REQUEST FOR PROPOSALS

LITTLE RIVER BAND OF OTTAWA INDIANS
2608 GOVERNMENT CENTER DRIVE
MANISTEE, ML 49660
PHONE: (231) 723-8288

REGARDING: REQUEST FOR PROPOSALS FOR WWTP IMPROVEMENTS PRELIMINARY ENGINEERING REPORT

PROPOSALS DUE: Monday June 16, 2025 5:00 pm EST

RFP NO.

1. PURPOSE

Little River Band of Ottawa Indians, a federally recognized Indian Tribe, is soliciting bid proposals from qualified firms for professional services associated with engineering services to develop a preliminary engineering report for a wastewater treatment facility that addresses meeting the Part 22 discharge limits for nitrogen and phosphorus and a new expanded discharge location.

This RFP does not commit the Tribe to accept any proposal submitted. The Tribe reserves the right to accept or reject any and all proposals, and to accept or reject any or all items in any proposal. The Tribe reserves the right to negotiate with any and all proposers and any and all parts of the proposals received, including, but not limited to, cost and other relevant details and to accept the proposal most advantageous to, and in the best interest of, the Tribe. The Tribe is not responsible for any costs incurred by the respondents in the preparation of responses to this RFP. The terms "vendor", "bidder," and "respondent" are used interchangeably throughout this RFP and are intended to refer to a person or entity submitting, or intending to submit, a proposal in response to this RFP.

1.1 **SCOPE OF WORK: PLEASE SEE ATTACHMENT A**

2. RFP ADMINISTRATIVE PROCREDURES

2.1 RFP CONTACT. The individual named below is the Tribal Contact. The Tribal Contact shall be the sole point of contact regarding this RFP from the date of issuance until selection of the successful bidder. To ensure clear and accurate communication and avoidance of the appearance of impropriety, from the date of issuance of this RFP until announcement of the successful bidder, proposers may contact only the RFP Contact. The RFP Contact will respond only to questions submitted in writing in accordance with this RFP. In the event that a vendor or someone acting on the vendor's behalf attempts to discuss this RFP verbally or in writing with any employee of the Tribe other than the RFP Contact/Contract Administrator designated below, the vendor may be disqualified as a prospective bidder.

Tribe's RFP Contact:

Gary Lewis, Utility Director
2608 Government Center Drive
Manistee, MI. 49660
Email: garylewis@lrboi-nsn.gov

2.2 RFP TIMETABLE. The dates set forth are subject to change, at the sole discretion of the Tribe:

EVENT	DATE
2.2.1 **RFP ISSUED**	May 23, 2025
2.2.3 **Due Date**	June 16, 2025

2.3 DUTY TO EXAMINE AND INQUIRIES REGARDING THE RFP.

2.3.1 It is the responsibility of each bidder to examine the RFP, including all amendments, seek clarification in writing (inquiries), and examine their proposal for accuracy before submitting the proposal. Lack of care in preparing a proposal shall not be grounds for modifying or withdrawing the proposal after the proposal due date and time, nor shall it give rise to any contract claim.

2.3.2 All inquiries concerning this RFP, including any questions related to the terms and conditions of this RFP, shall be made in writing and submitted to the RFP Contact at the physical address or email address noted above. Verbal inquiries will not be accepted.

2.4 CONTENT OF RFP AND SUPERSEDING EFFECT. This RFP is designed to provide prospective bidders with information necessary for the preparation of competitive proposals. Each bidder is responsible for determining all factors necessary for the submission of a comprehensive and compliant proposal. Proposals submitted in response to this RFP should be based solely on the material contained in the RFP, including
any amendments. This RFP supersedes all previous RFPs and all proposals, oral and written, and all negotiations, conversations, communications and discussions heretofore had between the parties, related to the subject matter of this RFP.

2.4.1 AMENDMENT OF RFP. The Tribe reserves the right to amend this RFP at any time. In the event it becomes necessary to amend, add to, or delete any part of the RFP, an amendment will be provided to all known vendors/prospective bidders who received the original RFP and will be posted on the Tribe's website.

2.5 SUBMISSION OF PROPOSAL. ***Every proposal submitted must include an original and three (3) copies.*** Proposals and copies must be submitted to the Little River Band of Ottawa Indians: **Gary Lewis, Utility Director, 2608 Government Center Drive, Manistee, MI. 49660. Proposals** must be received no later than 5:00 **P.M.(eastern time), Monday, June 16, 2025** ***Any proposal received after this deadline will not be accepted.*** Proposals must be submitted by Carrier (FedEx, UPS, etc.) The envelope must be SEALED and include the following notation on the bottom left-hand corner: "RFP FOR WWTP IMPROVEMENTS PER." Please also include company/individual name on the outside of the envelope. Bidders must allow ample mail delivery time to ensure timely receipt of their proposal. It is the bidder's responsibility to ensure that the proposal is received prior to the deadline. Postmarking by the due date will not substitute for actual receipt of the proposal by the Tribe. ***Proposals sent via email or fax will NOT be accepted.***

2.6 OPENING OF PROPOSALS. The proposals will be opened during a CLOSED BID OPENING on Tuesday, June 17, 2025 at 2:00 pm (eastern time), or as soon thereafter as practicable.

INTERVIEWS: The Tribe may conduct interviews with Proposers to clarify aspects set forth in their proposals or to assist in finalizing the ranking of top-ranked proposals. The interviews may be conducted in person or by phone. If conducted in person, interviews most likely will be held virtually using either Microsoft Teams or Zoom web meeting software. The Tribe will not reimburse Proposers for any cost incurred in traveling to or from the interview location.

2.7 REJECTION OF PROPOSALS. Notwithstanding any other provision of this RFP, at any time prior to execution of a written Contract, the Tribe reserves the right to reject any or all proposals, in whole or in part, to advertise for new proposals, to abandon the need for such services, and to cancel this RFP if it is in the best interest of the Tribe.

2.8 COSTS OF PREPARING PROPOSALS. The costs of preparing the proposal are the sole responsibility of the vendor. The Tribe is not responsible for any costs incurred by vendor which are

related to the preparation or delivery of the proposal or any other activities carried out by the vendor related to this RFP.

2.9 PROPOSALS PROPERTY OF THE TRIBE. All proposals become the property of the Tribe and shall not be returned to the bidder submitting a proposal. The bidder agrees that the Tribe may copy the proposal for purposes of facilitating the evaluation of the proposal or for any other reason.

2.10 VALIDITY OF PROPOSALS. All proposals shall be valid for a period of sixty (60) business days following the date on which proposals are due, except that the proposal of the successful bidder shall remain valid until expiration or termination of any contract based upon the successful bidder's proposal, between the Tribe and the successful bidder.

2.11 BIDDER'S REPRESENTATIONS.

2.11.1 By submitting a bid, the bidder certifies that they are authorized to conduct business in the State of Michigan.

2.11.2 By submitting this bid, the bidder certifies that they are experienced and qualified to perform the services required by this RFP and is properly staffed, organized, and financed to perform such services, and to commence such services immediately.

2.11.3 By submitting a bid, the bidder certifies that their bid and proposal were made and submitted without collusion or fraud and that they have not offered or received any kickbacks or inducements from any other bidder, supplier, manufacturer, or subcontractor in connection with its bid. The bidder also certifies that they have not conferred with any Tribal employee having official responsibility for this procurement transaction, any payment, loan, subscription, advance, deposit of money, services, or anything of more than nominal value, present or promised, unless consideration of substantially equal or greater value was exchanged.

2.12 NATIVE AMERICAN PREFERENCE REQUIREMENTS. Proposals are subject to the Tribe's General Procurement Policies and Procedures. Proposers claiming Native American Preference under this proposal, must include documentation that confirms that the proposer qualifies of having Native American Preference.

2.13 PROPOSAL EVALUATION AND SOURCES OF INFORMATION.

2.13.1 Proposals that comply with the mandatory requirements of this RFP will be evaluated by the RFP committee with respect to the point grading scheme below:

1. 25 points Experience and Reputation.
2. 25 points Understanding of Scope of Work.
3. 25 points Proposal Price.
4. 15 points Delivery time.
5. 05 points Native American Preference (certification required)
6. 05 points Small and minority businesses, women's business enterprises, and labor surplus are firms (certification required).

2.13.2 The Tribe reserves the right to request additional information from any bidder prior to final selection and award of a bid, and the bidder shall furnish to the Tribe all such information and data as may be requested. The Tribe also reserves the right to obtain from any and all sources, information concerning a bidder or a bidder's products, services or personnel, to make such reasonable investigations as the Tribe deems proper and necessary to determine the ability of a bidder to perform the services contemplated by this RFP, and the right to consider information from other sources such as the bidder's performance of other contracts. The Tribe may use any of this information to evaluate a bidder's proposal.

2.14 AWARD AND NOTIFICATION. The Tribe reserves the right to either award a purchase contract without further negotiations with the successful bidder or to negotiate contract terms with the selected bidder if in the best interest of the Tribe. The successful bidder may be required to attend a post-award meeting with representatives of the Tribe to discuss the terms and conditions of the purchase contract.

2.15 DISPUTES. In case of any doubt or differences of opinions as to the contents of this RFP, or interpretation of any provision of this RFP, the decision of the Tribe shall be final and binding upon all parties.

3. CONTENT AND FORMAT OF PROPOSAL

3.1 PURPOSE. These instructions prescribe the required format and content of the proposal and are designed to elicit information necessary to selection of the most qualified bidder, and to facilitate the submission of a proposal that is easy to understand and evaluate.

3.2 FORMAT. Proposals shall be prepared on 8.5" x 11" paper, single sided. **A proposal submission must include an original and three (3) copies of the proposal, including all attachments.**

3.3 CONTENT. Each proposal shall respond completely to the following questions and requests for information:

3.3.1 Please provide a description of the bidder's organization including size, goods and services offered and length of time in operation. Please include if the bidder is a registered MBE/WBE. Refer specifically to bidder's branch location or affiliate. Please provide full name, address, telephone number(s), fax number, and email address of bidder and bidder's primary contact, and verify that the bidder is authorized to conduct business in the State of Michigan.

3.3.2 Relevant Project Experience. Please provide the name and qualifications of the person(s) who will be responsible for general oversight of the project. List other projects similar in scope in the last five (3) years, listing each project name, project scope, and the role your firm played in the project.

3.3.3 Reputation. Please list three (3) entities, either commercial or governmental, to which bidder has provided similar services to within the past three (3) years. Include the name, address, telephone number, and email contact information of the point of contact, and a description of the goods and/or services provided. The Tribe reserves the right to conduct reference checks.

3.3.4 Understanding Scope of Work. Please summarize how your firm will organize this project.

3.3.5 Proposal Price.

3.3.6 Delivery Time. Please provide an estimated time that your team will require to accomplish Little River Band of Ottawa Indians scope in respect to this RFP.

3.3.7 Indian Preference. If claiming Native American Preference, please provide documentation of Indian Preference.

3.3.8 The submission of additional pertinent information beyond the requirements of this **RFP** is acceptable.

4. REQUIREMENTS

4.1 MARKETING PROHIBITION. The successful bidder shall not use the name of, or refer to, Little River Band of Ottawa Indians or any Tribal departments, program, or entity of the Tribe in any marketing activity. Nor will the successful bidder use said names or references thereto in any endorsement of its company, products, or services, without the written consent of the Little River Band of Ottawa Indians.

4.2 NO ASSIGNMENT. No bidder may assign its bid/proposal or any rights or obligations with respect thereto to any other party. No purchase contract between a successful bidder and the Tribe may be assigned by either party without the prior written consent of the other party, which consent may be given, withheld, or conditioned in the sole and absolute discretion of the party whose consent is sought. Any assignment, subcontract, or delegation in derogation of this provision shall be deemed void.

Attachments:

- **ATTACHMENT A - Scope of Work with attachments**
- **ATTACHMENT B - LRBOI Master Agreement for Services**

ATTACHMENT A

Scope of Work (SOW)

May 2025

Project Title: Little River Band of Ottawa Indians - WWTP Improvements PER

IHS Project Number: BE-24-N19

IHS Project Managers: Sarah Willoughby, P.E. and Matthew Zoch, P.E.

1. Background / Need for Service:

The Little River Band of Ottawa Indians (LRBOI) is soliciting proposals for the development of a Preliminary Engineering Report (PER) for their Wastewater Treatment Plant (WWTP) that addresses meeting the Part 22 discharge limits for nitrogen and phosphorus and a new expanded discharge location.

The LRBOI currently owns and operates a wastewater treatment plant consisting of a dual train sequencing batch reactor (SBR), an aerated lagoon system, a septage receiving station, sludge storage and two drain field discharge systems. LRBOI is anticipating additional flow and loading to the wastewater treatment facilities based on known future growth.

In 2020, LRBOI hired consultant company Gosling Czubak Engineering Sciences (GCES) to complete a study to evaluate current conditions and treatment capacities of the two wastewater treatments systems.

The Report of Engineering Study prepared by GCES is attached to this document. The following is a summary of the attached document:

- The two treatment systems cannot meet the future hydraulic loading when run independently of each other. However, the two treatments systems do have the combined capacity to handle the future hydraulic needs when operated in parallel.

- The LRBOI is not required to operate its Wastewater Plant under the Michigan Department of Environment, Great Lakes and Energy (EGLE) Groundwater Discharge Permit. The current discharge requirements that they follow are set forth by best management practices as recommended by the USEPA. However, the LRBOI desires to adopt the more stringent requirements of the EGLE Part 22 Groundwater Discharge Program. Adopting this standard will result in restrictions on the allowable nutrient levels of Total Inorganic Nitrogen (TIN) and Total Phosphorus (TP) in the discharge.

- The existing treatment systems struggle to consistently treat wastewater to the levels that would be required by Michigan Part 22 Groundwater Discharge limits. The lagoon system is not designed for phosphorus removal and is unable to reduce ammonia during winter months. The SBR, while designed to meet the Part 22 criteria is unable to achieve full treatment due to equipment aging/failure and buildup of solids in the SBR tanks.

- The engineering study report concluded that the upgrades that would be required to meet the Part 22 criteria would best be applied to the SBR system. Due to the age of the SBR system, there were recommendations to upgrade some aging equipment and by adding headworks to the system for screening and grit removal.

Concurrently with the wastewater treatment study, the LRBOI again worked with GCES to complete a hydrogeological investigation for a potential new discharge field location adjacent to the SBR. The hydrogeological investigation completed by GCES is also attached to this document. The findings in the report indicate that the site is generally favorable for a future discharge site. However, discharge area sizing and layout were not completed as part of the investigation.

The Tribe is currently in the process of upgrading the headworks for the WWTP. The new headworks will screen all incoming wastewater and septage for both the lagoon and the SBR. The new headworks is scheduled for startup by November 2025. The existing septage screen for the lagoon will then be demolished.

The Tribe intends to divide the incoming flow and septage between the SBR and Lagoon treatment systems as follows.

- After incoming flow is screened, all flow (except septage) will be directed to the SBR up to the design average daily flow of 180,000 gpd. Any flow in excess of 180,000 gpd and all septage will be directed to the lagoon.

The Tribe is planning to handle the SBR improvements separately and no additional analysis of the SBR system is required at this time. However, for the lagoon system, although significant planning has been completed to date, additional work is required to develop a comprehensive PER to outline alternatives to enhance treatment capabilities of the lagoon to meet the proposed discharge requirements. The PER shall also include a preliminary design and proposed layout for the new discharge area.

2. Summary of Work:

Prepare a PER that meets the guidelines to secure funding from various federal agencies (PER format described in Part 3). The PER will focus on the lagoon system and proposed discharge area. No additional analysis for the headworks or SBR system is included. The final work product will be a report that summarizes a range of alternatives, provides construction and operational cost projections, and estimates user costs. A preferred alternative will be selected with input from the Tribe, and a detailed description and cost estimate will be provided for the selected alternative.

The work required of the consultant shall include but not be limited to the following:

- Review all available reports and documents including the Report of Engineering Study and Hydrogeological Investigation Report prepared by GCES, record drawings, operation, and maintenance manuals, etc.
- Consult with the LRBOI on the headworks and any SBR upgrades that are in progress and ensure that the recommendations in PER for the lagoon are compatible and cost estimates include any integration costs.

- Collaborate with the LRBOI and IHS including in-person site visits, virtual meetings, and written communications.
- Gather data from the LRBOI regarding WWTP influent flows and loadings, effluent flows and loadings, sludge volume, etc. for the past 5 years.
- Gather data from the LRBOI regarding future development for a 20-year design period. Use this information to determine the estimated future WWTP flows, loadings, and sludge volumes for the lagoon to be used for the design analysis.
- Evaluate the current treatment performance and discuss the abilities of the lagoon to meet the estimated future demands considering the new discharge requirements.
- Identify reasonable alternatives for flows to the lagoon to meet the Part 22 treatment criteria.
- Complete a preliminary design and layout drawing for a new discharge system at the property covered by the hydrogeological investigation.
- Select an alternative and describe the rationale for selection.
- Prepare a detailed cost estimate for the selected alternative.
- Make recommendations for completing the work in phases if funding is not available for the full scope of work. The phases should be organized by the priority of the deficiencies and/or the most logical progression to limit system interruption when each phase is completed.

Note: Construction plans for SBR, lagoon and headworks addition are available upon request.

3. Requirements for the Work:

The Consultant shall:

- Assign a Professional Engineer (PE), registered in the State of Michigan to oversee the development of the PER for the duration of the work who has the requisite, demonstrable experience to successfully lead this project and who shall be identified in the Consultant's proposal.
- Designate a primary Project Manager to oversee the work being performed. A permanent change of the Project Manager (primary) shall occur only due to exceptional events such as employees resigning, and in those cases another equally or more qualified Project Manager shall be assigned. The Consultant's workload or preference shall not be a reason to switch Project Managers.
- Be legally qualified to do business in the State of Michigan, and shall provide registration/license numbers.
- Schedule and attend monthly virtual meetings to collaborate with the IHS and the LRBOI and to report on progress.
- Schedule and attend a minimum of two (2) in person meetings with the IHS and the LRBOI. The first meeting will be a kick-off meeting at the beginning of the project where the consultant will become familiar with the facility and gather data from the Tribal utility. The second meeting will be at the 90% completion stage where the consultant will present the recommendations to the LRBOI and IHS and obtain buy-in from all parties prior to finalizing the PER.

The following codes, guidelines and authorities shall be adhered to with regard to analyses of the existing wastewater systems, and proposed alternatives:

- United State Environmental Protection Agency (US EPA)
- "10 States Standards for Wastewater Facilities". Great Lakes - Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers
- Part 22 Rules, Groundwater Quality, State of Michigan Department of Environment Great Lakes and Energy

Units of measure used in reports and analyses shall be United States customary units, with preference given to:

- Length: miles, feet, inches
- Area: square miles, acres, square feet, square inches
- Volume: cubic feet, cubic yards
- Fluid Volume: gallons, million gallons
- Fluid Flow Rate: gallons per minute, million gallons per day
- Pressure: pounds per square inch

The PER shall conform to the format, TOC structure and content recommendations of the Interagency Memorandum dated January 16, 2013 attached to this document. This is also available online at the following locations:

https://www.ihs.gov/dsfc/resources/

https://www.ihs.gov/sites/dsfc/themes/responsive2017/display_objects/documents/InteragencyMemorandumPER1-16-2013.pdf

4. Deliverables:

The PER shall be provided to the LRBOI and IHS for review and comments at three stages: the 60%, 90% and Final Draft versions. The final PER shall incorporate or address any review comments from the Final Draft review. Present findings in a PER signed and sealed by Professional Engineer (PE).

The project deliverables shall be in the following formats:
Draft PER: editable MS Word document (Office 2016 or higher)
Final PER: PDF (Adobe Acrobat)

5. Place of Performance:

Consultant shall perform site visits to the Little River WWTP as required and shall anticipate at least two such site visits in proposed costs with more as needed.

Data analyses, report writing and any other work not needing in-person presence at the site may be performed remotely from any location in the USA. Consultant shall be mindful and cooperate to accommodate time zone differences during virtual meetings and calls.

6. Period of Performance / Schedule:

Complete all work within 6 months of task order award.

Consultant Deliverable	Date of Contract Deliverable	IHS/LRBOI Deliverable	Date of IHS Deliverable
Coordination with LRBOI and IHS for kick off meeting	Within two weeks of contract award		
60% review of the PER	3 months after contract award	IHS and LRBOI review and comment period	Complete review after 2 weeks of delivery of draft PER
90% review of PER	4 months after contract award	IHS and LRBOI review and comment period	Complete review after 2 weeks of delivery of draft PER
Final draft review of PER	5 months after contract award	IHS and LRBOI review and comment period	Complete review after 2 weeks of delivery of draft PER
Final signed PER	6 months after contract award		

7. Attachments:

1. GCES, Report of Engineering Study, Little River Band of Ottawa Indians- February 24, 2020 (22 pages)
2. GCES, Hydrogeological Investigation Report, Little River Band of Ottawa Indians WWTP Proposed Improvement Construction – Revised July 10, 2020 (187 pages)
3. Interagency Memorandum with PER Template (18 pages)

Report of Engineering Study

Little River Band of Ottawa Indians

Manistee, Michigan

February 24, 2020

Prepared by:
Gosling Czubak Engineering Sciences, Inc.
1280 Business Park Drive
Traverse City, Michigan
(231) 946-9191
www.goslingczubak.com

GCES Project # 2018096001.00

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Gosling Czubak
engineering sciences, inc.

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TABLE OF CONTENTS

1.0 PURPOSE

The Little River Band of Ottawa Indians (LRBOI) is a Native Sovereign Nation based near Manistee, Michigan. The LRBOI currently owns and operates a wastewater treatment facility consisting of a dual train sequencing batch reactor (SBR), an aerated lagoon system, a septage receiving station, sludge storage and two drain field discharge systems. LRBOI is anticipating additional flow and loading to the wastewater treatment facilities based on known future growth and requested Gosling Czubak Engineering (GCES) study and answer the following;

- How is the plant and the existing equipment currently operating?
- Can the designed plant handle the planned and future development in the service area?
- What upgrades are feasible and what is the estimated cost for these improvements?

2.0 SYSTEM DESCRIPTION

2.1 Design Flow and Loading

The existing wastewater treatment plant is a combination of two separate treatment facilities; the SBR designed and constructed in 2002 and the aerated lagoon that was designed and constructed in 2014. The two systems treat wastewater collected from the Little River Casino Resort, various commercial and residential units within LBROI community, residential and commercial users in Manistee Township, and septage waste brought in by haulers. The original basis of design for both systems are illustrated in the following tables.

2-1 BASIS OF SBR SYSTEM DESIGN

PARAMETERS		VALUE
Total Average Design Flow (gpd)		180,000
Peak Instantaneous (gpd)		270,000
Influent	BOD (mg/l)	700
	SS (mg/l)	200
	TKN (mg/l)	150
	NH3N (mg/l)	70
	P (mg/l)	20
Effluent	BOD (mg/l)	10
	SS (mg/l)	10
	TKN (mg/l)	5
	NH3N (mg/l)	1
	P (mg/l)	1

2-2 BASIS OF LAGOON SYSTEM DESIGN

PARAMETERS		VALUE
Total Average Design Flow (gpd)		200,000
Influent	BOD (mg/l)	350
	TKN (mg/l)	75
Effluent	BOD (mg/l)	30
	TKN (mg/l)	2

The current operation at the facility splits the flows between the two treatment systems with the majority of the septage receiving station getting sent to the lagoons for treatment and the remaining flow receiving treatment at the SBR. Both treatment systems have primary screening and discharge treated effluent into drain fields.

2.2 Sequencing Batch Reactor

The SBR was designed with two operating trains. Each train is set to complete up to three batches per day. Influent from the collection system goes through the influent header structure where it is split between the SBR or Lagoon Treatment process. Flow is metered prior to an in-channel mechanical fine screen. After screening, the wastewater moves to the Pre-Equalization Basin. The treatment process after this point is split between the two SBR trains. Screened influent is moved to either SBR tank based on the programed levels. Blowers provide air to each SBR to maintain the desired dissolved oxygen levels. Chemical addition occurs in the SBR to assist in the removal of nutrients, specifically phosphorus. A fixed decanter allows 30,700 gallons of treated effluent to move to the Post-Equalization (EQ) tank after the set time has been reached. Treated effluent is discharged from the Post-EQ tank through a cloth disc filter before it is discharged into drain fields. The drain field is a two-cell design and has a total area of 90,000 square feet, for an application rate of two gallons per square foot per day(sft/day) at design flow rate. During the process, waste activated sludge is pulled from the settled SBR tanks and is moved to sludge holding tanks. Prior to land application, the sludge pH must be adjusted and therefore is pumped back into the Lime Stabilization Tanks and mixed with Lime for the adjustment period of 48 hours.

2.3 Aerated Lagoon System

The aerated lagoon system was added in 2014 to increase the treatment capacity of the wastewater system. Wastewater from the collection system is diverted at the influent header structure and travels through a mechanical screen prior to being pumped to the lagoon system. The two basins operate in series at the lagoons with both basins having an effective depth of 16 feet. The first cell has a volume of 4.68 million gallons (MG) and would treat nearly 83% of the BOD. The second cell has a volume of 3.11 MG and would treat an additional 10% of the BOD and 97% of the TKN. It is noted in the system design that nitrogen treatment is not likely to occur in winter months due to cold temperatures. The secondary treatment cell effluent is discharged to the leach field. The leach field is a four-cell system, with each cell sized at 3,136 square feet. At the design flow, this is equivalent to an application rate of nearly sixteen gallons per square foot per day.

2.4 Permitting

The LRBOI is a Native Sovereign Nation and does not require a permit to operate its Wastewater Facility under the Michigan Department of Environment, Great Lakes and Energy (EGLE) Groundwater Discharge Permit. The design criteria are set forth by best management practices as recommended by the United State Environmental Protection Agency (EPA). Acting as good stewards of the environment, the tribe has requested that any improvements meet the more stringent requirements of the EGLE Part 22 Groundwater Discharge Program. This desire will add restrictions on the allowable nutrient levels of Total Inorganic Nitrogen (TIN) and Total Phosphorus (TP) in the discharge.

2-3 PART 22 STANDARD EFFLUENT PERMIT LIMITS

PARAMETER	MAXIMUM DAILY LIMIT	UNITS	MONITORING FREQUENCY
Flow	280,000	gpd	Daily
pH (minimum)	5.5	S.U.	3x Weekly
pH (maximum)	10	S.U.	3 x Weekly
Total Inorganic Nitrogen	5	mg/l	Calculation
Ammonia Nitrogen	report	mg/l	3 x Weekly
Nitrate Nitrogen	report	mg/l	3 x Weekly
Nitrite Nitrogen	report	mg/l	3 x Weekly
Chloride	250	mg/l	3 x Weekly
Sodium	150	mg/l	3 x Weekly
Total Phosphorus	1	mg/l	3 x Weekly

3.0 SYSTEM PERFORMANCE

3.1 System Flow

Based on data from 2018, LRBOI has a current influent flow ranging between 70,000 gpd and 161,000 gpd with an average daily flow of 122,000 gpd. Septage haulers contribute between 2,000 to 6,000 gpd of the average daily flow. Flows are at the lowest during the winter months and peak in the summer to

early fall. A peaking factor of 1.34 matches the observed peak day flows, for a design peak day of 163,480 gpd. Existing flows are within the range of the design flows of the existing SBR, and below the lagoon design flow.

3.2 Effluent Quality

Effluent quality is monitored per EPA requirements through monthly grab samples. The important criteria are explained below, with effluent results in the following figures.

Biochemical Oxygen Demand (BOD_5): The amount of dissolved oxygen needed to allow microorganisms to decompose the organic matter. This test is a good indication of the amount of organic load in the wastewater. Without organic removal, ammonia removal becomes more difficult.

Ammonia (NH_3-N): The concentration of ammonia in the wastewater. The breakdown of ammonia requires varying the amount of available oxygen to the microorganisms in the wastewater to convert it to Nitrite and then Nitrate before it is released as Nitrogen gas (N_2). Ammonia, Nitrite and Nitrate make up Total Inorganic Nitrogen, which is regulated under the Part 22 rules. Nitrite can be harmful when found in drinking water.

Total Phosphorus (TP): The concentration of phosphorus in the wastewater. High levels of phosphorus in water can create an environment favorable for deadly algae blooms. For this reason, the criteria phosphorus is only 1 mg/L. While a small amount of phosphorus can be biologically consumed, to achieve the low-criteria level requirement, chemical addition and filtration are the most effective means of removal.

FIGURE 1 – LRBOI BOD EFFLUENT

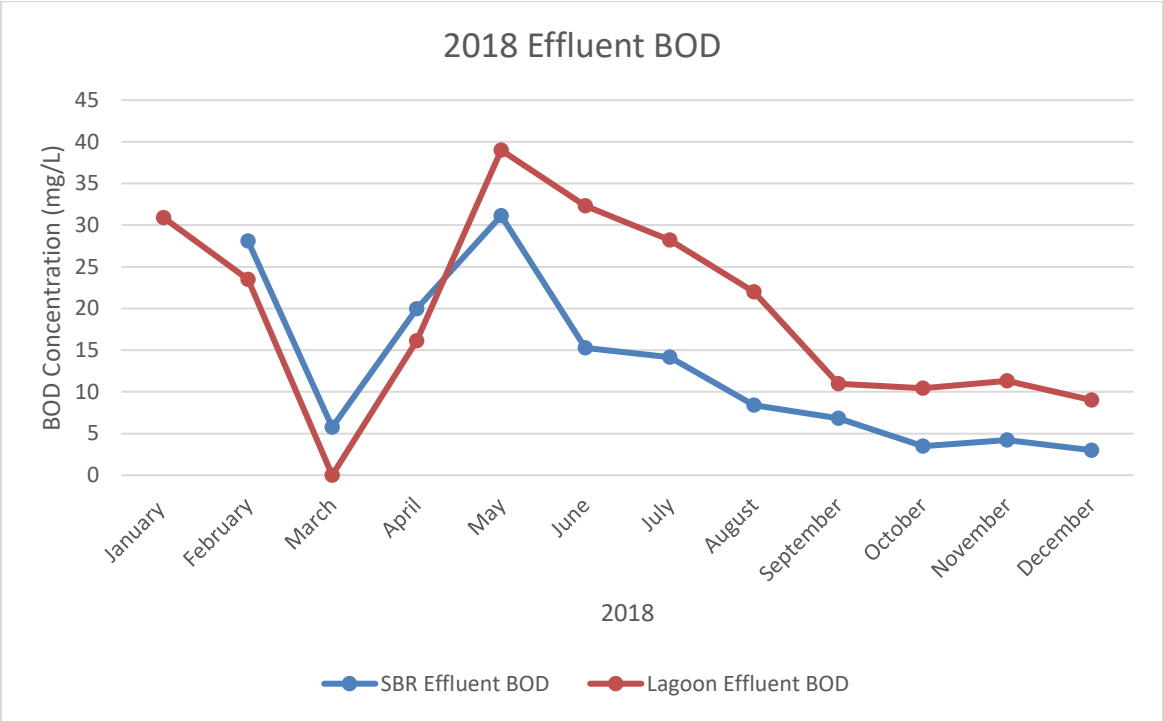


FIGURE 2 – LRBOI EFFLUENT AMMONIA

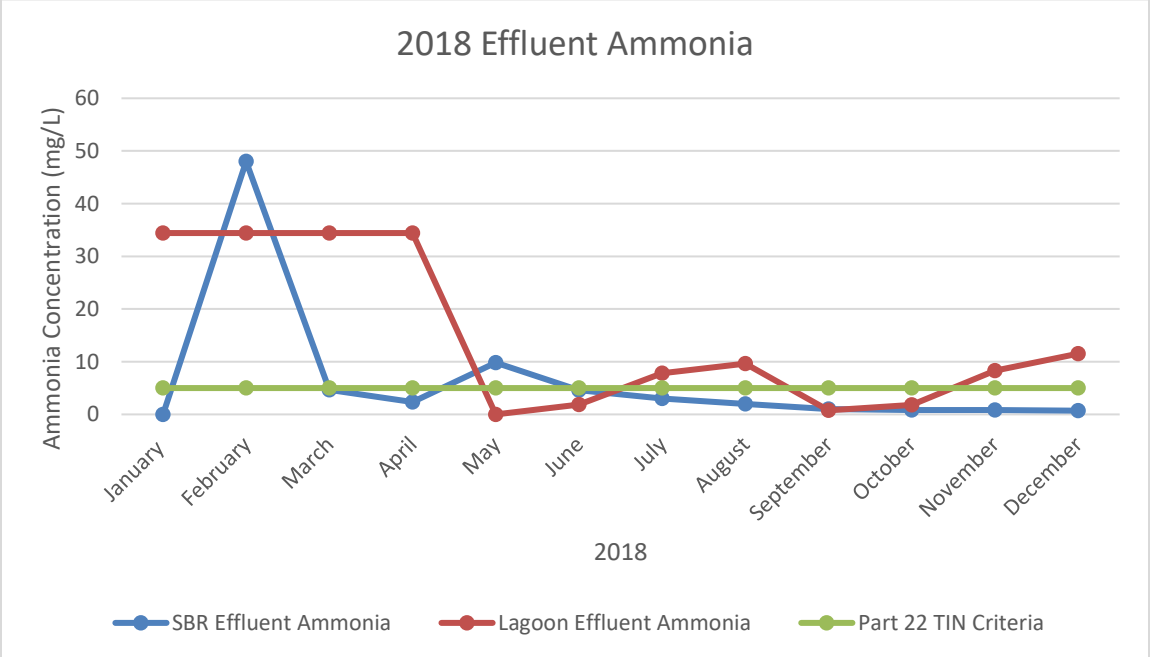
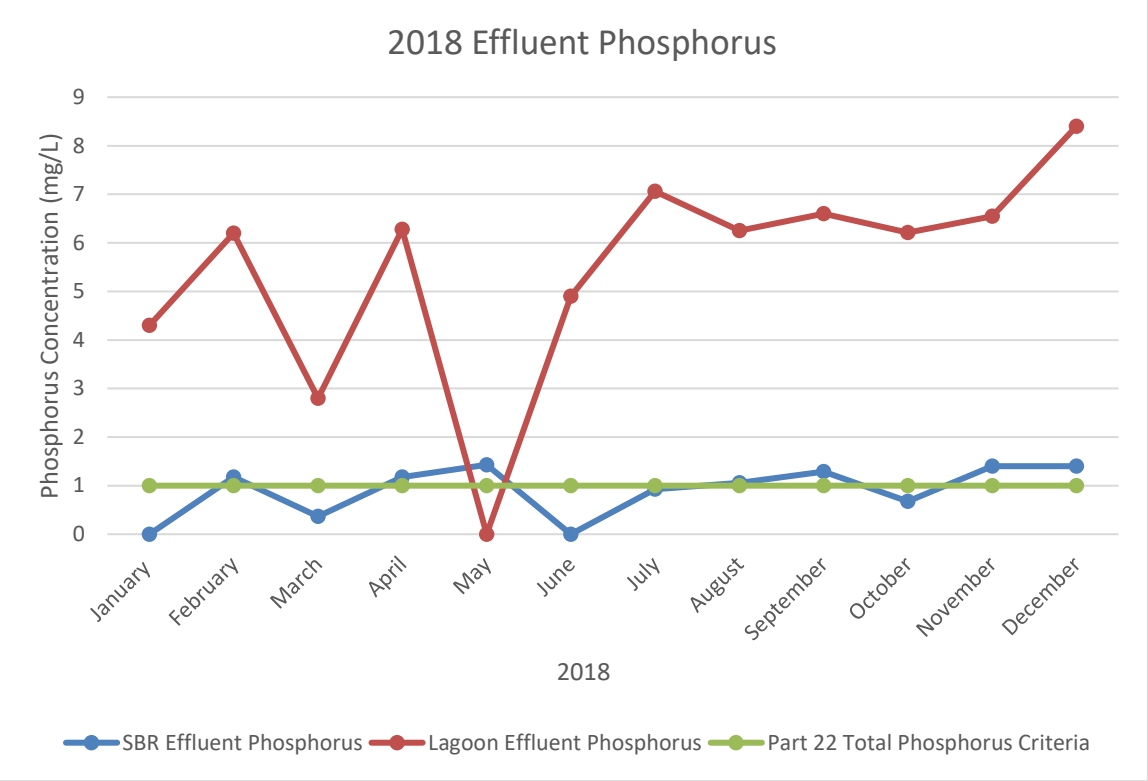


FIGURE 3 – LRBOI EFFLUENT PHOSPHORUS



The existing treatment systems struggle to consistently treat wastewater to the levels that would be required by Michigan Part 22 Groundwater Discharge limits (as illustrated in the graphs). The lagoon system is not designed for phosphorus removal and is unable to reduce ammonia during winter months. The SBR, while designed to meet the Part 22 criteria is unable to achieve full treatment due to equipment aging/failure and buildup of solids in the SBR tanks.

3.3 Future Ability

LBROI anticipates an expansion within the life expectancy (20 years) of the treatment plant that would increase flows. Future growth, both planned and unknown would increase average day flows from an existing 122,000 gpd up to an average day flow of 204,000 gpd with a max daily flow of 273,000 gpd. This exceeds the design flow of both the existing SBR and Lagoon system independently. But could be managed with both online. From the provided data, current BOD concentration to the SBR system appears to be within design range whereas the concentration of the influent BOD to the lagoon system exceeds design criteria. The septage receiving station that was added after the lagoon expansion is likely the major contributor of the high BOD concentration. Based on the provided data, system loading (BOD in lb/day,

which is calculated from flow and concentration) appears to be below design loading. In terms of design loading, the existing system has capacity for future expansion; however, the effluent quality shows that both systems are struggling to meet design (EGLE Part 22) discharge criteria (even though the influent flow and loading are within the design criteria). Future expansion is not feasible without upgrading the existing system, if Part 22 criteria is to be met. The inability of the two systems (separate or in combination) to meet design discharge limits is likely attributed to a combination of inefficient equipment performance and lack of proper primary treatment.

4.0 OBSERVATIONS

4.1 Existing Equipment

The effective operation of the existing WWTP equipment is essential in keeping performance at or near original design. The SBR equipment is now approximately eighteen years of age. Life expectancy on process equipment is up to 20 years before major rehabilitation or replacement is required. For example, the plant only operates one train of the process and it has been noted that many of the valves have already failed and required replacement. The SBR has been found to contain large amounts of grit as there is no grit removal as part of the primary treatment. Grit build up reduces SBR treatment capacity and efficiency. The existing auger style screen in a one-foot channel is in fair operating condition. But, again, is reaching its expected useful life. The existing screen is not designed to meet future flows. Current mechanical screens have become more effective at removing inorganics from the waste stream. The SBR tertiary filter has not had an operational automatic backwash system in over a year. The operator manually cleans the screen with a hose as needed and allows the flow to continue through the disc screen using hydraulic pressure. The panel for the filter is not operational. The filter has reached its useful life and will need a complete replacement. The existing pumps and blowers are currently operating sufficiently, however, would operate more efficiently with variable frequency drives (VFDs). VFDs would assist the SBR in better process control as well as efficiency.

The equipment at the lagoon system is only four years old and is in good operating condition. As with the SBR, large amounts of grit are found in the waste stream and have increased the sludge buildup on the bottom of the lagoons. The operator has noted that the existing diffusers located on the bottom of the lagoon basins do shift over time and must be relocated to their original position.

4.2 Performance

Both the SBR and Lagoon systems struggle to meet design effluent criteria. The quality of effluent of the SBR system is well below what the plant should be capable of producing (as documented). The SBR equipment no longer has the effectiveness of the original design. The lagoon system, with newer equipment, was not designed to meet Part 22 discharge criteria and would need major upgrades to meet new design criteria.

5.0 ALTERNATIVES

Based on new design criteria and existing systems evaluations, two alternatives were developed that would meet the following:

1. More stringent Part 22 effluent criteria
2. Allow for future growth

5.1 Alternative 1: SBR Improvements

The first alternative evaluated what improvements are necessary at the SBR plant to meet the design criteria. Since the existing SBR was originally designed using criteria similar to the new design criteria, it was found that the existing footprint and tanks could be used and only the equipment would need to be upgraded. As part of this alternative, all existing SBR equipment and piping would be removed and new SBR equipment would be installed. In addition, the SBR tanks may need some minor structural modifications with the addition of the new equipment. An important improvement would be enhanced primary treatment. The existing screen would be removed, and new combination screen and grit removal equipment would be installed in a new building where the existing influent splitter structure is located. This would reduce the volume of inorganic solids entering the SBR, which is currently a problem and inhibiting treatment. New chemical tanks and feed pumps would be installed to replace the existing FRP tanks that have reached their useful life. A new pumping system would be added to the existing Post-EQ tank and send the treated SBR effluent to a new tertiary filter. This upgraded treatment process could produce effluent quality that meets or exceeds Part 22 requirements (operated within the design basis). For this reason, the effluent would then be discharged into new rapid infiltration basins (RIBs). The existing drain field would be abandoned. The discharge rate for the new RIBs would be approximately 4 in/day (2.38 gal/sft/day) based on conducted field studies. With this alternative, all wastewater treatment

would be handled at the upgraded SBR, eliminating the need for the lagoon system. The lagoon system could be abandoned in place, or utilized for another purpose (i.e.- sludge storage).

5.2 Alternative 2: Lagoon Improvements

The second alternative evaluated what improvements would be necessary at the lagoon system to meet the design criteria. Since the existing lagoon was not originally designed to meet Part 22 discharge requirements, it was found additional treatment would need necessary as well as upgrades to the lagoon aeration. As part of this alternative, one of the existing lagoons would be converted into a new aeration basin. New aeration equipment would be installed that creates aerobic and anoxic zones to treat the BOD and Nitrogen. Two new clarifiers would also be installed within the footprint of the converted lagoon. Chemical addition prior to the clarifiers would be required to reduce phosphorus in the effluent. The second lagoon basin would remain but would become sludge storage. The new treatment process would generate more sludge than the previous lagoon system. The solids would be collected in the bottom of the clarifiers and be pumped back to the start of the aeration basin or wasted to sludge storage. Existing aeration equipment would be used to aerate the sludge storage lagoon to prevent odor issues. As with the SBR improvements, new primary treatment would be required for the lagoon system to work properly.

A new combination screen and grit removal equipment would be installed in a new building where the existing influent splitter structure is located prior to being pumped to the lagoon system. This will reduce the volume of inorganic solids entering the lagoon and potentially building up on the bottom. New chemical tanks and feed pumps would be installed in a new building next to the lagoons. A new pumping structure would be required to move sludge from the clarifiers to aeration or sludge storage basins. This upgraded treatment process would produce effluent quality that meets or exceeds Part 22 requirements. For this reason, the effluent could then be discharged into new rapid infiltration basins (RIBs). The existing drain field would be abandoned. A new effluent pump station would pump the treated water from the clarifiers to the new RIBs. The discharge rate for the new RIBs would be approximately 4 in/day (2.38 gal/sft/day) based on conducted field studies. With this alternative all wastewater treatment would be handled at the upgraded lagoon, eliminating the need for the existing SBR. The SBR could be abandoned in place or utilized for another purpose (i.e. – high strength waste and/or septage treatment).

6.0 COST ANALYSIS

The following cost analysis are given as a budgetary reference and do not necessarily include all costs associated with the items. Costs are highly subject to the project scope and market fluctuations. A breakdown of the Costs can be found in the Attachment 1.

6.1 Capital Improvements

- Alternative 1: $3,692,000
- Alternative 2: $4,446,000

6.2 Operation and Maintenance Costs

- Alternative 1: $62,609 annually
- Alternative 2: $69,503 annually

6.3 Present Worth Analysis

- Alternative 1: $3,345,188 over the 20-year planning period
- Alternative 2: $3,924,148 over the 20-year planning period

7.0 RECOMMENDATIONS

It is recommended that Alternative 1 is pursued for the following reasons:

1. Some form of improvement is required to meet discharge criteria
2. The poor and failing condition of existing facilities.
3. The 20-year Present Worth Analysis between the two alternatives shows that Alternative 1 has a lower overall cost than Alternative 2.
4. Capital Cost for Alternative 1 is substantially less than Alternative 2.
5. Estimated Operational Expenses for Alternative 1 is less than Alternative 2.
6. All the treatment processes would become more localized to the existing laboratory and office space.
7. All treatment units would be inside buildings making maintenance easier and reducing seasonal cold weather concerns.

8. More control over the treatment process. The SBR offers a better solution to treating the variable flows and loading that LRBOI has historically seen.

Attachment 1

Alternative Cost Estimates

Alternative 1: Existing System Rehabilitation + Process Upgrades
PRELIMINARY OPINION OF PROBABLE COST
WASTEWATER SYSTEM IMPROVEMENTS PROJECT
LRBOI

	Item	Quantity	Unit	Unit Price	Amount	Sub-Total
	Demolition					$115,000
1	Ex. SBR Equipment & Tank Cleaning	1	l.s.	$40,000	$40,000	
2	Ex. Screen	1	l.s.	$5,000	$5,000	
3	Ex. Blowers	1	l.s.	$15,000	$15,000	
4	Ex. Filter	1	l.s.	$5,000	$5,000	
5	Ex. Chemical Tanks	1	l.s.	$20,000	$20,000	
6	Misc Piping and other	1	l.s.	$30,000	$30,000	
	SBR Reactors					$783,000
1	SBR Equipment	1	l.s.	$460,000	$460,000	
2	SBR Equipment Installation	1	%	30%	$138,000	
3	Process Piping & Valves	1	l.s.	$55,000	$55,000	
4	Electrical & Control Wiring	1	l.s.	$100,000	$100,000	
5	Post-EQ Configuration, piping & valves	1	l.s.	$30,000	$30,000	
	Screening and Grit					$783,100
1	Headworks Building	800	sft	$300	$240,000	
2	HVAC/Electrical	800	sft	$250	$200,000	
3	Instrumentation/Gas Detection	1	l.s.	$25,000	$25,000	
4	Yard Piping	1	l.s.	$25,000	$25,000	
5	Equipment	1	l.s.	$215,000	$215,000	
6	Installation	1	%	30%	$64,500	
7	Earthwork	120	yd^3	$30	$3,600	
8	Misc Metals	1	l.s.	$5,000	$5,000	
9	Structural Concrete	1	l.s.	$5,000	$5,000	
	Rapid Infiltration Basins					$398,400
1	Earthwork	9	acre	$22,000	$187,000	
2	Yard Piping	2,000	ft	$45	$90,000	
3	Air Release Structure and Valves	1	l.s.	$25,000	$25,000	
4	Discharge Stone areas	9	ea	$2,000	$18,000	
5	Seeding/Restoration	1	l.s.	$3,000	$3,000	
6	Gravel	1,000	yd^3	$25	$25,000	
7	Fencing	2,800	ft	$18	$50,400	
	Tertiary Filter					$394,500
1	Filter Equipment	1	l.s.	$215,000	$215,000	
2	Installation	1	%	30%	$64,500	
3	New Filter Pump and Installation	1	l.s.	$75,000	$75,000	
4	Process Piping	1	l.s.	$15,000	$15,000	
5	Electrical/Instrumentation	1	l.s.	$25,000	$25,000	
	Chemical Feed					$93,500
1	Storage Tanks	1	ea	$35,000	$35,000	
2	Installation	1	%	30%	$10,500	
3	Chemical Feed Pumps	1	l.s.	$20,000	$20,000	
4	Process Piping	8	ea	$2,000	$16,000	
5	Panels, controls, Measurements	1	l.s.	$12,000	$12,000	
	System Improvements					$272,000
1	Pump Station Radio Telemetry Study	1	l.s.	$8,000	$8,000	
2	Pump Station Radio SCADA	4	ea	$15,000	$60,000	
3	System Integration	1	l.s.	$30,000	$30,000	
4	Composite Samplers	2	ea	$12,000	$24,000	
5	Effluent Pump Station	1	l.s.	$150,000	$150,000	
	Construction Total					$2,839,500
	Construction Contingencies (10%)					$284,000
	Engineering (20%)					$568,000
	Total Project Cost					$3,692,000

Alternative 2: Reconfigure Existing Lagoons + Process Upgrades
PRELIMINARY OPINION OF PROBABLE COST
WASTEWATER SYSTEM IMPROVEMENTS PROJECT
LRBOI

	Item	Quantity	Unit	Unit Price	Amount	Sub-Total
	Screening and Grit					$783,100
1	Headworks Building	800	sft	$300	$240,000	
2	HVAC/Electrical	800	sft	$250	$200,000	
3	Instrumentation/Gas Detection	1	l.s.	$25,000	$25,000	
4	Yard Piping	1	l.s.	$25,000	$25,000	
5	Equipment	1	l.s.	$215,000	$215,000	
6	Installation	1	%	30%	$64,500	
7	Earthwork	120	yd^3	$30	$3,600	
8	Misc Metals	1	l.s.	$5,000	$5,000	
9	Structural Concrete	1	yd^3	$5,000	$5,000	
	Ferric Chloride Addition					$136,000
1	Chemical Building	250	ft^2	$100	$25,000	
2	HVAC/Electrical	250	ft^2	$70	$17,500	
3	Storage Tanks	1	ea	$35,000	$35,000	
4	Installation	1	%	30%	$10,500	
5	Chemical Feed Pumps	1	l.s.	$20,000	$20,000	
6	Process Piping	8	ea	$2,000	$16,000	
7	Panels, controls, Measurements	1	l.s.	$12,000	$12,000	
	Chemical Mixing Box					$30,000
1	Reinforced Concrete	6	yd^3	$800	$4,800	
2	Slide Gates	2	ea	$8,000	$16,000	
3	Grating	20	sft	$60	$1,200	
4	Yard Piping	50	ft	$160	$8,000	
5	Propeller Mixer and Davit	1	l.s.	$12,000	$12,000	
6	Installation	1	%	30%	$0	
7	Electrical Service	1	l.s.	$5,000	$5,000	
	Rapid Infiltration Basins					$465,900
1	Earthwork	9	acre	$22,000	$187,000	
2	Yard Piping	3,500	ft	$45	$157,500	
3	Air Release Structure and Valves	1	l.s.	$25,000	$25,000	
4	Discharge Stone areas	9	ea	$2,000	$18,000	
5	Seeding/Restoration	1	l.s.	$3,000	$3,000	
6	Gravel	1,000	yd^3	$25	$25,000	
7	Fencing	2,800	ft	$18	$50,400	
	Biolac & Clarifier Site Preparation					$422,731
1	Ex. Lagoon Sludge Removal	229,509	gal	$0.14	$32,131	
2	Ex. Lagoon Underdrain Installation	3,000	ft	$20.00	$60,000	
3	Ex. Lagoon Backfill	13,500	yd^3	$15	$202,500	
4	Ex. Lagoon Class II Backfill -Clarifier Area	8,500	yd^3	$15	$127,500	
5	Gravel	75	yd^3	$8	$600	
6	Biolac Liner Installation	16,750	sft			
	Biolac & Clarifiers					$1,581,400
1	Clarifier Equipment	1	l.s.	$170,000	$170,000	
2	Structural Concrete	684	yd^3	$600	$410,400	
3	Biolac Equipment	1	l.s.	$350,000	$350,000	
4	Installation (Clarifiers and Biolac)	1	%	30%	$401,000	
5	Instrumentation and Integration	1	l.s.	$100,000	$100,000	
6	Electrical Power and Installation	1	l.s.	$150,000	$150,000	
	Construction Total					$3,419,131
	Construction Contingencies (10%)					$342,000
	Engineering (20%)					$684,000
	Total Project Cost					$4,446,000

Attachment 2

Alternative Operation and Maintenance Costs Estimates

Alternative 1: Existing System Rehabilitation + Process Upgrades
ANNUAL OPERATION AND MAINTENANCE COST
for
LRBOI

Treatment Method:
Alternative 1 - SBR Equipment Replacement with New Primary Treatment

Electrical Power

Item	*Description*	*Hp*	*Hours*	*Kw-hrs*	*Rate*	*Amount*
1	Screening Equipment	0.75	876	490	$0.110	$54
2	SBR Blowers	50	2190	81,687	$0.110	$8,986
3	SBR Pumps	30	4380	98,024	$0.110	$10,783
4	Chemical Mixer	2	4500	6,714	$0.110	$739
5	Filter/Sludge Pumps	10	500	3,730	$0.110	$410
6	Effluent Pumps	20	876	13,070	$0.110	$1,438

Miscellaneous

Item	*Description*	*Number of Events*	*Quantity*	*Unit Price*	*Amount*
1	Screenings/Grit Removal	1	6	$100.00	$600
2	Chemical	4	1,500	$1.50	$9,000
3	Equipment Repair	1	1	$30,000	$30,000
4	Misc. Utilities	1	6	$100	$600

Total Annual O,M&R Cost: $62,609

Alternative 2: Reconfigure Existing Lagoons + Process Upgrades
ANNUAL OPERATION AND MAINTENANCE COST
for
LRBOI

Treatment Method:
Alternative 2 - Lagoon Upgrades with New Primary Treatment

Electrical Power

Item	Description	Hp	Hours	Kw-hrs	Rate	Amount
1	Screening Equipment	0.75	876	490	$0.110	$54
2	Influent/Effluent Pumps	20	1752	26,140	$0.110	$2,875
3	Lagoon Aeration Blowers	50	4380	163,374	$0.110	$17,971
4	Clarifiers	1	8760	6,535	$1.110	$7,254
5	Chemical Mixer	2	4500	6,714	$0.110	$739
6	RAS/WAS Pumps	10	500	3,730	$0.110	$410

Miscellaneous

Item	Description	Number of Events	Quantity	Unit Price	Amount
1	Screenings/Grit Removal	1	6	$100.00	$600
2	Chemical	4	1,500	$1.50	$9,000
3	Equipment Repair	1	1	$30,000	$30,000
4	Misc. Utilities	1	6	$100	$600

Total Annual O,M&R Cost: $69,503

Attachment 3

Present Worth Analysis and Short Lived Depreciation

Present Worth Analysis & Short Lived Depreciation

Client Name: LRBOI

Federal Discount Rate for Water Resources Planning (Interest Rate) i = 0.012
Number of Years, n = 20 years

Alternative 1: Upgrade Existing SBR		**Alternative 2:** Upgrade Existing Lagoon	
Initial Capital Costs =	$3,692,000	**Initial Capital Costs =**	$4,446,000
Annual Operations & Maintenance Costs =	$62,609	**Annual Operations & Maintenance Costs =**	$69,503
Future Salvage Value =	$1,846,000	**Future Salvage Value =**	$2,223,000
Present Worth of 20 years of O & M =	$1,107,379	**Present Worth of 20 years of O & M =**	$1,229,322
PW = Annual OM *(1+i)^n-1 / i*(1+i)^n		**PW =** Annual OM *(1+i)^n-1 / i*(1+i)^n	
Present Worth of 20 yr Salvage Value =	$1,454,191	**Present Worth of 20 yr Salvage Value =**	$1,751,174
PW = FSV* 1 / (1 + i)^n			
Alternate 1 Total Present Worth =	$3,345,188	**Alternative 2 Total Present Worth =**	$3,924,148

Short Lived Depreciated Assets

Note: This is not intended to include every piece of equipment in the system. It is to itemize the critical equipment or maintencance items that money should be reserved and will impact rates and charges.

