New households constructing homes in the next 20 years will most likely be on their own private on-site wastewater disposal septic system. The County requires all new homes install a septic system with holding tanks only allowed as a last choice if the site is not suitable for a septic system.

- The Chamber of Commerce Website states the year round population at 718 people with 1600 during summer months. This estimate appears reasonable when compared to the 344 households in the DOA census data.
- Current septic code provides more options for systems when compared to the code followed prior to year 2000. Current code allows taller mounds be built where previously a holding tank was the only option. Based on the information provided above the capacity of the proposed system shall be designed as outlined below.

The existing septic system (FAST) located at the ball park is capable of treating and disposing of 3,000 gallons per day. This system was installed to handle year round residents currently on holding tanks.

Based on the information provided above the proposed design flow to dispose of all holding tank and septage waste can be estimated as follows:

Holding tank waste:

- Year 2011 metering by the Town indicated that the peak month for total gallons hauled of holding tank waste and septic tank waste was August which accounted for approximately 21.5% of the annual flow.
- Year 2011 total holding tank waste pumped and hauled = 949,915 gallons
- Estimated peak month = 21.5% (949,915) = 204,232 gallons/30 days = 6,588 gpd peak month holding tank waste.
- Utilize a 150% factor of safety to determine design flow = 6,588 x 150% = 9,882 gpd design flow for the peak month. Therefore **use 9,900 gpd as the design flow from the holding tank waste.**
- Historical peak month = 10,224 gpd (year 2007), therefore consistent with estimated peak
- **County sanitarian provided data indicating 203 users are currently served by holding tanks on the Island.**

Septic tank waste:

- Year 2011 annual volume hauled = 229,100 gallons
- Apply 20% for future growth and Town owned septic systems = 274,920 gallons
- Estimated peak month for year 2011 = 21.5% of overall annual x 229,100 gallons annually = 49,256 gallons peak month = 1,642 gpd peak.
- Historical peak month = 1,915 gpd (year 2007). Therefore **use 2,000 gpd as the design flow from the septic tanks.**

- **County sanitarian has provided data indicating 779 users are on a septic system (not holding tank) on the Island.**
- Maintain adequate room on the Town property to allow land spreading of the septic tank waste associated with the septic tank pumping.
- Land spreading on Town owned sites:
  - Gunnlaugsson Site (Open Site)
    - Approved for 39,000 gallons per acre per year
    - Maintain 2.8 acres x 39,000 gallons = 109,200 gallons yearly for septic tank wastes from the proposed large scale Town owned septic tank.
  - Airport sites
    - Approved for 12,165 gallons per acre per year
    - 26.18 acres previously permitted.

Total Wastewater Flows:

- **Total peak flows to be treated and disposed of = 9,900 gpd of holding tank waste plus 2,000 gpd of septic tank waste = 11,900 gpd total. 2,000 gpd of holding tank waste can continue to be directed to the Ball Park system. This leaves the new system handling 7,900 gpd of holding tank waste plus 2,000 gpd of septic tank waste.**
- **At a minimum, design a new system for a 9,900 gpd design flow (6,600 gpd forward flow) at the new site. Provide adequate treatment capabilities to handle up to 2,000 gpd of septic tank waste as part of the forward flow.**
- **Select a drain field and components suitable for treatment and disposal of 11,000 gpd with pretreatment to handle additional unforeseen peaks.**
- **No septic tank waste is allowed at the Ball Park system.**

System Design Parameters:

- Based on preliminary soil testing on all sites, the proposed trench loading rate for the sites in question can be estimated at 0.8 gpd/sqft with pretreatment. Final soil testing has confirmed the 0.8 gpd/sqft loading rate is correct using the pretreated effluent #2 standards. This loading rate is based on achieving 30 mg/l or lower BOD and TSS coming out of the pretreatment unit.
- Holiday and weekend flows will be greater than other daily flows. The system shall provide additional surge storage to accommodate the peaks. This can be provided by placing an equalizer tank prior to the pretreatment system with timers set to only forward flow a specified volume of effluent forward to the system. The proposed 6,600 gallon per day forward flow will be sent forward utilizing pumps on a timer with any excess held in the equalizer tank until such time as the pumps can catch up. This protects the treatment units and disposal field form being overloaded.
- Additional pretreatment is necessary to provide treatment of the higher strength septic tank waste.

