BETHLEHEM AUTHORITY IMPROVED FOREST MANAGEMENT PROJECT MONITORING REPORT

Blue Source LLC

Project Title	Bethlehem Authority IFM
Version	1.0
Report ID	*01*
Date of Issue	March 18, 2013
Project ID	*VCS project database ID, if registered*
Monitoring Period	*29-05-2012 to 31-12-2012*
Prepared By	Blue Source LLC
Contact	3165 E. Millrock Drive, Ste 340, Holladay, UT, 84121

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1 PROJECT DETAILS

1.1 Summary Description of Project

The Bethlehem Authority Improved Forest Management Project Area ("Project Area") is a 17,591-acre split-parcel situated in Monroe County and Carbon County, Pennsylvania. The Project Area has been put under a 60-year term conservation easement with The Nature Conservancy (TNC) with the intention of conserving the property and managing its forest resources sustainably into perpetuity. The Project Area has ecological, scientific, educational and aesthetic value in its present state as a natural area that has not been subject to development or severe exploitation.

The Project Area is comprised of primarily native forest types characteristic of the region and surrounds the headwaters of Tunkhannock Creek and Wild Creek that flow into the Delaware Basin. Interspersed with the hardwood forests are significant stands of mixed conifers and special habitat types including wetlands that provided habitat for a multitude of rare species and natural communities.

The project will extend the rotation age of the timber resource on the property by approximately 70 years compared to Common Practice, thereby reducing carbon emissions and increasing carbon sequestration. The project activity will employ a sustainable level of harvesting, as specified in the FSC compliant management plan required by the conservation easement, and will facilitate improvements in the overall health of the forest.

While executing this carbon stock enhancing harvest strategy, management practices will vary to some degree based on the unique ecological features of the Wild Creek and Tunkhannock tracts.

Within the Wild Creek Tract, management will be tailored for species diversity with primary target species of red oak, white oak, chestnut oak, red maple and white pine. The age structure, which is currently over-weighted in the two main age classes (90-120 and 60-75 years), will be better distributed through regeneration in appropriate areas to create vigorous young stands of early successional habitat while other stands are thinned and allowed to mature. The tract's plantations will be managed to optimal stocking for improved health, better growth and extended rotations. The deer herd will be controlled via increased hunting to allow the slow establishment of advanced oak regeneration, creating conditions where shelterwood management will successfully regenerate the oak forests. As healthy stands are allowed to mature and overstocked stands are thinned to control species and spacing, the property should experience forest stocking of increasing volume and value. Once these management goals are achieved, the Authority intends to continue to manage the forest under a long rotation harvest regime designed to sustain the forest's health and promote the ecosystem services it provides.

The Tunkhannock tract will be managed to promote healthy and expanding populations of rare, threatened, and endangered species, while encouraging increased carbon stocks. Black cherry, red maple, sugar maple, red oak, white oak, white pine and red spruce will be targeted species in the upland areas for value growth and regeneration and the percent stocking of beech will be reduced over time. The future forest will have a more diverse age class and species mix where portions of the current northern hardwood forest of 100-120 yr old stands will be successfully regenerated. Forest growth in terms of timber value and carbon capture will both be accelerated through (1) thinnings to control species and spacing, and (2) successful regeneration to overcome pressure from deer browse and competing vegetation which currently preclude new age classes of seedling establishment. The minor component of conifer plantations will be managed for growth and carbon capture where they remain healthy and considered for conversion to native forest where they fall into decline.

1.2 Sectoral Scope and Project Type

The Project is within sectoral scope 14; Agriculture, Forestry and Other Land Use (AFOLU). The AFOLU project category is Improved Forest Management, Extended Rotation Age (IFM ERA) and the methodology applied is VM0003 v1.1. The Project is an individual project.

1.3 Project Proponent

Project Proponent: Bethlehem Authority ("the Authority")

- Stephen Repasch | srepasch@bethlehem-pa.gov

1.4 Other Entities Involved in the Project

Project Developer Blue Source LLC

- Blue Source is responsible for the coordination, management, and development of the Bethlehem Authority IFM project. Following validation and verification, Blue Source will assume responsibility for all forest modeling and carbon calculations pertinent to the project. Throughout the project crediting period, Blue Source will oversee the reporting and upkeep of all project activities on behalf of the Bethlehem Authority.
- Contact: Jeff Cole | jcole@bluesource.com

Easement Holder/Forest Advisor The Nature Conservancy (TNC), Pennsylvania

- TNC holds and manages the Bethlehem Authority conservation easement, oversaw the drafting of the forest management plan to be utilized in the execution of the Bethlehem Authority IFM project and provided FSC certification. Throughout the crediting period TNC, in conjunction with WMS, will supervise or directly carry out all forest management, inventory, and monitoring activities within the project area.
- Contact: Josh Parrish | josh_parrish@tnc.org

Forest Advisor Woodlands Management Services LLC (WMS)

- WMS designed the forest inventory process utilized for the Bethlehem Authority IFM project and conducted onsite forest measurements. Throughout the crediting period WMS, in conjunction with TNC, will supervise or directly carry out all forest management, inventory, and monitoring activities within the project area. WMS will also establish a network of permanent inventory plots throughout the project area in order to facilitate future project inventory updates.
- Contact: Robin Wildermuth | wms1@hughes.net

Modeling Consultants Special Informatics Group (SIG)

- SIG executed all forest carbon modeling for the project and completed the associated carbon calculations. Following validation and verification SIG will have no further responsibilities in relation to the project.
- Contact: Charles Kerchner | ckerchner@sig-gis.com

Verification Entity Rainforest Alliance

- The Rainforest Alliance is the VCS approved VVB responsible for verifying the Bethlehem Authority IFM project.
- Contact: Lawson Henderson | lhenderson@ra.org

1.5 Project Start Date

The Project Start Date is represented by the conveyance of the term conservation easement on the Project Area. This action occurred on April 14, 2011.
[*The conservation easement is provided separately for validation and verification purposes*]

1.6 Project Crediting Period

The project has a 100-year crediting period. This time horizon coincides with both the completion of a full timber rotation under the IFM ERA forest management plan. The crediting period start date took place on May 29, 2012 in conjunction with the official issuance of Forest Stewardship Council (FSC) certification. The Project crediting period end date is May 29, 2112.

