Introduction to Wastewater Treatment Options for Small Communities

All wastewater treatment systems begin with the basic premise of wastewater collection followed by treatment and dispersal. There are several collection, pre-treatment, treatment, final dispersal or water recycling options for communities as noted in the chart on page 9. Communities have a wide variety of options to provide the best treatment in the most cost efficient manner. This guide will help communities begin sorting out the options. There are numerous examples available of Minnesota communities providing community – wide services involving mechanical or pond systems, or separation technologies for treatment followed by soil sub-surface, soil surface or surface water final dispersal. There are many examples of communities that allow individual, cluster (multi-home) systems or combinations using various options. Contact the University of Minnesota Extension Service or the Minnesota Pollution Control Agency to connect with communities with systems you may wish to explore.

Communities facing wastewater infrastructure improvements have the difficult task of identifying the appropriate technologies to meet their needs. This tool may be used to begin identifying some of the many choices available. The best fit for individual communities depends on many factors. These include assessing the community needs, current situation, evaluating soils, drinking water availability and quality, evaluation of existing wastewater treatment systems, community factors such as anticipated growth, desired community goals, community values, financing options and management options.

For help with this important first step in the planning process, refer to the University of Minnesota web site, http://septic.umn.edu, Communities section. Many resources are listed, along with staff contact information.

The first step is a community assessment, including detailed site evaluations and soils assessments. This will help communities determine which options may be viable. Assessments will help a community determine which options to focus upon and search out more detailed information. Communities will want to go through the assessment phase before looking at these technologies in detail. There is a checklist on page 10 to help communities track some options. ***This publication is a guide, not a detailed source of information on methods available. It is meant to help communities sort through options, determining where to focus time and energy on more extensive research and knowledge gathering.***

All systems need management. In a single family home, the owner is usually responsible to see that management happens. For multi-home (cluster or municipal) systems and some individual systems in designated areas, a responsible management entity with legal authority and administrative capability is needed to provide the necessary services and be accountable. These legal entities form the "community structure" for the community. More entities are including individual onsite systems in their management areas. Operation and maintenance of a system may be the most critical factor in a community's success. Communities need to consider ease of operation and maintenance costs including power supply, how the system will be managed, life-cycle costs and other factors. During the planning process, care must be taken to plan for appropriate operation and maintenance of the new or expanded system. Refer to the University of Minnesota Onsite Sewage Treatment Program web site, http://septic.umn.edu for a matrix of community structure options.

Note: some of the descriptors and terms used in this document are subjective to allow comparisons between technologies. No preferences are implied by these statements.

Note: Minnesota Rules Chapter 7080, which governs most small community wastewater treatment options is in the process of being revised, and may impact information provided in this document. This rule change is targeted for completion in late 2007. An updated version of this document will be available after the revised rule is finalized.

Updated 2/2007

Table of Contents

3Technology	Features	Advantages	Limitations	Management and Maintenance
Standard single family home onsite sewage treatment systems: ISTS systems ***Who designs:*** Minnesota licensed Designer. ***Who regulates:*** LGU following MPCA Code 7080 with local adaptations.				
Trench or Bed	· House plumbing goes to a septic tank, then to soil treatment system. · Type of system is dependent on soil conditions and other factors; homeowner cannot choose one over the other.	· Least expensive to install and maintain. · Most use gravity flow. · Systems are flexible regarding sizing, placement, and material in trench.	· Typically are dependent on homeowner knowledge and interest for proper management of system.	· Service (inspection; pumping if needed) by a Minnesota licensed ISTS professional at least every 3 years or as required by LGU. · Most are owner managed. · Owner should check caps, look for surfacing effluent, manage water use, check for plumbing leaks. · Tanks should have effluent screens.
Mound or At-Grade		· More effective at removing nitrogen than a trench or bed without addition of denitrification processes.		

Technology	Features	Advantages	Limitations	Management and Maintenance
Wastewater Collection Systems: Preliminary Treatment **Methods of collecting wastewater from individual homes for a community or multiple home (cluster) system** ***Who designs:*** Qualified Minnesota Professional Engineer. ***Who regulates:*** Usually LGU if less than or equal to 10,000 gal. per day flow and subsurface discharge. MPCA if over 10,000 gal. per day or surface discharge.				
Conventional Gravity Sewer	· No individual septic tanks – all raw sewage is piped via gravity to treatment area. · Typically uses 8" pipe in the street with manholes.	· Low operation and maintenance needs. · Uses gravity, so few mechanical parts such as pumps. · Relatively easy to expand system.	· Over time pipes and manholes may leak or crack, allowing rain and groundwater to enter system, resulting in infiltration and inflow issues. · Limited by topography (need lift stations where gravity does not work). · More expensive due to deep trenching in high water table or bedrock areas.	· Cleaning and televising of mainlines should be accomplished on a regular schedule by a licensed operator.
Grinder Pump Pressure Sewer	· Convey solid wastes suspended in wastewater by grinding solids into small particles. Grinder pump typically located in 30 gal. pump stations for single homes. · Typically uses 2 – 4" pipe.	· Uneven terrain and uphill collection possible. · Fewer infiltration/inflow issues with smaller and shallower pipes. · Relatively easy to expand system. · Pump stations can be located in areas where easements are not required. · Uses smaller sump tanks.	· More pump tanks. · Topographic limitations. · More hydraulic, mechanical, electrical issues. · Solids settling in community septic tanks may increase service requirements.	· Grinder pump maintenance needed. · Problems can occur with the electrical supply or pumps. · Cleaning of sump chambers should be done on a regular schedule.
Septic Tank Effluent Gravity (STEG)	· A system of septic tanks and small diameter collection mains. · Tanks may serve one or more homes. Number of tanks impacts system design. · Typically uses 4" pipe in the street.	· Relatively easy to expand system. · Lower operation and maintenance costs. · Uses gravity, so fewer pumps. · Uses cleanouts at the tanks. · No access ports in street. · Solids retained in septic tank, reducing the need for mainline cleaning. · Allows for easier diagnosis of problem users.	· Limited by topography – need lift stations where gravity flow not possible. · Leaking septic tanks may cause infiltration issues. · Septic tank on property undesirable to some property owners.	· Inspection and service by a Minnesota licensed ISTS professional at least every 3 years or as required by LGU.