- It is recommended that 3 foot wide trenches be used each 100 feet long.
- Therefore the overall system footprint will require the following trench quantity:
  - 11,000 gpd/0.8 gpd per sqft = 13,750 sqft required
  - 13,750 sqft/3 ft wide trench = 4,584 feet of trench.
  - Therefore recommend two cells each with 23 trenches, 3 feet wide by 100 feet long. That provides 3'x 100' x 23 trenches = 6,900 sqft per cell x 0.8 gpd/sqft = 5,520 gpd per cell x 2 cells = 11,040 gpd capacity of the drainfield.
- The trench and system layout shall be in accordance with guidelines established in Wisconsin DSPS "Pressure Distribution Component Manual for POWTS (Version 2.0)" as well as DSPS Chapter 83 of the Wisconsin Administrative Code.
- The cells shall be designed to allow shutting down one-third of the system (one cell) for winter and resting on an alternating basis each winter.
- Full system capacity would be used in summer months.
- Equalization and septic tank volume shall be provided to manage weekend/holiday peak flow surges and allow time dosing the field with a maximum of 6,600 gpd forward flow at the new system.

4. Existing facilities

The waste water flow generated by pumping of Island holding tanks and septic tanks is currently disposed of as follows:

- Wastewater collected and transported by privately owned (Johnson and Jorgenson) septic haulers utilizing tanker trucks.
- Wastewater is land spread on 11 different land spreading sites.
  - Myra A South - 3 acres
  - Myra A North - 3 acres
  - Myra A1 – 2.5 acres
  - Myra C East – 4 acres
  - Gunnlaugsson West – 1.7 acres
  - Airport A – 16.03 acres
  - Myra B -6 acres
  - Myra B1 – 3.5 acres
  - Myra C West – 4 acres
  - Gunnlaugsson East – 2.8 acres
  - Airport B – 10.14 acres
- 31 acres of the land spreading sites are owned by the Town and 23 acres leased.
- Wastewater is also dumped into an existing 3,000 gallon per day septic system (FAST) located at the Town ballpark site.
- A plan is included in Exhibit C in this report for the existing ballpark system. The location of the ballpark site is also shown on Exhibit A, Project Location Maps. The ballpark system was installed late in 1999. The system consists of the following:

    - Surge tank(s) for settling of solids and collection of holding tank waste
    - FAST 3.0 high strength waste treatment tank with 1500 gallon clarifier compartment prior to aerobic unit.
    - 2091 gallon septic tank receiving treated waste water from the FAST unit.
    - 2788 gallon pump chamber receiving effluent from the septic tank and pumping to the disposal fields for final disposal.
    - Pressurized in-ground laterals for effluent dispersal (8 laterals, each 90 feet long).
- The ballpark system has had reported operational issues in the recent years. The system has had issues with solids build up in the FAST tank. He Town has added additional Sludgehammer blower units to the system in an attempt to reduce the solids build up.
- Reasons for the issues at the ballpark are likely due to overloading the system in excess of the 2,000 gpd of forward flow to the system, or treatment of septic tank waste at the ballpark site. The system was designed for holding tank waste strength, not septic tank waste strength.
- The ballpark system would benefit from minimal use for an extended period of time to allow the fields and pretreatment system to dry out and rejuvenate. The system would also benefit from a complete pump out of the system with effluent filters checked and FAST media condition analyzed. Limiting the flow into the system to 2,000 gallons per day and limiting the strength of the flow to residential strength holding tank wastewater without septic tank waste, the system could eliminate the Sludgehammer add-ons should maintenance and up-keep of the Sludgehammers become an issue.
- Addition of flush valves to the existing ballpark system would allow flushing the laterals and prolong life expectancy of the disposal field.
- The wastewater disposed of at Town facilities is from the holding tank/septic tank pumper trucks. There is no Town owned sewer main/ interceptor delivering wastewater to current disposal sites.
- Financial status of existing facilities:
    - Town has provided information regarding the financial status of the utility district in Exhibit I of this report.

