FINAL

PRELIMINARY ENGINEER'S REPORT
FOR THE
EVALUATION OF SLUDGE PROCESSING AT THE WASTEWATER TREATMENT PLANT

City of Lockport
Niagara County, New York

PREPARED FOR:

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17J1-0095

May 2018

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1.0 EXECUTIVE SUMMARY

The purpose of this report is to evaluate sludge processing upgrades at the City of Lockport (City) Wastewater Treatment Plant (WWTP) and compost facility.

The WWTP and compost facility is located at 611 West Jackson Street in the northwest portion of the City of Lockport. The WWTP serves the City of Lockport and the Town of Lockport, which includes a total of approximately 41,700 people.

The existing WWTP utilizes an aerated grit chamber, bar screens, four (4) primary settling tanks, three (3) aeration tanks and four (4) final settling tanks. Preliminary treatment is provided in the grit chamber and bar screens; primary treatment is provided in the primary settling tanks; and secondary treatment is provided by the activated sludge process in the aeration tanks and final settling tanks. The treated wastewater is conveyed through existing chlorine contact tanks, though chlorination is no longer a part of the City's treatment process. Effluent from the WWTP is then discharged to Eighteen Mile Creek, which is a Class D waterbody.

Sludge resulting from the above treatment processes is thickened in a thickener tank then dewatered by two belt filter presses in the sludge disposal and handling building. Dewatered sludge is then transported to the compost facility and processed. The sludge undergoes a minimum of 14 days of active composting at a site off of the WWTP property to meet USEPA Class A requirements. Class A sludge is acceptable for land application, and the City markets the finished product to homeowners, landscapers, and commercial soil blenders. Only grit from the WWTP is typically landfilled.

The compost facility is nearing the end of its design service life and is in need of rehabilitation due to its age. Rehabilitation of the existing facility was evaluated and compared to four alternative sludge drying processes, including indirect heat drying and microwave drying. All alternatives were considered for technical feasibility, cost, and environmental impacts. All sludge drying alternatives considered have a footprint exceeding the available space within the sludge handling room (currently used as two truck bays), therefore several housing options were also considered. A new building, an addition above the existing sludge handling room, and reuse of the compost facility building were considered for equipment housing.

The recommended alternative is to install the Gryphan Dryer in a new building at the WWTP. The total project cost for the sludge processing upgrade project, including legal, engineering, and administrative costs, is $3.588 million. The City is advised to pursue funding opportunities offered in the New York Consolidated Funding Application (CFA) call for applications and engage the community regarding the proposed project.

2.0 PROJECT BACKGROUND & HISTORY

2.1 SITE INFORMATION

2.1.1 Location

The City of Lockport (City) is located in Niagara County, New York. The City is responsible for the operation, maintenance, and improvement of the wastewater treatment facilities. The proposed improvements are located at the City of Lockport Wastewater Treatment Plant at 611 West Jackson Street and compost facility, accessed at 5901 West Jackson Street. Sludge drying equipment is proposed either in or adjacent to the existing sludge disposal and handling building or the compost facility.

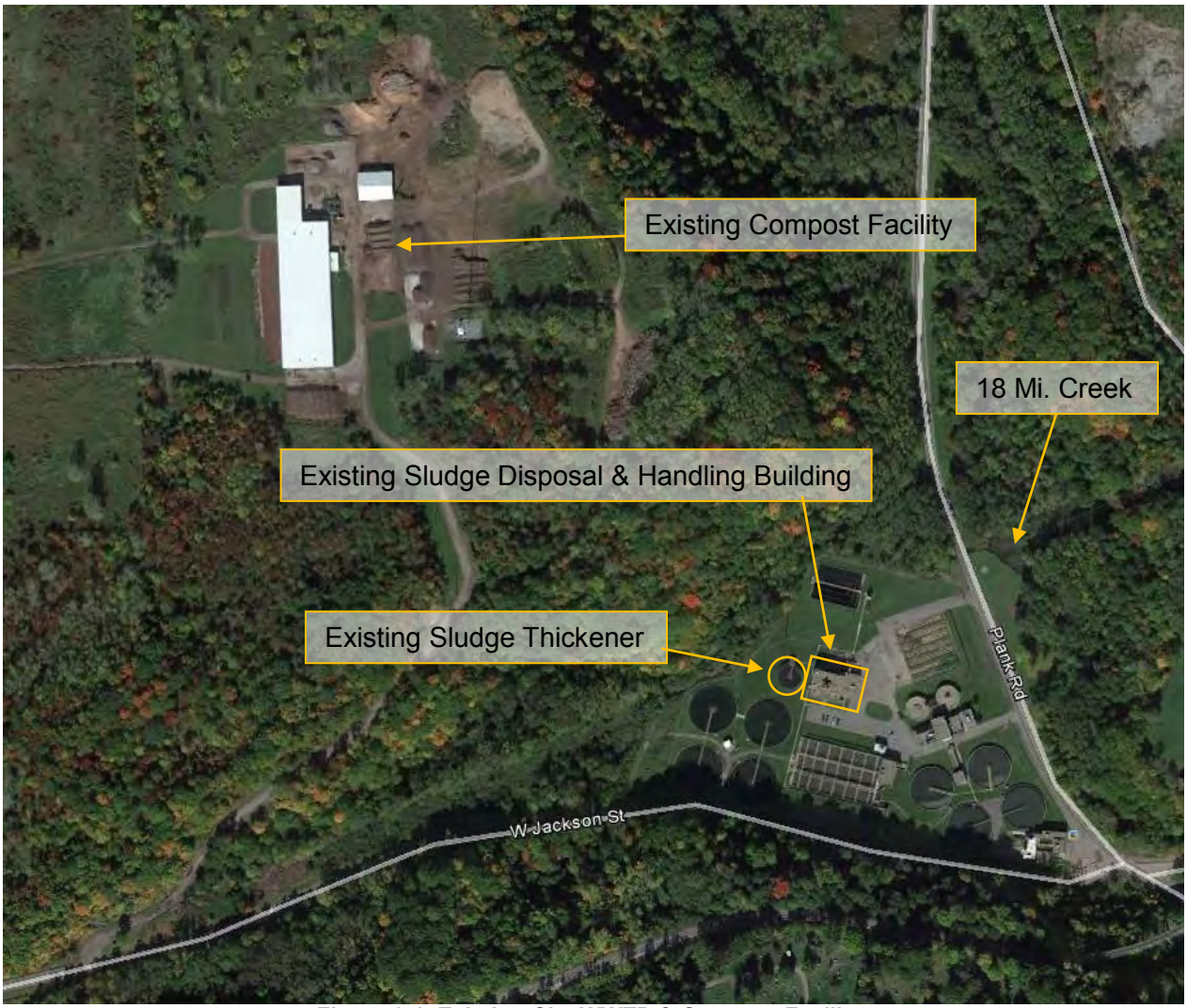

Figure 2-1. Existing City WWTP & Compost Facility

Please refer to the project location map in **Appendix A** and the City of Lockport Wastewater Treatment Plant Plans in **Appendix B** for detailed location and information on the sludge disposal and handling building.

2.1.2 Geologic Conditions

The United States Department of Agriculture (USDA) – National Resources Conservation Service's (NRCS) online soil reconnaissance tool, Web Soil Survey, was used to obtain soil information for the project site. Soil types anticipated to be encountered based on soil mapping are predominately alluvial land and silt loams in hydrologic soil group "A/D". The depth to bedrock is anticipated to be greater than 6.5 feet. The depth to the water table for the anticipated soil types ranges from approximately 0 to more than 6 feet. The water table elevation is dictated by the nearby water levels in Eighteen Mile Creek. The Custom Soil Resource Report is included in **Appendix C**.

2.1.3 Environmental Resources

Based on the mapping created using New York State Department of Environmental Conservation (NYSDEC) Environmental Resource Mapper, there are no significant environmental resources present immediately on-site. The Environmental Resource Map is included in **Appendix D**.

2.1.4 Floodplain Considerations

According to the FEMA Flood Insurance Rate Map (FIRM 36063C0237E) the project area is located in the 100-year and 500-year flood plain boundary. However, the project area is not located in the floodway. A copy of the FEMA Flood Insurance Rate Map is included in **Appendix E**.

The base flood elevation (BFE) for the 100-year flood is 364.1 feet. Existing slab of the sludge handling room is at an elevation of 363.5 feet. Consideration was given to the 100-year flood elevation in the design of sludge drying upgrades retrofitted to the existing sludge disposal and handling building and proposed structures. Proposed new structures are elevated above the 100-year floodplain in order to increase project resiliency to flooding.

2.2 OWNERSHIP & SERVICE AREA

The WWTP is owned by the City of Lockport and serves both the City and portions of the Town of Lockport (approximately 40% to the east, south, and west of the City). An estimated 29,400 users are included in the project service area.

2.2.1 Population Trends

The population in the service area is anticipated to remain constant as the wastewater collection and treatment facilities serve predominantly existing built-out neighborhoods. Each of these neighborhoods exhibit little area for further development.

The 1990, 2000, and 2010 U.S. Census also show that the populations in both the City and the Town of Lockport have not grown significantly in the last twenty years. The combined population of the City and 40% of the Town has actually declined in recent years. The population data is included in Table 1.

TABLE 1-1 – U.S. Census Population Data

Year	City of Lockport, NY	Town of Lockport, NY	40% of Town in Service Area	Combined Population
1990	24,426	16,596	6,639	31,065
2000	22,279	19,655	7,862	30,141
2010	21,165	20,529	8,212	29,377

While an increase in hydraulic or organic loading from the City and Town is not anticipated, the possible addition of sludge drying equipment could draw a larger customer base. The City may choose to accept sludge from new users for processing using the proposed drying equipment. With this in mind, equipment was selected that could provide additional future capacity if needed.

2.3 EXISTING FACILITIES & PRESENT CONDITION

2.3.1 Description & History

The City WWTP was originally constructed in 1940, with several upgrades in 1973. Sludge from the WWTP is thickened in a thickener tank then dewatered by belt filter presses in the sludge disposal and handling building. Dewatered sludge is then transported to the compost facility and composted for a minimum of 14 days to meet USEPA Class A time and temperature requirements for pathogen destruction and vector attraction reduction. The biosolids are then cured for a minimum of 2 months in outdoor wind rows. The compost facility was constructed in 1991 and is nearing the end of its design service life.

2.3.2 Permit Compliance

The City of Lockport operates the wastewater collection and treatment system under SPDES Permit No. NY-0027057. The current permit is included in **Appendix F**.

2.3.3 Flow & Loading

The City currently produces an average of 2,700 wet tons of sludge per year based on the City's monthly operating reports from 2012 to 2016. (The sludge volume is the total annual sludge produced from the belt filter press prior to composting.) The peak annual sludge production in recent years was 2,885 wet tons per year in 2015. The design annual sludge production from the filter press used in this evaluation is 2,900 wet tons per year. Average solids content of the sludge is 23%, with a range of 18 to 32%. Average volatile solids content of the sludge is 51%, with a range of 37 to 62%.

TABLE 2-1. City of Lockport Annual Sludge Production

Year	Sludge Volume (tons)	Avg. Mo. Solids Content (%)	Avg. Mo. Volatile Solids Content (%)
2012	2,765	23.7	50.2
2013	2,482	23.3	49.3
2014	2,688	23.1	50.6
2015	2,885	21.7	51.0
2016	2,713	23.2	52.1
Average	2,706	23.0	50.6

The belt filter press typically operates 3 days per week. Basic mixing trucks carrying approximately 4,500 pounds of sludge are used to transport dewatered sludge to the compost facility, which operates 6 days per week.

The population in the service area is anticipated to remain constant as the wastewater collection and treatment facilities serve predominantly existing built-out neighborhoods. Each of these neighborhoods exhibit little area for further development. An increase in hydraulic or organic loading is not anticipated in the existing area served by the project. However, the City may choose to accept sludge from other sources in the future. Therefore, the ability to expand the proposed sludge drying equipment was considered.

2.3.4 Existing Condition

The current sludge processing method utilizes a thickener tank, two belt filter presses, and a compost facility to process sludge. While the thickener tank and belt filter presses are expected to last for a number of years, the compost facility and ancillary equipment is nearing the end of its design service life. Rehabilitation is anticipated to be necessary in the near future to maintain operation of the facility.

During a site visit to the compost facility on August 21, 2017, the following was observed:

- The main building appears to be in fair condition. However, the operator noted that the Stayflex coating system, a spray-on foam insulator and corrosion protection system, used to seal the roof decking in 2007 was applied without first removing rust/corrosion to the beams. The Stayflex coating representative later provided our firm with a structural assessment (included in **Appendix G**) indicating that the building is structurally sound and only required minor repairs prior to application of the coating system. The Stayflex system does not require removal of rust/corrosion prior to application. If the City completed these minor repairs prior to coating system application, the building is anticipated to last another 15-20 years.
- Equipment is aged, and operators report frequent downtime for maintenance. Only two of three BDP compost agitators were operational at the time of the visit.
- Equipment replacement parts are no longer available through the manufacturer; three non-functional agitators located outside of the building are used for spare parts.
- New Holland and John Deer loaders are in good condition.
- 8 blower units are operational.
- Twelve composting bays, rails, and discharge pit are in fair condition.

- The biofilter is not well-maintained as weeds were growing in the filter and operator reported that the existing depth of media is likely less than required. Per the operator, there is currently about 1 foot of media above the stone base of the biofilter. Media should be replaced every 3 years to a depth of approximately 3 feet per the operator.
- Compost is sold for $20 per cubic yard, and is not screened to remove wood prior to sale. Operators report that many buyers prefer screened compost. Compost demand is less than production, as the facility has several years of compost stored in outdoor wind rows.

Figure 2-2. Compost Facility - Roof Decking with Stayflex Coating System

Figure 2-3. Existing BDP Agitators and Composting Bays

Figure 2-4. Non-functional Equipment used for Spare Parts

Figure 2-5. Outdoor Wind Rows

Figure 2-6. Biofilter

The sludge handling room in the sludge disposal and handling building appears to be in good condition. The existing building may be utilized to house alternative sludge drying equipment. Refer to **Appendix B** for plans of the existing sludge disposal and handling building.

During site visits to the sludge handling facilities at the WWTP on August 21 and November 1, 2017, the following was observed:

- Natural gas service is available in the southeast corner of the sludge handling room.
- Water service is available adjacent to the filter press and in the basement.
- Electricity is available in the electric room of the sludge handling and disposal building.
- Trench drains in the two truck bays on the sludge handling room are available for sewer/drain service.
- Existing polymer tanks and equipment on the south side of the sludge handling room are to remain in place and extend a maximum distance of approximately 12 feet from the southern wall. The footprint available for drying equipment in the existing room is limited to the two truck bays, approximately 30'L x 35'W x 15'H.

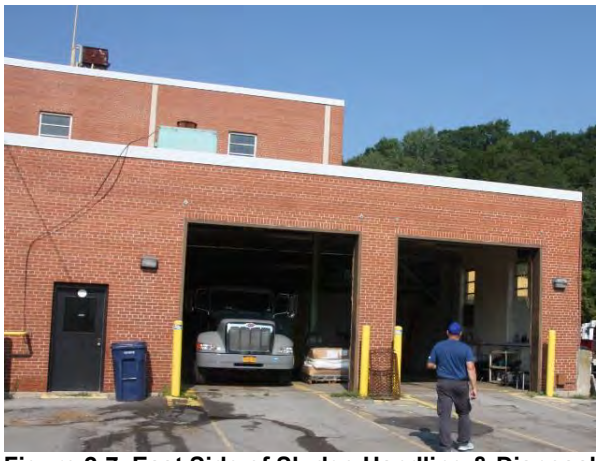

Figure 2-7. East Side of Sludge Handling & Disposal Building

Figure 2-8. North Truck Bay in Sludge Handling Room

Figure 2-9. South Truck Bay and Equipment on Southern Wall of Sludge Handling Room

Figure 2-10. Sludge Conveyance System for Loading Trucks (above South Truck Bay)

Figure 2-11. Sludge Conveyance System for Loading Trucks (above North Truck Bay)

Figure 2-12. Sludge Conveyance System to North of Building

Figure 2-13. Conveyor from Belt Filter Press

Figure 2-14. Conveyor to Sludge Handling Room

Figure 2-15. Polymer Tanks on South Wall of Sludge Handling Room

Figure 2-16. Polymer Tank in Southwest Corner of Sludge Handling Room

Figure 2-17. Natural Gas Service in Southeast Corner of Sludge Handling Room

Figure 2-18. Natural Gas Service with Modified Blow-off Regulator

2.4 DEFINITION OF THE PROBLEM

The City must handle and dispose of sludge resulting from wastewater treatment processes at the WWTP in accordance with local, federal and state regulations. Currently, the City composts dewatered sludge to produce a marketable product, which is sold to homeowners, landscapers, and commercial soil blenders for land application.

However, the existing compost facility and ancillary equipment is aged and approaching the end of its service life. The City must continue to process and dispose of sludge, and would like to continue marketing the finished product rather than landfilling dewatered sludge. Landfilling is subject to price increases and does not generate income, making it an undesirable option economically. While the composting process achieves the desired end product, the City is producing compost at a rate greater than current demand and has stockpiled several years of compost. Stockpiled compost may need to be disposed of in the future.

In order to continue selling processed sludge to the existing customer base, the City must meet USEPA Class A biosolids requirements, which includes pathogen destruction and vector attraction reduction.

Additional considerations include operation and maintenance. The compost facility currently requires three operators, several of whom are planning to retire. In addition to the poor condition of the composting equipment, there will soon be a shortage of personnel to operate the facility.

The City will not be able to continue composting sludge from the WWTP and producing marketable end product in the near future. The City would like to consider viable sludge processing options that are fiscally responsible in terms of capital costs, operation and maintenance costs, energy demand, and personnel requirements, that will produce marketable Class A biosolids.

2.5 FINANCIAL STATUS

The annual budget for the City of Lockport Compost Facility is currently approximately $393,000 and includes operating expenses, personnel salaries and benefits, and maintenance costs. The budget is specific to the compost facility, and does not include the cost of hauling sludge to the facility or WWTP operation.

The City does not have funding allocated to implement sludge processing upgrades at the WWTP and/or compost facility. The City authorized preparation of this report to support obtaining funds for this project via potential grant and bonding. The City raises funds through sewer rates and charges, compost sales, and taxes. Refer to the City website for further detail on rates and 2017 adopted budget.

3.0 ALTERNATIVES ANALYSIS

3.1 ALTERNATIVE 1 – NO ACTION

The City wastewater treatment plant will continue to process sludge using the existing thickener, belt filter presses, and compost facility. Without rehabilitation or replacement efforts, the existing compost equipment will continue to fail, resulting in extended down-time for maintenance and repairs. As existing equipment is no longer manufactured/available, once the City uses its existing supply of spare parts, equipment failure will result in the City's inability to compost sludge without capital investment. If composting is no longer viable, the City will be required to landfill dewatered sludge.

Because operators have reported that the existing agitators already require frequent maintenance, and many spare parts have been utilized, we anticipate that equipment replacement will be required in the near future to maintain compost facility operation. Therefore, the no action alternative is not recommended or feasible.

3.2 ALTERNATIVE 2 – COMPOST FACILITY REHABILITATION

3.2.1 Description

Rehabilitation of the compost facility is anticipated to include the following in order to prolong longevity and operation of the facility:

- Empty all twelve bays down to the aeration stone and replace the 2" layer of wood chip above the stone. Work to be completed by City personnel.

- Replace compost agitators (supplied by BDP Industries). BDP recommends replacing the three (3) 25 HP agitator/transfer dolly (A/D) sets with two (2) new 50 HP A/Ds. A new festoon system which supplies power to the A/Ds would also be required.
- Dolly rail and Agitator rail should be in good condition unless physically damaged or concrete moved.
- Replace Compost Process Control System (supplied by BDP). The control system interfaces with temperature probes mounted in the bay walls to monitor the compost temperature. There should be approximately five (5) per bay or sixty (60) total. These probes likely require replacement.
- For each temperature probe there is an associated 3 HP blower. Our recommendation would be to purchase three (3) new blowers (not supplied by BDP) to keep on hand and replace the blowers as they fail. Based on the vendor's recent experience upgrading a compost facility in Merrimack, NH, there should be no need to replace the aeration piping system in the stone.
- Repair/Replace the ventilation fans and ductwork as needed (not by BDP).
- Replace the wood chip media in the biofilter. Work to be completed by City personnel.

3.2.2 Construction Cost Estimate

The table below summarizes the probable cost for rehabilitation of the existing compost facility. Equipment, installation, mobilization, overhead and profit, contingency, and legal, engineering, and administrative fees are included in the project cost. The total project cost is estimated to be $2.545 million. Refer to **Appendix G** for supporting documentation of cost and the scope of work by Koester Associates & BDP Industries.

TABLE 3-1. Probable Project Cost of Compost Facility Rehabilitation

Compost Facility Equipment	**$1,750,000.00**
Equipment Installation	$ 100,000.00
Ventilation Fans & Ductwork	$ 35,000.00
Biofilter & Woodchips in Bays	$ 50,000.00
Mobilization/Demobilization (4%)	$ 77,000.00
Contingency (10%)	$ 201,000.00
Overhead & Profit (15%)	$ 332,000.00
Legal, Engineering & Administrative Fees (25%)	$ 636,000.00
TOTAL	**$2,545,000.00**

The annual operation and maintenance cost is anticipated to include the following:
- Labor for system operation and maintenance.
- Utility costs to operate the system.
- Compost amendment materials.
- Miscellaneous repairs and maintenance activities.

Based on the 2017 adopted budget, the annual operation and maintenance cost specific to the compost facility is estimated to be $393,000. This excludes hauling costs, which are estimated to be $10,000 annually. The estimated total annual cost to operate the compost facility is $403,000.

3.2.3 Non-Monetary Factors

Currently the compost facility is staffed 6 days per week by 3 operators. Several operators are scheduled to retire in the next couple of years. Continued use of the compost facility will require hiring and training new operators.

Compost demand is currently less than production, resulting in storage of finished product at the compost facility in outdoor wind rows. The NYSDEC has indicated that this backlog of material is objectionable.

3.3 SLUDGE DRYER ALTERNATIVES

Several sludge dryers were evaluated as alternative sludge processing methods to composting. All sludge dryers considered are designed to produce Class A biosolids, meeting USEPA time and temperature requirements for pathogen destruction and vector attraction reduction as specified in 40 CFR Part 503. Class A biosolids may be land applied and marketed to the public, similar to the compost product currently produced.

The following design criteria was applied to all sludge dryers considered, and is based on operating data from the past 5 years:

TABLE 3-2. Design Criteria for Sludge Dryers

Annual Wet Solids Production	2,900 tons
Annual Dryer Operating Hours	6,240 hours (5 days per week, 24 hours per day)
Inlet Percent Solids	23% (average), 18-32%
Outlet Percent Solids	90%
Volatile Solids Content	51% (average); 37-62%

Direct dryers, which are typically rotary dryers, are often selected when the desired end product is used for agricultural purposes. Direct dryers require dried solids recycling in order to avoid the "sticky" phase of sludge from 40-60% solids. In this condition, sludge is difficult to move inside the dryer. Because the City does not currently market its end product to agricultural users due to the presence of heavy metals in the City's sludge, and dried solids recycling would require a larger footprint, direct dryers were eliminated from further consideration.

Indirect dryers are primarily considered in this report due to higher thermal efficiencies, lower risk of explosion with lower temperatures, and no requirement for dried solids recycling. Indirect paddle dryers, which typically use a thermal oil or steam at a high temperature in a hollow metal paddle/auger to heat sludge indirectly, require a long startup and shutdown time. Paddle dryers are therefore appropriate and cost-effective in applications when operating 24/7. However, the WWTP is currently staffed five days each week. Paddle dryers were therefore eliminated from further consideration.

Current utility costs were provided by the City of Lockport. The City purchases natural gas at $1.823 per MMBTU and electricity at $0.0986 per kWh. Ongoing operation costs for the alternatives utilize these rates.

3.4 ALTERNATIVE 3 – KRUGER BIOCON DRYER

3.4.1 Description

The Kruger BioCon Dryer is an indirect convection belt dryer. Hot drying air is circulated through sludge layers on two belts to remove moisture from the material. Drying air is heated by thermal fluid heat exchangers, which utilize thermal oil heated by a natural gas fired thermal fluid heater. Drying air is recirculated through a condenser to remove moisture in a closed loop, which increases efficiency and reduces odor.

Sludge is carried through two zones of the dryer on stainless steel belts: the first drying zone at temperatures from 250-350°F and the end drying zone at 175-210°F. Sludge remains in the dryer for at least 60 minutes and achieves a dry solids content of 90% at the outlet. The dryer operates at negative pressure in the cabinet to prevent process air from escaping into the surrounding room.

Daily operation and maintenance requirements for the Kruger dryer include visual inspection of the product every 2 hours, sampling, and visual inspection of the screw conveyor, depositor nozzles, and dryer belt. The condenser should be cleaned on a weekly basis. Additional maintenance activities are required for the depositor nozzles, dryer belt, condenser, screw conveyor, fans, and gearboxes as outlined in the maintenance schedule in **Appendix H**.

The following equipment is included in Kruger's scope of supply for the BioCon system:

- *Live Bottom Cake Bin*
- *Main Sludge Feed Pumps*
  - Pump
  - Main Pump Manual Cleaning Valves
- *Dosing Pumps and Manifold*
  - 2 Pumps
  - Dosing Pump Manifold
  - Dosing Pump Manifold Manual Cleaning Valves
- *Stainless Steel Sludge Dryer*
  - Dryer Model (insulation and cladding included)
  - 2 Sludge Depositor Stations
  - Dosing Platform (on top of the dryer cabinet)
  - Depositor Motion Motor & Gearbox
  - 2 304 SS Drying Belts (Belt Drives included)
  - Sprinkler System
  - Extraction Screw Conveyor
  - Rotary Valve
  - 2 Warm Zone Drying Air Circulation Fans
  - 2 End Zone Drying Air Circulation Fans
  - Warm Zone Air/Thermal Oil Heat Exchanger
  - End Zone Air/Thermal Oil Heat Exchanger
  - Nozzle Cleaning Station
- *Drying Air Treatment*
  - Packed Bed Condenser
  - 2 Centrifugal Fans
  - Actuated Modulating Flow Control Valve
  - Spring-Loaded Pressure Reducing Valve

- *Energy Supply System (Thermal Oil System)*
  - Natural Gas Supply Train
  - Thermal Oil Heater
  - 2 Thermal Oil Pumps Main Loop (Duty + Redundant)
  - Thermal Oil Pump Secondary Loop (Duty)
  - Catch Tank
  - Storage Tank
- *Compressor (for valve actuation)*
- *Controls*
  - PLC Control System
  - Field Instruments

The overall footprint for the core equipment, including the dryer cabinet, platforms, condenser, external fans and appropriate clearances for maintenance and access is 55'L x 33'W x 21'H. In addition, the thermal fluid heater skid is 7'L x 11'W x 13'H. The storage hopper is anticipated to be 16'L x 6'W x 16.5'H.

Additional items that will be required in the project include:

- Concrete foundations, pads, tanks, structural components, walkways, stairs, platforms, stack, handrail, grating and covers,
- Equipment installation, piping to and from the BioCon system, interconnecting piping, manual isolation valves, anchor bolts, epoxy/adhesive for anchors,
- Solids handling/disposal system, including storage and conveyors,
- Laboratory systems or equipment,
- Motor control center, motor starters, adjustable frequency drives, main disconnects, breakers, generators, or power supply,
- Field wiring, interconnecting wiring, conduit, wiring terminations at equipment, local equipment disconnects, local equipment control panels, junction boxes, and wiring terminations at control panels,
- All work associated with buildings or other structures used for housing any part of the system provided, including HVAC and electrical work.

Refer to the BioCon proposal in **Appendix H** for further product information and scope of work.

The proposed equipment will not fit within the available space in the sludge handling room with required access and OSHA clearances. Refer to Section 3.8 for discussion of alternative housing options.

3.4.2 Equipment Cost Estimate

The table below summarizes the probable cost for purchase and installation of the Kruger BioCon Dryer. The sludge dryer and ancillary equipment, control systems, installation, mobilization, overhead and profit, contingency, and legal, engineering, and administrative fees are included in the project cost. The total equipment installation cost is estimated to be $5.714 million, excluding the cost of equipment housing (refer to Section 3.8 for discussion and costs). Refer to **Appendix H** for supporting documentation of cost and the scope of work by Kruger.

TABLE 3-3. Probable Equipment Installation Cost of Kruger BioCon Dryer

Kruger BioCon Sludge Dryer	**$ 2,525,000.00**
Process Equipment Installation (water, sewer, air, natural gas)*	$ 38,000.00
Equipment: Electrical Modifications*	$ 10,000.00
Access Platforms, Stairs, Rails, etc.	$ 50,000.00
Sludge Handling/Conveyance*	$ 750,000.00
Storage Hopper	$ 50,000.00
Exhaust & Air Treatment	$ 50,000.00
Mobilization/Demobilization (4%)	$ 139,000.00
Contingency (10%)	$ 362,000.00
Overhead & Profit (15%)	$ 597,000.00
Legal, Engineering & Administrative Fees (25%)	$ 1,143,000.00
TOTAL	**$ 5,714,000.00**

* Please note, utility installation and sludge handling costs assume housing in a new building, which is anticipated to require the least amount of work/materials of the new housing options feasible for this dryer.

The annual operation and maintenance cost is anticipated to include:

- Natural gas.
- Electricity.
- Material costs for oils, grease, cleaning agents, depositor nozzles, etc.
- Equipment replacement costs.
- Labor for system operation and maintenance.
- Air permitting fees.

Annual natural gas usage is anticipated to be 6,503 MMBTU at $1.823 per MMBTU for a total fuel cost of $11,900. Annual electricity required is 253,500 kWh at $0.0986 per kWh for a total electricity of $25,000 per year. Material costs for supplies used/replaced annually and equipment replacement costs are summarized in the Kruger proposal attached in **Appendix H**. The expected life of stators is 1-4 years, mechanical seals and fan belts is 3 years, depositor nozzles is 6 months, and drying belt is 10 years (replaced in sections). Adding the cost of grease, oil, and the compressor annual maintenance kit, the annual cost for equipment replacement and maintenance materials is estimated to be $11,200.

Labor costs, estimated to include 435 manhours per year at $75 per hour, total $32,625 annually.

In addition, an air permit is anticipated to be required. Based on current permit costs at the compost facility, this is estimated to be $3,800 per year.

The resulting total annual operation and maintenance cost is $85,000.

3.4.3 Non-Monetary Factors

The Kruger dryer is anticipated to produce a Class A biosolid that can be marketed to homeowners, landscapers, and commercial soil blenders. Depending upon the process used, sludge dryers produce biosolids that differ in size and shape. The Kruger dryer uses a distributor system that lays strings of sludge uniformly over the belt using rubber nozzles. Biosolids are dried, fall off of the belt as strings, and are broken up into approximately 1-inch strands.

Because all air is contained, dust control, odor control, and air permitting requirements are anticipated to be minimal. However, we recommend that the City meets with the NYSDEC to discuss any selected sludge drying alternatives and subsequent air permit requirements.

The large footprint of the Kruger sludge drying equipment requires either the installation of a new building adjacent to the existing sludge handling and disposal building, or reuse of the existing compost facility building with upgrades. If a new building at the WWTP site is selected, consideration must be given to raise all equipment above the 100-year floodplain.

3.5 ALTERNATIVE 4 – GRYPHON BIOSOLIDS DRYER

3.5.1 Description

The Gryphon Biosolids Dryer is also an indirect convection belt dryer. Hot drying air is circulated through sludge layers on a belt to remove moisture from the material. Drying air is directed by a blower through an inline natural gas burner where it is heated and then directed into the drying chamber through Teflon coated air injection plates, which operate at a pressure differential. Drying air is recirculated through a condenser to remove moisture in a closed loop, which increases efficiency and reduces odor.

Rather than using an extrusion process to place sludge on the drying belt (Kruger's process), sludge is processed in an in-feed sifter mechanism to break up the material into smaller pieces. Sensors are used to monitor the in-feed moisture, exiting residuals temperature, and exiting moisture to provide automatic control of the air volume, temperature, and belt speed to meet USEPA Class A biosolids requirements.

Much of the operation and maintenance required on the Gryphon dryer is automated, including automated chamber wash, belt wash and air filtration assembly wash. Visual inspection of the unit should be performed daily and should take an operator about 15 minutes to complete. Condenser filters should be swapped out and cleaned 1-2 times per week and is anticipated to be completed within 30 minutes. Additional maintenance requirements are included in the maintenance schedule in **Appendix I**.

Safety is also a consideration, and the unit is programmed to automatically shut down in case of high volatile gas. In terms of heat, the unit is programmable for air temperatures from 220-375°F and the drying chamber itself typically remains less than 175°F. Controls and feedback loops are included for the heater, chamber temperature, and process air temperature. In addition, a sprinkler system is included in the lid structure of the unit.

The following equipment is included in Gryphon's scope of supply for the biosolids dryer system:

- *Receptacle bin with auger feed to dryer*
- *Gryphon Model 0520 Dryer Unit*
  - Sifter Mechanism & Motor (with VFD)
  - Stainless Steel Drying Chamber
  - Ceramic/Teflon Coating on Injection Plates
  - PPS Drying Belt & Drive (with VFD)
  - Automated Chamber & Belt Wash
- *Re-circulating Air Stream Assembly*
  - Condenser with pump
  - Primary & Spare Filters
- *Cooling Tower*
  - Approx. 9' Dia. Cooling Tower
  - Booster pump (with VFD)
- *Energy Supply System*
  - Inline Natural Gas Burner
- *Air Blower (with VFD)*
- *Controls*
  - PLC Control System
  - Automation with sensors
- *Lift System*
  - Lid Lift
  - Hydraulic Pump

The overall footprint for the core equipment, including the dryer cabinet, condenser, inline natural gas burner and blower is 48.4'L x 16.7'W x 11.7'H. Excluding the burner and blower, the dryer unit is approximately 31 feet in length. The burner and blower may be turned to better fit within the anticipated required footprint. In addition, the controls cabinet is approximately 8'L x 3'W x 7'H and can be located as required. The cooling tower is approximately 9' in diameter and 8' in height, and can be located adjacent to the dryer or outside the building as space allows. The storage hopper has an anticipated footprint of 12.5'L x 7.5'W x 18'H.

Additional items that will be required in the project include:

- Concrete foundation for cooling tower if located outside.
- Equipment installation, piping to and from the dryer, and interconnecting piping, including,
  - Natural gas supply
  - 400V 3-phase power supply and breaker box
  - Water supply
  - Sewer drain
  - Air
- Exhaust piping & any required air treatment (carbon filter, biofilter, or chemical air filtration).
- Cold water supply and return to cooling tower and condenser.
- Conveyance to and from the dryer.
- All work associated with buildings or other structures used for housing any part of the system provided, including HVAC and electrical work.

Refer to the Gryphon proposal in **Appendix I** for further product information and scope of work.

The proposed equipment will not fit within the available space in the sludge handling room with required access and OSHA clearances. Refer to Section 3.8 for discussion of alternative housing options.

3.5.2 Equipment Cost Estimate

The table below summarizes the probable cost for purchase and installation of the Gryphon Biosolids Dryer. The sludge dryer and ancillary equipment, control systems, installation, mobilization, overhead and profit, contingency, and legal, engineering, and administrative fees are included in the project cost. The total equipment installation cost is estimated to be $2.194 million, excluding the cost of equipment housing (refer to Section 3.8 for discussion and costs). Refer to **Appendix I** for supporting documentation of cost and the scope of work by Gryphon.

TABLE 3-4. Probable Equipment Installation Cost of Gryphon Biosolids Dryer

Gryphon Biosolids Dryer	**$ 770,500.00**
Process Equipment Installation (water, sewer, air, natural gas)*	$ 21,000.00
Equipment: Electrical Modifications*	$ 8,000.00
Sludge Handling/Conveyance *	$ 480,000.00
Exhaust & Air Treatment	$ 50,000.00
Cooling Tower - Exterior Installation	$ 3,000.00
Mobilization/Demobilization (4%)	$ 54,000.00
Contingency (10%)	$ 139,000.00
Overhead & Profit (15%)	$ 229,000.00
Legal, Engineering & Administrative Fees (25%)	$ 439,000.00
TOTAL	**$ 2,194,000.00**

* Please note, utility installation and sludge handling costs assume housing in a building addition above the sludge handling room, which is anticipated to require the least amount of work/materials of the new housing options feasible for this dryer.

The annual operation and maintenance cost is anticipated to include:

- Natural gas.
- Electricity.
- Equipment replacement costs.
- Labor for system operation and maintenance.
- Air permitting fees.

Annual natural gas usage is anticipated to be 5,040 MMBTU at $1.823 per MMBTU for a total fuel cost of $9,220. Annual electricity required is about 162,000 kWh at $0.0986 per kWh for a total electricity of $15,965 per year. Replacement parts' costs and life cycles are included in the Gryphon proposal, and equate to an annual cost of approximately $20,000. This includes replacement of the belt, condenser filters, sifter brush, leveler brush assemblies, seals, and spray nozzles.

Labor costs, estimated to include 280 manhours per year at $75 per hour, total $21,000 annually.

In addition, an air permit is anticipated to be required. Based on current permit costs at the compost facility, this is estimated to be $3,800 per year.

The resulting total annual operation and maintenance cost is $70,000.

3.5.3 Non-Monetary Factors

The Gryphon dryer is anticipated to produce a Class A biosolid that can be marketed to homeowners, landscapers, and commercial soil blenders. Depending upon the process used, sludge dryers produce biosolids that differ in size and shape. The Gryphon dryer uses a sifter at the dryer inlet to break up biosolids to the desired size, which are reportedly compatible with agricultural spreaders.

Because all air is contained, dust control, odor control, and air permitting requirements are anticipated to be minimal. However, we recommend that the City meets with the NYSDEC to discuss any selected sludge drying alternatives and subsequent air permit requirements.

The footprint of the Gryphon sludge drying equipment requires either the installation of a new building addition above the existing sludge handling room, a new building adjacent to the existing sludge handling and disposal building, or reuse of the existing compost facility building with upgrades. If a new building at the WWTP site is selected, consideration must be given to raise all equipment above the 100-year floodplain.

The dryer's modular design would allow for future expansion if the City chooses to accept sludge from new sources.

3.6 ALTERNATIVE 5 – KLEIN BELT DRYING SYSTEM

3.6.1 Description

The Klein Belt Drying System is an indirect belt dryer. Dewatered sludge is fed through a progressive cavity dryer feed pump to the inlet hopper with a double shaft mixer to blend dewatered sludge with dried product. Blended sludge is extruded onto the belt in spaghetti-like strands using the distribution system. Sludge is dried on two high-porosity plastic belts as it comes into contact with heated drying air. Sludge moves through three zones in the dryer: the first drying zone on the upper belt, the second drying zone on the lower belt, and a cooling zone using ambient air on the lower belt. Controls and sensors throughout the dryer adjust belt speed and temperature to meet EPA Class A time and temperature requirements.

The finished product exits the dryer at a temperature of approximately 104°F. Dried product is discharged into a discharge screw followed by a rotary valve sealing the dryer to the atmosphere. Screw conveyors may transfer the dried product to a small storage hopper, which is partially used to feed the dryer as previously discussed. A discharge screw from the hopper may be used to load trucks for transport to a storage facility. Note, conveyors and storage hoppers are not included in Klein's proposal unless expressly noted, but will be required for dryer operation.

Drying air is heated using heat exchangers inside the dryer supplied by hot water. A boiler will be required, powered by natural gas. Use of natural gas and a boiler require a high temperature dryer, using air at approximately 265°F.

