

PART I - CLIMATE IMPACT AND INITIAL FINDINGS

CREST CLIMATE HUBS

CLIMATE ACTION REPORT

WOLF CREEK
FAYETTE COUNTY
FAYETTEVILLE, WV
United States of America

CONTRIBUTORS

- **Rajendra Kumar**
Climate Hub - Framework
- **S Pochendar**
Ecology
- **Niharika**
Sustainability
- **Sravan Kumar**
Climate Impact Study
- **Krishna J**
Concept & Design
- **Lakshmi**
Bio-Network (Flora & Fauna)
- **Satya Billa**
Art Director
- **Ajay Karthik**
Research
- **Divya Nandini**
Sr. Graphic Designer
- **Sai Kumar**
Layout & Design

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CLIMATE ACTION REPORT

FOR WOLF CREEK, FAYETTE COUNTY, WV BY CREST FOUNDATION

Climate change has enormous impact on survival of all living creatures. Failure to adapt is one of the major factors for extinction. Studying endangered species, geological changes and damage causing factors can lead way to define a methodical roadmap in conceptualizing Climate Hubs which has direct influence on human wellbeing as well.

A consolidative study based on online research from authentic sources focusing on several man-made developments across state of West Virginia further boiling down to Fayette county. This includes mapping of climate and geological changes occurred over period of time and its impact on natural resources. Fact remains that State of West Virginia ranks 49 of 50 in the state rankings of the US sustainability Development Report 2021. That makes it even more critical for Climate Hub to design targets based on corrective actions to achieve important Sustainability GOALS specific to Wolf Creek, Fayette County, WV.

These considerations are increasingly critical to integrate with the principles of the new age community developments across the modern world for future proof human science. Climate Action Report designed by CREST Foundation is a scientific framework to build Climate Hubs to combat both climate and lifecycle disasters. Part - I navigates first step towards Climate and Project Feasibility. Primary focus of this report is to constitute a solution framework to restore ecological balance with broad roadmap towards environmental impact goals of CREST Foundation overlapped and measured in comparison with UN Sustainable Development Goals defined for the state of West Virginia. Evidence and results occurred in this report will be further evolved in Report II - Climate Hub Design and Implementation Roadmap with micro level details based on intense on ground and inperson inspection of the site location involving several subject matter experts.

A photograph of a hiker standing on a rocky mountain ridge, silhouetted against a bright sky. The hiker is wearing a backpack and holding trekking poles. Below the ridge, a winding river flows through a valley, with more mountains visible in the distance under a clear blue sky.

PILOT STUDY OF
WOLF CREEK
AT FAYETTE COUNTY

PILOT STUDY OF FAYETTE COUNTY

WOLF CREEK

Wolf Creek is a thousand-acre mixed-use development situated in the heart of Fayette County, West Virginia dedicated to Residential development, Commercial development, Industrial development, environmental, education, and recreational purposes.

It is in one of the most diverse watersheds in Fayette County and is strategically located adjacent to US Route 19 at Appalachian Drive and S R 16.

Residents of Fayette County take pride in its naturally beautiful landscapes, recreational resources, affordable living conditions, ease of accessibility and friendly atmosphere.

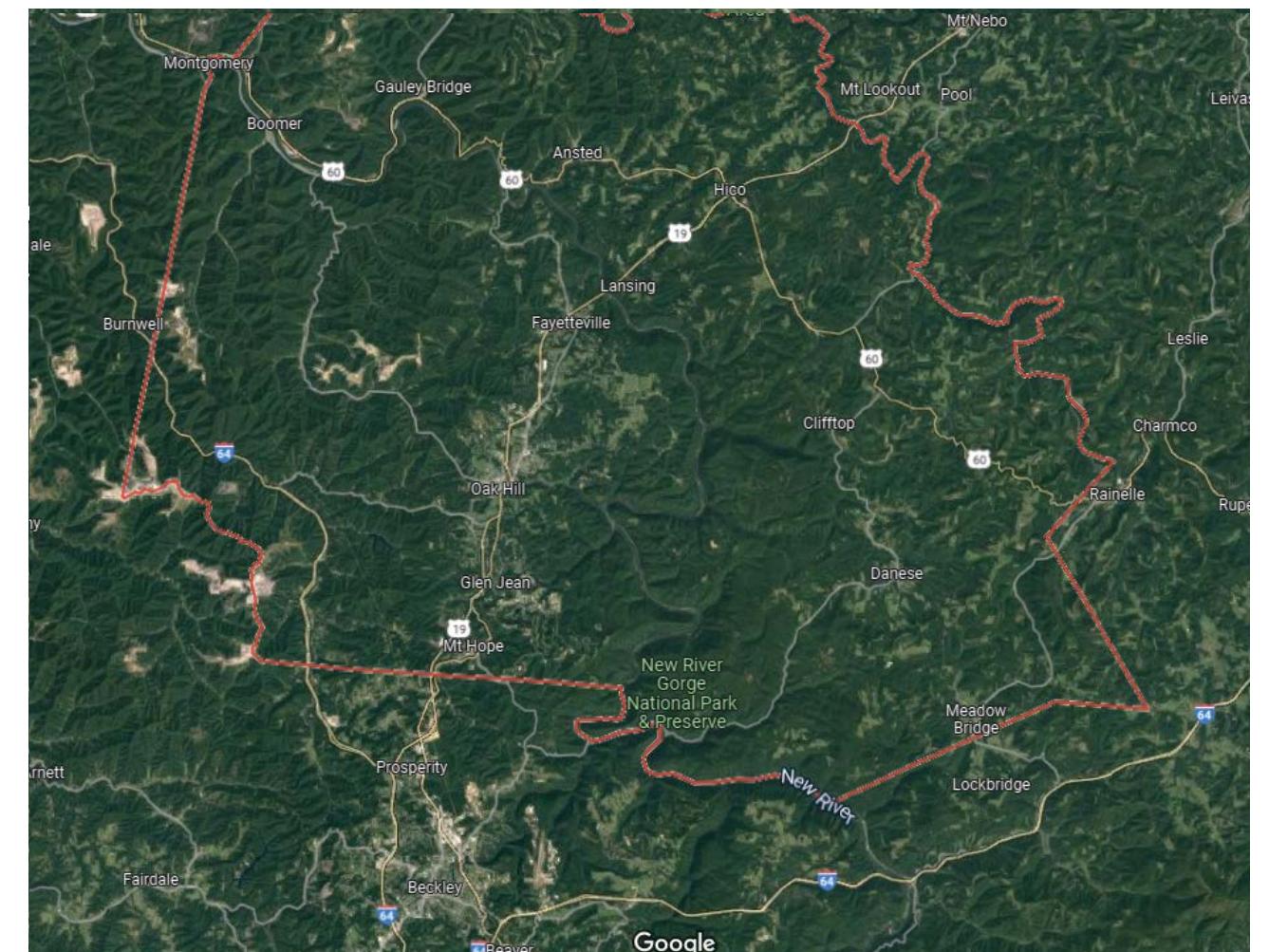


LOCATION

Fayetteville is home to the New River Gorge bridge with the world's longest arch at the time of its construction in 1976. The New River Gorge National River protects about 70,000 acres of land in and around the gorge. Named as America's one of the coolest small towns, Fayetteville with its rich history and endless outdoor opportunities is home to a diverse set of people from all walks of life. It is also one of the best destinations to shop from a community of talented artists and unique boutique shops. When snow falls, Fayetteville is transformed into a winter wonderland. Fayetteville sits on the edge of America's newest national park.



Location within the U.S. state of [West Virginia](#)



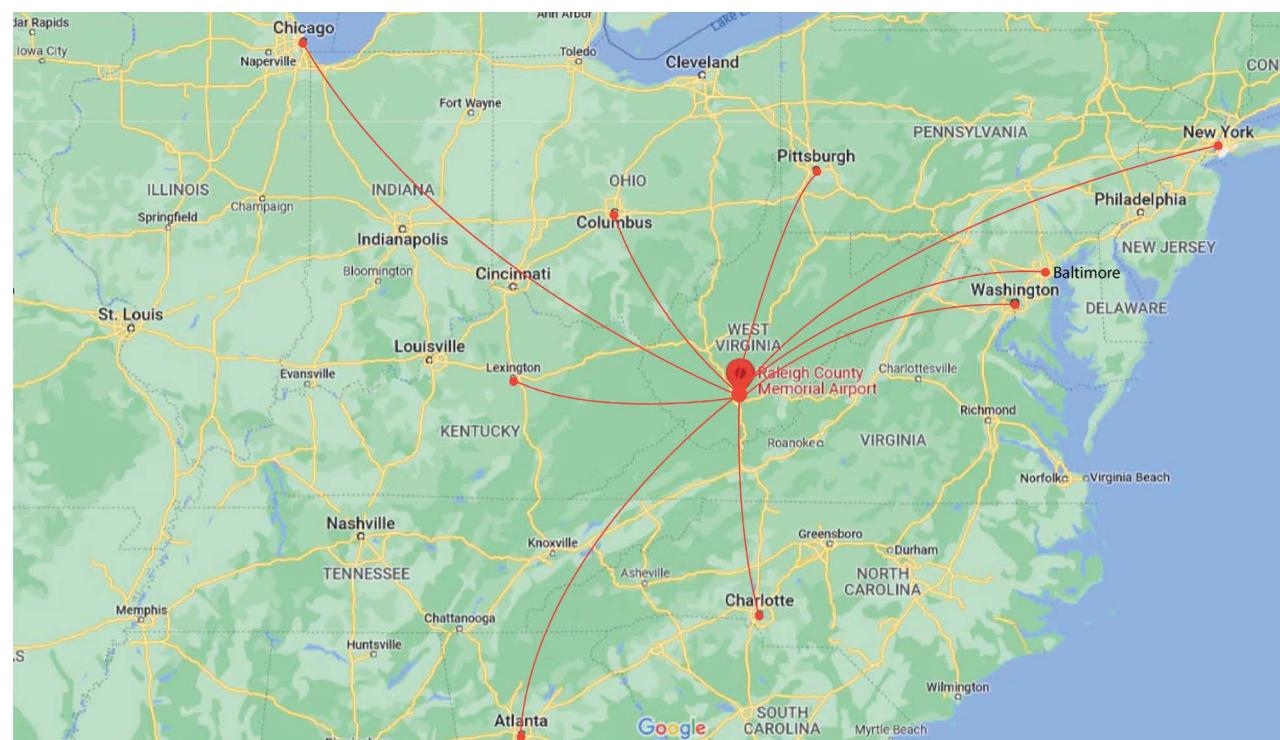
CONNECTIVITY

WOLF CREEK, FAYETTE COUNTY, WV

The Mountain State of West Virginia is within a day's drive of 50% of the U.S. population and a third of the Canadian market. The location gives businesses strategic access to major metropolitan centers without the big city costs and inconveniences. Washington, D.C., New York City, Baltimore, Pittsburgh, Charlotte, Raleigh, Columbus, Chicago, Lexington and Atlanta are all just a short distance away.

West Virginia has the connections to:

- More than 1,900 route miles of railways.
- Six major interstates
- Nearly 420 miles of navigable waterways. Five navigable rivers connect to international shipping ports.
- Eight commercial air services and 25 general aviation airports.



“Wolf Creek is located just 1.6 miles from Fayetteville, in the state of West Virginia.”

The location is off of U S Route 19 at Appalachian Drive and S R 16.

Closest airports near Wolf Creek are Beckley Raleigh County Memorial Airport and Yeager Airport connecting most major cities in West Virginia.

SURROUNDING DEVELOPMENTS

WOLF CREEK, FAYETTE COUNTY, WV

Close proximity to the New River Gorge makes Fayetteville home to some of the best hiking, climbing, and whitewater activities in the nation. Incredible restaurants and shopping experiences are around each corner. Fayetteville is just an 8-minute drive from Wolf Creek. Fayetteville has a unique blend of past and present.

The World-Famous Greenbrier resort is 45 mins drive from Wolf Creek.



ATTRACTI0NS

WOLF CREEK'S RECREATIONAL OPPORTUNITIES

Wolf Creek is situated in West Virginia's outdoor recreation capitol, Fayette County. Wolf creek offers unparalleled recreational opportunities. Numerous soft recreational activities are present around wolf creek.

New River Gorge Bridge

The New River Gorge Bridge is one of the most photographed places in West Virginia. The bridge was chosen to represent the state on the commemorative quarter released by the U.S. Mint in 2006. In 2013, the National Park Service listed the New River Gorge Bridge in the National Register of Historic Places as a significant historic resource.

Long Point Trail

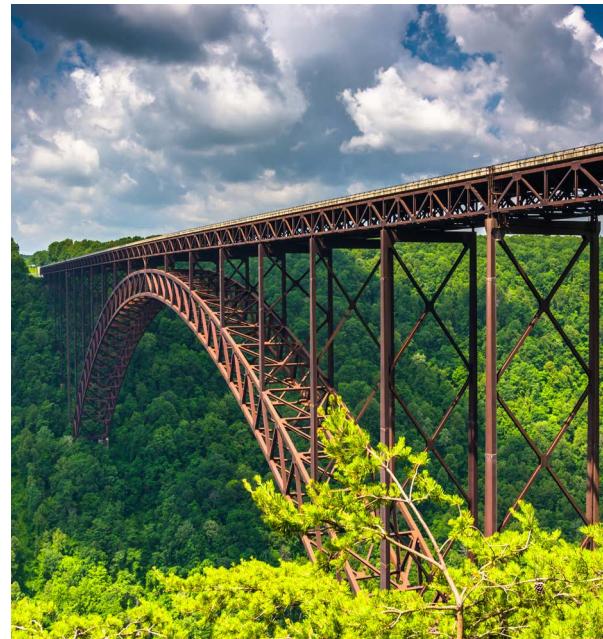
Behind the Endless Wall Trail, the hike to Long Point is considered the second most popular hike in the New River Gorge Recreation Area in West Virginia. The hike to the final viewpoint is approximately 1.6 miles and is a relatively easy hike with only 426 feet of elevation gain.

The Endless Wall Trail

The Endless Wall Trail is a 2.4 mile walk that passes through the rich forest and zig-zags around the cliff edge. Amongst all other river gorge trails, The Endless Wall has the most character and diversity.

Mountain Biking & Rock Climbing

West Virginia is one of the best places in the World for Mountain Biking and Rock Climbing. New River Gorge is easily the most sought after destination in the East Coast with world renowned climbing routes for magnificent single-pitch sport and trad climbing.



ATTRACTI0NS

WOLF CREEK'S RECREATIONAL OPPORTUNITIES

Whitewater Rafting

While West Virginia is one of the best places in the world for Whitewater Rafting, New River and Gauley River in the south of WV offer incredible thrills and experiences that will last a lifetime.

It is an adventure and to see and be surrounded by the beautiful scenery of the Mountain State with each season offering a different yet adventurous ride.



Boy Scouts of America West Virginia Welcome Center

The center will welcome all visitors and guests as they arrive at the Summit Bechtel Reserve. Through the welcome center, area residents will be provided opportunities to visit the reserve to take in the scenic views and natural surroundings while learning about the values of scouting, the Ruby's, and the state of West Virginia.



New River Gorge National Park

Winter is a special time to visit the park and experience the solitude and beauty that is not found in any other season. Ice formations appear along rock cliffs and frozen waterfalls are breathtaking. The best way to experience peace and solitude is to take a hike along the endless hiking trails, some are within walking distance of downtown.



ATTRACTI0NS

WOLF CREEK'S RECREATIONAL OPPORTUNITIES

Canyon Rim Visitor Center

Canyon Rim Visitor Center is the primary visitor contact station for area information and interpretation of the natural, cultural, recreational, and historic resources of New River Gorge National Park and Preserve, Bluestone National Scenic River, and Gauley River National Recreation Area. With an estimated 300,000 visitors each year, the center provides the park with a nationally recognized facility, revealing the beauty of the National Parks of Southern West Virginia to the nation and the world.



Thurmond

During the first two decades of the 1900s, Thurmond was a classic boomtown. It went from a prosperous small town to a near-ghost town with just five inhabitants. The town has a unique story and remarkably well-preserved buildings.

The annual Captain Thurmond's Challenge Extreme Triathlon is adventure enough to challenge any competitor and it is absolutely extreme!



Gauley River

Like the New and Bluestone Rivers, the Gauley has cut a gorge that supports diverse and abundant wildlife. Extremes in topography, elevation, and microclimate have resulted in a great diversity of plant life. The Gauley River rapids are known worldwide. Gauley River is an excellent example of a high energy system which supports rare plant species and their communities.



ATTRACTI0NS

WOLF CREEK'S RECREATIONAL OPPORTUNITIES

Nuttallburg

The Nuttallburg Tipple stands as a reminder of this once dynamic coal town.

First established in 1870, The Nuttallburg Coal Mining Complex and its attendant ghost town have been abandoned since the early 20th century, but determined hikers still visit the remains of the operation which are sitting in a lush West Virginia river gorge.



Bluestone River

Bluestone National Scenic River is preserved as a living landscape that provides an unspoiled experience for visitors and a haven for a variety of plants and animals. The Wild and Scenic river system protects rivers throughout the country that are free-flowing and possess "outstandingly remarkable" scenic, natural, cultural, geological, and recreational values.



Sandstone Falls

The largest waterfall on the New River, Sandstone Falls spans the river where it is 1500 feet wide. Divided by a series of islands, the river drops 10 to 25 feet.

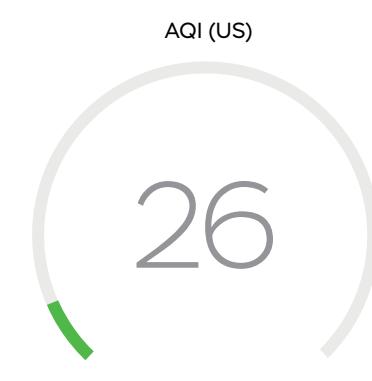
The falls form the dramatic starting line for the New Rivers final rush through the New River Gorge to its confluence with the Gauley River to form the Kanawha River.





STUDY OF
BIONETWORK
AT FAYETTE COUNTY

AIR

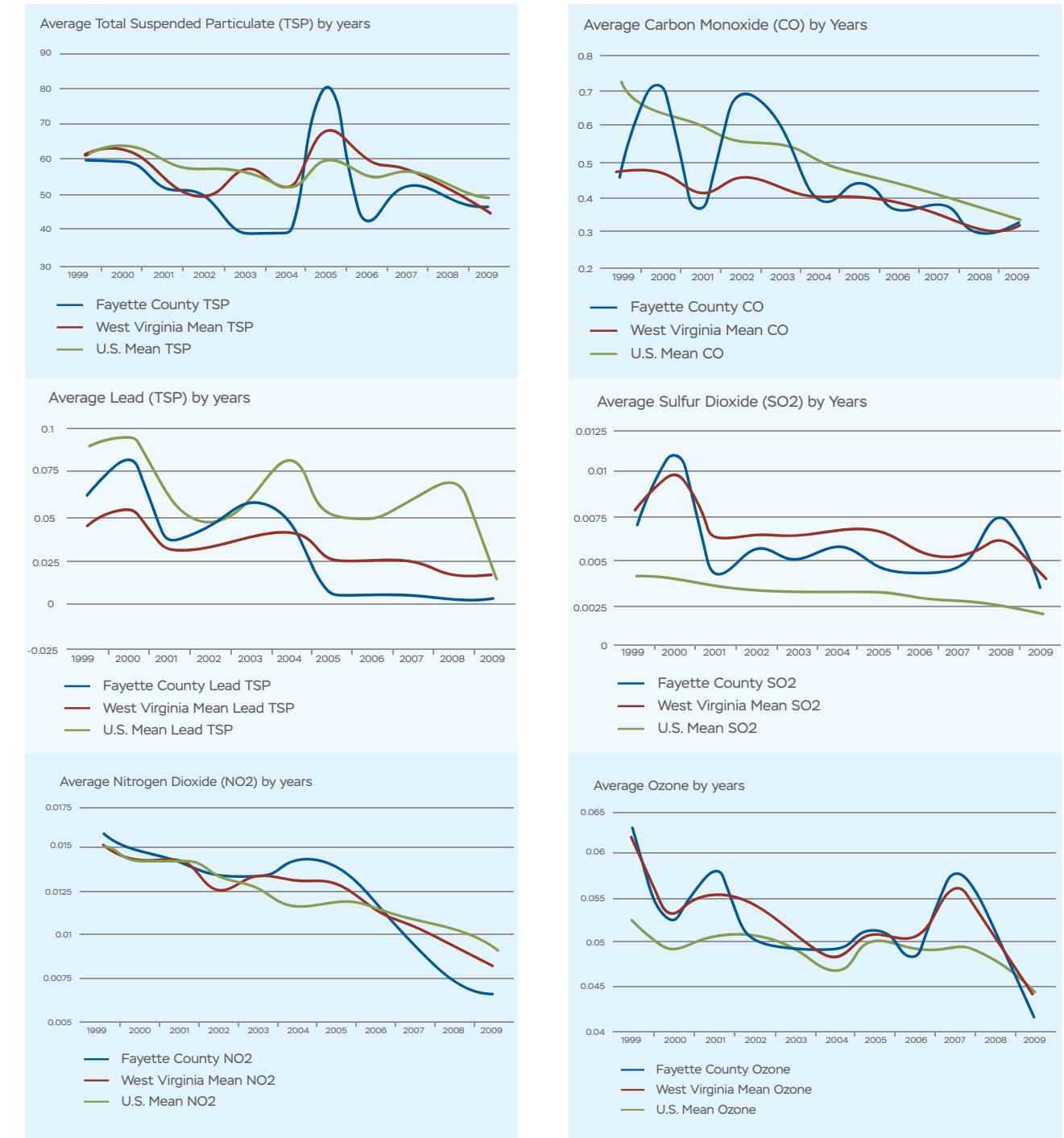


Air Quality Index
Current AQI: 26
Dominant pollutant:
O3

O3 PM2.5
64 6 $\mu\text{g}/\text{m}^3$
PM10 NO2
12 11 $\mu\text{g}/\text{m}^3$
SO2 CO
5 110 $\mu\text{g}/\text{m}^3$

The information on this page is based on the air quality database from the U.S. Environmental Protection Agency (EPA). Each location or city may not have their own monitoring site. Therefore, to calculate air quality we average in the data from the closest monitoring sites with distance considered to each location. For this location, data from monitoring sites located at 38.126111, -81.243056 (County: Fayette, WV); 37.807767, -81.197433 (County: Raleigh, WV); 38.18, -81.328333 (County: Fayette, WV); 38.166944, -81.356111 (County: Staunton City, VA); 37.777281, -81.185644 (County: Raleigh, WV); are used.

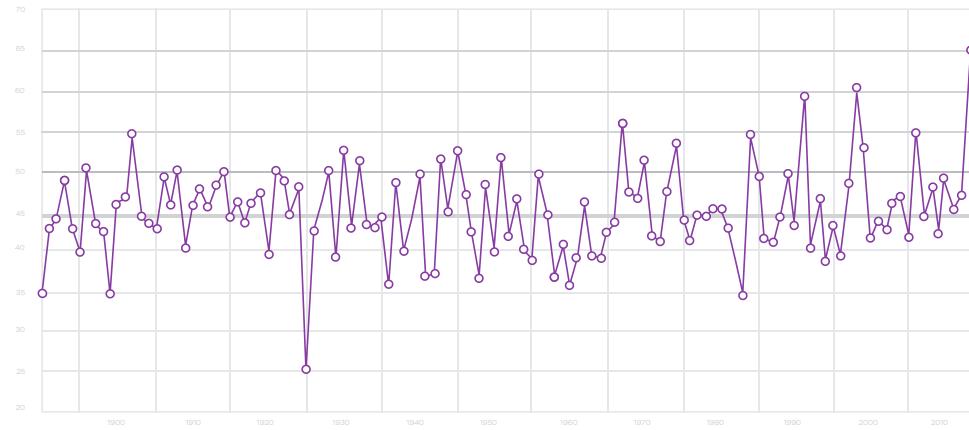
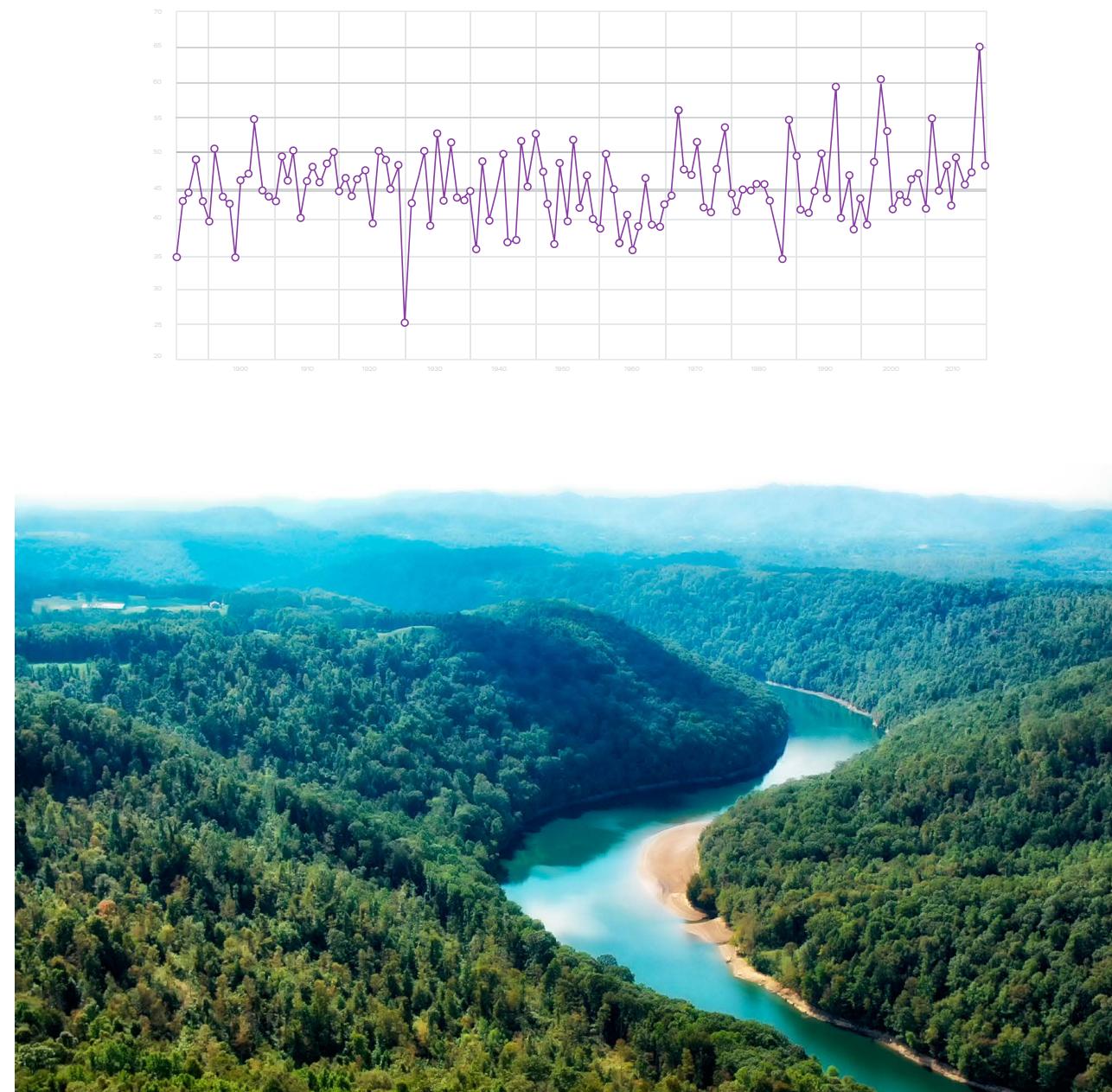
AIR



WATER

PRECIPITATION

The average annual rainfall for West Virginia is approximately 45 inches, though the rainfall totals vary across the different climatic regions of the state. It ranges from less than 36 inches in the portion of the state called the Potomac Highlands, to a maximum of over 65 inches in high elevation and isolated areas of the Allegheny Mountains.