For Alternative 1 Improvements

Item	Years of Life Expectancy	Number of Units	Replacement Cost	Funds to Set Aside Yearly
Screening Equipment	5	1	$15,000	$3,000
Blowers	8	1	$30,000	$3,750
Pumps	8	1	$60,000	$7,500
VFD and Electrical	8	1	$50,000	$6,250
Valves, Plumbing, Site	8	1	$20,000	$2,500
Chemical Feed Equipment	5	1	$10,000	$2,000
Filter Equipment	15	1	$10,000	$667
Collection System Pump Stations	10	1	$50,000	$5,000
Control Panels	15	1	$20,000	$1,333
Building Repairs (paint, fixtures)	15	1	$25,000	$1,667
			Total	$33,667

For Alternative 2 Improvements

Item	Years of Life Expectancy	Number of Units	Replacement Cost	Funds to Set Aside Yearly
Screening Equipment	5	1	$15,000	$3,000
Blowers	8	1	$10,000	$1,250
Pumps	8	1	$60,000	$7,500
VFD and Electrical	8	1	$20,000	$2,500
Valves, Plumbing, Site	8	1	$20,000	$2,500
Chemical Feed Equipment	5	1	$10,000	$2,000
Filter Equipment	15	1	$10,000	$667
Collection System Pump Stations	10	1	$50,000	$5,000
Control Panels	15	1	$20,000	$1,333
Building Repairs (paint, fixtures)	15	1	$5,000	$333
			Total	$26,083

Hydrogeological Investigation Report

Little River Band of Ottawa Indians

Wastewater Treatment Facility

Proposed Improvement Construction

Manistee County, Michigan

October 22, 2019

(Revised July 10, 2020)

Prepared by:
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TABLE OF CONTENTS

LIST OF ATTACHMENTS

1) **Site Location Map**
2) **Site Plan**
3) **Domestic Water Well Supply Map**
4) **Domestic Water Well Log**
5) **Wellhead Protection Area Locations**
6) **NRCS/USDA Soil Map**
7) **Soil Boring Logs**
8) **Monitoring Well Logs**
9) **Groundwater Elevation Data**
10) **Geological Cross Section**
11) **Soil Testing Results**
12) **Infiltration Testing Results**
13) **Groundwater Elevation Contour Map**
14) **Slug Testing Analysis Reports**
15) **Aquifer Properties Summary**
16) **Laboratory Analytical Reports**
17) **Groundwater Sampling Results Summary**

1.0 INTRODUCTION

The Little River Band of Ottawa Indians (LRBOI) is a Native Sovereign Nation based near Manistee, Michigan. The LRBOI currently own and operate a wastewater treatment facility consisting of a sequential batch reactor (SBR) system located on Dontz Road near M-22, adjacent to LRBOI's Little River Casino and Resort. LRBOI is planning to improve the existing treated effluent discharge process by adding rapid infiltration basins (RIBs) along with other anticipated improvements and additions to its facility.

This report presents the findings of recent hydrogeological investigation activities conducted by Gosling Czubak Engineering Sciences, Inc. (Gosling Czubak) on behalf of the Little River Band of Ottawa Indians in anticipation of future improvements. The report summarizes the scope of work, methods, procedures, and results used to determine the hydrogeological characteristics of the proposed rapid infiltration basins and surrounding areas. This report was revised on July 10, 2020 to include information from the 2009 Little River Band Source Water Projection Plan, which was not provided at the time of original report.

1.1 Purpose

The purpose of this investigation is to characterize hydrogeological conditions of the proposed discharge area and establish the basis for a groundwater monitoring network. As a Native Sovereign Nation, LRBOI will not apply for a State of Michigan groundwater discharge permit for wastewater treatment facility (WWTF) construction, but intends to operate in general accordance with environmental professional standards and neighboring jurisdictional requirements of the State of Michigan and Part 31 of the Natural Resources and Environmental Protection Act (NREPA, P.A. 451 of 1994, as amended).

1.2 Site Location and Description

The LRBOI wastewater treatment facility and proposed RIBs are in parts of Sections 21 and 28, Manistee Township (T22N, R16W), Manistee County, Michigan. The existing facility is located the south side of Dontz Road, ½-mile west of M-22 (Orchard Highway), with associated settlement/aeration lagoons and spray irrigation discharge areas located on the north side of Dontz Road. A Site Location Map is included as Attachment 1. The site property lines, horizontal grid control, topography, and

existing surface features were surveyed using an unmanned aerial vehicle (UAV) with global positioning system (GPS) data collection. A site plan of the WWTF facility is included as Attachment 2.

A map showing the area domestic water supply wells reviewed for this investigation is included as Attachment 3. Based on available information, the nearest private residential water well is located at least 300 feet west of the proposed discharge area. Domestic water supply well logs are included in Attachment 4.

The Little River Band of Ottawa Indians' Non-transient Non-community Water System (NTNCWS) consists of two wells located approximately 4,600 feet west-southwest of the proposed discharge area. The Source Water Protection Area (SWPA) for the NTNCWS is shown in Attachment 5 and its northeastern edge is located approximately 1,500 feet of the proposed discharge area.

The closest State of Michigan wellhead protection area (WHPA) belongs to the City of Manistee Well #10. The WHPA is approximately 3,700 feet southeast of the proposed discharge area. A map showing the WHPA and relative location to the WWTF is included as Attachment 5. Drinking water in the area of the WWTF is from both private residential water wells and public, groundwater-sourced systems.

2.0 GENERAL SITE SETTING

2.1 Topography

The natural surface features of the study area are the result of continental glacial advance/retreat processes which occurred during the Pleistocene Epoch between 12,000 and 16,000 years before present, and subsequent erosion and anthropogenic uses. The topography of the study area and surrounding land is generally flat, with the exception of southeast of the existing WWTF where a post-glacial erosional valley extends from Dontz Road south, toward the Manistee River Valley.

2.2 Surface Drainage

Based upon the sandy soils in the area and flat topography, infiltration is the primary pathway through which precipitation events within the watershed are captured and removed from the area, ultimately discharging into Lake Michigan via the Big Manistee River. The Big Manistee River is located 1.25 miles southwest of the proposed discharge area.

2.3 Surficial Soils

The U.S. Government survey map of surficial soil types present on the subject property and surrounding area are presented in Attachment 6. Soils descriptions from the soil survey for Benzie and Manistee Counties (Natural Resources Conservation Service Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov) within the investigation and proposed discharge area are presented below. Onsite soils evaluated during this investigation are discussed further in Section 4.1.

SOIL MAP SYMBOL	SOIL TYPE NAME AND SLOPE
63B	Coloma Sand, 0 to 6 percent slopes
47B	Spinks/Coloma Sand, 0 to 6 percent slopes

The Coloma Sand and Spinks-Coloma Sand are described as "somewhat excessively drained" or "well-drained" with "moderately high to high" capacities for transmitting water (K_{sat} range between 1.42 to 14.17 inches/hour).

2.4 Glacial Geology

The study area is situated in an area of glacial outwash (predominately sand and gravel) deposits between parts of the Manistee Moraine to the north and inter-glacial lake lacustrine deposits to the south. The glacial deposits in the study area are approximately 570 feet thick, based on the nearby oil well log for the plugged/abandoned Dontz et al 1-28 (P/N 30481).

2.5 Bedrock Geology

The uppermost bedrock formation underlying glacial deposits in the subject area is the Devonian-age Antrim Shale. Due to the thickness of the glacial deposits and the resulting depth to bedrock, further consideration of bedrock geology is beyond the scope of this investigation.

2.6 Surrounding Land Usage

The proposed discharge area is currently used as an agricultural field. Areas surrounding the study area are generally used for rural residential or agricultural purposes, with the exception of the LRBOI Casino and Hotel operation at the corner of M-22 and US-31. LRBOI land is not subject to neighboring

jurisdictional land use restrictions. The surrounding properties are zoned by Manistee Township as either Multiple Use M-1 or Ag-Forest Preservation AP-1.

3.0 INVESTIGATION METHODS AND PROCEDURES

The scope of field work for this investigation included soil borings with soil sampling; laboratory soil testing; installation of groundwater monitoring wells; collecting groundwater samples from monitoring wells; performing slug tests to estimate hydraulic conductivity; infiltration testing; and determination of groundwater flow direction and gradient.

Initially, two possible discharge locations were evaluated during soil boring activities. Based on results of the initial soil borings (SB-1 through SB-6), one study area located on the south side of Dontz Road was selected for further testing and evaluation. The specific tasks completed for this hydrogeological investigation are outlined in the following sections.

3.1 Soil Borings

Soil borings were completed in two separate mobilizations using a track mounted Geoprobe 7822 DT to continuously collect soil samples via direct push – macro core sampling methods, and a truck mounted CME-75 using 4.25-in (I.D.) hollow stem augers and split barrel samplers to install monitoring wells and collect additional soil samples.

Nine soil borings (six soil borings via macro core and one each at MW-1, MW-2, and MW-3), were completed between July 19, 2019 and July 31, 2019. A qualified geologist supervised the drilling of the borings and prepared a geologic log for each soil boring. Boring locations are shown on the Site Plan included in Attachment 2. Soil boring logs are included in Attachment 7.

3.2 Soil Sampling

Soil samples were collected for the purpose of subsurface soil characterization from grade to total depth from each soil boring. At MW-1, soil samples were collected continuously from 46-feet bgs (deepest advancement of initial direct push macro core) to total depth. At MW-2 and MW-3, soil samples were collected at 5-foot intervals from grade to total depth.

After completion of the soil borings and review of the lithology, soil samples were selected from varying depths for laboratory soil testing consisting of permeability testing and sieve analysis. For permeability testing, soil samples from SB-2 (5-10 ft bgs) and SB-2 (10-15 ft bgs) were selected. These depths were selected to evaluate intervals of suspected lower permeability lithology. For sieve analysis, the following locations and depth intervals were selected: SB-2 (10-15 ft bgs), SB-2 (20-25 ft bgs), SB-2 (25-30 ft bgs), MW-1 (53-61 ft bgs), MW-1 (61-72 ft bgs), MW-1 (72-79 ft bgs), and MW-1 (85-90 ft bgs). These sample depths were selected to aid in defining lithologic differences.

3.3 Monitoring Wells

Three groundwater monitoring wells (MW-1 through MW-3) were installed in the first saturated zone that was encountered. The wells are constructed of flush-jointed, two-inch diameter polyvinyl chloride (PVC) riser (casing) and a five-foot long section of 0.010-inch slot PVC screen. Sand filter packs were placed around the well screens from total depth to at least 2-feet above the screen.

The remaining annular space between the well and the borehole was filled with a combination of hydrated bentonite chips and native soil cuttings to seal the annular space. A locking, above ground protective steel casing was also concreted in place at each well. All monitoring wells were developed by over pumping and surging following installation. The well logs presented in Attachment 8 include the details of well completion.

The well locations were chosen to establish groundwater flow direction around the proposed rapid infiltration basin discharge area.

3.4 Water Level Measurements

After completion of the monitoring well installation, static water level measurements were collected from the monitoring wells. An electronic probe graduated to 0.01 foot is used for measurement. The water level measurements were used to calculate groundwater elevations and are summarized in Attachment 9. The water level data was also used to calculate the horizontal gradient of the receiving aquifer.

3.5 Groundwater Sampling

Prior to the monitoring well sampling, the water level in each well was measured and recorded in the field log. The monitoring wells were then sampled via low-flow sampling techniques. Dissolved oxygen, pH, conductivity, temperature, and turbidity are monitored using a flow-through, multiparameter cell over the course of several minutes as the water is pumped from the well. When the parameter measurements have stabilized, the flow-cell was disconnected, and a sample was collected into laboratory-supplied containers. The groundwater samples were kept on ice or refrigerated until submitted to ALS Environmental laboratory for analysis nitrogen (as ammonia, nitrate, nitrite, and Kjeldahl/TKN), alkalinity, biological and chemical oxygen demand, total phosphorus, sulfate, calcium, iron, magnesium, potassium, sodium and chloride.

3.6 Hydraulic Conductivity Estimates

A total of six slug tests were performed in the newly installed monitoring wells, MW-1 and MW-2. Three rising head tests were completed in each monitoring well using a pneumatic slug. A data logger transducer was lowered to the screened interval of each well. The top of the well casing was then sealed off using a rubber plug around the transducer cable and a valve controlling pressurization. While the valve was closed, air was pumped into the well until the gauge was at approximately 20 psi and allowed to stabilize. Once stabilization occurred and the groundwater level was lowered, the valve was opened the recovery of the water level was recorded.

3.7 Infiltration Testing

A total of four falling head, double-ring infiltrometer tests were performed at two locations to estimate the infiltration rate of the near-surface soil. Two tests were performed in the field west of MW-1 and two tests were performed in the field northwest of MW-2. To perform this test, approximately six inches of topsoil was cleared away to drive two rings into undisturbed soil. A two-foot diameter outer ring and a one-foot inner ring were driven into the ground approximately five inches, such that the top and bottom of the rings are at the same elevation. The outer ring was filled to contain eight inches of water above the surface, then the inner ring was filled to match this water level. To achieve saturated soil conditions, the inner ring pre-saturated for one hour while maintaining a constant water level in the outer ring. Once saturated soil conditions were achieved, the tests were performed by recording the amount of

time the inner ring took to drain completely while maintaining a constant water level in the outer ring. Water level readings were recorded every five minutes until the inner ring was empty.

3.8 Location and Elevation Survey

The site property lines, horizontal grid control, topography, and existing surface features were surveyed using a GPS-enabled UAV. Following the completion of the monitoring wells and soil borings, the horizontal location and elevation of each monitoring well and soil boring was surveyed. Vertical control for each well includes ground and top-of-casing elevations. Top-of-casing elevations were surveyed within ± 0.01 feet. All elevations measured are referenced to the North American Vertical Datum of 1988.

4.0 INVESTIGATION RESULTS

4.1 Site Geology

As shown on boring/well logs included in Attachments 7 and 8, surficial sandy or loamy topsoil with organics (roots) was encountered surface of throughout the site at a thickness of approximately 4 to 12-inches. Below surficial topsoil, soils generally consisted of fine to medium sand with varying amounts of silt and gravel to the termination depth of the soil borings. However, intervals or layers of lower permeability soils consisting of fine sand with “little” silt were encountered at most boring locations from below surficial topsoil to approximately one to 13 feet, and also at deeper depths (approximately 25 to 38 feet), occasionally containing clay seams and layers, at MW-2, MW-3 and SB-2.

A geological cross-section was completed to illustrate the soil conditions encountered. The cross-section is presented in Attachment 10.

4.1.1 Laboratory Soil Analysis

Constant head tests were conducted in general accordance to ASTM D2434-68 (2006). Based on the data from the two tests soil permeability of the onsite fine to medium sand (SB-2 at five feet) was approximately 14.16 inches per hour (in/hr) and the onsite fine sand (WB-2 at 10 feet) was approximately 2.0 in/hr. Mechanical grain size distribution testing confirmed soil classifications shown on the boring/well logs. Results of the laboratory soil testing is included in Attachment 11.

4.1.2 Infiltration Testing

Results of falling-head, double-ring infiltrometer testing are presented in Attachment 12. As shown in Attachment 12, average infiltration rates ranged from 5.2-in/hr to 18.1-in/hr between the two test locations.

4.2 Site Hydrogeology

Groundwater was encountered under unconfined, water table conditions at depths ranging from approximately 88 feet to 90 feet bgs. Aquifer materials consisted of fine to medium-grained sand with "trace" amounts silt. A bottom of the aquifer was not encountered during drilling activities, which explored to a maximum depth of approximately 11 feet below the water table.

Groundwater elevation contour maps were prepared using data collected on three separate measurement events summarized in Attachment 9. An example of the groundwater elevation contour mapping is presented in Attachment 13. As shown in Attachment 13, groundwater in the study area appears to flow toward the southwest. The horizontal gradient as determined from the August 15, 2019 data is 0.002 ft/ft.

4.2.1 Aquifer Characteristics

Hydraulic Conductivity – Slug Testing

Rising head pneumatic slug test data collected by the datalogging pressure transducer was analyzed using AQTESOLVE software. The horizontal hydraulic conductivity of the aquifer was evaluated using the Bouwer and Rice method for evaluating slug tests. Results of the Bouwer and Rice solution method for each test is included in Attachment 14 and summarized in the Aquifer Properties Table in Attachment 15. Hydraulic conductivity (K) values calculated from slug test results had a geometric mean at each location of 67.8 ft/day (MW-1) and 95.2 ft/day (MW-2) with an overall study area geometric mean of 80.5 ft/day.

Groundwater Velocity

The groundwater velocity for the unconfined aquifer was calculated using the following equation (Freeze & Cherry, 1979):

$$V = K * i / n$$

where: V = velocity in feet/day x days/year

K = Hydraulic Conductivity (feet/day)

i = Hydraulic Gradient (dimensionless)

n = porosity (dimensionless)

Using an assumed porosity of 0.30 percent for the predominantly medium dense, fine to medium-grained sand aquifer; an average hydraulic conductivity range of 68-95 feet/day (based on slug test results), and a hydraulic gradient of 0.002 (from groundwater flow map included as Attachment 13), the average linear groundwater velocity for the unconfined aquifer is estimated to be 0.45 to 0.63 feet per day, or 164.3 to 230 feet per year.

4.3 Water Quality

On September 9 and September 12, 2019, groundwater samples were collected from each onsite monitoring well. The laboratory reports for the September 9 and September 12, 2019 sampling event are presented in Attachment 16 and are summarized and compared to nearby regulatory standards in Attachment 17.

As shown in Attachment 17, the analytical results for analyzed parameters in samples collected from MW-1, MW-2, and MW-3 are either below the laboratory detection limits or do not exceed either typical Part 22 groundwater discharge limits or Part 201 Generic Residential Drinking Water Criteria.

5.0 CONCLUSIONS

This report was written to present findings of a hydrogeological investigation conducted at the proposed rapid infiltration basin discharge for the LRBOI WWTP. Conclusions from the investigation are summarized below:

- The area of proposed discharge is located on LRBOI-owned property currently used as an agricultural field. The nearest private residential water well is plotted at least 300 feet west of proposed RIB discharge areas, and the nearest wellhead protection area is located approximately 3,700 feet east of proposed RIB discharge areas.

- The investigation identified predominately sandy soils in the area of proposed RIB discharge, from ground surface to at least 101 feet below ground surface. Near-surface soils were found to be fine sand with "little" silt, and deeper intervals of silty sand, occasionally containing clay layers were encountered at certain boring locations. Based on thickness, the clay seams and layers are not likely to be continuous throughout the discharge area.
- Onsite infiltrometer testing found average near-surface infiltration rates ranged from 5.2-in/hr to 18.1-in/hr. Laboratory permeability testing on representative sand samples averaging similar rates of 14.16 in/hr and 2.0 in/hr.
- Groundwater was encountered under unconfined conditions at a depth of approximately 89 feet.
- A groundwater monitoring network was established around the area of proposed RIB discharge.
- Groundwater in the upper-most aquifer was found to flow toward the southwest, with a horizontal gradient of approximately 0.002 ft/ft. Hydraulic conductivities estimated by slug testing and analysis found an average hydraulic conductivity of 80.5 ft/day.
- Analytical results for groundwater samples collected from MW-1, MW-2, and MW-3 found background water quality of analyzed parameters with nearby regulatory limits.

6.0 FUTURE ACTIVITIES AND CONSIDERATIONS

Gosling Czubak is currently completing a preliminary engineering report and rate study as they relate to potential future improvements at the WWTP. Additional documents and activities related to the potential WWTP improvement may also include the following:

- Final design for WWTP improvements
- Discharge Management Plan (DMP)
- A groundwater monitoring program

The infiltration rate properties of onsite soil within the proposed RIB discharge was shown to vary with location. This variability is due to soil composition and in-situ compaction, which can also vary with depth. Site (RIB) preparation activities such as topsoil stripping and perimeter berm construction should be completed using methods and equipment to minimize soil compaction in the infiltration areas.

Double ring infiltrometer testing should be completed following RIB preparation to verify infiltration rate assumptions used for engineering design.

Additional groundwater monitoring wells are recommended for future discharge monitoring. The current well network was designed to provide groundwater flow and background groundwater quality data and may not be in appropriate locations to monitor future discharge depending on final design and location of the RIBs.

The observations, conclusions, and recommendations contained in this report pertain to this investigation as it relates to the project described. The borehole logs and other testing information provided for this project are intended for use with the complete report. The borehole logs depict the subsurface data obtained, and this information is representative of each location only; it should be understood that the soil conditions may vary between the test locations. In addition, the boreholes reflect soil and groundwater conditions at the time they were performed. This information should not be used for determining earthwork quantities, construction estimating, or other purposes. This report was prepared using generally accepted hydrogeological practices. Recommendations were developed based on the information gained from the soil borings and other testing performed, and other information reviewed from available government sources. No other warranty, expressed or implied, regarding the recommendations and conclusions provided in this report is offered.

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Attachment 1

Site Location Map

Site Location Map

Sheet 1 of 2

Waste Water Treatment Plant
Little River Band of Ottawa Indians
PARTS OF SECTIONS 21 & 28, T 22 N, R 16 W,
MANISTEE TOWNSHIP,
MANISTEE COUNTY, MICHIGAN

Job #:	2018096001.01
Date:	08/23/2019
Scale:	1" = 2000'
Drawn:	jrl
Chk'd.:	ARB
Rev.:	

Gosling Czubak
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CONSTRUCTION SERVICES | DRILLING | LANDSCAPE ARCHITECTURE

P:\2018096001.00\CADD-Data\C3D\2018096001 base.dwg Tab: site loc Saved by: jrlumley 8/23/2019 3:47 PM Plotted by: Jim Lumley 8/23/2019 3:49 PM

Attachment 2

Site Plan

Location:
PARTS OF SECTIONS 21 & 28,
T 22 N, R 16 W,
MANISTEE TOWNSHIP,
MANISTEE COUNTY, MICHIGAN
Sheet 1 of 1

Site Topographic Survey
Wastewater Treatment Plant
Little River Band of Ottawa Indians

Job #:	2018096001.01
Date:	10/21/2019
Scale:	1" = 500'
Drawn:	jrl
Chk'd.:	ARB
Rev.:	

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Attachment 3

Domestic Water Well Supply Map

LEGEND

51000001234 WELL ID. #
132'–138' SCREENED INTERVAL (B.G.S)

Well data is obtained from Wellogic, the Michigan Department of Environmental Quality Statewide Ground Water Database (SGWD). Although it represents the best available data, it cannot be considered a complete database of all the wells or well records in existence.

Beginning January 1, 2000 virtually 100% of new wells constructed are accounted for in Wellogic, however for wells older than 2000 the rate of inclusion varies from county to county, and may be considerably lower.

The locational information provided has varying degrees of accuracy, ranging from GPS point collection, map interpolation and digitizing, to address matching.

NORTH

SCALE 1" = 500'

0' 500' 1000'

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Job #: 2018096001.01
Date: 08/23/2019
Scale: 1" = 500'
Drawn: jrl
Chk'd.: ARB
Rev.: 10/21/2019

Water Well Locations - Site Aerial
Wastewater Treatment Plant
Little River Band of Ottawa Indians

Location:
PARTS OF SECTIONS 21 & 28,
T 22 N, R 16 W,
MANISTEE TOWNSHIP,
MANISTEE COUNTY, MICHIGAN

P:\2018096001.00\CADD-Data\C3D\2018096001 base.dwg Tab: water wells Saved by: jrlumley 10/21/2019 8:14 AM Plotted by: Jim Lumley 10/21/2019 8:28 AM

Attachment 4

Domestic Water Well Log

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221629001

Tax No: 510712900400	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 29	**Well Status:**
		WSSN:	**Source ID/Well No:**	

Well ID: 51000001278

Elevation: 707.06 ft.
Latitude: 44.2902812127
Longitude: -86.2638112252
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: DONTZ, DAN

Well Address:	**Owner Address:**
1995 DONTZ ROAD MANISTEE, MI 49660	1995 DONTZ ROAD MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 140.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 10/3/1974

Casing Type: Unknown **Height:** 2.10 ft. above grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 4.00 in. to 129.50 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Red Jacket **Pump Type:** Submersible
Model Number: **Pump Capacity:**
Drop Pipe Length: 119.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 102.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
7.00	10.00 ft.	129.50 ft. and 139.50 ft.

Fittings: Other

Formation Description	Thickness	Depth to Bottom
Red Clay & Stones	15.00	15.00
Sand & Gravel	2.00	17.00
Red Clay & Gravel	7.00	24.00
Sand Dry	80.00	104.00
Sand Wet/Moist	9.00	113.00
Red Clay	2.00	115.00
Sand Coarse Wet/Moist	25.00	140.00

Well Grouted: No

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 53-0405
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: FITTINGS: STANDARD. CLAY AND SAND ENTERED UNDER LYTHOLOGY WITH NO THICKNESS.
Other Remarks: Screen Fittings:Type Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221621002

Tax No: 510712100400	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 21	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001238

Elevation: 707.06 ft.
Latitude: 44.2906875397
Longitude: -86.2623072683
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: GUZIKOWSKI, PATRIC

Well Address:	**Owner Address:**
2030 DONTZ ROAD MANISTEE, MI 49660	2030 DONTZ ROAD MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 126.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 4/11/1975

Casing Type: Unknown **Height:** 6.00 ft. above grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 4.00 in. to 120.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Red Jacket **Pump Type:** Submersible
Model Number: **Pump Capacity:**
Drop Pipe Length: 105.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 91.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Formation Description	Thickness	Depth to Bottom
Brown Sand	8.00	8.00
Clay & Sand	15.00	23.00
Sand	16.00	39.00
Red Clay & Sand	2.00	41.00
Sand	49.00	90.00
Red Clay & Sand	10.00	100.00
Sand Fine Wet/Moist	18.00	118.00
Sand Coarse Water Bearing	8.00	126.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
7.00	6.00 ft.	120.00 ft. and 126.00 ft.

Fittings: Other

Well Grouted: No

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 53-0405
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: FITTINGS: STANDARD.
Other Remarks: Screen Fittings:Type Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221628003

Tax No: 510790007800	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 28	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001272

Elevation: 692.29 ft.
Latitude: 44.2857558416
Longitude: -86.2443131979
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: MANISTEE VET. HOSP.

Well Address:	**Owner Address:**
2738 ORCHARD HIGHWAY MANISTEE, MI 49660	2738 ORCHARD HIGHWAY MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 91.00 ft. **Well Use:** Other
Well Type: Replacement **Date Completed:** 12/19/1975

Casing Type: Unknown **Height:**
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 87.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Flint & Walling **Pump Type:** Jet
Model Number: **Pump Capacity:**
Drop Pipe Length: 79.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 73.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
6.00	4.00 ft.	87.00 ft. and 91.00 ft.

Fittings: Other

Formation Description	Thickness	Depth to Bottom
Sand	20.00	20.00
Sand & Stones	16.00	36.00
Sand & Gravel W/Stones	14.00	50.00
Sand & Gravel W/Stones	19.00	69.00
Clay & Gravel	1.00	70.00
Sand Gravel Clay	6.00	76.00
Sand Fine	14.00	90.00

Well Grouted: No

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 53-0405
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: FITTINGS: STANDARD. EJECTOR SET 12N-22V
Other Remarks: Well Use:Commercial, Screen Fittings:Type Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No:	Permit No: 51-1640	County: Manistee	Township: Manistee

Town/Range:	Section:	Well Status:	WSSN:	Source ID/Well No:
21N 16W	21	Active		

Well ID: 51000003323

Elevation:

Latitude: 44.29176789

Longitude: -86.25557537

Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:
ONE MILE WEST OF M22 ON NORTH SIDE OF DONTZ RD

Well Owner: MR PATRIC LAGIKOWSKI

Well Address:	Owner Address:
2152 DONTZ RD MANISTEE, MI 49660	2152 DONTZ RD MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 167.00 ft. **Well Use:** Household
Well Type: New **Date Completed:** 8/13/2001

Casing Type: Steel - black **Height:**
Casing Joint: Welded
Casing Fitting: Drive shoe

Diameter: 4.00 in. to 153.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:** 1.50
Manufacturer: Goulds **Pump Type:** Submersible
Model Number: 256515 **Pump Capacity:** 25 GPM
Drop Pipe Length: 110.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: Yes
Pressure Tank Type: Unknown
Manufacturer: Amtrol
Model Number: WX250 **Tank Capacity:** 40.0 Gallons
Pressure Relief Valve Installed: No

Static Water Level: 6.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Test pump
1.00 hrs. at 36 GPM

Formation Description	Thickness	Depth to Bottom
Topsoil	1.00	1.00
Sand & Stones	4.00	5.00
Clay	10.00	15.00
Sand	15.00	30.00
Clay & Sand	10.00	40.00
Sand	59.00	99.00
Sand Silty Fine	34.00	133.00
Sand Medium	18.00	151.00
Sand Coarse	16.00	167.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:** 2.00 ft. Above
Screen Material Type: Stainless steel-wire wrapped

Slot	Length	Set Between
10.00	14.00 ft.	153.00 ft. and 167.00 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Bentonite slurry	6.00	None	0.00 ft. to 167.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name: ED BENSON
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 51-1603
Business Name: ED BENSON W/D
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No:	Permit No: 51-1640	County: Manistee	Township: Manistee

Town/Range:	Section:	Well Status:	WSSN:	Source ID/Well No:
21N 16W	21	Active		

Well ID: 51000003323

Elevation:

Latitude: 44.29176789

Longitude: -86.25557537

Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:
ONE MILE WEST OF M22 ON NORTH SIDE OF DONTZ RD

Well Owner: MR PATRIC LAGIKOWSKI

Well Address:	Owner Address:
2152 DONTZ RD MANISTEE, MI 49660	2152 DONTZ RD MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 167.00 ft. **Well Use:** Household
Well Type: New **Date Completed:** 8/13/2001

Casing Type: Steel - black **Height:**
Casing Joint: Welded
Casing Fitting: Drive shoe

Diameter: 4.00 in. to 153.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:** 1.50
Manufacturer: Goulds **Pump Type:** Submersible
Model Number: 256515 **Pump Capacity:** 25 GPM
Drop Pipe Length: 110.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: Yes
Pressure Tank Type: Unknown
Manufacturer: Amtrol
Model Number: WX250 **Tank Capacity:** 40.0 Gallons
Pressure Relief Valve Installed: No

Static Water Level: 6.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Test pump
1.00 hrs. at 36 GPM

Formation Description	Thickness	Depth to Bottom
Topsoil	1.00	1.00
Sand & Stones	4.00	5.00
Clay	10.00	15.00
Sand	15.00	30.00
Clay & Sand	10.00	40.00
Sand	59.00	99.00
Sand Silty Fine	34.00	133.00
Sand Medium	18.00	151.00
Sand Coarse	16.00	167.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:** 2.00 ft. Above
Screen Material Type: Stainless steel-wire wrapped

Slot	Length	Set Between
10.00	14.00 ft.	153.00 ft. and 167.00 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Bentonite slurry	6.00	None	0.00 ft. to 167.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name: ED BENSON
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 51-1603
Business Name: ED BENSON W/D
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221628004

Tax No: 510712800400	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 28	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001273

Elevation: 700.49 ft.
Latitude: 44.288590442
Longitude: -86.2590713104
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: WILSON, MILTON

Well Address:	**Owner Address:**
2817 DONTZ ROAD MANISTEE, MI 49660	2817 DONTZ ROAD MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 117.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 4/21/1978

Casing Type: Unknown **Height:**
Casing Joint: Threaded & coupled
Casing Fitting: None

Diameter: 2.00 in. to 114.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Goulds **Pump Type:** Jet
Model Number: **Pump Capacity:**
Drop Pipe Length: 100.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 92.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Formation Description	Thickness	Depth to Bottom
Sand & Gravel	30.00	30.00
Sand	87.00	117.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
10.00	4.50 ft.	0.00 ft. and 0.00 ft.

Fittings: None

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Unknown	0.00	None	0.00 ft. to 0.00 ft.

Wellhead Completion: Unknown

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
Unknown	0 ft.	

Abandoned Well Plugged: No
Reason Not Plugged:

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 43-0539
Business Name:
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:
Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221632401

Tax No:	Permit No:	County: Manistee	Township: Manistee

Well ID: 51000001459

Elevation:

Latitude: 44.270898

Longitude: -86.276112

Method of Collection: QQQ - Centroid

Town/Range:	Section:	Well Status:	WSSN:	Source ID/Well No:
22N 16W	32	Active	2019051	001

Distance and Direction from Road Intersection:
2019051 WEST SHORE MEDICAL BLDG

Well Owner: WEST SHORE MEDICAL BLDG

Well Address:
1293 EAST PARKDALE AVE
MANSITEE, MI 49660

Owner Address:
1301 EAST PARKDALE AVE
MANSITEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 95.40 ft. **Well Use:** Type II public
Well Type: New **Date Completed:** 10/5/1996

Casing Type: Steel - black **Height:**
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 8.00 in. to 60.40 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Other **Pump Type:** Submersible
Model Number: **Pump Capacity:** 0 GPM
Drop Pipe Length: 54.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 22.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown
Pumping level 36.00 ft. after 4.00 hrs. at 250 GPM

Formation Description	Thickness	Depth to Bottom
Sand	40.00	40.00
Sand & Gravel	8.00	48.00
Red Clay	12.00	60.00
Clay & Gravel	1.00	61.00
Sand Coarse	4.00	65.00
Sand & Gravel Coarse	24.00	89.00
Sand Fine	7.00	96.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 8.00 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
7.00	35.00 ft.	60.40 ft. and 95.40 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Bentonite slurry	0.00	None	to 59.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
Sewer line	85 ft.	South

Drilling Machine Operator Name: DON CAMERON - CAMERON
Employment: Unknown

Contractor Type: Unknown **Reg No:** 53-1960
Business Name:
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: BOTTOM 5' 7-SLOT, TOP 5' 10-SLOT, MIDDLE 20' 12-SLOT

Other Remarks: Pump Manufacturer:BERKELEY

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No:	**Permit No:** W0007028	**County:** Manistee		**Township:** Manistee
Town/Range: 22N 16W	**Section:** 33	**Well Status:** Active	**WSSN:** 4030	**Source ID/Well No:** 10

Well ID: 51000004552

Elevation:

Latitude: 44.271306

Longitude: -86.248278

Method of Collection: GPS Std Positioning Svc SA Off

Distance and Direction from Road Intersection:
4000' S of US 31, 6500' E of Kemmer Rd, on the SE side of the airport

Well Owner: City of Manistee

Well Address:
Manistee #10
Manistee, MI

Owner Address:
70 Maple Street
Manistee, MI 49660

Drilling Method: Rotary
Well Depth: 330.00 ft. **Well Use:** Type I public
Well Type: New **Date Completed:**

Casing Type: Unknown **Height:** 2.00 ft. above grade
Casing Joint: Unknown
Casing Fitting: Unknown

Diameter: 16.00 in. to

Borehole: 10.00 in. to

Pump Installed: No
Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 10.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown
5.00 hrs. at 125 GPM

Screen Installed: No **Intake:** Unknown

Well Grouted: No

Wellhead Completion: 12 inches above grade

Formation Description	Thickness	Depth to Bottom
No Log	330.00	330.00

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:**
Business Name:
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No: 51-07-128-019-05	**Permit No:** 51-6570	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 28	**Well Status:** Active	**WSSN:**	**Source ID/Well No:**

Well ID: 51000006311

Elevation:

Latitude: 44.27574727

Longitude: -86.24761712

Method of Collection: GPS Std Positioning Svc SA Off

Distance and Direction from Road Intersection:
E of 31, W of Revolt Rd.

Well Owner: John Fisk

Well Address:	**Owner Address:**
2770 River Rd. Manistee, MI 49660	2770 River Rd. Manistee, MI 49660

Drilling Method: Rotary
Well Depth: 115.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 5/17/2017

Casing Type: PVC plastic **Height:** 1.00 ft. above grade
Casing Joint: Solvent welded/glued
Casing Fitting: None

Diameter: 5.00 in. to 107.00 ft. depth SDR: 21.00

Borehole: 8.50 in. to 115.00 ft. depth

Static Water Level: 28.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Air
Pumping level 80.00 ft. after 1.00 hrs. at 100 GPM

Screen Installed: Yes **Filter Packed:** Yes
Screen Diameter: 4.00 in. **Blank:** 2.00 ft. Above
Screen Material Type: PVC-saw cut

Slot	Length	Set Between
10.00	8.00 ft.	107.00 ft. and 115.00 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Grout pipe outside casing

Grouting Material	Bags	Additives	Depth
Concrete	33.00	None	0.00 ft. to 107.00 ft.

Wellhead Completion: Pitless adapter, 12 inches above grade

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	77 ft.	Northwest

Abandoned Well Plugged: Yes

Latitude: 44.2757778 **Longitude:** -86.2480529
Casing Diameter: 4 in. **Casing Removed:** No
Plugging Material: Bentonite chips/pellets
No. of Bags: 7.00 **Well Depth:** 60 ft.

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: 5/17/2017 **HP:** 1.00
Manufacturer: Grundfos **Pump Type:** Submersible
Model Number: 22SQE190 **Pump Capacity:** 22 GPM
Drop Pipe Length: 80.00 ft. **Pump Voltage:** 230
Drop Pipe Diameter: 1.00 in. **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: Yes
Pressure Tank Type: Diaphragm/bladder
Manufacturer: Well-X-Trol
Model Number: WX102 **Tank Capacity:** 4.4 Gallons
Pressure Relief Valve Installed: Yes

Formation Description	Thickness	Depth to Bottom
Sand	53.00	53.00
Clay	7.00	60.00
Sand	9.00	69.00
Clay	31.00	100.00
Sand & Gravel	15.00	115.00

Geology Remarks:

Drilling Machine Operator Name: CHAD MALLEY
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 37-2236
Business Name: Chad Malley Well Drilling
Business Address: 2626 E Weidman, Rosebush, MI, 48878

Water Well Contractor's Certification

This well and/or pump installation was performed under my registration.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No: 51-07-128-010-15	**Permit No:** 51-6002	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 28	**Well Status:** Active	**WSSN:**	**Source ID/Well No:**

Well ID: 51000006305

Elevation:

Latitude: 44.27836

Longitude: -86.25985

Method of Collection: GPS Std Positioning Svc SA Off

Distance and Direction from Road Intersection:
1/4 MILE S. OF RIVER RD. ON N. SIDE OF CHIPPEWA HWY END OF PRIVATE DR.

Well Owner:

Well Address:	**Owner Address:**
2020 CHIPPEWA HWY MANISTEE, MI 49660	2020 CHIPPEWA HWY MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 61.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 8/21/2015

Casing Type: Steel - black **Height:** 1.00 ft. above grade
Casing Joint: Welded
Casing Fitting: Drive shoe

Diameter: 4.00 in. to 55.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:** 0.50
Manufacturer: Goulds **Pump Type:** Submersible
Model Number: 10GS05422 **Pump Capacity:** 10 GPM
Drop Pipe Length: 26.00 ft. **Pump Voltage:** 240
Drop Pipe Diameter: 1.25 in. **Drilling Record ID:**
Draw Down Seal Used: Yes

Pressure Tank Installed: Yes
Pressure Tank Type: Diaphragm/bladder
Manufacturer: Goulds
Model Number: T-140 **Tank Capacity:** 45.2 Gallons
Pressure Relief Valve Installed: Yes

Static Water Level: 8.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Bailer
Pumping level 8.00 ft. after 1.00 hrs. at 18 GPM

Formation Description	Thickness	Depth to Bottom
Topsoil	1.00	1.00
Brown Sand	2.00	3.00
Sand	42.00	45.00
Clay	4.00	49.00
Sand Coarse	14.00	63.00

Screen Installed: Yes **Filter Packed:** Yes
Screen Diameter: 3.00 in. **Blank:** 2.00 ft. Above
Screen Material Type: PVC-slotted

Slot	Length	Set Between
10.00	6.00 ft.	55.00 ft. and 61.00 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Driven/dry grout

Grouting Material	Bags	Additives	Depth
Bentonite dry granular	3.00	None	0.00 ft. to 63.00 ft.

Wellhead Completion: Pitless adapter, 12 inches above grade

Geology Remarks:
IRON SAND AND STONE (ORANGE) AT BOTTOM.

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	100 ft.	North

Abandoned Well Plugged: No
Reason Not Plugged: Well still in use for non-drinking water purposes

Drilling Machine Operator Name: ED & BRENT BENSON
Employment: Unknown

Contractor Type: Water Well Drilling Contractor **Reg No:** 51-1603
Business Name: ED BENSON WELL DRILLING
Business Address:

Water Well Contractor's Certification

This well and/or pump installation was performed under my registration.

Signature of Registered Contractor **Date**

General Remarks: OWNER USING OLD WELL FOR YARD USE AND SPRINKLING.
Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No: 51-07-122-012-00	**Permit No:** 51-5712	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 22	**Well Status:** Active	**WSSN:**	**Source ID/Well No:**

Well ID: 51000006116

Elevation:

Latitude: 44.29575

Longitude: -86.24315

Method of Collection: GPS Std Positioning Svc SA Off

Distance and Direction from Road Intersection:
ON THE EAST SIDE OF ORCHARD HWY

Well Owner: DAVE & RUTH REVOLT

Well Address:	**Owner Address:**
3429 ORCHARD HWY MANISTEE, MI 49660	3429 ORCHARD HWY MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 119.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 3/3/2014

Casing Type: Steel - galvanized **Height:** 1.00 ft. above grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 4.00 in. to 113.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:** 0.75
Manufacturer: Franklin Electric **Pump Type:** Submersible
Model Number: 10FA07P4 **Pump Capacity:** 10 GPM
Drop Pipe Length: 100.00 ft. **Pump Voltage:** 230
Drop Pipe Diameter: 1.25 in. **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: Yes
Pressure Tank Type: Diaphragm/bladder
Manufacturer: Flex-Lite-Flexcon
Model Number: FL12 **Tank Capacity:** 35.0 Gallons
Pressure Relief Valve Installed: Yes

Static Water Level: 86.00 ft.
Well Yield Test: **Yield Test Method:** Bailer
Pumping level 86.00 ft. after 1.00 hrs. at 10 GPM

Unrestricted Flow Rate:

Formation Description	Thickness	Depth to Bottom
Sand	24.00	24.00
Red Clay & Sand	21.00	45.00
Sand	74.00	119.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 3.00 in. **Blank:**
Screen Material Type: Stainless steel-wire wrapped

Slot	Length	Set Between
7.00	6.00 ft.	113.00 ft. and 119.00 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Driven/dry grout

Grouting Material	Bags	Additives	Depth
Bentonite dry granular	3.00	None	0.00 ft. to 113.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	65 ft.	East

Abandoned Well Plugged: Yes

Latitude: 44.29575 **Longitude:** -86.24315
Casing Diameter: 2 in. **Casing Removed:** No
Plugging Material: Bentonite chips/pellets
No. of Bags: 4.00 **Well Depth:** 119 ft.

Drilling Machine Operator Name: DANIEL CAMERON
Employment: Employee
Pump Installer: BROC CAMERON

Contractor Type: Water Well Drilling Contractor **Reg No:** 53-1960
Business Name: CAMERON BROTHERS INC.
Business Address: 8710 N U.S. 31, FREE SOIL,, MI, 49411

Water Well Contractor's Certification

This well/pump was constructed under my supervision and I hereby certify that the work complies with Part 127 Act 368 PA 1978 and the well code.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No: 51-07-440-026-026-00	**Permit No:** 51-5789	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 32	**Well Status:** Active	**WSSN:**	**Source ID/Well No:**

Well ID: 51000006097

Elevation:

Latitude: 44.275532

Longitude: -86.274749

Method of Collection: GPS Std Positioning Svc SA Off

Distance and Direction from Road Intersection:
US 31 north to Kemmer Rd North to Brown Rd 1st house on left

Well Owner: Philip Fedder

Well Address:	**Owner Address:**
1449 Brown Rd Manistee, MI 49660	1449 Brown Rd Manistee, MI 49660

Drilling Method: Rotary
Well Depth: 47.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 6/11/2014

Casing Type: PVC plastic **Height:** 1.00 ft. above grade
Casing Joint: Solvent welded/glued
Casing Fitting: None

Diameter: 5.00 in. to 39.00 ft. depth SDR: 21.00

Borehole: 8.50 in. to 47.00 ft. depth

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:** 1.00
Manufacturer: Other **Pump Type:** Submersible
Model Number: 11L4D20X7-52 **Pump Capacity:** 20 GPM
Drop Pipe Length: 25.00 ft. **Pump Voltage:** 230
Drop Pipe Diameter: 1.00 in. **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: Yes
Pressure Tank Type: Diaphragm/bladder
Manufacturer: Flex-Lite-Flexcon
Model Number: FL17 **Tank Capacity:** 50.0 Gallons
Pressure Relief Valve Installed: Yes

Static Water Level: 12.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Air
Pumping level 18.00 ft. after 2.00 hrs. at 46 GPM

Formation Description	Thickness	Depth to Bottom
Sand Dry	12.00	12.00
Sand Water Bearing	35.00	47.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:**
Screen Material Type: PVC-slotted

Slot	Length	Set Between
7.00	8.00 ft.	39.00 ft. and 47.00 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Grout pipe outside casing

Grouting Material	Bags	Additives	Depth
Bentonite slurry	4.00	None	0.00 ft. to 36.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	61 ft.	South

Abandoned Well Plugged: Yes

Latitude: 44.275551 **Longitude:** -86.274546
Casing Diameter: 2 in. **Casing Removed:** No
Plugging Material: Bentonite chips/pellets
No. of Bags: 1.00 **Well Depth:** 34 ft.

Drilling Machine Operator Name: Jim Lehrbass
Employment: Employee
Pump Installer: Nate Jones

Contractor Type: Water Well Drilling Contractor **Reg No:** 53-2430
Business Name: West Michigan Well Drilling
Business Address: 440 E. Chauvez Rd, Scottville, MI, 49454

Water Well Contractor's Certification

This well/pump was constructed under my supervision and I hereby certify that the work complies with Part 127 Act 368 PA 1978 and the well code.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks: Pump Manufacturer:Schaeffer

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No: 51-07-440-027-00	**Permit No:** 51-5504	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 32	**Well Status:** Active	**WSSN:**	**Source ID/Well No:**

Well ID: 51000006023

Elevation:

Latitude: 44.27561

Longitude: -86.27473

Method of Collection: GPS Std Positioning Svc SA Off

Distance and Direction from Road Intersection:
US 31 N TO KEMMER NO TO BROWN 2ND HOUSE ON LEFT

Well Owner: DAVE MAJKSZAK

Well Address:	**Owner Address:**
1431 BROWN RD MANISTEE, MI 49660	1431 BROWN RD MANISTEE, MI 49660

Drilling Method: Rotary
Well Depth: 47.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 6/10/2013

Casing Type: PVC plastic **Height:** 1.00 ft. above grade
Casing Joint: Solvent welded/glued
Casing Fitting:

Diameter: 5.00 in. to 39.00 ft. depth SDR: 21.00

Borehole: 8.50 in. to 47.00 ft. depth

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:** 1.00
Manufacturer: Franklin Electric **Pump Type:** Submersible
Model Number: TIL4D20Z7S2 **Pump Capacity:** 20 GPM
Drop Pipe Length: 25.00 ft. **Pump Voltage:** 230
Drop Pipe Diameter: 1.00 in. **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: Yes
Pressure Tank Type: Diaphragm/bladder
Manufacturer: Flex-Lite-Flexcon
Model Number: FL17 **Tank Capacity:** 52.0 Gallons
Pressure Relief Valve Installed: Yes

Static Water Level: 12.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Air
Pumping level 18.00 ft. after 2.00 hrs. at 46 GPM

Formation Description	Thickness	Depth to Bottom
Sand Dry	12.00	12.00
Sand Water Bearing	35.00	47.00

Screen Installed: Yes **Filter Packed:** Yes
Screen Diameter: 4.00 in. **Blank:** 2.00 ft. Above
Screen Material Type: PVC-slotted

Slot	Length	Set Between
7.00	8.00 ft.	39.00 ft. and 47.00 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Grout pipe outside casing

Grouting Material	Bags	Additives	Depth
Bentonite slurry	4.00	None	0.00 ft. to 36.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	80 ft.	South

Abandoned Well Plugged: Yes

Latitude: 44.2756 **Longitude:** -86.27473
Casing Diameter: 2 in. **Casing Removed:** No
Plugging Material: Bentonite chips/pellets
No. of Bags: 1.00 **Well Depth:** 34 ft.

Drilling Machine Operator Name: JIM LEHRBASS
Employment: Employee
Pump Installer: JACK LEWIS

Contractor Type: Water Well Drilling Contractor **Reg No:** 53-2430
Business Name: WEST MICHIGAN WELL DRILLING
Business Address: 440 E CAHUVEZ RD, SCOTTVILLE, MI, 49454

Water Well Contractor's Certification

This well/pump was constructed under my supervision and I hereby certify that the work complies with Part 127 Act 368 PA 1978 and the well code.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No: 51-07-126-010-40	**Permit No:** 51-4530	**County:** Manistee		**Township:** Manistee
		Town/Range: 21N 16W	**Section:** 26	**Well Status:** Active	**WSSN:**	**Source ID/Well No:**

Well ID: 51000005590

Elevation:

Latitude: 44.27473

Longitude: -86.26798

Method of Collection: GPS Std Positioning Svc SA Off

Distance and Direction from Road Intersection:
S ON RIVER RD TO 4788 OFF OF N US 31

Well Owner: GARY SAMPLE

Well Address:
4782 RIVER RD
MANISTEE, MI

Owner Address:
3881 DAVISON LAKE RD
ORTONVILLE, MI 48462

Drilling Method: Rotary
Well Depth: 58.00 ft. **Well Use:** Household
Well Type: New **Date Completed:** 12/10/2009

Casing Type: PVC plastic **Height:**
Casing Joint: Unknown
Casing Fitting: None

Diameter: 5.00 in. to 50.00 ft. depth SDR: 21.00

Borehole: 7.88 in. to 58.00 ft. depth

Pump Installed: No
Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 29.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Air
Pumping level 31.00 ft. after 2.00 hrs. at 25 GPM

Formation Description	Thickness	Depth to Bottom
Yellow Sand	12.00	12.00
Sand Dry W/Clay	17.00	29.00
Sand Water Bearing	29.00	58.00

Screen Installed: Yes **Filter Packed:** Yes
Screen Diameter: 5.00 in. **Blank:**
Screen Material Type: PVC-wire wrapped

Slot	Length	Set Between
7.00	10.00 ft.	50.00 ft. and 58.00 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Bentonite slurry	4.50	None	0.00 ft. to 40.00 ft.

