**High Tunnel Manual**

**Part I**

**Planning: High Tunnel Site**

*Efficient Location*

Efficiency on the farm is very important; therefore, the location of a high tunnel will help with time management and profit margins. Take into consideration daily management activities such as rolling the sides up or down for proper ventilation, irrigation management and monitoring plant health and pest and disease pressures. The closer the tunnel is to home base the more efficient managing these daily activities will be.

*Soil Health*

This is one of the most critical pieces for a growing operation in and out of a high tunnel. Healthy soil contributes to resistance to plant and disease pressure, improves plant vitality and growth, and impacts financial viability for an operation. Much of this can be assessed with a soil test. Soil tests generally include nutrient content, pH, organic matter and nutrient recommendations. Local cooperative extension offices provide soil services. Request soil composition and organic matter content.

*Orientation of the structure*

Orientation meaning the direction the end walls or the broadside of the tunnel are facing. Ideally the end walls face the prevailing winds (less surface area) and the broadside/ length of the tunnel faces the South East, improving sun exposure during winter months. Two considerations are **prevailing winds** and **sun exposure**. Determining which direction the prevailing winds come in, and how much wind occurs around the site. And how much sun will the site receive? Sun exposure is important for extending the season and the off-season value (spring, summer, and fall). Facing the broadside to the South East and structural considerations like multi tunnels, adjacent structures, trees, and mountains will affect the growth of the crop. The period of sun exposure is also something to consider. How many hours a day will the tunnel get direct sunlight?

*Site Readiness*

Verifying that the high tunnel site is ready for construction is imperative. Good drainage, awareness of previous construction debris, and access to water and electricity are all key considerations for best practice.

**Drainage** - Important for many reasons; it dictates when you are able to cultivate the soil in your tunnel and helps with plant vigor also known as plant hardiness which increases health. Plants have to be able to breathe; flooding will cause root rot and high moisture level can be a source of disease vectors.

**Surrounding structures** - Will they contribute to additional water moving towards the tunnel? If so, how to address the additional water? Contact the local NRCS for consultation to look at these potential issues before building.

**Slope -** Less than 5 inches difference in height from one end of the tunnel to the other is acceptable for surface water drainage, anything more than that soil erosion issues may start to occur depending on soil type and surrounding structures.

**Foundations/ pre-existing construction -** Was there a previous structure on site? Be aware that there may be debris in the soil that would impact the installation of the ground posts. (Please call 811 before digging)

**Access to water –** A high tunnel is going to exclude rain therefore irrigation of some sort will be necessary inside the tunnel. Water is an important component for high tunnel production. How close is it to a pressurized spigot? If not close, is there surface water available? Pond, well, and streams are all potential options.There may be resources available for rain water collection systems - Contact the local NRCS office or water conservation district for information.

**Electricity -** Useful in a high tunnel by utilizing it for initial construction needs, water pump/ filter for micro irrigation, ventilation fans, lights, and inflation blower for a double layer of plastic. This could be a large expense for an operation, but will provide for a better growing environment.

\*Solar power is an option, but can be costly depending on what crops will be growing

\*Electricity is not a requirement but will allow for more efficient management

**Part II**

**Planning: High Tunnel Structure**

*Ventilation*

 There are many ways to ventilate a high tunnel. Non-electrical ventilation like roll up or down sides and shutter vents are efficient and normally come in a standard high tunnel kit depending on the vendor. Ventilation that requires electric are ridge vents, circulation fans and vent fans. Circulation fans moves the air that already exists in the tunnel through the plant canopy. Vent fans replace the air in your tunnel with the air from outside. All of these are great for moving air through a tunnel; but most importantly think of best practices for the crops that will be growing.

*Coverings*

High tunnels are regularly covered with one layer of a 6mil UV resistant (4 year warranty) poly-plastic. There are other options available, benefitting specific crops.

**Poly- plastic (woven)**- This is a woven 9 or 12 mil plastic that is thick to minimize dripping, has a strong break point but transmits less light.

**Double layer of 6 mil plastic**- With an inflation blower this acts as a layer of insulation to protect the crops from cold weather. Requires electricity.

**Interior frost protection –** Also known as row cover, varies in thickness so can be versatile for many different crops. Will need low tunnel hoops or floating system to utilize.

**Shade cloth** - Great for keeping temperatures a little cooler for crops like summer lettuces and greens. Absorbs UV radiation with black mesh. Only necessary to cover 30%-40% of tunnel to see difference.

*Access*

The inside of a high tunnel can be accessed many different ways. What will be used inside the tunnel? Walk behind tractors, tractors, wheelbarrows, trucks, etc. How many doors are ideal for efficiency? Door sizes and designs vary greatly and can be customized to fit the crop growing needs. Sliding and rolling doors, curtains, roll up doors, scissor doors are just a few common doors available for high tunnels. Certain high tunnel kits and manufacturers only have specific doors and prices can vary; this is an important consideration when thinking of a high tunnel structure.

**Part III**

**Planning: High Tunnel System**

*Water Sourcing & Irrigation*

More than one water source is recommended for best practice. **Rain water catchment** is a great way to irrigate inside a high tunnel and helps with surface water issues causing erosion and possible flooding in the high tunnel. There are cost share programs available for this conservation practice; contact the USDA-NRCS for information.

Using **surface water** is also a cheaper option. Ponds, wells, streams, and cisterns are all examples of what could possibly be available near the high tunnel site. A pump and plumbing materials will be necessary for this irrigation option.

If the high tunnel site is within reach of **municipal or county water source/ pressurized spigot** that is also an option. Check with local water company and NRCS on back flow prevention rules and regulations. There are different methods of irrigating in a high tunnel, although some methods may take more time and are less efficient. **Drip line irrigation** has been proven to be the most efficient method to irrigation a high tunnel due to the immediate water to root contact without creating more moisture in the air. Drip irrigation can also be ran on timers keeping moisture in the soil at a constant percentage. This option could possibly be a large expense for an operation.

*Tools & Equipment*

Weed control and pest & disease management are essential in a high tunnel. The following materials are helpful with managing crops in a high tunnel:

* + Woven ground cover- comes in different mils, sizes and colors.
	+ Insect netting- Keeps pests out of the high tunnel, but also has the potential to keep pollinators and beneficial insects out as well. There are great resources to help with planning for best practices \_\_\_\_\_\_\_\_\_
	+ Tillers/ small scale equipment- Controls weeds, preps beds for planting, harvests crops,
	+ Biological control- minimizes pest pressure by intentionally introducing natural predators and enemies