MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE COMMUNICATION

TO: C. Heidi Grether, Director
Department of Environmental Quality

FROM: Eric Oswald, Director
Drinking Water and Municipal Assistance Division

DATE: April 2, 2018

SUBJECT: Nestlé Waters North America, Inc.
Application for Permit to Increase the Water Withdrawal from Production Well 101

Nestlé Waters North America, Inc. (Nestlé) has requested to increase their withdrawal from the production well known as Production Well (PW)-101 from 250 gallons per minute (gpm) to 400 gpm. PW-101 was established in 2001 with a baseline capacity of 150 gpm. In April 2015, Nestlé increased the capacity of the well by 100 gpm via registration through the Water Withdrawal Assessment Tool. With the subsequent request of an additional 150 gpm, the total request above baseline is 250 gpm or 360,000 gallons per day (gpd) which exceeds the 200,000 gpd threshold that requires a permit.

This evaluation examines whether the proposed withdrawal meets the requirements of Section 17, of the Michigan Safe Drinking Water Act, 1976 PA 399, as amended (Act 399). Quotes from statutes are shown in italics and discussion is shown in standard font. Only the relevant portions of the applicable statutes are included below.

Nestlé requested evaluation under Section 17 in a July 16, 2016, application package, supplemented with additional requested submittals in March and November of 2017.

<u>Section 17, of Act 399 states:</u>

MCL 325.1701(3) A person who proposes to engage in producing bottled drinking water from a new or increased large quantity withdrawal of more than 200,000 gallons of water per day from the waters of the state or that will result in an intrabasin transfer of more than 100,000 gallons per day average over any 90-day period shall submit an application to the department in a form required by the department containing an evaluation of environmental, hydrological, and hydrogeological conditions that exist and the predicted effects of the intended withdrawal that provides a reasonable basis for the determination under this section to be made.

Department of Environmental Quality (DEQ) staff reviewed the July 16, 2016, submittal and requested additional information on February 14, 2017, which Nestlé provided on March 16, 2017. Evaluation of the newly submitted information generated more questions, and a second request for additional information was issued on June 21, 2017. Nestlé submitted the additional information on November 3, 2017. Extensive evaluations have been completed by technical staff in the DEQ and the Department of

Natural Resources (DNR). Nestlé continued to provide information and data in response to staff requests as the evaluations progressed, through mid-February 2018. As discussed below and in the accompanying technical memos, staff conclude that the information, in total, provides a reasonable basis to make a determination under this section.

MCL 325.1701(4) The department shall only approve an application under subsection (3) if the department determines both of the following:

(a) That the proposed use will meet the applicable standard provided in Section 32723 of the natural resources and environmental protection act, 1994 PA 451, MCL 324.32723.

The applicable standard referenced is Section 32723(6), which details the conditions that, if met, require the DEQ to issue a permit. Although this application and subsequent permit decision falls under the umbrella of Act 399, technical evaluations were required by reference to other statutes, enforced by multiple divisions of the DEQ and divisions of the DNR. Those evaluations were completed by the staff who normally enforce the statutes and are familiar with the reviews. After thoroughly considering the information provided by Nestlé, other available information, including relevant information provided through tribal consultation and public comment, staff conclude that the proposed use, subject to the conditions contained in the permit will meet the applicable standard. A discussion of the standard follows:

324.32723(6) The department shall issue a water withdrawal permit …if all of the following conditions are met:

(a) All water withdrawn, less any consumptive use, is returned, either naturally or after use, to the source watershed.

The proposed withdrawal is essentially 100 percent consumptive. Water withdrawn from the Great Lakes Basin and packaged within the Great Lakes Basin in a container that is less than 5.7 gallons is considered a consumptive use as defined in the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Act 451). MCL 324.32701(k). The applicant reports that the small volume of water not packaged is returned to the Muskegon River watershed where it was withdrawn. These returns happen at the well site, at the loading station in Evart, Michigan, and at the facility in Stanwood, Michigan.

(b) The withdrawal will be implemented so as to ensure that the proposal will result in no individual or cumulative adverse resource impacts…

Adverse resource impacts (ARI) in this instance is specifically defined in Part 327 of the Natural Resources and Environmental Protection Act (NREPA), in terms of certain impacts on fish populations, stream flows, or decreasing the level of a lake or pond with a surface area of five acres or more, 32701 (a) (ii) – (vi). Nestlé submitted a groundwater model to represent current conditions and to simulate water levels in the aquifer, on depletion from streams, and on the net effect on water movement through the wetlands as a result of pumping at the proposed increased capacity. The initial version of the model was not accepted so a modified model was submitted.

DEQ Water Resources Division staff completed an extensive review of the model. A copy of the review is attached. The review included an evaluation of the conceptual model, model grid, boundary conditions, parameter sensitivity analyses, model calibration, and groundwater modeling report. They conclude that the final groundwater model is adequately calibrated and can reproduce the site water levels and stream flows to a reasonable degree.