Technology	Features	Advantages	Limitations	Management and Maintenance
Septic Tank Effluent Pump (STEP)	· Each home has its own septic tank, or several homes may be connected to large septic tank. · Effluent flows by pressure out of septic tank into mainlines. · Typically uses 2 – 4” pipe.	· Uneven terrain and uphill collection possible. · Relatively easy to expand system. · Solids are retained in septic tank so reduced cleaning of mainlines, treatment facility is needed. · Smaller pipe size, shallow depth of burial. · Reduced infiltration/inflow. · No access ports in street. · Allows for easier diagnosis of problem users.	· Leaking septic tanks may cause infiltration issues. · Septic tank on property undesirable to some property owners.	· Service by a Minnesota licensed ISTS professional at least every 3 years or as required by LGU. · Effluent filter cleaning per manufacturer recommendations (typically annual). · Pump replacement as required.
Vacuum Sewer	· Valve pits located every 2-4 homes. A small diameter pipe carries the effluent to a vacuum pump station. · Typically uses 2 – 4” pipe.	· No power is required at valve pits. · Leaks are minimal and easily detected. · Shallow installation. · No manholes. · Useful for high water tables or rocky terrain.	· Not appropriate for areas with greater then 30 feet of elevation difference. · Economically feasible for 80 connections or more. · Must be within 2 mi. of vacuum pump.	· Servicing, maintenance on a regular basis by a licensed operator.

Regionalization or Combining with Another Community: **may include expanding an existing system in one or both communities, or establishing a new joint system using any of the technologies listed in this document.**

Technology	Features	Advantages	Limitations	Management and Maintenance
	· Connect communities to existing or building new wastewater treatment facilities. · May utilize a treatment system included in this document.	· Community ties into an existing facility – can be efficient for management issues. · May stimulate community growth.	· May be higher service, connection charges. · May require joint powers or annexation agreement. · May stimulate community growth.	· Requires trained, licensed Large System Operator.

Secondary Treatment: individual systems or decentralized systems

Most come between the septic tank and the final treatment/dispersal method. Most commonly, dispersal is via a soil—based treatment method.

Who designs: Qualified Minnesota Professional Engineer or qualified MPCA licensed Designer, depending on system chosen, size and other factors.

Who regulates: Usually LGU if less than or equal to 10,000 gal. per day flow. MPCA if over 10,000 gal. per day.

Technology	Features	Advantages	Limitations	Management and Maintenance
Aerobic Treatment Unit (ATU)	· Uses aerobic microorganisms to provide secondary treatment, removal of biodegradable organics and suspended solids. · All types need an air supply to create aerobic environment. · Aeration chamber may contain attached-growth (organisms attach to media) and/or suspended-growth microorganisms (microbes float freely and are settled).	· Aerobic treatment process is 10-20 times faster than anaerobic; more efficient. · May be able to retrofit an existing system. · Less space needs for pre-treatment than other secondary treatment options. · Available for ISTS, cluster or municipal use. · Option: can combine with membranes for advanced bacteria removal. · Provide reliable secondary treatment. · Reduces the biomat in soil treatment area. · May allow for higher loading rates in the dispersal area. · May allow for wider range of soil types in the soil dispersal area. · Media can be easily cleaned if plugged.	· Prefers a steady supply of food to maintain stable microbial population. · ATU’s are sensitive to drain cleaners, antibiotics, antibacterial products. · Limited nitrogen and phosphorus removal with standard design. · Additional components are needed for significant nitrogen or phosphorus removal. · Higher energy costs due to air source. · Location of air source: consider noise issues, temperatures, snow impacts. · Attached growth systems can plug if overloaded with solids (may be due to lack of maintenance or issues with use).	· Manufacturer of ATU requires specific management of components. · Generally, Minnesota licensed ISTS professional typically provides bi-annual or quarterly monitoring for individual systems. Cluster systems – generally more often service requirements. · Generally, higher maintenance costs and more intensive management needed than some other pre-treatment choices. · Must follow 7080 or local government requirements.

