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September 21, 2012

Via Email & U.S. Mail

Russ Anderson
Wisconsin Department of Natural Resources
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Re: Golden Sands Dairy proposal, Wood County; EIS Scoping Comments

Dear Mr. Anderson:

This letter is to provide comments to the Department of Natural Resources ("DNR" or "Department") regarding the scope of the Environmental Impact Statement ("EIS") the Department is preparing for the proposed Golden Sands Dairy project in Wood County, Wisconsin. This letter is written on behalf of Nicholas Karris of Karris Family Farms, which owns and operates three cranberry farms in the vicinity of the proposed dairy, one of which is devoted solely to organic cranberry production.

As you know, Golden Sands Dairy is a unique proposal, encompassing a 6,130 animal unit dairy, deforestation of thousands of acres of pine forest to make way for new irrigated agriculture, and 49 new high capacity wells to serve the dairy and irrigate the new cropland. Given these features and the sensitivity of the surrounding environment, we believe a thorough environmental review is necessary and appreciate the DNR's decision to observe the EIS process.

For the reasons that follow, the EIS should address the issues identified in this letter and in the attached comments of Mr. Ken Wade (two reports), Dr. Byron Shaw, and Mr. Robert Montgomery. This letter also discusses the Central Sands Dairy, which has common ownership with the proposed Golden Sands Dairy and a common design. Numerous incidents involving potential non-compliance with environmental requirements have occurred at Central Sands since it began operations approximately five years ago. These incidents must be investigated and resolved before Golden Sands Dairy can be permitted in order to avoid predictable impacts to ground and surface water and public health.

1) Water Quantity Impacts.

Obviously, the large number of proposed high capacity wells will have implications for ground water and surface water quantity in the area. The DNR also has expansive authority and responsibility to consider these impacts after *Lake Beulah Management District v. DNR*, 2011 WI 54. Even before that case, the large withdrawals proposed by Golden Sands Dairy would have required and still do require enhanced review under Wis. Stat. § 281.35(4)(a) and (b)1. Accordingly, the DNR must consider:

- Impacts to residential wells. There are hundreds of residential wells in the area, often shallow sand point wells. The EIS should consider impacts to these wells that will result from the dairy's pumping at the production site and for irrigation. The DNR should also consider appropriate limits, including reducing the pumping rate of the proposed wells in order to avoid impacts to local wells. For example, the DNR limited the pumping rate of two proposed high capacity wells associated with the proposed Richfield Dairy because of potential impacts to a neighboring residential well. (See DNR High Capacity Well File No. 01-3-0009; Permit Issued 11/3/11.) The rate in that case was 250 GPM per well in any 30-day period; the rate in this case will likely need to be much lower given the significantly larger number of wells and proximity and number of neighboring wells.

- Impacts to municipal water systems and existing commercial and industrial users.

- The amount and effects of groundwater drawdown on the many marshes, wetlands, trout streams, and other surface waters in the area. This evaluation must include impacts to fisheries, wetland vegetation, and other considerations like tourism.

- The cumulative impacts of the proposed pumping along with existing pumping and reasonably foreseeable high capacity well pumping in the region.

- Recharge rate. We understand the dairy claims that withdrawing water for irrigated agriculture and dairy use will have a recharge rate not significantly different than the current recharge rate on pine-dominated forests. The DNR must investigate the accuracy of this claim and whether the recharge rate will differ seasonally.

- Due to the size of the new withdrawals, the DNR must collect sufficient information to enable it to make decisions on all of the findings required by Wis. Stat. § 281.35(5)(d)[1]:

    1. That no public water rights in navigable waters will be adversely affected.
    2. That the proposed withdrawal does not conflict with any applicable plan for future uses of the waters of the state, including plans developed under ss. 281.12 (1) and 283.83.
    3. That both the applicant's current water use, if any, and the applicant's proposed plans for withdrawal, transportation, development and use of water resources incorporate reasonable conservation practices.
    4. That the proposed withdrawal and uses will not have a significant adverse impact on the environment and ecosystem of the Great Lakes basin or the upper Mississippi River basin.
    5. That the proposed withdrawal and uses are consistent with the protection of public health, safety and welfare and will not be detrimental to the public interest.
    6. That the proposed withdrawal will not have a significant detrimental effect on the quantity and quality of the waters of the state.
    7. Additional considerations if the proposed withdrawal will result in an interbasin diversion.

2) Water Quality Impacts.

The DNR must assess the project's impact on water quality from multiple perspectives: deforestation and conversion of land to irrigated agriculture, manure-spreading and irrigation, dairy site design, and well pumping. Most of these impacts are associated with excess nitrates, phosphorus, and pathogens entering ground and surface water.

As an initial matter, we recognize that the DNR is well aware of the problems of contamination attributable to commercial fertilizers and manure-spreading, and the risks that these sources of nutrients and contaminants pose to municipal water supplies,

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[1] The new withdrawals will easily exceed the trigger in Wis. Stat. § 281.35(4)(b)1.--2 million gallons per day in any 30 day period--for the findings in (5)(d). According to Golden Sands Dairy's application for the 49 high capacity wells, each well has a pump with a capacity of 1,000 GPM, and a proposed maximum water usage of 1,440,000 gallons per day. The applications further state that proposed average water useage per well per day is 720,000 gallons, which comes to 21,600,000 gallons in a 30 day period for each well. The high capacity well associated with Central Sands Dairy, on which Golden Sands Dairy is modeled, has used at least 3 million gallons per month every month since January 1, 2008, and often significantly more. WI DNR Drinking Water Data, High Capacity Well No. 68551.

private wells, and surface water. In fact, the DNR is currently engaging in a multi-agency process to determine how to reduce nutrients entering ground and surface water precisely because of the risks these nutrients present, the problems they have caused, and the costs associated with cleaning them up. *See* Developing Wisconsin's Nutrient Reduction Strategy, Multi-Agency Meeting (9/5/12). The very existence of this process indicates that current nutrient management strategies are not working, which makes permitting yet more sources of nutrients particularly problematic. It is therefore imperative that the DNR understand exactly how this project will contribute to these problems regardless of whether its application meets the requirements of current state law, and that the DNR deny or limit the permit as needed to address excess nutrients.

Deforestation and Converting Land to Irrigated Agriculture: Converting the current pine forest to irrigated agriculture will have multiple implications for surface and groundwater quality that must be understood, including impacts from stormwater runoff during and after deforestation, soil erosion, irrigation, and applying commercial fertilizers and manure and other process wastewater.

Manure-spreading: The DNR must evaluate the many risks posed to ground and surface water associated with manure spreading, including the conveyance of phosphorus, nitrates, and pathogens to and through surface and groundwater. This analysis should specifically address:

- the impacts associated with Golden Sands Dairy spreading solid and liquid manure in the fall and winter, as indicated in their NMP
- the planned method(s) of incorporation for spreading manure at all times of the year
- the porous, sandy nature of area soils and the high groundwater table
- anticipated nitrate loading into ground water and surface water, and the resulting health impacts to residential wells and surrounding farms (e.g. see Montgomery report showing significant reduction in cranberry yields in Central Sands when nitrates exceed 10PPM)
- the cumulative impacts of spreading manure from CAFOs and other sources of nutrients within the Central Sands area of Wisconsin
- the cumulative impacts of manure spreading and nutrient loading on fields in Golden Sands' NMP that receive nutrients from other sources, and whether it will be appropriate to allow spreading on fields that already exceed 100 or 200 ppm for phosphorus

In evaluating the above points, the DNR should consider recent research from the U.S. Geological Survey establishing a link between phosphorus use on agricultural fields and phosphorus in groundwater and streams.[2] Press Release, U.S.G.S., Phosphorus and Groundwater: Scientists Establish Links Between Agricultural Use and Transport to Streams (Feb. 2, 2012). One site studied in reaching this conclusion was in an area of Nebraska with similar soils to the Central Sands of Wisconsin.

One complication to evaluating manure spreading for this project is that the proposed application fields are not currently in production, but are pine forest. The EIS must address whether the dairy can at this point properly characterize these fields and their water features, depth to the water table or bedrock, yield goals, other sources of nutrients, and, ultimately, whether the dairy has enough acreage in its NMP to spread manure. The EIS must address whether it is even proper to consider the WPDES permit under these circumstances, much less grant it.

Dairy site design: Site design is a major concern given the amount of high-nutrient wastes generated and stored on-site, and given the area's sandy soils and high water table. The EIS should consider the effectiveness of the dairy's stormwater and runoff controls, storage facilities, and monitoring systems.

Regarding storage facilities, the dairy acknowledges groundwater in the area is as high as 12 to 14 feet below the surface elevation, but claims with little explanation that these high levels "seem[] to be in a perched water table condition." It then claims the water table is at a depth of 21.5 to 23.5 feet in the area of the waste storage pond. The DNR should obviously investigate the claim of perched groundwater since many of the dairy's own soil borings indicate moisture at much higher elevations than the claimed regional groundwater level. (The dairy's own application materials are internally inconsistent on these matters, since its Form 3400-025C states no perched water was encountered and does not identify the elevation of the allegedly perched water.) The EIS should also evaluate whether the groundwater table in this area fluctuates seasonally and with large storm events. More and deeper soils borings, i.e. down to groundwater, are also appropriate.

We are also concerned by the dairy's apparent plans to only use a concrete liner for the 30 million gallon waste storage pond (Design Report at 5) and minimal two feet of separation between the pond and regional groundwater--assuming the dairy is correct about regional groundwater levels, which we doubt. The dairy's proposal that "[G]round water separation is proposed to be confirmed during basin excavation" (Design Report at 11) is much too late. These important facts should be confirmed now, before any construction commences.

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[2] Press release and links to study *available at* <u>*www.usgs.gov/newsroom/article.asp?ID=3130&from=rss*</u>.

Well pumping: The DNR should consider whether drawdown will mobilize pollutants underground which will then contaminate groundwater resources.

3) Air emissions and odors.

Neighbors of CAFOs across the state have struggled with air emissions and odor associated with CAFO production sites and manure spreading. Golden Sands Dairy must be evaluated as to at least the following air impacts, both before and after the manure digester (currently considered "Phase II") is operational:

- Health and environmental impacts of hazardous air emissions from the production site and manure spreading, even if CAFOs are currently exempt from the requirements of NR 445
- Health and environmental impacts of other air emissions from the production site and manure spreading
- Health and environmental impacts specifically associated with aerial spraying of manure and other wastewater, including risks associated with aerialized pathogens.
- Effectiveness of proposed pollution controls or BMPs proposed by Central Sands Dairy and timing of the installation of those controls relative to construction and operation.
- Odor impacts.

Additionally, since CAFOs are not categorically exempt from construction and operation permit requirements in Wis. Admin. Code chs. NR 406 and 407, the EIS must collect all information necessary for the Department to make permit decisions under these chapters.

The DNR should also collect information that would enable it to determine whether it is necessary to exercise its authority under NR 429 to control odors at Golden Sands Dairy. While the DNR almost never does in the CAFO context, it should, considering repeated complaints of neighbors of other CAFOs (even those several miles away) that they cannot open their windows, work outside, garden, hang up laundry, grill outside, or otherwise spend time outdoors due to CAFO production and manure spreading odors. The DNR has already developed a comprehensive report regarding BMPs for air emission and odor control, and the DNR should consider whether it is appropriate to include any of these BMPs in the dairy's plans and specifications approval. *See* WI DNR, *Beneficial Management Practices for Mitigating Hazardous Air Emissions from Animal Waste in Wisconsin* (Dec. 13, 2010). Some of these BMPs include covering the lagoons, biofilters on exhaust outlets, buffers, using closed barns, and other measures.

The DNR will likely need additional information from Golden Sands Dairy to make these assessments, including specifications for the proposed manure digester.

4) Impacts to Other Agricultural Uses.

There are many existing agricultural uses of land near the proposed dairy, including the cranberry farms owned and operated by the Karris family and others. Regarding these uses, the DNR must, at a minimum, consider:

- Effects of water table drawdowns on cranberry marshes, including reductions in cranberry production.
- Runoff from nutrients applied to crops, including commercial fertilizer and manure, into cranberry marshes.
- The timing of nutrient application relative to cranberry production. Specifically, the EIS should consider whether to prohibit winter spreading, as well as concentrated spring and fall applications.
- Impacts of contaminated groundwater on cranberry marshes and cranberry processing.
- Health risks of consuming cranberries produced downstream of the CAFO production and manure application areas, especially risks associated with pathogens such as E. coli bacteria, and economic risks associated with any resulting industry-wide recalls.
- Whether the proposed operations will jeopardize the ability of the Karris family to claim organic status for their organic cranberry operation, Nekoosa Farms.

See also the attached report by Montgomery & Associates.

5) Water Quality of the Receiving Water.

The Petenwell Flowage of the Wisconsin River is the ultimate receiving water for the dairy's operations, yet it is on the State's 303(d) list of impaired waters. The DNR must consider the impacts this operation will have on the receiving waters and whether these waters will be further impaired, even if the dairy operates as permitted. The DNR should also consider whether dairy production will degrade the quality of receiving waters not on the 303d list.

6) Central Sands Dairy

The design report for Golden Sands Dairy states that it is "modeled after the Central Sands Dairy in Juneau County," also owned by Wysocki Farms/Ellis Industries and only about ten miles away from the Golden Sands site. (Design Report at 2.) Golden Sands Dairy also intends to irrigate liquid manure to cropland, much like Central Sands Dairy sprays liquid manure and wastewater from center pivots located at high capacity wells. (Design Report at 3.) Therefore, it is important that the DNR assess the performance of the Central Sands Dairy and its design features to better inform the DNR and the public about Golden Sands' projected impacts. Information we have collected from various sources including DATCP, the Town of Armenia, and DNR--some of it created by Central Sands Dairy itself--indicates the performance has been poor from the perspective of protecting water and air resources, as well as public health, and indicates violations of Central Sands Dairy's WPDES permit and applicable regulations.

Groundwater quality: As the DNR may or may not be aware, Central Sands Dairy has monitored groundwater quality around the dairy since 2008 at the Town of Armenia's request. Since approximately 2002, Agri-Alliance LLC has also been required by DATCP to monitor groundwater quality and collect other groundwater data due to an historic pesticide (dinoseb) spill on land adjacent to Central Sands Dairy. Agri-Alliance LLC is associated with Wysocki Farms and is the designated responsible party for the spill.

The dairy's monitoring results show consistently high levels of nitrates, often in excess of the enforcement standard of 10 mg/L, as indicated in the attached Wade report. It appears the dairy has not reported the results of these tests to the DNR, and it is unclear why. Neighbors also report that groundwater quality in the area was good until Central Sands Dairy began operating the dairy. As the following indicates, there are many possible culprits at Central Sands Dairy for the source of this pollution, including aerial spraying of manure and process wastewater, overspreading of waste, and the leaking of the waste storage lagoon and other on-site structures.

Aerial Spraying. A persistent and unaddressed problem at the Central Sands Dairy is spraying wastewater from center pivots, including manure, too close to homes, roads, and residential wells. As DNR's own records indicate, Central Sands Dairy has for years violated the requirement in Wis. Admin. Code § NR 214.14(1) that "[t]he nearest edge of wastewater spray shall be separated" at least 500 feet from the nearest inhabited dwelling (absent consent of the resident) and at least 250 feet from any potable water supply, and the requirements in Wis. Admin. Code § NR 243.13(2)(b)8. and 9. that manure cannot be applied within 100 feet of a direct conduit to groundwater or private well. DNR's own prior photos show the end of irrigation systems immediately abutting roadways and wastewater on neighboring lawns and what appears to be sprayed waste on a neighbor's lawn. Recent photos also show irrigation water is still sprayed on roads. While this water supposedly did not contain animal waste, our client obtained a sample of the water and submitted it to a laboratory for analysis, which showed extremely high E.coli levels (6,000 cfu/ML).

We also have significant concerns about pollutants entering groundwater through the center pivots and accompanying high capacity wells. The records we have reviewed indicate DNR repeatedly informed Central Sands Dairy that manure cannot be spread within 100 feet of a well or direct conduit to groundwater, which is the minimum distance required by Wis. Admin. Code § NR 243.13(2)(b)8. We are unsure how this can *ever* be accomplished when manure is sprayed from a center pivot located on a high capacity well. In a tacit admission that this is impossible (and that groundwater pollution is occurring), we understand Jeff Sommers of Central Sands Dairy has told DNR it essentially does not matter that they cannot accomplish the minimum separation distance since the soil is so permeable anyway and groundwater will be impaired by manure spreading regardless. (*See* Email from Terry Kafka to Mike Vollrath, 1/30/09 ("The basic premise [of Mr. Sommers' comments] is that due to the permeable nature of the sands, limiting applications within the 100 feet of the cased well would not reduce impacts to groundwater.").)

The DNR has also expressed concern that wastewater is backflowing into the high capacity wells, but has accepted the dairy's statement that it has installed backflow preventers on the wells. We are unaware of any confirmation or monitoring to ensure these backflow preventers actually work.

Overapplication of Manure: There is evidence Central Sands Dairy has overapplied manure and is continuing to do so, starting with high phosphorus levels in soils where manure is applied. According to the dairy's most recent annual report, phosphorus levels exceed 100 ppm in most fields, 200 ppm in many fields, and occasionally exceed 300 ppm. Additionally, neighbors have reported instances of apparent over-spreading and ponding. The dairy has also regularly spread both solid and liquid manure in fall and winter months.

Water Quantity: According to the DNR website, the high-capacity well associated with Central Sands Dairy (Well No. 69551) has pumped 3 million to 5 million gallons of water every month for which data is available.

Neighbor complaints/compliance: We have reviewed records sent to DNR containing neighbor complaints at Central Sands Dairy. Unfortunately, when complaints were passed on to the dairy, Central Sands did not seem to change its practices when approached with these complaints. The DNR also initiated no enforcement related to these complaints. The DNR failed even to require groundwater monitoring, which is becoming a more common requirement in recent CAFO permits.

We ask the DNR to promptly investigate these issues--many of which the DNR is already aware--and initiate appropriate permit modifications and enforcement.

Thank you for your consideration of these important matters. Please note that we reserve the right to submit addition comments on EIS scoping if the applicant modifies any aspect of its application, which it appears to be planning for at least the high-capacity well approval application. We also reserve the right to supplement these comments once we receive requested documents from the DNR on the Golden Sands Dairy high-capacity well application and Central Sands Dairy.

Please let us know if you have any questions.

Sincerely,

McGILLIVRAY WESTERBERG & BENDER LLC

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September 21, 2012

Via email and U.S. Mail

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RE: Proposed Golden Sands Dairy, Tn. Of Saratoga, Wood Co., WI – Scoping Comments Regarding Environmental Impact Statement

Dear Mr. Anderson:

I am a hydrogeologist and environmental engineer who has developed knowledge in waste management and groundwater flow issues, including application of groundwater flow and contaminant transport numerical models, during professional employment over 30 years with the Wisconsin Departments of Natural Resources and Transportation, and for a contractor to the U.S. Departments of Energy and Defense (see resume attached). I am familiar with the evaluation of impacts due to water withdrawals, including the recent decision of the Wisconsin Supreme Court in Lake Beulah Management District v. DNR, 2011 WI 54.

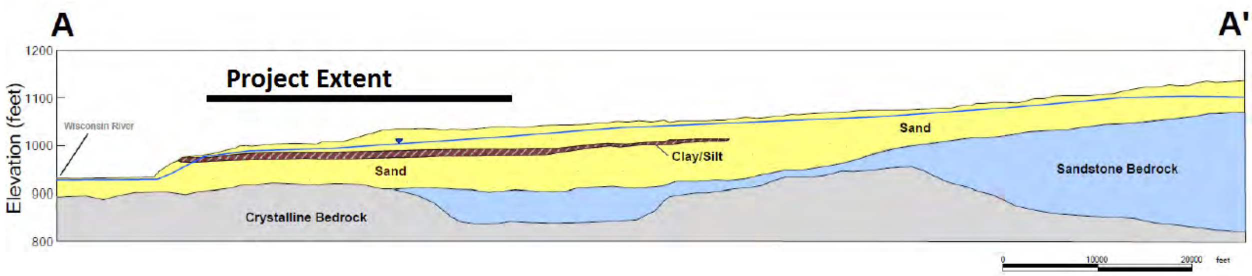
On behalf of Nicholas Karris of Karris Family Farms, I have reviewed the information available regarding the Golden Sands Dairy proposal including the dairy facility design, waste application plans, and high capacity well applications and other available information on the hydrogeology in the vicinity of the site and offer the following comments, conclusions and recommendations:

Project Description:

The proposed 100-acre dairy facility includes barns, milking parlor, livestock holding area, hay storage pad, silage pad, digester and concrete manure basin. Excavation up to 19 feet below existing grade will be required. The dairy is proposed to contain 5300 animals (3400 milk cows, 600 dry cows, 300 heifers and 1000 calves). 48,000,000 gallons of manure liquid and 24,156 tons of manure solids generated per year from the facility are proposed to be land-spread on 6321 acres of surrounding dairy-owned lands following a nutrient management plan. The spreading areas will be converted from existing pine forest and non-irrigated crop land to irrigated production of vegetables and dairy forage. Two high capacity wells would be constructed to serve the dairy facility and 47 additional wells would be constructed to irrigate the fields established for waste spreading and agricultural purposes.

Hydrogeology

The project site is located in the west central portion of the Wisconsin Central Sands region which is characterized by a thick deposit of very permeable coarse-grained sand and gravel glacial outwash sediments overlying bedrock. The dairy and waste application sites generally lie south of Seven Mile Creek and both north and south of Ten Mile Creek extending from one to 8.5 miles east of the Wisconsin River and Petenwell Flowage.



The water table is found in the sand and gravel at 10 to 20 feet below the surface with flow to the west. The sand and gravel is underlain by sandstone bedrock to the east and crystalline bedrock to the west. A layer of silt and clay approximately ten feet thick is found within the saturated zone of the sand and gravel (Papadopulos, 2012). Per calibrated basin-wide modeling results (Kraft & Mechenich, 2010 and Kraft et. al. 2011), the sand and gravel deposit conductivity in the project area ranges from 100 to 130 feet/day. The site area soils are sandy and very permeable allowing for high infiltration rates and low runoff. The groundwater recharge in the project area, as determined the by the referenced calibrated modeling, is 8 to 10 inches per year.

The project site area is located west of an extensive area of irrigated agricultural land use in the groundwater basin headwaters where the cumulative withdrawals of groundwater have resulted in very significant impacts to water levels, stream base flows, and lake level results (Kraft & Mechenich, 2010 and Kraft et. al. 2011). See Attachment 1 for the location of the high capacity irrigation wells. The high degree of lateral continuity and high permeability of the unconfined Central Sands aquifer causes it to be very susceptible to cumulative impacts of pumping with rapid propagation of significant hydrologic impacts miles from the areas of groundwater withdrawal. Very extreme impacts are evidenced by the Little Plover River now having periods of no flow and Long Lake having periods of complete dewatering.

The cause, magnitude and location of the impacts of irrigation throughout the Central Sands have recently become well documented using statistical analysis of observed water levels and calibrated numerical groundwater modeling, with the results published in scientific and authoritative peer-reviewed journals (Kraft & Mechenich, 2010 and Kraft et al. 2011). The pumping impacts on Central Sands lakes and streams quantified by Kraft et al. (2011) were well predicted by the work of Weeks and Stangland (1971) and Weeks et al. (1965) for the USGS before the area was as developed for groundwater pumping as it is today. This early research, documenting irrigation pumping impacts to the base flow of the Little Plover River, was used as part of the hydrogeological training curriculum for many years. The Central Wisconsin Groundwater Center, established in 1985, and later becoming the Center for Watershed Science and Education is part of University of Wisconsin – Stevens Point, University of Wisconsin Extension, has continued study of this area, establishing a large body of detailed information regarding the hydrogeology of the Central Sands, including both water quantity and quality issues. The recent groundwater modeling was able to use the many data control points available in the Central Sands, including well and lake water levels, which along with stream flow measurements allow for rigorous model calibration. This provides for a high degree of confidence in the model results. It is unusual to have this amount of specific hydrogeological information and analytical tools available for evaluation of the hydrogeological impacts in the Central Sands area, allowing for an unusual degree of scientific certainty as to the degree, extent, and significance of these impacts.

Coarse-grained highly permeable soils with little organic material content and low associated cation exchange capacity characterize the Central Sands and site area. The water infiltration rates are high and the runoff rates low. The soils are droughty, requiring irrigation for most commercial crops. The rapid infiltration, rapid draining and large soil pores allows for rapid movement of oxygenated surface water into and through the root zone. Large portions of commercial crop nutrient applications (fertilizer and manure) are rapidly washed below the root zone becoming inaccessible to plants and therefore larger nutrient additions are required to produce commercially viable crops. The reduced forms of nutrient nitrogen are usually rapidly oxidized to nitrate-nitrogen. It has been documented that, even with best agricultural management practices, cropping in the Central Sands has led to extreme inputs of nitrogen into the groundwater with approximately 75 to 125 lbs. of nitrogen per acre leaching into the groundwater below the cropped fields (Kraft & Mechenich, 1997)(Kraft, G.J. and W. Stites. 2003)(Stites, W. and G.J. Kraft. 2000 & 2001). The cumulative result is basin-wide nitrogen loading of the groundwater system with large areas of the groundwater system contaminated above the safe drinking water standard of 10 mg/l nitrate-N. The basin groundwater system has not yet reached equilibrium with the nitrogen loading; therefore, nitrate concentrations are anticipated to increase through time as continued nitrogen inputs cause nitrate-impacted groundwater to replace the remaining non-impacted water (Kraft & Mechenich, 1997). In addition to the impacts to private water supplies and groundwater-dependent aquatic systems, some municipal water systems now have the costs for nitrate treatment system installation and operation (Kraft & Mechenich, 1997. Studies in the Central Sands have documented that 70% of water supply wells within irrigated areas may exceed the safe drinking water standard of 10 mg/l nitrate-N (Stites, W. and G.J. Kraft. 2000 & 2001).

Existing Project Area Land Use

The Golden Sands Dairy project area is dominated by a large core area south of Seven Mile Creek and straddling each side of Ten Mile Creek which is largely undeveloped forest lands and non-irrigated crop land (see Attachment 2, 2008 aerial photo of project area). Numerous unsewered rural residential parcels are found immediately west of the project area toward the Wisconsin River and Petenwell Flowage and bordering portions of Seven Mile and Ten Mile Creeks. The Well survey data included with the September 21, 2012 citizen petition provided to Dan Baumann of the WDNR indicate the Town of Saratoga has a population of approximately 5000 people containing 2176 dwellings with private wells. Nekoosa Marsh, LLC, a large organic cranberry farm is seen in the northeast at the mouth of Seven Mile Creek and the Leola Creek cranberry farm is seen in the southeast part of the project area.

Dairy Facility Water Quality Impacts

The concrete-lined thirty million gallon manure storage basin is specified to be constructed with only two feet of separation of the base from groundwater with an operating manure depth developing over 28 feet of hydraulic head. As described in the attached environmental analysis of the Wysocki Central Sands Dairy, upon which this operation is modeled, the opportunity for concrete liner cracking or void development during construction is a concern for all concrete structures, thus the use of quotations for "watertight" in the descriptions provided for these facility designs. For this reason solid waste landfill design regulations have prohibited use of concrete liners for these facilities for decades. Also, as noted in the attached Central Sands report, groundwater level fluctuations can raise the water table with varying climatic conditions.

The high permeability, low organic content, low cation exchange and buffering capacity makes the site soils extremely susceptible to groundwater contamination. However, even CAFO sites with better soils can be problematic with these standard designs. For example, at the Rosendale Dairy groundwater monitoring has demonstrated the facility is contributing excess nitrate and pathogens (E. coli, total coliform bacteria) exceeding the NR 140 Enforcement Standard as it moves under the facility. Manure and waste liquids will also be present on the concrete-lined dairy barns.

Due to these conditions the EIS should evaluate design alternatives including: raising the manure basin base grades to provide greater separation to groundwater, adding a secondary liner of high density polyethylene (HDPE) under the concrete with an underdrain layer between for monitoring and remedial pumping. The use of a HDPE liner under the barn floors and surrounding leachate/wastewater tanks should be included as another alternative. A groundwater monitoring system should be implemented for the facility.

High Capacity Well Pumping Impacts

47 high capacity wells are proposed for seasonal irrigation use from April through October (see Attachment 3 for proposed well locations). For each well a 1000 gallon per minute (gpm) pump is specified with maximum water usage of 1,440,000 gallons per day (gpd) and a proposed average usage

of 720,000 gpd. In addition the dairy facility is proposing to use two additional high capacity wells on a year round basis. One dairy well would have a 275 gpm pump and is proposed with maximum water usage of 396,000 gallons per day (gpd) and a proposed average usage of 137,000 gpd and the other would have a 200 gpm pump with maximum water usage of 288,000 gallons per day (gpd) and a proposed average usage of 144,000 gpd. All 49 wells pumping at the same time seasonally (April through October) at their maximum allowed pumping would withdraw 47,475 gpm which is the equivalent of 105.87 cubic feet/sec (cfs). The wells pumping at their proposed average daily usage rate would withdraw 23,700 gpm which is equivalent to 52.8 cfs.

The quantity of proposed high capacity well pumping is significant relative to the flow conditions found in the streams adjacent the wells. The adjacent stream flows are dependent on the supply of groundwater recharged in the areas of the proposed wells. The streams experience fluctuations in flow seasonally as spring melting releases a large quantity of water, recharging the aquifer which then drains to the adjacent stream. The stream flow is reduced throughout the summer as the spring recharge is dissipated and high evapotranspiration rates in summer deplete surface water. In addition, stream flows fluctuate from year to year in response to drought periods where recharge is reduced, evapotranspiration increases and irrigation demands increase. Ten Mile Creek would suffer the greatest loss of groundwater discharge from the pumping because it is adjacent to the greatest proportion of the wells.

The Kraft & Mechenich, 2010 and Kraft et al. 2011 evaluation of irrigation pumping impacts showed that the average base flows to streams in the project area are already significantly affected with: 12% reduction for Buena Vista Creek near Kellner, 11% reduction for Four Mile Creek near Kellner and 8% for Ten Mile Creek at STH 13 near Nekoosa. The upper mile of headwaters of these streams showed extreme impacts with a reduction of 35% at both Buena Vista and Ditch #5 of the N. Branch of Ten Mile Creek. It is noted that since the base flow reductions were based on steady-state model conditions the actual flow reductions would be much greater during conditions of low flow base flow and high irrigation water demand such as during periods of lower precipitation.

UW-Stevens Point stream flow measurements in the Golden Sands Dairy project area headwater streams have documented the extreme impact to stream flows due to irrigation pumping:

Stream	Date Flow (cfs)	Date Flow (cfs)	Flow reduction (cfs)	% reduction
UW-SP #102 Buena Vista Cr.@100thRd	5-23-2012 56	7-24-2012 11	45	80%
UW-SP #108 Ditch #2 N. Fork@Isherwood (Buena Vista Cr.)	5-22-2012 8.1	7-24-2012 4.9	3.2	40%
UW-SP #109 Four Mile Cr. @Rd. (Ditch #4)	5-23-2012 60	8-31-2012 13	47	78%
UW-SP #111 Ten Mile Cr. Ditch #5@Taft	5-23-12 7.1	8-30-2012 1.8	5.3	75%
UW-SP #115 Four Mile Cr.@JJ&BB	5-22-2012 2.1	8-29-2012 0.31	1.8	85%
UW-SP #127 NB Ten Mile Cr. @Isherwood/Harding	5-23-2012 1.3	8-29-2012 0	1.3	100% (dry)

However, during the same time period, measurements at the following reference streams in the Central Sands, but outside of areas of heavy irrigation use, showed much less reduction in flow. UW-SP #113, Emmons Cr. @Rustic Rd. (Waupaca Co.), recorded a reduction of 29 to 25 cfs (14%). UW-SP #117, Lawrence Cr. @Eagle(Waushara Co.), recorded a reduction of 20 to 19 cfs (5%). UW-SP #139, W.Br.

White River@22 (Waushara Co.), recorded a reduction from 27 to 22 cfs (22%), and UW-SP #135, Spring Cr. @Q(Portage Co.), recorded steady flow at 16 cfs.

While the average base flow for Ten Mile Creek at STH 13 is about 55 cfs, the average base flow declines from 50 cfs in August to 40 cfs in September. 10% of the flows from 1964 to 2011 were less than 23 cfs. The lowest flows for the months of July, August, September and October were 23.6, 17.4, 20.2 and 17.8 cfs respectively. The lowest flow recorded was 10 cfs.

Papadopulos, 2012, recorded flows at Seven Mile Cr. at CTH "Z", just up from the Wisconsin River at 5.5 cfs on 5/24/2012 and 5.6 cfs on 6/14/12. Flow at Rangeline Rd., 2.5 miles up from the Wisconsin River, was recorded on 5/24 at 4.8 cfs. On 6/14/2012 the flow was recorded at approximately 2 cfs at both Highway U (80th St.) and 52nd St. Flow measurements for Spring Branch Creek, a tributary of Fourteen Mile Cr., could not be made on June 14, 2012 because the stream was dry. It can be seen in the 2008 aerial photo that there is irrigated agricultural land use at the headwaters of Spring Branch Creek which might account for an early dry up consistent with the UW-SP headwater irrigation impacts noted previously.

The comparison of both the maximum seasonal pumping of 105.87 cubic feet/sec (cfs) and the average daily water usage of 52.8 cfs proposed for the Golden Sands Dairy project to the various stream flows discussed above indicates significant impacts are likely even during climatically normal base flow conditions. This is evidenced by the early dry up of Spring Branch Creek this year due to the existing irrigation pumping in its headwaters. It appears likely that some streams, including Ten Mile Creek, would dry up during summer and fall during drought conditions when natural recharge is reduced and irrigation pumping and dairy cooling pumping would be at their maximums.

