Introduction

All dairy farms, regardless of size, generate milking center wastewater from both the milking parlor and the milk house. Each milking cow generates 3.5 to 11 gallons/day/cow of milking center wastewater. This wastewater typically contains low concentrations of manure, milk residue, and food grade cleansers, but high concentrations of nutrients and bacteria (Safferman, 2008). Unlike manure which contains economically usable levels of crop nutrients, milking center wastewater has no practical value.

A standard disposal practice for milking facility wastewater is to store it in a manure storage facility and land apply at agronomical rates. This waste can occupy a significant portion of the facility’s volume. The challenge of managing milking center wastewater is compounded for farmers who manage their dairy manure as a solid. Without a liquid manure storage facility the farmer has few options other than frequent hauling to crop fields or conventional septic systems. These disposal options have significant drawbacks; the expense and environmental risk of excessive runoff from waste hauling and septic system failure due to clogging caused by the milk fats and suspended solids. Since the vast majority of farms with fewer than 100 milk cows manage manure as a solid, these challenges fall disproportionately on smaller dairy farms. This is a widespread concern, since small dairy farms (less than 200 milk cows) represented approximately 85 percent of Michigan dairies in 2007. These smaller and usually older and less well-financed dairy farms need environmentally sensitive waste management options that are affordable and easily operated and maintained.

The basic functional principles of the Michigan filter mound for treating milking facility wastewater may be summarized as follows:

1. Milking center wastewater passes through a series of settling tanks to filter and capture solids and milk fats - - pretreatment. The solids are periodically pumped out of the tanks and typically land applied at agronomic rates. Commercial size effluent filters located at the outlets to the settling tanks enhance their pretreatment function.

2. Settled wastewater is dispersed through pressure dosing within the bark media into an infiltration area sized according to water volume generated and soil type. The bark media:
   • treats the wastewater prior to infiltration into the top soil
   • permits oxygen penetration to promote aerobic microbial treatment,
   • insulates the infiltration area to prevent freezing, and
   • minimizes offensive odor generation due to sorption by the organic matter.
3. The soil column beneath the mound, including the top soil, provides the further treatment (filtration, sorption, and microbial degradation) as the water progresses downward.

In contrast to a typical septic system and drain field, the Michigan filter mound uses the biologically active bark media and topsoil as part of the treatment system.

It is important to note the following key definitions relative to milking facilities:

- **Milk Parlor** – The facility in which the dairy cows are milked. The operating area for the workers is typically recessed below the floor where the cows are standing during milking. Wash down water from milk parlors typically include varying quantities of manure solids, urine, waste feed, milk.
- **Milk House** – The facility housing the milk bulk storage tank. Often also includes the sink and other devices for washing the milking equipment. Cows do not have access to the milk house. Wash down water from milk houses typically includes varying quantities of milk and cleaning chemicals. On occasion, small quantities manure solids carried on the feet of workers will also be in the wash down water.
- **Milking Center** – A facility where the Milk Parlor and the Milk House are included in a single facility typically sharing a common wash down water disposal system.

As you develop the plan for how the Michigan filter mound will fit into the farming operation, ensure there are discussions with the farmer regarding options for future expansion or infrastructure alterations on the farm. You also must consider management of the farm operation and how the operation and maintenance functions of the filter mound will fit with current farm management processes and procedures. Also consider all potential contributors to the wastewater and their impacts on the quantity and characteristics of the wastewater. This may include cleaning products, feeds, bedding, etc. As much as practicable, these items should be excluded from the filter mound. Including these contributors may require additional pretreatment features in the design and may require additional and/or more frequent maintenance activities.

Be sure to plan for utilization/disposal of the solids that accumulate in the settling tanks and are periodically pumped out. Where these solids are spread on cropland, their nutrient contribution should be part of the nutrient management plan for the farm.

No human waste shall be included in the wastewater treated in the filter mound.

**Regulatory Considerations**

Filter mounds for small dairy farms do not need permits provided the farm has less than 5,000 animal units and the daily volume is less than 10,000 gallons. Groundwater discharges in Michigan are regulated pursuant to Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, and the Part 22 Rules that were promulgated under Part 31. Rule 2210 of the Part 22
Rules exempts a discharge from an animal feeding operation that has less than 5,000 animal units if the discharge is determined by MDARD to be in accordance with Right To Farm Generally Accepted Agricultural and Management Practices. Provided there is not discharge to waters of the state.

Site Selection

Herd size
Theoretically, there is no herd size limitation for a filter mound. However, experience thus far has been limited to herd sizes of less than 200 head and daily wastewater volume production of no more than 1,000 gallons per day. Since the mound is sized based on hydraulic loading rate, the daily wastewater volume production is the primary factor.

