Geothermal Greenhouse Partnership, Inc

Final Report

December 2020

CWCB Funding (WSRA Grant)

Contract # POGG1 2015-252

The Geothermal Greenhouse Partnership Project in Pagosa Springs is complete (2015-2020) with regard to the expenditure of CWCB funds from the Water Supply Reserve Account Grant Program. The overall objects of the Project have been accomplished:

1. Prepare substructure for installation of water infrastructure outside and under greenhouse sites
2. Install water infrastructure outside and under greenhouse sites
3. Complete water infrastructure inside the three greenhouses

Appendix C includes the breakdown of those objectives into four main Tasks that are referenced in the text.

The total Project includes three 42 foot agricultural greenhouses heated by geothermal and solar energy (including a newly installed array of solar panels), grounded in permaculture or aquaponic practices, surrounded by beds, walk ways and public seating area (including an amphitheater), and graced by a newly installed pollinator/native plant garden - all centrally located in downtown Pagosa Springs at Centennial Park.

Water Supply Reserve Account Funds (WSRA) administered through the Colorado Water Conservation Board (CWCB) were used by the GGP to install water infrastructure both outside and inside the three greenhouse.

Early in the spring of 2015, the GGP begins working with Davies Engineering of Pagosa Springs as engineering plans and specifications get underway and are completed. By fall 2015 preparation of the .78 acre site is completed by UCAL Construction: embankment imported and compacted, trenches dug, bedding material and sleeves in place. By early winter supply and return pipes to bring geothermal, irrigation and potable water to each of the greenhouse sites are in place (Tasks 1, 2 & 3). Lines are stubbed out and connected to appropriate sources. The geothermal lines are connected to the town's geothermal supply; irrigation lines are connected to town well water and our local water utility; electrical supply lines are in place; potable water pipes are connected to town's potable water supply. Hundreds of hours of in kind work are included. With winter, work was suspended.

In early spring 2016 the Education Dome (non-CWCB funding) is ordered and installed and interior work (Task 4) begins. By the end of this season the installation of all geothermal, potable, and irrigation water systems is complete, including: the heat exchanger to exchange heat from raw geothermal to circulating water, in ground heating pipes and controls, irrigation pipes to the seven beds and controls, heated coil units in the 10,000 gallon water tank, and flow meters and temperature monitoring devices. These systems complete WSRA funded work in the first greenhouse.

By 2018 non-CWCB funding funding for the installation of the Community Garden Dome (CGD) and CWCB/CWP funding for the Innovation Dome (ID) have been received and the installations are completed.

In 2019 WSRA funds are used to provide water to the Inside of the Community Garden Dome (CGD)(Task 4). In the CGD that work included the three types of heating/cooling systems: the heat exchanger regulating the temperature and flow of geothermal water and the distribution system that underlies the pathways; the systems that deliver irrigation and potable water; the cooling systems - fans and misting system. These systems completed WSRA funded work in the second greenhouse.

The Innovation Dome is designed to be an aquaponic installation; hence, heating/cooling and irrigation systems are quite different than in the other two greenhouses. The installation of these system begins in 2019 and continues into 2020. On the ground floor pvc piping connecting the 800-gallon fish rearing tanks with the sump pump tank, clarifier tanks and degassing tanks are leveled and buried below ground. Leveling of all parts of the fish system is required for efficient (gravity fed) water flow and minimal pumping. More pvc pipes are buried and leveled to connect the fish system to the DWC plant beds allowing inflow and outflow. Pipes and valves allowing the flow of geothermal water into and out of the dome are installed and the heat exchanger which will allow heating of potable water for distribution within the dome is purchased and installed. Gravel is leveled and packed. Two evaporative coolers are mounted on the outside of the dome and exhaust fans with mushroom caps preventing entrance of insects are purchased and stored. The electrical panel is overbuilt to add future capacity and conduit is installed throughout. An early visit from the electrical inspector yields good advice on how to keep the system safe and pass the final inspection in the following year.

WSRA funding is consumed in 2020 with the payment of a long overdue invoice from Davis Engineering for work done at the outset of this project.

Commitments: We confirm that all matching commitments have been fulfilled.

Finally, please accept our sincere gratitude for the critical role that the CWCB has played in bringing to fruition the dreams and plans of a small but ardent group of volunteers with a mission in Pagosa Springs.

Our mission is to educate the community in sustainable agricultural practices by producing food year-round using local renewable energy.