Drying air is circulated in the dryer with radial air fans. Drying air is recirculated, with little exhaust air requiring conditioning and treatment through the spray condenser and two-stage chemical scrubber.

The Klein dryer includes automated cleaning devices for the belt and walls. The dryer is also equipped with an emergency sprinkler system that is activated by dust and smoke detection. Daily inspection of the dryer is recommended, and weekly maintenance includes washing out the dryer. Thorough dryer cleaning is recommended on an annual basis during a weeklong shutdown.

The following equipment is included in Klein (Centrysis)'s scope of supply for the belt dryer system:

- *Input*
  - Hopper on Dryer Feed Pump
  - Dryer Feed Pump
  - Distribution Unit
  - Tubing from Pump to Distribution Unit
- *Klein Compact-Dry 2/2 Model (High Temperature)*
  - Ventilation System (fresh air fan, circulation air fans, exhaust air fan)
  - Dryer Housing
  - Air Channels (with insulation)
  - Heat Exchangers for Warm Water
  - Plastic Drying Belts
  - Automated Wall & Belt Wash
- *Dry Product Discharge*
  - Dryer Discharge Screw
  - Rotary Valve
  - Crusher
  - Transition Pieces
- *Exhaust Conditioning*
  - Heat Recovery Unit
  - Spray Condenser Unit
  - Tubing for Exhaust Air (max. 16 ft.)
- *Controls*
  - Siemens S7 Control Unit
  - Switch Cabinet
  - Sensors
  - Cabling

The overall footprint for the high-temperature Compact Dryer is 24.6'L x 10'W x 15.5'H. Additional equipment provided by Klein includes:

- the heat recovery system and exhaust air treatment system, with a footprint of approximately 32'L x 6'W x 18'H,
- the dryer feed pump, with a footprint of 14'L x 3'W,
- the rotary valve and discharge assembly, with a footprint of 17'L x 2'W.

Additional items that will be required in the project include:

- Hot water boiler (natural gas powered),
- Equipment installation, piping to and from the dryer, and interconnecting piping, including
  - Natural gas supply
  - 400V 3-phase power supply and breaker box
  - Water supply
  - Sewer drain
- Solids handling/disposal system, including storage and conveyors,
- All work associated with buildings or other structures used for housing any part of the system provided, including HVAC and electrical work.

Refer to the Centrysis proposal in **Appendix J** for further product information and scope of work.

The proposed equipment will not fit within the available space in the sludge handling room with required access and OSHA clearances. Refer to Section 3.8 for discussion of alternative housing options.

3.6.2 Equipment Cost Estimate

The table below summarizes the probable cost for purchase and installation of the Klein belt drying system. The sludge dryer and ancillary equipment, control systems, installation, mobilization, overhead and profit, contingency, and legal, engineering, and administrative fees are included in the project cost. The total equipment installation cost is estimated to be $2.908 million, excluding the cost of equipment housing (refer to Section 3.8 for discussion and costs). Refer to **Appendix J** for supporting documentation of cost and the scope of work by Centrysis/Klein.

TABLE 3-5. Probable Equipment Installation Cost of Klein Belt Drying System

Klein Compact-Dry 2/2	**$ 767,000.00**
Process Equipment Installation (water, sewer, natural gas)*	$ 48,000.00
Equipment: Electrical Modifications*	$ 12,000.00
Sludge Handling/Conveyance*	$ 555,000.00
Storage Hopper	$ 50,000.00
Hot Water Boiler & Heat Exchanger	$ 335,000.00
Mobilization/Demobilization (4%)	$ 71,000.00
Contingency (10%)	$ 184,000.00
Overhead & Profit (15%)	$ 304,000.00
Legal, Engineering & Administrative Fees (25%)	$ 582,000.00
TOTAL	**$ 2,908,000.00**

* Please note, utility installation and sludge handling costs assume housing in a new building, which is anticipated to require the least amount of work/materials of the new housing options feasible for this dryer.

The annual operation and maintenance cost is anticipated to include:

- Natural gas.
- Electricity.
- Maintenance costs.
- Equipment replacement costs.
- Labor for system operation and maintenance.
- Chemical costs.
- Air permitting fees.

Annual natural gas usage is anticipated to be 10,317 MMBTU at $1.823 per MMBTU for a total fuel cost of $18,810 (includes natural gas required for the hot water boiler). Annual electricity required is 194,000 kWh at $0.0986 per kWh for a total electricity of $19,130 per year. Material costs for supplies used/replaced annually and equipment replacement costs are summarized in the Kruger proposal attached in **Appendix J**. Maintenance costs are estimated to be $7,600 per year. The life expectancy of the high temperature dryer is 10.3 years; dryer replacement costs are included for an annual cost of approximately $74,300.

Labor costs, estimated to include 260 manhours per year at $75 per hour, total $19,500 annually. Chemicals required for air treatment are estimated to be $6,840 annually any include sulfuric acid, sodium hydroxide, and hydrogen peroxide. Maintenance costs for the hot water boiler and heat exchanger are estimated at $1,500 annually.

In addition, an air permit is anticipated to be required. Based on current permit costs at the compost facility, this is estimated to be $3,800 per year.

The resulting total annual operation and maintenance cost is $152,000.

3.6.3 Non-Monetary Factors

The Klein dryer is anticipated to produce a Class A biosolid that can be marketed to homeowners, landscapers, and commercial soil blenders. Depending upon the process used, sludge dryers produce biosolids that differ in size and shape. The Klein dryer uses an extrusion process creating long strands and a crusher to break up biosolids into smaller strands, similar to the Kruger dryer process & finished product.

Because all air is contained, dust control, odor control, and air permitting requirements are anticipated to be minimal. However, we recommend that the City meets with the NYSDEC to discuss any selected sludge drying alternatives and subsequent air permit requirements.

The footprint of the Klein sludge drying equipment requires either installation of a new building adjacent to the existing sludge handling and disposal building, or reuse of the existing compost facility building with upgrades. If a new building at the WWTP site is selected, consideration must be given to raise all equipment above the 100-year floodplain.

The dryer's modular design would allow for future expansion if the City chooses to accept sludge from new sources.

3.7 ALTERNATIVE 6 – BURCH BIOWAVE BIOSOLIDS PROCESSING SYSTEM

3.7.1 Description

The Burch BioWave Biosolids Processing System uses industrial microwave equipment to dehydrate and treat dewatered biosolids. The process uses both microwave power and heated air to achieve 90% solids content and to meet EPA Class A time and temperature requirements. No additives or recycled material are required.

The Burch BioWave microwave dryer includes four main components: the applicator (oven) unit, microwave generators (transmitters), the control panel, and a compact gas-burning finish dryer. Dewatered sludge is directed to the input hopper of the microwave, where it is placed on a polypropylene belt and carried through the microwave applicator oven and finish dryer. A grinder is used to break up the dried product to the desired particle size (<2 mm or >2 mm options).

Microwave energy is produced in two microwave transmitters, which convert electricity to microwave energy. Microwaves are transmitted through aluminum ducts to the applicator oven, where they heat water molecules in the sludge through friction by volumetric heating. Volumetric heating is highly efficient in comparison to conduction or convection heating. As molecules are heated and run into each other, pathogens explode and are destroyed. No start-up or cool-down period is required using microwave technology.

Extreme temperatures are not generated in the process, and sludge typically exits the dryer at room temperature, increasing operator safety. In addition, microwave leakage is monitored with a Geiger counter at openings. Choke pins on a grid system (similar to the perforated screen on microwaves) are used to dissipate microwaves that could damage operators' eyes by looking directly at the microwaves.

All operations are integrated into the operator's interface panel, controlled by a color touch screen. The PLC control system also provides diagnostic capabilities. Normal recommended maintenance is a daily cleanup of the microwave cavities, which should take about 15 minutes and can be completed using a garden hose or shop vacuum. Minor equipment failures are usually limited to the microwave transmitters. Each transmitter contains a magnetron and diode, which can be replaced in less than two hours. Magnetrons have an anticipated lifespan of 8,000 to 10,000 hours.

Exhaust from the microwave dryer should be directed to a carbon filter for odor control (not included in Burch BioWave's scope of supply).

As an option, the City may choose to purchase a Combined Heat and Power (CHP) generator to reduce electricity use and increase waste heat use. While this adds significant capital cost, operation and maintenance costs are anticipated to be reduced, and the CHP generator may be used for back-up power generation during outages. There is NYSERDA funding available to assist with up to 40% of the capital cost of the generator. If the CHP generator is included, exhaust from the generator is approximately 250°F and ventilation air is required. The proposed unit is for outdoor application and comes in a sound proof enclosure.

The following equipment is included in Burch BioWave's scope of supply for the microwave dryer system:

- *In-feed Assembly*
- *Two (2) 75 kW Microwave Transmitters*
  - Waveguide Allowance (15', 3 bends per transmitter)
  - Cooling Pump
- *Microwave Applicator Unit*
  - Modular Polypropylene Belt
  - 4,000 CFM Exhaust Fan on VFD
  - Oven Cavity Gas Burner (not included if CHP Generator option is selected)
  - Hot Air Blowing System
- *Finish Dryer (with gas)*
- *Outlet Table*
- *Controls*
  - Complete PLC
- *CHP Generator & Components (optional)*

The overall footprint for the microwave dryer, with inlet, microwave applicator, and finish dryer is 45.6'L x 9.3'W x 11.9'H. Additional equipment provided by Burch BioWave includes:

- microwave transmitters, each with a foot print of approximately 8'L x 6'W,
- the main control box, with a footprint of 3'L x 1.2'W,
- optional CHP Generator, approximately 25'L x 8'W x 10'H in enclosure.

Additional items that will be required in the project include:

- Equipment installation, piping to and from the dryer, and interconnecting piping, including
  - Natural gas supply
  - High voltage & low voltage wiring, communication wiring, conduit for interconnection of transmitters to the control panels and applicator
  - Water supply
  - Sewer drain
- Exhaust ductwork and carbon filter,
- Waveguide support hangers,
- Solids handling/disposal system, including storage and conveyors,
- All work associated with buildings or other structures used for housing any part of the system provided, including HVAC and electrical work.

Refer to the Burch BioWave proposal in **Appendix K** for further product information and scope of work.

The proposed equipment will not fit within the available space in the sludge handling room with required access and OSHA clearances. Refer to Section 3.8 for discussion of alternative housing options. Please also note that microwave transmitters must be housed in a controlled atmosphere room.

3.7.2 Equipment Cost Estimate

The table below summarizes the probable cost for purchase and installation of the Burch BioWave biosolids processing system. The microwave dryer and ancillary equipment, control systems, installation, mobilization, overhead and profit, contingency, and legal, engineering, and

administrative fees are included in the project cost. The total equipment installation cost is estimated to be $1.61 million without the CHP generator and $2.785 million with the CHP generator, excluding the cost of equipment housing (refer to Section 3.8 for discussion and costs). Refer to **Appendix K** for supporting documentation of cost and the scope of work by Burch BioWave.

TABLE 3-6. Probable Equipment Installation Cost of Burch BioWave System (without CHP Generator)

Burch Biowave Drying System	**$**	**399,700.00**
Shipping	$	1,500.00
Process Equipment Installation (water, sewer, air, natural gas)*	$	20,000.00
Equipment: Electrical Modifications*	$	11,000.00
Sludge Handling/Conveyance*	$	390,000.00
Storage Hopper	$	50,000.00
Exhaust & Air Treatment	$	50,000.00
Transmitter Cooling Chiller	$	40,000.00
Transmitter Controlled Atmosphere Room	$	15,000.00
Mobilization/Demobilization (4%)	$	40,000.00
Contingency (10%)	$	102,000.00
Overhead & Profit (15%)	$	168,000.00
Legal, Engineering & Administrative Fees (25%)	$	322,000.00
TOTAL	**$**	**1,610,000.00**

* Please note, utility installation and sludge handling costs assume housing in a building addition above the sludge handling room, which is anticipated to require the least amount of work/materials of the new housing options feasible for this dryer.

TABLE 3-7. Probable Equipment Installation Cost of Burch BioWave System with CHP Generator

Burch BioWave Drying System (less oven cavity gas burner)	**$ 342,000.00**
CHP Generator	$ 768,470.00
Shipping	$ 2,500.00
Process Equipment Installation (water, sewer, air, natural gas)*	$ 26,000.00
Equipment: Electrical Modifications*	$ 9,000.00
Sludge Handling/Conveyance*	$ 390,000.00
Storage Hopper	$ 50,000.00
Exhaust & Air Treatment	$ 50,000.00
Transmitter Cooling Chiller	$ 40,000.00
Transmitter Controlled Atmosphere Room	$ 15,000.00
Mobilization/Demobilization (4%)	$ 68,000.00
Contingency (10%)	$ 176,000.00
Overhead & Profit (15%)	$ 291,000.00
Legal, Engineering & Administrative Fees (25%)	$ 557,000.00
TOTAL	**$ 2,785,000.00**

* Please note, utility installation and sludge handling costs assume housing in a building addition above the sludge handling room, which is anticipated to require the least amount of work/materials of the new housing options feasible for this dryer.

The annual operation and maintenance cost is anticipated to include:

- Natural gas.
- Electricity.
- Maintenance costs.
- Equipment replacement costs.
- Labor for system operation and maintenance.
- Air permitting fees.

For the stand-alone system (without the CHP Generator), annual natural gas usage is anticipated to be 5,902 MMBTU at $1.823 per MMBTU for a total fuel cost of $10,760. Annual electricity required is 651,500 kWh at $0.0986 per kWh for a total electricity of $64,240 per year (includes electricity to operate the cooling chiller). Maintenance costs (including labor) are estimated to be $49,920 per year. In addition, an air permit is anticipated to be required. Maintenance costs for the cooling chiller for the transmitters are estimated at $4,000 annually. Based on current permit costs at the compost facility, this is estimated to be $3,800 per year. The resulting total annual operation and maintenance cost is $133,000.

For the system with the CHP Generator, annual natural gas usage is anticipated to be 13,177 MMBTU at $1.823 per MMBTU for a total fuel cost of $24,020. Annual electricity required is 89,900 kWh at $0.0986 per kWh for a total electricity of $8,860 per year (includes electricity to operate the cooling chiller). Maintenance costs (including labor) are estimated to be $74,880 per year, which includes one major engine overhaul for 10 years of operation. In addition, an air permit is anticipated to be required. Maintenance costs for the cooling chiller for the

transmitters are estimated at $4,000 annually. Based on current permit costs at the compost facility, this is estimated to be $3,800 per year. The resulting total annual operation and maintenance cost is $116,000.

Refer to **Appendix K** for supporting operation and maintenance cost estimates.

3.7.3 Non-Monetary Factors

The Burch BioWave dryer is anticipated to produce a Class A biosolid that can be marketed to homeowners, landscapers, and commercial soil blenders. Depending upon the process used, sludge dryers produce biosolids that differ in size and shape. The microwave dryer uses a grinder to break up biosolids into either <2 mm or >2 mm particles depending on customer preference. The microwave drying process creates little dust.

Because all air is contained, dust control, odor control, and air permitting requirements are anticipated to be minimal. However, we recommend that the City meets with the NYSDEC to discuss any selected sludge drying alternatives and subsequent air permit requirements.

The footprint of the Burch BioWave sludge drying equipment requires either the installation of a new building addition above the existing sludge handling room, a new building adjacent to the existing sludge handling and disposal building, or reuse of the existing compost facility building with upgrades. If a new building at the WWTP site is selected, consideration must be given to raise all equipment above the 100-year floodplain.

The dryer's modular design would allow for future expansion if the City chooses to accept sludge from new sources.

3.8 EQUIPMENT HOUSING OPTIONS

Due to the footprint of the sludge drying equipment options and the existing equipment within the sludge handling room, the sludge drying equipment will not fit within the available space in the existing sludge handling room at the WWTP. Several alternative housing options were considered, including a new building adjacent to the sludge handling and disposal building, the addition of a new room above the existing sludge handling room, and reuse of the existing compost facility with required modifications. Feasibility of housing options for the four sludge dryers considered is summarized in the Table 3-8.

TABLE 3-8. Equipment Housing Options

Sludge Dryer	New Building	Addition Above Sludge Handling Room	Compost Facility Reuse
Kruger	✓		✓
Gryphon	✓	✓	✓
Klein	✓		✓
Burch BioWave	✓	✓	✓

Each housing option, including operation and cost implications, is discussed in detail in the following sections. The total project cost of a new sludge dryer would include both the equipment installation costs presented in Sections 3.4 to 3.7 and the housing costs presented in Sections 3.8.1 to 3.8.3. If Alternative 2, Compost Facility Rehabilitation, is selected, no additional housing modifications are anticipated and the cost estimate in Section 3.2 is complete.

3.8.1 Alternative A: New Building

The new building would be located to the north of the existing sludge disposal and handing building. A footprint of 80'L x 55'W x 25'H was selected for the purpose of cost estimating as it will provide sufficient space to house and access all sludge drying equipment considered. The building footprint may be refined depending upon the equipment selected.

The ceiling height requirement of 25' is beyond the typically limit for a timber pole barn structure, so the proposed building would be a pre-engineered metal building. It is assumed that the building will require a pile supported foundation as all other buildings on the site are pile supported. The equipment would need to be elevated approximately 3' above the existing grade to accommodate the required 2' of free board above the flood elevation. This will require site grading and a new access ramp. The cost of constructing the pile supported foundation, building and to elevate the equipment would be approximately $90/SF.

A storage facility would be required to protect dried material from rain and wind. The proposed storage building would span the existing sludge drying bed and be founded on a pile supported grade beam. The building would consist of hot dipped galvanized steel framework and truss roof system sheathed with a fabric cover. The cost of constructing the fabric covered building and foundation would be approximately $60/SF.

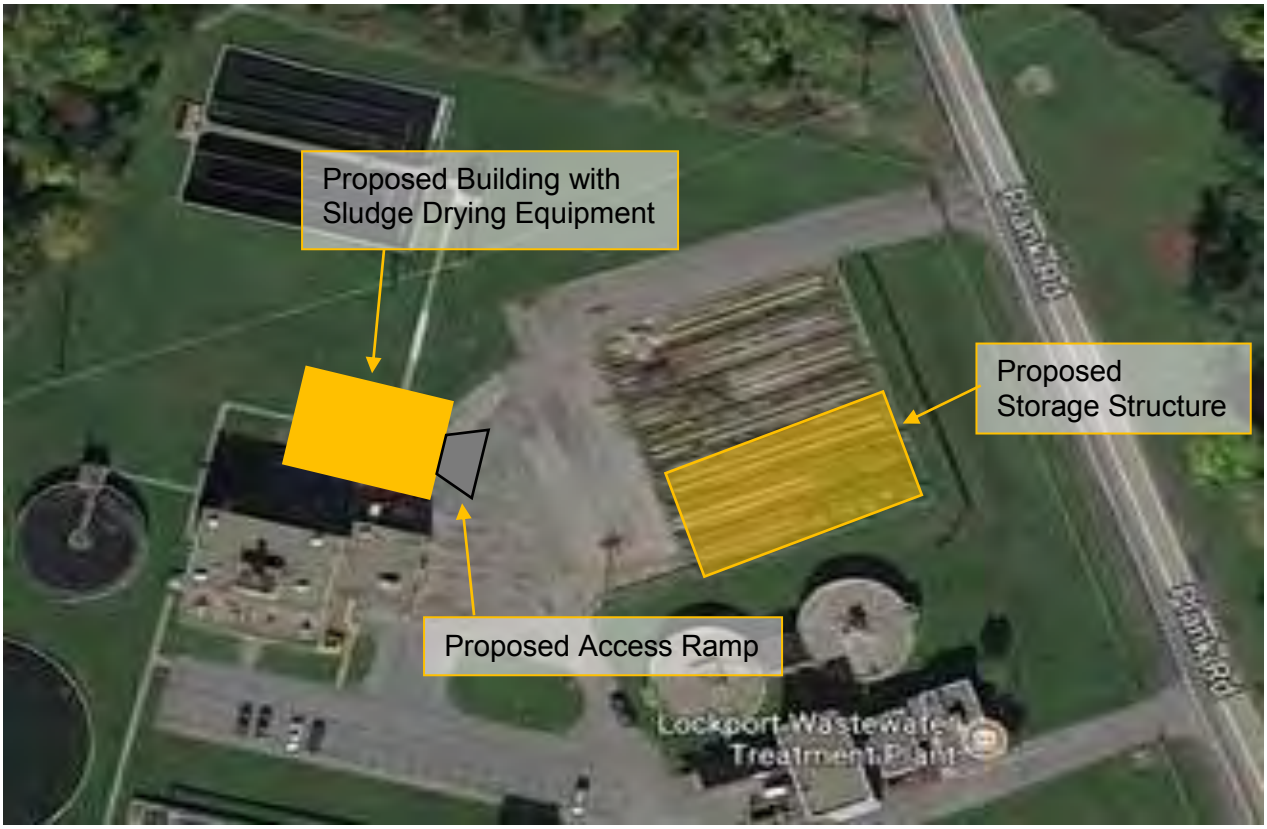

Figure 3-1. Proposed Building to House Sludge Dryer Equipment

The construction of a new building adjacent to the existing will allow for continued sludge processing using the belt filter press and composting facility during construction. When the new building and equipment is ready, conveyors can be directed from the existing truck bays to the new facility.

Operationally, a new building will require an operator to check equipment in an additional building. Depending upon the equipment selected, this may be once a day to numerous times a day. Because dewatered sludge must be conveyed to the new building, sludge is anticipated to cool down outside prior to in-feed to the dryer. This may require the dryer to operate at higher temperatures or at a slower feed rate in order to meet USEPA time and temperature requirements, resulting in greater energy use.

A new building will allow the opportunity for future expansion of the sludge drying operation, as space is available adjacent to the proposed building site. Additionally, a new building allows for design with ease of operator access in mind.

TABLE 3-9. Probable Construction Cost of a New Building

New Sludge Drying Building	**$ 400,000.00**
Site Work & Access Ramp	$ 50,000.00
Utility Installation (water, sewer, natural gas)*	$ 23,000.00
Electrical Service*	$ 2,000.00
Sludge Handling/Conveyance*	$ 75,000.00
Storage Structure over Sludge Drying Beds	$ 510,000.00
Mobilization/Demobilization (4%)	$ 42,000.00
Contingency (10%)	$ 110,000.00
Overhead & Profit (15%)	$ 182,000.00
Legal, Engineering & Administrative Fees (25%)	$ 349,000.00
TOTAL	**$ 1,394,000.00**

* Additional equipment and installation costs for extending utilities, services, and conveyance to the proposed housing location (in addition to the base equipment installation cost; refer to individual dryer sections for the scenario used to determine the base cost). Additional cost is included for the equipment scenario anticipated to add the most cost.

Additional operation and maintenance costs are anticipated to be minimal.

3.8.2 Alternative B: Addition Above Sludge Handling Room

The addition of a new room on top of the sludge handling room would provide a footprint of approximately 42'L x 35'W. This footprint would allow for installation of the Gryphon Biosolids Dryer and the Burch BioWave Biosolids Processing System; however, both drying systems would require reconfiguration as illustrated in Figures 3-2 and 3-3.

The existing roof will need to be demolished. The existing perimeter masonry bearing walls will need to be analyzed and likely reinforced. The interior steel framing will need to be reinforced. The reinforcement of the masonry bearing walls may require the addition of a steel frame around the perimeter which may reduce floor area, required addition piles and will disrupt the current processes on the first floor during construction. The existing adjacent building roof will need to be analyzed for snow drift loads. The second story construction would match the existing masonry with the requisite steel framing and the roof would consists of metal deck, insulation and membrane roofing. The cost of constructing this addition and reinforcement of the existing construction would be approximately $150/SF.

A storage facility would be required to protect dried material from rain and wind. The proposed storage building would span the existing sludge drying bed and be founded on a pile supported grade beam. The building would consist of hot dipped galvanized steel framework and truss roof system sheathed with a fabric cover. The cost of constructing the fabric covered building and foundation would be approximately $60/SF.

The Burch BioWave transmitters require housing in a controlled atmosphere room, so the proposed addition includes regulators for temperature and humidity.

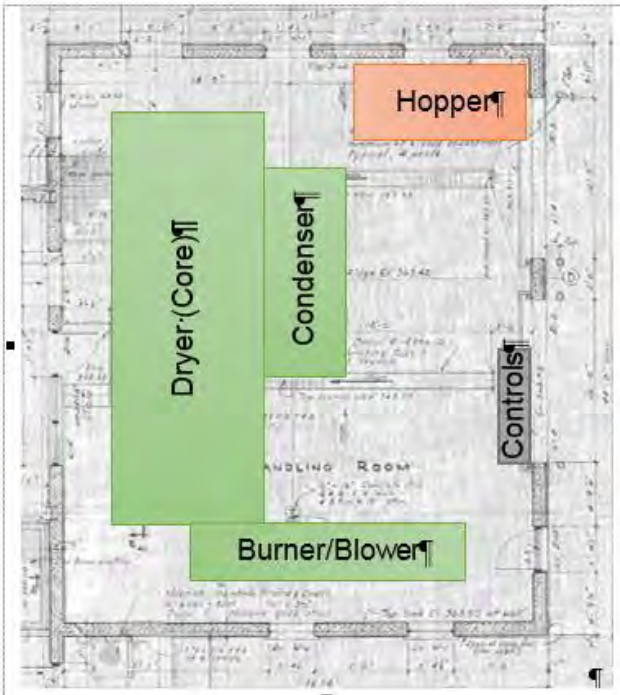

Figure 3-2. Conceptual Layout of Gryphon Equipment in Addition

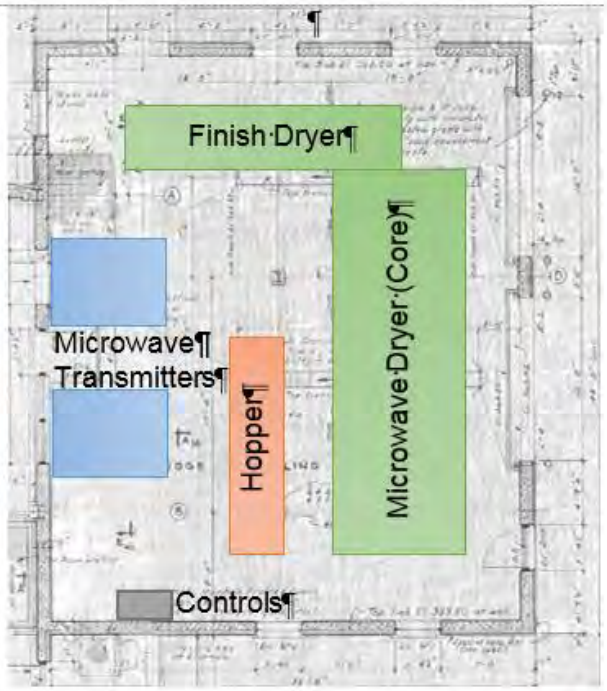

Figure 3-3. Conceptual Layout of Burch BioWave Equipment in Addition

A garage door is proposed on the south side of the building addition to allow equipment installation and access. A door is proposed in the southwest corner of the room near the existing stairwell in the sludge handling and disposal building.

Note, if the CHP Generator option is selected for use with the Burch BioWave microwave dryer, the generator will need to be located outside of the proposed building addition. Reuse of the existing concrete pad to the north of the building is proposed for an outdoor generator.

Construction of the building addition above the sludge handling room would allow for continued operation of the existing sludge processes; however, operation might be interrupted as additional support for the new room are constructed in the sludge handling room and construction of the east exterior wall takes place. Conveyance of sludge to the second story of the building will require special consideration of space constraints, with potential near vertical installations and tight bends.

While the addition eliminates the need for floodplain considerations in building design and preserves the available space to the north of the existing building for future expansion of other WWTP processes, the addition limits the available footprint for sludge drying equipment. The City will not have the opportunity to expand the sludge dryer in the future if the City wants to accept sludge from new customers. Additionally, the limited footprint of the addition will provide tight operator access for operation and maintenance. A forklift will be required to move pieces of equipment into and out of the building addition.

TABLE 3-10. Probable Construction Cost of an Addition Above the Sludge Handling Room

Building Addition & Modifications	**$ 245,000.00**
Storage Structure over Sludge Drying Beds	$ 510,000.00
Mobilization/Demobilization (4%)	$ 31,000.00
Contingency (10%)	$ 79,000.00
Overhead & Profit (15%)	$ 130,000.00
Legal, Engineering & Administrative Fees (25%)	$ 249,000.00
TOTAL	**$ 1,244,000.00**

Additional operation and maintenance costs are anticipated to be minimal.

3.8.3 Alternative C: Compost Facility Reuse

Reuse of the compost facility may be selected to house any of the considered sludge drying equipment. The main room of the existing compost facility building is approximately 340'L x 120'W, with 12 bays for composting sludge. Removal of 6 of these bays would provide sufficient space for sludge drying equipment and access. The remaining 6 bays could continue to be used for composting during the renovations to the opposite side of the building. After the sludge drying equipment is functional, the 6 remaining bays could then be used for storage of the dried product. Additional storage in an outdoor pole barn is also available at the compost facility.

The proposed equipment would be supported on an interior slab on grade (6" concrete slab on 12" subbase stone) within the existing compost facility. The existing concrete bin walls in the vicinity of the proposed equipment would need to be demolished and disposed of. 18" of excavation and disposal would be required to accommodate the proposed slab and subbase. The cost of preparing this facility for the proposed equipment would be approximately $15/SF.

Installation of utilities adequate to service the sludge dryer would also be required. A high voltage electrical service, natural gas service, water service, and sewer service would need to be installed up the approximately 2,300-foot long drive. In addition, radio telemetry would be required to communicate operation data and alarming to the WWTP.

Operationally, the use of the compost facility for sludge drying will require continued haulage of dewatered sludge to the facility. An operator from the WWTP will be required to check the offsite equipment on a daily basis. The City may also consider placing an operator at the compost facility full-time.

TABLE 3-11. Probable Construction Cost of Compost Facility Retrofit

Retrofit Existing Facility	**$ 310,000.00**
Utility Installation (water, sewer, natural gas)*	$ 382,000.00
Electrical Service*	$ 10,000.00
Sludge Handling/Conveyance*	$ 180,000.00
Radio Telemetry	$ 10,000.00
Mobilization/Demobilization (4%)	$ 36,000.00
Contingency (10%)	$ 93,000.00
Overhead & Profit (15%)	$ 154,000.00
Legal, Engineering & Administrative Fees (25%)	$ 255,000.00
TOTAL	**$ 1,430,000.00**

* Additional equipment and installation costs for extending utilities, services, and conveyance to the proposed housing location (in addition to the base equipment installation cost; refer to individual dryer sections for the scenario used to determine the base cost). Additional cost is included for the equipment scenario anticipated to add the most cost.

Additional operation and maintenance costs will include haulage of the dewatered sludge to the compost facility, estimated to be $10,000 per year. An operator will also be required to travel to the compost facility for daily inspection, or the City may choose to maintain operator presence at the facility full-time.

4.0 SUMMARY & COMPARISON OF ALTERNATIVES

4.1 EQUIPMENT OPTIONS

The five technically feasible solutions for sludge processing equipment, Alternatives 2-6, are summarized in Table 4-1 below.

TABLE 4-1. Comparison of Equipment Alternatives

	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Description	Compost Facility Rehabilitation	Kruger Dryer	Gryphon Dryer	Klein Dryer	Burch Biowave Dryer
Pros	• Produces Class A Biosolids • Retrofit in existing facilities • Known process • Customers are familiar with end product	• Produces Class A Biosolids • Automated O&M • More installations/ experience to date	• Produces Class A Biosolids • Automated O&M • Fewer operator hours • Modular design for future expansion	• Produces Class A Biosolids • Automated O&M • Fewer operator hours • Modular design for future expansion • Cooling zone • Exhaust air treatment	• Produces Class A Biosolids • Fewest operator hours • Modular design for future expansion
Cons	• Capital cost • More operators required to operate the facility • Disposal may be required if compost sales do not increase	• Large footprint • High capital cost • Requires more frequent inspection/ operator hours • Requires inlet feed pump	• No municipal installations to date	• Equipment life only 10 years • Dried product recycling required • Large exhaust conditioning unit & many pieces of ancillary equipment • Requires inlet feed pump	• High energy use • Controlled atmosphere (air conditioning) required
Non-Monetary Factors	• Operator retirement • Storing excess compost in wind rows is objectionable to NYSDEC	• Dried product is ~1" strands • Air permitting	• Dried product is particles compatible with spreaders • Air permitting	• Dried product is in strands • Air permitting	• Dried product can be <2 mm or >2 mm particles • Air permitting

	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6a	Alternative 6b
Description	Compost Facility Rehabilitation	Kruger Dryer	Gryphon Dryer	Klein Dryer	Burch BioWave Dryer	Burch BioWave Dryer (with CHP Generator)
Max. Operating Temperature	-	~350°F	~375°F	~265°F	~500°F	~500°F
Footprint Required*	-	80'L x 55'W x 25'H	75'L x 30'W x 22'H (plus cooling tower)	65'L x 40'W x 22'H	70'L x 30'W x 22'H	70'L x 30'W x 22'H (plus generator)
Est. Annual Labor Required	7,490 MHRS	435 MHRS	280 MHRS	260 MHRS	~80 MHRS	~100 MHRS
Annual Electricity Required	-	254 MWh	162 MWh	194 MWh	652 MWh	90 MWh
Annual Natural Gas Required	-	6,503 MMBTU	5,040 MMBTU	10,317 MMBTU	5,902 MMBTU	13,177 MMBTU
Lifecycle	15-20 years	20+ years	20+ years	10 years	20+ years	20+ years
Total Equipment Cost**	$2,545,000	$5,714,000	$2,194,000	$2,908,000	$1,610,000	$2,785,000
Annual O&M Cost	$403,000	$85,000	$70,000	$152,000	$133,000	$116,000
Life Cycle Cost***	$8,611,000	$6,994,000	$3,248,000	$5,196,000	$3,612,000	$4,531,000

* Footprint required assuming new building with required clearances. Gryphon and Burch Biowave dryers, when reconfigured, may fit within a 42'L x 35'W addition footprint.

** Total Equipment Cost includes equipment purchase, installation, mobilization, overhead and profit, contingency, and legal, engineering, and administrative fees. The cost to house the equipment in either a new building, addition, or rehabilitated facility are not included for sludge drying options.

*** The life cycle cost is based on the upfront capital required for construction and the annual operation and maintenance costs for the sludge drying equipment (excluding housing costs, refer to Table 4-1). A 20-year time period and an interest rate of 2.875% were used in the calculations.

4.2 HOUSING OPTIONS

The three technically feasible solutions for housing sludge processing equipment are summarized in Table 4-2 below.

TABLE 4-2. Comparison of Sludge Dryer Housing Alternatives

	Alternative A	Alternative B	Alternative C
Description	New Building	Addition Above Sludge Handling Room	Compost Facility Reuse
Feasibility	Alternatives 2-6	Alternatives 4 & 6	Alternatives 2-6
Pros	• Ease of construction/installation and continued operation of compost facility • Room for future expansion • Ease of access	• Utilizes existing structure to stay above floodplain • Preserves available space north of the existing building • No outdoor sludge conveyance • Lower capital cost	• Available space allows ease of access • Room for future expansion
Cons	• Pilings required due to onsite soils, increasing the cost of the building • Outdoor sludge conveyance may require more energy/increased temperature in the dryer to achieve Class A requirements	• Limited/tight access • No room for future expansion • Construction may interrupt sludge processing	• Haulage of dewatered sludge still required • Interrupted composting operation in half of the building • May require disposal of compost prior to construction
Non-Monetary Factors	• Operator at WWTP site • Building must be raised above floodplain	• Operator at WWTP site • Above floodplain	• Operator required offsite at compost facility • Above floodplain
Total Housing Cost*	$1,394,000	$1,244,000	$1,430,000
Annual O&M Cost	Negligible	Negligible	$10,000
Life Cycle Cost**	$1,394,000	$1,244,000	$1,581,000

* Total Housing Cost includes construction of housing, modification to existing facilities, mobilization, overhead and profit, contingency, and legal, engineering, and administrative fees. The cost of sludge drying equipment and installation are not included.
** The life cycle cost is based on the upfront capital required for construction and the annual operation and maintenance costs for the housing alternative. A 20-year time period and an interest rate of 2.875% were used in the calculations.

4.3 TOTAL PROJECT COSTS

The City may select an equipment alternative and any feasible housing alternative for a number of possible combinations that meet the project design criteria and objectives. Several possible approaches utilizing the Gryphon or Burch BioWave sludge dryer are considered below:

TABLE 4-3. Sample Comparison of Sludge Dryer & Housing Combinations

	Alternative 2	Alternative 4-A	Alternative 4-B	Alternative 4-C	Alternative 6a-B	Alternative 6b-A
Equipment Description	Compost Facility Rehabilitation	Gryphon Dryer	Gryphon Dryer	Gryphon Dryer	Burch BioWave Dryer	Burch BioWave Dryer (with CHP Generator)
Housing Description	N/A	New Building	Addition Above Sludge Handling Room	Compost Facility Reuse	Addition Above Sludge Handling Room	New Building
Total Equipment Cost	$2,545,000	$2,194,000	$2,194,000	$2,194,000	$1,610,000	$2,785,000
Total Housing Cost	N/A	$1,394,000	$1,244,000	$1,188,000***	$1,244,000	$1,394,000
Total Project Cost*	$2,545,000	$3,588,000	$3,438,000	$3,382,000	$2,854,000	$4,179,000
Annual O&M Cost	$403,000	$70,000	$70,000	$80,000	$133,000	$116,000
Life Cycle Cost**	$8,611,000	$4,642,000	$4,492,000	$4,587,000	$4,856,000	$5,925,000

* Total Project Cost includes equipment purchase, installation, construction of equipment housing, mobilization, overhead and profit, contingency, and legal, engineering, and administrative fees.

** The life cycle cost is based on the upfront capital required for construction and the annual operation and maintenance costs for the housing alternative. A 20-year time period and an interest rate of 2.875% were used in the calculations.

*** The compost facility retrofit is anticipated to be less than that presented in Section 3.8.3 with the Gryphon Dryer. Utility installation additions are estimated to be $241,000 and electrical service costs are not expected to increase.

5.0 RECOMMENDED ALTERNATIVE

5.1 BASIS OF SELECTION

Due to the lower operation and maintenance cost, less operator time with automated features, smaller footprint, and opportunity for expansion, the recommended alternative is the Gryphon Dryer in Alternative 4. The Gryphon Dryer requires less electricity and natural gas than the dryers considered in Alternatives 3, 4, and 5. Operation and maintenance costs are therefore significantly less than those required to achieve Class A biosolids in other dryer alternatives.

Compost facility rehabilitation in Alternative 2 has significantly higher annual operation and maintenance costs predominately due to labor. While the initial capital investment is lower than other alternatives, the life cycle cost is much higher than sludge dryer options.

Because the City is mindful of future opportunities to accept sludge from other users, opportunity for expansion is desired in both the selected equipment and housing. The addition above the sludge handling room, Housing Alternative B, is therefore not recommended. Ease of access for maintenance of the equipment is also an advantage of the other alternative housing options. Because the City would like to reduce hauling and labor costs and maintain equipment on the WWTP site, the new building in Housing Alternative A is recommended.

The recommended alternative is Alternative 4-A, to install the Gryphon Dryer in a new building at the WWTP site adjacent to the existing sludge handling building. This alternative will allow full operation of wastewater treatment and sludge processing at the WWTP facilities, will significantly reduce annual operation and maintenance costs and labor requirements in comparison to the existing compost facility, and can be constructed/installed while maintaining operation of the compost facility.