Wastewater Volume Production
In order to operate within the bounds of practical experience, at this point applicability of this design guide is limited to farms with wastewater volume production of no more than 1,500 gallons per day. The maximum daily wastewater volume production that will work for a site is dependent on the water intake rate of the soil. The higher the permeability of the soil, the greater the maximum daily wastewater volume production that can be managed for a filter mound system.

Daily wastewater volume production is the key factor in the design. The methods for determining daily wastewater volume production in priority order are as follows:
1. Place flow meters on all water lines that contribute water to the wastewater stream
2. Measure the water flow rate for normal use of all water that contribute water to the wastewater stream then time each of the operations to determine the combined daily volume.
3. Use water use estimates available from MSU Extension or other reputable sources. This is the least accurate method and should be supported by direct observation of water use and should be estimated on the high side of the range.

Ensure that the farmer notifies the designer regarding ANY changes made to milking frequency or any normal activities that could affect the volume or content of the milking center wastewater.

Avoid farms where grain is fed in the milk parlor. This grain gets into the settling tanks and rapidly clogs the filters.

Proximity to Milking Center
Consider the distance from the milking center or milk house to the proposed location. Space will be needed for the settling tanks and pump chamber. As much as possible, use gravity flow from the milking center to the first settling tank and between the settling
tanks in order to minimize costs for installation, operation, and maintenance. Minimizing pipe lengths will also have the following impacts:

- Reduce exposure to freezing.
- Reduce potential for clogging.
- Reduce installation costs.
- Reduce interference with other buried utilities.
- Reduce the head loss in the pipes from the pump chamber to the sequencing valve. This may allow the use of a smaller pump and will reduce energy consumption, thus reducing operating costs.

**Soils**

Conduct a subsurface investigation to classify the soil at the proposed site to depth of at least 3 feet. Identification of any compaction or restrictive layer must be documented as part of the subsurface investigation. Use USDA soil classification. The soil must also be classified by soil series. The subsurface investigation must be conducted by a qualified professional. Do not rely on the soil map unit shown in the soil survey for the site. The USDA soil classification is preferred because it more closely correlates to the hydraulic loading rates in the Hydraulic Loading Rates table (Schmidt, D.R., et al., 2008). The loading rates assume a soil surface slope of 2 percent or less a BOD₅ concentration of 750 mg/L typical of milking center wastewater after pretreatment in 2 settling tanks. Be sure to use the most restrictive soil in the upper 2 feet of the soil profile for determining the maximum hydraulic loading rate for the design. Deep tillage may be used to break through the most restrictive soil layer if that layer is underlain by a less restrictive layer and it is mechanically feasible to accomplish.

<table>
<thead>
<tr>
<th>Soil Texture</th>
<th>Loading Rate (gpd/ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse sand, medium sand, and loamy sand</td>
<td>0.32</td>
</tr>
<tr>
<td>Fine sand, sandy loam or loam</td>
<td>0.16</td>
</tr>
<tr>
<td>Silt loam, silt, or clay loam</td>
<td>0.12</td>
</tr>
</tbody>
</table>

Avoid soils that have been compacted due to previous traffic by animals or vehicles. Discussing site history with the farmer might identify compaction concerns based on previous or current use. Previous traffic will likely have reduced the void spaces normally expected in the soil, thus reducing the actual acceptable loading rate. Where the only available site has experienced traffic by animals or vehicles, extensive deep tillage will be required to restore at least some of the void spaces; ensure the tillage is done when soil conditions are conducive to this mechanical treatment. Even with the tillage, use professional judgment to reduce the maximum allowable loading rate for the design at any previously compacted sites.

**Water table**

Since aeration is a key factor in the treatment intended by the filter mound, it is important that the soil for at least 2 feet below the filter mound is not saturated. Therefore, when conducting the subsurface investigation, also determine the seasonal
high water table. If redoximorphic features in the soil are not adequate to indicate the seasonal high water table, the qualified professional performing the subsurface investigation should consider the landscape features and the soil survey information for the soil series as classified on the site to estimate the seasonal high water table.

Artificially lowering the seasonal high water table with a subsurface drainage system would be acceptable under the following conditions:

- The artificial drainage system is at least 20 feet from the toe of the filter mounds
- The drawdown is analyzed to illustrate the modified seasonal high water table provides the required 2 feet of unsaturated soil below the mounds.

Traffic patterns
Consider the following factors regarding traffic patterns and vehicular access for normal farm operations and for construction when locating a site.

