CO2 stocks at the project commencement date, the tree data was grown backwards to 11/06/18. This adjustment took place by growing individual trees backwards at the appropriate seasonal rate based on FVS predicted diameter and total height growth rates for each tree. The seasonal tree growth estimates are based on conversations with local foresters.

The start date projection used the same calibration as for the 100-year baseline and project modeling, except for the reported time increment. Instead of using 5-year intervals, the average annual diameter increment was calculated by growing individual trees in a 10-year interval (the FVS default) and then annualizing tree growth by dividing the growth increment by 10 for each tree.

Adjustments for End of Reporting Period

To determine CO2 stocks at the end of the reporting period, the tree data was grown forward to 9/30/2019. This adjustment took place by growing individual trees forwards at the appropriate seasonal rate based on FVS predicted diameter and total height growth rates for each tree. The seasonal tree growth estimates are based on

conversations with local foresters. Average annual diameter increment was calculated by growing each individual tree in FVS (using the same calibration as for the 100-year baseline and project modeling) for 10 years and then dividing by 10 to get the average annual increment for each tree.

Similarly, to grow the heights to the end of the reporting period, the FVS height growth estimates were used to grow the heights to the end of the reporting period height.

FVS Calibration

All FVS defaults for the Northeast variant were used besides the following calibration components:

- The location code for Wayne National Forest (914)
- Regeneration Values
- Site Index Values (see separate productivity analysis)
- The minimum acceptable harvest volume was set to 600 cubic feet per acre on the minimum harvest volumes for the property
- Cycle length was set to 5 years for the 100-year projection. The default cycle length of 10 years was used for the Start Date calculation, as described above.

Parameter or Attribute	Default Setting	
Number of Projection Cycles	1 (10 if using Suppose)	
Projection Cycle Length	10 years	
Location Code (National Forest)	922 – White Mountain	
Slope	5 percent	
Aspect	0 (no meaningful aspect)	
Elevation (default location)	20 (2000 feet)	
Latitude (Default location)	43.53	
Longitude (Default location)	71.47	
Site Species	SM	
Site Index	56 feet (total age; 50 years)	
Maximum Stand Density Index	Species specific	
Maximum Basal Area	Species specific	
Volume Equations	National Volume Estimator Library	
Pulpwood Volume Specifications:		
Minimum DBH / Top Diameter	Hardwoods	Softwoods
919 – Allegheny	6.0 / 5.0 inches	5.0 / 4.0 inches
920 – Green Mountain-Finger Lakes	8.0 / 4.0 inches	5.0 / 4.0 inches
921 – Monongahela	5.0 / 4.0 inches	5.0 / 4.0 inches
914 – Wayne, 911 – Wayne-Hoosier	6.0 / 4.0 inches	5.0 / 4.0 inches
922 – White Mountain	5.0 / 4.0 inches	5.0 / 4.0 inches
Stump Height	1.0 foot	1.0 foot
Sawtimber Volume Specifications:		
Minimum DBH / Top Diameter	Hardwoods	Softwoods
All location codes	11.0 / 9.6 inches	9.0 / 7.6 inches
Stump Height	1.0 foot	1.0 foot
Sampling Design:		
Large Trees (variable radius plot)	40 BAF	
Small Trees (fixed radius plot)	1/300th acre	
Breakpoint DBH	5.0 inches	

Regeneration

To determine the amount of additional regeneration for non-sprouting species (eastern redcedar and Virginia pine) after certain types of harvests, regeneration model input ratios from Nunery and Keeton 2010 were used ("Forest carbon storage in the northeastern United States: Net effects of harvesting frequency, post-harvest retention, and

wood products", Table 4). The table below shows the average regeneration rates after single-tree selection, clearcuts, and shelterwood relative to a background regeneration rate.

	Eastern Redcedar	Virginia Pine
Background	1.0	1.0
STS	5.0	5.0
Clearcut (Variable Retention)	7.0	7.0
Shelterwood	1.0	1.0

The background regeneration rate was used as a basis for developing ratios for estimating the regeneration after different types of harvests. The post-harvest regeneration TPA was input into the FVS key files using the natural regeneration partial establishment model. To simulate TPA densities post initial stem exclusion (after seedling mortality), the number of trees between 1.0”- 4.9" (as of the project commencement date) was used to represent the background regeneration rate for each stratum. The regeneration was assumed to enter into the stand five years after the harvest as five-year-old, 5’ tall seedlings (on average). 60% of the seedlings were assumed to survive after five years, which was based on input from forester’s familiar with seedling mortality in eastern Ohio.

Inventory Methology

For all applicable carbon pools, the following inventory methodology will be employed:

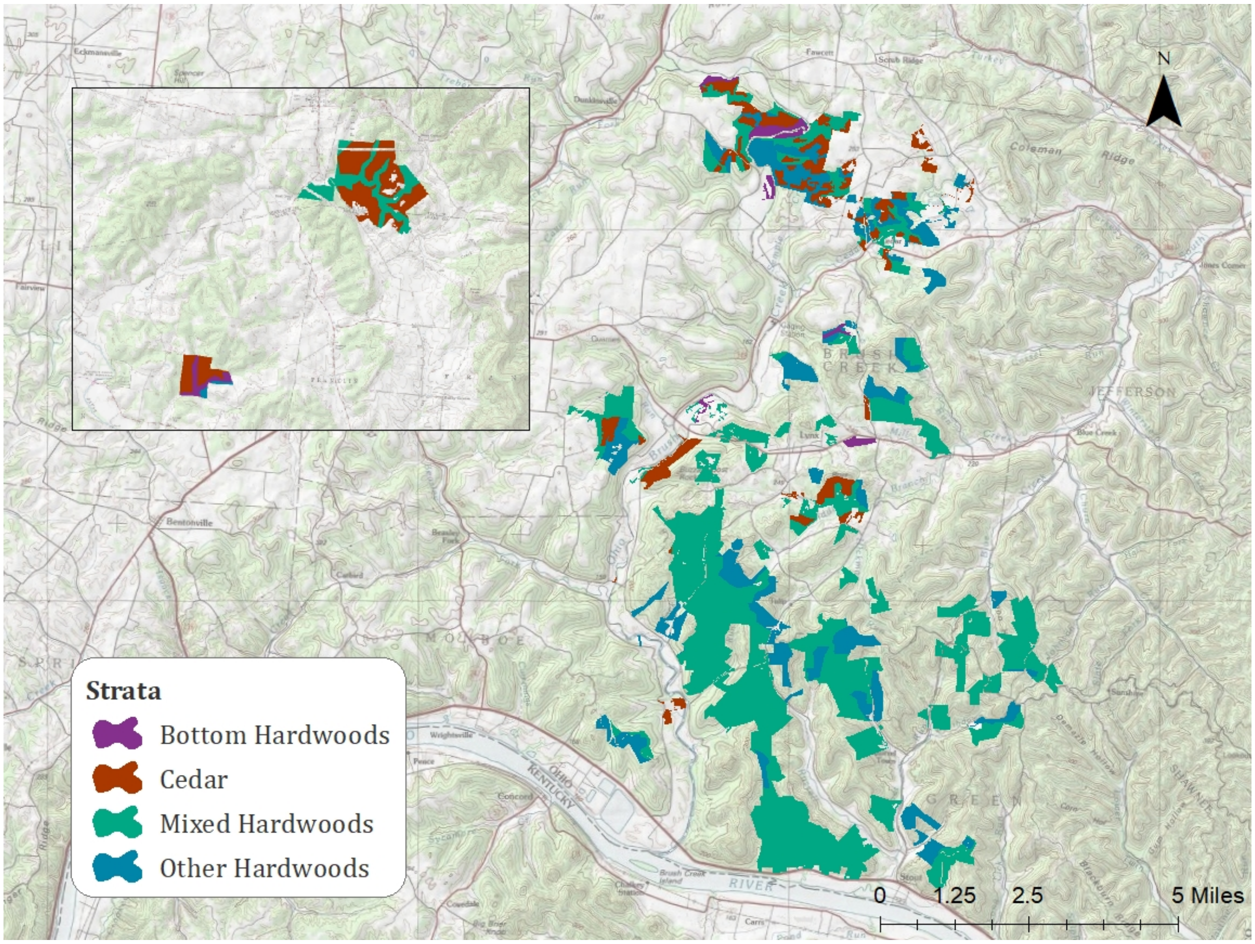
Project Boundary: The offset Project Area will be determined using the most recent geospatial file of the of the property. All roads, right-of-ways, major water bodies, and other non-forested areas will be removed from the Project Area. Some forested areas may be removed due to management considerations.

Stratification: Strata were developed from an initial forest type shapefile. This intial shapefile used spatial Landfire data (https://www.landfire.gov/evt.php) as a starting point. The initial shapefile was then systematically modified using recently collected forest inventory data (ca. 2018) and on-the-ground knowledge of stands. This initial shapefile had 11 forest types.