WATER

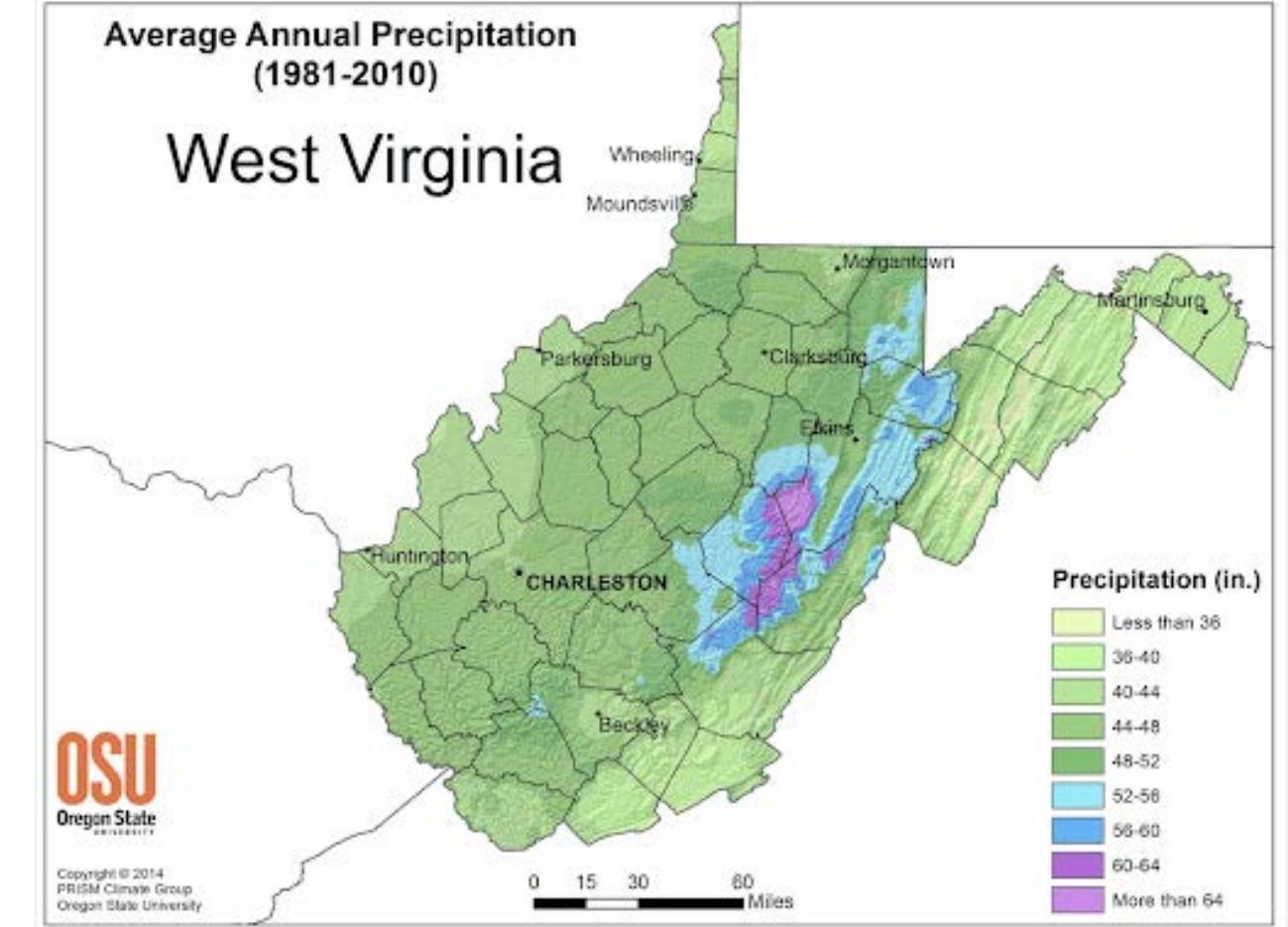
WATERSHED ASSESSMENT

Watershed

Wolf Creek watershed is in Fayette County, West Virginia and is a sub watershed of the lower New River watershed. The headwaters of Wolf Creek start at Summerlee, an abandoned mineland site that flow downstream through parts of Fayetteville and Oak Hill. Wolf Creek and its tributaries are impaired by high

levels of iron, aluminum, and fecal coliform bacteria as well as low pH.

The pH impairment identified in the TMDL is caused by the organic enrichment and sedimentation and can be solved by reducing iron loads and fecal coliform.

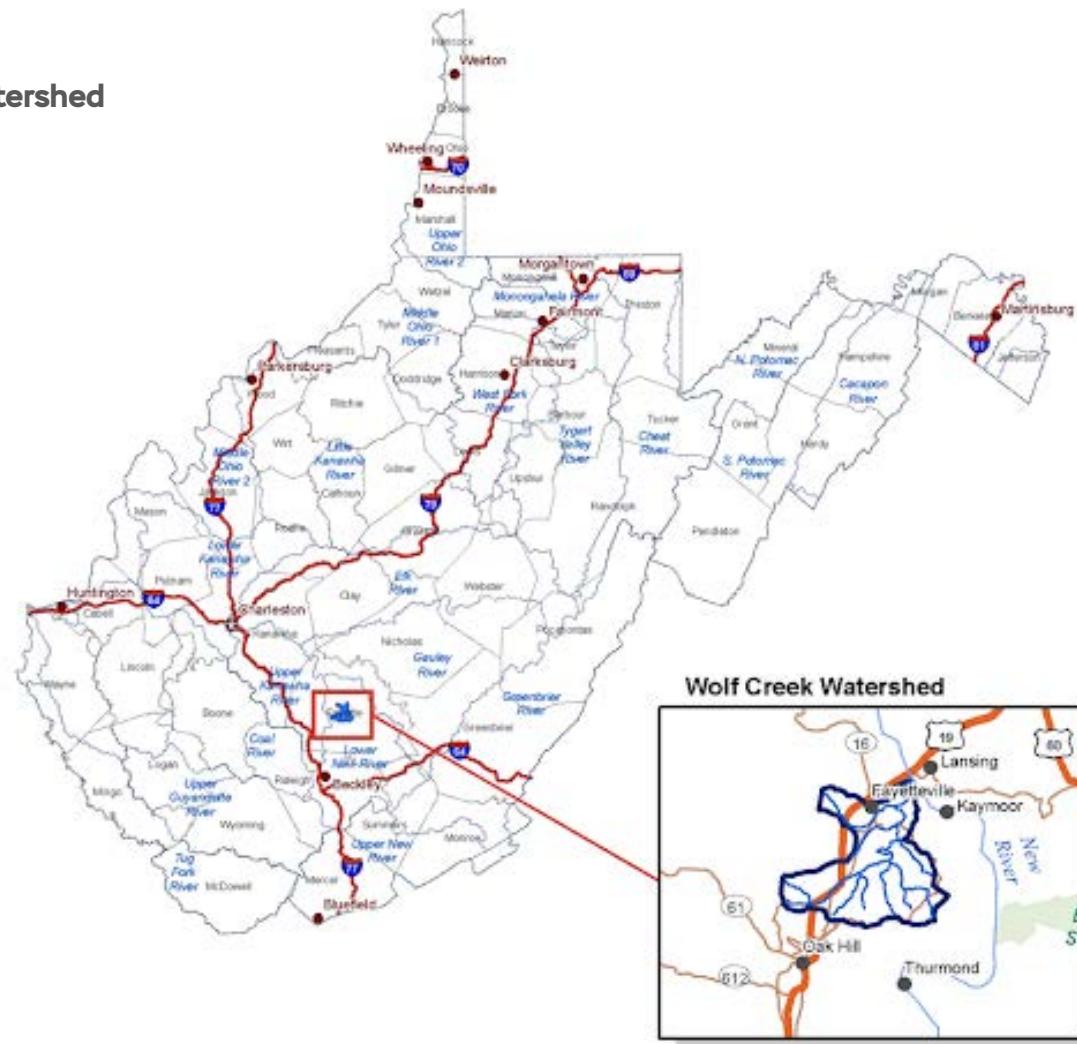


Fayette County, West Virginia gets 46 inches of rain, on average, per year. The US average is 38 inches of rain per year.

WATER

WATERSHED ASSESSMENT

Watershed



The Wolf Creek watershed, which encompasses approximately 10,947 acres, lies within the Allegheny Plateau. Valleys in the watershed tend to be narrow with very steep sides (20-30 percent slopes). The plateau areas between the stream valleys tend to be more gently rolling. Slopes of less than 10 percent are common in these areas. The headwaters of Wolf Creek are located in the southwestern part of the watershed above Lochgelly. Wolf Creek flows in a northeasterly

direction for approximately 10.5 miles before emptying in the New River. Wolf Creek originates at an elevation of approximately 2,000 feet. The stream gradient in the upper reaches is fairly gentle, averaging less than 5 percent until just below its confluence with House Branch. At this point, the stream channel steepens dramatically, dropping from an elevation of 1760 feet to 880 feet in a distance of just over one mile as it flows into the New River.

WATER

WATERSHED ASSESSMENT

The headwaters of Wolf Creek flow through areas that were surface mined for coal at one time and have since been reclaimed or capped. The Wolf Creek tributary originating on the Summerlee mine site [referred to as the unnamed tributary at river mile 8.7 in this watershed-based plan] flows through a wooded wetland between the culvert at Summerlee Road and the residential development approximately 1,000 feet to the east.

Wolf Creek flows through or adjacent to developed or agricultural land a majority of its length between its headwaters and the Fayetteville Reservoir. Tree cover, where it exists is generally a mix of oak, poplar, and

maple, with few evergreens. An exception to this is the area of Wolf Creek between Adkins Branch and Levisee Branch, where the stream flows through an area with a dense canopy of hemlock, rhododendron, and pine. North of the reservoir, Wolf Creek flows through the National Park Service's New River Gorge National River. The character of Wolf Creek changes dramatically along this section. The channel is rocklined and strewn with boulders, the gradient steepens, and the flow rate increases.

Land use in the Wolf Creek watershed has been divided into 12 categories

Table 2: Land use in the Wolf Creek watershed

Land use	Acres	Percent of total land use
Forest	6,903	63%
Agriculture	2,059	19%
Residential	1,230	11%
Mining	190	2%
Commercial and services	142	1%
Mixed urban	134	1%
Industrial	101	1%
Transportation	101	1%
Water (ponds and reservoirs)	35	< 1%
Mixed industrial and commercial	28	< 1%
Barren land-transitional	22	< 1%
Water treatment facility	2	< 1%
Total	10,947	100%

Source: Parsons Brinckerhoff (2004)

WATER

WATERSHED ASSESSMENT

Since 2004, when the Parsons Brinckerhoff report was released, certain conditions have changed in the watershed. In 2008, the City of Fayetteville transferred its water and wastewater systems to West Virginia American Water (Gray, 2008). In January 2008, several months before the transfer to West Virginia American, Fayetteville took its water treatment plant offline and began purchasing water from the company's New River facility in Beckwith (Gray, 2009). This remains the drinking water source for Fayetteville.

Also, a major interchange was constructed in 2007 on Route 19 in the Wolf Creek watershed. A 2005 United States Army Corps of Engineers (USACE) public notice document documented the planned construction. This initial plan included the filling of approximately 2,500 linear feet of stream and 4.3 acres of wetlands, the relocation of 430 linear feet of Wolf Creek, and the installation of several temporary dams (USACE, 2005, p 2). Sediment control practices at this site were the subject of litigation, as the City of Fayetteville contended that sediment was washing off the site and impacting

the reservoir downstream. The county circuit court case resulted in the construction company being ordered to repair a dam that was allowing excess sediment to fill Wolf Creek and to monitor all of their erosion-control fixtures on a daily basis (Hill, 2007).

“ Headwaters of Wolf Creek start at an abandoned mine land site contaminated by high levels of Iron, Aluminum and Fecal Coliform Bacteria that flow downstream through parts of Fayetteville and Oak Hill ”



WATER

WATER QUALITY

One or more streams in the Wolf Creek watershed are impaired. To quantify the water quality standard for biological impairments, the West Virginia Department of Environmental Protection (WVDEP) uses surveys of benthic macroinvertebrate communities. A West Virginia Stream Condition Index score is generated from this survey. Streams with a score of 60.6 or less are considered biologically impaired and placed on the list. The entire length of Wolf Creek has been listed for biological impairment.

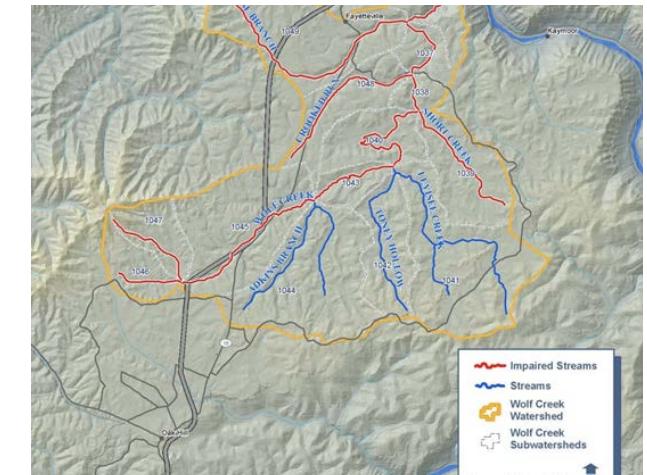


Table 4: Impaired streams and other streams requiring pollutant reductions

Stream	Stream code	Subwatershed codes	Impairments
<u>IMPAIRED STREAMS</u>			
Wolf Creek	WVKN-10	1036, 1037, 1038 1040, 1043, 1045, 1047	CNA-Biological Fecal coliform Iron
House Branch	WVKN-10-A	1049	Fecal coliform
Crooked Run	WVKN-10-B	1048	Fecal coliform
Short Creek	WVKN-10-C	1039	Fecal coliform
UNT/Wolf Creek RM 8.7	WWKN-10-M	1046	Aluminum(dissolved)
<u>OTHER STREAMS REQUIRING REDUCTIONS</u>			
Levisee Creek	WVKN-10-D	1041	NA
Toney Hollow	WVKN-10-D-1	1042	NA
Adkins Branch	WVKN-10-E	1044	NA

While the TMDL report provides a recent summary of water quality data, acid mine drainage (AMD) pollution has been documented in the past by the Plateau Action Network (PAN), WVDEP, and others.
Impaired streams in the Wolf Creek watershed

WATER

WATER QUALITY

USGS study shows fracking contamination in Wolf Creek watershed

By Sarah Plummer Register-Herald Reporter May 15, 2016

A new study led by the U.S. Geological Survey indicates waste from oil and gas disposal was found in surface waters and sediments near a controversial underground injection well in Lochgelly, just outside Oak Hill.

"Deep well injection is widely used by industry for the disposal of wastewaters produced during unconventional oil and gas extraction," said Dr. Denise Akob, lead author and geomicrobiologist with the U.S. Geological Survey's National Research Program.

"Our results demonstrate that activities at disposal facilities can potentially impact the quality of adjacent surface waters."

This is one of the first published studies to demonstrate injection disposal sites impact surface water quality. The study, "Wastewater disposal from unconventional oil and gas development degrades stream quality at a West Virginia injection facility," was published in Environmental Science and Technology, an American Chemical Society journal.

The scientists collected water and sediment samples upstream and downstream from the disposal site. All samples were taken within the Wolf Creek watershed near two controversial injection disposal wells operated by Danny Webb Construction.

These samples were analyzed for a series of chemical markers that are known to be associated with unconventional oil and gas wastewater.



“ Waste from oil and gas disposal was found in surface waters and sediments potentially impacting the quality of adjacent streams ”

WATER

WATER QUALITY

A second Lochgelly-site study called "Endocrine disrupting activities of surface water associated with a West Virginia oil and gas industry wastewater disposal site" was published in April. This study conducted biological assessment tests to determine if contamination of the surface waters causes endocrine disruption.

Endocrine disruptors are chemicals that interfere with normal functioning of organisms' hormones. Waters and sediments collected downstream from the disposal facility were elevated in chemicals associated with fracking wastewater, including sodium, chloride, strontium, lithium and radium, providing indications of wastewater-associated impacts in the stream.

"We found endocrine disrupting activity in surface water at levels that previous studies have shown are high enough to block some hormone receptors and potentially lead to adverse health effects in aquatic organisms," said Susan C. Nagel, director of the endocrine study and associate professor of Obstetrics,

Gynecology and Women's Health at University of Missouri.

Christopher Kassotis, Duke University scientist and lead author on the endocrine study, said it is critical to know what impacts injection wells may have on the surrounding environment.

"These studies are an important first step in that process," he said. Brandon Richardson, Oak Hill resident and co-founder of Headwaters Defense, said, "Despite relentless outcry from the local community about contamination at the site, there has never been a violation or fine issued by the West Virginia Department of Environmental Protection. Now, the federal government is confirming significant damage has been done to Wolf Creek. When will they shut him down?"

In January, the Fayette County Commission passed a countywide ban of the storage, use or disposal of oil and gas production waste. It is the first of its kind in West Virginia.



CLIMATE

Climate is the description of the long-term pattern of weather in a place. Climate can mean the average weather for a particular region and time period taken over 30 years. Climate is the average of weather over time. Fayette County, West Virginia gets 46 inches of rain, on average, per year. The US average is 38 inches of rain per year. Fayette County averages 38 inches of snow per year.

The US average is 28 inches of snow per year. On average, there are 158 sunny days per year in Fayette County. The US average is 205 sunny days. Fayette County gets some kind of precipitation, on average, 151 days per year. Precipitation is rain, snow, sleet, or hail that falls to the ground. In order for precipitation to be counted you have to get at least .01 inches on the ground to measure.

“ Flooding is quite common in West Virginia and may occur during any month of the year ”

Climate Averages

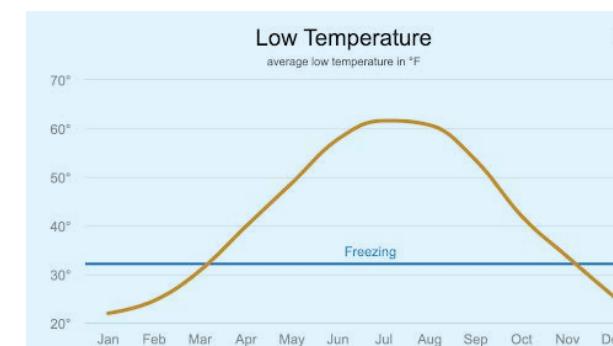
	Fayette, West Virginia	United States
Rainfall	46.4 in.	38.1 in.
Snowfall	37.6 in.	27.8 in.
Precipitation	150.5 days	106.2 days
Sunny	158 days	205 days
Avg. July High	82.2°	85.8°
Avg. Jan. Low	22.0°	21.7°
Comfort Index (higher=better)	7.1	7
UV Index	4.3	4.2
Elevation	1960 ft.	2443 ft.

CLIMATE

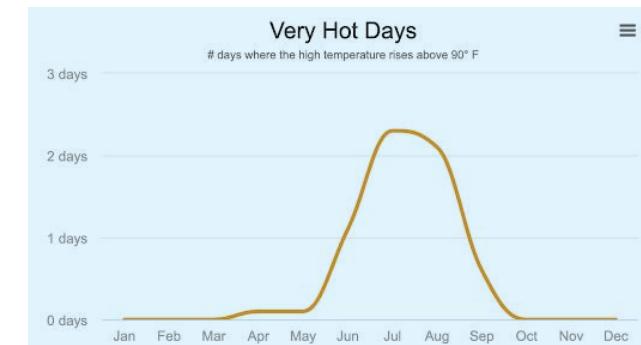
July is the hottest month for Fayette County with an average high temperature of 82.2°, which ranks it as cooler than most places in West Virginia. In Fayette County, there are 5 comfortable months with high temperatures in the range of 70-85°. The most pleasant months of the year for Fayette County are June, September and August.



In Fayette County, there are 6.3 days annually when the high temperature is over 90°, which is cooler than most places in West Virginia.

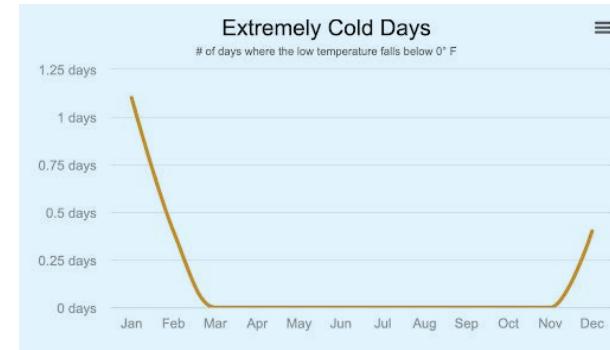


January has the coldest nighttime temperatures for Fayette County with an average of 22.0°. This is warmer than most places in West Virginia.



In Fayette County, there are 115.0 days annually when the nighttime low temperature falls below freezing, which is warmer than most places in West Virginia.

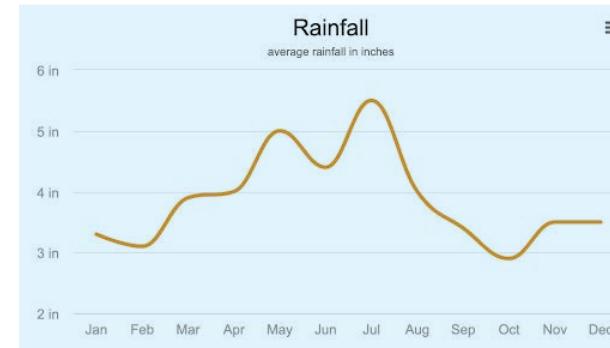
CLIMATE



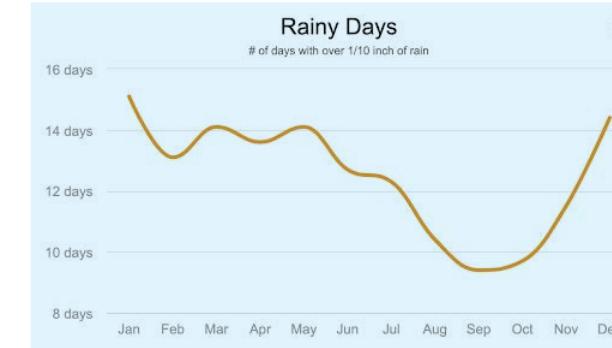
In Fayette County, there are 1.9 days annually when the nighttime low temperature falls below zero°, which is colder than most places in West Virginia.



The humidity is usually comfortable in Fayette County but some summer months can be sticky or muggy. July is the most humid month, though humidity is low for most of the year. The most humid months are July, August and June.



July is the wettest month in Fayette County with 5.5 inches of rain, and the driest month is October with 2.9 inches. The wettest season is Autumn with 30% of yearly precipitation and 21% occurs in Winter, which is the driest season. The annual rainfall of 46.4 inches in Fayette County means that it is wetter than most places in West Virginia.



January is the rainiest month in Fayette County with 15.1 days of rain, and September is the driest month with only 9.4 rainy days. There are 150.5 rainy days annually in Fayette County, which is rainier than most places in West Virginia. The rainiest season is Spring when it rains 28% of the time and the driest is Winter with only a 20% chance of a rainy day.

CLIMATE

EXTREMES WEATHER EVENTS

Flooding

Floods are one of the most common hazards in the United States and may occur any month of the year in West Virginia.



Source: [Weather.gov](#)

The earthquake index value is calculated based on historical earthquake events data using USA.com algorithm. It is an indicator of the earthquake level in a region. A higher earthquake index value means a higher chance of an earthquake.

Tornadoes

Given the terrain, there is a misconception that West Virginia does not have tornadoes. However, despite the hills and mountains, the state averages two tornadoes a year, and since 1950, more than 150 tornadoes have been recorded in West Virginia.

Earthquake Index, #16

Fayette County 0.04
West Virginia 0.06
U.S. 1.81



CLIMATE

WEATHER EXTREMES EVENTS

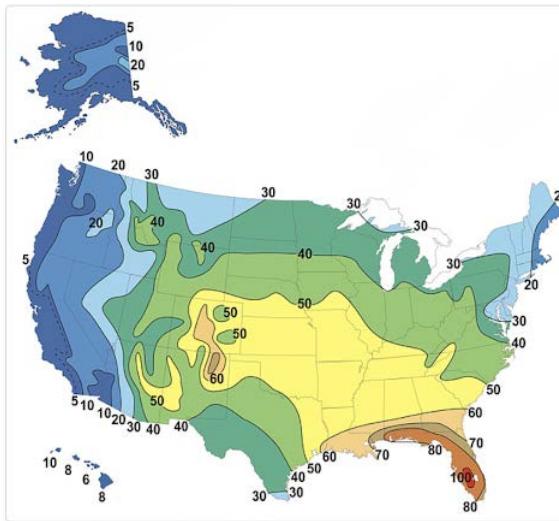
Tornadoes Index, #34



The tornado index value is calculated based on historical tornado events data using USA.com algorithm. It is an indicator of the tornado level in a region. A higher tornado index value means a higher chance of tornado events.

Thunderstorms

West Virginia typically sees between 40 and 50 thunderstorms a year, depending on the location within the state. While most of the thunderstorm activity is observed during the summer months, the passage of cold fronts through the state during the spring and fall can also spawn severe thunderstorms.



Source: NOAA SPC

Other Weather Extremes Events

A total of 10,082 other weather extremes events within 50 miles of Fayette County were recorded from 1950 to 2010. The following is a break down of these events:

Type Count	Type Count	Type Count	Type Count	Type Count
Avalanche: 0	Blizzard: 3	Cold: 122	Dense Fog: 7	Drought: 81
Dust Storm: 0	Flood: 1,739	Hail: 2,837	Heat: 79	Heavy Snow: 233
High Surf: 0	Hurricane: 0	Ice Storm: 56	Landslide: 2	Strong Wind: 198
Thunderstorm Winds: 4,184	Tropical Storm: 1	Wildfire: 27	Winter Storm: 104	Winter Weather: 66
Other: 343				

CLIMATE

HISTORICAL EARTHQUAKE EVENTS

A total of 1 historical earthquake event that had a recorded magnitude of 3.5 or above found in or near Fayette County.

Distance (miles)	Date	Magnitude	Depth (km)	Latitude	Longitude
43.8	1969-11-20	4.3	N/A	37.4	-81

Historical Tornado Events

A total of 12 historical tornado events that had recorded magnitude of 2 or above found in or near Fayette County.

Distance (miles)	Date	Magnitude	Start Lat/Log	End Lat/Log	Length	Width	Fatalities	Injuries	Property Damage	Crop Damage	Affected County
4.8	1961-02-25	2	37°59'N / 81°09'W		3.00 Miles	100 Yards	0	0	250K	0	Fayette
10.9	1990-05-26	2	38°09'N / 81°13'W		0.50 Mile	250 Yards	0	0	25K	0	Fayette
15.7	1974-04-04	3	37°48'N / 81°01'W	37°50'N / 80°58'W	3.30 Miles	33 Yards	0	0	0K	0	Raleigh
16.1	1974-04-04	3	37°50'N / 80°58'W	37°54'N / 80°47'W	10.80 Miles	33 Yards	1	8	2.5M	0	Fayette
24.6	1974-04-04	3	37°40'N / 81°16'W	37°42'N / 81°06'W	9.20 Miles	33 Yards	0	12	2.5M	0	Raleigh
25.1	1974-04-04	3	37°54'N / 80°47'W	38°01'N / 80°29'W	18.10 Miles	33 Yards	0	3	2.5M	0	Greenbrier
37.8	1975-04-24	2	37°47'N / 80°28'W		6.00 Miles	67 Yards	0	0	25K	0	Greenbrier
39.5	1965-04-08	2	37°30'N / 80°49'W		0.50 Mile	100 Yards	0	0	25K	0	Summers
40.0	1990-06-22	2	37°41'N / 80°30'W	37°42'N / 80°29'W	1.00 Mile	150 Yards	0	0	250K	0	Greenbrier
41.7	1990-06-22	2	37°38'N / 80°28'W	37°41'N / 80°30'W	4.00 Miles	150 Yards	0	0	250K	0	Monroe
43.3	1976-07-11	2	37°36'N / 80°34'W	37°33'N / 80°31'W	4.10 Miles	33 Yards	0	0	250K	0	Monroe
43.6	1965-04-12	2	37°24'N / 81°06'W				0	0	3K	0	Mercer

* The information on this page is based on the global volcano database, the U.S. earthquake database of 1638-1985, and the U.S. Tornado and Weather Extremes database of 1950-2010.