Wellhead Completion: Unknown

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name: JOHN F KEVEN T
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 53-1917
Business Name: PUMP ENGINEERING & SUPPLY INC
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No: 51-07-440-028-00	**Permit No:** 51-4135	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 32	**Well Status:** Active	**WSSN:**	**Source ID/Well No:**

Well ID: 51000005225

Elevation:

Latitude: 44.2756

Longitude: -86.27529

Method of Collection: GPS Std Positioning Svc SA Off

Distance and Direction from Road Intersection:
US31 N TO GUTHRIE RD N TO BROWN RD TO 1411

Well Owner: RICHELLE HARTWIG

Well Address:	**Owner Address:**
1411 BROWN RD MANISTEE, MI 49660	1411 BROWN RD MANISTEE, MI 49660

Drilling Method: Rotary
Well Depth: 42.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 7/19/2007

Casing Type: PVC plastic **Height:**
Casing Joint: Unknown
Casing Fitting: Unknown

Diameter: 5.00 in. to 34.00 ft. depth SDR: 21.00

Borehole: 8.50 in. to 42.00 ft. depth

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:** 1.00
Manufacturer: Other **Pump Type:** Submersible
Model Number: T1L4Y16P10 **Pump Capacity:** 16 GPM
Drop Pipe Length: 32.00 ft. **Pump Voltage:**
Drop Pipe Diameter: 1.00 in. **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: Yes
Pressure Tank Type: Diaphragm/bladder
Manufacturer: Well-X-Trol
Model Number: WX250 **Tank Capacity:** 44.0 Gallons
Pressure Relief Valve Installed: Yes

Static Water Level: 12.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Air
Pumping level 20.00 ft. after 2.00 hrs. at 36 GPM

Formation Description	Thickness	Depth to Bottom
Sand Dry	12.00	12.00
Sand Water Bearing	30.00	42.00

Screen Installed: Yes **Filter Packed:** Yes
Screen Diameter: 4.00 in. **Blank:** 2.00 ft. Above
Screen Material Type: PVC-wire wrapped

Slot	Length	Set Between
7.00	8.00 ft.	34.00 ft. and 42.00 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Bentonite slurry	4.00	None	0.00 ft. to 31.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	71 ft.	South

Abandoned Well Plugged: Yes

Casing Diameter: 2 in. **Casing Removed:** No
Plugging Material: Bentonite chips/pellets
No. of Bags: 3.50 **Well Depth:** 40 ft.

Drilling Machine Operator Name: JIM
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 53-2430
Business Name: WEST MICHIGAN WELL DRILLING
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks: Pump Manufacturer:SCHAEFER

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No: 51-07-133-001-00	**Permit No:** W07-51003	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 33	**Well Status:** Active	**WSSN:** 2023351	**Source ID/Well No:** 001

Well ID: 51000005142

Elevation: 635 ft.
Latitude: 44.27546
Longitude: -86.25596
Method of Collection: GPS Std Positioning Svc SA Off

Distance and Direction from Road Intersection: U.S. 31

Well Owner: Bill House / Owner/ Manager

Well Address: U.S. 31, Manistee, MI 49660

Owner Address: 2323 Airport Rd, Manistee, MI 49660

Drilling Method: Rotary
Well Depth: 104.00 ft. **Well Use:** Type II public
Well Type: New **Date Completed:** 7/10/2007

Casing Type: Steel - galvanized **Height:** 1.00 ft. above grade
Casing Joint: Threaded & coupled
Casing Fitting: None

Diameter: 4.00 in. to 90.00 ft. depth

Borehole: 4.00 in. to 104.00 ft. depth

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: 8/17/2007 **HP:** 3.00
Manufacturer: Grundfos **Pump Type:** Submersible
Model Number: 40S30-9 **Pump Capacity:** 60 GPM
Drop Pipe Length: 77.00 ft. **Pump Voltage:**
Drop Pipe Diameter: 2.00 in. **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: Yes
Pressure Tank Type: Diaphragm/bladder
Manufacturer: Well-Mate
Model Number: WM35-WB **Tank Capacity:** 35.9 Gallons
Pressure Relief Valve Installed: Yes

Static Water Level: 17.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Test pump
Pumping level 70.00 ft. after 4.00 hrs. at 60 GPM

Screen Installed: Yes **Filter Packed:** Yes
Screen Diameter: 3.00 in. **Blank:** 2.00 ft. Above
Screen Material Type: Stainless steel-slotted

Slot	Length	Set Between
15.00	12.00 ft.	90.00 ft. and 104.00 ft.

Fittings: None

Formation Description	Thickness	Depth to Bottom
Sand & Gravel Medium To Coarse Fine To	40.00	40.00
Red Clay	5.00	45.00
Red Clay & Sand Fine	5.00	50.00
Sand & Gravel Fine To Medium Fine	10.00	60.00
Sand & Gravel Fine To Medium Coarse	15.00	75.00
Red Clay	10.00	85.00
Sand Fine To Medium Fine	19.00	104.00

Well Grouted: Yes **Grouting Method:** Grout pipe outside casing

Grouting Material	Bags	Additives	Depth
Other	21.00	None	0.00 ft. to 80.00 ft.

Geology Remarks:

Wellhead Completion: 12 inches above grade

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	130 ft.	Northwest

Drilling Machine Operator Name: Richard Peterson
Employment: Employee
Pump Installer: Randy McCollum

Contractor Type: Water Well Drilling Contractor **Reg No:** 43-0539
Business Name: Peterson Well Drilling, CLC
Business Address: 6856 W 11 1/2 Mile, Irons, MI, 49644

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: Blacker Air Port, Grunofos Pump 3 Hp w/ 3 Hp. Franklin Motor And 3 Tanks WM 35 - WB And a Baker Monitor Pitless.

Other Remarks: Grouting Material 1:1 bag Benseal, 20bags cement, Elevation Collection Method:Unknown, Elevation Datum:Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No: 51-07-128-012-00	**Permit No:** 51-3924	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 28	**Well Status:** Active	**WSSN:**	**Source ID/Well No:**

Well ID: 51000004988

Elevation:

Latitude: 44.27697

Longitude: -86.25671

Method of Collection: GPS Std Positioning Svc SA Off

Distance and Direction from Road Intersection:
WELL IS W OF RIVER RD ON N SIDE OF CHIPPEWA HWY

Well Owner: CARL MEDUNA

Well Address:
2114 CHIPPEWA HWY
MANISTEE, MI 49660

Owner Address:
2114 CHIPPEWA HWY
MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 58.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 10/3/2006

Casing Type: Steel - galvanized **Height:**
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 4.00 in. to 54.00 ft. depth

Borehole: 4.00 in. to 58.00 ft. depth

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:** 0.75
Manufacturer: F.E. Myers **Pump Type:** Submersible
Model Number: 2MP7210 **Pump Capacity:** 12 GPM
Drop Pipe Length: 40.00 ft. **Pump Voltage:**
Drop Pipe Diameter: 1.25 in. **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 28.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Plunger
Pumping level 30.00 ft. after 2.00 hrs. at 28 GPM

Formation Description	Thickness	Depth to Bottom
Topsoil	1.00	1.00
Yellow Sand	27.00	28.00
Sand Water Bearing	17.00	45.00
Brown Clay	5.00	50.00
Sand Water Bearing	8.00	58.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:** 1.00 ft. Above
Screen Material Type: Stainless steel-wire wrapped

Slot	Length	Set Between
10.00	4.00 ft.	54.00 ft. and 58.00 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Bentonite slurry	2.00	None	0.00 ft. to 54.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	150 ft.	North

Abandoned Well Plugged: Yes

Casing Diameter: 2 in. **Casing Removed:** No
Plugging Material: Bentonite chips/pellets
No. of Bags: 2.50 **Well Depth:** 73 ft.

Drilling Machine Operator Name: PYHIL KLUESNER
Employment: Subcontractor

Contractor Type: Water Well Drilling Contractor **Reg No:** 51-1900
Business Name: KLUESNER WELL DRLG
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No: 51-07-129-021-00	**Permit No:** 51-3625	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 29	**Well Status:** Active	**WSSN:**	**Source ID/Well No:**

Well ID: 51000004827

Elevation:

Latitude: 44.27934

Longitude: -86.26808

Method of Collection: GPS Std Positioning Svc SA Off

Distance and Direction from Road Intersection:
.5 MI N OF US 31 ON KEMMER RD E .25 MI WELL ON KT

Well Owner: ADAM CZAK

Well Address:	**Owner Address:**
2227 KEMMER RD MANISTEE, MI 49660	2227 KEMMER RD MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 67.00 ft. **Well Use:** Household
Well Type: New **Date Completed:** 3/30/2006

Casing Type: Steel - black **Height:** 1.50 ft. above grade
Casing Joint: Welded
Casing Fitting: Drive shoe

Diameter: 4.00 in. to 61.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:** 1.00
Manufacturer: Goulds **Pump Type:** Submersible
Model Number: 10LS10422 **Pump Capacity:** 10 GPM
Drop Pipe Length: 95.00 ft. **Pump Voltage:**
Drop Pipe Diameter: 1.25 in. **Drilling Record ID:**
Draw Down Seal Used: Yes

Pressure Tank Installed: Yes
Pressure Tank Type: Diaphragm/bladder
Manufacturer: Well-Mate
Model Number: WM-6 **Tank Capacity:** 30.0 Gallons
Pressure Relief Valve Installed: No

Static Water Level: 6.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Test pump
1.00 hrs. at 20 GPM

Formation Description	Thickness	Depth to Bottom
Sand Fill	2.00	2.00
Black Topsoil	1.00	3.00
Sand Medium	37.00	40.00
Clay	10.00	50.00
Sand & Stones	17.00	67.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:** 2.00 ft. Above
Screen Material Type: PVC-wire wrapped

Slot	Length	Set Between
10.00	6.00 ft.	61.00 ft. and 67.00 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Bentonite dry granular	2.00	None	0.00 ft. to 67.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	60 ft.	Southeast

Drilling Machine Operator Name: ED & BRENT BENSON
Employment: Unknown

Contractor Type: Water Well Drilling Contractor **Reg No:** 51-1603
Business Name: ED BENSON WELL DRILLING
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No: 51-07-129-008-10	**Permit No:** 51-3501	**County:** Manistee		**Township:** Manistee
		Town/Range: 21N 16W	**Section:** 29	**Well Status:** Active	**WSSN:**	**Source ID/Well No:**

Well ID: 51000004765

Elevation:

Latitude: 44.2759035

Longitude: -86.273384

Method of Collection: Address Matching-House Number

Distance and Direction from Road Intersection:
Kemmer Road

Well Owner: Eric Solberg

Well Address:	**Owner Address:**
2114 Kemmer Rd Manistee, MI 49660	2114 Kemmer Road Manistee, MI 49660

Drilling Method: Rotary
Well Depth: 35.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 8/18/2005

Casing Type: PVC plastic **Height:** 1.00 ft. above grade
Casing Joint: Solvent welded/glued
Casing Fitting: None

Diameter: 5.00 in. to 30.00 ft. depth

Borehole: 8.50 in. to 35.00 ft. depth

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: 8/25/2005 **HP:** 1.00
Manufacturer: Sta-Rite **Pump Type:** Submersible
Model Number: 20SP4E02J **Pump Capacity:** 20 GPM
Drop Pipe Length: 25.00 ft. **Pump Voltage:**
Drop Pipe Diameter: 1.00 in. **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: Yes
Pressure Tank Type: Diaphragm/bladder
Manufacturer: Sta-Rite Signature
Model Number: SR35 **Tank Capacity:** 10.0 Gallons
Pressure Relief Valve Installed: Yes

Static Water Level: 5.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Air
Pumping level 5.00 ft. after 0.75 hrs. at 40 GPM

Formation Description	Thickness	Depth to Bottom
Sand	35.00	35.00

Screen Installed: Yes **Filter Packed:** Yes
Screen Diameter: 4.00 in. **Blank:** 2.00 ft. Above
Screen Material Type: PVC-wire wrapped

Slot	Length	Set Between
20.00	5.00 ft.	30.00 ft. and 35.00 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Grout pipe outside casing

Grouting Material	Bags	Additives	Depth
Bentonite slurry	2.00	None	0.00 ft. to 28.00 ft.

Wellhead Completion: Pitless adapter, 12 inches above grade

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	100 ft.	Southwest

Abandoned Well Plugged: Yes

Casing Removed:

Drilling Machine Operator Name: Michael MacEachern
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 83-2175
Business Name: Kastl Well Drilling
Business Address: 9287 W 30 1/2 mile Rd, Harrietta, MI, 49638

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks: Coordinate Source:Google well address geocoding

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No:	Permit No: 51-3543	County: Manistee	Township: Manistee

Town/Range:	Section:	Well Status:	WSSN:	Source ID/Well No:
22N 16W	33	Active		

Well ID: 51000004658

Elevation:

Latitude: 44.275113

Longitude: -86.260765

Method of Collection: Address Matching-House Number

Distance and Direction from Road Intersection:
WELL IS APPROX 1/2 WEST OF RIVER RD ON NORTH SIDE OF PARKDALE AVE

Well Owner: MANISTEE CHURCH OF CHRIST

Well Address:	Owner Address:
1876 E Parkdale Ave MANISTEE, MI 49660	1876 E PARKDALE AVE MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 93.00 ft. **Well Use:** Type III public
Well Type: New **Date Completed:** 9/1/2005

Casing Type: Steel - galvanized **Height:** 1.00 ft. above grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 4.00 in. to 89.00 ft. depth

Borehole: 4.00 in. to 93.00 ft. depth

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: 9/22/2005 **HP:** 0.50
Manufacturer: Milan **Pump Type:** Submersible
Model Number: 2MP5210 **Pump Capacity:** 12 GPM
Drop Pipe Length: 40.00 ft. **Pump Voltage:**
Drop Pipe Diameter: 1.25 in. **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: Yes
Pressure Tank Type: Diaphragm/bladder
Manufacturer: Well-X-Trol
Model Number: 202 **Tank Capacity:** 20.0 Gallons
Pressure Relief Valve Installed: Yes

Static Water Level: 15.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Plunger
Pumping level 50.00 ft. after 2.00 hrs. at 25 GPM

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:** 1.00 ft. Above
Screen Material Type: Stainless steel-slotted

Slot	Length	Set Between
10.00	4.00 ft.	89.00 ft. and 93.00 ft.

Fittings: None

Formation Description	Thickness	Depth to Bottom
Gravel & Sand	1.00	1.00
Sand	3.00	4.00
Brown Sand	11.00	15.00
Brown Sand Water Bearing	31.00	46.00
Red Clay	5.00	51.00
Rust Silt & Gravel Water Bearing	20.00	71.00
Pink Clay & Sand	2.00	73.00
Pink Clay	5.00	78.00
Sand Clay Gravel	9.00	87.00
Sand & Gravel Water Bearing	6.00	93.00

Well Grouted: Yes **Grouting Method:** Driven/dry grout

Grouting Material	Bags	Additives	Depth
Bentonite dry granular	5.00	None	0.00 ft. to 89.00 ft.

Geology Remarks:
YELLOW WATER AT 46' AND AT 71'

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	80 ft.	Northwest

Drilling Machine Operator Name: STEVE KLUESNER
Employment: Employee
Pump Installer: PHIL KLUESNER

Contractor Type: Water Well Drilling Contractor **Reg No:** 51-1900
Business Name: Phil Kluesner Well Drilling
Business Address: 17910 Coates Hwy, Brethren, MI, 49619

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks: Coordinate Source:Google well address geocoding

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No: 51 07 129 002 00	**Permit No:** 51-3365	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 29	**Well Status:** Active
		WSSN:		**Source ID/Well No:**

Well ID: 51000004617

Elevation: 682 ft.
Latitude: 44.290613
Longitude: -86.27369
Method of Collection: GPS Std Positioning Svc SA Off

Distance and Direction from Road Intersection:
ON THE SOUTH SIDE OF DONTZ ROAD

Well Owner: JOEL SWANSON

Well Address:	**Owner Address:**
1327 DONTZ RD. MANISTEE, MI 49660	1327 DONTZ RD. MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 100.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 6/1/2005

Casing Type: Steel - unknown **Height:**
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 4.00 in. to 94.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:** 1.00
Manufacturer: Sta-Rite **Pump Type:** Submersible
Model Number: 20SP4E02H **Pump Capacity:** 20 GPM
Drop Pipe Length: 84.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: Yes
Pressure Tank Type: Unknown
Manufacturer: Sta-Rite Signature
Model Number: SR60 **Tank Capacity:**
Pressure Relief Valve Installed: No

Static Water Level: 67.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Bailer
Pumping level 75.00 ft. after 0.50 hrs. at 25 GPM

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:**
Screen Material Type: Stainless steel-wire wrapped

Slot	Length	Set Between
6.00	6.00 ft.	94.00 ft. and 100.00 ft.

Fittings: Neoprene packer

Formation Description	Thickness	Depth to Bottom
Topsoil	1.00	1.00
Red Clay	20.00	21.00
See Comments	15.00	36.00
Unidentified Consolidated Fm	21.00	57.00
Sand & Stones Coarse	2.00	59.00
Sand Medium To Coarse	24.00	83.00
Red Clay	5.00	88.00
See Comments	4.00	92.00
Sand Water Bearing W/Clay	8.00	100.00

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Bentonite dry granular	3.00	None	0.00 ft. to 94.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:
GRAY CLAY, SAND AND STONES AT 56' RED CLAY, SAND AND STONES AT 92' FINE TO MEDIUM WATER BEARING SAND AND CLAY AT BOTTOM

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	80 ft.	Northwest

Abandoned Well Plugged: Yes

Casing Diameter: 2 in. **Casing Removed:** No
Plugging Material: Bentonite chips/pellets
No. of Bags: 3.50 **Well Depth:** 100 ft.

Drilling Machine Operator Name: JOHN SOBASKI
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 53-1960
Business Name: CAMERON BROTHERS, INC
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:
Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No: 51-07-129-010-00	**Permit No:** 51-2331	**County:** Manistee		**Township:** Manistee
		Town/Range: 21N 16W	**Section:** 29	**Well Status:** Active	**WSSN:**	**Source ID/Well No:**

Well ID: 51000004513

Elevation:

Latitude: 44.2750144

Longitude: -86.2734155

Method of Collection: Address Matching-House Number

Distance and Direction from Road Intersection:
Kemmer Road

Well Owner: Solberg Marina, Inc.

Well Address:	**Owner Address:**
2028 Kemmer Rd Manistee, MI 49660	267 Arthur Street Manistee, MI 49660

Drilling Method: Rotary
Well Depth: 45.00 ft. **Well Use:** Household
Well Type: New **Date Completed:** 10/12/2003

Casing Type: PVC plastic **Height:** 1.00 ft. above grade
Casing Joint: Solvent welded/glued
Casing Fitting: None

Diameter: 5.00 in. to 40.00 ft. depth

Borehole: 8.50 in. to 45.00 ft. depth

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: 10/12/2003 **HP:** 1.00
Manufacturer: Sta-Rite **Pump Type:** Submersible
Model Number: 20SP4D02J **Pump Capacity:** 20 GPM
Drop Pipe Length: 35.00 ft. **Pump Voltage:**
Drop Pipe Diameter: 1.00 in. **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: Yes
Pressure Tank Type: Diaphragm/bladder
Manufacturer: Sta-Rite Signature
Model Number: SR85 **Tank Capacity:** 25.0 Gallons
Pressure Relief Valve Installed: No

Static Water Level: 12.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Air
Pumping level 12.00 ft. after 0.75 hrs. at 40 GPM

Formation Description	Thickness	Depth to Bottom
Sand	45.00	45.00

Screen Installed: Yes **Filter Packed:** Yes
Screen Diameter: 4.00 in. **Blank:** 2.00 ft. Above
Screen Material Type: PVC-wire wrapped

Slot	Length	Set Between
20.00	5.00 ft.	40.00 ft. and 45.00 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Grout pipe outside casing

Grouting Material	Bags	Additives	Depth
Bentonite slurry	3.00	None	0.00 ft. to 35.00 ft.

Wellhead Completion: Pitless adapter, 12 inches above grade

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	85 ft.	South

Drilling Machine Operator Name: Michael MacEachern
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 83-2175
Business Name: Kastl Well Drilling
Business Address: 9287 W 30 1/2 mile Rd, Harrietta, MI, 49638

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks: Coordinate Source:Google well address geocoding

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No: 51-07-740-028-00	**Permit No:** 51-3239	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 27	**Well Status:** Active	**WSSN:**	**Source ID/Well No:**

Well ID: 51000004480

Elevation: 673 ft.
Latitude: 44.28625
Longitude: -86.24068
Method of Collection: Address Matching-House Number

Distance and Direction from Road Intersection:
ON NORTHWEST SIDE OF US 31; CHIPPEWA HWY

Well Owner: PATRICK EDMONDSON

Well Address:	**Owner Address:**
2986 CHIPPEWA HWY MANISTEE, MI 49660	2986 CHIPPEWA HWY MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 90.50 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 1/26/2005

Casing Type: Steel - unknown **Height:**
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 4.00 in. to 84.50 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:** 0.75
Manufacturer: Sta-Rite **Pump Type:** Submersible
Model Number: 10sp4d02h **Pump Capacity:** 10 GPM
Drop Pipe Length: 75.00 ft. **Pump Voltage:**
Drop Pipe Diameter: 1.25 in. **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: Yes
Pressure Tank Type: Unknown
Manufacturer: Sta-Rite Signature
Model Number: SR48 **Tank Capacity:** 48.0 Gallons
Pressure Relief Valve Installed: No

Static Water Level: 57.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Bailer
Pumping level 57.00 ft. after 0.50 hrs. at 10 GPM

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:**
Screen Material Type: Stainless steel-wire wrapped

Slot	Length	Set Between
7.00	6.00 ft.	84.50 ft. and 90.50 ft.

Fittings: Neoprene packer

Formation Description	Thickness	Depth to Bottom
Topsoil	1.00	1.00
Sand Medium To Coarse	19.00	20.00
Sand & Stones Medium To Coarse	16.00	36.00
Sand W/Stones W/Clay	3.00	39.00
Sand & Stones Coarse Water Bearing	40.00	79.00
Red Clay	2.00	81.00
Sand & Stones Coarse Water Bearing	9.00	90.00
Lithology Unknown	0.50	90.50

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Bentonite slurry	3.00	None	0.00 ft. to 84.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:
STILL GOOD 90'

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	65 ft.	Northwest

Abandoned Well Plugged: No
Reason Not Plugged: Other

Drilling Machine Operator Name: JOHN SOBASKI
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 53-1960
Business Name: CAMERON BROS INC
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: HELPER: DENNIS CREGG
Other Remarks: Not Plugged Reason:UNACCESSIBLE; DECK WITH ROOF BUILT OVER IT

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No: 51-07-128-010-20	**Permit No:** 51-3202	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 28	**Well Status:** Active	**WSSN:**	**Source ID/Well No:**

Well ID: 51000004442

Elevation:

Latitude: 44.2761886

Longitude: -86.2577868

Method of Collection: Address Matching-House Number

Distance and Direction from Road Intersection:
WELL IS ON NORTH SIDE OF CHIPPEWA HWY SOUTHWEST OF RIVER RD

Well Owner: DARIN FORBES

Well Address:	**Owner Address:**
2016 Chippewa Hwy MANISTEE, MI 49660	2016 CHIPPEWA HWY MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 58.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 12/9/2004

Casing Type: Steel - galvanized **Height:** 1.00 ft. above grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 4.00 in. to 54.00 ft. depth

Borehole: 4.00 in. to 58.00 ft. depth

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: 12/13/2004 **HP:** 1.00
Manufacturer: Flint & Walling **Pump Type:** Submersible
Model Number: 4F19 **Pump Capacity:** 20 GPM
Drop Pipe Length: 40.00 ft. **Pump Voltage:**
Drop Pipe Diameter: 1.25 in. **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: Yes
Pressure Tank Type: Diaphragm/bladder (Buried)
Manufacturer: Well-X-Trol
Model Number: 250 **Tank Capacity:** 44.0 Gallons
Pressure Relief Valve Installed: Yes

Static Water Level: 10.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Plunger
Pumping level 41.00 ft. after 2.00 hrs. at 30 GPM

Formation Description	Thickness	Depth to Bottom
Topsoil	1.00	1.00
Brown Sand Fine	2.00	3.00
Brown Sand	6.00	9.00
Brown Sand Water Bearing	38.00	47.00
Red Clay	5.00	52.00
Brown Sand Water Bearing	6.00	58.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:** 1.00 ft. Above
Screen Material Type: Stainless steel-slotted

Slot	Length	Set Between
10.00	4.00 ft.	54.00 ft. and 58.00 ft.

Fittings: None

Well Grouted: Yes **Grouting Method:** Driven/dry grout

Grouting Material	Bags	Additives	Depth
Bentonite dry granular	3.00	None	0.00 ft. to 54.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	50 ft.	North

Abandoned Well Plugged: Yes

Casing Diameter: 1.25 in. **Casing Removed:** No
Plugging Material: Bentonite chips/pellets
No. of Bags: 2.00 **Well Depth:** 45 ft.

Drilling Machine Operator Name: STEVE KLUESNER
Employment: Employee
Pump Installer: PHILLIP J. & PHIL KLUESNER

Contractor Type: Water Well Drilling Contractor **Reg No:** 51-1900
Business Name: Phil Kluesner Well Drilling
Business Address: 17910 Coates Hwy, Brethren, MI, 49619

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks: Coordinate Source:Google well address geocoding

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No: 51-07680-001-00	**Permit No:** 51-2310	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 22	**Well Status:** Active	**WSSN:**	**Source ID/Well No:**

Well ID: 51000003695

Elevation:

Latitude: 44.290026

Longitude: -86.242999

Method of Collection: Address Matching-House Number

Distance and Direction from Road Intersection:
ON THE EAST SIDE OF ORCHARD HWY IN PINEWOOD EST

Well Owner: GENE GUTOWSKI

Well Address:	**Owner Address:**
3013 ORCHARD HWY MANISTEE, MI 49660	3013 ORCHARD HWY MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 113.60 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 12/13/2002

Casing Type: Steel - black **Height:**
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 4.00 in. to 107.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:** 1.00
Manufacturer: Sta-Rite **Pump Type:** Submersible
Model Number: 20SP4E02H **Pump Capacity:** 20 GPM
Drop Pipe Length: 98.00 ft. **Pump Voltage:**
Drop Pipe Diameter: 1.25 in. **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: Yes
Pressure Tank Type: Unknown
Manufacturer: Sta-Rite Signature
Model Number: SR60 **Tank Capacity:** 60.0 Gallons
Pressure Relief Valve Installed: No

Static Water Level: 78.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Bailer
Pumping level 78.00 ft. after 0.50 hrs. at 10 GPM

Formation Description	Thickness	Depth to Bottom
Topsoil	1.00	1.00
Sand Medium To Coarse	7.00	8.00
Sand & Stones Medium To Coarse	12.00	20.00
Sand & Stones W/Clay Coarse	11.00	31.00
Sand & Stones Coarse	13.00	44.00
Sand Coarse	16.00	60.00
Sand Medium To Coarse	21.00	81.00
Sand & Stones Coarse Water Bearing	9.00	90.00
Sand Medium To Coarse Water Bearing	24.00	114.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:**
Screen Material Type: Stainless steel-wire wrapped

Slot	Length	Set Between
7.00	6.00 ft.	107.60 ft. and 113.60 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Bentonite slurry	2.00	None	0.00 ft. to 107.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:
STILL GOOD 114 - ???

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	60 ft.	Southeast

Abandoned Well Plugged: Yes

Casing Removed:

Drilling Machine Operator Name: JOHN SOBASKI
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 53-1960
Business Name: CAMERON BROS INC
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: HELPER: GARY CAMERON
Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No:	Permit No: 51-1640	County: Manistee	Township: Manistee

Town/Range:	Section:	Well Status:	WSSN:	Source ID/Well No:
21N 16W	21	Active		

Well ID: 51000003323

Elevation:

Latitude: 44.29176789

Longitude: -86.25557537

Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:
ONE MILE WEST OF M22 ON NORTH SIDE OF DONTZ RD

Well Owner: MR PATRIC LAGIKOWSKI

Well Address:	Owner Address:
2152 DONTZ RD MANISTEE, MI 49660	2152 DONTZ RD MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 167.00 ft. **Well Use:** Household
Well Type: New **Date Completed:** 8/13/2001

Casing Type: Steel - black **Height:**
Casing Joint: Welded
Casing Fitting: Drive shoe

Diameter: 4.00 in. to 153.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:** 1.50
Manufacturer: Goulds **Pump Type:** Submersible
Model Number: 256515 **Pump Capacity:** 25 GPM
Drop Pipe Length: 110.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: Yes
Pressure Tank Type: Unknown
Manufacturer: Amtrol
Model Number: WX250 **Tank Capacity:** 40.0 Gallons
Pressure Relief Valve Installed: No

Static Water Level: 6.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Test pump
1.00 hrs. at 36 GPM

Formation Description	Thickness	Depth to Bottom
Topsoil	1.00	1.00
Sand & Stones	4.00	5.00
Clay	10.00	15.00
Sand	15.00	30.00
Clay & Sand	10.00	40.00
Sand	59.00	99.00
Sand Silty Fine	34.00	133.00
Sand Medium	18.00	151.00
Sand Coarse	16.00	167.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:** 2.00 ft. Above
Screen Material Type: Stainless steel-wire wrapped

Slot	Length	Set Between
10.00	14.00 ft.	153.00 ft. and 167.00 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Bentonite slurry	6.00	None	0.00 ft. to 167.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name: ED BENSON
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 51-1603
Business Name: ED BENSON W/D
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No:	Permit No: 51-1604	County: Manistee	Township: Manistee

Town/Range:	Section:	Well Status:	WSSN:	Source ID/Well No:
22N 16W	32	Active		

Well ID: 51000003372

Elevation:

Latitude: 44.27515275

Longitude: -86.2758026

Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:
NORTH SIDE OF TUBBS RD

Well Owner: TIM KOSITZKY

Well Address:	Owner Address:
1412 TUBBS ROAD MANISTEE, MI 49660	1412 TUBBS ROAD MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 37.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 6/21/2001

Casing Type: Steel - black **Height:**
Casing Joint: Welded
Casing Fitting: Drive shoe

Diameter:

Borehole: 4.00 in. to 31.00 ft. depth

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:** 0.50
Manufacturer: Goulds **Pump Type:** Submersible
Model Number: 10LS05 **Pump Capacity:** 10 GPM
Drop Pipe Length: 20.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: Yes
Pressure Tank Type: Unknown
Manufacturer: Well-Mate
Model Number: WM9 **Tank Capacity:** 30.0 Gallons
Pressure Relief Valve Installed: No

Static Water Level: 12.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Other
1.00 hrs. at 20 GPM

Formation Description	Thickness	Depth to Bottom
Topsoil	1.00	1.00
Sand & Clay	4.00	5.00
Loam W/Clay Sandy	5.00	10.00
Sand W/Clay	30.00	40.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:** 2.00 ft. Above
Screen Material Type: PVC-wire wrapped

Slot	Length	Set Between
10.00	6.00 ft.	31.00 ft. and 37.00 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Bentonite dry granular	1.00	None	

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	60 ft.	Northeast

Drilling Machine Operator Name: ED BENSON
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 51-1603
Business Name: BENSON WELL DRLG
Business Address:

Abandoned Well Plugged: Yes

Casing Removed:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks: Yield Test Method:BAILER & TEST PUMP

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No: 51-07-740-022-00	**Permit No:** 51-1354	**County:** Manistee		**Township:** Manistee
		Town/Range: 21N 16W	**Section:** 22	**Well Status:** Active	**WSSN:**	**Source ID/Well No:**

Well ID: 51000003118

Elevation:

Latitude: 44.28709176

Longitude: -86.24036969

Method of Collection: Address Matching-House Number

Distance and Direction from Road Intersection:

Well Owner: Neil H. Wick

Well Address:	**Owner Address:**
3026 Chippewa Manistee, MI 49660	3026 Chippewa Manistee, MI 49660

Drilling Method: Rotary
Well Depth: 203.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 10/27/2000

Casing Type: PVC plastic **Height:**
Casing Joint: Unknown
Casing Fitting: None

Diameter: 5.00 in. to 196.00 ft. depth

Borehole: 8.50 in. to 203.00 ft. depth

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:** 0.75
Manufacturer: Flint & Walling **Pump Type:** Submersible
Model Number: **Pump Capacity:** 10 GPM
Drop Pipe Length: 100.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: Yes
Pressure Tank Type: Unknown
Manufacturer: Well-Rite-Flexcon
Model Number: WR-100 **Tank Capacity:** 32.0 Gallons
Pressure Relief Valve Installed: No

Static Water Level: 49.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Air
Pumping level 105.00 ft.

Formation Description	Thickness	Depth to Bottom
Topsoil	1.00	1.00
Sand	19.00	20.00
Sand & Gravel	20.00	40.00
Sand & Clay Stringers	15.00	55.00
Sand Gravel Clay	65.00	120.00
Sand & Clay	54.00	174.00
Sand & Clay Stringers	11.00	185.00
Sand	18.00	203.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:** 2.00 ft. Above
Screen Material Type: PVC-wire wrapped

Slot	Length	Set Between
10.00	5.00 ft.	196.00 ft. and 203.00 ft.

Fittings: Unknown

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Bentonite slurry	10.00	None	0.00 ft. to 188.00 ft.

Wellhead Completion: Pitless adapter, 12 inches above grade

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	55 ft.	West

Abandoned Well Plugged: Yes

Casing Removed:

Drilling Machine Operator Name: Tony Rivard
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 83-1981
Business Name: Jim Jeffers Well Drilling
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No: 51-07-129-005-20	**Permit No:** 51-1055	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 32	**Well Status:** Active	**WSSN:**	**Source ID/Well No:**

Well ID: 51000003050

Elevation:

Latitude: 44.27557417

Longitude: -86.26466554

Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:
ON THE NORTH SIDE OF US 31

Well Owner: JIM RAATZ

Well Address:

Owner Address:
1810 PARKDALE AVENUE
MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 63.00 ft. **Well Use:** Household
Well Type: New **Date Completed:** 8/10/2000

Casing Type: Steel - black **Height:**
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 4.00 in. to 57.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:** 1.00
Manufacturer: Sta-Rite **Pump Type:** Submersible
Model Number: 20SP4E02H **Pump Capacity:** 20 GPM
Drop Pipe Length: 48.00 ft. **Pump Voltage:**
Drop Pipe Diameter: 1.25 in. **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: Yes
Pressure Tank Type: Unknown
Manufacturer: Well-X-Trol
Model Number: WX302 **Tank Capacity:** 86.0 Gallons
Pressure Relief Valve Installed: No

Static Water Level: 14.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Bailer
Pumping level 4.00 ft. after 0.50 hrs. at 10 GPM

Formation Description	Thickness	Depth to Bottom
Sand	14.00	14.00
Sand Coarse W/Stones	26.00	40.00
Brown Clay	8.00	48.00
Red Clay & Sand	3.00	51.00
Sand Coarse W/Clay	2.00	53.00
Sand & Stones Coarse Water Bearing	10.00	63.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:**
Screen Material Type: Stainless steel-wire wrapped

Slot	Length	Set Between
7.00	6.00 ft.	57.00 ft. and 63.00 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Bentonite dry granular	1.00	None	0.00 ft. to 57.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	50 ft.	East

Drilling Machine Operator Name: RANDY SMITH
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 53-1960
Business Name: CAMERON BROTHERS INC
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: PUMP: 2 WIRE;HELPER: DANIELLE CAMERON

Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No:	Permit No: 51-1095	County: Manistee	Township: Manistee

Town/Range:	Section:	Well Status:	WSSN:	Source ID/Well No:
22N 16W	29	Active		

Well ID: 51000003070

Elevation:

Latitude: 44.28349

Longitude: -86.273466

Method of Collection: Section - Centroid

Distance and Direction from Road Intersection:
1/4 MILE SOUTH OF DONTZ RD; ON EAST SIDE OF SNIDER RD

Well Owner: DAN GESTAD

Well Address:

Owner Address:
2449 SNIDER ROAD
MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 136.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 9/26/2000

Casing Type: Steel - black **Height:**
Casing Joint: Unknown
Casing Fitting: Drive shoe

Diameter:

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:** 0.75
Manufacturer: Goulds **Pump Type:** Submersible
Model Number: **Pump Capacity:** 10 GPM
Drop Pipe Length: 120.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: Yes
Pressure Tank Type: Unknown
Manufacturer: Amtrol
Model Number: WX203 **Tank Capacity:** 10.0 Gallons
Pressure Relief Valve Installed: No

Static Water Level: 102.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Other
1.00 hrs. at 20 GPM

Formation Description	Thickness	Depth to Bottom
Topsoil	1.00	1.00
Sand	3.00	4.00
Sand Fine	13.00	17.00
Loam W/Clay Sandy	12.00	29.00
Sand Fine	21.00	50.00
Clay	4.00	54.00
Sand Coarse	49.00	103.00
Sand Silty Water Bearing	22.00	125.00
Sand Medium	11.00	136.00
Sand & Clay Medium	2.00	138.00
Sand Fine Silty	10.00	148.00
Gray Clay	1.00	149.00
Gray Sand	1.00	150.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:** 2.00 ft. Above
Screen Material Type: PVC-wire wrapped

Slot	Length	Set Between
10.00	6.00 ft.	130.00 ft. and 136.00 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Bentonite dry granular	5.00	None	0.00 ft. to 136.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
Unknown	50 ft.	East

Drilling Machine Operator Name: ED BENSON
Employment: Employee

Abandoned Well Plugged: Yes

Casing Removed:

Contractor Type: Water Well Drilling Contractor **Reg No:** 51-1603
Business Name: ED BENSON WELL DRLG
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks: Yield Test Method:BAILER & TEST PUMP

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221632043

Tax No: 510744002500	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 32	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001457

Elevation: 615.15 ft.
Latitude: 44.275557275
Longitude: -86.2737733896
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:
CORNER OF KEMMER RD AND BROWN RD.

Well Owner: DIETZ, MR. JOHN

Well Address:
1950 KEMMER RD
MANISTEE, MI 49660

Owner Address:
1950 KEMMER RD
MANISTEE, MI 49660

Drilling Method: Auger/Bored
Well Depth: 41.00 ft. **Well Use:** Household
Well Type: New **Date Completed:** 9/10/1990

Casing Type: Unknown **Height:**
Casing Joint: Unknown
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 37.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Goulds **Pump Type:** Jet
Model Number: **Pump Capacity:** 0 GPM
Drop Pipe Length: 30.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 14.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown
Pumping level 0.00 ft. after 1.00 hrs. at 20 GPM

Formation Description	Thickness	Depth to Bottom
Sand Fill	3.00	3.00
Sand	5.00	8.00
Loam W/Clay	7.00	15.00
Sand Water Bearing	26.00	41.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
10.00	0.00 ft.	0.00 ft. and 0.00 ft.

Fittings: None

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Bentonite slurry	0.00	None	0.00 ft. to 25.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	50 ft.	South

Drilling Machine Operator Name: ED BENSON
Employment: Unknown

Contractor Type: Unknown **Reg No:** 51-1603
Business Name:
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:
Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221632042

Tax No: 510744002700	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 32	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001456

Elevation: 611.87 ft.
Latitude: 44.275543273
Longitude: -86.2758267716
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: MR DON CRANT

Well Address:	**Owner Address:**
1379 BROWN RD MANISTEE, MI 49660	CANDON RD MANISTEE, MI 49660

Drilling Method: Auger/Bored
Well Depth: 38.00 ft. **Well Use:** Household
Well Type: New **Date Completed:** 9/25/1990

Casing Type: Steel - black **Height:**
Casing Joint: Welded
Casing Fitting: None

Diameter:

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Other **Pump Type:** Submersible
Model Number: **Pump Capacity:** 0 GPM
Drop Pipe Length: 0.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 9.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown
Pumping level 0.00 ft. after 1.00 hrs. at 18 GPM

Formation Description	Thickness	Depth to Bottom
Sand Fill	3.00	3.00
Topsoil	1.00	4.00
Sand	2.00	6.00
Clay	3.00	9.00
Sand Water Bearing	29.00	38.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:** 2.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
10.00	6.00 ft.	32.00 ft. and 38.00 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Bentonite slurry	0.00	None	0.00 ft. to 25.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name: ED BENSON
Employment: Unknown

Contractor Type: Unknown **Reg No:** 51-1603
Business Name:
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks: Pump Manufacturer:BURKS

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221632039

Tax No: 510744003900	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 32	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001453

Elevation: 611.91 ft.
Latitude: 44.2754907908
Longitude: -86.2739298862
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: NORTHWEST SAVINGS AND LOAN

Well Address:	**Owner Address:**
MANISTEE, MI 49660	MANISTEE, MI 49660

Drilling Method: Auger/Bored
Well Depth: 38.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:**

Casing Type: Unknown **Height:** 0.00 ft. below grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 34.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Goulds **Pump Type:** Jet
Model Number: **Pump Capacity:** 0 GPM
Drop Pipe Length: 21.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 10.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown
Pumping level 0.00 ft. after 1.00 hrs. at 10 GPM

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
0.00	4.00 ft.	34.00 ft. and 38.00 ft.

Fittings: Bremer check valve

Formation Description	Thickness	Depth to Bottom
Topsoil	1.00	1.00
Sand	4.00	5.00
Green Clay & Sand	2.00	7.00
Sand	3.00	10.00
Sand Water Bearing	15.00	25.00
Sand Coarse Water Bearing	15.00	40.00
Clay	2.00	42.00

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Bentonite slurry	0.00	None	0.00 ft. to 0.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	75 ft.	North

Abandoned Well Plugged: No
Reason Not Plugged:

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 51-1603
Business Name:
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:
Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221632030

Tax No: 510744002900	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 32	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001444

Elevation: 612.89 ft.
Latitude: 44.2755443106
Longitude: -86.2756740144
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: TIGHE, JOE

Well Address:
MANISTEE, MI 49660

Owner Address:
KERRY ROAD
MANISTEE, MI 49660

Drilling Method: Auger/Bored
Well Depth: 38.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:**

Casing Type: Unknown **Height:** 0.00 ft. below grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 34.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Goulds **Pump Type:** Jet
Model Number: **Pump Capacity:** 0 GPM
Drop Pipe Length: 21.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 12.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Formation Description	Thickness	Depth to Bottom
Sand	12.00	12.00
Clay	1.00	13.00
Sand Water Bearing	15.00	28.00
Sand Water Bearing	10.00	38.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
0.00	4.00 ft.	34.00 ft. and 38.00 ft.

Fittings: Bremer check valve

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Other	0.00	None	0.00 ft. to 0.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Abandoned Well Plugged: No
Reason Not Plugged:

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 51-1603
Business Name:
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:
Other Remarks: Grouting Material 1:Listed as other in Wellkey

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221632015

Tax No: 510744002100	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 32	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001429

Elevation: 610.27 ft.
Latitude: 44.2761061814
Longitude: -86.2754846165
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: GRANT, DONALD

Well Address:
MANISTEE, MI 49660

Owner Address:
505 RAMSDELL ST
MANISTEE, MI 49660

Drilling Method: Hollow Rod
Well Depth: 40.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 12/9/1974

Casing Type: Unknown **Height:**
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 35.50 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Flint & Walling **Pump Type:** Jet
Model Number: **Pump Capacity:** 0 GPM
Drop Pipe Length: 21.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 10.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Formation Description	Thickness	Depth to Bottom
Red Sand	8.00	8.00
White Marl W/Sand	10.00	18.00
Sand & Gravel Coarse	22.00	40.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
7.00	4.50 ft.	35.50 ft. and 40.00 ft.

Fittings: Bremer check valve

Well Grouted: No

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	75 ft.	North

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:**
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:
Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221632020

Tax No: 510744002600	**Permit No:**	**County:** Manistee		**Township:** Manistee	
		Town/Range: 22N 16W	**Section:** 32	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001434

Elevation: 610.27 ft.
Latitude: 44.2755609244
Longitude: -86.2747179485
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: HEDDER, PHILLIP

Well Address:
MANISTEE, MI 49660

Owner Address:
RR
MANISTEE, MI 49660

Drilling Method: Driven Hand
Well Depth: 42.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 11/13/1971

Casing Type: Unknown **Height:** 0.00 ft. below grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 0.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Other **Pump Type:** Jet
Model Number: **Pump Capacity:** 0 GPM
Drop Pipe Length: 29.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 12.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Formation Description	Thickness	Depth to Bottom
Sand	42.00	42.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
10.00	5.00 ft.	37.00 ft. and 42.00 ft.

Fittings: Neoprene packer

Well Grouted: No

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	53 ft.	Southeast

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 51-0364
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks: Pump Manufacturer:RAPIDAYTON

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221632011

Tax No: 510744002700	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 32	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001425

Elevation: 610.27 ft.
Latitude: 44.2754319834
Longitude: -86.2748907696
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: NORTHWEST SAVINGS AND LOAN

Well Address:	**Owner Address:**
MANISTEE, MI 49660	MANISTEE, MI 49660

Drilling Method: Auger/Bored
Well Depth: 40.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 12/22/1978

Casing Type: Unknown **Height:** 0.00 ft. below grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 36.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Goulds **Pump Type:** Jet
Model Number: **Pump Capacity:** 0 GPM
Drop Pipe Length: 21.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 12.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown
Pumping level 0.00 ft. after 2.00 hrs. at 12 GPM

Formation Description	Thickness	Depth to Bottom
Topsoil	1.00	1.00
Sand	11.00	12.00
Sand Water Bearing	28.00	40.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
0.00	4.00 ft.	36.00 ft. and 40.00 ft.

Fittings: None

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Other	0.00	None	0.00 ft. to 0.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Abandoned Well Plugged: No
Reason Not Plugged:

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 51-1603
Business Name:
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:
Other Remarks: Grouting Material 1:Listed as other in Wellkey

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221632009

Tax No: 510744004000	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 32	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001423

Elevation: 612.89 ft.
Latitude: 44.2750738527
Longitude: -86.2755834061
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: NORTHWEST SAVINGS AND LOAN

Well Address:	**Owner Address:**
1392 TUBBS ROAD MANISTEE, MI 49660	1392 TUBBS RD MANISTEE, MI 49660

Drilling Method: Auger/Bored
Well Depth: 40.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 12/22/1978

Casing Type: Unknown **Height:** 0.00 ft. below grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 36.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Goulds **Pump Type:** Jet
Model Number: **Pump Capacity:** 0 GPM
Drop Pipe Length: 21.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 999.99 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown
Pumping level 0.00 ft. after 2.00 hrs. at 10 GPM

Formation Description	Thickness	Depth to Bottom
Topsoil	1.00	1.00
Sand	11.00	12.00
Sand Water Bearing	28.00	40.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
0.00	4.00 ft.	36.00 ft. and 40.00 ft.

Fittings: Other

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Other	0.00	None	0.00 ft. to 0.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Abandoned Well Plugged: No
Reason Not Plugged:

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 51-1603
Business Name:
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: FITTINGS: 1 1/4 COUPLING.
Other Remarks: Grouting Material 1:Listed as other in Wellkey, Screen Fittings:Type Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221629011

Tax No: 510712900100	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 29	**Well Status:**
		WSSN:	**Source ID/Well No:**	

Well ID: 51000001288

Elevation: 656.2 ft.
Latitude: 44.2903663263
Longitude: -86.2684460519
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: WEIVER, STANLEY

Well Address:	**Owner Address:**
DONTZ ROAD MANISTEE, MI 49660	DONTZ ROAD MANISTEE, MI 49660

Drilling Method: Auger/Bored
Well Depth: 109.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 8/14/1975

Casing Type: Unknown **Height:** 0.00 ft. below grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 105.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Goulds **Pump Type:** Jet
Model Number: **Pump Capacity:** 0 GPM
Drop Pipe Length: 105.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 70.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown
Pumping level 70.00 ft. after 1.00 hrs. at 6 GPM

Formation Description	Thickness	Depth to Bottom
Clay	70.00	70.00
Clay Sandy	20.00	90.00
Sand Fine Wet/Moist	10.00	100.00
Sand Coarse Water Bearing	9.00	109.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
10.00	4.00 ft.	105.00 ft. and 109.00 ft.

Fittings: Other

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Bentonite slurry	0.00	None	0.00 ft. to 0.00 ft.

Wellhead Completion: Other, 12 inches above grade

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Abandoned Well Plugged: No
Reason Not Plugged:

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 83-0798
Business Name:
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: FITTINGS: C. DRIVE SHOE.
Other Remarks: Wellhead Completion:12 inch Above Grade, Screen Fittings:Type Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221631048

Tax No: 510713200100	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 33	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001367

Elevation: 609.28 ft.
Latitude: 44.275125
Longitude: -86.260723
Method of Collection: Address Matching-House Number

Distance and Direction from Road Intersection:

Well Owner: FORBES, DONALD

Well Address:
1878 E. PARKDALE AVENUE
MANISTEE, MI 49660

Owner Address:
1878 E. PARKDALE AVENUE
MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 62.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 1/13/1978

Casing Type: Unknown **Height:**
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 58.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Flint & Walling **Pump Type:** Unknown
Model Number: **Pump Capacity:**
Drop Pipe Length: 30.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 8.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Formation Description	Thickness	Depth to Bottom
Sand Coarse	27.00	27.00
Sand & Clay Coarse	10.00	37.00
Red Clay	12.00	49.00
Sand & Gravel Coarse Water Bearing	13.00	62.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
7.00	4.00 ft.	58.00 ft. and 62.00 ft.

Fittings: Other

Well Grouted: No

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 53-0405
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: J
Other Remarks: Screen Fittings:Type Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221629010

Tax No: 510712901700	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 29	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001287

Elevation: 608.63 ft.
Latitude: 44.2794167522
Longitude: -86.2688857882
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: REED, FOREST JR.

Well Address:	**Owner Address:**
2251 KEMMER ROAD MANISTEE, MI 49660	2251 KEMMER ROAD MANISTEE, MI 49660

Drilling Method: Driven Hand
Well Depth: 68.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 11/6/1968

Casing Type: Unknown **Height:** 3.00 ft. above grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 65.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Flint & Walling **Pump Type:** Jet
Model Number: **Pump Capacity:**
Drop Pipe Length: 0.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 7.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Formation Description	Thickness	Depth to Bottom
Sand Wet/Moist	32.00	32.00
Hardpan	6.00	38.00
Clay	16.00	54.00
Sand	15.00	69.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
10.00	3.00 ft.	65.00 ft. and 68.00 ft.

Fittings: Neoprene packer

Well Grouted: No

Geology Remarks:

Wellhead Completion: Other

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	72 ft.	Southwest

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 51-0364
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks: Wellhead Completion:Approved Pit

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221629009

Tax No: 510712900800	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 29	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001286

Elevation: 670.96 ft.
Latitude: 44.2798168066
Longitude: -86.274126494
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: THOMPSON, PETE

Well Address:
KEMMER ROAD
MANISTEE, MI 49660

Owner Address:
KEMMER ROAD
MANISTEE, MI 49660

Drilling Method: Auger/Bored
Well Depth: 41.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 5/5/1972
Casing Type: Unknown **Height:** 0.00 ft. below grade
Casing Joint: Threaded & coupled
Casing Fitting: None

Diameter: 4.00 in. to 0.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Other **Pump Type:** Submersible
Model Number: **Pump Capacity:**
Drop Pipe Length: 30.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 20.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Formation Description	Thickness	Depth to Bottom
Sand Fine	41.00	41.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 2.00 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
7.00	5.00 ft.	36.00 ft. and 41.00 ft.

Fittings: Neoprene packer

Well Grouted: No

Geology Remarks:

Wellhead Completion: Other, 12 inches above grade

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 43-0539
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks: Wellhead Completion:12 inch Above Grade, Pump Manufacturer:RAPIDAYTON

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221629006

Tax No: 510712900100	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 29	**Well Status:**
		WSSN:		**Source ID/Well No:**

Well ID: 51000001283

Elevation: 707.06 ft.
Latitude: 44.2902381092
Longitude: -86.2671922229
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: DONTZ, FLORIAN

Well Address:	**Owner Address:**
1847 DONTZ ROAD MANISTEE, MI 49660	1847 DONTZ ROAD MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 161.00 ft. **Well Use:** Irrigation
Well Type: Replacement **Date Completed:** 6/6/1972

Casing Type: Unknown **Height:** 3.00 ft. below grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 6.00 in. to 0.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Red Jacket **Pump Type:** Submersible
Model Number: **Pump Capacity:**
Drop Pipe Length: 133.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 106.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 0.00 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
7.00	10.00 ft.	151.00 ft. and 161.00 ft.

Fittings: None

Formation Description	Thickness	Depth to Bottom
Sand Coarse	30.00	30.00
Sand	10.00	40.00
Sand Coarse	23.00	63.00
Clay & Sand Cemented	5.00	68.00
Sand	38.00	106.00
Sand Fine	24.00	130.00
Sand & Clay Fine Red	12.00	142.00
Sand Fine	6.00	148.00
Sand Coarse Wet/Moist	14.00	162.00

Well Grouted: No

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 53-0405
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221629008

Tax No: 510712900800	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 29	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001285

Elevation: 608.63 ft.
Latitude: 44.2779650574
Longitude: -86.2739531043
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: SOLBERG, LESTER

Well Address:	**Owner Address:**
2114 KEMMER ROAD MANISTEE, MI 49660	2114 KEMMER ROAD MANISTEE, MI 49660

Drilling Method: Hollow Rod
Well Depth: 45.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 7/29/1974

Casing Type: Unknown **Height:**
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 40.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Flint & Walling **Pump Type:** Jet
Model Number: **Pump Capacity:** 0 GPM
Drop Pipe Length: 30.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 10.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Formation Description	Thickness	Depth to Bottom
Red Sand	6.00	6.00
Gray Marl	4.00	10.00
Sand Coarse	18.00	28.00
Sand & Gravel Coarse	17.00	45.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
7.00	5.00 ft.	40.00 ft. and 45.00 ft.