The final stratification combined these 11 forest types into 4 forest types, based on species similarities between initial strata and aerial imagery. Two of the original 11 forest types were initially identified as “grassland” and “non-forested”. For these 2 types, areas were determined as forested using aerial imagery, ground-truthed using plots inventoried in these forest types, and allocated areas to one of 4 forest strata using aerial imagery of adjacent areas. All plots were assigned to strata after the inventory was collected (i.e., post-inventory). The following table shows the total area in each of the 4 strata.

Strata	Acres
Bottom Hardwoods	285.7
Cedar	1,615.7
Mixed Hardwoods	8,385.8
Other Hardwoods	2,805.5
Total	**13,092.7**

Strata Map



Plot Number and Locations: A systematic grid of permanent inventory plots was installed across the project area. The total number of plots sampled, 246, was the number of plots needed to reach a 90% statistical confidence interval of sampling of no more than ±5% of the mean.

Monumentation: Permanent inventory plot centers will be monumented with a rebar pole pounded into the ground and topped with a small rebar cap flush with the ground. Plots that are located in areas devoid of forest cover will be recorded as such and will not be relocated. If a plot falls in an area with no trees, take a note to describe why it is non-stocked (i.e. in a field or rock outcropping).

Sampling Method: Permanent, fixed-radius plots will be established across the property to facilitate precise tracking of individual tree growth and ease of verification. At each plot location, a 1/15th-acre (30.4’ radius) fixed-radius plot will be established to measure all trees greater than or equal to 5.0” in diameter at breast height (DBH); and a 1/100th-acre (11.78’ radius) sub-plot will be taken to capture woody trees and saplings less than 5” (1.0 to 4.9” DBH). This plot design gave forest managers the opportunity to consistently track the growth and development of specific trees over an extended timeline and will allow for improved' ease of plot location during field work and site verifications.

The protocol defines trees as “A woody perennial plant, typically large and with a well-defined stem or stems carrying a more or less definite crown with the capacity to attain a minimum diameter at breast height of 5 inches and a minimum height of 15 feet with no branches within 3 feet from the ground at maturity.” As a result, please measure

all species >=1” DBH that meet this definition (a master list of FIA species codes for trees found on the property can be found on the final page of this document).

Statistical Standard: Mean biomass estimates (e.g. above ground carbon per acre) for the ownership will be reported with a minimum statistical precision of +/– 5% of the mean at the 95% confidence level. These objectives may be adjusted for more or less precision based on a property-specific analysis of data collection cost relative to return.

Sampling Frequency: Full project-level inventories of the carbon project will be conducted at 6-12 year intervals. Inventories of select portions of the Project Area will be updated periodically in response to natural disturbance or significant forest management activities. Traditional pre-and post-harvest monitoring techniques will be employed to inform land managers of potential needs to implement a more comprehensive monitoring of carbon pools (refer to Pearson, Brown, Birdsey 2007).

Harvest Re-Measurement: If a plot is harvested, the plot will be re-measured within 6 months of yarding to assess which trees will be taken out so that the inventory can be updated for the current reporting period. Bluesource will work with the landowner to determine which plots have been harvested during the reporting period.

Data Collection Materials: Data will be collected on handheld electronic data recorders. If data recorders are not available, field data can be collected on paper tally sheets and manually entered into a computer for data analysis. All data sheets will be scanned and sent to Bluesource.

QA/QC Field Procedures: At least 5% of the plots will be checked by a different forester than cruised the plot, preferably by someone senior to the field crew. This will involve full plot measurement to identify any problems with determining in/out trees, species calls, defect measurements, DBH measurements, and height measurements. Any consistent height, species, DBH, or defect errors will be resolved by talking with the foresters.

QA/QC Desk Procedures: The following QA/QC approach is designed to ensure that field data, once input, is appropriately managed and maintained, and that subsequent calculations using that data to determine onsite carbon stocks and associated ARBOC issuance are correctly implemented. A three-stage QA/QC process with a defined review group for the project will be established, engaging both personnel intimately familiar with all project files and documentation, as well as independent reviewers are able to bring “fresh eyes” to key outputs.

Independent Forester Review: The project implementation team (Bluesource) has a team of foresters with intimate knowledge of the files, models and documents. The development of quantitative components, such as Access databases, FVS model runs and Excel workbooks, are led by one of these foresters. Prior to finalization, a second forester who did not lead development of that component is tasked with a QA/QC review including random examinations and data checks to identify and fix any errors.

Technical Review: Once quantitative outputs are finalized, exported from Access/FVS to Excel, and are ready to be transferred into the Offset Project Data Report (OPDR) and other project documents, an independent manager reviewed these outputs. This individual performs data checks by tracing key outputs back from final ARBOC calculations though the chain of Excel documents to the underlying Access/FVS database.

Senior Management Review: Once outputs have been transferred from Excel to the OPDR and other project documents, a senior manager reviews these documents and checks that all quantitative elements have been correctly exported from the underlying workbook. At this stage, the senior manager (or other individual not involved in document preparation) also reviews text, grammar and formatting for presentation and accuracy.

Data Processing and Storage: Manually and electronically filed data are stored and archived. Backup copies of all electronically stored data -are maintained in a separate data center with scheduled archiving to assure data protection. Future revisions to project documents after initial verification and registration will be clearly identified by saving them as separate files and including the date of revision in any modified documents. All data will be stored on Dropbox or similar online cloud storage service as well as on an external hard drive and kept by Bluesource for a minimum of 15 years.

Monitoring Plan

Annual monitoring will be carried out to track changes in carbon stocks. The Project Owner will submit annual Offset Project Data Reports and undertake 6-year site verification for 100 years following ARBOC issuance. Annual monitoring reports will contain inventory updates reflecting growth and any significant disturbances.

The Project Area will be re-inventoried at least every 12 years. During re-inventory, a subset of the current permanent plots, sufficient to maintain desired inventory confidence statistics, will be visited and re-measured. If it is calculated for future inventories that less than the full number of plots are needed to achieve a desired confidence statistics, then randomly selected plots will be excluded from future calculation and retired, ensuring no continually measured plots are older than 12 years. Similarly, if it is found that more plots are needed to achieve a desired confidence statistics, plot may be added into the inventory in a random design. Otherwise, if the re-inventory results in a sampling error of >=5.1%, then the appropriate confidence deduction will be applied in accordance to the requirements of the COP. Inventories of select portions of the Project Area will be updated periodically in response to natural disturbance or significant forest management activities. Any plots that are subject to harvesting activities or significant disturbances will be reinventoried.

If plot monumentation cannot be found during a re-inventory, the plots will be re-monumented using the same procedures as the original monumentation at the same GPS location of the given plot.

Any updates to the inventory methodology will be approved in advance by a third-party verification body and by ARB, and documented in the project change log.

In addition to inventory sampling, management staff will monitor the general health and condition of the forest forest management activities (e.g. road maintenance, timber harvesting, boundary marking, etc.), typically conducted on primary accessroads and notable bridges/culverts annually.

Each year, the forest carbon inventory and documentation will be updated via the following process:

New forest inventory data obtained from scheduled sampling during the previous year will be incorporated.

Inventory data will be updated to account for any significant natural disturbance (e.g. insect infestation, fire, destructive wind storm, etc.). A significant event is any singular event that impacts one or more of the plots, or impacts collectively 53 acres or more of the property (each plot represents ~53 acres, 13,093 acres/246 plots). If there is removal of >=50% of the standing stocks as a result of the disturbance across the affected area, then the disturbance will be considered a “significant event” and require a remeasurement or addition of plots.

In the event that a significant event occurs, but no plots are impacted, a proportional number of plots will be installed so that the inventory reflects the impacts of the event (i.e. 1 plot per 53 acres). Plots will be placed using an approved random selection method in GIS such as the random point generator tool. If plots are impacted by a significant event, they will be remeasured and incorparated into the inventory statistics, and will thus be reflective of the event.

New inventory samples or harvest data, modeling growth, and disturbances using FVS or another approved growth will be incorporated. If new individual tree growth data is available from remeasured plots, this data will be used to calibrate the diameter increment model to the actual tree growth. If no growth data is available, or if the growth estimates seem unreasonable, all calibration parameters used in the baseline modeling will be applied to modeling the new inventory data.

Any necessary modification to spatial data based on boundary adjustments or other changes will be made.

Results will be incorporated in the annual OPDR.

The aboveground Common Practice (CP) value is 72.23 mtCO2e/acre with a live value of 86.3 mtCO2e/acre.