As with any model, there are uncertainties associated with the model output. There is one area, SF-8, where the model, simulating pumping at 400 gpm after 20 years, predicts a streamflow depletion >20 percent of the index flow calculated by DEQ staff at this location as part of the permit application review. Part 327 defines ARI as a greater than 20 percent reduction of stream index flow in cold water streams. The model predicted stream flow depletion from the index flow for pumping at 250 gpm above baseline capacity (i.e., 400 gpm total) does not exceed 20 percent after 20 years. Staff note that there is also uncertainty in the predictions at SF-8 because of the characteristics of the location; the stream monitored is very small and the area is subject to temporary ponding of water. These circumstances indicate a need to monitor the area in question closely and reduce pumping immediately if an ARI appears possible with continued pumping. Staff conclude that based on the measured and modeled flows at SF-8, ongoing and expanded monitoring in this location is warranted if the request to increase pumping to 400 gpm is approved. The complete evaluation of streamflow depletions is attached as the Stream Flow Technical Review.

(c) *Subject to section 32723, the withdrawal will be implemented so as to ensure that it is in compliance with all applicable local, state, and federal laws as well as all legally binding regional interstate and international agreements, including the boundary waters treaty of 1909.*

The following potentially applicable laws were evaluated.

Part 303 (Wetlands Protection) of the NREPA, MCL 324.30301

Part 303 requires permits for certain activities in regulated wetlands, including draining surface water from a wetland. Wetlands staff have reviewed the water budget predictions for wetlands from the point of withdrawal out to the 0.05 foot drawdown contour. They conclude that a permit is not required for the proposed activity. The small drawdown levels predicted within the wetland complexes connected to the regional aquifer are within the variability inherent in the groundwater model.

Staff recommend incorporating baseline and long-term monitoring into the permit conditions. The monitoring plan should incorporate detailed hydrology and vegetation sampling, performance standards and reporting, all designed to detect potential impacts to wetlands as a result of draining surface water from a wetland. If monitoring data show measurable effects on the wetlands, the permittee should be required to reduce pumping to 250 gpm and provide a corrective action plan to the DEQ. The wetland staff evaluations are attached for reference.

Part 342, Great Lakes-St. Lawrence River Basin Water Resources Compact, MCL 324.34201

In Section 4.10 of this interstate compact and a parallel international agreement with the Provinces of Ontario and Quebec, each state, including Michigan, committed itself to create a program for management and regulation of new or increased withdrawals and consumptive uses from the Basin, consistent with the decision-making standard contained in Section 4.11.

Michigan implemented the Compact in 2008 through amendments to Part 327, which adopted a decision-making standard in 32723(6) that is based on Section 4.10 of the Compact, with the exception of the statutory criteria for reasonable use in Compact Section 4.11. Reasonable use under the Compact is based on the evaluation of factors listed below.

1) *Whether the proposed Withdrawal or Consumptive Use is planned in a fashion that provides for efficient use of the water, and will avoid or minimize the waste of Water;*

   Wise use is made of existing water supplies in that the water supply when not needed is simply not used. There is no need to pump to waste and the bottling process generates little waste water.

2) *If the Proposal is for an increased Withdrawal or Consumptive Use, whether efficient use is made of existing water supplies;*

   Nestlé has self-certified that they are, and will remain, in compliance with industry standard practices ensuring efficient use of the water. The proposed use does not conflict with any other current uses of the aquifer. Future proposals must be accommodated to ensure equal access to the resource.

3) *The balance between economic development, social development and environmental protection of the proposed Withdrawal and use and other existing or planned withdrawals and water uses sharing the water source;*

   There will be modest economic benefits to the local community through increased jobs, taxes, and a reputation as an area of exceptional environmental quality. No negative environmental or social effects are evident or anticipated.

4) *The supply potential of the water source, considering quantity, quality, and reliability and safe yield of hydrologically interconnected water sources;*

   Application materials, extensive evaluation and consideration by staff, along with experience with the aquifer in the area, lead staff to conclude that the aquifer can sustain the proposed withdrawal without deleterious effects to the dependent resources.

5) *The probable degree and duration of any adverse impacts caused or expected to be caused by the proposed Withdrawal and use under foreseeable conditions, to other lawful consumptive or non-consumptive uses of water or to the quantity or quality of the Waters and Water Dependent Natural Resources of the Basin, and the proposed plans and arrangements for avoidance or mitigation of such impacts; and*

   Any permit will include monitoring with defined trigger points, the crossing of which would require actions which may include a reduction in pumping if measured values indicate that an unacceptable impact is possible, contrary to staff assessments.

6) *If a Proposal includes restoration of hydrologic conditions and functions of the Source Watershed, the Party may consider that.*

   The proposal does not anticipate any negative impacts that would necessitate restoration nor is Nestlé proposing preemptive mitigation measures or actions. Monitoring and operating conditions included in the permit are designed to detect and avoid impacts before they occur.

Part 17 (Michigan Environmental Protection Act) of NREPA, MCL 324.1701

Part 17 is a statute of broad application that is intended to protect the air, water, and other natural resources and the public trust in those resources from pollution, impairment, or destruction.

Staff reviews support the conclusion that the activity proposed, subject to the conditions of this permit, will not cause pollution, destruction, or impairment of natural resources or the public trust therein. In addition to the DEQ staff technical reviews discussed above, the following environmental evaluations by DEQ and DNR staff also support that conclusion:

Aquatic Life and Aquatic Habitat

Staff biologists reviewed the macroinvertebrate and aquatic life population data and water characteristics collected along Chippewa Creek and Twin Creek over multiple years. Stream depth and width were also reviewed for multiple stations in the immediate drainage area. They conclude that the predicted changes in stream flows and water depth will have a negligible effect on macroinvertebrate life, aquatic life, temperature, and dissolved oxygen levels in the creeks. They recommend ongoing monitoring of surface water quality parameters and periodic biological surveys if the permit is granted. Their evaluation is attached.