FLORA & FAUNA

AGRICULTURE & FOREST ECOSYSTEMS AT FAYETTE COUNTY

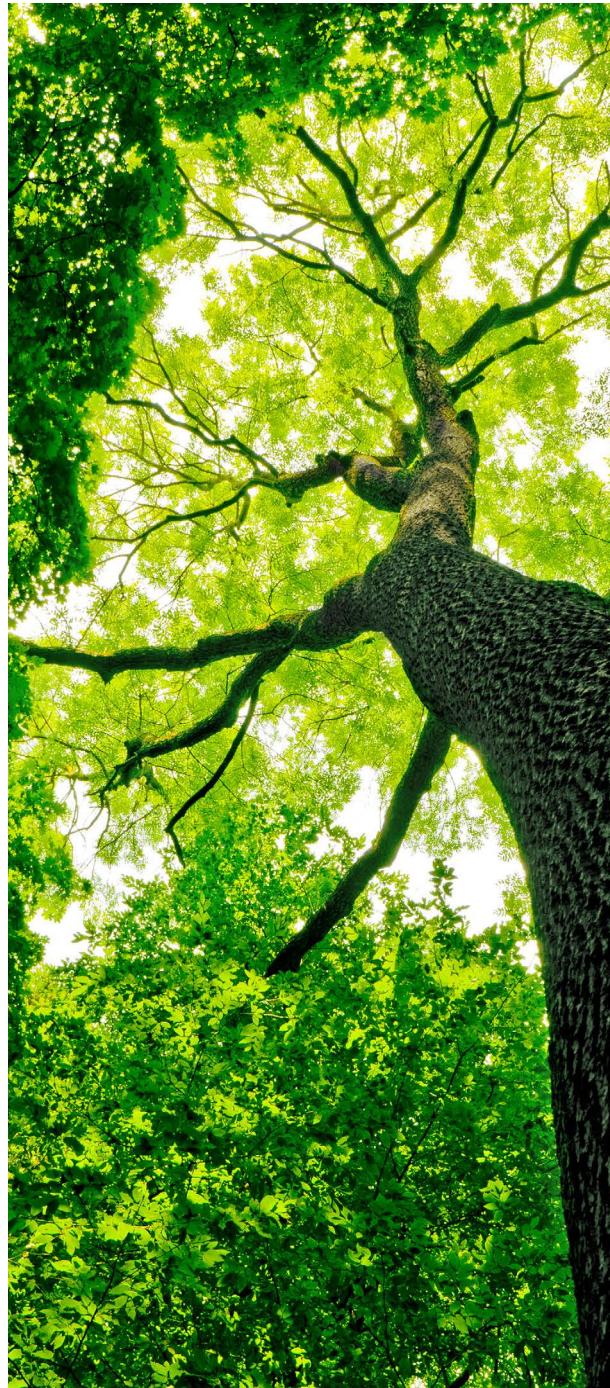
Extensive forests. Bountiful rainfall. Rich soil. West Virginia's diverse landscape is home to a wide array of plants, animals and fungi. Here, you'll find more than 57 species of amphibians and reptiles, 70 wild mammals, 178 species of fish, nearly 300 species of bird and numerous species of plants and fungi. West Virginia is an ideal location for a wide array of plants and fungi.

Flora

Flora of Fayette County is Diverse and vast with several species observed frequently. The forests of West Virginia have lots of different hardwood tree species, making the area a wonderful place to leaf peep. The predominance of the Red Maple tree: This species is one of the most abundant trees in the eastern US, and its scarlet red leaves make for spectacular fall viewing.

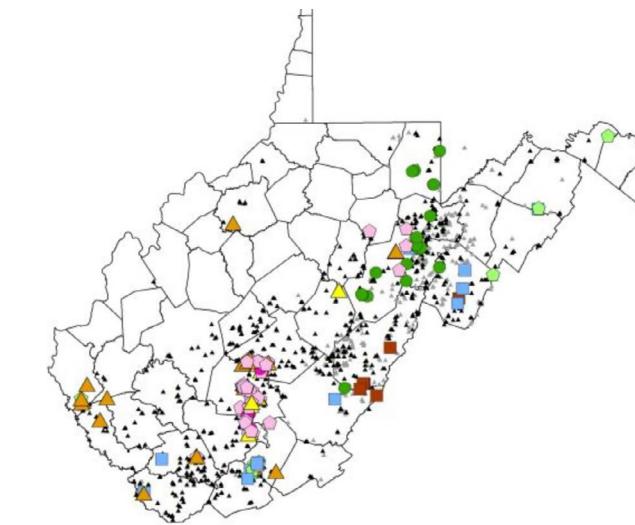
The Oak tree: There are a few different species of oak such as the Northern Red Oak, the Pin Oak, the Scarlet Oak and the Swamp Chestnut oak. They all grow very tall, so their leaves are prominently seen in the canopy. The other species covering the mountains are the Dogwood, the Sourwood, the Black Gum and the Sumac. The Hickory family: The Pignut Hickory, the Shagbark Hickory, the Shellbark Hickory, and the Mockernut Hickory all produce dull yellow or brownish-yellow leaves when they turn.

The Birch trees: Both the River Birch and the Sweet Birch dot the forest with yellow pigment, although the dull yellow of the River Birch will be more noticeable down lower in the valleys. Walnut trees, including the Black and White Walnut and the White Ash, the American Elm, the Silver Maple, the Black Locust, and the Beech trees all contribute to the ecosystem of West Virginia. The Sugar Maple: Sassafras and White Oak trees are dominant species of the forests apart from Witch Hazel and Sweetgum.



FLORA

AGRICULTURE & FOREST ECOSYSTEMS AT FAYETTE COUNTY



- WVNHP plots with hemlock
- ▲ FIA plots with hemlock
- Upland Hemlock - Hardwood Forest Plots
 - Allegheny Mountains Hemlock - Hardwood Forest
 - Chestnut Oak (- Hemlock) / Catawba Rosebay Forest
 - Hemlock - Chestnut Oak Forest
 - Hemlock - Hardwood / Great Laurel Acidic Cove Forest
 - Rich Hemlock - Hardwood Forest
 - Ridge and Valley Hemlock - White Pine Forest
 - ▲ Western Plateaus Hemlock - Hardwood Forest
 - ▲ Yellow Birch (- Hemlock, Tuliptree) Cold Cove Forest

Thenfourteen largest families of west virginia vascular plants

Family	Genera	Species
Apiaceae	25	42
Asteraceae	82	267
Brassicaceae	28	63
Caryophyllaceae	17	44
Cyperaceae	14	184
Ericaceae	12	29
Fabaceae	34	88
Lamiaceae	34	78
Liliaceae	29	61
Orchidaceae	18	44
Poaceae	71	199
Ranunculaceae	18	51
Rosaceae	24	164
Scrophulariaceae	24	52

FLORA

AGRICULTURE & FOREST ECOSYSTEMS AT FAYETTE COUNTY



Choke Cherry



Blackberries



Blueberries



Coralberries

FLORA

AGRICULTURE & FOREST ECOSYSTEMS AT FAYETTE COUNTY



Buttonbush



Climbing Bittersweet



Gooseberries



Haws



Elderberries



Grapes



Crabapples



Winterberry



Laurels



Mountain Fetterbush



Mountain Laurel



Plums



Hazelnuts



Hollies



Roses



Huckleberries



Scrub Oak



Serviceberries



Sweetfern



Viburnums



Sumac



Pawpaw



Hawthorn



Greenbriers



Virginia Creeper

FLORA

AGRICULTURE

In West Virginia, the typical start date, or the date of the last frost, ranges from September 1-October 15 lasting for an average of about 160 days.

In a 2017 Farm Market Viability study, the WVU Food Justice Lab found that vegetable farms made up only 3% of the total farms in the New River and Greenbrier River Foodshed. Farms included in their study mostly produced vegetables with 91% surveyed producing vegetables, 67% also raised livestock, 60% produced fruit, and 43% produced eggs.

Local food in West Virginia remains a growing industry. While still small compared to industrial scale agriculture in other regions, West Virginia local foods already have

an important economic impact. A recent small survey of supporting organizations and local food hubs found gross sales of at least \$1,191,678 in 2016. Demand for local food is also growing. A 2015 USDA Economic Research Service report Trends in U.S. Local and Regional Food Systems

A Report to Congress found that producer participation in local food systems is on the rise, and that the value of sales of local food appears to be increasing. US production of all vegetables is projected to increase an average of 0.6 percent a year for the next decade. This would mean an increase from 131.3 billion pounds in 2014 to 139.3 billion pounds in 2024. West Virginia has an opportunity to become part of that increase.



FLORA & FAUNA

ENDANGERED SPECIES

Status and Distribution of Threatened and Endangered Species (Updated July 2017)			
COMMON NAME	SCIENTIFIC NAME	STATUS	DISTRIBUTION
MAMMALS			
Cougar, eastern	<i>Felis concolor cougar</i>	E	May occur throughout the entire state. However, this species may be extinct or extirpated and there have been no documented, verified occurrences in WV in over 100 years.
Indiana bat	<i>Myotis sodalis</i>	E	May occur throughout the state. Known hibernacula (caves or abandoned mine portals) in Fayette, Greenbrier, Mercer, Monroe, Pendleton, Pocahontas, Preston, Randolph, and Tucker Counties. Critical habitat: Hellhole Cave, Pendleton County.
Virginia big-eared bat	<i>Corynorhinus</i>	E	Known summer or winter caves located in Grant, Pendleton, Randolph, Tucker and Counties. Also known to utilize abandoned mine portals in Fayette and Tucker Counties. May also occur in mine portals and caves throughout the state, particularly in Hardy, Kanawha, Mercer, Monroe, Nicholas, Preston, Raleigh, Summers, and Wyoming Counties.
Northern long-eared bat	<i>Myotis septentrionalis</i>	T	Occurs statewide. Hibernacula found in Pocahontas, Randolph, Tucker, Summers, Kanawha, Fayette, Raleigh, Preston, Hardy, Pendleton, Greenbrier, Monroe, Mercer, Grant, Mineral, Logan, Boone, Lincoln, and Marion Counties. K

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MAMMALS			
Gray Bat	<i>Myotis grisescens</i>	E	his species has been documented in Logan and Pendleton County, but it may use caves, abandoned mine portals, or bridges, in Wayne, Cabell, Lincoln, Kanawha, Boone, Fayette, Raleigh, Summers, Monroe, Mercer, McDowell, Wyoming, or Mingo Counties.
AMPHIBIANS			
Cheat Mountain salamander	<i>Plethodon nettingi</i>	E	Grant, Pendleton, Pocahontas, Randolph, and Tucker Counties.
FISHES			
Diamond darter salamander	<i>Crystallaria cincotta</i>	E	Clay and Kanawha Counties - Elk River.
CRUSTACEANS			
Madison Cave isopod salamander	<i>Antrolana lira</i>	T	Known in Jefferson County and may potentially also occur in Berkeley County.
Big Sandy Crayfish	<i>Cambarus callainus</i>	T	Tug Fork Watershed - Tug Fork River including tributaries
Guyandotte River Crayfish	<i>Cambarus veteranus</i>	E	Upper Guyandotte Watershed - Guyandotte River including tributaries
MOLLUSKS			
Mussel, clubshell	<i>Pleurobema clava</i>	E	Braxton, Clay and Kanawha Counties - Elk River. Harrison and Lewis Counties - Hackers Creek; Doddridge County - Meathouse Fork Pleasants, and Tyler Counties - Middle Island Creek Doddridge,

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MOLLUSKS			
Mussel, fanshell	<i>Cyprogenia stegaria</i>	E	Doddridge, Ritchie, and Wirt Counties - South Fork Hughes River Braxton, Calhoun, Gilmer, Wirt, and Wood Counties - Little Kanawha River; Mason, Pleasants, Tyler, Wayne, Wetzel, and Wood Counties - Ohio River; Harrison and Lewis Counties - West Fork River; Fayette, Kanawha, Mason and Putnam Counties - Kanawha River; Ritchie County - North Fork Hughes River.
Mussel, James spiny	<i>Pleurobema</i>	E	Fayette, Kanawha, Mason and Putnam Counties - Kanawha River; Cabell, Jackson, Mason, Pleasants, Tyler, Wayne, Wetzel, and Wood Counties - Ohio River.
Mussel, northern riffleshell	<i>Epioblasma torulosa rangiana</i>	E	Monroe County - Cove Creek, South Fork of Potts Creek, and Potts Creek.
Mussel, pink mucket	<i>Lampsilis abrupta</i>	E	Braxton, Clay and Kanawha Counties - Elk River and the lower ½ mile of these tributaries: Birch River, Blue Creek, and Laurel Creek
Mussel, rayed bean	<i>Villosa fabalis</i>	E	Braxton, Clay and Kanawha Counties - Elk River and the lower ½ mile of these tributaries: Birch River, Blue Creek, and Laurel Creek.

FLORA & FAUNA

Mussel, sheepnose	<i>Plethobasus cyphyus</i>	E	Fayette and Kanawha, Mason and Putnam Counties - Kanawha River; Cabell, Jackson, Mason, Pleasants, Tyler, Wayne, Wetzel, and Wood Counties - Ohio River.
Mussel, tubercled blossom pearly	<i>Torulosa</i>	E	Fayette, Kanawha, Mason, and Putnam Counties - Kanawha River. May be extinct.
Mussel, snuffbox	<i>Epioblasma triquetra</i>	E	Cabell County, Braxton County, Calhoun County, Clay County, Doddridge County, Gilmer County, Harrison County, Jackson County, Kanawha County, Lewis County, Marion County, Marshall County, Mason County, Monongalia County, Putnam County, Ritchie County, Roane County, Tyler County, Wayne County, Wetzel County, Wirt County & Wood County.
Snail, flat-spined three-toothed land	<i>Triodopsis platysayoides</i>	T	Monongalia and Preston Counties, including both sides of Cheat River Gorge
PLANTS			
Harperella	<i>Ptilimnium nodosum</i>	E	Berkeley County - Back Creek; Morgan County - Cacapon River, Potomac River, and Sleepy Creek.
Northeastern bulrush	<i>Scirpus ancistrochaetus</i>	E	Known in Berkeley and Hardy Counties and may potentially also occur in Hampshire, Mineral, Morgan, and Pendleton Counties.
Running buffalo clover	<i>Trifolium stoloniferum</i>	E	Known in Barbour, Brooke, Greenbrier, Fayette, Pendleton, Pocahontas, Randolph, Webster, and Tucker Counties. May potentially also occur in Monongalia and Preston Counties based on historical records.

FLORA & FAUNA

Shale barren rock cress	<i>Boechera</i>	E	Greenbrier, Hardy, and Pendleton Counties.
Small whorled pogonia	<i>Isotria medeoloides</i>	T	Greenbrier, Randolph, Tucker, and Pocahontas Counties.
Virginia spiraea	<i>Spiraea virginiana</i>	T	Fayette County - Gauley River, Meadow River, and New River; Greenbrier County - Greenbrier River and Meadow River; Mercer and Summers Counties - Bluestone River; Nicholas County - Gauley River and Meadow River; Pocahontas County - Greenbrier River; Raleigh County - Marsh Fork River, Dingess Branch, and Millers Camp Branch. May also potentially occur in Upshur County.
INSECTS			
Rusty patched bumble bee	<i>Bombus affinis</i>	E	May occur throughout the entire state. However, this species may be extirpated and has not been documented since 2000.



FLORA & FAUNA

ENDANGERED SPECIES



Hermit Thrush:
Marked as least concern by IUCN



Evening Grosbeak:
Marked as least concern by IUCN



Long-eared Owl:
Marked as least concern by IUCN



Sora:
Predation and Roadkill



Blackpoll Warbler:
Marked as least concern by IUCN



Snowshoe Hare:
Vulnerability to climate change



Rudiloria kleinpeteri:
Marked as least concern by IUCN



Star-nosed Mole:
Marked as least concern by IUCN



Coal Skink:
Marked as least concern by IUCN



Upland Chorus Frog:
Habitat loss



Pied-billed Grebe:
Habitat loss due to destruction of wetlands



Gray Bat:
Apparently secure and Human disturbance



Semipalmated Sandpiper:
Heavily dependent on few key stop over habitats during migration.



Bald Eagle:
Thinning of eggshells due to exposure to pesticide DDT and hunting.



Eastern Meadowlark:
Suitable for agricultural areas. Decline due to loss of suitable habitat.



Northern bobwhite:
Suitable for agricultural areas. Decline due to loss of suitable habitat.

FLORA & FAUNA

ENDANGERED SPECIES



Passenger Pigeon:



Upland Sandpiper:



Wood Stork:



Sharp-shinned Hawk:



Golden Winged Warbler:
Marked as least concern by IUCN



Peregrine Falcon:



Hooded Merganser:



Northern Goshawk:



Rusty blackbird
Marked as Vulnerable by IUCN.



Olive-sided flycatcher
Marked as Near Threatened by IUCN.



eastern spadefoot
Marked as least concern by IUCN.



Marbled salamander
Marked as least concern by IUCN



Cave salamander
Marked as least concern by IUCN.



Eastern worm snake
Marked as least concern by IUCN.



Rough Green snake
Marked as least concern by IUCN.



eastern kingsnake
Marked as least concern by IUCN.

FLORA & FAUNA

ENDANGERED SPECIES



Indiana bat
Marked as least concern by IUCN



Allegheny woodrat
Marked as Near Threatened by IUCN.



American chestnut
Marked as Critically Endangered by IUCN.



Halloween pennant
Marked as secure by IUCN.



Common Snowdrop
Marked as Near Threatened by IUCN.



broad-headed skink
Marked as least concern by IUCN.



Bushy Bluestem
Marked as secure by IUCN.



banded pennant
Marked as secure by IUCN.



Spectaclecase
Marked as endangered by IUCN.



Fanshell
Marked as critically endangered by IUCN.



Blue corporal
Marked as secure by IUCN.



Pink Mucket
Marked as vulnerable by IUCN.



Slaty skimmer
Marked as secure by IUCN.



Pharaoh cicada
Marked as near threatened by IUCN.



Sheepsnose
Marked as vulnerable by IUCN.



Maryland meadowbeauty
Marked as secure by IUCN.

FLORA & FAUNA

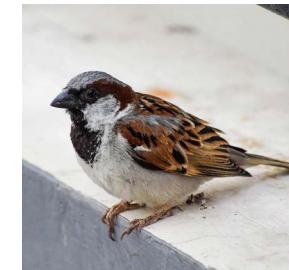
ENDANGERED SPECIES



Brown Creeper:
Marked as Least Concern by IUCN.



Blackburnian Warbler:
Marked as Least Concern by IUCN.



White-throated Sparrow:
Marked as Least Concern by IUCN.



Loggerhead Shrike:
Marked as Near threatened by IUCN.



Yellow-bellied Sapsucker
Marked as Least Concern by IUCN.



Black Vulture
Marked as Least Concern by IUCN.



Prothonotary Warbler:
Marked as Least Concern by IUCN.



Yellow-crowned Night-Heron:
Marked as Least Concern by IUCN.



Eastern Hognose Snake:
Marked as Least Concern by IUCN



Common Box Turtle:
Marked as Vulnerable by IUCN.



Chimney Swift:
Marked as Vulnerable by IUCN.



Eastern Spotted Skunk:
Marked as Vulnerable by IUCN.



Pine Snake:
Marked as Least Concern by IUCN.



Little Brown Bat:
Marked as Endangered by IUCN.



Northern Cricket Frog:
Marked as Least Concern by IUCN



Appalachian Cottontail:
Marked as Near threatened by IUCN.

FLORA & FAUNA

ENDANGERED SPECIES



white M hairstreak
Marked as secure by IUCN.



Running buffalo clover
Marked as vulnerable by IUCN.



Canadian yew
Marked as least concern by IUCN



Cobra clubtail
Marked as least concern by IUCN



Osprey
Marked as Least Concern by IUCN.



Cerulean Warbler:
Marked as Near threatened by IUCN.



Cooper's Hawk:
Marked as Least Concern by IUCN.



Horned Grebe:
Marked as Vulnerable by IUCN.



Cerulean warbler
Marked as near threatened by IUCN.



Blackburnian warbler
Marked as least concern by IUCN.



Blackpoll warbler
Marked as near threatened by IUCN.



Pine warbler
Marked as least concern by IUCN.



Kentucky coffeetree
Marked as secure by IUCN.



Virginia meadowsweet
Marked as Imperiled by IUCN



West Virginia white
Marked as Imperiled by IUCN.



Eastern whip-poor-will
Marked as Near threatened by IUCN.

FLORA & FAUNA

ENDANGERED SPECIES



blue-winged teal
Marked as least concern by IUCN.



northern bush katydid
Marked as secure by IUCN.



American Black Duck:
Marked as Least Concern by IUCN.



Ribbon snake
Marked as least concern by IUCN.



Fraser's sedge
Marked as apparently secure by IUCN.



American Coot:
Marked as Least Concern by IUCN.



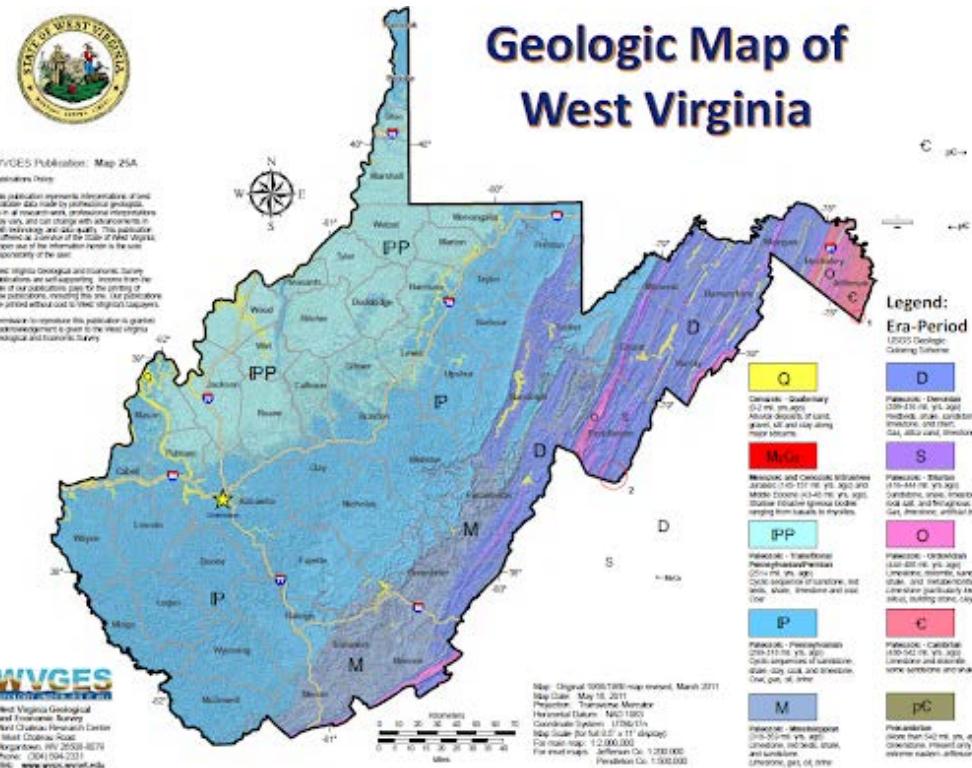
Hellbender:
Marked as Near threatened by IUCN.

GEOLOGY

The majority of bedrock exposed at the surface in West Virginia is sedimentary in origin, deposited during the Paleozoic Era (545 to 230 million years ago); very few igneous or metamorphic rocks are exposed at the surface due to deep burial beneath the thick Paleozoic cover. The geologic history of West Virginia prior to the Paleozoic is poorly understood. The oldest exposed rock in the State, in the tip of the eastern panhandle, is the Precambrian Catoctin Greenstone, A metamorphosed lava which erupted 800 million years ago.

During the Late Mississippian, the sea regressed from West Virginia leaving a low-lying, swampy Pennsylvanian terrain which produced thousands of feet of mainly non-marine sandstone, shale, and coal, the State's economic mainstay.

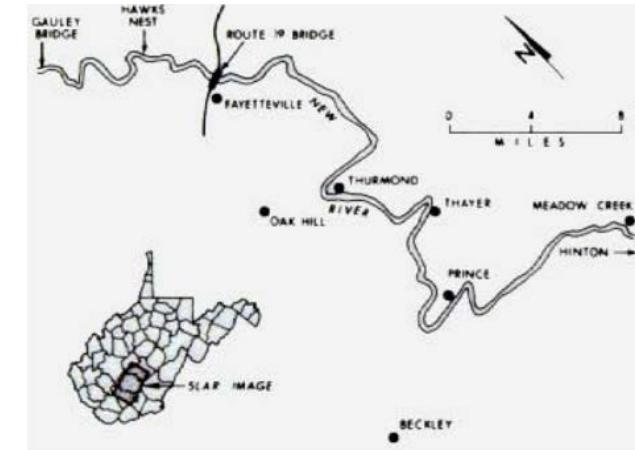
“Rocks found in Fayetteville are formed due to volcanic eruptions 800 million years ago resulting in formation of 1000s of feet of non-marine sandstone, shale and coal”



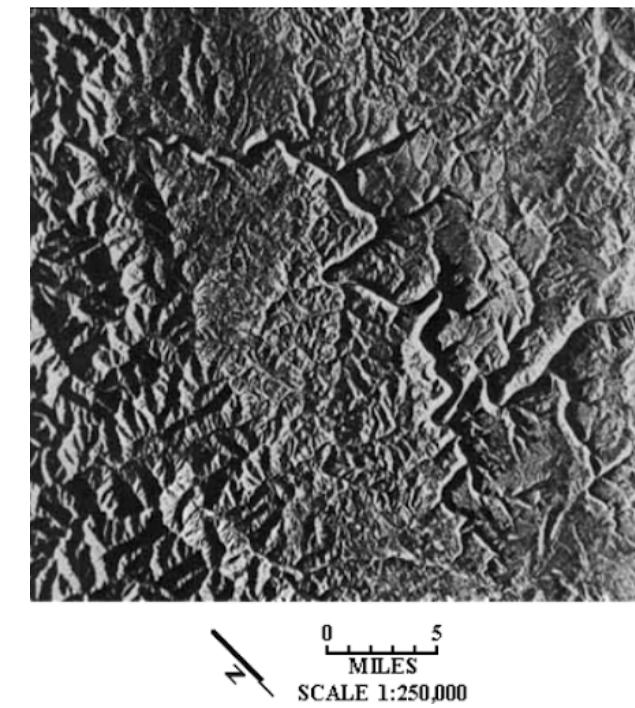
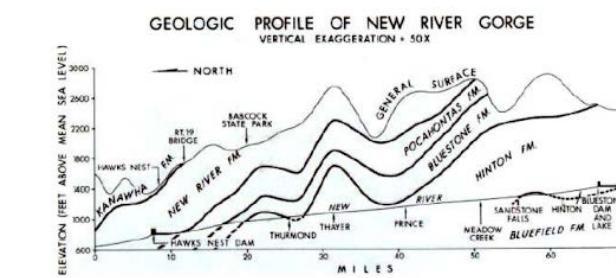
GEOLOGY

The New River Gorge passes through Fayette. Wolf creek is a tributary of this river.