5.2 CONSTRUCTION COST ESTIMATE

The estimate of total project cost for all proposed activities, including equipment, installation, a new building to house the sludge dryer equipment, storage structure for the dried product, mobilization, overhead and profit, contingency, legal, engineering, and administrative costs is $3,588,000 as shown in Table 4-3.

5.3 PROJECT SCHEDULE

The preliminary project schedule is as follows:

- Design Development and Final Design - January 2019
- Permit Applications and Design Approval - March 2019
- Bidding - April 2019
- Construction - May 2019 to December 2019

5.4 COMMUNITY ENGAGEMENT

Because the implementation of this project may result in an end product different from the current finished product from the compost facility, input from the public should be considered. The homeowners, landscapers, and commercial soil blenders that purchase City compost

should be consulted to determine if the resulting end product from a sludge dryer would be desirable.

The residents within the service area should be adequately and proactively informed about any project affecting the wastewater treatment facilities and compost facilities. The City should make information easily accessible and engage the public throughout all phases of this project. It is recommended that the City engage the public through Public Information Meeting(s) prior to making decisions to proceed with project financing.

5.5 ENGINEERING REPORT CERTIFICATION & SMART GROWTH ASSESSMENT

The Engineering Report Certification and Smart Growth Assessment Form are included in **Appendices L & M**, respectively.

6.0 REFERENCES

40 CFR Part 503. USEPA.

Biosolids Technology Fact Sheet: Heat Drying. EPA 832-F-06-029. United States Environmental Protection Agency. Office of Water, Washington D.C. September 2006.

City of Lockport. 2017 Adopted Budget. http://www.lockportny.gov/wp-content/uploads/2015/02/2017_Budget_-_Adopted.pdf

City of Lockport. Monthly Operating Reports. 2012-2017.

Cost of Landspreading and Hauling Sludge from Municipal Wastewater Treatment Plants. Case Studies. EPA/530/SW-619. October 1977.

Descriptive Data of Municipal Wastewater Treatment Plants in New York State. New York State Department of Environmental Conservation, Division of Water. January 2004.

Lake Ontario and Minor Tribs Waterbody Inventory/Priority Waterbodies List: Eighteenmile Creek Watershed. New York State Department of Environmental Conservation. August 2007. http://www.dec.ny.gov/docs/water_pdf/wilkontweighteenmile.pdf.

Local Limits Update: Lockport Wastewater Treatment Plant. GHD Consulting Services, Inc. August 2016.

Water and Wastewater Engineering Design Principles and Practice. Mackenzie L. Davis. McGraw Hill, New York. 2011.

APPENDIX A

PROJECT LOCATION MAP

APPENDIX B

CITY OF LOCKPORT WWTP DRAWINGS

APPENDIX C

CUSTOM SOIL RESOURCE REPORT

APPENDIX D

ENVIRONMENTAL RESOURCES MAPPING

APPENDIX E

FLOOD MAPPING

APPENDIX F

CITY OF LOCKPORT SPDES PERMIT

APPENDIX G

COMPOST FACILITY REHABILITATION CORRESPONDENCE & STRUCTURAL ASSESSMENT

Brooke Hamberger

From: Tom Posella <tomp@koesterassociates.com>
Sent: Wednesday, September 13, 2017 5:08 PM
To: Brooke Hamberger
Cc: 'Jay Zgoda'; Mark Koester
Subject: RE: Compost Photos

Hi Brooke,

Based on my conversations with BDP, I'm sending along a proposed scope. They are obviously familiar with the facility since it's theirs!

Merrimack, NH just completed a similar upgrade on their 1994 vintage (15) bay facility, Lockport is a little smaller at 12 bays. They spent about $2.8M on that upgrade total. However, most of that money was spent on rehabbing the building roof. BDP thought Lockport rehabbed the building about 8 years ago and installed Stayflex coating system which is a spray on foam insulator and corrosion protection system, one of photo's clearly shows this.

The concrete should still be in decent shape. So, sight unseen (minus the helpful photos) here is a potential scope from BDP:

1) Empty all bays down to the aeration stone and replace the 2" layer of wood chip above the stone. Lockport can do this work themselves..
2) Replace Compost Agitators, BDP can supply these. As with Merrimack, BDP recommends replacing the (3) 25 HP agitator/transfer dolly (A/D) sets with (2) new 50 HP A/Ds. They would also need a new festoon system which supplies power to the A/Ds.
3) Dolly rail and Agitator rail should be in good condition unless physically damaged or concrete moved.
4) Replace Compost Process Control System. BDP can also supply this. The control system interfaces with temperature probes mounted in the bay walls to monitor the compost temperature. There should be about (5) per bay or (60) total. These probes would probably need to be replaced as well.
5) For each temp probe there is an associated (3) HP blower. Our recommendation would be to purchase (3) new ones (not from BDP) to keep on hand and replace the blowers as they fail. Based on Merrimack experience there should be no need to touch the aeration piping system in the stone.
6) Repair/Replace the ventilation fans and ductwork as needed. (not by BDP)
7) As far as BDP is aware Lockport has not had any problems with odor complaints. So they presume the existing biofilter size is adequate. They might want to replace the wood chip media depending on its age. Again work they could themselves.

Assuming there are no structural issues with the building, slabs are in good condition and ventilation is working adequately, we would budget $1.5M to $1.75M for all this equipment. Installation should be fairly straight forward and would be approximately $100,000.

Hope this helps. Please let me know if there is anything else.

Thank you

Tom

KOESTER

Thomas J. Posella Jr., P.E.
Vice President
585-202-0224

From: Brooke Hamberger [mailto:bhamberger@nussclarke.com]
Sent: Wednesday, September 13, 2017 11:35 AM
To: Tom Posella <tomp@koesterassociates.com>
Cc: 'Jay Zgoda' <jzgoda@nussclarke.com>
Subject: Compost Photos

Hi Tom,

I do not have plans of the compost facility, but have attached some recent photos. I hope this helps! Thanks!

Brooke N. Hamberger, E.I.T.
Engineer
3556 Lake Shore Road, Suite 500
Buffalo, NY 14219
p: 716.827.8000 x 242 | f: 716.826.7958 | c: 301.538.8006
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STRUCTURAL ASSESSMENT AND CONDITION SURVEY

LOCKPORT
COMPOSTING FACILITY

LOCKPORT, NY

INSPECTED BY

WORLD INTERNATIONAL TESTING, INC.

STEUBENVILLE, OH

INSPECTION DATES

DECEMBER 11-13, 2006

February 1, 2007

Mr. Michael Diel
City of Lockport
Public Utilities Department
611 West Jackson Street
Lockport, NY 14094
P) 716.433.1612 / F) 716.433.1397

RE: Structural Assessment and Condition Survey - Lockport, New York Composting Facility

Dear Mr. Diel:

As per your request, we have completed a structural integrity inspection and a corrosion evaluation for the Lockport Composting Facility in Lockport, NY. The overall results were favorable, with only minor structural deficiencies noted. Several small fractures were discovered at a column web details in the Mixing Area and several anchor bolts in the Composting Area will need retrofitting. At this time, the deficiencies in their current state do not warrant catastrophic safety concerns. The majority of the deficiencies were associated with premature coating failures and steel substrate exposure. The resulting contamination has introduced corrosion cells and advancing section loss. Maintenance should be considered in the near future to preserve the designed structural integrity of the steel strand facility.

The measurable section loss is limited to secondary structural members including purlins, sway bracing, brackets and bolts. Although no primary steel replacement or retrofitting is required at this time, we are recommending that several secondary structural components be repaired to prevent potential safety concerns in the future. In addition to these isolated details, several duck work hanger supports were found to be sheared with several approaching failure. These details should be replaced with corrosion resistant or stainless equal members. We have suggested that cables or chains be used to temporarily support the ductwork to prevent the system from collapsing. It should be noted that the steel deterioration is in an accelerated state, and that preventive maintenance measures should be implemented in the near future to prevent the need for large-scale steel replacement measures. Externally, the decking, gutters and penetrations were evaluated with moderate deterioration noted. The roof decking is experiencing large-scale coating degradation and substrate exposure on the lapped edges and seams and should receive a protective coating barrier in the reasonable near future. A total of three-(3) punctures and eleven-(11) holes were noted on the exterior roof, which will be discussed in further detail in the report.

The report will summarize our ultrasonic test results and identify weaknesses discovered throughout the facility. Our report will also include probable cause theories for coating deterioration on the structural steel. The collective data from the test areas will provide valuable information on deterioration trends, and will assist in determining the most appropriate course of action to address future rehabilitation needs. This information will be vital in recommending appropriate design criteria, repair sequences and material selections. All of the deficiencies will be discussed in further detail in the report.

Sincerely,

Joseph Bressler
President/Civil Engineer
WORLD INTERNATIONAL TESTING, INC.

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DIVISION I:

PURPOSE, DESCRIPTION AND EXECUTIVE SUMMARY

DIVISION I: PURPOSE, DESCRIPTION AND EXECUTIVE SUMMARY

A. PURPOSE

World International Testing, Inc. was contacted by to perform field evaluations on a steel strand structure at the Lockport Composting Facility in Lockport, New York. The facility was constructed in 1993 and due to the visual discovery of steel deterioration, a structural survey was requested.

The purpose of the field survey was to conduct a comprehensive structural survey and corrosion evaluation on the roof deck, purlins, girders, columns, joists and ancillary components. Information was gathered during the field survey and compiled for the purpose of presenting the findings, and for furnishing recommendations for repairs, repainting, corrosion protection, compliance, projected life expectancy and related preventive maintenance measures.

The enclosed inspection report addresses structural and design deficiencies in the structural steel, critical loss in section to structural members, preventive maintenance items and repairs, and deficiencies related to safety, sanitary and general operations. Inspection and test results are contained.

World International Testing, Inc. has developed a nondestructive evaluation and inspection program specifically to meet the above-requirements and the particular needs of the owner. The report will allow the owner to maintain accurate data and a case history for each individual item. The data will also permit us to duplicate test conditions from each inspection, enabling us to plot deficiencies and make recommendations for corrective maintenance work prior to failure. This type of record keeping is necessary in maintaining realistic **Accept/Reject/Fracture Critical** criteria. Final arrangements were made and the inspection survey took place December 11, 12 and 13, 2006.

B. DESCRIPTION & GENERAL DATA

1. **Location/Address:** 800 Co-Co Lane, Columbus, NJ 08022
2. **Description and Design:** Steel Strand Low Slope Assembly
3. **Purpose:** Compost Facility
4. **Construction Date:** 1993
5. **Building Dimensions and General Data:**
   - **a. Ground Elevation**: 509′ (Top of Slab)
   - **b. Low Roof Elevation**: No Data
   - **c. High Roof Elevation**: No Data
   - **d. Dimensions:** 119′-5′′ x 342′ main + (59.5′ x 86′ covered storage)
   - **e. Square Footage:** 45,986′ sq. ft. (excluding office)
   - **f. Interior Area Tested:** 45,986′ sq. ft.
   - **g. Water Shed:** Low-Slope Less than 1:12
   - **h. Manufactured By**: No Data Building Code 93BOCA
   - **i. Live Load**: 40 PSF Snow / 15 PSF Wind / 2 Mechanical
   - **j. Drift Load**: Per WSI A58.15 Section 7.7

NOTE: Reference enclosed report and CAD Diagrams for additional pertinent dimensions on structural members and accessories.

DIVISION I: PURPOSE, DESCRIPTION AND EXECUTIVE SUMMARY (Cont'd)

C. EXECUTIVE SUMMARY

Numerous regions of steel deterioration were documented due to events relating to composting activity. Deficiencies from caustic aggression and persistent condensation cycles, influenced by both environmental factors and compost degradation vapors, were apparent. The deterioration, for the most part, is affecting non-corrosion resistant hanger details and low dimensional steel members, more specifically the purlins. It is apparent that premature coating flaws or insufficient material selection contributed greatly to the current conditions. The more advanced concerns were located primarily in the Composting Area of the facility. The deterioration was well noted, with the discovery of advancing corrosion around purlin penetrations and purlin flange edges, sheared and near 100% section loss regions on the ductwork hangers, and the discovery of several anchor U-Bolts with < 75% section loss. An effective protective coating system for the building steel and isolated retrofits will need to be implemented in the near future, or large-scale secondary steel component replacement will be required.

With the degree of obvious advancing deterioration, the concerns of the owner are well warranted. The focus of the concerns has now shifted to the depth of steel degradation. The Ultrasonic Testing revealed that the primary steel girders and columns are functioning well, and no significantly weakened steel was discovered. One deficient area noted concerns the roof center flange connection at column line 11. The east and west flange have a 5/16″ gap and it is not certain if it is construction related or if the bolts are deteriorating internally allowing girder movement. One additional area of concern was noted in the Mixing Area where two small fractures were discovered in the web detail of column A15. The fractures are located at the X-Bracing connection, and may be due to section loss and stress amplification. No catastrophic concerns exist at this time; however, due to the nature of crack propagation under loading, the fractures should be repaired.

The secondary members are experiencing advancing deterioration, with isolated areas of 100% section loss noted on the low wall dimension 1″ x 1″ framing angles. Advanced deterioration was also discovered on the flange edges and manufactured penetrations of the purlins. It is obvious that the current building protective coating system cannot effectively protect itself from deterioration, and will not reach its designed life projections.

Premature steel deterioration in composting facilities can be attributed to the following: Moisture vapors in moisture-saturated air will condense when it is cooled. The temperature at which air becomes saturated with moisture vapors and condensation begins is referenced as the dew point temperature. In addition to condensation factors attacking the roof system, vapor pressures are also playing an important role in the roof deterioration. All gases, including water vapor, exert pressure. The amount of pressure that water vapor exerts is a function of temperature and relative humidity. The greater the temperature and the higher the relative humidity, the greater the water vapor pressure. As in the case of the compost facility, there are different temperature and relative humidity conditions on either side of the roof barrier. With two different ambient parameters, there will be a corresponding vapor pressure differential. The air on the side of the barrier that has the higher vapor pressure will move to reach equilibrium with the air on the side of the barrier with the lower vapor pressure. This is referred to as vapor drive. The greater the vapor-pressure differential, the greater the vapor drive.

DIVISION I: PURPOSE, DESCRIPTION AND EXECUTIVE SUMMARY (Cont'd)

C. EXECUTIVE SUMMARY (Cont'd)

As with the case of the Lockport Composting Facility, in climates with outside temperatures typically colder than the inside temperature, relatively lower water-vapor pressure will exist externally. The warmer interior air will exert a higher vapor pressure than the outside air. Under these conditions, the vapor drive will be from the interior of the building to the exterior.

Due to the flow of warm air upward, vapor migration in most instances will be upward, and as moisture permeates through barriers, condensation will occur.

At this time, the steel deficiencies in their current state do not warrant catastrophic safety concerns. As mentioned, the majority of the recordable deficiencies were associated with purlins supporting the roof deck and secondary ancillary components. For the most part, the measurable critical section loss is limited to secondary structural members and does not warrant primary steel replacement or retrofitting.

One final area of concern pertains to the exterior roof deck. Large-scale coating degradation was noted on the lapped edges and seams. Additionally, a total of three-(3) punctures and eleven-(11) holes were noted on the exterior roof deck panels. The punctures were not corrosion related and had characteristics of exterior physical impact. The holes were a result of drill misses during construction for the fasteners that were never repaired. These areas will have to be repaired to prevent moisture aggression from rain and environmental elements. Insulation failure is evident at the reciprocated bottom sides at these failure locations.

Recommendations for repairs and material replacement have been included, along with options addressing short term or long term goals. One urgent temporary recommendation was made to the plant supervisor pertaining to the ductwork supports in the composting area. With the sheared and near shearing potential of multiple ductwork hangers, temporary chains or cables should be installed at several locations to prevent the catastrophic collapse of the duct system.

The data collected from our evaluation would suggest that steel degradation has been ongoing for several years. There is reason to project that this deterioration would continue with a conventional replacement coating. Also, to achieve long-term service goals, the technical options are limited.

All of these deficiencies, along with other notable items, will be discussed in more detail in the report.

"END DIVISION I: PURPOSE, DESCRIPTION AND EXECUTIVE SUMMARY"

DIVISION II:

TEST RESULTS

DIVISION II: TEST RESULTS

A. MIXING AREA:

1. GENERAL INFORMATION:

The Mixing Area is located at the North end of the facility, and consists of the area between columns C-12 through C-15. The square footage for the Mixing Area was estimated at 7,170 square feet. There is a blanket insulation system on the bottom side decking of the interior which restricted evaluation. The majority of the primary girder and secondary detail members were accessible for inspection. The results are contained.

a. Number of Steel Girders:	4
b. Number of Columns:	15 (4-East 4-West 5-North 2-South)
c. Number of Purlins:	78 (approx.)
d. Diagonal Framing Angles:	72 (approx. 12 per girder x 2 sides) (2″ x 2″ x ¼″)
e. Sway Rods:	6
f. Transverse Framing Angles:	78 (Locking Tab 26 per bay staggered) (1″ x 1″)
g. Insulated:	Yes
h. Type of Insulation;	Blanket Fiberglass (approx. 4″)
i. Evidence of Insulation Failure:	Minor
j. Evidence of Roof Deck Leaks:	Yes
k. Roof Type:	Robertson Versapanel Gauge 26 Interior & Exterior (Not Confirmed)

2. INSULATION SYSTEM:

Blanket Insulation with fiberglass characteristics. There is no insulation on the side walls.

3. STRUCTURAL STEEL CONDITIONS:

The majority of the accessible structural steel in the Mixing Area was subjected to visual and spot ultrasonic testing. The girders and columns were of a tapered design, with the maximum widths measured at 53 ½″ for the girders, and 53 ½″ for the columns. There were no areas of significant deterioration noted on the girders or columns.

The column to girder detail and all girder splice connections were evaluated, and no notable deflection or deficiencies were documented. The bolted connections and fasteners are secure; however, large-scale coating deterioration was noted. The girder sway rods were found to have notable section loss in the threaded areas and on the fastening nut. This condition was typical for the majority of the rod details. One area of concern was noted on the West wall at Column A15 where two small fractures were discovered in the web detail of column A15. The fractures are located at the X-Bracing connection and may be due to section loss and stress amplification. No deformation or catastrophic concerns exist at this time; however, due to the nature of crack propagation under loading, the fractures should be repaired (reference Note-21-06).

DIVISION II: TEST RESULTS (Cont'd)

3. STRUCTURAL STEEL CONDITIONS: (Cont'd)

The purlins were of an 8″ "Z" design with 3 ½″ flanges. The low-wall dimensions of the purlins are experiencing advancing deterioration. The most significant deterioration was noted at the flange edges and penetrations. The maximum section loss noted was 60% on the purlin upper and lower flanges and at penetrations (see photos). These areas are isolated and do not warrant replacement in their current state. The fastening bolts were experiencing advancing loss of section. The fastening bolts were experiencing section loss as high as 30% in isolated instances.

The diagonal stiffeners 2″ x 2″ framing angles are sound; however, they are experiencing section loss at the purlin web fastening point. The pre-drilled orifices are experiencing section loss at the edges. There are approximately 12 members per girder with some exceptions. The units are bolted and welded to the girder bottom flange and to the web of the roof purlin. Although there are no structural deficiency concerns for these regions, it is an indicator of events that will progress if the corrosion is not addressed in the near future.

Other notes of concern relate to the festoon 2″ x 2″ x 3/16 ″ support brackets. Advanced coating deterioration and early stage section loss was noted. The section loss is approaching 10% and should receive a protective coating barrier in the near future.

One final note pertains to the electrical conduit network. Numerous areas of deterioration and sheared conduit lines were discovered. These areas should be repaired and upgrading to prevent line damage or the potential of arcing.

There is no indication that the steel has received any new protective coatings since construction. No Dry Film Thicknesses were taken during this inspection cycle.

4. ROOF DECK CONDITIONS:

The inspection of the interior roof deck revealed favorable conditions. When residual contaminants were removed from the interior roof deck at specific test points, the deck was found to be sound, with the protective coating system still functioning as designed. Externally, several notes of interest were documented. The exterior roof deck is experiencing coating degradation and substrate exposure on the lapped edges and seams. Due to the low wall geometry of roof decking, progressive section loss will have detrimental implications to the integrity of the roof deck. The decking should receive a protective coating barrier in the reasonable near future. A total of six-(6) holes were noted on the exterior roof. The holes were not impact related and were a result of drill misses during construction that were never repaired.

The evaluation documented notable deterioration concerns in the building structure. With the discovery of advancing section loss in the secondary and ancillary components, deterioration to the primary structural members is inevitable. No large-scale steel replacement is warranted at this time; however, when comparing similar facilities with more progressive deterioration, delaying a protective coating material application will be detrimental to the steel. This is due to the acceleration factors involved in corroding steel. To assist in preparing bid documents for future rehabilitation, square footage estimates and a general repair schedule has been provided.

DIVISION II: TEST RESULTS (Cont'd)

DEFECT INVENTORY-REPAIR SCHEDULE
MIXING AREA

NOTE #	LOCATION	DEFICIENCY	RECOMMENDATION
NOTE 8-06	EXTERIOR ROOF DECK PANELS 1-115	ROOF PANEL EDGES AND FASTENERS EXPERIENCING ADVANCING COATING DEGRADATION AND EARLY STAGE SECTION LOSS	HAND TOOL OR POWER TOOL CLEAN ALL VISIABLE CORROSION AND APPLY TWO STRIPE COATS OF RUST BOND
NOTE 10-06	EXTERIOR ROOF DECK PANEL 22 (WEST)	OLD SCREW HOLE FROM MISS ALLOWING RAIN AND MOISTURE TO ENTER BUILDING UNDER INSULATION	CLEAN AND SEAL OPENING WITH CAULKING
NOTE 11-06	EXTERIOR ROOF DECK PANEL 1 (WEST)	(4) OLD SCREW HOLE FROM MISSES ALLOWING RAIN AND MOISTURE TO ENTER BUILDING UNDER INSULATION ALSO PANELS LIFTING	INSTALL NEW FASTNERS WITH LARGER WASHERS CLEAN AND APPLY COATINGS
NOTE 20-06	MIXING FLOOR CONDUIT	ELECTRIC CONDUIT SHEARED IN MULTIPLE LOCATIONS AND BRACKET SOUTH SIDE	REPAIR EXPOSED CONDITIONS UPGRADE TO CORROSION RESISTENT MATERIALS
NOTE 21-06	MIXING FLOOR COLUMN A-15	(2) FRACTURES IN WEBBING OF X-BRACE ¼″ LONG UPPER WEST CORNER ¾″ LONG LOWER WEST CORNER	GRIND OUT CRACKS AND WELD BY QUALIFIED WELDER IMPLIMENTING AWS STANDARDS.

B. COMPOSTING AREA:

1. GENERAL INFORMATION:

The Composting Floor consists of the area between columns C-1 through C-12. The square footage for the Composting Floor was estimated at 38,816 square feet. There is an insulation system at the interior roof and the majority of the interior roof deck surfaces are concealed. This limited the evaluation of the roof deck and steel. The primary girders and columns were exposed. The results are contained.

a.	**Number of Steel Girders:**	(11)-Primary and (1)-End Beam
b.	**Number of Columns:**	52 total (24 main columns) (22 center) (6 south)
c.	**Number of Purlins:**	286
d.	**Diagonal Framing Angles:**	286 (2″ x 2″)
e.	**Transverse Framing Angles:**	275 approx. (1″ x 1″)
f.	**Sway Braces:**	18 –X (roof)
g.	**Insulated:**	Yes
h.	**Type of Insulation;**	Blanket Fiberglass (approx. 4″)
i.	**Evidence of Insulation Failure:**	Minor
j.	**Evidence of Roof Deck Leaks:**	Yes
k.	**Roof Type:**	Robertson Versapanel Gauge 26 Interior & Exterior (Not Confirmed)

DIVISION II: TEST RESULTS (Cont'd)

2. INSULATION SYSTEM:

Blanket Insulation with fiberglass characteristics. There are indications of moisture behind the insulation from roof leaks. There is no insulation on the side walls.

3. STRUCTURAL STEEL CONDITIONS:

The majority of the accessible structural steel in the Composting Floor area was subjected to Visual and spot Ultrasonic Testing. The eleven center girders and east and west exterior columns were of a tapered design, with the maximum widths measured at 53 ½″ for the girders and 53 ½″ for the columns. There were no areas of significant deterioration noted on the girders or columns. The south end girders were atypical in design (see drawings). None of the beams are experiencing significant section loss or catastrophic concerns.

The column to girder details and all girder splice connections were evaluated, and two notable defects were documented. At the center flange connection for C-11 a visible gap between flanges of 5/16″ was noted. It is not certain if this space originated during construction or is deformation from stresses. No stress risers were detected in the area, which is a positive note. In either case, we are recommending that the bolts be replaced. One additional concern is the anchor bolts on the west wall, where (12) anchor nuts and bolts were found to have excessive section loss. The east wall anchors were sound. Only the west side anchors are deteriorating, which may be due to the fans being located on the west wall and the affect of air content and air flow. The bolted connections are secure, although coating breakdown and advancing section loss was visible. We are recommending that these areas be retrofitted to maintain performance and design criteria for the structure.

The purlins were of an 8″ "Z" design with 3½″ flanges. The low wall dimensions of the purlins are experiencing moderate flange and web deterioration. The most significant deterioration was noted at the flange edges and penetrations. The maximum section loss noted was 55% on the purlin upper and lower flanges edges and at penetrations (see photos). The diagonal 2″ x 2″ framing angles are secure; however, they are experiencing advancing corrosion. Remedial action should be considered in the not to distant future. Additionally, the 1″ x 1″ transverse framing angles at the purlin are experiencing significant section loss. These members have secondary structural axial functions and assist in purlin alignment purposes. Although not crucial to the structural integrity of the building, they should be maintained. We are estimating that 10% of the 275 units be replaced. They are a tabbed detail and no welding is required for replacement.

The deterioration in the Composting Areas was more significant than in any other area of the facility due to more prevalent hostile vapors in this area. There was noticeable build-up in the ductwork, which may be restricting maximum air movement. Additionally, there are a series of fans at the north and south curtain barriers that are deteriorated and do not appear functional. The four- (4) fans should be removed or restored.

DIVISION II: TEST RESULTS (Cont'd)

3. STRUCTURAL STEEL CONDITIONS: (Cont'd)

Other deterioration noted concerns the ductwork all-thread hangers. Sheared hangers and hangers with near 100% section loss were documented. The deterioration is approaching catastrophic levels and recommendations for temporary supporting were communicated to plant supervision. The ductwork hangers should all be upgraded to a stainless steel equal. An effective protective coating system for the building steel and isolated retrofits will need to be implemented in the near future, or large-scale secondary steel component replacement will be required. No replacement steel is warranted at this time, with the exception of the hangers and anchor bolts (nuts).

4. ROOF DECK CONDITIONS:

The roof deck underside is beginning to develop breaches in its insulation. No corrosion cells were visible on the underside decking at the insulation failure areas. Externally, several notes of interest were documented. The exterior roof deck is experiencing coating degradation and substrate exposure on the lapped edges and seams. Due to the low wall geometry of roof decking, progressive section loss will be detrimental to the integrity of the roof deck. The decking should receive a protective coating barrier in the reasonable near future. A total of eight-(8) holes were noted on the exterior roof. Five-(5) of the holes were not impact related and were a result of drill misses during construction, which were never repaired. The remaining three-(3) holes had puncture related characteristics from impact. The holes are allowing moisture to enter the building and damage the underside insulation.

The evaluation documented isolated deterioration in the Composting Area building structure. The discovery is not a concern at this time. Due to current section loss conditions and the potential for progressive section loss, a protective coating system will be necessary in the not too distant future. To assist in preparing bid documents for future rehabilitation, square footage estimates and a general repair schedule has been provided.

See the enclosed Defect Inventory and CAD drawings for additional data.

DIVISION II: TEST RESULTS (Cont'd)

DEFECT INVENTORY-REPAIR SCHEDULE
COMPOSTING AREA

NOTE #	LOCATION	DEFICIENCY	RECOMMENDATION
NOTE 1-06	COLUMN LINE 11 @ CENTER FLANGE CONNECTION	THERE IS A 5/16″ GAP BETWEEN EAST AND WEST GIRDER FLANGES, IT IS NOT CERTAIN IF CONSTRUCTION RELATED OR MOVEMENT	REPLACE BOLTS (4) 3/4″ DIAMETER x 2 ½″
NOTE 2-06	X-BRACING BETWEEN COLUMN LINE 10-11	ROOF SWAY BRACES EXPERIENCING < 32% SECTION LOSS	APPLY PROTECTIVE BARRIER SYSTEM REASONABLE NEAR FUTURE
NOTE 3-06	COMPOSTING AREA NUMEROUS LOCATIONS BETWEEN C-8 AND C-12	THE 1″ x 1″ PURLIN TRANSVERSE FRAMING ANGLES EXPERIENCING NEAR 100% SECTION LOSS	REPLACE APPROX. 10% OF 275 FRAMING ANGLES IN COMPOSTING AREA (TABBED ENDS - NOT WELDED)
NOTE 4-06	DUCTWORK HANGERS	(2) SHEARED AND (4) NEAR 100% SECTION LOSS ON ½″ DIAMETER ALL THREAD HANGERS	TEMORARILY SECURE DUCTWORK SYSTEM WITH CABLES OR CHAINS. REPLACE ALL 34 TWIN HANGERS (68) TOTAL WITH STAINLESS STEEL EQUALS
NOTE 5-06	OLD FANS @ CURTAIN WALLS	ALL (4) FANS AT NORTH AND SOUTH COMPOSTING CURTAINS ADVANCED SECTION LOSS ON SUPPORT DETAILS	REMOVE OLD FANS THAT APPEAR TO BE OUT OF SERVICE OR REPLACE
NOTE 6-06	COLUMN ANCHOR BOLTS WEST WALL	REPLACE (12) NUTS ON ANCHORS DUE TO < 75% SECTION LOSS	REPALCE NUTS AND WASHERS AT FOOTERS. WELDING MAY BE REQUIRED
NOTE 7-06	EXTERIOR ROOF PANEL 42 (E)	(2) PUNCTURES IN ROOF (IMPACT RELATED)	CLEAN AND SEAL OPENING WITH NEOPREME PATCHING MATERIAL
NOTE 9-06	EXTERIOR ROOF DECK PANEL 38 (WEST)	OLD SCREW HOLE FROM DRILL MISS ALLOWING RAIN AND MOISTURE TO ENTER BUILDING UNDER INSULATION	CLEAN AND SEAL OPENING WITH CAULKING
NOTE 13-06	EXTERIOR ROOF DECK GENERAL	MAJORITY OF ROOF SCREWS ON EXTERIOR CORRODING ALONG WITH GUTTER BRACKETS	HAND TOOL CLEAN OR MACHINE TOOL CLEAN TOUCH UP (2 COATS) WITH RUST BOND COATING
NOTE 14-06	EXTERIOR ROOF DECK PANEL 84 (WEST)	OLD SCREW HOLE FROM DRILL MISS ALLOWING RAIN AND MOISTURE TO ENTER BUILDING UNDER INSULATION	CLEAN AND SEAL OPENING WITH CAULKING
NOTE 15-06	EXTERIOR ROOF DECK PANEL 89 (WEST)	OLD SCREW HOLE FROM DRILL MISS ALLOWING RAIN AND MOISTURE TO ENTER BUILDING UNDER INSULATION	CLEAN AND SEAL OPENING WITH CAULKING

DIVISION II: TEST RESULTS (Cont'd)

DEFECT INVENTORY-REPAIR SCHEDULE
COMPOSTING AREA

NOTE #	LOCATION	DEFICIENCY	RECOMMENDATION
NOTE 16-06	EXTERIOR ROOF DECK PANEL 101 (WEST)	OLD SCREW HOLE FROM DRILL MISS ALLOWING RAIN AND MOISTURE TO ENTER BUILDING UNDER INSULATION	CLEAN AND SEAL OPENING WITH CAULKING
NOTE 17-06	EXTERIOR ROOF DECK PANEL 94 (WEST)	OLD SCREW HOLE FROM DRILL MISS ALLOWING RAIN AND MOISTURE TO ENTER BUILDING UNDER INSULATION	CLEAN AND SEAL OPENING WITH CAULKING
NOTE 18-06	EXTERIOR ROOF DECK PANEL 45 (EAST)	SMALL PUNCTURE ON RIDGE OF PANEL ALLOWING RAIN AND MOISTURE TO ENTER BUILDING UNDER INSULATION	CLEAN AND SEAL OPENING WITH CAULKING
NOTE 19-06	EAST SIDE WALL SHEATING	IMPACT DAMGE AND PUNCTURE ON SIDE WALL PANELS	PATCH AND REPAIR
NOTE 25-06	COMPOSTING DOORWAYS	NUMEROUS DOORWAYS HAVE NO PANIC BARS OR WORKING CYLINDERS	UPGRADE ALL DOORS TO BUILDING AND FIRE CODE SPECIFICATIONS

C. COVERED STORAGE AREA:

1. GENERAL INFORMATION:

The Covered Storage Area is located at the west region of the facility, and consists of the area between columns C-1 through C-10. The square footage for the Covered Storage Floor was estimated at 5,117 square feet. The area is open and no insulation system is present. The majority of the interior side walls and roof deck surfaces are exposed. This assisted in the evaluation of the roof deck and steel. The results are contained.

- **a. Number of Steel Girders:** (3) Primary and (2) End Beam
- **b. Number of Columns:** (12)
- **c. Number of Purlins:** (39)
- **d. Diagonal Framing Angles:** N/A
- **e. Transverse Framing Angles:** N/A
- **f. Sway Braces:** 6
- **g. Insulated:** No
- **h. Type of Insulation;** N/A
- **i. Evidence of Insulation Failure:** N/A
- **j. Evidence of Roof Deck Leaks:** No
- **k. Roof Type:** Robertson Versapanel – Gauge 26 Int. & Ext. (Not Confirmed)

DIVISION II: TEST RESULTS (Cont'd)

2. INSULATION SYSTEM:

N/A

3. STRUCTURAL STEEL CONDITIONS:

The majority of the accessible structural steel in the Covered Storage Area was subjected to visual and spot Ultrasonic Testing. The components of the structure consist of tapered and straight beams and included channel beams 8 ½" x 3 ½".

The column to girder detail and all girder splice connections were evaluated and no notable deficiencies were documented. The bolted connections are secure. There were two-(2) notes of interest concerning the column G-19 and the header beam of the north opening between G-18 and G-19. Both of these areas are experiencing significant deformation from impact from material movement equipment. The G-19 column should be considered for reinforcement or replacement.

Also noted was physical impact damage to the column piers more profound at G-17. Exposed reinforcement steel is evident. The impact is from material movement equipment. More care should be given when operating heavy equipment.

The purlins were of a 10″ "Z" design with 3¼″ flanges. The exterior open air conditions are not creating hostile environments for the steel. No replacement steel is warranted at this time.

4. ROOF DECK CONDITIONS:

The roof deck survey documented favorable interior and exterior conditions.
Reference the following CAD Diagrams for additional data.

DEFECT INVENTORY-REPAIR SCHEDULE
COVERED STORAGE AREA

NOTE #	LOCATION	DEFICIENCY	RECOMMENDATION
NOTE 22-06	OUTDOOR COVERED STORAGE G-17 CONCRETE PIER	SIGNIFICANT DETERIORATION AND DAMAGE FROM MATERIAL LOADING EQUIPMENT	CHIP ALL LOOSE MATERIAL AND REPAIR DAMAGED CONCRETE
NOTE 23-06	OUTDOOR COVERED STORAGE HEADER BEAM G-18 TO G-19	SIGNIFICANT DEFORMATION FROM IMPACT FROM MATERIAL LOADING EQUIPMENT ON PORTAL BEAM	HEAT STRAIGHTEN OR REINFORCE AREA
NOTE 24-06	OUTDOOR COVERED STORAGE G-19 COLUMN	SIGNIFICANT DEFORMATION ON C-CHANNEL COLUMN 8 ½″ X 3 ¼″ FROM MATERIAL LOADING EQUIPMENT	REPLACE MEMBER OR REINFORCE WITH PLATING

DIVISION III:

NONDESTRUCTIVE TESTING PROCEDURES

DIVISION III: NONDESTRUCTIVE TESTING PROCEDURES

A. GENERAL - NDT SURVEY:

The enclosed data reflects specific Nondestructive Testing (NDT) methods performed by W.I.T., Inc. NDT procedures performed herein were in compliance with specific federal, state and local guidelines and in some cases included proprietary testing procedures of W.I.T., Inc., which have been provided in this evaluation report solely for the use by W.I.T., Inc. customers. Interpretation and duplication of the test methods and procedures to obtain similar data shall not be acceptable without authorization of the OWNER and/or direct supervision of a W.I.T., Inc. qualified representative. In addition, CAD diagrams prepared by W.I.T., Inc. have been provided to assist in the presentation of the data obtained during the survey.

B. NDT AND INSPECTION METHODS:

The enclosed data reflects specific NDT methods performed during the field evaluation. W.I.T., Inc. roof structure inspection procedures will require that one or more of the following NDT methods be conducted during a standard roof structure assessment survey, unless otherwise specified. NDT methods utilized during our survey and their purposes include:

1. **Ultrasonic Testing (UT):**
   a. Subsurface weld evaluations for cracks, porosity and miscellaneous discontinuities (shear and longitudinal waves).
   b. Wall thicknesses for pitting, section loss, and corrosion mapping on accessible structural members, (longitudinal wave).
   c. Subsurface evaluations for cracks, stress, discontinuities and section loss for bolts, pins, shafts and rods (longitudinal and shear waves).

2. **Magnetic Particle Testing (MT):**
   Near surface weld evaluations for cracks, porosity and miscellaneous discontinuities.

3. **Visual Testing (VT):**
   Accessible areas of the structure, roof panels and penetrations will receive a visual inspection depending on accessibility, surface cleanliness, time availability, and scope of the inspection survey.

4. **Miscellaneous Testing:** As indicated, W.I.T., Inc.'s roof structure evaluation procedures require that one or more of the above NDT methods be implemented. W.I.T., Inc. reserves the right to implement any of the following testing methods and procedures should it become necessary:

   a. Radiographic Testing (RT)
   b. Liquid Dye Penetrant (PT)
   c. Eddy Current/Resistivity (ET)

DIVISION III: NONDESTRUCTIVE TESTING PROCEDURES

d. Tensile strength
e. Microscopy
f. Vacuum Testing
g. Heavy Metal Analysis
h. Coating Assessment (CA)
    1) Magnetic Film Thickness (Type I/pull-off and Type II/dual probe)
    2) Adhesion (Cross-cut, X-cut and Dolley)
    3) Tooke (destructive testing)

C. CERTIFICATION OF PERSONNEL AND NDT METHODS:

NDT technicians shall hold a minimum Level II certification in the method of testing being implemented in accordance with AWS, ASNT, SNT-TC-1A, NACE or W.I.T., Inc. Level II corporate certification, and in compliance with company qualification procedures.

"END DIVISION III: NONDESTRUCTIVE TESTING PROCEDURES"

DIVISION IV:

RECOMMENDATIONS

DIVISION IV: RECOMMENDATIONS

A. GENERAL RECOMMENDATIONS:

The enclosed detailed recommendations were made based on the structural assessment and condition survey performed on the steel strand structure for the specific purpose of presenting the findings and for furnishing recommendations for repairs, recoating, corrosion protection, compliance and related preventive maintenance measures. The goals of the recommendations for restoration are to provide the necessary work to extend the useful life of the building structure.