Threatened and Endangered Species, Fisheries, and Wildlife Review

Staff biologists in the DNR reviewed the application materials and information from the Michigan Natural Features Inventory to evaluate whether the proposed activity would impact terrestrial or aquatic plant and animal species. They observe that the proposed activity is unlikely to result in a dramatic increase in stream temperatures. It follows that temperature sensitive species would not be impacted. They also note that four mussel species and one fish species listed as being of Special Concern are identified in the Michigan Natural Features Inventory County Element database for the area. They further note that those species have not historically been found in these creeks and maintain that it is unlikely that they would be found in the habitats identified in Twin and Chippewa Creeks. They recommend monitoring for these species and well as stream temperature. Their review memo is attached for reference.

1836 Treaty of Washington and Consent Decree in *United States v Michigan*

The 1836 Treaty of Washington is a legally binding agreement between the United States government and several Native American tribes, under which the Tribes ceded certain territory to the United States, including the area in the vicinity of the proposed activity, while reserving rights to hunt, fish, and gather in the ceded territory. The 2007 consent decree in *United States v Michigan* addressed the legal rights and responsibilities of the signatory tribes, the United States, and the State of Michigan under the treaty. Both the treaty and the consent decree are federal law.

The technical and, environmental reviews discussed above support the conclusion that the activity proposed, subject to the conditions of this permit, will be implemented so as to ensure that it is in compliance with the treaty and the consent decree.

(d) The proposed use is reasonable under common law principles of water law in Michigan.

In applying this condition of Section 32723(6), the Department has referred to the leading, and most relevant Michigan appellate court decision, *Michigan Citizens for Water Conservation v Nestlé, 269 Mich App 25 (2005)*. In that case, the Michigan Court of Appeals explained the common law "reasonable use balancing test" that is to be used on a case-by-case basis to balance competing interests in the use of shared water resources. The factors, a brief explanation of each, and a brief discussion of each follow:

- *<u>The purpose of the proposed use</u> – this includes considering whether the use is "natural" (i.e. uses necessary for the existence of the landowner) or "artificial" (e.g. commercial profit or recreations), and whether the use benefits the land from which it is extracted. Uses that benefit the riparian land from which the groundwater is removed are given preference over uses that ship the water away.*

  Withdrawing the water for bottling is "artificial," in that it proposes to use the water for a profit-making enterprise. The proposed use, subject to the conditions of the permit, does not significantly reduce the benefits of the resource to the dependent communities. Nestlé has to maintain the discharge to the spring as a matter of maintaining it as a source of spring water and is also motivated to protect nearby land to preserve water quality. The conditions of the permit assure that the system will be closely watched and the increased pumping will be reduced or suspended if impacts appear possible.

- *The suitability of the use to the location – This includes considering the nature of the water resource affected, (e.g. whether it is ample and would only be marginally affected, or marginal so the effects could be more significant), and the pattern of local uses to which water resources are customarily put in the area affected.*

  Conclusions of the technical reviews are that the aquifer can sustain the proposed withdrawal without unacceptable consequences for the natural systems that depend on the water. The location is one of a limited number of locations where one might withdraw water and be able to market it as spring water. Local use of the aquifer is primarily as a drinking water source and for recreation. The proposed activity, subject to the conditions of the permit, will not harm those other uses.

- *The extent and amount of harm caused by the use – this includes considering not only the economic harm and benefits to the parties, but also the social benefits and cost of such use, such as its effect on fishing, navigation, and conservation. Protecting existing uses is an important consideration in balancing competing uses.*

  The proposed activity, subject to the conditions of the permit, is expected to have economic benefits to Nestlé and the community through increased jobs and revenue with no discernable economic harm. There is no anticipated effect on fishing, navigation, or conservation. The extensive monitoring included as permit conditions will increase awareness of the plant and animal community's abundance and distribution.

- *The extent, duration, necessity and application of the use, including any effects on the quantity, quality, and level of the water. A use that is excessive, or unnecessary and harms another's use, is unreasonable, especially if it can be readily modifies to mitigate the harm.*

  The proposed use, subject to the conditions of the permit, is not excessive. Technical evaluations indicate that the aquifer and its dependent natural features can sustain the increased pumping without harm. The conditions included stipulate actions that will modify the permitted activities if harm is anticipated. There is no anticipated significant negative effect on the natural uses of the water and water dependent features from the proposed use. The proposed use will not diminish other users of the resource.

- *Any other factor relevant under the circumstances of the particular case.* *The court did not provide any examples of other factors.*

  Recognizing that a number of conclusions are based on models that estimate the effects of pumping and this is the first application reviewed under Section 17 of Act 399; significant monitoring requirements are recommended to confirm that the system responds as expected.

Based on the considerations above and the conclusions of the technical evaluations, staff have determined that the proposed use is reasonable. The permit, subject to the conditions, will ensure fair participation for all parties to realize the benefits of the resource, the use of the water supply as a source of water for bottling has value and is a reasonable use, and there will be no unreasonable harm.