- Minimize locations where the pipes will go below roadways and other traffic areas that are kept open all winter. Frost penetration is deeper where snow cover is removed. To minimize the potential for freezing, pipes in those locations may need to be placed deeper, may have to be covered with insulating material, and will need to be empty except when distributing wastewater. Keeping empty will require layout to ensure gravity flow.
- Vehicular access will be needed for construction of the filter mound and for maintenance associated with replacement of the bark media. While this type of access may be infrequent after construction, it must be considered during siting to ensure effective implementation of required maintenance.
- Vehicular access will be needed for installation of the settling tanks and pump chamber and for maintenance associated with periodic pumping of the tanks. While this type of access may be infrequent after construction, it must be considered during siting to ensure effective implementation of required maintenance.
- Don’t place the filter mound in a location that would inhibit traffic views or other sightlines that are important to the farm.

Power
Pressure dosing is a key part of the filter mound operation. Therefore, electrical power is required at least for the pump. If installation of a new power pole(s) is required, ensure the pole is placed where it will not interfere with vehicular access for maintenance of the settling tanks. Also, even when power from the utility is interrupted, the cows must be milked and wastewater will be generated. Therefore, the pump must be connected to an automatic backup power supply. Most dairy farms have automatic generators to ensure a continuous supply of electricity to the milking center; the best approach is to connect the filter mound pump to this same system.

Slope
Filter mounds should be placed on sites where the natural ground slope is less than 2 percent. As the ground slope increases, the residence time at the ground surface is
reduced and the actual infiltration rate is reduced. Also, the wastewater distributed in
the mound on the upper slope area that does not infiltrate in the soil immediately below
will move laterally downslope at the bark:soil surface interface. The downslope
migration will further increase the hydraulic loading in the downslope areas of the
mound and will increase the likelihood of wastewater seeping out beyond the toe of the
mound.

Some land leveling within the area of the filter mound may be used to decrease the
ground slope. However, since the natural topsoil is an integral part of the treatment
process, land leveling should not be done to an extent where more than half of the
natural topsoil layer is removed. Care must be taken in any land leveling activity to
minimize compaction of the soil. When land leveling will be part of the construction, use
professional judgment to reduce the maximum allowable hydraulic loading rate for the
design at that site.

Where upslope areas will contribute runoff to the filter mound area, install diversions to
redirect this runoff. The additional runoff into the filter mound will add unwanted
hydraulic loading to the soils below the filter mound.

Where the filter mound is located on sloping land, a much as feasible lay out the
mounds so the distribution lines are placed along the contours to ensure the lines are as
level as possible.

Setbacks/Location
Since filter mounds have no more potential for groundwater contamination than a
subsurface wastewater leach field, similar setback distances should be followed.

Do not locate filter mounds within any established rights-of-way such as roads, legal
drains, utilities, and pipelines. Check with the appropriate officials for required setbacks
associated with any nearby rights-of-way.

To minimize the potential for contamination of surface waters, filter mounds should be
located outside of floodplains. However, if site restrictions require location within a
floodplain, they shall be protected from inundation or damage from a 25-year flood
event, or larger if required by laws, rules, and regulations.

Do not locate filter mounds in areas designated as wetlands.

Use the setback distances listed below to ensure compliance with State of Michigan
subsurface sewage disposal criteria. Note the setback distances are the minimum
horizontal isolation distance as measured from the perimeter of soil dispersal system or
tank to the identified feature.
### Design

The required size of the filter mound is determined by dividing the daily wastewater volume by the maximum allowable hydraulic loading rate.

The flow sequence of a typical 1,000 gallon per day filter mound system is shown in the flow path below. This section provides guidance for designing individual components along that flow path.
Pretreatment
Prior to distribution in the filter mound, the wastewater is to be pretreated primarily for solids removal. Pretreatment should include the following in the sequence listed:

1. When milking parlor wastewater is included, practices or activities that might be unique to this farm should be considered (i.e. feeding, trimming, animals transporting straw, sand, mud. etc.). Take into consideration what solutions exist or could be incorporated. Preventative solutions can include:
   i. Install a sump in the parlor for initial solids settling. Clean out the sump after each milking to maximize efficient settling.
   ii. Insure that all drain covers are intact and have openings that will trap unwanted materials. Drain covers should be cleared after each milking.
   iii. A grinder pump can be utilized as a solution.