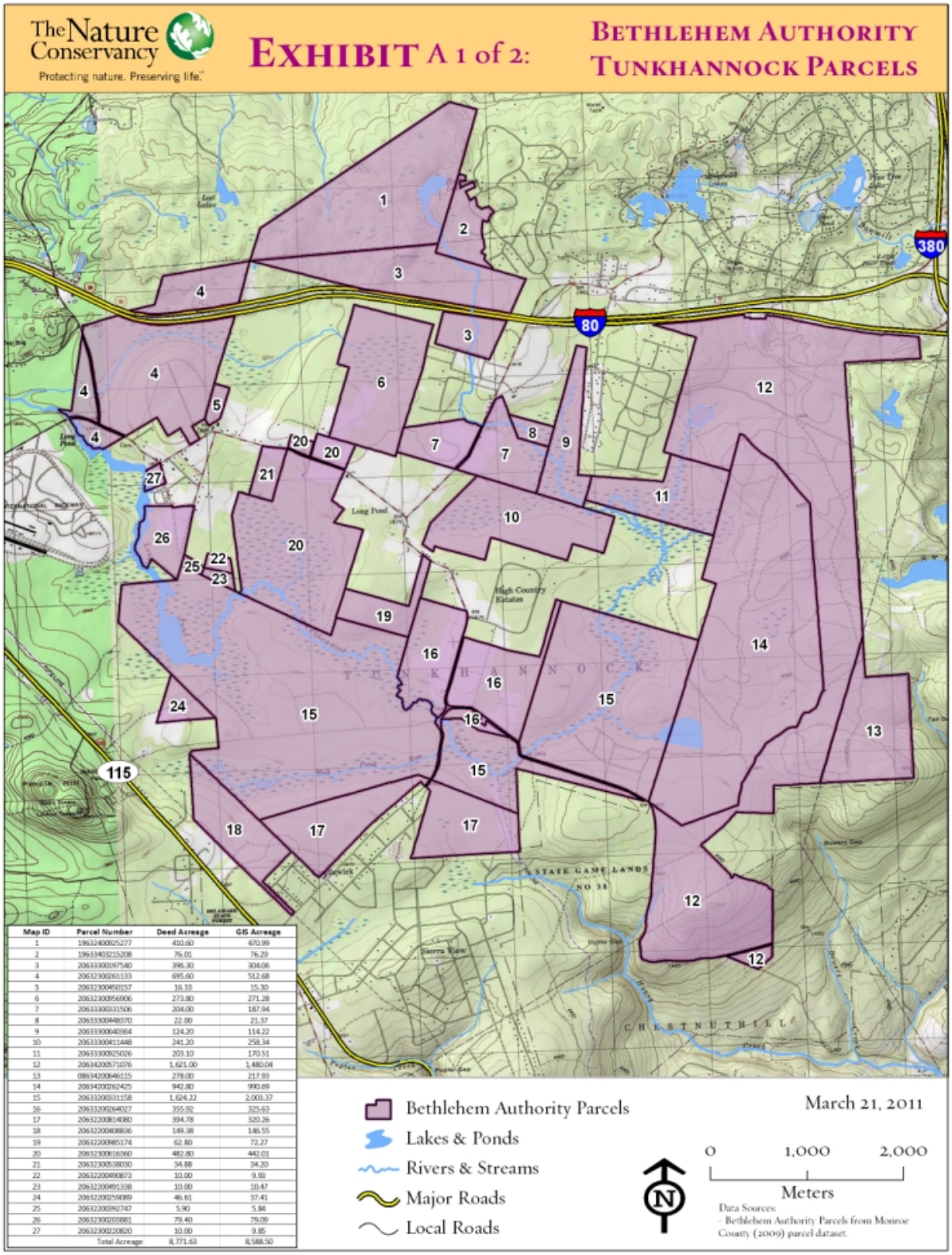
1.7 Project Location

The Project Area is located in Monroe and Carbon County, Pennsylvania and is comprised of two semi-contiguous areas of land parcels. The 'Tunkhannock Parcels' are situated in Monroe County, bordering Interstate 80. These are identified in Exhibit A 1 of 2 with Map ID's 1 through 27. The second is the 'Wild Creek Parcels' which straddle the Monroe and Carbon Country borders (See Exhibit A, 2 of 2), bordering Interstate 476. These land parcels are identified as with Map ID's 1 thru 44. Each individual land parcel also has a unique Parcel identification number (PIN).

The Tunkhannock Parcels in the Project area represent a total acreage of approximately 4,653 acres and are bisected by the Tunkhannock Creek. The Wild Creek Parcels in the Project area represent a total acreage of approximately 12,938 acres and are bisected by the Wild Creek.

Exhibit B shows the proximity of the Tunkhannock and Wild Creek Parcels.

[*KMZ files, with the associated KML component provided separately for validation and verification purposes*]



Map ID	Parcel Number	Deed Acreage	GIS Acreage
1	19612400025277	410.60	470.99
2	19633403215208	76.01	76.29
3	20633300197540	396.30	304.06
4	20632300261133	695.60	512.68
5	20632300450157	16.33	15.30
6	20632300056906	273.80	271.28
7	20633300331506	204.00	187.94
8	20633300448370	22.00	21.37
9	20633300640964	124.20	114.22
10	20633300411448	241.20	258.34
11	20633300925026	203.10	170.51
12	20634200571076	1,621.00	1,480.04
13	08634200646115	278.00	217.93
14	20634200262425	942.80	990.69
15	20633200331158	1,624.22	2,003.37
16	20633200264027	355.92	325.63
17	20632200814080	394.78	320.26
18	20632200408936	149.38	146.55
19	20632200985174	62.80	72.27
20	20632300616060	482.80	442.01
21	20632300538030	34.88	34.20
22	20632200490873	10.00	9.98
23	20632200491338	10.00	10.47
24	20632200259089	46.61	37.41
25	20632200892747	5.90	5.84
26	20632300203881	79.40	79.09
27	20632300220820	10.00	9.85
	Total Acreage	8,771.63	8,588.50

Tunkhannock Stratification Map (4,653 acres)

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EXHIBIT A 2 of 2: BETHLEHEM AUTHORITY WILD CREEK PARCELS

Monroe County 2009 Parcels

Map ID	Parcel Number	Deed Acreage	GIS Acreage
1	13621901064000	0.68	0.70
2	13621901054827	0.55	0.57
3	13621901054735	0.55	0.56
4	13621900140920	22.54	22.08
5	13620900954279	118.47	108.24
6	13620900924845	120.00	141.93
7	13621900003603	19.00	20.11
8	13621800091510	35.28	34.71
9	13620800765765	1,300.00	2,148.58
10	13631000106064	33.00	18.13
Monroe County Total Acreage:		1,650.07	2,495.62

Carbon County 2011 Parcels

Map ID	PIN	Parcel ID	Deed Acreage	GIS Acreage
11	5279479755	12-51-A5	None Listed	648.00
12	5370897058	12-51-A6	None Listed	536.81
13	5360601371	23-51-A1INLIEU	None Listed	1,014.71
14	5259984701	23-51-A3	None Listed	29.33
15	5269356237	24-51-A3,4	None Listed	666.82
16	5269843769	24-51-A1	None Listed	1,061.64
17	5279013304	13-51-A1INLIEU	None Listed	317.74
18	None Listed	--WATER	None Listed	265.24
19	5278302412	14-56-A1	None Listed	1,131.49
20	5277962504	15-56-A31	None Listed	9.19
21	5267753322	26-56-A35	None Listed	918.07
22	5267753322	26-56-A35	None Listed	437.19
23	5267753322	26-56-A35	None Listed	1.41
24	5267898650	25-56-B1	None Listed	309.83
25	5267791856	25-56-B2	None Listed	69.25
26	5268602355	25-51-A4	None Listed	30.47
27	5268418912	25-51-A3INLIEU	482.00	503.51
28	5268449125	25-51-A2	None Listed	425.40
29	5268652869	25-51-A1	None Listed	146.81
30	5268251620	25-51-A5INLIEU	None Listed	52.56
31	None Listed	38-51-A1.01	204.51	204.71
32	None Listed	38-51-A1.02	40.04	39.76
33	5258416613	38-51-A4INLIEU	None Listed	708.66
34	5258025243	52-51-A8	None Listed	149.83
35	5248955806	51-51-A8.01	None Listed	154.88
36	5258097691	37-51-A6INLIEU	298.00	381.50
37	5258750282	37-51-A1	None Listed	376.26
38	5258475479	37-51-A7.04	None Listed	14.21
39	5258578547	37-51-A4	None Listed	287.60
40	5258770445	37-51-A3	None Listed	30.49
41	5258777268	37-51-A2INLIEU	None Listed	25.39
42	5259402080	37-51-A7	None Listed	244.11
43	5259920832	37-51-A9	None Listed	54.25
44	5276772476	15-56-A11	None Listed	56.62
		Carbon County Total Acreage:	1,019.55	11,303.71
		Monroe County Total Acreage:	1,650.07	2,495.62
		Grand Total Acreage:	**2,669.62**	**13,799.32**

Bethlehem Authority Parcels
Lakes & Ponds
Rivers & Streams
Major Roads
Local Roads
Secondary Roads