Technology	Features	Advantages	Limitations	Management and Maintenance
Constructed Wetland	· Lined, constructed area uses anaerobic bacteria to treat wastewater. · Cell is filled with 20-24" solid media – usually gravel. · Wetland vegetation is planted. · Used to recreate the treatment processes that occur in natural wetlands.	· Microorganisms, media and plants provide secondary treatment. · Appropriate option for communities or individuals where adequate affordably priced land is available. · Wetlands have esthetic appeal. · Provide easier operation than some types. · Provide reliable treatment. · Reduces the biomat in soil treatment area. · May allow for higher loading rates in the dispersal area. · May allow for wider range of soil types in the soil dispersal area.	· Larger land requirements than other media filter systems. · More susceptible to freezing – must be designed for temperature control. · Vegetation needs to be managed including plant diversity, weed management; re-planting if necessary. · Vegetation needs to be harvested if nutrient removal is a goal. · Full treatment capability not reached until vegetation is established. · Media may plug if overloaded with solids due to issues with use or lack of maintenance.	· May require higher frequency of maintenance than other options. · Generally, Minnesota licensed ISTS professional typically provides annual monitoring for individual systems. Cluster systems – generally more often service requirements. · Must follow 7080 or local government requirements.
Recirculating Media Filter (RMF)	· Use a sand, gravel, peat or synthetic textile filter with a recirculation tank. · Mixes a portion of filtered effluent with incoming effluent from the septic tank. · Effluent passes through the filter several times before going to pressurized soil treatment.	· Designed and operated for advanced nitrogen removal. · Some systems send effluent back to septic tank versus recirculating tank for increased denitrification. · Smaller land area requirement. · Provide reliable secondary treatment. · Reduces the biomat in soil treatment area. · May allow for higher loading rates in the dispersal area. · May allow for wider range of soil types in the soil dispersal area.	· Requires more pumps and controls than single pass media filters, increasing management requirements. · Media may plug if overloaded with solids due to issues with use or lack of maintenance.	· Generally, Minnesota licensed ISTS professional typically provides annual monitoring for individual systems. Cluster systems – generally more often service requirements. · Manufacturer of pre-treatment unit requires specific component management. · Must follow 7080 or local government requirements.
Single Pass Media Filter (SPMF)	· Use natural, mineral or synthetic media such as sand, gravel or peat; in lined cells, or prefabricated containers. · Wastewater is treated as it moves over the media surfaces. Harmful organisms and organic material are removed from the wastewater in the media filter. · Typically have effluent filter, pumps, control panel.	· Ease of operation and easier start up. · Effective for removing organic matter and pathogens. · Provide reliable secondary treatment. · Reduces the biomat in soil treatment area. · May allow for higher loading rates in the dispersal area. · May allow for wider range of soil types in the soil dispersal area.	· Peat deteriorates over time – must be replaced. · Requires dosing pumps, timers and controls. · Can require more area than ATU or RMF options. · Media may plug if overloaded with solids due to issues with use or lack of maintenance.	· Generally, Minnesota licensed ISTS professional typically provides annual monitoring for individual systems. Cluster systems – generally more often service requirements. · Manufacturer of pre-treatment unit requires specific management of components. · Must follow 7080 or local government requirements.

Technology	Features	Advantages	Limitations	Management and Maintenance
Mechanical (Municipal) Treatment Plants, Large Aerobic Treatment Units and Pond Systems *Preliminary Treatment* – Physical separation (removal of materials such as debris, rocks, etc.). Impacted by type, number of septic tanks, if any. *Primary Treatment* – Separate solids from effluent via a variety of methods such as sedimentation tanks that use filtration and settling procedures. *Secondary Treatment* – An aerobic, biological process designed to remove nutrients, especially ammonia. Includes the methods listed below, and the pre-treatment options listed above (*usually called "pre-treatment" when discussing onsite treatment methods; secondary treatment in municipal).* *Tertiary Treatment* – Additional treatment to remove a specific nutrient (Phosphorus or nitrogen), reduce Biological Oxygen Demand (BOD), Total Suspended Solids (TSS). BOD and TSS should be < 30 mg/l. and/or pathogens. *Final dispersal* – Soil based or surface water discharge. Requires NPDES/SDS permit from the MPCA. Most systems create sludge, which must be dispersed. ***Who designs:*** Qualified Minnesota licensed Professional Engineer. ***Who regulates:*** MPCA for all surface water discharges. Requires MPCA professional operator license, based on technology chosen.				
Secondary or Pre-Treatment Wastewater Treatment Options for large clusters or municipal treatment. Typically, these methods utilize surface-water discharge methods, some use soil-based methods. See previous section for additional pre-treatment options.				
Activated Sludge	· Functions similar to aerobic treatment unit – is much larger. · Often called "Package plant."	· Requires the smallest space of the municipal options.	· High sampling and management costs. · More mechanical parts. · May be higher noise, odor concerns. · Requires a disinfection process for pathogen removal. · Usually not suitable for high flow fluctuations.	· Requires a trained, licensed Large System Operator. · Most need monitoring on a frequent basis.
Aerated Pond	· Mechanical aeration provides oxygen for treatment. · Discharge may be continuous or spring/fall, depending on receiving waters and permits. · Typically use surface water discharge.	· Smaller footprint (since it is deeper) – smaller land requirement. · Ammonia removal is more consistent than other choices. · Usually are fewer odor issues than other choices.	· Has more mechanical parts so higher management needs. · Provides medium performance level. · Higher energy costs.	
Rotating Biological Contactor	· An aerobic treatment unit. · Media disks pick up wastewater as they rotate through the wastewater. · Organisms use organic matter in wastewater for food.	· Medium management costs. · Medium – high performance levels.	· Higher energy costs – a mechanical solution.	
Stabilization Pond (Lagoon)	· Used by many small communities. Consist of large lagoon cells about 9' deep for oxidation of organics and settling, then a discharge method – typically spring/fall discharge to surface waters. · Ponds use microbes existing naturally in water for treatment.	· Lower capitol installation costs than some other choices. · Lower operational requirements than other large systems. · Reduced sludge dispersal issues. · Uses natural disinfection process. · Non-mechanical solution. · Solids are stored in the ponds until disposal.	· Larger land requirements. · May have higher algae concentrations – may impact surface water discharge. · May have seasonal odor control issues. · May be aesthetic issues. · Lower quality discharge. · Low performance system. · Higher risk for public safety issues.	