(e) For permit applications received on or after January 1, 2009, the applicant has self-certified that he or she is in compliance with environmentally sound and economically feasible water conservation measures developed by the applicable water user's sector under section 32708a or has self-certified that he or she is in compliance with environmentally sound and economically feasible water conservation measures developed for the water use associated with that specific withdrawal.

The application was received on July 16, 2016, after the above referenced date. Nestlé has self-certified in Section 5.0 and Attachment A-10 of their application that they are, and will remain, in compliance with established conservation measures.

(f) The department determines that the proposed withdrawal will not violate public or private rights and limitations imposed by Michigan water law or other Michigan common law duties.

In determining that no ARI is expected, that the use of the resource by others will not be impacted, that no threatened or endangered species are impacted, that no wetland permit is needed, that fish and macroinvertebrate populations are expected to continue to thrive as before the pumping, and by incorporating extensive monitoring with thresholds that will require reduced pumping, if crossed, the staff find no reason to conclude public or private rights or limitations as imposed from any law will be violated. In, addition, the permit explicitly states that the withdrawal permit does not affect any other public or private legal rights

(b) The person will undertake activities, if needed, to address hydrologic impacts commensurate with the nature and extent of the withdrawal. These activities may include those related to the stream flow regime, water quality, and aquifer protection.

The extensive technical evaluations, attached, do not lead staff to conclude that the proposed activity, subject to the conditions of the permit, will have hydrologic impacts. As a condition of the permit, the holder is required to monitor a wide range of parameters to compare to thresholds the crossing of which will be assumed to presage unacceptable environmental impacts. The conditions further stipulate actions the permit holder must take immediately if a threshold is crossed. Actions include reducing or suspending withdrawals in excess of currently approved capacity (250 gpm) until the threat of possible impact has passed.

Thresholds will be set at regulatory criteria if available, stream temperature, for example. In the absence of established criteria, thresholds will be set with reference to baseline data which is to be collected at the outset of monitoring. The baseline information is intended to offer a comprehensive data set collected using consistent and agreed upon methods, times, and measures. It will represent site conditions that exist at the time the permit was issued.

MCL 325.1701(5) Before proposing activities under subsection (4)(b), the person proposing to engage in producing bottled drinking water shall consult with local government officials and interested community members.

The following condition in the permit ensures that the applicant will consult with local officials and community members: "If, pursuant to this permit, or at the direction of the Department, or on its own initiative, the permit holder proposes to pursue activities under subsection (4)(b) of Section 17 (activities to address hydrologic impacts), the permit holder or their representative shall submit a plan to the Department for consideration and approval. The plan must include sufficient supporting information such that the Department can reasonably determine that the proposed activities are warranted and are likely to be effective. The plan must include provisions for consulting with the community. Approval from the Department is required prior to implementing activities".

MCL 325.1701(6) Before making the determination under subsection (4), the department shall provide public notice and an opportunity for public comment of not less than 45 days.

The public comment period opened on September 19, 2016, and closed at 5:00 p.m. on April 21, 2017, a total of 214 days.

MCL 325.1701(7) If the person proposing to engage in producing bottled drinking water under subsection (3) does not have a permit under section 4, the person shall request a determination under subsection (4) when that person applies for a permit under section 4. If the person proposing to engage in producing bottled drinking water has previously received a permit under section 4, the person shall obtain approval under subsection (4) prior to beginning the operations. A proposed use for which the department makes a determination that the conditions of subsection (4) will be met shall be considered to satisfy the requirements of section 4.11 of the compact.

At the time of this review, Nestlé did not hold a permit under Section 4. This application constitutes application under Section 4. Nestlé submitted an application in July 2016, has participated in multiple discussions with DEQ staff, and has submitted additional information as requested.

MCL 325.1701(8) A person seeking a departmental determination under subsection (4) shall submit an application fee of $5,000.00 to the department. The department shall transmit application fees received under this section to the state treasurer to be credited to the water use protection fund created in section 32714.

Nestlé has paid the $5,000 fee.

The remaining paragraphs of Section 17, while relevant and applicable, do not require a discussion to demonstrate compliance.

In conclusion, after extensive consideration and analysis of the application and other available information, as well as consultation with DNR staff on natural resource issues and with staff of the Department of Attorney General on legal issues, technical staff within the DEQ recommend that the permit, subject to all the included conditions, be issued.

Attachments

Attachment I

Groundwater Model Technical Review

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE COMMUNICATION

TO: FILE

FROM: Jill Van Dyke, C.P.G., Geology Specialist, Great Lakes Shorelands Unit
Surface Water Assessment Section, Water Resource Division

DATE: March 30, 2018

SUBJECT: Technical Review – Nestle White Pine Springs Modified MODFLOW-USG Model Review

Background

Nestle Water North America, Inc. submitted an application to the Michigan Department of Environmental Quality (MDEQ) in July 2016 seeking approval under Section 17 of the Michigan Safe Drinking Water Act, 1976 PA 399, as amended (Act 399) to increase water production (for bottled water) from an existing well (PW-101) at the site referred to as "White Pine Spring" (WPS) located north of Evart, Michigan. Nestle proposes to increase its withdrawal from a current capacity of 250 gallons per minute (gpm) to 400 gpm continuous. An initial groundwater simulation and report for 250 gpm increased pumping from PW-101 was submitted to the MDEQ March 17, 2017. On June 21, 2017, following a review of the initial groundwater simulation, the MDEQ requested a revised groundwater model and report that better evaluated the interactions between the streams, wetlands, and aquifer. A modified groundwater model and Addendum Report was submitted to the MDEQ November 3, 2017, with subsequent information needed for the review and clarifications being sent up until February 13, 2018.