Fittings: Bremer check valve

Well Grouted: No

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	75 ft.	South

Abandoned Well Plugged: No
Reason Not Plugged:

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:**
Business Name:
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:
Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221629005

Tax No: 510712901700	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 29	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001282

Elevation: 608.63 ft.
Latitude: 44.2780665879
Longitude: -86.2692438383
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: SPENCER, GEORGE

Well Address:	**Owner Address:**
1818 PARKDALE AVE. MANISTEE, MI 49660	1818 PARKDALE AVE. MANISTEE, MI 49660

Drilling Method: Hollow Rod
Well Depth: 41.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 11/12/1973

Casing Type: Unknown **Height:**
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 36.50 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Flint & Walling **Pump Type:** Jet
Model Number: **Pump Capacity:** 0 GPM
Drop Pipe Length: 31.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 14.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Formation Description	Thickness	Depth to Bottom
Sand	7.00	7.00
Blue Clay	3.00	10.00
Sand & Gravel	31.00	41.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
7.00	4.50 ft.	36.50 ft. and 41.00 ft.

Fittings: Bremer check valve

Well Grouted: No

Geology Remarks:

Wellhead Completion: Other, 12 inches above grade

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	150 ft.	West

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:**
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks: Wellhead Completion:12 inch Above Grade

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221629003

Tax No: 510712901700	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 29	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001280

Elevation: 616.83 ft.
Latitude: 44.2781542255
Longitude: -86.2636815105
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: FORBES, DONALD

Well Address:
1878 PARKDALE AVE
MANISTEE, MI 49660

Owner Address:
1878 PARKDALE AVE
MANISTEE, MI 49660

Drilling Method: Hollow Rod
Well Depth: 61.60 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 4/29/1985

Casing Type: Steel - black **Height:**
Casing Joint: Threaded & coupled
Casing Fitting: None

Diameter: 2.00 in. to 57.60 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Flint & Walling **Pump Type:** Jet
Model Number: **Pump Capacity:**
Drop Pipe Length: 21.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 999.99 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Formation Description	Thickness	Depth to Bottom
Sand	39.00	39.00
Red Clay	18.00	57.00
Sand Coarse Water Bearing	4.60	61.60

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
7.00	4.00 ft.	57.60 ft. and 61.60 ft.

Fittings: Bremer check valve

Well Grouted: No

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 53-0405
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:
Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221629001

Tax No: 510712900400	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 29	**Well Status:**
		WSSN:	**Source ID/Well No:**	

Well ID: 51000001278

Elevation: 707.06 ft.
Latitude: 44.2902812127
Longitude: -86.2638112252
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: DONTZ, DAN

Well Address:	**Owner Address:**
1995 DONTZ ROAD MANISTEE, MI 49660	1995 DONTZ ROAD MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 140.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 10/3/1974

Casing Type: Unknown **Height:** 2.10 ft. above grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 4.00 in. to 129.50 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Red Jacket **Pump Type:** Submersible
Model Number: **Pump Capacity:**
Drop Pipe Length: 119.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 102.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
7.00	10.00 ft.	129.50 ft. and 139.50 ft.

Fittings: Other

Formation Description	Thickness	Depth to Bottom
Red Clay & Stones	15.00	15.00
Sand & Gravel	2.00	17.00
Red Clay & Gravel	7.00	24.00
Sand Dry	80.00	104.00
Sand Wet/Moist	9.00	113.00
Red Clay	2.00	115.00
Sand Coarse Wet/Moist	25.00	140.00

Well Grouted: No

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 53-0405
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: FITTINGS: STANDARD. CLAY AND SAND ENTERED UNDER LYTHOLOGY WITH NO THICKNESS.
Other Remarks: Screen Fittings:Type Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221628008

Tax No: 513712801005	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 28	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001277

Elevation: 610.23 ft.
Latitude: 44.2764181637
Longitude: -86.2617541531
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:
0.6 MI EAST KEMMER RD. 80' NORTH US 31

Well Owner: ACKER, WM

Well Address:
MANISTEE, MI 49660

Owner Address:
1990 E. PARKDALE
MANISTEE, MI 49660

Drilling Method: Driven Hand
Well Depth: 76.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 10/30/1990

Casing Type: Steel - black **Height:** 5.00 ft. below grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 63.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Goulds **Pump Type:** Jet
Model Number: **Pump Capacity:** 0 GPM
Drop Pipe Length: 30.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 18.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Formation Description	Thickness	Depth to Bottom
Sand	18.00	18.00
Clay	5.00	23.00
Sand	42.00	65.00
Clay	5.00	70.00
Sand	6.00	76.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 3.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
10.00	5.00 ft.	71.00 ft. and 76.00 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Bentonite slurry	0.00	None	0.00 ft. to 0.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	120 ft.	West

Drilling Machine Operator Name: HUGH ROLLIN
Employment: Unknown

Contractor Type: Unknown **Reg No:** 51-0364
Business Name:
Business Address:

Abandoned Well Plugged: Yes

Casing Removed:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:
Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221628007

Tax No: 510712801200	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 28	**Well Status:**
		WSSN:	**Source ID/Well No:**	

Well ID: 51000001276

Elevation: 621.42 ft.
Latitude: 44.2771316275
Longitude: -86.2575101551
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: MEDUNA, CARL

Well Address:	**Owner Address:**
7114 CHIPPEWA HWY. MANISTEE, MI 49660	7114 CHIPPEWA HWY. MANISTEE, MI 49660

Drilling Method: Hollow Rod
Well Depth: 62.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 6/7/1967
Casing Type: Unknown **Height:**
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 58.00 ft. depth

Borehole:

Pump Installed: No
Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 21.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Formation Description	Thickness	Depth to Bottom
Sand Coarse	24.00	24.00
Sand Fine W/Clay	30.00	54.00
Sand Coarse	8.00	62.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
70.00	4.00 ft.	58.00 ft. and 62.00 ft.

Fittings: Other

Well Grouted: No

Geology Remarks:

Wellhead Completion: Other, 12 inches above grade

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:**
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: FITTINGS: 1 1/4 IN COUPLING.
Other Remarks: Wellhead Completion:12 inch Above Grade, Screen Fittings:Type Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221628006

Tax No: 510712800610	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 28	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001275

Elevation: 612.75 ft.
Latitude: 44.2778549151
Longitude: -86.2557777741
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: ONEKAMA BUILDER

Well Address: MANISTEE, MI 49660

Owner Address: ONEKAMA, MI 49676

Drilling Method: Driven Hand
Well Depth: 56.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 5/6/1977

Casing Type: Unknown **Height:** 5.00 ft. below grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 46.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Goulds **Pump Type:** Jet
Model Number: **Pump Capacity:** 0 GPM
Drop Pipe Length: 31.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 12.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Formation Description	Thickness	Depth to Bottom
Sand	43.00	43.00
Clay	5.00	48.00
Sand	8.00	56.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
10.00	5.00 ft.	51.00 ft. and 56.00 ft.

Fittings: Neoprene packer

Well Grouted: No

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	70 ft.	North

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 51-0364
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:
Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221628005

Tax No: 510712800400	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 28	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001274

Elevation: 616.83 ft.
Latitude: 44.278505523
Longitude: -86.2555973306
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: HELMINAIK, ED

Well Address:	**Owner Address:**
RIVER ROAD MANISTEE, MI 49660	RIVER ROAD MANISTEE, MI 49660

Drilling Method: Driven Hand
Well Depth: 55.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 10/22/1979

Casing Type: Unknown **Height:** 3.00 ft. below grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 47.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Other **Pump Type:** Unknown
Model Number: **Pump Capacity:**
Drop Pipe Length: 0.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 14.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Formation Description	Thickness	Depth to Bottom
Sand	42.00	42.00
Clay	4.00	46.00
Sand	9.00	55.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
10.00	5.00 ft.	50.00 ft. and 55.00 ft.

Fittings: Other

Well Grouted: No

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	64 ft.	North

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 51-0364
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: FITTINGS: STANDARD.
Other Remarks: Pump Manufacturer:Pump Manufacturer unknown, Screen Fittings:Type Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221628003

Tax No: 510790007800	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 28	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001272

Elevation: 692.29 ft.
Latitude: 44.2857558416
Longitude: -86.2443131979
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: MANISTEE VET. HOSP.

Well Address:	**Owner Address:**
2738 ORCHARD HIGHWAY MANISTEE, MI 49660	2738 ORCHARD HIGHWAY MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 91.00 ft. **Well Use:** Other
Well Type: Replacement **Date Completed:** 12/19/1975

Casing Type: Unknown **Height:**
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 87.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Flint & Walling **Pump Type:** Jet
Model Number: **Pump Capacity:**
Drop Pipe Length: 79.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 73.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
6.00	4.00 ft.	87.00 ft. and 91.00 ft.

Fittings: Other

Formation Description	Thickness	Depth to Bottom
Sand	20.00	20.00
Sand & Stones	16.00	36.00
Sand & Gravel W/Stones	14.00	50.00
Sand & Gravel W/Stones	19.00	69.00
Clay & Gravel	1.00	70.00
Sand Gravel Clay	6.00	76.00
Sand Fine	14.00	90.00

Well Grouted: No

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 53-0405
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: FITTINGS: STANDARD. EJECTOR SET 12N-22V
Other Remarks: Well Use:Commercial, Screen Fittings:Type Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221628004

Tax No: 510712800400	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 28	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001273

Elevation: 700.49 ft.
Latitude: 44.288590442
Longitude: -86.2590713104
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: WILSON, MILTON

Well Address:	**Owner Address:**
2817 DONTZ ROAD MANISTEE, MI 49660	2817 DONTZ ROAD MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 117.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 4/21/1978

Casing Type: Unknown **Height:**
Casing Joint: Threaded & coupled
Casing Fitting: None

Diameter: 2.00 in. to 114.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Goulds **Pump Type:** Jet
Model Number: **Pump Capacity:**
Drop Pipe Length: 100.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 92.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Formation Description	Thickness	Depth to Bottom
Sand & Gravel	30.00	30.00
Sand	87.00	117.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
10.00	4.50 ft.	0.00 ft. and 0.00 ft.

Fittings: None

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Unknown	0.00	None	0.00 ft. to 0.00 ft.

Wellhead Completion: Unknown

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
Unknown	0 ft.	

Abandoned Well Plugged: No
Reason Not Plugged:

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 43-0539
Business Name:
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:
Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221628002

Tax No: 510712801800	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 28	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001271

Elevation: 618.47 ft.
Latitude: 44.2758768927
Longitude: -86.2464666515
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: LINDERMAN, RICHARD

Well Address:
RIVER ROAD
MANISTEE, MI 49660

Owner Address:
RIVER ROAD
MANISTEE, MI 49660

Drilling Method: Driven Hand
Well Depth: 59.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 10/11/1972

Casing Type: Unknown **Height:** 5.00 ft. below grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 4.00 in. to 49.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Flint & Walling **Pump Type:** Submersible
Model Number: **Pump Capacity:** 0 GPM
Drop Pipe Length: 42.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 21.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown
Pumping level 25.00 ft. after 1.00 hrs. at 25 GPM

Formation Description	Thickness	Depth to Bottom
Sand	47.00	47.00
Clay	7.00	54.00
Sand	5.00	59.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
10.00	5.00 ft.	54.00 ft. and 59.00 ft.

Fittings: Neoprene packer

Well Grouted: No

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	220 ft.	East

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 51-0364
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:
Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221628001

Tax No: 510712801750	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 28	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001270

Elevation: 618.47 ft.
Latitude: 44.2759652968
Longitude: -86.2451826069
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: BEATTY, GORDON

Well Address:	**Owner Address:**
2800 RIVER ROAD MANISTEE, MI 49660	2800 RIVER ROAD MANISTEE, MI 49660

Drilling Method: Driven Hand
Well Depth: 57.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 8/25/1973

Casing Type: Unknown **Height:** 5.00 ft. below grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 47.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Other **Pump Type:** Jet
Model Number: **Pump Capacity:** 0 GPM
Drop Pipe Length: 31.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 12.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Formation Description	Thickness	Depth to Bottom
Sand	46.00	46.00
Clay	4.00	50.00
Sand	7.00	57.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
10.00	5.00 ft.	52.00 ft. and 57.00 ft.

Fittings: Neoprene packer

Well Grouted: No

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	70 ft.	North

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 51-0364
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks: Pump Manufacturer:BURKS

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221627003

Tax No: 510712701200	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 27	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001267

Elevation: 620.11 ft.
Latitude: 44.275882316
Longitude: -86.2399342303
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: HARTHUN, ARNIE

Well Address:	**Owner Address:**
3182 RIVER ROAD MANISTEE, MI 49660	3182 RIVER ROAD MANISTEE, MI 49660

Drilling Method: Auger/Bored
Well Depth: 58.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 4/4/1979

Casing Type: Unknown **Height:** 0.00 ft. below grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 54.00 ft. depth

Borehole:

Pump Installed: No
Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 21.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown
Pumping level 0.00 ft. after 1.00 hrs. at 10 GPM

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
0.00	4.00 ft.	54.00 ft. and 58.00 ft.

Fittings: Bremer check valve

Formation Description	Thickness	Depth to Bottom
Sand Fill	2.00	2.00
Topsoil	1.00	3.00
Orange Sand	15.00	18.00
Orange Sand Water Bearing	12.00	30.00
Sand Coarse Water Bearing	11.00	41.00
Clay	5.00	46.00
Sand Coarse Water Bearing	12.00	58.00

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Other	0.00	None	0.00 ft. to 0.00 ft.

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 51-1603
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: SET SCREEN BETWEEN 36 & 40', BUT WATER HAD AN ODER
Other Remarks: Grouting Material 1:Listed as other in Wellkey

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221622008

Tax No: 510768002000	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 22	**Well Status:**
		WSSN:	**Source ID/Well No:**	

Well ID: 51000001247

Elevation: 715.26 ft.
Latitude: 44.2971357814
Longitude: -86.2424517463
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: SCHRAMSKI, JEROME

Well Address:	**Owner Address:**
3387 ORCHARD HIGHWAY MANISTEE, MI 49660	3387 ORCHARD HIGHWAY MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 115.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 7/26/1978

Casing Type: Unknown **Height:** 3.00 ft. above grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 4.00 in. to 109.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Red Jacket **Pump Type:** Submersible
Model Number: **Pump Capacity:**
Drop Pipe Length: 97.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 87.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Formation Description	Thickness	Depth to Bottom
Sand Dry	16.00	16.00
Sand & Clay Fine Red	22.00	38.00
Sand & Gravel Dry	52.00	90.00
Sand Fine Wet/Moist	25.00	115.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
6.00	6.00 ft.	109.00 ft. and 115.00 ft.

Fittings: Other

Well Grouted: No

Geology Remarks:

Wellhead Completion: Other

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 53-0405
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: FITTINGS: STANDARD. WELL HEAD COMPLETION: 60 GAL. TANK.
Other Remarks: Wellhead Completion:Completion Type Not Known, Screen Fittings:Type Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221622002

Tax No: 510768000800	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 22	**Well Status:**
		WSSN:		**Source ID/Well No:**

Well ID: 51000001241

Elevation: 716.9 ft.
Latitude: 44.2946220121
Longitude: -86.2424744046
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: ANDERSON,LESLIE

Well Address:
MANISTEE, MI 49660

Owner Address:
LOT #8 PINEWOOD ESTATES
MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 108.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 10/31/1977

Casing Type: Unknown **Height:**
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 104.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Jacuzzi **Pump Type:** Jet
Model Number: **Pump Capacity:**
Drop Pipe Length: 92.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 86.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Formation Description	Thickness	Depth to Bottom
Topsoil	4.00	4.00
Sand & Gravel Coarse	41.00	45.00
Gravel	21.00	66.00
Sand Coarse	18.00	84.00
Sand & Clay	14.00	98.00
Sand Fine Wet/Moist	9.00	107.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
6.00	4.00 ft.	104.00 ft. and 108.00 ft.

Fittings: Other

Well Grouted: No

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 53-0405
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: FITTINGS: STANDARD
Other Remarks: Screen Fittings:Type Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221622001

Tax No: 510768000800	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 22	**Well Status:**
		WSSN:		**Source ID/Well No:**

Well ID: 51000001240

Elevation: 716.9 ft.
Latitude: 44.2960946155
Longitude: -86.2422738671
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: MILLER, DALE J.

Well Address:
3189 ORCHARD HIGHWAY
MANISTEE, MI 49660

Owner Address:
9477 NORTH M-22
MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 102.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 9/14/1978

Casing Type: Unknown **Height:** 1.90 ft. above grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 98.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Flint & Walling **Pump Type:** Jet
Model Number: **Pump Capacity:**
Drop Pipe Length: 88.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 85.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
7.00	4.00 ft.	98.00 ft. and 102.00 ft.

Fittings: Other

Formation Description	Thickness	Depth to Bottom
Sand Coarse	53.00	53.00
Gravel	14.00	67.00
Sand Coarse	18.00	85.00
Sand Coarse Water Bearing	17.00	102.00

Well Grouted: No

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name:
Employment: Unknown

Abandoned Well Plugged: No
Reason Not Plugged:

Contractor Type: Unknown **Reg No:** 53-0405
Business Name:
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: FITTINGS: STANDARD
Other Remarks: Screen Fittings:Type Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221621002

Tax No: 510712100400	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 21	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001238

Elevation: 707.06 ft.
Latitude: 44.2906875397
Longitude: -86.2623072683
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: GUZIKOWSKI, PATRIC

Well Address:	**Owner Address:**
2030 DONTZ ROAD MANISTEE, MI 49660	2030 DONTZ ROAD MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 126.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 4/11/1975

Casing Type: Unknown **Height:** 6.00 ft. above grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 4.00 in. to 120.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Red Jacket **Pump Type:** Submersible
Model Number: **Pump Capacity:**
Drop Pipe Length: 105.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 91.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Formation Description	Thickness	Depth to Bottom
Brown Sand	8.00	8.00
Clay & Sand	15.00	23.00
Sand	16.00	39.00
Red Clay & Sand	2.00	41.00
Sand	49.00	90.00
Red Clay & Sand	10.00	100.00
Sand Fine Wet/Moist	18.00	118.00
Sand Coarse Water Bearing	8.00	126.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
7.00	6.00 ft.	120.00 ft. and 126.00 ft.

Fittings: Other

Well Grouted: No

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 53-0405
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: FITTINGS: STANDARD.
Other Remarks: Screen Fittings:Type Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221620006

Tax No: 513712000720	**Permit No:**	**County:** Manistee		**Township:** Manistee
Town/Range: 22N 16W	**Section:** 20	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001236

Elevation: 639.76 ft.
Latitude: 44.298102274
Longitude: -86.2743579483
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:
1/4 MI N OF CEDAR CR RD ON E SIDE OF VIRGIL JOHN RD.

Well Owner: ALM CONSTRUCTION

Well Address:
1442 VIRGIL JOHNSON RD
MANISTEE, MI 49660

Owner Address:
1121 PARKDALE AVE.
MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 84.00 ft. **Well Use:** Household
Well Type: New **Date Completed:** 7/11/1991

Casing Type: Steel - black **Height:**
Casing Joint: Welded
Casing Fitting: Drive shoe

Diameter:

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Tait **Pump Type:** Submersible
Model Number: **Pump Capacity:** 0 GPM
Drop Pipe Length: 60.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 30.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown
Pumping level 0.00 ft. after 1.00 hrs. at 20 GPM

Formation Description	Thickness	Depth to Bottom
Clay	10.00	10.00
Sand	20.00	30.00
Sand Water Bearing	15.00	45.00
Clay	15.00	60.00
Sand Coarse Wet/Moist	24.00	84.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:** 2.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
10.00	6.00 ft.	78.00 ft. and 84.00 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Bentonite slurry	0.00	None	0.00 ft. to 30.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name: ED BENSON
Employment: Unknown

Contractor Type: Unknown **Reg No:** 51-1603
Business Name:
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:
Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221620004

Tax No: 510712001101	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 20	**Well Status:**
		WSSN:	**Source ID/Well No:**	

Well ID: 51000001234

Elevation: 687.37 ft.
Latitude: 44.29134874
Longitude: -86.268768044
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: HARRIS,ROBERT

Well Address:
SUIDA ROAD
MANISTEE, MI 49660

Owner Address:
24 CABERFAE HIGHWAY
MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 138.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 6/22/1976
Casing Type: Unknown **Height:** 1.50 ft. above grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 4.00 in. to 132.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Red Jacket **Pump Type:** Submersible
Model Number: **Pump Capacity:**
Drop Pipe Length: 117.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 105.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
6.00	6.00 ft.	132.00 ft. and 138.00 ft.

Fittings: Other

Formation Description	Thickness	Depth to Bottom
Sand	70.00	70.00
Red Sand Coarse	2.00	72.00
Gravel & Sand	18.00	90.00
Sand	20.00	110.00
Sand Coarse	5.00	115.00
Sand Coarse Water Bearing	16.00	131.00
Sand Wet/Moist	7.00	138.00

Well Grouted: No

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 53-0405
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: FITTINGS: STANDARD.
Other Remarks: Screen Fittings:Type Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221620003

Tax No: 510712000600	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 20	**Well Status:**
		WSSN:	**Source ID/Well No:**	

Well ID: 51000001233

Elevation: 670.96 ft.
Latitude: 44.2980795807
Longitude: -86.2661785154
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: SMITH, JOHN J.

Well Address:	**Owner Address:**
1994 CEDAR ROAD MANISTEE, MI 49660	1994 CEDAR ROAD MANISTEE, MI 49660

Drilling Method: Hollow Rod
Well Depth: 98.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 12/12/1972

Casing Type: Unknown **Height:**
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 93.50 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Other **Pump Type:** Jet
Model Number: **Pump Capacity:** 0 GPM
Drop Pipe Length: 80.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 60.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Formation Description	Thickness	Depth to Bottom
Red Clay	30.00	30.00
Red Clay & Gravel	40.00	70.00
Sand & Clay Fine Red	20.00	90.00
Sand Coarse	8.00	98.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
7.00	4.50 ft.	93.50 ft. and 98.00 ft.

Fittings: Other

Well Grouted: No

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	80 ft.	Southeast

Abandoned Well Plugged: No
Reason Not Plugged:

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:**
Business Name:
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: FITTINGS: #434 1 1/4" SCREEN COUPLING, #479 2" BREMER BAIL CHECK, #421 2" CLOSED SHOE.
Other Remarks: Pump Manufacturer:DECATOR PUMP COMPANY, Screen Fittings:Type Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221620002

Tax No: 510712001400	**Permit No:**	**County:** Manistee			**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 20	**Well Status:**	**WSSN:**	**Source ID/Well No:**

Well ID: 51000001232

Elevation: 702.13 ft.
Latitude: 44.2916819768
Longitude: -86.2693664247
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: SWITALSKI, DENNIS

Well Address:	**Owner Address:**
3057 SWITALSKI ROAD MANISTEE, MI 49660	3057 SWITALSKI ROAD MANISTEE, MI 49660

Drilling Method: Hollow Rod
Well Depth: 84.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 8/31/1985

Casing Type: Unknown **Height:** 0.00 ft. below grade
Casing Joint: Threaded & coupled
Casing Fitting: None

Diameter: 4.00 in. to 79.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Goulds **Pump Type:** Submersible
Model Number: **Pump Capacity:** 0 GPM
Drop Pipe Length: 65.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 44.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown
Pumping level 0.00 ft. after 1.00 hrs. at 20 GPM

Formation Description	Thickness	Depth to Bottom
Topsoil	1.00	1.00
Clay	7.00	8.00
Loam W/Clay	5.00	13.00
Clay	17.00	30.00
Sand	14.00	44.00
Sand Water Bearing	40.00	84.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 4.00 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	**Length**	**Set Between**
10.00	5.00 ft.	79.00 ft. and 84.00 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	**Bags**	**Additives**	**Depth**
Bentonite slurry	0.00	None	0.00 ft. to 0.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:

Nearest Source of Possible Contamination:

Type	**Distance**	**Direction**
Septic tank	60 ft.	South

Abandoned Well Plugged: No
Reason Not Plugged:

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 51-1603
Business Name:
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:
Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No: 51-07-128-010-15	**Permit No:** 51-6002	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 28	**Well Status:** Active	**WSSN:**	**Source ID/Well No:**

Well ID: 51000006305

Elevation:

Latitude: 44.27836

Longitude: -86.25985

Method of Collection: GPS Std Positioning Svc SA Off

Distance and Direction from Road Intersection:
1/4 MILE S. OF RIVER RD. ON N. SIDE OF CHIPPEWA HWY END OF PRIVATE DR.

Well Owner:

Well Address:	**Owner Address:**
2020 CHIPPEWA HWY MANISTEE, MI 49660	2020 CHIPPEWA HWY MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 61.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 8/21/2015

Casing Type: Steel - black **Height:** 1.00 ft. above grade
Casing Joint: Welded
Casing Fitting: Drive shoe

Diameter: 4.00 in. to 55.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:** 0.50
Manufacturer: Goulds **Pump Type:** Submersible
Model Number: 10GS05422 **Pump Capacity:** 10 GPM
Drop Pipe Length: 26.00 ft. **Pump Voltage:** 240
Drop Pipe Diameter: 1.25 in. **Drilling Record ID:**
Draw Down Seal Used: Yes

Pressure Tank Installed: Yes
Pressure Tank Type: Diaphragm/bladder
Manufacturer: Goulds
Model Number: T-140 **Tank Capacity:** 45.2 Gallons
Pressure Relief Valve Installed: Yes

Static Water Level: 8.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Bailer
Pumping level 8.00 ft. after 1.00 hrs. at 18 GPM

Formation Description	Thickness	Depth to Bottom
Topsoil	1.00	1.00
Brown Sand	2.00	3.00
Sand	42.00	45.00
Clay	4.00	49.00
Sand Coarse	14.00	63.00

Screen Installed: Yes **Filter Packed:** Yes
Screen Diameter: 3.00 in. **Blank:** 2.00 ft. Above
Screen Material Type: PVC-slotted

Slot	Length	Set Between
10.00	6.00 ft.	55.00 ft. and 61.00 ft.

Fittings: Neoprene packer

Well Grouted: Yes **Grouting Method:** Driven/dry grout

Grouting Material	Bags	Additives	Depth
Bentonite dry granular	3.00	None	0.00 ft. to 63.00 ft.

Wellhead Completion: Pitless adapter, 12 inches above grade

Geology Remarks:
IRON SAND AND STONE (ORANGE) AT BOTTOM.

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	100 ft.	North

Abandoned Well Plugged: No
Reason Not Plugged: Well still in use for non-drinking water purposes

Drilling Machine Operator Name: ED & BRENT BENSON
Employment: Unknown

Contractor Type: Water Well Drilling Contractor **Reg No:** 51-1603
Business Name: ED BENSON WELL DRILLING
Business Address:

Water Well Contractor's Certification

This well and/or pump installation was performed under my registration.

Signature of Registered Contractor **Date**

General Remarks: OWNER USING OLD WELL FOR YARD USE AND SPRINKLING.
Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221629011

Tax No: 510712900100	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 29	**Well Status:**
		WSSN:	**Source ID/Well No:**	

Well ID: 51000001288

Elevation: 656.2 ft.
Latitude: 44.2903663263
Longitude: -86.2684460519
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: WEIVER, STANLEY

Well Address:	**Owner Address:**
DONTZ ROAD MANISTEE, MI 49660	DONTZ ROAD MANISTEE, MI 49660

Drilling Method: Auger/Bored
Well Depth: 109.00 ft. **Well Use:** Household
Well Type: Replacement **Date Completed:** 8/14/1975

Casing Type: Unknown **Height:** 0.00 ft. below grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 2.00 in. to 105.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Goulds **Pump Type:** Jet
Model Number: **Pump Capacity:** 0 GPM
Drop Pipe Length: 105.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 70.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown
Pumping level 70.00 ft. after 1.00 hrs. at 6 GPM

Formation Description	Thickness	Depth to Bottom
Clay	70.00	70.00
Clay Sandy	20.00	90.00
Sand Fine Wet/Moist	10.00	100.00
Sand Coarse Water Bearing	9.00	109.00

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 1.25 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
10.00	4.00 ft.	105.00 ft. and 109.00 ft.

Fittings: Other

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Bentonite slurry	0.00	None	0.00 ft. to 0.00 ft.

Wellhead Completion: Other, 12 inches above grade

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Abandoned Well Plugged: No
Reason Not Plugged:

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 83-0798
Business Name:
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: FITTINGS: C. DRIVE SHOE.
Other Remarks: Wellhead Completion:12 inch Above Grade, Screen Fittings:Type Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID: 51221629006

Tax No: 510712900100	**Permit No:**	**County:** Manistee		**Township:** Manistee
		Town/Range: 22N 16W	**Section:** 29	**Well Status:**
		WSSN:		**Source ID/Well No:**

Well ID: 51000001283

Elevation: 707.06 ft.
Latitude: 44.2902381092
Longitude: -86.2671922229
Method of Collection: Interpolation-Map

Distance and Direction from Road Intersection:

Well Owner: DONTZ, FLORIAN

Well Address:	**Owner Address:**
1847 DONTZ ROAD MANISTEE, MI 49660	1847 DONTZ ROAD MANISTEE, MI 49660

Drilling Method: Cable Tool
Well Depth: 161.00 ft. **Well Use:** Irrigation
Well Type: Replacement **Date Completed:** 6/6/1972

Casing Type: Unknown **Height:** 3.00 ft. below grade
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe

Diameter: 6.00 in. to 0.00 ft. depth

Borehole:

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:**
Manufacturer: Red Jacket **Pump Type:** Submersible
Model Number: **Pump Capacity:**
Drop Pipe Length: 133.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 106.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Unknown

Screen Installed: Yes **Filter Packed:** No
Screen Diameter: 0.00 in. **Blank:** 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
7.00	10.00 ft.	151.00 ft. and 161.00 ft.

Fittings: None

Formation Description	Thickness	Depth to Bottom
Sand Coarse	30.00	30.00
Sand	10.00	40.00
Sand Coarse	23.00	63.00
Clay & Sand Cemented	5.00	68.00
Sand	38.00	106.00
Sand Fine	24.00	130.00
Sand & Clay Fine Red	12.00	142.00
Sand Fine	6.00	148.00
Sand Coarse Wet/Moist	14.00	162.00

Well Grouted: No

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
None		

Drilling Machine Operator Name:
Employment: Unknown

Contractor Type: Unknown **Reg No:** 53-0405
Business Name:
Business Address:

Abandoned Well Plugged: No
Reason Not Plugged:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

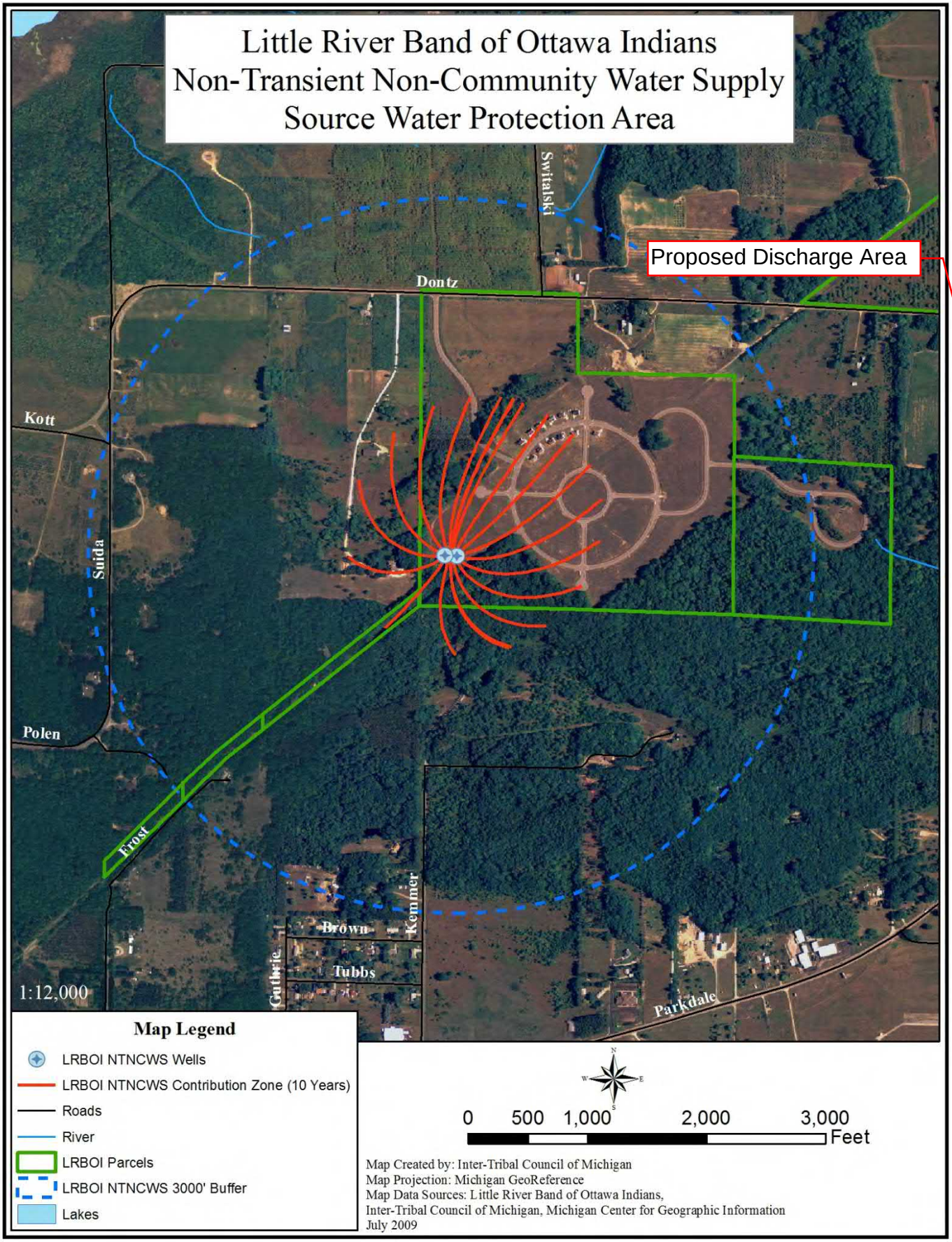
Signature of Registered Contractor **Date**

General Remarks:

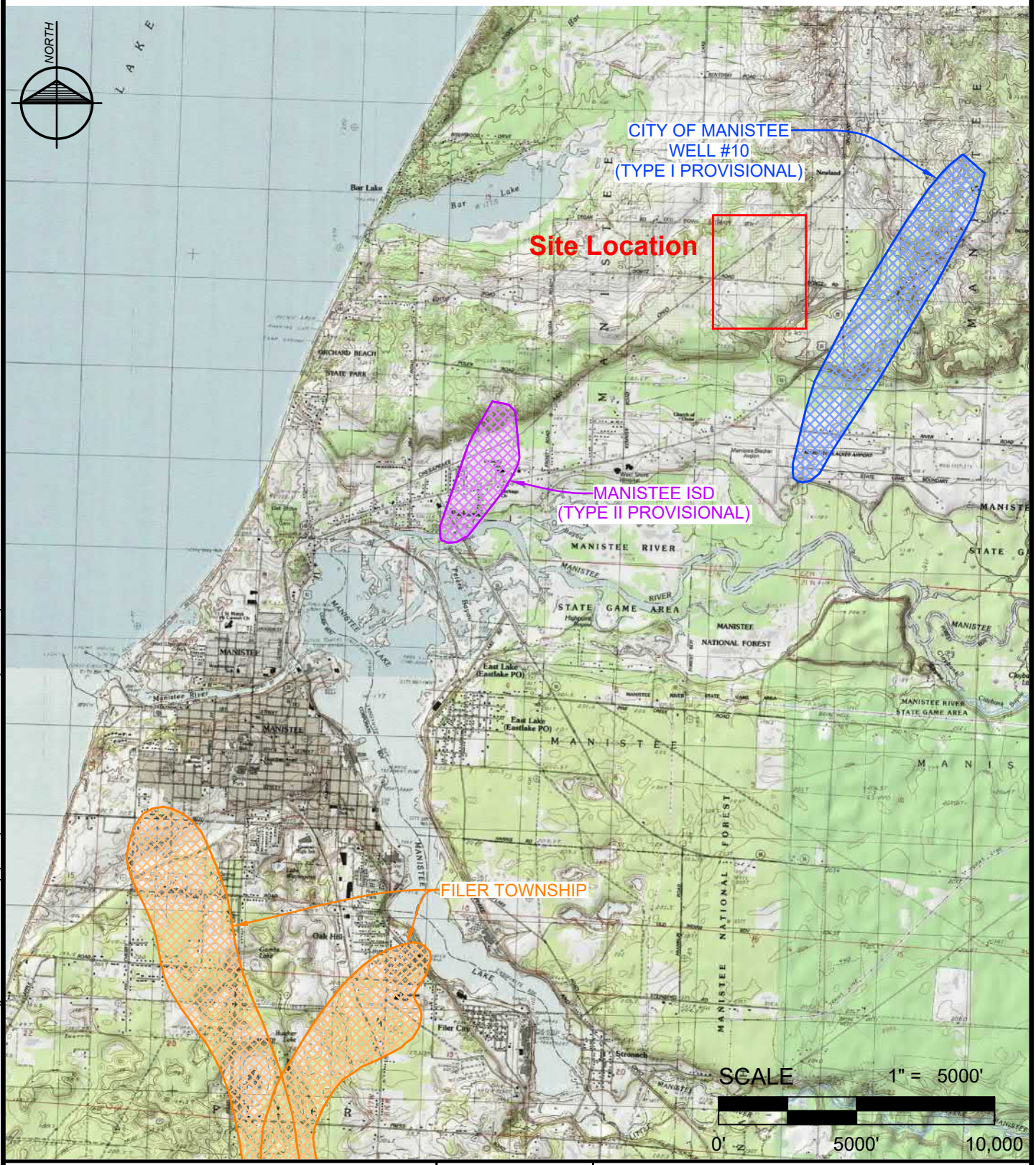
Other Remarks:

Attachment 5

Wellhead Protection Area Locations


Little River Band of Ottawa Indians
Non-Transient Non-Community Water Supply
Source Water Protection Area
Proposed Discharge Area
Switalski
Dontz
Kott
Snida
Polen
Frost
Kemmer
Brown
Tubbs
Guthrie
Parkdale
1:12,000
Map Legend
LRBOI NTNCWS Wells
LRBOI NTNCWS Contribution Zone (10 Years)
Roads
River
LRBOI Parcels
LRBOI NTNCWS 3000' Buffer
Lakes
N
W
E
S
0 500 1,000 2,000 3,000
Feet
Map Created by: Inter-Tribal Council of Michigan
Map Projection: Michigan GeoReference
Map Data Sources: Little River Band of Ottawa Indians,
Inter-Tribal Council of Michigan, Michigan Center for Geographic Information
July 2009

Wellhead Protection Area Location Map



Sheet 1 of 1

Waste Water Treatment Plant
Little River Band of Ottawa Indians
PARTS OF SECTIONS 21 & 28, T 22 N, R 16 W,
MANISTEE TOWNSHIP,
MANISTEE COUNTY, MICHIGAN

Job #:	2018096001.01
Date:	09/10/2019
Scale:	1" = 5000'
Drawn:	jrl
Chk'd.:	ARB
Rev.:	

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1280 Business Park Drive, Traverse City, Michigan
231-946-9191 800-968-1062
www.goslingczubak.com info@goslingczubak.com
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P:\2018096001.00\CADD-Data\C3D\2018096001 base.dwg Tab: WHPA Saved by: jrlumley 9/10/2019 2:14 PM Plotted by: Jim Lumley 9/10/2019 2:20 PM

Attachment 6

NRCS/USDA Soil Map

NORTH

LEGEND

47B SPINKS–COLOMA SANDS, 0 to 6 PERCENT SLOPES

63B COLOMA SANDS, 0 to 6 PERCENT SLOPES

Location:
PARTS OF SECTIONS 21 & 28,
T 22 N, R 16 W,
MANISTEE TOWNSHIP,
MANISTEE COUNTY, MICHIGAN
Sheet 1 of 1

NRCS Soils Map
Wastewater Treatment Plant
Little River Band of Ottawa Indians

Job #:	2018096001.01
Date:	10/21/2019
Scale:	NOT TO
Drawn:	jrl
Chk'd.:	ARB
Rev.:	

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Attachment 7

Soil Boring Logs

Gosling Czubak engineering sciences, inc.

Key to Gosling Czubak Boring Logs and Well Construction Diagrams

SOIL CLASSIFICATION INFORMATION

SOIL DESCRIPTIONS

Example: **Silty fine SAND (SM) - trace clay - occasional clay seams - dense - brown/gray below 40 feet - wet**
(1 - 2 - 3 - 4 - 5 - 6 - 7- 8 - 9 - 10)

1a FOR COARSE GRAINED PRIMARY MATERIAL: Secondary Material of 15 to 50%, if applicable. (eg. Silty, Clayey)
1b FOR FINE GRAINED PRIMARY MATERIAL: Secondary Material of 30 to 50%, if applicable (eg. Gravelly, Sandy)

2 PRIMARY MATERIAL (in CAPs)- SILT, SAND, GRAVEL, or CLAY
Note: fine, medium and/or coarse grained SAND
fine and/or coarse grained GRAVEL

3 (USCS) Unified Soil Classification System (USCS) symbol(s) is presented at the end of the soil description (in parentheses) based on ASTM gradation and plasticity testing. See attached USCS chart.

4 Additional Materials (with percentage descriptors as below)

Fine Grained Material	Coarse-Grained Material
15 to 30% - "some" or "with"	5 to 15% - "little"
5 to 15% - "little"	< 5% - "trace" or "few"
< 5% - "trace" or "few"	

5 Description of sorting or grading. For example, "well-sorted, or "poorly graded."

6 Occurrences (with frequency descriptors as below) - cobbles, boulders, bricks, layers, seams, etc.
Greater than one per 12-inches = "frequent"
One per 12-inches = "occasional"

Note: Seams = < 1-inch in thickness
Layers = > 1-inch in thickness

7 Angularity and mineral composition, if warranted

8 Odor or Sheen, if applicable

9 Soil Strength Description (Relative density for sand, or Consistency for silts/clays)

10 Color

11 Moisture - "dry" or "wet" or "moist"
"dry" = absence of apparent moisture
"moist" = damp but not saturated
"wet" = saturated

Particle Sizes	
Boulders	- > 12-in
Cobbles	- 12 to 3 in
Course gravel	- 3 to 3/4 in
Fine gravel	- 3/4 to 0.187-in
Coarse sand	- 4.75 to 2.0-mm
Medium sand	- 2.0 to 0.425-mm
Fine sand	- 0.425 to 0.075-mm
Clay/Silt	- < 0.075-mm

Relative Density	SPT N-Value
"very loose"	W.O.H. to 4
"loose"	5 to 10
"medium dense"	11 to 30
"dense"	31 to 50
"very dense"	over 50

Consistency	SPT N-Value	Ppen, tsf
"very soft"	WOH to 2	0 - 0.125
"soft"	2 to 4	0.125 - 0.25
"medium stiff"	4 to 8	0.25 - 0.5
"stiff"	8 to 15	0.5 - 1.0
"very stiff"	15 to 30	1.0 - 2.0
"hard"	over 30	2.0 - 4.0

NOTES AND GENERAL INFORMATION

1. Drilling and sampling activities are indicative of subsurface conditions only at locations where data are taken, and when data are taken. Conditions at locations not evaluated may differ from professional interpretation.

2. Environmental boring logs present soil and groundwater data collected for resource development, depositional environment, groundwater flow and/or contaminant transport analyses and may not for be suited for geotechnical or structural engineering use unless otherwise arranged.

3. Stratigraphic Contacts: Solid line denotes a sudden, observed soil transition.
Dashed line denotes a gradual or gradational soil transition.
Dotted line denotes an inferred transition, therefore the type and specific location of the transition is unknown / approximated.

3. Common abbreviations: WOH = Weight of (SPT) Hammer DHH = Down Hole Hammer HA = Hand Auger
DR = Drove Rock (During SPT) NR = No Recovery
Ppen = Pocket Penetrometer (unconfined compressive strength in tons per square foot)

Gosling Czubak
engineering sciences, inc.

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)			
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)	GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
		SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)			
SILTS AND CLAYS Liquid limit less than 50%		ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

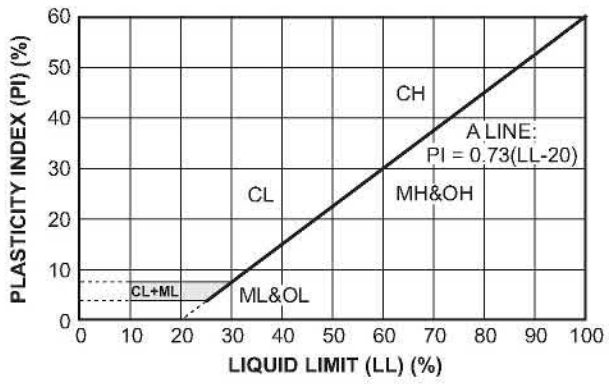
LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent ..... GW, GP, SW, SP
More than 12 percent ..... GM, GC, SM, SC
5 to 12 percent ..... Borderline cases requiring dual symbols

PLASTICITY CHART



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engineering sciences, inc.

Engineers Surveyors
Landscape Architecture
Environmental and Drilling Services
1280 Business Park Dr., Traverse City, Michigan 49686
(231) 946-9191

PROJECT: Little River Casino Wastewater HGI
PROJECT NO.: 2018096001
PROJECT LOCATION: Manistee, MI
CLIENT: Little River Band of Ottawa Indians
DRILLING COMPANY: Shepler Well Drilling **RIG:** 7822 DT
DRILLER: C. Bridson **LOGGED BY:** M. Korndorfer

LOG OF BORING: SB-1

GROUND ELEVATION: 694.4 **DATE:** 07/16/2019
DRILLING LOCATION: Refer to Site Plan
DRILLING METHOD: Direct Push - Macro Core
BOREHOLE DIAMETER (IN): +/- 3 in. **TOTAL DEPTH (FT):** 60
STATIC WATER LEVEL: ▽ NA **CAVING DEPTH:** ℄ NA

Elevation (feet)	Graphic	Soil Description (See Boring Log Key)	Depth (feet)	Sample Type	Sample No.	Recovery (in)	Blow Counts	Notes	Pocket Penetrometer (tsf)	% < #200	TEST RESULTS
		4 inches sandy TOPSOIL - dark brown	0								Plastic Limit ⊢⊣ Liquid Limit; Water Content - × %; SPT RESULT - ▲ N Value; 10 20 30 40 50
			0.25								
		Fine SAND (SM) - little silt - orange/brown									
			1.5								
690		Fine to medium SAND (SP) - trace silt and coarse sand - occasional coarse sand layers below 10ft - light brown - moist	5		SS1	60					
					SS2	60					
685			10		SS3	60					
680			15		SS4	60			1.25		
			19								
675		Interbedded CLAY/SAND/SILT layers	20		SS5	60			1.25		
			22								
670		CLAY (CL) - trace silt - brown	25		SS6	60					
			25								
665		Fine to medium SAND (SP) - trace coarse sand - light brown	30								

Refusal at 60-feet bgs. Boring was backfilled from total depth to surface using Bentonite Chips.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

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DRILLING COMPANY: Shepler Well Drilling **RIG:** 7822 DT
DRILLER: C. Bridson **LOGGED BY:** M. Korndorfer

LOG OF BORING: SB-1

GROUND ELEVATION: 694.4 **DATE:** 07/16/2019
DRILLING LOCATION: Refer to Site Plan
DRILLING METHOD: Direct Push - Macro Core
BOREHOLE DIAMETER (IN): +/- 3 in. **TOTAL DEPTH (FT):** 60
STATIC WATER LEVEL: ▽ NA **CAVING DEPTH:** ▽ NA

Elevation (feet)	Graphic	Soil Description (See Boring Log Key)	Depth (feet)	Sample Type	Sample No.	Recovery (in)	Blow Counts	Notes	Pocket Penetrometer (tsf)	% < #200	TEST RESULTS: Plastic Limit ⊢⊣ Liquid Limit; Water Content - × %; SPT RESULT - ▲ N Value (10 20 30 40 50)
660		Clayey SAND (SC) - light brown - moist	34								
			34.5								
		Fine to medium SAND (SP) - trace coarse sand - light brown	35		SS7	60					
			36								
		Fine to coarse SAND (SP) - occasional fine gravel - light brown			SS8	60					
655			40		SS9	60					
650			45		SS10	60					
			48								
645		Fine to medium SAND (SP) - trace silt - light brown - moist below 55 ft bgs	50		SS11	60					
640			55		SS12	60					
635			60								
		Boring terminated at 60 ft.									

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PROJECT LOCATION: Manistee, MI
CLIENT: Little River Band of Ottawa Indians
DRILLING COMPANY: Shepler Well Drilling **RIG:** 7822 DT
DRILLER: C. Bridson **LOGGED BY:** M. Korndorfer

LOG OF BORING: SB-2

GROUND ELEVATION: 701.6 **DATE:** 07/16/2019
DRILLING LOCATION: Refer to Site Plan
DRILLING METHOD: Direct Push - Macro Core
BOREHOLE DIAMETER (IN): +/- 3 in. **TOTAL DEPTH (FT):** 47
STATIC WATER LEVEL: ▽ NA **CAVING DEPTH:** ▽ NA

Elevation (feet)	Graphic	Soil Description (See Boring Log Key)	Depth (feet)	Sample Type	Sample No.	Recovery (in)	Blow Counts	Notes	Pocket Penetrometer (tsf)	% < #200	TEST RESULTS
700		6 inches TOPSOIL - sandy - dark brown	0								Plastic Limit ⊢⊣ Liquid Limit
			0.5								Water Content - × %
		Fine to medium SAND (SP) - little silt - orange/brown	1								SPT RESULT - ▲ N Value
		Fine to medium SAND (SP) - trace silt - light brown			SS1	60					10 20 30 40 50
			5								
695					SS2	60					
			7								
		Fine SAND (SM) - little silt - brown - moist									
			9								
		Fine SAND (SP) - trace silt - light brown									
690			10		SS3	60					
			15								
					SS4	60					
			16								
685		Fine to medium SAND (SP) - trace silt - light brown									
			20								
680					SS5	60					
			25								
675					SS6	60					
			27.5								
		Fine SAND (SP) - little silt - light brown									
			30								
670											

Refusal at 47-feet bgs. Boring was backfilled from total depth to surface using Bentonite Chips.

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PROJECT NO.: 2018096001
PROJECT LOCATION: Manistee, MI
CLIENT: Little River Band of Ottawa Indians
DRILLING COMPANY: Shepler Well Drilling **RIG:** 7822 DT
DRILLER: C. Bridson **LOGGED BY:** M. Korndorfer

LOG OF BORING: SB-2

GROUND ELEVATION: 701.6 **DATE:** 07/16/2019
DRILLING LOCATION: Refer to Site Plan
DRILLING METHOD: Direct Push - Macro Core
BOREHOLE DIAMETER (IN): +/- 3 in. **TOTAL DEPTH (FT):** 47
STATIC WATER LEVEL: ▽ NA **CAVING DEPTH:** ▽ NA

Elevation (feet)	Graphic	Soil Description (See Boring Log Key)	Depth (feet)	Sample Type	Sample No.	Recovery (in)	Blow Counts	Notes	Pocket Penetrometer (tsf)	% < #200	TEST RESULTS
665		Fine to medium SAND (SP) - trace coarse sand - occasional sandy silt and clay layers (3-6in thick) between 33.5 and 34.5 ft) - light brown	32								Plastic Limit ⊢⊣ Liquid Limit; Water Content - × %; SPT RESULT - ▲ N Value; 10 20 30 40 50
			35		SS7	60			0.75		
					SS8	60					
660			40		SS9	60					
			45		SS10	24					
655		Boring terminated at 47 ft.									
650											
645											
640											

Refusal at 47-feet bgs. Boring was backfilled from total depth to surface using Bentonite Chips.

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CLIENT: Little River Band of Ottawa Indians
DRILLING COMPANY: Shepler Well Drilling **RIG:** 7822 DT
DRILLER: C. Bridson **LOGGED BY:** M. Korndorfer

LOG OF BORING: SB-3

GROUND ELEVATION: 696.7 **DATE:** 07/16/2019
DRILLING LOCATION: Refer to Site Plan
DRILLING METHOD: Direct Push - Macro Core
BOREHOLE DIAMETER (IN): +/- 3 in. **TOTAL DEPTH (FT):** 20
STATIC WATER LEVEL: ▽ NA **CAVING DEPTH:** ▽ NA

Elevation (feet)	Graphic	Soil Description (See Boring Log Key)	Depth (feet)	Sample Type	Sample No.	Recovery (in)	Blow Counts	Notes	Pocket Penetrometer (tsf)	% < #200	TEST RESULTS
695		1 foot TOPSOIL - sandy - black/dark brown	0								Plastic Limit ⊢⊣ Liquid Limit
			1								Water Content - × %
		Fine SAND (SP) - trace silt - orange/brown									SPT RESULT - ▲ N Value
			2.5								10 20 30 40 50
		Fine to medium SAND (SP) - trace coarse sand - trace silt - light brown			SS1	60					
690			5		SS2	60					
			9								
		Fine to coarse SAND (SP) - trace silt - light brown	10		SS3	60					
685			15								
680					SS4	60					
			20								
		Boring terminated at 20 ft.									
675											
670											
665											

Boring was backfilled from total depth to surface using Bentonite Chips.