2. Install settling tanks with a total capacity of at least 4 times the daily wastewater volume. At least two tanks should be used rather than one large tank. Use tanks without internal wall-type baffles. Include quick-release manhole covers for the settling tanks to accommodate easy access for maintenance. Tanks must be water-tight and must be vacuum tested holding a vacuum of 4 inches of mercury for 5 minutes with no loss (see ASTM C1227, Standard Specification for Precast Concrete Septic Tanks)

3. If there are more than 2 settling tanks, install a pipe baffle at the end of the tanks that do not have effluent filters. The effluent filters described next, should be installed in the tanks hydraulically immediately prior to the pump chamber.
   - Include a slit type (maximum 1/16 inch width), commercial size effluent filter (Polylok PL-525, or equivalent) at the exit to the second settling tank hydraulically prior to the pump chamber. Use a filter with a daily flow rate at least 5 times the design daily wastewater production volume.
   - Include a commercial size effluent filter with maximum 1/16 inch circular holes (Sim/tech A-1 Vault filter, or equivalent) at the exit to the settling tank located hydraulically immediately prior to the pump chamber. Use a filter with a daily flow rate at least 5 times the design daily wastewater production volume.
   - Include a screen filter (maximum 3/32 inch holes) immediately after the pump in the pressure line from the pump to the sequencing valve.

As discussed in the Introduction, consider all potential contributors to the wastewater and their impacts on the quantity and characteristics of the wastewater. This may include cleaning products, feeds, bedding, etc. As much as practicable, these items should be excluded from the filter mound. Including these contributors may require additional pretreatment features in the design and may require additional and/or more frequent maintenance activities.
Slit-Type Effluent Filter

Effluent Filter With Circular Holes
Bark
Use shredded hardwood tree bark. The bark should have rectangular shapes that taper to a splintered end, and on average are approximately 1.5-2.0 inches long by 0.2-0.4 inches thick by 0.5-1 inches wide. Place at least 3 feet depth of compacted bark between the distribution lines and the soil surface.

Distribution
A pump pressurized distribution system shall be used to uniformly distribute the wastewater to the filter mound. Gravity distribution to the filter mound is not allowed. The transfer pipe from the pump to the sequencing valve shall have a minimum diameter of 2 inches and be free draining with a minimum slope of 1 percent preferably flowing back to the pump chamber. The pump should be housed in the pump compartment of a two compartment tank or in a separate pump chamber. The pump chamber shall be sized for a 1 day of wastewater production or 500 gallons, whichever is greater. Use an effluent pump with an outlet screen filter.

The pump shall be designed to deliver at least 3 feet of head to the last hole in the furthest distribution line. A standard effluent pump can be used for this function and sized based on the pipe size, distance, pipe losses and elevations. Pump manufacturers will be able to identify the specific pump appropriate for the system based on an analysis using their own software.
Pumping is controlled by a timer programmed to operate on set intervals based on the design daily flow volume. Include a low water float switch to prevent pumping when there is insufficient wastewater to pump. Also include a high water float controlled alarm to provide an alert when the pumping chamber is full.

Use a pressure controlled sequencing valve (e.g. Hydrotec K-Rain, model 6404, or equivalent) to equally distribute the wastewater to each section. Place the sequencing valve on a stable base to prevent tipping. This may be accomplished with a pea stone filled riser pipe resting on a pea stone pad. Fill the void between the sequencing valve and the lid of the riser with Styrofoam chips or other insulation. Secure the lid of the riser. Install a ball valve at each of the exit lines from the sequencing valve. This will allow repair of individual filter mound sections without shutting down the entire system. Note the sequencing valve and ball valves in the picture below.

![Sequencing Valve and Ball Valves](image)

Use a minimum of 2 distribution sections. Include additional distribution sections as determined by the desired rest time between dosing individual areas of the soil receiving effluent. Longer rest periods are desirable. Sequencing valves are commercially available for up to 6 sections.

Wastewater flows from the sequencing valve to a manifold pipe at the head end of a distribution section. Use flexible pipe for the first few feet of pipe immediately upstream of the manifolds at the head of the distribution lines to allow for settling of the bark without breaking the line. Each section should consist of four lines of 1.5 inch diameter Schedule 40 PVC pipe with 3/16 inch holes at 2.5 feet on-center and the holes pointing up. PVC is used because the holes would be dimensionally stable, while the “memory” characteristic of PE pipe would allow the holes to partially close. All distribution pipes
are placed at the same elevation and equally spaced horizontally across the width of the mound. Filter mounds should not include more than 4 parallel distribution lines within a distribution section. Spacing between distribution lines should approximately 18 inches to accommodate the covering chambers. The maximum length of each section will depend on the pump selected in the design, but no distribution lines should exceed 100 feet in length. Include a weep hole in the bottom of the pipe at the clean-out end in each distribution line so the pipe can drain and water will not freeze in the pipe.