5. Need for project

The improvements to the existing waste disposal process used on the Island are needed for the following reasons:

- 23 acres of the land spreading sites are currently leased by the Town. The Town has been notified that a substantial portion of the leased lands will not be available in the coming years.
- The existing 3,000 gallon per day FAST system at the ball park has had issues with performance likely due to overloading.

6. System operation and management

Disposal of wastewater from all holding tanks on the island is currently pumped and hauled by one of two licensed haulers on the island. Holding tanks are pumped when an alarm float in the tank triggers the alarm and the homeowner contacts the pumper. A standard sized residential holding tank (approx 2000 gallons) would typically be pumped once every two weeks if the home is occupied by a family. The vacation homes have much greater time between pump-outs based on limited use.

Septic tanks are required to be pumped one time every three years unless the county is supplied with and inspector's certification that the solids build-up in the septic tank is not to a level that warrants pumping.

Residents pay the pumper directly for the pumping service. The Town charges the pumper based on reported gallons disposed oat one of the current spreading sites of ballpark system. Current rate charged to the owner is 2 cents per gallon of waste.

Current fee structure per Town:

- Pumper pumps and charges property owner for their service. They spread septage and enter the gallons spread into 'Carmody' system.
- Once per month, Utility District downloads the entered information and invoices the system owner a separate bill from the Utility District for the amount of gallons x $0.02 per gallon. Invoices are done through the Town's accounting system.
- Owner pays Utility District and monies are deposited into Utility District's account.
- Any delinquent owners are contacted by letter to pay. If after 3 letters or approx. 1 1/2 - 2 years delinquent, the charge is collected through their property tax bill.

The Town has not had complaints or received reports of high nitrate levels in existing residential wells indicating the existing septic systems are likely operating as intended. The County tracks all septic systems in the County and requires inspections of systems at time of real estate transfers. Should a septic system be deemed failing, the owner would likely be required to re-build as a mound system. The County considers a holding tank as a system of last resort and only permits if the site will not accommodate a mound system or better.

7. Alternatives considered

The four previously identified sites were considered as wastewater disposal alternatives. All four sites are located on Town owned properties. A description of each alternative and the advantages and disadvantages of each are listed below:

- ***Open Site***
  - Advantages
    - Majority of the site has previously been cleared due to its existing use as a land spreading site.
    - Terrain/slopes would accommodate an on-site disposal bed/field nicely.
    - Existing gravel drive into the site could be used to service the system and during construction.
    - Soils are adequate in depth to support an in-ground septic system
    - A portion of the site could be maintained for convenient septic tank waste land spreading and disposal of the septic tank waste generated from the on-site system.
    - Electricity nearby in Gunnaulgsson Road and the Town Dump.
    - No environmental concerns apparent.
    - Site is remotely located to hide system from public view.
    - Site is centrally located on the Island for hauler's convenience.

  - Disadvantages
    - Located adjacent to Town gravel pit, potentially hampering distant future expansion.
    - Utilize a portion of the existing land spreading site to place the septic system.
- ***Wooded Site***
  - Advantages
    - Existing dirt lane into the site could be used to service the system and during construction.
    - Soils are adequate in depth to support an in-ground septic system
    - Site is remotely located to hide system from public view.
    - Electricity nearby in Gunnlaugsson Road.
    - No environmental concerns apparent.
    - Not currently a land spreading site, therefore preserves land spreading capacity at other locations.
    - Site is centrally located on the Island for hauler's convenience.

  - Disadvantages
    - Mature hardwoods would need to be cleared for construction of system. This would add cost and is environmentally questionable.
    - It is a long run from Gunnlaugsson Road to the site to construct a gravel drive at the current dirt lane location.

- ***Dump Road Site***
  - Advantages
    - Existing paved road into the dump provides direct access to the site.

- Soils are pure sand with water table deep enough to support an in-ground system.
- Area is already cleared of trees.
- Not currently a land spreading site, therefore preserves land spreading capacity at other locations.
- Site is centrally located on the Island for hauler's convenience

  - Disadvantages
    - Site is located in an area that has monitoring wells to monitor the dump facility.
    - Site is located approximately 250 feet from a large wetland complex
    - Stacks of old tires and animal cages have been identified that would need to be re-located or removed from the septic site.