Selecting technical solutions to address the deterioration occurring at the Lockport Composting Facility should be based on the owner's financial needs, budget capabilities, and on short and long term goals. Several options or solutions have been presented, and the owner's responsibility is to select a restoration plan that best fits their plans. Due to the vast degree of deterioration caused by environmental factors and compost operations, the amount of work is extensive. A preferable low-maintenance situation for a compost facility would consist of more concrete and less steel. When steel is used as a primary structural component in a facility with harsh environmental characteristics, selecting specific materials designed to protect against corrosion, and understanding moisture migration sources at the facility is imperative. In summary, multiple design deficiencies during the original construction have brought us to the current state, and they must now be addressed to prevent large-scale structural replacement.

To resolve the problems based on budget restraints, our recommendations will include design upgrades, which will be performed more efficiently and reduce long-term maintenance costs. Our solutions will recommend comprehensive rehabilitation measures. It is understandable that the owners' preference is to not interrupt facility operations and coordinate rehabilitation with seasonal demands and maintenance intervals. If the rehabilitation sequence is to be performed in intervals, the cost may increase significantly. Specific recommendations are contained.

Note that the following recommendations were based on the data gathered and on evaluation experiences on similar structures. Due to unpredictable rates of corrosion, delaying a restoration project may result in quantities greater than those estimated. This should be factored in as an option during the restoration process.

B. STEEL REPAIRS:

1. **Restoration of Structural Steel:** Procedures and sequence include:

   a. **Girders:** The structural integrity of the main primary girders and columns are sound. There are isolated points of section loss on the fastening details. The total number of girders and roof joists evaluated were nineteen-(19). No girder replacement is required at this time. We are recommending that several bolts be replaced due to the visible spacing between flanges.

#	LOCATION	DEFICIENCY	REPAIR RECOMMENDATION
a.1	Girder C-11	Center Flange at Ridge - 5/16″ Gap	Replace (4) Bolts ϕ 3/4″ x 2 1/2″

DIVISION IV: RECOMMENDATIONS (Cont'd)

b. Purlins: The purlins are experiencing advancing flange edge deterioration and advancing section loss at penetration points in the webs. The deterioration was more pronounced in the Composting Area. Currently, the deterioration is isolated and is not affecting the load bearing capabilities of the purlins. A delay in the restoration cycle may warrant large scale purlin retrofitting. Abrasive-blast cleaning and the application of a protective coating system would not be a long-term solution for restoration and would not address the top flange crevices that are corroding at an accelerated rate. The only way to address the unexposed top flange would be to remove the roof deck sections. This would be labor intensive and an alternative option would be more feasible. The most effective avenue for purlin preservation would be with the use of a spray polyurethane foam material or SPF application. No purlin replacement or repairs are warranted at this time. The total number of 8″ x 3 1/2″ and 10″ x 3 1/2″ Purlins is approximately 403.

c. Columns: The structural integrity of the main columns is sound. There are isolated points of section loss on the fastening details. The total number of support columns evaluated was seventy-nine (79). One column replacement or repair is being recommended in the covered storage area. Column G19 has significant deflection from mobile equipment impact, which should be addressed. We are also recommending two-(2) fractures be repaired and twelve-(12) anchor nuts be retrofitted.

#	LOCATION	DEFICIENCY	REPAIR RECOMMENDATION
c.1	Columns	Anchor U-Bolts @ A5, A8, A9, A10 & A11	Replace (12) Anchor Nuts Welding May Be Required
c.2	Columns	Fractures @ A15 (1/4″ and 3/4″)	Repair Fractures
c.3	Columns	C-Channel Portal Column (G19) 8 1/2″ x 3 1/2″ x 1/8″ x 129 1/2″ Long	Replace or Reinforce G19

d. Roof Deck Replacement and Repairs: The evaluation of the roof discovered no significant interior deterioration at this time. Externally, fourteen-(14) holes or small punctures were discovered on the in the deck panels. The drill holes and impact related defects should be repaired to prevent moisture permeation. No deck replacement is required at this time. The exterior roof deck should receive a protective coating.

#	LOCATION	DEFICIENCY	REPAIR RECOMMENDATION
d.1	Roof Deck	(14) Holes in Roof Deck	Repair (14) Holes With Caulking Repair (1) Hole with 6″ x 6″ Neoprene Patch
d.2	Roof Deck	Exterior Roof Crevices, Seams & Fasteners	Apply 2 Coats Rust Bond Protective Coating (approx. 4,500 sq. ft.)

DIVISION IV: RECOMMENDATIONS (Cont'd)

e. Miscellaneous Repairs: As mentioned throughout the report, the all-thread support rods and fasteners are actively corroding. Currently, numerous hangers and fastener details are experiencing 100% section loss. Additionally, old unused hanger details should be removed to discourage corrosion advancement and facilitate new system application. Finally, the framing angles, diagonal and horizontal, are experiencing moderate section loss.

#	LOCATION	DEFICIENCY	REPAIR RECOMMENDATION
e.1	Compost Area	68 (34 x 2) Old Support Rods for Ductwork	Replace with 1/2″ Stainless Equals
e.2	Compost Area	(27) 1″ x 1″ Transverse Framing Angles Tab not Welded	Replace 10%
Note: If SPF System Is Considered, e.2 Items Do Not Need Replaced			
e.3	Compost Area	8′ x 8′ Wall Sheeting Damaged from Impact	Repair Sheeting
e.4	Compost Area	North & South Curtain Walls (4) Deteriorated Fan Details	Upgrade or Remove
e.5	Covered Storage Area	Concrete Pier Damaged From Mobile Equipment Impact (Column G17)	Chip All Loose Material & Reform
e.6	Mixing Area	Electrical Conduits Has Exposed Wiring and Deteriorated Junction Box	Repair Isolated Areas
e.7	Compost Area	Man Doors Missing Working Cylinders and Panic Bars (Code Violation)	Upgrade All Man Doors

f. Protective Coating Application: The evaluation of the roof discovered no interior deterioration at this time.

#	LOCATION	DEFICIENCY	REPAIR RECOMMENDATION
f.1	Exterior Roof Deck	Surface Area (45,986 sq. ft.)	Apply (2) Coats of a Chemical Resistant Barrier
f.2	Exterior Roof Deck	Corroding Seams & Fasteners (4,500 sq. ft.)	Stripe-Coat All Seams & Fasteners
f.3	Interior Deck Surfaces	Unprotected Surface	Apply SPF Protective Barrier

Note: If an SPF system is selected to address the purlin deterioration, the hanger rods should be replaced prior to the spray foam application.

DIVISION IV: RECOMMENDATIONS (Cont'd)

g. Engineering Bid Documents and Quality Control: Finally, budgeting should incorporate engineering specification cost and quality control measures for warranty and performance disclosure.

#	MISCELLANEOUS ITEMS	COST
g.1	Preparation of Bid Documents and Project Specifications	N/A
g.2	Quality Control Inspections Daily Logs, Photographs, Testing and Final Report	$600.00/day
g.3	Contingency and Unanticipated Work	10%

We recommend that the warranty requirements be clearly defined, and any exceptions included in the successful bidder's contract.

NOTE: The subtotals above reflect our opinion for a structural steel strand building rehabilitation: All of the items are not mandatory, but are considered important if the structural of the structural steel is to remain functional to the facility's operational goals. Implementation of the recommendations above should allow the Owner to achieve a refurbishment cycle of approximately 25-30 years, provided repairs, surface preparation and coating application procedures are implemented in a quality manner.

C. CLOSING COMMENTS

If a Spray Polyurethane Foam System is selected for revitalization, the static load effects of additional materials must be discussed. In researching material yields and weights, the following technical data was available based on 1″ of Polyurethane Foam and .030″ DFT's (Dry Film Thickness). Note that the information is based on the materials in a liquid state.

Foam Weight: .35 lbs. / sq. ft.
Coating Weight: .48 lbs. / sq. ft.

The design load capabilities, along with the safety factors incorporated in the original engineering calculations for the structure, will support a proposed interior SPF rehabilitation option.

The total square foot weight of the SPF material is .83 lbs. / sq. ft. or 1.66 lbs. / sq. ft. for interior and exterior systems.

We are also researching the claims by the Department of Defense Navel Research on their field testing results for the SPF materials. The test results indicate that with sandbag proof loading and impact amplification loading, the SPF System performed satisfactorily, and actually provided additional bridging strength for the roof structure.

DIVISION IV: RECOMMENDATIONS (Cont'd)

One final note concerns the warranties and quality of the restoration project. We strongly recommend that a Quality Assurance Program be implemented during rehabilitation to provide documentation of specification compliance and to provide documentation on material performance should a dispute arise. We also recommend that follow-up surveys be performed every 2-3 years to evaluate material performance and to address any deficiencies promptly.

In closing, other notes of consideration during rehabilitation are the presence and handling of hazardous materials and worker protection protocol as per OSHA and EPA requirements. Protecting structural steel in aggressive environments has been challenging. Conventional coatings have had marginal success. It is extremely vital to have uncontaminated substrates and environmental conditions well within the ranges specified by the manufacturer. The coatings never reach their designed life expectancy, unless applied at the steel manufacturer's facility with acceptable conditions. It has been our experience that utilizing an SPF (spray polyurethane foam) system will achieve long-term steel protection due to minimal surface preparation requirements and strong vapor barrier resistance. All of these issues should be addressed in the rehabilitation specifications.

D. DISCLAIMER AND CLOSURE

Evaluation of Data: We hereby certify the items listed have been tested in conformance with specifications noted. This report represents World International Testing, Inc.'s interpretation of the results obtained from the testing procedures and is not to be construed as a guarantee of warranty of the condition of the materials tested. World International Testing, Inc. shall not be held liable for misinterpretation of the condition, loss, damages, injury, or death arising from or attributable to delay proceeding a testing procedure, or subsequent to performance of a testing procedure. Equipment is maintained in calibration by an independent agency using blocks traceable to the U.S. Bureau of Standards, Washington, D.C.

"END DIVISION IV: RECOMMENDATIONS"

DIVISION V:

PROJECT PHOTOGRAPHS

ELEVATION VIEW, CITY OF LOCKPORT, NEW YORK, COMPOST FACILITY.

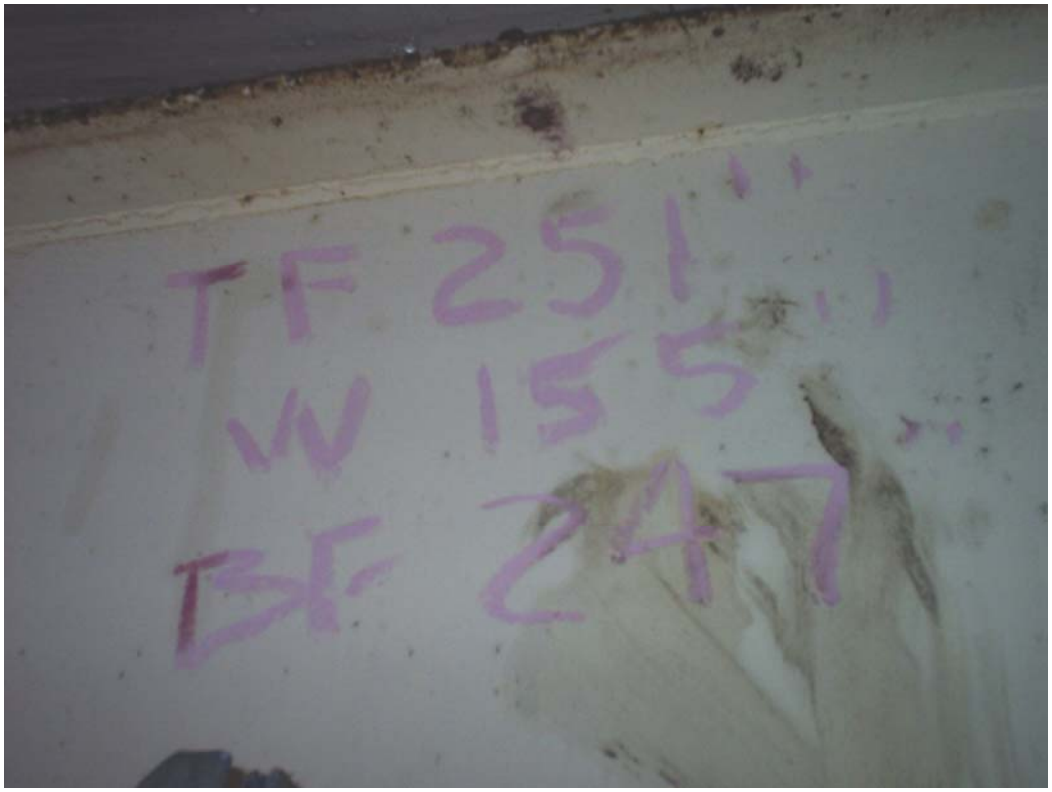
VIEW OF NORTHEND OF FACILITY, COVERED STORAGE AREA.

GENERAL CONDITION PHOTO OF MIXING FLOOR AREA.

PHOTO OF ROOF GIRDER EVALUATION ACTIVITY.

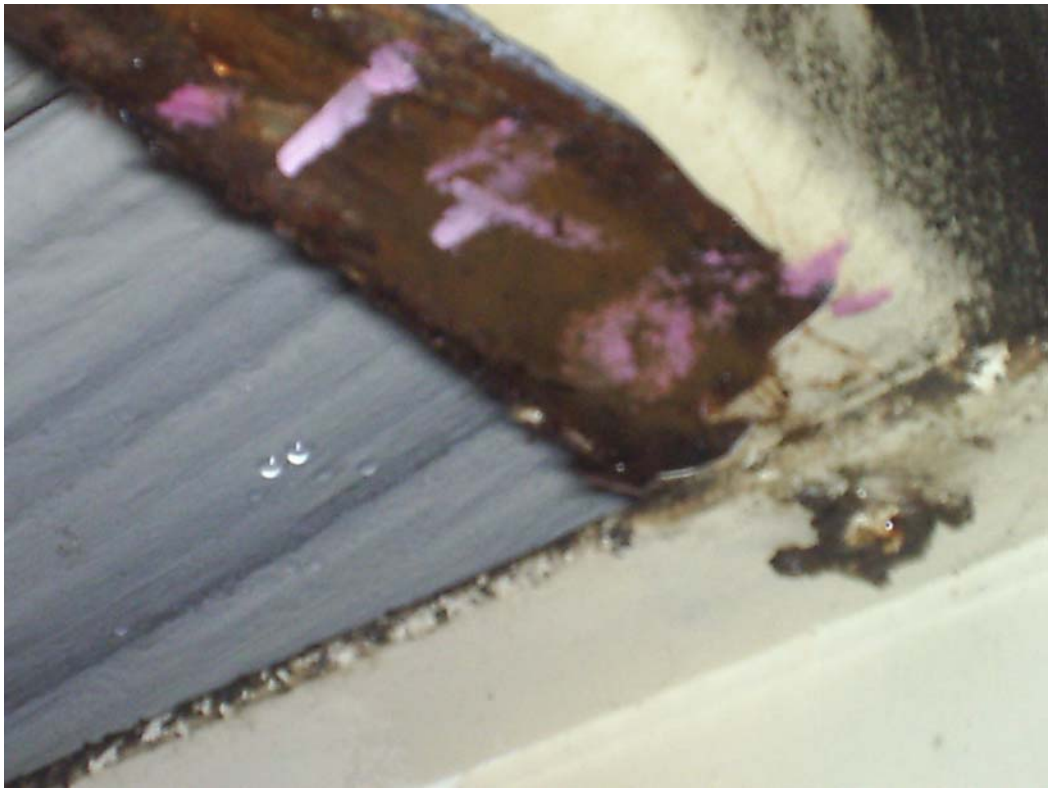
CORROSION AND SECTION LOSS PROGRESSING AT COLUMN GIRDER CONNECTION.

PHOTOGRAPH OF ULTRASONIC TESTING OF ROOF GIRDERS, MIXING FLOOR.



ULTRASONIC TEST RESULTS FAVORABLE WITH NO CATASTROPHIC CONCERNS.

ADDITIONAL VIEW OF ULTRASONIC TESTING ACTIVITY (FESTOON SUPPORT W 10″ X 5 3/4″).



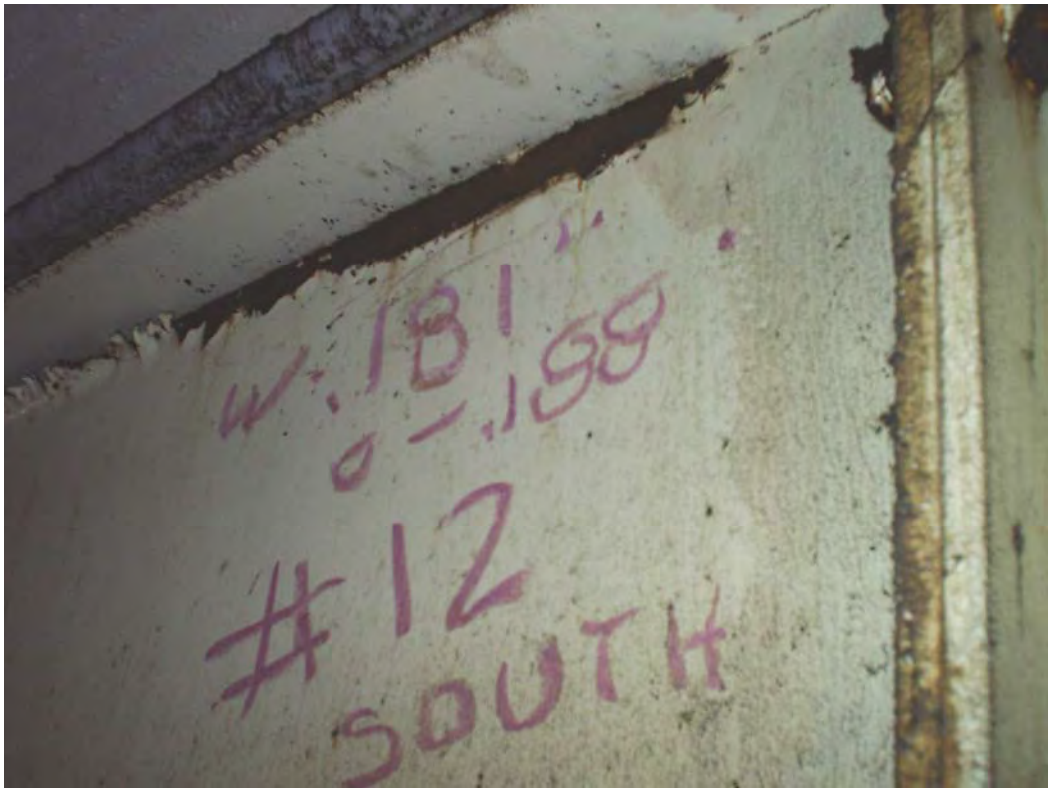
PHOTOGRAPH OF ULTRASONIC TESTING ROOF PURLINS.

PHOTOGRAPH OF ULTRASONIC TESTING 2″ X 2″ FRAMING ANGLES.

VIEW OF ROOF PURLIN CONDITIONS, INTERIOR OF BOTTOM FLANGE.

BOTTOM SIDE OF ROOF DECK, CONDITIONS FAVORABLE
UNDER INSULATION (HEAVY CONDENSATION TYPICAL).

GENERAL CONDITION PHOTO, GIRDER #12.

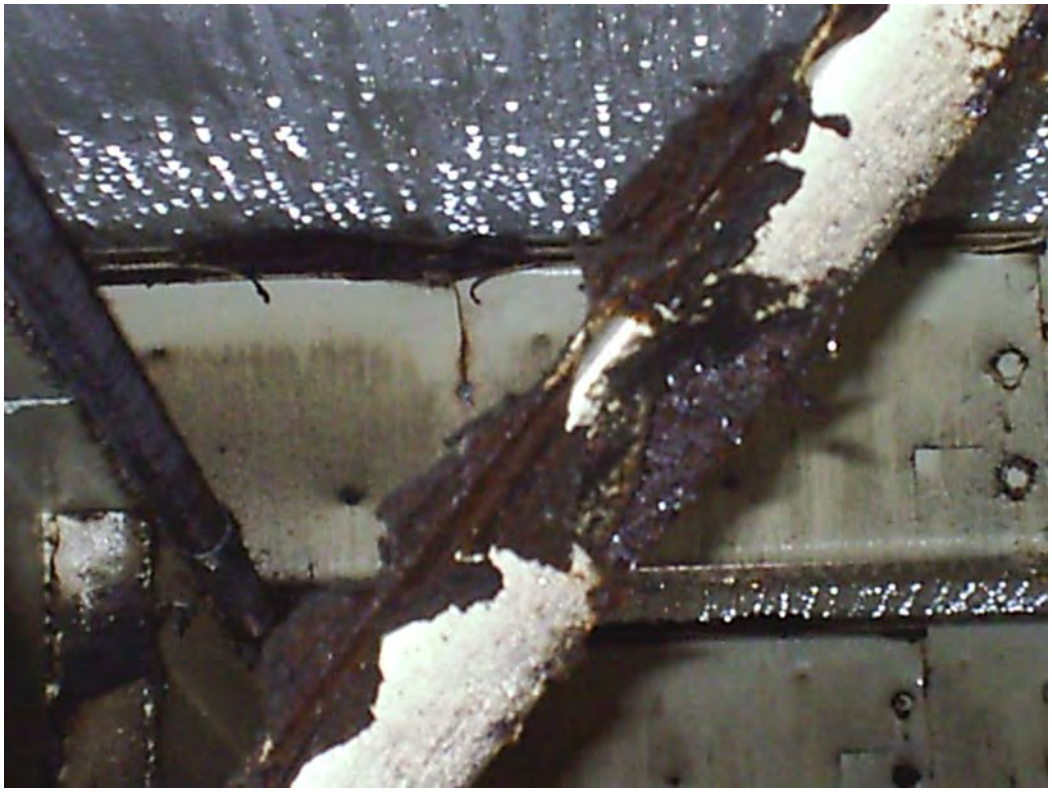


ULTRASONIC TEST RESULTS WERE FAVORABLE FOR GIRDER #12. NO SIGNIFICANT SECTION LOSS.

NOTE THE GIRDER DESIGN CONSISTS OF SKIP WELDS AND NON-CONTINUOUS FILLETS (TYPICALLY ONE SIDE OF WEB TO FLANGE CONNECTION NOT WELDED).

GENERAL CONDITION VIEW, COMPOST AREA.

TYPICAL GIRDER COLUMN CONNECTION, COMPOST AREA.



2″ X 2″ DIAGONAL FRAMING ANGLES ARE EXPERIENCING MORE ADVANCED SECTION LOSS IN COMPOSTING AREA.

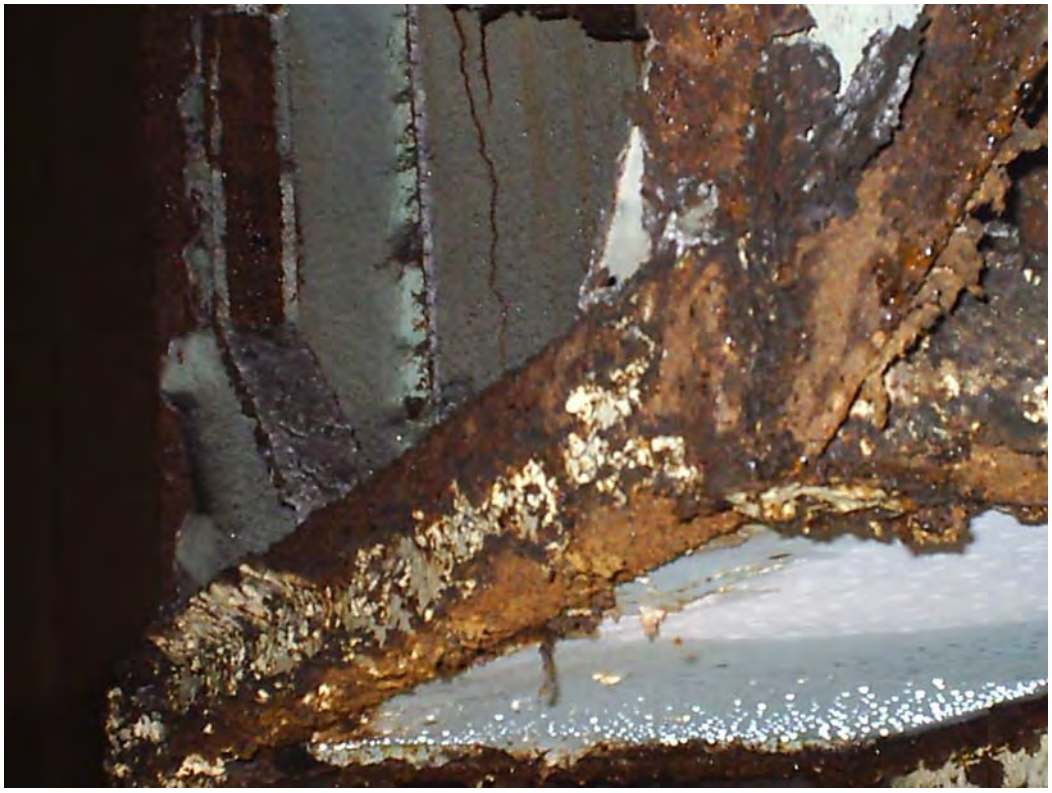
1″ X 1″ HORIZONTAL FRAMING ANGLES ARE ALSO EXPERIENICING MORE ADVANCED DETERIORATION WITH SEVERAL NEAR 100% SECTION LOSS.

ADDITIONAL VIEW OF 1″ X 1″ FRAMING DETAIL WITH TAB DETERIORATION NEAR 100%.

PHOTOGRAPH OF ROOF X-BRACING WITH NOTABLE LOSS OF SECTION.

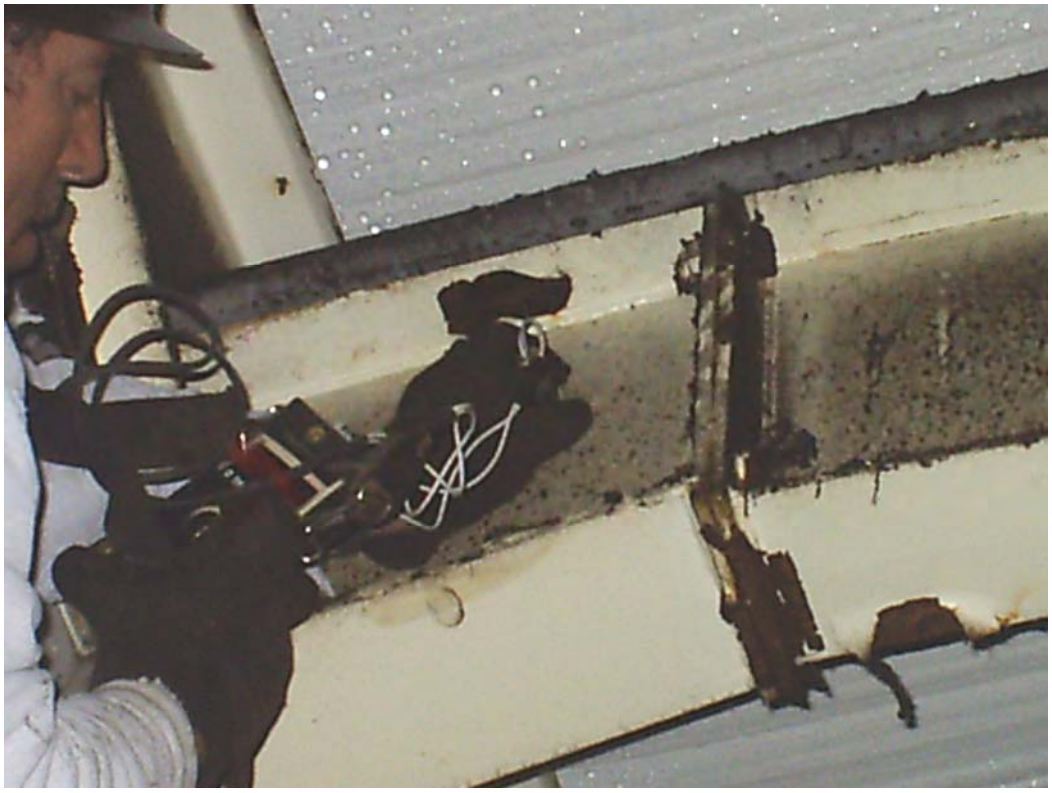
ZOOM VIEW OF X-BRACE (SWAY) WITH 32% SECTION LOSS.
PROTECTIVE COATINGS RECOMMENDED IN THE REASONABLE NEAR FURTURE.

OLD FANS AT MIXING TO COMPOST TRANSITION ARE
EXPERIENCING SIGNFICANT SECTION LOSS ON SUPPORT DETAILS.



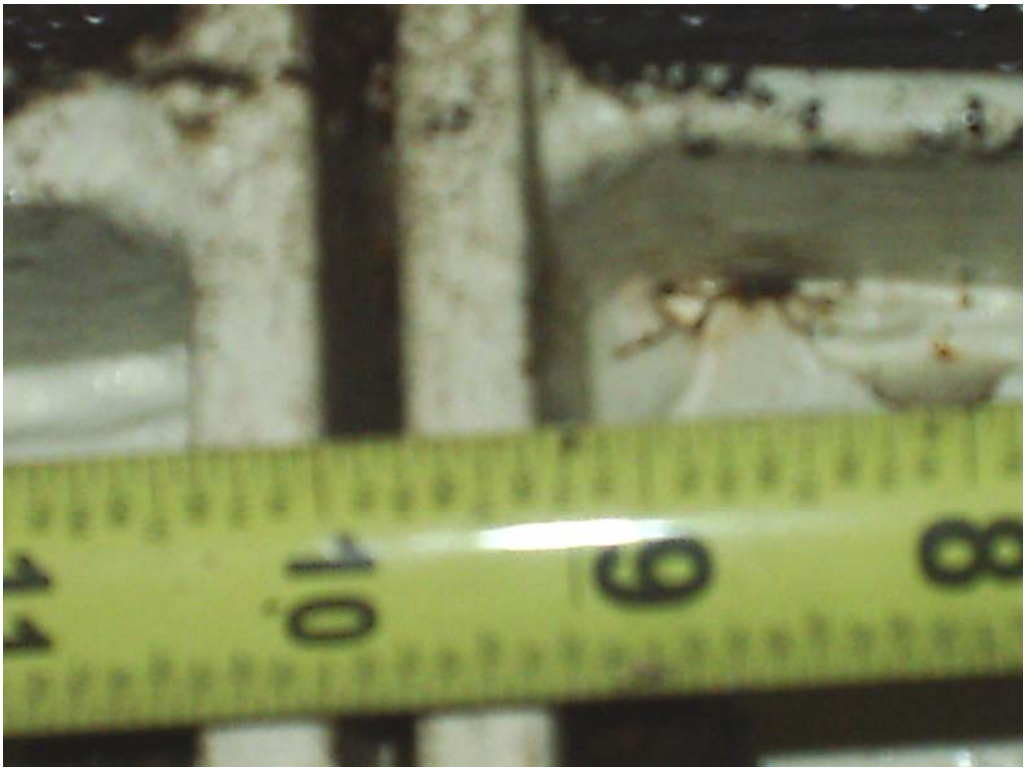
ADDITIONAL VIEW OF DETERIORATION ON FAN COMPONENTS.
ALL (4) FANS SHOULD BE REMOVED IF NOT IN SERVICE.

PHOTOGRAPH OF ULTRASONIC TESTING ACTIVITY,
ROOF GIRDERS AND PURLINS, COMPOST AREA.



ADDITIONAL VIEW OF ULTRASONIC TESTING ACTIVITY.

PHOTOGRAPH OF CENTER GIRDER CONNECTION FOR C-11.
FLANGE SEPARATION IS A CONCERN WITH 5/16″ VISIBLE OPENING.



THE CAUSE OF DEFORMATION IS NOT CERTAIN. WE ARE RECOMMENDING CONNECTION BE SECURED WITH (4) NEW 2 1/2″ X ϕ 3/4″ BOLTS.

THE HANGER DETAILS ARE EXPERINCING ADVANCING SECTION LOSS AND DETERIORATION.

AFTER FURTHER EVALUATION OF THE DUCTWORK SUPPORT RODS, NEAR CATASTROPHIC CONDITIONS WERE DISCOVERED. TWO WERE FOUND TO BE SHEARED, AND SEVERAL HAVE NEAR 100% SECTION LOSS. ALL (68) SHOULD BE REPLACED WITH STAINLESS EQUAL (2 X 34). WE RECOMMEND TEMPORARY SUPPORT UNTIL RESTORATION IMPLEMENTED.

PHOTOGRAPH OF MIXING AREA STRUCTURAL CONDITION SURVEY.

VIEW OF GIRDER CONNECTION WITH R5-R15 SECTION LOSS.

ROOF FANS IN MIXING AREA DEVELOPING ADVANCING
COATING DETERIORATION AND EDGE CORROSION.

TWO FRACTURES WERE DISCOVERED IN WEB AT X-BRACING IN MIXING AREA (A-15).
FRACTURES WERE 1/4″ AND 3/4″ LONG.

LEFT:
OUTSIDE COVERED STORAGE AREA
(G-17) COLUMN EXPERIENCING
IMPACT DAMAGE FROM LOADER.

RIGHT:
CORNER POST AT G-19 EXPERINCING
SIGNIFICANT DEFORMATION
FROM LOADER IMPACT.

EXTERIOR ROOF WAS ALSO EVALUATED FOR CONDITION AND PREDICTIVE MAINTENANCE.

THE LAPPED EDGES OF THE ROOF DECK ARE EXPERIENCING ADVANCING DETERIORATION OF THE COATINGS AND EARLY SECTION LOSS.

DURING OUR SURVEY, NUMEROUS PUNCTURES AND HOLES WERE NOTED (VIEW OF N-7-06) AT PANEL 42-EAST.

ADDITIONAL VIEW OF ADVANCING COATING DETERIORATION, ALL AREAS.

PHOTOGRAPH OF N-9-06, OLD SCREW HOLE FROM DRILL MISS NEVER REPAIRED.

ADDITIONAL VIEW OF OLD SCREW HOLES DISCOVERED WITH NO INDICATION OF REPAIRS. HOLES ARE ALLOWING MOISTURE AND RAIN TO ENTER BUILDING AND SATURATE INSULATION.

APPENDIX H

KRUGER BIOCON DRYER PROPOSAL

Proposal
Lockport, NY

BioCon® Thermal Dryer

Proj. No. 5700132711

Submitted to: City of Lockport, NY

Submitted by: Brandon Ray
Application Engineer

Date: 10/17/2017

Veolia Water Technologies, Inc. (dba Kruger)
4001 Weston Parkway
Cary, NC 27513
tel. +1 919-677-8310 • fax +1 919-677-0082

Water Technologies

Introduction

Kruger is pleased to present this *preliminary* BioCon Dryer proposal to City of Lockport, NY.

Kruger's scope of supply for the BioCon dryer includes live bottom cake bin, sludge feed pumps, dosing pumps, a thermal dryer cabinet (inclusive of depositors, SS drying belts, sprinkler system, and extraction conveyor), circulation fans, heat exchanger, drying air treatment, PLC control system, required field instruments and SCADA. For the dryer, a natural gas fired thermal fluid heater is provided for the energy supply to the drying process.

The overall footprint of the core equipment is 55'L x 33'W x 21'H. This includes the dryer cabinet, platforms, condenser, external fans and appropriate clearances for maintenance and access. Not included in this footprint is the thermal fluid heater skid (7'L x 11'W x 13'H).

We Know Water

Kruger is a water and wastewater solutions provider specializing in advanced and differentiating technologies. Kruger provides complete processes and systems ranging from biological nutrient removal to mobile surface water treatment. The ACTIFLO® Microsand Ballasted Clarifier, BioCon® Dryer, BIOSTYR® Biological Aerated Filter (BAF) and NEOSEP™ MBR are just a few of the innovative technologies offered by Kruger. Kruger is a subsidiary of Veolia Water, a world leader in engineering and technological solutions in water treatment for industrial companies and municipal authorities.

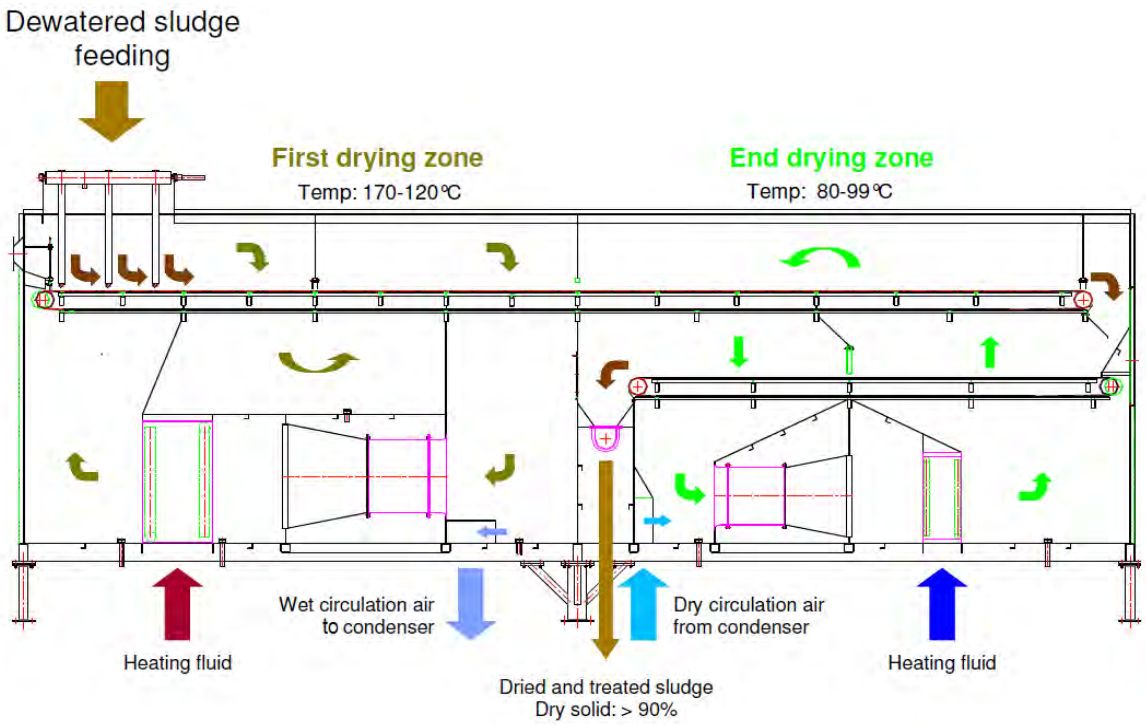
Veolia Water Solutions & Technologies, the fully-owned subsidiary of **Veolia Water**, is the world leader in water and wastewater treatment with over 155 years of experience. As an experienced design-build company and a specialized provider of technological solutions in water treatment, Veolia combines proven expertise with unsurpassed innovation to offer technological excellence to our industrial customers. Based on this expertise, we believe that we have developed the best solution for your application. Below is a brief description of the proposed project.

Process Description

The BioCon® dryer system was developed to be the safest, simplest and most efficient drying system on the market today. Special consideration was taken during the development of the BioCon dryer system to ensure flexibility, while minimizing noise, odor, and dust production.

BioCon systems are designed to be efficient and environmentally friendly using the following design aspects:

- Sludge drying occurs at relatively low temperatures.
- The principle of indirect heating of the drying air is applied.
- The drying air, which is in direct contact with the sludge, is recycled in a closed circuit.
- The dryer operates at negative pressure in the cabinet, preventing process air from escaping into the surroundings.
- Processed biosolids are dried to a minimum DS content of 90% and meets Class A requirements.
- The end product characteristics are adaptable to meet the disposal requirements and market demands of the municipality.