The New River has performed natural surgery for us by cutting the Gorge from Hinton to Gauley Bridge (Figures 1a & b). This cut has exposed a view of the rocks that allows us to understand the present geologic conditions and interpret their geologic history (Figure 2). Such a scene is rare in the world, and consequently geologists take full advantage of these unique canyons. However, it is similar to putting together a jigsaw puzzle with many pieces missing and without the picture on the box.



As the river flows toward the north, the average elevation of the surrounding ridges also decreases northward, and the rock layers show this same inclination, or dip. So as one travels downstream, each successive rock layer disappears below the river and out of view as shown below.



GEOLOGY

STRATIGRAPHY

By examining the rocks along the Gorge, the sequence of layers can be pieced together to produce a cross-section of the entire 66 miles as shown above. From this study of rock strata, stratigraphy, the rocks can be placed in chronological order and grouped together into formations as shown in the table below. The age of the rocks is determined by the various types of fossils found in them. Similar rock types with similar fossils are grouped together as formations in the correct chronological position.

The rock sequences in the Gorge contain seven formations which can be lumped together into two major groups; the four oldest being of Mississippian age (the Mauch Chunk Group) and the three youngest of Pennsylvanian age (the Pottsville Group).



Straight fractures in Pineville sandstone just below Hawks Nest Dam. They consistently trend in a northeast direction, identical to many other fractures in Fayette County."

The rocks and fossils that are found in the New River Gorge are the keys to unraveling much of the past. Geologists must also examine the rocks throughout southern West Virginia to get a broader picture of the trends and changes that they have undergone. The geological information that we have today represents over 150 years of work and study by geologists, miners, and oil and gas operators.

ALARMING

CLIMATE INDICATORS

WEST VIRGINIA

This younger Pennsylvanian Group is distinctive because it is the oldest one containing commercial coal beds in West Virginia. The major boundary between the older Mississippian and younger Pennsylvanian occurs in rocks approximately 325 million years old.

The rocks were originally deposited horizontally as sediments in water bodies and swamps, but today they dip to the northwest at about 60 feet per mile due to subsequent tilting by mountain-building forces that affected all the Appalachians as shown below. The geologist can measure the true thickness of each layer, and by adding them together can obtain a total thickness of about 4,000 feet. This is not to be confused with the maximum depth of the Gorge, which is about 1,600 feet. The rock sequence is much thicker because the layers are tilted.

West Virginia's climate is changing. Majority of the state has warmed one-half to one degree (F) in the last century, with heavy rainstorms becoming more frequent. In the coming decades, a changing climate is likely to increase flooding, harm existing ecosystems, increase health problems, and possibly threaten recreational activities.

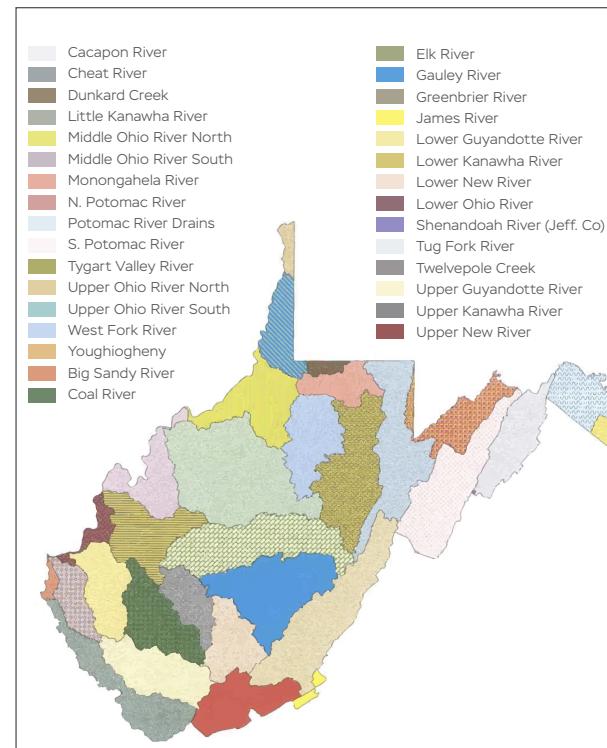
Carbon dioxide reacts with water to form carbonic acid, so the oceans are becoming more acidic. The surface of the ocean has warmed about one degree during the last 80 years, and sea level is rising at an alarming rate. Warming is also causing snow to melt earlier in spring.

In recent decades, the state has had flood-related disaster declarations nearly every year. These disasters

have often been associated with heavy rainstorms that also caused landslides and mudslides.

Increasingly heavy rains could increase pollution runoff and harm water that is used for fishing and swimming. Forests and Farms Rising temperatures and changes in rainfall are unlikely to substantially reduce forest cover in West Virginia, although the composition of those forests may change. More droughts would reduce forest productivity, and climate change is also likely to increase the damage from insects and disease. But longer growing seasons and increased carbon dioxide concentrations could more than offset the losses from those factors.

Forests cover more than three-quarters of the state.



“Frequency of very hot days is increasing. On an average, people in West Virginia will experience about 47 extremely hot days in 2050”

ALARMING

CLIMATE INDICATORS

WEST VIRGINIA

Maple, beech, and birch are the most common tree species in the central part of the state, while oak and hickory dominate the forests elsewhere. As the climate changes, oak and hickory trees are likely to become more common in the central part of the state as well. Climate change may also pose challenges for farmers.

Longer frost-free growing seasons and increased concentrations of atmospheric carbon dioxide tend to increase yields for many crops during an average year.

But more severe droughts and more hot days are likely to reduce yields. Higher temperatures are also likely to reduce livestock productivity: hot weather causes cows to eat less, grow more slowly, and produce less milk—and it can threaten their health.



Flood waters from the little Kanawha river in Parkersburg credit:
ED Hupp, Wood County Emergency Management

ALARMING

CLIMATE INDICATORS

ECOSYSTEMS

A changing climate threatens ecosystems by disrupting the existing relationships between species. Wildflowers and woody perennials are blooming—and migratory birds are arriving—sooner in spring. Not all species adjust in the same way, however, so the food that one species need may no longer be available when that species arrives on its migration. This can lead to animals not getting enough food. Warmer temperatures allow deer populations to increase, leading to a loss of forest underbrush, which, in turn, makes some animals more vulnerable to predators. Rising temperatures also enable invasive species to move into areas that were

“Compared to people in the United States, people in West Virginia will face increased risks from storm and heat due to climate change over next 30 years”

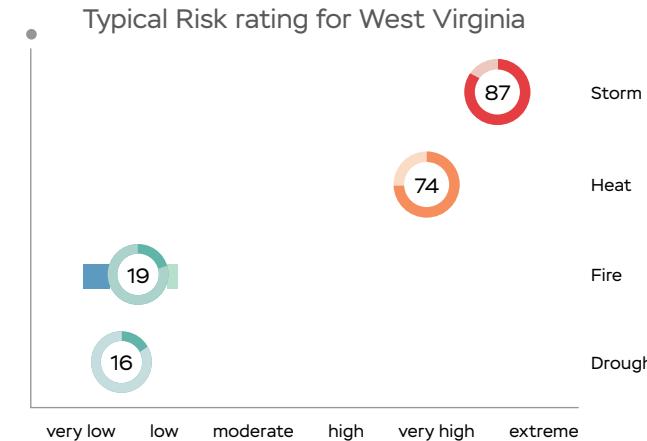


ALARMING

CLIMATE INDICATORS

ECOSYSTEMS

previously too cold. Rising temperatures and changing precipitation could also harm aquatic ecosystems. Warmer water lowers the level of dissolved oxygen in surface water, which can severely limit fish populations. Because fish cannot regulate their body temperatures, warmer water can make a stream uninhabitable for fish that require cooler water. Warmer water can also increase the frequency of algal blooms, which can be toxic and further reduce dissolved oxygen. Summer droughts may amplify these effects, while periods of extreme rainfall can cause runoff that increases pollution in streams.



ALARMING

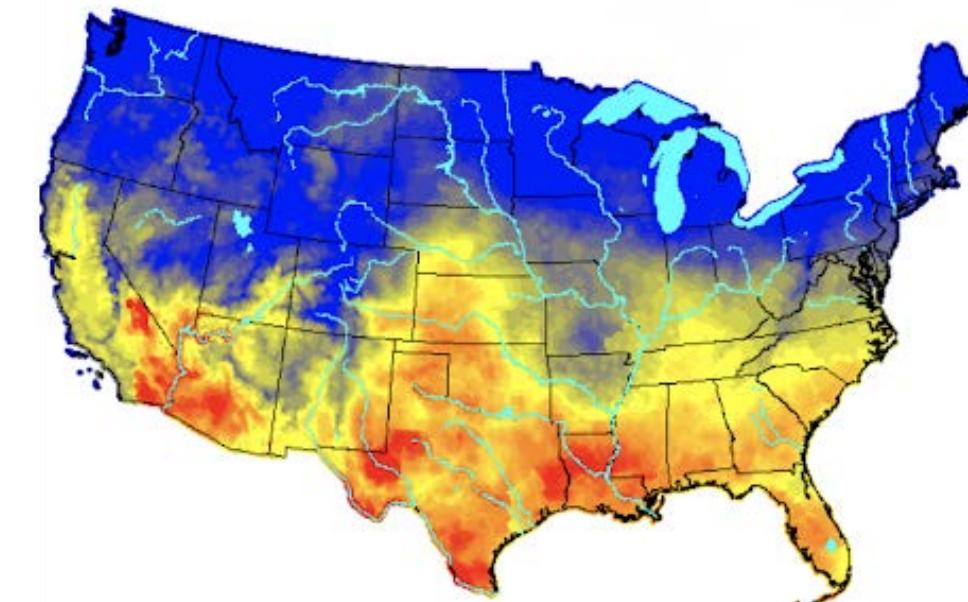
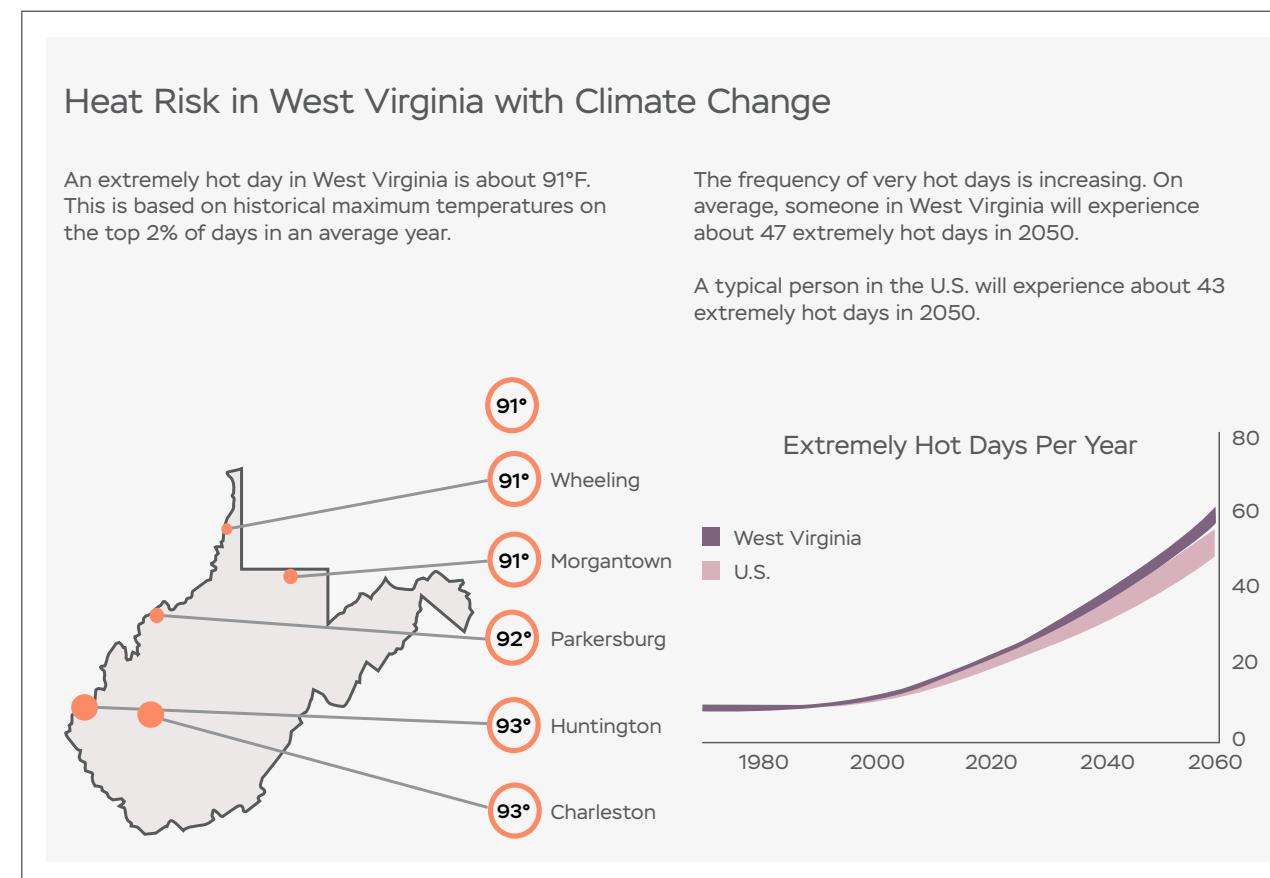
CLIMATE INDICATORS

ECOSYSTEMS

Livestock Stress due to Heat Stress

West Virginia's top agricultural industry is broiler production, while beef cattle and calves, dairy cattle, chickens and turkeys are also raised in the state. Many animals do not have sweat glands, they are unable to cool themselves through evaporation of sweat on their skin. Instead, animals will try and wade in the water, or breathe heavily to release added heat in their bodies. When animals are under heat stress, they can stop eating, decrease in weight, stop milk or egg production, and may not be able to reproduce.

“Second creek falls along with limestone, caverns, and karst terrain due to which contaminants on the surface could get diverted to the property through creek and karst basins”





INCOME AND EMPLOYMENT

According to US Census Bureau data, West Virginia is Third from the bottom in per capita income, ahead of only Arkansas and Mississippi. It is also the Last state in median household income. One major contributor to the state's low economic rankings is the low educational level of its population. The proportion of West Virginia's adult population with a bachelor's degree is the lowest in the country, at 15.3%.

One of the major resources in West Virginia's economy is coal. West Virginia also engaged in drilling oil, but currently only has small/medium sized scatter natural gas fields. Farming is also practiced in West Virginia the state ranks second in the US in total coal production, with about 15% of the US total. It is also a leader in steel, glass, aluminum, and chemical manufactures. Major agricultural commodities are poultry and eggs, dairy products, and apples.

Tourism is increasingly popular in mountainous West Virginia. More than a million acres have been set aside in 37 state parks and recreation areas and in 9 state forests and 2 national forests. 65.5% of the total civilian noninstitutional population aged 16-64 is employed. 15% of youth aged 16-24 are not enrolled in school and not employed. 5.1% of the population aged 25-64 years old is unemployed. Average income of a Fayette County resident is \$20,041 per year and the median household income is \$38,239 per year while the US average is \$28,555 and \$53,482 per year, respectively.

Median household income in Fayette County, WV is \$41,394. Average income of Men in West Virginia is 1.39 times higher than that of women. The income inequality in West Virginia (measured using the Gini index) is 0.444, which is lower than the national average.

PEOPLE

Fayette County Courthouse is surrounded by great public art, shops, music venues, a yoga studio, pubs, breweries, restaurants. In each one of these places, you'll find the smiling faces of people that are lucky enough to call this place home. One reason to love this little town is that its charm radiates from its people. The people of Fayetteville have created a fantastic place to live and made it a fun place to visit.

The total population of Fayette County as of 2014 is 45,709, which is 3.93% less than what it was in 2000. The population growth rate is much lower than the state average rate of 2.52% and is much lower than

“Largest industries in Fayette County, WV are Health Care & Social Assistance, Retail Trade, and Educational Services, and the highest paying industries are Mining, Quarrying, & Oil & Gas Extraction, Agriculture, Forestry, Fishing & Hunting, & Mining, and Information”



the national average rate of 11.61%. The Fayette County population density is 68.39 people per square mile, which is lower than the state average density of 76.51 people per square mile and is lower than the national average density of 82.73 people per square mile.

The residents of Fayetteville love to share their favorite hiking trails, best bike rides in addition to art, culture, history, antiques and amazing food.

LIFESTYLE STUDY

WEST VIRGINIA'S CULTURE

West Virginia has kept the Appalachian culture, which originated during the American Civil War, alive throughout the years. This is seen mostly through its folk music, brought by the Irish and Scottish settlers in the 18th century, which consists of the fiddle, banjo, and the Appalachian dulcimer. African-American blues is also an important part of West Virginia's culture, as is bluegrass and old-time country music. For more than 20 years Elkins, has hosted the annual Augusta Heritage Festival, which celebrates the Appalachian culture in West Virginia.

English and German ancestry is the most dominant in West Virginia, making up for more than 50 percent of the population. The town of Helvetia, however, is made up of predominantly of Swiss immigrants, a phenomenon celebrated at the annual Swiss-themed

Helvetia Community Fair. Still, it is the Scots-Irish that influence the state's culture the most, and not only through music. They also brought quilt making to West Virginia, although now the state has a style unique to itself. Quilting techniques here include the lack of contrasting borders, a unified pattern, and blocks pieced in a pattern, obscured by same color patterns and adjacent fabrics.

“Appalachian culture with its rich folk music is most predominant in West Virginia”



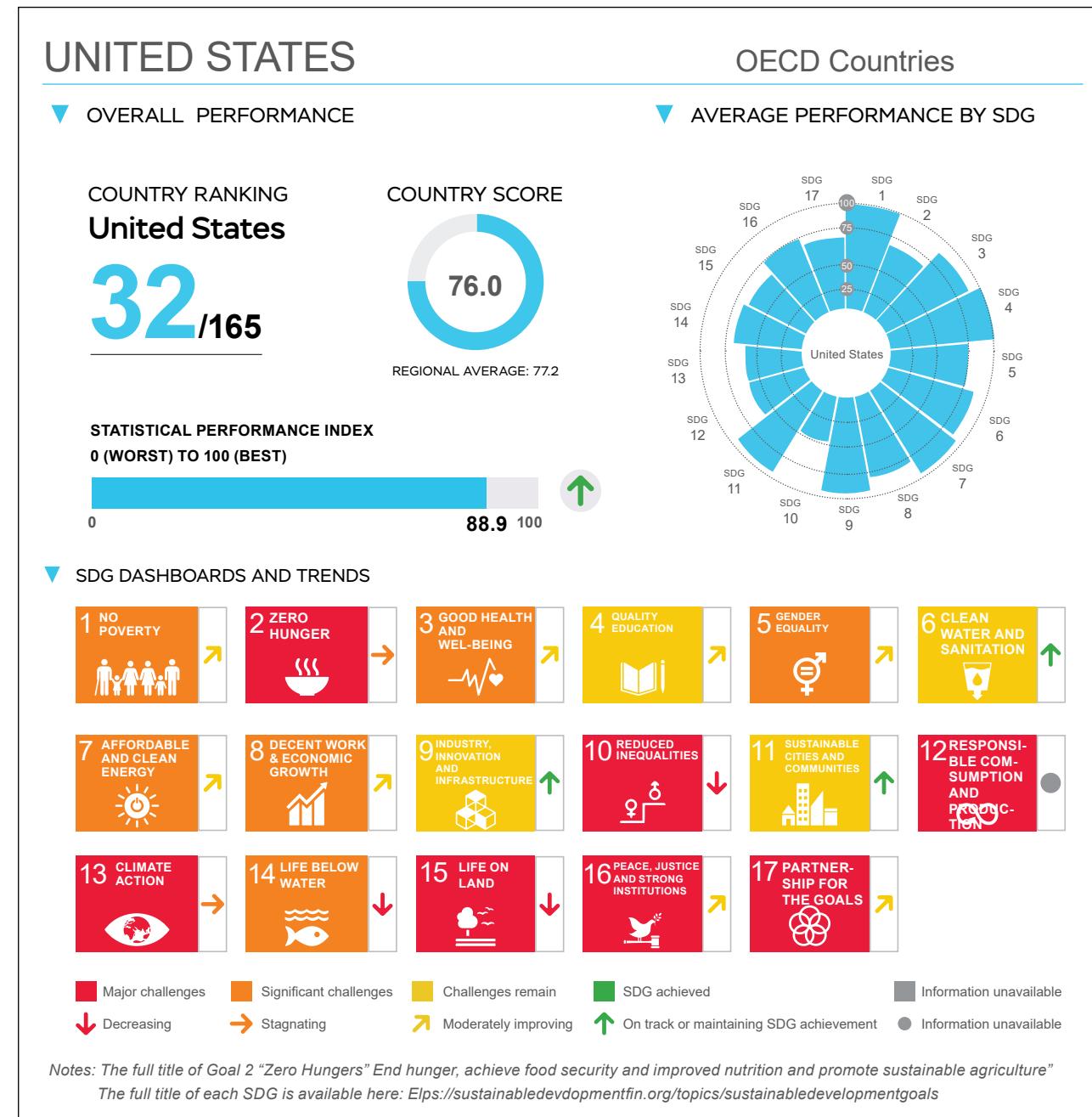
The background of the image is a wide-angle photograph of a natural landscape during sunset. It features a river winding through a valley, surrounded by mountains covered in dense forests. The trees display a variety of autumn colors, from deep reds and oranges to yellows and greens. The sky is filled with dramatic, layered clouds, with the sun low on the horizon, casting a warm, golden glow over the scene. A thin red horizontal line runs across the middle of the image, partially obscuring the landscape.

UNITED STATES SUSTAINABILITY DEVELOPMENT REPORT

STATE WISE RANKINGS

PERFORMANCE OF 193 UN MEMBER STATES

Countries are ranked by their overall score. The overall score measures a country's total progress towards achieving all 17 SDGs. The score can be interpreted as a percentage of SDG achievement. A score of 100 indicates that all SDGs have been achieved.

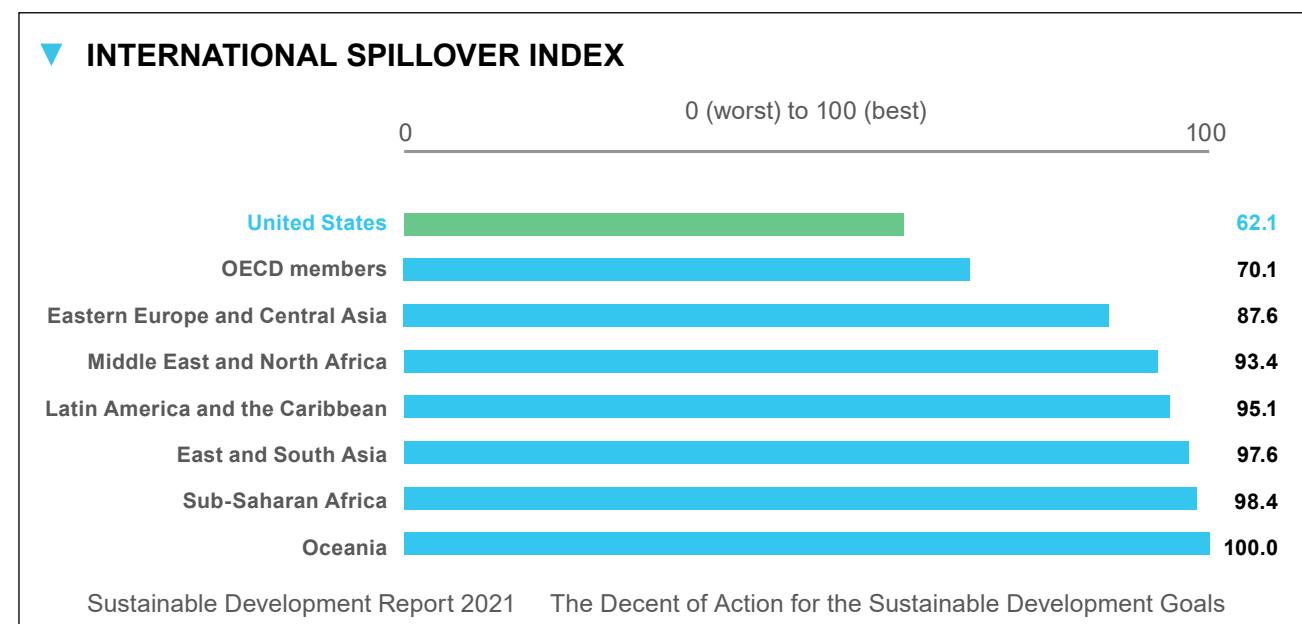


INTERNATIONAL SPILLOVER INDEX

Each country's actions can have positive or negative effects on other countries' abilities to achieve the SDGs. The Spillover Index assesses such spillovers along three dimensions: environmental & social impacts embodied into trade, economy & finance, and security. A higher score means that a country causes more positive and fewer negative spillover effects.

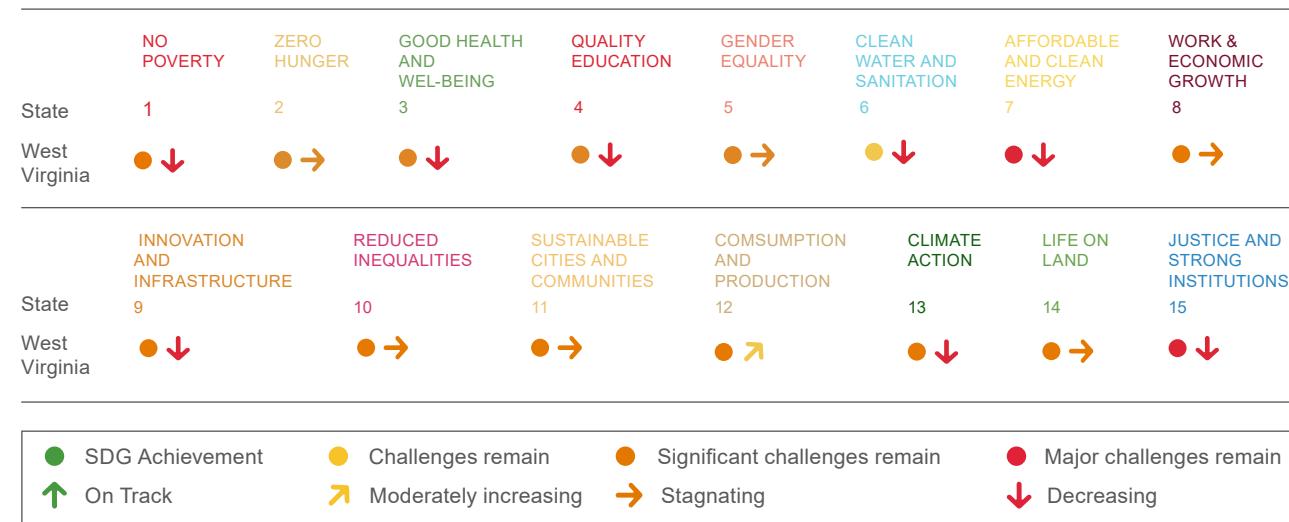
USA ranks 32nd in the listing with a score of 88.9 in the statistical performance index. However, the spillover score of USA is 62.1 with a rank of 146 out of 165 which means that there is huge scope for improvement on curtailing its negative spillover effects

United States
SDR 2021
Spillover score
Spillover score : 62.14/100 Spillover rank : 146/165



STATE WISE RANKINGS - USA

West Virginia ranks 49 out of 50 in the state wise sustainability rankings which means it has a huge scope for improvement and need to interfere.