The maintenance of base flow for these creeks is critical for the support of trout populations due to trout dependence on the cold groundwater discharge necessary to insuring adequate dissolved oxygen is provided for fish respiration. The warming of stream temperatures due to reduced base flow produces a reduction in stream dissolved oxygen because of the decreased solubility of oxygen in warm water. This means that although the resource may not be impacted by pumping during climate-related periods of high groundwater recharge and discharge, reduced or low irrigation pumping, or colder air temperatures; severe impacts are likely and would be expected during weather variations resulting in low base flow and increased heat loads in summer. It is noted that there have been 10 episodes of severe drought in the Central Sands since the 1930's. In comparison, the drought of 2006, which resulted in significant stream flow reductions in irrigated areas, was only rated as a moderate drought, with a Palmer Drought Severity Index of -2, and corresponded to a 5 inch reduction in precipitation at Steven Point from a normal of 33 inches to 28 inches.

The discussion above leads to the following recommendations for EIS scoping of project groundwater pumping impacts:

1. The EIS should recognize that establishing over 6000 acres of irrigated agriculture in an area with non-irrigated crop or forest land use commits the area to extremely large groundwater withdrawals. The no action alternative should address this issue.
2. The proposed project pumping must be evaluated as part of the cumulative impacts of the existing irrigation pumping.
3. The proposed pumping must be evaluated for low flow conditions corresponding to drought conditions.
4. Additional flow measurements of the following streams in the project area are needed to better establish seasonal base flow fluctuations:

<u>Seven Mile Creek:</u>

@ CTH "Z"

@Rangeline Rd.

@STH 13

<u>Ten Mile Creek:</u>

@ CTH "Z"

@ Rangeline Rd.

@STH 13 (#136 from UW-Stevens Point model)

@STH 73

@CTH "U"

@ Tower Rd.

Ditch #4@Taft (#110 UW-Stevens Pt. – currently monitored)

Ditch #5@Taft (#111 UW-Stevens Pt. – currently monitored)

North Branch Ten Mile@Isherwood/Harding (#127 UW-Stevens Pt. – currently monitored)

<u>Spring Branch of Fourteenmile Creek</u>

@County Line Rd. (aka Adams Ave.)

@Akron Dr.

@ 9th Ave.

Staff gages should be installed and monitored for all potentially impacted cranberry operations and any other ponded water or lakes.

5. Non-published records of stream flows in the project area should be sought out. Past historical observations of duration and amount of flow at Spring Branch Cr., especially prior to irrigated agriculture in the headwaters, should be located and interviews with long-term residents and cranberry growers included. The history and magnitude of irrigation pumping at the Spring Branch headwaters should be determined and evaluated in relation to Spring Branch Cr. hydrology.
6. The project area groundwater impacts should be evaluated with a numerical flow model. The model should be calibrated to a base flow condition corresponding to a pre-irrigation pumping land use condition. The cumulative impacts of the proposed Golden Sands Dairy project pumping in addition to the existing irrigation pumping should be simulated in both steady state and with transient simulations of drought conditions. The existing irrigation pumping and recent drought periods can serve as a model calibration and validation tool. The irrigation evaluation made as part of the Kraft & Mechenich, 2010 and Kraft et al. 2011, using the net recharge reduction as a stress input appears to be a reasonable approach. Use of that model by personnel at UW-Stevens Point, along with some transient calibrations to drought stresses, would provide an efficient means to evaluate the project impacts and also provide assurance of an independent modeling effort. The potential hydrologic significance of the thin silt and clay layer (New Rome member) found within the sand and gravel aquifer should be evaluated as part of the modeling. The recharge parameter used for model input should be carefully evaluated in regard to the change in land use from pine forest and non-irrigated agriculture to irrigated agriculture.
7. The evaluation of pumping impact drawdowns, especially during drought situations, on the continued viability of the project area's many shallow private water supply sand point wells should be made. The Well survey data included with the September 21, 2012 citizen petition provided to Dan Baumann of the WDNR, indicated that the Town of Saratoga has over 602 sand points with depths as shallow as 12 feet and median depth of 48 feet.

Facility Nutrient Impacts

The Golden Sands Dairy Nutrient Management Plan indicates the operation will generate 48,000,000 gallons of manure liquid and 24,156 tons of manure solids per year. Assuming 15 lbs. of total nitrogen per 1000 gallons of liquid and 10 lbs. of total nitrogen per ton of solid, the nitrogen generated would be 720,000 lbs. and 241,560 lbs. respectively, for a total of 961,560 lbs. of nitrogen per year. The Central Sands Dairy with 3000 cows, 500 dry cows, 250 heifers, and 640 calves is estimated to generate 802,339 lbs. of nitrogen and 280,116 lbs. of phosphorus per year according to historic manure sampling presented in the Snap-Plus Animal Units Report. It can be seen that the relative nitrogen amounts generated by each dairy conforms to their relative dairy herd sizes. If spread uniformly over the entire 6321 acres available for spreading the 961,560 lbs. of nitrogen at Golden Sands Dairy would result in an average loading of 152 lbs. of N per acre. Assuming the N to P ratio is constant to that of the Central

Sands Dairy, the total phosphorus generated for Golden Sands Dairy would be 335,860 lbs. per year. If spread uniformly over the entire 6321 acres available for spreading the 335,860 would result in an average phosphorus loading of 53 lbs. of phosphorus per acre.

In order to grow commercial corn or vegetable crops at the irrigated areas of the Golden Sands Dairy additional nitrogen would be applied to maximize crop yields.

The proposed manure spreading areas' soil and hydrogeological characteristics facilitate excessive leaching of nitrogen into the groundwater from applied agricultural nutrients, even when best agricultural management practices are observed. Using a groundwater nitrogen loading rate of 100 pounds per acre per year and a groundwater recharge rate of 9 inches per year (0.75 ft/yr) the resultant nitrate concentration can be calculated as follows:

Nitrate-N concentration (mg/l) in groundwater underlying cropped field =

$$[(100 \text{ lbs. N/acre}) (454 \text{ g/lb}) (1000\text{mg/g})]/ [(0.75 \text{ ft}) (43{,}569 \text{ ft}^2\text{/acre}) (27.7 \text{ l/ft}^3)] = 50.2 \text{ mg/l}$$

Similar nitrate concentrations have been found in the groundwater underlying irrigated cropped areas in the Central Sands. This indicates that in the vicinity of the cropped fields the groundwater is likely to exceed the federal Safe Drinking water Standard and NR 140, Wis. Adm. Code Enforcement Standard of 10.0 mg/l. As documented by the groundwater monitoring at Central Sands Dairy (attached report) the nitrate concentrations down-gradient from the irrigated fields, including adjacent private water supply wells, have values greater than 30 mg/l. An upgradient well, originally placed in a forested land use area similar to that currently existing in the Golden Sands project area, had nitrate levels of less than 2 mg/l, as would be expected in a forested area, but after the lands upgradient from the well were converted to irrigated agriculture the nitrate levels increased to 16.2 and 17.8 mg/l in the following two years.

The conversion of the existing forest and non-irrigated agricultural land use in the Golden Sands project area would result in the gradual increase of nitrate in the groundwater from concentrations that are currently very low to concentrations of between 30 to 50 mg/l as the groundwater system reaches equilibrium with the nitrogen inputs. The Well survey data included with the September 21, 2012 citizen petition provided to Dan Baumann of the WDNR indicated recent sampling of 83 residential wells in the project area had a median nitrate value of 1 mg/l. Large zones of down-gradient groundwater would contain nitrate concentrations well above the NR 140 nitrate enforcement standard (Safe Drinking Water Standard) of 10 mg/l. Many private well owners in the project area would be adversely affected.

As the aquifer equilibrates to the nitrate contaminant load, discharge water nitrate concentrations would increase and result in increased stream, spring, and pond nitrate concentrations. Chern et al., (1999) reported that research indicates: nitrate concentrations lower than the drinking water standard cause substantial egg and fry mortality in some salmonid fish species; when rearing trout or warm water species the US Fish and Wildlife Service recommends nitrate levels not exceed 3 ppm; and that tadpoles exposed to nitrate at the drinking water standard show decreased appetite, sluggishness and paralysis prior to death.

Increased concentrations of nitrate or phosphorus in surface waters can lead to eutrophication conditions in which increased plant growth and the accompanying increased biological oxygen demand would reduce dissolved oxygen levels to the point of causing negative fishery and aquatic life impacts.

The animal waste has been documented to contain pathogenic bacteria (fecal coliform/E. coli) that have been detected during groundwater monitoring at the Rosendale Dairy and during sampling of irrigation water at the Central Sands Dairy. The high permeability and the low organic content of the soils at the manure waste spreading sites increases the probability that pathogens would travel through the aquifer materials to near-by private wells.

The Nekoosa Marsh organic cranberry farm is a particularly sensitive potential receptor of contaminated surface or groundwater. The organic berry production requires that nitrate concentrations in the bogs be less than 5 mg/l and the fresh packed produce cannot have any detectable bacteria pathogens such as those found in the dairy waste.

Manure contains relatively high levels of phosphorus. Excess spreading of manure, such as has occurred at Central Sands Dairy which is sited on similar soils, can lead to phosphorus accumulation in the soil. Runoff or leaching and transport through the groundwater can result in surface water eutrophication.

The discussion above leads to the following recommendations for EIS scoping of project groundwater and surface water quality impacts:

1. The EIS should recognize the siting of the dairy operation requires disposal of very large amounts of nitrogen and phosphorus waste that otherwise would not require management. The no action alternative should address this issue.
2. The degree and extent of nitrate and phosphorus contamination of the groundwater due to irrigated agriculture-based dairy waste disposal should be evaluated.
3. The degree and extent of nitrate and phosphorus contamination of the surface water, including groundwater discharge sources, due to irrigated agriculture-based dairy waste disposal should be evaluated.
4. The potential for bacterial pathogen contamination of surface and groundwater should be evaluated.
5. The environmental impacts associated with the use of spray irrigation as a dairy waste land application method should be carefully evaluated, including serving as a potential vector for pathogen contamination, and consider all the associated regulatory requirements of NR243 and NR214, Wis. Adm. Codes.
6. Sensitive contaminant receptors, including private well owners and organic cranberry operations, should be identified and the economic costs and health risks evaluated.

7. The potential for surface water impacts, including eutrophication and toxicity, from dairy-derived nitrate and phosphorus impacts should be evaluated and the economic impacts determined.
8. Existing studies and water analyses in the area of Central Sands irrigated agriculture and from CAFOs statewide should be used to evaluate how much nitrate, pesticide residues, pharmaceuticals and pathogens are known to be in local water supplies and therefore may be of concern for drinking water users in the proposed project area.
9. The EIS should evaluate what animal pharmaceuticals may be used in this farming operation and potential mechanism for transport in surface and groundwater.
10. The numerical groundwater flow modeling recommended to quantify pumping impacts should be used as the base for evaluation of nitrate and phosphorus impacts. Particle tracking simulations should be conducted to determine the direction and location of contaminant movements and help identify sensitive receptors. An areal two-dimensional numerical simulation of nitrate and phosphorus movement including both transient and steady state conditions should be used. Due to the lack of solute calibration targets, sensitivity analysis of model hydrologic parameters and solute input should be used to bracket potential outcomes. Where sensitive receptors warrant, vertical cross-section slices of the areal model should be used to more accurately predict vertical nitrate distribution, flux and discharge point locations.
11. A private well survey should be conducted to identify well locations, water levels, and well screen position in the aquifer. The wells should be sampled for nitrate in order to determine background conditions. Historic water analyses from private wells in the project should be obtained and used to help describe background water quality. The contaminant evaluation will need to provide special attention to the project area's many shallow private water supply sand point wells. The Well survey data included with the September 21, 2012 citizen petition provided to Dan Baumann of the WDNR should be used as a resource.
12. A comprehensive multi-level groundwater monitoring system, similar to what is required by NR214, Wis. Adm. Code for spray irrigation land waste application systems, should be required for all the waste spreading fields. Monitoring should include total coliform, E. coli, and phosphorus along with nitrate. It should be discussed in the alternatives section of the EIS.
13. The EIS alternatives analysis should include use of alternative dairy facility designs including use of a high density polyethylene (HDPE) liner with a monitored drainage layer above, that would be placed below the concrete waste manure basin, dairy barns, and any other structures that are expected to contain waste liquids.

Prepared by Kenneth S. Wade, P.E., P.G. –September 21, 2012

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Experience

2011 to present – Hydrogeological and environmental engineering consulting in areas of waste land spreading, high capacity wells, chlorinated solvent spills, and wetland hydrology.

1993 to 2011 – manage the hazardous materials program for Wisconsin Department of Transportation, Southeast Region. Major projects include Miller Park Baseball Stadium, Lake Arterial Parkway, Park East, and Marquette Interchange. Manage hydrologic assessment of WisDOT wetland program issues.

1987 to 1993 – Wisconsin Department of Natural Resources, Bureau of Solid Waste Management, made feasibility determinations for solid waste facilities, coordinated hydrologic assessments of Crandon Mine Environmental Impact Statement.

1986 to 1987 – Idaho National Engineering Laboratory, Department of Energy (EG&G), hazardous and radioactive waste assessments for soil and groundwater, dioxin soil testing at Agent Orange storage sites (U.S. Department of Defense), with Level 1 security clearance.

1980 to 1985 – Wisconsin DNR, Bureau of Solid and Hazardous Waste Management with duties similar to DNR above.

1978 to 1980 – Colorado State University, graduate research, uranium solution mining impacts, reported to Colorado Dept. of Health.

1976 to 1977 – Brodhead High School, taught chemistry, advanced chemistry, and physics

1975 to 1976 – Solar Specialists, Inc., solar space heating and hot water installation

Education

1981 – 1985, U. of Wisconsin-Madison, graduate study in numerical groundwater flow and contaminant transport modeling; USGS Training Center, groundwater modeling

1978 – 1980, Colorado State University, Master of Geology

1970 – 1974, U. of Wisconsin-Madison, BS in secondary education

Other Experience

Town Board Chair – Town of Middleton, Dane County Wisconsin, 1989-1990

Restoration Ecology – Ongoing prairie, oak-savanna, wetland restoration in conjunction with "The Prairie Enthusiasts" on 226 acres of land in western Dane County.

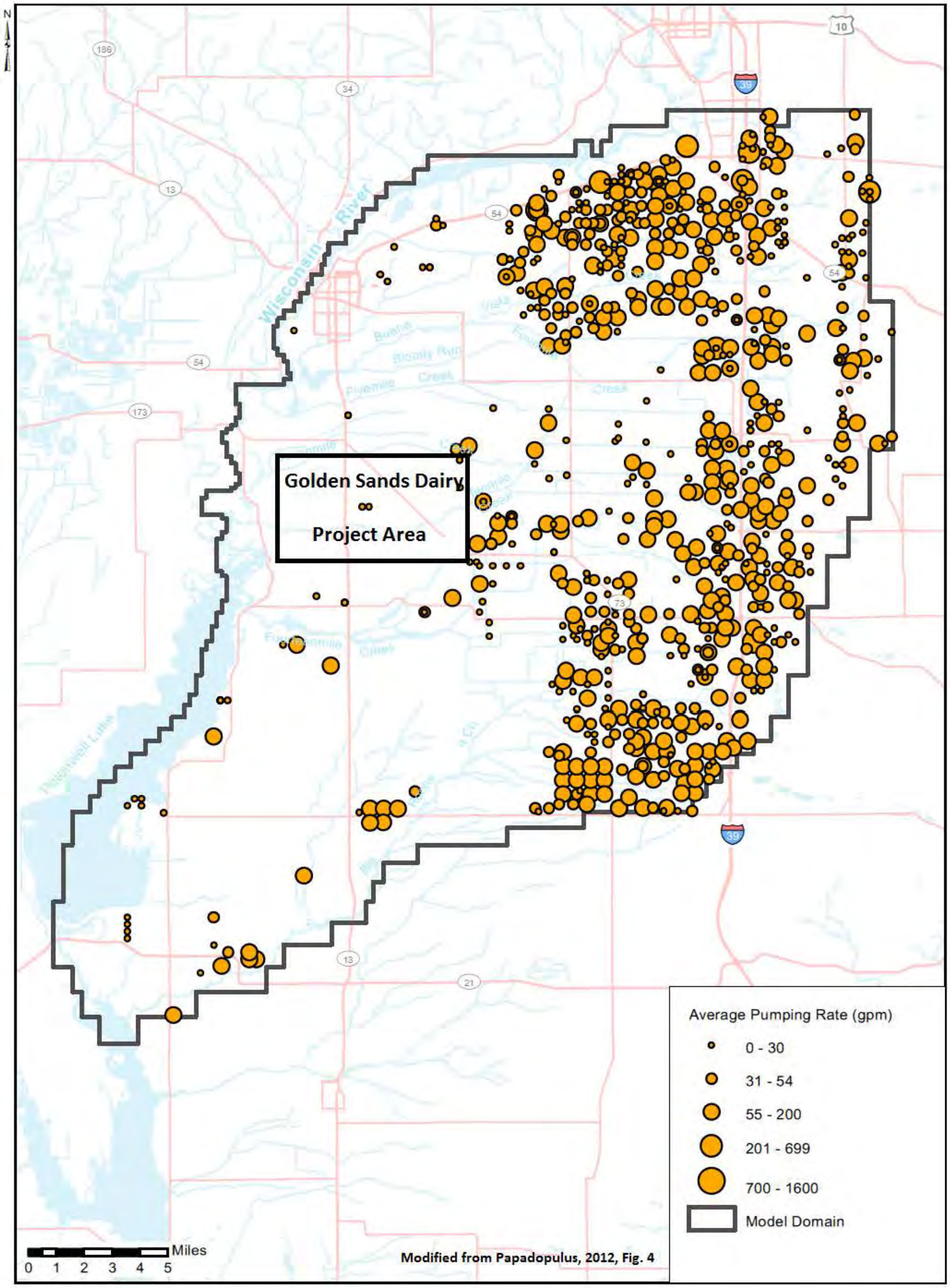
Extensive outdoor experience including: mountaineering and rock climbing, winter camping, bicycling, and kayaking

Registration

Wisconsin Professional Engineer, # 30156

Wisconsin Professional Geologist, # 556

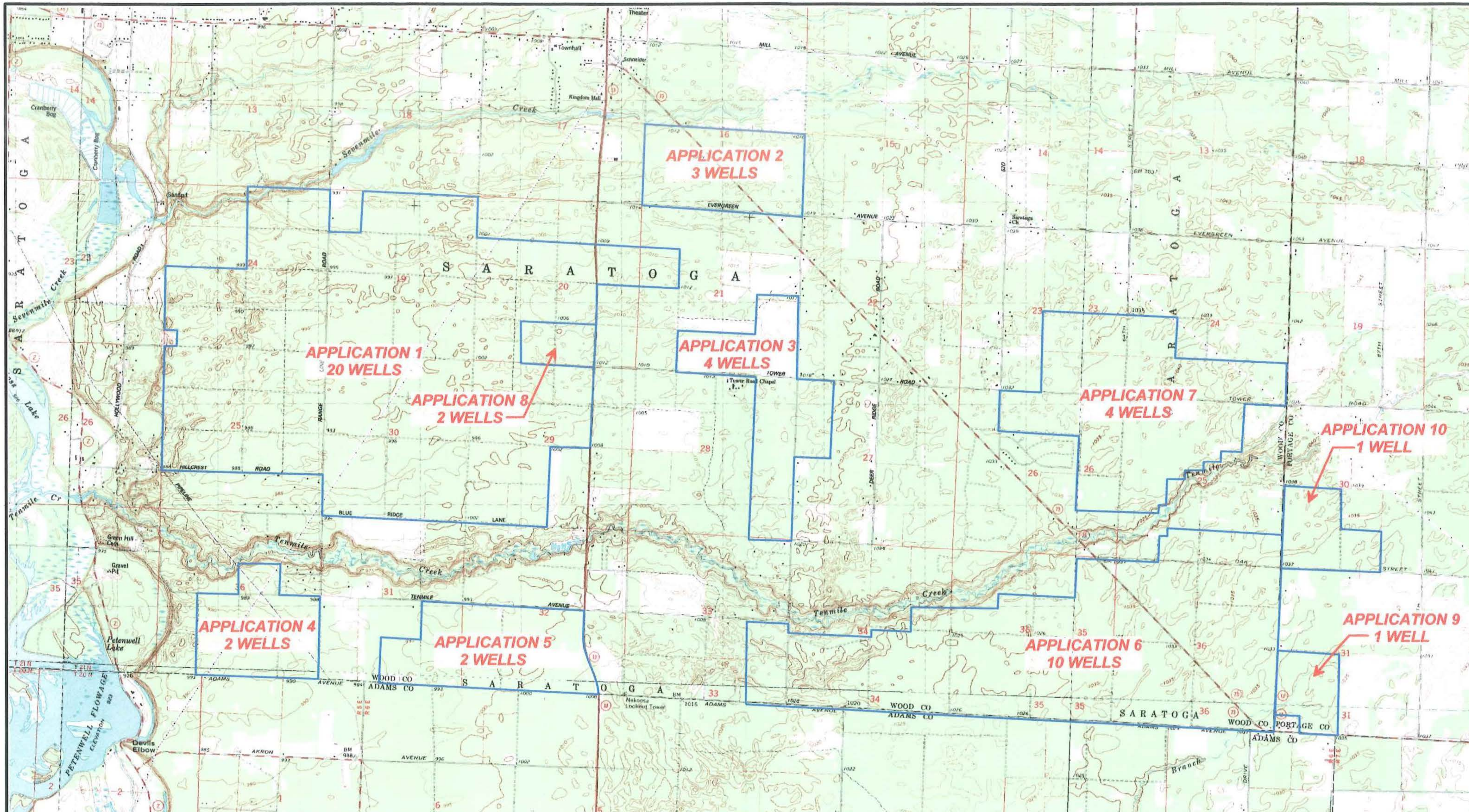
Hazardous Waste Operations and Emergency Response Certified (29 CFR1910.120)



Attachment 1: Location of Existing High Capacity Wells with Pumping Rates

Attachment 2

ATTACHMENT 3



PARCEL BOUNDARIES

SOURCE: USGS 7.5 minute topographic quadrangle, Wisconsin Rapids South, Wisconsin, 1984.

SCALE IN FEET

0 1500 3000 4500 6000

WISCONSIN

QUADRANGLE LOCATION

NORTH

RJN Environmental Services, LLC
Surface Water Studies
Groundwater Studies
Site Investigations
4631 COUNTY ROAD A OREGON, WISCONSIN 53575 (608) 576-3001

WYSOCKI PRODUCE FARM, INC.
SUMMARY OF HIGH CAPACITY WELL APPLICATIONS

FIGURE 1

DRAWN BY	PROJ. No.	DATE	FILE
RN	12-203	5 JUN 12	COVER

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September 21, 2012

Robert Rohland
Wisconsin Department of Natural Resources
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Wausau, WI, 54401
Robert.rohland@wisconsin.gov

RE: Central Sands Dairy, Tn. of Armenia, Juneau Co., WI, WPDES #WI-0063533-02-0 – Comments Regarding Environmental Conditions

Dear Mr. Rohland:

On behalf of Nicholas Karris of Karris Family Farms, I have reviewed the hydrogeological conditions, design and operations at the Central Sands Dairy (CSD) facility and am providing the following observations, conclusions and recommendations:

Central Sands Dairy Facility Description:

The 80-acre dairy facility is located in the S ½ of the NW ¼ of Section 12, T20N, R4E, Tn. of Armenia, Juneau County (see locator map, Attachment 1). The WPDES permit WI-0063533-01-0 was approved October 27, 2006 and operation began in 2007. The WPDES permit was reapproved as WI-0063533-02-0 on January 1, 2012. The facility includes cow barns, milking parlor and holding area, concrete silage storage pad, one concrete liquid manure storage basin, two concrete manure solids storage pads, one digester, five concrete tanks for soaker water, one concrete tank for solids pad runoff, one hay storage area, and runoff infiltration basins (see 2010 aerial photo of facility and monitoring wells, Attachment 2). The dairy is permitted for 3000 milking cows, 500 dry cows, 250 heifers, and 640 calves with animal waste land-spread in the surrounding area following a nutrient management plan.

The Central Sands is estimated to generate 802,339 lbs. of nitrogen and 280,116 lbs. of phosphorus per year according to historic manure sampling presented in waste spreading reports.

Historic Land Use Activities

The 1938 aerial photo (Attachment 3) shows the future CSD site to be agricultural fields with lands to the west forested. The lands to the east transition to increased agriculture use. The 2005 aerial photo

(Attachment 4) shows the future CSD site to be irrigated agriculture with forested lands to the west. The 2008 aerial photo (Attachment 5) shows the CSD has been constructed and the lands to the west in forest. The 2010 aerial photo (Attachment 6) shows the extent of irrigated area in the CSD area and documents the conversion of 160 acres of forested land to the west of the CSD site (NE ¼ of Sec. 11) and also the 320 acres to its west (W1/2 of Sec. 11) to irrigated agriculture.

Hydrogeology

The site is located in the Wisconsin Central Sands region over 150 feet of very permeable sand and gravel glacial outwash sediments overlying bedrock. The site has little topographic relief and is located approximately 1.75 miles west of the Wisconsin River Petenwell Flowage and 4.5 miles east of the main branch of Cranberry Cr. See topographic map, Attachment 7. The Cranberry Cr. tributary located 2.5 miles west of the site has intermittent flow. Regional groundwater flow in the site area is shown on the 1981 Wisconsin Geologic and Natural History Water Table Map (Attachment 8). With water table elevations of 940 to 945 feet MSL and a surface elevation of 960 feet MSL the water table would be approximately 15 to 20 feet below the surface and flow to the southeast. Ground water measurements in borings made for CSD in 2006 gave elevations from 940.81 to 942.34 feet MSL with the direction of flow generally to the southeast. Groundwater elevations would be expected to fluctuate seasonally due to variations in precipitation and recharge and also in response to the extensive irrigation well pumping in the area and the CSD facility high capacity well. Groundwater elevations measured from 2004 through 2010 at the Agri-Alliance spill site, located 650 feet southeast of the CSD entrance at CTH "G", document up to 4.0 feet of water table elevation fluctuation with the 2010 elevations being two to four feet higher than the 2006 elevations(see Attachment 9). The Agri-Alliance monitoring also confirmed flow was generally to the southeast, with minor variation that may be due to irrigation pumping or Lake Petenwell stage elevation fluctuations.

Sandy highly permeable soils with little organic material content characterize the Central Sands and site area. The water infiltration rates are high and the runoff rates low. The soils are droughty, requiring irrigation for most commercial crops. The rapid infiltration, rapid draining and large soil pores allow for rapid movement of oxygenated surface water into and through the root zone. Large portions of commercial crop nutrient and dairy waste applications (fertilizer and manure) are rapidly washed below the root zone becoming inaccessible to plants and therefore larger nutrient additions are required to produce commercially viable crops. The reduced forms of nutrient nitrogen are usually rapidly oxidized to nitrate-nitrogen. It has been documented that, even with best management agricultural practices, cropping in the Central Sands has led to extreme inputs of nitrogen into the groundwater with approximately 75 to 125 lbs. of nitrogen per acre leaching into the groundwater below the cropped fields (Kraft & Mechenich, 1997),(Kraft, G.J. and W. Stites. 2003),(Stites, W. and G.J. Kraft. 2000 & 2001). The cumulative result is basin-wide nitrogen loading of the groundwater system with large areas of the groundwater system contaminated above the safe drinking water standard of 10 mg/l nitrate-N. The basin groundwater system has not yet reached equilibrium with the nitrogen loading; therefore, nitrate concentrations are anticipated to increase through time as continued nitrogen inputs cause nitrate-impacted groundwater to replace the remaining non-impacted water (Kraft & Mechenich, 1997). In addition to the impacts to private water supplies and groundwater-dependent aquatic systems, some municipal water systems now have the costs for nitrate treatment system installation and operation (Kraft & Mechenich, 1997. Studies in the Central Sands have documented that 70% of water supply wells within irrigated areas may exceed the safe drinking water standard of 10 mg/l nitrate-N (Stites, W. and G.J. Kraft. 2000 & 2001). In contrast, uncropped lands such as the forested areas west of CSD have very low nitrogen inputs and the underlying groundwater nitrate concentrations would be expected to be very low, generally less than the NR 140 PAL of 2.0 mg/l.

Water Quality Monitoring at the CSD Wells

CSD installed test wells at three locations near the dairy to monitor the nitrate levels of the ground water. These wells help develop background information on nitrate concentrations and indicate if a problem develops near the dairy. Inquiries to WDNR staff (Terry Kafka, Laura Chern, Gretchen Wheat and Robert Rohland) regarding the availability of any groundwater quality monitoring at the CSD indicated they were unaware of the installation or monitoring of any wells at the CSD facility.

However the Agri-Alliance Spill Site (WDATCP #02406071101), referenced above regarding water levels, utilized two of the CSD wells referenced as part of their spill investigation ("MW-1" and "PZ-1"). The well logs for these wells are described in "Appendix B, Off-Site Well Construction Data" (Attachment 10). The logs document the wells were installed by Dave Paulson of "Soil Essential" on January 10, 2008 and certified by Ryan S. Haney of Sand Creek Consultants, Inc. The well contact was listed as Gordon Jones, Central Sands Dairy, LLC, 8550 Central Sands Rd., Bancroft, WI, 54921. The boring log showed sand to 45 feet. MW-1 was screened from 20 to 30 feet below the surface and PZ-1 was screened from 40 to 45 feet below the surface. The bottom of the well forms notes that the completed forms must be filed with the DNR per State law and administrative code requirements.

Copies of groundwater sampling results from the five monitoring wells which were placed at three locations were provided by Ken Winters, Town of Armenia Zoning Commission (see Attachment 11, "Table 1"). Approximate locations of the wells are noted on the 2010 Aerial – Central Sands Dairy Groundwater Monitoring Locations" (Attachment 2). This information provided conforms to the well construction data contained in the logs referenced above and includes well screen depths for: MW-2 (15 to 25 feet), PZ-2 (35 to 40 feet), and MW-3 (14 to 24 feet). NO3/NO2 and NH3/NH4 analyses were reported once for each well for 2008, 2009, 2010, and 2011. Since the wells have been sampled in either January or February for each of those years it is expected that sampling results from 2012 may also be available.

MW-3 is in an up-gradient position relative to the CSD facility and showed very low NO3/NO2 values for 2008 and 2009 (1.8 and 1.3 mg/l), but increased in 2010 and 2011 (16.2 and 17.8 mg/l) with the concentrations greater than the NR 140, Wis. Adm. Code Enforcement Standard (ES) of 10 mg/l. It was noted that the forested area, reportedly owned by Okray, west and up-gradient of the well, was cleared for irrigated agriculture in 2009. It is likely the spike in NO3/NO2 is due to the addition of excess nutrients in the cleared area. It is probable the NO3/NO2 concentrations will continue to increase until steady state conditions are reached.

MW-2 and PZ-2 are immediately down-gradient from the CSD liquid manure storage basin. Total nitrogen in MW-2 increased from low levels in 2008 and 2009 (2.8 and 2.0 mg/l) to over the ES in 2010 and 2011 (13.3 and 10.1 mg/l). It is noted that NH3/NH4 was a significant component of the total nitrogen in 2010 and 2011 (5.8 and 6.5 mg/l). This level of NH3/NH4 would not naturally be expected in even a fertilized sandy soil. It is more likely due to the anaerobic conditions resulting from leakage of manure from the CSD liquid manure storage basin or other manure sources further up-gradient such as the barns. The liquid manure storage basin is the most likely source since the base of the basin was designed for an elevation of 944 feet MSL and groundwater fluctuations, as described previously, are likely to rise to that elevation or above. With little or no unsaturated soil below the liner the reduced nitrogen species in the manure (NH3/NH4) can move into the groundwater without significant oxidation. The five-inch thick concrete manure storage basin liner is not backed by compacted clay or a plastic liner nor is there an underdrain system or lysimeter to monitor liner leakage. Even a small number of cracks or voids in the concrete could allow significant leakage due to the hydraulic head on the liner (972.6 – 944 = 28.6 feet). PZ-2 NO3/NO2 concentrations decreased significantly from a high of34 mg/l in 2008 to a low of 0.2 mg/l in 2011. The high level in 2008 is most likely due to residual excess nutrient additions from the irrigated agriculture in the site area prior to the CSD facility construction. Though the NH3/NH4 concentrations in PZ-2 are relatively low it is noted they increase significantly from 0.03 mg/l in 2010 to 0.55 mg/l in 2011. This most likely is a result of the leakage of manure into an anaerobic groundwater condition as described previously.

MW-1 and PZ-1 are located immediately down-gradient from a 160-acre irrigated field. NO3/NO2 concentrations for MW-1 and PZ-1 are not significantly different. They are over the ES and have ranged from 16.3 to 34.1 mg/l, with all values over the ES of 10 mg/l. The lack of very significant concentration changes with time or depth at this location is most likely a reflection of a long history of irrigated crop land use over the large field area up-gradient of the wells. The long term over-application of fertilizer or nutrient wastes has allowed the nitrate concentrations to approach a steady-state condition to at least the depth of the piezometer (45 feet).

<u>Other Water Quality Observations in CSD Facility Area</u>

1. NO3/NO2 measurements at the Hoffman residence at N15883 CTH “G” (35.9 and 37.8 mg/l) located immediately east and down-gradient of either the same field discussed for MW-1 and PZ-1 or the irrigated field across the CSD entrance drive south of it.

2. NO3/NO2 measurement at the Bob Owens residence 23.9 mg/l) located on CTH “G” east of the CSD.

3. NO3/NO2 measurement at N15761 23rd Ave. N., Nekoosa (30.7 mg/l).

4. Pivot well sample north of CSD south of 3rd St. taken in August of 2012 when manure was not being spread. This sample had a positive E. coli result of 6000 cfu/mL (See photo, Attachment 12).

5. Water sample from Spud Creek along manure spread field (19th and 4th St.) with no inflow or outflow from creek tested unsafe at 376 cfu/100mL E. coli.