BioCon Schematic Overview

Design Summary

Design Assumptions

- Inlet sludge is 100% municipal. Imported and/or industrial sludge are not included.
- Dryer operation is 5 days per week, 24 hrs per day.
- 60-80% volatile solids

Design Data

	Per System	Units
Annual Dry Solids	667	ton DS / yr
Sludge Cake Loading	929	lb cake / hr
Inlet Solids Composition	23	%
Outlet Solids Composition	90	%
Annual Operating Hours	6,240	hr / yr
Gross Dried Product Flow	741	ton product / yr
Evaporative Load	692	lb evap / hr
Consumption: Fuel	1,500	BTU / lb evap
Installed Electric Load	70	kW
Consumption: Electric	40	kW
Consumption: Effluent (77°F)	26	gpm
Consumption: Effluent (59°F)	20	gpm

Scope of Supply

Kruger is pleased to present our scope of supply which includes process engineering design, equipment procurement, and field services required for the proposed treatment system, as related to the equipment specified. The work will be performed to Kruger's high standards under the direction of a Project Manager. All matters related to the design, installation, or performance of the system shall be communicated through the Kruger representative giving the Engineer and Owner ready access to Kruger's extensive capabilities.

Process and Design Engineering

Kruger provides comprehensive process engineering and design support for our BioCon system, including but not limited to:

- Detail process design assistance
- Provision of drawings and specifications for use by the consulting engineer in developing the detailed plant design.
- Provision of calculations and other data and attendance at meetings as necessary during state approval processes.
- Shop drawing submittal for Engineer's review and approval. Includes detailed equipment information for all equipment supplied by Kruger.
- Equipment installation instructions for all equipment supplied by Kruger, as well as detailed Operations and Maintenance Manuals.
- The process would be "Vision" and "Vision Air" ready, which means at any time the County can choose to avail Veolia's Vision Service of online (or cloud based) monitoring, remote operation, process management and advance analytics.

BioCon Equipment and Instrumentation

Kruger shall supply the following equipment associated with the BioCon system:

Description	Per System
Main Sludge Feed Pumps	
Pump	1
Main Pump Manual Cleaning Valves	included
Dosing Pumps and Manifold	
Pump	2
Dosing Pump Manifold	1
Dosing Pump Manifold Manual Cleaning Valves	included
Stainless Steel Sludge Dryer	
Dryer Model (insulation and cladding included)	SD2311-I
Dryer Qty	1
Sludge Depositor Station	2
Dosing Platform (on top of the dryer cabinet)	1
Depositor Motion Motor & Gearbox	1
304 SS Drying Belts (Belt Drives included)	2
Sprinkler System	1
Extraction Screw Conveyor	1
Drying Air Circulation Fan	0
Rotary Valve	1

Description	Per System
Warm Zone Drying Air Circulation Fan	2
End Zone Drying Air Circulation Fan	2
Warm Zone Air/Thermal Oil Heat Exchanger	1
End Zone Air/Thermal Oil Heat Exchanger	1
Nozzle Cleaning Station	1
Drying Air Treatment	
Packed Bed Condenser	1
Centrifugal Fans	2
Actuated Modulating Flow Control Valve	1
Spring-Loaded Pressure Reducing Valve	1
Energy Supply System (Thermal Oil System)	
Natural Gas Supply Train	1
Thermal Oil Heater	1
Thermal Oil Pump Main Loop (Duty + Redundant)	2
Thermal Oil Pump Secondary Loop (Duty)	1
Catch Tank	1
Storage Tank	1
Compressor (for valve actuation)	1

Scope of Supply BY INSTALLER/PURCHASER

The following items are NOT included in the scope of supply for the BioCon system and should be provided for by the Installing Contractor/Purchaser of the system *unless explicitly stated as included in the above scope of supply*. These items include, but are not necessarily limited to, the following items:

- Concrete foundations, pads, tanks, structural components, walkways, stairs, platforms, stack, handrail, grating and covers,
- Equipment installation, piping to and from the BioCon system, interconnecting piping, manual isolation valves, anchor bolts, epoxy/adhesive for anchors,
- Influent sludge pumping, influent screening and grit removal facilities,
- Calibration or auxiliary gas cylinders,
- Solids handling/disposal system and digester equipment,
- Chemical addition systems, chemicals or reagents, containment, odor control equipment, laboratory systems or equipment,
- Motor control center, motor starters, adjustable frequency drives, main disconnects, breakers, generators, or power supply,
- Field wiring, interconnecting wiring, conduit, wiring terminations at equipment, local equipment disconnects, local equipment control panels, junction boxes, and wiring terminations at control panels,
- All electrical and mechanical hardware with the exception of the equipment that is identified above,
- All work associated with buildings or other structures used for housing any part of the system provided, including HVAC and electrical work.

Field Services

Kruger provides very comprehensive support of our systems throughout the installation and start-up period. Our experienced staff of field service personnel will inspect the installation of each component and assist in mechanical start-up, and will typically include direct manufacturer assistance for key pieces of equipment. Our dedicated team of instrumentation and controls engineers will provide calibration and start-up of all instrumentation and onsite verification of proper functioning of our PLC programming and operator interface systems. Process Engineers will assist in verification of program functions, start-up of the process, any process performance testing and optimization of the process. Kruger personnel will also provide onsite instruction of the operations staff in the proper operation of the Kruger supplied equipment and systems.

Pricing and Schedule

The price for the BioCon system, as defined herein, including process and design engineering, field services, and equipment supply is **$2,525,000.**

Pricing is FOB shipping point, with freight allowed to the job site. This pricing does not include any sales or use taxes. In addition, pricing is valid for ninety (90) days from the date of issue.

Please note that the above pricing is expressly contingent upon the items in this proposal and are subject to Kruger Standard Terms of Sale detailed herein

Equipment shall be delivered within 20-24 weeks after receipt of written approval of the shop drawings.

Kruger Standard Terms of Payment

The terms of payment are as follows:

- 10% on receipt of fully executed contract
- 15% on submittal of shop drawings
- 75% on the delivery of equipment to the site

Payment shall not be contingent upon receipt of funds by the Contractor from the Owner. There shall be no retention in payments due to Kruger. All other terms per our Standard Terms of Sale are attached.

All payment terms are net 30 days from the date of invoice. Final payment is not to exceed 120 days from delivery of equipment.

Kruger Standard Terms of Sale

1. Applicable Terms. These terms govern the purchase and sale of the equipment and related services, if any (collectively, "Equipment"), referred to in Seller's purchase order, quotation, proposal or acknowledgment, as the case may be ("Seller's Documentation"). Whether these terms are included in an offer or an acceptance by Seller, such offer or acceptance is conditioned on Buyer's assent to these terms. Seller rejects all additional or different terms in any of Buyer's forms or documents.

2. Payment. Buyer shall pay Seller the full purchase price as set forth in Seller's Documentation. Unless Seller's Documentation provides otherwise, freight, storage, insurance and all taxes, duties or other governmental charges relating to the Equipment shall be paid by Buyer. If Seller is required to pay any such charges, Buyer shall immediately reimburse Seller. All payments are due within 30 days after receipt of invoice. Buyer shall be charged the lower of 1 ½% interest per month or the maximum legal rate on all amounts not received by the due date and shall pay all of Seller's reasonable costs (including attorneys' fees) of collecting amounts due but unpaid. All orders are subject to credit approval.

3. Delivery. Delivery of the Equipment shall be in material compliance with the schedule in Seller's Documentation. Unless Seller's Documentation provides otherwise, Delivery terms are F.O.B. Seller's facility.

4. Ownership of Materials. All devices, designs (including drawings, plans and specifications), estimates, prices, notes, electronic data and other documents or information prepared or disclosed by Seller, and all related intellectual property rights, shall remain Seller's property. Seller grants Buyer a non-exclusive, non-transferable license to use any such material solely for Buyer's use of the Equipment. Buyer shall not disclose any such material to third parties without Seller's prior written consent.

5. Changes. Seller shall not implement any changes in the scope of work described in Seller's Documentation unless Buyer and Seller agree in writing to the details of the change and any resulting price, schedule or other contractual modifications. This includes any changes necessitated by a change in applicable law occurring after the effective date of any contract including these terms.

6. Warranty. Subject to the following sentence, Seller warrants to Buyer that the Equipment shall materially conform to the description in Seller's Documentation and shall be free from defects in material and workmanship. The foregoing warranty shall not apply to any Equipment that is specified or otherwise demanded by Buyer and is not manufactured or selected by Seller, as to which (i) Seller hereby assigns to Buyer, to the extent assignable, any warranties made to Seller and (ii) Seller shall have no other liability to Buyer under warranty, tort or any other legal theory. If Buyer gives Seller prompt written notice of breach of this warranty within 18 months from delivery or 1 year from beneficial use, whichever occurs first (the "Warranty Period"), Seller shall, at its sole option and as Buyer's sole remedy, repair or replace the subject parts or refund the purchase price therefore. If Seller determines that any claimed breach is not, in fact, covered by this warranty, Buyer shall pay Seller its then customary charges for any repair or replacement made by Seller. Seller's warranty is conditioned on Buyer's (a) operating and maintaining the Equipment in accordance with Seller's instructions, (b) not making any unauthorized repairs or alterations, and (c) not being in default of any payment obligation to Seller. Seller's warranty does not cover damage caused by chemical action or abrasive material, misuse or improper installation (unless installed by Seller). THE WARRANTIES SET FORTH IN THIS SECTION ARE SELLER'S SOLE AND EXCLUSIVE WARRANTIES AND ARE SUBJECT TO SECTION 10 BELOW. SELLER MAKES NO OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE.

7. Indemnity. Seller shall indemnify, defend and hold Buyer harmless from any claim, cause of action or liability incurred by Buyer as a result of third party claims for personal injury, death or damage to tangible property, to the extent caused by Seller's negligence. Seller shall have the sole authority to direct the defense of and settle any indemnified claim. Seller's indemnification is conditioned on Buyer (a) promptly, within the Warranty Period, notifying Seller of any claim, and (b) providing reasonable cooperation in the defense of any claim.

8. Force Majeure. Neither Seller nor Buyer shall have any liability for any breach (except for breach of payment obligations) caused by extreme weather or other act of God, strike or other labor shortage or disturbance, fire, accident, war or civil disturbance, delay of carriers, failure of normal sources of supply, act of government or any other cause beyond such party's reasonable control.

9. Cancellation. If Buyer cancels or suspends its order for any reason other than Seller's breach, Buyer shall promptly pay Seller for work performed prior to cancellation or suspension and any other direct costs incurred by Seller as a result of such cancellation or suspension.

10. LIMITATION OF LIABILITY. NOTWITHSTANDING ANYTHING ELSE TO THE CONTRARY, SELLER SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, SPECIAL, PUNITIVE OR OTHER INDIRECT DAMAGES, AND SELLER'S TOTAL LIABILITY ARISING AT ANY TIME FROM THE SALE OR USE OF THE EQUIPMENT SHALL NOT EXCEED THE PURCHASE PRICE PAID FOR THE EQUIPMENT. THESE LIMITATIONS APPLY WHETHER THE LIABILITY IS BASED ON CONTRACT, TORT, STRICT LIABILITY OR ANY OTHER THEORY.

11. Miscellaneous. If these terms are issued in connection with a government contract, they shall be deemed to include those federal acquisition regulations that are required by law to be included. These terms, together with any quotation, purchase order or acknowledgement issued or signed by the Seller, comprise the complete and exclusive statement of the agreement between the parties (the "Agreement") and supersede any terms contained in Buyer's documents, unless separately signed by Seller. No part of the Agreement may be changed or cancelled except by a written document signed by Seller and Buyer. No course of dealing or performance, usage of trade or failure to enforce any term shall be used to modify the Agreement. If any of these terms is unenforceable, such term shall be limited only to the extent necessary to make it enforceable, and all other terms shall remain in full force and effect. Buyer may not assign or permit any other transfer of the Agreement without Seller's prior written consent. The Agreement shall be governed by the laws of the State of North Carolina without regard to its conflict of laws provisions.

VEOLIA

BioCon Annual Operation Cost

Lockport, NY

UTILITY COSTS

Natural Gas Cost	**$1.823**	per MMBTU
Electrical Cost	**$0.0986**	per kW-hr

OPERATING DATA

Operating Hours per Day	24	hrs/day
Operating Days	260	days
Annual Operating Hours	6,240	hrs
Supplemental Energy Requirement	**1.04**	MMTBU/hr
	25.0	MMBTU/day
Electrical Requirement, Consumed	**40**	kW/hr
	960	kW-hr/day

ANNUAL COSTS

Fuel

Annual Energy Requirement at Steady State	6,490	MMBTU
Start-up Fuel (per start-up)	0.260	MMBTU/start-up
Number of Start-ups per Year	52	
Total Annual Energy Requirement	6,503	MMBTU
Total Annual Fuel Cost	**11,855**	**$/yr**

Electrical

Annual Electricity Requirement	253,500	kW-hr/yr
Annual Electrical Cost	**24,995**	**$/yr**

Recommended Spare Parts List		
Equipment Item	**Quantity**	**Total Part Cost (includes all quantities)**
Main Pumps		
Stator	1	$ 1,236.95
Mechanical Seal	1	$ 2,940.60
Dosing Pumps		
Stator	2	$ 1,331.20
Mechanical Seal	1	$ 2,036.45
Fans		
DAT Fan Belt	2	$ 390.00
VAC Fan Belt	2	$ 169.00
Dryer		
Depositor Nozzles	100	$ 1,133.60
Gearbox and Motors		
Grease for bearings, shaft seals	keep grease on hand, each gearbox will need approx. 0.5 oz (3-5 pumps)	n/a
Synthetic oil for gear motors	keep oil on hand, each gearbox will need approx. 9 quarts of oil	n/a
Compressor		
Annual Maintenance Kit		$ 2,673.00
		$ 11,911

Veolia Water Technlogies, Inc.
dba Kruger
4001 Weston Parkway
Cary, NC 27513
www.veoliawatertech.com .

VEOLIA

Base: Preventative Maintenance Task & Schedule													
Action	**Equipment Name/Group**	**Quantity**	**Task Type**	**Daily**	**Weekly**	**Monthly**	**Quarterly**	**Semi-Annually**	**Annually**	**Duration per Item (min)**	**Total Duration (min)**	**Material Costs**	**Comments**
Visually Inspect Product Falling off of top and bottom belts	product sampling	2	Operations	X						2	4	n/a	Visual inspection every 2 hours
Running Sample through microwave analyzer	product sampling	2	Operations	X						10	20	n/a	Run sample through analyzer 1-2 times daily
• Insure all trough covers, guards and drive guards are installed whenever the conveyors are operating. • Check drive for unusual noises or vibrations. • Check screw conveyor for unusual noises or vibrations. • Check for material spills at inlets and outlet and clean. Find cause and correct.	screw conveyor	1	Operations	X						2	2	n/a	
Inspect for clogs and tears	Depositor Nozzles	6	Operations	X							5	n/a	At beginning of every run
Visually inspect belt scrapers and brush to ensure they are not damaged and are sufficiently cleaning the belt.	Dryer Belt	2	Operations	X						2	4	n/a	Before each start-up and periodically during operation.
Mechanical Seal	Condenser	1	Operations		X					1	1	n/a	If greater than 6"WC, clean packing & mist eliminator
replacing nozzles	Depositor Nozzles	6	Operations				X			2		see spare part list	Recommended to replace as a set quarterly or as needed.
Visually inspect the belt tightness and alignment	Dryer Belt	2	Maintenance	X						5	10	n/a	
Visually inspect oil color and level	Depositor Gearbox	1	Maintenance			X				1	1	n/a	
Visually inspect oil color and level	Dryer Belt Gearbox	2	Maintenance			X				1	2	n/a	
Visually inspect oil color and level	Pump Gearbox	4	Maintenance			X				1	4	n/a	
Grease Belt drive & motor bearings	Fan	4	Maintenance				X			5	20	see spare part list	
Visually inspect belt wear and measure tension	Fan	4	Maintenance				X			5	20	n/a	
Vacuum and clean out fines	Dryer Compartment & Heat Exchanger	1	Maintenance			X				1	1	n/a	Every 8-12 weeks or as needed. Fines cleaning frequency will vary depending on sludge origin and constituents.
• Check shaft seals visually and maintain as necessary. • Check shaft couplings for tightness. • Check for elongation of cross holes in screw or drive shaft. • Check coupling bolts. • Open covers and inspect trough for wear. • Inspect screw flights for wear and wear pattern. • Lubricate all external conveyor bearings at tail or drive end.	screw conveyor	1	Maintenance				X			30	30	see spare part list	
Change Oil	Depositor Gearbox	1	Maintenance					X		10	10	see spare part list	Change oil after initial 1,500 hrs of operation and at 5,000 hr intervals after that.
Change Oil	Dryer Belt Gearbox	2	Maintenance					X		10	20	see spare part list	Change oil after initial 1,500 hrs of operation and at 5,000 hr intervals after that.
Change Oil	Pump Gearbox	4	Maintenance					X		10	40	see spare part list	Oil should be changed after 10,000 hrs of operation or two years.
Initial oil change for drive at 10,000 hours and every two years afterwards.	screw conveyor	1	Maintenance					X		15	15	see spare part list	
Measure wearing strips	Dryer Belt	2	Maintenance						X	10	20	n/a	
Clean packing	Condenser	1	Maintenance						X	480	480	cost for muriatic acid	Cleaning frequency can vary depending on the water characteristics. Typical schedule is every 1 year.
Clean mist eliminator	Condenser	1	Maintenance						X			cost for muriatic acid	Cleaning frequency can vary depending on the water characteristics. Typical schedule is every 1 year.
Tighten belt	Dryer Belt	2	Maintenance							20	40	n/a	Typically every 2 years.

2.9 hrs	TOTAL OPERATIONS HOURS PER WEEK
17.6 hrs	TOTAL OPERATIONS HOURS PER MONTH
0.8 hrs	TOTAL MAINTENANCE HOURS PER WEEK
1.0 hrs	TOTAL MAINTENANCE HOURS PER MONTH

Veolia Water Technlogies, Inc.
dba Kruger
4001 Weston Parkway
Cary, NC 27513
www.veoliawatertech.com .

APPENDIX I

GRYPHON BIOSOLIDS DRYER PROPOSAL

GRYPHON®
environmental, LLC
Advanced Drying Technology

Made In the U.S.A.

Proposal # LPN-0520-101817-V1

City of Lockport, NY
WWTP—Biosolids Dryer

c/o: Nussbaumer & Clarke, Inc.
Michael Marino, CEO
Brooke Hamberger, Engineer
Nicholas Dobmeier Project Engineer

Capital Equipment, Design, Installation, Training & Commissioning of a Gryphon Model 0520 Drying Unit with a Natural Gas Burner

Model 0520 Dryer

Proposal Offered By:
Gryphon Environmental, LLC
2920 Fairview Drive
Owensboro, KY 42303
Contact: Tid Griffin, CEO (270) 485-2680

Manufacturer Representatives: Koester and Associates
Mark Koester
Tom Posella

AUTO-ADJUSTING, EXPANDABLE 0520 MODEL DRYER WITH WASH-OUT, CERAMIC/TEFLON INJECTION PLATES, NATURAL GAS BURNER, CONTROLS, BLOWER, PRE / POST-PROCESS SENSORS, AUTOMATED WASH SYSTEMS, LID LIFTING ASSEMBLY, CONTROLS AND RE-CIRCULATING AIR STREAM. INSTALLED AND COMMISSIONED.

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ATTACHMENTS

1.0 PROJECT SUMMARY

1.1 Gryphon Background and Technology

Gryphon Environmental, LLC delivers patented advanced drying technology that produces dry yields from biosolids and suspensions in a cost-effective manner. Gryphon technology uses combinations of negative and positive pressure to reduce the energy demands of drying and designs systems as "segments", enabling future expandability while reducing the production costs. The thoughtful design of the re-circulating air stream and highly automated software system results in the most advanced drying system available. The replicating segments result in the most cost-effective solution on the market. Advancements are wrapped in a maintenance-friendly mechanical design that has few moving parts and predictable results. Control of the desired dry yield is automated with auto-adjusting 1) air volume, 2) air temperature, and 3) belt speed. Our systems are built with energy efficiency, performance, reduced capital costs and sustainability as the driving design criteria.

Gryphon was founded by Tid Griffin in 2007. Gryphon has two ISO 9001 certified manufacturers that provide us American-made stainless steel that is laser cut, formed and welded to Gryphon's specific design and tolerances. Fabricated components are then shipped to Gryphon's Owensboro, Kentucky facility for assembly, quality control and F.A.T. (client Factory Acceptance Test). Processing biosolids, biomass, proteins and paper residuals, Gryphon technologies have been installed in the United States and internationally, from Canada to South Africa.

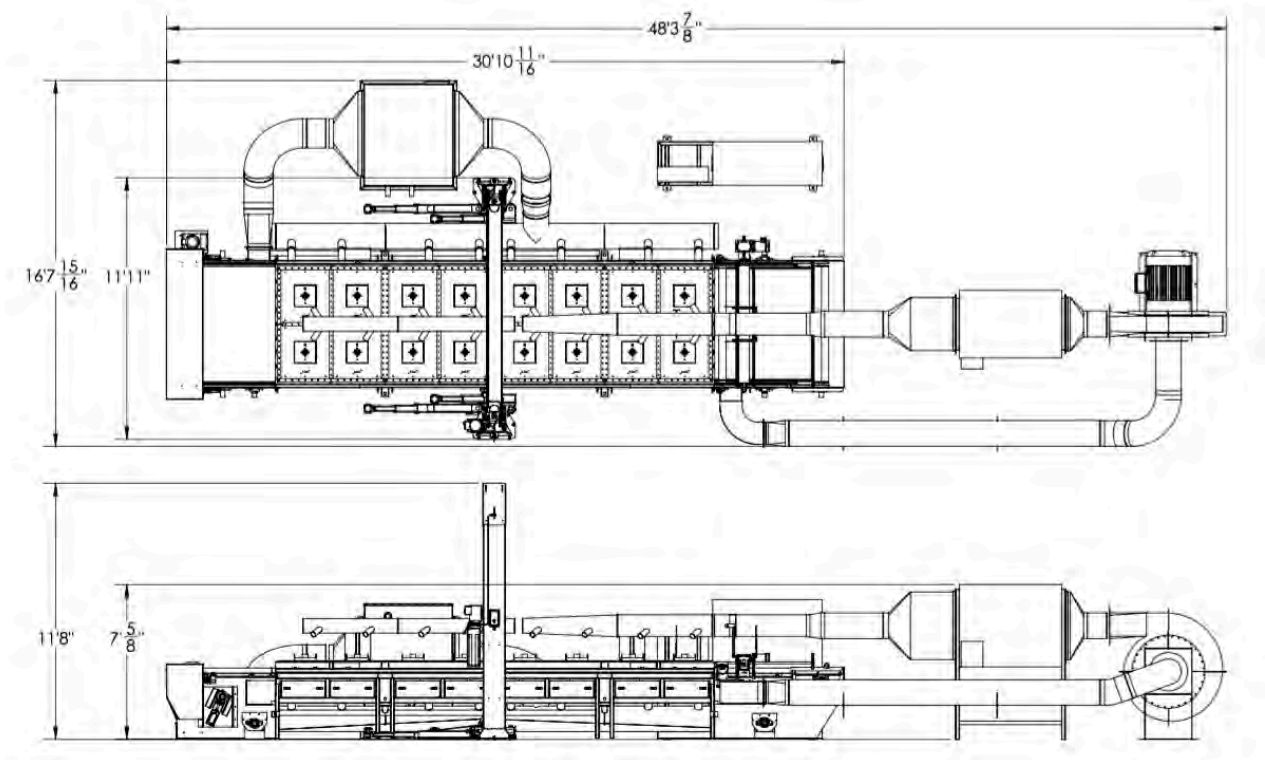
TECHNOLOGY ADVANTAGES

- Modular Design – Enables additions to the length of the dryer for additional capacity. Reduces capital cost. Decreases lead times for delivery and installation.
- Efficiency – Anticipated Thermal Energy Demand of 2.1 MMBTU Per Ton of Water Removed.
- Re-circulated air stream reduces/eliminates exhaust released to atmosphere and associated permitting. Eliminates the needs for bag-houses, scrubbers or exhaust stacks.
- Flexible throughput enabled by advanced temperature & air volume controls. – ON THE FLY AUTOMATION.
- Flexible sourcing of thermal energy; including electrical, natural gas, fuel oil, waste heat or steam.
- Advanced software enables "lights-out" operation and three-level alarming.
- Reduced maintenance enabled by air filters that can be rapidly swapped during operation of the dryer.
- Ease of annual maintenance with removable condenser coils and mechanical lid-lifting mechanism.
- Automated Dryer washing of chambers – Operators select frequency and duration.
- Controllable Air Volume, Air Temperature, Height of In-feed, and Cycle Time.
- Less than 5-minute Start-up time to begin biosolids processing. (45 minutes for natural gas dryers)
- Less than 15-minute Shut-down that includes 10 minutes of visual inspection.
- Reduced installation time & cost, with an anticipated one-two weeks required for installation.
- Remote diagnostics capability.
- Low chamber temperature enhances drying safety.

1.2 Equipment Specifications – Lockport WWTP

Installation Specifications

Size:	Model 0520 Dryer System
Material:	Municipal Biosolids dewatered to an average 23% TS
Process Volumes:	The dryer is designed to remove ~10 tons of water daily when processing WWTP biosolids on a 24 hour basis. The drying demand of the Lockport application is 8.28 tons of water removed daily.
Project Requirement:	Process 2,900 wet tons of average 23% TS biosolids to >90% TS.
Operating Scheduled:	Specified client operating schedule is 5 days per week, 24 hours per day.
Steel Procurement Act:	All Dryer steel, fabrication and assembly are produced and occur in the United States and meets the requirements of the Pennsylvania Steel Procurement Act.
Equipment Orientation:	To fit in the 35ft by 35 ft space at the Lockport WWTP, the Dryer's burner and blower assembly will be turned 90 degrees.



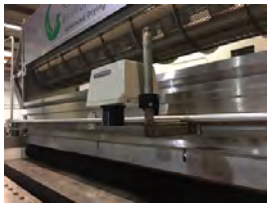
Automation Features and Optional Equipment included in Lockport WWTP Dryer:

Laser Level Sensors: Provides readings of product volume going to the Dryer and relays the data to the Dryer's PLC. Results in automatic control of air volume, temperature and belt speed to adjust the drying process.

Exiting Residuals Temperature Sensor: Provides Two (2) temperature readings of the dried residuals product and relays the data to the Dryer's PLC. The data is used for trend monitoring and to assist in reporting for Class A, EQ biosolids.

Dried Product Temp Sensor

Exiting Moisture Sensor: Provides moisture readings of the dried product and relays the data to the Dryer's PLC. Results in automatic control of air volume, temperature and belt speed to adjust the drying process as it does with the In-Feed sensor.



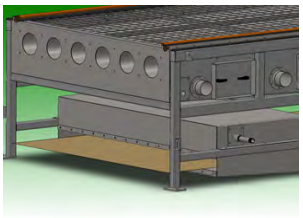
Biosolids Moisture Sensor

Sifter Mechanism: Sifter mechanism is standard. The sifter is placed at the in-feed of the dryer. The sifter is a rotating brush system that acts to break large clumps of material into small pieces. This increases surface area exposure and enhances the drying efficiency. It also produces ideal particles for use with standard agricultural spreaders. The Lockport WWTP sifter will also have a manually triggered self-cleaning mechanism to eliminate blockages, should they occur.

In-Feed Sifter Assembly

Ceramic/Teflon Coated Air Injection Plates: Gryphon will provide a ceramic/Teflon coating on the dryer's air injection plates to allow for ease in maintenance and the prevention of dust build-up on the plates. The anti-static coating helps to reduce any static clinging of fine dust that can appear on the injection plates and also makes the routine cleaning of the plates a simple and quick. In our experience, we feel that the coating is advantageous for the Lockport WWTP dryer.

Automated Chamber and Belt Wash: The Belt Wash is also included in the proposal. The dryer's chambers include spray bars with high-pressure nozzles and are positioned at the ends of each drying chamber. The Dryer PLC controls solenoids to trigger washing of any dust or material that passes through the dryer's conveyor belt. The Operator may select the frequency and duration of the wash cycles. Drainage trays are located within the chamber and a flush spray assists the evacuation of the water from the unit. In this proposal, belt spray bars are also included to prevent blinding of the belt by fine particles or polymer from the dewatering operations. These are also programmable and controlled by the Dryer PLC to enable automated cyclical cleaning, further reducing manual maintenance of your Gryphon Dryer.



Belt Wash Assembly - 0520

SS Condenser & Filter Assembly

Condenser / Filter Assembly: The dryer is provided with a patented condenser and filtration assembly that allow easy access and on-the-fly rotation of the air filtration. Both primary and spare filters are supplied with the unit. The Lockport WWTP condenser will be fitted with an automated, internal spray wash system behind the filters. The spray wash is programmed by the operator for frequency and duration of cleaning (while in operation). This function greatly reduces the frequency in which the filters are removed and cleaned. When more extensive cleaning is required, we have designed the filters with a roll-out assembly. While the system is in operation, the dryer will slow all processing speeds, and open the door that houses the filter. The filter is then rolled out of the condenser and onto a cart. The clean replacement is then rolled into the condenser and the dryer resumes normal operation. This process normally takes less than 5 minutes and is expected to be needed once or twice per week. Once rotated, the removed filters may be hosed down and stored for the next required filter rotation. The filters have a capture rate to 49 micron. They are provided in 2-inch to 6-inch corrugated widths, depending upon the material being dried. The Lockport WWTP will be provided with primary and spare 2" thick filters to enable the maximum air-flow and filter surface area. The condenser coils are specified as 304 SS with aluminum fins. The cold water supply from the plant's non-potable water system.

Blower Upgrade: All Blower air-contact points for the Lockport WWTP dryer are upgraded to 304 SS.

Volatile Gas Monitoring: The dryer system will include an in-line volatile gas monitoring system. The monitor will measure for 25% LEL for alarming and air purge, and 50% LEL for automatic shut-down. These units are to be calibrated on an annual basis for safety.

Inline Natural Gas Burner: Gryphon will supply a Stelter & Brinck Inline Natural Gas Burner with the Lockport WWTP dryer. All PLC systems, software and operating valves to supply the required natural gas from the client's disconnect (at the location of the burner) will be provided. The Lockport WWTP Inline Burner will be fitted with 304SS for all air contact points. The client will be responsible for supply and piping of the natural gas to the burner, along with a disconnect valve. Gryphon will supply the flow control valve with 4-20 milliamp controls. Gryphon will coordinate with the client the flange connections, flow control valves and piping design. Gas consumption at dryers full capacity will equal 1 MMBTU/hr. The gas burner will be sized for 1.5 MMBTU/hr. We estimate normal operating conditions to utilize approximately 0.85 MMBTU/hr.

1.3 ITEMIZED INCLUDED OPTIONS and EXCLUDED OPTIONS

OPTIONAL ITEMS INCLUDED IN PROPOSAL AS PER SITE-SPECIFIC REQUIREMENTS

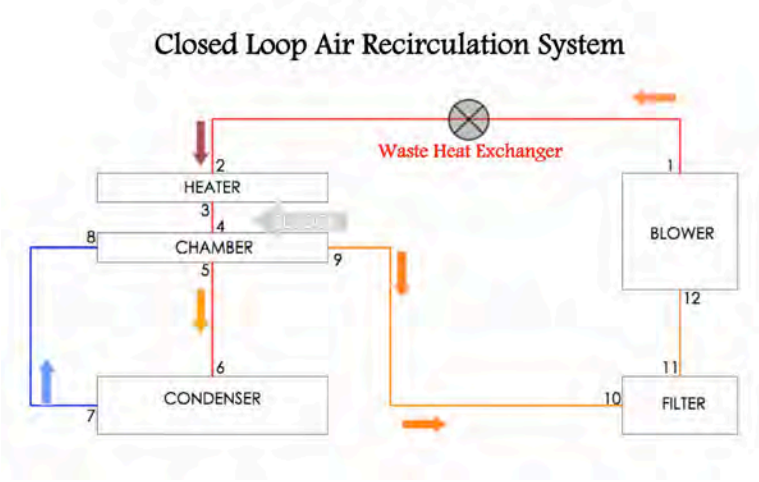
Fully installed dryer with cooling tower, condenser, controls, automation, receptacle bin and auger feed to dryer, freight, installation, training and commissioning.

OPTIONAL ITEMS NOT INCLUDED IN PROPOSAL

Item 1) Field wiring, conduit, electrical flexible connections to the Gryphon electrical cabinet
Item 2) Extra runs of piping not covered in Spec section or Scope of Supply unless noted
Item 3) Vent piping from all regulators/valves, according to local codes
Item 4) Non-potable water piping to the condenser and wash down manifold
Item 5) Seismic engineering or stamping
Item 6) Water drain piping from condenser
Item 7) Commissioning costs associated with freight, sampling and testing
Item 8) Taxes (tax-exempt project) and/or Bonding
Item 9) Unloading at job-site and anchor bolts
Item 10) Storage and handling fees for delays in delivery by client
Item 11) Supply of fuel oil to the #2 Fuel Oil Inline Burner
Item 12) Water supply piping to/from condenser/pump skid/cooling tower

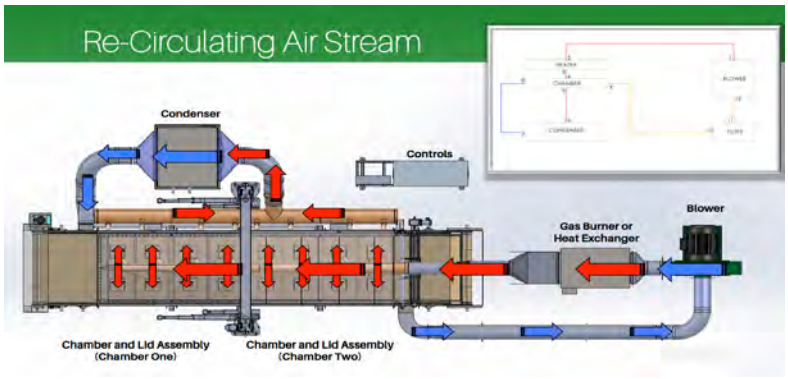
1.4 Re-Circulating Air Stream – reduced emissions

The Gryphon technology uses a filter and condenser assembly to clean and condense the air stream once it passes through the biomass. This process enables the client to then re-circulate the air stream back to the systems blower for reuse. To reduce energy costs as much as possible, the Gryphon dryer routes the re-circulated air through tubes within our drying chamber to pick up waste heat of the drying process. This reduces energy demands 8-10% in most installations.



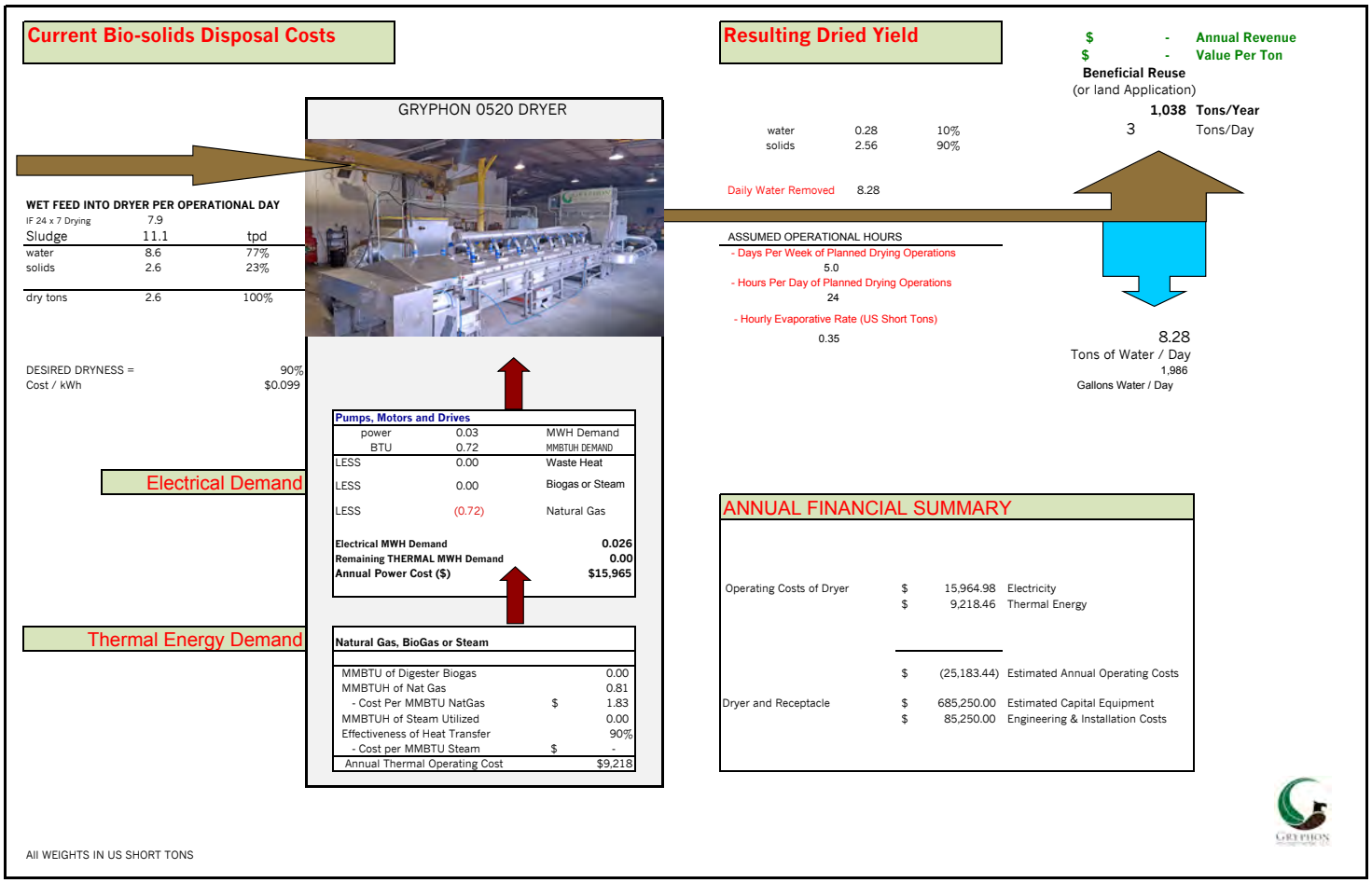
The net result of the re-circulating air stream is the potential elimination of exhaust air that would require bag houses, scrubbers, and/or exhaust stacks. This also greatly reduces the demands of air permitting. Exhaust air is limited to 7.8% of the total air stream when using an Inline Burner (to account for the burner's introduced air). The exhausted air will have been filtered to 49 micron,

passed through a condenser and released at 90-120F. Below is a top-level view of the dryer with the air stream path indicated as arrows.



1.5 Estimated Thermal BTU's Per Pound of Water Evaporated

Gryphon normally requires as little as 2.1 MMBTU per ton of water evaporated for process heat. This is a result of our patented pressure differentials. In essence, Gryphon uses pressure differentials to reduce the relative humidity of the air that passes through the suspension. This, in combination of the expansion that occurs as it passes through the suspension, results in less latent energy requirements and, as a result, requires less energy to operate. Utilizing thermal energy from an inline burner, we allow for an additional 10% for the heat exchanged to the dryer's process air. For conservative engineering, we suggest adding an additional 10% to the required energy demand to account for volumetric changes to the feed rate of wet biosolids from the dewatering device.