- ***Red Barn Site***
  - Advantages
    - Site had previously been cleared, therefore only minor clearing is necessary.
    - Soils are adequate in depth to support an in-ground septic system
    - Site is located in an area where neighboring business/residence could possibly direct connect to the system utilizing a lift station.
    - Electricity is nearby at South Shore Drive.
    - No environmental concerns apparent.
    - Not currently a land spreading site, therefore preserves land spreading capacity at other locations.
  - Disadvantages
    - Site located adjacent to a Town park, therefore tanks and truck access likely to be very visible to the public.
    - Truck route to pass many residential homes.
    - The site is located along the south shore of the Island, creating long haul times for pumper trucks to access the site.
    - Remotely located from Town land spreading sites.
- ***System Choices***
  - The septic system will fall under Wisconsin Department of Safety and Professional Services (DSPS) jurisdiction and review. If the on-site system were to exceed 12,000 gallons per day the Wisconsin Department of Natural Resources (DNR) would have permitting authority and perform a joint review with DSPS. Based on being classified as a large system under DSPS guidelines the selected system shall receive pretreatment to reduce nitrates prior to subsurface disposal.
  - The pretreatment systems selected for this analysis include a Fixed Activated Sludge Treatment (FAST) system as well as a recirculating gravel filter (RGF) system. Both systems will be able to meet pretreatment requirements including nitrate removal.

- The FAST system consists of a blower unit that continuously blows oxygen into a fixed media inside a concrete tank. The blower unit is located above grade with the tank located below grade. Effluent is pumped into the FAST system utilizing timers to regulate the volume reaching the system to assure adequate treatment before passing the treated effluent on to the disposal trenches.
- The RGF system passes septic tank effluent through a gravel media by dispersing the effluent using pumps to the surface of a gravel media layer. The effluent passes through the gravel media thus being filtered. A portion of the filtered effluent is moved forward to the disposal trenches with a portion being recirculated back to the pump tank to be passed through the gravel media for additional filtration. During times of low flows additional passes through the media would be expected.
- Cost comparisons of each system have been included in Exhibit G of this report.

8. Selection of an alternative

The four potential sites were analyzed for feasibility, cost and long term operation. Based on the information collected, the following considerations were used to make this recommendation.

- 1st Choice
  - The ***Open Site*** is being recommended as the best alternative. The site is the logical choice based on location, cost, current use, soils, and contour of the land. The site is large enough to allow addition of future tanks should unforeseen flow increases occur. The remainder of the site can be maintained for land spreading allowing land spreading of the septic tank sludge from the new system at the same location. There are no environmental concerns and the surrounding woodlands isolate the site from neighbors and traffic on Gunnlaugsson Road. Based on the Open Site being the first choice a full environmental report was completed for this site. The findings included in this report indicated no evidence of environmental impact. An intensive Phase 1 Archaeological survey was completed by Midwest Archaeological Consultants clearing the site of archaeological concerns. The proposed Open Site septic tank and disposal field would be located approximately 350 feet from the nearest home and residential well. State well code NR812.08 requires a minimum of 250 feet from a septic system greater than 8,000 gallons per day and a residential well.

- 2nd Choice
  - The ***Red Barn Site*** is being recommended as the second best choice. The site is suitable in all aspects, but the location in an existing park area will be an issue based on truck traffic, odor and visibility.

- 3rd Choice
  - The ***Wooded Site*** is being recommended as the third best choice. The site is suitable in all aspects, but the distance from the Town road and location in a mature forest would make construction costs increase and cause unneeded destruction based on other suitable choices. The small depressions and humps within the system area also cause some difficulty in setting an absorption system elevation.

- 4th Choice
  - The ***Dump Road Site*** has been determined to be the least desirable choice for the proposed system. Space is limited due to adjacent wetlands, existing road and tire/cage stockpiles. The presence of existing monitor wells for the landfill operation raises regulatory concerns regarding excavation in that area. The system installation would also require clean up of the existing stockpiles. This may also be a long term source for sand for Town use in the future if needed.