See Attachment 14.

NR214, Wis. Adm. Code Spray Irrigation Requirements

CSD has been conducting its spray irrigation waste application without conformance to the requirements of NR 214, Wis. Adm. Code (which is also incorporated through reference in NR243.15(6)):

NR 214.14(1)(b) requires that the nearest edge of wastewater spray shall be separated by at least 500 feet from the nearest inhabited dwelling, except that the distance may be reduced with the written consent of any affected owners and occupants. The department may require a greater distance depending on the type of distribution system and potential for aesthetic and public health impacts. The CSD is not in conformance with this requirement.

NR 214.14(3)(b) requires discharge to be limited to prevent exceedence of a substance's preventive action limit (PAL) in groundwater.

NR 214.12(3)(c) limits total nitrogen application to the annual nitrogen need of the cover crop.

NR 214.14(4)(b) requires monitoring of irrigation discharge for total daily flow and may also include analysis of $BOD_{5,}$ TSS, N, Cl, metals or other pollutant that may be present and may require per (c) submittal of electronic monitoring reports.

NR 214.14(5)(b) requires twice yearly cutting of cover crops in order to remove nutrients from the system or if cut only once the applied nutrients limited accordingly.

NR 214.14(5)(c) requires annual soil testing of each individual spray irrigation field for available nitrogen, phosphorus, and potassium and used to determine the agronomic needs of the cover crop.

NR 214.14(5)(d) requires submittal of a management plan that insures conformance with NR 214.

NR 214.20 requires soil investigations for spray irrigation systems that include: identification of spreading sites, existing soil survey data, detailed soils map, soil cation exchange capacity, agronomic soil nutrient testing. Per NR 214.20(6) test pits and preliminary site investigation is required followed by a full scale treatment site investigation that includes additional test pits, soil borings to either 25 feet or the groundwater, with description of the soils.

NR 214.21 requires a comprehensive multi-level groundwater monitoring system for systems treating equal to greater than 1.0 million gallons a day (gpd) or a single level groundwater monitoring system for systems that treat 15,000 gpd or more, but less than 1.0 million gpd. However, NR 214.21(1)(c) allows the department to require either a single- or multi-level groundwater monitoring system for any land treatment system regardless of treatment volume in consideration of waste strength and characteristics, waste volume, dosage schedule, geology of the area, soil type, and application rates relative to groundwater flow velocity .

The groundwater monitoring system must conform to NR 141 and consist of an adequate number of wells to define groundwater flow direction and determine land treatment groundwater impacts. In-field well tests are required to determine hydraulic conductivity and gradients. A map showing the wells, treatment area, property boundaries, and the location of all wells, wetlands, streams, and lakes within 0.5 miles of the treatment site. Sampling for seasonal operations minimal sampling is required prior to system startup and 2 times during or within 2 months after the time the treatment system is used. The department may require analysis of: elevation, depth to groundwater, organic N, NH3/NH4-N, NO3/NO2-N, chloride, sulfate, TDS, alkalinity, hardness, field pH and conductivity, BOD_5, COD, sodium, calcium, magnesium, iron and manganese with other substances required dependent on the waste characteristics and the potential for groundwater contamination.

Nutrient Loading Rates (Phosphorus)

WDNR correspondence indicates excess phosphorus (greater than 100 ppm) has accumulated in the soils in the CSD waste spreading areas with a majority exceeding 200 ppm and that additional action should be taken to reduce soil phosphorus to below 100 ppm.

2011 Spreading Report and Snap-Plus Data and 590 Assessment Plan

A review of the 2011 waste spreading report indicated the following:

1) The report appears to be incomplete with the following data categories missing:
    a) Date of waste application.
    b) Soil conditions at time of application.
    c) The report section for description of “Rotation” and “Tillage” was not completed.
    d) The report section for reporting phosphorus field rotation budgets and target values (the phosphorus index (PI), P2O5 balance and P2O5 Balance Target) were checked “NA”, though it would appear that phosphorus management as part the waste spreading program would be necessary.
2) The phosphorus soil tests showed all spreading fields with phosphorus well above 100 ppm with 7 fields above 200 ppm.

3) The application rates reported in the spreading report (see Attachment 13) for the post digester solids appear to be excessive and may account for some of the soil accumulation of phosphorus reported by the DNR. A calculation of the phosphorus loading rates from the reported data is tabulated below:

Field Name	Field Size Acres	Manure Analysis P (lbs./ton)	Application Rate, tons/A	P Application Rate, lbs/A
Casino N	110	60	500	273
Casino S	79	60	350	266
NO1	60	60	200	200
NO2	60	60	200	200
NO3	65	60	350	323
NO4	65	60	350	323
NO5	65	60	200	185
NO7	65	60	350	323
NO8	75	60	500	400
NO9	75	60	460	368

Conclusions

1. CSD and its waste land spreading areas are located in a hydrogeologic environment very susceptible to groundwater contamination with significant documented water quality impacts related to over-application of crop and animal waste nutrients on irrigated lands with development of extensive areas of groundwater with nitrate concentrations exceeding the NR 140 ES of 10 mg/l.

2. Groundwater monitoring wells were installed and monitored by CSD since January 2008, apparently without reporting to the DNR. Monitoring results with contaminant levels exceeding the NR 140 ES and increasing contaminant concentration trends signifying a contaminant release were apparently not reported to the DNR.

3. The spike in NO3/NO2 in MW-3 indicates a significant release of contaminants from the upgradient irrigated field. The contaminants are most likely related to the excess crop application of nitrogen nutrients.

4. The increase in reduced nitrogen at MW-2 and PZ-2 indicates a release of manure contaminants from the up-gradient liquid manure storage basin is occurring. The lack of adequate liner separation above the groundwater and potential liner design and installation deficiencies are the most likely cause of the release.

5. The high levels of groundwater nitrate documented in MW-1, PZ-1 and nearby private water supply wells indicate the up-gradient irrigated field has received excess nitrogen loading from crop nutrients or waste manure application.

6. The documentation of E. coli from a pivot well sample and from the Spud Cr. drainage along with documented E. coli impacts at other CAFOs indicates E. coli and total coliform are potential contaminants of concern warranting comprehensive monitoring in both land-applied wastewater and groundwater at the CSD facility and its land application fields.

7. The CSD is not in conformance with the spray irrigation requirements of NR 214.

8. Excessive accumulation of phosphorus in CSD waste application fields appears to be a result of over-application of waste nutrients and poses a risk to Lake Petenwell due to eutrophication impacts.

Recommendations

As part of WDNR's investigation and determination of what enforcement activities may be required for the Central Sands Dairy I make the following suggestions for some of the specific actions and activities that should be considered.

1. The CSD WPDES permit could be modified to include:

    a. A groundwater monitoring plan conforming with NR 141 for the dairy facility using the existing wells supplemented by two additional well nests located up-gradient of any irrigated fields and two additional well nests located in potential down-gradient directions. The plan should include quarterly measurement of water level (MSL and BGS), organic-N, NH3/NH4-N, NO3/NO2-N, total coliform and E. coli bacteria. The data should be reported electronically to the DNR quarterly with an annual report summarizing the results and providing recommendations for additional investigation or facility design or operational modifications that may be indicated. A map showing the wells, facility design features, property boundaries, and the location of all wells, wetlands, streams, and lakes within 0.5 mile of the site should be provided.

b. A comprehensive groundwater monitoring plan conforming to NR 141 for all non-spray irrigation dairy facility waste land spreading fields should be required. The plan should include quarterly measurement of water level (MSL and BGS), organic-N, NH3/NH4-N, NO3/NO2-N, total coliform and E. coli bacteria. The data should be reported electronically to the DNR quarterly with an annual report summarizing the results and providing recommendations for additional investigation or waste application modifications that may be indicated. A map showing the wells, field application areas, property boundaries, and the location of all wells, wetlands, streams, and lakes within 0.5 mile of the treatment site should be provided.

c. A study of the CSD liquid waste manure storage basin and any other concrete-lined facilities, such as the cow barns, that may be leaking organic contaminants into the groundwater should be required. Any existing as-built documentation should be reviewed and reports of deficient construction evaluated as to their significance. The manure basin should be drained and inspected and a remedial lining plan implemented as needed. The basin liner elevation should be field documented. The potential groundwater elevation fluctuation under the basin should be evaluated and a remediation redesign that maintains a substantial separation of the liner bottom and the groundwater implemented.

d. Phosphorus and nitrogen soil and waste characterization monitoring requirements and waste application rates for all field waste application sites should be modified to insure excessive soil phosphorus does not accumulate and groundwater loading of nitrogen does result in a continued exceedence of the NR 140 ES of 10 mg/l.

e. The CSD waste spray irrigation fields should be required to conform with NR214 including:

   i. A separation of 500 feet between the edge of spray and all inhabited buildings.

   ii. Monitoring total daily spray flow, organic-N, NH3/NH4-N, NO3/NO3-N, total coliform and E. coli

   iii. Establishment of total nitrogen application rates that ensure the groundwater nitrate concentrations will not exceed or continue to exceed the NR 140 ES of 10 mg/l.

   iv. Require twice yearly cutting of field cover crops or if cut only once the applied nutrients limited accordingly.

   v. Require annual soil testing of each individual spray irrigation field for available nitrogen, phosphorus, and potassium and used to determine the agronomic needs of the cover crop.

vi. Submit a management plan that insures conformance with NR 214.

vii. Require a soil investigation for the spray irrigation system that includes: identification of spreading sites, existing soil survey data, detailed soils map, soil cation exchange capacity and agronomic soil nutrient testing. Per NR 214.20(6), test pits and preliminary site investigation should be required followed by a full scale treatment site investigation that includes additional test pits, soil borings to either 25 feet or the groundwater, with description of the soils.

viii. Require a comprehensive multi-level groundwater monitoring system that conforms to NR 141 and includes an adequate number of wells to define groundwater flow direction and determine land treatment groundwater impacts. In-field well tests should be required to determine hydraulic conductivity and gradients. A map showing the wells, treatment area, property boundaries, and the location of all wells, wetlands, streams, and lakes within 0.5 mile of the treatment site should be provided. Quarterly sampling for measurement of water level (MSL and BGS), organic-N, NH3/NH4-N, NO3/NO2-N, total coliform and E. coli bacteria should be required and reported electronically to the DNR quarterly with an annual report summarizing the results and providing recommendations for additional investigation or waste application modifications that may be indicated.

Include the sampling of any private water supply wells within ¼ mile of each of the spreading fields for the same parameters except for water level , whenever the owner's permission can be obtained.

2. DNR should require CSD to immediately submit all existing groundwater monitoring data, including well construction logs, borings, and analyses (including 2012).

3. DNR should require CSD to immediately identify all private water supply wells within ½ mile of all designated waste spreading fields and begin quarterly groundwater sampling for NO3/NO2, total coliform and E. coli bacteria for all wells within ¼ mile of the spreading fields with electronic reporting to the DNR quarterly. A locator map of all sampled wells, GPS located, with accompanying well logs where obtainable from public records or well owner contact, should be provided.

4. An inspection of operations should be conducted that insures that land application of any wastes by other than spray irrigation maintains a separation from the spreading areas of at least 100 feet from private wells or direct conduits for movement into the groundwater(per NR243.14(2)(8) and (9)).

5. DNR should require CSD to immediately begin sampling of the five existing dairy groundwater monitoring wells for water level, organic-N, NH3/NH4, NO3/NO2, total coliform and E. coli

bacteria for all wells within ¼ mile of the spreading fields with electronic reporting to the DNR quarterly.

Prepared by Kenneth S. Wade, P.E., P.G. – September 20, 2012

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Kraft, G.J., B.A. Browne, W.M. DeVita, & D.J. Mechenich. 2004. Nitrate and Pesticide Penetration into a Wisconsin Central Sand Plain Aquifer, College of Natural Resources, University of Wisconsin – Stevens Point

Kraft, G.J., D.J. Mechenich. 1997. Contaminant Source Assessment and Management Using Groundwater Flow and Contaminant Models in the Steven Point – Whiting Plover Wellhead Protection Area

Kraft, G.J. and W. Stites. 2003. Nitrate impacts on groundwater from irrigated vegetable systems in a humid north-central US sand plain. Agriculture, Ecosystems, and Environment 100:63-74.

Lippelt, I.D. and R.D. Hennings. 1981. Irrigable Lands Inventory – Phase I Groundwater and Related Information. Wisconsin Geological and Natural History Survey, Madison Wisconsin

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Stites, W. and G.J. Kraft. 2001. Nitrate and chloride loading to groundwater from an irrigated north-central U.S. sand-plain vegetable field. J. of Environmental Quality. V. 30:1176-1184.

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Experience

2011 to present – Hydrogeological and environmental engineering consulting in areas of waste land spreading, high capacity wells, chlorinated solvent spills, and wetland hydrology.

1993 to 2011 – manage the hazardous materials program for Wisconsin Department of Transportation, Southeast Region. Major projects include Miller Park Baseball Stadium, Lake Arterial Parkway, Park East, and Marquette Interchange. Manage hydrologic assessment of WisDOT wetland program issues.

1987 to 1993 – Wisconsin Department of Natural Resources, Bureau of Solid Waste Management, made feasibility determinations for solid waste facilities, coordinated hydrologic assessments of Crandon Mine Environmental Impact Statement.

1986 to 1987 – Idaho National Engineering Laboratory, Department of Energy (EG&G), hazardous and radioactive waste assessments for soil and groundwater, dioxin soil testing at Agent Orange storage sites (U.S. Department of Defense), with Level 1 security clearance.

1980 to 1985 – Wisconsin DNR, Bureau of Solid and Hazardous Waste Management with duties similar to DNR above.

1978 to 1980 – Colorado State University, graduate research, uranium solution mining impacts, reported to Colorado Dept. of Health.

1976 to 1977 – Brodhead High School, taught chemistry, advanced chemistry, and physics

1975 to 1976 – Solar Specialists, Inc., solar space heating and hot water installation

Education

1981 – 1985, U. of Wisconsin-Madison, graduate study in numerical groundwater flow and contaminant transport modeling; USGS Training Center, groundwater modeling

1978 – 1980, Colorado State University, Master of Geology

1970 – 1974, U. of Wisconsin-Madison, BS in secondary education

Other Experience

Town Board Chair – Town of Middleton, Dane County Wisconsin, 1989-1990

Restoration Ecology – Ongoing prairie, oak-savanna, wetland restoration in conjunction with "The Prairie Enthusiasts" on 226 acres of land in western Dane County.

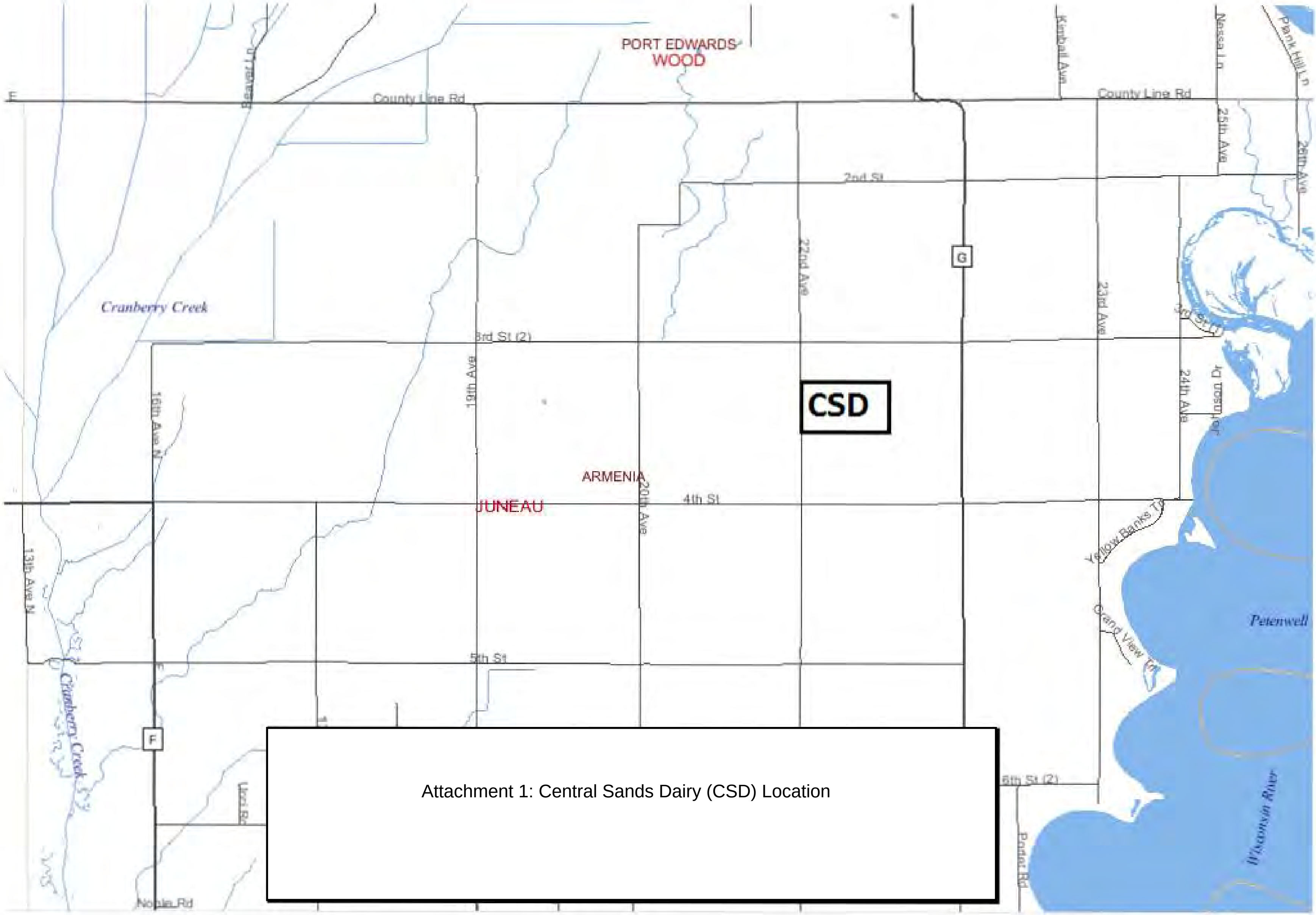
Extensive outdoor experience including: mountaineering and rock climbing, winter camping, bicycling, and kayaking

Registration

Wisconsin Professional Engineer, # 30156

Wisconsin Professional Geologist, # 556

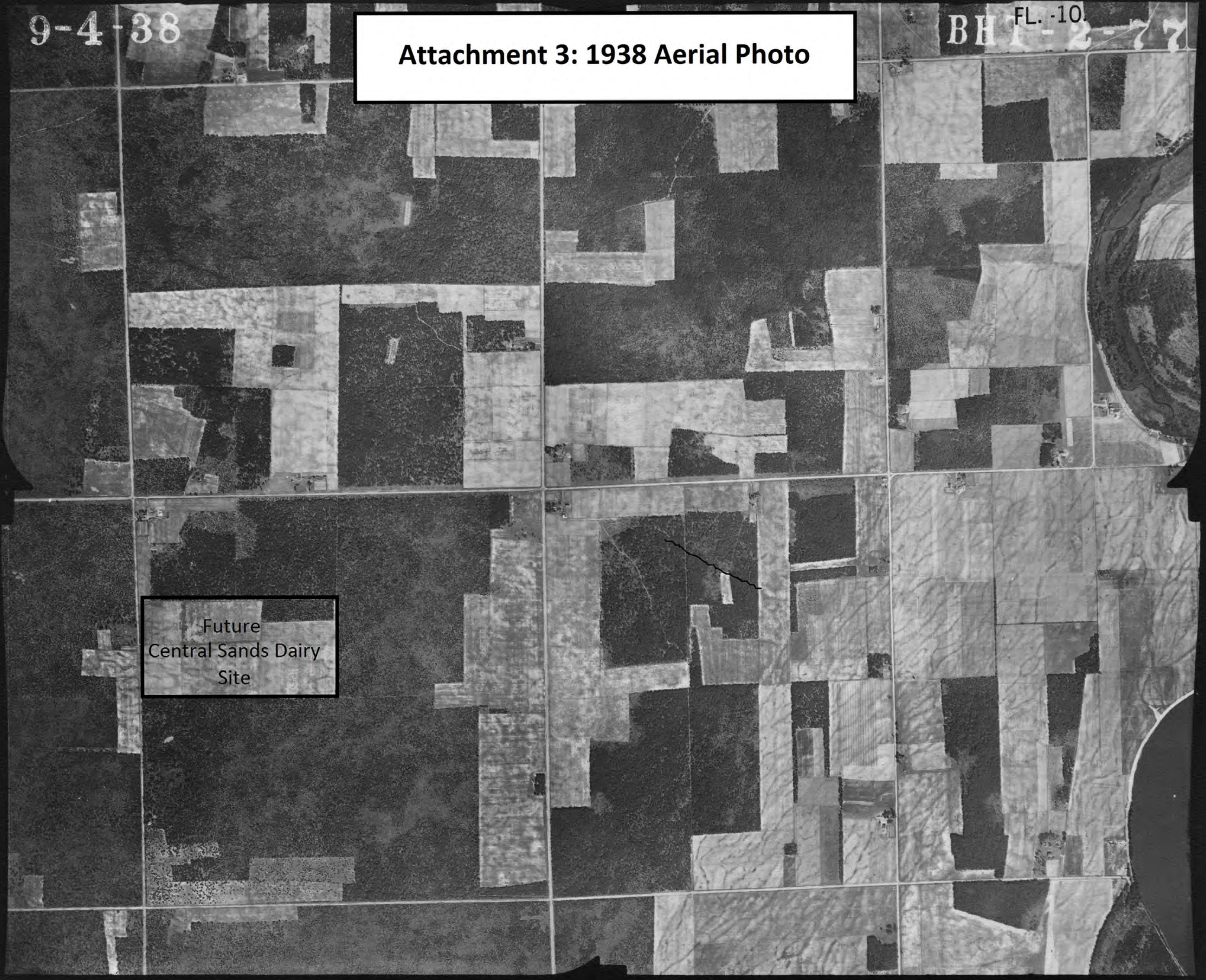
Hazardous Waste Operations and Emergency Response Certified (29 CFR1910.120)



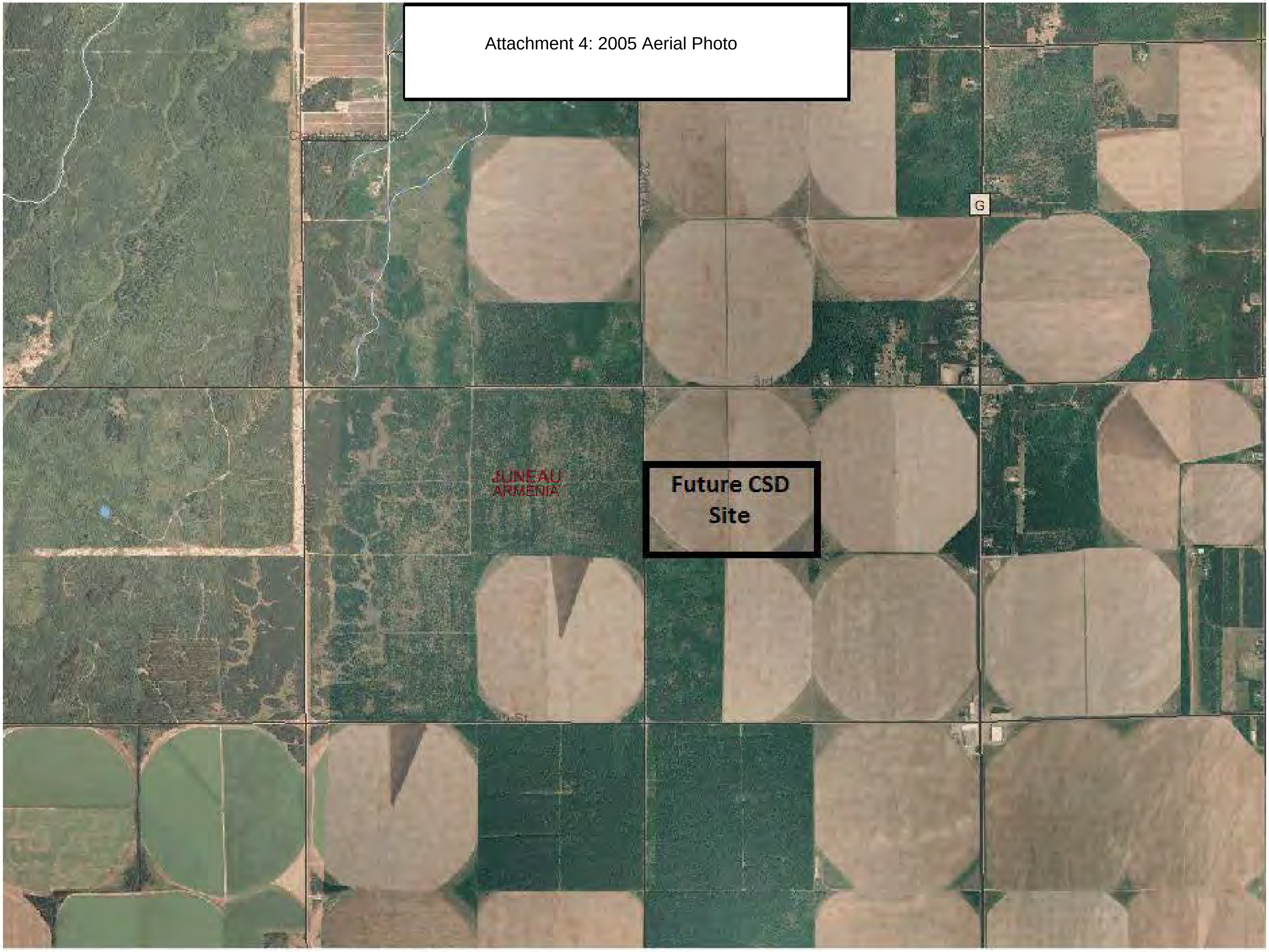
Attachment 1: Central Sands Dairy (CSD) Location

Attachment 2:
2010 Aerial Photo - Central Sands Dairy Groundwater Monitoring Well Locations

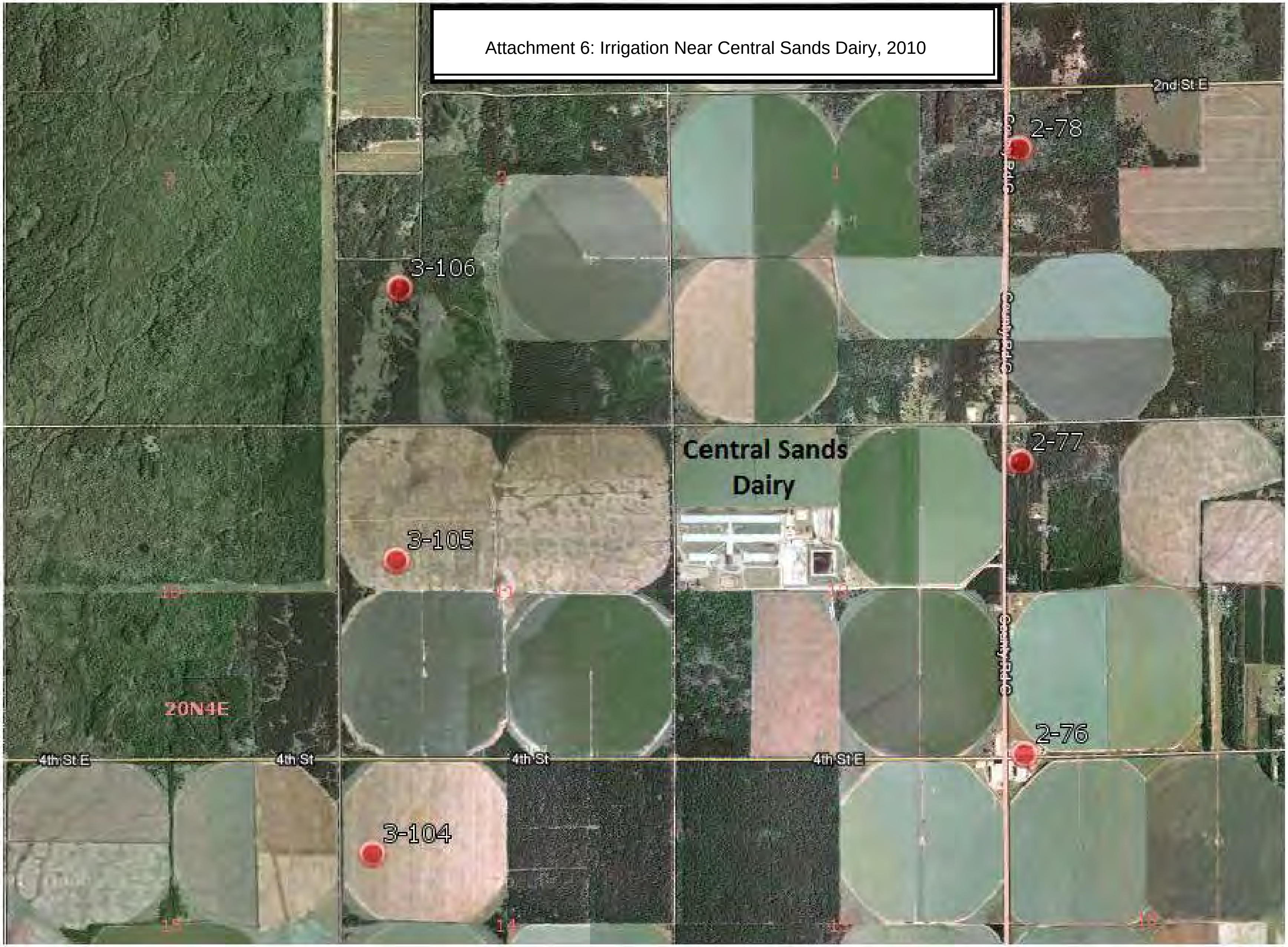
Attachment 3: 1938 Aerial Photo



Attachment 4: 2005 Aerial Photo

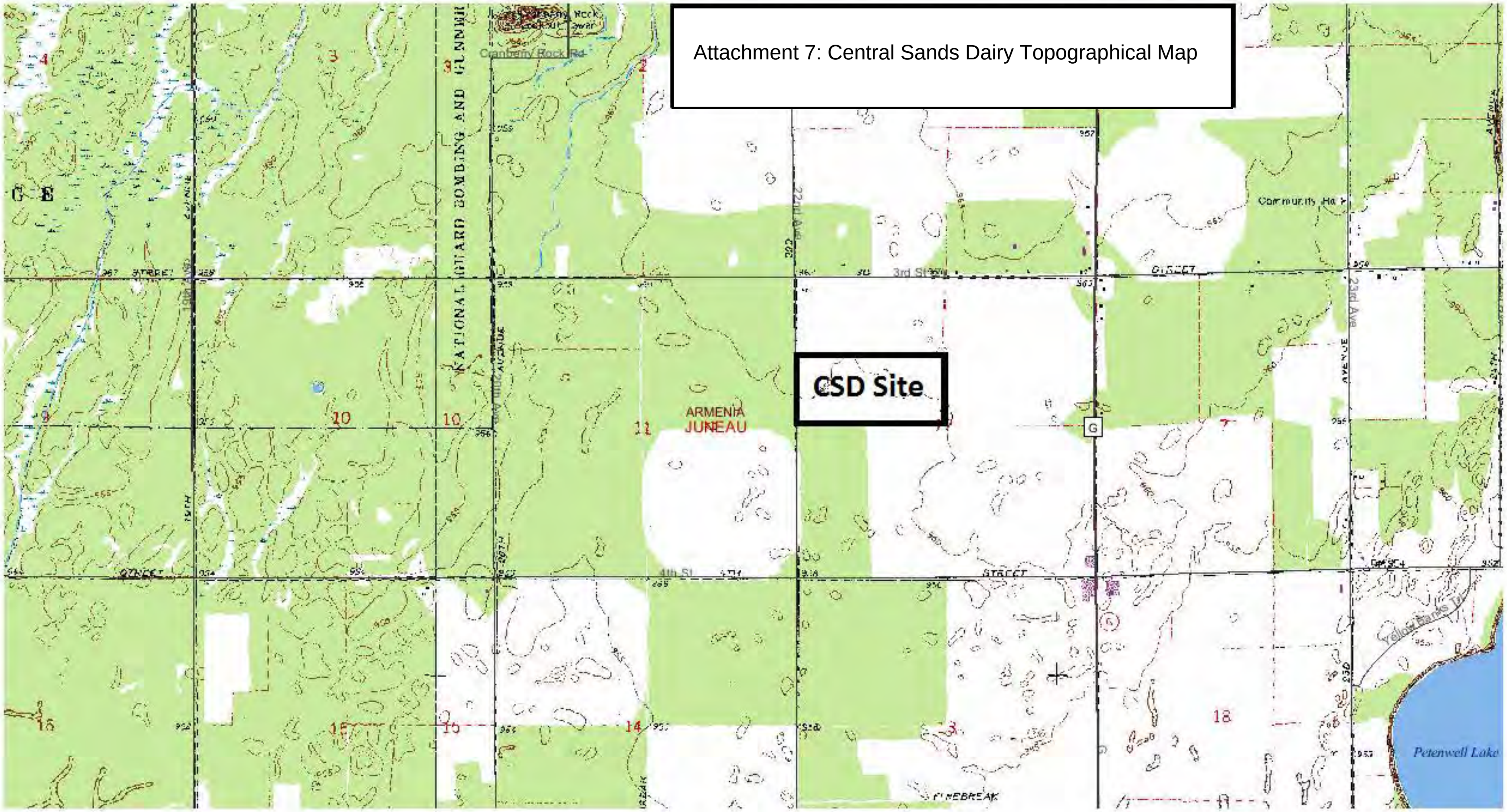



Attachment 5: 2008 Aerial Photo - Central Sands Dairy (CSD)
G
CSD Site
ARMENIA

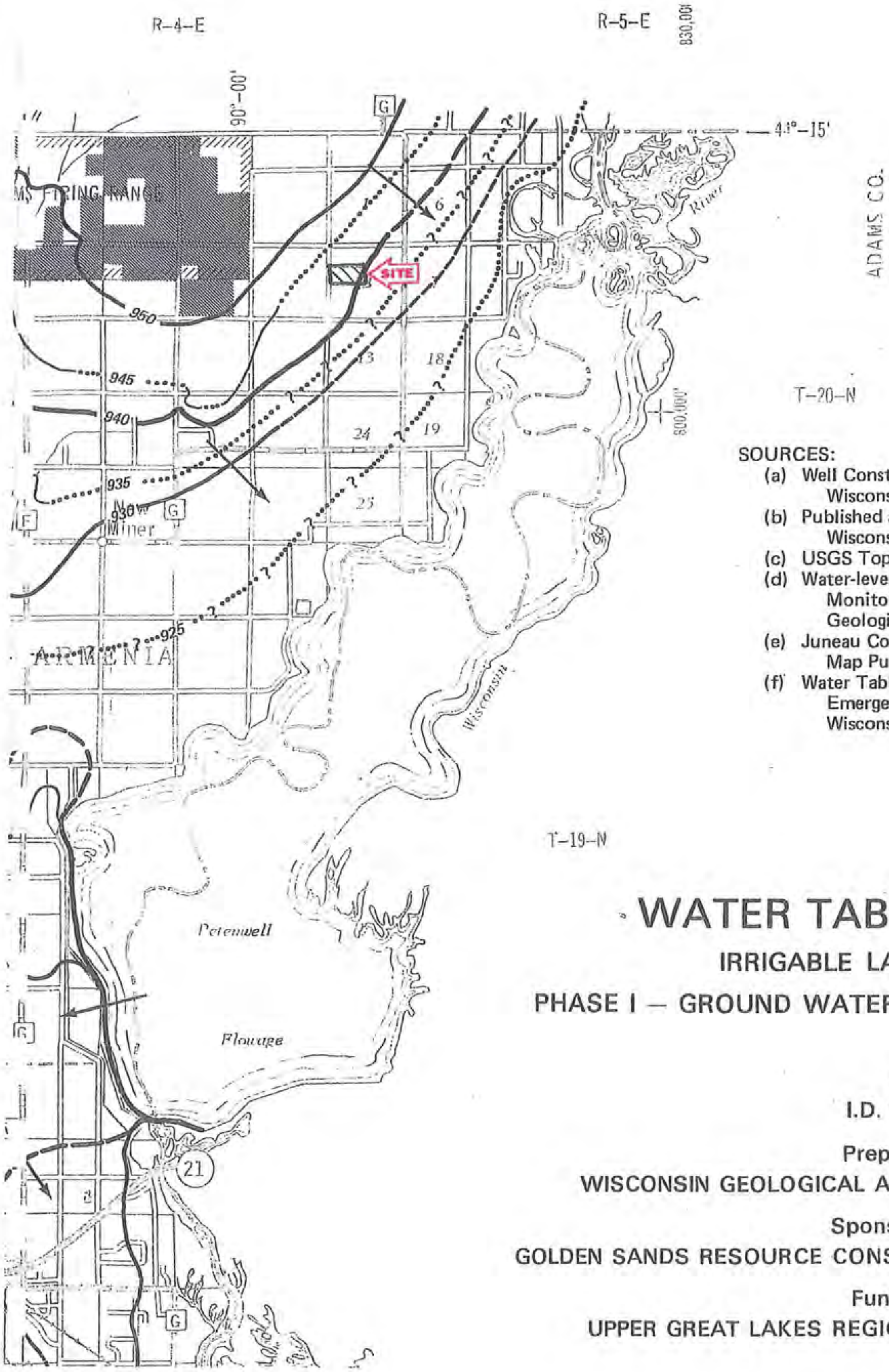


Attachment 6: Irrigation Near Central Sands Dairy, 2010

Attachment 7: Central Sands Dairy Topographical Map



Attachment 8: Central Sands Dairy Water Table Map



SOURCES:
(a) Well Constructor's Reports (1936-1979) — Wisconsin Department of Natural Resources
(b) Published and unpublished Geologic Logs (1896-pres Wisconsin Geological & Natural History Survey
(c) USGS Topographic Maps
(d) Water-level observation wells from the Ground-Water Monitoring Network operated and maintained by Geological and Natural History Survey and USGS.
(e) Juneau County Land Atlas and Plat Book, 1980, Roc Map Publishers, Inc.
(f) Water Table Survey Notes (1935-1938) — Emergency Conservation Work (ECW) — Wisconsin Conservation Department