Distribution Line and Manifold Schematic

Distribution Lines from Sequencing Valve

Include a clean out with a ball valve at the end of each distribution line to accommodate removal of any solids that may accumulate in the distribution pipe.

The transfer pipe from the pump to the sequencing valve shall have a minimum diameter of 2 inches and be free draining with a minimum slope of 1 percent preferably flowing back to the pump chamber. Include a weep hole in the pressure line from the pump chamber to
the sequencing valve to ensure the water drains from the line when the pump is off. The weep hole must be in the lowest portion of the pipe in the pump chamber.

Cleanout Ports at Ends of Distribution Pipes

Cover all the distribution lines with a leach field chamber designed specifically for wastewater distribution. The chambers (ADS ARC 18, or equivalent) promote splash distribution on the surface of the shredded bark and enhance aeration. Cover the chambers with approximately 12 inches of shredded bark to minimize odor and for insulation to minimize potential for freezing during the winter months.
A 1H:1V side slope should be maintained for all the mounds because this is a stable slope for the shredded bark, allows some air flow into the distribution line chambers, and allows walking access to the top of the mounds without disturbing the filter material below the distribution pipes.

![Typical Michigan Filter Mound Cross Section with 4 Distribution Lines](image1)

It is preferred to locate filter mound sections linearly. Where filter mound sections will be located parallel to each other, maintain a minimum of 10 feet of open ground surface between the toes of adjacent mounds. This open ground surface will provide room for

![Constructed Filter Mound Showing Typical Cross Section](image2)
maintenance activities and will minimize the potential for seepage from one mound section to adjacent downslope mound sections.

**Construction**

Due to the complexity of the overall Michigan filter mound system, it is essential that installation be performed by a qualified contractor.

Prior to installation of the filter mounds, prepare the soil as needed to accomplish construction. The vegetation should be closely mowed and clippings removed prior to deep tillage/chiseling, but there is no need to remove the sod.

Compact the soil under the filter mound must be prevented during construction to the greatest extent possible. Track-mounted equipment is highly recommended.

Compact the bark prior to placement of the distribution lines in order to minimize differential settlement that may cause the distribution lines to break.

**System Startup and Testing**

As each zone of the distribution system is completed, it should be flushed to remove dirt and all plastic shavings, and whatever. Then it should be leak tested and set for proper operating pressure. To leak test, run at maximum possible pressure.

Each zone should be set so that there is at least 3 feet of head at the end of the laterals. Conduct the pressure test before the chambers are installed over the distribution lines and observe the height of the water squirt out all the holes in the laterals. If any of the holes are plugged, it will be quite evident during this pressure test. Correcting the plugged holes is relatively simple before the chambers are installed. In doing these things with the sequencing valve in line, each time the pump is kicked off, it will have to be restarted and cycled through the number of sequencing valve outlets with enough run time to pressurize the valve in order to sequence the valve back around to the zone that you are working on. It would probably be nice to have clean water in the tank while doing all this.

In addition to the above, it is important to get the pump timer set correctly when the system is started so it is dosing each section of the treatment mound as desired. Set the pump timer so that it delivers the total daily volume flow in about 18 hours. This provides time for extra doses if needed. Keep the flow from each orifice during each dose under 0.5 gallons, so each time the pump runs, it should run long enough to pressurize the system plus run for about 30 seconds. At start up, check to see how long it takes to pressurize the laterals after the pump kicks on -- and after the system is running normally, that is the supply line and all the laterals are full to their normal drained back level. It will take several seconds to pressurize. The timer should be set for the pump to run for the time it takes to pressurize plus the 30 seconds. Some adjustments to the timer will be needed as experience is gained with the system and
daily wastewater volume at the farm. The timer off float on the pump will shut the timer off after the system has delivered the amount of wastewater that has been generated that day regardless if it takes 20 cycles to do the job or more or less. By reading the cycle counter from time to time, you will know the average number of cycles per day that are required to handle the wastewater generated.

References

Advisory for Precast Concrete Septic Tank Installations and Inspections. 2006. Technical Advisory Council for Onsite Wastewater Treatment.

ASTM C 1227, Standard Specification for Precast Concrete Septic Tanks.


USDA Natural Resources Conservation Service. 2012. Milking Center Wastewater Treatment (796), Michigan Interim Practice Standard.