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CLIENT: Little River Band of Ottawa Indians
DRILLING COMPANY: Shepler Well Drilling **RIG:** 7822 DT
DRILLER: C. Bridson **LOGGED BY:** M. Korndorfer

LOG OF BORING: SB-4

GROUND ELEVATION: 694.6 **DATE:** 07/16/2019
DRILLING LOCATION: Refer to Site Plan
DRILLING METHOD: Direct Push - Macro Core
BOREHOLE DIAMETER (IN): +/- 3 in. **TOTAL DEPTH (FT):** 20
STATIC WATER LEVEL: ▽ NA **CAVING DEPTH:** ▽ NA

Elevation (feet)	Graphic	Soil Description (See Boring Log Key)	Depth (feet)	Sample Type	Sample No.	Recovery (in)	Blow Counts	Notes	Pocket Penetrometer (tsf)	% < #200	TEST RESULTS
694		1 foot TOPSOIL - sandy - black/dark brown	0								Plastic Limit ⊢⊣ Liquid Limit
			1								Water Content - × %
		Fine SAND (SP) - little silt - orange/brown			SS1	60					SPT RESULT - ▲ N Value
			3								10 20 30 40 50
		Fine to medium SAND (SP) - trace silt - light brown									
690			5		SS2	60					
685			10		SS3	60					
680			15								
			16								
		Silty CLAY (CL) - stiff - brown			SS4	60			0.75		
			17.5								
		Fine to medium SAND (SP) - trace coarse sand - brown - moist									
675			18.5								
		Silty CLAY (CL) - very stiff - brown	20								
		Boring terminated at 20 ft.									
670											
665											

Boring was backfilled from total depth to surface using Bentonite Chips.

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DRILLER: C. Bridson **LOGGED BY:** M. Korndorfer

LOG OF BORING: SB-5

GROUND ELEVATION: 704.8 **DATE:** 07/16/2019
DRILLING LOCATION: Refer to Site Plan
DRILLING METHOD: Direct Push - Macro Core
BOREHOLE DIAMETER (IN): +/- 3 in. **TOTAL DEPTH (FT):** 20
STATIC WATER LEVEL: ▽ NA **CAVING DEPTH:** ▽ NA

Elevation (feet)	Graphic	Soil Description (See Boring Log Key)	Depth (feet)	Sample Type	Sample No.	Recovery (in)	Blow Counts	Notes	Pocket Penetrometer (tsf)	% < #200	TEST RESULTS
705		6 inches TOPSOIL - sandy - dark brown	0								Plastic Limit ⊢⊣ Liquid Limit
			0.5								Water Content - × %
		Fine SAND (SP) - little silt - orange/brown	1		SS1	60					SPT RESULT - ▲ N Value
		Fine SAND (SP) - trace silt - brown	3								10 20 30 40 50
700		Fine to medium SAND (SP) - trace silt - occasional sandy silt seams between 3-4 ft - brown	5		SS2	60					
695			10		SS3	60					
690			15		SS4	60					
		Fine to coarse SAND (SP) - light brown	17								
685			20								
		Boring terminated at 20 ft.									
680											
675											

Boring was backfilled from total depth to surface using Bentonite Chips.

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PROJECT NO.: 2018096001
PROJECT LOCATION: Manistee, MI
CLIENT: Little River Band of Ottawa Indians
DRILLING COMPANY: Shepler Well Drilling **RIG:** 7822 DT
DRILLER: C. Bridson **LOGGED BY:** M. Korndorfer

LOG OF BORING: SB-6

GROUND ELEVATION: 706.7 **DATE:** 07/16/2019
DRILLING LOCATION: Refer to Site Plan
DRILLING METHOD: Direct Push - Macro Core
BOREHOLE DIAMETER (IN): +/- 3 in. **TOTAL DEPTH (FT):** 20
STATIC WATER LEVEL: ▽ NA **CAVING DEPTH:** ℄ NA

Elevation (feet)	Graphic	Soil Description (See Boring Log Key)	Depth (feet)	Sample Type	Sample No.	Recovery (in)	Blow Counts	Notes	Pocket Penetrometer (tsf)	% < #200	TEST RESULTS
705		6 inches TOPSOIL - sandy - dark brown	0								Plastic Limit ⊢⊣ Liquid Limit
		0.5 Fine to medium SAND (SP) trace silt - brown			SS1	60					Water Content - × %
		4 Silty fine SAND (SM) - light brown	5		SS2	60					SPT RESULT - ▲ N Value
700			10		SS3	60					10 20 30 40 50
		11 Fine to medium SAND (SP) - little silt - light brown	15		SS4	60					
695			20								
690		Boring terminated at 20 ft.									
685											
680											
675											

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Attachment 8

Monitoring Well Logs

Gosling Czubak engineering sciences, inc.

Key to Gosling Czubak Boring Logs and Well Construction Diagrams

SOIL CLASSIFICATION INFORMATION

SOIL DESCRIPTIONS

Example: **Silty fine SAND (SM) - trace clay - occasional clay seams - dense - brown/gray below 40 feet - wet**
(1 - 2 - 3 - 4 - 5 - 6 - 7- 8 - 9 - 10)

1a FOR COARSE GRAINED PRIMARY MATERIAL: Secondary Material of 15 to 50%, if applicable. (eg. Silty, Clayey)
1b FOR FINE GRAINED PRIMARY MATERIAL: Secondary Material of 30 to 50%, if applicable (eg. Gravelly, Sandy)

2 PRIMARY MATERIAL (in CAPs)- SILT, SAND, GRAVEL, or CLAY
Note: fine, medium and/or coarse grained SAND
fine and/or coarse grained GRAVEL

3 (USCS) Unified Soil Classification System (USCS) symbol(s) is presented at the end of the soil description (in parentheses) based on ASTM gradation and plasticity testing. See attached USCS chart.

4 Additional Materials (with percentage descriptors as below)

Fine Grained Material	Coarse-Grained Material
15 to 30% - "some" or "with"	5 to 15% - "little"
5 to 15% - "little"	< 5% - "trace" or "few"
< 5% - "trace" or "few"	

5 Description of sorting or grading. For example, "well-sorted, or "poorly graded."

6 Occurrences (with frequency descriptors as below) - cobbles, boulders, bricks, layers, seams, etc.
Greater than one per 12-inches = "frequent"
One per 12-inches = "occasional"

Note: Seams = < 1-inch in thickness
Layers = > 1-inch in thickness

7 Angularity and mineral composition, if warranted

8 Odor or Sheen, if applicable

9 Soil Strength Description (Relative density for sand, or Consistency for silts/clays)

10 Color

11 Moisture - "dry" or "wet" or "moist"
"dry" = absence of apparent moisture
"moist" = damp but not saturated
"wet" = saturated

Particle Sizes	
Boulders	- > 12-in
Cobbles	- 12 to 3 in
Course gravel	- 3 to 3/4 in
Fine gravel	- 3/4 to 0.187-in
Coarse sand	- 4.75 to 2.0-mm
Medium sand	- 2.0 to 0.425-mm
Fine sand	- 0.425 to 0.075-mm
Clay/Silt	- < 0.075-mm

Relative Density	SPT N-Value
"very loose"	W.O.H. to 4
"loose"	5 to 10
"medium dense"	11 to 30
"dense"	31 to 50
"very dense"	over 50

Consistency	SPT N-Value	Ppen, tsf
"very soft"	WOH to 2	0 - 0.125
"soft"	2 to 4	0.125 - 0.25
"medium stiff"	4 to 8	0.25 - 0.5
"stiff"	8 to 15	0.5 - 1.0
"very stiff"	15 to 30	1.0 - 2.0
"hard"	over 30	2.0 - 4.0

NOTES AND GENERAL INFORMATION

1. Drilling and sampling activities are indicative of subsurface conditions only at locations where data are taken, and when data are taken. Conditions at locations not evaluated may differ from professional interpretation.

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Dashed line denotes a gradual or gradational soil transition.
Dotted line denotes an inferred transition, therefore the type and specific location of the transition is unknown / approximated.

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DR = Drove Rock (During SPT) NR = No Recovery
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UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

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GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)		
		GW	Well-graded gravels, gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)		
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)		
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		SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)		
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		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)			
SILTS AND CLAYS Liquid limit less than 50%		ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

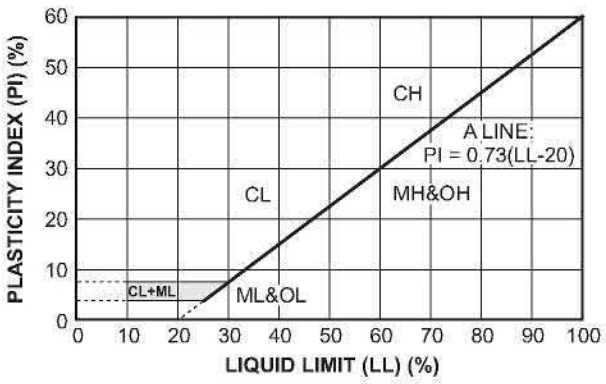
LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent ..... GW, GP, SW, SP
More than 12 percent ..... GM, GC, SM, SC
5 to 12 percent ..... Borderline cases requiring dual symbols

PLASTICITY CHART



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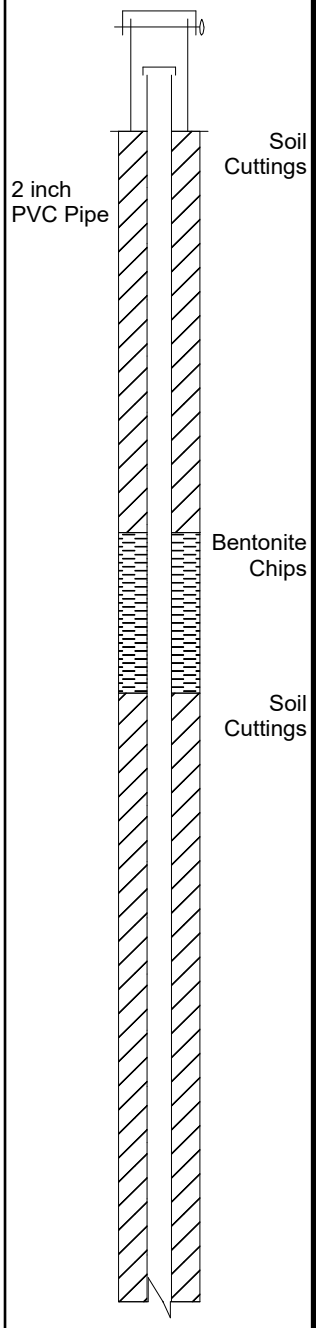
PROJECT: Little River Casino Wastewater HGI
PROJECT NO.: 2018096001
PROJECT LOCATION: Manistee, MI
CLIENT: Little River Band of Ottawa Indians
DRILLING COMPANY: Gosling Czubak Engineering
DRILLER: M. Allen **RIG:** CME-75

LOG OF MONITORING WELL: MW-1

LOGGED BY: M. Korndorfer **DATE:** 7/30/2019
DRILLING METHOD: 4.25-in (ID) Hollow-Stem Auger
BOREHOLE DIAMETER (IN): +/- 10 in
STATIC WATER LEVEL (FT): ▽ 88.36
GROUND ELEVATION: 701.8 **TOP OF CASING:** 704.99

Graphic	Soil Description (See Boring Log Key)	Depth (feet)/ Elevation (NAVD88)	Sample Type	Sample No.	Blow Counts	Recovery (in)	PID (ppm)	WELL CONSTRUCTION
	6 inches TOPSOIL - sandy - dark brown	0 / 701.8						
	Fine to medium SAND (SP) - little silt - orange/brown	0.5						
	Fine to medium SAND (SP) - trace silt - light brown	1 / 700						
		5						
	Fine SAND (SM) - little silt - brown - moist	7 / 695						
	Fine SAND (SP) - trace silt - light brown	9						
		10 / 690						
		15						
	Fine to medium SAND (SP) - trace silt - light brown	16 / 685						
		20 / 680						
		25						
	Fine SAND (SP) - little silt - light brown	27.5 / 675						



Soil information above 46 feet was taken from SB-1.
Monitoring Well was constructed using 2 inch PVC piping and a 5 foot, 10-slot PVC screen. Screened Interval = 97-92 ft bgs.
Bentonite Chips were used to seal the borehole. Remaining borehole was backfilled using soil cuttings.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

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LOG OF MONITORING WELL: MW-1

LOGGED BY: M. Korndorfer **DATE:** 7/30/2019
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STATIC WATER LEVEL (FT): ▽ 88.36
GROUND ELEVATION: 701.8 **TOP OF CASING:** 704.99

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Graphic	Soil Description (See Boring Log Key)	Depth (feet)/ Elevation (NAVD88)	Sample Type	Sample No.	Blow Counts	Recovery (in)	PID (ppm)	WELL CONSTRUCTION
		30 / 670						
	Fine to medium SAND (SP) - trace coarse sand - occasional sandy silt and clay layers (3-6in thick) between 33.5 and 34.5 ft) - light brown	32						
		35 / 665						
		40 / 660						
		45						
	Fine to medium SAND (SP) - trace coarse sand - occasional sandy gravel layers (2in thick at 56.25ft) - dense to very dense - light brown	46 / 655		SS1	24 21 27 50/3	24		
				SS2	12 12 14 15	24		
		50 / 650		SS3	10 7 17 43	24		
				SS4	12 20 32 50/3	24		
		55 / 645		SS5	10 20 38 50/2	24		
				SS6	10 29 39 50/4	24		
				SS7	8 20 40 50/3	24		
		60		SS8	8 24	24		
		61						

Soil information above 46 feet was taken from SB-1.
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DRILLING COMPANY: Gosling Czubak Engineering
DRILLER: M. Allen **RIG:** CME-75

LOG OF MONITORING WELL: MW-1

LOGGED BY: M. Korndorfer **DATE:** 7/30/2019
DRILLING METHOD: 4.25-in (ID) Hollow-Stem Auger
BOREHOLE DIAMETER (IN): +/- 10 in
STATIC WATER LEVEL (FT): ▽ 88.36
GROUND ELEVATION: 701.8 **TOP OF CASING:** 704.99

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Graphic	Soil Description (See Boring Log Key)	Depth (feet)/ Elevation (NAVD88)	Sample Type	Sample No.	Blow Counts	Recovery (in)	PID (ppm)	WELL CONSTRUCTION
	Sandy GRAVEL (GP) - dense - light brown	640			23 26			
	62							
	Fine to medium SAND (SP) - trace silt - medium dense - light brown			SS9	12 12 12 18	24		
		65		SS10	22 12 14 18	24		
		635						
				SS11	3 5 12 17	24		
		70		SS12	4 6 11 14	24		
		630						
	72.25			SS13	3 6 9 11	24		
	Fine to coarse SAND (SP) - trace silt - occasional gravel - medium dense - light brown			SS14	6 10 15 21	24		2 inch PVC Pipe; Bentonite Chips
		75		SS15	13 11 13 20	24		
		625		SS16	10 13 20 28	24		Soil Cuttings
	79.25			SS17	9 12 19 28	24		
	Fine to medium SAND (SP) - trace silt - dense - light brown - moist/ wet below 88 ft	80		SS18	15 13 19 22	24		Filter Sand
		620						
				SS19	15 14 20 40	24		
		85		SS20	4 5 8 20	24		
		615						
	▽			SS21	5 7 13 23	24		
		90		SS22	6 6 10 10	24		
		610						
				SS23	5 4 7	24		10-slot Screen

Soil information above 46 feet was taken from SB-1.
Monitoring Well was constructed using 2 inch PVC piping and a 5 foot, 10-slot PVC screen. Screened Interval = 97-92 ft bgs.
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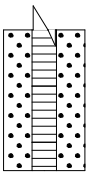
LOG OF MONITORING WELL: MW-1

LOGGED BY: M. Korndorfer **DATE:** 7/30/2019
DRILLING METHOD: 4.25-in (ID) Hollow-Stem Auger
BOREHOLE DIAMETER (IN): +/- 10 in
STATIC WATER LEVEL (FT): ▽ 88.36
GROUND ELEVATION: 701.8 **TOP OF CASING:** 704.99

Graphic	Soil Description (See Boring Log Key)	Depth (feet)/ Elevation (NAVD88)	Sample Type	Sample No.	Blow Counts	Recovery (in)	PID (ppm)	WELL CONSTRUCTION
		95 / 605		SS24	13 4 5 16 19	24		
	Boring terminated at 97 ft.							

100 / 600
105 / 595
110 / 590
115 / 585
120 / 580
125



Soil information above 46 feet was taken from SB-1.
Monitoring Well was constructed using 2 inch PVC piping and a 5 foot, 10-slot PVC screen. Screened Interval = 97-92 ft bgs.
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CLIENT: Little River Band of Ottawa Indians
DRILLING COMPANY: Gosling Czubak
DRILLER: M. Allen **RIG:** CME-75

LOG OF MONITORING WELL: MW-2

LOGGED BY: M. Korndorfer **DATE:** 7/31/2019
DRILLING METHOD: 4.25-in (ID) Hollow-Stem Auger
BOREHOLE DIAMETER (IN): +/- 10 in
STATIC WATER LEVEL (FT): ▽ 89.88
GROUND ELEVATION: 704.6 **TOP OF CASING:** 707.50

Graphic	Soil Description (See Boring Log Key)	Depth (feet)/ Elevation (NAVD88)	Sample Type	Sample No.	Blow Counts	Recovery (in)	PID (ppm)	WELL CONSTRUCTION
	6 inches sandy TOPSOIL - dark brown	0 / 705						2 inch PVC Pipe; Soil Cuttings
	Fine SAND (SM) - little silt - loose - light brown	0.5						
		5 / 700	SS	SS1	3 3 5 7	24		
		10 / 695	SS	SS2	3 2 2 4	24		Bentonite Chips
	Fine to medium SAND (SP) - trace coarse sand - occasional gravel - loose to medium dense - light brown	13						
		15 / 690	SS	SS3	2 2 5 7	24		Soil Cuttings
		20 / 685	SS	SS4	3 4 7 7	24		
		25 / 680	SS	SS5	5 2 3 4	24		
	Fine SAND (SM) - little silt - medium dense - light brown	28						

Monitoring Well was constructed using 2 inch PVC piping and a 5 foot, 10-slot PVC screen. Screened Interval = 100-95 ft bgs. Bentonite Chips were used to seal the borehole. Remaining borehole was backfilled using soil cuttings.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

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DRILLING COMPANY: Gosling Czubak
DRILLER: M. Allen **RIG:** CME-75

LOG OF MONITORING WELL: MW-2

LOGGED BY: M. Korndorfer **DATE:** 7/31/2019
DRILLING METHOD: 4.25-in (ID) Hollow-Stem Auger
BOREHOLE DIAMETER (IN): +/- 10 in
STATIC WATER LEVEL (FT): ▽ 89.88
GROUND ELEVATION: 704.6 **TOP OF CASING:** 707.50

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Graphic	Soil Description (See Boring Log Key)	Depth (feet)/ Elevation (NAVD88)	Sample Type	Sample No.	Blow Counts	Recovery (in)	PID (ppm)	WELL CONSTRUCTION
	37	30 — 675		SS6	9 9 21 24	24		
	Fine to medium SAND (SP) - trace silt - occasional gravelly sand layers (2-in thick at 50ft) - dense to medium dense - light brown	35 — 670		SS7	6 14 25 30	24		
		40 — 665		SS8	8 15 22 22	24		
		45 — 660		SS9	10 15 30 35	24		
		50 — 655		SS10	12 9 12 13	24		
		55 — 650		SS11	6 8 12 12	24		
		60 — 645		SS12	10 6 12 14	24		

Monitoring Well was constructed using 2 inch PVC piping and a 5 foot, 10-slot PVC screen. Screened Interval = 100-95 ft bgs. Bentonite Chips were used to seal the borehole. Remaining borehole was backfilled using soil cuttings.

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DRILLING COMPANY: Gosling Czubak
DRILLER: M. Allen **RIG:** CME-75

LOG OF MONITORING WELL: MW-2

LOGGED BY: M. Korndorfer **DATE:** 7/31/2019
DRILLING METHOD: 4.25-in (ID) Hollow-Stem Auger
BOREHOLE DIAMETER (IN): +/- 10 in
STATIC WATER LEVEL (FT): ▽ 89.88
GROUND ELEVATION: 704.6 **TOP OF CASING:** 707.50

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Graphic	Soil Description (See Boring Log Key)	Depth (feet)/ Elevation (NAVD88)	Sample Type	Sample No.	Blow Counts	Recovery (in)	PID (ppm)	WELL CONSTRUCTION
		65 / 640		SS13	5 5 7 10	24		
	69.5	70 / 635		SS14	6 5 10 13	24		
	Fine to medium SAND (SP) - trace coarse sand - trace gravel - occasional gravelly sand layers (74.5ft) - medium dense - light brown	75 / 630		SS15	3 7 10 15	24		2 inch PVC Pipe; Bentonite Chips
	78							Soil Cuttings
	Fine to medium SAND (SP) - trace silt - medium dense - light brown - wet below 87 ft bgs	80 / 625		SS16	9 6 11 13	24		
		85 / 620		SS17	6 7 12 16	24		
		90 / 615		SS18	3 5 10 21	24		Filter Sand

Monitoring Well was constructed using 2 inch PVC piping and a 5 foot, 10-slot PVC screen. Screened Interval = 100-95 ft bgs. Bentonite Chips were used to seal the borehole. Remaining borehole was backfilled using soil cuttings.

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PROJECT LOCATION: Manistee, MI
CLIENT: Little River Band of Ottawa Indians
DRILLING COMPANY: Gosling Czubak
DRILLER: M. Allen **RIG:** CME-75

LOG OF MONITORING WELL: MW-2

LOGGED BY: M. Korndorfer **DATE:** 7/31/2019
DRILLING METHOD: 4.25-in (ID) Hollow-Stem Auger
BOREHOLE DIAMETER (IN): +/- 10 in
STATIC WATER LEVEL (FT): ▽ 89.88
GROUND ELEVATION: 704.6 **TOP OF CASING:** 707.50

Graphic	Soil Description (See Boring Log Key)	Depth (feet)/ Elevation (NAVD88)	Sample Type	Sample No.	Blow Counts	Recovery (in)	PID (ppm)	WELL CONSTRUCTION
		95 – 610		SS19	8 6 10 13	12		Filter Sand; 10-slot PVC Screen
		100 – 605		SS20	4 6 8 7	4		
	Boring terminated at 101 ft.	105 – 600 110 – 595 115 – 590 120 – 585 125 – 580						

Monitoring Well was constructed using 2 inch PVC piping and a 5 foot, 10-slot PVC screen. Screened Interval = 100-95 ft bgs. Bentonite Chips were used to seal the borehole. Remaining borehole was backfilled using soil cuttings.

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PROJECT LOCATION: Manistee, MI
CLIENT: Little River Band of Ottawa Indians
DRILLING COMPANY: Gosling Czubak
DRILLER: M. Allen **RIG:** CME-75

LOG OF MONITORING WELL: MW-3

LOGGED BY: M. Korndorfer **DATE:** 7/31/2019
DRILLING METHOD: 4.25-in (ID) Hollow-Stem Auger
BOREHOLE DIAMETER (IN): +/- 10 in
STATIC WATER LEVEL (FT): ▽ 89.65
GROUND ELEVATION: 703.4 **TOP OF CASING:** 706.25

Graphic	Soil Description (See Boring Log Key)	Depth (feet)/ Elevation (NAVD88)	Sample Type	Sample No.	Blow Counts	Recovery (in)	PID (ppm)	WELL CONSTRUCTION
	6 inches sandy TOPSOIL - dark brown	0 / 705						2 inch PVC Pipe; Soil Cuttings
	Fine SAND (SM) - little silt - loose - light brown	0.5						
		5 / 700		SS1	3 1 2 2	24		
		10 / 695		SS2	2 2 2 2	24		Bentonite Chips
	Fine to medium SAND (SP) - trace silt - loose - light brown	13 / 690						
		15		SS3	2 1 2 3	24		Soil Cuttings
		685						
		20		SS4	3 5 10 12	24		
		680						
		25		SS5	5 5 3 8	24		
	Fine SAND (SM) - little silt - occasional clayey silt layers - medium dense - brown - moist	25.5 / 675						

Monitoring Well was constructed using 2 inch PVC piping and a 5 foot, 10-slot PVC screen. Screened Interval = 98-93 ft bgs. Bentonite Chips were used to seal the borehole. Remaining borehole was backfilled using soil cuttings.

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PROJECT LOCATION: Manistee, MI
CLIENT: Little River Band of Ottawa Indians
DRILLING COMPANY: Gosling Czubak
DRILLER: M. Allen **RIG:** CME-75

LOG OF MONITORING WELL: MW-3

LOGGED BY: M. Korndorfer **DATE:** 7/31/2019
DRILLING METHOD: 4.25-in (ID) Hollow-Stem Auger
BOREHOLE DIAMETER (IN): +/- 10 in
STATIC WATER LEVEL (FT): ▽ 89.65
GROUND ELEVATION: 703.4 **TOP OF CASING:** 706.25

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Graphic	Soil Description (See Boring Log Key)	Depth (feet)/ Elevation (NAVD88)	Sample Type	Sample No.	Blow Counts	Recovery (in)	PID (ppm)	WELL CONSTRUCTION
		30 / 670		SS6	4 6 7 9	24		
	Silty fine SAND (SM) - medium dense - brown	30.5						
		35 / 665		SS7	5 8 9 12	24		
	Fine SAND (SP) - little silt - medium dense - light brown 2 in gravelly sand layer at 50 ft bgs	38						
		40 / 660		SS8	4 4 4 6	24		
	Fine to medium SAND (SP) - trace silt - medium dense - light brown	43						
		45 / 655		SS9	4 9 18 23	24		
		50 / 650		SS10	5 12 21 23	24		
	Fine to coarse SAND (GP-SP) - little gravel - medium dense - light brown	55 / 645		SS11	5 4 8 10	24		
		60		SS12	3 6 11 16	24		

Monitoring Well was constructed using 2 inch PVC piping and a 5 foot, 10-slot PVC screen. Screened Interval = 98-93 ft bgs. Bentonite Chips were used to seal the borehole. Remaining borehole was backfilled using soil cuttings.

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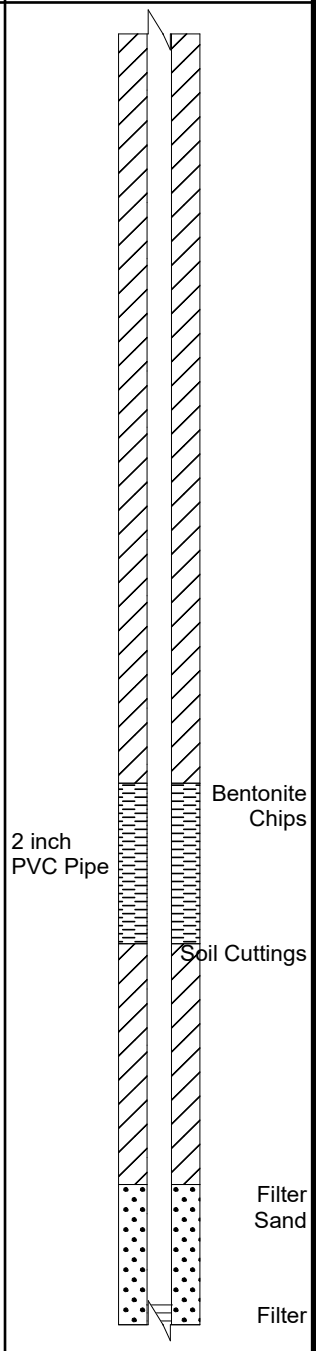
DRILLER: M. Allen **RIG:** CME-75

LOG OF MONITORING WELL: MW-3

LOGGED BY: M. Korndorfer **DATE:** 7/31/2019
DRILLING METHOD: 4.25-in (ID) Hollow-Stem Auger
BOREHOLE DIAMETER (IN): +/- 10 in
STATIC WATER LEVEL (FT): ▽ 89.65
GROUND ELEVATION: 703.4 **TOP OF CASING:** 706.25

Graphic	Soil Description (See Boring Log Key)	Depth (feet)/ Elevation (NAVD88)	Sample Type	Sample No.	Blow Counts	Recovery (in)	PID (ppm)	WELL CONSTRUCTION
	63	640						
	Fine to medium SAND (SP) - trace silt - medium dense - light brown -moist/wet below 86 ft	65		SS13	3 4 7 11	24		
		635						
		70		SS14	3 5 10 12	24		
		630						
		75		SS15	4 8 12 13	24		
		625						
		80		SS16	4 10 14 20	24		
		620						
		85		SS17	12 19 29 36	24		
		615						
		90		SS18	5 5 13 20	24		
		610						



Monitoring Well was constructed using 2 inch PVC piping and a 5 foot, 10-slot PVC screen. Screened Interval = 98-93 ft bgs. Bentonite Chips were used to seal the borehole. Remaining borehole was backfilled using soil cuttings.

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DRILLING COMPANY: Gosling Czubak
DRILLER: M. Allen **RIG:** CME-75

LOG OF MONITORING WELL: MW-3

LOGGED BY: M. Korndorfer **DATE:** 7/31/2019
DRILLING METHOD: 4.25-in (ID) Hollow-Stem Auger
BOREHOLE DIAMETER (IN): +/- 10 in
STATIC WATER LEVEL (FT): ▽ 89.65
GROUND ELEVATION: 703.4 **TOP OF CASING:** 706.25

Graphic	Soil Description (See Boring Log Key)	Depth (feet)/ Elevation (NAVD88)	Sample Type	Sample No.	Blow Counts	Recovery (in)	PID (ppm)	WELL CONSTRUCTION
		95 / 605		SS19	5 5 13 20	24		Sand; 10-slot PVC Screen
	Boring terminated at 100 ft.	100 / 600 105 / 595 110 / 590 115 / 585 120 / 580 125						

Monitoring Well was constructed using 2 inch PVC piping and a 5 foot, 10-slot PVC screen. Screened Interval = 98-93 ft bgs. Bentonite Chips were used to seal the borehole. Remaining borehole was backfilled using soil cuttings.

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Attachment 9

Groundwater Elevation Data

Client: **Little River Band of Ottawa Indians**
Project: **WWTP HGI**
Project No.: **2018096001.00**

DEPTH TO GROUNDWATER MEASUREMENTS

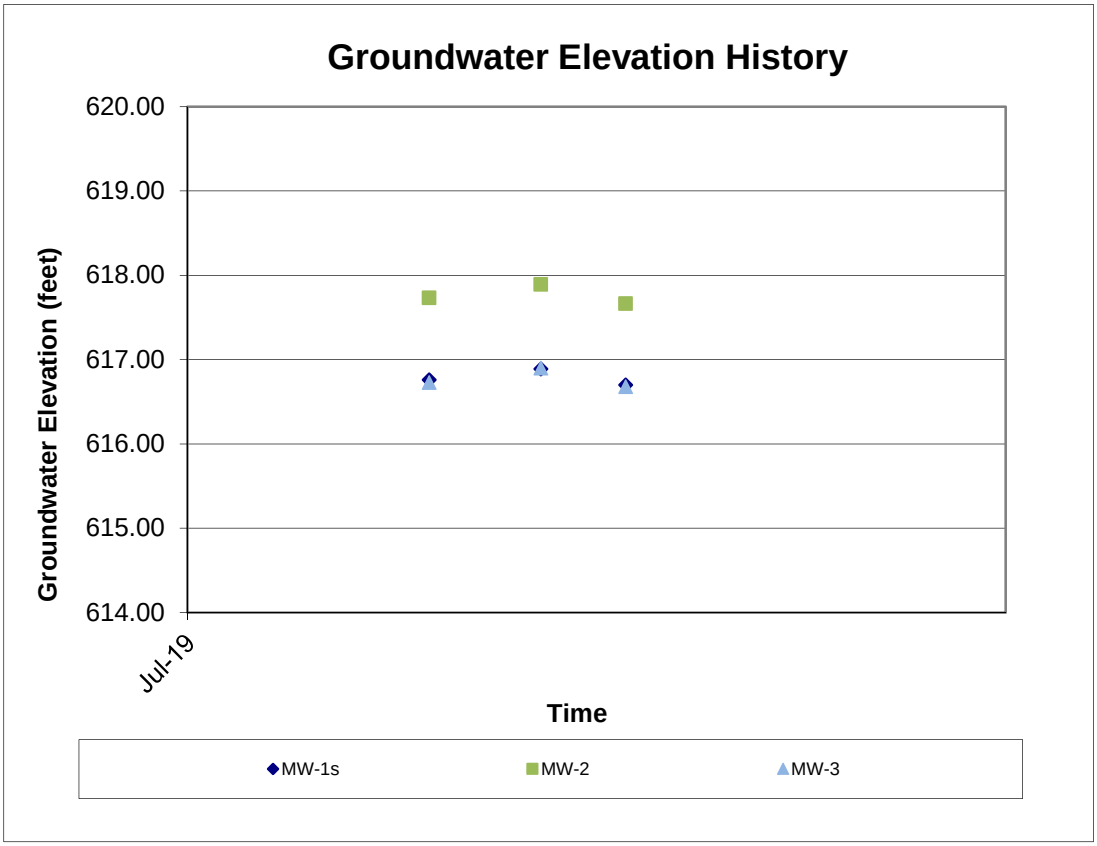
(feet, below top of casing)

Well I.D.	T.O.C. Elevation	8/15/2019	9/5/2019	9/21/2019		
MW-1s	704.99	88.23	88.10	88.29		
MW-2	707.50	89.77	89.61	89.84		
MW-3	706.25	89.52	89.35	89.57		

GROUNDWATER ELEVATIONS

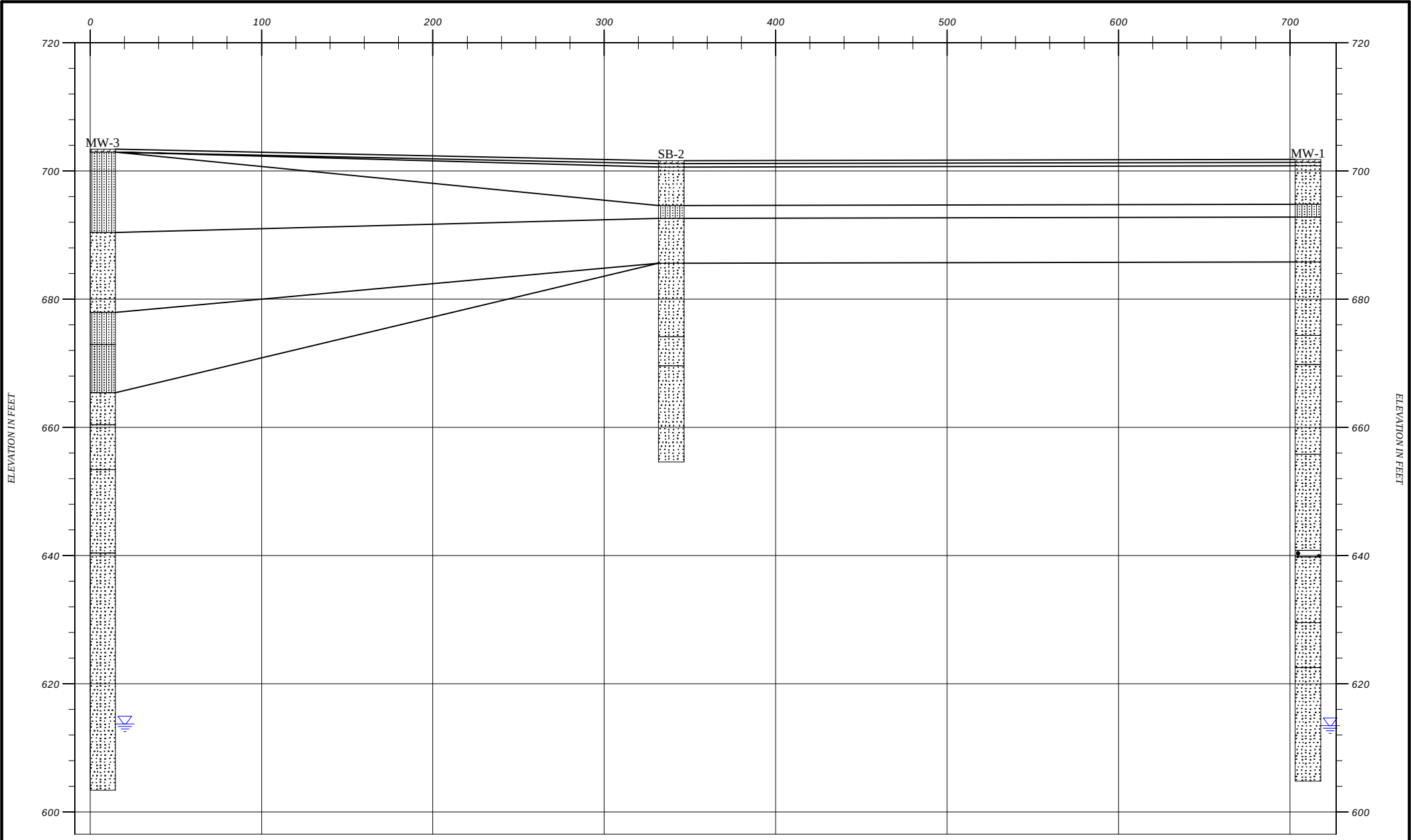
(feet, NAVD88)

Well I.D.	T.O.C. Elevation	8/15/2019	9/5/2019	9/21/2019		
MW-1s	704.99	616.76	616.89	616.70		
MW-2	707.50	617.73	617.89	617.66		
MW-3	706.25	616.73	616.90	616.68		

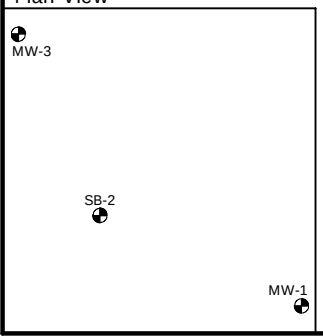


Attachment 10

Geological Cross Section



Plan View



Strata symbols

- Topsoil
- Silty sand
- Poorly graded sand
- Poorly graded gravel

Gosling Czubak Engineering Sciences, Inc.

GENERALIZED SOIL PROFILE

HORIZONTAL SCALE: 1"=(proportional)'	DRAWN BY/APPROVED BY	DATE DRAWN
VERTICAL SCALE: 1"=20'	MK	10/21/2019

Little River Casino Wastewater HGI

PROJECT NO. 2018096001

FIGURE NUMBER

Attachment 11

Soil Testing Results

Gosling Czubak Associates

Engineers
Surveyors
Formerly
Perla Stout Associates

Gosling Czubak Associates, P.C.
525 West Fourteenth
Traverse City, MI 49684
616 946-9191

CONSTANT-HEAD PERMEABILITY TEST

DATE 10 — 9 — 19

PROJECT LITTLE RIVER CASINO W.W. HGT

BORING NO. SB 2 @ 10'

Sample or Specimen No.

Wt in grams	Tare plus dry soil			Diameter of specimen, cm	D	3.5
	Tare			Area of specimen, sq cm	A	9.62
	Dry soil	W_s		Initial height of specimen, cm	L	7.0
Specific gravity		G		Initial vol of spec, cc = AL	V	67.34
Vol of solids, cc = $W_s + G$		V_s		Initial void ratio = $(V - V_s) + V_s$	e	

Distance between piezometer taps, cm L_1

Test No.		1.		2.		3	
Height of specimen, cm	L	7.0		7.0		7.0	
Void ratio = $(AL - V_s) + V_s$	e						
		1a	1b	2a	2b	3a	A3b
Reading of piez 1, cm	h_1						
Reading of piez 2, cm	h_2						
Head loss, cm = $h_1 - h_2$	h	38.1	38.1	38.1			38.1
Quantity of flow, cc	Q	46.5	44.7	43.9			45.03
Elapsed time, sec	t	600	600	600			600
Water temperature, °C	T	17.2	17.2	17.2			17.2
Viscosity correction factor(1)	R_T	1.072	1.072	1.072			1.072
Coefficient of permeability,(2) cm/sec	k_{20}						
	Avg						

(1) Correction factor for viscosity of water at 20° C obtained from table VII-1.

(2) $k_{20} = \frac{Q \times L \times R_T}{h \times A \times t}$. $\frac{45.03 \times 7.0 \times 1.072}{38.1 \times 9.62 \times 600} = \frac{337.9}{219913.2}$ 1.54 $\times 10^{-3}$

where L = height of specimen or distance between piezometer taps if used.

1.54 $\times 10^{-3}$ CM/SEC.

Remarks

Technician YNK Computed by YNK Checked by

Gosling Czubak Associates

Engineers
Surveyors
Formerly
Perla Stout Associates

Gosling Czubak Associates, P.C.
525 West Fourteenth
Traverse City, MI 49684
616 946-9191

CONSTANT-HEAD PERMEABILITY TEST

DATE 10 — 9 — 15

PROJECT LITTLE RIVER CASINO WLM HGI

BORING NO. SB2 @ 5'

Sample or Specimen No.

Wt in grams						
	Tare plus dry soil			Diameter of specimen, cm	D	3.5
	Tare			Area of specimen, sq cm	A	9.62
	Dry soil	W_s		Initial height of specimen, cm	L	7.0
Specific gravity		G		Initial vol of spec, cc = AL	V	67.34
Vol of solids, cc = $W_s \div G$		V_s		Initial void ratio = $(V - V_s) \div V_s$	e	

Distance between piezometer taps, cm L_1

Test No.		1		2		3	
Height of specimen, cm	L	7.0		7.0		7.0	
Void ratio = $(AL - V_s) \div V_s$	e						
		1a	1b	2a	2b	3a	AVG 3b
Reading of piez 1, cm	h_1						
Reading of piez 2, cm	h_2						
Head loss, cm = $h_1 - h_2$	h	38.1	38.1	38.1			38.1
Quantity of flow, cc	Q	329	300	265			298
Elapsed time, sec	t	600	600	600	~~600~~		600
Water temperature, °C	T	17.8	17.8	17.8			17.8
Viscosity correction factor(1)	R_T	1.056	1.056	1.056			1.056
Coefficient of permeability,(2) cm/sec	k_{20}						
	Avg						

(1) Correction factor for viscosity of water at 20° C obtained from table VII-1.

(2) $k_{20} = \frac{Q \times L \times R_T}{h \times A \times t}$. $\frac{298 \times 7.0 \times 1.056}{38.1 \times 9.62 \times 600} = \frac{2202.8}{219913.2}$ 1.00×10^{-2}

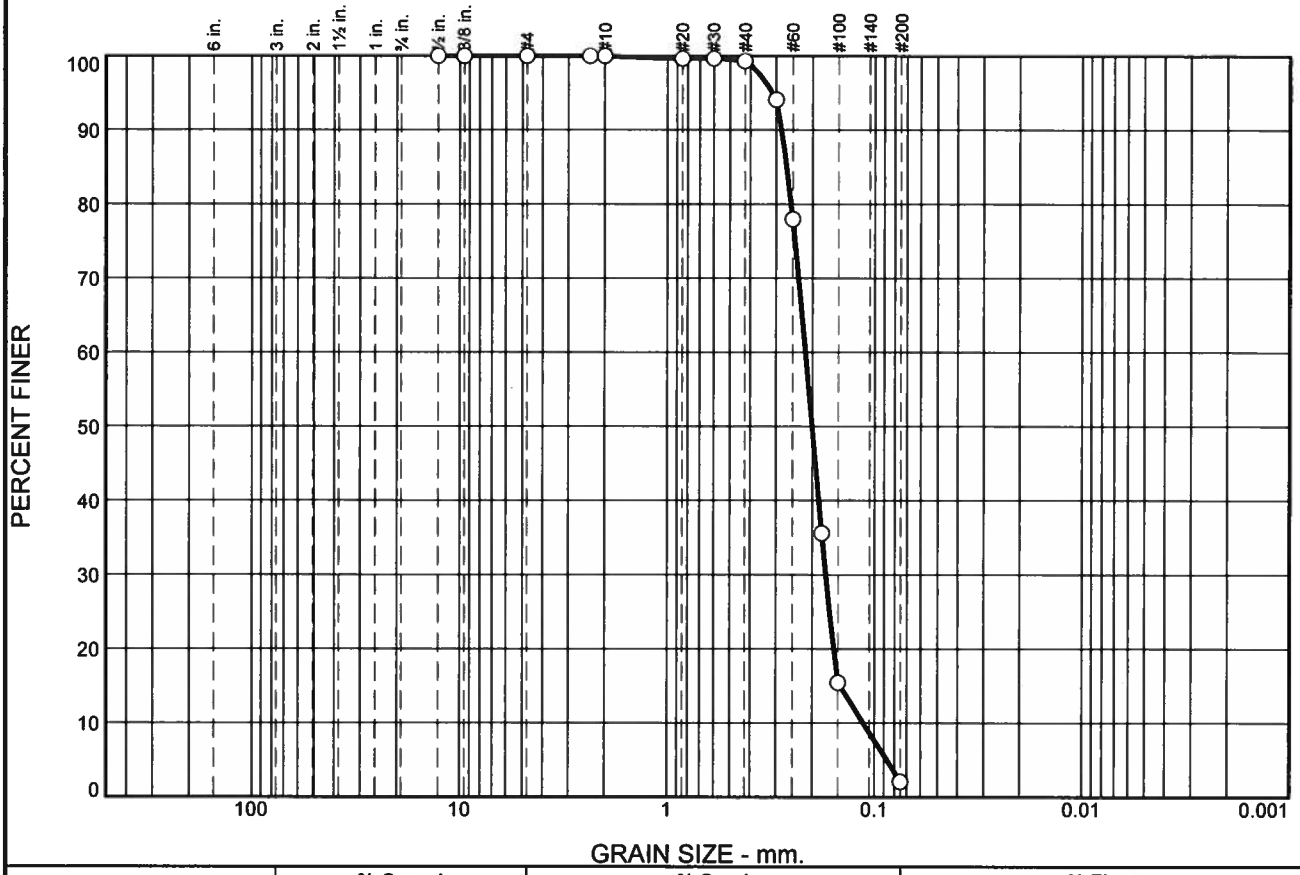
where L = height of specimen or distance between piezometer taps if used.

1.00×10^{-2} CM/SEC.