Executive Summary

This report summarizes the results of the MDEQ review of the Nestle modified groundwater model submitted in a Permit Application Package under Section 17 of the Michigan Safe Drinking Water Act, 1976 PA 399, as amended. The modified groundwater model submitted in November 2017 as detailed in *An Addendum to the Evaluation of Groundwater and Surface Water Conditions in the Vicinity of Well PW-101, Osceola County, Michigan* by S.S. Papadopulos & Associates, Inc. (SSPA) dated November 2017 (Addendum Report) replaces the original groundwater model submitted and documented in a report titled *Evaluation of Groundwater and Surface Water Conditions in the Vicinity of Well PW-101, Osceola County, Michigan* by SSPA, dated July 2016. The modified groundwater model was submitted to better evaluate the potential effects of groundwater withdrawals from the Nestle well PW-101 located at the White Pine Springs Site by including definitions for streams, wetlands, seeps, and rivers into the conceptual model development.

The MDEQ review consisted of the evaluation of the modified groundwater model submitted by SSPA/Nestle on November 17, 2017. The review included an evaluation of the conceptual model, model grid, boundary conditions, parameter sensitivity analyses, model calibration, and groundwater modeling report. With the exception of the groundwater modeling Addendum

Report, the aspects of the components of the modified model were determined to be appropriate.

However, the MDEQ believes that there were enough model changes to warrant a completely revised groundwater modeling report for the modified model as requested by the MDEQ in a letter dated June 21, 2017. However, only an addendum report was submitted that described the modified model changes. Therefore, complete model documentation requires referring back to the original model report for any model aspect that was not changed as described in the addendum. In addition, the Addendum Report did not provide all the information necessary which resulted in multiple requests for the required information to ensure that all the appropriate documentation was submitted. This resulted in additional review time and delays.

To assist in the review of the modified model, SSPA submitted the model files in a format that could be viewed in the Groundwater Vistas graphical interface. The actual modified groundwater model simulations and the Parameter Estimation code (PEST) evaluations were run by SSPA from the DOS prompt using script files rather than using the Groundwater Vistas graphical interface in part due to issues with the interface or simulation processing speeds and efficiency. This resulted in several apparent modeling artifacts found in the Groundwater Vistas files that SSPA provided to aid in the MDEQ's review. Further explanation of these artifacts was provided by SSPA staff and these explanations were evaluated as reasonable.

The overall modified model appears to be a calibrated model that can match the general groundwater levels and stream flow conditions. The calibration is constrained by both matching groundwater levels and stream flows which lower the uncertainty or "non-uniqueness" of the model. The predicted effects based on the groundwater model simulating continuous pumping of PW-101 at 150 gpm for 10 and 20 years, 250 gpm for 10 and 20 years, and 400 gpm for 10 to 20 years are summarized in the following sections.

Both Twin Creek and Chippewa Creek are cold stream watersheds meaning that Part 327 only authorizes 20 percent or less cumulative stream flow reduction in the index flow before a cold watershed moves into a Zone D or potential ARI conditions. As noted on Table 1 – Flow and Flow Reduction Comparisons and Estimates – Nestle SSPA Groundwater Model, the modified model predicts less than 11 percent stream flow reduction from index flow for 400 gpm continuous pumping from PW-101 for 20 years simulation for both Twin and Chippewa Creeks with the exception of Chippewa Creek location SF-8 located within wetland A just upstream of Decker Ponds. After pumping PW-101 at 400 gpm for 20 years the model predicts a 26.7 percent flow reduction from the index flow at location SF-8. In addition, the modified groundwater model predicts roughly 0.7 feet (ft.) or less of drawdown in the wetlands to the west and south of PW-101 that have been reviewed for potential adverse resource impacts (ARI) as noted on Table 2 – Drawdown Estimates Read from the SSPA-Nestle Groundwater Model Files. Small areas of the local wetlands have an uncertainty of a slightly larger drawdown of 0.9 ft. or less occurring due to model uncertainty.

Based upon this review, the modified model is capable of matching the groundwater levels and stream flows in conditions that are consistent with the precipitation and recharge assumptions applied in the model. However, several locations were identified that exhibit increased uncertainty as noted in the following sections. Should a permit be issued, it is recommended that select areas of the site near or in wetlands, springs, or streams should employ additional monitoring that would be part of a post audit protocol to include response actions if expected drawdown, water level, or stream flow reductions are exceeded.