Project Assessment Areas

AssessmentArea	AA2	Supersection	Site Class	Common Practice	Acres	%
Southern Allegheny Plateau Lowland Hardwoods	SAPLH	SAP	All	71.85	-	0%
Southern Allegheny Plateau Mixed Pine-Hardwoods	SAPPH	SAP	All	73.68	-	0%
Southern Allegheny Plateau Northern Conifer	SAPNC	SAP	All	50.24	-	0%
Southern Allegheny Plateau Oak-Hickory	SAPOHL	SAP	High	119.13	-	0%
Southern Allegheny Plateau Oak-Hickory	SAPOHH	SAP	Low	112.48	-	0%
Southern Allegheny Plateau Upland Hardwoods	SAPUHH	SAP	High	96.54	1,224.1	9%
Southern Allegheny Plateau Upland Hardwoods	SAPUHL	SAP	Low	81.10	4,546.6	35%
Central Interior Broadleaf Forest Eastern Low Plateau Cove Forest	CIBCFH	CIBFELP	High	104.26	75.8	1%
	CIBCFL	CIBFELP	Low	79.44	334.8	3%
Central Interior Broadleaf Forest Eastern Low Plateau Lowland Hardwoods	CIBLH	CIBFELP	All	101.18	154.5	1%
Central Interior Broadleaf Forest Eastern Low Plateau Mixed Upland Hardwoods	CIBMUHH	CIBFELP	High	87.68	631.3	5%
	CIBMUHL	CIBFELP	Low	64.41	2,812.8	21%
Central Interior Broadleaf Forest Eastern Low Plateau Northern Hardwoods	CIBNHL	CIBFELP	High	95.29	236.9	2%
	CIBNHL	CIBFELP	Low	83.36	90.6	1%
Central Interior Broadleaf Forest Eastern Low Plateau Oak-Hickory	CIBOHH	CIBFELP	High	121.65	-	0%
	CIBOHL	CIBFELP	Low	101.60	-	0%
Central Interior Broadleaf Forest Eastern Low Plateau Oak-Pine	CIBOP	CIBFELP	All	47.55	2,985.2	23%
Central Interior Broadleaf Forest Eastern Low Plateau Pine	CIBP	CIBFELP	All	47.56	-	0%
Total				**72.23**	**13,092.7**	

The Common Practice value is calculated in the EoA_Spp_Importance_Calcs.xlsx workbook using the following 6 step process:

a. Determine all possible supersection/assessment area combinations. The project area overlaps 2 supersections. These supersections and all possible assessments areas are included in the "Assessment_Areas_Data" tab.

b. Crosswalk all species in the inventory to each of the applicable supersection/assessment areas. This is accomplished in the "AA_Species_Lookup_Area" tab. All of the species in the inventory were cross-referenced with associated species for each of the assessment areas. Not all of the species in the assessment areas encompassed all of the species in the project area. To ensure that all species in the inventory were associated with at least one assessment area, species not specified in the "Associated Species" listed in the Assessment Area data were assigned to "Mixed Upland" in the “Central Interior Broadleaf Forest Eastern Low Plateau” Supersection, and "Upland Hardwoods" in the “Southern Allegheny Plateau” Supersection. These Assessment Areas were chosen for the species not listed because these species most closely match the diverse mix of hardwoods found the in the Mixed Upland hardwood and Upland

Hardwood Assessment areas. The list of species not found in "Associated Species" in the Assessment_Areas_Data tab are listed as "Other Species" at the far right of the "AA_Species_Lookup_Area" tab.

c. Once all species in the project area were assigned to at least one Assessment Area, they were assigned a score based on a combination of Basal Area and TPA. Species Importance Values are a standard way of characterizing the species composition and structure of a forest. This process uses the USFS definition of Species Importance Value from the Tree Atlas program:
    - IV(x) = 50*BA(x) / BA(all species) + 50*NS(x) / NS(all species) [1]
      where x is a particular species on a plot, IV(x) is the Species Importance Value for species x, BA is basal area, and NS is number of stems (summed for overstory and understory trees).

   Using this equation, an Importance Value is calculated for every species for each plot. This is calculated in the Species Importance Value in the "Treelist_AA_Spp_Imp" tab. The sum of this metric is 1 for each plot, so it is effectively a weighted importance of each species within a given plot.

d. Productivity is calculated for each plot as a function of Site Index and species based on soils data. Productivity calculations (grouping plots into high/low) are in the SiteClass_Crosswalk tab. The detailed derivation of the site index/productivity relationship is calculated in a separate file (EOA_SoilAnalysis_Productivity.xlsx).

e. Given the above information a pivot table is created in "FT_AA_Imp_Scores" that groups plots by forest type and productivity. The Species Importance Value is summed and compared for each Assessment Area. The Assessment Area with the highest score is used for that forest type.

f. Toward the right side of the "FT_AA_Imp_Scores", the scores are aggregated and weighted by area (using the Acres tab) to arrive at a weighted Common Practice value in the AA_Species_Lookup_Area tab.

Summary of Applicable Baseline Carbon Pools

Carbon Pool	Total tCO2e	mtCO2e / acre
IFM-1 Standing Live:	1,129,547	86.27
IFM-3 Standing Dead:	51,727	3.95
Baseline Carbon in Harvested Wood Delivered to Mill (tCO2e)	13,104	1.00
Baseline Carbon in Trees Harvested for Wood Products (tCO2e)	25,146	1.92
Baseline Carbon Stored Long-term in Wood Products (tCO2e) - Excl Landfill	2,004	0.15
Long-term storage in wood products in landfills	2,634	0.20
Baseline Carbon Stored Long-term in Wood Products (tCO2e) - Incl Landfill	4,638	0.35

1. **Baseline Carbon Stocks**

Aboveground (mtCO2e/acre)	Belowground (mtCO2e/acre)	Live (mtCO2e/acre)	Dead (mtCO2e/acre)	Standing (mtCO2e/acre)
72.23	14.05	86.27	3.95	90.22

2. **Minimum Baseline Level for above-ground standing live tree carbon stocks (MBL)**

The LMU extends beyond the Project Area, so additional analysis was conducted on the ECS (LMU excluding the Project Area) to determine the formula for WCS. ECS analysis was conducted in the “EdgeofAppalachia_InvCalcs_LMU.xlsx” file. Tree Data is recorded in “TreeData” tab, then processed in “Start_Calcs_CO2” tab, and summarized in “Start_Stats” tab. The AG live CO2 estimate for these plots is 100.3 tonnes CO2e/acre. The ICS estimate is 114.97 tonnes CO2e/acre. As defined in Equation 5.7 of the protocol, if abs(1-ECS/ICS) ≤ 0.2, then WCS = ICS. For this project, abs(1-ECS/ICS) = abs(1-100.3 / 115.6) = 0.13, 0hich is less than 0.2. That means that WCS = ICS in this case. Because the ICS (114.97) is above the CP (72.23), we use the equation MBL = MAX(CP, MIN(ICS, CP+ ICS -WCS)) for calculating the MBL. In this case, the MBL is the CP (Common Practice), or 72.23 (mtCO_2e/acre).

[1] https://www.nrs.fs.fed.us/atlas/tree/treeatlas_intro.html

3. If the Forest Project's initial standing live carbon stocks are below Common Practice, a determination of the "High Stocking Reference" for the Project Area.

Because the project's initial standing live carbon stocks are above common practice, this section is N/A.

4. Estimated Baseline Wood Products

Baseline Carbon Stored Long-term in Wood Products (tCO2e) - Excl Landfill

Units	Lumber	Plywood	OSB	Non-Structural Panels	Miscellaneous Products	Paper
Hardwood	871	-	646	55	136	128
Softwood	77	1	34	42	7	7

Long-term storage in wood products in landfills (tCO2e)

Units	Lumber	Plywood	OSB	Non-Structural Panels	Miscellaneous Products	Paper
Hardwood	1,443	-	259	50	350	392
Softwood	49	1	14	38	19	21

Secondary Effects

The equation below outlines the process by which secondary effects are calculated for IFM projects:

$$If \sum_{n-1}^{y}(AC_{hv,n} - BC_{hv,n}) < 0, then\ SE_y = (AC_{hv,y} - BC_{hv,y}) \times 20\%$$

SE_y = Estimated annual Secondary Effects.

$AC_{hv,n}$ =Actual amount of onsite carbon harvested in reporting period n (prior to delivery to a mill), expressed in CO_2-equivalent tons.

$BC_{hv,n}$ =Estimated average baseline amount of onsite carbon harvested in reporting period n (prior to delivery to a mill), expressed in CO_2-equivalent tons, as determined in Step 1 of Section 5.1.5.

Y = The current year or reporting period.

In the case of the Edge of Appalachia IFM project, this equation is applied as follows:

Secondary Effects Inputs	Tonnes CO2e
Actual Carbon in Trees Harvested for Wood Products	0
Baseline Carbon in Trees Harvested for Wood Products	25,146
Difference Between Actual and Baseline Carbon in Trees Harvested for Wood Products	-25,146
Secondary Effects Emissions	-5,029

Total Net GHG reductions and GHG removal enhancements (QRy) For the Reporting Period

This final calculation for the project reporting period is carried out in the *Edge of Appalachia ARBOC Calculation Worksheet* (provided separately for verification purposes) and summarized below.