Remarks

Technician YNK Computed by YNK Checked by

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.7	97.2	2.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5	100.0		
0.375	100.0		
#4	100.0		
#8	100.0		
#10	100.0		
#20	99.7		
#30	99.7		
#40	99.3		
#50	94.1		
#60	78.0		
#80	35.6		
#100	15.4		
#200	2.1		

* (no specification provided)

Material Description

Fine SAND (SP) - trace silt - light brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.2828 D_{85}= 0.2673 D_{60}= 0.2164
D_{50}= 0.2008 D_{30}= 0.1720 D_{15}= 0.1467
D_{10}= 0.1131 C_u= 1.91 C_c= 1.21

Classification

USCS= SP AASHTO=

Remarks

F.M.=0.91

Source of Sample: SB-2 **Depth:** 10
Sample Number: SS3

Date: 10/2/19

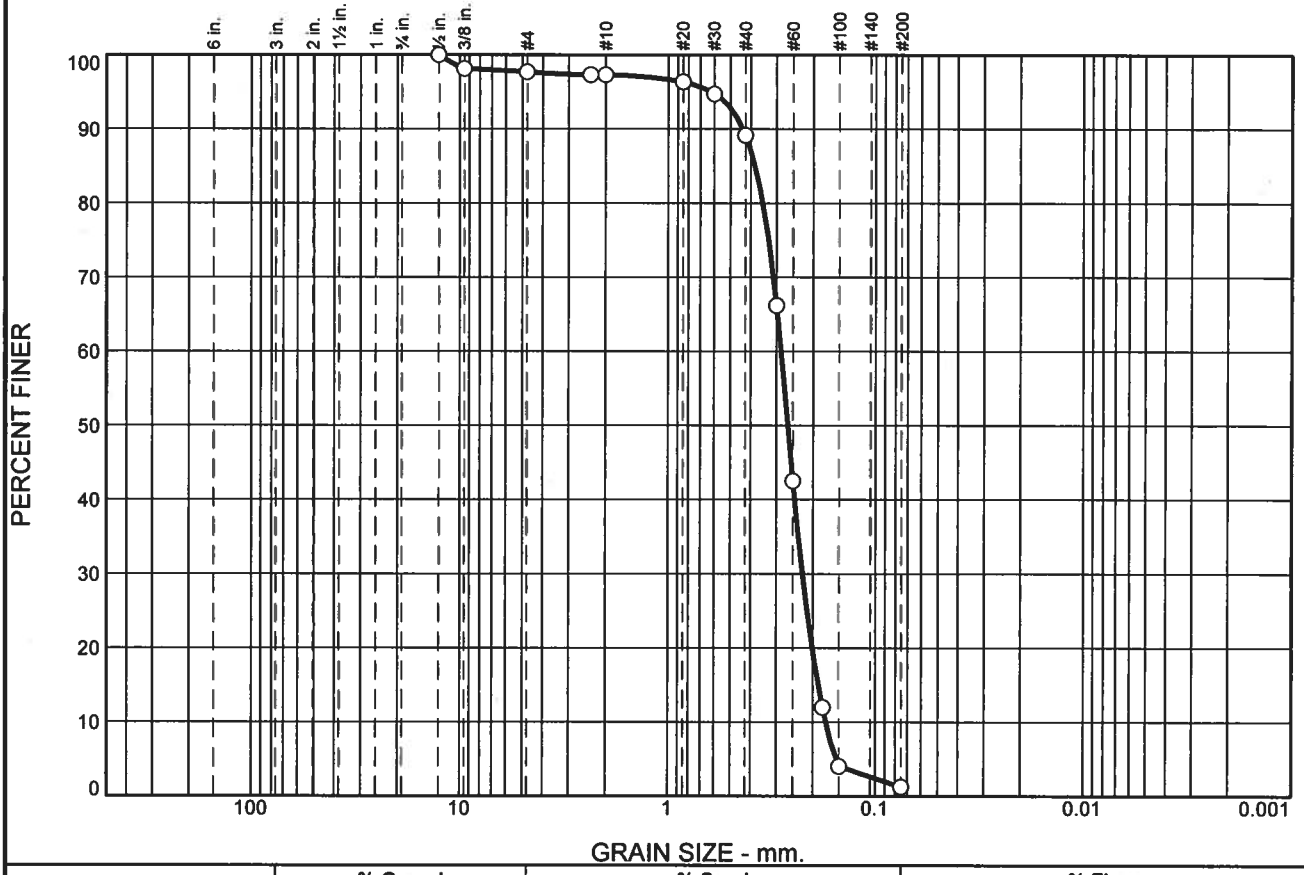
Gosling Czubak Engineering Sciences, Inc.
Traverse City, Michigan

Client: Little River Band of Ottawa Indians
Project: Little River Casino Wastewater HGI

Project No: 2018096001 **Figure**

Tested By: D. Fisk **Checked By:** A. Biteman

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.3	0.4	8.2	87.9	1.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5	100.0		
0.375	98.1		
#4	97.7		
#8	97.3		
#10	97.3		
#20	96.4		
#30	94.7		
#40	89.1		
#50	66.2		
#60	42.5		
#80	12.0		
#100	4.0		
#200	1.2		

* (no specification provided)

Material Description

Fine to medium SAND (SP) - trace silt - light brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.4376 D_{85}= 0.3820 D_{60}= 0.2852
D_{50}= 0.2646 D_{30}= 0.2244 D_{15}= 0.1887
D_{10}= 0.1737 C_u= 1.64 C_c= 1.02

Classification

USCS= SP AASHTO=

Remarks

F.M.=1.45

Source of Sample: SB-2 **Depth:** 20
Sample Number: SS5

Date: 10/2/19

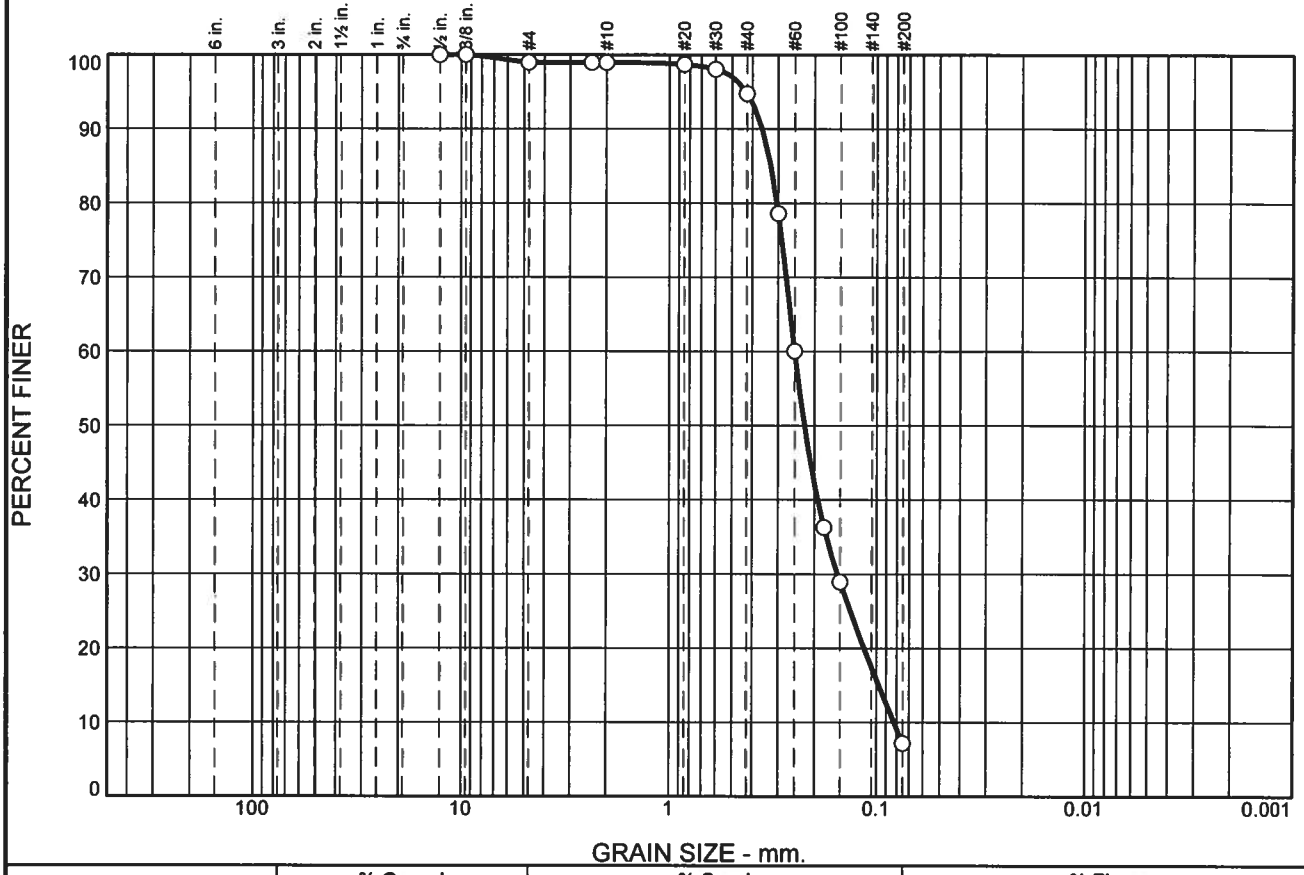
Gosling Czubak Engineering Sciences, Inc.
Traverse City, Michigan

Client: Little River Band of Ottawa Indians
Project: Little River Casino Wastewater HGI

Project No: 2018096001 **Figure**

Tested By: D. Fisk **Checked By:** A. Biteman

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.0	0.0	4.2	87.6	7.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5	100.0		
0.375	100.0		
#4	99.0		
#8	99.0		
#10	99.0		
#20	98.7		
#30	98.0		
#40	94.8		
#50	78.6		
#60	60.1		
#80	36.3		
#100	29.0		
#200	7.2		

* (no specification provided)

Material Description

Fine SAND (SP) - little silt - light brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3597 D_{85}= 0.3267 D_{60}= 0.2499
D_{50}= 0.2235 D_{30}= 0.1544 D_{15}= 0.0976
D_{10}= 0.0826 C_u= 3.03 C_c= 1.16

Classification

USCS= AASHTO=

Remarks

F.M.=0.98

Source of Sample: SB-2 **Depth:** 25
Sample Number: SS6

Date: 10/2/19

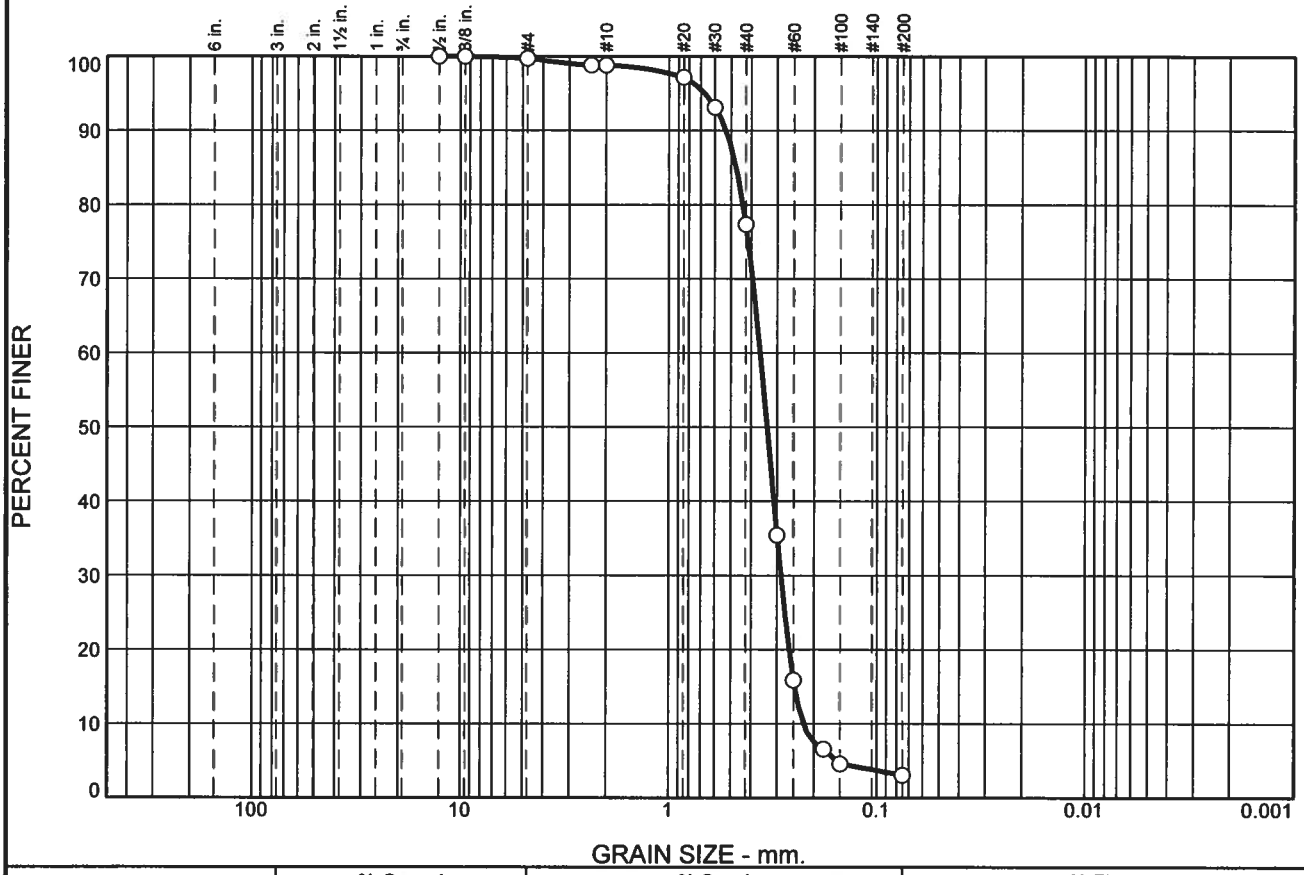
Gosling Czubak Engineering Sciences, Inc.
Traverse City, Michigan

Client: Little River Band of Ottawa Indians
Project: Little River Casino Wastewater HGI

Project No: 2018096001 **Figure**

Tested By: D. Fisk **Checked By:** A. Biteman

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.3	0.9	21.5	74.2	3.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5	100.0		
0.375	100.0		
#4	99.7		
#8	98.8		
#10	98.8		
#20	97.2		
#30	93.1		
#40	77.3		
#50	35.4		
#60	15.9		
#80	6.6		
#100	4.6		
#200	3.1		

* (no specification provided)

Material Description

Fine to medium SAND (SP) - trace coarse sand - occasional sandy gravel layers (2in thick at 56.25ft) - dense to very dense - light brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.5304 D_{85}= 0.4733 D_{60}= 0.3625
D_{50}= 0.3354 D_{30}= 0.2872 D_{15}= 0.2469
D_{10}= 0.2240 C_u= 1.62 C_c= 1.02

Classification

USCS= AASHTO=

Remarks

F.M.=1.70

Source of Sample: MW-1 **Depth:** 56
Sample Number: SS6

Date: 10/2/19

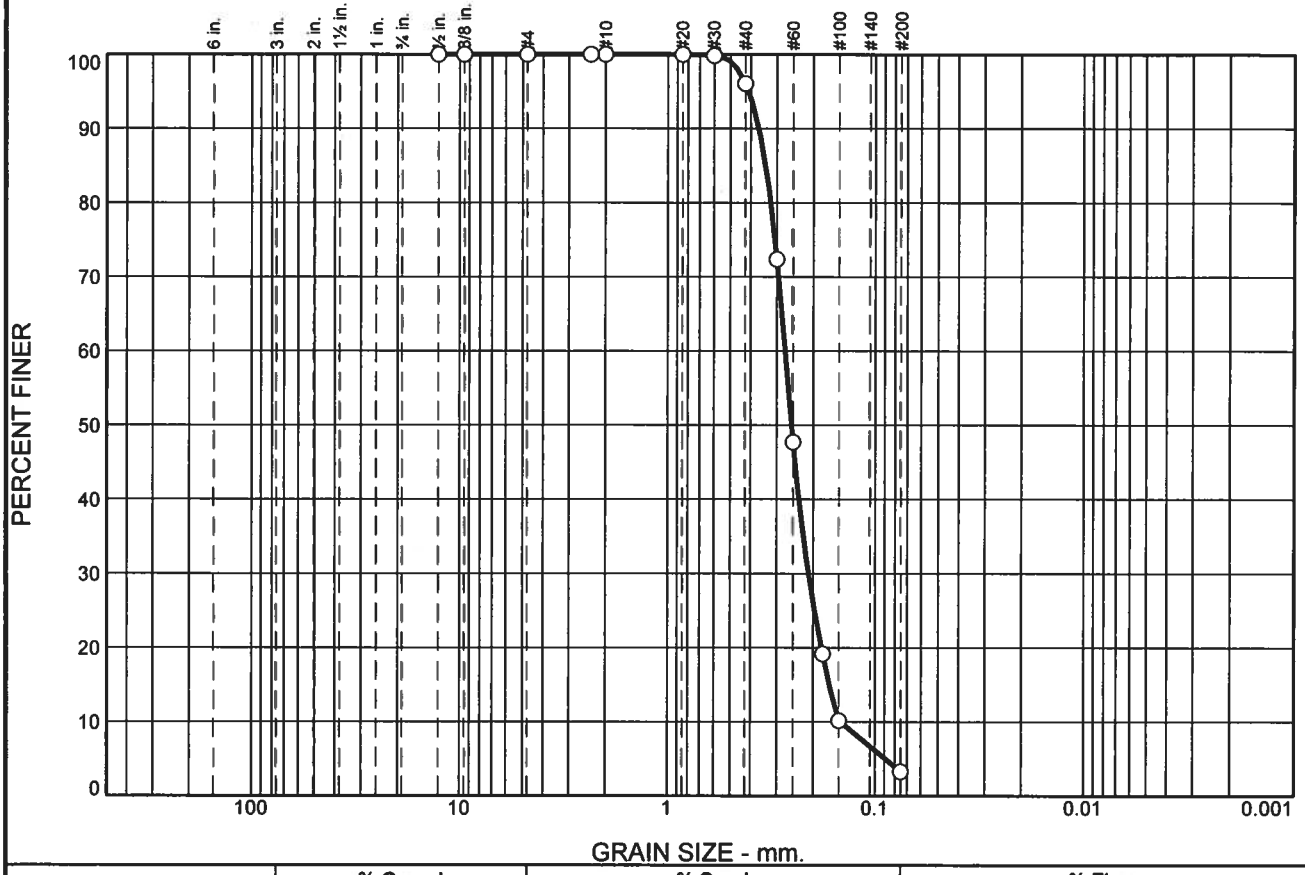
Gosling Czubak Engineering Sciences, Inc.
Traverse City, Michigan

Client: Little River Band of Ottawa Indians
Project: Little River Casino Wastewater HGI

Project No: 2018096001 **Figure**

Tested By: D. Fisk **Checked By:** A. Biteman

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	3.9	92.8	3.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5	100.0		
0.375	100.0		
#4	100.0		
#8	100.0		
#10	100.0		
#20	100.0		
#30	99.8		
#40	96.1		
#50	72.4		
#60	47.7		
#80	19.2		
#100	10.2		
#200	3.3		

* (no specification provided)

Material Description

Fine to medium SAND (SP) - trace silt - medium dense - light brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3673 D_{85}= 0.3410 D_{60}= 0.2735
D_{50}= 0.2544 D_{30}= 0.2105 D_{15}= 0.1669
D_{10}= 0.1473 C_u= 1.86 C_c= 1.10

Classification

USCS= SP AASHTO=

Remarks

F.M.=1.18

Source of Sample: MW-1 **Depth:** 64
Sample Number: SS10

Date: 10/2/19

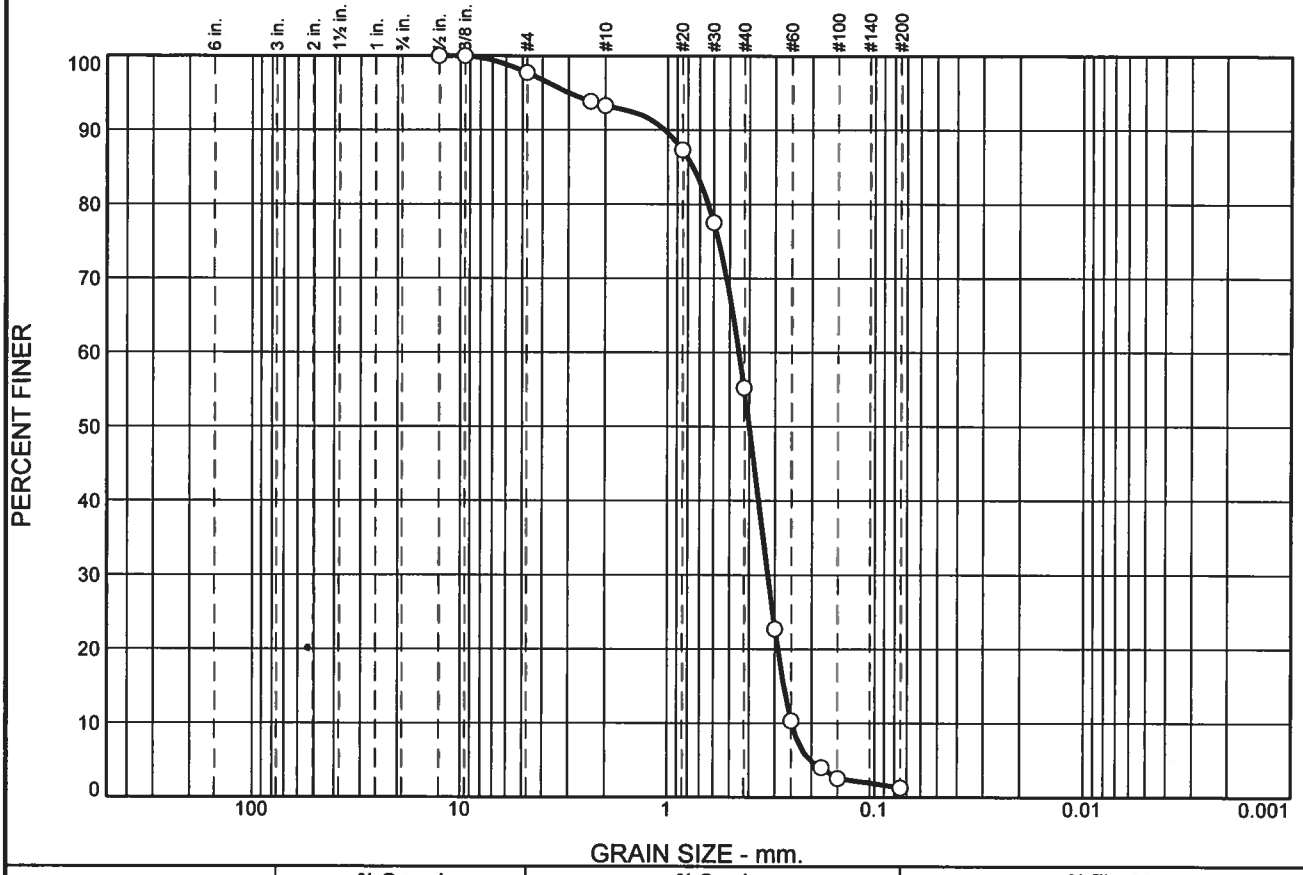
Gosling Czubak Engineering Sciences, Inc.
Traverse City, Michigan

Client: Little River Band of Ottawa Indians
Project: Little River Casino Wastewater HGI

Project No: 2018096001 **Figure**

Tested By: D. Fisk **Checked By:** A. Biteman

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.3	4.4	38.0	54.0	1.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5	100.0		
0.375	100.0		
#4	97.7		
#8	93.9		
#10	93.3		
#20	87.3		
#30	77.5		
#40	55.3		
#50	22.7		
#60	10.4		
#80	4.0		
#100	2.6		
#200	1.3		

* (no specification provided)

Material Description

Fine to coarse SAND (SP) - trace silt - occasional gravel - medium dense - light brown

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.0330 D_{85}= 0.7562 D_{60}= 0.4502
D_{50}= 0.4008 D_{30}= 0.3254 D_{15}= 0.2711
D_{10}= 0.2481 C_u= 1.81 C_c= 0.95

Classification

USCS= SP AASHTO=

Remarks

F.M.=2.14

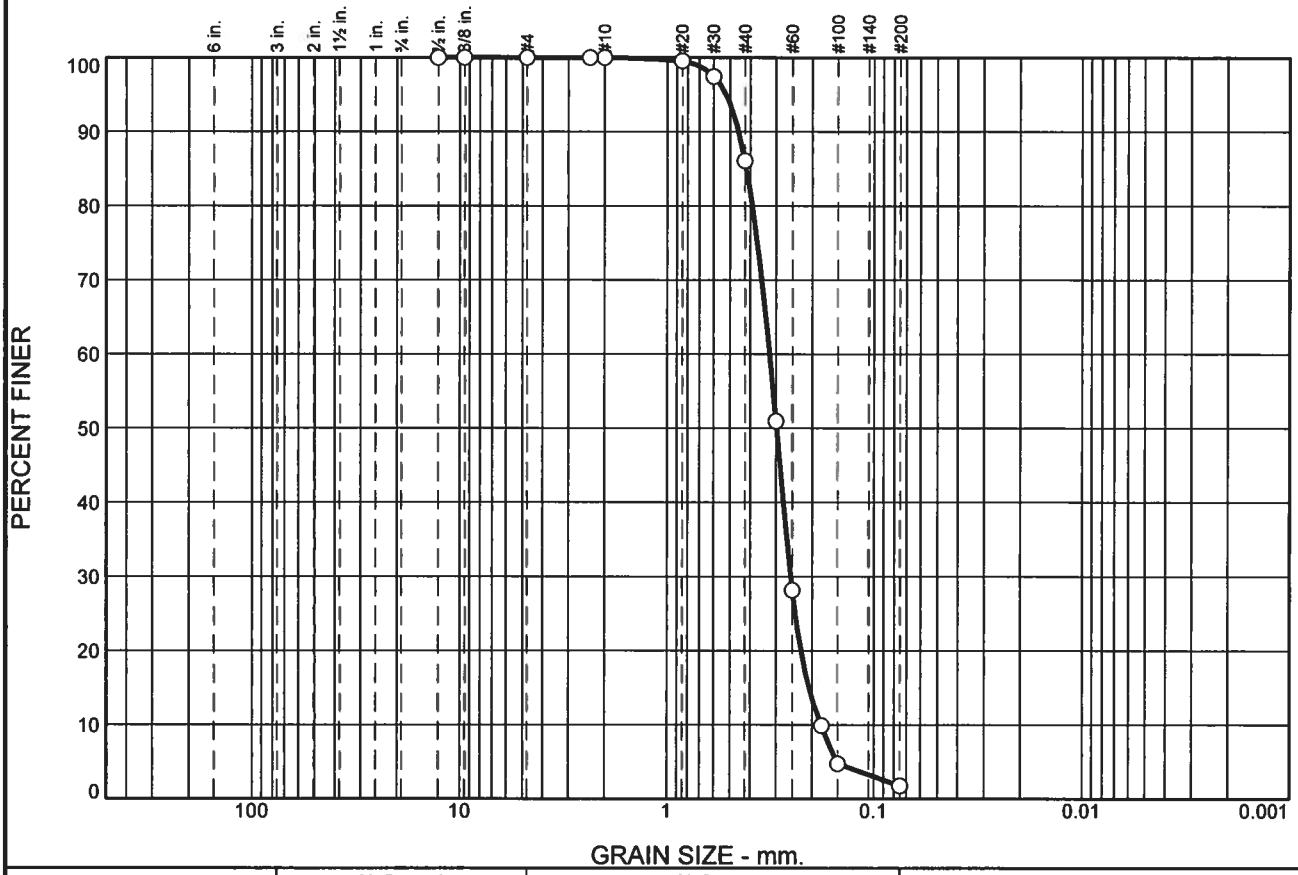
Source of Sample: MW-1 **Depth:** 74
Sample Number: SS14 **Date:** 10/2/19

Gosling Czubak Engineering Sciences, Inc.
Traverse City, Michigan

Client: Little River Band of Ottawa Indians
Project: Little River Casino Wastewater HGI
Project No: 2018096001 **Figure**

Tested By: D. Fisk **Checked By:** A. Biteman

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	13.9	84.3	1.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5	100.0		
0.375	100.0		
#4	100.0		
#8	100.0		
#10	100.0		
#20	99.6		
#30	97.4		
#40	86.1		
#50	50.9		
#60	28.1		
#80	9.9		
#100	4.8		
#200	1.8		

* (no specification provided)

Material Description

Fine to medium SAND (SP) - trace silt - dense - light brown - moist/wet below 88 ft

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.4555 D_{85}= 0.4181 D_{60}= 0.3225
D_{50}= 0.2978 D_{30}= 0.2544 D_{15}= 0.2074
D_{10}= 0.1806 C_u= 1.79 C_c= 1.11

Classification

USCS= AASHTO=

Remarks

F.M.=1.47

Source of Sample: MW-1 **Depth:** 86
Sample Number: SS20 **Date:** 10/2/19

Gosling Czubak Engineering Sciences, Inc. Traverse City, Michigan	**Client:** Little River Band of Ottawa Indians **Project:** Little River Casino Wastewater HGI **Project No:** 2018096001 **Figure**

Tested By: D. Fisk **Checked By:** A. Biteman

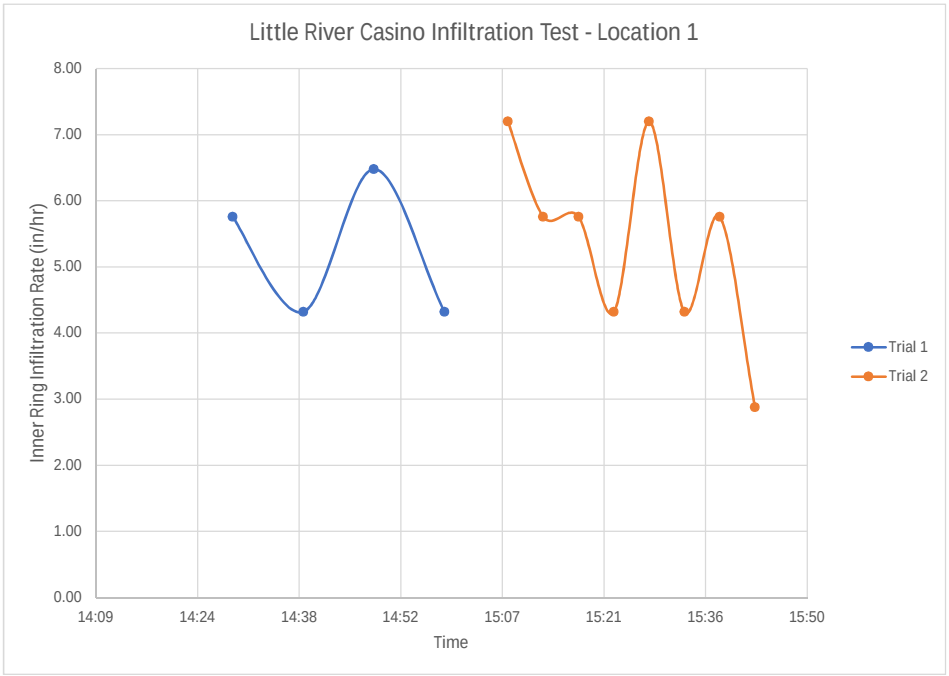
Attachment 12

Infiltration Testing Results

							Constants	**Area (cm^2)**	**Area (in^2)**	
Project Name:	LRBOI - Wastewater Infiltration Test						**Inner Ring**	729	113.0	
Project No.:	2018096001						**Annular Space**	2189	339.3	
Tested By:	Brendan Ruppen/Max Korndorfer									
Test Location:	Test Area 1 (NE of MW-2 in Field)						**Penetration Depth of Outer Ring:**			6-inches
Test Liquid Used:	TC Tap Water		pH:				Water Table Depth:		Not Encountered (greater than 22-in)	

						Flow Readings				Remarks
Trial #	**Start / End**	**Date (MM/DD/YY)**	**Time (HR:MIN)**	**Elapsed Time Chg/ (Total) (Min)**	Elapsed Time (hrs)	**Inner Ring Reading (in, BTOR)**	**Inner Ring Flow (in^3)**	**Annular Space Reading (in, BTOR)**	**Inner Infiltration Rate (in/h)**	**Weather conditions Etc...**
1	Start Test	9/21/2019	14:19			8.28		10.38		Sunny, 70deg F
			14:29	10.0	0.1667	9.24	108.48	10.38	5.76	
			14:39	10.0	0.1667	9.96	81.36	10.38	4.32	
			14:49	10.0	0.1667	11.04	122.03	10.38	6.48	
	End Test		14:59	10.0	0.1667	11.76	81.36	10.38	4.32	
				40.0	0.6667		393.22	10.38	5.22	<- Trial Average
2	Start Test		15:03			8.16		10.38		
			15:08	5.0	0.0833	8.76	67.80	10.38	7.20	
			15:13	5.0	0.0833	9.24	54.24	10.38	5.76	
			15:18	5.0	0.0833	9.72	54.24	10.38	5.76	
			15:23	5.0	0.0833	10.08	40.68	10.38	4.32	
			15:28	5.0	0.0833	10.68	67.80	10.38	7.20	
			15:33	5.0	0.0833	11.04	40.68	10.38	4.32	
			15:38	5.0	0.0833	11.52	54.24	10.38	5.76	
	End Test		15:43	5.0	0.0833	11.76	27.12	10.38	2.88	
				40.0	0.6667		406.78	10.38	5.40	<- Trial Average

Falling Head Infiltration Test using a Double Ring Infiltrometer.

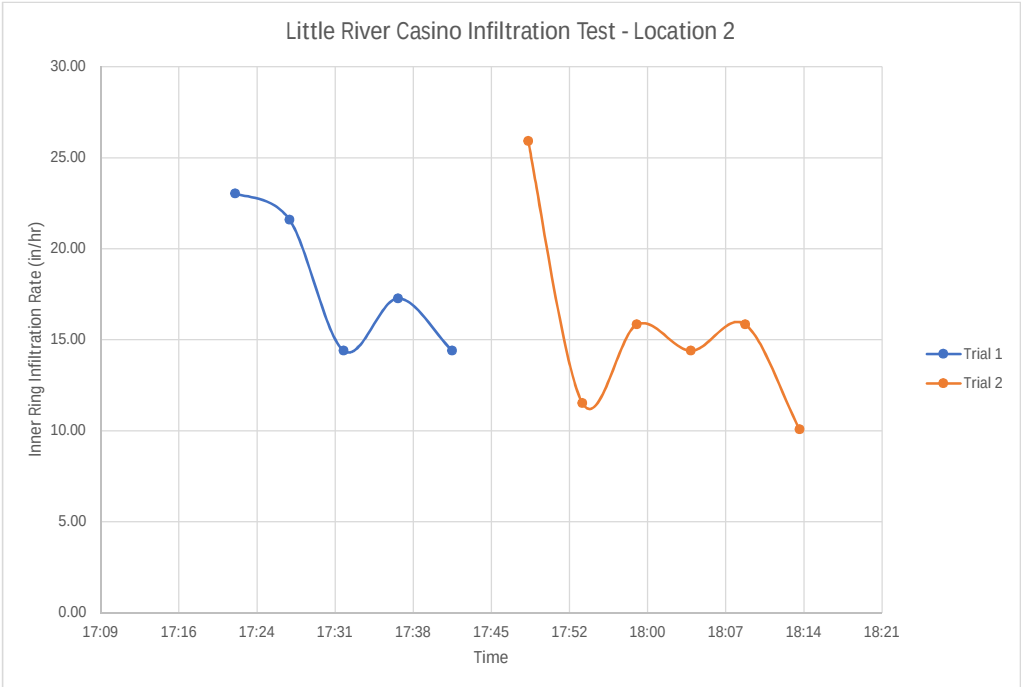


Gosling Czubak engineering sciences, inc.

		Constants	**Area (cm2)**	**Area (in2)**	
Project Name:	LRBOI - Wastewater Infiltration Test	**Inner Ring**	729	113.0	
Project No.:	2018096001	**Annular Space**	2189	339.3	
Tested By:	Brendan Ruppen/Max Korndorfer				
Test Location:	Test Area 2 (North of MW-1 in Field)	**Penetration Depth of Outer Ring:**			6-inches
Test Liquid Used:	TC Tap Water pH:	Water Table Depth:		Not Encountered (greater than 22-in)	

Trial #	Start / End	Date (MM/DD/YY)	Time (HR:MIN)	Elapsed Time Chg/ (Total) (Min)	Elapsed Time (hrs)	Flow Readings: Inner Ring Reading (in, BTOR)	Flow Readings: Inner Ring Flow (in^3)	Flow Readings: Annular Space Reading (in, BTOR)	Flow Readings: Inner Infiltration Rate (in/hr)	Remarks: Weather conditions Etc...
1	Start Test	9/21/2019	17:17			7.32		10.38		Sunny, 70deg F
			17:22	5.0	0.0833	9.24	216.95	10.38	23.04	
			17:27	5.0	0.0833	11.04	203.39	10.38	21.60	
			17:32	5.0	0.0833	12.24	135.59	10.38	14.40	
			17:37	5.0	0.0833	13.68	162.71	10.38	17.28	
	End Test		17:42	5.0	0.0833	14.88	135.59	10.38	14.40	
				25.0	0.4167		854.24	10.38	18.14	<- Trial Average
2	Start Test		17:44			7.32		10.38		
			17:49	5.0	0.0833	9.48	244.07	10.38	25.92	
			17:54	5.0	0.0833	10.44	108.48	10.38	11.52	
			17:59	5.0	0.0833	11.76	149.15	10.38	15.84	
			18:04	5.0	0.0833	12.96	135.59	10.38	14.40	
			18:09	5.0	0.0833	14.28	149.15	10.38	15.84	
	End Test		18:14	5.0	0.0833	15.12	94.92	10.38	10.08	
				30.0	0.5000		881.36	10.38	15.60	<- Trial Average

Falling Head Infiltration Test using a Double Ring Infiltrometer.



Attachment 13

Groundwater Elevation Contour Map

North
Scale Bar (ft)
0 200 400

Dontz Road

MW-3
616.73

MW-2
617.73

617.30
617.10
616.90

GW Flow Direction

MW-1
616.76

Notes:
Based on Aug. 15, 2019 measurements.
Contour Interval = 0.10 feet
Vertical Datum: NAVD88 derived from GPS

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CIVIL ENGINEERING | SURVEYING | ENVIRONMENTAL SERVICES | GEOTECHNICAL
CONSTRUCTION SERVICES | DRILLING | LANDSCAPE ARCHITECTURE

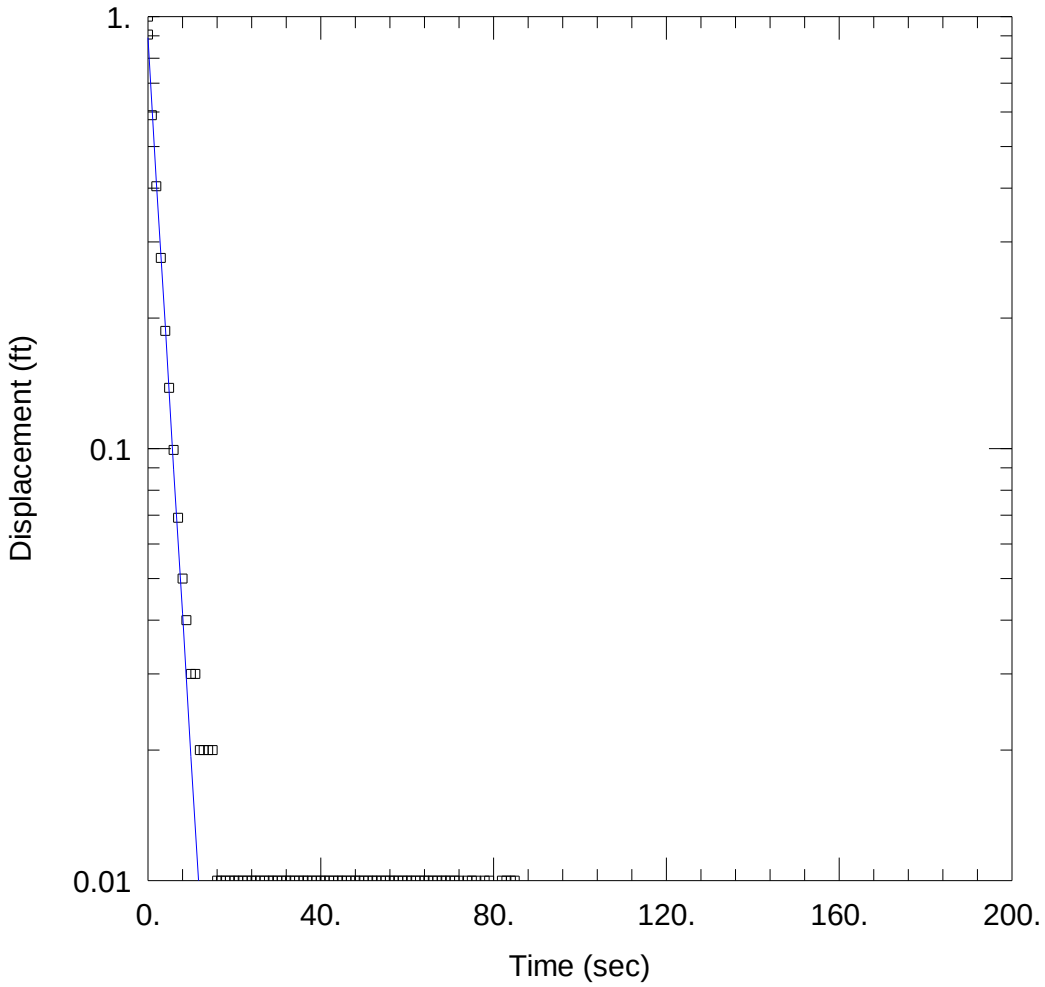
Job No.: 2018096001
Date: 10/2/2019
Scale: 1 inch = 200 feet (1:166.67)
Drawn: ARB
Chk'd:
Rev'd:

SITE PLAN & GROUNDWATER ELEVATION CONTOUR MAP
WWTP HGI
Little River Band of Ottawa Indians

Location:
PARTS of SECTIONS 21 & 28
T22N, R16W,
MANISTEE TOWNSHIP,
MANISTEE COUNTY, MICHIGAN

Attachment 14

Slug Testing Analysis Reports



WELL TEST ANALYSIS

Data Set: P:\2018096001.00\Docs\HGI Related\Slug Testing\LRBOI WWTP - MW-2 Test 3.aqt
Date: 10/16/19 Time: 10:41:04

PROJECT INFORMATION

Company: Gosling Czubak Engineering
Client: LRBOI
Project: 2018096001
Location: Manistee Co., Michigan
Test Well: MW-1
Test Date: 8/15/2019

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

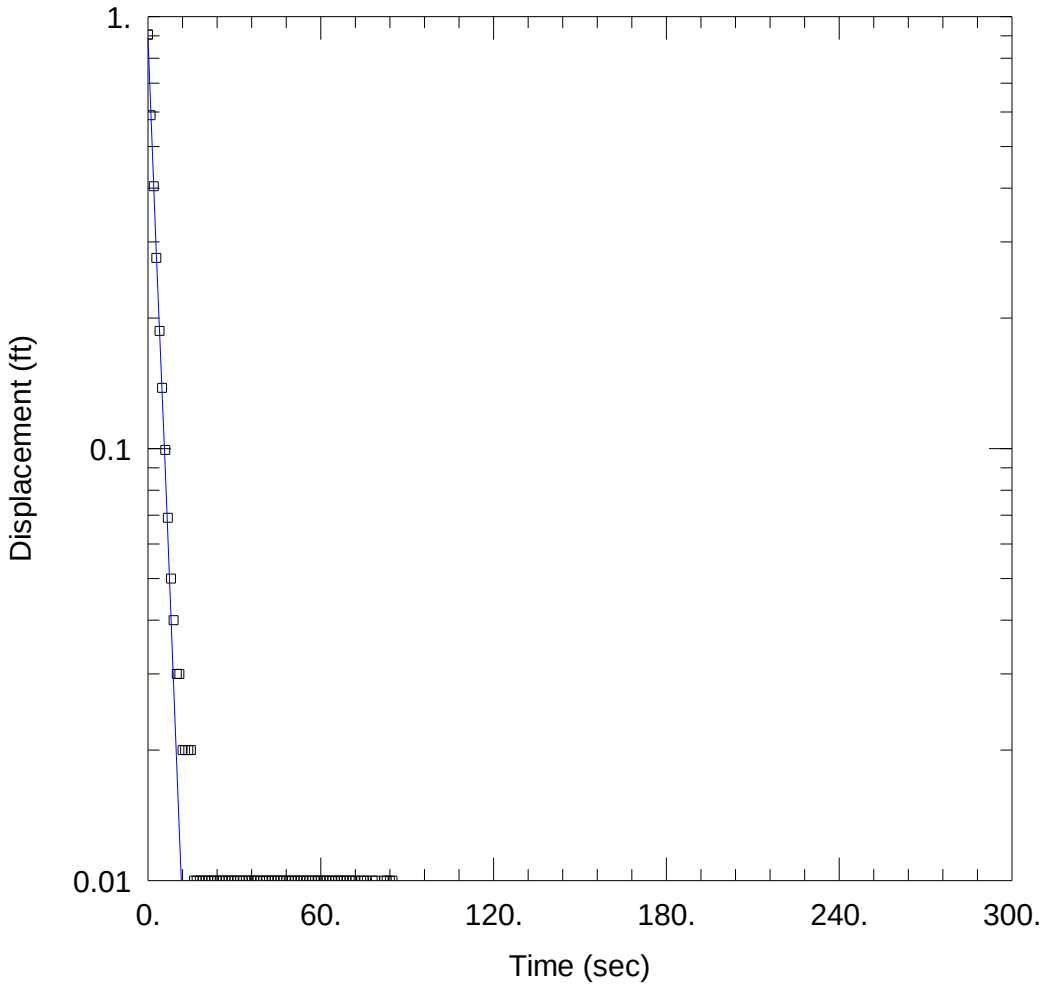
WELL DATA (MW-2)

Initial Displacement: 1. ft
Total Well Penetration Depth: 13.93 ft
Casing Radius: 0.083 ft
Static Water Column Height: 13.93 ft
Screen Length: 5. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.04876 ft/min
y0 = 0.891 ft



WELL TEST ANALYSIS

Data Set: P:\2018096001.00\Docs\HGI Related\Slug Testing\LRBOI WWTP - MW-1 Test 1.aqt
Date: 10/17/19 Time: 07:58:59

PROJECT INFORMATION

Company: Gosling Czubak Engineering
Client: LRBOI
Project: 2018096001
Location: Manistee Co., Michigan
Test Well: MW-1
Test Date: 8/15/2019

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

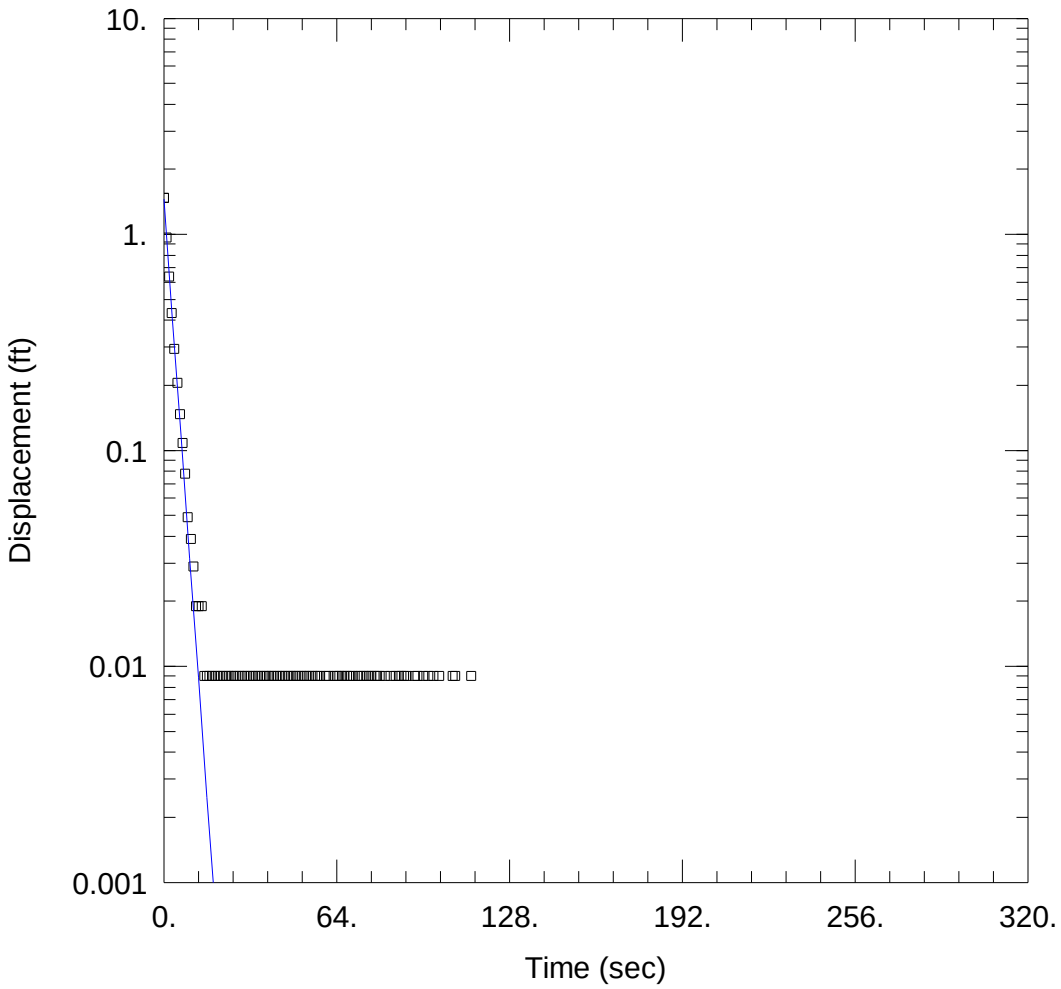
WELL DATA (MW-1)

Initial Displacement: 0.906 ft
Static Water Column Height: 12.07 ft
Total Well Penetration Depth: 12.07 ft
Screen Length: 5. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.04786 ft/min
y0 = 0.891 ft



WELL TEST ANALYSIS

Data Set: P:\2018096001.00\Docs\HGI Related\Slug Testing\LRBOI WWTP - MW-1 Test 2 (100 ft).aqt
Date: 10/17/19 Time: 08:05:45

PROJECT INFORMATION

Company: Gosling Czubak Engineering
Client: LRBOI
Project: 2018096001
Location: Manistee Co., Michigan
Test Well: MW-1
Test Date: 8/15/2019

AQUIFER DATA

Saturated Thickness: 100. ft Anisotropy Ratio (Kz/Kr): 1.

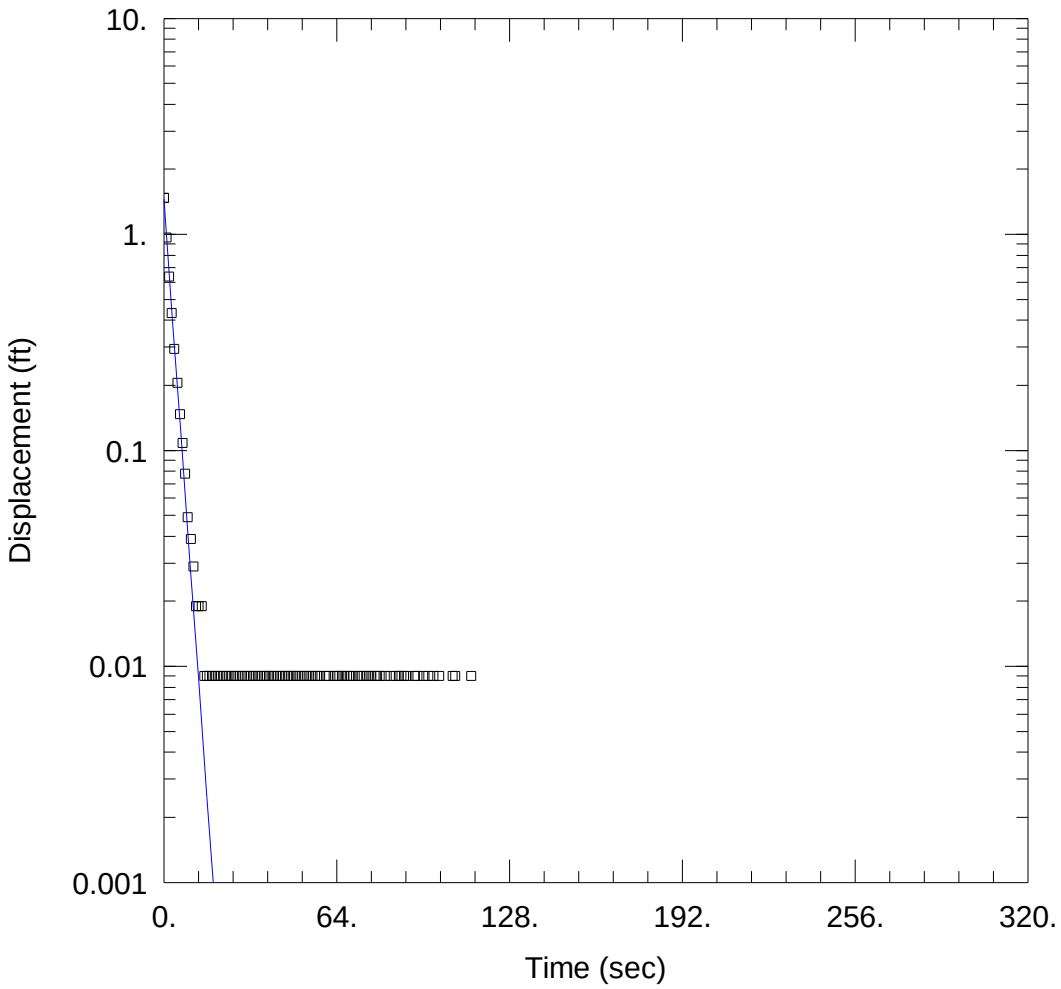
WELL DATA (MW-1)

Initial Displacement: 1.476 ft Static Water Column Height: 12.07 ft
Total Well Penetration Depth: 12.07 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.04982 ft/min y0 = 1.46 ft



WELL TEST ANALYSIS

Data Set: P:\2018096001.00\Docs\HGI Related\Slug Testing\LRBOI WWTP - MW-1 Test 2.aqt
Date: 10/17/19 Time: 08:02:44

PROJECT INFORMATION

Company: Gosling Czubak Engineering
Client: LRBOI
Project: 2018096001
Location: Manistee Co., Michigan
Test Well: MW-1
Test Date: 8/15/2019

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

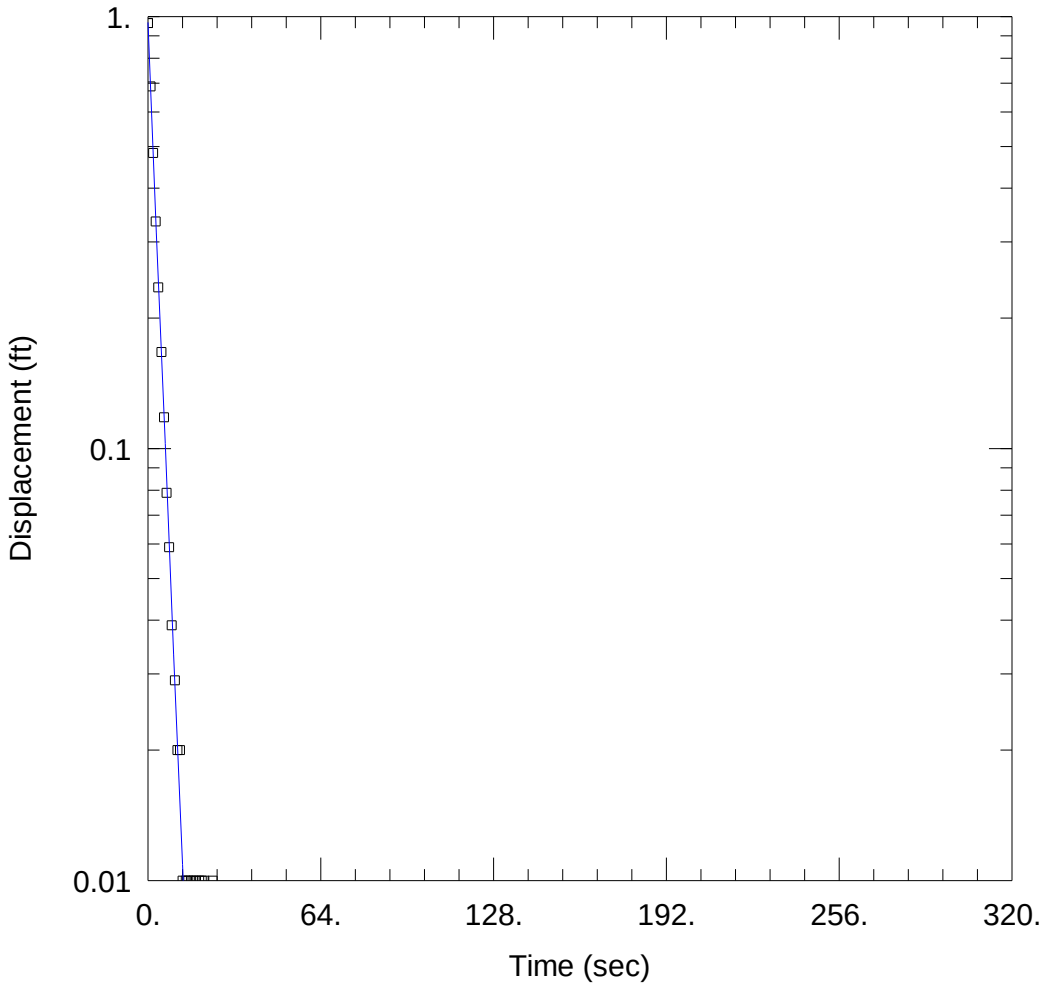
WELL DATA (MW-1)

Initial Displacement: 1.476 ft
Total Well Penetration Depth: 12.07 ft
Casing Radius: 0.083 ft
Static Water Column Height: 12.07 ft
Screen Length: 5. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.04982 ft/min
y0 = 1.46 ft



WELL TEST ANALYSIS

Data Set: P:\2018096001.00\Docs\HGI Related\Slug Testing\LRBOI WWTP - MW-1 Test 3.aqt
Date: 10/17/19 Time: 08:04:30

PROJECT INFORMATION

Company: Gosling Czubak Engineering
Client: LRBOI
Project: 2018096001
Location: Manistee Co., Michigan
Test Well: MW-1
Test Date: 8/15/2019

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

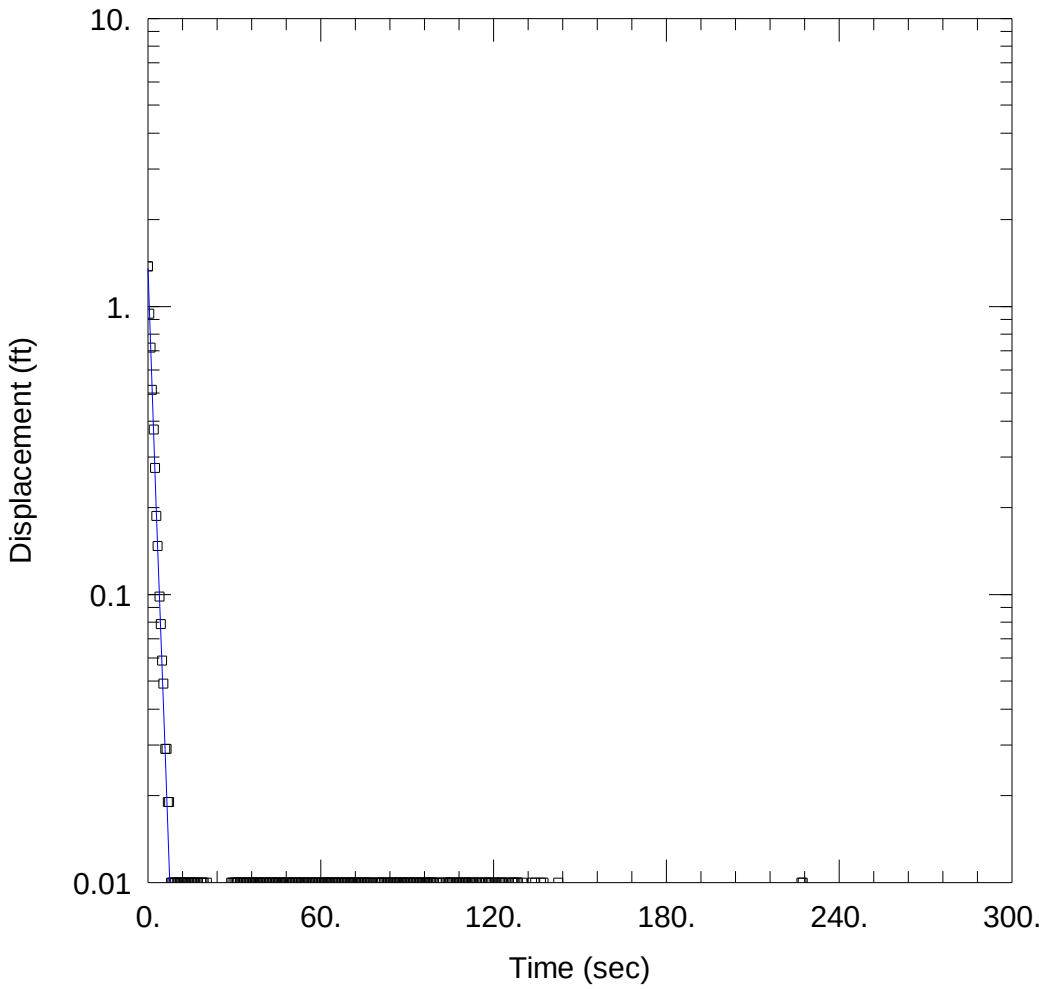
WELL DATA (MW-1)

Initial Displacement: 0.965 ft
Total Well Penetration Depth: 12.07 ft
Casing Radius: 0.083 ft
Static Water Column Height: 12.07 ft
Screen Length: 5. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.0438 ft/min
y0 = 0.9686 ft



WELL TEST ANALYSIS

Data Set: P:\2018096001.00\Docs\HGI Related\Slug Testing\LRBOI WWTP - MW-2 Test 1.aqt
Date: 10/16/19 Time: 10:51:51

PROJECT INFORMATION

Company: Gosling Czubak Engineering
Client: LRBOI
Project: 2018096001
Location: Manistee Co., Michigan
Test Well: MW-1
Test Date: 8/15/2019

AQUIFER DATA

Saturated Thickness: 100. ft
Anisotropy Ratio (Kz/Kr): 1.