<table>
<tr><th>Technology</th><th>Features</th><th>Advantages</th><th>Limitations</th><th>Management and Maintenance</th></tr>
<tr><td>Trickling Media Filter</td><td>▪ Wastewater is distributed over aerated media; trickles down.
▪ Have a settling basin (clarifier) to capture solids.</td><td>▪ Low – medium management costs.
▪ Medium performance levels.
▪ Same principle as media filters.</td><td>▪ More likely to have odor problems
▪ Need a building for temperature, odor control, mechanical components.</td><td></td></tr>
<tr><td colspan="5">Final Treatment and Dispersal
Who designs: Qualified Minnesota Professional Engineer or qualified, MPCA licensed Designer, depending on system chosen, size and other factors.
Who regulates: Usually LGU if less than or equal to 10,000 gal. per day flow. MPCA if over 10,000 gal. per day.</td></tr>
<tr><td colspan="5">Subsurface Land Discharge</td></tr>
<tr><td>At-Grade Bed</td><td>▪ Use pressure dosing into a rock bed.
▪ Community systems may use a series of at-grades.</td><td>▪ Higher level of maintenance than trenches due to pumps.
▪ Common system with much experience, expertise available.</td><td>▪ Large land area requirement.
▪ Require pumps, controls.
▪ Has potential for groundwater mounding.
▪ Requires soil conditions with adequate separation (greater than 3 feet).
▪ Backup site needed for replacement.</td><td rowspan="3">▪ Servicing by a Minnesota licensed ISTS professional at least every 3 years or as required by LGU for individual systems, more frequently for cluster systems.
▪ Check caps, look for surfacing effluent, manage water use and watch for leaks in household plumbing.
▪ It is recommended that cluster or community systems have a legal entity for management. This is required if the community receives public funding.</td></tr>
<tr><td>Mound</td><td>▪ Creates separation by adding clean sand above ground.
▪ Community systems may use a series of mounds.</td><td>▪ More effective at removing nitrogen than other choices without addition of denitrification processes.
▪ Higher level of maintenance than trenches due to pumps.
▪ Common; experience and expertise available.</td><td>▪ Large land area requirement.
▪ Requires soil conditions with adequate separation (greater than 1 foot).
▪ Backup site needed for replacement.
▪ Require pumps and controls.
▪ Potential for ground water mounding.</td></tr>
<tr><td>Trench and Bed</td><td>▪ Used when there is sufficient unsaturated and permeable soil beneath the drain field, and adequate space for the system.
▪ Community systems may use a series of trenches.
▪ May use rock, chambers or gravelless pipe in the trenches.</td><td>▪ Least expensive to install and maintain – can use gravity flow (some systems – especially larger community systems are pressurized).
▪ Systems are flexible for sizing, placement.
▪ Effective at removing pathogens, phosphorus and ammonia.
▪ Lower installation and maintenance costs.</td><td>▪ Large land area requirement.
▪ Requires soil conditions with adequate separation (greater than 5 feet).
▪ Backup site needed for replacement.
▪ Require pumps, controls if pressurized.
▪ Potential for ground water mounding.</td></tr>
<tr><td>Drip Distribution</td><td>▪ Generally follows secondary treatment systems.
▪ Always has an effluent filter in the design.
▪ Disperses wastewater over a large subsurface area; adding to soil slowly and shallowly.</td><td>▪ Shallow, uses soils more likely to be aerobic.
▪ Maximizes use of evapo-transpiration.
▪ Timed dosing prevents over-saturation.
▪ More uptake by plants since is shallow.
▪ Can be used in more slowly permeable soils such as in wooded areas, allowing communities to preserve natural areas.
▪ Encourages water re-use.
▪ More nutrient reduction than some methods.</td><td>▪ Effluent must be well filtered – small holes in piping plug easily.
▪ Shallow, so can be freezing issues in the pipes.
▪ Rodents can cause problems.
▪ Requires proper installation to prevent freezing.
▪ Maintenance is critical to success.
▪ Additional management needs if many homes are unoccupied in winter – more susceptible to freezing.</td><td>▪ Monitor regularly for plugging and freezing issues
▪ Check caps, look for surfacing effluent, manage water use and watch for leaks in household plumbing.
▪ Inspection and servicing by a Minnesota licensed ISTS professional. Typically, annually or more frequently for cluster systems.</td></tr>
</table>