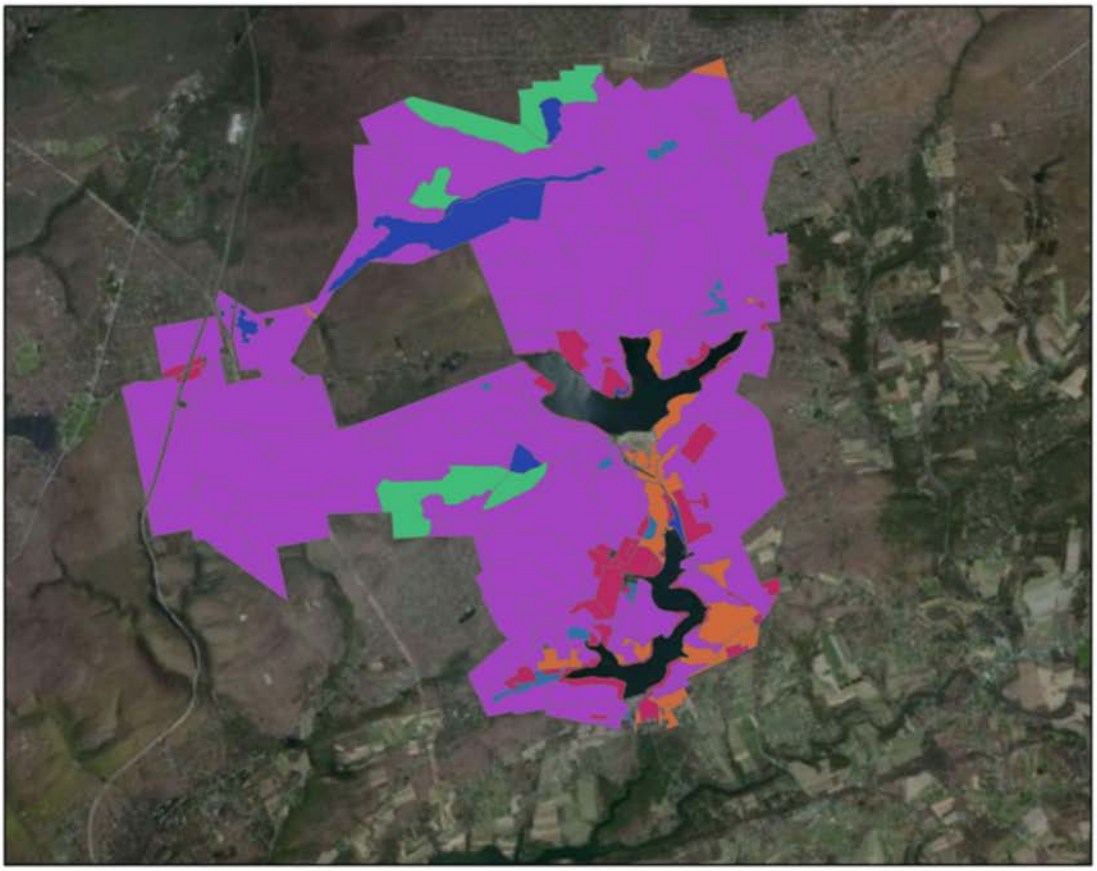
March 29, 2011

0 1,000 2,000
Meters

Data Sources:
- Bethlehem Authority parcels from Carbon County (2011) and Monroe County (2009) parcel datasets.

*NOTE: Carbon County 2011 Parcel dataset is missing a number of deed acreages, and three PIN numbers.

Wild Creek Stratification Map (12,938 acres)



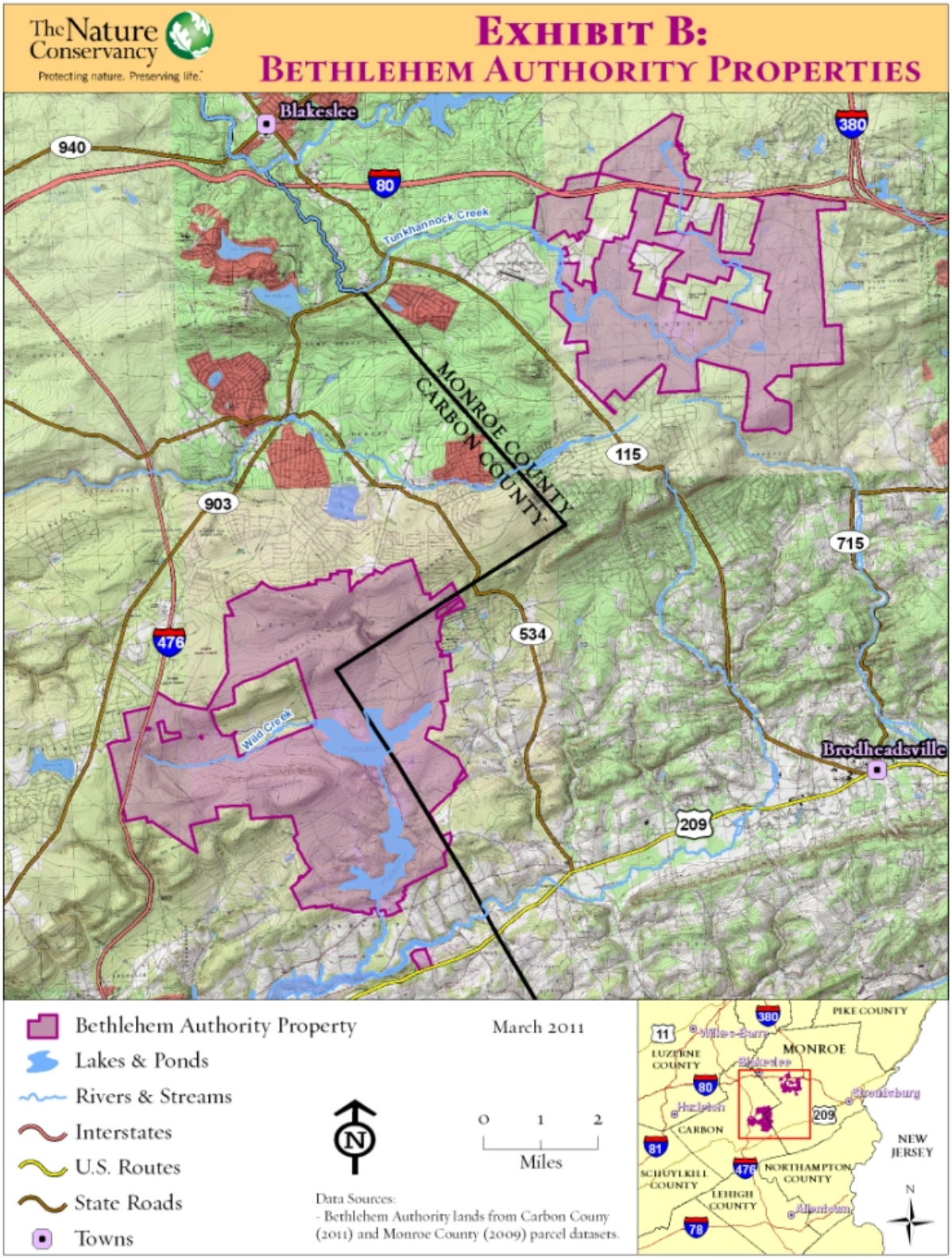

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EXHIBIT B:
BETHLEHEM AUTHORITY PROPERTIES
Blakeslee
940
80
380
Tunkhannock Creek
MONROE COUNTY
CARBON COUNTY
115
903
715
534
476
Wild Creek
Brodheadsville
209
Bethlehem Authority Property
Lakes & Ponds
Rivers & Streams
Interstates
U.S. Routes
State Roads
Towns
March 2011
0 1 2
Miles
N
Data Sources:
- Bethlehem Authority lands from Carbon County (2011) and Monroe County (2009) parcel datasets.
PIKE COUNTY
MONROE
LUZERNE COUNTY
CARBON
SCHUYLKILL COUNTY
NORTHAMPTON COUNTY
LEHIGH COUNTY
NEW JERSEY
Stroudsburg
Allentown
11
81
78