Rank	State	Score	Trend
1	Vermont	60.4	→
2	Massachusetts	58.8	→
3	Washington	58.2	→
4	Minnesota	57.1	→
5	Maine	56.2	→
6	Oregon	55.5	→
7	New Hampshire	54.8	→
8	Hawaii	54.5	→
9	Maryland	54.3	→
10	California	54.1	→
11	New York	53.9	→
12	Connecticut	53.8	→
13	Colorado	53.6	→
14	New Jersey	52.4	→
15	Rhode Island	52.3	→
16	Wisconsin	51.2	→
17	Idaho	49.6	→
18	Delaware	48.4	→
19	Michigan	48.3	→
20	Virginia	48.2	→
21	Nebraska	47.4	→
22	Utah	46.6	→
23	Iowa	46.3	→
24	South Dakota	46.2	→
25	Illinois	44.6	→

Rank	State	Score	Trend
26	Montana	44.7	→
27	Nevada	44.5	→
28	Kansas	43.7	→
29	Pennsylvania	43.2	→
30	North Carolina	43.2	→
31	Arizona	42.9	→
32	Wyoming	42.3	→
33	Florida	41.9	→
34	Georgia	41.4	→
35	North Dakota	40.4	→
36	Missouri	40.4	→
37	South Carolina	39.5	→
38	Tennessee	39.5	→
39	Ohio	39.1	→
40	Kentucky	38.2	→
41	Texas	38.1	→
42	New Mexico	37.7	→
43	Alaska	36.9	→
44	Indiana	36.8	→
45	Alabama	34.3	→
46	Oklahoma	33.7	→
47	Arkansas	32.8	→
48	Louisiana	31.2	→
49	West Virginia	30.9	→
50	Mississippi	30.5	→

“ West Virginia ranks 49th out of 50 states in the state wise rankings ”

“ Trends for West Virginia show decrease in values for 8 Sustainability Goals while all others either show stagnation or no improvement ”

West Virginia





An aerial photograph of a river flowing through a dense forest. The river has a rocky bed and is surrounded by lush green trees. The perspective is from above, looking down the length of the creek.

CREST CLIMATE ACTION TARGETS

WOLF CREEK,
FAYETTE COUNTY, WV



CLIMATE HUB

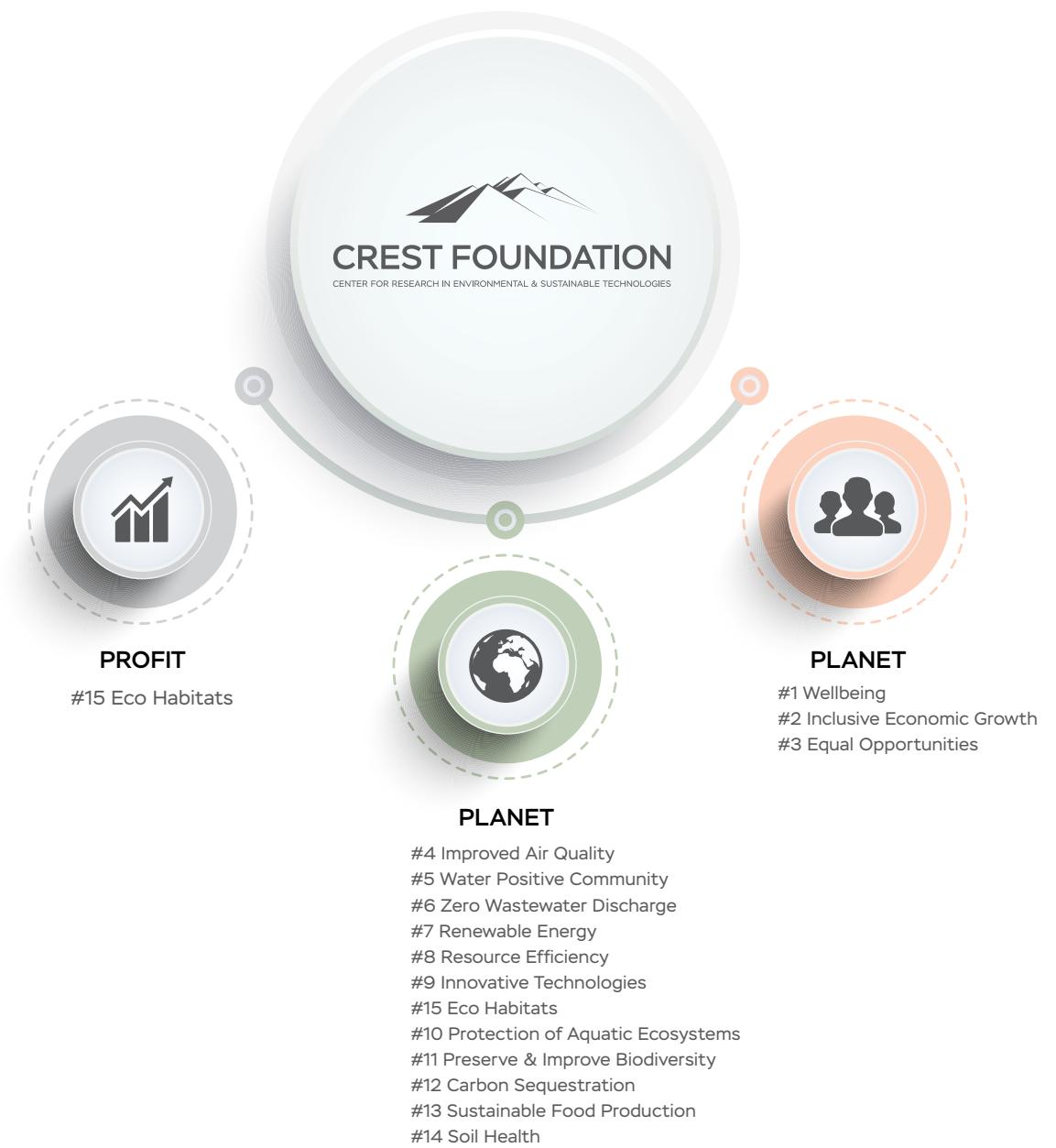
60% of the world's population will live in cities by 2030. Buildings consume a lot of energy and, together with the construction industry, contribute to 40% of the world's carbon dioxide emissions. As wildfires, hurricanes, and other dramatic climatic events become the norm, establishing baseline data to track climate change becomes vital.

Today, it's easier and more convenient for people to work and live in air-conditioned homes and offices. These closed-door living situations increase exposure to indoor air pollutants, which is unhealthy in the long run. Constant expansion and ever-growing demands of urban age have become major contributors for depletion of natural resources, deforestation, extinction of millions of plant & animal species and global warming which are bringing the human race closer to extinction each day.

CREST Foundation's Climate Hubs are designed to create a paradigm shift in building forest ecosystems that promote De-urbanization by reducing urban loads, forming farm communities that are organic, Net-Zero & Carbon Neutral. These communities reduce food miles and create access to chemical free, unaltered, safe and healthy food. The communities also include herbal forests that help absorb affluents and increase oxygen levels in the atmosphere thereby contributing to global cooling. These communities adapt proven watershed techniques to recharge deep aquifers and increase reserves for fast depleting potable water besides fueling rural development & sustained circular economy.

Climate Hubs are the new age, future proof, low density mixed-use climate responsive habitats which include. The Habitats include food forests, education institutes, healthcare, sports, and work facilities within them providing free power, vegetables, fruits, milk & meat for a lifetime. The habitats introduce its residents to uncontaminated fresh air, safe water, and healthy soil while also adding wellness and sustainable ecosystems to their modern living standards. Climate Hub is designed to create an impeccable impact on biodiversity that helps in restoring the environmental balance & play a key role in safeguarding the future of the human race on planet earth.

CREST FOUNDATION'S #15 CLIMATE ACTION TARGETS FOR WOLF CREEK, FAYETTE COUNTY





KEY CLIMATE ACTION TARGET **#1 WELLBEING**

People and the way they live are important aspects of the community along with their interactions within and outside. Their involvement in social welfare is an essential criterion for the wellbeing of a Climate Hub. To ensure healthy interaction within the community, Climate Hub incorporates the below elements into its design,

Amenities for physical wellbeing of the occupants:

Specially designed spaces to conduct Social, Financial, Physical & Community Level events will be an essential part of design. The project will assign common activity spaces for community events, parties and get togethers etc., to bring people from different walks of life together for a healthy social interaction. Thereby also addressing several psychosomatic medical disorders in humans such as depression, sleep disorders, social isolation etc., and enhances overall well-being.

Wolf Creek has several hidden scenic paths that are a joy to fitness enthusiasts and nature lovers alike. There will be cycling and jogging pathways and other relevant infrastructure through such routes to ensure and increase the use of cycles within the community.

The farm buffer area that is continuous and uninterrupted throughout the farm is designed to promote passive health with pebble walkways, semi covered spaces to practice yoga or just plain meeting and conversation spaces.

Climate Hub will also have its very own Medical Spa where one can relish leisure with ayurvedic massages, well equipped body care salon, at the luxury of their community spaces itself.

Congregated spaces for discussions and awareness programs: Tie ups with NGOs and rehabilitation centers etc., is part of the wellness plan of a Climate Hub. Help from these organizations by conducting workshops to promote healthy lifestyles contribute to supporting overall wellbeing of the community.

Health benefits of taking organic food: Climate Hub is a community driven by "The Greenculture" who respect nature's way to lead a life of self-sustenance through completely sustainable methods of farming. Community members get to witness firsthand the design, execution and maintenance of Witnessed, unadulterated organic food cultivated without the use of harmful chemicals, antibiotics or growth hormones



KEY CLIMATE ACTION TARGET #2 INCLUSIVE ECONOMIC GROWTH

Employment to people from surrounding rural areas thereby increasing their income levels: A Climate Hub will need several personnel for service roles such as Construction, Administration, Security, Housekeeping, and many more. CREST would identify staff required from people in surrounding counties and provide them with skill development training to eventually hire them as part of the maintenance team for the whole property. So, the employment needs are locally fulfilled.

Apart from opportunities within the community, there would be an increase in auxiliary job opportunities because of the development such as, road maintenance, kitchen support, waste management, marketplaces etc., creating a spillover effect by also improving the property prices. Climate Hub will have the capacity to provide employment to approximately 400 support staff without any discrimination based on religion, sex, race, nationality, age.

This in turn positively contributes to the per capita income levels and decreases the unemployment rate of the county.

Places like WV and Fayette County, have relatively less population, hence, there is potential for support to be provided at a larger scale with the help of climate Hub

Helping people de-urbanize: Simple living standards such as waste management starting at home, letting go of redundant spending habits, becoming one with nature, exploring possibilities of a minimalistic lifestyle would all become part of everyday life at Wolf Creek Climate Hub.

“ About 400 jobs will be created for people in surrounding towns and villages ”



KEY CLIMATE ACTION TARGET #3 EQUAL OPPORTUNITIES

Zero discrimination as the motto, Climate Hub will provide equal Opportunities irrespective of Gender, Religion, Caste & Color

It is important to create a community that is fair, inclusive, and builds a workforce which reflects diversity. A diverse community allows all contributors to contribute their knowledge, skills, and abilities to the community regardless of background, religion, race, gender, sexual orientation, or any grounds for discrimination and eliminating barriers to participation.

Climate Hub follows a Diversity Policy that provides a framework for the organization to achieve the following.

- Diversity in the context of employment primarily refers to the equal employment opportunity provided to everyone.



KEY CLIMATE ACTION TARGET **#4 IMPROVED AIR QUALITY**

Air Quality in Fayette County is good with negligible ground Ozone levels (O₃)

Smog (Smoke + Fog) is the main reason for increase in ground level ozone. It is formed when smoke from vehicles is mixed with fog. It is extremely toxic to plants and can cause breathing difficulties in humans.

Vehicular pollution is reduced within the community by introducing safer means of commuting e.g., e-bikes, cycling, other sustainable commuting options etc.,

Use of low VOC compounds:

VOCs are only one of several toxic compounds that can be found in paints. VOCs are crucial pollutants because of

their contribution to the formation of ground-level ozone. When VOCs are released into the atmosphere, they react with nitrogen oxides (NO_x) to create ozone molecules. Ground-level ozone can have many impacts on human health and is the key pollutant that causes smog.

Low VOC refers to volatile organic compounds that are not harmful to the environment and humans as they contain a lower amount of VOC content than conventional paints and create no impact on the ozone layer.

All farming and afforestation activities in the property will be chemical free ensuring the end users have zero exposure to pesticides.



“
Plant species for Afforestation at Wolf Creek are carefully chosen to reduce toxicity and maintain good Air Quality”

KEY CLIMATE ACTION TARGET **#5 WATER POSITIVE COMMUNITY**

The water demand for the project is primarily domestic and farming. The project intends to use rainwater for all its domestic requirements. The Annual domestic water requirement is 74,318,745 Gallons. 100% of the domestic water requirement will be met by harvested rainwater.

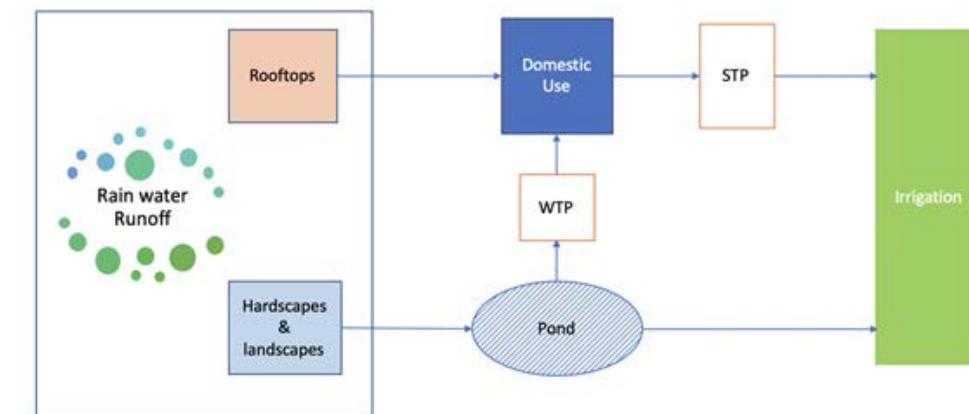
The average mean precipitation of the state is 45 inches with an average of 145 days of precipitation. The site has a rainwater harvesting potential of 252,757,898 Gallons of water. The rainwater from rooftops and rainwater runoff from the landscape areas will be collected separately as the filtration requirement is different for rooftop rainwater which has less sediments. The runoff from rooftops will be collected in tanks and filtered for domestic use. About 60% of the domestic water requirement can be met with the rainwater collected from rooftops. The runoff from hardscapes and landscapes can be collected along the trenches and will be routed into the rainwater collection ponds. The remaining 40% of the domestic water is taken from the collection ponds after adequate filtration in the water treatment plant.

The collected rainwater will be filtered in the water treatment plant and distributed for domestic use.

Water consumption would be further controlled/reduced with the help of water efficient plumbing fixtures

“
Reduction of ground level Ozone (O₃) is vital to improving air quality at Wolf Creek”

The annual farming water requirement of the project is 60,605,775 gallons. The available treated waste water from the STP is 59,454,996 gallons i.e, 98% of the farming water requirement is met with the treated wastewater. Remaining 2% will be taken from the rainwater collection ponds



KEY CLIMATE ACTION TARGET #6 ZERO WASTEWATER DISCHARGE

Wolf Creek Climate Hub will be a zero-wastewater discharge site. It is observed that the water in the streams of Greenbrier watershed have fecal contaminants due to failure of septic systems.

The project will have an onsite wastewater treatment facility to treat the black and grey water using natural biological systems and chemical free methods. The treated wastewater will be used for farming and landscaping purposes.

There is no discharge of liquid effluent into surface waters, in effect completely eliminating the environmental pollution associated with the treatment.

Effective use of wastewater treatment, recycling, and reuse contributes to water conservation through reduced intake of fresh water.

It is a wastewater management strategy that eliminates liquid waste and maximizes water usage efficiency.

“Wastewater treatment facility at Wolf Creek is critical to keep water contamination under control”



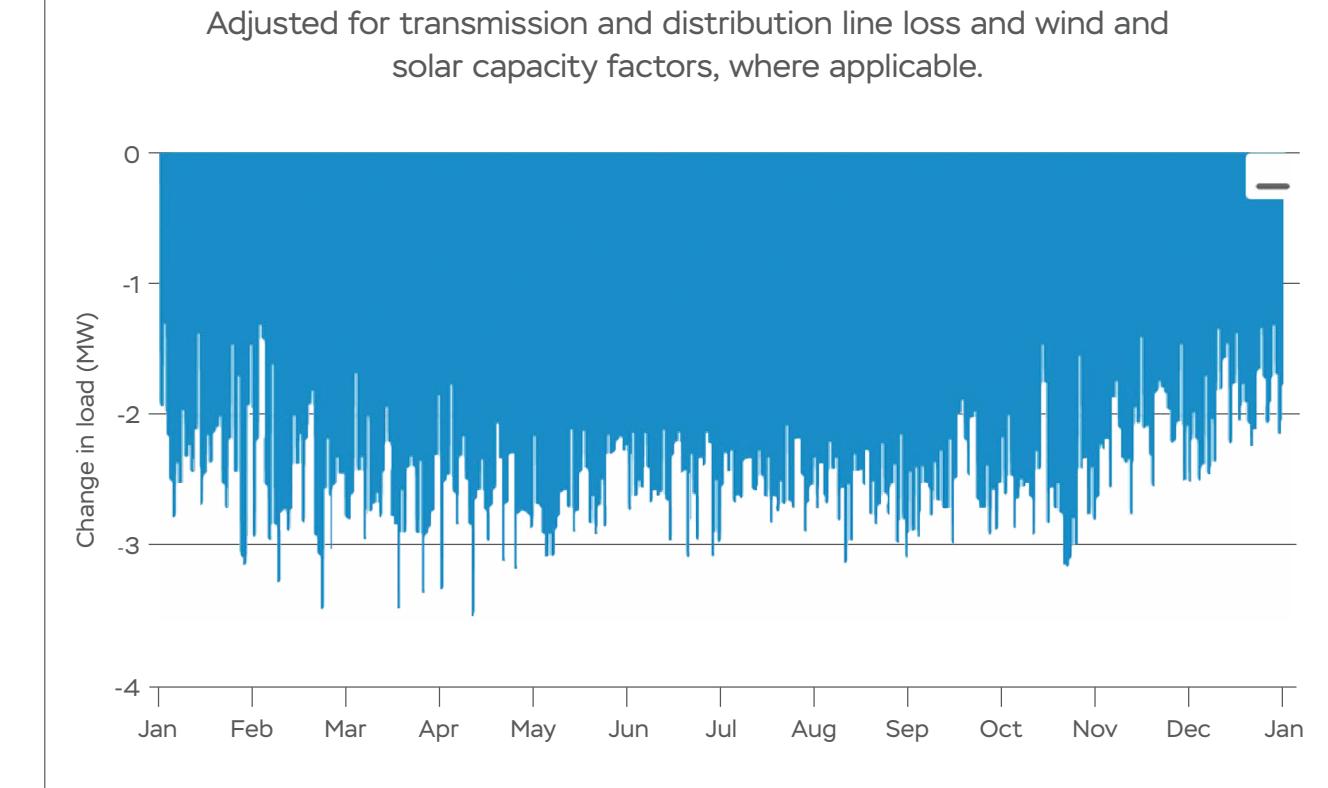
KEY CLIMATE ACTION TARGET #7 RENEWABLE ENERGY

Climate Hubs are net zero-energy positive communities which produce renewable energy through solar and wind energy systems to meet 100% of the energy demand loads.

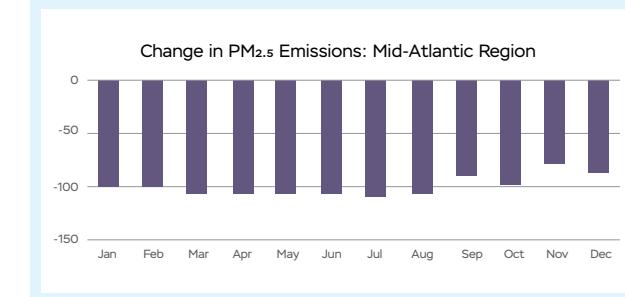
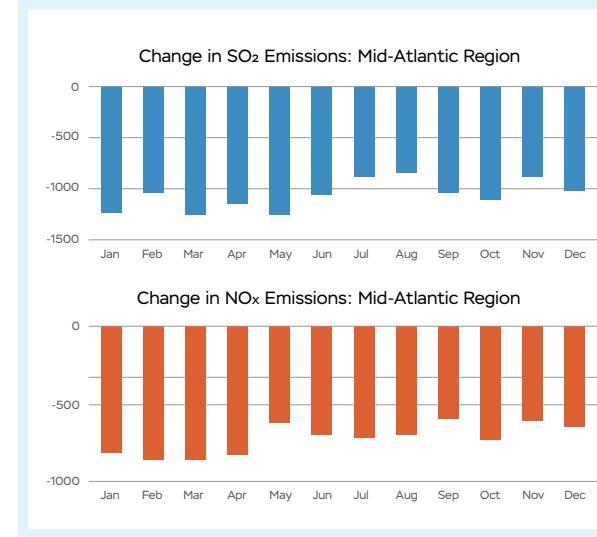
The combined annual energy consumption per household is approx. 13408kwh. The total energy demand for the project including common areas and amenities would be approx. 10,042,523 kwh.

A solar wind hybrid energy system of 6.5MW capacity shall be installed which would produce energy of approx. 10,063,914 kwh

“10,042,523 kwh energy demand loads of Wolf Creek shall be met through Clean Energy using Solar Wind Hybrid system”



AVOIDED EMISSIONS POST INSTALLATION OF RENEWABLE ENERGY SYSTEMS



“ CO₂ Emissions avoided due to Renewable Energy is equivalent to carbon sequestered by 57,185 trees ”

The graphs show the impact the installation of 3.5MW Renewable Energy system at Wolf Creek has in emissions of particulate matter (PM_{2.5}), nitrogen oxides (NO_x), sulfur dioxide (SO₂), carbon dioxide (CO₂), volatile organic compounds (VOCs), and ammonia (NH₃) from electric power plants at state level.

The table shows original emissions, avoided emissions post-installation of Renewable Energy systems and the impact due to Renewable energy systems on the Mid-Atlantic Region

ANNUAL REGIONAL DISPLACEMENTS & MICRO GRID

Annual Regional Displacements: Mid-Atlantic Region

	Original	Post-EE/RE	EE/RE Impacts
Generation(mwh)	462, 205, 000	462, 199, 110	-5, 890
Total Emissions from Fossil Generation Fleet			
SO ₂ (lb)	384, 131, 570	384, 125, 080	-6, 490
NO _x (lb)	285, 094, 440	285, 090, 160	-4, 280
Ozone season NO _x (lb)	121, 757, 180	121, 755, 150	-2,030
CO ₂ (tons)	319, 283, 750	319, 279, 440	-4,310
PM _{2.5} (lb)	40, 034, 350	40, 033, 800	-550
VOCs (lb)	6, 885, 850	6, 885, 730	-110
NH ₃ (lb)	8, 069, 740	8, 069, 610	-130
AVERT-derived Emission Rates:	Average Fossil		Marginal Fossil
SO ₂ (lb/MWh)	0. 831		1. 101
NO _x (lb/MWh)	0. 617		0. 727
Ozone season NO _x (lb/MWh)	0. 580		0. 732
CO ₂ (tons/MWh)	0. 691		0. 731
PM _{2.5} (lb/MWh)	0. 087		0. 094
VOCs (lb/MWh)	0. 015		0. 019
NH ₃ (lb/MWh)	0. 017		0. 022

Negative numbers indicate displaced generation and emissions. All results are rounded to the nearest ten. A dash ('-') indicates a result greater than zero, but lower than the level of reportable significance.

When solar power is not in tune with energy demand loads, the demand is met by the external electrical grid.

Net Metering is the policy that allows individuals with solar to get a credit on their electric bill for the energy they produce from their system.

Net Metering is used to compensate for energy deficiency when production is low. When energy production is greater than required, the excess energy is exported to the grid.

The West Virginia senate passed a bill that exempts solar power purchase agreements from state regulatory jurisdiction in an effort to encourage retail customer investment in solar energy.

“ Amount of renewable energy produced within Wolf Creek Climate Hub will displace 6 GWh of regional fossil fuel generation over a year. This equals the annual electricity consumption by 487 homes in the United States ”

KEY CLIMATE ACTION TARGET

#8 RESOURCE EFFICIENCY

Population explosion, coupled with improved lifestyle needs of people, results in increased solid waste generation in urban as well as rural areas of the country.

All wastes become hazardous if not carefully disposed of resulting in irreversible damage to earth overtime. But what is equally important is that all waste is recyclable.

Recycling reduces demand of virgin materials, consumes less water and energy. There is a need to look at waste not merely as an environmental polluter but as a recyclable material of great potential and energy saver.

Strategies for Waste Management & Reduction:

Types and quantity of waste generated by the community will be monitored. residents, staff and vendors would be educated on how to reduce the waste.

Waste hierarchy shows the best way to avoid shrinkage of valuable resources by preventing waste from getting generated in the first place. The goal is to maximize efficiency and avoid unnecessary consumption through behaviors such as :

- Selecting items with the least packaging or that require the fewest resources to produce
- Avoiding disposable goods or single-use materials
- Buying products that are recycled, recyclable, repairable, refillable, re-usable or biodegradable
- Using leftover food rather than throwing it away

KEY OBJECTIVES:

- To take all reasonable steps to ensure that waste management controls are observed.
- To minimize the amount of waste generated and maximize the amount of waste reused and recycled.
- To reuse and recycle as much waste as possible on-site. Where on-site reuse is not possible, identify the most appropriate waste management option in line with the waste hierarchy.
- To manage waste as close as possible to the site location.
- To provide training to improve awareness of waste management issues with all residents, staff and vendors and to improve waste management practices on-site

RESOURCE EFFICIENCY



“ Wolf Creek Climate Hub is a Zero waste to landfill project ”

Types of Waste : Domestic waste can be broadly classified in to 5 types

1. Dry Waste (paper, plastics, tetra packs, cardboard, glass, thermocol, etc)
2. Wet Waste (food leftovers, rotten fruits, eggshells, tea leaves, flowers, etc.,)
3. Sanitary Waste (sanitary napkins, diapers, bandages, condoms, etc)
4. E- Waste (all electronic waste like batteries, phones, chargers, computer parts, appliances, etc.,)
5. Hazardous Waste (chemicals, cosmetics, paints, oils, medicines, syringes, razors, broken glass, etc.,)



RESOURCE EFFICIENCY

SEGREGATION OF WASTE AT HOME LEVEL :

For simplification and ease of segregation for residents, there would be three bins only at home level

- Dry Waste
- Wet Waste
- Reject Waste – Sanitary & Hazardous Waste.
- Wet waste would be transferred to the Biogas plants for power generation & compost
- Dry waste would be transferred to central waste storage facility where it will be further segregated into papers, cardboard, plastic, metals, rubber, thermocol, etc.,
- Closed loop systems
- All recyclable materials will be sent to recycling facilities and non-recyclable plastics will be used as raw material in plastic to fuel/energy systems to recover energy.
- Sanitary waste like diapers and sanitary napkins must be covered fully in newspaper and marked with a red cross. They will be incinerated within the site.
- E-waste is collected quarterly by the housekeeping team and stored centrally and will be picked up by recycling vendors
- Hazardous waste like chemicals, paints, oils, pesticides will be separately stored in the HHW bin at the central waste storage facility and will be handed over to permitted Hazardous waste treatment facility.