Appendix A

MILKING CENTER WASTEWATER TREATMENT
SAMPLE BILL OF MATERIALS AND COST ESTIMATE
(Note: Only includes two 50-foot long distribution sections)
<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Quantity</th>
<th>Unit Cost</th>
<th>Total</th>
<th>Requirements</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Settling Tank, 2500 gallon, water tight (one with 2 compartments)</td>
<td>ea</td>
<td>2</td>
<td>$1,400.00</td>
<td>$2,800.00</td>
<td>PI</td>
<td></td>
</tr>
<tr>
<td>Simtek circular filter, STF-100</td>
<td>ea</td>
<td>1</td>
<td>$500.00</td>
<td>$500.00</td>
<td>PI</td>
<td></td>
</tr>
<tr>
<td>Polylok Filter, PL-525, 1/16&quot;</td>
<td>ea</td>
<td>1</td>
<td>$400.00</td>
<td>$400.00</td>
<td>PI</td>
<td></td>
</tr>
<tr>
<td>Simtek A-1 Vertical Filter</td>
<td>ea</td>
<td>1</td>
<td>$500.00</td>
<td>$500.00</td>
<td>PI</td>
<td></td>
</tr>
<tr>
<td>Grade Level Hatch Cover for Tanks, 24-inch diameter,</td>
<td>ea</td>
<td>5</td>
<td>$175.00</td>
<td>$875.00</td>
<td>PI</td>
<td></td>
</tr>
<tr>
<td>Fiberglass, 2,500 lb. wheel load capacity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade Level Hatch Cover for Sequencing Valve Riser, 36-inch</td>
<td>ea</td>
<td>1</td>
<td>$175.00</td>
<td>$175.00</td>
<td>PI</td>
<td></td>
</tr>
<tr>
<td>diameter, Fiberglass, 2,500 lb. wheel load capacity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pipe, PVC, Sch. 40, 1.5-inch diameter, perforated with 3/16-inch</td>
<td>LF</td>
<td>400</td>
<td>$1.00</td>
<td>$400.00</td>
<td>TBD</td>
<td>About 200' per 50' section</td>
</tr>
<tr>
<td>holes at 2.5-feet center</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pipe, PVC, Schd 40, 220 PSI, 4-inch diameter, non-perforated</td>
<td>LF</td>
<td>150</td>
<td>$2.90</td>
<td>$435.00</td>
<td>TBD</td>
<td>About 100' PI, remainder TBD</td>
</tr>
<tr>
<td>Pipe, PE, 2-inch diameter, 160 PSI</td>
<td>LF</td>
<td>200</td>
<td>$3.00</td>
<td>$600.00</td>
<td>TBD</td>
<td>About 150' PI, remainder TBD</td>
</tr>
<tr>
<td>Pipe, PVC, Schd 40, 220 PSI, 2-inch diameter</td>
<td>LF</td>
<td>100</td>
<td>$1.50</td>
<td>$150.00</td>
<td>TBD</td>
<td></td>
</tr>
<tr>
<td>Pipe, PE, Dual Wall (N-12), 36-inch diameter</td>
<td>LF</td>
<td>10</td>
<td>$35.00</td>
<td>$350.00</td>
<td>TBD</td>
<td></td>
</tr>
<tr>
<td>Pipe, PVC, 24-inch diameter, risers for tanks</td>
<td>LF</td>
<td>6</td>
<td>$45.00</td>
<td>$270.00</td>
<td>PI</td>
<td></td>
</tr>
<tr>
<td>Valve Box, 10-inch</td>
<td>ea</td>
<td>8</td>
<td>$20.00</td>
<td>$160.00</td>
<td>TBD</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous Pipe Fittings</td>
<td>Lump Sum</td>
<td>1</td>
<td>$600.00</td>
<td>$600.00</td>
<td>TBD</td>
<td>About $400.00 PI, remainder TBD</td>
</tr>
<tr>
<td>Styrofoam, 2-inch thick</td>
<td>sq.ft.</td>
<td>250</td>
<td>$0.90</td>
<td>$225.00</td>
<td>PI</td>
<td></td>
</tr>
<tr>
<td>K-Rain &quot;Hydrotek&quot; Sequencing Valve, model 6404</td>
<td>ea</td>
<td>1</td>
<td>$375.00</td>
<td>$375.00</td>
<td>PI</td>
<td></td>
</tr>
<tr>
<td>Union, 1.5&quot;, for &quot;Hydrotek&quot; Valve</td>
<td>ea</td>
<td>3</td>
<td>$15.00</td>
<td>$45.00</td>
<td>TBD</td>
<td>1 each PI, 1 each per 50' section</td>
</tr>
<tr>
<td>Pump, 1 HP, 220 volt, 68 gpm at 38 feet of head,</td>
<td>ea</td>
<td>1</td>
<td>$725.00</td>
<td>$725.00</td>
<td>PI</td>
<td></td>
</tr>
<tr>
<td>StraRite/Orenco Systems, Inc, model PS01012; with outlet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Controller for Pump, (with timer, event counter and run time</td>
<td>ea</td>
<td>1</td>
<td>$520.00</td>
<td>$520.00</td>
<td>PI</td>
<td></td>
</tr>
<tr>
<td>meter), Orenco Systems, Inc., model MVP-S2PTRO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shredded Bark, single grind: Hardwood/Aspen</td>
<td>cu.yd.</td>
<td>350</td>
<td>$16.00</td>
<td>$5,600.00</td>
<td>TBD</td>
<td></td>
</tr>
<tr>
<td>Electrical connections, labor</td>
<td>Lump Sum</td>
<td>1</td>
<td>$1,500.00</td>
<td>$1,500.00</td>
<td>PI</td>
<td></td>
</tr>
<tr>
<td>Construction Labor (assumes 3 days installation) and rental of</td>
<td>Lump sum</td>
<td>1</td>
<td>$2000.00-$</td>
<td>TBD</td>
<td>Site Specific</td>
<td>Site layout, conditions and distance between milhouse/parlor, tanks, mound.</td>
</tr>
<tr>
<td>equipment (backhoe, tele-handler, skid steer)</td>
<td></td>
<td></td>
<td>3000.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pea stone, to bed line around hydrotek and manifolds</td>
<td>cu.yd.</td>
<td>10</td>
<td>$35.00</td>
<td>$350.00</td>
<td>TBD</td>
<td></td>
</tr>
<tr>
<td>AD'S Septic chambers over distribution pipes</td>
<td>ea</td>
<td>80</td>
<td>$19.00</td>
<td>$1,520.00</td>
<td>TBD</td>
<td></td>
</tr>
<tr>
<td>Parlor filtering (sump or alternatives)</td>
<td>ea</td>
<td>1</td>
<td>TBD</td>
<td></td>
<td>Site Specific</td>
<td>Will depend on existing installation, methods, and practices</td>
</tr>
<tr>
<td>2&quot; diameter flex hose, 24&quot; long (Gates 26513)</td>
<td>ea</td>
<td>2</td>
<td>$50.00</td>
<td>$100.00</td>
<td>TBD</td>
<td></td>
</tr>
<tr>
<td>1.5&quot; PVC Ball Valve</td>
<td>ea</td>
<td>2</td>
<td>$20.00</td>
<td>$40.00</td>
<td>TBD</td>
<td></td>
</tr>
</tbody>
</table>