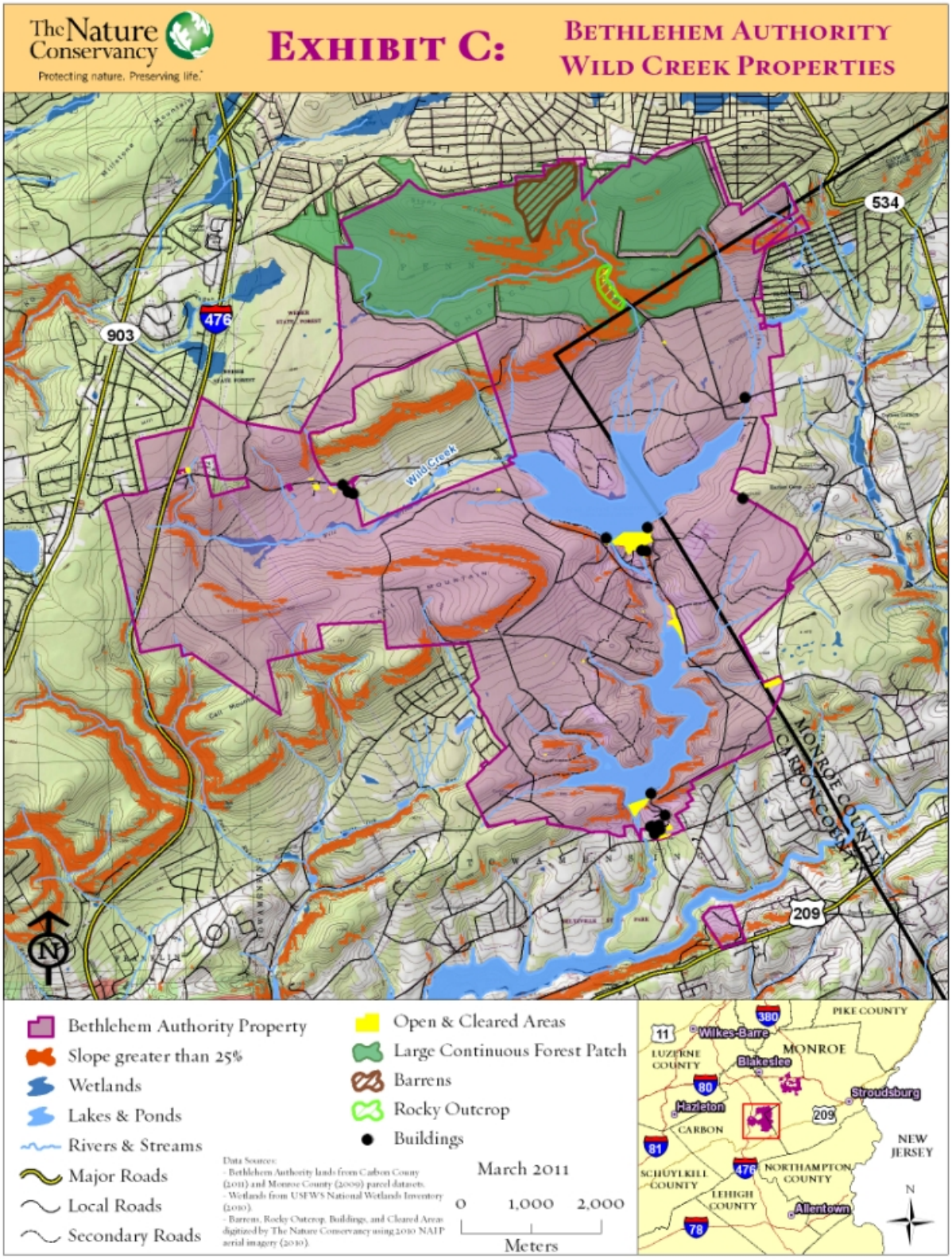
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EXHIBIT C:
BETHLEHEM AUTHORITY
WILD CREEK PROPERTIES
903
476
534
209
Wild Creek
MONROE COUNTY
CARBON COUNTY
Bethlehem Authority Property
Slope greater than 25%
Wetlands
Lakes & Ponds
Rivers & Streams
Major Roads
Local Roads
Secondary Roads
Open & Cleared Areas
Large Continuous Forest Patch
Barrens
Rocky Outcrop
Buildings
Data Sources:
- Bethlehem Authority lands from Carbon County (2011) and Monroe County (2009) parcel datasets.
- Wetlands from USFWS National Wetlands Inventory (2010).
- Barrens, Rocky Outcrop, Buildings, and Cleared Areas digitized by The Nature Conservancy using 2010 NAIP aerial imagery (2010).
March 2011
0 1,000 2,000
Meters
PIKE COUNTY
Wilkes-Barre
LUZERNE COUNTY
MONROE
Blakeslee
Stroudsburg
Hazleton
CARBON
NEW JERSEY
SCHUYLKILL COUNTY
NORTHAMPTON COUNTY
LEHIGH COUNTY
Allentown
N