WATER TABLE ELEVATION

IRRIGABLE LANDS INVENTORY

PHASE I — GROUND WATER AND RELATED INFORMATI

By:
I.D. LIPPELT

Prepared by:
WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

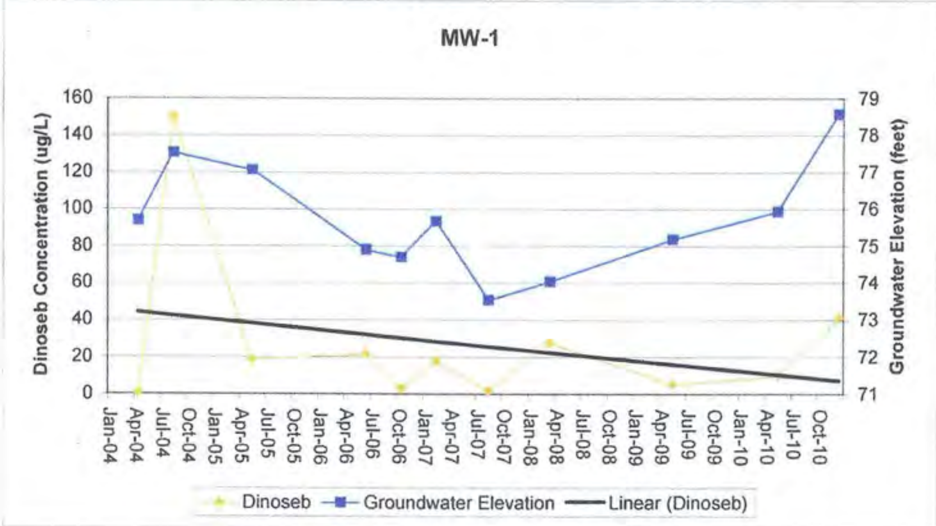
Sponsored by:
GOLDEN SANDS RESOURCE CONSERVATION AND DEVELOPMENT

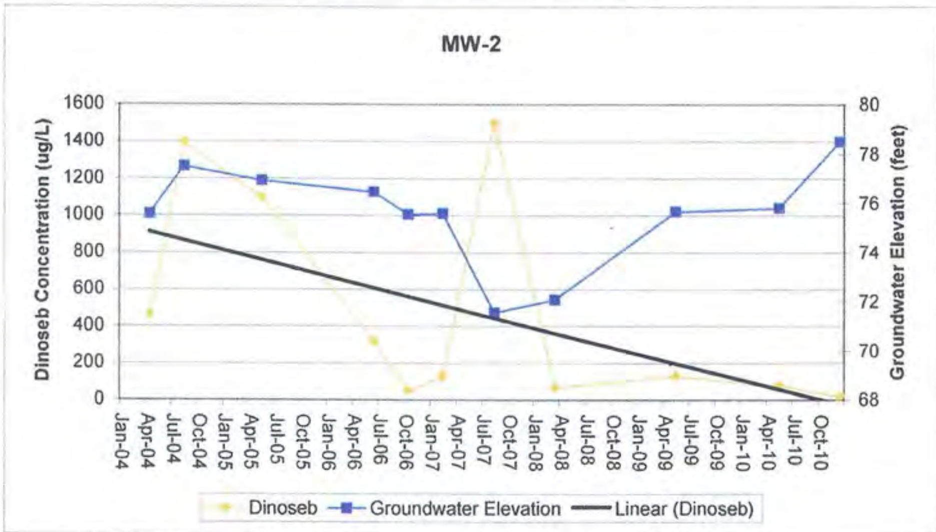
Funded by:
UPPER GREAT LAKES REGIONAL PLANNING COMMISSION

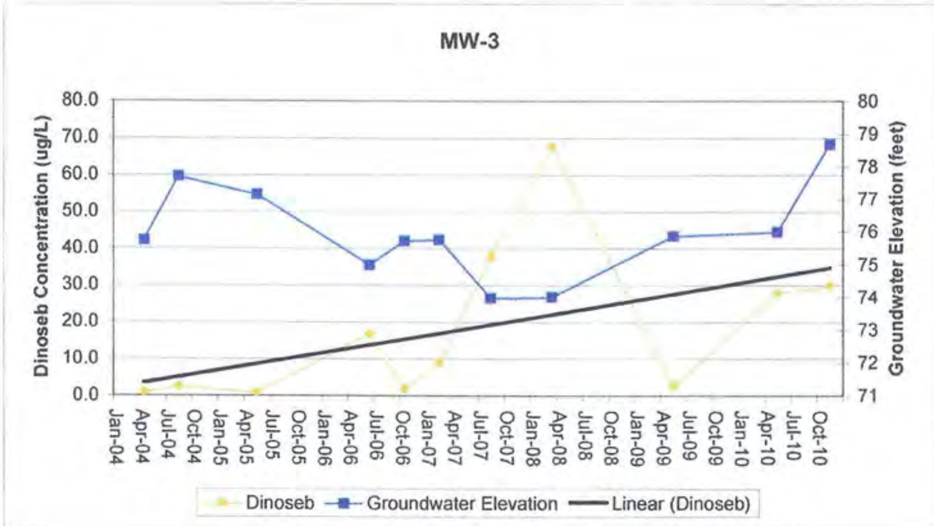
Attachment 9

Groundwater Elevations – Agri-Alliance Spill Site, WDATCP #02406071101

(NW ¼, SW ¼, Sec. 6, 20N,R5E, N1569 CTH "G", Nekoosa, WI)







Attachment 10

APPENDIX B

Off-Site Well Construction Data

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION

Form 4400-122 Rev. 7-98

Route To: Watershed/Wastewater ☒ Waste Management ☐
Remediation/Revelopment ☐ Other ☐ ________

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Central Sands Dairy	— — — — — — —	MW-1

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Dave Last Name: Parker Firm: Soil Essentials	01/10/2008 (mm dd yyyy)	01/10/2008 (mm dd yyyy)	Direct-Push

WI Unique Well No.	DNR Well ID No.	Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
— — — — —	— — —		____ Feet MSL	____ Feet MSL	3 inches

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☐
State Plane ________ N, ________ E S/C/N
NW 1/4 of SW 1/4 of Section 12, T 20 N, R 4 E/W

Lat ___ ° ___ ' ___ "
Long ___ ° ___ ' ___ "

Local Grid Location: ____ Feet ☐ N ☐ S ____ Feet ☐ E ☐ W

Facility ID	County	County Code	Civil Town/City/ or Village
	Juneau	29	Necedah

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Sample: Blow Counts	Depth in Feet (Below ground surface)	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–2	Blind drill to 30' ↓										
			6	Loose Brown Sand										
			8		SP									
			16–18		SP									
			24	EOB @30'										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm
[signature]	Sand Creek Consultants, Inc.

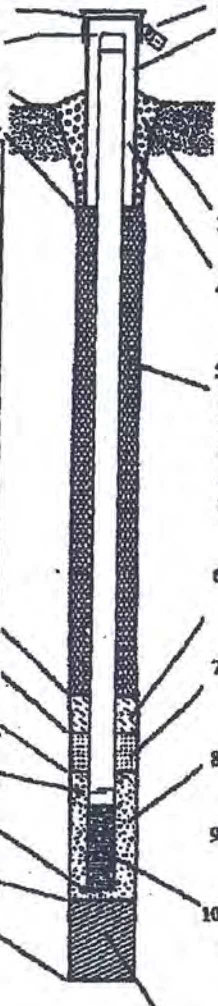
This form is authorized by Chapters 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats. Completion of this form is mandatory. Failure to file this form may result in forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involve Personally identifiable information on this form is not intended to be used for any other purpose. NOTE: See instructions for more information, including where the completed form should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☒ Waste Management ☐ Remediation/Redevelopment ☐ Other ☐

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name	Local Grid Location of Well	Well Name
Central Sands Dairy	____ ft. ☐N. ☐S. ____ ft. ☐E. ☐W.	MW-1
Facility License, Permit or Monitoring No.	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. ___ ° ___ ' ___ " Long. ___ ° ___ ' ___ " or	Wis. Unique Well No. / DNR Well ID No.
Facility ID	St. Plane ____ ft. N, ____ ft. E. S/C/N	Date Well Installed 01/10/2008 (m m d d y y y y)
Type of Well; Well Code ___/___	Section Location of Waste/Source: SW 1/4 of SW 1/4 of Sec. 12, T. 20 N, R. 4 ☒E ☐W	Well Installed By: Name (first, last) and Firm: Dave Paulson, Soil Essentials
Distance from Waste/Source ____ ft.; Enf. Stds. Apply ☐	Location of Well Relative to Waste/Source: u ☐ Upgradient; s ☐ Sidegradient; d ☐ Downgradient; n ☐ Not Known; Gov. Lot Number	



A. Protective pipe, top elevation ____ ft. MSL

B. Well casing, top elevation ____ ft. MSL

C. Land surface elevation ____ ft. MSL

D. Surface seal, bottom ____ ft. MSL or ____ ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☒
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☒ No

14. Drilling method used: Rotary ☐ 5 0; Hollow Stem Auger ☐ 4 1; Other ☒ — Direct-Push

15. Drilling fluid used: Water ☐ 0 2; Air ☐ 0 1; Drilling Mud ☐ 0 3; None ☒ 9 9

16. Drilling additives used? ☐ Yes ☒ No

Describe ____

17. Source of water (attach analysis, if required):

Granular Bentonite 7.5-1

E. Bentonite seal, top ____ ft. MSL or __1__ ft.

Bentonite Sleeve 17.5-7.5

F. Fine sand, top ____ ft. MSL or __-__ ft.

G. Filter pack, top ____ ft. MSL or __-__ ft.

Foam Bridge 20-17.5

H. Screen joint, top ____ ft. MSL or __20__ ft.

I. Well bottom ____ ft. MSL or __30__ ft.

J. Filter pack, bottom ____ ft. MSL or __30__ ft.

K. Borehole, bottom ____ ft. MSL or __30__ ft.

L. Borehole, diameter __3__ in.

M. O.D. well casing __1.01__ in.

N. I.D. well casing __.75__ in.

1. Cap and lock? ☒ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: __3__ in.
b. Length: __6__ ft.
c. Material: Steel ☒ 0 4; Other ☐
d. Additional protection? ☐ Yes ☒ No
If yes, describe: ____

3. Surface seal: Bentonite ☒ 3 0; Concrete ☐ 0 1; Other ☐ — Sand

4. Material between well casing and protective pipe: Bentonite ☐ 3 0; Other ☒ — Sand

5. Annular space seal: a. Granular/Chipped Bentonite ☒ 3 3
b. ____ Lbs/gal mud weight ... Bentonite-sand slurry ☐ 3 5
c. ____ Lbs/gal mud weight ..... Bentonite slurry ☐ 3 1
d. ____ % Bentonite ...... Bentonite-cement grout ☐ 5 0
e. ____ Ft^3 volume added for any of the above
f. How installed: Tremie ☐ 0 1; Tremie pumped ☐ 0 2; Gravity ☒ 0 8

6. Bentonite seal: a. Bentonite granules ☒ 3 3
b. ☐1/4 in. ☐3/8 in. ☐1/2 in. Bentonite chips ☐ 3 2
c. 20 lbs Other ☐

7. Fine sand material: Manufacturer, product name & mesh size
a. Native Formation
b. Volume added ____ ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Native Formation
b. Volume added ____ ft^3

9. Well casing: Flush threaded PVC schedule 40 ☒ 2 3; Flush threaded PVC schedule 80 ☐ 2 4; Other ☐

10. Screen material: PVC
a. Screen type: Factory cut ☒ 1 1; Continuous slot ☐ 0 1; Other ☐
b. Manufacturer ____
c. Slot size: __0.010__ in.
d. Slotted length: __10__ ft.

11. Backfill material (below filter pack): None ☒ 1 4; Other ☐

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm
[signature]	Sand Creek Consultants, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☑ Waste Management ☐ Remediation/Redevelopment ☐ Other ☐ ______

Facility/Project Name	County Name	Well Name	
Central Sands Dairy	Juneau	MW-1	
Facility License, Permit or Monitoring Number	**County Code**	**Wis. Unique Well Number**	**DNR Well ID Number**
	29	______	____

1. Can this well be purged dry? ☐ Yes ☒ No
2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☐ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☒ 51
   - pumped slowly ☐ 50
   - Other ______ ☐
3. Time spent developing well: 25 min.
4. Depth of well (from top of well casisng): 32.4 ft.
5. Inside diameter of well: .75 in.
6. Volume of water in filter pack and well casing: 0.7 gal.
7. Volume of water removed from well: 2. gal.
8. Volume of water added (if any): .0 gal.
9. Source of water added: —
10. Analysis performed on water added? ☐ Yes ☒ No (If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 25.4 ft.	25.9 ft.
Date	b. 01/11/2008 (mm dd yyyy)	01/11/2008 (mm dd yyyy)
Time	c. 1:50 ☐ a.m. ☒ p.m.	2:15 ☐ a.m. ☒ p.m.
12. Sediment in well bottom	1.0 inches	.0 inches
13. Water clarity	Clear ☐ 10 Turbid ☒ 15 (Describe)	Clear ☒ 20 Turbid ☐ 25 (Describe)

Fill in if drilling fluids were used and well is at solid waste facility:

14. Total suspended solids	____ mg/l	____ mg/l
15. COD	____ mg/l	____ mg/l

16. Well developed by: Name (first, last) and Firm
First Name: Dave Last Name: Paulson
Firm: Soil Essentials

17. Additional comments on development:

Name and Address of Facility Contact/Owner/Responsible Party
First Name: Gordon Last Name: Jones
Facility/Firm: Central Sands Dairy
Street: 8550 Central Sands Road
City/State/Zip: Bancroft, WI 54921

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: [signature]
Print Name: Ryan S. Haney
Firm: Sand Creek Consultants

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122 Rev. 7-98

Route To: Watershed/Wastewater ☑ Waste Management ☐
Remediation/Revelopment ☐ Other ☐ ____________

Page 1 of 2

Facility/Project Name: Central Sands Dairy	License/Permit/Monitoring Number:	Boring Number: PZ-1
Boring Drilled By: Name of crew chief (first, last) and Firm — First Name: Dave, Last Name: Parker, Firm: Soil Essentials	Date Drilling Started: 01/10/2008 (mm/dd/yyyy)	Date Drilling Completed: 01/10/2008 (mm/dd/yyyy)	Drilling Method: Direct-Push
WI Unique Well No. / DNR Well ID No. / Well Name	Final Static Water Level: ____ Feet MSL	Surface Elevation: ____ Feet MSL	Borehole Diameter: 3 inches
Local Grid Origin ☐ (estimated: ☐) or Boring Location ☐; State Plane ____ N, ____ E S/C/N; NW 1/4 of SW 1/4 of Section 12, T 20 N, R 4 E/W	Lat ° ' "; Long ° ' "	Local Grid Location: ____ Feet ☐ N ☐ S; ____ Feet ☐ E ☐ W
Facility ID	County: Juneau	County Code: 29	Civil Town/City/ or Village: Nekoosa

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				Grass										
				0-1 Topsoil, organics, roots black to brown	Soil									
	48/30		2	1-4 Loose, m-c sand, strong brown	SP					dry				
			4	4-8 SAA, coarser grained	SP					slight				
	48/36		6											
			8	8-12 SAA, slightly moist	SP					slight				
	48/38		10											
			12	12-16 SAA	SP					moist				
	48/40		14											
			16	16-20 SAA, trace gravel	SP									
	48/30		18							moist				
			20	20-24 SAA, sat @ 23.8'	SP									
	48/36		22							sat				
			24											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm: Sand Creek Consultants, Inc.

This form is authorized by Chapters 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats. Completion of this form is mandatory. Failure to file this form may result in forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involve. Personally identifiable information on this form is not intended to be used for any other purpose. NOTE: See instructions for more information, including where the completed form should be sent.

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122 Rev. 7-98

Route To: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Revelopment ☐ Other ☐ ______

Facility/Project Name: Central Sands Dairy	License/Permit/Monitoring Number: _ _ _ _ _ _ _	Boring Number: PZ-1	
Boring Drilled By: Name of crew chief (first, last) and Firm — First Name: Dave Last Name: Paulson Firm: Soil Essentials	Date Drilling Started: 05/11/2008 (mm/dd/yyyy)	Date Drilling Completed: 05/11/2008 (mm/dd/yyyy)	Drilling Method: Direct-Push
WI Unique Well No. / DNR Well ID No. / Well Name	Final Static Water Level ____ Feet MSL	Surface Elevation ____ Feet MSL	Borehole Diameter 3 inches
Local Grid Origin ☐ (estimated: ☐) or Boring Location ☐ State Plane ____ N, ____ E S/C/N; SW 1/4 of SW 1/4 of Section 12, T 20 N, R 4 E/W	Lat ° ' " Long ° ' "	Local Grid Location ____ Feet ☐ N ☐ S ____ Feet ☐ E ☐ W	
Facility ID	County: Juneau	County Code: 29	Civil Town/City/ or Village: Nekoosa

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/Comments
			26		SP									
	48/33		28	28-32 SAA	SP									
			30											
	48/40		32	32-36 SAA	SP									
			34											
	48/42		36	36-40 SAA	SP									
			38											
	48/44		40	40-44 SAA	SP									
			42											
	12/12		44	44-45 SAA	SP									
			46	EOB @ 45'										
			48											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm
[signature]	Sand Creek Consultants

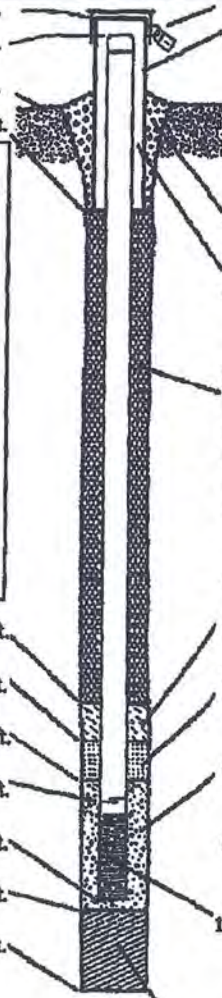
State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☒ Waste Management ☐ Remediation/Redevelopment ☐ Other ☐ ______

MONITORING WELL CONSTRUCTION

Form 4400-113A Rev. 7-98

Facility/Project Name: Central Sands Dairy	Local Grid Location of Well: ______ ft. ☐N. ☐S. ______ ft. ☐E. ☐W.	Well Name: PZ-1
Facility License, Permit or Monitoring No.	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. ___ ° ___ ' ___ " Long. ___ ° ___ ' ___ " or	Wis. Unique Well No. | DNR Well ID No.
Facility ID	St. Plane ______ ft. N, ______ ft. E. S/C/N	Date Well Installed: 01/10/2008 (m m d d y y y y)
Type of Well / Well Code: 1	Section Location of Waste/Source: SW 1/4 of SW 1/4 of Sec. 12, T. 20 N, R. 4 ☒E ☐W	Well Installed By: Name (first, last) and Firm: Dave Paulson, Sand Essentials
Distance from Waste/Source ______ ft. | Enf. Stds. Apply ☐	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☒ Downgradient n ☐ Not Known | Gov. Lot Number	



A. Protective pipe, top elevation ______ ft. MSL

B. Well casing, top elevation ______ ft. MSL

C. Land surface elevation ______ ft. MSL

D. Surface seal, bottom ______ ft. MSL or ______ ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☒
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☒ No

14. Drilling method used: Rotary ☐ 5 0
Hollow Stem Auger ☐ 4 1
Direct-Push Other ☒

15. Drilling fluid used: Water ☐ 0 2 Air ☐ 0 1
Drilling Mud ☐ 0 3 None ☒ 9 9

16. Drilling additives used? ☐ Yes ☒ No

Describe ______

17. Source of water (attach analysis, if required): ______

Granular Bentonite 17.5 - 1
E. Bentonite seal, top ______ ft. MSL or 1 ft.

Bentonite Sleeve 27.5 - 17.5
F. Fine sand, top ______ ft. MSL or ______ ft.

G. Filter pack, top ______ ft. MSL or 37.5 ft.

Foam Bridge 40 - 37.5
H. Screen joint, top ______ ft. MSL or 40 ft.

I. Well bottom ______ ft. MSL or 45 ft.

J. Filter pack, bottom ______ ft. MSL or 45 ft.

K. Borehole, bottom ______ ft. MSL or 45 ft.

L. Borehole, diameter 3 in.

M. O.D. well casing 1.05 in.

N. I.D. well casing .75 in.

1. Cap and lock? ☒ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 3 in.
b. Length: 6 ft.
c. Material: Steel ☒ 0 4
Other ☐
d. Additional protection? ☐ Yes ☒ No
If yes, describe: ______

3. Surface seal: Bentonite ☒ 3 0
Concrete ☐ 0 1
Other ☐

4. Material between well casing and protective pipe:
Bentonite ☐ 3 0
SAND Other ☒

5. Annular space seal: a. Granular/Chipped Bentonite ☒ 3 3
b. ____ Lbs/gal mud weight ... Bentonite-sand slurry ☐ 3 5
c. ____ Lbs/gal mud weight ..... Bentonite slurry ☐ 3 1
d. ____ % Bentonite ...... Bentonite-cement grout ☐ 5 0
e. ____ Ft^3 volume added for any of the above
f. How installed: Tremie ☐ 0 1
Tremie pumped ☐ 0 2
Gravity ☒ 0 8

6. Bentonite seal: a. Bentonite granules ☒ 3 3
b. ☐1/4 in. ☐3/8 in. ☐1/2 in. Bentonite chips ☐ 3 2
c. 23 lbs Other ☐

7. Fine sand material: Manufacturer, product name & mesh size
a. Native Formation
b. Volume added ______ ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Native Formation
b. Volume added ______ ft^3

9. Well casing: Flush threaded PVC schedule 40 ☒ 2 3
Flush threaded PVC schedule 80 ☐ 2 4
Other ☐

10. Screen material: PVC
a. Screen type: Factory cut ☒ 1 1
Continuous slot ☐ 0 1
Other ☐
b. Manufacturer ______
c. Slot size: 0.010 in.
d. Slotted length: 5 ft.

11. Backfill material (below filter pack): None ☒ 1 4
Other ☐

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: [signature] | Firm: Sand Creek Consultants, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☒ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐ ____________

Facility/Project Name	County Name	Well Name	
Central Sands Dairy	Juneau	PZ-1	
Facility License, Permit or Monitoring Number	**County Code**	**Wis. Unique Well Number**	**DNR Well ID Number**
	29	------	---

1. Can this well be purged dry? ☐ Yes ☐ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☐ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☒ 51
   - pumped slowly ☐ 50
   - Other ____________ ☐

3. Time spent developing well 25 min.

4. Depth of well (from top of well casisng) 43 ft.

5. Inside diameter of well .75 in.

6. Volume of water in filter pack and well casing 2. gal.

7. Volume of water removed from well 2. gal.

8. Volume of water added (if any) 0 gal.

9. Source of water added ——

10. Analysis performed on water added? ☐ Yes ☒ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 25.26 ft.	25.67 ft.
Date	b. 01/11/2008 (mm dd yyyy)	01/11/2008 (mm dd yyyy)
Time	c. 1:50 ☐ a.m. ☒ p.m.	2:15 ☐ a.m. ☒ p.m.
12. Sediment in well bottom	1. inches	.0 inches
13. Water clarity	Clear ☐ 10 Turbid ☒ 15 (Describe)	Clear ☒ 20 Turbid ☐ 25 (Describe)

Fill in if drilling fluids were used and well is at solid waste facility:

14. Total suspended solids ______ mg/l ______ mg/l

15. COD ______ mg/l ______ mg/l

16. Well developed by: Name (first, last) and Firm
First Name: Dave Last Name: Paulson
Firm: Soil Essentials

17. Additional comments on development:

Name and Address of Facility Contact/Owner/Responsible Party	I hereby certify that the above information is true and correct to the best of my knowledge.
First Name: Gordon Last Name: Jones	Signature: [signature]
Facility/Firm: Central Sands Dairy	Print Name: Ryan S. Haney
Street: 8550 Central Sands Road	
City/State/Zip: Bancroft, WI 54921	Firm: Sand Creek Consultants

NOTE: See instructions for more information including a list of county codes and well type codes.

Attachment 11

SAND CREEK CONSULTANTS, Inc.

Environmental and Geological Scientists and Engineers

www.sand-creek.com

October 31, 2007

Gordy Jones
Central Sands Dairy, Inc.
....
Nekoosa, WI ....

Subject: Proposal for Monitoring Well & Piezometer Installation
Central Sands Dairy, Inc. – Nekoosa, WI

Dear Dr. Jones:

Thank you for the opportunity to submit a proposal to you to coordinate and oversee monitoring well and piezometer installation at your Central Sands Dairy site. You indicated that you want to sample groundwater at three locations and at two depths at each location (at the water table and approximately 10 feet below the water table).

In the enclosed tables, we have presented cost estimates for four different options of monitoring well installation. Keep in mind that the Wisconsin Department of Natural Resources (DNR) has established codes for well construction that are listed in Chapter NR 141, Wisconsin Administrative Code. To deviate from any of these guidelines requires a variance from the DNR under NR 141.31, and is typically only granted under special circumstances when standard well construction is "not feasible." Code requires that a water table well be constructed with 2-inch diameter material and with 10-foot long screen that intersects the water table (meaning the screened part of the well will typically extend to 7 or 8 feet below the water table with a couple of feet of well screen above the water table to allow for water table fluctuations). Wells positioned below the water table (piezometers) are required to be 2-inch diameter and have 5-foot long screens. To minimize costs we discuss several alternatives. Upon your review of the following information we should hold discussions to confirm your objectives. At that point we can determine whether to file a variance request with the DNR.

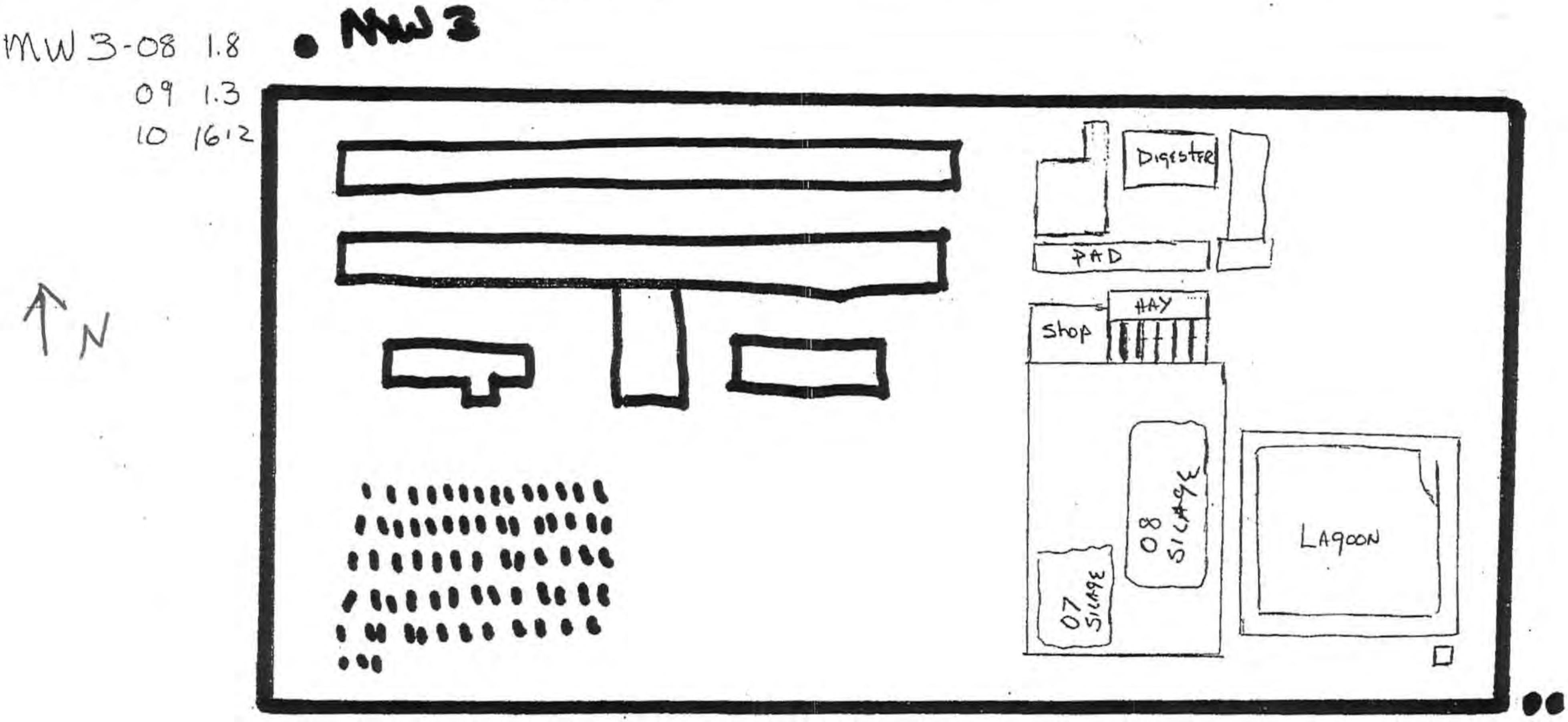
Based on drilling conducted on the adjacent Agri-Alliance property, and a review of well construction reports (18 records) for the area, soils generally consist of sand and gravel to greater than 60 feet below ground surface (bgs). You indicated that the depth to groundwater at your property is approximately 20 feet.