Summary	Tonnes CO2e
ARBOCs Issued	684,708
Buffer Pool Contributions	120,426
Annual ARBOCs Issued to Account Holder	564,282

Part X. Attachments

Attachment A: Forest Owner

Please see corresponding folder containing all deeds.

Attachment B: Public Projects

N/A

Attachment C: Qualified Conservation Easement

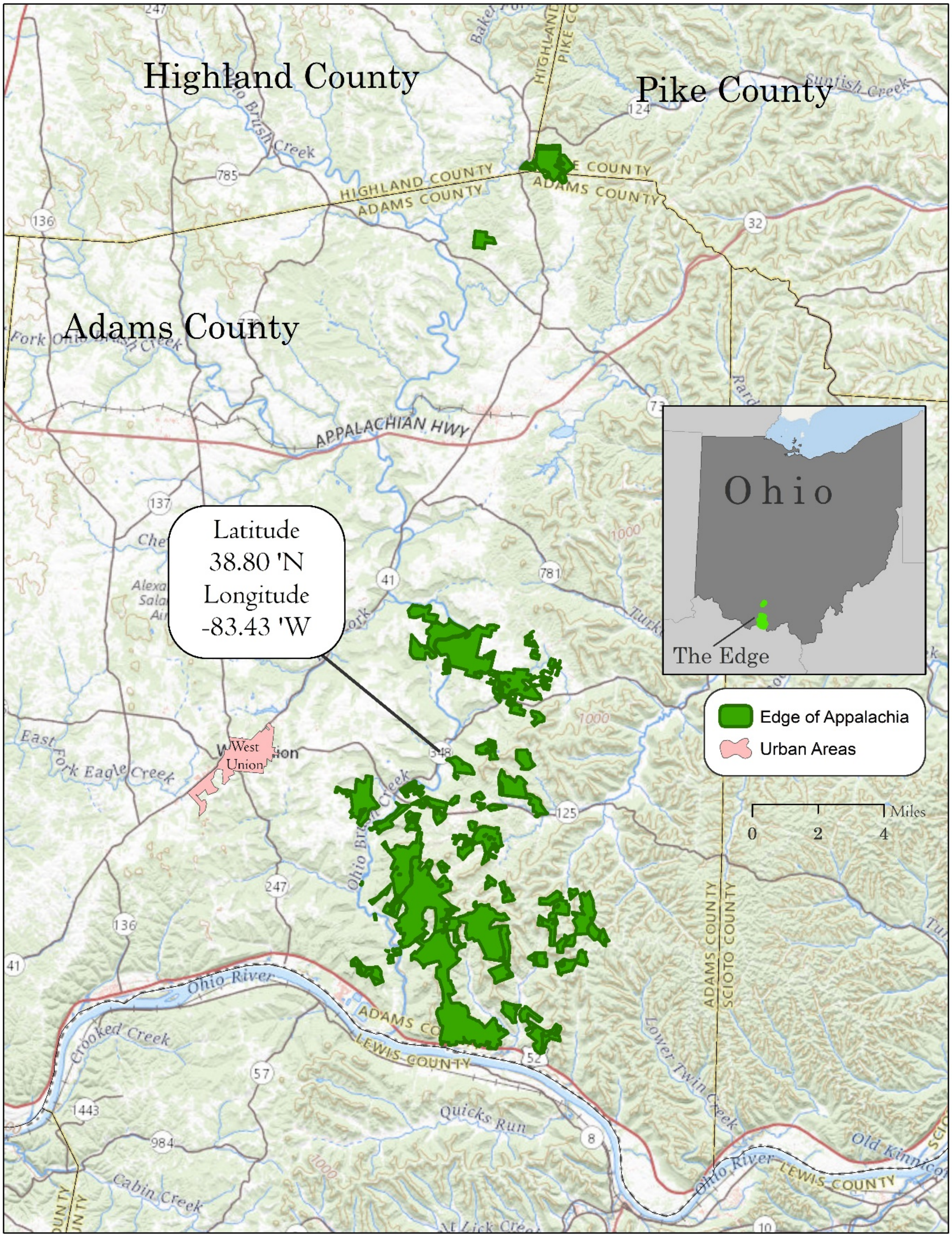
N/A

Attachment D: Tribal Projects

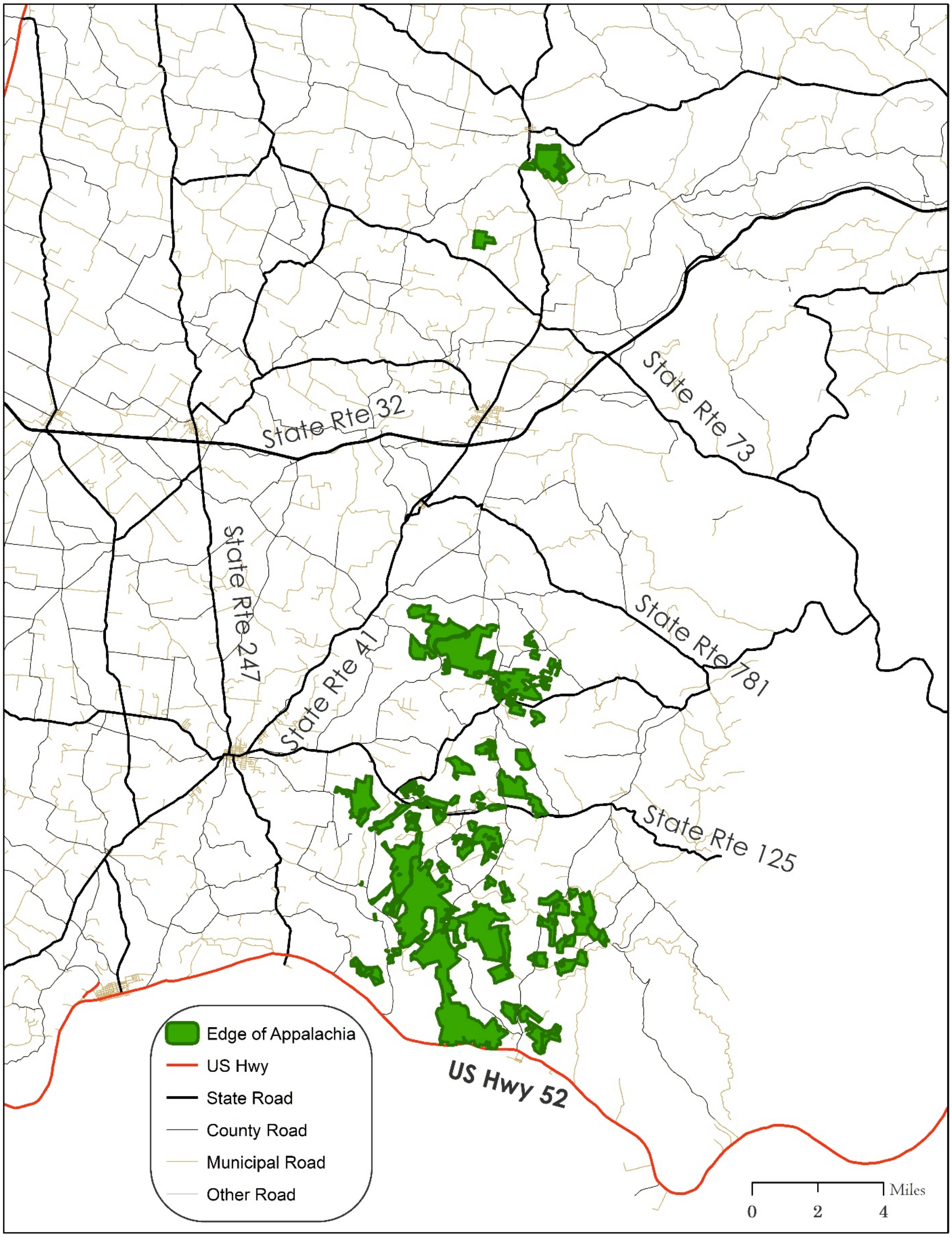
N/A

Attachment E: Project Maps