Pl - (per installation) requirement shown is per installation assuming that the minimum installation would be a filter mound with 2, 50' sections (100' total) and maximum of 4, 50' sections (200' total).

TBD - (to be determined) requirement shown is variable and will depend on conditions of construction and site.

Estimate provided for guidance only. Quantities provided are representative of constructing 2, 50' sections, 100' total filter mound.
Inspections and maintenance are required to achieve the intended function, benefits, and life of the practice. The landowner/operator is responsible to establish and implement an inspection and maintenance program. Items to inspect and maintain during the 10-year design life of the practice include, but are not limited to those listed below.

1. Inspect after significant storm events and at least annually to identify repair and maintenance needs.
2. Do not enter confined places without proper safety precautions for breathing and exit while inspecting or repairing equipment.
3. Perform routine maintenance of all mechanical components in accordance with manufacturer’s recommendations.
4. Inspect or test all pipe, sumps, pumps, electrical systems, controls, and other components and appurtenances.
5. Promptly repair or replace damaged or inoperable components.
6. Protect the components from damage by farm equipment and livestock.
7. Repair any settlement or erosion that occurs along the transfer pipes with soil and reseed as needed. If this problem persists, evaluate the pipe for leakage and erosion of the fill material into or along the pipe.
8. Waste milk must not be dumped into the filter mound system. Milk significantly increases the COD loading to the filter mound system. The increased COD can overwhelm the aerobic bacteria in the mound, turning it into an anaerobic condition. If it is necessary to discharge milk into the filter mound system, limit those discharges to no more than 5 gallons of milk for every 1,000 gallons of wastewater. In the event an entire bulk tank must be emptied, pump the settling tanks within 12 hours of the release.
9. Where filter mounds will be adjacent to animal areas, fence the perimeter of the mounds to prevent animal access. This will minimize the potential for soil compaction in the areas adjacent to the mounds and will minimize the potential disease transfer.
10. The table below provides guidance for the frequency and estimated time for various maintenance activities. If experience shows the system is functioning effectively for the initial frequencies, the time passage between maintenance activities may be increased.