Headquarters
110 S. Stevens Street
P.O. Box 1512 • Rhinelander, WI 54501
(715) 365-1818 • Fax (866) 608-6473

Branch Office
123 S. Main Street
P.O. Box 218 • Amherst, WI 54406
(715) 824-5169 • Fax (866) 608-6473

New Mexico Affiliate
CMB Environmental & Geological Services, Inc.
P.O. Box 2304 • Roswell, NM 88202
Phone (505) 622-2012

MW 3-08 1.8
09 1.3
10 16.2



MW2	08	2.8
	09	2.0
	10	13.3
PZ2	08	34
	09	8.[illegible]
	10	.0[illegible]
MW3	08	33
	09	16.3
	10	26.8
PZ1	08	32.5
	09	32.3
	10	34.1

MW = 20' GROUND WATER

PZ = 30' 10' DEEPER than GROUND WATER

Table 1
Groundwater Sample Results
Central Sands Dairy
Nekoosa, WI

Sample ID	Date	Nitrogen (mg/L) NO3/NO2 Nitrogen	NH3/NH4 Nitrogen	Total Nitrogen
MW-1	1/11/2008	**31**	2	33
	1/30/2009	**16.3**	-	16.3
	2/17/2010	**26.8**	-	26.8
	1/18/2011	**24.1**	0.04	24.1
MW-2	1/11/2008	*2.8*	-	2.8
	1/30/2009	*2.0*	-	2.0
	2/17/2010	*7.5*	*5.8*	13.3
	1/18/2011	*3.6*	*6.5*	10.1
MW-3	1/10/2008	1.8	-	1.8
	1/30/2009	1.3	-	1.3
	2/17/2010	**16.2**	-	16.2
	1/18/2011	**17.8**	-	17.8
PZ-1	1/11/2008	**31**	1.5	32.5
	1/30/2009	**32.3**	-	32.3
	2/17/2010	**34.1**	-	34.1
	1/18/2011	**28.9**	0.02	28.9
PZ-2	1/11/2008	**34**	-	34
	1/30/2009	*8.3*	-	8.3
	2/17/2010	-	0.03	0.03
	1/18/2011	0.2	0.55	0.75
Scale House	1/11/2008	-	-	-
	NR 140 PAL:	2	0.97	
	NR 140 ES:	10	9.7	

- = Not detected above method detection limit.

Bold type indicates exceedence of NR 140 Enforcement Standard (ES), Wisconsin Administrative Code.

Italic type indicates exceedence of NR 140 Preventative Action Limit (PAL), Wisconsin Administrative Code.

Blank cells indicate no standard established.

NE = Not Established

Attachment 12: Irrigation Over Spray North of Central Sands Dairy South of 3rd St., Sampled August 2012

FRASE CROP CONSULTING, LLC.

JEFFREY E. FRASE
E-10305 CTH. HH
OSSEO, WI 54758

HOME (715)597-3693
Cell # (715)577-4945
E-mail jeffreyfrase@centurytel.net

1-31-2012

Bob Rohland
Ag. Runoff Management Specialist

Black River Falls Service Center
910 Highway 54 East
Black River Falls, WI 54615

Subject: WPDES Annual Spreading Report of Central Sands Dairy, LLC

In compliance with the WPDES Permit of Central Sands Dairy,LLC, Nekoosa, WI., Permit No. WI-0063533-02-0, I am submitting the following Annual Reports required in Section 3.2.13 of the Permit.

Manure applications for Permit period 2011

Manure sample analysis results

Quarterly facilities inspection reports for 2011

Monitoring & Inspection Program Reports for 2011

Sincerely;

Jeff Frase

Jeff Frase
Frase Crop Consulting, LLC.

DNR CAFO ANNUAL SPREADING REPORT
For 2011
Reported for Central Sands Dairy LLC

Snap-Plus version 1.132.8

Printed 1/28/2012
Plan Completion/Update Date: Missing

Prepared for
Central Sands Dairy LLC

Instructions:
Before running this report update SNAP-Plus from what was planned to happen during this cropping year, to what actually happened for all parameters (e.g., crop, tillage, nutrients applied).
Add rows as needed and fill in the three columns that SNAP-Plus cannot.

Attach other necessary reports and lab results to document compliance with:

- Tolerable Soil Loss (Field Data and 590 Assessment)
- Soil testing (Soil Test Report)
- Manure testing (CAFO Nutrient Sources)

Test methods and other information for sampling manure and soil required under Ch. NR 243.19, Wis. Admin. Code shall be retained for 5 years.

Record-keeping requirements may vary according to permit. See your permit for specific record-keeping requirements that apply to your operation. If your permit requires reporting on soil conditions*, see Ch. NR 243.03, Wis. Admin. Code for soil condition definitions (saturated, frozen, snow-covered). If snow-covered, indicate inches of snow present.

						Manure/Process Wastewater Application					Manure Applied Nutrients (lbs/acre)		UW Crop Nutrient Recs (lbs/acre)		Total Nutrients Applied + Credits from legumes, manure credits, fertilizer (lbs/acre)			
Field ID	Slope (%)	Previous Crop	Current Crop	Date of Applic.	Acres Applied	Manure/Process Wastewater Source	Manure Analysis Lbs avail/Ton or 1000 gal. (Ns/Ni-P-K)	Manure Appl. Rate (Tons-Gals/Acre)	Spread Method	Soil Condition (sat, non-sat, frozen, snow)	N	P2O5	N	P2O5	N	P2O5	Excess N Amount (Lbs/Acre)	Comm
CASINO N	4	Snapbean to Snapbean	Potatoes, late harvest, to small grain cover crop										-1	0	-1	-1	0	
						Post Digestor Solids	5/ 7- 4- 2	10	Incorporated		67	44						
							0/ - 0- 60	500	Incorporated		0	0						
							9/ - 28- 4	10	Incorporated		10	32						
							5/ - 18- 10	5	Incorporated		3	10						
							32/ - 0- 0	40	Incorporated		142	0						
CASINO S	3	Alfalfa	Alfalfa (1st cut) to Corn silage										-1	0	-1	-1	0	
						Post Digestor Solids	5/ 7- 4- 2	10	Unincorporated		50	44						
							0/ - 0- 60	350	Unincorporated		0	0						
							5/ - 18- 10	3	Incorporated		2	6						
							46/ - 0- 0	125	Unincorporated		58	0						
N01	2	Sweet corn to Late Summer Direct Seeded Legume Forage	Alfalfa										-1	0	-1	-1	0	
						Post Digestor												

Field ID	Slope (%)	Previous Crop	Current Crop	Date of Applic.	Acres Applied	Manure/Process Wastewater Application: Manure/Process Wastewater Source	Manure Analysis Lbs avail/Ton or 1000 gal. (Ns/Ni-P-K)	Manure Appl. Rate (Tons-Gals/Acre)	Spread Method	Soil Condition (sat, non-sat, frozen, snow)	Manure Applied Nutrients (lbs/acre) N	Manure Applied Nutrients (lbs/acre) P2O5	UW Crop Nutrient Recs (lbs/acre) N	UW Crop Nutrient Recs (lbs/acre) P2O5	Total Nutrients Applied + Credits from legumes, manure credits, fertilizer (lbs/acre) N	Total Nutrients Applied + Credits from legumes, manure credits, fertilizer (lbs/acre) P2O5	Excess N Amount (Lbs/Acre)	Comm
						Solids	5/ 7- 4- 2	10	Unincorporated		50	44						
							0/ - 0- 60	200	Unincorporated		0	0						
N02	2	Sweet corn to Late Summer Direct Seeded Legume Forage	Alfalfa										-1	0	-1	-1	0	
						Post Digestor Solids	5/ 7- 4- 2	10	Incorporated		67	44						
							0/ - 0- 60	200	Incorporated		0	0						
N03	1	Corn silage to small grain cover crop	Snapbean to Snapbean										-1	0	-1	-1	0	
						Post Digestor Solids	5/ 7- 4- 2	10	Incorporated		67	44						
							0/ - 0- 60	350	Incorporated		0	0						
							32/ - 0- 0	10	Incorporated		35	0						
N04	1	Corn silage to small grain cover crop	Snapbean to Snapbean										-1	0	-1	-1	0	
						Post Digestor Solids	5/ 7- 4- 2	10	Incorporated		67	44						
							0/ - 0- 60	350	Incorporated		0	0						
							32/ - 0- 0	10	Incorporated		35	0						
N05	1	Potatoes, late harvest, to small grain cover crop	Alfalfa										-1	0	-1	-1	0	
						Post Digestor Solids	5/ 7- 4- 2	7	Incorporated		47	31						
							0/ - 0- 60	200	Incorporated		0	0						
N06	1	Corn grain	Snap Beans late plant to small grain cover crop										-1	0	-1	-1	0	
						Post Digestor Solids	5/ 7- 4- 2	7	Incorporated		47	31						
N07	1	Corn grain	Snapbean to Snapbean										-1	0	-1	-1	0	

						Manure/Process Wastewater Application					Manure Applied Nutrients (lbs/acre)		UW Crop Nutrient Recs (lbs/acre)		Total Nutrients Applied + Credits from legumes, manure credits, fertilizer (lbs/acre)			
Field ID	Slope (%)	Previous Crop	Current Crop	Date of Applic.	Acres Applied	Manure/Process Wastewater Source	Manure Analysis Lbs avail/Ton or 1000 gal. (Ns/Ni-P-K)	Manure Appl. Rate (Tons-Gals/Acre)	Spread Method	Soil Condition (sat, non-sat, frozen, snow)	N	P2O5	N	P2O5	N	P2O5	Excess N Amount (Lbs/Acre)	Comm
						Post Digestor Solids	5/ 7- 4- 2	10	Incorporated		67	44						
							0/ - 0- 60	350	Incorporated		0	0						
							32/ - 0- 0	12	Incorporated		43	0						
N08	2	Snapbean to Snapbean to small grain cover	Potatoes, late harvest, to small grain cover crop										-1	0	-1	-1	0	
						Post Digestor Solids	5/ 7- 4- 2	10	Incorporated		67	44						
							0/ - 0- 60	500	Incorporated		0	0						
							32/ - 0- 0	20	Incorporated		71	0						
							32/ - 0- 0	25	Incorporated		89	0						
N09	1	Peas to Snapbean to small grain cover	Potatoes, late harvest, to small grain cover crop										-1	0	-1	-1	0	
						Post Digestor Solids	5/ 7- 4- 2	10	Incorporated		67	44						
							0/ - 0- 60	460	Incorporated		0	0						
							5/ - 18- 10	5	Incorporated		3	10						
							32/ - 0- 0	45	Incorporated		160	0						
N10	1	Potatoes, late harvest, to small grain cover crop	Sweet Corn middle plant (May 20 - June 10) with small grain cover crop										-1	0	-1	-1	0	
						Post Digestor Liquid	3/ 4- 1- 9	10000	Incorporated		43	11						
						Post Digestor Liquid	3/ 4- 1- 9	12000	Incorporated		52	14						
						Post Digestor Liquid	3/ 4- 1- 9	8000	Incorporated		35	9						
							5/ - 18- 10	3	Incorporated		2	6						
N11	1	Alfalfa	Alfalfa (1st cut) to Corn silage										-1	0	-1	-1	0	
						Post Digestor Liquid	3/ 4- 1- 9	10000	Incorporated		43	11						
						Post Digestor Liquid	3/ 4- 1- 9	10000	Incorporated		43	11						
						Post Digestor												

Snap-Plus Field Data and 590 Assessment Plan

Snap-Plus version 1.132.8

Reported for Central Sands Dairy LLC

Printed 1/28/2012
Plan Completion/Update Date: Missing
Prepared by FRASE CROP CONSULTING

Prepared for
Central Sands Dairy LLC

Field data: 6894.0 total acres reported.

Field Name	Field Group (sub farm)	FSA Tract #	FSA Field #	Acres	County	Soil Series & Map Symbol	Field Slope (%)	Field Slope Length (ft)	Below Field Slope To Water (%)	Distance To Water (ft)	N and Field Restrictions	Contour / Filters	Rotation	Tillage	Report Period	Field "T" t/ac	Rot Avg Soil Loss t/ac	Rot Avg PI	Soil Test P ppm	Rot P2O5 Bal lb/ac	P2O5 Bal Target lb/ac
CASINO N		8798	6896	110.0	WI-Juneau	Plainfield (PfB)	4	300	2.1 - 6	301 - 1000	P	no / no			2011 - 2015	5	0.2	NA	104	NA	NA
CASINO S		8798	6896	79.0	WI-Juneau	Plainfield (PfB)	3	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	171	NA	NA
N01		8991	7373	60.0	WI-Wood	Plainfield (PfA)	2	600	2.1 - 6	301 - 1000	P	no / no			2011 - 2013	5	0.0	NA	241	NA	NA
N02		8991	7373	60.0	WI-Wood	Plainfield (PfA)	2	200	0 - 2	301 - 1000	P	no / no			2011 - 2012	5	0.0	NA	232	NA	NA
N03		7056	7373	65.0	WI-Wood	Plainfield (PfA)	1	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	167	NA	NA
N04		7056	7373	65.0	WI-Wood	Plainfield (PfA)	1	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	199	NA	NA
N05		7056	7373	65.0	WI-Wood	Plainfield (PfA)	1	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.0	NA	182	NA	NA
N06		7057	7373	65.0	WI-Wood	Plainfield (PfA)	1	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.0	NA	156	NA	NA
N07		7057	7373	65.0	WI-Wood	Plainfield (PfA)	1	200	0 - 2	0 - 300	P	no / no			2011 - 2013	5	0.1	NA	172	NA	NA
N08		9601	7373	75.0	WI-Wood	Friendship (FrA)	2	151	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.3	NA	109	NA	NA
N09		9601	7373	75.0	WI-Wood	Plainfield (PfA)	1	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.0	NA	129	NA	NA
N10		7058	7373	85.0	WI-Wood	Plainfield (PfA)	1	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	176	NA	NA
N11		7059	7373	85.0	WI-Wood	Plainfield (PfA)	1	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	202	NA	NA
N12		3562	7373	65.0	WI-Wood	Plainfield (PfA)	1	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	170	NA	NA
N13		3562	7373	65.0	WI-Wood	Plainfield (PfA)	1	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	196	NA	NA
N14		7058	7373	65.0	WI-Wood	Plainfield (PfA)	1	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	185	NA	NA
N15		7058	7373	65.0	WI-Wood	Plainfield (PfA)	1	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	204	NA	NA
N16		4312	7373	65.0	WI-Juneau	Friendship (FrB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.0	NA	178	NA	NA
N17		4312	7373	65.0	WI-Wood	Plainfield (PfA)	1	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.0	NA	197	NA	NA
N18		7411	7351	100.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	149	NA	NA
N19		9604	7373	65.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	194	NA	NA
N20		9604	7373	65.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	210	NA	NA
N21		9604	7373	65.0	WI-Juneau	Plainfield (PfB)	3	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	206	NA	NA
N22		9604	7373	65.0	WI-Juneau	Plainfield (PfB)	3	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	157	NA	NA
N23		9603	7373	60.0	WI-Juneau	Plainfield (PfB)	3	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	126	NA	NA
N24		9603	7373	60.0	WI-Juneau	Plainfield (PfB)	3	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	158	NA	NA
N25		9603	7373	60.0	WI-Juneau	Plainfield (PfB)	3	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	162	NA	NA

Field Name	Field Group (sub farm)	FSA Tract #	FSA Field #	Acres	County	Soil Series & Map Symbol	Field Slope (%)	Field Slope Length (ft)	Below Field Slope To Water (%)	Distance To Water (ft)	N and Field Restrictions	Contour / Filters	Rotation	Tillage	Report Period	Field "T" t/ac	Rot Avg Soil Loss t/ac	Rot Avg PI	Soil Test P ppm	Rot P2O5 Bal lb/ac	P2O5 Bal Target lb/ac
N26		9603	7373	60.0	WI-Juneau	Plainfield (PfB)	3	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	156	NA	NA
N27		8454	7373	75.0	WI-Juneau	Friendship (FrB)	3	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	165	NA	NA
N28		8454	7373	75.0	WI-Juneau	Friendship (FrB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	179	NA	NA
N29		4314	7373	75.0	WI-Juneau	Plainfield (PfB)	3	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	124	NA	NA
N30		4314	7373	75.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	146	NA	NA
N31		9604	7373	75.0	WI-Juneau	Plainfield (PfB)	3	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	139	NA	NA
N32		9604	7373	75.0	WI-Juneau	Plainfield (PfB)	3	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	175	NA	NA
N33		9603	7373	60.0	WI-Juneau	Plainfield (PfB)	3	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	169	NA	NA
N34		9603	7373	60.0	WI-Juneau	Plainfield (PfB)	3	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.0	NA	158	NA	NA
N35		9603	7373	60.0	WI-Juneau	Plainfield (PfB)	3	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	149	NA	NA
N36		9603	7373	60.0	WI-Juneau	Plainfield (PfB)	3	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	171	NA	NA
N37		4314	7373	75.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	145	NA	NA
N38		4314	7373	75.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	125	NA	NA
N39		9604	7373	75.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	136	NA	NA
N40		9604	7373	75.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.0	NA	139	NA	NA
N41		4319	7373	70.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	171	NA	NA
N42		9604	7373	70.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	0 - 300	P	no / no			2011 - 2013	5	0.2	NA	69	NA	NA
N43		9604	7373	75.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	164	NA	NA
N44		9604	7373	75.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	199	NA	NA
N45		9605	7373	45.0	WI-Juneau	Meehan (MnA)	1	25	0 - 2	0 - 300	WP	no / no			2011 - 2013	5	0.0	NA	120	NA	NA
N46		9605	7373	65.0	WI-Juneau	Meehan (MnA)	1	25	0 - 2	0 - 300	WP	no / no			2011 - 2013	5	0.0	NA	118	NA	NA
N47		9605	7373	75.0	WI-Juneau	Meehan (MnA)	1	100	0 - 2	0 - 300	WP	no / no			2011 - 2013	5	0.0	NA	131	NA	NA
N48		9605	7373	75.0	WI-Juneau	Meehan (MnA)	1	25	0 - 2	0 - 300	WP	no / no			2011 - 2013	5	0.1	NA	128	NA	NA
N49		4316	7373	60.0	WI-Juneau	Meehan (MnA)	1	200	0 - 2	0 - 300	WP	no / no			2011 - 2013	5	0.0	NA	143	NA	NA
N50		4316	7373	60.0	WI-Juneau	Friendship (FrB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.0	NA	160	NA	NA
N51		7606	7373	75.0	WI-Juneau	Plainfield (PfB)	3	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	163	NA	NA
N52		7606	7373	75.0	WI-Juneau	Plainfield (PfB)	3	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	154	NA	NA
N53		9604	7373	75.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	144	NA	NA
N54		7606	7373	75.0	WI-Juneau	Plainfield (PfB)	3	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	141	NA	NA
N55		9604	7373	65.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	160	NA	NA
N56		9604	7373	65.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	154	NA	NA
N57		7605	7373	75.0	WI-Juneau	Friendship (FrB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	128	NA	NA

Field Name	Field Group (sub farm)	FSA Tract #	FSA Field #	Acres	County	Soil Series & Map Symbol	Field Slope (%)	Field Slope Length (ft)	Below Field Slope To Water (%)	Distance To Water (ft)	N and Field Restrictions	Contour / Filters	Rotation	Tillage	Report Period	Field "T" t/ac	Rot Avg Soil Loss t/ac	Rot Avg PI	Soil Test P ppm	Rot P2O5 Bal lb/ac	P2O5 Bal Target lb/ac
N58		7605	7373	75.0	WI-Juneau	Friendship (FrB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	151	NA	NA
N59		4310	7373	75.0	WI-Juneau	Friendship (FrB)	4	200	0 - 2	0 - 300	P	no / no			2011 - 2013	5	0.2	NA	137	NA	NA
N60		4310	7373	75.0	WI-Juneau	Friendship (FrB)	4	200	0 - 2	0 - 300	P	no / no			2011 - 2013	5	0.0	NA	121	NA	NA
N61		4311	7373	100.0	WI-Juneau	Friendship (FrB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	125	NA	NA
N62		7603	7373	75.0	WI-Juneau	Friendship (FrB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	122	NA	NA
N63		7603	7373	75.0	WI-Juneau	Friendship (FrB)	4	200	0 - 2	0 - 300	P	no / no			2011 - 2013	5	0.0	NA	128	NA	NA
RDO 01E		8451	6896	67.0	WI-Wood	Plainfield (PfA)	3	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	127	NA	NA
RDO 01W		8451	6896	66.0	WI-Wood	Friendship (FrA)	2	151	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.4	NA	143	NA	NA
RDO 02N		8451	6896	54.0	WI-Wood	Plainfield (PfA)	3	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.0	NA	124	NA	NA
RDO 02S		8451	6896	54.0	WI-Wood	Plainfield (PfA)	1	200	0 - 2	301 - 1000	P	no / no	POl+cv-SCm+cv-[SB-SB]+cv	CP/NTcvr-NT/NTcvr-Fcult/Dcvr	2011 - 2013	5	0.0	0	130	-74	0
RDO 03		8449	6896	142.0	WI-Wood	Plainfield (PfA)	1	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.0	NA	115	NA	NA
RDO 04N		8450	7351	66.0	WI-Wood	Plainfield (PfA)	1	200	0 - 2	301 - 1000	P	no / no			2011 - 2012	5	0.1	NA	163	NA	NA
RDO 04S		8450	7351	67.0	WI-Wood	Plainfield (PfA)	1	200	0 - 2	301 - 1000	P	no / no			2011 - 2012	5	0.0	NA	149	NA	NA
RDO 06E		8453	6896	67.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	149	NA	NA
RDO 06W		8453	6896	66.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	144	NA	NA
RDO 07E		8453	6896	66.0	WI-Juneau	Plainfield (PfB)	3	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	149	NA	NA
RDO 07W		8453	6896	67.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	142	NA	NA
RDO 08		8453	6896	70.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	140	NA	NA
RDO 09E		8458	6896	66.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2012	5	0.2	NA	137	NA	NA
RDO 09W		8458	6896	66.0	WI-Juneau	Plainfield (PfB)	3	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	110	NA	NA
RDO 10		8458	6896	68.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	181	NA	NA
RDO 11N		8452	7351	66.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2012	5	0.1	NA	177	NA	NA
RDO 11S		8452	7351	67.0	WI-Juneau	Plainfield (PfB)	3	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	164	NA	NA
RDO 12N		8452	7373	67.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	136	NA	NA
RDO 13E		8452	7373	67.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	1543	NA	NA
RDO 13W		8452	7373	66.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	162	NA	NA
RDO 14		8459	6896	36.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	131	NA	NA
RDO 15		8459	6896	65.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	141	NA	NA
RDO 16		8460	7373	69.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.0	NA	146	NA	NA
RDO 17E		8459	6896	80.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2012	5	0.0	NA	146	NA	NA
RDO 17W		8459	6896	80.0	WI-Juneau	Plainfield (PfB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	170	NA	NA
RDO					WI-	Friendship				301 -					2011 -						

Field Name	Field Group (sub farm)	FSA Tract #	FSA Field #	Acres	County	Soil Series & Map Symbol	Field Slope (%)	Field Slope Length (ft)	Below Field Slope To Water (%)	Distance To Water (ft)	N and Field Restrictions	Contour / Filters	Rotation	Tillage	Report Period	Field "T" t/ac	Rot Avg Soil Loss t/ac	Rot Avg PI	Soil Test P ppm	Rot P2O5 Bal lb/ac	P2O5 Bal Target lb/ac
18N		8454	7373	67.0	Juneau	(FrB)	4	200	0 - 2	1000	P	no / no			2013	5	0.2	NA	117	NA	NA
RDO 18S		8454	7373	67.0	WI-Juneau	Friendship (FrB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	116	NA	NA
RDO 19E		8454	7373	67.0	WI-Juneau	Friendship (FrB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	146	NA	NA
RDO 19S		8454	7373	25.0	WI-Juneau	Friendship (FrB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2012	5	0.0	NA	83	NA	NA
RDO 19W		8454	7373	67.0	WI-Juneau	Friendship (FrB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	126	NA	NA
RDO 20		8461	6896	36.0	WI-Juneau	Friendship (FrB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	124	NA	NA
RDO 21N		8455	6896	67.0	WI-Juneau	Friendship (FrB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.1	NA	134	NA	NA
RDO 21S		8455	6896	66.0	WI-Juneau	Friendship (FrB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	130	NA	NA
RDO 22		8456	6896	133.0	WI-Juneau	Friendship (FrB)	4	200	0 - 2	301 - 1000	P	no / no			2011 - 2013	5	0.2	NA	137	NA	NA

Crop Abbreviations

Abbreviation	Crop
[F-Cg]	Alfalfa (1st cut) to Corn grain
[F-Csl]	Alfalfa (1st cut) to Corn silage
[PE-Fs]	Peas to Late-Direct Seeded Legume Forage
[PE-SB]	Peas to Snapbean
[PE-SB]+cvr	Peas to Snapbean to small grain cover
[SB-Fs]	Snap beans to Late-Direct Seeded Legume Forage
[SB-SB]	Snapbean to Snapbean
[SB-SB]+cv	Snapbean to Snapbean to small grain cover
[SC-Fs]	Sweet corn to Late Summer Direct Seeded Legume Forage
A	Alfalfa
Cg	Corn grain
Csl+cv	Corn silage to small grain cover crop
POe+cv	Potatoes, early harvest, to small grain cover crop
POl+cv	Potatoes, late harvest, to small grain cover crop
SBe30	Snap Beans early plant, 30 inch row
SBe30+cv	Snap Beans early plant to small grain cover crop
SBl30+cv	Snap Beans late plant to small grain cover crop
SCe+cv	Sweet Corn early plant (before May 20) with small grain cover crop
SCl+cv	Sweet Corn late plant (June10 or Later) with small grain cover crop
SCm	Sweet Corn middle plant (May 20 - June 10)
SCm+cv	Sweet Corn middle plant (May 20 - June 10) with small grain cover crop

Tillage Abbreviations

Abbreviation	Tillage
CP/Dcvr	Chisel Plow, cover crop disked
CP/NTcvr	Chisel Plow, cover crop no till
FCD/NTcvr	Fall Chisel, disked , cover crop no till
Fcult/Dcvr	Field Cultivation, cover crop disked
Fcult/NTcvr	Field Cultivation, cover crop no till
None	None
NT	No Till
NT/Dcvr	No Till, cover crop disked
NT/NTcvr	No Till, cover crop no till
SCD	Spring Chisel, disked
SCD/NTcvr	Spring Chisel, disked, cover crop no till
SFC	Spring Cultivation
SFC/NTcvr	Spring Cultivation, cover crop no till

Restriction Legend

Code	Description of Code
P	High permeability N restricted soils
R	N restricted soils with less than 20 inches to bedrock
W	N restricted soils with less than 12 inches to apparent water table
+	This map unit may have any of the N restrictive features, however an on-site investigation is needed to identify which restrictions may actually be present.
S	Field in SWQMA.
D	Drinking water well within 50 feet of field.
C	Conduit to groundwater within 200 feet upslope of field.
L	Local winter spreading restriction.

ATTACHMENT 14

1) N15883 Cty Rd. G, Town of Armenia: - HOFFMAN SAMPLE #1
   Hardness-Total--216 mg/lCaCo3
   Alkalinity--8 mg/lCaCo3
   Conductivity --531 umhos/cm
   pH--6.31 std. units
   Saturation Index---2.8 Corrosive
   Nitrogen-Nitrate/Nitrite--35.9 mg/lN
   Chloride--44.8 mg/l

2) N15761 23rd Ave. N. Nekoosa
   Hardness-Total--220 mg/lCaCo3
   Alkalinity--28 mg/lCaCo3
   Conductivity-- 501 umhos/cm
   pH--7.23 std. units
   Saturation Index-- -1.3 Corrosivity Moderate
   Nitrogen-Nitrate/Nitrite 30.7 mg/lN
   Chloride--36.6 mg/l

3)

AgSource Laboratories

A Subsidiary of Cooperative Resources International

1001 Frontage Road * Stratford WI 54484

WATER TEST REPORT

WISCONSIN DATCP CERTIFICATION # 424

REPORT DATE....... 8/15/2012

SAMPLE #: 4197 – Spud Creek along manure spread field (19TH and 4th street); no inflow or outflow from creek

SAMPLE DESCRIPTION:
NITRATE DESCRIPTION:
SAMPLED: SET UP: 8/ 3/2012

ADDITIONAL TEST: MEMBRANE FLTRTN ECOI 376 cfu/100mL UNSAFE
NITRATE-N 18.60 mg/L (UNSAFE - WIS. STANDARD)

4)

AgSource Laboratories

A Subsidiary of Cooperative Resources International

1001 Frontage Road * Stratford WI 54484

WATER TEST REPORT

WISCONSIN DATCP CERTIFICATION # 424

Nick Karris 771
415 N LaSalle
Chicago , IL,60654

REPORT DATE....... 8/31/2012

SAMPLE #: 4560

WELL ADDRESS: church Armania- sample #12068 N15296 19th ave (and 5th ave)

SAMPLE DESCRIPTION: garden hose
NITRATE DESCRIPTION:
SAMPLED: 8/26/2012 SET UP: 8/28/2012(2:30PM)

COLIFORM TEST	18-22 HRS	DATE	INTERPRETATION
	POSITIVE	8/29/2012	UNSAFE (>=1/100 mls)

ADDITIONAL TEST: TOTAL PHOSPHOROUS 0.09 mg/L
ADDITIONAL TEST: TOTAL COLIFORM 0.09 total cfu/100mL
ADDITIONAL TEST: MEMBRANE FLTRTN ECOI 1 E.coli cfu/100mL SAFE
NITRATE-N < 0.50 mg/L (SAFE - WIS. STANDARD)

5)

AgSource Laboratories
A Subsidiary of Cooperative Resources International
1001 Frontage Road * Stratford WI 54484

WATER TEST REPORT

WISCONSIN DATCP CERTIFICATION # 424

REPORT DATE....... 8/16/2012
(REPRINTED ON.... 8/22/2012)

SAMPLE #: 4198

SAMPLE DESCRIPTION: Pivot well sample north of dairy south of 3rd Street (not spreading manure at time of sample)
Central Sands 2
NITRATE DESCRIPTION:
SAMPLED: SET UP: 8/15/2012

ADDITIONAL TEST: ORTHOPHOSPHATE 0.06 mg/L
ADDITIONAL TEST: E.COLI 6000 cfu/mL
Alkalinity Total 46.00 mg/L
NITRATE-N < 0.50 mg/L (SAFE - WIS. STANDARD)
pH 6.01

			IDEAL RANGES FOR DRINKING WATER
CALCIUM		15.56 ppm	0 - 50 ppm
MAGNESIUM		4.73 ppm	0 - 30 ppm
IRON		1.050 ppm	0 - .30 ppm
SODIUM		3.03 ppm	0 - 30 ppm
MANGANESE	<	0.050 ppm	0 - .05 ppm
SULFATES	<	0.71 ppm	0 - 75 ppm
POTASSIUM		1.31 ppm	0 - 50 ppm
CHLORIDE		1.10 ppm	0 - 10 ppm
CONDUCTIVITY		128.80 mohms/cm	
BORON	<	0.100 ppm	
WATER HARDNESS		58.33 (VERY SOFT WATER)	
		3.43 (Grains Per Gallon)	

6)

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A Subsidiary of Cooperative Resources International

1001 Frontage Road * Stratford WI 54484

WATER TEST REPORT

WISCONSIN DATCP CERTIFICATION # 424

Nick Karris
415 N LaSalle
Chicago , IL,60654

771

REPORT DATE....... 8/31/2012

SAMPLE #: 4561

WELL ADDRESS: Bob Owens house Armania - Hwy G to east of Dairy
sample #12068

SAMPLE DESCRIPTION: hose
NITRATE DESCRIPTION:
SAMPLED: 8/26/2012 SET UP: 8/28/2012(2:30PM)

COLIFORM TEST	18-22 HRS	DATE	INTERPRETATION
	NEGATIVE	8/29/2012	SAFE (<1/100 mls)

ADDITIONAL TEST: TOTAL PHOSPHOROUS 0.07 mg/L
ADDITIONAL TEST: TOTAL COLIFORM 0.07 total cfu/100mL
ADDITIONAL TEST: MEMBRANE FLTRTN ECOI 1 E.coli cfu/100mL SAFE
NITRATE-N 23.90 mg/L (UNSAFE - WIS. STANDARD)

7)

WATER TEST REPORT

WISCONSIN DATCP CERTIFICATION # 424

Nick Karris 771
415 N LaSalle
Chicago , IL,60654

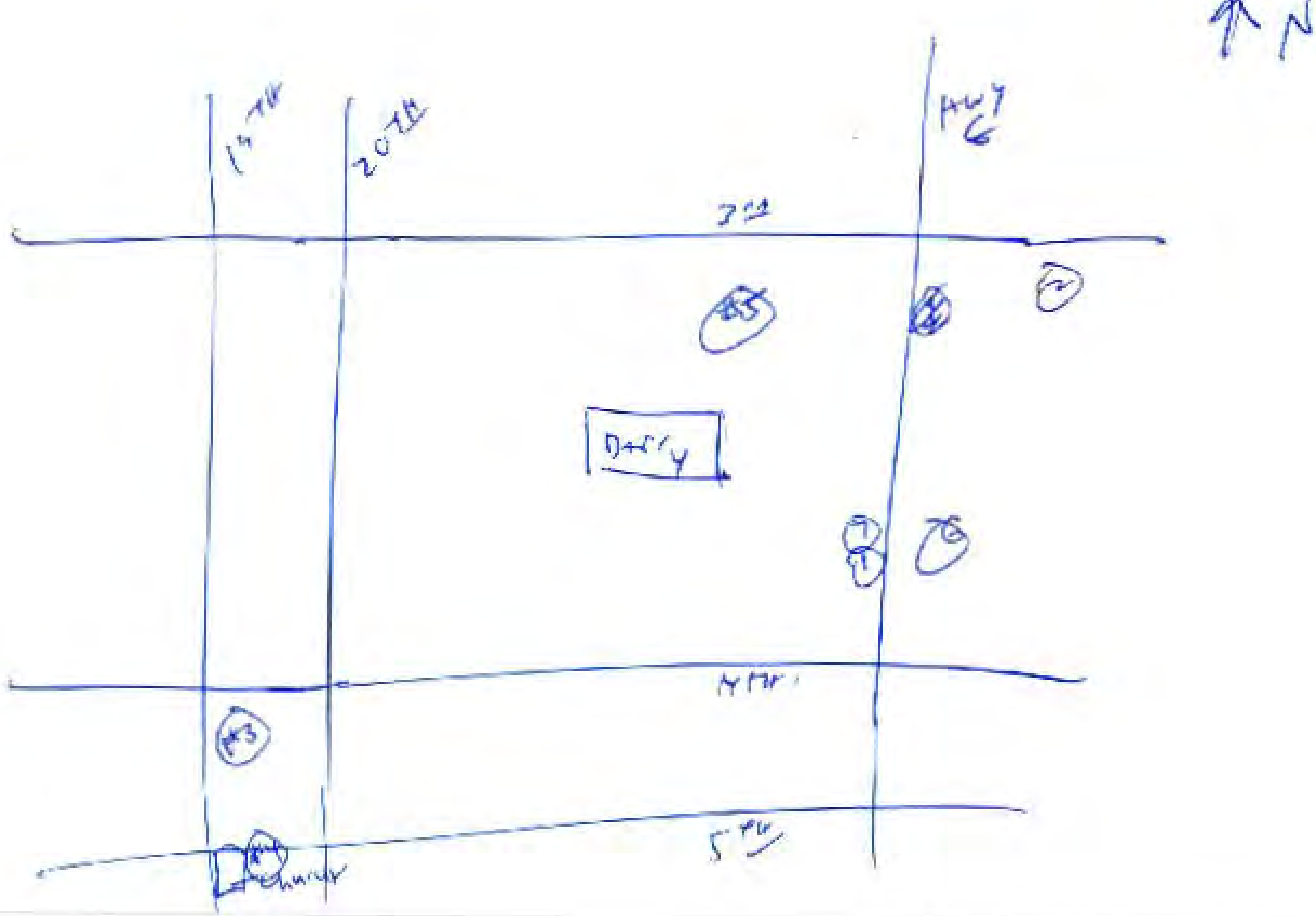
REPORT DATE....... 8/31/2012

SAMPLE #: 4606

WELL ADDRESS: town of Armania, Hoffman House (Hwy G east of dairy)

SAMPLE DESCRIPTION: 833G
NITRATE DESCRIPTION:
SAMPLED: 8/26/2012 SET UP: 8/30/2012

ADDITIONAL TEST: MEMBRANE FLTRTN ECOI 1 cfu/100mL
NITRATE-N 37.80 mg/L (UNSAFE - WIS. STANDARD)


N
19th
20th
Hwy 6
Dairy
5th


NORTHWEST PART
ARMENIA
T.20N.-R.4E.
HARDWOOD
AIR-TO-GROUND
GUNNERY AND
BOMBING RANGE

Byron Shaw
Soil and Water Consulting LLC

9250 Shaw Drive
Amherst Junction WI
WI 54407
bmshaw@wi-net.com

September 21, 2012

Russ Anderson
Wisconsin Department of Natural Resources
3911 Fish Hatchery Road
Fitchburg, WI 53711

Dear Mr. Anderson:

The following are my comments and suggestions relative to the EIS for the proposed Golden Sands Dairy in the Town of Saratoga.