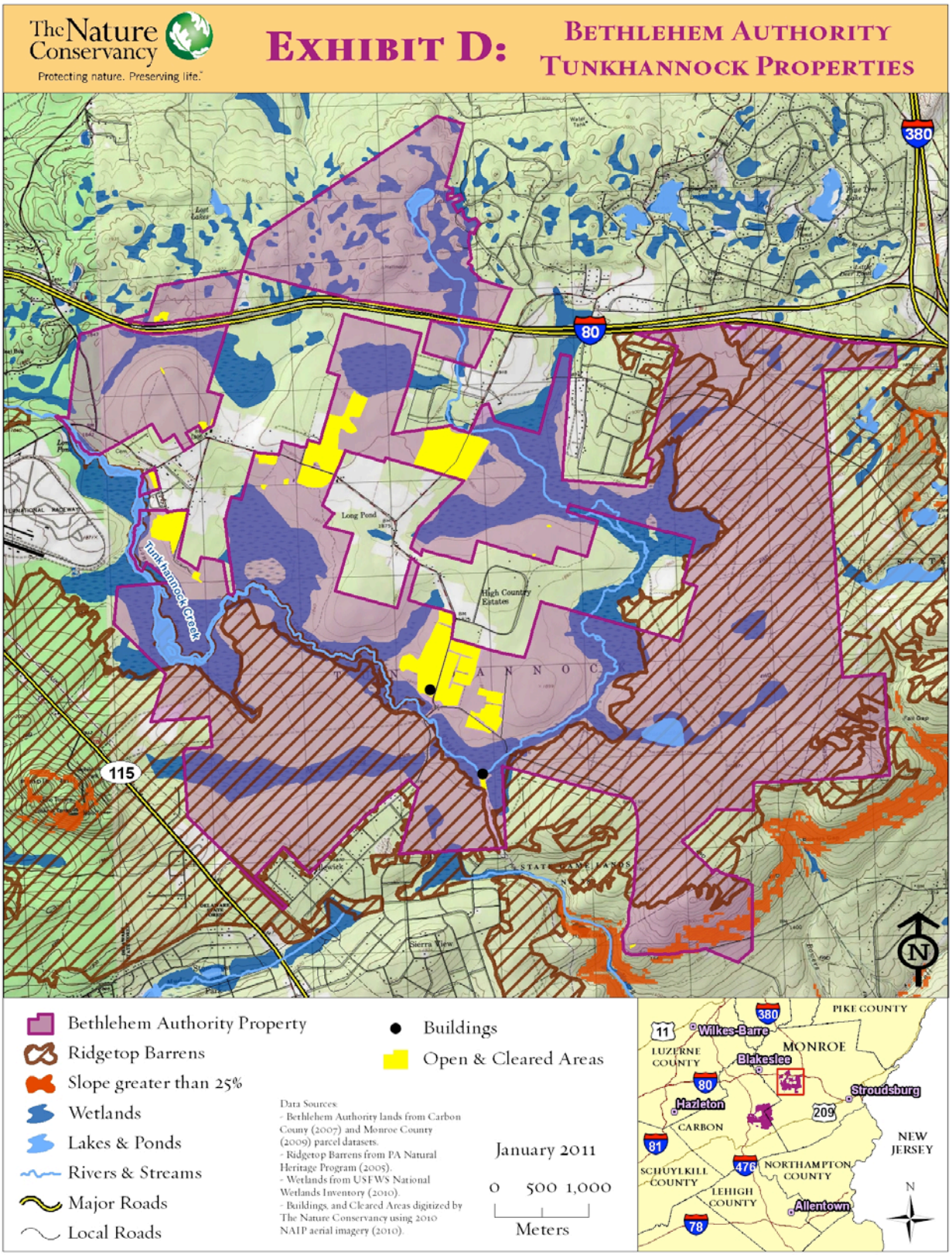
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EXHIBIT D:
BETHLEHEM AUTHORITY TUNKHANNOCK PROPERTIES
Tunkhannock Creek
Long Pond
High Country Estates
80
380
115
Bethlehem Authority Property
Ridgetop Barrens
Slope greater than 25%
Wetlands
Lakes & Ponds
Rivers & Streams
Major Roads
Local Roads
Buildings
Open & Cleared Areas
Data Sources:
- Bethlehem Authority lands from Carbon County (2007) and Monroe County (2009) parcel datasets.
- Ridgetop Barrens from PA Natural Heritage Program (2005).
- Wetlands from USFWS National Wetlands Inventory (2010).
- Buildings, and Cleared Areas digitized by The Nature Conservancy using 2010 NAIP aerial imagery (2010).
January 2011
0 500 1,000
Meters
PIKE COUNTY
Wilkes-Barre
LUZERNE COUNTY
MONROE
Blakeslee
Stroudsburg
Hazleton
CARBON
NEW JERSEY
SCHUYLKILL COUNTY
NORTHAMPTON COUNTY
LEHIGH COUNTY
Allentown
N

1.8 Title and Reference of Methodology

Approved VCS Methodology VM0003, Version 1.1

"Methodology for Improved Forest Management through Extension of Rotation Age"

Sectoral Scope 14

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

The initial project inventory was completed in early 2012 and project forestry staff is currently preparing for the 2013 commencement of the inventory update described in section 3.3 of this document.

Limited forest management activities were carried out during the current monitoring period (5-29-2012 through 12-31-2012). Several stands in strata five of the Tunkhannock tract were thinned from below, reducing stand basal areas by approximately 35%. These cuts occurred over 70 acres and yielded an estimated 1200 green tons of merchantable timber volume.

In August 71 acres of low-stocked, non-merchantable stands in stratum one and two were mowed and burned to encourage more vigorous future growth on the Tunkhannock tract. As VM0003 only requires that secondary effects be accounted for from burned *logging slash*, and defines *logging slash* as "Branches, other dead wood residues, and foliage left on the forest floor after timber removal," secondary effects did not result from these burns because no timber was removed from the stands subject to these treatments.

Future harvesting activities depicted in the modeled *Project Scenario* will be carried out in accordance with the Bethlehem Authority Forest Management Plan. For greater detail on planned management activities, consult the Tunkhannock and Wild Creek *Master Treatment* Excel sheets.

Management staff consistently monitor the general health and condition of the forest throughout the course of normal forest management activities (e.g. road maintenance, timber harvesting, boundary marking, etc.), reducing the risk of reversal by disease, pest invasion, and unauthorized timber removal.

The applicability conditions of VM0003 and the VCS standard prohibit any *activity shifting leakage* as result of the implementation of an IFM project. As the Bethlehem project area is the only forestland owned/managed by BA, this requirement is automatically met. *Market effects leakage* (20%) was calculated based on a comparison of the percentage of merchantable timber per acre on the project site compared to other forests within the region (See PD section 3.3 for a detailed description of all leakage calculations). *Market effects leakage* will be re-assed at each verification but does not require additional specific leakage management activities.

**[*A letter from the Bethlehem Authority's head forester, confirming that all forest management activities occurring on the Bethlehem site between the start of the project crediting period and the conclusion of the first monitoring period have been in full*

***accordance with the management activities described in the FSC Management Plan and are accurately reflected in the Bethlehem Project Description and Monitoring documents, is provided separately for validation and verification purposes*]**

[*Bethlehem Authority Forest Management Plan* and *Tunkhannock/Wild Creek Master Treatment Excel files provided separately for validation and verification purposes*]

2.2 Deviations from the Monitoring Plan

None.

2.3 Grouped Project

N/A. This is an individual project.

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Data Unit / Parameter:	*ABSL,1*
Data unit:	Acre
Description:	Area of baseline stratum, 1
Source of data:	GPS coordinates
Value applied:	11,508.2
Justification of choice of data or description of measurement methods and procedures applied:	Recommended in VM0003
Any comment:	

Data Unit / Parameter:	*ABSL,2*
Data unit:	Acre
Description:	Area of baseline stratum, 2
Source of data:	GPS coordinates
Value applied:	944.3
Justification of choice of data or description of measurement methods and procedures applied:	Recommended in VM0003
Any comment:	

Data Unit / Parameter:	*ABSL,3*

Data unit:	Acre
Description:	Area of baseline stratum, 3
Source of data:	GPS coordinates
Value applied:	1,907.7
Justification of choice of data or description of measurement methods and procedures applied:	Recommended in VM0003
Any comment:	

Data Unit / Parameter:	*ABSL,4*
Data unit:	Acre
Description:	Area of baseline stratum, 24
Source of data:	GPS coordinates
Value applied:	0
Justification of choice of data or description of measurement methods and procedures applied:	Recommended in VM0003
Any comment:	No acres currently represent this stratum (Natural Conifers – Low Stock) but in the future, management will cause acres to be shifted into this forest type.

Data Unit / Parameter:	*ABSL,5*
Data unit:	Acre
Description:	Area of baseline stratum, 5
Source of data:	GPS coordinates
Value applied:	1,566
Justification of choice of data or description of measurement methods and procedures applied:	Recommended in VM0003
Any comment:	

Data Unit / Parameter:	*ABSL,6*
Data unit:	Acre
Description:	Area of baseline stratum, 6

Source of data:	GPS coordinates
Value applied:	80.5
Justification of choice of data or description of measurement methods and procedures applied:	Recommended in VM0003
Any comment:	No acres currently represent this stratum (Hardwoods – Low Stock) but in the future, management will cause acres to be shifted into this forest type.