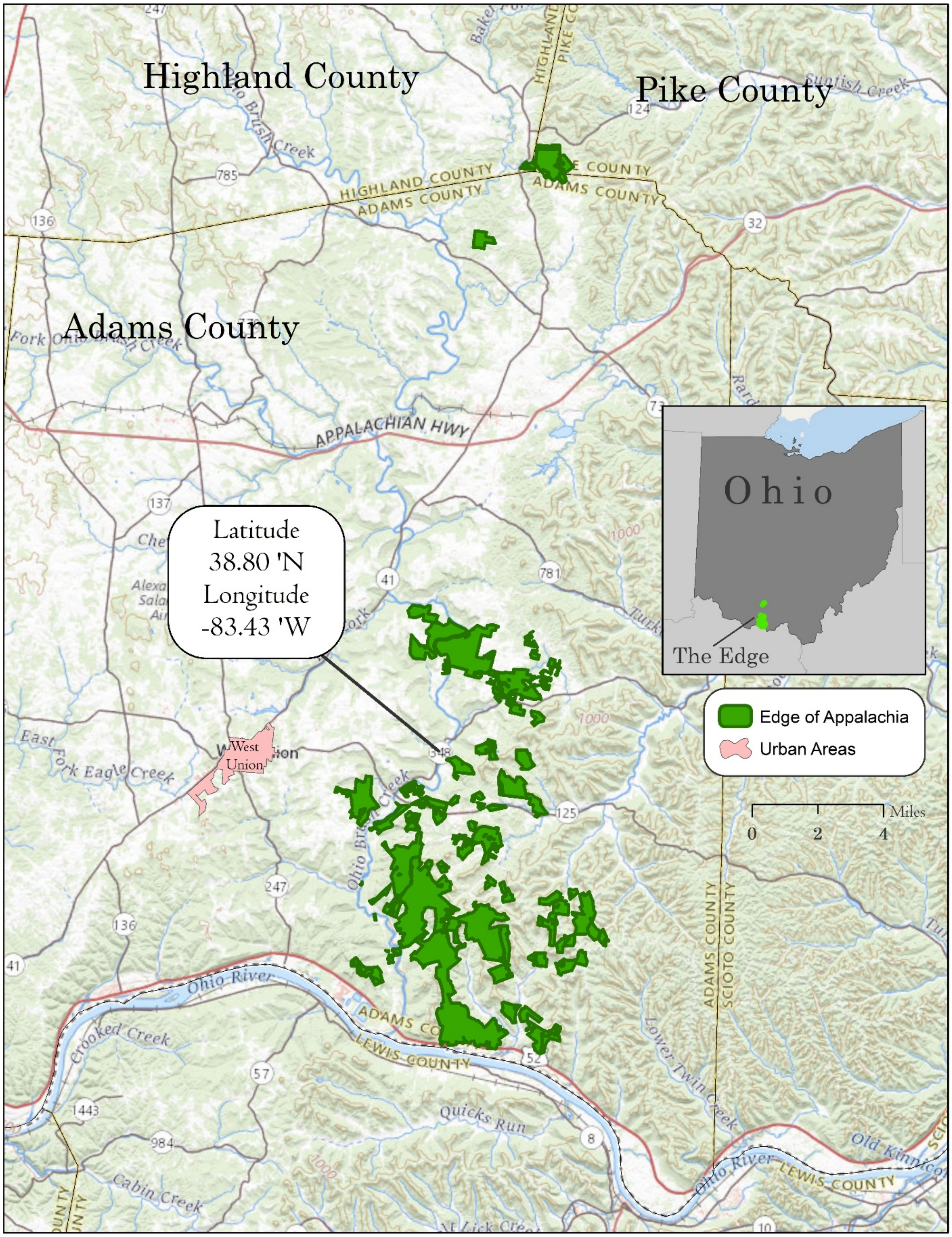
Governing jurisdictions, and latitude/longitude coordinates



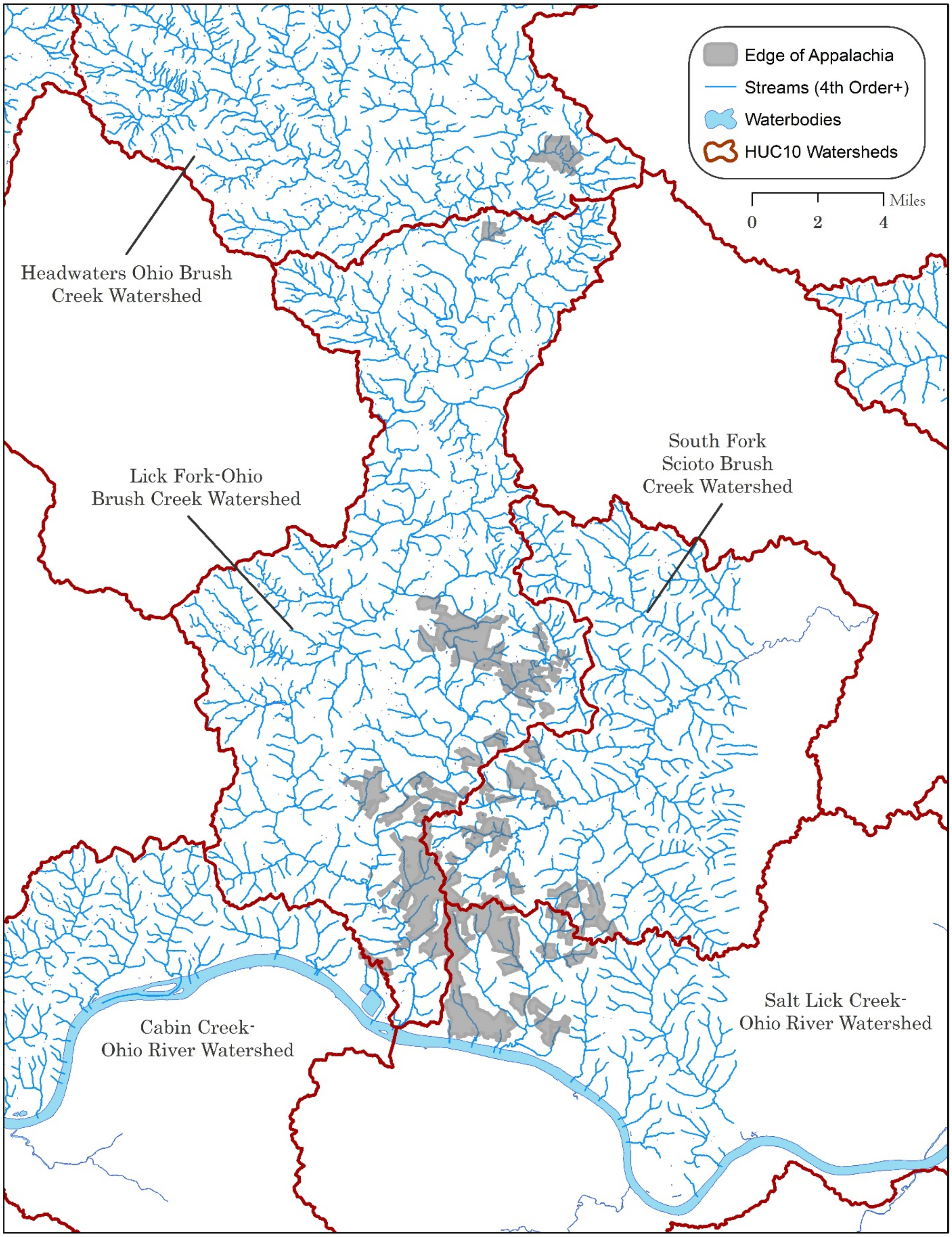
Public and private roads (map)



Towns (map)


Highland County
Pike County
Adams County
HIGHLAND COUNTY
ADAMS COUNTY
APPALACHIAN HWY
Latitude
38.80 'N
Longitude
-83.43 'W
West
Union
Ohio
The Edge
Edge of Appalachia
Urban Areas
Miles
0
2
4
Ohio River
LEWIS COUNTY
ADAMS COUNTY
SCIOTO COUNTY