I am an emeritus professor of water resources from UW Stevens Point and have spent over 40 years teaching, conducting research, directing an environmental analysis program and acting as a state wide water quality specialist for UW Extension. Since retiring in 2000, I have done part time consulting on a wide range of soil and water resource projects throughout the U.S. A number of these projects have involved evaluating environmental impacts of CAFO's. An abbreviated CV is attached.

I have reviewed the WPDES permit application and Draft Nutrient Management Plan for the proposed Golden Sands Dairy and some groundwater and surface water monitoring information from the Central Sands Dairy area, attached. I have also reviewed some DNR email correspondence relative to the Central Sands Dairy operated by the same entity proposing the Golden Sands Dairy.

The water quality adjacent to and down gradient from the Central Sands Dairy is particularly troubling and suggests that both the existing lagoon and land spreading activities are causing serious water quality problems. These include both high nitrate in groundwater and surface water as well as the presence of ecoli in Spud Creek adjacent to a field receiving manure. Ecoli of 376 cfu/100ml and Nitrate-N concentration of 18.6 are very high values for surface water. Private well samples showing 36.6 and 44.8 mg/l nitrate nitrogen are exceptionally high even for the central sands region of Wisconsin. There are also elevated concentrations of ammonia down gradient of the manure lagoon indicating there is probable leakage of the cement lined lagoon. This permitted Operation is obviously not being monitored effectively and regardless of whether it is following NRCS 590, lagoon construction and DNR 243 guidelines, it is causing serious water quality problems.

DNR should look very closely into the issues at this existing dairy while conducting the investigation for the EIS for the proposed Golden Sands Dairy. Solutions to existing problems should be implemented and incorporated into any new project to prevent similar problems from occurring at other facilities, especially the proposed Golden Sands Dairy to be located on similar soils and operated by the same owners.

In addition to water quality problems there have also been a number of complaints by local homeowners relative to manure spraying onto their property and high nitrates in their groundwater. I reviewed groundwater test results from a study conducted in 1985 by UW Extension in the town of Armenia and surrounding areas and found nitrate levels to be much lower than are currently present in both private and monitoring wells down gradient of the Central Sands Dairy. The highest nitrate found in that study was 20mg/l and many samples were less than 0.2 mg/l.

DNR has authority under NR 214 and NR 243 to require groundwater monitoring but seldom does so for CAFOs. The lack of adequate monitoring of groundwater and surface water down gradient of lagoons and fields receiving waste from CAFOs is a major problem in assessing whether these facilities are being operated in a way to protect water resources and whether NRCS 590 or NR 243 adequately protect water quality. The scale of these operations, handling waste in excess of what a city of 250,000 people would produce, without any monitoring is extremely negligent by a state agency charged with protecting Wisconsin's water resources.. The state of New Mexico has initiated a mandatory monitoring program of groundwater for all CAFOs, with many showing serious groundwater problems. I suspect the same would be found in WI. With the proliferation of CAFOs in Wisconsin generally and the Central Sands in particular, the DNR should follow suit for both the production site and application fields.

Reviewing the Nutrient management plan submitted by Golden Sands Dairy indicates they will not be doing anything better than following NRCS 590 and NR 243, even to the point of requesting variances to allow winter spreading restrictions and stating they will be using yield goals that exceed documented crop yields by 15 percent. This is not good for water quality.

Discharge to streams, wetlands and eventually the 303d listed Petenwell flowage are all serious potential impacts that need evaluating, in addition to well-documented human health impacts from injesting high nitrates through contaminated well water. The Listed status of the Petenwell Flowage requires that DNR prevent any nutrient additions to that body of water. This is obviously not happening with the Central Sands Dairy and not likely to happen with the proposed Golden Sands Dairy. Soil test data for the Central sands disposal fields show many to be in excess of 200 ppm phosphorus, far above even the liberal limits of the NRCS 590 standard. DNR has apparently not put enough or any restrictions on additional spreading on these fields. Runoff, wind erosion and even groundwater from fields this overloaded with phosphorus pose serious problems to downstream water resources.

The initial soil test phosphorus data for the proposed dairy will, I am sure, be fairly low as are the nitrate concentrations in groundwater down gradient of the forests currently on the proposed dairy property. Once used for intensive agricultural purposes and manure disposal, both of these conditions will dramatically change. This will impact downstream users of groundwater and downstream water resources. My client in this case operates an organic cranberry farm immediately down gradient of the proposed Golden Sands Dairy. His groundwater/spring water used for his operation is currently very low in nitrate and pesticides. If this changes there is a high probability his crop will be affected and he could lose his organic certification. The cranberry industry is convinced that high nitrates in groundwater, used for spring frost protection, stimulates bud break and makes the crop very susceptible to further frost damage.

In view of all these consideration, I request that DNR take into consideration the following in performing an adequate EIS for this proposed operation:

1. Potential impact to the Organic Cranberry operation from likely groundwater and surface water contamination. Aerial drift of pesticides and bacteria from spray irrigation should also be evaluated.

2. As there is a high probability of impact to private well water quality and quantity, the DNR should evaluate requiring that all down gradient private well should be sampled monthly for a year for nitrates, coliform and ecoli bacteria and pesticide residues by an independent party at the dairy's expense. A thorough evaluation of wells down gradient of the Central Sands Dairy prior to any land alterations should be included in this analysis.

3. Potential impact to the Petenwell Flowage and Lake Camelot including nutrient additions from groundwater flow as well as from streams draining the proposed project area. The very high soil phosphorus levels present at Central Sands Dairy would indicate groundwater should be monitored for phosphorus as well as nitrogen.

4. The DNR should consider developing a surface and groundwater monitoring program for the project if approved to document the impact if any to the area water quality and quantity issues. This monitoring should include groundwater within 2 miles downgradient of the production site and application fields and all streams and lakes that may receive groundwater or surface water originating from the site or application fields.

5. The DNR should evaluate the projected impacts to groundwater and nutrient loading to surface water in the Petenwell watershed even if the dairy observes NRCS 590 and DNR 243,

6. There are other impacts that should be included in an EIS including, green house gas emissions from; methane, carbon dioxide and nitrogen oxides; air quality and associated health effects on humans and wildlife from manure and pesticide spraying; impact on tourism and quality of life for local residents; impact of local water quantity and local groundwater supplies.

7. The DNR should consider whether practices such as winter spreading in a watershed draining to an impaired water body should be allowed at all. Even Fall spreading is likely to cause groundwater problems on these highly leachable soils. Nitrification and leaching can occur either in fall or early spring before crop growth can use the applied nitrogen.

8. The DNR should consider prohibiting nutrient additions to target yield goals set above average crop yields. If anything yield goals and fertilizer application rates should be reduced on these vulnerable soils in an attempt to achieve water quality standards. Monitoring results from the area near Central Sands Dairy suggest fertilizing to the existing yield goals results in serious groundwater and surface water pollution.

9. In conducting the EIS, DNR should consider water quality impacts to local streams and lakes as well as downstream impacts. This entire area eventually drains to the Gulf of Mexico which has severe water quality problems linked to nitrate from upstream sources. Nitrate values in excess of 30 mg/l in groundwater and 18 mg/l in Spud Creek indicate a serious nitrate problem west of the WI River already exists from similar intensive agricultural activities.

10 DNR should review potential groundwater contamination from microbes and pharmaceutical products used in the dairy industry. There is potential for bacteria, viruses, antibiotics and hormones to reach groundwater and surface water. Facilities need to be designed to eliminate this possibility. Monitoring the existing Central Sands Dairy could provide valuable information on these threats.

Byron H Shaw PhD

Emeritus Prof Water Resource
Professonal Soil Scientist #104-112
Professional Hydrologist 162-111

Byron Shaw past 10 year Vita: September 2012
Education

BS 1964 Soil Science, University of Wisconsin, Madison
MS 1966 Soil Science, University of Wisconsin, Madison
PhD 1968 Soil Science major, Water Chemistry minor; University of Wisconsin, Madison

Experience
Soil and Water Consultant 2000-present
Wisconsin Licensed Professional Soil Scientist No: 104-112. 2000 to present
Wisconsin Licensed Professional Hydrologist No: 162-111. 2000 to present
Emeritus Professor Water Resources UW Stevens Point, College of Natural Resources 2001
Professor of Soil and Water Science, UW-Stevens Point, College of Natural Resources, 1978-Present (Associate Professor 1973-78, Assistant Professor 1968-73)
Discipline Coordinator, Water Resources, UW-Stevens Point, College of Natural Resources, 1983-86
Water Resource Specialist, UW-Extension, 1977-2000 41%
Director, Environmental Task Force Program, UW-Stevens Point, College of Natural Resources, 1973-2000 34%
Major Professor to over 50 MS Graduate students. 1971-2000

Courses Taught (last 5 years at UWSP)

Water 492/692 - Advanced Techniques of Environmental Analysis
Water 350 - Current Issues in Water Resources
Water 475/675 - Groundwater Management
Water 381 - Internship - Supervise about 40 interns/semester in ETF Lab
Water 499 - Special Studies
Water 799 - Thesis, advise four-six graduate students/semester
Water 385/585 - Techniques in Hydrogeology
NR 475 - International Environmental Studies

Publications: Past 10 years.
Russelle,M.P., J.F.S.Lamb, M.B.Turyk, B.H.Shaw and B. Peterson. 2007. Managing Nitrogen Contaminated Soils:Benefits of N2-Fixing Alfalfa. Agron. J. 99:738-746
Nichols S. A. and Byron Shaw. 2002. The influence of Groundwater Flow on the Distribution and Abundance of Aquatic Plants in some Wisconsin Lakes.
Journal of Freshwater Ecology, 17:2 pp283-295
B.Shaw, C. Sparacio, J. Stelzer. 2001. Assessment of Shallow Groundwater Flow and Chemistry and Interstitial Water, Sediment, Aquatic Macrophyte Chemistry for Tri Lakes, Adams County Wisconsin. Final Report to WDNR. 76pp.
Turyk, N. and B.H. Shaw. 2000. Nutrient and Water Budget Modeling of the Petenwell Flowage, Adams, Juneau, and Wood Counties Wisconsin. UW-Stevens Point, WI. pp. 69.
Hudson, M. and B.H. Shaw, 2000. An Evaluation of Past and Present Water Quality Conditions in Rinehart Lake, Portage County, WI. UW-Stevens Point, WI. pp. 83
Cook, R. and B.H. Shaw, 2000. Relationships Between Private Well Water, Stream Base Flow Water and Land Use in the Tomorrow-Waupaca River Watershed. UW-Stevens Point, WI. pp.116

Presentations.
Keynote presentation to Wisconsin Association of Land Conservation Employees annual meeting 2007.
Title: Do Current Laws and Policies Protect Wisconsin's Water Resources

Committies and boards past 10 years

-Wisconsin Department of Natural Resources Phosphorus Standards Advisory Committee. 2008-2010
-Member Board of Directors; River Alliance of Wisconsin 2002 to 2010
-interagency committee on revising NRCS 590 Nutrient Management standard 2000-2001
-Wisconsin Dept of Natural Resources Phosphorus standard technical committee 1997-2002
-Technical advisory committee to Village of Plover on aquifer protection 2001

Consulting activities past 10 years

Consulting Activities

Big Bass Lake Association. 2000-2001. Prepare lake management plan.
USEPA. 2001Testify on Nutrient Management guidance
Midwest Environmental Advocates. 2001 Evaluate proposed EPA Nutrient Management Guidance Documents.2001
Opitz Farms. 2001 and 2003 Made recommendations for a potential groundwater monitoring network for a large heifer grazing operation.
Citizens for Clean Water around Badger.2001. Evaluate sediment sampling results and identify hazardous related to dredging sediments with varying levels of heavy metals
2007 Evaluate nutrient management plan for dairy forage research center
Boardman Law Firm and City of Chippewa Falls. 2002 Evaluate sources of contamination to city well fields. Gave testimony via deposition. City received significant financial compensation.
Lake Sinissippi Improvement District.2003 Evaluate proposed watershed monitoring plan and review cadmium levels in sediment .
Midwest Environmental Advocates. 2003 Evaluate potential environmental impacts from a proposed Beef feed lot in Manitowoc County. Testified at county hearing. Permit was denied.
Midwest Environmental Advocates and Centerville Cares.2003-2004 Evaluate Manure management plan and land application records for a large Dairy. Identify environmental hazards and make recommendations. Judge found in favor of petitioners
Midwest Environmental Advocates. 2004-2005 Evaluate data relative to a groundwater pollution case in Kewaunee County and render opinion on source of contamination. Polluters required to pay impacted homeowners.
Lawyers for Clean Water. 2005-2006 Evaluate water quality impacts and solutions for a Polo field and Horse stalls in California. Out of court settlement resulted in significant BMP implementation.
Town of Magnolia, Rock Co Wisconsin. 2005-2006 Review Manure management plan for Larson Farms and identify any Environmental hazards that may exist.
Univ of WI Center for Watershed Studies. 2004-2006 Review draft documents and help direct research project of Portage County Lakes
Lawyers for Clean water 2008-2009 Evaluate environmental impacts of existing and proposed developments in Malibu CA.
Crawford county Advocates. 2008-2009 Evaluate potential environmental impacts of a proposed Hog CAFO in southern WI.
Centervill Cares environmental group. 2008 evaluate nutrient management plan of a large CAFO for environmental compliance
Lawyers for Clean water 2008-2009 Evaluate potential groundwater impacts from a wastewater Lagoon in Colfax CA

Racine Co WI private citizen 2008-2009 Evaluate potential environmental impacts of a proposed Dairy CAFO
Town of Magnolia 2007-2010 review Nutrient Management Plan and Evaluate environmental impacts from a large Dairy operation. Testify at several Town Board hearings
Town of Little Black, Taylor Co WI 2009-2010 Review and comment on environmental adequacy of nutrient management plan for a proposed 5000 plus head dairy operation.
Law Offices of Charles Tebbutt. 2009-2012 Review groundwater data and propose groundwater monitoring program for Faria Dairy CAFO in central WA. CARE (community association for restoration of the environment)

Monterey Coast keeper, 2010 Review and comment on nutrient management plan for Gallo Farms, Monterey CA

Depositions and trials:
Boardman Law Firm and City of Chippewa Falls. 2002 Evaluate sources of contamination to city well fields. Gave testimony via deposition. City received significant financial compensation.

Midwest Environmental Advocates. 2004 Evaluate nutrient management plan and operation of a large heifer feedlot operation in Jackson County and identify environmental hazards. Testified via deposition out of court settlement.

Community Association for restoration of the Environment vs Faria Dairy 2011 deposition and Federal District Court Trial. Testified on nutrient contributions to groundwater, groundwater monitoring. Judge ruled in favor of CARE.

Awards

Invited to give Keynote presentation to Wisconsin Association of Land Conservation Employees. Feb 2007.

Wisconsin Clean Water Achievement Award. WI Dept. of Natural Resources 2002

First Distinguished Service Award from Wisconsin Chapter American Water Resources Association 2000

Awarded Emeritus Professor of Water Resources by UW Stevens Point 2001

University of Wisconsin Stevens Point Distinguished Service Award 2000

1) N15883 Cty Rd. G, Town of Armenia: - HOFFMAN SAMPLE #1
   Hardness-Total--216 mg/lCaCo3
   Alkalinity--8 mg/lCaCo3
   Conductivity --531 umhos/cm
   pH--6.31 std. units
   Saturation Index---2.8 Corrosive
   Nitrogen-Nitrate/Nitrite--35.9 mg/lN
   Chloride--44.8 mg/l

2) N15761 23rd Ave. N. Nekoosa
   Hardness-Total--220 mg/lCaCo3
   Alkalinity--28 mg/lCaCo3
   Conductivity-- 501 umhos/cm
   pH--7.23 std. units
   Saturation Index-- -1.3 Corrosivity Moderate
   Nitrogen-Nitrate/Nitrite 30.7 mg/lN
   Chloride--36.6 mg/l

3)

AgSource Laboratories

A Subsidiary of Cooperative Resources International

1001 Frontage Road * Stratford WI 54484

WATER TEST REPORT

WISCONSIN DATCP CERTIFICATION # 424

REPORT DATE....... 8/15/2012

SAMPLE #: 4197 – Spud Creek along manure spread field (19TH and 4th street); no inflow or outflow from creek

SAMPLE DESCRIPTION:
NITRATE DESCRIPTION:
SAMPLED: SET UP: 8/ 3/2012

ADDITIONAL TEST: MEMBRANE FLTRTN ECOI 376 cfu/100mL UNSAFE
NITRATE-N 18.60 mg/L (UNSAFE - WIS. STANDARD)

4)

AgSource Laboratories

A Subsidiary of Cooperative Resources International

1001 Frontage Road * Stratford WI 54484

WATER TEST REPORT

WISCONSIN DATCP CERTIFICATION # 424

Nick Karris   771
415 N LaSalle
Chicago , IL,60654

REPORT DATE....... 8/31/2012

SAMPLE #: 4560

WELL ADDRESS: church Armania- sample #12068   N15296 19th ave (and 5th ave)

SAMPLE DESCRIPTION: garden hose
NITRATE DESCRIPTION:
SAMPLED: 8/26/2012   SET UP: 8/28/2012(2:30PM)

COLIFORM TEST	18-22 HRS	DATE	INTERPRETATION
	POSITIVE	8/29/2012	UNSAFE (>=1/100 mls)

ADDITIONAL TEST: TOTAL PHOSPHOROUS   0.09 mg/L
ADDITIONAL TEST: TOTAL COLIFORM   0.09 total cfu/100mL
ADDITIONAL TEST: MEMBRANE FLTRTN ECOI   1 E.coli cfu/100mL SAFE
NITRATE-N   < 0.50 mg/L (SAFE - WIS. STANDARD)

5)

AgSource Laboratories
A Subsidiary of Cooperative Resources International
1001 Frontage Road * Stratford WI 54484

WATER TEST REPORT

WISCONSIN DATCP CERTIFICATION # 424

REPORT DATE....... 8/16/2012
(REPRINTED ON.... 8/22/2012)

SAMPLE #: 4198

SAMPLE DESCRIPTION: Pivot well sample north of dairy south of 3rd Street (not spreading manure at time of sample)
Central Sands 2
NITRATE DESCRIPTION:
SAMPLED: SET UP: 8/15/2012

ADDITIONAL TEST: ORTHOPHOSPHATE		0.06 mg/L
ADDITIONAL TEST: E.COLI		6000 cfu/mL
Alkalinity Total		46.00 mg/L
NITRATE-N	<	0.50 mg/L (SAFE - WIS. STANDARD)
pH		6.01

			IDEAL RANGES FOR DRINKING WATER
CALCIUM		15.56 ppm	0 - 50 ppm
MAGNESIUM		4.73 ppm	0 - 30 ppm
IRON		1.050 ppm	0 - .30 ppm
SODIUM		3.03 ppm	0 - 30 ppm
MANGANESE	<	0.050 ppm	0 - .05 ppm
SULFATES	<	0.71 ppm	0 - 75 ppm
POTASSIUM		1.31 ppm	0 - 50 ppm
CHLORIDE		1.10 ppm	0 - 10 ppm
CONDUCTIVITY		128.80 mohms/cm	
BORON	<	0.100 ppm	
WATER HARDNESS		58.33 (VERY SOFT WATER)	
		3.43 (Grains Per Gallon)	

6)

AgSource Laboratories
A Subsidiary of Cooperative Resources International
1001 Frontage Road * Stratford WI 54484

WATER TEST REPORT

WISCONSIN DATCP CERTIFICATION # 424

Nick Karris   771
415 N LaSalle
Chicago   , IL,60654

REPORT DATE....... 8/31/2012

SAMPLE #: 4561

WELL ADDRESS: Bob Owens house Armania - Hwy G to east of Dairy
sample #12068

SAMPLE DESCRIPTION: hose
NITRATE DESCRIPTION:
SAMPLED: 8/26/2012 SET UP: 8/28/2012(2:30PM)

COLIFORM TEST	18-22 HRS	DATE	INTERPRETATION
	NEGATIVE	8/29/2012	SAFE (<1/100 mls)

ADDITIONAL TEST: TOTAL PHOSPHOROUS 0.07 mg/L
ADDITIONAL TEST: TOTAL COLIFORM 0.07 total cfu/100mL
ADDITIONAL TEST: MEMBRANE FLTRTN ECOI 1 E.coli cfu/100mL SAFE
NITRATE-N 23.90 mg/L (UNSAFE - WIS. STANDARD)

7)

AgSource Laboratories

A Subsidiary of Cooperative Resources International

WATER TEST REPORT

WISCONSIN DATCP CERTIFICATION # 424

Nick Karris   771
415 N LaSalle
Chicago   , IL,60654

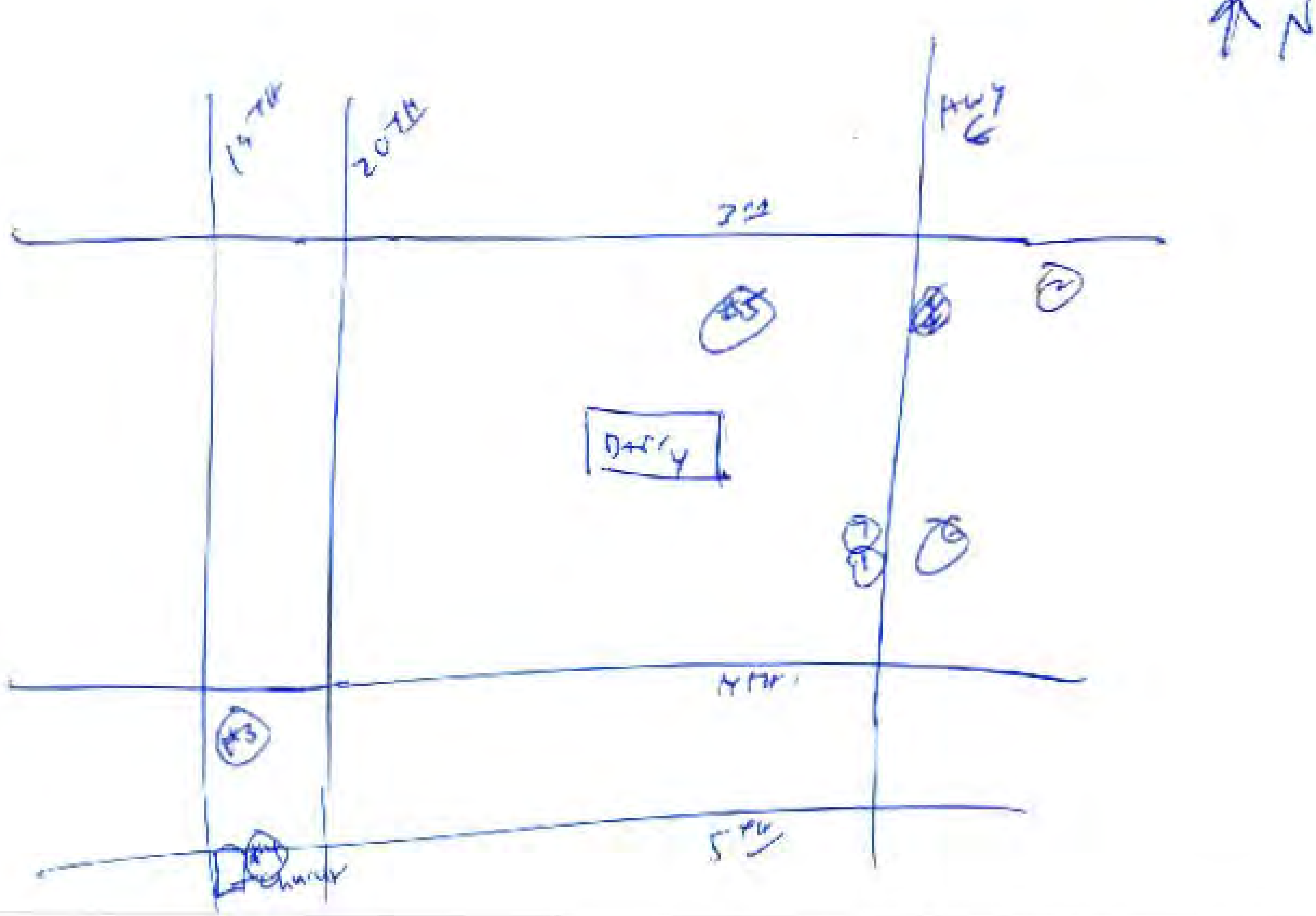
REPORT DATE....... 8/31/2012

SAMPLE #:   4606

WELL ADDRESS: town of Armania, Hoffman House (Hwy G east of dairy)

SAMPLE DESCRIPTION: 833G
NITRATE DESCRIPTION:
SAMPLED: 8/26/2012   SET UP: 8/30/2012

ADDITIONAL TEST: MEMBRANE FLTRTN ECOI   1 cfu/100mL
NITRATE-N   37.80 mg/L (UNSAFE - WIS. STANDARD)


N
Hwy 6
Dairy


NORTHWEST PART
ARMENIA
T.20N.-R.4E.
HARDWOOD
AIR-TO-GROUND
GUNNERY AND
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September 21, 2012

Wisconsin Department of Natural Resources
Attn: Mr. Russ Anderson
3911 Fish Hatchery Road
Fitchburg, WI 53711

Re: Comments on Environmental Impact Statement Scope
Golden Sands Dairy CAFO, Town of Saratoga, Wood County, WI
MARS Project Number: 1561

VIA: EMAIL

Dear Mr. Anderson:

On behalf of Karris Family Farms, Montgomery Associates Resource Solutions (MARS) is pleased to provide comments on scope development for the Environmental Impact Statement (EIS) the Wisconsin Department of Natural Resources (DNR) will be preparing for the proposed Golden Sand Dairy (GSD) Concentrated Animal Feeding Operation (CAFO). Our comments focus primarily on water quality and water quantity concerns.

Karris Family Farms operates several cranberry marshes in the vicinity of the proposed GSD and their associated croplands. Based on available information about the proposed GSD operation, observations from another CAFO operated by the applicant (Central Sands Dairy), and observed trends in water quality and availability, there is substantial evidence that the GSD would create adverse impacts to Karris Family Farms marshes, as well as residents and others located in the vicinity of the GSD operation. Given the range of potential surface water and groundwater impacts from the CAFO, cranberry operations both upgradient and downgradient on a hydrologic or hydrogeologic basis could be affected.

This letter is intended to provide perspective on the unique impacts to cranberry operations the GSD CAFO may cause. We have described the potential impacts and rationale in the subsequent sections. We request the DNR to address these concerns in the EIS.

Hydrologic Setting

The environmental setting in the vicinity of the GSD is well documented. The Wisconsin Central Sands region is dominated by granular soils, exhibiting high permeability and hydraulic conductivity. Focusing closer on the proposed CAFO project area, the soils are a loamy sand and the water table is generally 10-20 feet below ground surface. Groundwater flow is westerly, with an approximate gradient of 0.0013 ft/ft east of STH 13 and an approximate gradient of 0.0033 ft/ft west of STH 13 (Lippelt & Hennings, 1981). Regional surficial drainage is also westerly, to the Wisconsin River/Petenwell Flowage via Sevenmile Creek, Tenmile Creek and Fourteen Mile Creek. When surface water bodies are present, they are generally expressions of the water table. Impoundments, such as cranberry reservoirs, or Lakes Camelot/Arrowhead/Sherwood, can provide groundwater recharge, or be locations of groundwater discharge, depending on the seasonality and groundwater conditions.

VALUE OF CRANBERRY OPERATIONS IN THE VICINITY OF GSD

Currently, there are about 200 active cranberry marshes in the state of Wisconsin. The cranberry growing industry in Wisconsin is significant from historical, cultural and economic perspectives. Cranberries are the number one fruit crop of the state and Wisconsin produces more cranberries than any other state in the country. Cranberries contribute nearly $300 million annually to the state's economy and support approximately 3,400 jobs.

Local to the proposed GSD, 14 individual cranberry operations, growing over 1,300 acres of cranberries, are located within five miles of the CAFO and associated fields planned for irrigation and landspreading of dairy manure. Cranberry operations within the vicinity of the GSD are shown on *Figure A* attached. Further analyzing cranberry operations relative to the GSD operations using GIS, *Table 1* shows cranberry bed-acres and respective distance from the proposed CAFO and GSD landspreading/irrigation activities.

Table 1: Cranberry Acreage within Vicinity of GSD

Distance (mi.)	Cranberry Acreage (ac.)
0-1	213
1-2	197
2-3	244
3-4	351
4-5	336
Total	1,341

The approximately 1,300 acres of beds in the vicinity of the CAFO operation produce annual gross revenue of approximately $15 million (based on 2011 data). Therefore, local cranberry production is a reflection of the statewide importance of this industry.

There is the potential for negative impacts to cranberry operations should the proposed GSD be developed. In addition to the value of the crop, the direct costs should a cranberry bed be destroyed due to lack of water or water quality impacts are quite substantial. This is because, unlike conventional row crops, cranberries are a perennial crop that require from 3 to 5 years to mature and become fully established to bear fruit. In other parts of the state, there are some cranberry beds that have been farmed continuously for over 100 years. In the vicinity of the GSD CAFO, most cranberry acreage has been developed over the past 30 years. Since cranberries are a perennial crop, one "bad" year that decimates the plants can set a marsh back up to 5 years and depending on their financial situation, may put them out of business entirely. For the purposes of identifying the significance of potential economic impacts, *Table 2* identifies several cranberry crop failure scenarios and the resulting economic losses for the 1,300 acres of cranberries within the GSD vicinity.

Table 2: Economic Losses from Cranberry Crop Failure

Damage from Inability to Provide:	Irrigation	Frost Protection	Harvest	Winter Icing
Crop Loss	30%	50%	70%	90%
Estimated Losses	$ 4,504,950	$ 7,508,250	$ 10,511,550	$ 13,514,850

A worst-case scenario would be a catastrophic event, such as a drought exacerbated by a lowered water table through irrigation pumping, creating reduced water availability and resulting in the death of the cranberry plants. *Table 3* shows the cost for reestablishing the beds and the resulting loss in revenue for cranberry growers.

Table 3: Cost of Cranberry Plant Death

Vine cost/acre	$ 5,000
Installation cost/acre	$ 5,000
Total cost/acre:	$ 10,000
Total replanting cost for 1,300 acres	$ 13,000,000
Annual lost revenue x 4 yrs	$ 60,066,000
Total cost	$ 73,066,000

This data is provided to illustrate the value of the crop and the very high costs of replanting cranberry beds if water quantity or water quality impacts are severe.