1.6 Process Flow and Material Handling

Gryphon anticipates that the most important aspect of processing will be in the material handling of the biosolids. Biosolids with characteristics that inhibit piling or stacking may be difficult to process through the Dryer's sifter mechanism. Biosolids that is capable of stacking normally has no problems with the process. In more simple terms, material that has the consistency of mashed potatoes does not break into particles and this results in large clumps being placed onto the dryer belt. The net result is poor operating efficiency. With biosolids projects, Gryphon elects to provide a series of 2-3 counter-rotating brushes to level the material placed on the dryers in-feed table. This gently levels the material without degradation. It also enables electronic sensors to monitor the depth of the material and provides data to the PLC. With the data, the Gryphon PLC can alter the speed of the feeding conveyors to ensure consistent drying quality.

1.7 Dry Yield Percentage Solids – Class A Adherence

Gryphon dryers are the most technologically robust and automated in the industry. Using Human Machine Interfaces (HMI touch panels) operators can adjust the dryer's settings in minutes. Pre-programmable options for dryness, inlet cake solids, maintenance, performance metrics and diagnostics are included with the equipment.

The Gryphon drying units use variations in 1) volume of process air, 2) temperature of process air, 3) belt speed, and 4) manually adjustable in-feed leveling brushes to control the percentage moisture exiting the dryer. By increasing temperature or by decreasing the belt speed, the dry yield will increase in percentage solids. The optional moisture meters are placed to monitor in-let wet residual moisture content to automate changes to the processing parameters based on the variations in in-let moisture. This enables the dryer to yield consistent dry product and to adhere to the selected moisture content of the final product. Selected dry solid yields can range from 50% to 95% solids, depending on the settings on the PLC's HMI.

Adherence to Class A EQ biosolids product by EPA 503 regulations, Gryphon provides a wealth of tools to the client. We have numerous moisture and temperature meters that record data on an ongoing basis. This data is sent to a historian and is then sent to the client operations center and to Gryphon's headquarters. Measurements can be taken at 5-60 second intervals. The full data log is then made available to assist in the reporting to state agencies.

Pathogen Reduction Methods

1) Gryphon provides moisture meters on the exiting side of the dryer. These meters serve to both record data and to provide the PLC with variances, when they occur. This enables Gryphon's software to allow for these variances and adjust belt speed, process temperature or process air volumes to maintain biosolids quality. This recorded information is sent to a historian for trend monitoring and is available for reporting.
2) Biosolids are exposed to the hot gas (heated air stream) as it passes through the dryer. The cycle time of the process is recorded to provide the historian with data on both the exposure temperature and the duration of the exposure.

3) Time and temperature readings are taken with dual IR (infrared) sensors at the exiting side of the dryer. This records the temperature of the biosolids directly after the dryer and again, 5-15 seconds later, prior to it dropping off of the conveyor belt. These dual readings provide a Time-and temperature stamp on the processed biosolids. This data is also provided to the historian for trend monitoring and available for reporting.

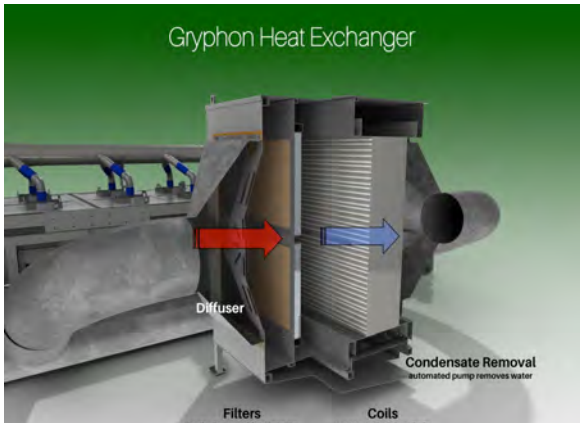
1.8 Maintenance and Personnel Requirements

Gryphon Dryers are fully automated to perform the majority of maintenance and cleaning on a programmed, automated basis. The Dryer has:

- Automated wash-out of chamber (programmable for frequency and duration)
- Automated belt wash (programmable for frequency and duration)
- Maintenance-free bearings
- Automated wash of air filtration assemblies (programmable for frequency and duration)
- Automated belt tracking
- Automated startup and warm-up procedure
- Automated alarms and shutdown
- Automated monitoring of belt integrity
- Automated monitoring of process air flow and pressure differentials
- Automated monitoring of process temperatures
- Automated fire suppression
- Automated condenser filter spray wash

In addition, the Gryphon Dryer has control functions to manage material flow into and from the dryer, system temperatures and system pressures. In the dryer, your unit will have thermocouples and sensors providing real-time data to the systems PLC. These provide low, medium and high urgency alarms to operating staff if conditions are altered outside of normal operating parameters. Medium and High Urgency alarms automatically shut down feed systems and dryer operations for maximum safety.

Maintenance of your Dryers will include swapping of the primary filters (pictured below) that prevent dust particles from entering the condenser coils and blower units. The condenser design enables a “guillotine style” filter assembly that takes less than five minutes to unlock, slide out, and swap. This design also enables an air lock when the filter assembly is pulled out of the condenser to ensure that the filter units can be swapped while the unit is in operation. This design



Condenser and "swap-in-operation" filters – Shown is the Model 10-series condenser

feature prevents tedious and costly shut-down time for maintenance and greater reduces operator/maintenance time. Once the reusable filters are swapped, most clients elect to clean the removed filters with a water hose so that the same process may be repeated when required. The condenser filters are made of multiple stainless steel mesh materials designed for durability, maximum air-flow and maximum particulate capture. They are provided in a durable stainless steel frame, with epoxy inserts. They are designed to last years, if properly maintained.

Monthly or Semi-annual maintenance may include routine cleaning of the dryer chambers or internal condenser coils. As seen above, the condenser filters may be safely pulled out of the condenser while in operation and cleaned/swapped. In addition, the Condenser has plexi-glass side-walls to enable the operators and maintenance to see inside the unit to determine if coil fouling has occurred and if coil cleaning is required. The large coil is placed on a roller system to make annual maintenance a rapid and effective process. As an added benefit, the plexi-glass also enables operators to see water as it is being condensed out of the air stream by the coils. Redundant level switches in the condenser evacuate condensed water automatically to a storage container or to the sewer.

1.9 Safety Programming

Safety in Gryphon drying equipment is prioritized in the avoidance and response to dust and high temperatures. In the case of dust, the dryers utilize high temp PPS conveyor belting to reduce particles from traversing through the belt and into the chamber. Finer dust particles that do pass through the belt are either carried to the condenser's filter media or remains in the chamber where wash-out systems routinely clean the unit with spray nozzles. The Dryer's PLC programming allows the operator to select the frequency and duration of the spray system. The use of a re-circulating air stream enables Gryphon to capture any dust particles in the air stream.

Gryphon technology enables the use of lower temperatures during processing. With injection temperatures programmable from 220 to 375 F, the biosolids will absorb the vast majority of the provided thermal energy and the drying chamber rarely exceeds 175 F. PLC control uses automated feedback from numerous thermocouples located through-out the re-circulating air stream (trunk-line, heater, lids, chambers, pre and post condenser). Thermocouple data is used by the PLC to control dryer throughput and to maintain low chamber temperatures, even if the dryer runs empty. For example, if the dryer is not loaded with material, the heat passes through the conveyor belt and thermocouples located directly below the belt pick up on the rise in temperature. The immediate result is the reduction or elimination of supplied heat to the air stream. Gryphon systems maintain these levels of control with advanced software. Also installed with every Gryphon dryer is a sprinkler system located in the lid structure of the unit. These saturate the conveyor, lid and chamber if triggered. In total, Gryphon has four levels of fire prevention in each unit 1) heater controls and feedback loops, 2) chamber temperature controls and feedback loops, 3) process air temperature controls and feedback loops, 4) fire suppression unit.

In additional, moving parts, such as conveyors, drives and motors, are protected with guarding. Site requirements in safety have been a focus since Gryphon's inception. Our client base includes house-hold names in paper, consumer goods and food processing. Gryphon has worked with these clients to meet and exceed their internal protocols for safety and alarming. Enhanced guarding and safety developed in these installations is made available to all customers.

Large moving components, such as the lid structure, are only moved during maintenance or for visual inspection. These lifting mechanisms are programmed with three levels of visual and manual procedural requirements to be satisfied prior to lifting/lowering.

2.0 DRYER INSTALLATION

2.1 Pricing – Capital Equipment, Installation, Training & Commissioning

Capital Equipment Purchase Price				
Line Item	QTY.	Description	Unit Price	Total
1	1	Gryphon MODEL 0520 Dryer Unit		$685,250
2	1	Ceramic/Teflon Coating on Injection Plates	included	
3-A	1	Gryphon Re-Circulating Air Stream Assembly (Condenser)	included	
3-B	1	~300 GPM Cooling Tower (cold water re-circ.)	included	
4	1	Recepticle Bin and Auger Feed System to Dryer	included	
5	1	Stelter & Brinck, In-Line Natural Gas Burner	included	
		TOTAL CAPITAL PURCHASE PRICE		**$685,250**

Engineering Services, Installation, Training and Onsite/Remote support

Pre-Installation Engineering/ Services				
Line Item	Quantity	Description	Unit Price	Total
6	1	Site Meetings at Client Location		
7	1	Progress Meetings (via Phone) and Site Engineering		
8	1	Packaging, Loading, Shipment - All Equipment		
Installation, Training and Commissioning				
Line Item	Quantity	Description	Unit Price	Total
9	1	Operator and Maintenance Training Program		
10	1	Site Installation Management for Dryer and Components		
11	1	Engineering Site Visits and Post-Installation Services		
		REMOTE DIGNOSTICS SUPPORT IN FIRST YEAR OF SERVICE		
		TOTAL SERVICES PURCHASE PRICE		**$85,250**

Summary of Lump Sum Price – Installed and Operational

	TOTAL CAPITAL PURCHASE PRICE	$685,250
	TOTAL SERVICES PURCHASE PRICE	$85,250
	TOTAL LUMP SUM INSTALLED PRICE	$770,500

Pricing and Delivery Schedule is Valid for 120 Days
All Prices in US Dollars
FOB Destination

(1) Due Net 60 Days – payment due NET 60 days from issuance of purchase order.

(2) Due Upon Readiness for Shipment (120 days) - payment due on the agreed date for the product to ship, scheduled at 90 days from Purchase Order. Payment is still due in 120 days if delays to shipment occur due to client change-orders or client postponement of shipment. Storage fees of 1% of total capital equipment cost per month per system shall apply for any client postponement of shipment. This cost is to cover warehousing and ongoing inventory insurance required of Gryphon.

(3) Due at the prior to occur of (A) time Dryer is able to process biosolids at the client site or (B) 45 days from the delivery of the dryer if client does not have utilities, material handling or personnel to begin the commissioning of the dryer.

(4) Due Upon Final Commissioning - Payment for Final Commissioning is due 60 days following delivery of unit if the buyer is unable to provide utilities, dewatered product, material handling to/from the dryer or personnel required to operate and commission the dryer unit. Final Commissioning shall be based on the demonstrated ability to produce greater or equal to 90% TS biosolids from no more than 11.1 wet tons of biosolids per day with a moisture content not in excess of 80% (i.e., 20% TS) on a minimum 5-day consecutive operating schedule and a downtime due to repairs of less than 10% over the prior two-weeks of operation.

Gaps in wet sludge production, supply of sludge at less than 20% TS, or reduced rates of sludge being delivered to the Gryphon dryer shall be removed from any performance metrics and shall not result in any negative impact to Gryphon meeting the performance requirements.

Allow 120 days from purchase order to shipment of Dryer and Components. Installation requires approximately two weeks for system start-up and approximately three weeks of commissioning.

Note: Loading of dryer and components onto flatbed trailers is included.

Freight to be FOB destination. Insurance included.

Gryphon performance metrics are based on the steady supply of biosolids from the fan press. The quality of the biosolids can have an impact on both performance and safety. Therefore, we provide the following table for biosolids sludge requirements:

Gryphon Environmental Biosolids Dryer

Sludge Content Specification Sheet

Item No.	Parameter	Unit	Min.	Max.
1	Dry solids cake	% -Feed	18	30
2	Volatile Solids	% -DS	48	70
3	Ash content	% -DS	0	50
4	Total fiber content (sum of medium and coarse particles)	% -DS	N/A	N/A
5	Coarse fibers (>1.2mm)	% -DS	N/A	N/A
6	Medium sized fibers (0.3 – 1.2mm)	% -DS	N/A	N/A
7	pH – of sludge prior to dewatering	PH	6	8
8	F.O.G. -Hexane Extractable Material	mg/kg-DS	0	50000
9	Chloride – total (liquid and solid phase of dewatered cake)	mg/kg-DS	0	1000
10	Fluoride – total (liquid and solid phase of dewatered cake)	mg/kg-DS	0	100
11	Sulphur -total (liquid and solid phase of dewatered cake)	mg/kg-DS	0	5000
12	BTX (benzene, toluene and xylene)	mg/kg-DS	0	50
13	PCB´s – total	mg/kg-DS	0	0.5
14	Total Hydrocarbons	mg/kg-DS	0	500
15	Sludge cake temperature	Deg. F	70	105

LEGEND: Unit Description mg/kg -DS Milligrams of Parameter Substance per kilogram of Dried Solids,
% -DS Percentage of Parameter Substance per unit quantity of Dried solids,
% -ash Percentage of Parameter Substance per unit quantity ash content,

NOTES:

* Gryphon Environmental drying systems are not designed to receive flammable or explosive input materials. Under no circumstances shall waste containing petroleum products or related chemicals be treated.

** All sewage sludge foreign substances (such as stones, pieces of wood or metal etc.) must not be processed in drying plant.

2.2 ITEMIZED ADDITIONS / OPTIONS

Material handling modifications into the dryer and for dried product exiting the dryers will be the responsibility of Client. Gryphon will provide I/O lists and PLC tie-ins for the controls and monitoring of those conveyor drive systems. Gryphon may supply a receptacle bin for holding wet biomass prior to the dryer. Cost for the receptacle will be based on the construction, height and capacity of the receptacle. Client to provide a 480 V, power disconnect box at location of dryers. AMP specifications provided on attached Process and Instrumentation Diagram.

2.3 WARRANTY – From Time of Delivery

One-Year Parts and Labor Warranty (from date of delivery).

Annual Service and Maintenance Agreement Available Upon Request (Price TBD based on features).

Replacement Parts Outside of Warranty Periods
See Attachment – Standard Replacement Parts

PPS Belting

Belt One	$ 12,800

Anticipated Belt Life is three-five years of service. Foreign substances, such as plastics, fats, oils or greases may damage or adversely affect the life of the PPS Belting and consequentially void the warranty.

Engineering and Support Options Beyond Design and Installation

Onsite Engineering Support Minimum 8 hours, travel reimbursed	$ 140.00/hr./engineer
Remote Engineering Support	Included (standard)
Onsite Fabrication or System Relocation Svc. Minimum 8 hours, travel reimbursed	$ 210.00/hr./fabricator

Standard Gryphon Software upgrades will be made available to Client at no cost. Specialized client software modifications will be subject to billable engineering time as defined above.

All replacement parts pricing is valid for one year from date of Agreement execution.

2.4 TERMS AND CONDITIONS

PARTIES

GRYPHON ENVIRONMENTAL, LLC., A COMMONWEALTH OF KENTUCKY CORPORATION, IS REFERRED TO AS "SELLER" AND THE PURCHASING PERSON OR ENTITY LISTED ON THE FRONT HEREOF OR DESCRIBED IN THE ATTACHED AGREEMENT IS REFERRED TO AS "BUYER". ALL MATERIALS, GOODS, SYSTEMS, SERVICES OR WORK DESCRIBED ON THE FRONT HEREOF OR IN THE ATTACHED AGREEMENT, REGARDLESS OF TYPE, ARE REFERRED TO AS "PRODUCTS".

PERFORMANCE OF THE GRYPHON DRYER ASSUMES THAT BUYER PROVIDES A CONSISTANT SUPPLY OF WET SUSPENSION TO THE DRYER. AMOUNT MAY BE INCREASED AS PERFORMANCE METRICS ARE EXCEEDED.

BUYER MAY NOT RELOCATE THE DRYER UNIT WITHOUT VOIDING WARRANTY UNLESS AGREED IN WRITING BY GRYPHON.

BUYER AGREES TO NOT REPRODUCE THE GRYPHON SYSTEM OR SHARE TECHNICAL OR PROPRIETARY OR INTELLECTUAL PROPERTY OF THE GRYPHON DRYER. BUYER FURTHER AGREES THAT GRYPHON DRAWINGS, TECHNOLOGY AND INTELLECTUAL PROPERTY WILL BE PROTECTED AS AGREED IN THE TERMS AND CONDITIONS SET FORTH BY A MUTUAL NON DISCLOSURE AGREEMENT TO BE EXECUTED BETWEEN THE PARTIES AND ANY AMENDMENTS THEREAFTER.

ALL PRICES ARE FOB DESTINATION, AND PAYMENT TERMS ARE SPECIFIED IN WRITING BY SELLER ON THE FRONT HEREOF OR OTHERWISE, REGARDLESS OF WHETHER OR NOT BUYER HAS BEEN PAID BY ITS CUSTOMER FOR SUCH PRODUCT. INVOICES UNPAID AND PAST DUE WILL BE SUBJECT TO A SERVICE CHARGE ON THE UNPAID BALANCE AT AN INTEREST RATE EQUAL TO THE LESSER OF EIGHTEEN PERCENT (18%) PER ANNUM OR THE MAXIMUM ALLOWABLE INTEREST RATE UNDER APPLICABLE LAW, AND BUYER SHALL BE RESPONSIBLE AND LIABLE FOR ALL EXPENSES INCURRED BY SELLER IN COLLECTION, INCLUDING REASONABLE ATTORNEYS' FEES.

SHIPMENT: DELIVERY: RISK OF LOSS

TITLE TO, AND RISK OF LOSS OF, THE PRODUCTS SHALL PASS TO BUYER AS SOON AS THE PRODUCTS ARE SHIPPED BY SELLER TO THE CLIENT DESTINATION. SHIPPING ARRANGEMENTS SHALL BE MADE OR APPROVED BY SELLER. EACH SHIPMENT DATE IS APPROXIMATE, AND SELLER SHALL NOT BE RESPONSIBLE FOR ANY DAMAGES OF ANY KIND RESULTING FORM ANY DELAY IN SHIPMENT OR DELIVERY OF ANY PRODUCTS. NO DEFERMENT OF SHIPMENT AT BUYER'S REQUEST BEYOND THE SHIPMENT DATE ACKNOWLEDGED OR QUOTED BY SELLER WILL BE MADE EXCEPT UPON WRITTEN NOTICE TO SELLER AT LEAST THIRTY (30) DAYS IN ADVANCE OF SUCH SHIPMENT DATE AND ON TERMS THAT WILL INDEMNIFY SELLER AGAINST ALL LOSS AND ADDITIONAL EXPENSEINCLUDING, BUT NOT LIMITED TO, DEMURRAGE, HANDLING, STORAGE, INSURANCE AND CARRYING CHARGES, RESULTING FROM SUCH DEFERMENT.

WARRANTY

SELLER WARRANTS EACH OF ITS PRODUCTS TO BE FREE FROM ANY DEFECT IN MATERIAL OR WORKMANSHIP FOR A PERIOD OF ONE (1) YEAR FROM THE DATE OF SHIPMENT.

CANCELLATIONS

AFTER ACCEPTANCE BY SELLER, AN ORDER SHALL NOT BE SUBJECT TO CANCELLATION BY BUYER EXCEPT UPON PAYMENT TO SELLER IN CASH OF THE FOLLOWING CANCELLATION CHARGES (I) 40% OF THE PURCHASE PRICE FOR ANY ORDER CANCELLED BEFORE DRAWINGS ARE SENT BY SELLER, (II) 70% OF THE PURCHASE PRICE FOR ANY ORDER CANCELLED AFTER DRAWINGS ARE SENT BY SELLER AND BEFORE SELLER SHIPS EQUIPMENT TO CLIENT DESTINATION.

SELLER'S SPECIFICATIONS: TECHNICAL DATA. ETC

ANY SPECIFICATIONS, DRAWINGS, PLANS, NOTES, INSTRUCTIONS, ENGINEERING NOTICES OR TECHNICAL DATA OF SELLER FURNISHED TO BUYER SHALL BE DEEMED TO BE INCORPORATED HEREIN BY REFERENCE THE SAME AS IF FULLY SET FORTH HEREIN. SELLER SHALL AT ALL TIMES RETAIN TITLE TO ALL SUCH INFORMATION AND DOCUMENTS, AND BUYER SHALL NOT DISCLOSE ANY OF IT TO ANY PARTY OTHER THAN ANY PARTY DULY AUTHORIZED BY SELLER IN WRITING. UPON SELLER'S REQUEST, BUYER SHALL PROMPTLY RETURN TO SELLER ALL SUCH INFORMATION, DOCUMENTS AND COPIES THEREOF.

CREDIT

RIGHTS OF SELLER. IF BUYER SHALL FAIL TO PAY ANY INDEBTEDNESS TO SELLER PROMPTLY WHEN DUE, SELLER MAY, IF IT SO ELECTS, WITH OR WITHOUT DEMAND FOR ANY PAYMENT PAST DUE, AND WITHOUT PREJUDICE TO ANY OTHER RIGHTS OR REMEDIES AVAILABLE TO IT, TAKE SOME OR ALL OF THE FOLLOWING ACTIONS:

(A) REQUIRE CASH PAYMENT IN ADVANCE OR ON DELIVERY OR ON PRESENTATION OF A SIGHT DRAFT ATTACHED TO A BILL OF LADING, LETTER OF CREDIT OR SUCH OTHER SECURITY OR PROOF OF RESPONSIBILITY AS IS SATISFACTORY TO SELLER, AS A CONDITION TO MAKING FURTHER SHIPMENTS OF PRODUCTS TO BUYER OR ANY OF ITS CUSTOMERS (IRRESPECTIVE OF WHETHER SUCH SHIPMENTS ARE IN EXPRESSION OF THE TERMS OF SUCH AGREEMENT, ALL PRIOR OR CONTEMPORANEOUS WRITTEN OR ORAL COMMUNICATIONS, AGREEMENTS, ORDERS, FORMS OR NEGOTIATIONS WITH RESPECT TO SUCH SUBJECT MATTER BEING MERGED HEREIN. BY WAY OF ILLUSTRATION AND NOT LIMITATION, BUYER'S ORDER SHALL BE DEEMED TO INCORPORATE, WITHOUT EXCEPTION, ALL TERMS AND CONDITIONS HEREOF, NOTWITHSTANDING ANY ORDER FORM OF BUYER CONTAINING ADDITIONAL OR CONTRARY TERMS OR CONDITIONS, UNLESS BUYER SHALL HAVE EXPRESSLY ADVISED SELLER TO THE CONTRARY IN A WRITING APART FROM SUCH ORDER FORM AND NO ACKNOWLEDGMENT BY SELLER OF ANY ORDER BY BUYER SHALL BE DEEMED AN ACCEPTANCE BY SELLER OF ANY SUCH ADDITIONAL OR CONTRARY TERMS OR CONDITIONS. ANY ACKNOWLEDGMENT BY SELLER OF ANY ORDER BY BUYER IS EXPRESSLY CONDITIONAL ON BUYER ASSENTING TO, OR OTHERWISE BEING BOUND BY, ANY TERMS AND CONDITIONS HEREOF WHICH ARE IN ADDITION OR CONTRARY TO THE TERMS AND CONDITIONS OF BUYER'S ORDER FORM. NO ADDITIONAL OR CONTRARY TERMS, CONDITIONS OR MODIFICATIONS MAY BE MADE TO THESE TERMS AND CONDITIONS EXCEPT BY A WRITTEN INSTRUMENT SIGNED BY ONE OF SELLER'S OFFICERS. STENOGRAPHIC AND CLERICAL ERRORS ARE SUBJECT TO CORRECTION BY SELLER.

INTENDED USE

THE GRYPHON UNIT PROPOSED IS DESIGNED TO DRY BUYER PRODUCED RESIDUALS. UTILIZING THE SYSTEM TO DRY OR PROCESS OTHER MATERIALS MUST BE APPROVED BY THE MANUFACTURER (GRYPHON) IN ADVANCE AND GRYPHON RESERVES THE RIGHT TO SUPERVISE TRIALS INVOLVING OTHER SUSPENSIONS OR CHANGES TO THE INTENDED USE. EXCEPT AS SET FORTH IN THIS SECTION, GRYPHON SPECIFICALLY DISCLAIMS ALL OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED, WHETHER ARISING BY OPERATION OF LAW OR OTHERWISE, INCLUDING WITHOUT LIMITATION, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS OF THE PRODUCT FOR A PARTICULAR PURPOSE, CONDITION OR QUALITY OF THE PRODUCT, ANY TRADE USAGE OR DEALING. ANY DETERMINATION OF THE SUITABILITY OF THE PRODUCT FOR THE USE CONTEMPLATED BY BUYER IS BUYER'S SOLE RESPONSIBILITY.

LIMITATION OF LIABILITY AND LIMITED REMEDIES

NOTWITHSTANDING ANYTHING HEREIN TO THE CONTRARY, IN NO EVENT WILL GRYPHON BE LIABLE TO BUYER FOR ANY LOST OR PROSPECTIVE PROFITS, INDIRECT, INCIDENTAL, CONSEQUENTIAL, SPECIAL, EXEMPLARY OR PUNITIVE DAMAGES, INCLUDING, WITHOUT LIMITATION, LOST EARNINGS, LOST PROFITS OR BUSINESS INTERRUPTION, WHETHER OR NOT BASED UPON GRYPHON'S NEGLIGENCE, BREACH OF WARRANTY, STRICT LIABILITY, IN TORT OR ANY OTHER CAUSE OF ACTION. BUYER'S EXCLUSIVE REMEDY AGAINST GRYPHON FOR ANY CAUSE OF ACTION UNDER THE AGREEMENT, INCLUDING WITHOUT LIMITATION FOR FAILURE TO DELIVER OR DELIVERY OF NON-CONFORMING PRODUCT, IS, AT GRYPHON'S OPTION LIMITED TO (A) REPLACEMENT OF THE NON-CONFORMING PRODUCT; OR (B) REFUND TO BUYER OF THE PORTION OF THE PURCHASE PRICE PAID BY BUYER AND ATTRIBUTABLE TO SUCH NON-CONFORMING OR UNDELIVERED PRODUCT. IN NO EVENT SHALL GRYPHON'S CUMULATIVE LIABILITY EXCEED THE PRICE OF PRODUCT SOLD WHICH WAS THE DIRECT CAUSE OF THE ALLEGED LOSS, DAMAGE OR INJURY. IN ANY EVENT, BUYER ACKNOWLEDGES AND AGREES THAT THE RETURN OF THE FULL SALES PRICE FOR THAT PRODUCT SOLD WHICH WAS THE CAUSE OF THE ALLEGED LOSS, DAMAGE OR INJURY WILL PREVENT THE FOREGOING REMEDIES FROM FAILING OF THEIR ESSENTIAL PURPOSE, AND THAT SUCH REMEDY IS FAIR AND ADEQUATE.

GOVERNING LAW

THIS DOCUMENT AND THE SALE OF ALL PRODUCTS, AND ANY DISPUTES RELATING THERETO, SHALL BE GOVERNED BY, CONSTRUED IN ACCORDANCE WITH AND RESOLVED UNDER THE SUBSTANTIVE AND PROCEDURAL (BUT NOT CONFLICTS) LAWS OF THE COMMONWEALTH OF KENTUCKY.

3.0 DELIVERABLES

Gryphon To Provide:

A) Design/Build of Gryphon 0520 Model Dryer
B) Freight to destination
C) Spare Parts to include: TBD
D) Warranty on Parts and Labor subject to normal wear and tear. Itemized Warranty schedule defined in section WARRANTY (above).
E) Training program for operators and maintenance to include safety, operations, standard and advanced maintenance.
F) Installation and Commissioning of Dryer and Components

Lockport WWTP To Provide:

A) Weatherproof housing for dryer unit
B) Steam source capable to run the dryer
C) 400V 3-Phase power supply to dryer unit –AMP service to be determined based upon availability of waste heat, includes termination into adjacent breaker box
D) Water supply lines to dryers
E) Water/Sewer runoff drain from dryer
F) Installation equipment and labor which may include a crane, forklift(s), and manpower to locate the machine, install material handling to /from dryer.

A Table of Utility connections and the responsible supplier and installer of the connections is listed below.

CLIENT TO PROVIDE

Utility	AMPS / VOLUME IN ATTACHMENTS	VOLTAGE OR PRESSURE	FED FROM	FED TO	HOOK-UP RESPONSIBLE
POWER DRYER A					
3-PHASE TO GRY CABINET/DISCONNECT	**Yes**	480	client MCC	GRY CABINET A	Client
LOW VOLTAGE (120 VOLT)	**Yes**	120	client MCC	GRY CABINET B	Client
NATURAL GAS SUPPLY					
BURNER (with 100% RESERVE AT MAX SPEC.)	**Yes**	1 MMBTUH	Supply Line	BURNER	Client
EXHAUST FROM DRYER					
EXHAUST - BLOWER (AT MAX SPEC + 15%)	**Yes**	1.2 - 1.5 PSI	BURNER PRE-Transition	SCRUBBER or ATM.	Client
COLD WATER RECIRC. - DRYER A					
PIPING COOLING TOWER - CONDENSER (Maximum in Summer plus 15% reserve capacity)	**Yes**	90 PSI	COOLING TOWER (and return)	CONDENSER (and return)	Client
COMPRESSED AIR DRYER					
INSTRUMENT QUALITY AIR	**negligible use**	100 PSI	Supply Line	Gryphon Panel	Client
SEWER LINE DRYER					
CONDENSATE REMOVED	**Yes**		CONDENSER A-1/2	sewer or drain	TBD (distance)
BELT/CHAMBER WASH	**Yes**		WASH DRAINS	sewer or drain	TBD (distance)
EFFLUENT WATER SUPPLY					
CHAMBER AND BELT WASH SOLENOID STAND	**Yes**	90 PSI	Supply Line	Solenoid Stand	Client

GRYPHON TO PROVIDE

COMPONENT	Quantity Of Motors	VOLTAGE	FED FROM	FED TO	HOOK-UP RESPONSIBLE
MAIN BLOWER - VFD	**1**	480	Gryphon Panel	blower	Gryphon
DRYER CONVEYOR DRIVE - VFD	**1**	480	Gryphon Panel	drive	Gryphon
COMBUSTION AIR BLOWER - VFD	**1**	480	Gryphon Panel	blower	Gryphon
SIFTER MOTOR - VFD	**1**	480	Gryphon Panel	sifter	Gryphon
WASH PUMP - Solenoids - intermittent	**1**	480	Gryphon Panel	pumps	Gryphon
COOLING TOWER PUMP - VFD - Redundant	**1**	480	Gryphon Panel	pumps	Gryphon
CONDENSER PUMP (condensate) - intermittent	**1**	480	Gryphon Panel	pumps	Gryphon
LEVELING BRUSH - continuous	**1**	480	Gryphon Panel	motor	Gryphon
COOLING TOWER FAN - continuous	**1**	480	Material Panel	motor	Gryphon
LID LIFT HYDRAULIC PUMP - intermittent	**1**	480	Material Panel	drive	Gryphon
EFFLUENT WATER SUPPLY					
CHAMBER AND BELT WASH SOLENOID STAND	**1 Pump**	90 PSI	Solenoid Stand	multiple	Gryphon

Utility Summary

- System Water

COMPONENT	GPM	PSI	FED FROM	FLOWS TO	HOOK-UP RESPONSIBLE
COOLING TOWER MAKE-UP (max)	**3**	> 20	Potable water	COOLING TOWER	Client
WASH PUMP Supply (intermittent)	**70**	85-95	filtered only	Solenoid Stand	Client

- EFFLUENT WATER SYSTEM

COMPONENT	PSI	FLOW	FED FROM	FED TO	HOOK-UP RESPONSIBLE
CONDENSER PUMP per day (intermittent)	9	40 GPM	GRY Drain	trench	
CHAMBER WASH per day (GPD)	atm	280 GPD	GRY Drain	trench	
CHAMBER WASH per day (GPM - in operation)	atm	70 GPM	GRY Drain	trench	
BELT WASH per day (full cycle daily)	atm	1200 GPD	GRY Drain	trench	
BELT WASH per day (GPM in operation)	atm	70 GPM	GRY Drain	trench	

- Air

COMPONENT	PSI	FLOW	FED FROM	FED TO	HOOK-UP RESPONSIBLE
ROLL TENSION	100	0	snub roller		Client to snub roller
BELT TRACKER	100		snub roller		Client to snub roller
CONDENSER DOOR	100		snub roller		Client to snub roller

- Plumbing

COMPONENT	SCHEDULE	MATERIAL	FED FROM FEED TO	HOOK-UP RESPONSIBLE	Utility Number
COOLING WATER	40	TBD			7.1
CHAMBER DRAINS TO PIT	40	TBD			6.2
BELT WASH TO PIT	40	TBD			6.2
SUMP TO GRAY WATER TANK	40	TBD			NA
COOLING TOWER LINES	40	TBD			4.1

- Exhaust Air

COMPONENT					
Hourly Evaporative Capacity (Tons)	0.25	0.33	0.42	0.50	
Blower's Processing Air Volume (SCFM)	3,200	3,600	5,000	5,400	
EXHAUST AIR (CFM)	256	288	400	432	
Exhaust Air Pressure	atm	atm	atm	atm	

EXHAUST AIR WILL BE FILTERED TO 49 MICRON AND WILL HAVE BEEN CONDENSED TO 90 DEGREES. FROM THE CONDENSER IT WILL TRAVEL THROUGH THE PRE-HEAT PIPES AND BLOWER. IT WILL DISCHARGE AT APPROXIMATELY 120 F AND AT 1.0 to 1.5 PSI. IT WILL IMMEDIATELY GO TO ATMOSPHERIC CONDITIONS AS IT IS EITHER RELEASED TO THE ATMOSPHERE OR ENTERS PIPING TO A MINI-SCRUBBER.

3.1 PERFORMANCE - Operating Budget

Based on preliminary data, we anticipate the Gryphon Dryer to have the following performance characteristics for the variations in biosolids processed:

MOTORS:	Estimated 65 - 95 kW/ Ton of Water Evaporated - Varies depending on throughput and dryer settings Estimated 26 kW/h demand (0.35 tons water removed / hour)
THERMAL DEMAND:	Estimated 2.1 – 2.7 MMBTU PER Ton of Water Evaporated Estimated 0.81 MMBTUH demand (0.35 tons water removed / hour)

3.2 DATA LINK TO SITE CONTROL ROOM

A communications line (multiple CAT5 or CAT6 cables) shall be provided by client for connecting the Gryphon dryer to the site's Operations Center. Conduit runs and installation will be the responsibility of the client. The line will enable the staff to monitor the Gryphon dryer and to be notified of alarms and operations. Gryphon will provide controls assistance to link the Gryphon dryers to the existing Operations Center monitoring stations. The Gryphon dryer comes standard with Square D PLC systems. Client may opt to utilize an alternative controls package (e.g. Rockwell) for an additional cost. Gryphon will provide requirements on software versions to determine the best means of connecting and reporting into existing site PLC systems.

3.3 REMOTE ACCESS AND MONITORING

The data links will also provide the means for Gryphon to provide off-site monitoring of the units. Gryphon engineering teams will be able to provide trouble-shooting and engineering support remotely. This is a major advantage to keeping maintenance and repair costs to a minimum.

Gryphon will coordinate the feedback and controls for material handling flow to the dryer. Gryphon will work with Lockport WWTP's contracted engineering firm to ensure that the fan press, receptacle and the dryer perform in a controlled environment. This may include some or all of the following:

1) Supply of sonar sensors above the receptacle and feedback to the Gryphon PLC
2) Control of the feed auger of the client-supplied receptacle
3) Electronic eyes or laser level sensors for feed onto the Gryphon belt, with feedback to Gryphon PLC's and integrated software to control the receptacle auger.
4) Potential speed control of the fan press by Gryphon PLC.

3.4 SCHEDULE

Allow up to 120 days from purchase order to delivery of Dryer and Components. The production schedule may be reduced with a written request by the client and approval by Gryphon.
Installation requires approximately two weeks for the dryer system start-up and three weeks for commissioning.

Planned Schedule:

Purchase Order and Deposit: Date of PO/Deposit
Preparation of Submittals and Drawings: Month One-Two
Factory Acceptance Test: Month Three-Four

F.A.T. includes the start-up of primary motors and evaluation of the dryer unit. Includes the review of guarding, alarms and controls. It DOES NOT include the operation of the dryer. The belt will not be placed on the dryer until the unit is installed at the client location.

Shipment of Dryer and components:Month Four
Commissioning and Training: Begins Two-Three Weeks following Delivery
Final Punch-list and Commissioning: Within one month of delivery

4.0 Installations – Sampling of Sites

Customer Name	Customer Type	Location (City, ST)	Status (Delivered, PO Rec'd for Fabrication, PO Rec'd for Engineering, Under Negotiation)	Month/Year Installed (Projected to be installed forbacklog/ pipeline)	# of units	Unit Size	capacity (water removed per day)
SAMPLING OF INSTALLATIONS							
Large Paper Company	Paper Industry	KY	Delivered/Operational Pilot for 6 months	May, 2011	1	Model 2.5 by 12	2.5-3
Large Paper Company #2	Paper Industry	GA	Delivered/Operational	June, 2012	1	Model 2.5 by 12	2.5-3
Organic Fertilizer and Protein Producer #1	Industrial	Langley, B.C.	Delivered/Operational	May, 2014	1	Model 2.5 by 12	2.5-3 (lighter load at low temp for biomass)
Organic Fertilizer and Protein Producer #1	Industrial	Langley, B.C.	Delivered/Operational	June, 2014	1	Model 0530	10-15 (lighter loads at low temp drying (~270F)
Organic Fertilizer and Protein Producer #2	Industrial	Cape Town, South Africa	Delivered/Operational	February, 2015	1	Expandable Model 0520	11.09 (sometimes lower with low temp needs)
JRI, Inc.	Industrial	NV	Delivered/Operational	April, 2016	1	Expandable Model 0520	5-15 (depending on input
Southeast Organics	Industrial	GA	Installed	March, 2017	1	Expandable Model 1040	40-60, depending on input
Pottstown, PA	Municipal	PA	Going into production	in production	1	Model 1050	50-70 TWR/D
Large Chicken Producer	Industrial	KY	Installed	July, 2017	1	Model 0318	10-20 Wet tons daily
DOE Municipal Facility	Municipal	TN	Going into production	in production	1	Model 0318	5-8 Wet tons daily


GRYPHON
environmental, LLC

5.0 Execution of Proposal / Agreement

BUYER MAY EXECUTE THIS AGREEMENT WITH A PURCHASE ORDER REFERENCING THIS PROPOSAL AND THE DEPOSIT AS DEFINED IN THE CAPITAL PRICING SECTION OF THIS DOCUMENT.

Thanks, and we look forward to a long, productive and mutually successful business relationship.