**Recommended Michigan Filter Mound Maintenance Actions and Schedule.**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Frequency</th>
<th>Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean filters</td>
<td>1/quarter</td>
<td>60-90 minutes</td>
</tr>
<tr>
<td>Replace socks on Sim/Tech A-1 Vertical Filter (if socks being used)</td>
<td>As required</td>
<td>15 minutes</td>
</tr>
<tr>
<td>Clean sump and/or drain covers in milking parlor – part of normal cleaning</td>
<td>daily</td>
<td>30 minutes/week</td>
</tr>
<tr>
<td>Visual inspection of Mound</td>
<td>1/week</td>
<td>5 minutes</td>
</tr>
<tr>
<td>Pump tanks and dispose of contents</td>
<td>1/3-6 months</td>
<td>6 hours</td>
</tr>
<tr>
<td>Flush distribution lines</td>
<td>1/year</td>
<td>1 hour, 2 persons</td>
</tr>
<tr>
<td>Annual check (by qualified contractor) of pumps, floats, hydrotech valve, and pump controls.</td>
<td>1/year</td>
<td></td>
</tr>
<tr>
<td>Replenish bark</td>
<td>As required</td>
<td></td>
</tr>
<tr>
<td>Contact contractor and any other participating parties if ANY changes are made to milking frequency or any normal activities that could affect the volume or content of the milking center waste water.</td>
<td>As required</td>
<td></td>
</tr>
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Filter Mound Maintenance Procedure

Filter Mound maintenance routines and frequency is going to be very dependent on the facilities, condition, and practices conducted on the installed farm. Monitoring of the filter and tank contents during the first few months will help determine these efforts.

It is also equally important to understand that not adhering to proper maintenance can have an undesirable affect on the integrity of the filter mound system. Be certain that if control panel alarms occur to address the situation immediately.

Discuss with the landowner his plan for disposal of waste when emptying the tanks, i.e. suitable land available year round to apply.

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</table>
Filter Cleaning

- Cleaning should occur when the system is normally at a rest ... in between milkings but after the system has processed the previous milking/cleaning.
- Turn off pump in control panel.
- A hose with a spray nozzle, bucket, and mixture of brushes are beneficial. Bleach can also be used (50% solution) but may not be required. When using bleach, 1 gal. of bleach is adequate for complete procedure.
- Remove polyloc filter and rinse, spraying with water may be adequate. Brush more difficult surfaces and rinse again.
- Remove vertical filter, one at a time to clean. Place stopper in filter housing while cleaning. Spray, brush, and rinse as required. Replace and repeat.
- Turn on pump in control panel.

Tools of the trade: (from left to right)

- Stopper for vertical filter housing when the filter is removed.
- Hook tool to remove vertical filter caps and filters.
- Screen filter wrench
- Removal tool for tank access covers

Always have on hand:

- Pail or bucket
- Bleach (if using)
- Assorted brushes (inexpensive and disposable “Dollar Store” type).
Polyloc Filter Cleaning
Vertical Filter Cleaning
Screen Filter Cleaning
Flushing Lines in Filter Mound

- Best with 2 persons. One on Mound and one at Control Panel
- Turn off pump in Control Panel.
- Open up clean-out valves (one section at a time)
- Turn switch in Control Box to manual.
- Locate section being pumped to; wait for all solids/fats to clear section lines.
- Turn off switch in Control Panel, wait 30 seconds, turn switch back manual.
- Locate section being pumped to; wait for all solids/fats to clear section lines. Repeat for each section.
- Close all clean-out valves.
- Turn on pump in control panel
- If no flow exists in a line, snake a hose down the clean out and flush out. If not successful, a break in the line may have occurred.

Tank Pumping

- Turn off pump in control panel.
- Tanks to be emptied in conventional manner of the available equipment.
- Aggressive agitation before pumping can be extremely beneficial.
- Tanks should be cleaned in order of flow.
- Filters should be removed. Care should be taken when guiding pump hoses around filter housings.
- Dispose of tank contents in an appropriate manner.
- Turn on pump in control panel

- It’s a good idea to clean filters while you have them removed and after tank pumping.
Examples of what to look for in a milk parlor to reduce undesirable materials from entering the filter mound system.

What to avoid: Cracked or damaged drain covers

Or plugged
Keep sump system clean

Trapping solids, sand, or other materials