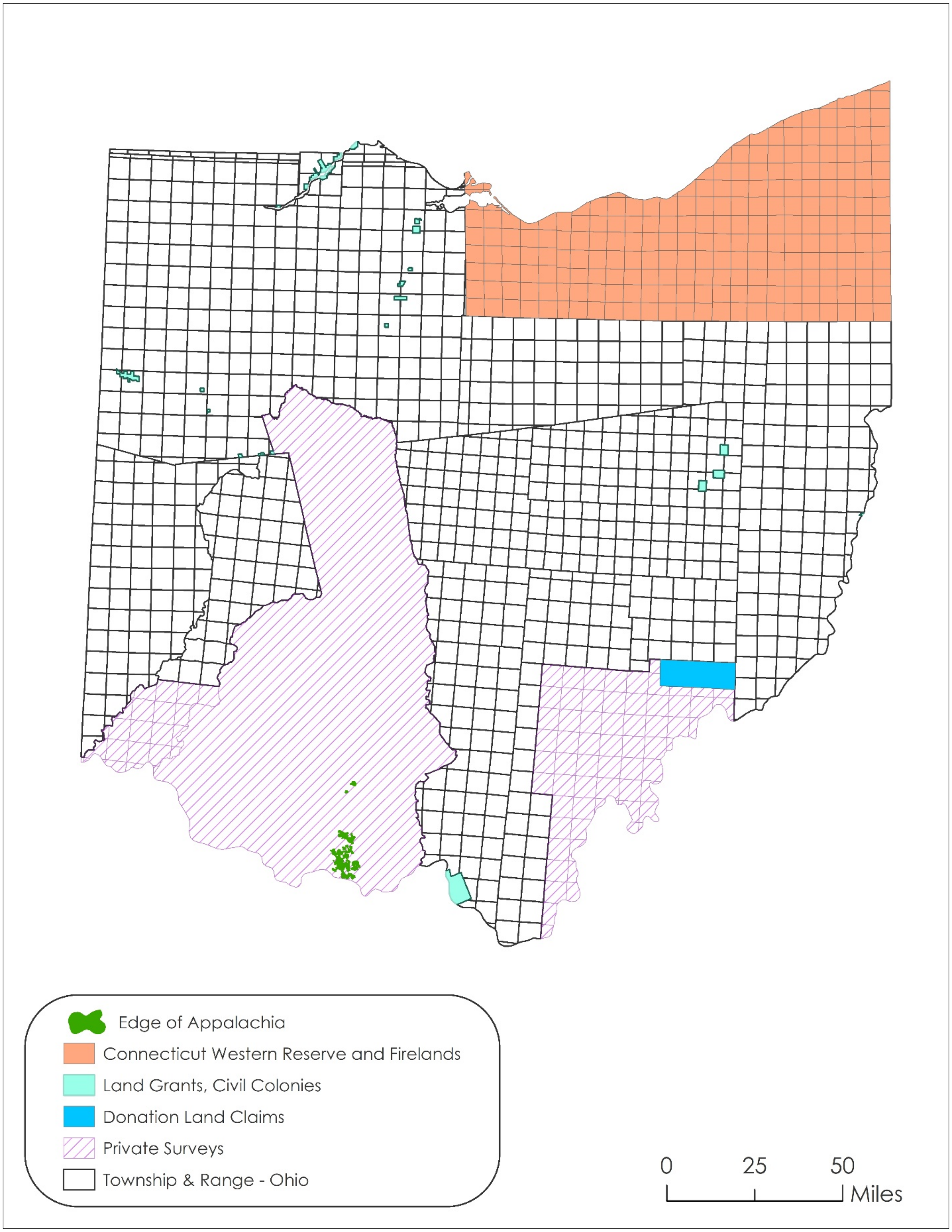
Major watercourses (4th order or greater), water bodies, and watershed description (map)



Bluesource- Edge of Appalachia Improved Forest Management Project
ACR439
CAFR5439

Topography (map)

Townships, ranges, and sections (map)

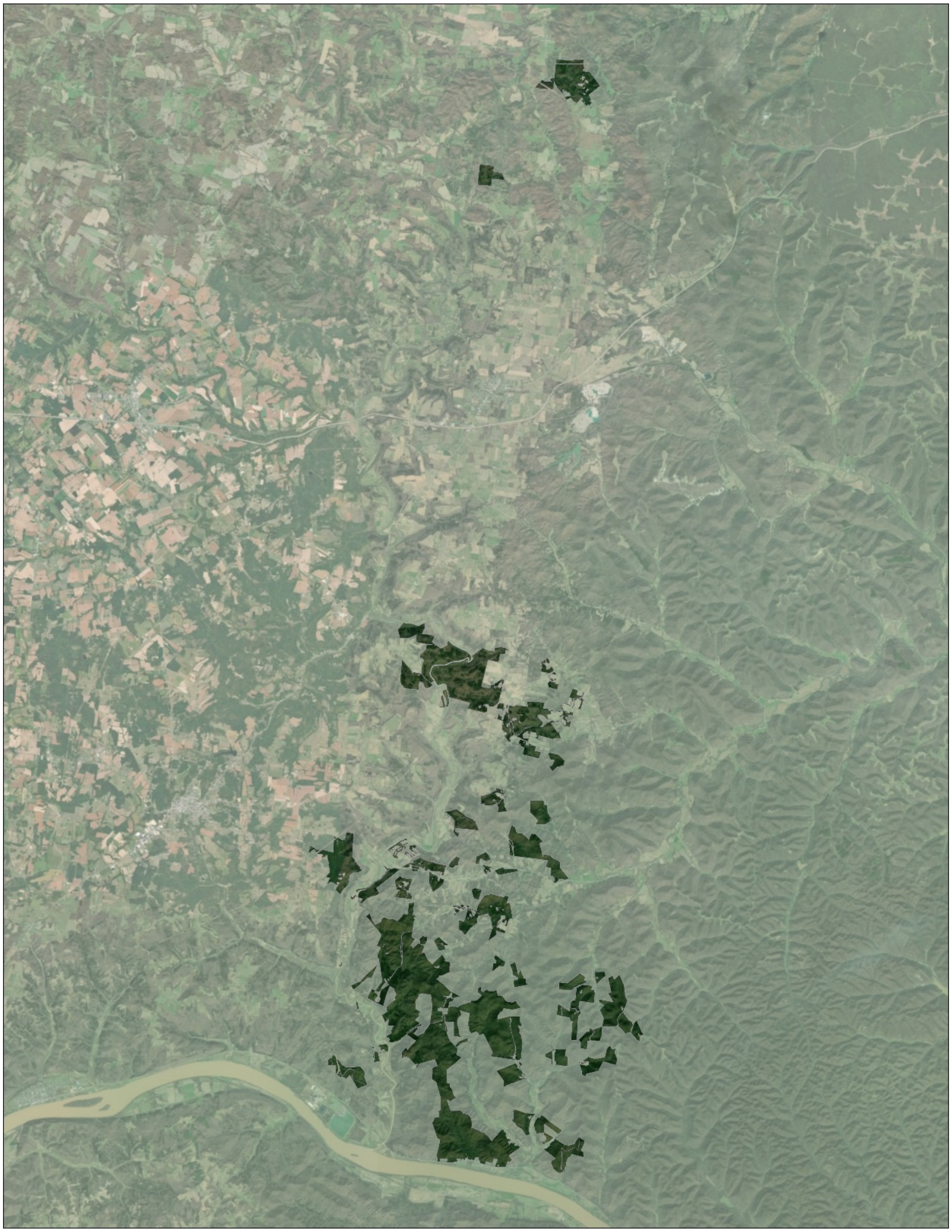


Georeferenced shape file

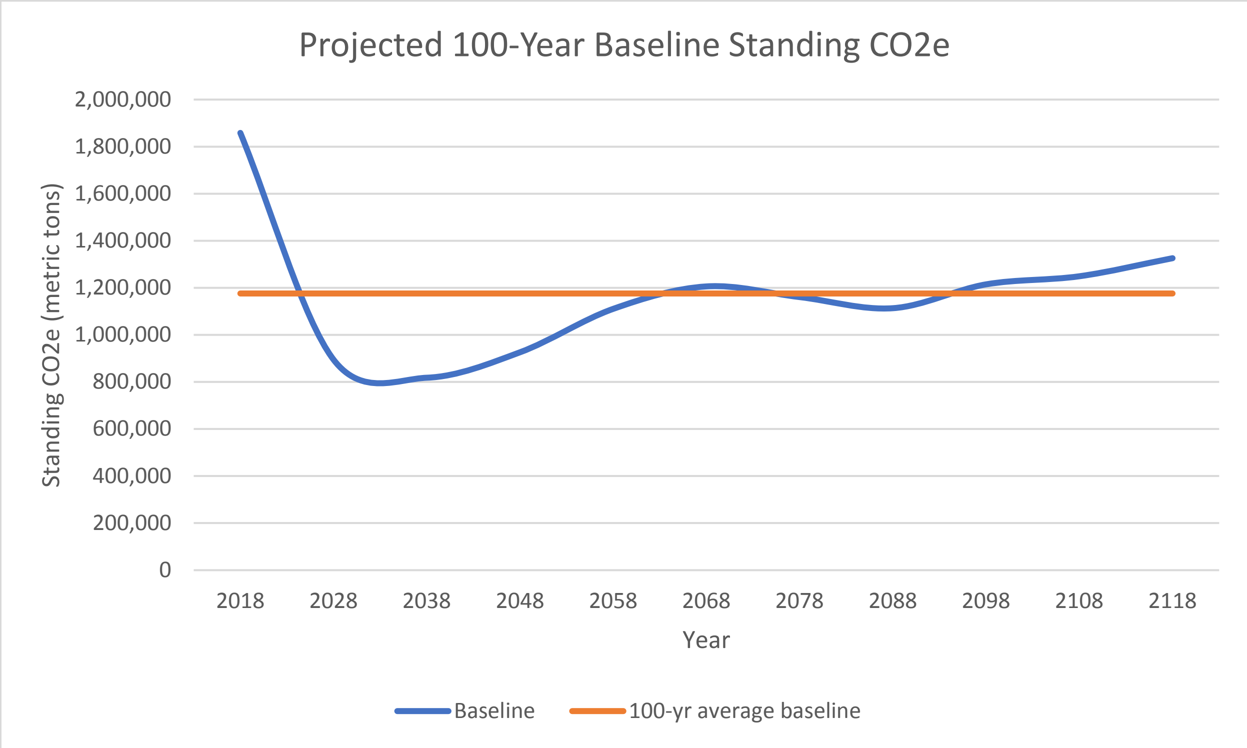
Please see provided georeferenced shapefile.