Data Unit / Parameter:	*ABSL,7*
Data unit:	Acre
Description:	Area of baseline stratum, 7
Source of data:	GPS coordinates
Value applied:	1007.6
Justification of choice of data or description of measurement methods and procedures applied:	Recommended in VM0003
Any comment:	

Data Unit / Parameter:	*ABSL,8*
Data unit:	Acre
Description:	Area of baseline stratum, 8
Source of data:	GPS coordinates
Value applied:	586.4
Justification of choice of data or description of measurement methods and procedures applied:	Recommended in VM0003
Any comment:	

Data Unit / Parameter:	*BEF*
Data unit:	Dimensionless
Description:	Biomass expansion factor for conversion of annual net increment (including bark) in stem biomass to total above-ground tree biomass increment for species *j*

Source of data:	Jenkins et al. (2003) allometric equations within the FVS' Fire and Fuels Extension Carbon Submodel
Value applied:	Provided in carbon inventory model
Justification of choice of data or description of measurement methods and procedures applied:	Respected BEF equations for the region by both academia and industry
Any comment:	

Data Unit / Parameter:	*CF*
Data unit:	t C t^{-1} d.m.
Description:	Carbon fraction of dry matter
Source of data:	VM0003
Value applied:	Default value 0.5 t C t^{-1} d.m.
Justification of choice of data or description of measurement methods and procedures applied:	Recommended in VM0003
Any comment:	

Data Unit / Parameter:	*D*
Data unit:	t d.m. m^{-3}
Description:	Basic wood density
Source of data:	National and species-specific data from US Forest Service Forest Vegetation Simulator (FVS)
Value applied:	Provided in carbon inventory model
Justification of choice of data or description of measurement methods and procedures applied:	Recommended in VM0003
Any comment:	

Data Unit / Parameter:	D_{DW}
Data unit:	t d.m. m^{-3}
Description:	Basic wood density of dead wood in the density class – sound (1), intermediate (2) and rotten (3)
Source of data:	FVS
Value applied:	Provided in carbon inventory model

Justification of choice of data or description of measurement methods and procedures applied:	Recommended in VM0003
Any comment:	

Data Unit / Parameter:	*fj(DBH,H)*
Data unit:	t d.m. tree^{-3}
Description:	Allometric equation for species j linking diameter at breast height (DBH) and possibly height (H) to above-ground biomass of living trees
Source of data:	Jenkins et al. (2003) allometric equations within the FVS' Fire and Fuels Extension Carbon Submodel
Value applied:	Provided in carbon inventory model
Justification of choice of data or description of measurement methods and procedures applied:	Recommended in VM0003
Any comment:	

Data Unit / Parameter:	*WW*
Data unit:	kg kg^{-1}.
Description:	WW = Fraction of extracted biomass effectively emitted to the atmosphere during production
Source of data:	The source of data is the published paper of Winjum et al. 1998
Value applied:	Provided in carbon inventory model
Justification of choice of data or description of measurement methods and procedures applied:	Prescribed in VM0003
Any comment:	

Data Unit / Parameter:	*PMLFT*
Data unit:	%
Description:	Mean merchantable biomass as a proportion of total aboveground tree biomass for each forest type
Source of data:	Official Government data and statistics within FVS

Value applied:	Provided in carbon inventory model
Justification of choice of data or description of measurement methods and procedures applied:	Recommended in VM0003
Any comment:	

Data Unit / Parameter:	*R*
Data unit:	kg kg^{-1}.
Description:	Root-shoot ratio appropriate for biomass increment of forest type / biome
Source of data:	Jenkins et al. (2003) allometric equations within the FVS' Fire and Fuels Extension Carbon Submodel
Value applied:	Provided in carbon inventory model
Justification of choice of data or description of measurement methods and procedures applied:	Recommended in VM0003
Any comment:	

Data Unit / Parameter:	*SLF*
Data unit:	unitless
Description:	Short lived fraction - proportion of wood products that oxidize immediately in the first three years after harvesting
Source of data:	The Forestry Appendix of US Department of Energy's Technical Guidelines for The Voluntary Reporting of Greenhouse Gas Program (Section 1605b) http://www.eia.doe.gov/oiaf/1605/Forestryappendix[1].pdf Also available as a US Forest Service General Technical Report at: http://www.fs.fed.us/ne/durham/4104/papers/ne_gtr343.pdf Winjum et al., 1998
Value applied:	Provided in carbon inventory model
Justification of choice of data or description of measurement methods and procedures applied:	Recommended in VM0003

Any comment:	

Data Unit / Parameter:	*MLF*
Data unit:	unitless
Description:	Medium lived fraction - Proportion of wood products that decay over a 20 year period after harvest
Source of data:	The Forestry Appendix of US Department of Energy's Technical Guidelines for The Voluntary Reporting of Greenhouse Gas Program (Section 1605b) http://www.eia.doe.gov/oiaf/1605/Forestryappendix[1].pdf Also available as a US Forest Service General Technical Report at: http://www.fs.fed.us/ne/durham/4104/papers/ne_gtr343.pdf Winjum et al., 1998
Value applied:	Provided in carbon inventory model
Justification of choice of data or description of measurement methods and procedures applied:	Recommended in VM0003
Any comment:	

Data Unit / Parameter:	*LLF*
Data unit:	unitless
Description:	Long lived fraction - proportion of wood products that remain stored for 100 years after harvest
Source of data:	The Forestry Appendix of US Department of Energy's Technical Guidelines for The Voluntary Reporting of Greenhouse Gas Program (Section 1605b) http://www.eia.doe.gov/oiaf/1605/Forestryappendix[1].pdf Also available as a US Forest Service General Technical Report at: http://www.fs.fed.us/ne/durham/4104/papers/ne_gtr343.pdf

	Winjum et al., 1998
Value applied:	Provided in carbon inventory model
Justification of choice of data or description of measurement methods and procedures applied:	Recommended in VM0003
Any comment:	

3.2 Data and Parameters Monitored

Data Unit / Parameter:	**A_1**
Data unit:	Acres
Description:	Area of stratum 1
Source of data:	GIS shape file derived from GPS coordinates
Description of measurement methods and procedures to be applied:	Strata area figures adjusted based on stocking levels and species distribution projected in modeling and verified through inventory updates
Frequency of monitoring/recording:	Yearly after 2016
Value applied:	1,1508.2
Monitoring equipment:	Hand held GPS unit, GIS software
QA/QC procedures to be applied:	Meta data is kept current and uncorrupted
Calculation method:	
Any comment:	

Data Unit / Parameter:	**A_2**
Data unit:	Acres
Description:	Area of stratum 2
Source of data:	GIS shape file derived from GPS coordinates
Description of measurement methods and procedures to be applied:	Strata area figures adjusted based on stocking levels and species distribution projected in modeling and verified through inventory updates
Frequency of monitoring/recording:	Yearly after 2016
Value applied:	944.3
Monitoring equipment:	Hand held GPS unit, GIS software
QA/QC procedures to be applied:	Meta data is kept current and uncorrupted
Calculation method:	
Any comment:	

Data Unit / Parameter:	A_3
Data unit:	Acres
Description:	Area of stratum 3
Source of data:	GIS shape file derived from GPS coordinates
Description of measurement methods and procedures to be applied:	Strata area figures adjusted based on stocking levels and species distribution projected in modeling and verified through inventory updates
Frequency of monitoring/recording:	Yearly after 2016
Value applied:	1,907.7
Monitoring equipment:	Hand held GPS unit, GIS software
QA/QC procedures to be applied:	Meta data is kept current and uncorrupted
Calculation method:	
Any comment:	

Data Unit / Parameter:	A_4
Data unit:	Acres
Description:	Area of stratum 4
Source of data:	GIS shape file derived from GPS coordinates
Description of measurement methods and procedures to be applied:	Strata area figures adjusted based on stocking levels and species distribution projected in modeling and verified through inventory updates
Frequency of monitoring/recording:	Yearly after 2016
Value applied:	0
Monitoring equipment:	Hand held GPS unit, GIS software
QA/QC procedures to be applied:	Meta data is kept current and uncorrupted
Calculation method:	
Any comment:	

Data Unit / Parameter:	A_5
Data unit:	Acres
Description:	Area of stratum 5
Source of data:	GIS shape file derived from GPS coordinates
Description of measurement methods and procedures to be applied:	Strata area figures adjusted based on stocking levels and species distribution projected in modeling and verified through inventory updates
Frequency of monitoring/recording:	Yearly after 2016