Cranberry Marsh Water Needs and Vulnerability

Water availability is one of the most critical elements of operating a cranberry marsh. Each cranberry marsh stores the water it uses throughout the year in reservoirs, using a combination of gravity and pumps to distribute the water to the right place when needed. Water use by cranberry growers can be separated into three main uses, irrigation, frost protection, and flooding, both for harvest and winter ice formation to protect cranberries from desiccation over winter. Each of these water uses is distributed through different times of the year. The sequence of operation of a typical cranberry marsh through the year is described in the “Marsh Activities” article provided by Cranberry Central in Tomah, Wisconsin, included as *Attachment 1*.

Water used for irrigation is pumped from reservoirs and applied during the growing season using sprinklers. Cranberries can require up to 0.20-0.25 inches of water per acre per day during the hottest, driest and windiest weather. The standard recommendation is for vines to receive an inch of water per week from either rain, capillary action from groundwater, irrigation or some combination of these.

Frost protection applies water to prevent damage to buds and berries when they are sensitive to temperatures below freezing in the spring and fall. It is necessary to apply at least 0.10 inch of water per acre per hour to provide basic frost protection.

The most widely recognized use of flooding in cranberry cultivation is for harvest. Water is moved from the reservoir using pumps or control structures and moved through ditches into individual beds to aid in stripping the berries from the vines and removal from the beds for processing. The beds are also flooded when freezing conditions are present to encase the vines in ice and prevent desiccation during the dry winter months. Some growers also perform a flood in spring to remove winter ice, provide frost protection, or pest management. During each flood event, between 12-15 inches of water is applied to the bed. Many cranberry operations also have water recovery systems that allow them to pump water used for flooding back into their reservoirs for future use. *Table 4* shows typical seasonal distribution of water use by cranberry marshes in the Central Sands.

Table 4: Seasonal Water Use Distribution for Cranberry Marshes

Month	Inches	Water Use
December	12	Winter Flood
January	4	
February	0	
March	4	Frost protection
April	10	Frost protection/Irrigation
May	3	Irrigation
June	3	
July	4	
August	4	
September	5	Frost protection/Irrigation
October	17	Frost Protection/Harvest flood
November	0	
Annual Total	66	

The water supply for cranberry marshes is almost always provided by a water storage reservoir located uphill and upgradient of the cranberry beds. Water is distributed from the cranberry beds via systems of channels and ditches with individual control structures to allow for water movement and flood storage retention. Additional channels are used to remove water from the beds, and may include a recirculation system to conserve water. The system of reservoirs ditches and beds is different for every cranberry marsh, and can be quite complex. An illustration of a typical cranberry marsh in the Central Sands is included in *Figure 1* below:

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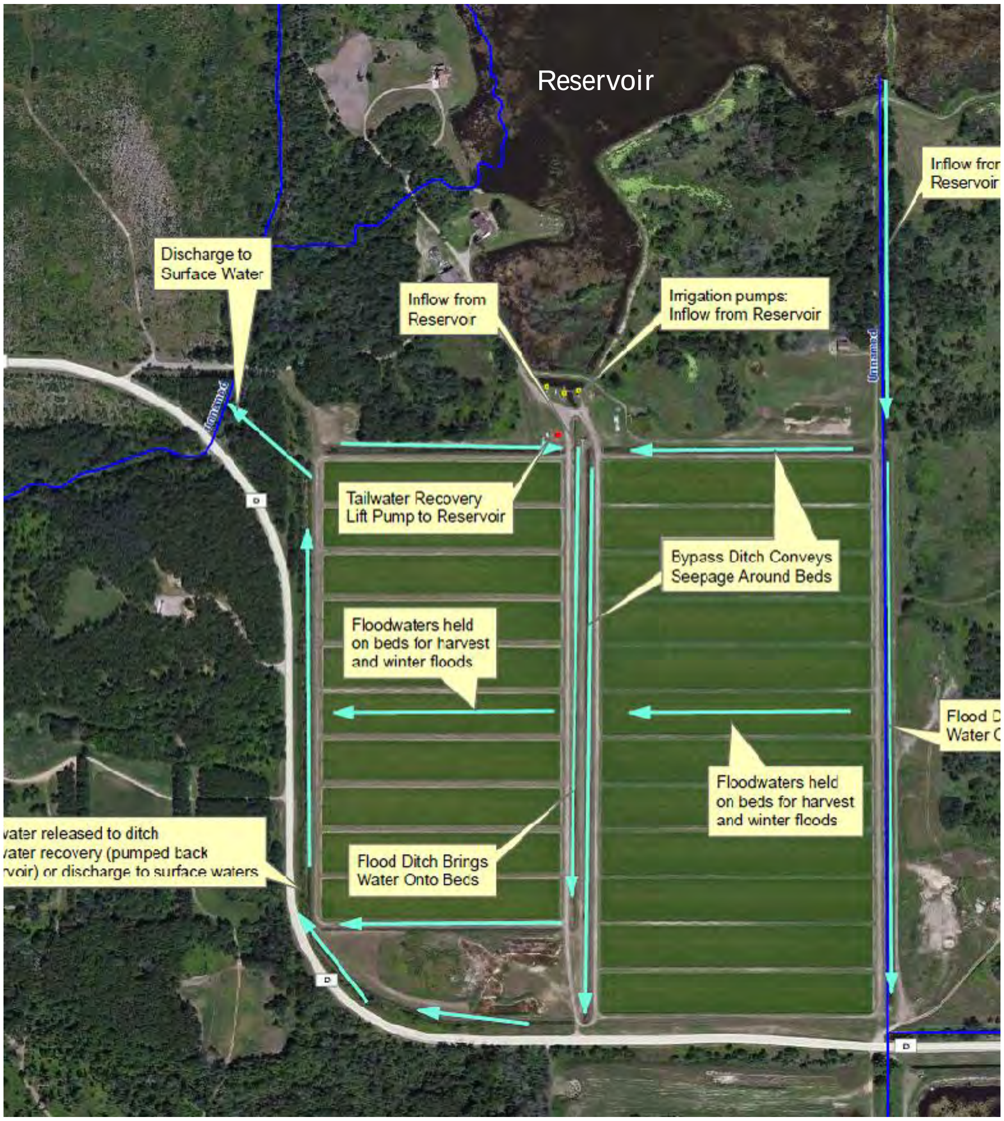

Figure 1: Typical layout of cranberry marsh in the Central Sands, showing reservoirs and channels

The availability of large volumes of water from reservoirs is critical for successful cranberry marsh management. On an annual basis, approximately 66 inches of water is applied to the beds through irrigation, frost protection and various flooding operations. Thus, maintaining reservoir water storage volume is an ongoing operational task at every cranberry marsh. Alternative water supplies, such as groundwater pumping, are not viable alternatives. For example, a typical cranberry bed has an area of 4 acres. Pumping continuously from a single well at 1,000 GPM would take 9 days to add 15 inches an individual bed. Considering the average size of cranberry marshes in the vicinity of the GSD is 90 acres, it would take three wells pumping at 1,000 GPM year-round to supply enough water just for a single flood event such as the harvest flood. This discussion illustrates that maintenance of reservoir water volume is critical to the continued operation of cranberry marshes, particularly those in the vicinity of GSD.

Additionally, the temperature of water stored in reservoirs is critical to application of winter floods. , where the objective is to have the flood water quickly turned to ice to provide desiccation protection to the cranberry vines and allow vehicles to drive over the beds and place a layer of sand to promote plant growth.. The reservoir temperatures during the winter (approximately 32°F) allow winter flood water from reservoirs to turn to ice relatively quickly after being placed over the beds. Thus, in addition to the difficulty in obtaining adequate flood volume in a short time using groundwater pumping, the relatively high temperature of groundwater (approximately 50°F) makes it unsuitable for winter flood use.

The water supply reservoirs supporting Cranberry operations in the Central Sands region typically receive water from both surface water streams and groundwater. Therefore, they are very sensitive to potential changes in both streamflow, especially stream baseflow, and groundwater table elevation. The sensitivity of the existing cranberry water supply storage reservoirs to groundwater table fluctuation is due to their construction. Nearly all of the marshes are constructed within the highly permeable sandy subsoil of the area. Therefore, the water levels in the cranberry marsh water storage reservoirs in this region are generally an expression of the water table, with water exhibiting seasonal fluctuation and with levels modestly regulated by control structures. However, given the typically unlined construction of the existing storage reservoirs and the high permeability of the local sandy soils, the control structures really only limit the maximum water elevation of the reservoirs.

Cranberry reservoirs also provide secondary functions such as nutrient attenuation as well as reduction of peak flows during intense runoff events and in extreme cases, cranberry beds have historically been used to provide flood storage, protecting structures and property downstream from damage.

Some newer marshes use elevated reservoirs that area lined with low permeability soil or synthetic membrane liners. However these systems also have higher development and operation costs as well as much higher evaporative losses of water. Construction of above-ground reservoirs at existing cranberry operations were typically not be feasible due to development costs, land availability, and impacts to regulatory water features.

- *The EIS of the GSD project irrigated agriculture operation must specifically evaluate the extreme sensitivity of cranberry marsh water supply to small fluctuations in groundwater table elevations and local stream discharge. This analysis must include specific evaluations of storage reservoir, volume, connectivity to the local aquifer, and location with respect to groundwater table reductions produced by the irrigated agriculture. Surface water stream flow reduction must be based on specific analysis of stream bottom elevations and hydraulic controls with respect to the proposed irrigation system.*

The significance of cranberry marsh water reservoir storage has been dramatically illustrated this year due to the drought conditions of the summer of 2012. The droughty conditions and lower storage reservoir water levels observed in 2012 have created a disastrous situation for many cranberry marshes in the vicinity of the proposed GSD. Growers have had to carefully manage the water available in their reservoirs to try and reserve enough for irrigation, frost protection, harvest and formation of winter ice. *Figure 2*, shows the low water levels and exposed bed conditions in September 2012 at Holly Creek Ranch cranberry marsh. This marsh is located approximately 2 miles south of the proposed GSD dairy. Under present conditions, growers have inadequate water for all of these uses. The cranberry harvest will be completed over the coming weeks and numbers will be available on marsh productivity and yield data. While not a quantitative measure of the potential effects of the proposed GSD high capacity wells, using the yield data from 2012 does provide a proxy for the impacts of reduced water level on the cranberry industry and other agricultural users in the Central Sands.

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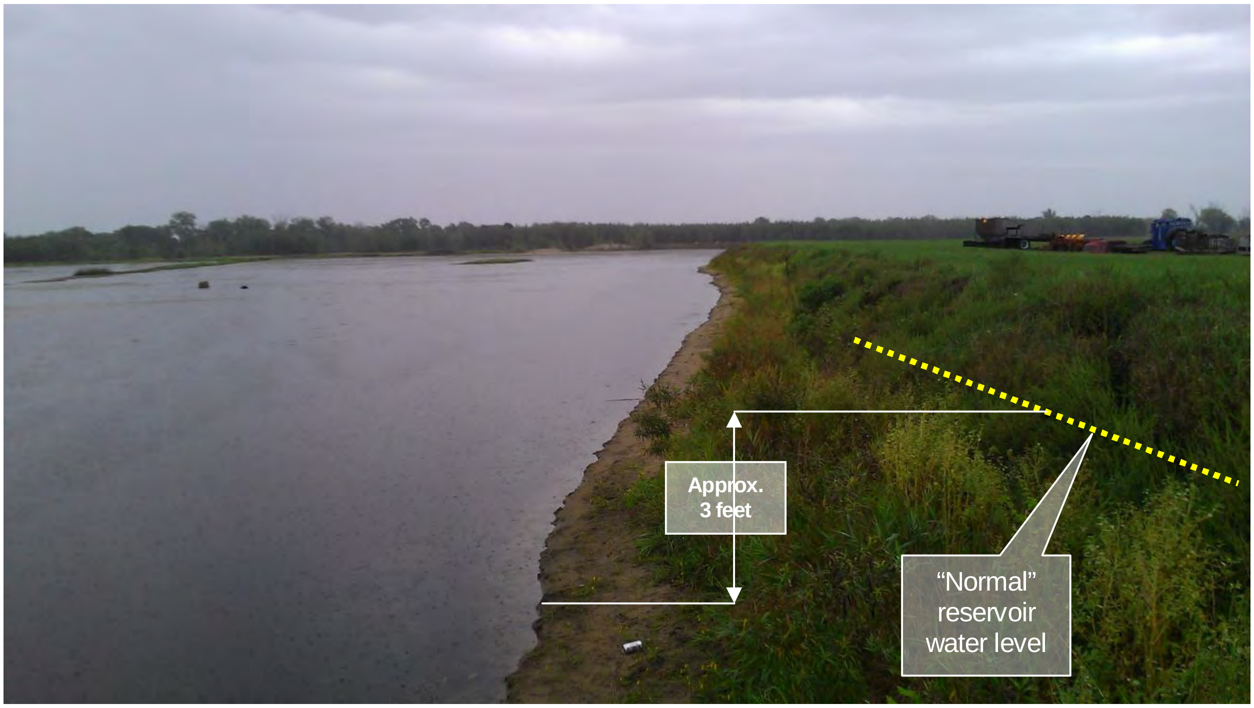

Figure 2: September 2011 photo of water storage reservoir at Holly Creek Ranch cranberry marsh, illustrating the loss of water storage due to drought related reductions in water table elevation

IMPACTS OF GSD ON CRANBERRY MARSHES AND EIS REQUIREMENTS FOR EVALUATION OF CRANBERRY WATER SUPPLY IMPACTS

We recommend DNR work with an independent party to develop a comprehensive groundwater model to show potential impacts from the proposed land use changes and cumulative impacts from pumping of all high-capacity wells proposed for use in irrigation of the GSD associated croplands. The most efficient method to achieve this would be to build on the existing groundwater modeling work by Dr. George Kraft and others at UW-Stevens Point.

The modeling effort must consider a range of precipitation conditions and pumping scenarios and not just focus on "average annual" values. Cranberry growers are presently facing considerable impacts from the drought conditions occurring this year. The groundwater model should evaluate transient conditions to reflect the seasonality of withdrawals for irrigation use. Additionally, the groundwater evaluation must consider pumping effects during droughty conditions, such as this past year. With reduced precipitation during the growing season, irrigation wells are pumped at a much higher rate to supply crops sufficient water. A steady state model that assumes average annual precipitation, pumping, recharge, and uses average groundwater elevation for the input parameters won't fully capture the range of potential impacts from GSD irrigation to other agricultural users, private wells, and waterbodies in the vicinity of the proposed dairy operation, particularly during conditions such as observed in 2012. The DNR should also require the model that not only evaluates average precipitation conditions, but also extreme precipitation scenarios as well.

The proposed GSD includes 47 proposed high-capacity wells and associated irrigation systems for in approximately 6,400 acres. Given observations of the impacts of progressively more intense irrigated agriculture in the Central Sands, this project should be anticipated to produce a substantial change in the hydrology of the local area, which will affect the cranberry marshes identified and discussed above. A long process of research data acquisition and peer-reviewed research reports on irrigation impacts to groundwater and surface water hydrology in the Central Sands is available. The most recent paper in this long series of research is "Irrigation Effects in the Northern Lake States: Wisconsin Central Sands Revisited, with George Kraft of the College of Natural Resources – University of Wisconsin Stevens Point as lead author. This paper draws major conclusions regarding several issues critical to water supply for cranberry operations:

1. Groundwater pumping and crop irrigation has produced a significant net reduction in groundwater recharge supply to the local aquifer.

2. The reduction in recharge and the hydraulic impacts of high-capacity well operation have produced groundwater table declines exceeding 3 feet in areas less than 15 miles east of the proposed GSD project. The extent of the groundwater table reduction produced by operation of irrigated agriculture is illustrated in *Attachment 2*, taken from the recent paper cited above.

3. The reduced recharge and high-capacity well operation has also reduced streamflow in the local watercourses, all of which receive their base flow from groundwater supply. The magnitude of stream flow reduction has been significant in areas surrounding the proposed GSD project, as illustrated in the stream flow reduction map included in *Attachment 3*.

The proposed GSD project is a substantial local expansion of the irrigated agriculture that has already been shown to produce substantial water table and streamflow impacts in the Central Sands. The impacts on streamflow diminishment and water table reduction identified would be anticipated to occur surrounding the proposed GSD project, because the overall hydrologic conditions are essentially identical.

The research study conclusions summarized above were drawn based on extensive data analysis and modeling, but did not include local transient effect impact analyses on specific streams or water table conditions which could be extremely important in analyzing impacts for the GSD project. In their application materials, GSD has noted they plan to irrigate approximately 14 inches per year. Assuming all 6,400 acres is irrigated, the annual irrigation total for GSD lands is about 7,500 ac/ft. Heavy pumping for irrigation could draw 6 inches of water from the aquifer during hot months, which could reduce aquifer water surface elevations more than twice that depth (more than 12 inches) due to the porosity (effective storage) effects of the sandy aquifer. These groundwater table reductions could be extremely significant locally to cranberry operations. Considering current conditions show water levels in cranberry reservoirs are already 2.5-3 feet below average conditions, an additional 12 in reduction in groundwater elevation from GSD irrigation pumping would exacerbate and already disastrous situation.

In summary, based on available research and current experience under drought conditions, the significant and expectable condition that will affect cranberry marsh water supply will be the cumulative effects of three impacts:

1. The several-foot lowering of the local water table and diminishment of local streamflow due to periodic drought conditions that have occurred as recently as this summer, and can be expected to occur regularly in the future;

2. The additional lowering of the water table due to the operation of high-capacity wells at GSD and the 47-well irrigated agriculture system to be created, immediately adjacent to areas of the Central Sands where irrigation has produced long-term water table declines of approximately 3 feet; and

3. The short-term lowering of the water table that would result from extremely heavy irrigation pumping during weeks long or months long drought conditions, which would produce water table lowering and streamflow diminishment additional to what would be predicted using long-term analysis approaches.

- *The EIS analysis of irrigated agricultural impacts must consider cumulative additional impacts to the stream flow and water table diminishment identified in analyses conducted by UW-Stevens Point researchers and recently published. It is critical to identify the additional extent of lowered water table and diminished stream flow considering the conditions of lowered water table and diminished streamflow that already exist.*

- *The EIS analysis must address the specific impacts of water table lowering and streamflow reduction on cranberry operations in the vicinity of the GSD including the combined cumulative effects of periodic drought conditions, long-term study state reductions due to operation of irrigation systems, and short-term impacts due to extreme pumping rates in drought conditions.*

- *Because the water supply impact analyses will be conducted using complex groundwater and surface water models, and the impacts of agriculture and industry are potentially severe, DNR must create independent third party peer review of the analyses submitted by GSD and DNR's internal evaluation. A panel of WI-based or even national experts could be created and we anticipate that DNR could obtain a detailed and objective review using this approach. DNR should also consider conducting independent surface water and groundwater modeling to evaluate issues that may not be adequately addressed in the GSD's technical submittal material.*

- *Since water availability is such an important part of cranberry operations Karris Family Farms must be represented by their own independent expert during the groundwater model evaluation to ensure cranberry water management impacts are accurately characterized as part of the modeling effort.*

The DNR should also consider climate change impacts in their review of the proposed CAFO. The Wisconsin Initiative on Climate Change Impacts (WICCI) has identified potential impacts that may affect agricultural operations. Specifically, the WICCI Central Sands Hydrology Working Group was established to evaluate the hydrologic effects climate change may have on this irrigated landscape. We encourage DNR to seek objective input from the working group on how the proposed CAFO operation will change hydrology in the context of anticipated climate change effects.

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WATER QUALITY ISSUES

The proposed GSD and associated landspreading operations on the cropped fields creates a significant source of pollutants to groundwater and surface water resources that does not presently exist within the project vicinity. Of particular interest to cranberry operations are elevated nitrogen concentrations and *E. coli*. Elevated nitrogen reduces cranberry yields and the presence of *E. coli* on cranberries disqualifies their sale as fresh fruit. Both affect the economic viability of a given cranberry marsh.

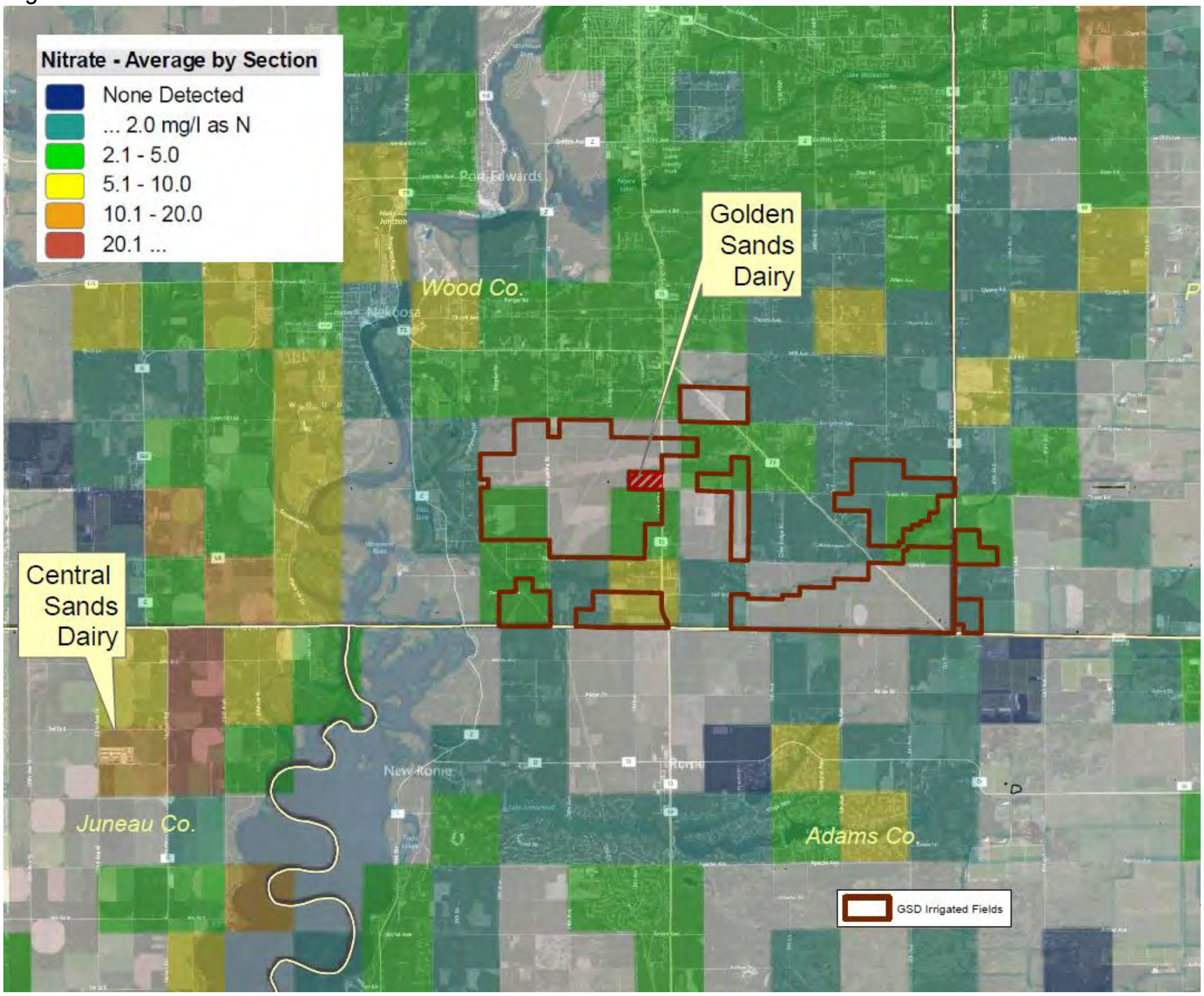
Cranberry growers have developed nutrient management plans to guide fertilizer application as plant needs dictate. Unlike conventional crops which may receive fertilizer application once or twice during the growing season, cranberries are fertilized throughout the growing season. Growers apply nutrients in frequent, but small doses, basing the rate and formulation on the stage of plant development as well as using soil and tissue nutrient data to identify deficiencies. Using this approach, only the amount of nutrients needed by the cranberry plan are applied, leaving little fertilizer available for leaching into the groundwater or discharging to surface waters.

Nitrate

Elevated groundwater nitrate concentrations are already present in the vicinity of the GSD CAFO. The Central Wisconsin Groundwater Center has compiled laboratory testing results for various pollutants and mapped them by section. *Figure 3* shows that nitrate data in the vicinity of the proposed GSD CAFO and near the CSD CAFO.

Montgomery Associates Resource Solutions, LLC

Figure 3: Private Well Nitrate Data

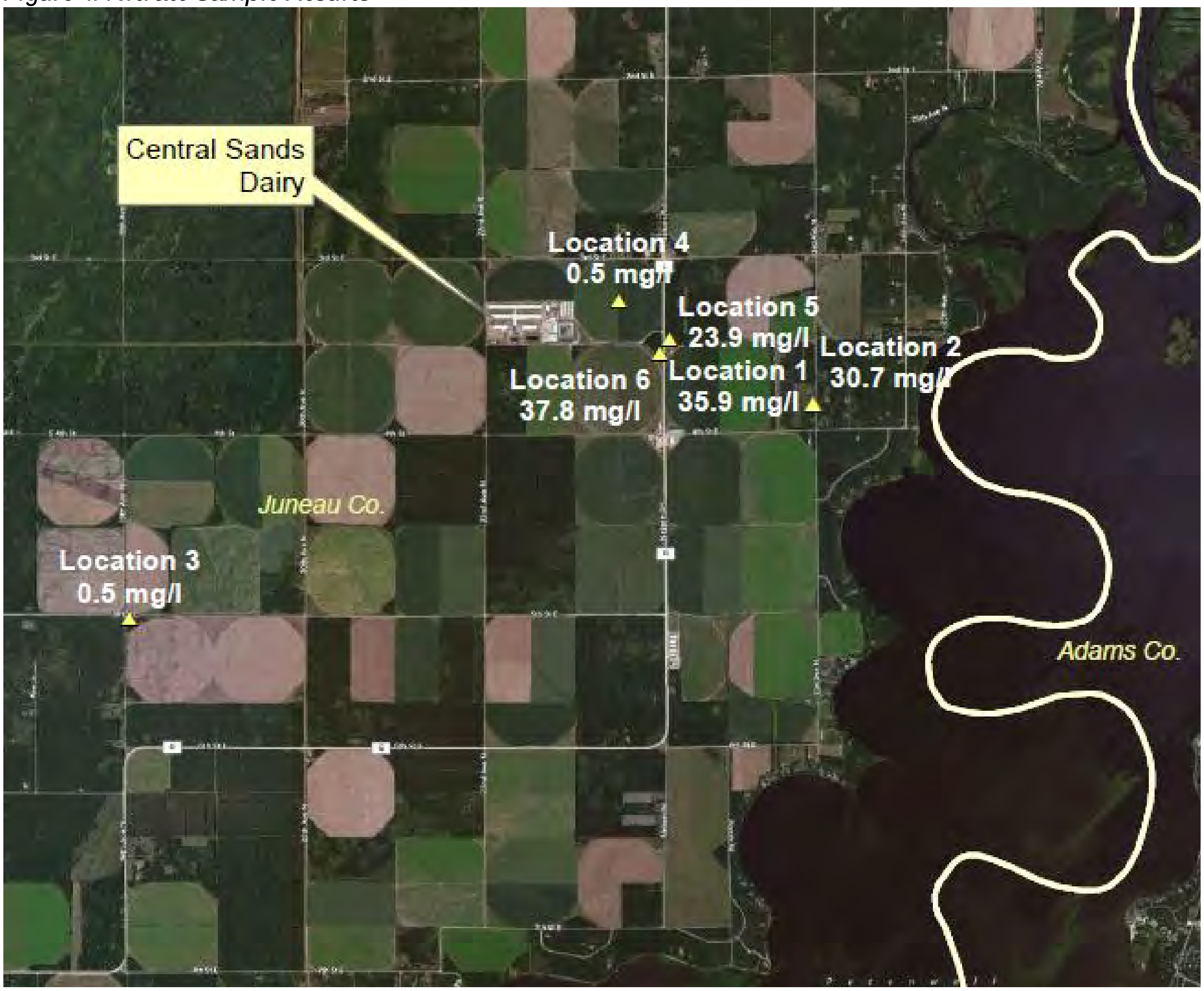


The existing elevated nitrate concentrations in groundwater have been produced by irrigated agriculture with primarily conventional chemical nutrient application, not through the spreading of animal manure. Although the GSD application is for a CAFO and associated irrigated agricultural areas used for manure spreading, the issue of land-use conversion and nutrient application under a potentially modified proposal also needs to be evaluated with respect to groundwater impacts.

- *The alternatives analysis portion of the EIS should thoroughly evaluate the hydrologic and water quality impacts of the land-use conversion to irrigated agriculture with conventional nutrient application as one of the project alternatives, and specifically evaluate changes in groundwater and surface water quality associated with land-use conversion to irrigated agriculture, but without manure spreading.*

The Central Sands Dairy (CSD) CAFO, also operation by the applicant, is located on the west side of the Wisconsin River, but is in a similar environmental setting. Water samples were collected in August 2012 from wells near the CSD operation and submitted to a certified laboratory for analysis. This sample collection effort was intended to provide screening level assessment of groundwater quality near the CSD and is not a comprehensive investigation of water quality. The samples showed nitrate concentrations above the Wisconsin Administrative Code NR 140 Enforcement Standard of 10 mg/l downgradient from the CSD. *Figure 4* shows the sample locations and results. Laboratory reports for the water samples are included as *Attachment 4*.

Figure 4: Nitrate Sample Results



The sample data shows that groundwater in the vicinity of the CSD operation is contaminated with nitrate and given the similarities in environmental setting and farm management practices, suggests that the proposed GSD CAFO would create an increase in nitrate concentration in groundwater at that location as well. Although the codified performance standards in NR 151, NR 243 and ATCP 50 and the NRCS 590 standard are intended to protect surface and groundwater resources while allowing sufficient nutrients for successful crop growth, reliance on the prescribed practices and analytical tools is insufficient to characterize the risk for contaminating groundwater. The easiest way to verify manure landspreading operations are not contaminating groundwater is to conduct a groundwater sampling program using existing private wells, or through a network of monitoring wells.

- *We expect the EIS to investigate the potential for groundwater quality impacts based on the performance of existing CAFOs operating in the Central Sands Region using water quality results from wells located near the facilities.*

As noted previously, water is applied to cranberry beds spring for frost protection, keeping the buds and new vine growth from damage associated with frost and freezing temperatures. Although cranberries typically use nitrogen in the ammonium form, relatively high pH conditions (for cranberries) in the Central Sands makes nitrate more available for uptake. Excessive nitrogen has been shown to cause the buds to swell and burst, rendering them unable to develop fruit later in the growing season. Additionally, research by UW Horticulture cranberry researchers showed elevated nitrate levels in water applied to cranberry beds early during the growing season also lowered berry yield by promoting woody vine growth instead of fruit[1]. This overgrowth shades the flower and subsequent fruit, affecting pollination, increasing fruit rot, and suppressing fruit color. Bud set is also reduced, affecting next year's crop. A yield reduction of 1/3 has been estimated by industry horticulture experts if reservoir nitrate levels are similar to those observed immediately downgradient from CSD.

In 2011, Karris Family Farms-Holly Ranch Cranberry marsh observed a decrease in cranberry yield of nearly 50 percent compared to their 10 year average (115 bbls/ac vs. 230 bbls/ac.), largely attributed to elevated nitrate levels in spring runoff. Spring nitrate concentrations were 12-15 mg/l compared to 6-8 mg/l during the summer. Assuming a background nitrate concentration of 7 mg/l, the nitrogen loading rate is 1.6 pounds of nitrogen per acre for each inch of water applied. Cranberries only need 20 pounds of nitrogen per acre, annually for fruit production. With a typical annual water usage of 66 inches, approximately 106 pounds of nitrate is applied to the beds through the background nitrate concentration alone. Since the cranberry water use is seasonal, nitrogen is inadvertently applied to the beds during times when it isn't needed for fruit growth (spring frost protection). Cranberry farms have already been affected by increased nitrogen concentrations in the reservoir water.

The nutrient management plan submitted by the GSD to DNR described landspreading of solid and liquid manure in the spring, prior to planting or in fall after the crop was harvested. Application of manure during these times is problematic since the crop needs do not match the nutrient availability and mineralization to inorganic forms of nitrogen is likely to occur, prior to uptake by the plant. Inorganic nitrogen in the form of nitrate and ammonium are very soluble in water. In granular soils, both forms of nitrogen are prone to leaching though the soil profile, entering the water table. Leaching is most likely to occur during the spring thaw under saturated soil conditions. During this time, there is little to no plant uptake of inorganic nitrogen. Little nitrogen is bound in the soil due to the neutral electrochemical charge characterized by loamy sand soils in the project vicinity. This nitrogen cycle processes are fairly well understood, but losses through volatilization, mineralization and leaching are difficult to predict. A recent paper (Gupta et. al. 2004. "Tillage and Manure Application Effects on Mineral Nitrogen Leaching from Seasonally Frozen Soils." Journal of Environmental Quality, 33:1238–1246.) describes these processes well from research completed in southwestern Wisconsin. With the proposed application rates and likelihood of mineralization and leaching, groundwater quality will be affected. Reliance on NRCS 590

[1] Kosola, K., Randhawa, D., Stackpoole, S., Workmaster, B.A. (2006) Nitrate in cranberry irrigation water—Initial observations during the 2005 growing season. Proc. of the 2006 Wisconsin Cranberry School.

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standards and other standard guidance is not effective for quantifying the potential for nitrate leaching from manure into the water table for facilities located in the Central Sands Region.