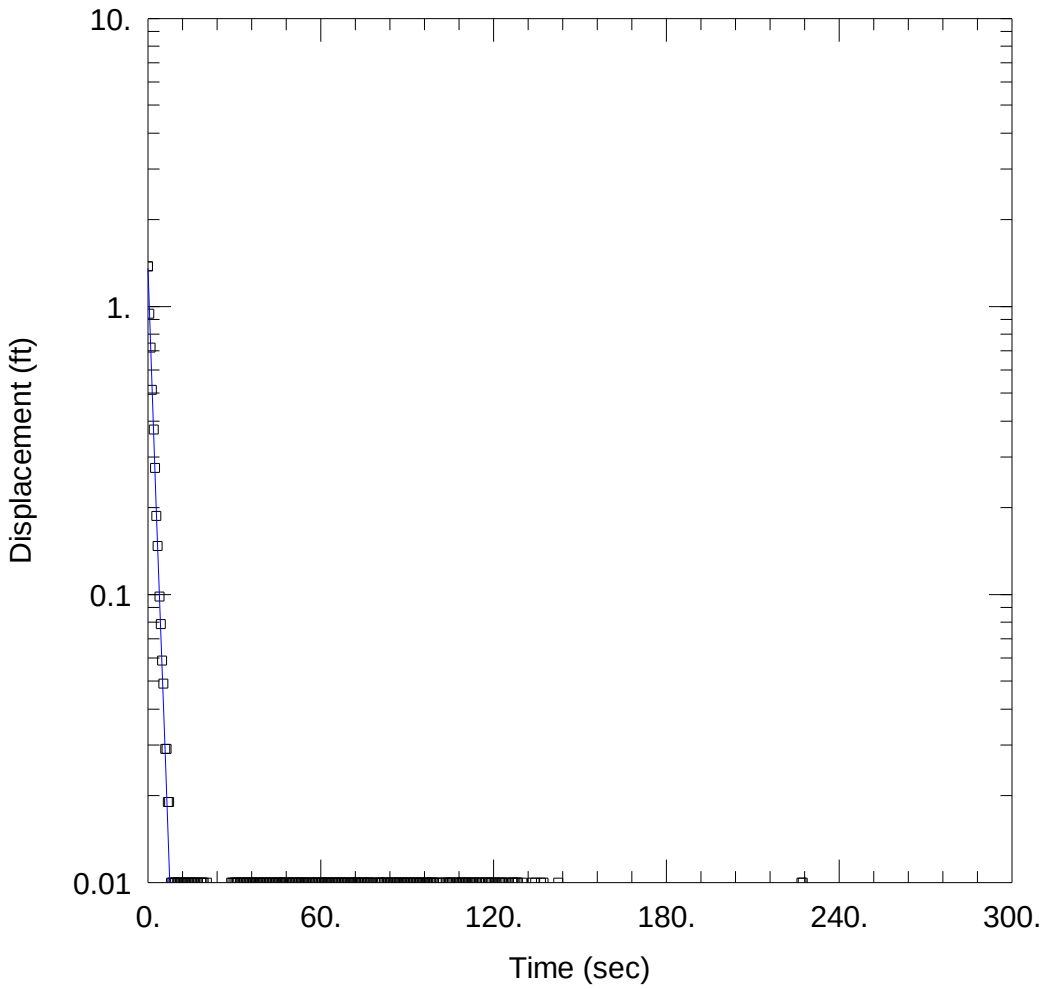
WELL DATA (MW-2)

Initial Displacement: 1.378 ft
Total Well Penetration Depth: 13.93 ft
Casing Radius: 0.083 ft
Static Water Column Height: 13.93 ft
Screen Length: 5. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.08251 ft/min
y0 = 1.358 ft



WELL TEST ANALYSIS

Data Set: P:\2018096001.00\Docs\HGI Related\Slug Testing\LRBOI WWTP - MW-2 Test 1.aqt
Date: 10/16/19 Time: 10:47:47

PROJECT INFORMATION

Company: Gosling Czubak Engineering
Client: LRBOI
Project: 2018096001
Location: Manistee Co., Michigan
Test Well: MW-1
Test Date: 8/15/2019

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

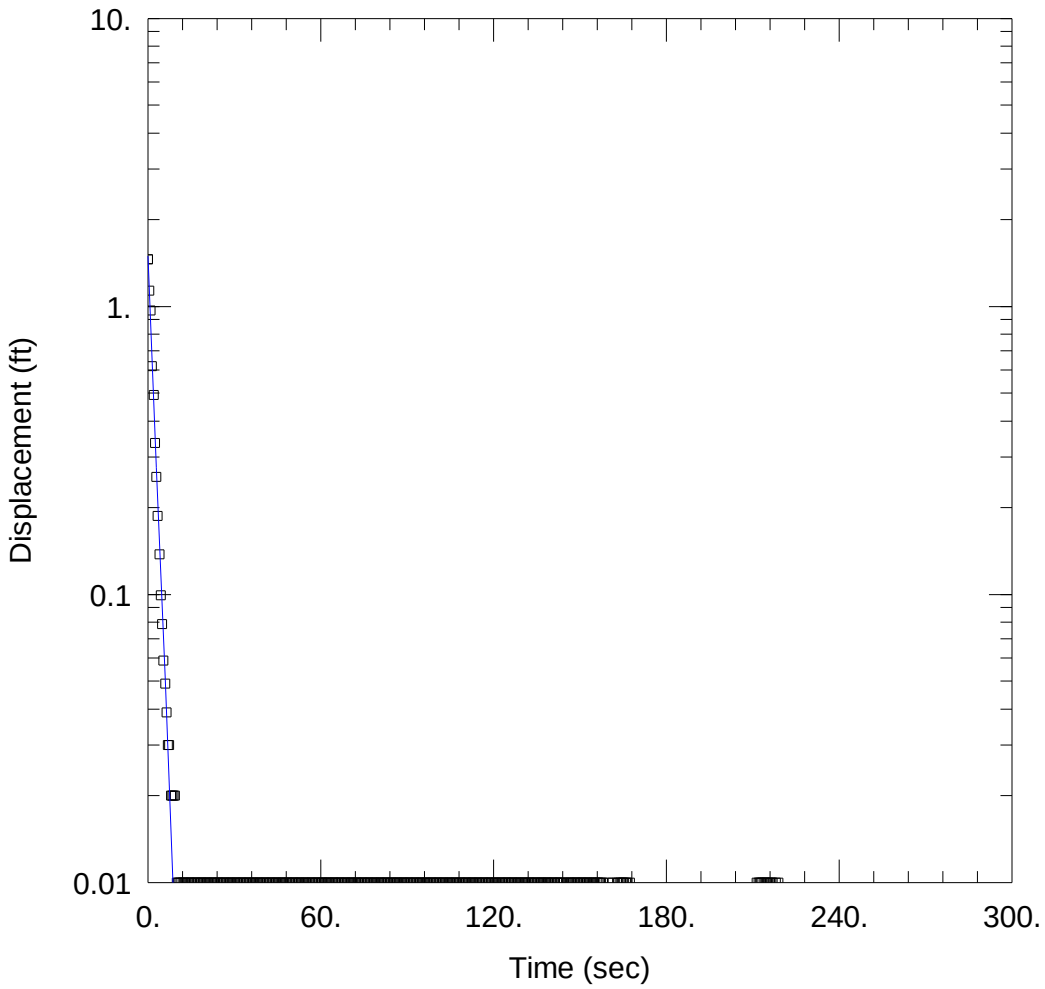
WELL DATA (MW-2)

Initial Displacement: 1.378 ft
Total Well Penetration Depth: 13.93 ft
Casing Radius: 0.083 ft
Static Water Column Height: 13.93 ft
Screen Length: 5. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.08251 ft/min
y0 = 1.358 ft



WELL TEST ANALYSIS

Data Set: P:\2018096001.00\Docs\HGI Related\Slug Testing\LRBOI WWTP - MW-2 Test 2.aqt
Date: 10/16/19 Time: 10:37:16

PROJECT INFORMATION

Company: Gosling Czubak Engineering
Client: LRBOI
Project: 2018096001
Location: Manistee Co., Michigan
Test Well: MW-2
Test Date: 8/15/2019

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-2)

Initial Displacement: 1.457 ft
Total Well Penetration Depth: 13.93 ft
Casing Radius: 0.083 ft
Static Water Column Height: 13.93 ft
Screen Length: 5. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.07181 ft/min
y0 = 1.498 ft

Attachment 15

Aquifer Properties Summary

Client: Little River Band of Ottawa Indians
Project: WWTP HGI
Project #: 2018096001

Slug Testing Analysis Results Summary

Test	Analysis Method	Conductivity (feet/day)
MW-1 #1	Bouwer & Rice	68.92
MW-1 #2	Bouwer & Rice	71.74
MW-1 #3	Bouwer & Rice	63.07
	Geometric Mean:	**67.81**
	Arithmetic Mean:	**67.91**

MW-2 #1	Bouwer & Rice	118.8
MW-2 #2	Bouwer & Rice	103.4
MW-2 #3	Bouwer & Rice	70.2
	Geometric Mean:	**95.2**
	Arithmetic Mean:	**97.5**

Overall Geometric Mean:	**80.5**
Overall Arithmetic Mean:	**82.5**

Notes and Significant Assumptions

Notes:

1) Results presented were estimated using AQTESOLV for Windows software.
2) Results are based on data collected during slug testing completed in August 2019.

Significant Assumptions:

1) The aquifer is assumed to be isotropic and infinite in extent.
2) The aquifer is assumed to be unconfined based on drilling data.
3) The saturated aquifer thickness is unknown, but assumed to be 50 feet.

Attachment 16

Laboratory Analytical Reports

24-Sep-2019

Adam Biteman
Gosling Czubak Engineering Sciences, Inc.
1280 Business Park Drive
Traverse City, MI 49686

Re: **Gosling (Little River Band 2018096001.01)** Work Order: **19090886**

Dear Adam,

ALS Environmental received 1 sample on 13-Sep-2019 09:30 AM for the analyses presented in the following report.

The analytical data provided relates directly to the samples received by ALS Environmental - Holland and for only the analyses requested.

Sample results are compliant with industry accepted practices and Quality Control results achieved laboratory specifications. Any exceptions are noted in the Case Narrative, or noted with qualifiers in the report or QC batch information. Should this laboratory report need to be reproduced, it should be reproduced in full unless written approval has been obtained from ALS Environmental. Samples will be disposed in 30 days unless storage arrangements are made.

The total number of pages in this report is 18.

If you have any questions regarding this report, please feel free to contact me:

ADDRESS: 3352 128th Avenue, Holland, MI, USA
PHONE: +1 (616) 399-6070 FAX: +1 (616) 399-6185

Sincerely,

Gary Byar

Electronically approved by: Gary Byar

Gary Byar
Project Manager

Report of Laboratory Analysis

ALS Group, USA

Date: 24-Sep-19

Client: Gosling Czubak Engineering Sciences, Inc.
Project: Gosling (Little River Band 2018096001.01)
Work Order: **19090886**

Work Order Sample Summary

Lab Samp ID	Client Sample ID	Matrix	Tag Number	Collection Date	Date Received	Hold
19090886-01	MW-3	Groundwater		9/12/2019 14:01	9/13/2019 09:30	☐

ALS Group, USA

Date: *24-Sep-19*

Client: Gosling Czubak Engineering Sciences, Inc.
Project: Gosling (Little River Band 2018096001.01) **Work Order:** 19090886
Sample ID: MW-3 **Lab ID:** 19090886-01
Collection Date: 9/12/2019 02:01 PM **Matrix:** GROUNDWATER

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
METALS BY ICP-MS			**SW6020A**		Prep: SW3015A 9/18/19 12:22	Analyst: **STP**
Calcium	**50**		**0.50**	**mg/L**	1	9/18/2019 03:48 PM
Iron	ND		0.080	mg/L	1	9/18/2019 03:48 PM
Magnesium	**16**		**0.20**	**mg/L**	1	9/18/2019 03:48 PM
Potassium	**1.1**		**0.20**	**mg/L**	1	9/18/2019 03:48 PM
Sodium	**8.0**		**0.20**	**mg/L**	1	9/18/2019 03:48 PM
ALKALINITY			**A2320 B-11**			Analyst: **DVD**
Alkalinity, Bicarbonate (as CaCO3)	**180**		**10**	**mg/L**	1	9/14/2019 10:50 AM
BIOCHEMICAL OXYGEN DEMAND			**A5210B-11**		Prep: A5210B 9/13/19 13:10	Analyst: **QTN**
Biochemical Oxygen Demand	ND		2.0	mg/L	1	9/18/2019 08:49 AM
CHLORIDE			**A4500-CL E-11**			Analyst: **JDR**
Chloride	**7.9**		**1.0**	**mg/L**	1	9/13/2019 03:36 PM
CHEMICAL OXYGEN DEMAND			**E410.4 R2.0**			Analyst: **ATS**
Chemical Oxygen Demand	**5.4**		**5.0**	**mg/L**	1	9/18/2019 02:57 PM
AMMONIA AS NITROGEN (DISTILLED)			**A4500-NH3 G-11**		Prep: A4500-NH3 B 9/17/19 11:06	Analyst: **CAC**
Ammonia as Nitrogen	ND		0.15	mg NH3-N/L	1	9/17/2019 03:31 PM
NITROGEN, NITRITE			**A4500-NO2 B-11**			Analyst: **EMJ**
Nitrogen, Nitrite	ND		0.020	mg/L	1	9/13/2019 02:01 PM
NITROGEN, NITRATE			**E353.2 R2.0**			Analyst: **JZB**
Nitrogen, Nitrate	**1.9**		**0.020**	**mg/L**	1	9/16/2019 10:49 AM
PHOSPHORUS, TOTAL			**E365.1 R2.0**		Prep: E365.1 R2.0 9/16/19 18:07	Analyst: **CAC**
Phosphorus, Total	ND		0.050	mg/L	1	9/17/2019 12:17 PM
SULFATE			**A4500-SO4 E-11**			Analyst: **JDR**
Sulfate	**8.5**		**1.0**	**mg/L**	1	9/16/2019 02:09 PM
NITROGEN, TOTAL KJELDAHL			**A4500-NH3 G-11**		Prep: A4500-N B 9/17/19 13:15	Analyst: **CAC**
Nitrogen, Total Kjeldahl	ND		1.0	mg/L	1	9/18/2019 12:40 PM

Note: See Qualifiers page for a list of qualifiers and their definitions.

Client: Gosling Czubak Engineering Sciences, Inc.
Project: Gosling (Little River Band 2018096001.01)
Work Order: 19090886

Case Narrative

Batch 142542 The MS/MSD data for Ammonia is not related to this project's sample. No data requires qualification.

Batch 142543 Sample 19090886-01B MSD PASC_365.1_W The MSD recovery for Phosphorous was outside of the control limit. However, the MS recovery and the RPD between the MS and MSD was in control. No qualification is required for this analyte. Client Sample ID: MW-3

Batch R270569 The MS/MSD data for Chloride is not related to this project's sample. No data requires qualification.

Batch R270668 The MS/MSD data for Sulfate is not related to this project's sample. No data requires qualification.

Batch R270817 Sample 19090886-01B MS/MSD COD_410.4LL_W The MS/MSD recovery for COD was below the lower control limit. The corresponding result in the parent sample may be biased low for this analyte. Client Sample ID: MW-3

ALS Group, USA

Date: 24-Sep-19

Client: Gosling Czubak Engineering Sciences, Inc.

Work Order: 19090886

Project: Gosling (Little River Band 2018096001.01)

QC BATCH REPORT

Batch ID: **142618** Instrument ID **ICPMS3** Method: **SW6020A**

MBLK Sample ID: **MBLK-142618-142618** Units: **mg/L** Analysis Date: **9/18/2019 03:18 PM**

Client ID: Run ID: **ICPMS3_190918A** SeqNo: **5926847** Prep Date: **9/18/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Calcium	ND	0.50								
Iron	ND	0.080								
Magnesium	ND	0.20								
Potassium	ND	0.20								
Sodium	0.06101	0.20								J

LCS Sample ID: **LCS-142618-142618** Units: **mg/L** Analysis Date: **9/18/2019 03:20 PM**

Client ID: Run ID: **ICPMS3_190918A** SeqNo: **5926848** Prep Date: **9/18/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Calcium	9.899	0.50	10	0	99	80-120	0			
Iron	9.58	0.080	10	0	95.8	80-120	0			
Magnesium	9.91	0.20	10	0	99.1	80-120	0			
Potassium	9.783	0.20	10	0	97.8	80-120	0			
Sodium	10.33	0.20	10	0	103	80-120	0			

MS Sample ID: **19090886-01DMS** Units: **mg/L** Analysis Date: **9/18/2019 03:50 PM**

Client ID: **MW-3** Run ID: **ICPMS3_190918A** SeqNo: **5927298** Prep Date: **9/18/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Calcium	57.72	0.50	10	49.94	77.8	75-125	0			O
Iron	9.582	0.080	10	0.0144	95.7	75-125	0			
Magnesium	24.7	0.20	10	15.84	88.6	75-125	0			
Potassium	10.72	0.20	10	1.054	96.7	75-125	0			
Sodium	17.66	0.20	10	7.984	96.8	75-125	0			

MSD Sample ID: **19090886-01DMSD** Units: **mg/L** Analysis Date: **9/18/2019 03:52 PM**

Client ID: **MW-3** Run ID: **ICPMS3_190918A** SeqNo: **5927300** Prep Date: **9/18/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Calcium	57.6	0.50	10	49.94	76.6	75-125	57.72	0.196	20	O
Iron	9.402	0.080	10	0.0144	93.9	75-125	9.582	1.89	20	
Magnesium	24.77	0.20	10	15.84	89.4	75-125	24.7	0.3	20	
Potassium	10.67	0.20	10	1.054	96.2	75-125	10.72	0.5	20	
Sodium	17.54	0.20	10	7.984	95.6	75-125	17.66	0.71	20	

The following samples were analyzed in this batch: 19090886-01D

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Gosling Czubak Engineering Sciences, Inc.
Work Order: 19090886
Project: Gosling (Little River Band 2018096001.01)

QC BATCH REPORT

Batch ID: **142445** Instrument ID **WETCHEM** Method: **A5210B-11**

MBLK Sample ID: **MBLK-142445-142445** Units: **mg/L** Analysis Date: **9/18/2019 08:49 AM**
Client ID: Run ID: **WETCHEM_190918C** SeqNo: **5925483** Prep Date: **9/13/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Biochemical Oxygen Demand	0.15	2.0								

LCS Sample ID: **LCS-142445-142445** Units: **mg/L** Analysis Date: **9/18/2019 08:49 AM**
Client ID: Run ID: **WETCHEM_190918C** SeqNo: **5925484** Prep Date: **9/13/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Biochemical Oxygen Demand	194.4	2.0	198	0	98.2	85-115	0			

DUP Sample ID: **19090842-01A DUP** Units: **mg/L** Analysis Date: **9/18/2019 08:49 AM**
Client ID: Run ID: **WETCHEM_190918C** SeqNo: **5925491** Prep Date: **9/13/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Biochemical Oxygen Demand	1698	2.0	0	0	0	0-0	1664	2.06	20	

The following samples were analyzed in this batch: 19090886-01A

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Gosling Czubak Engineering Sciences, Inc.
Work Order: 19090886
Project: Gosling (Little River Band 2018096001.01)

QC BATCH REPORT

Batch ID: **142542** Instrument ID **LACHAT2** Method: **A4500-NH3 G-11**

MBLK Sample ID: **MBLK-142542-142542** Units: **mg NH3-N/L** Analysis Date: **9/17/2019 02:44 PM**
Client ID: Run ID: **LACHAT2_190917C** SeqNo: **5923791** Prep Date: **9/17/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Ammonia as Nitrogen	ND	0.15								

LCS Sample ID: **LCS-142542-142542** Units: **mg NH3-N/L** Analysis Date: **9/17/2019 02:45 PM**
Client ID: Run ID: **LACHAT2_190917C** SeqNo: **5923792** Prep Date: **9/17/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Ammonia as Nitrogen	0.9875	0.15	1	0	98.8	75-119	0			

MS Sample ID: **19090864-01B MS** Units: **mg NH3-N/L** Analysis Date: **9/17/2019 02:54 PM**
Client ID: Run ID: **LACHAT2_190917C** SeqNo: **5923799** Prep Date: **9/17/2019** DF: **20**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Ammonia as Nitrogen	24.46	3.0	1	24.84	-38	75-119	0			SO

MSD Sample ID: **19090864-01B MSD** Units: **mg NH3-N/L** Analysis Date: **9/17/2019 02:55 PM**
Client ID: Run ID: **LACHAT2_190917C** SeqNo: **5923800** Prep Date: **9/17/2019** DF: **20**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Ammonia as Nitrogen	20.86	3.0	1	24.84	-398	75-119	13.26	44.5	20	SRO

The following samples were analyzed in this batch: 19090886-01B

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Gosling Czubak Engineering Sciences, Inc.
Work Order: 19090886
Project: Gosling (Little River Band 2018096001.01)

QC BATCH REPORT

Batch ID: **142543** Instrument ID **LACHAT2** Method: **E365.1 R2.0**

MBLK Sample ID: **MBLK-142543-142543** Units: **mg/L** Analysis Date: **9/17/2019 12:11 PM**
Client ID: Run ID: **LACHAT2_190917A** SeqNo: **5923506** Prep Date: **9/16/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total	ND	0.050	0	0	0		0			

LCS Sample ID: **LCS-142543-142543** Units: **mg/L** Analysis Date: **9/17/2019 12:15 PM**
Client ID: Run ID: **LACHAT2_190917A** SeqNo: **5923509** Prep Date: **9/16/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total	1.077	0.050	1	0	108	90-110	0			

LCS Sample ID: **LCS2-142543-142543** Units: **mg/L** Analysis Date: **9/17/2019 12:16 PM**
Client ID: Run ID: **LACHAT2_190917A** SeqNo: **5923510** Prep Date: **9/16/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total	1.047	0.050	1	0	105	90-110	0			

MS Sample ID: **19090798-01B MS** Units: **mg/L** Analysis Date: **9/17/2019 11:49 AM**
Client ID: Run ID: **LACHAT2_190917A** SeqNo: **5923486** Prep Date: **9/16/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total	1.247	0.050	1	0.1777	107	90-110	0			

MS Sample ID: **19090886-01B MS** Units: **mg/L** Analysis Date: **9/17/2019 12:18 PM**
Client ID: **MW-3** Run ID: **LACHAT2_190917A** SeqNo: **5923512** Prep Date: **9/16/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total	1.086	0.050	1	0.02173	106	90-110	0			

MSD Sample ID: **19090798-01B MSD** Units: **mg/L** Analysis Date: **9/17/2019 11:50 AM**
Client ID: Run ID: **LACHAT2_190917A** SeqNo: **5923487** Prep Date: **9/16/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total	1.218	0.050	1	0.1777	104	90-110	1.247	2.35	20	

MSD Sample ID: **19090886-01B MSD** Units: **mg/L** Analysis Date: **9/17/2019 12:19 PM**
Client ID: **MW-3** Run ID: **LACHAT2_190917A** SeqNo: **5923513** Prep Date: **9/16/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total	1.132	0.050	1	0.02173	111	90-110	1.086	4.15	20	S

The following samples were analyzed in this batch: 19090886-01B

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Gosling Czubak Engineering Sciences, Inc.
Work Order: 19090886
Project: Gosling (Little River Band 2018096001.01)

QC BATCH REPORT

Batch ID: **142565** Instrument ID **LACHAT2** Method: **A4500-NH3 G-11**

MBLK Sample ID: **MBLK-142565-142565** Units: **mg/L** Analysis Date: **9/18/2019 12:36 PM**
Client ID: Run ID: **LACHAT2_190918A** SeqNo: **5926504** Prep Date: **9/17/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Total Kjeldahl	ND	1.0								

LCS Sample ID: **LCS-142565-142565** Units: **mg/L** Analysis Date: **9/18/2019 12:37 PM**
Client ID: Run ID: **LACHAT2_190918A** SeqNo: **5926505** Prep Date: **9/17/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Total Kjeldahl	10.29	1.0	10	0	103	85-115	0			

LCS Sample ID: **LCS2-142565-142565** Units: **mg/L** Analysis Date: **9/18/2019 12:39 PM**
Client ID: Run ID: **LACHAT2_190918A** SeqNo: **5926506** Prep Date: **9/17/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Total Kjeldahl	9.763	1.0	10	0	97.6	85-115	0			

MS Sample ID: **19090886-01B MS** Units: **mg/L** Analysis Date: **9/18/2019 12:41 PM**
Client ID: **MW-3** Run ID: **LACHAT2_190918A** SeqNo: **5926508** Prep Date: **9/17/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Total Kjeldahl	10.51	1.0	10	0.272	102	85-115	0			

MS Sample ID: **19090783-01C MS** Units: **mg/L** Analysis Date: **9/18/2019 12:57 PM**
Client ID: Run ID: **LACHAT2_190918A** SeqNo: **5926521** Prep Date: **9/17/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Total Kjeldahl	13.19	1.0	10	3.117	101	85-115	0			

MSD Sample ID: **19090886-01B MSD** Units: **mg/L** Analysis Date: **9/18/2019 12:42 PM**
Client ID: **MW-3** Run ID: **LACHAT2_190918A** SeqNo: **5926509** Prep Date: **9/17/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Total Kjeldahl	10.3	1.0	10	0.272	100	85-115	10.51	2.02	15	

MSD Sample ID: **19090783-01C MSD** Units: **mg/L** Analysis Date: **9/18/2019 12:58 PM**
Client ID: Run ID: **LACHAT2_190918A** SeqNo: **5926522** Prep Date: **9/17/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Total Kjeldahl	13.05	1.0	10	3.117	99.3	85-115	13.19	1.07	15	

The following samples were analyzed in this batch: 19090886-01B

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Gosling Czubak Engineering Sciences, Inc.
Work Order: 19090886
Project: Gosling (Little River Band 2018096001.01)

QC BATCH REPORT

Batch ID: **R270441** Instrument ID **WETCHEM** Method: **A4500-NO2 B-11**

MBLK Sample ID: **MB-R270441-R270441** Units: **mg/L** Analysis Date: **9/13/2019 02:01 PM**
Client ID: Run ID: **WETCHEM_190913J** SeqNo: **5915975** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Nitrite	ND	0.020								

LCS Sample ID: **LCS-R270441-R270441** Units: **mg/L** Analysis Date: **9/13/2019 02:01 PM**
Client ID: Run ID: **WETCHEM_190913J** SeqNo: **5915976** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Nitrite	0.1929	0.020	0.2	0	96.4	80-120	0			

MS Sample ID: **19090886-01C MS** Units: **mg/L** Analysis Date: **9/13/2019 02:01 PM**
Client ID: **MW-3** Run ID: **WETCHEM_190913J** SeqNo: **5915979** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Nitrite	0.1759	0.020	0.2	-0.0009	88.4	80-120	0			

MSD Sample ID: **19090886-01C MSD** Units: **mg/L** Analysis Date: **9/13/2019 02:01 PM**
Client ID: **MW-3** Run ID: **WETCHEM_190913J** SeqNo: **5915980** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Nitrite	0.1741	0.020	0.2	-0.0009	87.5	80-120	0.1759	1.03	10	

The following samples were analyzed in this batch: 19090886-01C

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Gosling Czubak Engineering Sciences, Inc.
Work Order: 19090886
Project: Gosling (Little River Band 2018096001.01)

QC BATCH REPORT

Batch ID: **R270482** Instrument ID **Titrator 1** Method: **A2320 B-11**

MBLK Sample ID: **MB-R270482-R270482** Units: **mg/L** Analysis Date: **9/14/2019 10:50 AM**
Client ID: Run ID: **TITRATOR 1_190914A** SeqNo: **5917284** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Alkalinity, Bicarbonate (as CaCO3)	ND	10								

DUP Sample ID: **19090513-51E DUP** Units: **mg/L** Analysis Date: **9/14/2019 10:50 AM**
Client ID: Run ID: **TITRATOR 1_190914A** SeqNo: **5917300** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Alkalinity, Bicarbonate (as CaCO3)	152.4	10	0	0	0	0-0	149.9	1.62	10	

DUP Sample ID: **19090735-01A DUP** Units: **mg/L** Analysis Date: **9/14/2019 10:50 AM**
Client ID: Run ID: **TITRATOR 1_190914A** SeqNo: **5917305** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Alkalinity, Bicarbonate (as CaCO3)	220.4	10	0	0	0	0-0	221.4	0.462	10	

The following samples were analyzed in this batch: 19090886-01C

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Gosling Czubak Engineering Sciences, Inc.
Work Order: 19090886
Project: Gosling (Little River Band 2018096001.01)

QC BATCH REPORT

Batch ID: **R270569** Instrument ID **GALLERY** Method: **A4500-Cl E-11**

MBLK Sample ID: **MB-R270569-R270569** Units: **mg/L** Analysis Date: **9/13/2019 03:36 PM**
Client ID: Run ID: **GALLERY_190913B** SeqNo: **5918999** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	ND	1.0								

MS Sample ID: **19090736-01AMS** Units: **mg/L** Analysis Date: **9/13/2019 03:36 PM**
Client ID: Run ID: **GALLERY_190913B** SeqNo: **5919009** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	55.35	1.0	50	16.63	77.4	88-116	0			S

MSD Sample ID: **19090736-01AMSD** Units: **mg/L** Analysis Date: **9/13/2019 03:36 PM**
Client ID: Run ID: **GALLERY_190913B** SeqNo: **5919010** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	55.82	1.0	50	16.63	78.4	88-116	55.35	0.846	10	S

LCS1 Sample ID: **LCS1-R270569** Units: **mg/L** Analysis Date: **9/13/2019 03:36 PM**
Client ID: Run ID: **GALLERY_190913B** SeqNo: **5919000** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	10.21	1.0	10	0	102	88-113	0			

LCS2 Sample ID: **LCS2-R270569** Units: **mg/L** Analysis Date: **9/13/2019 03:36 PM**
Client ID: Run ID: **GALLERY_190913B** SeqNo: **5919019** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	51.7	1.0	50	0	103	88-116	0			

The following samples were analyzed in this batch: 19090886-01C

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Gosling Czubak Engineering Sciences, Inc.
Work Order: 19090886
Project: Gosling (Little River Band 2018096001.01)

QC BATCH REPORT

Batch ID: **R270603A** Instrument ID **LACHAT** Method: **E353.2 R2.0**

MBLK Sample ID: **MBLK-R270603A** Units: **mg/L** Analysis Date: **9/16/2019 10:33 AM**
Client ID: Run ID: **LACHAT_190916A** SeqNo: **5919892** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Nitrate	ND	0.020								

LCS Sample ID: **LCS-R270603A** Units: **mg/L** Analysis Date: **9/16/2019 10:34 AM**
Client ID: Run ID: **LACHAT_190916A** SeqNo: **5919893** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Nitrate	2.535	0.020	2.5	0	101	90-110	0			

MS Sample ID: **19090735-01B MS** Units: **mg/L** Analysis Date: **9/16/2019 10:36 AM**
Client ID: Run ID: **LACHAT_190916A** SeqNo: **5919895** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Nitrate	3.373	0.020	2.5	0.8328	102	90-110	0			

MSD Sample ID: **19090735-01B MSD** Units: **mg/L** Analysis Date: **9/16/2019 10:38 AM**
Client ID: Run ID: **LACHAT_190916A** SeqNo: **5919896** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Nitrate	3.314	0.020	2.5	0.8328	99.2	90-110	3.373	1.76	5	

The following samples were analyzed in this batch: 19090886-01B

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Gosling Czubak Engineering Sciences, Inc.
Work Order: 19090886
Project: Gosling (Little River Band 2018096001.01)

QC BATCH REPORT

Batch ID: **R270668** Instrument ID **GALLERY** Method: **A4500-SO4 E-11**

MBLK Sample ID: **MB-R270668-R270668** Units: **mg/L** Analysis Date: **9/16/2019 02:09 PM**
Client ID: Run ID: **GALLERY_190916B** SeqNo: **5921983** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfate	ND	1.0								

MS Sample ID: **19090833-14EMS** Units: **mg/L** Analysis Date: **9/16/2019 02:09 PM**
Client ID: Run ID: **GALLERY_190916B** SeqNo: **5921986** Prep Date: DF: **4**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfate	136.9	4.0	50	96.22	81.4	95-118	0			S

MSD Sample ID: **19090833-14EMSD** Units: **mg/L** Analysis Date: **9/16/2019 02:09 PM**
Client ID: Run ID: **GALLERY_190916B** SeqNo: **5921987** Prep Date: DF: **4**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfate	136.1	4.0	50	96.22	79.8	95-118	136.9	0.571	10	S

LCS1 Sample ID: **LCS1-R270668** Units: **mg/L** Analysis Date: **9/16/2019 02:09 PM**
Client ID: Run ID: **GALLERY_190916B** SeqNo: **5921984** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfate	10.15	1.0	10	0	101	90-119	0			

LCS2 Sample ID: **LCS2-R270668** Units: **mg/L** Analysis Date: **9/16/2019 02:09 PM**
Client ID: Run ID: **GALLERY_190916B** SeqNo: **5922007** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfate	54.58	1.0	50	0	109	95-118	0			

The following samples were analyzed in this batch: 19090886-01C

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Gosling Czubak Engineering Sciences, Inc.
Work Order: 19090886
Project: Gosling (Little River Band 2018096001.01)

QC BATCH REPORT

Batch ID: **R270817** Instrument ID **WETCHEM** Method: **E410.4 R2.0**

MBLK	Sample ID: **CCB/MBLK-R270817**			Units: **mg/L**			Analysis Date: **9/18/2019 02:57 PM**			
Client ID:	Run ID: **WETCHEM_190918L**			SeqNo: **5926788**			Prep Date:		DF: **1**	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chemical Oxygen Demand	ND	5.0								

LCS	Sample ID: **CCV/LCS-R270817**			Units: **mg/L**			Analysis Date: **9/18/2019 02:57 PM**			
Client ID:	Run ID: **WETCHEM_190918L**			SeqNo: **5926787**			Prep Date:		DF: **1**	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chemical Oxygen Demand	27.89	5.0	30	0	93	90-110	0			

MS	Sample ID: **19090886-01B MS**			Units: **mg/L**			Analysis Date: **9/18/2019 02:57 PM**			
Client ID: **MW-3**	Run ID: **WETCHEM_190918L**			SeqNo: **5926794**			Prep Date:		DF: **1**	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chemical Oxygen Demand	11	5.0	15	5.37	37.5	90-110	0			S

MSD	Sample ID: **19090886-01B MSD**			Units: **mg/L**			Analysis Date: **9/18/2019 02:57 PM**			
Client ID: **MW-3**	Run ID: **WETCHEM_190918L**			SeqNo: **5926795**			Prep Date:		DF: **1**	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chemical Oxygen Demand	11.35	5.0	15	5.37	39.9	90-110	11	3.13	20	S

The following samples were analyzed in this batch: 19090886-01B

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

ALS Group, USA

Date: 24-Sep-19

Client: Gosling Czubak Engineering Sciences, Inc.
Project: Gosling (Little River Band 2018096001.01)
WorkOrder: **19090886**

QUALIFIERS, ACRONYMS, UNITS

Qualifier	Description
*	Value exceeds Regulatory Limit
**	Estimated Value
a	Analyte is non-accredited
B	Analyte detected in the associated Method Blank above the Reporting Limit
E	Value above quantitation range
H	Analyzed outside of Holding Time
Hr	BOD/CBOD - Sample was reset outside Hold Time, value should be considered estimated.
J	Analyte is present at an estimated concentration between the MDL and Report Limit
ND	Not Detected at the Reporting Limit
O	Sample amount is > 4 times amount spiked
P	Dual Column results percent difference > 40%
R	RPD above laboratory control limit
S	Spike Recovery outside laboratory control limits
U	Analyzed but not detected above the MDL
X	Analyte was detected in the Method Blank between the MDL and Reporting Limit, sample results may exhibit background or reagent contamination at the observed level.

Acronym	Description
DUP	Method Duplicate
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LOD	Limit of Detection (see MDL)
LOQ	Limit of Quantitation (see PQL)
MBLK	Method Blank
MDL	Method Detection Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
PQL	Practical Quantitation Limit
RPD	Relative Percent Difference
TDL	Target Detection Limit
TNTC	Too Numerous To Count
A	APHA Standard Methods
D	ASTM
E	EPA
SW	SW-846 Update III

Units Reported	Description
mg NH3-N/L	Milligrams Ammonia-Nitrogen per Liter
mg/L	Milligrams per Liter

ALS Group, USA

Sample Receipt Checklist

Client Name: **GOSLING** Date/Time Received: **13-Sep-19 09:30**

Work Order: **19090886** Received by: **DS**

Checklist completed by Diane Shaw 13-Sep-19 Reviewed by: Nathan Williams 13-Sep-19

eSignature Date eSignature Date

Matrices: Groundwater

Carrier name: FedEx

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shipping container/cooler?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time?	Yes ☑	No ☐	
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐	
Sample(s) received on ice?	Yes ☑	No ☐	
Temperature(s)/Thermometer(s):	2.4/2.4 c	SR2	
Cooler(s)/Kit(s):			
Date/Time sample(s) sent to storage:	9/13/2019 10:54:27 AM		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☑	No ☐	N/A ☐
pH adjusted?	Yes ☐	No ☑	N/A ☐
pH adjusted by:	-		

Login Notes:

Client Contacted: Date Contacted: Person Contacted:

Contacted By: Regarding:

Comments:

CorrectiveAction:

Cincinnati, OH +1 513 733 5336
Everett, WA +1 425 356 2600
Fort Collins, CO +1 970 490 1511
Holland, MI +1 616 399 6070
Houston, TX +1 281 530 5656
Middletown, PA +1 717 944 5541
Spring City, PA +1 610 948 4903
Salt Lake City, UT +1 801 266 7700
South Charleston, WV +1 304 356 3168
York, PA +1 717 505 5280

Chain of Custody Form

Page ___ of ___

COC ID: 40170

ALS Project Manager: | ALS Work Order #: 1909088C

Customer Information		Project Information		Parameter/Method Request for Analysis	
Purchase Order		Project Name	LRB01 - Wastewater	A	Ammonia Nitrogen, Nitrate, Nitrite, TKN
Work Order		Project Number	2018081b001.01	B	Alkalinity, BOD COD
Company Name	Gosling Czubak	Bill To Company	GCES	C	Total Phosphorus
Send Report To	A. Bikeman	Invoice Attn	A. Bikeman	D	Sulfate
Address	1280 Business Park Dr.	Address	SAME	E	Calcium
				F	Iron
City/State/Zip	Traverse City, MI	City/State/Zip		G	Magnesium
Phone	(231) 946-9191	Phone		H	Potassium
Fax		Fax		I	Sodium
e-Mail Address	arbikeman@goslingczubak.com	e-Mail Address		J	Chloride

No.	Sample Description	Date	Time	Matrix	Pres.	# Bottles	A	B	C	D	E	F	G	H	I	J	Hold
1	MW-3	9-12-19	1401	GW	2,3,8	4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

Sampler(s) Please Print & Sign: Joshua Gervie

Shipment Method: Drop-off

Turnaround Time in Business Days (BD): ☐ 10 BD ☒ 5 BD ☐ 3 BD ☐ 2 BD ☐ 1 BD ☐ Other ___

Results Due Date:

Relinquished by:	Date: 9-12-19	Time: 1540	Received by:		
Relinquished by:	Date: 9/12/19	Time: 1645	Received by (Laboratory):	9/13/19	0930
Logged by (Laboratory):	Date: 9/13/19	Time: 1045	Checked by (Laboratory):		

Notes: Gosling - Misc

Cooler ID	Cooler Temp
SD2	2.4°C
pH 7	

QC Package: (Check One Box Below)
☐ Level II Std QC ☐ TRRP Checklist
☐ Level III Std QC/Raw Data ☐ TRRP Level IV
☐ Level IV SW846/CLP
☐ Other ___

Preservative Key: 1-HCl 2-HNO_3 3-H_2SO_4 4-NaOH 5-$Na_2S_2O_3$ 6-$NaHSO_4$ 7-Other 8-4°C 9-5035

Note: 1. Any changes must be made in writing once samples and COC Form have been submitted to ALS Environmental.
2. Unless otherwise agreed in a formal contract, services provided by ALS Environmental are expressly limited to the terms and conditions stated on the reverse.
3. The Chain of Custody is a legal document. All information must be completed accurately.

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13-Sep-2019

Adam Biteman
Gosling Czubak Engineering Sciences, Inc.
1280 Business Park Drive
Traverse City, MI 49686

Re: **Gosling (Little River Band Waste Water 2018096001)** Work Order: **19090373**

Dear Adam,

ALS Environmental received 2 samples on 06-Sep-2019 09:30 AM for the analyses presented in the following report.

The analytical data provided relates directly to the samples received by ALS Environmental - Holland and for only the analyses requested.

Sample results are compliant with industry accepted practices and Quality Control results achieved laboratory specifications. Any exceptions are noted in the Case Narrative, or noted with qualifiers in the report or QC batch information. Should this laboratory report need to be reproduced, it should be reproduced in full unless written approval has been obtained from ALS Environmental. Samples will be disposed in 30 days unless storage arrangements are made.

The total number of pages in this report is 20.

If you have any questions regarding this report, please feel free to contact me:

ADDRESS: 3352 128th Avenue, Holland, MI, USA
PHONE: +1 (616) 399-6070 FAX: +1 (616) 399-6185

Sincerely,

Gary Byar

Electronically approved by: Gary Byar

Gary Byar
Project Manager

Report of Laboratory Analysis

ALS Group, USA

Date: 13-Sep-19

Client: Gosling Czubak Engineering Sciences, Inc.
Project: Gosling (Little River Band Waste Water 2018096001)
Work Order: **19090373**

Work Order Sample Summary

Lab Samp ID	Client Sample ID	Matrix	Tag Number	Collection Date	Date Received	Hold
19090373-01	MW-1	Water		9/5/2019 12:20	9/6/2019 09:30	☐
19090373-02	MW-2	Water		9/5/2019 13:05	9/6/2019 09:30	☐

ALS Group, USA

Date: *13-Sep-19*

Client: Gosling Czubak Engineering Sciences, Inc.
Project: Gosling (Little River Band Waste Water 2018096001) **Work Order:** 19090373
Sample ID: MW-1 **Lab ID:** 19090373-01
Collection Date: 9/5/2019 12:20 PM **Matrix:** WATER

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
METALS BY ICP-MS			**SW6020A**		Prep: SW3015A 9/11/19 08:48	Analyst: **STP**
Calcium	**33**		**0.50**	**mg/L**	1	9/11/2019 04:40 PM
Iron	**0.099**		**0.080**	**mg/L**	1	9/11/2019 04:40 PM
Magnesium	**10**		**0.20**	**mg/L**	1	9/11/2019 04:40 PM
Potassium	**0.90**		**0.20**	**mg/L**	1	9/11/2019 04:40 PM
Sodium	**0.62**		**0.20**	**mg/L**	1	9/11/2019 04:40 PM
ALKALINITY			**A2320 B-11**			Analyst: **DVD**
Alkalinity, Bicarbonate (as CaCO3)	**100**		**10**	**mg/L**	1	9/7/2019 04:25 PM
BIOCHEMICAL OXYGEN DEMAND			**A5210B-11**		Prep: A5210B 9/6/19 15:34	Analyst: **QTN**
Biochemical Oxygen Demand	ND		2.0	mg/L	1	9/11/2019 08:40 AM
CHLORIDE			**A4500-CL E-11**			Analyst: **JDR**
Chloride	**3.8**		**1.0**	**mg/L**	1	9/10/2019 12:39 PM
CHEMICAL OXYGEN DEMAND			**E410.4 R2.0**			Analyst: **ATS**
Chemical Oxygen Demand	**5.4**		**5.0**	**mg/L**	1	9/12/2019 03:01 PM
AMMONIA AS NITROGEN (DISTILLED)			**A4500-NH3 G-11**		Prep: A4500-NH3 B 9/10/19 12:45	Analyst: **CAC**
Ammonia as Nitrogen	ND		0.15	mg NH3-N/L	1	9/10/2019 03:49 PM
NITROGEN, NITRITE			**A4500-NO2 B-11**			Analyst: **EMJ**
Nitrogen, Nitrite	ND		0.020	mg/L	1	9/6/2019 04:04 PM
NITROGEN, NITRATE			**E353.2 R2.0**			Analyst: **JZB**
Nitrogen, Nitrate	**2.4**		**0.020**	**mg/L**	1	9/11/2019 10:21 AM
PHOSPHORUS, TOTAL			**E365.1 R2.0**		Prep: E365.1 R2.0 9/10/19 17:13	Analyst: **CAC**
Phosphorus, Total	ND		0.050	mg/L	1	9/11/2019 10:37 AM
SULFATE			**A4500-SO4 E-11**			Analyst: **JDR**
Sulfate	**4.9**		**1.0**	**mg/L**	1	9/9/2019 02:32 PM
NITROGEN, TOTAL KJELDAHL			**A4500-NH3 G-11**		Prep: A4500-N B 9/8/19 12:45	Analyst: **CAC**
Nitrogen, Total Kjeldahl	ND		1.0	mg/L	1	9/9/2019 10:36 AM

Note: See Qualifiers page for a list of qualifiers and their definitions.

ALS Group, USA

Date: *13-Sep-19*

Client: Gosling Czubak Engineering Sciences, Inc.
Project: Gosling (Little River Band Waste Water 2018096001) **Work Order:** 19090373
Sample ID: MW-2 **Lab ID:** 19090373-02
Collection Date: 9/5/2019 01:05 PM **Matrix:** WATER

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
METALS BY ICP-MS			**SW6020A**		Prep: SW3015A 9/11/19 08:48	Analyst: **STP**
Calcium	**64**		**0.50**	**mg/L**	1	9/11/2019 04:45 PM
Iron	**0.16**		**0.080**	**mg/L**	1	9/11/2019 04:45 PM
Magnesium	**16**		**0.20**	**mg/L**	1	9/11/2019 04:45 PM
Manganese	**0.011**		**0.0050**	**mg/L**	1	9/11/2019 04:45 PM
Potassium	**4.6**		**0.20**	**mg/L**	1	9/11/2019 04:45 PM
Sodium	**9.4**		**0.20**	**mg/L**	1	9/11/2019 04:45 PM
ALKALINITY			**A2320 B-11**			Analyst: **DVD**
Alkalinity, Bicarbonate (as CaCO3)	**180**		**10**	**mg/L**	1	9/7/2019 04:25 PM
BIOCHEMICAL OXYGEN DEMAND			**A5210B-11**		Prep: A5210B 9/6/19 15:36	Analyst: **QTN**
Biochemical Oxygen Demand	ND		2.0	mg/L	1	9/11/2019 08:40 AM
CHLORIDE			**A4500-CL E-11**			Analyst: **JDR**
Chloride	**17**		**1.0**	**mg/L**	1	9/10/2019 12:39 PM
CHEMICAL OXYGEN DEMAND			**E410.4 R2.0**			Analyst: **ATS**
Chemical Oxygen Demand	**6.8**		**5.0**	**mg/L**	1	9/12/2019 03:01 PM
AMMONIA AS NITROGEN (DISTILLED)			**A4500-NH3 G-11**		Prep: A4500-NH3 B 9/10/19 12:45	Analyst: **CAC**
Ammonia as Nitrogen	ND		0.15	mg NH3-N/L	1	9/10/2019 03:50 PM
NITROGEN, NITRITE			**A4500-NO2 B-11**			Analyst: **EMJ**
Nitrogen, Nitrite	ND		0.020	mg/L	1	9/6/2019 04:04 PM
NITROGEN, NITRATE			**E353.2 R2.0**			Analyst: **JZB**
Nitrogen, Nitrate	**1.6**		**0.020**	**mg/L**	1	9/11/2019 10:51 AM
PHOSPHORUS, TOTAL			**E365.1 R2.0**		Prep: E365.1 R2.0 9/10/19 17:13	Analyst: **CAC**
Phosphorus, Total	ND		0.050	mg/L	1	9/11/2019 10:40 AM
SULFATE			**A4500-SO4 E-11**			Analyst: **JDR**
Sulfate	**10**		**1.0**	**mg/L**	1	9/9/2019 02:32 PM
NITROGEN, TOTAL KJELDAHL			**A4500-NH3 G-11**		Prep: A4500-N B 9/8/19 12:45	Analyst: **CAC**
Nitrogen, Total Kjeldahl	ND		1.0	mg/L	1	9/9/2019 10:41 AM

Note: See Qualifiers page for a list of qualifiers and their definitions.