Value applied:	1,566
Monitoring equipment:	Hand held GPS unit, GIS software
QA/QC procedures to be applied:	Meta data is kept current and uncorrupted
Calculation method:	
Any comment:	

Data Unit / Parameter:	$\mathbf{A_6}$
Data unit:	Acres
Description:	Area of stratum 6
Source of data:	GIS shape file derived from GPS coordinates
Description of measurement methods and procedures to be applied:	Strata area figures adjusted based on stocking levels and species distribution projected in modeling and verified through inventory updates
Frequency of monitoring/recording:	Yearly after 2016
Value applied:	80.5
Monitoring equipment:	Hand held GPS unit, GIS software
QA/QC procedures to be applied:	Meta data is kept current and uncorrupted
Calculation method:	
Any comment:	

Data Unit / Parameter:	$\mathbf{A_7}$
Data unit:	Acres
Description:	Area of stratum 7
Source of data:	GIS shape file derived from GPS coordinates
Description of measurement methods and procedures to be applied:	Strata area figures adjusted based on stocking levels and species distribution projected in modeling and verified through inventory updates
Frequency of monitoring/recording:	Yearly after 2016
Value applied:	1007.6
Monitoring equipment:	Hand held GPS unit, GIS software
QA/QC procedures to be applied:	Meta data is kept current and uncorrupted
Calculation method:	
Any comment:	

Data Unit / Parameter:	$\mathbf{A_8}$

Data unit:	Acres
Description:	Area of stratum 8
Source of data:	GIS shape file derived from GPS coordinates
Description of measurement methods and procedures to be applied:	Strata area figures adjusted based on stocking levels and species distribution projected in modeling and verified through inventory updates
Frequency of monitoring/recording:	Yearly after 2016
Value applied:	586.4
Monitoring equipment:	Hand held GPS unit, GIS software
QA/QC procedures to be applied:	Meta data is kept current and uncorrupted
Calculation method:	
Any comment:	

Data Unit / Parameter:	**Ap**
Data unit:	Acres
Description:	Area of sample plot
Source of data:	
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	Variable radius plot design using BAF 10 prism

Data Unit / Parameter:	DBH
Data unit:	in
Description:	Diameter at breast height of tree
Source of data:	Field measurement
Description of measurement methods and procedures to be applied:	Tree diameter measured 4.5ft. above the ground
Frequency of monitoring/recording:	Updated during annual inventory process
Value applied:	
Monitoring equipment:	Measured with Logger Tape or calipers
QA/QC procedures to be applied:	Equipment will be maintained in excellent

	condition
Calculation method:	
Any comment:	

Data Unit / Parameter:	*Index*
Data unit:	Dimensionless
Description:	Site Index
Source of data:	Field measurement
Description of measurement methods and procedures to be applied:	Tree cores taken 4.5ft. above the ground (breast height)
Frequency of monitoring/recording:	Updated during annual inventory process
Value applied:	
Monitoring equipment:	Increment borer
QA/QC procedures to be applied:	Equipment will be maintained in excellent condition. If early rings are narrow in comparison to latter rings (signifying suppression) another core is taken from an alternate site tree
Calculation method:	
Any comment:	

Data Unit / Parameter:	**H**
Data unit:	ft
Description:	Height of tree
Source of data:	Field measurement
Description of measurement methods and procedures to be applied:	Executed in accordance with standard forest mensuration practices
Frequency of monitoring/recording:	Updated during annual inventory process
Value applied:	
Monitoring equipment:	Suunto Clinometer with percent and topographic scales
QA/QC procedures to be applied:	Equipment will be maintained in excellent condition and all height entries will be double checked for reasonableness prior to submission for verification
Calculation method:	
Any comment:	

Data Unit / Parameter:	**PMP_i**
Data unit:	%
Description:	Merchantable biomass as a proportion of total aboveground tree biomass for stratum i within the project boundaries
Source of data:	
Description of measurement methods and procedures to be applied:	Executed in accordance with standard forest mensuration practices
Frequency of monitoring/recording:	Yearly
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	All calculations double checked for accuracy prior to submission for verification
Calculation method:	Divide the FVS merchantable biomass output for a given stratum by the total above ground live tree biomass in said stratum
Any comment:	

Data Unit / Parameter:	**T**
Data unit:	yr
Description:	Number of years between monitoring time t and t1 (T = t2 – t1)
Source of data:	Monitoring reports
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Yearly
Value applied:	
Monitoring equipment:	Calendar
QA/QC procedures to be applied:	All calculations double checked for accuracy prior to submission for verification
Calculation method:	Subtraction
Any comment:	

3.3 Description of the Monitoring Plan

The following material outlines the monitoring plan to be followed during the first 10 years following project validation. It should be noted that modifications made to the measurement and monitoring techniques reviewed during the initial project field verification (e.g. permanent plot monumentation and the recording of tree heights to the nearest foot) have been implemented to improve ease of plot location and increase carbon measurement precision.

Monitoring Method

In the year of validation/verification (2013), a representative sample of 240 variable radius permanent inventory plots will be established across the project area. 43 of these plots will be integrated from a network of pre-existing continuous forest inventory (CFI) plots on the property dating back to 1991. GIS software will be utilized to randomly distribute plot locations across the various project stratum, in proportion to stratum acreage, while incorporating the 43 existing CFI plots. All 240 permanent plots will be re-inventoried at least once over the following decade to calibrate forest growth models and improve carbon sequestration projections.

Permanent inventory plot centers will be logged using a professional grade GPS unit and monumented by a rebar pole buried in the ground and topped with a florescent plastic cap. Live trees qualifying as "in" using a BAF 10 prism will be recorded for species, total height (in feet), merchantable height to a 4" top, sawtimber height to a 10" top, % missing/rotten[1], and DBH (in 1/10th inches). Site index measurements will be recorded from a dominant tree on every fourth plot sampled. These site index figures will be used to improve growth and yield model results. Standing dead trees qualifying as "in" using a BAF 10 prism will be recorded for height as tree originally stood (based on height of neighboring trees, in feet), height in current condition (in feet), DBH (in inches), % missing/rotten, and decay class[2] (1, 2, or 3). All height measurements will be based on clinometer or laser range finder readings. All DBH measurements will be taken using a logger's tape. All inventoried trees of 5" DBH or greater will be marked with a permanent paint dot at breast height and numbered according to the order within the plot in which they were measured. At each plot a metal tag labeled with the inventory plot number and distance to plot center will be driven at ground level into the inward facing base of a dominant/codominant tree to allow for location of plot center if permanent paint markings fade. This plot design will give 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. It should be noted that harvest activities will not be affected by permanent plot locations. This will ensure that permanent plots accurately reflect the silvicultural treatments on the stands in which they reside.

In addition to inventory sampling, management staff will consistently monitor the general health and condition of the forest throughout the course of normal forest management activities (e.g. road maintenance, timber harvesting, boundary marking, etc.), reducing the risk of reversal by disease, pest invasion, and unauthorized timber removal. Any scheduled forest treatments will be documented through pre and post treatment monitoring and all forest removals will be tracked by product class. During pre treatment monitoring, forest staff verify stand stocking and condition

[1]If there are portions of the tree that are missing/rotten, percent defect should be estimated with by visually dividing the tree into thirds, estimating the percentage that is missing or rotten in each third, and then using these estimates to determine the total defect by assuming that 70% of biomass is in the bottom third, 25% is in the middle third, and 5% is in the top third.