- **System type choice**
  - The FAST pretreatment system option with an in-ground pressurized disposal system is recommended. The FAST system is recommended over the RGF system for the following reasons:
    - Cost of FAST system for 11,000 gallons per day disposal field (7,900 gpd holding tank plus 2,000 gpd septic, with a 6,600 gpd forward flow by timer) including security, shed, fencing, engineering, attorney, repairs to existing ballpark system, inspection, equipment and installation is estimated at $519,000 (see Exhibit E).
    - Cost of RGF system for same gallons per day inclusive of same amenities is estimated at $527,248 (see Exhibit E).
    - FAST system is much simpler to operate with fewer/smaller pump requirements.
    - FAST system has a smaller footprint than the RGF
    - The FAST is located below grade helping insulate during winter months with lower flows.
    - FAST system needs less O&M effort
    - FAST system can be factory constructed and delivered in one piece already in the tank. The RGF requires stone specifications be strictly complied to and checked during construction. The RGF would take several days to construct on-site.

- FAST system is currently being maintained and monitored by Town staff at the ball park septic system, therefore staff is familiar with the operation and maintenance requirements.
- The RGF would be exposed to the elements causing concern of rodent damage and freezing in winter during periods of low flow and freezing temperatures.
- The RGF would have greater chance of human contact with the effluent.
- The FAST system shall be designed based on achieving 30 mg/l BOD and TSS levels prior to sending forward to the disposal fields.
- FAST also boasts a 65-70% reduction in nitrates.

Other technologies considered for use include:

- Orenco AdvanTex pretreatment device.
    - This system consists of textile sheets hung on racks with the effluent sprayed onto the media for aerobic treatment. This system is well suited for residential strength wastewater but would require additional tank volume or pretreatment be placed up front to provide the necessary settling/treatment of the wastewater before introduction to the AdvanTex media.
    - The Advantex literature states that the "maximum allowable wastewater strength pumped to an Advantex Treatment system is residential strength wastewater, this would have average BOD = 130, TSS = 40 and TKN= 65".
    - The higher strength associated with the septic tank waste would require pretreatment or a much greater up front septic tank/equalization tank volume.
    - Labor for maintenance of the AdvanTex system is greater than other options considered. The textile sheets need to be cleaned on a regular basis.
- Manufactured media filter
    - The RGF was analyzed above. Another manufactured media filter is the peat filter. Concerns with the peat filter include:
        - Clogging due to the higher strength

Surface discharge of the treated wastewater was ruled out due to the difficulty associated with obtaining a DNR discharge permit. Surface discharge typically requires tertiary treatment including ozone treatment for elimination of pathogens. The disposal field provides the tertiary treatment utilizing the soil.

The in-ground pressurized disposal field was selected over a mound system for several reasons:

- The in-ground system is permitted due to adequate depth to the limiting factor.
- Mounds require import of mound system below the system elevation adding cost.
- The cost of the in-ground system is less than the mound.

Opportunities may exist to spray irrigate or use drip irrigation in areas based on soil conditions. Spray irrigation could allow use of the wooded site without clearing many trees. Drip irrigation could be placed avoiding trees where possible

Concerns with spray irrigation include:

- Potential for human contact with wastewater.
- Impact to wildlife.
- Only allowed during growing season.

Concerns with drip irrigation include:

- Potential for damage to the shallow/exposes lines by animals.
- Risk of freezing during low flow times in winter.

For the reasons stated above spray irrigation and drip irrigation have been ruled out as desirable alternatives.

Disposal field media considered included:

- EZ Flow media: This media is commonly used in Door County, easy to transport, easy to install and economical.

- Gravel bed: Placement of gravel as the trench media is an option. The disadvantages of gravel include the inconsistency of the material from a gradation and cleanliness standpoint. This would require additional testing during construction, take longer, and provide an opportunity for substandard materials to be included.

- Infiltrator Chambers: The cost of the Infiltrators is similar to the EZ Flow. The reason it was not selected was due to the additional height of the chamber which would result in additional fill over the system near the low end where the trenches

will likely be very near the existing ground surface based on the soil testing completed on-site.

Observation pipes shall be included in the disposal field as well as flush valves to meet state code and provide adequate means of system maintenance. Monitoring wells will not be required in the system area. The observation pipes will provide visual inspection of the disposal trench and allow evaluation of potential system ponding.

Additional needs that may be desired by the Town could involve a system to accurately meter the amount of wastewater delivered by each pumper. Currently pumpers report the volumes delivered to the Town. An electronic metering method could be implemented to allow detailed record keeping assuring system capacity is not exceeded and help with the Town's billing system.