Groundwater Model Technical Review

Conceptual Model – The basic site conceptual model used in the previous 2016 groundwater model was used for the modified model. However, the modified model encompassed a much larger area (approximately 320 square-miles) than the original model (50-square miles) and was developed using the MODFLOW-USG software code instead of MODFLOW 2000. The modified model consisted of nine layers (compared to five layers in the original 2016 model) that extend to an elevation of 700 ft. above MSL (compared to 900 ft. above MSL in the original 2016 model) to include more of the glacial sediments observed on well records. The finite-difference grid uses natural rivers as the external model boundaries and grid refinement to 50-foot square grid cells in the area of the PW-101 well. Stream, river, drain, or lake, boundary cells were used to define the areas hydrological features such as streams, creeks, rivers, seeps, springs, wetlands, and ponds in the PW-101 site area which is appropriate. The boundary conditions representing the edge of the model and the internal hydrological features of the model were reviewed and also appear to be appropriate.

Recharge – Following discussion with Nestle and SSPA staff, the MDEQ suggested using a more reasonable recharge rate than the constant 14 inches/year used in the initial model. It was agreed that the recharge distribution used in the Groundwater Inventory Mapping (GWIM) Project 2005 should at least be used as a starting point in the model. The model recharge rates were based on the Groundwater Inventory Mapping Project estimates for each square mile in the model area and ranged from 5 to 15 inches per year. The recharge rates between 9 and 10 inches per year used in the area of PW-101 for the modified model also appear to be appropriate based on United States Geological Survey (USGS) estimates and local weather station data.

For the evaluation of the seasonal surface water flows in and out of the wetlands for use in the wetlands budget analyses, the modified model was run starting with the initial conditions from the calibrated steady-state groundwater model and then varying the recharge rate monthly to simulate seasonal changes in recharge. Recharge was specified as zero from November through late February when surface soils are typically frozen and small during the summer and fall months. Since the groundwater model's recharge rates were specified as annual average values, SSPA applied a recharge scaling factor to proportion the yearly recharge to a monthly basis (Addendum Report page 22). SSPA ran the monthly simulation for the normal year twice but only output the second year so it is calibrated. The stress periods from 13 to 24 represent the seasonal cycle for the "normal" year. The "normal" year rates were then reduced by 30 percent to represent the "dry" year and then were increased 30 percent above the "normal" year rates to represent the "wet" year. The "wet" and "dry" years were then simulated for two years using the initial conditions determined from the "normal" year. The "normal", "wet", and "dry" year scaling factor was provided by MDEQ wetland staff as a typical approach for the wetlands evaluation.

Aquifer Parameters

Hydraulic Conductivity - The hydraulic conductivity was initially estimated for the regional portion of the modified modal based on the transmissivity values from the

GWIM project and dividing that value by the thickness of the glacial aquifer at that location. The vertical hydraulic conductivity was estimated as one-tenth of the horizontal hydraulic conductivity which is a typical method. The initial estimates of hydraulic conductivity in the local model area around PW-101 were the calibrated hydraulic conductivity values from the original 2016 groundwater model. These values were subsequently adjusted during model calibration.

The hydraulic conductivity values were reviewed and found to be consistent with information described on the area soil borings or well log records that were provided.

Conductance - Conductance for the seeps, streams, rivers, wetlands is based on the thickness of the deposits at the base of the feature, and the vertical hydraulic-conductivity of these soils. The conductance was defined for this model as a leakance or vertical hydraulic conductivity divided by the thickness. This normalized conductance value was reported to range between 1 to 10 ft./day. More detailed information regarding the conductance of the wetlands, streams, rivers, and ponds is found in the Addendum Report (page 14). The methods described appear to be appropriate based on what is known of the site geology and hydrogeology from onsite soil borings and flow measurements.

Specific Yield - A specific yield of 0.14 and a storage coefficient of 10^{-5} were specified in each model layer for all transient model simulations (storage is not a factor in steady-state models). These values are consistent with storage parameters estimated from an aquifer test conducted at PW-101 in June 2001 and an aquifer test at the test wells TW-1, TW-2 and TW-3 in August 2000 and represent site-specific information. However, the specific yield value would be expected to vary in areas of finer sediments or thin varied layered sediments.

Model Parameter Estimation and Sensitivity Simulations – the software program PEST was used to evaluate the sensitivity of parameters based on observation data. SSPA indicates that the most sensitive model parameter was found to be the horizontal and vertical hydraulic conductivity in the upper five model layers. SSPA conducted the standard sensitivity analysis but since the model is constrained by water level and flow data, and hydraulic conductivity values calculated based on the two aquifer tests conducted at the site, the need for further modifications were not identified. Four sensitivity simulation models were provided that independently varied the modified model horizontal and vertical hydraulic conductivities by plus and minus 25 percent. Table H-2 in the Addendum Report compares the stream flows in the calibrated model with the results of the vertical and horizontal hydraulic conductivity simulations.

The sensitivity of the model to variations in the specific yield of the aquifer were also conducted. The modified model uses a constant specific yield of 0.14 that was calculated based on the on-site aquifer testing. Based on the variations in the coarse grained aquifer materials observed in site well logs, it is possible that the specific yield could range from values of 0.10 to 0.25 as indicated in the report. Sensitivity simulations were run to evaluate the drawdown response changes related to the range in possible specific yield values and 250 gpm pumping from PW-101. If the hydraulic conductivity is more in the range of the 0.1, there could be slightly higher drawdown at the southern wetlands. The MDEQ ran a 400 gpm simulation with continuous pumping from PW-101 and the specific yield of 0.10. The drawdown predicted at the wetlands was very similar to the same simulation using the 0.14 value for specific yield except that the drawdown at wetland G, for example, was approximately 0.2 ft. higher at 0.5 ft.