Client: Gosling Czubak Engineering Sciences, Inc.
Project: Gosling (Little River Band Waste Water 2018096001)
Work Order: 19090373

Case Narrative

Batch 142087 Sample 19090373-01D BOD_5210B_W The sample dilutions set up for BOD analysis did not meet the oxygen depletion criteria of at least 2 mg/L. The result should be considered estimated. Client Sample ID: MW-1

Batch 142087 Sample 19090373-02D BOD_5210B_W The sample dilutions set up for BOD analysis did not meet the oxygen depletion criteria of at least 2 mg/L. The result should be considered estimated. Client Sample ID: MW-2

Batch 142239 Sample 19090373-01B MS PASC_365.1_W The MS recovery was above the upper control limit. The corresponding result in the parent sample was non-detect, therefore no qualification is necessary: Client Sample ID: MW-1

ALS Group, USA

Sample Receipt Checklist

Client Name: **GOSLING** Date/Time Received: **06-Sep-19 09:30**

Work Order: **19090373** Received by: **DS**

Checklist completed by Diane Shaw (eSignature) 06-Sep-19 (Date) Reviewed by: Nathan Williams (eSignature) 10-Sep-19 (Date)

Matrices: Water

Carrier name: FedEx

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shipping container/cooler?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time?	Yes ☑	No ☐	
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐	
Sample(s) received on ice?	Yes ☑	No ☐	
Temperature(s)/Thermometer(s):	3.4/3.4 c	SR2	
Cooler(s)/Kit(s):			
Date/Time sample(s) sent to storage:	9/6/2019 2:46:32 PM		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☑	No ☐	N/A ☐
pH adjusted?	Yes ☐	No ☑	N/A ☐
pH adjusted by:	-		

Login Notes:

Client Contacted: Date Contacted: Person Contacted:

Contacted By: Regarding:

Comments:

CorrectiveAction:

Batch ID: **142251** Instrument ID **ICPMS3** Method: **SW6020A**

MBLK Sample ID: **MBLK-142251-142251** Units: **mg/L** Analysis Date: **9/11/2019 04:11 PM**

Client ID: Run ID: **ICPMS3_190911A** SeqNo: **5910905** Prep Date: **9/11/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Calcium	ND	0.50								
Iron	ND	0.080								
Magnesium	ND	0.20								
Manganese	ND	0.0050								
Potassium	ND	0.20								
Sodium	ND	0.20								

LCS Sample ID: **LCS-142251-142251** Units: **mg/L** Analysis Date: **9/11/2019 04:13 PM**

Client ID: Run ID: **ICPMS3_190911A** SeqNo: **5910908** Prep Date: **9/11/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Calcium	10.28	0.50	10	0	103	80-120	0			
Iron	10.2	0.080	10	0	102	80-120	0			
Magnesium	10.4	0.20	10	0	104	80-120	0			
Manganese	0.1005	0.0050	0.1	0	100	80-120	0			
Potassium	10.16	0.20	10	0	102	80-120	0			
Sodium	10.74	0.20	10	0	107	80-120	0			

MS Sample ID: **19090373-01CMS** Units: **mg/L** Analysis Date: **9/11/2019 04:42 PM**

Client ID: **MW-1** Run ID: **ICPMS3_190911A** SeqNo: **5912497** Prep Date: **9/11/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Calcium	41.96	0.50	10	33.2	87.6	75-125	0			
Iron	10.11	0.080	10	0.09896	100	75-125	0			
Magnesium	19.51	0.20	10	10.05	94.5	75-125	0			
Manganese	0.1042	0.0050	0.1	0.006084	98.1	75-125	0			
Potassium	10.75	0.20	10	0.8977	98.6	75-125	0			
Sodium	10.97	0.20	10	0.6184	104	75-125	0			

MSD Sample ID: **19090373-01CMSD** Units: **mg/L** Analysis Date: **9/11/2019 04:44 PM**

Client ID: **MW-1** Run ID: **ICPMS3_190911A** SeqNo: **5912498** Prep Date: **9/11/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Calcium	42.54	0.50	10	33.2	93.4	75-125	41.96	1.37	20	
Iron	10.77	0.080	10	0.09896	107	75-125	10.11	6.35	20	
Magnesium	20.44	0.20	10	10.05	104	75-125	19.51	4.67	20	
Manganese	0.1077	0.0050	0.1	0.006084	102	75-125	0.1042	3.35	20	
Potassium	11.49	0.20	10	0.8977	106	75-125	10.75	6.67	20	
Sodium	11.62	0.20	10	0.6184	110	75-125	10.97	5.7	20	

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Gosling Czubak Engineering Sciences, Inc.
Work Order: 19090373
Project: Gosling (Little River Band Waste Water 201809600

QC BATCH REPORT

Batch ID: **142251** Instrument ID **ICPMS3** Method: **SW6020A**

The following samples were analyzed in this batch:

19090373-01C	19090373-02C

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Gosling Czubak Engineering Sciences, Inc.
Work Order: 19090373
Project: Gosling (Little River Band Waste Water 201809600

QC BATCH REPORT

Batch ID: **142087** Instrument ID **WETCHEM** Method: **A5210B-11**

MBLK	Sample ID: **MBLK-142087-142087**			Units: **mg/L**			Analysis Date: **9/11/2019 08:40 AM**			
Client ID:	Run ID: **WETCHEM_190911A**			SeqNo: **5909316**			Prep Date: **9/6/2019**		DF: **1**	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Biochemical Oxygen Demand	0.1	2.0								

LCS	Sample ID: **LCS-142087-142087**			Units: **mg/L**			Analysis Date: **9/11/2019 08:40 AM**			
Client ID:	Run ID: **WETCHEM_190911A**			SeqNo: **5909317**			Prep Date: **9/6/2019**		DF: **1**	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Biochemical Oxygen Demand	191.6	2.0	198	0	96.8	85-115	0			

DUP	Sample ID: **19090324-01A DUP**			Units: **mg/L**			Analysis Date: **9/11/2019 08:40 AM**			
Client ID:	Run ID: **WETCHEM_190911A**			SeqNo: **5909324**			Prep Date: **9/6/2019**		DF: **1**	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Biochemical Oxygen Demand	129	2.0	0	0	0	0-0	130.1	0.849	20	

The following samples were analyzed in this batch:

19090373-01D	19090373-02D

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Gosling Czubak Engineering Sciences, Inc.
Work Order: 19090373
Project: Gosling (Little River Band Waste Water 201809600

QC BATCH REPORT

Batch ID: **142122** Instrument ID **LACHAT2** Method: **A4500-NH3 G-11**

MBLK Sample ID: **MBLK-142122-142122** Units: **mg/L** Analysis Date: **9/9/2019 10:12 AM**
Client ID: Run ID: **LACHAT2_190909A** SeqNo: **5902705** Prep Date: **9/8/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Total Kjeldahl	ND	1.0								

LCS Sample ID: **LCS-142122-142122** Units: **mg/L** Analysis Date: **9/9/2019 10:13 AM**
Client ID: Run ID: **LACHAT2_190909A** SeqNo: **5902706** Prep Date: **9/8/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Total Kjeldahl	9.453	1.0	10	0	94.5	85-115	0			

LCS Sample ID: **LCS2-142122-142122** Units: **mg/L** Analysis Date: **9/9/2019 10:14 AM**
Client ID: Run ID: **LACHAT2_190909A** SeqNo: **5902707** Prep Date: **9/8/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Total Kjeldahl	9.16	1.0	10	0	91.6	85-115	0			

MS Sample ID: **19090345-01C MS** Units: **mg/L** Analysis Date: **9/9/2019 10:17 AM**
Client ID: Run ID: **LACHAT2_190909A** SeqNo: **5902709** Prep Date: **9/8/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Total Kjeldahl	10.25	1.0	10	-0.2842	105	85-115	0			

MS Sample ID: **19090245-07A MS** Units: **mg/L** Analysis Date: **9/9/2019 10:33 AM**
Client ID: Run ID: **LACHAT2_190909A** SeqNo: **5902723** Prep Date: **9/8/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Total Kjeldahl	15.81	1.0	10	6.235	95.8	85-115	0			

MSD Sample ID: **19090345-01C MSD** Units: **mg/L** Analysis Date: **9/9/2019 10:18 AM**
Client ID: Run ID: **LACHAT2_190909A** SeqNo: **5902710** Prep Date: **9/8/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Total Kjeldahl	10.67	1.0	10	-0.2842	110	85-115	10.25	4.02	15	

MSD Sample ID: **19090245-07A MSD** Units: **mg/L** Analysis Date: **9/9/2019 10:35 AM**
Client ID: Run ID: **LACHAT2_190909A** SeqNo: **5902724** Prep Date: **9/8/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Total Kjeldahl	14.92	1.0	10	6.235	86.8	85-115	15.81	5.79	15	

The following samples were analyzed in this batch: 19090373-01B 19090373-02B

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Gosling Czubak Engineering Sciences, Inc.
Work Order: 19090373
Project: Gosling (Little River Band Waste Water 201809600

QC BATCH REPORT

Batch ID: **142216** Instrument ID **LACHAT2** Method: **A4500-NH3 G-11**

MBLK Sample ID: **MBLK-142216-142216** Units: **mg NH3-N/L** Analysis Date: **9/10/2019 03:41 PM**
Client ID: Run ID: **LACHAT2_190910A** SeqNo: **5908083** Prep Date: **9/10/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Ammonia as Nitrogen	ND	0.15								

LCS Sample ID: **LCS-142216-142216** Units: **mg NH3-N/L** Analysis Date: **9/10/2019 03:42 PM**
Client ID: Run ID: **LACHAT2_190910A** SeqNo: **5908086** Prep Date: **9/10/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Ammonia as Nitrogen	1.015	0.15	1	0	102	75-119	0			

MS Sample ID: **19090217-28A MS** Units: **mg NH3-N/L** Analysis Date: **9/10/2019 03:57 PM**
Client ID: Run ID: **LACHAT2_190910A** SeqNo: **5908099** Prep Date: **9/10/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Ammonia as Nitrogen	1.213	0.15	1	0.1182	109	75-119	0			

MSD Sample ID: **19090217-28A MSD** Units: **mg NH3-N/L** Analysis Date: **9/10/2019 03:59 PM**
Client ID: Run ID: **LACHAT2_190910A** SeqNo: **5908100** Prep Date: **9/10/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Ammonia as Nitrogen	1.164	0.15	1	0.1182	105	75-119	1.213	4.12	20	

The following samples were analyzed in this batch: 19090373-01B 19090373-02B

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Gosling Czubak Engineering Sciences, Inc.
Work Order: 19090373
Project: Gosling (Little River Band Waste Water 201809600

QC BATCH REPORT

Batch ID: **142239** Instrument ID **LACHAT** Method: **E365.1 R2.0**

MBLK Sample ID: **MBLK-142239-142239** Units: **mg/L** Analysis Date: **9/11/2019 10:34 AM**
Client ID: Run ID: **LACHAT_190911A** SeqNo: **5909577** Prep Date: **9/10/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total	ND	0.050								

LCS Sample ID: **LCS-142239-142239** Units: **mg/L** Analysis Date: **9/11/2019 10:35 AM**
Client ID: Run ID: **LACHAT_190911A** SeqNo: **5909578** Prep Date: **9/10/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total	1.044	0.050	1	0	104	90-110	0			

MS Sample ID: **19090373-01B MS** Units: **mg/L** Analysis Date: **9/11/2019 10:38 AM**
Client ID: **MW-1** Run ID: **LACHAT_190911A** SeqNo: **5909581** Prep Date: **9/10/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total	1.13	0.050	1	0.02332	111	90-110	0			S

MS Sample ID: **19090046-04C MS** Units: **mg/L** Analysis Date: **9/11/2019 10:54 AM**
Client ID: Run ID: **LACHAT_190911A** SeqNo: **5909595** Prep Date: **9/10/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total	1.828	0.050	1	0.8228	101	90-110	0			

MSD Sample ID: **19090373-01B MSD** Units: **mg/L** Analysis Date: **9/11/2019 10:39 AM**
Client ID: **MW-1** Run ID: **LACHAT_190911A** SeqNo: **5909582** Prep Date: **9/10/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total	1.129	0.050	1	0.02332	111	90-110	1.13	0.0885	20	S

MSD Sample ID: **19090046-04C MSD** Units: **mg/L** Analysis Date: **9/11/2019 10:55 AM**
Client ID: Run ID: **LACHAT_190911A** SeqNo: **5909596** Prep Date: **9/10/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total	1.817	0.050	1	0.8228	99.4	90-110	1.828	0.604	20	

LCS2 Sample ID: **LCS2-142239-142239** Units: **mg/L** Analysis Date: **9/11/2019 10:36 AM**
Client ID: Run ID: **LACHAT_190911A** SeqNo: **5909579** Prep Date: **9/10/2019** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total	1.019	0.050	1	0	102	90-110	0			

The following samples were analyzed in this batch: 19090373-01B 19090373-02B

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Gosling Czubak Engineering Sciences, Inc.
Work Order: 19090373
Project: Gosling (Little River Band Waste Water 201809600

QC BATCH REPORT

Batch ID: **R269977** Instrument ID **WETCHEM** Method: **A4500-NO2 B-11**

MBLK	Sample ID: **MB-R269977-R269977**			Units: **mg/L**			Analysis Date: **9/6/2019 04:04 PM**			
Client ID:	Run ID: **WETCHEM_190906S**			SeqNo: **5899821**			Prep Date:		DF: **1**	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Nitrite	ND	0.020								

LCS	Sample ID: **LCS-R269977-R269977**			Units: **mg/L**			Analysis Date: **9/6/2019 04:04 PM**			
Client ID:	Run ID: **WETCHEM_190906S**			SeqNo: **5899822**			Prep Date:		DF: **1**	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Nitrite	0.1908	0.020	0.2	0	95.4	80-120	0			

MS	Sample ID: **19090373-01A MS**			Units: **mg/L**			Analysis Date: **9/6/2019 04:04 PM**			
Client ID: **MW-1**	Run ID: **WETCHEM_190906S**			SeqNo: **5899824**			Prep Date:		DF: **1**	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Nitrite	0.1816	0.020	0.2	0.0016	90	80-120	0			

MSD	Sample ID: **19090373-01A MSD**			Units: **mg/L**			Analysis Date: **9/6/2019 04:04 PM**			
Client ID: **MW-1**	Run ID: **WETCHEM_190906S**			SeqNo: **5899825**			Prep Date:		DF: **1**	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Nitrite	0.183	0.020	0.2	0.0016	90.7	80-120	0.1816	0.768	10	

The following samples were analyzed in this batch: 19090373-01A 19090373-02A

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Gosling Czubak Engineering Sciences, Inc.
Work Order: 19090373
Project: Gosling (Little River Band Waste Water 201809600

QC BATCH REPORT

Batch ID: **R270000** Instrument ID **Titrator 1** Method: **A2320 B-11**

MBLK Sample ID: **MB-R270000-R270000** Units: **mg/L** Analysis Date: **9/7/2019 04:25 PM**
Client ID: Run ID: **TITRATOR 1_190907A** SeqNo: **5900992** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Alkalinity, Bicarbonate (as CaCO3)	ND	10								

DUP Sample ID: **19090257-01A DUP** Units: **mg/L** Analysis Date: **9/7/2019 04:25 PM**
Client ID: Run ID: **TITRATOR 1_190907A** SeqNo: **5900995** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Alkalinity, Bicarbonate (as CaCO3)	622.4	10	0	0	0	0-0	621.7	0.125	10	

DUP Sample ID: **19090381-01B DUP** Units: **mg/L** Analysis Date: **9/7/2019 04:25 PM**
Client ID: Run ID: **TITRATOR 1_190907A** SeqNo: **5901000** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Alkalinity, Bicarbonate (as CaCO3)	46.91	10	0	0	0	0-0	48.51	3.35	10	

The following samples were analyzed in this batch: 19090373-01A 19090373-02A

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Gosling Czubak Engineering Sciences, Inc.
Work Order: 19090373
Project: Gosling (Little River Band Waste Water 201809600

QC BATCH REPORT

Batch ID: **R270162** Instrument ID **GALLERY** Method: **A4500-SO4 E-11**

MBLK Sample ID: **MB-R270162-R270162** Units: **mg/L** Analysis Date: **9/9/2019 02:32 PM**
Client ID: Run ID: **GALLERY_190909B** SeqNo: **5906226** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfate	ND	1.0								

MS Sample ID: **19090373-01AMS** Units: **mg/L** Analysis Date: **9/9/2019 02:32 PM**
Client ID: **MW-1** Run ID: **GALLERY_190909B** SeqNo: **5906230** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfate	53.42	1.0	50	4.866	97.1	95-118	0			

MSD Sample ID: **19090373-01AMSD** Units: **mg/L** Analysis Date: **9/9/2019 02:32 PM**
Client ID: **MW-1** Run ID: **GALLERY_190909B** SeqNo: **5906231** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfate	53.77	1.0	50	4.866	97.8	95-118	53.42	0.653	10	

LCS1 Sample ID: **LCS1-R270162** Units: **mg/L** Analysis Date: **9/9/2019 02:32 PM**
Client ID: Run ID: **GALLERY_190909B** SeqNo: **5906227** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfate	10.13	1.0	10	0	101	90-119	0			

LCS2 Sample ID: **LCS2-R270162** Units: **mg/L** Analysis Date: **9/9/2019 02:32 PM**
Client ID: Run ID: **GALLERY_190909B** SeqNo: **5906243** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfate	52.38	1.0	50	0	105	95-118	0			

The following samples were analyzed in this batch: 19090373-01A 19090373-02A

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Gosling Czubak Engineering Sciences, Inc.
Work Order: 19090373
Project: Gosling (Little River Band Waste Water 201809600

QC BATCH REPORT

Batch ID: **R270243** Instrument ID **GALLERY** Method: **A4500-Cl E-11**

MBLK Sample ID: **MB-R270243-R270243** Units: **mg/L** Analysis Date: **9/10/2019 12:39 PM**
Client ID: Run ID: **GALLERY_190910B** SeqNo: **5909502** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	ND	1.0								

MS Sample ID: **19090373-01AMS** Units: **mg/L** Analysis Date: **9/10/2019 12:39 PM**
Client ID: **MW-1** Run ID: **GALLERY_190910B** SeqNo: **5909508** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	53.7	1.0	50	3.81	99.8	88-116	0			

MSD Sample ID: **19090373-01AMSD** Units: **mg/L** Analysis Date: **9/10/2019 12:39 PM**
Client ID: **MW-1** Run ID: **GALLERY_190910B** SeqNo: **5909509** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	53.73	1.0	50	3.81	99.8	88-116	53.7	0.0559	10	

LCS1 Sample ID: **LCS1-R270243** Units: **mg/L** Analysis Date: **9/10/2019 12:39 PM**
Client ID: Run ID: **GALLERY_190910B** SeqNo: **5909503** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	10.15	1.0	10	0	101	88-113	0			

LCS2 Sample ID: **LCS2-R270243** Units: **mg/L** Analysis Date: **9/10/2019 12:39 PM**
Client ID: Run ID: **GALLERY_190910B** SeqNo: **5909526** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	51.34	1.0	50	0	103	88-116	0			

The following samples were analyzed in this batch: 19090373-01A 19090373-02A

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Gosling Czubak Engineering Sciences, Inc.
Work Order: 19090373
Project: Gosling (Little River Band Waste Water 201809600

QC BATCH REPORT

Batch ID: **R270269** Instrument ID **LACHAT2** Method: **E353.2 R2.0**

MBLK	Sample ID: **MBLK-R270269**				Units: **mg/L**			Analysis Date: **9/11/2019 10:18 AM**		
Client ID:		Run ID: **LACHAT2_190911A**			SeqNo: **5910059**		Prep Date:		DF: **1**	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Nitrate	ND	0.020								

MBLK	Sample ID: **MBLK NO3 2-R270269**				Units: **mg/L**			Analysis Date: **9/11/2019 11:21 AM**		
Client ID:		Run ID: **LACHAT2_190911A**			SeqNo: **5910109**		Prep Date:		DF: **1**	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Nitrate	ND	0.020								

The following samples were analyzed in this batch: 19090373-01B 19090373-02B

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Gosling Czubak Engineering Sciences, Inc.
Work Order: 19090373
Project: Gosling (Little River Band Waste Water 201809600

QC BATCH REPORT

Batch ID: **R270370** Instrument ID **WETCHEM** Method: **E410.4 R2.0**

MBLK Sample ID: **CCB/MBLK-R270370** Units: **mg/L** Analysis Date: **9/12/2019 03:01 PM**
Client ID: Run ID: **WETCHEM_190912L** SeqNo: **5913620** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chemical Oxygen Demand	ND	5.0								

LCS Sample ID: **CCV/LCS-R270370** Units: **mg/L** Analysis Date: **9/12/2019 03:01 PM**
Client ID: Run ID: **WETCHEM_190912L** SeqNo: **5913616** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chemical Oxygen Demand	27.89	5.0	30	0	93	90-110	0			

MS Sample ID: **19090373-01B MS** Units: **mg/L** Analysis Date: **9/12/2019 03:01 PM**
Client ID: **MW-1** Run ID: **WETCHEM_190912L** SeqNo: **5913622** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chemical Oxygen Demand	19.8	5.0	15	5.37	96.2	90-110	0			

MSD Sample ID: **19090373-01B MSD** Units: **mg/L** Analysis Date: **9/12/2019 03:01 PM**
Client ID: **MW-1** Run ID: **WETCHEM_190912L** SeqNo: **5913623** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chemical Oxygen Demand	20.5	5.0	15	5.37	101	90-110	19.8	3.47	20	

The following samples were analyzed in this batch: 19090373-01B 19090373-02B

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

ALS Group, USA

Date: 13-Sep-19

Client: Gosling Czubak Engineering Sciences, Inc.
Project: Gosling (Little River Band Waste Water 2018096001)
WorkOrder: **19090373**

QUALIFIERS, ACRONYMS, UNITS

Qualifier	Description
*	Value exceeds Regulatory Limit
**	Estimated Value
a	Analyte is non-accredited
B	Analyte detected in the associated Method Blank above the Reporting Limit
E	Value above quantitation range
H	Analyzed outside of Holding Time
Hr	BOD/CBOD - Sample was reset outside Hold Time, value should be considered estimated.
J	Analyte is present at an estimated concentration between the MDL and Report Limit
ND	Not Detected at the Reporting Limit
O	Sample amount is > 4 times amount spiked
P	Dual Column results percent difference > 40%
R	RPD above laboratory control limit
S	Spike Recovery outside laboratory control limits
U	Analyzed but not detected above the MDL
X	Analyte was detected in the Method Blank between the MDL and Reporting Limit, sample results may exhibit background or reagent contamination at the observed level.

Acronym	Description
DUP	Method Duplicate
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LOD	Limit of Detection (see MDL)
LOQ	Limit of Quantitation (see PQL)
MBLK	Method Blank
MDL	Method Detection Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
PQL	Practical Quantitation Limit
RPD	Relative Percent Difference
TDL	Target Detection Limit
TNTC	Too Numerous To Count
A	APHA Standard Methods
D	ASTM
E	EPA
SW	SW-846 Update III

Units Reported	Description
mg NH3-N/L	Milligrams Ammonia-Nitrogen per Liter
mg/L	Milligrams per Liter

January 16, 2013

INTERAGENCY MEMORANDUM

Attached is a document explaining recommended best practice for the development of Preliminary Engineering Reports in support of funding applications for development of drinking water, wastewater, stormwater, and solid waste systems.

The best practice document was developed cooperatively by:

- US Department of Agriculture, Rural Development, Rural Utilities Service, Water and Environmental Programs;
- US Environmental Protection Agency (EPA), Office of Water, Office of Ground Water and Drinking Water and Office of Wastewater Management;
- US Department of Housing and Urban Development (HUD), Office of Community Planning and Development;
- US Department of Health and Human Services, Indian Health Service (IHS);
- Small Communities Water Infrastructure Exchange;

Extensive input from participating state administering agencies was also very important to the development of this document.

Federal agencies that cooperatively developed this document strongly encourage its use by funding agencies as part of the application process or project development. State administered programs are encouraged to adopt this document but are not required to do so, as it is up to a state administering agency's discretion to adopt it, based on the needs of the state administering agency.

A Preliminary Engineering Report (Report) is a planning document required by many state and federal funding agencies as part of the process of obtaining financial assistance for development of drinking water, wastewater, solid waste, and stormwater facilities. The attached Report outline details the requirements that funding agencies have adopted when a Report is required.

In general the Report should include a description of existing facilities and a description of the issues being addressed by the proposed project. It should identify alternatives, present a life cycle cost analysis of technically feasible alternatives and propose a specific course of action. The Report should also include a detailed current cost estimate of the recommended alternative. The attached outline describes these and other sections to be included in the Report.

Projects utilizing direct federal funding also require an environmental review in accordance with the National Environmental Policy Act (NEPA). The Report should indicate that environmental issues were considered as part of the engineering planning and include environmental information pertinent to engineering planning.

For state administered funding programs, a determination of whether the outline applies to a given program or project is made by the state administering agency. When a program or agency adopts this outline, it may adopt a portion or the entire outline as applicable to the program or project in question at the discretion of the agency. Some state and federal funding agencies will not require the Report for every project or may waive portions of the Report that do not apply to their application process, however a Report thoroughly addressing all of the contents of this outline will meet the requirements of most agencies that have adopted this outline.

The detailed outline provides information on what to include in a Report. The level of detail required may also vary according to the complexity of the specific project. Reports should conform substantially to this detailed outline and otherwise be prepared and presented in a professional manner. Many funding agencies require that the document be developed by a Professional Engineer registered in the state or other jurisdiction where the project is to be constructed unless exempt from this requirement. Please check with applicable funding agencies to determine if the agencies require supplementary information beyond the scope of this outline.

Any preliminary design information must be written in accordance with the regulatory requirements of the state or territory where the project will be built.

Information provided in the Report may be used to process requests for funding. Completeness and accuracy are therefore essential for timely processing of an application. Please contact the appropriate state or federal funding agencies with any questions about development of the Report and applications for funding as early in the process as practicable.

Questions about this document should be referred to the applicable state administering agency, regional office of the applicable federal agency, or to the following federal contacts:

Agency	Contact	Email Address	Phone
USDA/RUS	Benjamin Shuman, PE	ben.shuman@wdc.usda.gov	202-720-1784
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HUD	Stephen Rhodeside	stephen.m.rhodeside@hud.gov	202-708-1322
IHS	Dana Baer, PE	dana.baer@ihs.gov	301-443-1345

Sincerely,

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Jacqueline M. Ponti-Lazuruk, Assistant Administrator
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/Ronald Ferguson/ 01/16/13
Ronald Ferguson, PE, RADM, Director
Division of Sanitation Facilities Construction, Indian Health Service

/Stanley Girmont/ 01/16/13
Stanley Girmont, Director
Office of Block Grant Assistance, US Department of Housing and Urban Development

Attachment

WORKING GROUP CONTRIBUTORS

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Border Environment Cooperation Commission	Joel Mora, PE
Colorado Department of Local Affairs	Barry Cress
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Montana Department of Commerce	Kate Miller, PE
North Carolina Department of Commerce	Olivia Collier
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North Carolina Department of Commerce	Vickie Miller, CPM
Rhode Island Department of Health	Gary Chobanian, PE
Rhode Island Department of Health	Geoffrey Marchant

ABBREVIATIONS

NEPA – National Environmental Policy Act
NPV – Net Present Value
O&M – Operations and Maintenance
OMB – Office of Management and Budget
Report – Preliminary Engineering Report
SPPW – Single Payment Present Worth
USPW – Uniform Series Present Worth

GENERAL OUTLINE OF A PRELIMINARY ENGINEERING REPORT

1) PROJECT PLANNING
   a) Location
   b) Environmental Resources Present
   c) Population Trends
   d) Community Engagement

2) EXISTING FACILITIES
   a) Location Map
   b) History
   c) Condition of Existing Facilities
   d) Financial Status of any Existing Facilities
   e) Water/Energy/Waste Audits

3) NEED FOR PROJECT
   a) Health, Sanitation, and Security
   b) Aging Infrastructure
   c) Reasonable Growth

4) ALTERNATIVES CONSIDERED
   a) Description
   b) Design Criteria
   c) Map
   d) Environmental Impacts
   e) Land Requirements
   f) Potential Construction Problems
   g) Sustainability Considerations
      i) Water and Energy Efficiency
      ii) Green Infrastructure
      iii) Other
   h) Cost Estimates

5) SELECTION OF AN ALTERNATIVE
   a) Life Cycle Cost Analysis
   b) Non-Monetary Factors

6) PROPOSED PROJECT (RECOMMENDED ALTERNATIVE)
   a) Preliminary Project Design
   b) Project Schedule
   c) Permit Requirements
   d) Sustainability Considerations
      i) Water and Energy Efficiency
      ii) Green Infrastructure

iii) Other

e) Total Project Cost Estimate (Engineer's Opinion of Probable Cost)

f) Annual Operating Budget
   i) Income
   ii) Annual O&M Costs
   iii) Debt Repayments
   iv) Reserves

7) CONCLUSIONS AND RECOMMENDATIONS

DETAILED OUTLINE OF A PRELIMINARY ENGINEERING REPORT

1) PROJECT PLANNING

Describe the area under consideration. Service may be provided by a combination of central, cluster, and/or centrally managed individual facilities. The description should include information on the following:

a) Location. Provide scale maps and photographs of the project planning area and any existing service areas. Include legal and natural boundaries and a topographical map of the service area.

b) Environmental Resources Present. Provide maps, photographs, and/or a narrative description of environmental resources present in the project planning area that affect design of the project. Environmental review information that has already been developed to meet requirements of NEPA or a state equivalent review process can be used here.

c) Population Trends. Provide U.S. Census or other population data (including references) for the service area for at least the past two decades if available. Population projections for the project planning area and concentrated growth areas should be provided for the project design period. Base projections on historical records with justification from recognized sources.

d) Community Engagement. Describe the utility's approach used (or proposed for use) to engage the community in the project planning process. The project planning process should help the community develop an understanding of the need for the project, the utility operational service levels required, funding and revenue strategies to meet these requirements, along with other considerations.

2) EXISTING FACILITIES

Describe each part (e.g. processing unit) of the existing facility and include the following information:

a) Location Map. Provide a map and a schematic process layout of all existing facilities. Identify facilities that are no longer in use or abandoned. Include photographs of existing facilities.

b) History. Indicate when major system components were constructed, renovated, expanded, or removed from service. Discuss any component failures and the cause for the failure. Provide a history of any applicable violations of regulatory requirements.

c) Condition of Existing Facilities. Describe present condition; suitability for continued use; adequacy of current facilities; and their conveyance, treatment, storage, and disposal capabilities. Describe the existing capacity of each component. Describe and reference compliance with applicable federal, state, and local laws. Include a brief analysis of overall current energy consumption. Reference an asset management plan if applicable.

d) Financial Status of any Existing Facilities. (Note: Some agencies require the owner to submit the most recent audit or financial statement as part of the application package.) Provide information regarding current rate schedules, annual O&M cost (with a breakout of current energy costs), other capital improvement programs, and tabulation of users by monthly usage categories for the most recent typical fiscal year. Give status of existing debts and required reserve accounts.

e) Water/Energy/Waste Audits. If applicable to the project, discuss any water, energy, and/or waste audits which have been conducted and the main outcomes.

3) NEED FOR PROJECT

Describe the needs in the following order of priority:

a) Health, Sanitation, and Security. Describe concerns and include relevant regulations and correspondence from/to federal and state regulatory agencies. Include copies of such correspondence as an attachment to the Report.

b) Aging Infrastructure. Describe the concerns and indicate those with the greatest impact. Describe water loss, inflow and infiltration, treatment or storage needs, management adequacy, inefficient designs, and other problems. Describe any safety concerns.

c) Reasonable Growth. Describe the reasonable growth capacity that is necessary to meet needs during the planning period. Facilities proposed to be constructed to meet future growth needs should generally be supported by additional revenues. Consideration should be given to designing for phased capacity increases. Provide number of new customers committed to this project.

4) ALTERNATIVES CONSIDERED

This section should contain a description of the alternatives that were considered in planning a solution to meet the identified needs. Documentation of alternatives considered is often a Report weakness. Alternative approaches to ownership and management, system design (including resource efficient or green alternatives), and sharing of services, including various forms of partnerships, should be considered. In addition, the following alternatives should be considered, if practicable: building new centralized facilities, optimizing the current facilities (no construction), developing centrally managed decentralized systems, including small cluster or individual systems, and developing an optimum combination of centralized and decentralized systems. Alternatives should be consistent with those considered in the NEPA, or state equivalent, environmental review. Technically infeasible alternatives that were considered should be mentioned briefly along with an explanation of why they are infeasible, but do not require full analysis. For each technically feasible alternative, the description should include the following information:

a) Description. Describe the facilities associated with every technically feasible alternative. Describe source, conveyance, treatment, storage and distribution

facilities for each alternative. A feasible system may include a combination of centralized and decentralized (on-site or cluster) facilities.

b) Design Criteria. State the design parameters used for evaluation purposes. These parameters should comply with federal, state, and agency design policies and regulatory requirements.

c) Map. Provide a schematic layout map to scale and a process diagram if applicable. If applicable, include future expansion of the facility.

d) Environmental Impacts. Provide information about how the specific alternative may impact the environment. Describe only those unique direct and indirect impacts on floodplains, wetlands, other important land resources, endangered species, historical and archaeological properties, etc., as they relate to each specific alternative evaluated. Include generation and management of residuals and wastes.

e) Land Requirements. Identify sites and easements required. Further specify whether these properties are currently owned, to be acquired, leased, or have access agreements.

f) Potential Construction Problems. Discuss concerns such as subsurface rock, high water table, limited access, existing resource or site impairment, or other conditions which may affect cost of construction or operation of facility.

g) Sustainability Considerations. Sustainable utility management practices include environmental, social, and economic benefits that aid in creating a resilient utility.

i) Water and Energy Efficiency. Discuss water reuse, water efficiency, water conservation, energy efficient design (i.e. reduction in electrical demand), and/or renewable generation of energy, and/or minimization of carbon footprint, if applicable to the alternative. Alternatively, discuss the water and energy usage for this option as compared to other alternatives.

ii) Green Infrastructure. Discuss aspects of project that preserve or mimic natural processes to manage stormwater, if applicable to the alternative. Address management of runoff volume and peak flows through infiltration, evapotranspiration, and/or harvest and use, if applicable.

iii) Other. Discuss any other aspects of sustainability (such as resiliency or operational simplicity) that are incorporated into the alternative, if applicable.

h) Cost Estimates. Provide cost estimates for each alternative, including a breakdown of the following costs associated with the project: construction, non-construction, and annual O&M costs. A construction contingency should be included as a non-construction cost. Cost estimates should be included with the descriptions of each technically feasible alternative. O&M costs should include a rough breakdown by O&M category (see example below) and not just a value for each alternative. Information from other sources, such as the recipient's accountant or other known technical service providers, can be incorporated to assist in the development of this section. The cost derived will be used in the life cycle cost analysis described in Section 5 a.

Example O&M Cost Estimate	
Personnel (i.e. Salary, Benefits, Payroll Tax, Insurance, Training)	
Administrative Costs (e.g. office supplies, printing, etc.)	
Water Purchase or Waste Treatment Costs	
Insurance	
Energy Cost (Fuel and/or Electrical)	
Process Chemical	
Monitoring & Testing	
Short Lived Asset Maintenance/Replacement*	
Professional Services	
Residuals Disposal	
Miscellaneous	
Total	

* See Appendix A for example list

5) SELECTION OF AN ALTERNATIVE

Selection of an alternative is the process by which data from the previous section, "Alternatives Considered" is analyzed in a systematic manner to identify a recommended alternative. The analysis should include consideration of both life cycle costs and non-monetary factors (i.e. triple bottom line analysis: financial, social, and environmental). If water reuse or conservation, energy efficient design, and/or renewable generation of energy components are included in the proposal provide an explanation of their cost effectiveness in this section.

a) Life Cycle Cost Analysis. A life cycle present worth cost analysis (an engineering economics technique to evaluate present and future costs for comparison of alternatives) should be completed to compare the technically feasible alternatives. Do not leave out alternatives because of anticipated costs; let the life cycle cost analysis show whether an alternative may have an acceptable cost. This analysis should meet the following requirements and should be repeated for each technically feasible alternative. Several analyses may be required if the project has different aspects, such as one analysis for different types of collection systems and another for different types of treatment.

1. The analysis should convert all costs to present day dollars;
2. The planning period to be used is recommended to be 20 years, but may be any period determined reasonable by the engineer and concurred on by the state or federal agency;
3. The discount rate to be used should be the "real" discount rate taken from Appendix C of OMB circular A-94 and found at (www.whitehouse.gov/omb/circulars/a094/a94_appx-c.html);
4. The total capital cost (construction plus non-construction costs) should be included;

5. Annual O&M costs should be converted to present day dollars using a uniform series present worth (USPW) calculation;
6. The salvage value of the constructed project should be estimated using the anticipated life expectancy of the constructed items using straight line depreciation calculated at the end of the planning period and converted to present day dollars;
7. The present worth of the salvage value should be subtracted from the present worth costs;
8. The net present value (NPV) is then calculated for each technically feasible alternative as the sum of the capital cost (C) plus the present worth of the uniform series of annual O&M (USPW (O&M)) costs minus the single payment present worth of the salvage value (SPPW(S)):

$$NPV = C + USPW\ (O\&M) - SPPW\ (S)$$

9. A table showing the capital cost, annual O&M cost, salvage value, present worth of each of these values, and the NPV should be developed for state or federal agency review. All factors (major and minor components), discount rates, and planning periods used should be shown within the table;
10. Short lived asset costs (See Appendix A for examples) should also be included in the life cycle cost analysis if determined appropriate by the consulting engineer or agency. Life cycles of short lived assets should be tailored to the facilities being constructed and be based on generally accepted design life. Different features in the system may have varied life cycles.

b) Non-Monetary Factors. Non-monetary factors, including social and environmental aspects (e.g. sustainability considerations, operator training requirements, permit issues, community objections, reduction of greenhouse gas emissions, wetland relocation) should also be considered in determining which alternative is recommended and may be factored into the calculations.

6) PROPOSED PROJECT (RECOMMENDED ALTERNATIVE)

The engineer should include a recommendation for which alternative(s) should be implemented. This section should contain a fully developed description of the proposed project based on the preliminary description under the evaluation of alternatives. Include a schematic for any treatment processes, a layout of the system, and a location map of the proposed facilities. At least the following information should be included as applicable to the specific project:

a) Preliminary Project Design.

i) Drinking Water:

Water Supply. Include requirements for quality and quantity. Describe recommended source, including site and allocation allowed.

Treatment. Describe process in detail (including whether adding, replacing, or rehabilitating a process) and identify location of plant and site of any process discharges. Identify capacity of treatment plant (i.e. Maximum Daily Demand).

Storage. Identify size, type and location.

Pumping Stations. Identify size, type, location and any special power requirements. For rehabilitation projects, include description of components upgraded.

Distribution Layout. Identify general location of new pipe, replacement, or rehabilitation: lengths, sizes and key components.

ii) Wastewater/Reuse:

Collection System/Reclaimed Water System Layout. Identify general location of new pipe, replacement or rehabilitation: lengths, sizes, and key components.

Pumping Stations. Identify size, type, site location, and any special power requirements. For rehabilitation projects, include description of components upgraded.

Storage. Identify size, type, location and frequency of operation.

Treatment. Describe process in detail (including whether adding, replacing, or rehabilitating a process) and identify location of any treatment units and site of any discharges (end use for reclaimed water). Identify capacity of treatment plant (i.e. Average Daily Flow).

iii) Solid Waste:

Collection. Describe process in detail and identify quantities of material (in both volume and weight), length of transport, location and type of transfer facilities, and any special handling requirements.

Storage. If any, describe capacity, type, and site location.

Processing. If any, describe capacity, type, and site location.

Disposal. Describe process in detail and identify permit requirements, quantities of material, recycling processes, location of plant, and site of any process discharges.

iv) Stormwater:

Collection System Layout. Identify general location of new pipe, replacement or rehabilitation: lengths, sizes, and key components.

Pumping Stations. Identify size, type, location, and any special power requirements.

Treatment. Describe treatment process in detail. Identify location of treatment facilities and process discharges. Capacity of treatment process should also be addressed.

Storage. Identify size, type, location and frequency of operation.

Disposal. Describe type of disposal facilities and location.

Green Infrastructure. Provide the following information for green infrastructure alternatives:

- Control Measures Selected. Identify types of control measures selected (e.g., vegetated areas, planter boxes, permeable pavement, rainwater cisterns).
- Layout: Identify placement of green infrastructure control measures, flow paths, and drainage area for each control measure.
- Sizing: Identify surface area and water storage volume for each green infrastructure control measure. Where applicable, soil infiltration rate, evapotranspiration rate, and use rate (for rainwater harvesting) should also be addressed.
- Overflow: Describe overflow structures and locations for conveyance of larger precipitation events.

b) Project Schedule. Identify proposed dates for submittal and anticipated approval of all required documents, land and easement acquisition, permit applications, advertisement for bids, loan closing, contract award, initiation of construction, substantial completion, final completion, and initiation of operation.

c) Permit Requirements. Identify any construction, discharge and capacity permits that will/may be required as a result of the project.

d) Sustainability Considerations (if applicable).

i) Water and Energy Efficiency. Describe aspects of the proposed project addressing water reuse, water efficiency, and water conservation, energy efficient design, and/or renewable generation of energy, if incorporated into the selected alternative.

ii) Green Infrastructure. Describe aspects of project that preserve or mimic natural processes to manage stormwater, if applicable to the selected alternative. Address management of runoff volume and peak flows through infiltration, evapotranspiration, and/or harvest and use, if applicable.

iii) Other. Describe other aspects of sustainability (such as resiliency or operational simplicity) that are incorporated into the selected alternative, if incorporated into the selected alternative.

e) Total Project Cost Estimate (Engineer's Opinion of Probable Cost). Provide an itemized estimate of the project cost based on the stated period of construction. Include construction, land and right-of-ways, legal, engineering, construction program management, funds administration, interest, equipment, construction contingency, refinancing, and other costs associated with the proposed project. The construction subtotal should be separated out from the non-construction costs. The non-construction subtotal should be included and added to the

construction subtotal to establish the total project cost. An appropriate construction contingency should be added as part of the non-construction subtotal. For projects containing both water and waste disposal systems, provide a separate cost estimate for each system as well as a grand total. If applicable, the cost estimate should be itemized to reflect cost sharing including apportionment between funding sources. The engineer may rely on the owner for estimates of cost for items other than construction, equipment, and engineering.

f) Annual Operating Budget. Provide itemized annual operating budget information. The owner has primary responsibility for the annual operating budget, however, there are other parties that may provide technical assistance. This information will be used to evaluate the financial capacity of the system. The engineer will incorporate information from the owner's accountant and other known technical service providers.

i) Income. Provide information about all sources of income for the system including a proposed rate schedule. Project income realistically for existing and proposed new users separately, based on existing user billings, water treatment contracts, and other sources of income. In the absence of historic data or other reliable information, for budget purposes, base water use on 100 gallons per capita per day. Water use per residential connection may then be calculated based on the most recent U.S. Census, American Community Survey, or other data for the state or county of the average household size. When large agricultural or commercial users are projected, the Report should identify those users and include facts to substantiate such projections and evaluate the impact of such users on the economic viability of the project.

ii) Annual O&M Costs. Provide an itemized list by expense category and project costs realistically. Provide projected costs for operating the system as improved. In the absence of other reliable data, base on actual costs of other existing facilities of similar size and complexity. Include facts in the Report to substantiate O&M cost estimates. Include personnel costs, administrative costs, water purchase or treatment costs, accounting and auditing fees, legal fees, interest, utilities, energy costs, insurance, annual repairs and maintenance, monitoring and testing, supplies, chemicals, residuals disposal, office supplies, printing, professional services, and miscellaneous as applicable. Any income from renewable energy generation which is sold back to the electric utility should also be included, if applicable. If applicable, note the operator grade needed.

iii) Debt Repayments. Describe existing and proposed financing with the estimated amount of annual debt repayments from all sources. All estimates of funding should be based on loans, not grants.

iv) Reserves. Describe the existing and proposed loan obligation reserve requirements for the following:

Debt Service Reserve – For specific debt service reserve requirements consult with individual funding sources. If General Obligation bonds are proposed to be used as loan security, this section may be omitted, but this should be clearly stated if it is the case.

Short-Lived Asset Reserve – A table of short lived assets should be included for the system (See Appendix A for examples). The table should include the asset, the expected year of replacement, and the anticipated cost of each. Prepare a recommended annual reserve deposit to fund replacement of short-lived assets, such as pumps, paint, and small equipment. Short-lived assets include those items not covered under O&M, however, this does not include facilities such as a water tank or treatment facility replacement that are usually funded with long-term capital financing.

7. CONCLUSIONS AND RECOMMENDATIONS

Provide any additional findings and recommendations that should be considered in development of the project. This may include recommendations for special studies, highlighting of the need for special coordination, a recommended plan of action to expedite project development, and any other necessary considerations.

Appendix A: Example List of Short-Lived Asset Infrastructure

Estimated Repair, Rehab, Replacement Expenses by Item within up to 20 Years from Installation)	
Drinking Water Utilities	**Wastewater Utilities**
Source Related	**Treatment Related**
Pumps	Pump
Pump Controls	Pump Controls
Pump Motors	Pump Motors
Telemetry	Chemical feed pumps
Intake/ Well screens	Membrane Filters Fibers
Water Level Sensors	Field & Process Instrumentation Equipment
Pressure Transducers	UV lamps
Treatment Related	Centrifuges
Chemical feed pumps	Aeration blowers
Altitude Valves	Aeration diffusers and nozzles
Valve Actuators	Trickling filters, RBCs, etc.
Field & Process Instrumentation Equipment	Belt presses & driers
Granular filter media	Sludge Collecting and Dewatering Equipment
Air compressors & control units	Level Sensors
Pumps	Pressure Transducers
Pump Motors	Pump Controls
Pump Controls	Back-up power generator
Water Level Sensors	Chemical Leak Detection Equipment
Pressure Transducers	Flow meters
Sludge Collection & Dewatering	SCADA Systems
UV Lamps	**Collection System Related**
Membranes	Pump
Back-up power generators	Pump Controls
Chemical Leak Detection Equipment	Pump Motors
Flow meters	Trash racks/bar screens
SCADA Systems	Sewer line rodding equipment
Distribution System Related	Air compressors
Residential and Small Commercial Meters	Vaults, lids, and access hatches
Meter boxes	Security devices and fencing
Hydrants & Blow offs	Alarms & Telemetry
Pressure reducing valves	Chemical Leak Detection Equipment
Cross connection control devices	
Altitude valves	
Alarms & Telemetry	
Vaults, lids, and access hatches	
Security devices and fencing	
Storage reservoir painting/patching	

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TRIBAL COUNCIL
PHONE: (231) 723-6845
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MASTER AGREEMENT FOR SERVICES

This Contract for Services is between the Little River Band of Ottawa Indians ("Band"), a federally recognized Indian Tribe,
and

Contractor name:
Address:
City: State: Zip code:

Phone no:
Federal ID Number (or social security number if self-employed):

RECITATIONS

The Band, as represented by the Office of Ogema, and the Contractor, _____ _____ (collectively known as the "Parties") do hereby mutually agree and covenant the following:

1. TERM. The length of this Contract is from the _____ day of _____, _____ to the _____ day of _____, _____.

2. SERVICES. The Contractor shall be responsible for providing the following services: (Check one of the following)

☐as listed in _____, attached & incorporated herein. ☐as listed in the space provided.

_____
_____
_____
_____

3. PAYMENT. The Band agrees to pay the Contractor in accordance with the terms of this agreement. Payment for Services is limited to a maximum of _____. The Band agrees to pay the Contractor in the following manner:

_____
_____
_____

4. GRANT FUNDING. The services described in this contract:
(Check one of the following)

☐ are not paid with grant funds. ☐ are paid with grant funds as described in the space provided and/or as described in _____, attached & incorporated herein.

_____

_____

_____

5. NON-DISCLOSURE. No information resulting from this Contract or made accessible to the Contractor may be communicated to any third party for any purpose without the express written permission of the Band.

6. CONFIDENTIALITY. Both Parties recognize and acknowledge that this Contract creates a confidential relationship between the Band and the Contractor. Information exchanged, whether written, oral or otherwise, is confidential in nature. Contractor agrees not to use, directly or indirectly, for its benefit or for the benefit of others, during the term of this Contract, or anytime thereafter, any confidential information which is or may be acquired or developed in connection with or as a result of this Contract.

7. CONTRACTOR RESPONSIBILITIES. Contractor shall apply the necessary skill, effort and diligence consistent with custom and tradition associated with Contractor's performance, art, craft or trade and shall provide all materials needed for Contractor's performance, presentation or service as described in Paragraph 2 of this Agreement.

8. WARRANTIES. Contractor represents and warrants to the Band that it has the experience and ability to perform the services required by this Contract; that it will perform in a professional manner; and that it, or agents acting on its behalf, have the power to enter into and perform this Contract.

9. INSURANCE. Contractor will obtain and maintain throughout the term of this Contract carry appropriate insurance which meets the Band's requirements. Contractor agrees provide the Band with the Certification of Insurance as detailed herein:

a. WORKERS COMPENSATION. The Contractor warrants and represents that it carries the appropriate workers compensation policy coverage and that no persons employed or performing under the terms of this Contract are excluded under that coverage. The Contractor agrees to and shall indemnify and hold the Band harmless against and from any and all loss, damages or costs incurred for any workers compensation claims including but not limited to attorney's fees. The Contractor shall provide the Band with a copy of the Contractor's workers compensation coverage policy prior to signing this Contract;

b. Employer's liability or similar insurance for damages arising out of bodily injury, by accident or disease, including death at any time resulting there from, sustained by employees of Contractor while engaged in performing this Agreement in an amount of no less than $500,000;

c. Comprehensive general liability insurance for bodily injury liability, including death, property damage liability, incurred in connection with the performance of this Agreement with minimum limits of $1,000,000 in respect of claims arising out of personal injury, or sickness or death in any one accident or disaster, and $500,000 in respect of claims arising out of property damage in any one accident or disaster.

d. Comprehensive automobile liability insurance in respect of motor vehicles owned, licensed or hired by Contractor for bodily injury liability, including death and property damage, incurred in connection with the performance of this Agreement with minimum limits of $1,000,000 in respect of claims arising out of personal injury, or sickness, or death in any one accident or disaster, and $500,000 in respect of any claims arising out of property damage in any one accident or disaster

The Contractor warrants and represents that it currently has and will maintain during the term of this Agreement the insurance coverage described herein.

10. TAXES.

a. Employment Taxes. The Contractor shall be responsible for all withholding and any other employment taxes due to any taxing authority.

b. Sales and Use Tax. The Band is exempt from Michigan sales and use tax on tangible personal property and materials for affixation that are purchased and used within the reservation. The Contractor shall be responsible for obtaining tax exemption certificates from the Band's Tax Office if taxable materials are included in this Contract.

11. ASSIGNMENT, SUBCONTRACTING. This Contract may not be assigned by either Party for any reasons. The Contractor may sub-contract any or all services provided in the Contract with the prior written approval of the Band, provided that all terms, limitations, and requirements of this Contract shall be applicable to any sub-contractor.

12. TERMINATION. This Contract may be terminated upon thirty (30) days advance written notice by either Party. In the event of termination, no payment of services shall be rendered unless the service was rendered or produced prior to receipt of notice of termination.

13. INDEPENDENT CONTRACTOR STATUS. The Parties hereto expressly understand and agree that Contractor is acting as an independent contractor in the performance of each and every part of this Agreement. Contractor has no authority to bind, obligate, or speak for the Band. Contractor is not currently an employee of the Band or any of its enterprises, and Contractor will promptly notify the Purchasing Office of the Tribal Government if there are any in that status.

14. PROTECTION OF PROPERTY AND PERSONS. Contractor shall at all times conduct Contractor's activities safely and shall provide necessary safeguards for the protection of participants, members of the public and real and personal property. Contractor shall indemnify and hold the Tribe harmless for any and all property, injury or other loss or damage resulting from the negligence of the Contractor, and for claims brought against and or expenses (including attorney fees) incurred by the Tribe resulting from Contractor's activities.

15. VALIDITY OF CONTRACT. This contract shall not be valid or enforceable prior to ratification by the Tribal Council. Tribal Council ratified this Contract pursuant to Resolution# _____.

16. ENTIRE AGREEMENT. This Contract, together with Attachments referenced and incorporated in the Contract, reflects and contains the entire agreement between the Parties.

17. VENUE; CHOICE OF LAW. Venue for any dispute arising out of this Contract shall be the Little River Band of Ottawa Indians Tribal Court. This Contract, and any disputes arising out of this Contract, shall be governed by the laws of the Little River Band of Ottawa Indians.

18. SOVEREIGN IMMUNITY. Nothing in this Contract shall be construed to be a waiver of the sovereign immunity of the Little River Band of Ottawa Indians or any of its subordinate enterprises or entities.

19. AMENDMENT. Any amendment to this Contract must be made in writing and must be signed by the Parties and ratified by the Tribal Council.

20. SEVERABILITY. Should any provision of this Contract, or part thereof, be held under any circumstances in a court of competent jurisdiction to be invalid or unenforceable, such invalidity or unenforceability shall not affect the validity or enforceability of any other provision of this Contract or other part of such provision.

21. NOTIFICATION OF TRIBAL REGISTRATION REQUIREMENTS FOR SEX OFFENDERS. In accordance with the Tribe's Sex Offender registration laws, Ordinance #11-400-11, any sex offender (Tribal member and non-tribal member) from any jurisdiction has a duty to register with the Tribe's Public Safety Department if they work, live, or go to school on Tribal land. This includes any individual who provides services to the Tribe and its Enterprises, whether they are a contractor, employee, vendor, or an employee of a vendor. Tribal land includes all land owned by the Tribe, whether in fee or Trust. Registration in another jurisdiction does not absolve an offender from their obligations to register under Tribal law.

Little River Band of Ottawa Indians	_____
By: _____	By: _____
Its: Tribal Ogema	Its: Principal _____
Date: _____	Date: _____