Technology	Features	Advantages	Limitations	Management and Maintenance
Surface Water Discharge				
Surface Water Discharge	· Discharges into a local surface water body - usually a river, ditch or stream. · Requires NPDES/SDS Permit from MPCA (*see glossary).*	· Receiving waters can accept large flows. · Do not need soil on site to accept wastewater.	· Requires acceptable receiving waters close to the treatment area. · Higher management requirements. · Additional disinfection may require chlorination or UV methods.	· MPCA Licensed Operator. · Regular testing by licensed operator to ensure permit requirements are being met; high maintenance requirements.
Surface Discharge to Land				
Spray Distribution	· Discharges to a land surface via irrigation technology. · Most often applied to farm fields, golf courses or wooded areas.	· Maximizes use of evapo-transpiration. · Timed dosing prevents over-saturation. · Increases water and nutrient uptake by plants. · Can be used in more slowly permeable soils, in wooded areas and varying terrain so can preserve natural areas. · Encourages water re-use.	· Higher management requirements due to more mechanical parts. · Large land area requirement. · Risk of human contact increases the costs of pretreatment including a disinfection component. · Winter storage required.	· MPCA Licensed Operator. · Operator needs understanding of crop management in addition to managing the collection and secondary treatment systems.
Holding Tanks, Privies and Onsite Separation Technology ***Who designs:*** Qualified Minnesota Professional Engineer or qualified MPCA licensed Designer, depending on system chosen, size and other factors. ***Who regulates:*** LGU following MPCA Code 7080 with local adaptations, if any.				
Holding Tank	· Stores all wastes until removed for treatment off-site. · Considered a collection and storage device.	· Allows temporary use while permanent options are being explored, if permitted. · Allows limited water use if no other options.	· Often prohibited except under special circumstances. May be temporary only. · Frequent pumping means higher costs.	· Service Contract with a Minnesota licensed ISTS professional as required by LGU. · Alarms required.
Outhouse or Privy	· Allowable if follow guidelines. · Must have appropriate soils or have a holding tank beneath.	· Appropriate in cabin settings without running water.	· May be aesthetic issues. · Does not allow greywater treatment. · Must meet all setbacks.	· Service by a Minnesota licensed ISTS professional as required by LGU.
Source Separation toilet	· Separates toilet waste (blackwater) from the rest of sewage (greywater). Toilets do not flush. May use composting, incinerating or chemical toilets to remove the solids.	· Dispersal area reduced by 40% due to flow and organic loading reductions. · Significantly reduces water usage by eliminating toilet flushing. · Reduces organic, nitrate and pharmaceutical loading to soil treatment system. · Reduces bacteria levels in the waste stream. · Reliable secondary treatment. · Reduces biomat in soil treatment area. · May allow for higher loading rates in dispersal area. · May allow for wider range of soil types. · Media can be easily cleaned if plugged. · Useful where installing soil treatment system is not an option and/or where there are issues obtaining drinking water.	· Larger space requirements for the system if located in a basement. · Requires higher commitment to management than some systems. · May be aesthetic issues in a home. · Requires major plumbing differences in existing homes or businesses.	· Service by a Minnesota licensed ISTS professional as required by LGU. · Solids must be dispersed of in accordance with Federal 503 Rules.
Grey water Treatment System	· Treat and disperse of the water using aerobic treatment.		· Larger space needed. · Requires higher commitment to management than some systems.	· Service by a Minnesota licensed ISTS professional as required by LGU.
Water Recycling System	· Recycles, treats greywater with mechanical filtration and disinfection to meet irrigation or drinking water standards.		· Initial cost is often higher than drilling a well and providing a separate wastewater treatment system.	· Must frequently monitor water quality. · Service by a Minnesota licensed ISTS professional as required by LGU.

Summary of Treatment Options for Small Communities to Consider

This table summarizes the information in this document. For more information, refer to the identified page in the publication, then to the sources listed on page 11 or talk to your local permitting authority, the agency listed as the regulator for the system, or to a professional who can design a system.

		See page	ISTS	Cluster Soil-based	Cluster non-soil based	Large Cluster or Municipal
Collection, Preliminary Treatment						
1 septic tank per home	Collection via STEG, STEP or Grinder Pump	3, 4	X	X	X	X
1 septic tank per home	Collection via gravity or pressure	3, 4	X	X	X	X
1 septic tank for multiple homes	Collection via STEG, STEP, Grinder Pump Pressure Sewer	3, 4		X	X	X
No septic tanks	Collection via vacuum or conventional gravity	3, 4		X	X	X
No septic tanks	Use of separation technologies	8 X		X	X	X
Secondary Treatment (Additional treatment between collection and final treatment/dispersal)						
Aerobic Treatment Unit (ATU) or Activated Sludge	Uses aerobic microorganisms to provide secondary treatment, removal of biodegradable organics and suspended solids. Effluent passes through the ATU going to soil treatment or further treatment followed by discharge.	4 X		X	X	X
Constructed Wetland	Lined, constructed area uses anaerobic bacteria to treat wastewater.	5 X		X	X	X
Recirculating Media Filter	Sand, gravel, peat or synthetic textiles filter with a recirculation tank. Effluent passes through the filter several times before going to soil treatment or further treatment followed by discharge.	5 X		X	X	X
Single pass media filter	Use natural, mineral or synthetic media such as sand, gravel or peat; or in lined cells, or prefabricated containers. Effluent passes through the filter before going to soil treatment or further treatment followed by discharge.	5 X		X	X	X
Stabilization Pond/Lagoon, Aerated Pond, Rotating Biological Contactor, Trickling Filter	Secondary or Pre-Treatment options for large clusters or municipal treatment facilities. The most common methods for communities to provide secondary treatment of wastewater.	6				X
Final Treatment and Dispersal						
Drip Distribution	Subsurface soil discharge. Disperses wastewater over a large subsurface area; adding to soil slowly and shallowly.	7 X		X	X	X
Trenches, beds, mounds, at-grades	Subsurface soil discharge. Cluster systems may use a series of trenches, mounds or at-grades.	7 X		X		X
Surface water discharge	Discharge into a local surface water body, usually a river, stream or ditch.	7			X	X
Spray distribution	Surface discharge to land. Discharges to a land surface via irrigation technology.	8		X		X
Holding Tanks, Privies, Source Separation Technologies						
Holding tank	Stores all wastes until removed by pumper for treatment off-site. Often prohibited except under special circumstances. May be temporary only.	8 X			X	
Privy	Appropriate in cabin settings without running water.	8 X				
Separation Technology	Separates toilet waste (blackwater) from the rest of sewage (greywater); uses a variety of methods to remove solids, treat and disperse wastewater.	8 X		X	X	X

Choosing the Most Appropriate Treatment System for Your Community

The charts and tables in this document point out how difficult it can be to sort out the best options for your community. The following checklist may be useful in providing some guidelines for the selection process. This list is not comprehensive – you will find other questions to add. It will be of the most use when combined with a full community assessment (see the University of Minnesota Extension Service web site at http://septic.umn.edu/scwep/community for help with the assessment phase). Most communities will need input from agencies, potential service providers, designers and/or engineers to complete this information.