[2]**Decay Class 1**: Leaves still attached and having intact bark, fine twigs, and branches. **Decay Class 2:** Logs are starting to decompose, leaves largely are absent, and many of the fine twigs have fallen off the larger branches. Bark is typically loose, but only starting to fall off the log. **Decay Class 3:** Only a few large branches remaining, often in the form of stubs, the bark is falling off in large patches, and evidence of sloughing of sapwood is also evident. The outer wood is easily crushed by hand, although the inner portions can appear completely sound.

before marking stands to designate trees for removal, perimeter of sale, and protected areas. During the harvest forest staff periodically inspect the site to review forest treatment activities and ensure compliance with management standards. Inspection reports are generated documenting inspection findings. Post harvest, a final inspection is carried out to assess conditions of the residual stand, quality of cleanup, and the retirement/stabilization of the landing and skid trails. Following natural disturbance events, affected project stands will be assessed for damage by Bethlehem forestry staff. If damage is significant, the effected areas will be re-inventoried and project scenario models will be adjusted to reflect onsite carbon stocks. Any changes in strata boundaries necessitated by harvesting or natural disturbances (i.e. stands moving from high stocking to low stocking through mortality or harvest) will be mapped and documented.

In years in which forest plots are not re-inventoried carbon stocks will be monitored through forest growth and yield modeling using the US Forest Service's FVS software.

Leakage will be consistently monitored throughout the project crediting period. As the Bethlehem Project Area is the only working forestland owned/managed by BA, the project is automatically in compliance with VM0003's prohibition of *activity shifting leakage*. The project's *Market effects leakage* will be re-assed, prior to each project verification, based on a comparison of the percentage of merchantable timber per acre on the project site compared to other forests within the region (See section 3.3 for a detailed description of all leakage calculations).

In accordance with the VCS AFOLU Requirement document (v3.3), the project baseline will be updated every 10 years. All decadal inventories following the 2013 inventory update, will be carried out in concurrence with the baseline update and the project scenario model and long term average will be calibrated/updated to reflect the most current state of the Bethlehem forest.

Organizational Structure, Responsibilities and Competencies

Blue Source LLC (Blue Source) will oversee the execution and reporting of all project reporting, modeling, and monitoring activities on behalf of the landowners, the Bethlehem Authority. The Nature Conservancy-Pennsylvania (TNC) and Woodlands Management Services LLC (WMS) will be responsible for "on the ground" forest management activities on the project area, and will conduct inventory measurements and data collection. After forest inventory data collection, both WMS and TNC will report results to Blue Source for processing and updating of modeling projections. After processing is complete Blue Source will house all data and submit the necessary documentation for compliance with VCS standards. Blue Source, TNC, or BA will store data in an online cloud storage account for at least two years after the conclusion of the project.

Blue Source is the leading climate change offset portfolio in the nation with more publicly registered third-party verified GHG offsets than any other company in North America. They have deep expertise in carbon project development and substantial experience working with forest carbon.

TNC is an internationally respected NGO that has been active in environmental management for over 60 year. TNC has a long history working with forest based carbon projects dating back to the groundbreaking1996 Noel Kempff climate action project. TNC's Pennsylvania chapter has a staff of qualified natural resource managers and is responsible for Pennsylvania's Working Woodlands forest conservation program designed to protect the states forests while improving private forest management, providing revenue for forest landowners, and fighting climate change.

WMS is a consulting firm specializing in forest management, timberland investment, and land conservation services. WMS staff holds professional degrees in Forestry, Environmental Management, Biology, and Environmental Studies, and collectively bring 45 years of forest management experience to the organization. Founded in 1994, WMS currently manages over 50,000 acres of forestland.

Methods for Generating, Recording, Storing, Aggregating, Collating and Reporting Data

All data will be collected on hand held Pocket PC data recorders incorporated with Pocket Dog data collection software, then downloaded and compiled on Office Dog. All equipment utilized throughout the course of the project will be regularly calibrated to the equipment's specifications and/or the relevant national standards.

Field personnel will use the following equipment for obtaining forest carbon data:

- 75' Logger Tape designed to measure in 10ths of inches
- Clinometer with percent and topographic scales
- 10 Basal Area Factor Prism
- Compass
- Increment borer
- Pocket PC equipped with PocketDog software
- Professional grade GPS handheld unit with point locations

All sample points will be located using professional grade handheld GPS units. At each point the cruiser will carryout the measurement and monumentaion practices described in the *Monitoring Method* section above.

All field data collectors will receive field training and complete several plots with an experienced collector before heading off on their own. Data collectors will be provided with data entry procedure documents that define species codes, product codes and overstory/regeneration tally methods. Tables of 10 BAF critical distances will be provided to each forester to verify border trees.

At each sample plot live trees qualifying as "in" using a BAF 10 prism will be recorded for all of the metrics described in the *Monitoring Method* section above. Where necessary, monumentation will be modified to incorporate new "in" trees and replace degraded monumentation materials. Pocketdog inventory data collection software will be used to record inventory plot data on HP ipaq handheld computers. Custom Pocketdog method sets will be patterned and designed per documented inventory procedures and provided by Fountains Forestry. These custom method sets will help to maintain the integrity of the data by prompting input, listing codes, and constraining entries with custom validation rules.

All inventory data will be uploaded, processed and compiled by TNC and WMS using TwoDog's OfficeDog software. This will allow for the data to be easily converted to other formats for additional analysis pertaining to carbon offset generation. Multiple backups (to multiple hard drives) of raw data will be performed each time cruise data is uploaded. After upload, TNC or WMS will back up all inventory data and send a copy to Blue Source for statistical analysis and model updating. Blue Source will then compile all monitoring data and analysis and submit the required documentation for verification. BA will store all data in an online DropBox account for at least two years after the conclusion of the project.

Procedures for Auditing and Non-conformities

Non-conformities will be minimized by utilizing Twodog inventory software to analyze inventory plot data. Pocketdog inventory plots will be uploaded directly from the ipaq handhelds into the Twodog inventory software to avoid transcription errors. Once uploaded, inventory plots will be sorted into corresponding forest stands. As plots are sorted into appropriate stand types, data from each plot will be automatically validated by the Twodog software. Twodog will automatically return validation errors for any anomalous entry and trigger the data analyst to make appropriate corrections.

Sufficient field data will be collected to ensure that the uncertainty thresholds within the protocol are upheld. Uncertainty (i.e. the 90% confidence interval as a percentage of the mean) for all measurement pools will be maintained below 10% and a conservative approach will be taken in the selection of parameter values.

Ultimately stand data summary reports will be reviewed for reasonableness by WMS foresters, printed and entered into GIS stand layer attributes tables for archiving and use in day-to-day forest management activities. Additional review of the Twodog stand data reports and GIS attributes tables will be performed as the stand data is analyzed.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

Carbon stock changes in above ground and below ground biomass = -6,872 tCO2e

Carbon stock changes in dead wood biomass = -138 tCO2e

Carbon stock changes in wood products = 1,898 tCO2e

Carbon emissions due to biomass burning as part of forest management = 0 CO2e

Total Baseline emissions = **-5,112 tCO2e** [3]

4.2 Project Emissions

Carbon stock changes in above ground and below ground biomass, dead wood biomass, and wood products = 25,480 tCO23

Carbon emissions due to biomass burning as part of forest management = 0 CO2e

Total Baseline emissions = **25,480 tCO2e**[3]

4.3 Leakage

Market effects leakage = .2

[3] See the VCS Calculations spreadsheet and Carbon Calculation Methods document within the *Carbon Calculations* folder for greater detail.

Leakage emissions = .2*(-5,112+25,480) = **6,119 tCO2e**

4.4 Summary of GHG Emission Reductions and Removals.

Period	Baseline emissions (tCO2e)	Project removals (tCO2e)	Leakage emissions (tCO2e)	Net GHG emission reductions (tCO2e) before risk deduction	Net GHG emission reductions (tCO2e) after10% risk deduction
5/29/12-12/31/12	-5,112	25,480	6,119	24,474	22,027

5 ADDITIONAL INFORMATION

N/A