The parameters used in the model appear to be appropriate based on available site data that was reviewed. It is possible that the slightly higher residuals observed in a few select areas may be due to the actual hydraulic conductivity or specific yield values differing from the modified model values.

Calibration - The steady-state modified model was calibrated for the period of time from 2007 through 2016 using Nestle site monitoring data. This period of time was reportedly chosen because of the length and quality of the water level and availability of stream flow data. There was some pumping from the aquifer from PW-101 of between 50 to 200 gpm until the last months of 2015 into 2016, so the calibration period 2007 to 2016 does not strictly represent the baseline before any activity at the PW-101 well. However, a review of the median water levels used over the ten-year period do not show effects of the limited pumping. As indicated, the water level targets used were the median values collected from monitoring points from 2007 to 2016 and were used to represent average conditions. When compared to the median target values for the period 2001-2002 (a more limited data set), the water levels during the modified model calibration period (2007-2016) were slightly higher than the earlier water level measurements. The median water level values in the groundwater modeling Addendum Report were consistent with the median water levels that the MDEQ calculated based on monitoring data previously submitted to the Department.

A review of the residual difference between the 2001-2002 median water level targets and the 2007-2016 targets found a range from -0.2 ft. near the White Pine Springs to -0.82 ft. to the northeast and MW-108 indicating that the median target levels used were higher than the early water level measurements in 2001-2002. However, the use of the longer period of data should provide a better calibrated model and the inclusion of the limited time that pumping had occurred (pumping between 50 – 200 gpm from June 2015 through 2016) does not show significant effects on the creeks and southern spring areas when the 10 years of data are used. The model domain outside of the PW-101 site area was calibrated using the available depth to water for logs found in the MDEQ Wellogic well records system. While it tends to mix water levels from different time periods potentially, the use of this data is understandable since that is the available data in the regional area where Nestle monitoring has not occurred.

The modified model was also calibrated to the available Nestle stream flow data. This helps to constrain the calibration and generally tends to lower the uncertainty of a model as a whole. The median stream flows at measured locations are higher from 2007-2016 than in 2001-2002 time period with the exception of location SF-1 on Twin Creeks where median flow was lower in 2007-2016.

Figure 5 in the Addendum Report shows the residual difference in feet between the steady-state groundwater model calculated heads and the target water levels. Overall the residuals are low considering that the water levels are reported in terms of thousands of feet. When reviewing water level changes or drawdown in areas of wetlands of interest, then these slightly higher residuals may need to be considered. Just north of wetland G the steady-state water level residual is -0.4 ft. and at the east edge of wetland H the steady-state water level residual is -.07 ft. A negative residual in this case means that the model calibrated water level is higher than the actual measured data. For the overall assessment of the model calibration these small values are not significant. However, when considering the drawdown in these wetland areas, the residuals are within the same magnitude as the drawdown predictions. Therefore, it is possible that the actual drawdown in the wetland areas showing these negative residuals would tend to add additional drawdown to the model predicted levels. Other wetland areas with larger negative residuals include wetlands U and P.

SSPA states that the largest uncertainty in the modified model calculations is likely in the calculations of changes in the water table at non-perched wetlands in topographic depressions such as wetland G. On page 9 of the Addendum Report SSPA states that "Wetlands B, C, D, E, H, Q and Y are located in topographic depressions where the water table may intersect land surface (it is uncertain based on available data as to whether or not these wetlands are perched)". As they further state, there may be an uncertainty in the water levels in these wetlands due to the nature of the subsurface materials and the unknown extent. However, the calculations in these areas could be conservative as they assert but they could also be too lenient because of this uncertainty.

Based on the information in the Addendum Report, discussions with SSPA, and a review of the files provided, the calibration process appears to be acceptable and the model is generally well calibrated.

Model Error and Measured Data Residual – One of the means used to illustrate how effectively a model is reproducing the measured data is to plot the measured water levels versus the model generated water levels (Figure 7, SSPA Full Addendum Report 2017) or the measured flows versus the model generated flows (Figure 8, SSPA Full Addendum Report 2017). When the measured data versus the model generated data fall on a 45 degree line, it is an indication that there is good correspondence between the measured and calculated values.

The plot of the observed water levels versus the model calculated water levels for this groundwater model fit very closely to a 45 degree line which is typically taken to show that the model has a low error in predicting the water levels. Similarly, the plot of the observed stream flow versus the model calibrated flow also fits a 45 degree line as well. It was noted that the flow for Weir 6 shows a value indicating a slightly higher predicted flow at this location by the model.

In addition to the good fit between the measured data and the model calculated values, the Nestle site monitor wells generally show a low residual difference between the targets and the calibrated groundwater model values. The highest water level residuals in the immediate PW-101 site area are calculated at the MW-103 and MW-105 wells. The residuals for the private wells in the area are more variable likely due to the mixing of water level data based on the year the well was drilled. The highest residual is 8.6 ft. at well 67000004049 (outside the immediate site area located in Leroy Michigan approximately 7.5 miles to the northwest of well PW-101).

The groundwater model review confirmed the low error in matching the groundwater water level and stream flow data as noted in the Addendum Report.