Buyer:

The City of Lockport, NY Hereby Agrees to the Terms and Conditions of Sale,

_____ _____

Authorized Signature Date

_____

Printed Name and Title

Gryphon:

Agreed and Accepted:

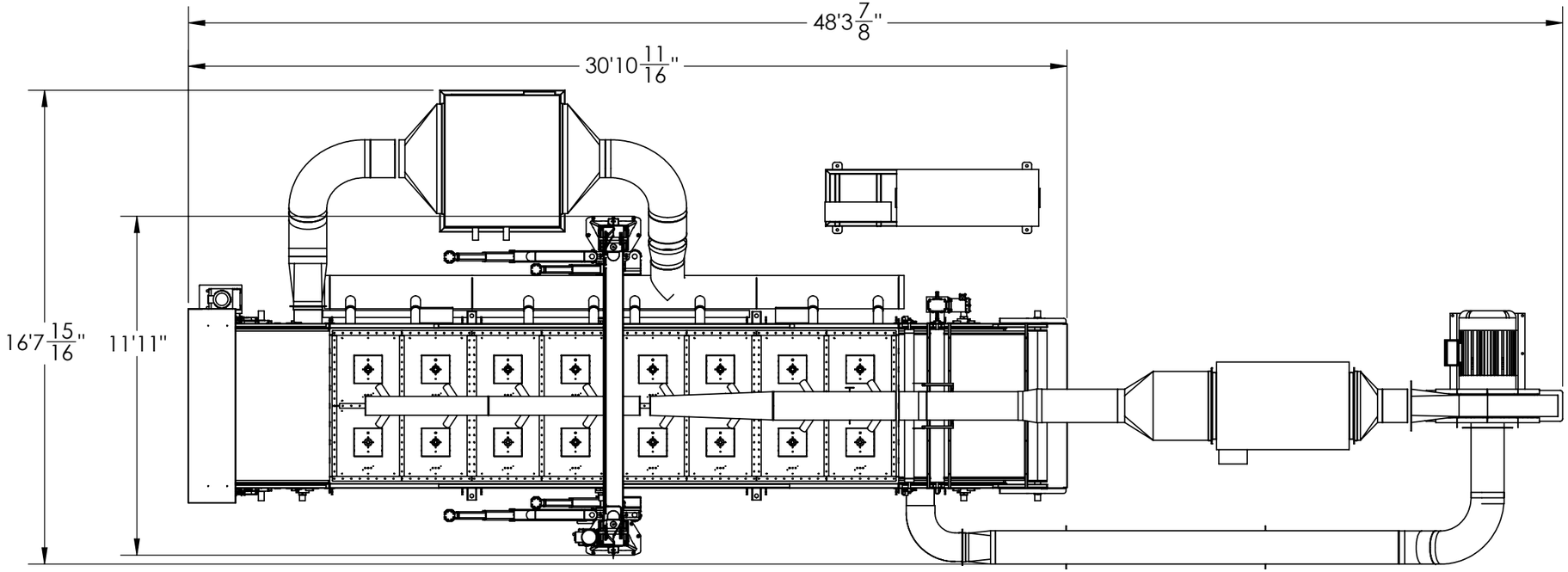
_____ _____

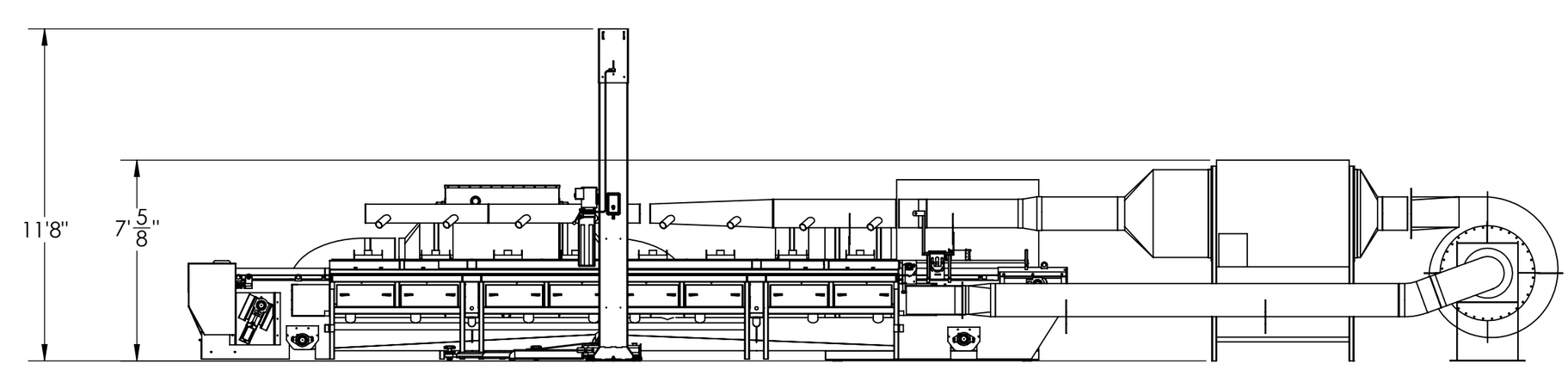
W. Tid Griffin, CEO Date

ATTACHMENTS

System Renderings
System Layout Dryer (Footprint)
Utility Summary (power)
Sample Maintenance Schedule with Recommended Spare Parts
Sample Extended Maintenance Agreement

System Layout Dryer (Footprint)





UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± 1/32" BEND ±1° TWO PLACE DECIMAL ±.03 THREE PLACE DECIMAL ±.005
MATERIAL:
GAUGE:
Int'l Patent Pending U.S. Patent Pending 12/587,137 U.S. Patent 7,749,395 B2 U.S. Patent 8,673,156

	NAME	DATE
DRAWN BY:	ANIKET C.	01/30/15
CHECKED BY:	CESTES	01/30/15
DESCRIPTION:	-	

DO NOT SCALE DRAWING

LAST SAVED BY AND DATE: User - 1/30/2015

Gryphon Environmental
2920 Fairview Drive
Owensboro, KY 42303

Title: GRYPHON DRYER 5x20 EQUIPMENT LAYOUT

SIZE	DWG NO:	REV:
B	GD510_5x20_Layout	0

SCALE: 1:55 | SHEET 1 OF 1

ZONE	REV.	DESCRIPTION	DATE	APPROVED

Utility Summary (power)

Gryphon Environmental, LLC CONFIDENTIAL
2920 Fairview Drive
Owensboro, KY 42303
Contact: Tid Griffin, CEO; 270-485-2680; tid@2gryphon.com

Document Number	17-VOL	
Revision	A	
Contact Numbers:	Chad Estes	270-363-1911; chad@2gryphon.com
	Justin Lord	270-316-4137; Jlord@2gryphon.com
	Mike Fritchley	812-431-6077; mfritchley@2gryphon.com

Project Status Report

Job No.:	17-VOL
Executed Agreement No.:	TBD
Client Purchase Order #	TBD
Provided By:	GRY-Engineering
Engineer/Technicians:	J Lord, C Estes, M Fritchley

Client Contact Numbers:	

Copied:

ENPW-JSA	Gryphon Environmental, LLC
	Justin Lord
	Tid Griffin
	Mike Fritchley

Reference Drawings (sets) and Documents	
P&ID	
Preliminary Layout	
- includes utility connections	
Utility Summary (below)	
Mass and Energy Balance	
Reponse to BCM Questions	
Mass and Energy Balance	
Cooling Tower Specs/Drawings	
Wash Pump/CT Pump Specs	
Preliminary Layout - Rev C	
P&ID - Rev B	

Design Criteria		
Section One	Site Utilities	Power, Water, Sewer, Air, Plumbing, Action Items
Section Two	Material Handling	Scope, Report Details, Action Items

Section Three	Specialty Equipment	Scope, Report Details, Action Items
Section Four	Delivery	Scope, Report Details, Action Items
Section Five	Budgets	Scope, Report Details, Action Items
Section Six	Action Items	Action items and Owners
Section Seven	Approvals	Approvals needed to proceed

CLIENT TO PROVIDE

Utility	AMPS / VOLUME IN ATTACHMENTS	VOLTAGE OR PRESSURE	FED FROM	FED TO	HOOK-UP RESPONSIBLE	Utility Number
POWER DRYER A						
3-PHASE TO GRY CABINET/DISCONNECT	**Yes**	480	client MCC	GRY CABINET A	Client	1.1
LOW VOLTAGE (120 VOLT)	**Yes**	120	client MCC	GRY CABINET A	Client	1.2
#2 FUEL OIL SUPPLY						
BURNER (with 100% RESERVE AT MAX SPEC.)	**Yes**	1 MMBTUH	Supply Line	BURNER	Client	2.1
EXHAUST FROM DRYER						
EXHAUST - BLOWER (AT MAX SPEC + 15%)	**Yes**	1.2 - 1.5 PSI	BURNER PRE-Transition	SCRUBBER or ATM.	Client	3.1
COLD WATER RECIRC. - DRYER A						
PIPING COOLING TOWER - CONDENSER (Maximum in Summer plus 15% reserve capacity)	**Yes**	90 PSI	COOLING TOWER (and return)	CONDENSER (and return)	Client	4.1
COMPRESSED AIR DRYER						
INSTRUMENT QUALITY AIR	**negligible use**	100 PSI	Supply Line	Gryphon Panel	Client	5.1
SEWER LINE DRYER						
CONDENSATE REMOVED	**Yes**		CONDENSER A-1/2	sewer or drain	TBD (distance)	6.1
BELT/CHAMBER WASH	**Yes**		WASH DRAINS	sewer or drain	TBD (distance)	6.2
EFFLUENT WATER SUPPLY						
CHAMBER AND BELT WASH SOLENOID STAND	**Yes**	90 PSI	Supply Line	Solenoid Stand	Client	7.1

GRYPHON TO PROVIDE

COMPONENT	Quantity Of Motors	VOLTAGE	FED FROM	FED TO	HOOK-UP RESPONSIBLE	Utility Number
MAIN BLOWER - VFD	**1**	480	Gryphon Panel	blower	Gryphon	N/A
DRYER CONVEYOR DRIVE - VFD	**1**	480	Gryphon Panel	drive	Gryphon	N/A
COMBUSTION AIR BLOWER - VFD	**1**	480	Gryphon Panel	blower	Gryphon	N/A
SIFTER MOTOR - VFD	**1**	480	Gryphon Panel	sifter	Gryphon	N/A
WASH PUMP - Solenoids - intermittent	**1**	480	Gryphon Panel	pumps	Gryphon	N/A
COOLING TOWER PUMP - VFD - Redundant	**1**	480	Gryphon Panel	pumps	Gryphon	N/A
CONDENSER PUMP (condensate) - intermittent	**1**	480	Gryphon Panel	pumps	Gryphon	N/A
LEVELING BRUSH - continuous	**1**	480	Gryphon Panel	motor	Gryphon	N/A
COOLING TOWER FAN - continuous	**1**	480	Material Panel	motor	Gryphon	N/A
LID LIFT HYDRAULIC PUMP - intermittent	**1**	480	Material Panel	drive	Gryphon	N/A
EFFLUENT WATER SUPPLY						
CHAMBER AND BELT WASH SOLENOID STAND A	**1 Pump**	90 PSI	Solenoid Stand	multiple	Gryphon	N/A

1.2 System Water

COMPONENT	GPM	PSI	FED FROM	FLOWS TO	HOOK-UP RESPONSIBLE	Utility Number
COOLING TOWER MAKE-UP (max)	3	> 20	Potable water	COOLING TOWER	Client	4.1
WASH PUMP Supply (intermittent)	70	85-95	filtered only	Solenoid Stand	Client	7.1

1.3 EFFLUENT WATER SYSTEM

COMPONENT	PSI	FLOW	FED FROM	FED TO	HOOK-UP RESPONSIBLE	Utility Number
CONDENSER PUMP per day (intermittent)	9	40 GPM	GRY Drain	trench		6.1
CHAMBER WASH per day (GPD)	atm	280 GPD	GRY Drain	trench		7.1
CHAMBER WASH per day (GPM - in operation)	atm	70 GPM	GRY Drain	trench		7.1
BELT WASH per day (full cycle daily)	atm	1200 GPD	GRY Drain	trench		7.1
BELT WASH per day (GPM in operation)	atm	70 GPM	GRY Drain	trench		7.1

1.4 Air

COMPONENT	PSI	FLOW	FED FROM	FED TO	HOOK-UP RESPONSIBLE	Utility Number
ROLL TENSION	100	0	snub roller		Client to snub roller	5.1
BELT TRACKER	100		snub roller		Client to snub roller	5.1
CONDENSER DOOR	100		snub roller		Client to snub roller	5.1

1.5 Plumbing

COMPONENT	SCHEDULE	MATERIAL	FED FROM FEED TO	HOOK-UP RESPONSIBLE	Utility Number
COOLING WATER	40	TBD			7.1
CHAMBER DRAINS TO PIT	40	TBD			6.2
BELT WASH TO PIT	40	TBD			6.2
SUMP TO GRAY WATER TANK	40	TBD			NA
COOLING TOWER LINES	40	TBD			4.1

1.6 Exhaust Air

COMPONENT						Utility Number
Hourly Evaporative Capacity (Tons)	0.25	0.33	0.42	0.50		3.1
Blower's Processing Air Volume (SCFM)	3,200	3,600	5,000	5,400		
Static Pressure (inches Water Column)	14.59	18.47	35.62	42		
EXHAUST AIR (CFM)	256	288	400	432		
Exhaust Air Pressure	atm	atm	atm	atm		

EXHAUST AIR WILL BE FILTERED TO 49 MICRON AND WILL HAVE BEEN CONDENSED TO 90 DEGREES. FROM THE CONDENSER IT WILL TRAVEL THROUGH THE PRE-HEAT PIPES AND BLOWER. IT WILL DISCHARGE AT APPROXIMATELY 120 F AND AT 1.5 PSI. IT WILL IMMEDIATELY GO TO ATMOSPHERIC CONDITIONS AS IT IS EITHER RELEASED TO THE ATMOSPHERE OR ENTERS PIPING TO A MINI-SCRUBBER.

2. SECTION TWO: MATERIAL HANDLING

2.1 SCOPE

N/A - Not in current scope (sample drawings of receptacle/hoppers have

2.2 MATERIAL HANDLING REPORT DETAILS

Will coordinate end of dryer discharge with the bucket conveyor assembly.

3. SECTION THREE: SPECIALTY EQUIPMENT

3.1 SCOPE

Class II, Div II requirements

1 All electrical boxes require gaskets.
2 All connections (conduit) must be inclusive of a Myers Hub (dust proof)
3 Need quotes for cooling water supply pump (ONLY IF INTERIOR)
4 Solenoids are fine with seals
5 All motors must be compliant
- Airpro and BDI quotes, S&B

3.2 SPECIALTY EQUIPMENT REPORT DETAILS

N/A

4. SECTION FOUR: DELIVERY

4.1 SCOPE

N/A

4.2 DELIVERY REPORT DETAILS

N/A

5. SECTION FIVE: BUDGETS

No Change Orders At This Time

6. ACTIONS ITEMS

6.1 ACTION ITEMS LIST

ACTION ITEM	doc. #	ACTION BY	ACTION DUE DATE	COMPLETED DATE	NOTIFY WHEN COMPLETE

6. APPROVALS NEEDED

APPROVALS NEEDED TO PROCEED

SECTION #	ITEM TO BE APPROVED	NEED BY DATE	APPROVER SIGNATURE

Sample Maintenance Schedule with

Gryphon Environmental, LLC
2920 Fairview Drive
Owensboro, KY 42303 CONFIDENTIAL

Standard Maintenance Schedule and Replacement Parts

Scheduled Maintenance

Daily or Weekly Action	Time Requirement
· Condenser Filter - swap, clean and inspect	25 minutes

AS-NEEDED (MONTHLY TO SEMI-ANNUAL)	Time Requirement
· Lift Lid for Injection Plate Cleaning	inspection and modify as per location
· Pressure Washing of Conveyor Belt (assumes no auto wash installed)	
· Condenser Coil Flush	1 hour
· Cooling Tower Flush	1 hour - during operation
· Condenser Coil External Wash (reduced with Auto Wash)	1 hour

AS-NEEDED (ANNUAL)	Time Requirement
· Sifter Brush Replacement	1 hour
· Level Brush and Exit Table Brush Chain Oil	1 hour
· Injection Plate - Lid Opening and Inspection	3 hour
· Condenser Coil Flush	1 hour
· Condenser Coil External Wash	1 hour
· Leveler Brush and Exit Table Brush Replacement	2.5 hour

Scheduled Maintenance - Visual Inspection

Daily

- Conveyor Belt - tracking
- Conveyor Belt - blinding and wear
- Leveler Section - brush
- Heater Functionality - pressure and flow
- Chamber Temperatures
- Condenser Coil Inspection
- Sifter Assembly - Brush and Screen - blinding and wear
- Drying Chamber - spray wash funcionality
- Cooling Tower - water temp and water supply

Weekly

- Seals on Dryer - inspect for air leaks
- Dryer Injection Plates - inspect weekly for first three months of operation

Monthly

- Gas In-line Burner - per Operator Manual
- Lid Lifts Inspections per Operator Manual

Quarterly

- Gear Box
- Motor Couplings
- Gas In-line Burner - per Operator Manual
- Challenger Lift Inspections per Operator Manual
- Leveler Brush Chain and Sprocket
- Exit Table Brush Assembly Chain and Sprocket

Recommended Spare Parts

Replacement Parts - Schedule

Life Cycle (Years)	Supplier	Model	Description	Recommended Spare	Qty.	Approx. Cost (each)
2 Years	Gryphon Environmental	Sample: 50 micron	Condenser Filters (Set of 4)	Provided	4	$1,200.00
1 Year	Gryphon Environmental	GRY-XXXX-SIFT-Set	Sifter Brush Set - 5ft wide, Set of 8 replacement brushes	YES	1	$2,880.00
1-2 Year	Gryphon Environmental	GRY-XXXX-Brush-Exit	6” diameter x 62” brush x .006 crimped black polypropylene Exit Brush Assembly	NO	1	$1,350.00
1-2 Year	Gryphon Environmental	GRY-XXXX-6-Level	6" Leveller Brush Assembly	NO	1	$1,350.00
1-2 Year	Gryphon Environmental	GRY-XXXX-4-Level	4" Leveller Brush Assembly	NO	1	$1,250.00
1-2 Year	Gryphon Environmental		Standard Model 05-Series Skirt Assembly Seals - 25-45 ft length	YES	2	$1,785.00
10 Years	Gryphon Environmental		Leveller Section Drive Motor	NO		
10 Years	Gryphon Environmental		Maintenance-free Bearings	NO		
10 Years	Gryphon Environmental		Belt and Sifter Drive Motors	NO		
2-5 Years	Gryphon Environmental	E3P48D75	Teledyne Relays Relay; SSR; Control; Cur-Rtg 75A; Ctrl-V 30DC; Vol-Rtg 600AC; Screw; UL; E3P Series	YES	>5	$265.00
2 Years	Gryphon Environmental		Standard E Seals - 1" 50 Ft Length	YES	2	$750.00
2 Years	Gryphon Environmental		Standard E Seals - 3/4" x 50 Ft Length	YES		$750.00
2-5 Years	Gryphon Environmental	GRY-MODEL1060-5099	Model 05-Series PPS Belt -High Temp, High Flow	YES		Options below
			Model 0510 (estimated costs)		1	$8,200.00
			Model 0520 (estimated costs)		1	$12,800.00
			Model 0530 (estimated costs)		1	$14,250.00
			Model 0540 (estimated costs)		1	$17,100.00
3 Year	Gryphon Environmental		Leveler Section Chain and Sprocket	NO		
3 Year	Gryphon Environmental		Exit Table Brush Chain and Sprocket	NO		
5 Years	Gryphon Environmental		Chamber Wash Spray Nozzles	YES	>10	$45.00
5 Years	Gryphon Environmental		Belt Wash Spray Nozzles	YES	>5	$65.00
spare	Gryphon Environmental		6" Thermocoupler Assembly	YES	>5	$82.00
spare	Gryphon Environmental		32" Thermocoupler	YES	>5	$160.00
spare	Gryphon Environmental		Heater Lid Gasket Set 10x10	NO		$950.00
spare	Gryphon Environmental		Duct Clamps (multiple sizes)	YES	>5	$17-49
spare	Gryphon Environmental		Injection Plate Gasket Set 5x10	NO		$1,760.00

Sample Extended Maintenance Agreement

Extended Warranty Agreement
Standard Terms and Conditions

SECTION ONE - PARTIES

Seller: Gryphon Environmental, LLC
2920 Fairview Drive
Owensboro, KY 42303

Purchaser: _____
Address: _____
_____
_____
_____

All written notifications and communications subject to the Extended Warranty shall be sent or copied to the Primary Contacts, listed as:

Seller: Chad Estes (chad@2gryphon.com) and Mike Fritchley (mfritchley@2gryphon.com)

Purchaser: _____(email)_____
_____(email)_____
_____(email)_____
_____(email)_____

Approved Communications: Changes to the Primary Contacts may be made with the same notification proceedures. Although Text, voice calls or other forms of communication may be used in relation to the Extended Warranty, Seller and Purchaser agree that only email and written notifications shall be considered formal notification.

SECTION TWO - EQUIPMENT

SAMPLE ONLY

The Equipment shall be defined as: Gyphon Model # 1040 Dryer, Serial Number GRY-16-1040-07; With Major Components and Model/Serial Numbers BLOWER #21510; BURNER #118146; BURNER COMBUSTION FAN #Z1506020150; WASH PUMP #C231554-01J61; WASH PUMP MOTOR #Z1608181462; BELT #GKD-0008717; MAIN DRIVE #BT163202187; MOISTURE METER #466-100-1PA-RS5; HMI PANEL #HMIGTO5310; DRIVE VFD #ATV630C16N4; ENTRY FEED VFD #ATV930D11N4; 20HP VFD #ATV630D15N4; SIFTER VFD #ATV930U75N4; CIRCUIT BRKR #LLL36600U31X; CONDENSER COIL #0816-B15657.

'NEW' CONDITION: The Seller and Purchaser acknowledge that the Equipment is sold NEW.

SECTION THREE – OPTIONAL EXTENDED WARRANTY

Please note that any warranty services or questions must be accompanied by the order number from the transaction through which the warranted product was purchased. ***The order number serves as your warranty number and must be retained.*** GRYPHON will offer no warranty service without this number.

As part of the purchase of a new Model _____ Dryer, an Optional 3-year parts and limited labor warranty will be available at the rate of 3.75% of the Original Capital Purchase Price (excludes engineering and installation services costs). The warranty begins at the first anniversary of the

original shipment and will not automatically be passed along to second owners. The decision to repair or replace any part will be made by GRYPHON management only.

Parts Warranty: In the event of a problem, the customer contacts GRYPHON with situation. GRYPHON's service technicians will provide over the phone and remote diagnostics trouble shooting measures to resolve situation for which the customer is responsible for executing all required troubleshooting steps to determine the problem. Once problem is determined, GRYPHON will send any replacement part(s) required to customer at no charge for the part(s). Customer is responsible for freight for all parts and if expedited freight is required they must specify. *See below for individual part warranty breakdown*. The customer is responsible for labor for installing the new parts(s) and is required, if necessary, to send damaged parts back to GRYPHON. In the event that a replacement or repair is deemed to require GRYPHON technicians, GRYPHON will provide the required technician at no cost to the customer. The customer will be invoiced for any replaced components and credit will be issued upon return of the defective component to GRYPHON unless otherwise agreed upon by GRYPHON.

LABOR WARRANTY: Labor is not included as standard with any part of the warranty unless agreed upon ahead of time by GRYPHON management. During the 3-year Extended Warranty, if a problem occurs and all trouble-shooting efforts have been fully performed and exhausted by the customer and the problem still persists, GRYPHON will send in a technician to the customer's facility to resolve the problem. In this case, a helper may be required to aid our technician at no charge to GRYPHON. Labor to repair may be furnished at the customer's plant in the continental U.S. only and only if GRYPHON is in agreement that the problem is not due to improper use of the machine or wrongful tampering with the machine by customer or other entity.

The Three-Year Extended Warranty Covers The Following:

- Blower
- Natural Gas Burner
- Pneumatic cylinders and seals
- Drive components
- Shafts
- Bearings
- Motors
- Electrical items not related to PLC
- Sifter Brushes
- Leveler Brushes
- Exit Table Belt Brush
- Chamber Wash Nozzles
- Belt Wash Nozzles
- Lid Lift Assembly
- Ductwork (non-cosmetic)
- Belt-tracking Assembly
- Pumps
- Valves
- Structural integrity of non-removable parts of the machine
- PLC and Controls
- Fittings
- PPS Conveyance Belt
- Moisture and temperature sensors
- Chamber Skirt Seal Assembly
- Lid, chamber and Condenser Seals
- Condenser Coil (assumes proper maintenance and cleaning)
- Chains and Sprockets
- Thermocouples and Fittings
- Cooling Tower Assembly (if applicable)
- Insulation (non-cosmetic)
- Gas, pressure and flow sensors

Standard Replacement Parts: Certain components have Scheduled Replacements that shall be replaced on a manufacturer-recommended, scheduled basis. These components/parts are SUBJECT TO REPLACEMENT COSTS BY THE PURCHASER, unless repairs or replacements are deemed by GRYPHON to be necessary for the proper performance of the Equipment and prior to the scheduled replacement date, in which case, the components are covered under the Extended Warranty. GRYPHON reserves the right to forego replacement of components that show little or no signs of fatigue at the time of their scheduled replacement. At the time of the manufacturer-scheduled replacement, both replaced parts and parts deemed by Gryphon to not need replacement are covered under the Extended Warranty up to their next scheduled replacement date.

Annual Purchaser-Responsible Replacement Parts

- Below parts are replaced during the Annual GRYPHON onsite service call

- Sifter Brushes ($2,950)
- Leveler Brushes ($3,180 for both)
- Exit Table Belt Brush ($1,756)
- Belt Wash Nozzles ($2,300 for full set)
- Burner Flame Rod ($250)

Annual Service/Maintenance Site Visit Provided by GRYPHON Under Extended Warranty

- Onsite Technician (3-5 Days)
- Full Dryer Inspection
- Preventive Maintenance

Weekly Remote Maintenance / Diagnostics Provided by GRYPON Under Extended Warranty

- Remote Login (scheduled)
- System Loop Pressure and Flow review and recording
- Condenser differential review and recording
- Volatile gasses review and recording
- Thermocouple operability
- Temperature (system loop) review and recording
- Class-A certification data review and recording (temp, moisture)
- System alarm reviews and recording
- OTHER: as requested by client technicians.

Terms and Conditions of Extended Warranty

Shipping fees incurred from returns for under-warranty service in the first 90-days will be paid by GRYPHON. All shipping fees both to and from GRYPHON following this 90-day period must be paid by the Purchaser. All returns, both during and following the 90-day period, must be affected via the Procedures for Obtaining Warranty Service described below.

All original parts (parts installed by GRYPHON at the original system build or provided as replacement parts) replaced by GRYPHON or its authorized service center, become the property of GRYPHON. Any after-market additions or modifications will not be warranted.

GRYPHON makes no other warranty, either express or implied, including but not limited to implied warranties of merchantability, fitness for a particular purpose, or conformity to any representation or

description, with respect to the dryer other than as set forth in the Original Purchase Agreement between the parties. GRYPHON makes no warranty or representation, either express or implied, with respect to any other manufacturer's product or documentation, its quality, performance, merchantability, fitness for a particular purpose, or conformity to any representation or description other than as set forth in the Original Purchase Agreement between the parties.

Except as provided below, GRYPHON is not liable for any loss, cost, expense, inconvenience or damage that may result from use or inability to use the dryer. Under no circumstances shall GRYPHON be liable for any loss, cost, expense, inconvenience or damage resulting from misuse, failure of the Purchaser to complete timely maintenance, failure of components or systems not supplied by Gryphon, or events that are normally covered by the Purchaser's insurance (e.g. Acts of God).

The warranty and remedies set forth below are exclusive and in lieu of all others, oral or written, expressed or implied. No reseller, agent or employee is authorized to make any modification, extension or addition to this warranty.

Warranty Conditions

The above Extended Limited Warranty is subject to the following conditions:

1. This warranty extends only to products distributed and/or sold by GRYPHON, as defined above in Section Two - Equipment. It is effective only if the products are purchased and operated in the USA. (Within the Continental USA)
2. This warranty covers only normal use of the Equipment. GRYPHON shall not be liable under this warranty if any damage or defect results from (i) misuse, abuse, neglect, improper shipping or installation; (ii) disasters such as fire, flood, lightning or improper electric current; or (iii) service or alteration by anyone other than an authorized GRYPHON representative or trained Purchaser staff; (iv) damages incurred through irresponsible use, including those resulting from failure of Purchaser to perform proper and timely maintenance, or other non-recommended practices.
3. Maintenance Logs may be required for coverage under the Standard or Extended Warranty. Proper and timely maintenance are the full responsibility of the Purchaser. Parts or Service required due to the failure of the Purchaser to conduct proper and timely maintenance may void part or all of the Standard or Extended Warranty.
4. No warranty extension will be granted for any replacement part(s) furnished to the purchaser in fulfillment of this Warranty.
5. GRYPHON and its Authorized Service Center accepts no responsibility for any required service, replacement parts, maintenance or repairs resulting from Client modifications to the Equipment, including PLC coding, unless authorized in writing by GRYPHON.
6. All pre-installed and post-installation modifications to the software programs are copyrighted by and licensed to GRYPHON.
7. Warranty of parts may be void if Purchaser neglects to inform GRYPHON of component failures in a timely manner (within 48 hours following an alarm condition or discovery of failed component). Costs for repair or replacement of Parts/Components requiring repair or replacement due to neglect of the Purchaser to notify Gryphon in writing of related parts/components failure, shall be the responsibility of the Purchaser.
8. Warranty is subject to established sludge quality characteristics as defined in the Purchase Agreement.

Return of Non-Defective Products

A defective component may be returned to GRYPHON for replacement during the term of the Warranty for replacement. Replacement parts shall be shipped from GRYPHON or drop-shipped from the OEM provider. Lead-times for parts are subject to the available and potentially the fabrication/assembly time of Gryphon.

Recommended Spare Parts List

Client agrees to purchase and provide adequate storage of the following list of spare parts.

TBD – Examples Only

Item: PPS Belting Specs._____
Item: Relays and breakers Specs._____
Item: Burner spare parts Specs._____
Item: Spare PLC components Specs._____

A spare parts inventory ensures rapid replacement and limited down-time for repairs.

GRYPHON agrees to provide the on-site installation services for the following replaced components:

TBD – Examples Only

Item: VFD's Specs._____
Item: Minimum First Dryer PPS Belt Specs._____
Item: PLC or HMI Specs._____
Item:_____ Specs._____
Item:_____ Specs._____

APPENDIX J

KLEIN BELT DRYING SYSTEM PROPOSAL

NUMBER: 08000

DATE: 08/22/17

TO: Brooke Hamberger, E.I.T.
NUSSBAUMER & CLARKE, INC.
3556 Lake Shore Road, Suite 500
Buffalo, NY 14219-1494
716.827.8000 x. 242
www.nussclarke.com
bhamberger@nussclarke.com

REF: Belt Drying System

Budgetary Proposal
Lockport, NY – Belt Drying System

Centrisys Contact:
Alexander Kraemer
Regional Sales Manager
Centrisys/CNP
9586 58th Place
Kenosha, WI 53144
D: +1 (262) 328-7104
E: alexander.kraemer@centrisys.us

Centrisys Representative:
Mr. Rick Calmes
Manufacturers' Representative
G. P. Jager, Inc.
Buffalo/Rochester, NY Office:
10836 Partridge Road, Holland, NY 14080
D: +1 (716) 222-4101
E: rcalmes@jagerinc.com

Centrisys is pleased to provide this quotation for the following:

High temperature option

1.A Basic-Design

1.	Qty:	1
2.	Media:	Dewatered sludge from WWTP,
3.	Media Input:	approx. 929 lb/h
4.	Operation Time:	approx. 6,240 h/year
5.	DS-Concentration Inlet:	approx. 23 %
6.	DS-Concentration Outlet:	min.: 90 %,
7.	Evaporation Capacity:	approx. 761 lbs-H_2O/h
8.	Heat Source:	Indirect heating
9.	Sludge Dryer:	**One (1) Compact-Dry 2/2**

Low temperature option

1.ABasic-Design

1.	Qty:	1
2.	Media:	Sewage sludge from WWTP,
3.	Media Input:	approx. 929 lb/h
4.	Operation Time:	approx. 6,240 h/year
5.	DS-Concentration Inlet:	approx. 23 %
6.	DS-Concentration Outlet:	min.: 90 %,
7.	Evaporation Capacity:	approx. 761 lbs-H_2O/h
8.	Heat Source:	Indirect heating
9.	Sludge Dryer:	**One (1) Compact-Dry 2/3**

1.B Scope of supply

No.	Description
1	*Media Input*
	hopper on dryer feed pump, dryer feed pump, distribution unit, tubing from pump to distribution unit,
1	*Sludge Dryer*
	With ventilation system made up by fresh air fan, circulation air fans and exhaust air fan, dryer housing and air channels, insulation of air channels, heat exchangers for warm water
1	*Dry Product Discharge*
	dryer discharge screw, rotary valve, crusher, transition pieces
	Exhaust Conditioning
1	heat recovery unit, tubing for exhaust air (max. 16 Ft)

1	spray condenser unit, tubing for exhaust air (max. 16 Ft)
	Process Control
1	material for cabling, measuring equipment, sensors for operation and safety, switch cabinet form B1, control unit Siemens S7 and process visualization of operational components

ITEM 2 SERVICES

2.A <u>Drawings and Installation, Operation and Maintenance (IO&M) Manuals:</u>

1. Submittal Drawings: One (1) electronic copy included; prints by request
2. Final Drawings: Two (2) prints & One (1) electronic copy included
3. O&M Manuals: Two (2) prints & One (1) electronic copy included

2.B <u>Start-Up Assistance:</u>

Centrisys will furnish one factory representative to assist in installation inspection, start-up supervision, and operator training. Dates of service to be scheduled upon Buyer's written request.

<u>BUDGET PRICE:</u>

One (1) Compact-dry 2/2 ..... **$ 766,860.00**USD
One (1) Compact-dry 2/3 ..... **$ 1,030,140.00**USD

F.O.B. Kenosha-WI, freight included, taxes excluded.

VALIDITY:

Purchase Price is valid for sixty (60) calendar days from Quotation date, for shipment of Equipment within the timetable stated below in ITEM 4.

PAYMENT TERMS:

30% with order; 60% upon shipment; 10% after startup not to exceed 90 days after shipment.

ITEM 3 TIMETABLE

Submittal phase: 6-8 weeks after the order receipt
Approval phase: 3 weeks for the customer to approve the drawings
Shipment phase: 24-26 weeks following receipt of the Approval drawings

Dates are subject to confirmation upon receipt of written Purchase Order.

ITEM 4 WARRANTY

One (1) year from the equipment start up or eighteen (18) months from delivery.

ITEM 5 TERMS & CONDITIONS

All sales are subject to Centrisys' Terms & Conditions of sale found at the end of this document.

BUYER/OWNER RESPONSIBILITY:

- All utilities that are required for operation
- Unloading, uncrating, installation and installation supervision. Installation will, at minimum, require a forklift and possibly a crane/hoist.
- Readiness of the Equipment before requesting start-up service. Non-readiness may incur additional charges.
- Compatibility of Equipment materials of construction with process environment.
- Piping connections, platforms, gratings and railings unless stated otherwise.
- Any other auxiliary equipment or service not detailed above.

Issued by

Madhavi Batchu
Applications Engineer

Date:08/25/17

Roughly dimensioning of a dryer

Drying material: dewatered sewage sluge

	ENTER VALUE	
DS inlet	23,0%	-DS
DS outlet	90,0%	-DS
Dewatered sludge quantity	2.900	t/a
Operation hours	6.240	h/a
Hot air temperature[*1]	80	°C
Througput dryer	0,46	t/h
Water evaporation capacity:	346	kg-H_2O/h
Exhaust air from dryer:	6.100	m³/h
Specific thermal energy consumption	0,850	kWh/kg-H_2O/h
Specific electric energy consumption	0,090	kWh/kg-H_2O/h
Thermal energy consumption	294	kW
Yearly thermal energy consumption	1.835	MWh/a
Electricity consumption	31	kW
Yearly electricity consumption	194	MWh/a
Cost of heat	0,03	€/kWh
Cost of electricity	0,15	€/kWh
Haulage costs of dewatered material	10,00	€/t
Tipping costs of dewatered material	60,00	€/t
Yearly saving of sludge haulage costs	21.589	€/a

Yearly saving of sludge tipping costs	129.533 €/a
Yearly costs of thermal energy	55.052 €/a
Yearly costs of electricity	29.145 €/a
Yearly costs of chemicals	20.801 €/a
Yearly costs of man power	50,00 €/h
Costs of man power	13.000 €/a
Yearly costs of maintenance	9.677 €/a
Yearly savings (+) *2	151.122 €/a
Yearly operation costs (-) *2	127.675 €/a
Depriciation time	27,51 years

The required dryer is a	**Compact-Dry 2 / 3**
Price:	**645.150 €**

Footprint dryer*3:

Length	9,0 m
With	3,0 m
Height	4,7 m

*1 heat source temperature minus 10°C / maximum: 120°C hot air temperature

*2 water / waste water / chemicals / personnel not included

*3 only dryer

Roughly dimensioning of a dryer

Drying material: dewatered sewage sluge

	ENTER VALUE	
DS inlet	23,0%	-DS
DS outlet	90,0%	-DS
Dewatered sludge quantity	2.900	t/a
Operation hours	6.240	h/a
Hot air temperature[*1]	130	°C
Througput dryer	0,46	t/h
Water evaporation capacity:	346	kg-H_2O/h
Exhaust air from dryer:	1.700	m³/h
Specific thermal energy consumption	0,850	kWh/kg-H_2O/h
Specific electric energy consumption	0,090	kWh/kg-H_2O/h
Thermal energy consumption	294	kW
Yearly thermal energy consumption	1.835	MWh/a
Electricity consumption	31	kW
Yearly electricity consumption	194	MWh/a
Cost of heat	0,03	€/kWh
Cost of electricity	0,15	€/kWh
Haulage costs of dewatered material	10,00	€/t
Tipping costs of dewatered material	60,00	€/t
Yearly saving of sludge haulage costs	21.589	€/a

Yearly saving of sludge tipping costs	129.533 €/a
Yearly costs of thermal energy	55.052 €/a
Yearly costs of electricity	29.145 €/a
Yearly costs of chemicals	5.797 €/a
Yearly costs of man power	50,00 €/h
Costs of man power	13.000 €/a
Yearly costs of maintenance	6.452 €/a
Yearly savings (+) *2	151.122 €/a
Yearly operation costs (-) *2	109.445 €/a
Depriciation time	10,32 years

The required dryer is a	**Compact-Dry 2 / 2**
Price:	**430.100 €**

Footprint dryer*3:

Length	6,0 m
With	3,0 m
Height	4,7 m

*1 heat source temperature minus 10°C / maximum: 120°C hot air temperature

*2 water / waste water / chemicals / personnel not included

*3 only dryer

Process Description

Pro-Dry

Hot Water

(technical subject to change)

Sülzle Klein GmbH
Konrad-Adenauer-Strasse 194
57572 Niederfischbach
Germany

Phone: +49 (0) 2734 43480-0
Fax: +49(0) 2734 43480-130
Email: info@suelzle-klein.com

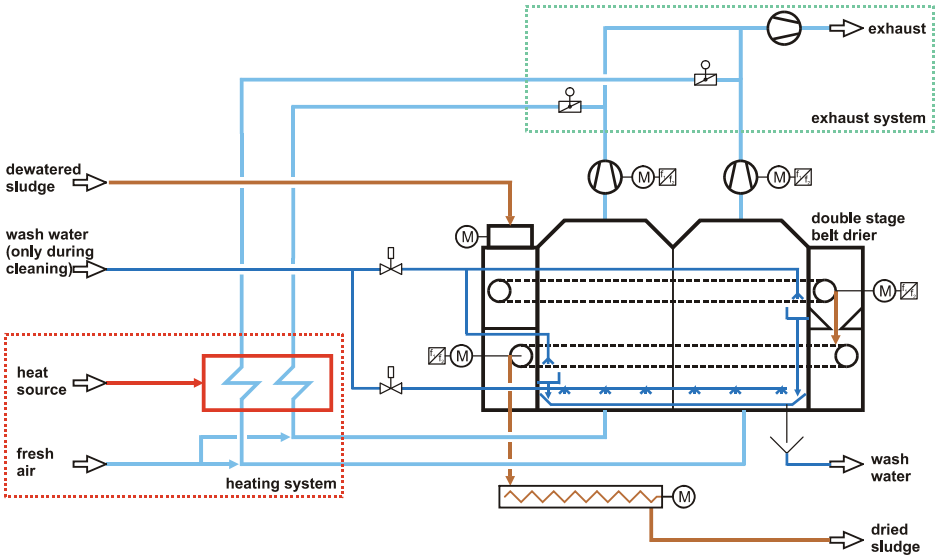
Process Description Pro-Dry HW

Pos. 1.: General Remarks

The Biosolids Drying Process with a Sülzle Klein Pro-Dry Belt Dryer consists of the following main process steps:

- Dewatered Sludge Input,
- Dewatered Sludge Feeding,
- Sludge Drying System,
- Heating System,
- Exhaust Conditioning,
- Exhaust Treatment,
- Dry Product Conveying.