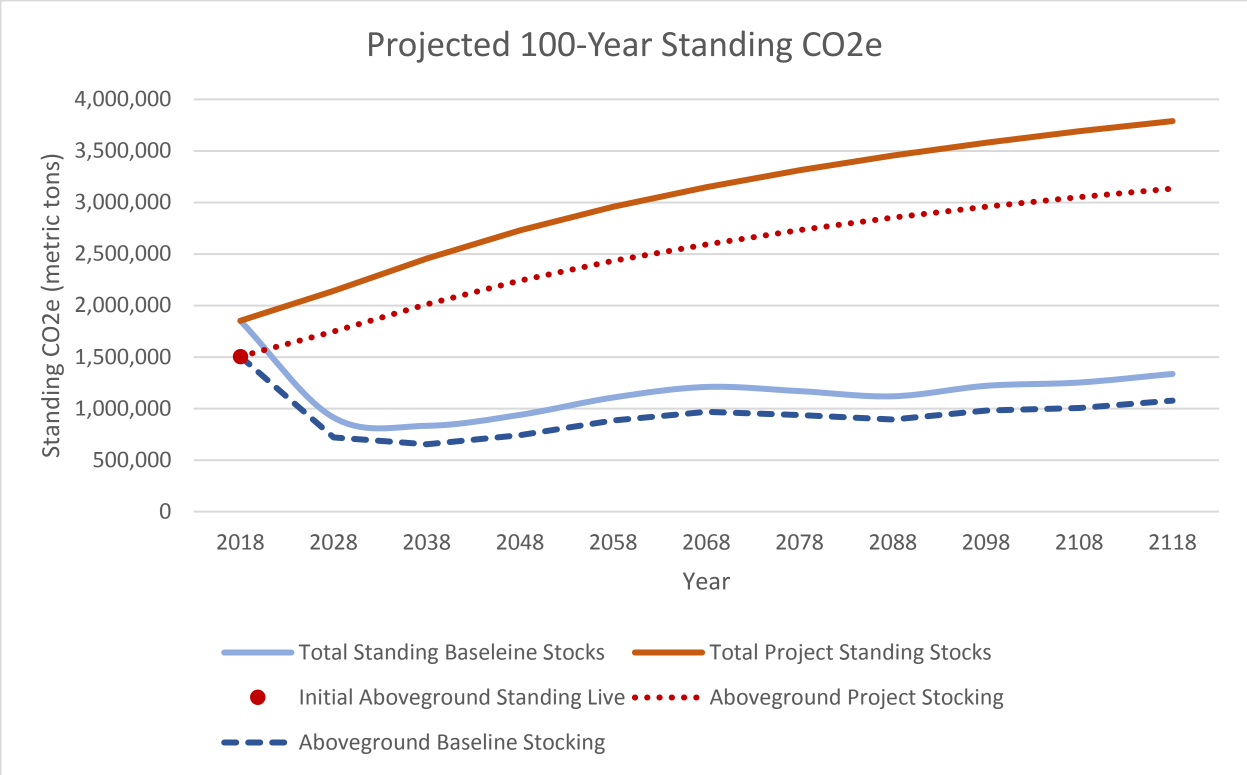
Attachment F: Canopy Cover

As evidence by recent aerial imagery, the Project Area contains greater than 10% canopy cover.



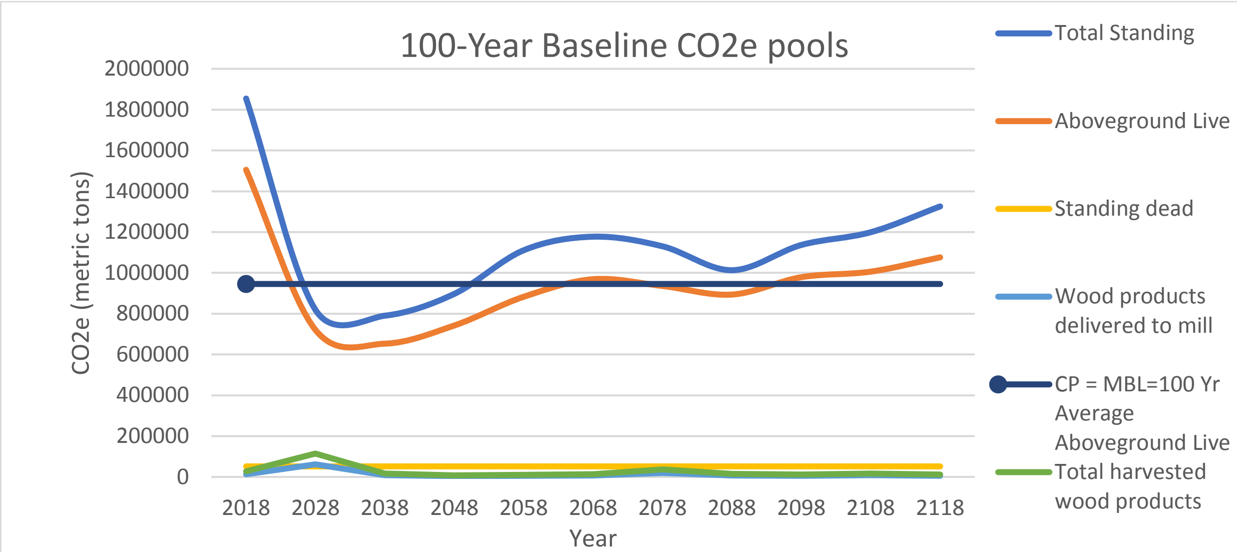
Attachment G: 100-year Baseline





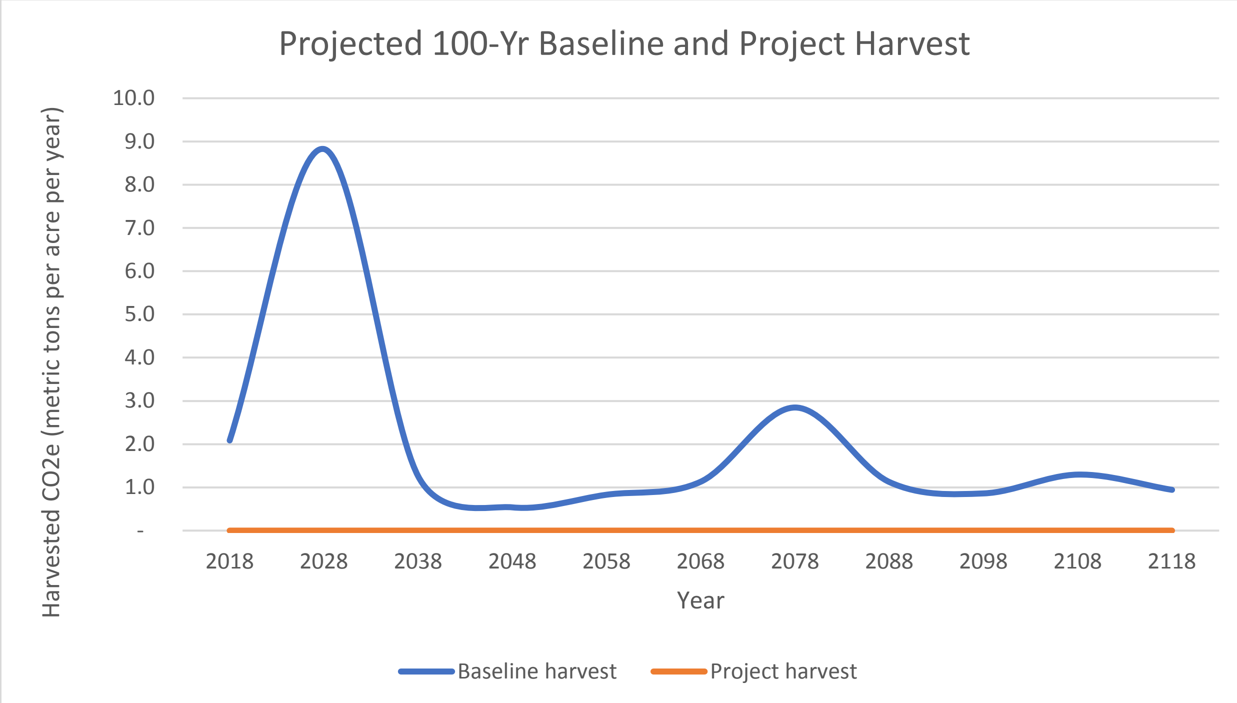
Projects stocks are projected to continuing growing over time as there is no harvesting. A description of the baseline over time may be found in Attachment H.

Attachment H: Baseline Onsite Carbon Stocks



Overall, the management objective in the baseline is focused on early reductions in carbon stocks to maximize net present timber revenue, with secondary harvests during the second rotation. Over a 100-year period, this will cause the project area to reach the average common practice baseline in the region.

Attachment I: 100-Year Baseline and Actual Harvest Volumes



Actual harvest volumes not applicable since there are no ongoing or planned commercial harvests.