RESOURCE EFFICIENCY

Wolf Creek project would generate about 1744 US Tons of waste Annually ie 3,489,400 pounds of waste. The potential methane gas that will be generated if the waste goes in to a landfill is 109,916 kgs which is equivalent to 3,077,650 kgs of CO₂. The avoided CO₂ emissions due to proper handling of waste is equal to carbon sequestration by 18,430 trees.



KEY CLIMATE ACTION TARGET

#9 INNOVATIVE TECHNOLOGIES

In the U.S., discarded plastic is far more likely to end up in a landfill or a facility like Covanta's than it is to be recycled.

According to the Environmental Protection Agency, Americans recycled only 9.1% of their plastics in 2015. Waste-to-energy facilities combusted 15.5%. But the most likely destination for the plastics discarded in the U.S. is the landfill.

According to EPA, recycling metals, paper, and plastics recovers roughly 16 billion J of energy per metric ton of material. Burning that same ton for energy saves about 7 billion J.

Proponents of waste to energy say the technology is cleaner than other power sources. According to SWANA's O'Brien, waste-to-energy plants emit less CO₂, sulfur dioxide, and nitrogen oxides than coal-fired power plants do per unit of power.

Waste-to-energy plants emit less than coal-and oil based energy plants but more than natural gas plants.

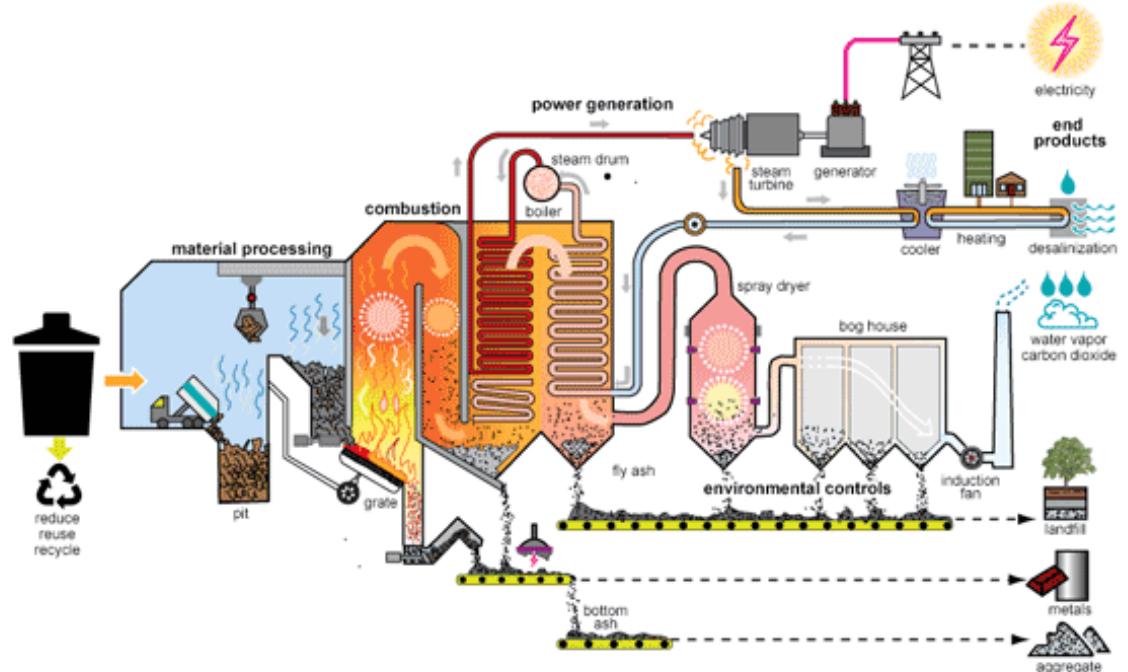
FUEL	EMISSIONS, kg/(MW·h)		
	CARBON DIOXIDE	SULFUR DIOXIDE	NITROGEN OXIDES
Municipal solid waste	560.45	0.23	1.50
Coal	1,022.27	5.91	2.73
Oil	760.00	5.45	1.82
Natural gas	515.91	0.05	0.77

Source: Jeremy O'Brien, director of applied research, Solid waste association of North America

ENERGY POTENTIAL FROM WASTE

If all municipal solid waste headed to landfills each year could be converted to energy, we could produce enough electricity to power nearly 14 million households annually. That could be more than 12 percent of American households powered solely from garbage. In other words, we have a domestic source of energy that could power 14 million homes every year.

“ Municipal solid waste when converted to energy has the ability to produce electricity enough to power 14 million households annually ”

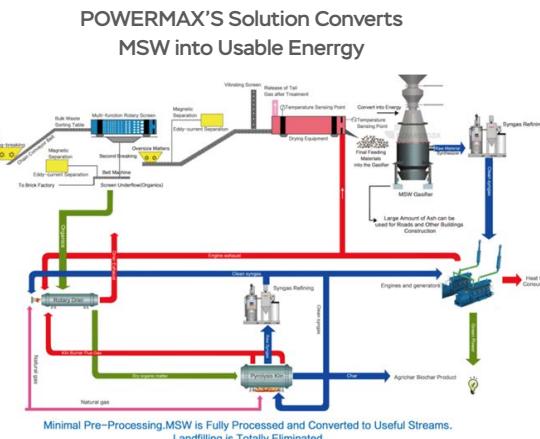


INNOVATIVE TECHNOLOGIES - POWERMAX WASTE GASIFICATION

POWERMAX Waste Gasification Power Generation System is to use RDF (fuel made by crushing, selecting, drying and compressing of the combustible rubbish) as raw materials and adopts the advanced technology of waste gasification to produce combustible gas. The steam produced from the burning of the gas can be used by the steam turbine to generate power (POWERMAX Waste Gasification Steam Power Generation Technology), or the combustible gas can be cooled down to drive the power generation of the gas gensets(POWERMAX Waste Gasification Gas Engine Power Generation Technology). In addition, the produced gas can also be delivered directly to all kinds of boilers or kilns for heating and thermal application; or to be supplied to residential users as their household energy.



POWERMAX Waste Gasification Power Generation System has two types. The POWERMAX Waste Gasification Gas Engine Power Generation Technology includes three steps. The first step is RDF gasification, which converts processed RDF into syngas. The second step is syngas purification. The produced gas usually contains contaminants including dust, coke, tar and etc. The contaminants must be removed by the purification system and cooled down to ensure the normal operation of the gas engine. The third step is gas power generation through the gas engine. The high temperature exhaust flue gas produced by the gas engine can be reused by waste heat boiler to generate steam or hot water for civil or industrial use and can also provide heat for the drying process of the RDF.



INNOVATIVE TECHNOLOGIES - PLASTIC 2 OIL

Plastic2Oil Inc. has pioneered the development of a process that derives ultra-clean, ultra-low sulphur fuel which does not require further refining, directly from unwashed, unsorted waste plastics.

The modular design of the P2O process is built on a structure of racked reactors, feeders and towers which allows for cost-effective process efficiencies.

Plastic2Oil has been issued all necessary permits



to operate by the New York State Department of Environmental Conservation (NYSDEC). Engineering report performed by SAIC validates and verifies the technology and economics.

The processor requires only 4,500 sq. ft. of operating space. Height requirement is approximately 20 ft. Highly automated; very low operator to processor ratio. Modular design allows for easy deployment.

“ Wolf Creek Climate Hub employs innovative technologies that help in energy generation through waste such as deriving energy/fuel from unrecyclable plastic etc., ”

PLASTIC 2 OIL - PROCESS & RESOURCE USAGE

The conversion ratio for waste plastic into fuel averages 86%. Approximately 1 gallon of fuel is extracted from 8.3 lbs. of plastic.

The processor uses its own off-gases as fuel (approximately 10-12% of process output); minimal energy is required to run the machine. Approximately 2-4% of the resulting product is Petcoke (Carbon Black), a high BTU fuel. Emissions are lower than a natural gas furnace of similar size, and the quality of the emissions improve with increased feed rates. Results from the final stack test performed by Conestoga-Rivers & Associates confirm that the processor emissions are well within the limits allowable under a NYSDEC air permit.



The P2O processor is designed to use minimal amounts of external energy. As well as being beneficial for the environment, this is also a significant factor in the commercial viability of the process. Water is used for cooling only and usage is minimized through recycling the water in a non-contact closed loop. The water is not in contact with the process itself, keeping it clean and uncontaminated. Only 53 kWh electricity is required to run the fans, pumps and small motors. No electricity is used in the transformation of the plastic to fuel. Natural gas is only used on start-up to heat the reactor – once the processor is running, the reactor is heated with its own off-gases. A facility-wide gas compression system governs natural gas usage throughout the entire production process.

PLASTIC 2 OIL - PARTNERSHIPS

Plastic waste is expensive to deal with and leads to the need for increased landfill capacity. With Plastic2Oil's P2O technology, companies can manage expensive waste plastic streams, reduce costs and align themselves with viable environmentally responsible initiatives.

A second option for business partnership with Plastic2Oil® is one which involves processors being installed at corporate sites that manage large volume plastic streams. Installing a P2O processor at these sites helps organizations to:

- Decrease tonnage of waste plastic that is currently being directed to landfill and reduce cost associated with disposal (ie. tipping fees).
- Have access to affordable, cleaner burning fuels that reduce emissions into the environment.
- Respond to a growing expectation for business & government to align with green initiatives and be more environmentally responsible.



As both solar radiation and wind vary throughout the year, neither solar nor wind based system can provide reliable power individually. Thus, hybridizing Solar Wind system provides reliable source of energy all round the year.

PowerMill™ designed and built by WindStream Technologies and solves the problem of deploying utility scale wind power devices where conventional Horizontal Axis Wind Turbines (HAWT) do not meet the geographical or resource needs of the area. Built to harness lower wind speeds than are required by large HAWT, the PowerMill™ utilizes WindStream' proprietary Vertical Axis Wind Turbine (VAWT) technology with a system of solar panels making up a true hybrid renewable energy solution. Packaged into a convenient turn-key solution, the PowerMill™ is uniquely designed

“ Solar Wind Hybrid System enhances power generation to 24 hours 365 days a year making it most efficient ”



to be installed where traditional utility scale devices cannot provide a compelling return on investment for the owner/operator.

Features

- All in one micro-grid ready system.
- Deploys straight out of container.
- Flexibility with wind, PV and battery inversion.
- Containerized battery storage and control system.
- Off-grid capability.
- Container acts as stabilizer for mounting and installation.

Advantages – On Grid/Off Grid

- More Power
- Highly Scalable
- More reliable
- Fast Installation
- Improved Generation Stability
- Less Space

KEY CLIMATE ACTION TARGET

#10 PROTECTION OF AQUATIC ECOSYSTEMS

Wolf Creek has been listed on the Environmental Protection Agency's (EPA) 303d impaired stream list in accordance with the laws of the Clean Water Act since 2004 for fecal coliform, iron, and biological impairments.

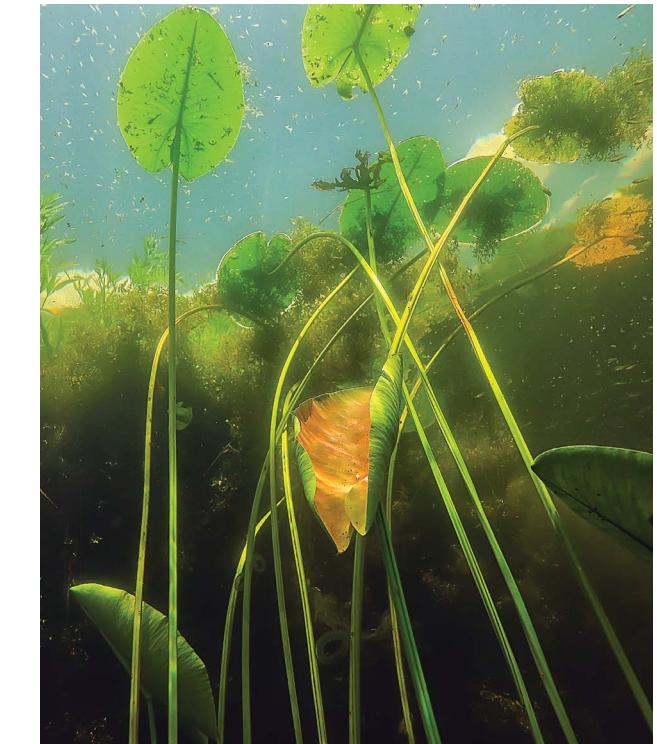
United States Environmental Protection Agency (USEPA) bases aquatic life criteria on how much of a chemical can be present in surface water before it is likely to harm plant and animal life. The strategy to protect both freshwater and saltwater organisms from short-term and long-term exposure is crucial to conserving aquatic ecosystems.

Contaminants of concern (CECs) such as pharmaceuticals and Personal Care Products (PPCPs) are being detected in low levels in surface water which

might have an impact on aquatic life. These CECs and PPCPs act as Endocrine Disruptors that alter the normal functions of hormones resulting in various health defects predominantly reproductive effects in aquatic organisms

Use of natural materials for cleaning and housekeeping: Replacing harmful cleaning chemicals with natural materials reduces the flow of toxic waste into wastewater. Seepage of toxic substances into water streams kills organisms which are essential for maintaining the natural ecosystem while also making it unsafe for consumption. The conventional chemical substances have a terrible impact on our waterways, air quality, soil health, and wildlife habitatsquality, soil health, and wildlife habitats.

“ Use of natural cleansing agents has shown to reduce toxicity in Aquatic Ecosystems ”



MEASURES TO PREVENT CONTAMINATION OF WATERWAYS

To prevent livestock from having direct access to streams, thereby protecting streambanks from disturbance, few best practices have to be employed to not just reduce streambank erosion, but to also reduce fecal coliform pollution.

Livestock fencing: If livestock are kept away from the streams, they cannot trample the streambanks and disturb the riparian vegetation.

Armored stream crossings: Sometimes, it is necessary to preserve stream crossings so that livestock can be moved to other locations. Armored stream crossings can be built to prevent livestock from disturbing riparian areas.

“ Reduction of fecal coliform pollution in water bodies will be one of the primary goals of Wolf Creek Climate Hub ”



MEASURES TO PREVENT CONTAMINATION OF WATERWAYS

Alternative watering sources: If livestock are fenced away from streams that had been used for watering, alternative watering sources such as springs may need to be developed.

Riparian buffers: Protected stream buffers allow natural riparian vegetation to grow and stabilize streambanks.

Management of untreated sewage must be removed from streams to protect leaching of coliforms to marine ecosystems. Several specific measures can be taken to meet this broad goal. The Fayette County Commission's Comprehensive Wastewater Management Plan for Fayette County was developed to address wastewater management issues and improve overall water quality, and includes several control measures that can help solve fecal coliform discharges from onsite sewer systems, as listed below some of which can be altered to suit the requirements of the Climate Hub at Wolf Creek,

Replacing and repairing onsite systems and leach fields. In some cases, onsite systems are the most appropriate solution. Traditional septic systems and drain fields can work well if properly installed and maintained.

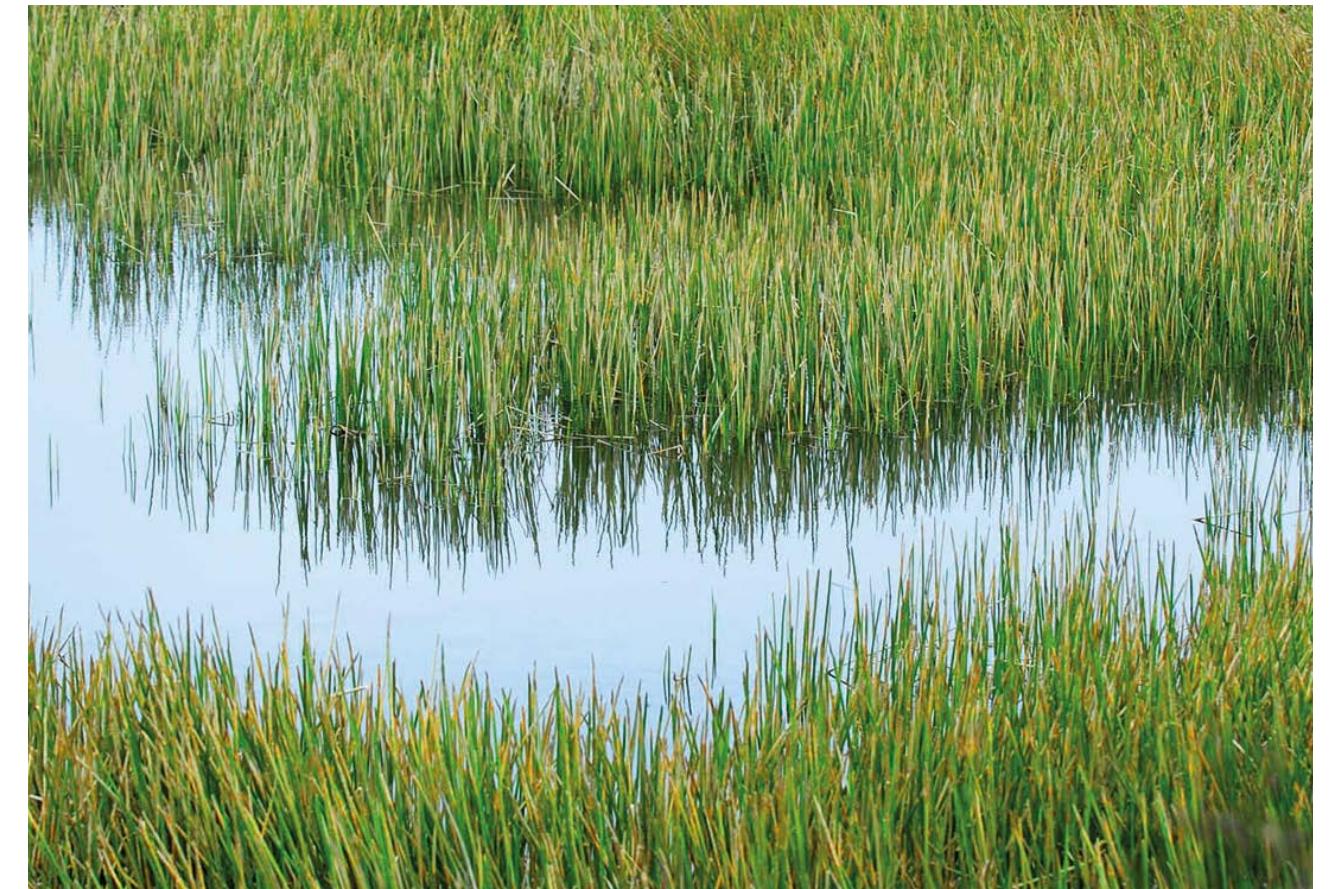
Upgrading underground injection control (UIC) permitted systems: Some onsite wastewater systems are permitted with UIC permits. These systems may be upgraded to better control fecal coliform discharges.

Installing community cluster systems: In some cases, cluster systems are a more practical or economical alternative. Cluster systems can serve up to hundreds of homes. These systems incorporate options that bridge the extremes between individual onsite systems and

centralized systems. Septic tanks are installed at each house, and the septic tank effluent is then piped to a central location for treatment and dispersal.

Extending lines for municipal and public service district systems. Collection systems for large, centralized systems can be extended in some locations to take on discharged wastewater through failing or nonexistent onsite systems.

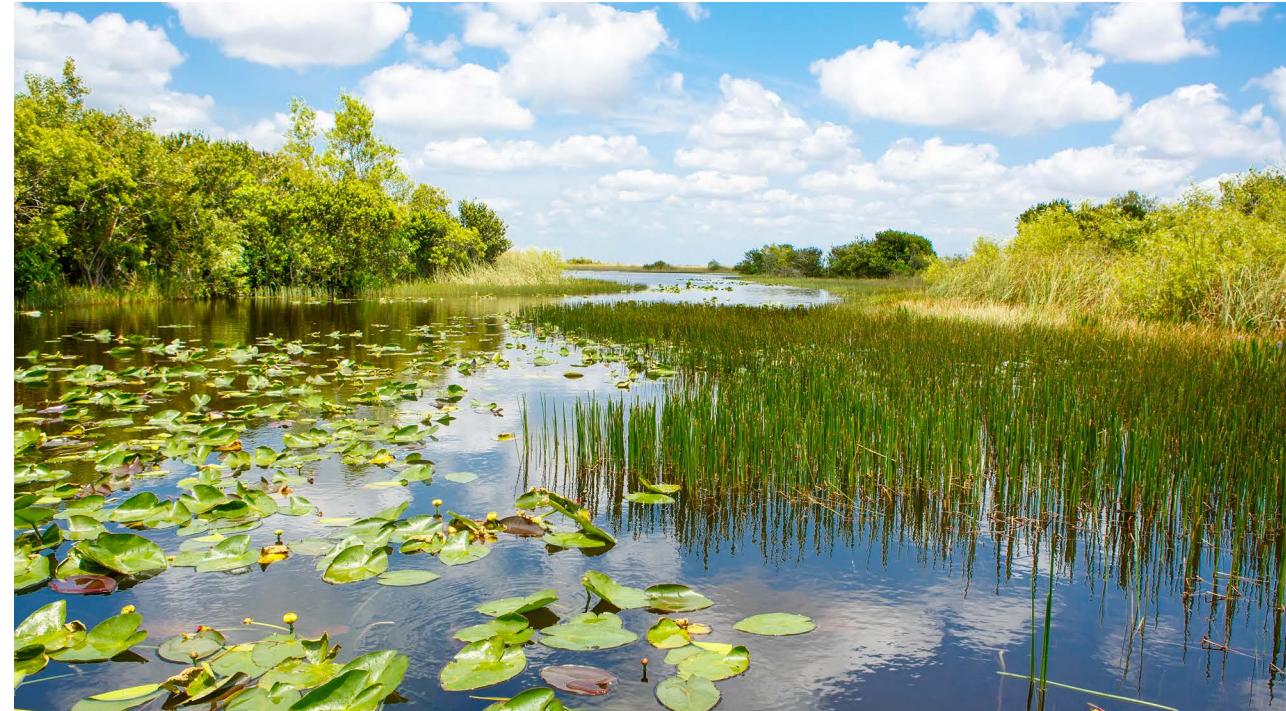
When lots are near wetlands or floodplains, when there is shallow depth to bedrock or water table, or when soil percolation rates are slower than 1 hour/inch, the addition or modification of onsite systems is not feasible and an offsite solution must be found.



Three main aspects that alter the wetland quality are, Physical (filling, draining, excavating, diverting water, flooding, clearing, withholding sediment, shading etc.), Chemical (changing nutrient levels & introducing toxins) and Biological (grazing & disrupting natural populations).

We will identify existing wetlands to make sure construction activities are away from these wetlands. Quality of water, biodiversity, species count and groundwater levels shall be monitored periodically to monitor health of wetlands.

Wolf creek climate hub is a zero waste discharge project. Hence, all wetlands will be protected from release of toxins and waste. As the project harvests rainwater for domestic use, there will be no reduction in ground water table due to any activities conducted within the project.



We will use natural contours as far as possible without altering existing levels for all developmental activities. This will ensure a natural path is set for flow of water without any change to its course.

“Successful management of Wetlands is crucial to avail its numerous and widespread benefits of biotic diversity”

KEY CLIMATE ACTION TARGET

#11 PRESERVE & IMPROVE BIODIVERSITY

West Virginia is known as the hardiness zone

AFFORESTATION

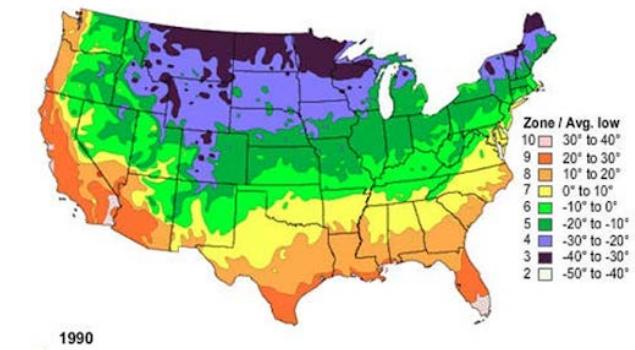
Crop Diversity took a major hit due to the aggressive Green Revolution model in Agriculture whose focus was on high responsive seeds, external inputs such as chemicals for pest and nutrient management etc.

Monocropping system in agriculture has been a fairly recent phenomenon that came to life because it was easy to implement. But, if a farmer plants the same crop in the same field year after year, the plants use up the same nutrients from the soil and attract the same pests each year. Therefore, farmers planting monocultures must work even harder to kill those pests and replenish the nutrients lost in the soil, locking them into a vicious cycle of chemicals, pests, and farm expenses.

These monocropping techniques reduce the biodiversity of the land and it is huge problem in modern agriculture. Earlier, agricultural diversity has been part of a farmers' process of cultivation reducing the vulnerability of crops to various diseases and pests.

Such a diversity in agriculture replenishes soil nutritional capacity, attracts new sets of plant and animal species that can self-sustain over a period while also preventing soil erosion, attracting predators, provide food security and dilute the risk of depending on single crop for one's livelihood.

The know-how on combining two sets of crops to be cultivated together is a must for such a system to be successful. Using plant varieties that do not tolerate each other would lead to a disastrous output for yield and quality.



“An average homeowner can save up to 20% on energy bills but just having the right trees in the right place. Trees improve air quality, protect soil from runoff, sequester carbon and many more”

Wolf Creek Climate Hub will have various guilds/multiple cropping systems for cultivation that work extremely well with each other.

Apart from diversity in fruit and vegetable varieties, Wolf Creek Climate Hub will also implement diversity in its forest & avenue plantations.

Trees play an important role in creating safer, healthier, and more connected communities. Cleaning the air, filtering water, and protecting soil from runoff while also providing shade and cooling our homes.

Healthy forests are critical to conserving some of the complex ecosystems of the planet by supporting the habitats of wildlife and aquatic life and keeping the waterways healthy.

A concerted effort to create forests through Afforestation is one of the primary goals of a Climate Hub. It helps in Carbon Capture by reduction of atmospheric CO₂ resulting in conducive habitats for wildlife, improving water quality, enhancing soil health, and creating natural windbreaks.

Reforestation will be done in places where the trees have been damaged or dead due to natural calamities or man-made disasters.

Plantation of native trees, medicinal herbs including hardwoods, bare-root conifers, shrubs, wildflowers, such as, White Cedar (Arborvitae), Paper Birch, American Cranberry, and Red Osier Dogwood would help reduce erosion, reduce stormwater runoff, and create habitat for pollinators.



In one year, an acre of mature trees absorbs the amount of CO₂ produced by a car driven 26,000 miles i.e., 48 pounds before releasing Oxygen in exchange.

KEY CLIMATE ACTION TARGET #12 CARBON SEQUESTRATION

Heat from the earth is trapped in the atmosphere due to high levels of carbon dioxide (CO₂) and other heat-trapping gases that prohibit it from releasing the heat into space. This creates a phenomenon known today as the "greenhouse effect."

Trees help by removing (sequestering) CO₂ from the atmosphere during photosynthesis to form carbohydrates that are used in plant structure/function and return oxygen back into the atmosphere as a byproduct. Roughly half of the greenhouse effect is caused by CO₂. Therefore, trees act as carbon sinks, alleviating the greenhouse effect.