List components or systems to research further in these boxes

Factor					
System Design *use a rating system (excellent/good/fair/poor; high/medium/low, etc.) to rate each of your system choices*					
Ease/cost of installation for new, or repairs of existing system					
Maintenance: service provider needed, frequency of maintenance, costs of management/maintenance					
Component and/or system longevity					
Overall system reliability (research reports, information from communities with similar systems)					
Site Suitability					
Depth to water table or other limiting conditions					
Soil permeability – redoximorphic features, potential for ground water mounding.					
Required setbacks from wetlands, surface waters, shorelands, structures, property lines, other factors					
Proximity to public and private wells					
Footprint needed for collection, treatment(s) and dispersal at one or more sites and on each property					
Adequate space available for alternate or replacement site(s) in the future					
Ease of access for routine maintenance by vehicles such as pump or service trucks, in all seasons					
Potential or existing drainage patterns					
Aesthetic Concerns					
Landscaping removal or damage to individual properties, streets, central locations					
Use and enjoyment of community property by all residents. What is in property owners' line of vision?					
Appearance on individual lots and within the community					
Waste Type, Strength, Quantity					
Number of individual homes with the number of potential bedrooms					
Commercial, community or business– indicate type (manufacturing, church, school, gas station, etc.)					
Food service/restaurants, schools that produce higher fats/oils/grease and other wastewater issues.					
Seasonal properties – may cause large variations in flow (seasonal cabins, resorts, other)					
Cost Considerations					
Design, development other up-front costs					
Installation, construction, equipment, property purchase, other costs					
Maintenance, management costs including power. Cost to each property. Annual and long-term costs					
Debt service and future repair/replacement costs					
Regulatory, Legal, Administrative Costs and Considerations					
State and local regulations (EPA, MPCA, LGU): can this system be created here?					
If not an incorporated city: what Organizational Structure may be established? At what costs?					
Maintenance, management contracts/agreements for all components					
Costs of easements if needed; costs involved with crossing any roads, utilities.					

Glossary

Activated Sludge Functions similar to aerobic treatment unit (ATU) – much larger. Often called "package plant."

Aerated Ponds Mechanical aeration to provide oxygen for treatment. Discharge may be continuous or spring and fall, depending on receiving waters and permits.

Aerobic Treatment Unit (ATU) Uses aerobic microorganisms to provide secondary treatment, removal of biodegradable organics and suspended solids. There are several types of units available, using a variety of processes. Performance of types varies.

At-Grade system A pressurized soil treatment system. Wastewater is dosed to a drainfield rock bed that is constructed on original soil at the ground surface.

Blackwater waste produced by toilets.

Constructed Wetland Lined, constructed area uses anaerobic bacteria to treat wastewater.

Conventional Gravity Sewer All raw sewage is piped via gravity to treatment area. Typically uses 8" pipes in the street.

Drip distribution Subsurface land discharge. Disperses wastewater over a large subsurface area, close to the surface. adding to soil at a slow, consistent rate.

Greywater Sewage that does not contain toilet waste.

Greywater Treatment System A system that receives, treats and disperses of only greywater.

Grinder Pump Pressure Sewer Convey solid wastes suspended in wastewater by grinding solids into small particles. Grinder pump typically located in 30 gal pump stations for single homes. Typically uses 2 – 4" pipe.

Holding Tank A closed water – tight tank for storage of sewage until it can be transported to a point of treatment and dispersal.

Imminent threat to public health or safety (ITPHS) Situations with the potential to immediately and adversely affect or threaten public health or safety. At a minimum, this includes ground surface or surface water discharges and sewage backup into a dwelling or other establishment.

ISTS: Individual Sewage Treatment System. A sewage treatment system serving a dwelling(s) or other establishment(s) using sewage tanks followed by soil treatment and disposal or using advanced treatment devices that discharge below final grade. ISTS includes holding tanks and privies.

ISTS Code 7080 Minnesota Pollution Control Agency (MPCA) 7080 code for soil-based treatment . Regulates from one home to 30 homes or 10,000 gpd per day of flow or less. Regulated by MPCA Chapter 7080 and/or local government rules.

ISTS Professional a person who designs, installs, alters, repairs, maintains, pumps or inspects all or part of an ISTS.

LGU: Local Government Unit. May be a county, city, statutory area or township with jurisdiction including septic codes, through local ordinances.

LSTS: Large Subsurface Treatment System. Cluster and establishment soil based treatment/dispersal systems with greater than 10,000 gallons per day of flow.

Mound System A soil treatment system with a rock bed elevated above the original soil with clean sand to overcome soil limitations.

National Pollutant Discharge Elimination System (NPDES) and State Disposal System (SDS) Wastewater Treatment Systems discharging into surface waters must have permits. NPDES is a federal program established under the Clean Water Act, aimed at protecting the nation's waterways from point and non-point pollution sources. SDS is a state program regulating discharges to ground surface or sub-surface. They are combined into one permit and administered by the Minnesota Pollution Control Agency (MPCA) when both permits are required. Most ISTS systems do not require permits. See the MPCA web site for details (http://www.pca.state.mn.us/water/wastewater.html#permits).

Privy an aboveground structure with an underground cavity used for the storage or treatment and disposal of toil wastes.

Recirculating Media Filters Sand, gravel, peat or synthetic textiles filter with a recirculation tank. Effluent passes through the filter several times before going to soil treatment.