Attachment J: N/A

Attachment K: Legal Constraints

The Project baseline must consider Ohio Best Management Practices:

- Streamside Management Zone- variable width buffer, slope dependent
- There are no endangered species on the property, so no ESA restrictions were modeled in the baseline

All BMPs and FPA requirements have been modeled into the baseline.

Table 4. Baseline Constraints Table

Constraint	Reference	Geographic Location	Acreage	Associated Agency	Silvicultural Method
SMZ Acres	Ohio Best Management Practices	Variable width buffers, slope dependent	477.8 acres	Ohio Dept of Forestry	Let Grow

Attachment L: Financial Feasibility

A financial analysis (Forest Protocol section 5.2.1(e)(2)(A))) of the baseline growth and harvest regime reveals that the activities represented in baseline scenario are clearly feasible.

Commercially viable species in the project area include oak, maple, yellow-poplar, walnut, cherry, ash, hickory, and other hardwood and softwood species.

Species	Saw timber stumpage ($/Mbf)*	Pulp price ($/ton)
black walnut	$875	$0
white oak	$525	$0
red oak	$422	$0
sugar maple	$367	$0
black cherry	$340	$0
ash	$306	$0
red maple	$280	$0
hickory	$243	$0
basswood	$225	$0
yellow-poplar	$225	$0
Mixed hardwood	$75	$0
Mixed softwood	$75	$0

*Average of mean Spring 2018 (March/April/May 2018) and Fall 2018(Sept/Oct/Nov) prices for Southeast Ohio

Source: Comparison of Prices Paid for Ohio Sawlogs by Region (Doyle Scale) – Jan 31 2019, "January 2019 Report" website link

Because stumpages were estimated above, variable costs are assumed to be $0. Variable costs would include harvest management costs such as equipment mobilization, logging, hauling, camping, roadwork (layout/ construction/ maintenance), travel to and from the job site, boundary delineation (property/sale/unit), and timber marking/paint. In addition, it was assumed that there are additional administrative costs on the property: $10 per acre.

There were no readily available sources for pulp prices, but discussion with a local forester, and local economic studies show that there is a significant pulp market in the area. Pulp prices were conservatively assumed to be $0/ton.

Ultimately, even with the conservative estimate for pulp prices, the financial analysis estimates the baseline harvest activities to be financially viable over a 100-year term using the pricing estimates cited above.

Baseline Modeling

Site Index

Site Index was calculated from tree cores taken in the field and processed by Rocky Mountain Tree Ring Research. The available outputs following processing tree cores included tree species, DBH, Height, Pith Date (calendar year), DBH Age (years). From these outputs, Site Index was calculated using species-specific site index curves[2]. See "EdgeofAppalachia_SiteIndex_Calcs.xlsx" for more detailed calculations.

Silvicultural Prescriptions

A no harvest, or "let grow," prescription was modeled for the stands. This prescription modeled what would happen in the absence of harvesting. Single-tree selection prescriptions were modeled for all strata. These were implemented using the single-tree selection routine available in FVS with the following specifications: 2-inch diameter class, Q-Factor of 1.4, minimum DBH of 5.0" and maximum DBH of 40.0". These prescriptions were applied to all riparian buffers.

Clearcut prescriptions were implemented in FVS by harvesting all the trees. There are 10 clearcut prescriptions that were designed to implement the harvests, with the first clearcut harvest occurring in one of the first 10 time periods. A possible second clearcut harvest was implemented for each of the clearcut prescriptions based on two triggers: (1) a 2nd clearcut can only be implemented at least 50 years after the 1st clearcut, and (2) the stand basal area must have grown to at least 100 ft^2/acre. This allowed for the harvesting across to property to remain staggered over time. The second cut usually occurred at least approximately 60 years after the first harvest.

The shelterwood prescriptions were implemented using a two-stage shelterwood approach. The stocking trigger for the shelterwood cut was 80 ft^2 of basal area and was done with a thin from below to 50 ft^2 of residual basal area with a minimum tree size of 5". This cut was meant to remove intermediate or suppressed saplings and poles because the smaller understory trees suppress development of vigorous seedlings of the preferred species. For all strata, if a plot had >80 ft^2 of basal area as of the project Start Date, the shelterwood cut was scheduled for the first cycle (first 5 years). The natural regeneration was induced in the stand after the shelterwood cut to simulate natural reproduction under the protection of the older stand. Five years after the shelterwood cut, an overstory removal was simulated using a thin from above while leaving all trees < 5" DBH. After the first overstory removal, the next

[2] Carmean, W. H., Hahn, J. T., & Jacobs, R. D. (1989). Site index curves for forest tree species in the eastern United States. *General Technical Report NC-128. St. Paul, MN: US Dept. of Agriculture, Forest Service, North Central Forest Experiment Station*, *128*.

shelterwood cut was implemented when the stand had grown to at least 80 ft^2 of basal area with a minimum time of 40 years in between cuts.

Record tripling was turned off in FVS to minimize the number of trees records to process and because it was not needed due to there being enough plots to express the variability of the stands. The default mortality models were used including random and density-induced mortality.

The following table shows the silvicultural methods used for the project and baseline harvest and management prescriptions including the harvest frequency for each prescription, as well as the acreage allocated to each harvest prescription is also provided.

Table 5. Silvicultural Prescriptions Acreage Allocations

ID	Prescription Description	Baseline Rx Acres	Project Rx Acres
CC_2019	Clearcuts starting in 1st time period. A 2nd clearcut is possible, but two conditions must be met: (1) the 2nd clearcut must be at least 50 years after the 1st clearcut, and (2) the stand basal area must be at least 100 ft2/acre.	491.7	-
CC_2024	Clearcuts starting in 2nd time period. A 2nd clearcut is possible, but two conditions must be met: (1) the 2nd clearcut must be at least 50 years after the 1st clearcut, and (2) the stand basal area must be at least 100 ft2/acre.	4,413.1	-
CC_2029	Clearcuts starting in 3rd time period. A 2nd clearcut is possible, but two conditions must be met: (1) the 2nd clearcut must be at least 50 years after the 1st clearcut, and (2) the stand basal area must be at least 100 ft2/acre.	975.8	-
CC_2034	Clearcuts starting in 4th time period. A 2nd clearcut is possible, but two conditions must be met: (1) the 2nd clearcut must be at least 50 years after the 1st clearcut, and (2) the stand basal area must be at least 100 ft2/acre.	685.6	-
CC_2039	Clearcuts starting in 5th time period. A 2nd clearcut is possible, but two conditions must be met: (1) the 2nd clearcut must be at least 50 years after the 1st clearcut, and (2) the stand basal area must be at least 100 ft2/acre.	445.2	-
CC_2044	Clearcuts starting in 6th time period. A 2nd clearcut is possible, but two conditions must be met: (1) the 2nd clearcut must be at least 50 years after the 1st clearcut, and (2) the stand basal area must be at least 100 ft2/acre.	214.4	-
CC_2049	Clearcuts starting in 7th time period. A 2nd clearcut is possible, but two conditions must be met: (1) the 2nd clearcut must be at least 50 years after the 1st clearcut, and (2) the stand basal area must be at least 100 ft2/acre	152.8	-
CC_2054	Clearcuts starting in 8th time period. A 2nd clearcut is possible, but two conditions must be met: (1) the 2nd clearcut must be at least 50 years after the 1st clearcut, and (2) the stand basal area must be at least 100 ft2/acre.	162.5	-
CC_2059	Clearcuts starting in 9th time period. A 2nd clearcut is possible, but two conditions must be met: (1) the 2nd clearcut must be at least 50 years after the 1st clearcut, and (2) the stand basal area must be at least 100 ft2/acre.	47.2	-
CC_2064	Clearcuts starting in 10th time period. A 2nd clearcut is possible, but two conditions must be met: (1) the 2nd clearcut must be at least 50 years after the 1st clearcut, and (2) the stand basal area must be at least 100 ft2/acre.	-	-
GROW	Let grow with no harvesting.	2,117.5	13,092.71
SHW	Shelterwood harvest to 50 ft^2 basal area, overstory removal 5 years later, 80 ft^2 basal area stocking trigger.	2,818.4	-
STS50	Single-Tree Selection (starting in the first time period) thinning to 50 ft^2 basal area.	94.4	-
STS75	Single-Tree Selection (starting in the first time period), thinning to 75 ft^2 basal area.	50.2	-

VT_20BA	Thin to 20 ft^2 basal area in first time period. For subsequent time periods, thin from above to 20 ft^2/acre if the basal area exceeds 100 ft^2/acre.	424.1	-

Optimization

To determine a combination of baseline harvest scenarios that would result in a 100-year average CO2 equal to the common practice aboveground CO2/acre, all the possible 100-year baseline scenarios for every plot were copied into a spreadsheet in a format that could be read by optimization (linear programming) software. The optimization software (Frontline Analytic Solver) was used to allocate acreage to different prescriptions for each plot so that the average aboveground CO2 over 100 years equaled the common practice baseline, while meeting all the constraints.