On average, one acre of new forest can sequester about 2.5 tons of carbon annually. Young trees absorb CO₂ at a rate of 13 pounds per tree each year. Trees reach their most productive stage of carbon storage at about 10 years at which point they are estimated to absorb 48 pounds of CO₂ per year. At that rate, they release enough oxygen back into the atmosphere to support two human beings. Planting 100 million trees could reduce an estimated 18 million tons of carbon per year and consequently save American consumers \$4 billion each year on utility bills

Wolf Creek Climate Hub aims to plant a minimum of 116,000 plants at Wolf Creek which would sequester approximately 780 tons to CO₂ in one year

There are certain methods employed to improve carbon sequestration, they are:

Plantation of shrubs/cover crops & Improved plantations:

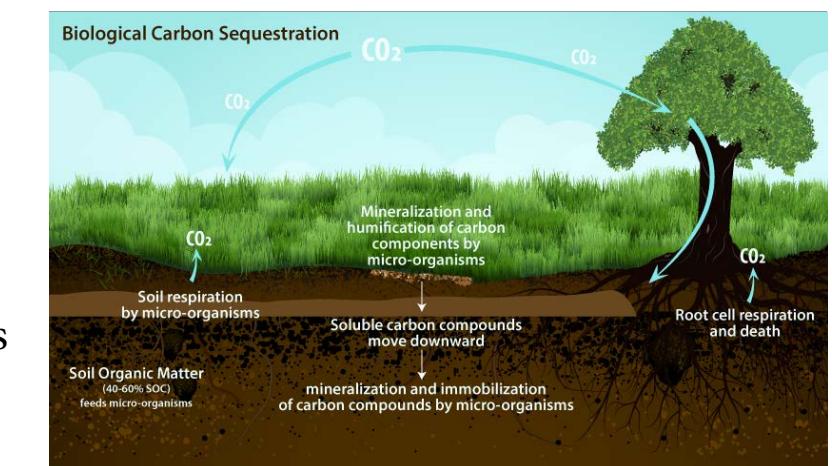
Shrubs are a necessary part of the landscape for carbon sequestration. Carbon sequestration opportunities in croplands include the use of cover crops and improved cropland nutrient management. Cover crops, grown when fields are normally bare, provide additional carbon inputs to soils. Use of cover crops such as corn, soy, wheat, rice, and cotton

Reforestation & Urban Reforestation & Natural Forest Management:

carbon sequestration in above- and belowground biomass and soils gained by converting non-forest to forest.

Biochar: As composition of Biochar is majority carbon (70-80%), it can contribute more carbon than plant residue (40% approx.) of similar biomass

Cover/Alley Cropping: Cover crops or intercropping techniques provide a vegetative cover and protect soil from erosion and nitrate leaching



CARBON SEQUESTRATION POTENTIAL OF COVER CROPS

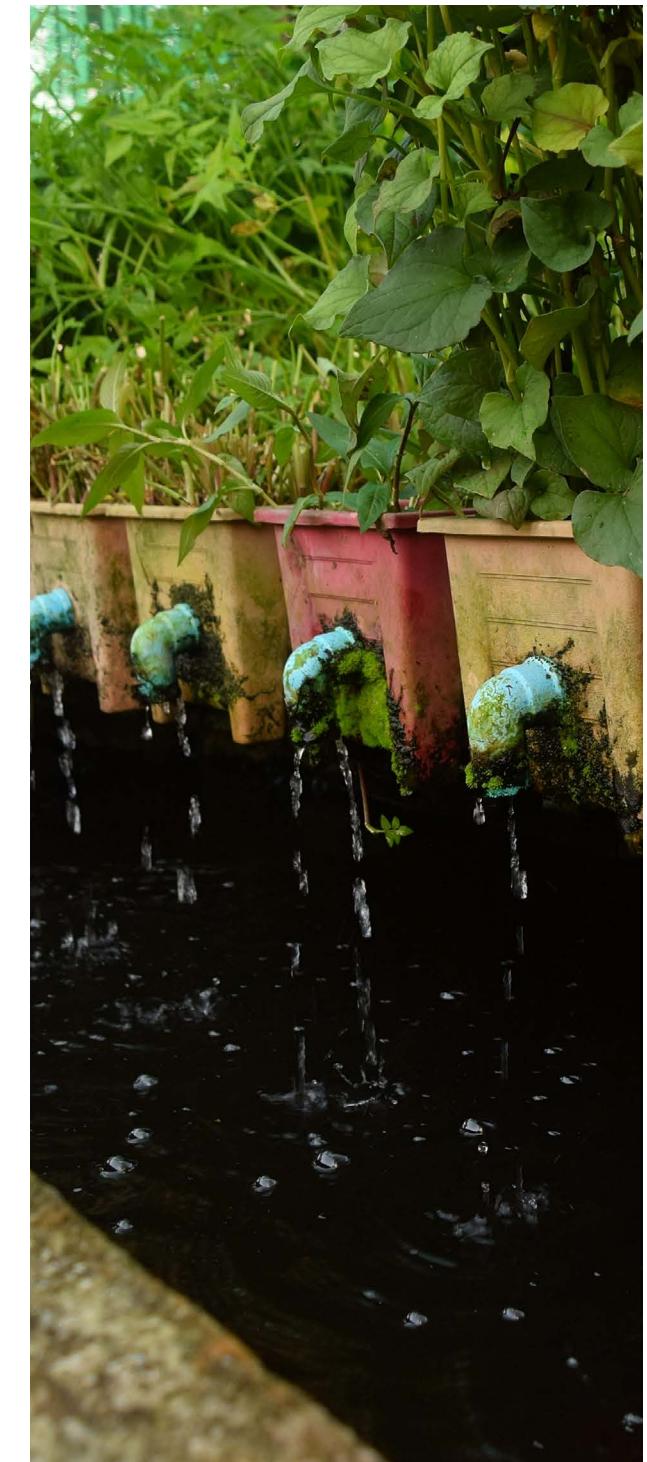
REFERENCE	DESCRIPTION OF CROPS	CARBON SEQUESTRATION POTENTIAL
Abdalla et al. (2019)	Legume/non-legume mixes	0.54 tonnes C/ha/yr
Poplau and Don (2015)	Legumes and non-legumes	0.32 tonnes C/ha/yr
Follet et al. (2001)	Legumes and grasses	0.6–0.9 tonnes C/ha/yr
Lal et al. (1998)	Legumes and grasses	0.3–0.7 tonnes C/ha/yr
Bruce et al. (1999)	Grassland	0.8 tonnes C/ha/yr
Sperow et al. (2003)	Winter cover crops	0.2 tonnes C/ha/yr
Jian et al. (2020)	Legumes and grasses	0.56 tonnes C/ha/yr (+15.5 %)
McDaniel et al. (2014)	Legume/non-legume mixes	+8.5% increase of total soil carbon

CARBON SEQUESTRATION POTENTIAL OF COVER CROPS

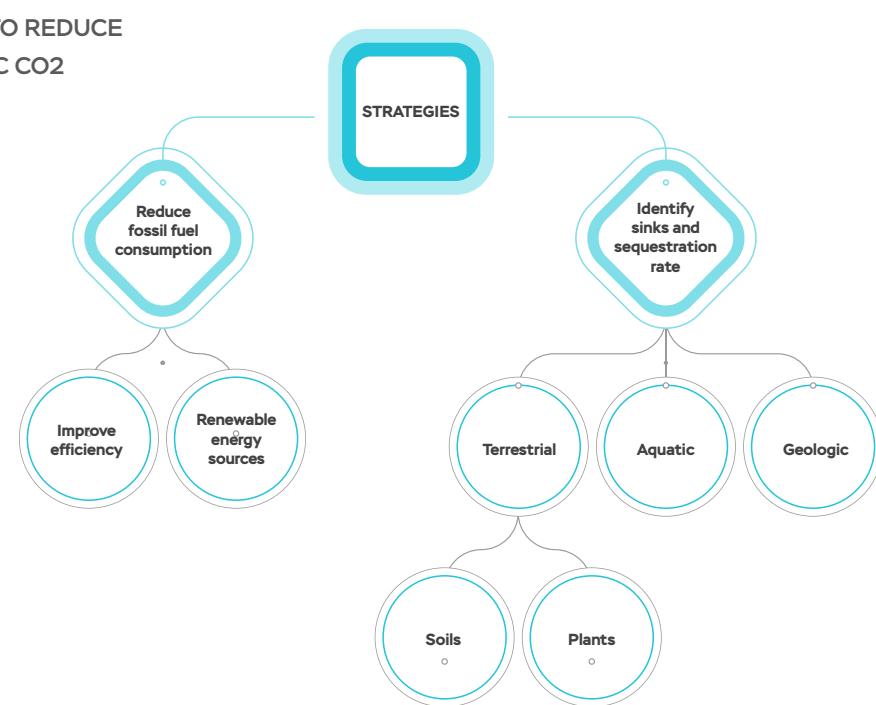
Cropland nutrient management: It is important to be informed about several crop management strategies such as crop selection, crop rotation, and cover crops etc. that result in reduced atmospheric carbon levels

Improved manure management: Strategies such as tillage, residue management, soil fertility enhancement, water usage control and erosion control also help in effective carbon sequestration

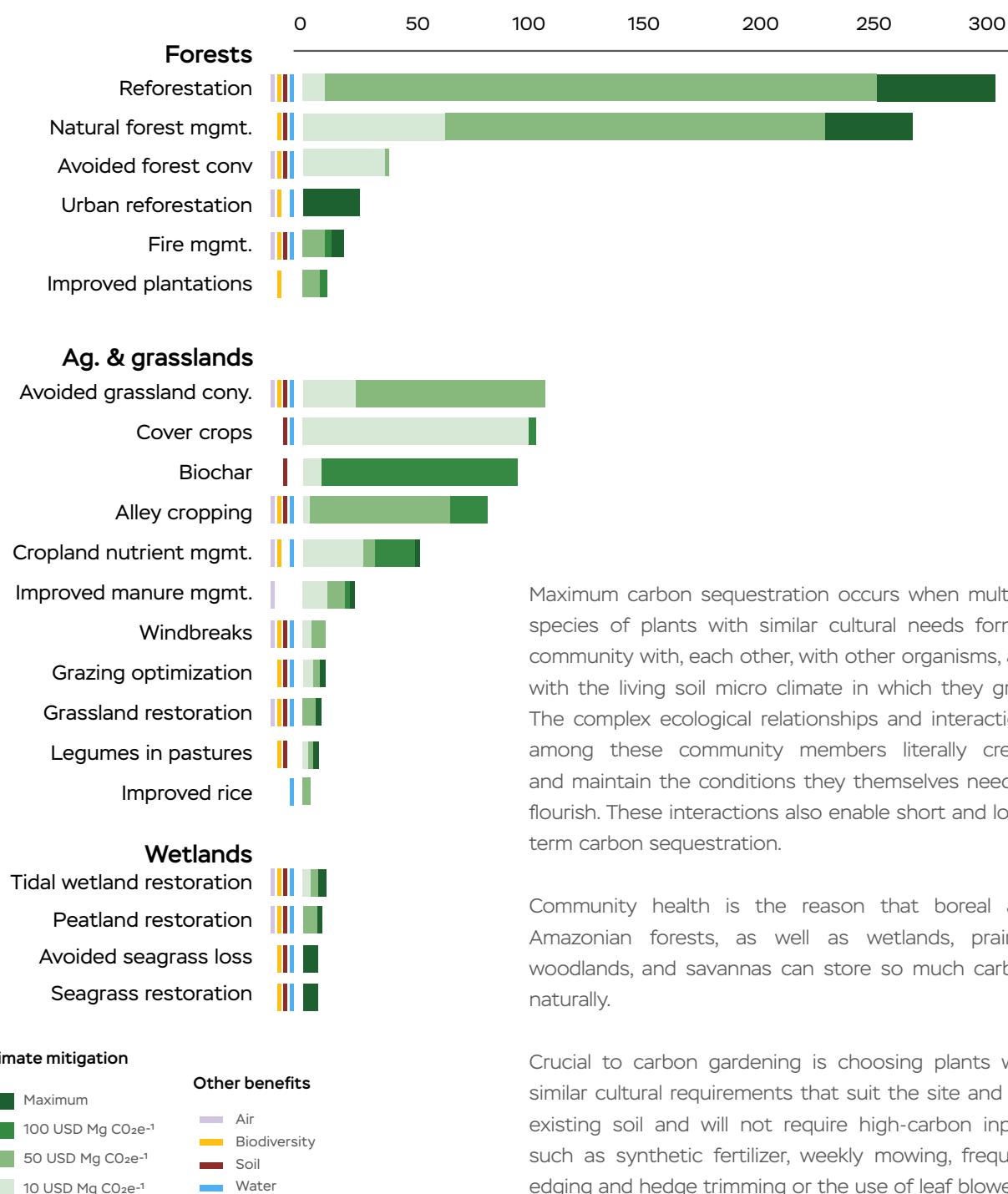
- Windbreaks
- Grazing optimization
- Grassland restoration
- Peatland restoration
- Avoided seagrass loss
- Seagrass restoration



“ Carbon sequestration is achieved by planting different kinds of species with similar cultural needs forming a community of organization with complex ecological relationships ”



CLIMATE MITIGATION POTENTIAL IN 2025 (Tg CO₂ e year⁻¹)



Nor would a carbon-storing design call for conservation-inappropriate practices such as weekly watering, leaving soil bare through the winter, or growing water-dependent exotic ornamentals in arid regions.

Further, any plant mix should aim for at least 80% native plants. Every region has guilds of native plants—natural companions—that might be suitable for the soil and light conditions of the region's gardens. And if starting with an established garden, there is no need to rip everything out and start over.

Careful assessment and thoughtful changes such as adding native trees and bushes and surrounding them with a mixed understory/groundcover of low-growing perennials—a living mulch—so they can form a community, rather than isolating them in mulch islands, will improve carbon sequestration remarkably soon, though sequestering significant amounts of carbon is not a quick, do-and-done project.

While soil will start improving rapidly near the surface, the downward percolation of soluble organic matter and its conversion to stable soil carbon takes longer; but this is what we should strive for.

Total Pounds of Carbon Sequestered:

425,326

Total Pounds of Equivalent CO₂ Sequestered

1,560,945

Equivalent CO₂ Sequestered in Short Tons / 2000

780

“ Carbon sequestration rapidly improves soil on the surface but the real goal is to improve downward percolation of organic matter which eventually becomes stable carbon **”**



TYPES OF TREES FOR WOLF CREEK AND THEIR CARBON SEQUESTRATION DATA

Name	Tree Type (H/C)	Growth Rate (S/M/F)	Tree Age (B)	Number of Age 0 trees planted (C)	Survival Factor (D)	Number of Surviving Trees (E = C x D)	Annual Sequestration Rate lbs/tree (F)	Carbon Sequestered (G = E x F)
Ash, white, Fraxinus americana	H	F	2	2000	0.736	1472	5.4	7948.8
Ash, mountain, American, Sorbus americana	H	M	4	2000	0.678	1356	5.2	7051.2
Aspen, bigtooth, Populus grandidentata	H	M	4	2000	0.678	1356	5.2	7051.2
Basswood, American, Tilia americana,	H	F	4	2000	0.678	1356	8.5	11526
Beech, American, Fagus grandifolia	H	S	4	2000	0.678	1356	2.8	3796.8
Birch, yellow, Betula alleghaniensis	H	S	4	2000	0.678	1356	2.8	3796.8
Birch, river, Betula nigra	H	M	4	2000	0.678	1356	5.2	7051.2
Boxelder, Acer negundo	H	F	4	2000	0.678	1356	8.5	11526
Buckeye, Ohio, Aesculus glabra	H	S	4	2000	0.678	1356	2.8	3796.8
Catalpa, northern, Catalpa speciosa	H	F	4	2000	0.678	1356	8.5	11526
Cherry, black, Prunus serotina	H	F	4	2000	0.678	1356	8.5	11526
Crabapple, Malus spp.	H	M	4	2000	0.678	1356	5.2	7051.2
Cedar-white, northern, Thuja occidentalis	C	M	4	2000	0.678	1356	3.1	4203.6
Cucumbertree, Magnolia acuminata	H	F	4	2000	0.678	1356	8.5	11526
Cottonwood, eastern, Populus deltoides	H	M	4	2000	0.678	1356	5.2	7051.2
Dogwood, flowering, Cornus florida	H	S	4	2000	0.678	1356	2.8	3796.8
Elm, American, Ulmus americana	H	F	4	2000	0.678	1356	8.5	11526
Elm, slippery, Ulmus rubra	H	M	4	2000	0.678	1356	5.2	7051.2
Elm, slippery, Ulmus rubra	H	M	4	2000	0.678	1356	5.2	7051.2
Fir, Douglas, Pseudotsuga menziesii	C	F	4	2000	0.678	1356	5.2	7051.2
Hackberry, Celtis occidentalis	H	F	4	2000	0.678	1356	8.5	11526
Hawthorne, Crataegus spp.	H	M	4	2000	0.678	1356	5.2	7051.2
Hickory, bitternut, Carya cordiformis	H	S	4	2000	0.678	1356	2.8	3796.8
Hickory, mockernut, Carya tomentosa	H	M	4	2000	0.678	1356	5.2	7051.2
Hickory, shagbark, Carya ovata	H	S	4	2000	0.678	1356	2.8	3796.8
Hickory, pignut, Carya glabra	H	M	4	2000	0.678	1356	5.2	7051.2
Holly, American, Ilex opaca	H	S	4	2000	0.678	1356	2.8	3796.8
Honeylocust, Gleditsia triacanthos	H	F	4	2000	0.678	1356	8.5	11526
Hophornbeam, eastern, Ostrya virginiana	H	S	4	2000	0.678	1356	2.8	3796.8
Horsechestnut, common, Aesculus	H	F	4	2000	0.678	1356	8.5	11526

TYPES OF TREES FOR WOLF CREEK AND THEIR CARBON SEQUESTRATION DATA

Name	Tree Type (H/C)	Growth Rate (S/M/F)	Tree Age (B)	Number of Age 0 trees planted (C)	Survival Factor (D)	Number of Surviving Trees (E = C x D)	Annual Sequestration Rate lbs/tree (F)	Carbon Sequestered (G = E x F)
Locust, black, Robinia pseudoacacia	H	F	4	2000	0.678	1356	8.5	11526
Magnolia, southern, Magnolia grandiflora	H	M	4	2000	0.678	1356	5.2	7051.2
Maple, bigleaf, Acer macrophyllum	H	S	4	2000	0.678	1356	2.8	3796.8
Maple, red, Acer rubrum	H	M	4	2000	0.678	1356	5.2	7051.2
Maple, silver, Acer saccharinum	H	M	4	2000	0.678	1356	5.2	7051.2
Maple, sugar, Acer saccharum	H	S	4	2000	0.678	1356	2.8	3796.8
Maple, Norway, Acer platanoides	H	M	4	2000	0.678	1356	5.2	7051.2
Mulberry, red, Morus rubra	H	F	4	2000	0.678	1356	8.5	11526
Oak, black, Quercus velutina	H	M	4	2000	0.678	1356	5.2	7051.2
Oak, chestnut, Quercus prinus	H	S	4	2000	0.678	1356	2.8	3796.8
Oak, pin, Quercus palustris	H	F	4	2000	0.678	1356	8.5	11526
Oak, northern red, Quercus rubra	H	F	4	2000	0.678	1356	8.5	11526
Oak, scarlet, Quercus coccinea	H	F	4	2000	0.678	1356	8.5	11526
Oak, white, Quercus alba	H	S	4	2000	0.678	1356	2.8	3796.8
Pine, Virginia, Pinus virginiana	C	M	4	2000	0.678	1356	3.1	4203.6
Redbud, eastern, Cercis canadensis	H	M	4	2000	0.678	1356	5.2	7051.2
Sassafras, Sassafras albidum	H	M	4	2000	0.678	1356	5.2	7051.2
Sugarberry, Celtis laevigata	H	F	4	2000	0.678	1356	8.5	11526
Sycamore, Platanus occidentalis	H	F	4	2000	0.678	1356	8.5	11526
Walnut, black, Juglans nigra	H	F	4	2000	0.678	1356	8.5	11526
Willow, black, Salix nigra	H	F	4	2000	0.678	1356	8.5	11526
Pine, Scotch, Pinus sylvestris	C	S	4	2000	0.678	1356	1.6	2169.6
Pine, white eastern, Pinus strobus	C	F	4	2000	0.678	1356	5.2	7051.2
Fir, balsam, Abies balsamea	C	S	4	2000	0.678	1356	1.6	2169.6
Hemlock, eastern, Tsuga canadensis	C	M	4	2000	0.678	1356	3.1	4203.6
Tamarack, Larix laricina	C	F	4	2000	0.678	1356	5.2	7051.2
Spruce, Norway, Picea abies	C	M	4	2000	0.678	1356	3.1	4203.6
Spruce, red, Picea rubens	C	S	4	2000	0.678	1356	1.6	2169.6
Total Pounds of Carbon Sequestered								425326
Total Pounds of Equivalent CO2 Sequestered								1560945
Equivalent Co2 Sequestered in Short Tons /2000								780

KEY CLIMATE ACTION TARGET

#13 SUSTAINABLE FOOD PRODUCTION

Climate Hub will consist of native perennial rangeland along with perennial pasture land and cropland agriculture incorporating grazing and no-till cropping systems including a wide-variety of cash crops, multi-species cover crops along with all natural grass finished beef and goat apart from pastured laying hens, and swine. This diversity would regenerate the natural resources without the use of synthetic fertilizers or harmful chemicals in the form of pesticides and fungicides.

Comprehensive cropping patterns would be followed where we cultivate vegetable & Fruit varieties that are suitable for the type of soil present. These will ensure, community is self-reliant on the produce from the farm. However, we need to bear in mind that the farm is subject to natural disasters. Community Farming, Personal farming, Animal husbandry, Aqua farming, etc., are just a few components of farming at Wolf Creek Climate Hub.

The community farming comprises majority of the



“ 90 acres of land will be dedicated to Agriculture and Horticulture providing unadulterated, nutritious organic food to its residents ”

essential farm produce based on the water availability. We need approx. 90 acres to be dedicated to forests, fruits and vegetables with diverse cropping patterns designed to benefit the plants nutrient supply in such a way that it also promotes passive health care. The plant care and nutrient supply in the farm is predominantly done using animal manure prepared from the animal husbandry unit.

- Few important aspects of farming at Wolf Creek Climate Hub would be,
- Use of native tree/plant species
- Improve Biodiversity by introduction of at least 30% percentage of diverse plant species
- Promote overall well-being from consuming safe food.
- Witnessed and unaltered production & processing
- Reduction in food miles because food required by the community is locally grown as per the need.
- Animal husbandry units that is capable of supplying required milk, meat and eggs to the community

SUSTAINABLE FOOD PRODUCTION

Moisture preservation techniques are employed to reduce water dependency of the farm by at least 50% using,

1. Live mulch, garden waste and coconut waste to cover the surface.
2. Soil breeding-live organic mulch as a continuous farm cover
3. Active farmland manure from the animal husbandry unit
4. Part of green fodder for the farm animals will be grown within the community farm area

The farm is designed to be water independent; all water systems are designed based on the rainwater available in Fayette County every year.

Irrigation techniques will be designed in consultation with experts in the field. Scientific methods would be

used to calculate the sizes and placement of the storm water trenches that channelize the water falling on the site in a controlled way without any soil erosion.

Other essential Steps to improve farming at Wolf Creek Climate Hub include,

- Companion cropping techniques
- Natural pest control methods using locally available substances, Bio control Agents, Herbal Concoctions, trap crops etc.,

Compost preparation: Large quantities of waste material is available as vegetable refuse, farm litter such as weeds, Sewage sludge and animal waste from home units and common areas. Excreta can be converted into useful compost manure by conserving and subjecting it to a controlled process of anaerobic decomposition. Compost is used in the same way as Farmyard Manure and is good for application to all soils and all crops.

Vermicompost: Organic manure produced by the activity of earthworms that generally live in soil, eat biomass and excrete it in digested form. It is generally estimated that 1800 worms is an ideal population for one sq. meter can feed on 80 tones of humus per year. These are rich in macro and micronutrients, vitamins, growth hormones and immobilized microflora. The average nutrient content of vermicompost is much higher than that of Farmyard Manure. It contains 1.60% N, 5.04% P2O and 0.80% K2O with small quantities of micronutrients. Application of vermicompost facilitates easy availability of essential plant nutrients to crop.

- Crop rotation
- Grid-free power sourcing
- Pooling of knowledge systems & regular hassle free up-keep and maintenance
- Sharing of profits and loss
- Water security ensured as water is harvested, and conservation works effectively for large areas.
- Expert care for the farm, energy, water and every aspect of the farm and living
- Active community that is run by professionals with a process driven approach.
- Reliable work force in the farm due to the structured incentivized employment with proper growth ladders.

KEY CLIMATE ACTION TARGET

#14 SOIL HEALTH

Soil at Wolf Creek is healthy considering the vast forest cover in the area however; there are no specific soil reports available and more information can be gathered only when an on ground survey is performed.

As per the watershed assessments, there seems to be heavy leaching of chemicals due to unhealthy water.

Soil in Fayette County is good for cultivating tomatoes, peppers, and eggplant, as well as crops with a long growing season, like broccoli, cauliflower, and brussels sprouts.

Other crops include Arugula, Basil, Beet, Bell Pepper, Carrot, Cantaloupe, Broccoli, Cabbage, Potato, Pumpkin, Radish, Rosemary, Sage, Parsley, Oregano, Parsnip, Peas, Cauliflower, Celery, Chive, Eggplant, Dill, Cucumber, Corn,

Cilantro, Kohlrabi, Kale, Jalapeno Pepper, Green Bean, Okra, Onion, Lettuce, Tomato, Thyme, Watermelon, Winter Squash, Turnip, Spinach, Sweet Potato, Zucchini, Swiss Chard etc.

There are several soil fortification methods that will be employed to improve soil health at Wolf Creek before plantation such as,

Use of Animal/plant Manure: The organic manure is derived from biological sources like plant, animal, and human residues. Organic manure helps in augmenting crop growth and soil productivity. The direct effect of organic manure relates to the uptake of humid substances or its decomposition products favoring the growth and yield of plants. Indirectly, it augments the

SOIL HEALTH

beneficial soil microorganisms and their activities and thus increases the availability of macro and micro plant nutrients.

Compost: Large quantities of waste material are available as vegetable refuse, farm litter, such as weeds, sugarcane trash, Sewage sludge and animal waste in houses and in areas like human and industrial refuse; therefore, excreta can be converted into useful compost manure by conserving and subjecting these to a controlled process of anaerobic decomposition. Compost is used in the same way as FYM and is good for application to all soils and all crops.

Green Manuring: It is a practice of plowing or turning into the soil under-composted green plant tissues for the purpose of improving physical structure as well as

fertility of the soil. From the time immemorial, turning in a green crop for improvement of the conditions of the soil has been a popular farming practice.

Green Manuring, wherever feasible, is the principal supplementary means of adding organic matter to the soil. It consists of growing a quick growing crop and plowing it under to incorporate it into the soil. The green manure crop supplies organic matter as well as additional nitrogen, particularly if it is a legume crop, which has the ability to fix nitrogen from the air with the help of its root-nodule bacteria.

A leguminous crop producing 25 tons of green matter per hectare, will add about 60 to 90 kg of nitrogen when plowed under. This amount would equal an application of 3 to 10 tons of FYM based on organic

“ Understanding the level of soil contamination at Wolf Creek due to the leaching of heavy chemicals in the water streams is of utmost priority ”



SOIL HEALTH

matter and its nitrogen contribution. The green manure crops also exercise a protective action against erosion and leaching.

Contour bunding: Contour plowing or contour farming or Contour bunding is the farming practice of plowing and/or planting across a slope following its elevation contour lines.

Contour bunding is a proven sustainable land management practice for marginal, sloping, and hilly land where the soil productivity is very low. Contour bunding consists of narrow based trapezoidal bunds on contours to impound runoff water behind them so that it can gradually infiltrate into the soil for crop use. Generally recommended for areas receiving <600 mm rainfall (low rainfall areas). Spacing between two bunds is commonly expressed in terms of the V.I. (Vertical interval) which is the difference in elevation between two similar points on two consecutive blinds.