To summarize the alternatives considered it has been determined that the FAST system provides the best alternative for pretreatment of the higher strength wastewater that is anticipated with the septic tank waste. Other options would not be effective in treatment of the higher strength waste resulting in greater chance of failure in the disposal field. The FAST system also required less maintenance, staff training and labor hours.

9. Conclusion and recommendation

Based on the analysis provided above as well as the supporting information provided in Exhibits A through I later in the report the following recommendation is provided by Baudhuin Incorporated:

- **Total peak flows to be treated and disposed of = 9,900 gpd of holding tank waste plus 2,000 gpd of septic tank waste = 11,900 gpd total. 2,000 gpd of holding tank waste can continue to be directed to the Ball Park system. This leaves the new system handling 7,900 gpd of holding tank waste plus 2,000 gpd of septic tank waste.**

- **At a minimum, design a new system for a 9,900 gpd design flow (6,600 gpd forward flow) at the *Open Site* (aka Gunnlaugsson Site). Provide adequate treatment capabilities to handle up to 2,000 gpd of septic tank waste as part of the forward flow.**

- **Select a drain field and components suitable for treatment and disposal of 11,900 gpd after pretreatment.** The system shall consist of three FAST 9.0 units capable of treating up to 9,900 gpd of household holding tank strength waste water plus 2,000 gpd of septic tank strength waste water.

- **Limit the forward flow to the drain field using timers on the pumps to assure the disposal field is not overloaded. .** Provide surge capacity in the tanks to accommodate peak flows.

- Terminate (or allow to expire) current land spreading contracts upon stat-up of the new system. The remainder of the *Open Site* (2.8 acres) shall be maintained as a land spreading site to accommodate the septic tank sludge removed from the on-site system.

    - The open site is approved for 39,000 gallons per acre per year of land spreading.

    - The remaining 2.8 acres can accept 2.8 x 39,000 =109,200 gallons yearly for septic tank waste. That availability exceeds all foreseen needs for the onsite system.

- The higher strength of the septic tank waste (estimated 4,000 mg/l BOD and 15,000 mg/l TSS) compared to the holding tank waste (tested at a max of 390 BOD in July 2011 and max of 290 TSS in July 2011) requires the additional FAST units to be included in the main system to allow BOD reduction suitable for subsurface disposal in the proposed septic field.

- The *Open Site* system along with the existing *Ball Park* system should be loaded as follows:
    - Open Site system: quantity dumped not to exceed 7,900 gpd of holding tank waste plus 2,000 gpd of septic tank waste. A forward flow of 6,600 gpd to three 9.0 FAST systems by timer, with the remainder stored in the surge capacity of the tanks
    - Ball Park system: forward flow not to exceed 2,000 gpd to the FAST system (holding tank waste only).
    - Placement of forward flow limits by utilizing pumps on timers and providing surge storage capacity in the tank layout will accommodate holiday peak flows.

- Year 2011 records indicate that average daily flows of holding tank waste during off-season months were as follows:
    - December 921 gpd
    - January 505 gpd
    - February 657 gpd
    - March 392 gpd
    - April 829 gpd

- The greatly reduced average flows indicate that the ball park system could be utilized during the months of December through April allowing shutting down the *Open Site* system to save on electricity and rest the beds associated with the large system. The cells of the large system should also be zoned to allow resting/taking off-line one-third the system at any time to perform repairs or rest that portion of

the drain field to allow rejuvenation. Tanks shall be pumped empty in winter months if the large system is rested for a period to exceed one week.

- It is recommended that a head works metering system be implemented if budget allows to accurately meter and bill the pumpers for wastewater delivered to the system. It is also recommended that security cameras and a chain link fence surrounding the tanks be installed to prevent illegal dumping into the system.

- Based on the issues reported with function of the existing 3,000 gpd ball park system it would be recommended to rest that system when possible during the spring and fall months when all flows can be handled by the large system (until such time that 6,000 gpd of holding tank waste are being hauled). The restrooms at the ballpark facility would still be allowed to utilize the system.

- Implementing the proposed combination of the proposed large system, the existing ball park system will provide the most economical/practical system while allowing expiration of the privately held land spreading leases.

- The construction and operational budgets for the alternatives considered are located in Exhibits E and H of this report.