Rotating Biological Contactor Media drums pick up wastewater as circulate. Organisms on the media layer use organic matter on wastewater for food. Uses aerobic & anaerobic bacteria.

Seasonal Dwelling a dwelling occupied or used for less than 180 days per year and less than 120 consecutive days. (Code 7080 definition)

Septage Solids and liquids removed during periodic maintenance of an individual sewage treatment system, or solids and liquids that are removed from toilet waste treatment devices.

Septic Tank Effluent Gravity (STEG) System of septic tanks and small diameter collection mains. Septic tanks may serve one or more homes. Typically uses 4" pipes in the street.

Septic Tank Effluent Pump (STEP) Each home has its own septic tank or several homes can be connected to a larger septic tank. Effluent flows by pressure out of septic tank into mainline. Typically uses 2 – 4" pipe.

Sewage waste produced by toilets, bathing, laundry, or culinary operations.
Single pass media filters Use natural, mineral or synthetic media such as sand, gravel or peat; or in lined cells, or prefabricated containers.
Spray irrigation Surface discharge to land. Discharges to a land surface via irrigation technology.
Stabilization Ponds Used by many small communities. Consist of large lagoon cells about 4' deep for oxidation of organics and settling, then a discharge method – typically spring/fall discharge to surface waters. Ponds use microbes existing naturally in water for treatment. See Mechanical/Municipal Treatment section.
Surface water discharge Discharge into a local surface water body, usually a river, stream or ditch.
Toilet waste treatment devices other toilet waste apparatuses including incinerating, composting, biological, chemical, re-circulating or holding toilets or portable restrooms.
Trench Subsurface land discharge using a trench that contains drainfield rock or other medium, covered with topsoil.
Trickling Filter Wastewater is distributed over media; trickles down. Typically includes a clarifier to capture solids.
Vacuum Sewers Valve pits are located every 2-4 homes. A small diameter pipe carries the effluent away to a vacuum pump station. Typically uses 2 – 4" pipe.

Sources:

- Minnesota Pollution Control Agency, Wastewater Division, www.pca.state.mn.us/water/wastewater.html, 651-282-2663, 800-657-3864
- Onsite Sewage Treatment Program, University of Minnesota Extension Service web site: http://septic.umn.edu.
- *Residential Cluster Development: Fact Sheet Series* (MI-7059). 1998. 1-800-876-8636 or http://shop.extension.umn.edu.
- *Small Community Wastewater Solutions: A Guide to Making Treatment, Management and Financial Decisions. BU-07734.* University of Minnesota Extension Service, 2002. 1-800-876-8636 or http://shop.extension.umn.edu. $15.00. 2002.

  This book is an excellent resource for communities working on wastewater treatment issues including why we need to treat wastewater, collecting community data including site evaluations, options for individual and cluster treatment, more information on these structures, options, management options, financing community systems, working with professionals, and how to develop and implement a process in your community.

Chart on page 10 adapted from "Choosing a Wastewater Treatment System," a Series About Onsite Wastewater Treatment Alternatives, University of Rhode Island Cooperative Extension Service. Publication number 94602CASindd. January, 2005. www.uri.edu/ce/wq/ or 401-874-2900.

Reviewers: This document was reviewed by:

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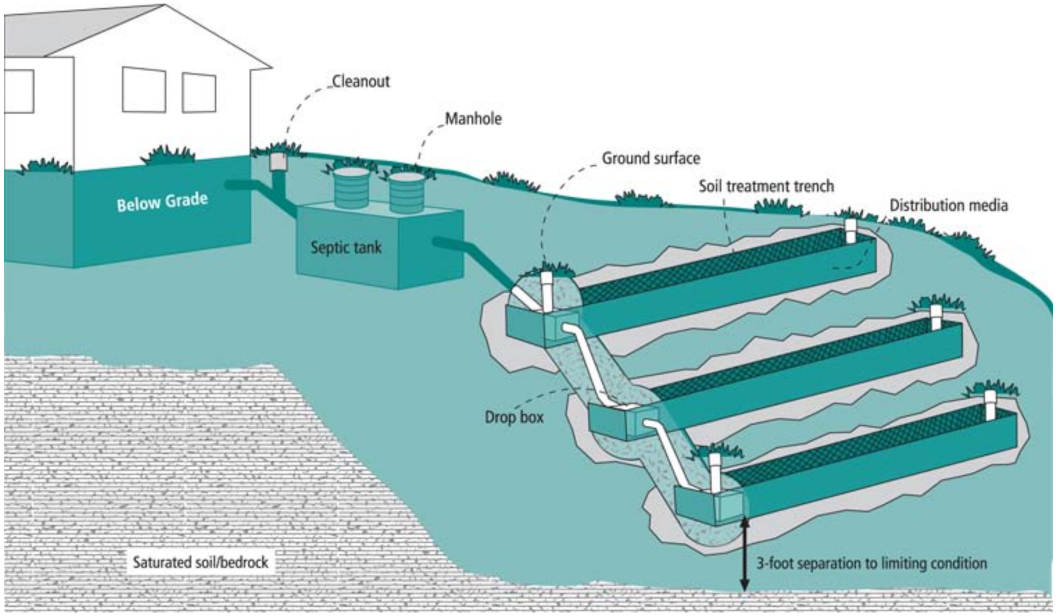
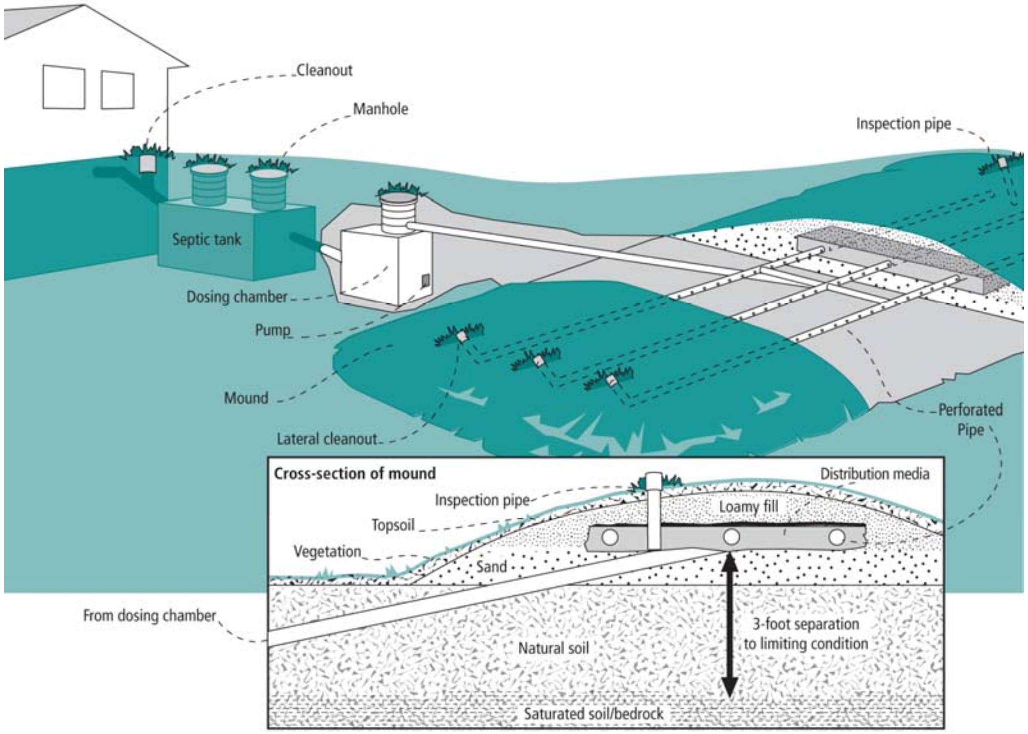
Compiled by Valerie Prax, Regional Extension Educator, Onsite Sewage Treatment Program, University of Minnesota Extension Service.



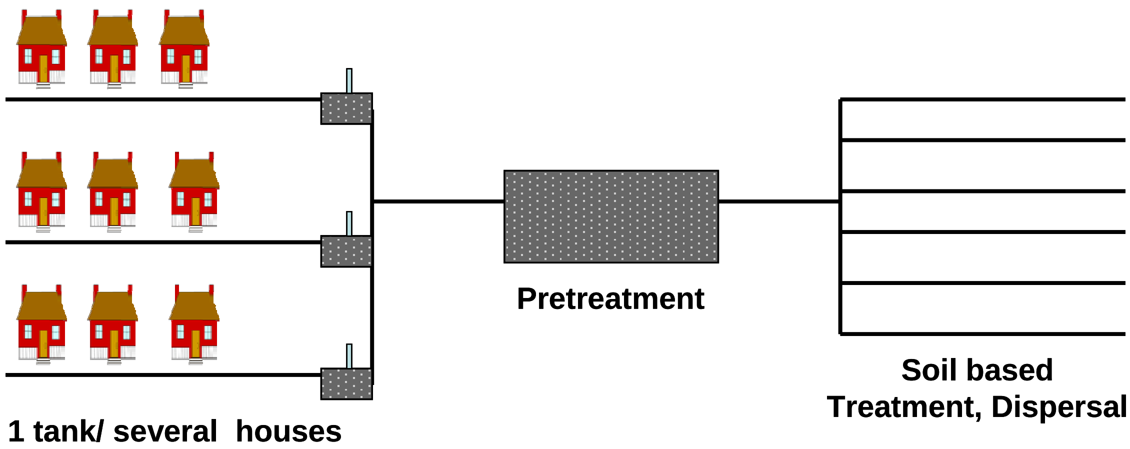
Components of an individual septic system:

- Plumbing from sources of wastewater to tank.
- Septic tank(s); may include pump tank – must be pumped periodically to remove septage, which must be dispersed of by the pumper.
- If pre-treatment option is installed, goes after the tank.
- If not gravity fed, pumps, lift stations, other mechanical parts.
- If gravity fed, drop box(s) to distribute to soil treatment area.
- Soil treatment area – may be in-ground system, at-grade or mound, depending on soil and other factors such as size required.

Individual System: In-Ground or Drain Field



Individual System: Mound



Cluster Septic System

- Collects wastewater from multiple homes via any of the wastewater collection systems (see pages 2 and 3). System may include small businesses, or may only serve a business such as resort, gas station or restaurant.
- Tanks may be installed for each home, or may serve more than one home.
- Wastewater is usually (not always) piped to a pre-treatment system, which often includes larger collection tanks before the system. See pages 3– 4 for information on pre-treatment options.
- Wastewater goes to a final treatment/dispersal system – may be subsurface or surface soil based, or surface water based. See pages 6 – 7 for information.

Mechanical Treatment Plant

- Collects wastewater from multiple homes and businesses via any of the wastewater collection systems (see pages 2 and 3) without tanks.
- Sewage (solids and liquids) are piped, usually via gravity to a treatment plant. See page 5 for the most common options in Minnesota.
- Treated wastewater is discharged, usually to local surface waters.
- Most systems have bio-solids or sludge that must be dispersed of periodically.