APPENDIX A

Attached files and links

Attached are photos of the domes, and an engineering drawing and here is a link to a short video https://www.youtube.com/watch?v=mwb3J5fgSdc that we prepared in September to advertise our Covid-19 adapted Breakfast with Balloons fundraiser (which originally had brought supporters to the sight to enjoy an early morning breakfast and hot air balloon ascension) renamed Breakfast in a Balloon which allowed our supporters to join us for breakfast separately after they had picked up a take-out breakfast at our favorite local coffee shop. Not shown are the newly installed solar panels; otherwise, the video offers a full picture of our accomplishments and speaks better than a 1000 words.

APPENDIX B

Uses of the Domes and how the GGP is handling the COVID threat

The Education Dome has served as the GGP site for sustainable agriculture education (public school, charter schools, home school, and 4H) for three years. During summers the site grows produce to be sold at the local farmers market to help sustain the GGP. In March of 2020 everything changes. Classes end and produce is redirected toward supplying our local Food Pantry Network with nutritious fresh produce for their clientele. In December of 2020 Food Systems|Food Equity Archuleta, a local Coalition supplying local food to the community that is in need, purchases a CSA from the GGP to continue supplying the Food Pantry Network with fresh produce through April. This income is directed to sustain the GGP.

From its inception the function of the Community Garden Dome has been to invite community groups in to grow and share production with those who can use it. In March of 2020 this function takes on added urgency as our local Food Pantry Network sought local sources for nutritious fresh produce and the CGD contributes its harvest.

From its inception the Innovation Dome is designated as the greenhouse to sustain the GGP through income derived from raising specialty crops for our local restaurants. It is also the last and most complex of the three domes to bring to a productive state. Since March progress has slowed dramatically. Finally, however, arrangements have been made with Santa Fe Community College for an intern to move to Pagosa Springs and begin the productive operation of the dome and serve as mentor for instruction of local volunteers and staff.

Obstacles overcome: Our main obstacle has always involved *time*, the time required to finish a project which is heavily dependent on volunteer labor; the time required to engage professionals in a relatively small project who are in demand for much larger projects. So it has taken us five years to complete the project involving WSRA funding but we have done it.

APPENDIX C

The Scope of Work

TASK 1 – Provide Geothermal Water

Description of Task

- *Provide geothermal water to create a suitable climate for winter gardening inside greenhouses by connecting to Town's geothermal system.*

Method/Procedure

- *Trench and Install supply and return pipes, and connect pipes and embed in appropriate bedding materials, compact and backfill.*
- *Apply asphalt and gravel across parking lots and roadways as needed*
- *Install flow meter and temperature monitoring devices, plus appropriate valves and connections to future greenhouses*

Deliverable

Town geothermal water available and ready for connection to interior systems of greenhouse.

TASK 2 – Provide Well Water

Description of Task

- *Provide well water to create a suitable environment for year-round gardening inside the greenhouses by connecting to Town's Infiltration well nearby.*
- *Provide irrigation water to surrounding beds.*

Method/Procedure

- *Trench and Install supply and return pipes, connect pipes and embed in appropriate bedding materials, compact and backfill.*

- *Provide electrical supply to pump.*
- *Install pump, flow meter and temperature monitoring devices, plus appropriate valves and connections to future greenhouses*

Deliverable

- *Town well water available and ready for connection to interior systems of greenhouses*

TASK 3 – Provide Potable Water

Description of Task

- *Provide potable water for human consumption, hand washing and produce preparation for gardening inside greenhouses by connecting to Town's potable water system.*

Method/Procedure

- *Trench and Install supply and return pipes, connect pipes and embed in appropriate bedding material, compact and backfill.*
- *Apply asphalt and gravel across parking lots and roadways as needed*
- *Install appropriate valves and connections to future greenhouses*

Deliverable

- *Potable water available and ready for connection to interior systems of greenhouses*

The above three tasks will be repeated for each of the three greenhouses.

TASK 4 – Provide water to inside of Dome

Description of Task

- *Install Interior heating /cooling and irrigation systems in greenhouse.*

Method/Procedure

- *Install 3 types of heating/cooling systems to create optimum growing conditions for year round gardening in Growing Dome Greenhouse:*
  - *In ground heating for winter growing*
  - *Radiators for hanging/cooling*
  - *Heat exchange coils in the water tank for heating/cooling according to season*
- *Install irrigation systems*
  - *Irrigation*
  - *Sprinkler*
  - *Misting*

Deliverable

- *These systems provide Temperature stabilizing systems; fully operational heating/cooling, irrigation and misting system optimize and maximize plant yields while minimizing water consumption. These systems will be monitored and recorded to provide valuable information for other comparable project and for educational purposes*

*THE ABOVE TASKS ARE THE SAME FOR EACH OF THE THREE DOMES**

(* 2020 Note: As we learned by experience, the process of providing water to the inside of the Innovation Dome was quite different than the other two domes.)