- *The EIS must explore the fate of nitrogen from fall and spring applied manure and enumerate the potential for nitrogen leaching. This can be achieved through mass balance calculation from existing CAFO field data, or from theoretical nitrogen budget calculations that better estimate leaching potential.*

E. coli

The significance of pathogens due to human and animal waste impacting groundwater supplies has received increasing research attention in the past 10 years. Currently published research, including the study conducted for the Wisconsin DNR by the Wisconsin Geological and Natural History Survey and the Marshfield clinic research foundation (Human Viruses as Tracers of Wastewater Pathways into Deep Municipal Wells, December 2010), among other studies, illustrates that viruses and other pathogens can rapidly migrate into groundwater systems. Ongoing research at the Marshfield clinic research foundation is specifically evaluating the issue of pathogen migration to groundwater from manure application. Groundwater monitoring adjacent to existing CAFOs should be able to provide additional data on this issue.

The Wisconsin Department of Health Services has previously addressed public health considerations for spray irrigation of manure slurry in reviewing the Rock Prairie Dairy CAFO. Although the GSD proposes seasonal manure applications, disturbance of dry biosolids under windy conditions can provide a vector for pathogen transport. At a recent presentation to the Town of Saratoga, a microbiologist from United States Department of Agriculture Agricultural Research Service (USDA-ARS) reported that airborne pathogens from manure landspreading can be carried up to 2 miles from the field which it was applied. This is particularly important since fall tillage operations may coincide with cranberry harvesting and allow deposition of *E. coli* and other pathogens in the reservoirs, cranberry beds or on fruit immediately before they are sent to customers.

A positive *E. coli* test result on harvested fresh cranberries can have widespread impact. An *E. coli* outbreak linked to cranberries could result in an industry-wide recall, affecting not only Karris Family Farm marshes, but other growers in the region, resulting in millions of dollars of lost revenue.

For example, the Karris Family Farms-Nekoosa East marsh raises organic cranberries for sale as fresh fruit. This operation is certified by the Midwest Organic Services Association (MOSA) as an organic farm (producer no. WI-G0986-05). To meet eligibility for organic certification, MOSA requires growers to meet USDA standards for organic operations. Due to the nature of the Nekoosa East marsh operations, MOSA also requires periodic testing of water for coliform and nitrate. Additionally, the customers who buy fresh fruit from the Nekoosa East marsh regular require testing for *E. coli* to ensure the safety of the food to consumers. To date, both testing programs have shown that the water and fruit meet the standards and the private well data from the Central Wisconsin Groundwater Center shows nitrate concentrations are below regulatory standards. MOSA will not renew the organic certification if water tests show a nitrate concentration above 10 mg/l. Revocation of organic certification or a positive test for *E. coli* would result in significant economic impact to the Nekoosa East marsh by limiting the market for their product.

Fields designated for landspreading of manure by GSD are located within ¾ mile of the Nekoosa East cranberry marsh and drain to Sevenmile Creek. Sevenmile Creek supplies water to the reservoirs used by the Nekoosa East marsh in addition to the groundwater discharging to the reservoirs.

Additionally, research by the USDA-ARS has shown that *E. coli* can survive for months in stream bed sediment and be mobilized during high flow events. Consequently, *E. coli* carried by runoff into Sevenmile Creek and discharging to the Nekoosa East reservoir can be mobilized during periods of high flow, such as harvest flooding and contaminate the cranberries during harvest.

- *Due to the proximity of this cranberry marsh to the fields designated for landspreading, the potential for E. coli contamination through surface runoff, groundwater and wind transport is significant. The EIS must evaluate the potential for migration of pathogens from the GSD fields from overland flow via Sevenmile Creek or through pathways such as groundwater discharge or windborne dust.*

OTHER ISSUES

There are many nearby residents relying on private driven sandpoint wells for their water supply. GIS analysis shows over 300 homes located within ¼ mile of the proposed GSD-managed fields. Many of these wells are shallow (<20 feet deep) making them particularly prone to small changes in the water table elevation and contamination from changes in land use. The depth to groundwater in this area is generally 10 to 20 feet below ground surface. Relatively small changes in the water table elevation can have a significant impact on well productivity and it is likely some of the closest and shallower wells will dry up completely when irrigation wells are pumped at a high rate during the growing season. Additionally, shallow wells provide little filtering of surface contaminants and as shown on Figure 2, there many wells in this area that are already affected by nitrate contamination. These wells are also the most at risk of impact from reduced water availability from GSD irrigation pumping resulting in seasonal groundwater drawdown.

- *The EIS must evaluate the affect manure landspreading and irrigation pumping will have on water quality and quantity for shallow private water wells.*

We appreciate the opportunity to provide input to the EIS process. Please feel free to contact us should you have any questions or comments regarding this letter report.

Montgomery Associates: *Resource Solutions, LLC*

Robert J. Montgomery, P.E.	Benjamin R. Nelson
Principal	Environmental Scientist

Attachments:	Figure A	Cranberry Operations in the Vicinity of the Proposed GSD CAFO
	Attachment 1	Cranberry Central: Description of Cranberry Marsh Processes
	Attachment 2	Figure Showing Extent of Central Sands Groundwater Table Decline

Attachment 3 Baseflow Reduction Due to Irrigated Agriculture in the Central Sands Area
Attachment 4 Laboratory Analytical Reports for Samples Collected Near CSD CAFO

Cc: Nicholas Karris, Karris Family Farms

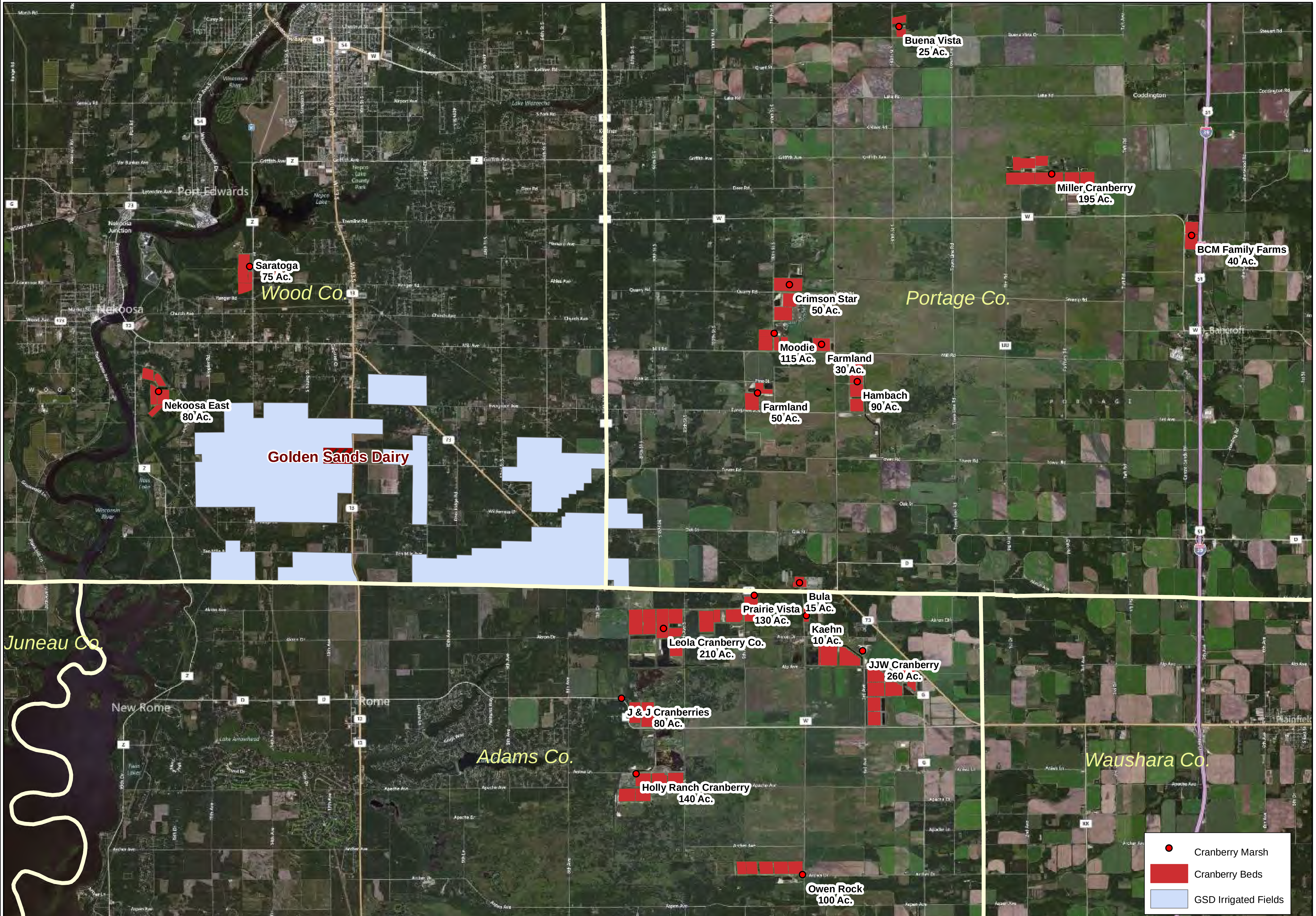


Figure A
Cranberry Operations in Vicinity of Proposed Golden Sands Dairy

Golden Sands Dairy: EIS Scoping Comments
Town of Saratoga, Wood County, WI
Mr. Nick Karris: Holly Ranch Cranberry

MONTGOMERY ASSOCIATES:
RESOURCE SOLUTIONS, LLC
119 South Main Street | Cottage Grove, WI 53527
(608) 839-4422 | www.ma-rs.org

DRAWN BY	CHECKED BY
DYL	BRN

0 0.75 1.5 Miles

SCALE
1 inch = 1.5 miles

PROJECT NO.	DATE
1561	Sept. 12, 2012

SHEET NO.
1 of 1

Attachment 1

Article on cranberry marsh operations taken from cranberry central website

Reference: http://www.cranberrycentral.com/activities.html

Home
About Us
Products
Cranberry History
Health Benefits
Recipes
Marsh Activities
Links
Contact Us

Marsh Activities

SOME OF THE PROCESSES OUR CRANBERRIES GO THROUGH

Cranberry beds:

Cranberry beds as a general rule in Wisconsin, are vine to vine 150 feet wide and as long as desired but usually not exceeding 1200 to 1400 feet long. This is primarily due to an easier faster flooding process. Most of the new marshes that have been built in the past ten years or so are referred to as upland marshes. Upland marshes are built in higher generally sandier soil and not peat soil. Most upland marshes are not flooded by gravity or gravity is only available to be used in one direction for water flow. That being either flooding into the beds are draining the water back out and putting it back in the individual marshes pond. Upland marsh Cranberries are grown entirely in sand and as such requires the installation of an irrigation system. Cranberries grow just like any other crop and are not in water other than during harvest or winter flood. Irrigation is also used in protecting fruit and budding vines from freezing in the spring and fall.

Lots of water is needed:

Availability of water and lots of it are a must especially on an upland cranberry marsh. Peat beds are generally much less vulnerable to drying out because of the organic content which is able to hold moisture unlike sand. Most upland cranberry marshes are required to be irrigated on a daily basis. On the marsh pictured below approximately 30 to 40 million gallons of water are required to put on one flood. This is only done in the spring. The flooding is sometimes done in the spring for freezing protection. The flooding of the cranberry bedds is also done in the fall for the harvest of the berries. The cranberry beds are also flooded again when there are temperatures cold enough for making ice for sanding or general protection from severe cold. This water is recycled and used over and over again but it has to always be available.

Irrigation:

The sand in the cranberry beds allows spoon-feeding of desired nutrients to feed the crop. Cranberries are known to flourish better in a lower P.H. soil. Some marshes tend to have to add correctives to the sand to maintain a lower P.H., such as sulfur. In many of the newer beds the irrigation is buried under the sand and the sprinklers can be taken in and out as desired for winter flooding and harvest.

Spring and Fall Frost protection:

Cranberries and the non-dormant pre-harvested plants must be maintained at a temperature above 32 degrees for the most part. There are exceptions but very few. Most cranberry marshes are equipped with automatic sensing devices, which some are computerized. The sensor tells the unit that the temperature is at a predetermined warning point and sends off an alarm to the person in charge of starting the sprinkler system. As long as the vines and fruit are kept sprinkled from 32 degrees or lower until very cold temperatures are present, the fruit does not freeze. The plants will cake up with ice, which at times gets very thick by morning. Most of the time once the temperature has gotten below a pre-determined temperature the irrigation will not be shut off until the sun is up and starting to warm the vines.

Fertilizing:

Fertilizing, for the most part, is accomplished by the use of granular type applications, which are applied with a boom. The cranberry boom is pulled behind a tractor or driven when mounted to a large truck frame. Most upland, newer cranberry beds are 150 feet across or close to that. The cranberry-fertilizing boom is pulled behind and is long enough to extend out to the middle of the cranberry bed. Small granules are sent out through numerous tubes that blow high velocity air down them causing the granuals to spread evenly as the boom moves slowly down the dike parallel with the bed.

Pest control:

There are many pests that have to be dealt with on a typical cranberry marsh. Most medium to larger sized marshes contract with consultants who specifically scout for pests. Integrated Pest Management (IPM) scouts are trained too specifically use management practices to protect the Eco system and area wildlife.

Pollinating with Bees:

Bees are utilized in most of the modern cranberry marshes. The bees' help to spread the pollen to cause the pollination of more of the cranberry blossoms, which in turn usually, has a greater yield effect. Generally speaking the more hives per acre HPA the higher the yield potential. The average marsh that either rents or has their own bee hives uses 1 to 3 hives per acre.

Weeding and whiping weeds:

Weeding is not one of the favorite activities at most cranberry marshes. Because of the high organic content and granular fertilizer put on the vines and sand that the cranberries grow in there are usually a lot of freeloaders that tend to show up for a nice place to live and be spoon fed. Many marshes have problems with small trees. Willows and maples are very prevalent at southern and central Wisconsin marshes. Clover is also known for trying to establish a home within the cranberry vines. Many sedges are also abundant in damper ground. Initially weeds are a very big concern when the beds are in their first and second years. After the canopy develops the sun is shaded from the ground and one can no longer see any sand. At this point in time the vines themselves tend to have a major influence in keeping the weed population in check.

Keeping dikes mowed:

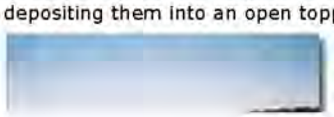
Dikes are the roads around the cranberry beds. They are about 3 feet higher then the material, (sand) that the cranberry vines are growing in. The dike completely surrounds all of the cranberry beds. This is what holds the water in when flooding the vines for harvest, freezing protection, or winter flood. The dikes have grass growing on them for the prevention of erosion, and have to be mown. They also produce some weeds that will tend to go to seed if not kept at a reasonable height. The dikes are also what the cranberry boom drives down to fertilize the cranberries as well as for the application of pesticides and herbicides as well as almost all maintenance activities.

Preparing for harvest:

Harvest frequently tests how well a grower has maintained their equipment. Tractors, beaters ATV's bog boom berry pumps, harvest machines etc all have to be tuned and made ready. Fresh fruit harvest has different equipment. Not to mention the numerous pears of wader boots that the harvest help wear during the harvest process itself. Harvest is done slightly different dependent on the area of the country the marsh is in. The description of most of the marsh activities is based primarily on a Wisconsin marsh. Wisconsin produced 52 % of all of the cranberries produced in the United States last year. Harvest bog boom is basically a boom that was developed for Oil spills by the petroleum industry. This material has a cable in it and a chain that are floating on top of the water during harvest. The material goes clear across the cranberry bed and usually plenty of slack is left in it about 300 feet are in the water at any given time on a 150 foot wide cranberry bed. The strong floating material designed to pull in oil slicks where oil spills took place works great for pulling the floating berries down to the end of the bed during harvest. When you see pictures of cranberries being harvested the bog boom is what keeps the berries corralled More detail on cranberry harvest.

Cranberry Harvest:

The marsh owner as well as the surrounding communities welcomes the cranberry harvest. The largest cranberry festival in the world is held in Warrens Wisconsin during the harvest season. First the irrigation lines have to be removed from the cranberry beds. Most of the time they have been used a lot because this is also a time where frost protection is a common event in the fall. After the irrigation is removed or during the removal process of the irrigation lines the harvest flood is started. After the floodwater is close to rising over the top of the vines the beater tractor beats the fruit with reels that spin down into the water. As this separates the fruit from the vine the cranberries being air filled float to the top. The bog boom which floats on top of the water and has a cable in a skirt which goes about 5 inches under water form a moving pouch all the way across the cranberry bed. Tens of thousands of pounds of cranberries are pulled slowly down to the end of the bed. This is accomplished by a tractor pulling on each side of the bed slowly pulling the cranberries as the boom moves towards the end. After the berries are all rounded up the boom is now encircling the cranberries that are floating and up to several inches in depth. Different types of harvest machines are currently being used for elevating the cranberries from the water and a first cleaning as well as depositing them into an open topped semi or tandem dump truck. The most used type of harvest machine in this area is referred to as a berry pump.



It's basically a pump that was designed to move small fish from one pond or lake to another without injuring them. It works quite well for transferring the cranberries from the water into the waiting semi.

Vines go dormant:

After the berries are removed from the bed the bed debris is cleaned off which is usually floating at one end brought down by the wind. The water is then allowed to flow out of the bed and the vines will soon turn to a burgundy color. Cranberry plants are perennial and the same leaves you see go dormant that turn burgundy are the same leaves you will see the next summer turning green. At this point in time wooden lath boards are put into the beds marking the ditches and or any other items that will be under the winter ice that may be a hazard for a 60 thousand-pound dumptruck to drive over. Mainly for marking the ditches surrounding the entire edge of the cranberry bed. This approximately one foot wide ditch is used as a drainage ditch inside of the cranberry bed.

Winter flood:

Winter flood is the term describing the usual latest flood intended to make ice for protection of the cranberry vines over the winter. It is very important not to flood to soon as the vines are still alive and continue to be oxygen dependent. It's important that the unfrozen part of the ice (the water below) is not left on the beds for longer than seven to ten days. Some growers monitor oxygen levels and will leave the water on for longer periods of time. As the ice freezes down closer to the ground the plants deplete the available oxygen even faster. It's a delicate balancing act. After the time determined to be appropriate has arrived the bulk head boards have to be taken out, usually frozen in the ice they frequently have to be removed with a chain saw or broken with a hammer. It's important to let the unfrozen water out. It could potentially damage or kill some of the vines if the oxygen content of the water has been depleted.

Winter Sanding of the cranberry beds:

Sanding of cranberry beds is a very good horticultural activity. The process involves driving usually tandem dumptrucks onto the frozen beds with 8 t0 10 inches of ice. The objective is to pour sand out of the back of the trucks while driving on the ice covering the cranberry beds. Most growers prefer about ½ inch in thickness. This is accomplished by a roller system attached to the back of the dump trucks. The sand is also most often screened. Screening takes the ice chunks and rocks out of the sand so that the roller system is not compromised. By sanding the vines, new growth, will fill in and the upright count will dramatically increase over just nature itself. Most people know how strawberries send out runners. Cranberries are very much like this. Runners do not produce very much fruit at all if any. They are more vegitative in nature not reproductive. The uprights however when covered with sand do produce what are referred to as uprights. Uprights are where budding takes place. This is where blossoms are formed and the fruit of the cranberry plant is produced. Basically things that grow in a horizontal plain in a cranberry bed are not helping to produce more fruit as a general rule. To a point they can actually rob nutrients from the reproductive portions of the cranberry plant. Pruning will be brought up later for to many horizontal runners. Sanding of beds is also of great value as far as from an IPM scout point of view.

Integrated Pest Management consultants agree that when some of the cranberry enemies, bugs, lay eggs for the next summers hatch sand may stop a percentage of them from hatching if they become buried.

Equipment maintenance:

Equipment maintenance is very important. Most cranberry equipment involves the use of hydraulic equipment. Almost all equipment that enters a cranberry bed utilizes vegetable oil synthesized hydraulic oil. This product is very expensive compared to regular hydraulic fluid. The main purpose for this is in case of an accident, leak or spill, the contents of the hydraulic lines and motor are edible. Cranberry marshes have a long history of taking care of the environment and protecting the quality of the product they produce.

Winter marsh activities:

The cranberry marsh activity almost always slows way down in the winter. This gives the marsh employees and owner a chance to catch up on equipment maintenance. Marsh owners are very careful not to allow oil leaks or problems that occur that have the potential to compromise the crop or vines as well as ground water. Marshes are so totally dependent on enormous amounts of water. They consider themselves stewards of the water and find it very important to treat this natural resource with a great deal of respect. Water is a must and it must be taken care of. Pictured above is a pile of sand which is mounded up high in preparation for winter sanding. The ground will freeze the top four to five feet of sand and will render it unusable. That is why the pile has to be very large.

Attachment 2

Extent of groundwater table decline due to irrigated agriculture in the Central Sands

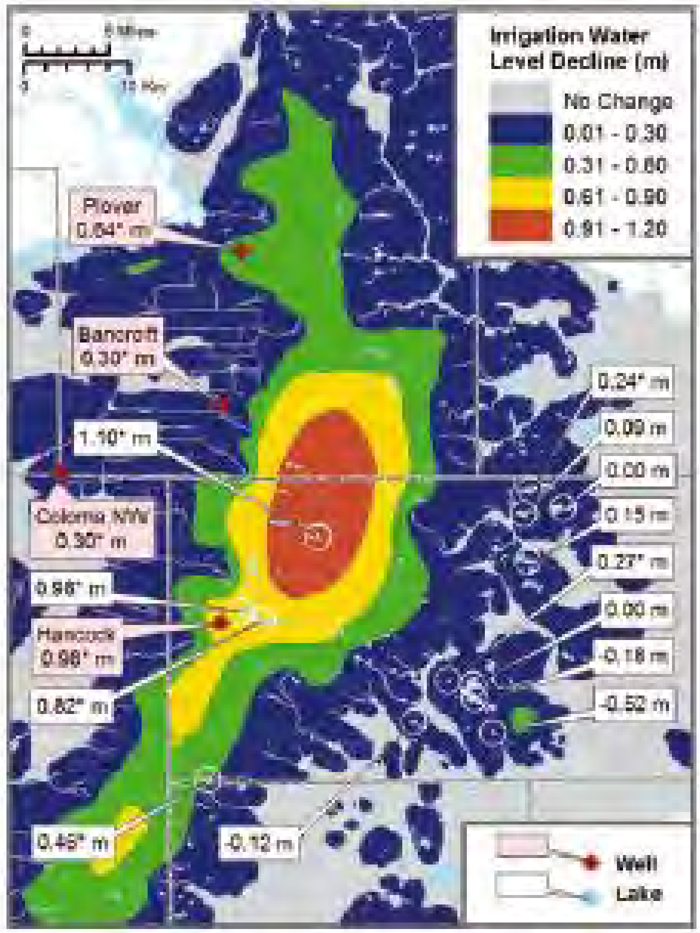


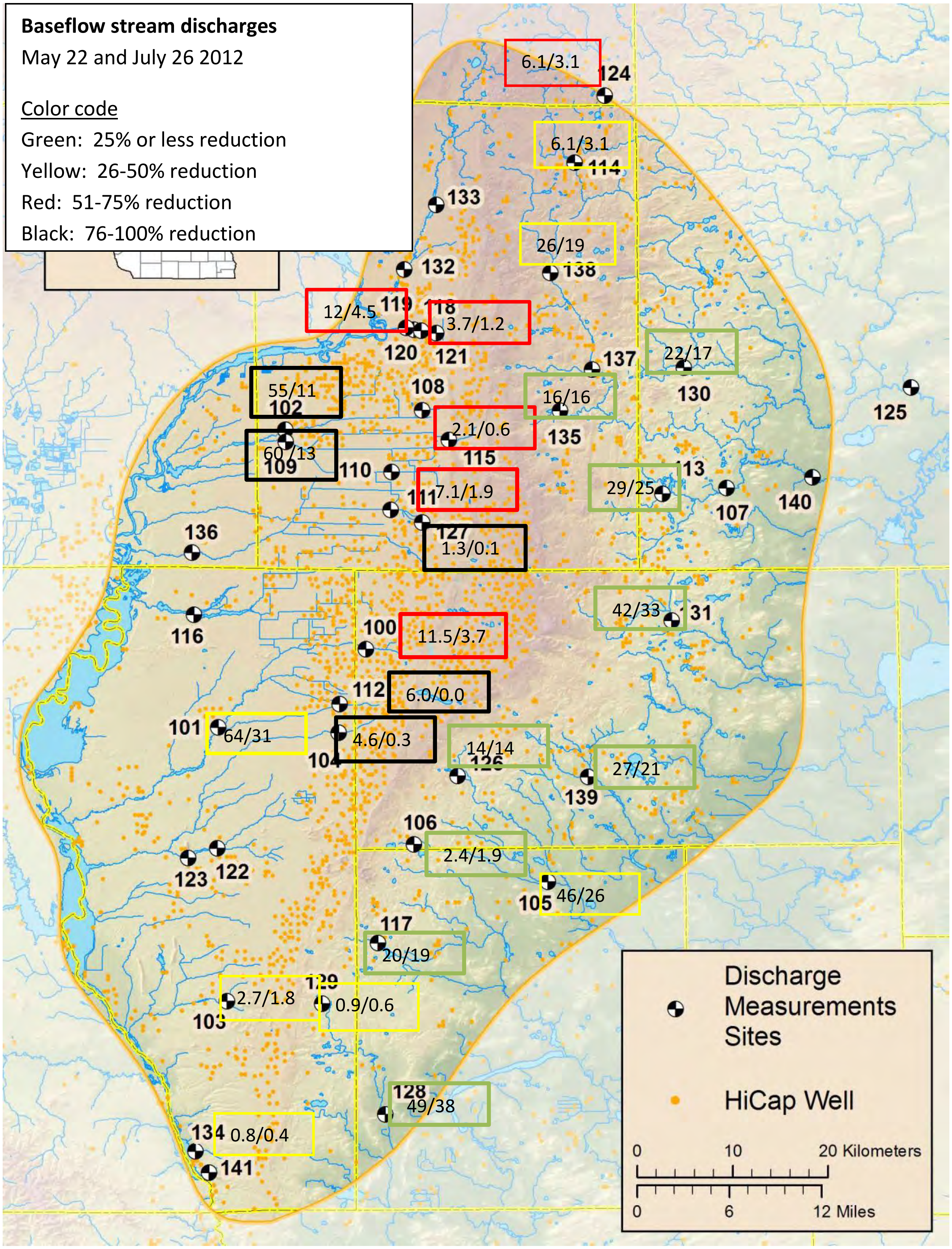
Figure 9. Simulated groundwater level declines with 45 mm/year of net recharge reduction on irrigated land. Also shown are irrigation-induced monitoring well and lake level declines (1999 to 2008) inferred from hydrographs (boxes). Bancroft and Coloma NW declines are average of two estimates (Table 2) (*significant decline at $p \leq 0.05$).

Source: Kraft, et al, “Irrigation Effects in the Northern Lake States: Wisconsin Central Sands Revisited”, Groundwater, Volume 50, Number 2, March-April 2012, page 308-318

Attachment 3

Baseflow reduction due to irrigated agriculture in the Central Sands area

Reference: provided by George Kraft, University of Wisconsin-Stevens Point



Baseflow stream discharges
May 22 and July 26 2012
Color code
Green: 25% or less reduction
Yellow: 26-50% reduction
Red: 51-75% reduction
Black: 76-100% reduction
6.1/3.1
124
6.1/3.1
114
133
26/19
132
138
12/4.5
119
3.7/1.2
120
121
137
22/17
130
55/11
102
108
16/16
125
2.1/0.6
135
60/13
109
110
115
29/25
107
140
7.1/1.9
136
1.3/0.1
42/33
116
100
11.5/3.7
112
6.0/0.0
101
64/31
4.6/0.3
104
14/14
27/21
139
106
2.4/1.9
123
122
105
46/26
117
20/19
2.7/1.8
0.9/0.6
128
49/38
134
0.8/0.4
141
Discharge Measurements Sites
HiCap Well
0 10 20 Kilometers
0 6 12 Miles

Attachment 4

Water Sample Laboratory Reports

1) N15883 Cty Rd. G, Town of Armenia: - HOFFMAN SAMPLE #1
Hardness-Total--216 mg/lCaCo3
Alkalinity--8 mg/lCaCo3
Conductivity --531 umhos/cm
pH--6.31 std. units
Saturation Index---2.8 Corrosive
Nitrogen-Nitrate/Nitrite--35.9 mg/lN
Chloride--44.8 mg/l

2) N15761 23rd Ave. N. Nekoosa
Hardness-Total--220 mg/lCaCo3
Alkalinity--28 mg/lCaCo3
Conductivity-- 501 umhos/cm
pH--7.23 std. units
Saturation Index-- -1.3 Corrosivity Moderate
Nitrogen-Nitrate/Nitrite 30.7 mg/lN
Chloride--36.6 mg/l

3)

AgSource Laboratories
A Subsidiary of Cooperative Resources International
1001 Frontage Road * Stratford WI 54484

WATER TEST REPORT

WISCONSIN DATCP CERTIFICATION # 424

REPORT DATE....... 8/15/2012

SAMPLE #: 4197 – Spud Creek along manure spread field (19TH and 4th street); no inflow or outflow from creek

SAMPLE DESCRIPTION:
NITRATE DESCRIPTION:
SAMPLED: SET UP: 8/ 3/2012

ADDITIONAL TEST: MEMBRANE FLTRTN ECOI 376 cfu/100mL UNSAFE
NITRATE-N 18.60 mg/L (UNSAFE - WIS. STANDARD)

4)

AgSource Laboratories
A Subsidiary of Cooperative Resources International
1001 Frontage Road * Stratford WI 54484

WATER TEST REPORT

WISCONSIN DATCP CERTIFICATION # 424

Nick Karris
415 N LaSalle
Chicago , IL,60654

771

REPORT DATE....... 8/31/2012

SAMPLE #: 4560

WELL ADDRESS: church Armania- sample #12068 N15296 19th ave (and 5th ave)

SAMPLE DESCRIPTION: garden hose
NITRATE DESCRIPTION:
SAMPLED: 8/26/2012 SET UP: 8/28/2012(2:30PM)

COLIFORM TEST	18-22 HRS	DATE	INTERPRETATION
	POSITIVE	8/29/2012	UNSAFE (>=1/100 mls)

ADDITIONAL TEST: TOTAL PHOSPHOROUS 0.09 mg/L
ADDITIONAL TEST: TOTAL COLIFORM 0.09 total cfu/100mL
ADDITIONAL TEST: MEMBRANE FLTRTN ECOI 1 E.coli cfu/100mL SAFE
NITRATE-N < 0.50 mg/L (SAFE - WIS. STANDARD)

5)

AgSource Laboratories
A Subsidiary of Cooperative Resources International
1001 Frontage Road * Stratford WI 54484

WATER TEST REPORT

WISCONSIN DATCP CERTIFICATION # 424

REPORT DATE....... 8/16/2012
(REPRINTED ON.... 8/22/2012)

SAMPLE #: 4198

SAMPLE DESCRIPTION: Pivot well sample north of dairy south of 3rd Street (not spreading manure at time of sample)
Central Sands 2
NITRATE DESCRIPTION:
SAMPLED: SET UP: 8/15/2012

ADDITIONAL TEST: ORTHOPHOSPHATE 0.06 mg/L
ADDITIONAL TEST: E.COLI 6000 cfu/mL
Alkalinity Total 46.00 mg/L

NITRATE-N	<	0.50 mg/L (SAFE - WIS. STANDARD)	
pH		6.01	
			IDEAL RANGES FOR DRINKING WATER
CALCIUM		15.56 ppm	0 - 50 ppm
MAGNESIUM		4.73 ppm	0 - 30 ppm
IRON		1.050 ppm	0 - .30 ppm
SODIUM		3.03 ppm	0 - 30 ppm
MANGANESE	<	0.050 ppm	0 - .05 ppm
SULFATES	<	0.71 ppm	0 - 75 ppm
POTASSIUM		1.31 ppm	0 - 50 ppm
CHLORIDE		1.10 ppm	0 - 10 ppm
CONDUCTIVITY		128.80 mohms/cm	
BORON	<	0.100 ppm	
WATER HARDNESS		58.33 (VERY SOFT WATER) 3.43 (Grains Per Gallon)	

6)

AgSource Laboratories
A Subsidiary of Cooperative Resources International
1001 Frontage Road * Stratford WI 54484

WATER TEST REPORT

WISCONSIN DATCP CERTIFICATION # 424

Nick Karris 771
415 N LaSalle
Chicago , IL,60654

REPORT DATE....... 8/31/2012

SAMPLE #: 4561

WELL ADDRESS: Bob Owens house Armania - Hwy G to east of Dairy
sample #12068

SAMPLE DESCRIPTION: hose
NITRATE DESCRIPTION:
SAMPLED: 8/26/2012 SET UP: 8/28/2012(2:30PM)

COLIFORM TEST	18-22 HRS	DATE	INTERPRETATION
	NEGATIVE	8/29/2012	SAFE (<1/100 mls)

ADDITIONAL TEST: TOTAL PHOSPHOROUS 0.07 mg/L
ADDITIONAL TEST: TOTAL COLIFORM 0.07 total cfu/100mL
ADDITIONAL TEST: MEMBRANE FLTRTN ECOI 1 E.coli cfu/100mL SAFE
NITRATE-N 23.90 mg/L (UNSAFE - WIS. STANDARD)

7)

AgSource Laboratories
A Subsidiary of Cooperative Resources International

WATER TEST REPORT

WISCONSIN DATCP CERTIFICATION # 424

Nick Karris 771
415 N LaSalle
Chicago , IL,60654

REPORT DATE....... 8/31/2012

SAMPLE #: 4606

WELL ADDRESS: town of Armania, Hoffman House (Hwy G east of dairy)

SAMPLE DESCRIPTION: 833G
NITRATE DESCRIPTION:
SAMPLED: 8/26/2012 SET UP: 8/30/2012

ADDITIONAL TEST: MEMBRANE FLTRTN ECOI 1 cfu/100mL
NITRATE-N 37.80 mg/L (UNSAFE - WIS. STANDARD)