Land Preparation: Land preparation includes Obstruction to surface flow and tillage to influence intake of water. Deep plowing or chiseling has been

found to reduce the rate of erosion. Rough cloddy surface is also effective in reducing erosion.

Contour cultivation: A line joining the points of equal elevation is called a contour. All the cultural practices such as plowing, sowing, inter-cultivation etc. done across the slope reduce soil and water loss. By plowing and sowing across the slope, each ridge of plow furrow and each row of the crop act as obstruction to the runoff and provide more time for water to enter into the soil leading to reduced soil and water loss.

Strip Cropping: it is a method used when a slope is too steep) crops are planted / grown in the form of relatively narrow strips across the land; this method becomes more effective for erosion control.

Crop rotation / cropping system: Mono-cropping of erosion permitting crops. Intercropping of erosion permitting crops accelerates soil and water loss year after year. It has been found that erosion permitting crops and erosion resisting crops or their rotation is effective for reducing soil and water loss. Inclusion of legumes like grass in crop rotation reduces soil loss



SOIL HEALTH

even in soils having 13% slopes.

Cover crops: Good ground cover by canopy gives the protection to the land like an umbrella besides conserving soil moisture, and minimizing soil erosion. The third crops hold those soluble nutrients, which are lost by leaching. The advantage of legumes as cover crops is the addition of organic matter.

Mulching: Mulching – with available plant residues – reduces the soil loss considerably by protecting the soil from direct impact of rain and reducing sedimentation. A minimum plant residue cover of 30 percent is necessarily carried with runoff. Vertical mulching to keep runoff and soil loss within the acceptable limits also reduces soil loss particularly in vertisols by increasing infiltration

Rainwater harvesting Method: Water harvesting techniques had been evolved and developed centuries ago. Ground water resources get naturally recharged through percolation. But due to indiscriminate development and rapid urbanization, exposed surface for soil has been reduced drastically with resultant

reduction in percolation of rainwater, thereby depleting ground water resources. Rainwater harvesting is the process of augmenting the natural filtration of rainwater into the underground by artificial methods. "Conscious collection and storage of rainwater to cater to demands of water, for drinking, domestic purpose & irrigation is termed as Rainwater Harvesting."

Why harvest rainwater:

- To arrest groundwater decline and augment ground water table
- To increase water quality in aquifers
- To conserve surface water runoff during monsoon
- To reduce soil erosion
- To inculcate a culture of water conservation

“ Wolf Creek Climate Hub will use components such as, animal manure, soil from nearby creeks and compost from within the community to improve Soil fertility ”

KEY CLIMATE ACTION TARGET

#15 ECO-HABITATS

The housing units will be designed on passive architecture principles,

- Highly energy efficient units with less dependency on mechanical heating, cooling, ventilation, and lighting demand systems and instead use 'natural' sources to create comfortable conditions inside the buildings.
- Passive design measures include building orientation, air sealing, continuous insulation, windows, daylighting, and ventilation to improve indoor air quality, comfort and health of the occupants by designing a building to take advantage of natural ventilation opportunities

- Priority would be given to the locally available materials to minimise the associated environmental impacts resulting from transportation.
- Design optimization to reduce the quantity of materials required for construction
- Identifying ideal land pockets while also maintaining the natural topography with minimal disturbance to the existing land conditions
- Building a cyclist and pedestrian friendly infrastructure.
- Infrastructure convenient and easy to access for physically disabled.

“Eco-Habitats at Wolf Creek are climate responsive structures that promote human well-being while incorporating sustainable design principles”



LAND USE AND ZONING

Extent of the property is approximately 900 acres, and land pockets suitable for development is 250 acres. The best strategy for saleability would be to allot divisible plots along with an undivided share of unusable forest lands as a single unit which makes

perfect economic sense to the person investing in it. Road connections would be assessed and concluded for other usable pockets of lands only after a thorough on ground survey is conducted.



Based on data provided and that available online from topographical maps and google maps, usable land pocket has been determined to be 250 acres. Development is planned with divisible lands in scattered pockets & UDS (undivided share) subdivisions.

RESIDENTIAL	SPORTS & AMENITIES - 5 Acres
Luxury Forest Homes	
<ul style="list-style-type: none"> Total Area: 80 Acres No. of Units: 40 Homes Area per Unit: 2 Acres, BUA of 6000 sft (G+1) 	Playcourts <ul style="list-style-type: none"> Tennis Court - 2no.s BasketBall - 1 no.s Clubhouse - 10,000 sft BUA <ul style="list-style-type: none"> Banquet Hall Mini Theatre Indoor Games Snookers Table Tennis Gymnasium Workspaces
Aspirational Homes	
<ul style="list-style-type: none"> Total Area: 75 Acres No. of Units: 150 Homes Area per Unit: 0.5 Acres, BUA of 3000 sft (G+1) 	
Affordable/Millennial/Veteran Housing	
<ul style="list-style-type: none"> Total Area: 50 Acres No. of Units: 400 Homes Area per Unit: 1/8th Acre, BUA of 400 sft 	HEALTHCARE & WELLNESS <ul style="list-style-type: none"> Hospital 2 Acres, 30,000 sft BUA 30 bedded hospital Off-Grid Wellness Capsules <ul style="list-style-type: none"> 1 Acre, 8,000 sft BUA - Spa Rooms
EDUCATION	
School (Pre-Primary & Primary)	ANIMAL HUSBANDRY
<ul style="list-style-type: none"> 5 acres & 20,000 sft BUA 	20 Acres & 10,000 Sft BUA <ul style="list-style-type: none"> Cattle Farm Poultry Farm
HOSPITALITY	
Eco Resort	INDUSTRIES
<ul style="list-style-type: none"> 10 Acres, 60 Pods each 400 sft & total BUA: 24,000 sft 	Soap Making Factory <ul style="list-style-type: none"> 1Acre & 4000 sft BUA Cold pressed oil plant <ul style="list-style-type: none"> 1 Acre & 5000 sft BUA

ECO HABITATS

LUXURY FOREST HOMES

**Total Area: 80 acres | Area per unit: 2 Acres 6000SFT with
No of units: 40 homes**



Pristine uninterrupted view to enjoy what the forest has to offer.

Minimalistic contemporary style homes that are designed with a fully open view, which gives a look and feel of living in nature, which is apt for the next highly chosen home designs in America in Luxury segment.

This style is suggested for Luxury Forest homes with the use of completely visible landscape pockets and fully grown forest trees accommodated as part of living spaces. The infinity swimming pool gives a nice feel as a highly ambitious architectural feature suitable for West Virginia's temperate conditions.

ECO HABITATS

ASPIRATIONAL HOMES

Total Area: 75 acres | Area per unit: 1/2 Acre 3000SFT with
No of units: 150 homes



The design attempts to catch as many views of the forest as possible and take most advantage of the house's setting in between slender tree trunks. At the same time, house seeks to protect the forest by going around trees as construction progresses across the terrain. This expansion into multiple directions is compensated on the inside, where the design truly becomes "whole" again around the interior staircase. The staircase focuses user's attention, at times even strenuously directing it towards the surrounding nature.

ECO HABITATS

AFFORDABLE/MILLENIAL/VETERAN HOUSING

Total Area: 50 acres | Area per unit: 1/8 Acre 4000 SFT with
No of units: 400 homes



A feel-good style home with a view of the water body makes the stay pleasant. The project follows the conditions that nature provides and houses float freely on pillars on slopes to achieve minimal footprint on the surrounding environment - where forest becomes our backyard. The houses position, height and rotation have been chosen to give each house the best possible view. Façade materials are based on and inspired by nature.

ECO HABITATS

EDUCATION

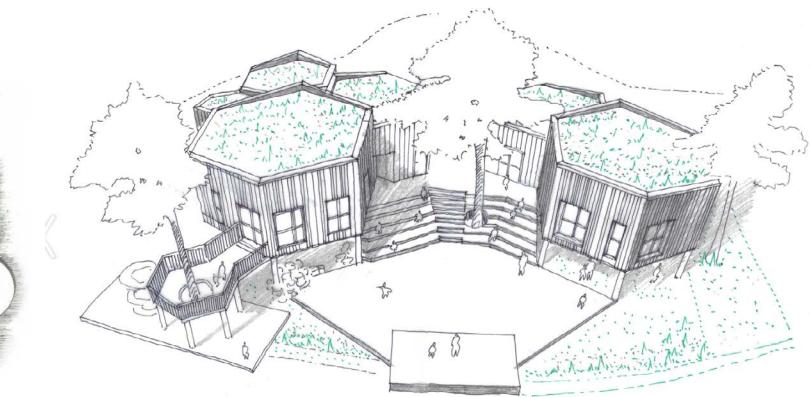
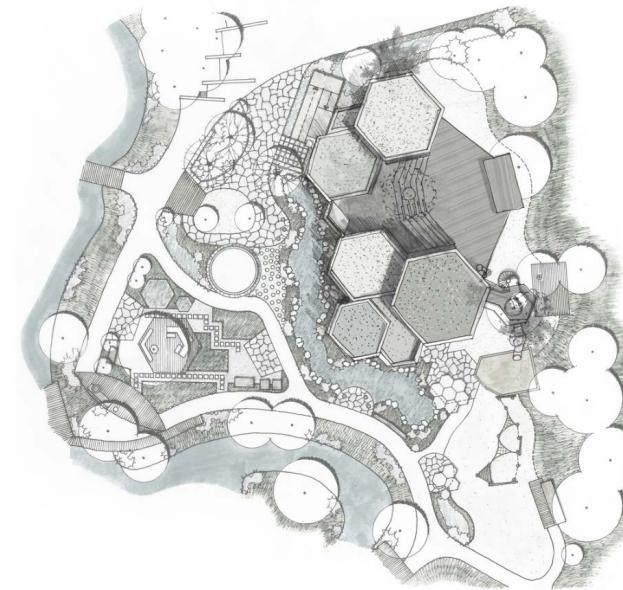
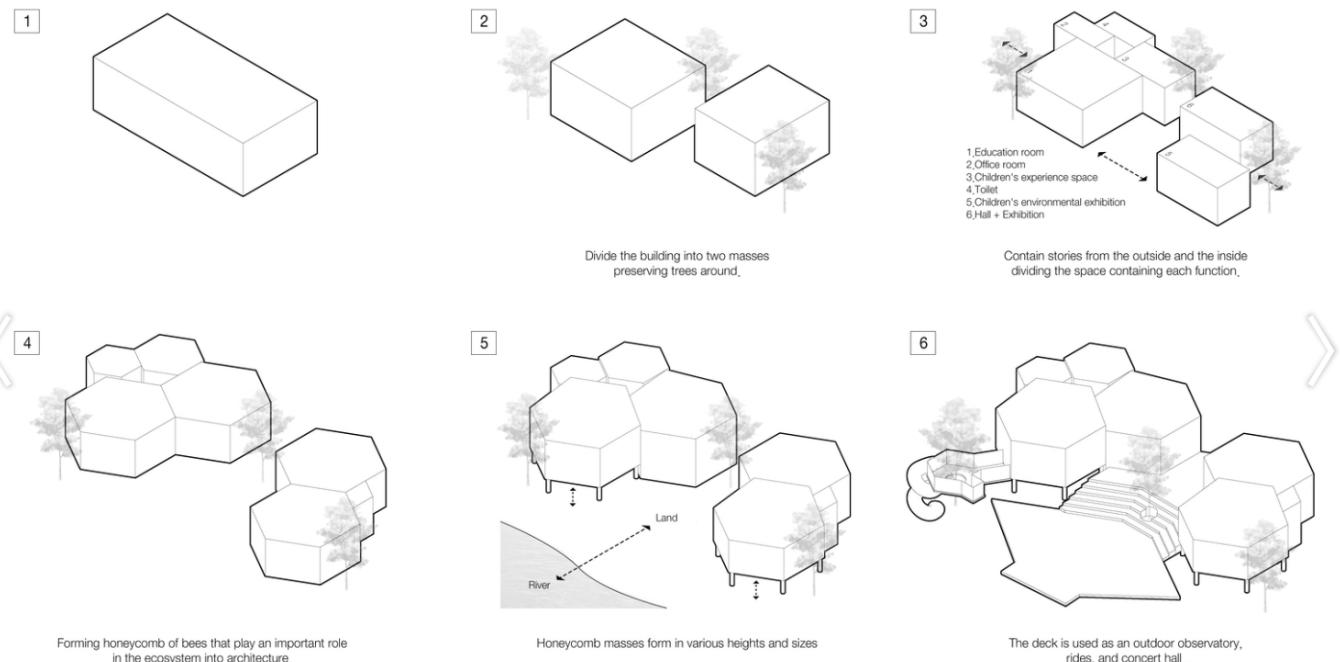
SCHOOL

Total Area: 5 acres | Built up area: 20,000 SFT



A green school is an energy efficient, high performing school that can be environmentally beneficial, economical to build and operate, that offers improved learning environments. It uses 33% less energy than a conventionally designed school. The school will include more efficient lighting, better use of day lighting, sensors and efficient heating and cooling systems.

With commissioning and extensive building automation systems, green school at Wolf Creek Climate Hub will allow for centralized control of performance from design models



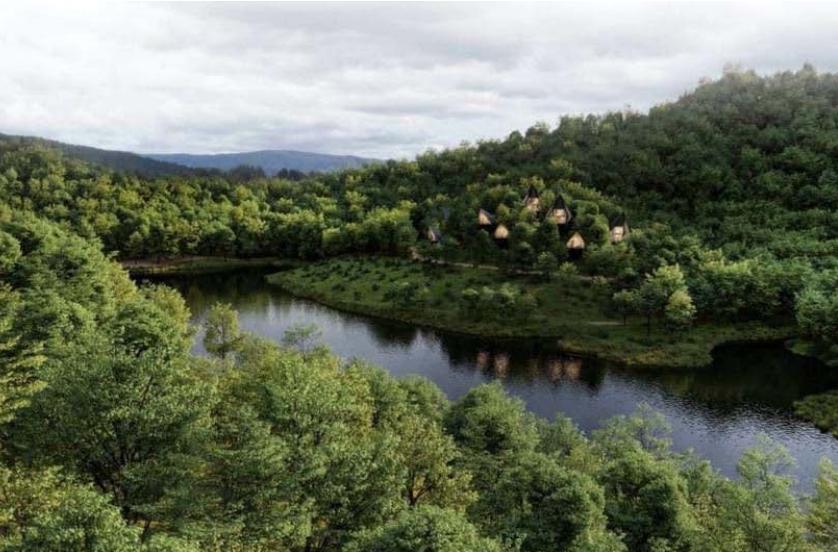
ECO HABITATS

HOSPITALITY

ECO RESORT

Total Area: 10 acres | Area per unit: 400 SFT

No of units: 60 Pods



To meet the environment-friendly aim of the project, it is important to make little impact on the natural surroundings with minimal footprint and conserving as many trees as possible.



Platforms that match the hues of the surroundings form bases for the resort structure that blends in harmoniously with the landscape. Each section is located on the mountain side and perfectly integrated to the landscape. The forms are extremely strong yet use little material and remain lightweight. Ventilation is enabled through large windows, offering views down the mountainside to the nearby creek. When the cabins are lit up at night, the windows resemble eyes peering out from the trees.

ECO HABITATS

SPORTS & AMENITIES

Total Area: 5 acres

Built up area: 10,000 SFT

Playcourts

- Tennis Court - 2 no.s
- BasketBall - 1 no.s

Clubhouse - 10,000 sft BUA

- Banquet Hall
- Mini Theatre
- Indoor Games
- Snookers
- Table Tennis
- Gymnasium
- Workspaces



ECO HABITATS

HEALTHCARE & WELLNESS

HOSPITAL

Total Area: 2 acres | Built up area: 30,000 SFT

Green Hospital is a concept that redefines how healthcare facilities are built to protect the environment. Greater the amount of energy consumed in a hospital, Greater the release of toxic wastes to the environment, putting human lives at risk of other diseases and death. In a typical healthcare center, lighting, water heating, and space heating account for more than 65% of energy consumption. Therefore, it remains essential for construction of healthcare facilities to involve incorporation of green designs and concepts into process and reduce impact on the environment, cut down operational costs, and increase energy efficiency. Core measures adopted for green buildings include use of energy-efficient lighting systems, medical equipment, and use of tech-enhanced renewable energy systems. In addition to using energy more efficiently, it is important to create designs that allow more daylight exposure and natural ventilation into the environment.



ECO HABITATS

HEALTHCARE & WELLNESS

OFF-GRID WELLNESS CAPSULES

Total Area: 1 acre | Built up area: 8,000 SFT



Wellness Village is a uniquely crafted facility incorporating an outdoor gym, medical massage center, long-term care center, women and children's facilities, wellness clinics, a boutique wellness hotel and spa, sports & fitness facilities, health-related F&B and other retail outlets etc.,

The setting provides end to end services with focus on preventive healthcare for residents and locals alike. Main goal of the center would be to create a serene wellness atmosphere and heal body, mind and soul.

The masterplan depicts a journey of wellness and looks to create a holistic delivery system.

ECO HABITATS

ANIMAL HUSBANDRY

CATTLE FARM & POULTRY

Total Area: 20 acres | Built up area: 10,000 SFT



ECO HABITATS

INDUSTRIES

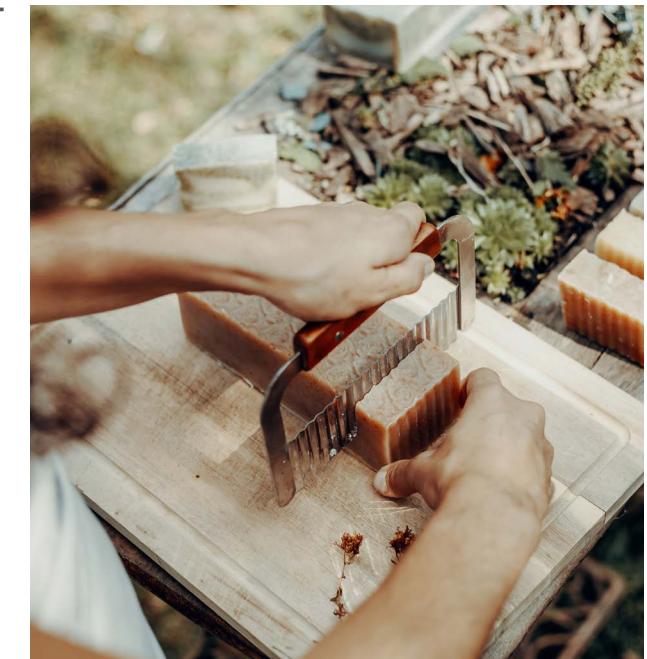
SOAP MAKING FACTORY

Total Area: 1 acre | Built up area: 4,000 SFT

Forest is a source of many herbs and various plants with exceptional medicinal properties. There are a few plants which emit a naturally soothing smell while there are others that cure scars/burns etc. all of which can be used as part of raw material for soaps and other body care solutions.

Climate Hub at Wolf Creek will have an inhouse soap making factory that makes good use of natural materials available in the forest to manufacture and supply homemade soaps and body care solutions for residents within the community and locals nearby.

Such a facility will not just help in utilizing available resources within the property but also in upliftment of lifestyle of people in surrounding towns and villages by creating learning and employment opportunities.



ECO HABITATS

INDUSTRIES

COLDPRESSED OIL PLANT

Total Area: 1 acre | Built up area: 5,000 SFT

Oil is an essential ingredient in everyday cooking apart from other benefits related to wellness. The extraction of oil has been industrialized due to an increase in demand for consumption leading to compromise in quality and adulteration of the product.

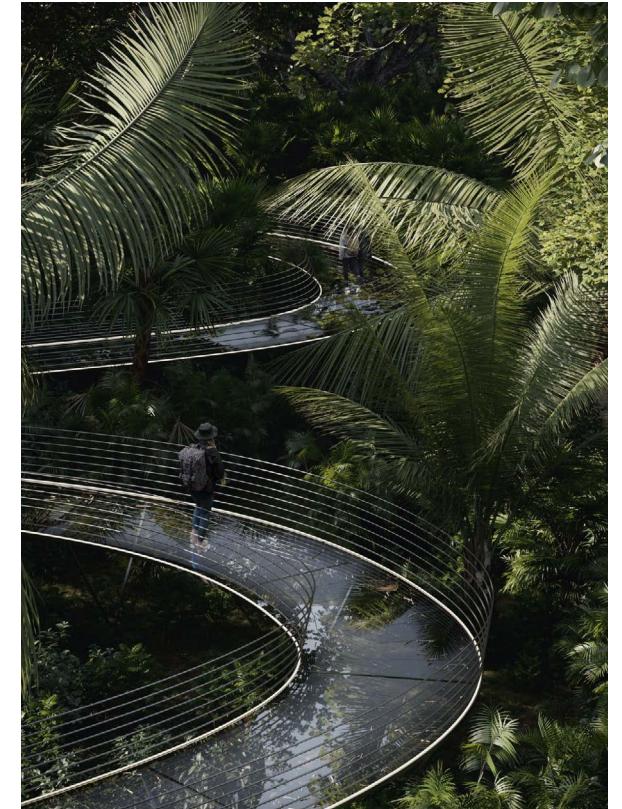
Wolf Creek will have a small-scale industry for Cold pressed oil within the community to provide pure and healthy oil to the residents by keeping the process as natural as possible.

The availability and access to raw material in the forest and farm areas assures success of an Oil Plant. The locals will be trained in the process of oil making to increase their craft and knowledge. Several employment opportunities will be created which inturn will increase revenue and help in uplifting the quality life.



ECO HABITATS

COMMON AREAS



DEVELOPMENT SUMMARY



FINANCIALS

Total Project Value : USD **174,758,375**

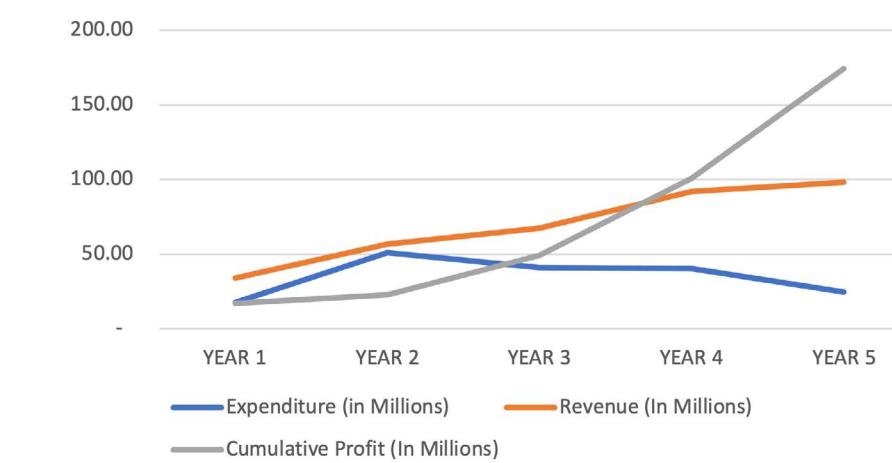
Revenue : USD **347,513,946**

Gross Profit : USD **172,755,571**

Profit Share

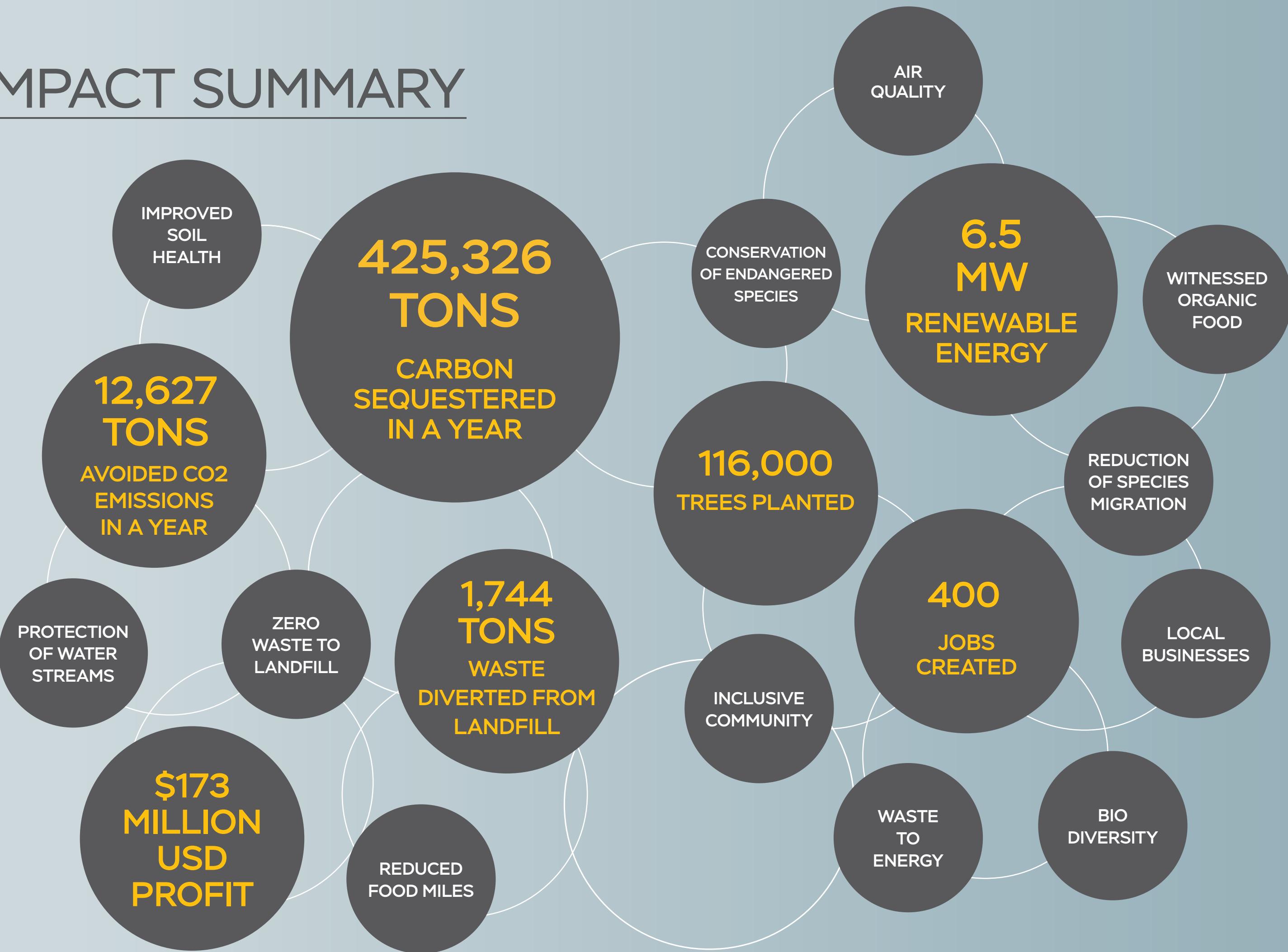
Land Owner Share	15%	USD 25,913,336
CREST Foundation	5%	USD 8,637,779
Developer	50%	USD 86,377,786
ROI to Investor	30%	USD 51,826,671
(\$25million Investment)		

Yearly Cashflows



	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
Expenditure (in Millions)	17.23	50.64	40.77	40.17	24.46
Revenue (In Millions)	33.88	56.60	67.10	91.85	98.08
Cumulative Profit (In Millions)	16.66	22.62	48.95	100.64	174.26

IMPACT SUMMARY



“
We do not inherit the earth from our ancestors;
We borrow it from our children ”

- David R. Brower

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USA

700, 12TH STREET,
N.W., SUITE 700,
WASHINGTON DC 20005

INDIA

#27, SRI VISHNU ELITE, 5TH FLOOR,
JAYABHERI ENCLAVE II,
GACHIBOWLI, HYDERABAD-500032