A process diagram may look as follows:



In the drying building a dryer, the equipment for conveying wet sludge and dried product, the heat generation system, an air ventilation system as well as the exhaust conditioning and treatment system is installed.

Biggest part is the 2-belt dryer, which is equipped with a sludge input and feeding system, with a number of fans for ventilation and exhaust and dual gas burners for heat generation.

The exhaust gas of the dryer is conditioned in a heat recovery and spray condenser unit and is then sent to further treatment.

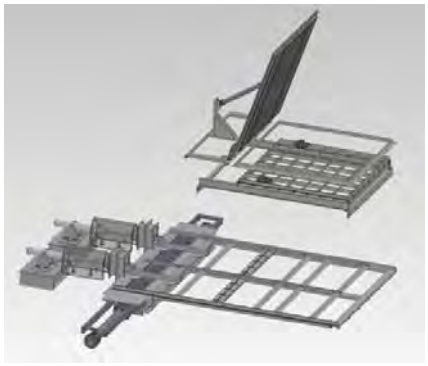
The dried granulate is discharged from the dryer and is transported towards a dry product silo or to an alternative storage solution.

Pos. 2.: Dewatered Sludge Input

The dewatered sludge from the WWTP is transferred by screw conveyors or eccentric screw pumps towards the wet sludge bunker.

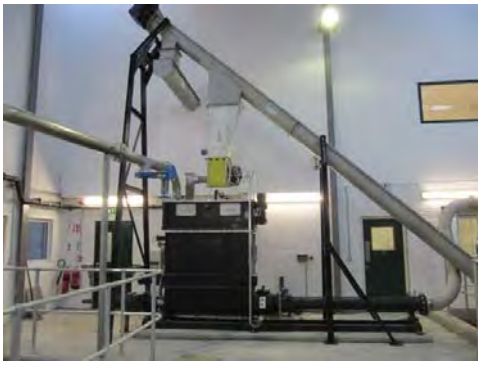
Sludge from other WWTPs in dewatered condition is received by trucks and is dumped into the wet sludge bunker. A hydraulically activated push-floor system transfers the sludge towards the eccentric screw pump designed as silo pump.

Then the sludge from the bunker and the sludge from the chute are pumped towards the dryer feed pump.



Pos. 3.: *Dewatered Sludge Feeding*

The dewatered sludge enters the dryer by help of the dryer feed pump. The pump is equipped with a double shaft mixer on top for blending the wet sludge with dry product. Blending is done to enhance the mechanical stability of the wet cake for a better distribution on the upper belt.



The Sülzle Klein Pro-Dry Belt Dryer is equipped with a special distribution system which produces a sludge bed on top of the upper belt which has a high surface area for a good and intensive contact to the heated drying air. The sludge bed has a high porosity for an equal air flow.

A variable belt drive with VSD-control allows an adjustment of the belt speed due to the throughput to achieve a similar and equal sludge layer on the belt.

Pos. 4.: *Sludge Drying System*

The dryer consist of the dryer body, the so called housing around the dryer and the air ventilation system. The air ventilation system is made up by an air circulation system directly around the dryer and the exhaust air channels.

Radial air fans inside the process air duct system provide a permanent recirculation of process air. A mayor part of the circulating hot air is recycled to the dryer and one smaller part is given to the exhaust air conditioning and treatment process.

By using two air fans per segment of the dryer the process air is distributed evenly when it passes the layer of sludge on the belts. Also a relatively low air speed is achieved that no dust can be sucked through the belts and no deposit of dust is created inside the dryer.

During drying process nearly no dust is produced and so no filter system is necessary to have an exhaust quality with a dust concentration of less than 3 mg/m³ of dust. The dust concentration is permanently monitored and a system of tray and belt cleaning devices can be used to keep the dryer free of particles and to avoid disposals.

A mayor part of the hot air is recycled to the dryer and one smaller part is given to the following exhaust air conditioning and treatment process.

After distribution, the layer of sludge moves slowly into the dryer through an air lock and is carried through the upper drying zone (upper belt).

The sludge layer on the upper belt has a height of approx. 70 mm and is adjusted by the speed of the distribution of the pelletizing unit. The upper belt is moved into the dryer in cycles. The distribution unit moves from one side of the belt to the other and at the turning positions the upper belt moves forward the length of the placed sludge layer. Using VSD-control for the belt drives an adjustment of the belt speed is allowed according to the throughput to achieve a similar and equal sludge layer on the belt.

At the end of the upper belt the sludge leaves the drying zone through an air lock again and is discharged onto the next lower belt, where it is conveyed slowly through the second drying zone composed of the lower belt.

During the drying process on the belts the sludge volume is reduced. At the same time the bulk density decreases.

A moisture sensor control is installed at the end of the lower drying zone to controls the remaining moisture in the dried sludge.

At the end of the lower drying zone (lower belt) the dried granulate is moved through a cooling zone. Here the dry product is cooled with fresh air. For this purpose an air flow is floating through the dry material. Under normal operation conditions, temperatures of approx. 40 °C of the dry product will be achieved by using ambient air with a temperature of 20° C. In summer, the temperature of the dry product will be slightly higher.

The retention time of the bio solids inside the dryer will be high enough to produce a valuable with constant high quality as: high ds-concentration, class A due to US EPA norms, very little amount of dust and easy to handle dried product.

After drying the dry product leaves the dryer and is discharged into a conveyor.

A sprinkler system is available to avoid fire and explosion risks. In the unlikely case of an high dust concentration permanently monitored by a dust sensor or of temperatures above a safety level of 150 °C the sprinkler system opens and keeps the dryer in safe conditions. In the case of a high dust concentration the recirculating air fans are stopped to prevent dust to be transported through the system. There is a demand of a fail safe water supply to the sprinkler system.

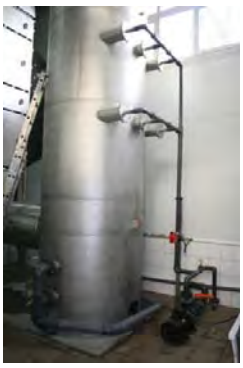
Pos. 5.: Heating System

The process air cycle of the dryer is heated with a set of heat exchangers besides the dryer body operated with hot water from CHP-units situated on the WWTP. The temperature of the process air is kept always in safe range below every ignition temperature level by several temperature sensors. For maintenance and inspection the dryer housing may be entered after the dryer has been shut down. Burners for biogas or natural gas can be used as an alternative as well.

Pos. 6.: Exhaust Air Conditioning

The exhaust conditioning process step is equipped with a heat recovery and a spray condenser unit. In the heat recovery unit a portion of the heat content in the exhaust air is transferred into the fresh air, which is then distributed into the dryer.

In the condensing stage a spray condenser cools down the exhaust air to approx. 40 °C using process water and a portion of odour as well as dust is captured. The condensate and the sprayed water will be collected in the bottom of the condenser to be drained. An exhaust fan sucks the exhaust gas out of the dryer and so the total system is kept under a light low pressure (vacuum) to avoid diffuse emissions of odour into the drying building.



Pos. 7.: Exhaust Air Treatment

After the exhaust conditioning stage the exhaust air passes a two-stage chemical scrubber system with an acidic and caustic stage for the removal of critical substances.

The exhaust air is treated with oxidative elements (acidic solution) which absorb and oxidize many of the organic content materials. Additionally several alkaline connections (amines) are separated in this stage as well.

In the alkaline stage the sour gases are removed by neutralization with caustic soda solution.

The bio filter is used for biological treatment of the remaining odour causing components of the exhaust air, before the exhaust air is emitted to environment

Pos. 8.: Dry Product Conveying

The dried sludge is discharged out of the dryer into discharge screw followed by a rotary valve sealing the dryer against atmosphere. The DS-concentration of the dried product is measured all the time to guarantee the proposed outlet-DS-concentration, i.e. 90 %.

Screw conveyors transfer the dried product into a small storage hopper. A part of the dry product from the dryer discharge will be mixed with wet sludge in a double shaft mixer to blend the de-watered sludge. By blending wet sludge and dry product the mechanical stability of the sludge will be improved. Improving the mechanical stability leads to better drying properties.

The dried product is then released by help of another discharge screw attached to the hopper. Subsequent conveyors for truck loading or a pneumatic feeder for silo storage may follow.

Unique selling points of the Sülzle Klein Dryers in comparison with other dryers:

1. *Segments:*

Sülzle Klein dryers are built segment wise and so it is easy to extend them in future.
All parts of the plant being contact with the product or the polluted air are made of stainless steel. Expected the belt.
The dryer is easy to maintain and easily accessible. The heat exchangers in the inside of the plant are available for cleaning from both side.

2. *Feeding of the wet sludge*

The feeding is going on continuously driven by a sludge pump and an extruder. We increase the surface of the dryable sludge. The product is dust free. (if you feed with a screw you will get a lot of dust!) our feeding system is completely covered in order to minimizing of the false air. The distributor is driven by a chain. The feeding will be done by an exocentric screw pump.

3. *Crusher*

The dryer has a crusher for preparing of the materials in the inlet.

4. *Air technique*

The amount of the circulated air as well as the temperature can be regulated in each of the segments in order to increase the energy efficiency of the plant.
In in- and outlet we operate the dryer under low pressure in order to avoid smelling and condensation. This pressure is controlled and adjustable.

5. *Dryer belts*

Sülzle Klein used to use permeable belts made by plastic, because it has a lot of advantages in comparison with metallic belts such as less dust production, longer durability, easy cleaning. Belt width is between 2,5-3,00 m

6. *Quality of the dried material*

The DS content of the material is always above 90% in order to avoid auto ignition phenomes in the silo of the dried material.
The spread of the grain size of the particles is tight. We achieve a dusty (x < 0,1 mm) content of less than 1,0 %.

7. *Monitoring of the quality of the dried material*

We monitor the quality of the dried material continuously. If the humidity of the material is getting above of a certain value, the plant takes some actions in order to avoid discharging of wet materials.
We also monitor the temperature of the dried materials. Temperatures over 50 °C exclude the storage of the materials in the silo.

8. *Cooling of the granulate*

We have an active cooling system of the granulate in our plants in order to cool down the granulate below the 50°C mark in order to avoid a condensation of the rest water in the silo.

9. *Cleaning*

Our dryers are equipped with automatic cleaning devices (belt and walls).

10. *Safety devices*

We have an emergency cooling for the case of a locally overheating of the sludge.
The monitoring of the overheating of the sludge will be done by continuous Dust- and smoke detection with

two independent methods: spread light measurement AND temperature measuring.
In case of exceeding of the limit the sludge will be flooded by water in the dryer.

11. *Heat recovery.*

We always achieve a heat recovery value of at least 60 %.

12. *Discharge*

Discharge will be done by a discharge screw to minimizing false air

13. *Back mixing*

There is a possibility to install our own back feeding system in order to handle also not complete dewatered sludge. The dryed sludge will be given to the initial sludge at the beginning of the process.

APPENDIX K

BURCH BIOWAVE DRYING SYSTEM PROPOSAL

PROJECT FEASIBILITY EVALUATION

Lockport, NY
2017

Submitted By:
Burch BioWave, Inc.
October 16, 2017

BURCH BIOWAVE® PROCESS OVERVIEW

Burch BioWave® is a patented process utilizing industrial microwave equipment to dehydrate and treat mechanically dewatered biosolids. The Burch BioWave® is a process that is recognized by the USEPA as a process capable of producing Class A biosolids by reducing pathogen content to levels beneath detection. Additionally, the BioWave® process is capable of producing Exceptional Quality biosolids by meeting one of two drying options (Option 7 or Option 8) of the Vector Attraction Reduction criteria as defined and published by the USEPA in the 503 sludge regulations.

The Burch BioWave® process uses a unique combination of microwave power and heated air to dry mechanically dewatered biosolids up to and exceeding 90% dry solids. The process can be adjusted to achieve any desired dry solids content in the product up to and sometimes exceeding 90%. Systems are custom sized based on throughput needs and the amount of water to be removed.

Burch BioWave, Inc. works only with highly knowledgeable and long established manufacturers of industrial microwave equipment for the production of their systems. Burch BioWave® combines the extensive knowledge and experience of their staff in the by-product management industry with unique experience and engineering capabilities of microwave systems to offer the highest quality equipment, knowledge, and support to their customers.

Burch BioWave® microwave systems are modular and are comprised of three main components: the applicator (or oven) unit, the microwave generators (transmitters), and control panel complete with touchscreen technology and system programming. Each transmitter is capable of producing up to 100 kWh of microwave power. Each applicator unit is comprised of up to four (4) separate cavities. Each cavity is specifically sized to accept and handle a certain amount of microwave power. Systems typically contain multiple cavities and transmitters. Cavities are manufactured with flanges that bolt directly to the next cavity. Microwaves are transmitted through special aluminum waveguide ducts from the transmitters to the applicator unit. The entire operation is controlled from one touchscreen on one main control panel.

A fourth component is sometimes incorporated into the process, particularly when the desired end product is expected to contain very little remaining moisture (85% TS or above). In these cases a compact gas-burning finish dryer that is added in sequence to the end of the microwave process. It is used to help eliminate any remaining vapor escaping the product. The operation of this finish dryer is incorporated seamlessly into the overall continuous-flow process.

Small System Overview (375 kW)

High Quality Finished Product

LOCKPORT REQUIREMENTS

The following design criteria was used to determine the size / type of system required:

Equipment Sizing Information:

Scenario #1 Design Criteria (English Units):
2900 Wet Ton per Year
Initial Solids Concentration: 23% average
Final Desired Solids Concentration: 90%
Unit would operate 24 hours per day, 5 days per week

	23% TS INPUT
CALCULATED THROUGHPUT	0.50 Wet Tons per Hour Total
MICROWAVE POWER REQUIREMENT	90 kWh per Hour
SYSTEM SIZE	150 kW plus gas finish dryer
QUANTITY	1 Complete System

System Information

Burch BioWave 150 kW Biosolids Processing System with Finish Dryer
Maximum Microwave Power Production: 150 kWh
Maximum Moisture Removal Rate: 894 pounds per hour

The system will not need to run at full power to meet the throughput criteria provided – refer to section titled 'Operating /Maintenance Costs'

PROCESS FLOW

Microwave drying systems can be tied directly to the output of the belt filter presses or other mechanical dewatering systems. Conveyors (not supplied by Burch BioWave) can be used to transfer material from the beltpress output to the input hopper of the microwave. Alternatively, the BioWave® system can be operated independently of the mechanical dewatering process when cake sludge is fed to the system from a storage area.

Burch BioWave® recommends placement of the microwave system as close as possible to the mechanical dewatering system if both systems are to run simultaneously. This simplifies the operation and minimizes the labor required to manage both systems.

The Burch BioWave® process does not require any additives and does not recycle any material. The material, once inside the input hopper for the microwave, is distributed on the main microwave belt and is simply run through the applicator oven, and the finish dryer when applicable, where it emerges at the output end thoroughly processed.

EQUIPMENT RELIABILITY / OPERABILITY

Microwave equipment has very few moving parts so it's inherently reliable. Moving parts in the Burch BioWave® system are limited to two conveyors both relatively slow moving. A cooling pump within the microwave transmitter housing and a hot air blowing system comprise the balance of the mechanized parts. All other equipment is electrical in nature, motors to drive pumps and blower, components used to create the microwave energy, and a PLC control system. This design creates a system which is failure free for long periods of time.

Minor equipment failures are normally limited to the microwave generation equipment (transmitters). There are two components within the transmitter that do wear out—the magnetron and diodes. But transmitters are redundant in the design of the overall drying system. Usually two or more are incorporated into a system. If one does go down for maintenance the overall system can continue to treat product - albeit at a reduced throughput rate.

Restoring the equipment from a failure is very easy. The PLC based control system provides operators with diagnostic capabilities through the operator's interface screen so determining the problem can normally be done quickly. Magnetron or diode replacement, two wear items noted above, are simple operations that require less than two hours to complete.

The microwave drying system is simple to operate. All operations are integrated into the operator's interface panel. The system is controlled by one person through a ten inch color touch screen. Multiple languages can be supported.

The normal recommended maintenance is a daily cleanup of the microwave cavities to remove any product that may remain in them. This should typically take 15 minutes and can be accomplished easily with one person using a garden hose or shop vacuum.

The microwave system is warranted for a period of one-year from start-up, or 18 months from delivery, whichever occurs first. The only two items not covered in this warranty are the magnetrons and belting. Most magnetrons are warranted for the first 3,000 hours of use and have an expected lifespan of 8,000 – 10,000 hours. Replacement magnetrons are easily and quickly obtained from Burch BioWave. It is not advised that spare magnetrons be stocked by the Owner because non-usage can affect their lifespan. Belting is not warranted, but is also quickly and easily obtained when needed. The Owner could easily store a spare belt if desired.

IMPLEMENTATION

The amount of energy required to dry a given product is well documented so system sizing can be quickly established with confidence. The microwave drying system is modular in design. Microwave transmitters and cavities can be quickly configured into a design depending on required throughput rates. Additionally, the modularity of the BioWave® systems allows for simple expandability of the systems if increased future demands require.

Programming of the system uses an Allen Bradley platform and is easily incorporated into existing plant operating systems. The BioWave® system can be integrated with the operation of the plant's belt presses or other mechanical dewatering processes to maximize the automation of the entire dewatering/drying process.

Because the BioWave® does not agitate the biosolids in any way, there is no dust to contend with. Though an odor control system is not often required and is not provided with Burch BioWave® equipment, odor control can easily be achieved and implemented with a simple carbon filter system if the owner desires.

The Burch BioWave® process is a simple operation. There are no lengthy start-up or shut-down procedures. The belt is simply loaded with material, the microwave transmitters are turned on, and the system is ready to process. Likewise, for shutdown, once the belt is empty, the microwave transmitters are simply shut off and cooled for a few minutes. Because the oven is not required to reach a certain temperature prior to processing, the system is ready to process material almost immediately upon start-up. And because heat is generated within the material, and not within the oven cavity, the inside of the cavity can be accessed at any time once the transmitters are shut-off – there is no required cool down period and no danger to operators.

CHP GENERATOR/MICROWAVE COMBINATION OPTION

Combining the Burch BioWave microwave dryer with a packaged CHP system provides an innovative solution to the process of dewatering solids. It addresses these two primary challenges:

- The BioWave process is very effective but the cost of grid-power electricity challenges the economics in most areas.
- Gas-fired distributed generation has received a slow adoption due to the challenges of matching the waste heat use as well as customers concerns about loss of power to mission-critical circuits.

A CHP-power BioWave system would address the two issues above and it would provide a unique set of competitive advantages to a wastewater plant that needs product drying. There is no other unit on the market that has the versatility of drying rates, affordable capital costs, back-up power generation, demand-side-management and quality of end-product. This is a great product offering that also appeals to sustainability-minded customers . There is NYSERDA funding available to help on capital cost of the generator and well as credits for excess electricity produced by generator and can be used to power the WWTP during outages.

Natural gas

KRAFT ENERGY SYSTEMS
COMBINED HEAT AND POWER

KN 285
indoor

engine model	E 3262 E302
generator model	LSA 47.2 VS2
electric output	285 kWe
Amps @ 600V @ 0.8 P.F.	343 Amps
Amps @ 480V @ 0.8 P.F.	429 Amps
Amps @ 208V @ 0.8 P.F.	989 Amps
fuel consumption (LHV)	2,644,000 BTU/hr
max. engine BHP	402 BHP
no. of cylinders / arrangement	12 / V
bore & stroke	5.20 × 6.18 in
displacement	1573 cu in
BMEP	113.1 psi
compression ratio	12 : 1
ventilation air required	8000 SCFM
electric efficiency	36.8 %
thermal efficiency	52.5 %
combined efficiency	89.3 %

KRAFT ENERGY SYSTEMS

MAN

Balance Data Sheet
KN 285 Outdoor

KRAFT ENERGY SYSTEMS
COMBINED HEAT AND POWER

E 3262 E302 – natural gas, 1800 rpm

% load	100%	75%	50%
Air – fuel ratio	λ = 1.0	λ = 1.0	λ = 1.0
Fuel consumption in LHV[1] [kW]	775	619	466
Fuel consumption in LHV[1] [BTU/Hr]	2 643 509	2 112 234	1 591 289
Max. mechanical power [kW]	299	225	152
Max. mechanical power [BHP]	402	302	204
Electric heat rate* [MJ/kWhe]	9,79	10,42	11,78
Electric heat rate* [BTU/kWe-Hr]	9 275	9 881	11 166
Alternator efficiency – LSA 47.2 VS2 (480 V; 60 Hz)	95,2%	94,8%	93,7%
Generator electric output [kWe]	285,0	213,8	142,5
Internal el. consumption – year-round average [kWe]	7,6		
Net electrical output [kWe]	277,5		
Thermal output – total heat recovery [kW]	407	340	274
Thermal output – total heat recovery [BTU/Hr]	1 388 784	1 160 631	933 513
Heat recovered from jacket water [kW]	239	213	184
Heat recovered from jacket water [BTU/Hr]	814 792	727 465	627 283
Heat recovered from exhaust [kW] [2]	168	127	90
Heat recovered from exhaust [BTU/Hr] [2]	573 992	433 166	306 230
Electrical efficiency*	36,8%	34,5%	30,6%
Thermal efficiency*	52,5%	54,9%	58,7%
Combined efficiency*	89,3%	89,5%	89,2%
Combustion air flow [kg/h]	950	760	572
Combustion air flow [scfm]	432	345	260
Exhaust temperature [°C]	639	609	580
Exhaust temperature [°F]	1 182	1 129	1 076
Exhaust gas flow [kg/h]	1 006	805	606
Exhaust gas flow [Lb/Hr]	2 219	1 775	1 335
Radiant heat [kW]	39	31	23
Radiant heat [BTU/Hr]	132 175	105 612	79 564

[1]) Lower heating fuel value [BTU/cf]	868	*LHV
Higher heating fuel value [BTU/scf]	970	HHV
[2]) CHP exhaust outlet temperature [°C]	120	
CHP exhaust outlet temperature [°F]	248	

Technical data based on ISO 3046.
Standard reference conditions:
Pressure 100 kPa, temperature 25 °C, relative humidity 30 %
Pressure 14.5 psi, temperature 77 °F, relative humidity 30 %
Tolerance for fuel consumption +5 %
Tolerance for heating outputs data ±8 %

Burch BioWave with 285KW generator @ 75% 21 hours/day unit Process Flow
Daily Operation Numbers

2,748 Gallon/Day
Urea Water

Output

15.8
Tons/Day
26% Solid Cake

Input

Moving Belt Microwave Oven

4.4
Tons/Day
92% Solid Cake

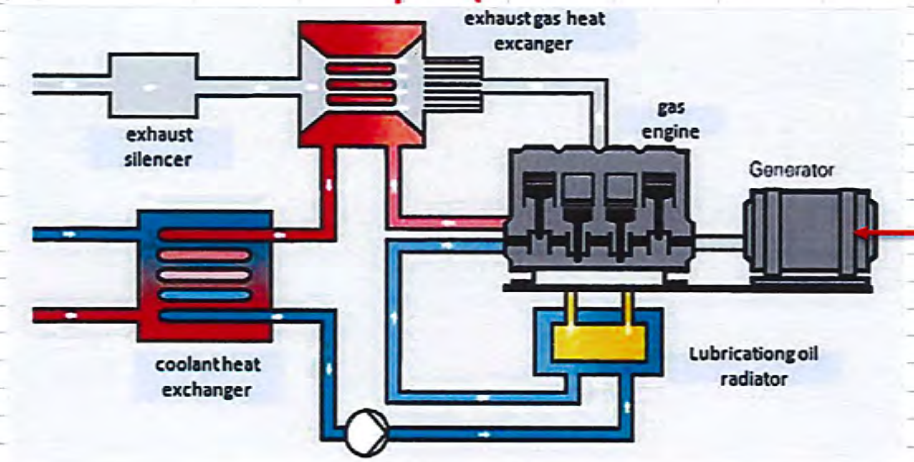
Output

Input

Input

4,494 KWhrs/Day
Power Requirements

18 MMBTU
Daily Thermal Requirement



2.20 MCFH
Gas Input

Key Metrics Used for Sketch

Microwave drying				
KWhr/lb of water removed	0.33			
BTU/lb removed microwave	1,126	BTU/lb		
Heat blanket required	492	BTU/lb		
	1,618			
Waste Heat				
Incoming temperature	60			
BTU/lb removed convectively	1,122			
	1,182	BTU/lb		
Available power	214	KW		
Available waste heat	0.84	MMBTUH		
			KWhr/MMBTU	293.08
Heat blanket requirements	318,771	BTU/Hr		
			% by mode	% of delta
Microwave water removed	648	lbs/hr	60%	39%
Convective evaporation	439	lbs/hr	40%	27%
	1,088	lbs/hour	0.54	tons/hour
Incoming percent solids	26%			
Desired percent solids	92%			

OPERATING COSTS

Microwave energy is the most efficient means to heat a load, assuming the load will couple with the energy. This isn't a problem in drying applications that contain water since a water molecule is a perfect dipolar molecule that produces ideal coupling conditions. No microwave energy is wasted through convection or conduction of heat; it is all used to heat the water molecule through friction and heat is generated volumetrically.

Because heat is generated from within the material being processed, there is no warm-up or cool-down period required for the system. The system can process material from the very second that it is powered on consequently reducing wasted energy consumption.

Microwave energy production is also very efficient. Only a small portion of the electrical energy used is lost to heat. The amount of energy required is directly related to the amount of water to be removed.

The cost associated with the energy consumed is largely related to the local cost of electricity since electricity is, by far, the major form of energy used by the system.

There is a certain amount of fossil fuel used—propone or natural gas—to provide heated air to enhance steam removal by means of a burner located at the output end of the system. It is also necessary for the finish dryer component, if incorporated.

There are no chemical additives required and the entire process typically requires 1 or 2 trained operators (depending on the system size).

Calculations based on operating system 6,240 hours per year and processing 2,900 wet ton.

Burch BioWave Stand-Alone System (w/o CHP Generator)

Total Electric Consumption	561,600 kWh
Estimated Electric Cost/Wet Ton	$21.49
Total Gas Consumption	59,030 Therms/year
Estimated Gas Cost/Wet Ton	$3.70
Estimated Maintenance Cost/Hour	$8.00
Maintenance Cost/Wet Ton	$17.21
Total Cost/Wet Ton	**$42.41**

Burch BioWave System with CHP Generator

Total Gas Consumption	131,801 Therms
Estimated Gas Cost/Wet Ton	$8.32
Estimated Electric Cost/Wet Ton	$0.00
Estimated Maintenance Cost/Hour	$12.00 (*includes one major engine overhaul for 10 years of operation.)*
Maintenance Cost/Wet Ton	$25.82
Total Cost/Wet Ton	**$34.14**

REPAIR & REPLACEMENT

The microwave drying system is constructed of stainless steel, a very durable material that withstands attack from virtually all chemicals and materials present in biosolids.

Because the BioWave® system contains very few moving and wearing parts, maintenance costs are low compared to other mechanical systems. Replacement parts can be easily and quickly obtained through Burch BioWave, Inc.

Industrial microwave systems have been used for over thirty years. Over 2,000 microwave transmitters are currently in use worldwide providing energy for drying and heating applications. The technology has been proven to be very robust.

The customer's operators are trained by BioWave® representatives during equipment start-up on preventative maintenance to maximize the life of all equipment and parts and to minimize replacement and repair costs.

740-694-9146 (phone)
740-694-4188 (fax)

17860 Ankneytown Road
P O Box 230
Fredericktown, OH 43019

Michael R. Burch, President
Patricia A. Burch, Secy.-Treas.

September 19, 2017

To: Nussbaumer & Clarke
Brooke Hamberger

Re: Lockport NY

Budgetary Quote No. 20170919

Thank you for the opportunity to quote your byproduct drying needs. Burch BioWave is pleased to offer the following:

	BURCH BIOWAVE DRYING SYSTEM	***BBM-150***
	No. of Lines Required	***1***
		Quantity
	Standard System Components	
	75 kW Transmitter	*2*
	12' Oven Cavity w/ Door	*1*
	Modular Polypropylene Belt	*1*
	In-Feed Assembly	*1*
	4,000 CFM Exhaust Fan on VFD	*1*
	Outlet Table	*1*
	Waveguide Allowance (15', 3 bends per transmitter)	*1 LOT*
	Oven Cavity Gas Burner	*1*
	Finish Dryer with gas	*1*
	Complete PLC	*1*
	Standard Warranty	*Included*
	Standard System Price	***$399,700.00 USD***
	Optional CHP Generator	
	Delete Oven Cavity Gas Burner &	***($57,700.00) USD***
	Add CHP Generator & Components	***$768.470.00 USD***
	Total System with ALL Options	***$1,110,470.00 USD***

Shipping costs are not included in this quotation.

Startup and training will depend on the specific requirements of the buyer and will be charged at a standard daily service rate plus travel and living expenses to be billed as incurred.

Additional waveguide lengths, if required, can be provided at an additional cost.
Spare parts can be provided per buyers specifications for additional cost.

Customer is responsible, prior to commissioning, for the following:

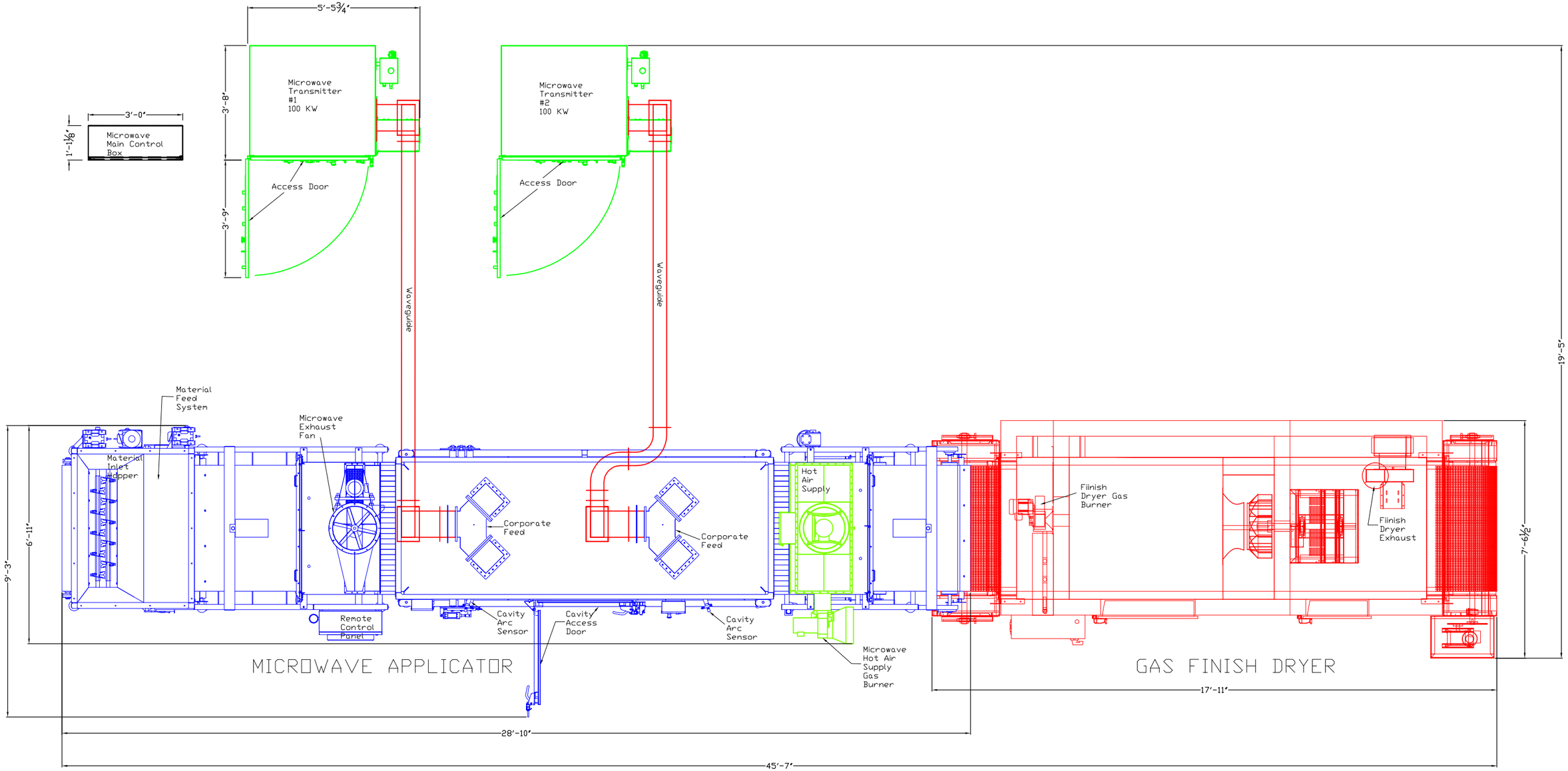
- **Equipment layout and installation (except generator installation which will be by manufacturer)**
- **Connection of electrical and plumbing service to the equipment and ensuring the quality of service. Burch BioWave will perform final wire terminations.**
- **Ensuring main electrical service of 3 Phase 480 V 50/60 Hz with a standard +/- 5% constant supply. If the local electrical service does not meet this requirement, please contact us with your local service specification.**

ALL PRICES QUOTED ABOVE ARE IN US DOLLARS. TAXES AND FREIGHT ARE NOT INCLUDED. PRICES ARE BUDGETARY ONLY.

All sales are subject to Burch BioWave's standard Terms and Conditions.

This proposal excludes the following:

- Exhaust ductwork beyond the BioWave blower flange
- Waveguide support hangers
- High voltage & low voltage wiring, communication wiring, conduit including that used for interconnection of the transmitters to the control panels and to the applicator



BBM150 with Finish Dryer Plan View

UNLESS SPECIFIED OTHERWISE:
ALL DIMENSIONS ARE IN INCHES.
REMOVE ALL BURRS & SHARP EDGES.
TOLERANCES:
X.X ±.06 ANGULAR = ±1°
X.XX ±.03 FRACTIONS =±1/8
X.XXX =±.010 SURFACE FINISH = 63?

MAT'L: SEE BOM

WEIGHT: NA lbs

THIS DRAWING INCORPORATES THIRD ANGLE PROJECTION

DO NOT SCALE THIS DRAWING

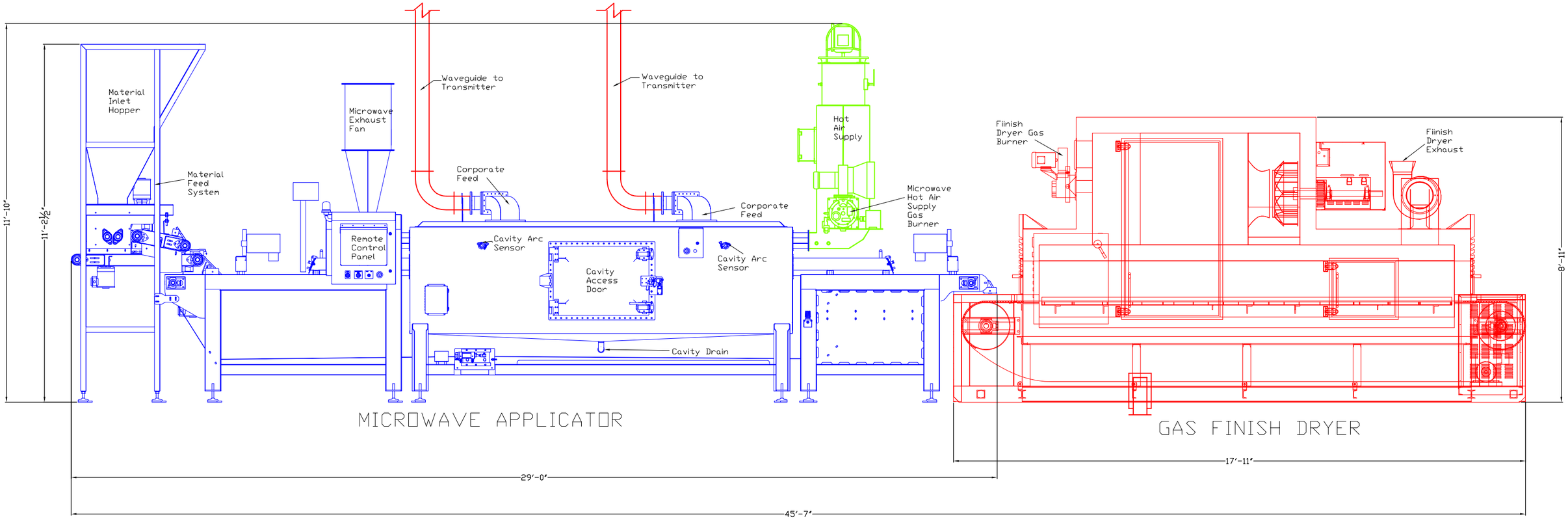
Burch Biowave
17860 Ankneytown Road
Fredericktown, OH 43019

DRAWING TITLE:
BBM200 with Finish Dryer

DRAWN BY: BMB
CHK'D BY:
APP'D:

DATE: 10/14/14	SCALE: Not to Scale	SHEET 1 OF 3
6X307	B	BBM200G-1 A
CODE IDENT.	SIZE	DRAWING NO. REV

4 3 2



BBM150 with Finish Dryer Section View

UNLESS SPECIFIED OTHERWISE:
ALL DIMENSIONS ARE IN INCHES.
REMOVE ALL BURRS & SHARP EDGES.
TOLERANCES:
X.X ±.06 ANGULAR = ±1°
X.XX ±.03 FRACTIONS =±1/8
X.XXX =±.010 SURFACE FINISH = 63?

MAT'L: SEE BOM

WEIGHT: NA lbs

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DO NOT SCALE THIS DRAWING

Burch BioWave
17860 Ankneytown Road
Fredericktown, OH 43019

DRAWING TITLE:
BBM200 with Finish Dryer

DRAWN BY: BMB
CHK'D BY:
APP'D:

DATE: 10/14/14	SCALE: Not to Scale	SHEET 2 OF 3
6X307	B	BBM200G-2 A
CODE IDENT.	SIZE	DRAWING NO. REV

4 3 2

APPENDIX L

ENGINEERING REPORT CERTIFICATION

APPENDIX M

SMART GROWTH ASSESSMENT