Modified Groundwater Model Simulation Files - MODFLOW-USG input and output files were provided to allow review of the modified model using the Groundwater Vistas graphical user interface for the requested steady-state calibrated and transient simulations. On December 8, 2017, SSPA confirmed that the Groundwater Vistas files were provided to aid the MDEQ in the review of the model but these specific files were not used to execute the actual simulations. The modified model simulations and the Parameter Estimation code (PEST) evaluations were run from the DOS prompt and using script files rather than using the Groundwater Vistas graphical interface in part due to issues with the interface and simulation processing speeds and efficiency.

The files provided included multiple transient pumping simulations that were run for 10- and 20-year periods to assess when the model simulations are expected to approach steady-state conditions. In this area, the 20-year simulations were found to approximate steady-state conditions. The output water levels (heads) from the final calibrated model simulation that was run with no pumping in PW-101 were used as the initial heads in the transient simulations. The following model files were reviewed for consistency with the groundwater modeling Addendum Report:

- Calibrated steady-state model – no PW-101 pumping
- Transient model, 150 gpm continuous pumping from PW-101 for 10 Years
- Transient model, 150 gpm continuous pumping from PW-101 for 20 Years
- Transient model, 250 gpm continuous pumping from PW-101 for 10 Years
- Transient model, 250 gpm continuous pumping from PW-101 for 20 Years
- Transient model, 400 gpm continuous pumping from PW-101 for 10 Years
- Transient model, 400 gpm continuous pumping from PW-101 for 20 Years
- Transient model, Historical pumping PW-101 from 2011 -2016
- Transient model, PW-101 aquifer test 2001
- Transient model, TW-3 aquifer test 2000
- Transient models, recharge, normal, dry, and wet year
- Transient models, vertical and horizontal conductivity tests plus 25 percent and minus 25 percent

The model files were consistent with the model descriptions although there were apparent artifacts due to the application of additional processing programs that were used outside of the Groundwater Vistas graphic user interface. Rerunning the transient models produced very similar, if not the same, drawdown and water level predictions with a few exceptions associated with the Decker Ponds. In a supplemental memorandum on January 8, 2018, SSPA provided clarification on the apparent drawdown anomaly at Decker Ponds that appear in the Groundwater Vistas files provided for viewing of the Lake package information in MODFLOW-USG as an issue with Groundwater Vistas. This issue tends to add uncertainty to the evaluation of the drawdown in wetland CC observed in the provided model files and the water level drawdown predicted in the Decker Ponds.

In a memorandum dated January 8, 2018, SSPA provided the model calculated drawdowns for Decker Ponds modeled as Lake 1 and Lake 2 as noted in a subsequent section.

Historical PW-101 Pumping - The calibrated steady-state groundwater model was run using monthly time steps over the June 2011 through December 2016 period of time when the PW-101 well was intermittently pumping at various rates ranging generally from 25 gpm to 200 gpm for short periods of time. The model was used to show the water level drawdown and the predicted stream flow reductions that this pumping is expected to produce.

This historical simulation predicted that the stream flow reduction at the mouth (the location where the MDEQ typically calculates index flows) of Twin Creek is 38 gpm and the stream flow reduction at the mouth of Chippewa Creek is 37 gpm (see Table 1). This historical simulation also predicts approximately 0.1 ft. or less drawdown in the wetland areas to the west and south of the PW-101 well associated with this pumping.

Additional Calibration Targets – TW-1, TW-2, TW-3 and PW-101 Aquifer Tests - The calibrated groundwater model was also used to simulate the aquifer tests that were run at wells TW-1, TW-2, and TW-3 in August 2000 and in PW-101 in June 2001. The results from these two aquifer tests were included as calibration targets for the modified model in a second phase of model calibration.

Pumping from the TW-1, TW-2, and TW-3 wells showed significant flow reductions in Weirs 2, 3, 4 but not in Weir 1 (the eastern most weir monitored in the 2000 test area). All of these weirs were located within approximately 200 ft. (Weir 1) to 400 ft. (Weirs 2, 3, 4) south of the TW-1, TW-2, and TW-3 pumping wells used in the August 2000 aquifer test.

The June 2001 aquifer test was conducted by pumping well PW-101 which is located approximately 1500 feet to the north-northwest of the TW-1, TW-2, and TW-3 well locations. The PW-101 well was pumped for eight days at a constant 400 gpm. The actual resulting drawdown at the PW-101 well was 12.63 ft. The drawdown calculated by the transient PW-101 model appears to be roughly 1 to 16 percent less than the measured drawdown during the test based on a query of the model file provided. The transient drawdown targets that exists in the provided Groundwater Vistas file are marked steady-state while they show-up in the transient PW-101 Groundwater Vistas simulation file in the correct layer. It was not clear that these targets were represented correctly. However, a discussion with the SSPA groundwater modeler, Mr. Chris Muffels, indicated that these apparent multiple listed targets were artifacts on how the Groundwater Vistas files were provided and not representative of the actual model.

Predicted Effects of PW-101 400 GPM Continuous Pumping

Model Predicted Stream Flow Reductions – Table 1 presents the site locations for median flow measurements from 2007-2016, the model calibrated flow in gpm, summer month median flows, MDEQ index flow, MDEQ 50 percent flow exceedance for the Nestle raw data and the modified model predicted flow reductions predicted for the historical 2011 – 2016 pumping, 150 gpm 20 year, 250 gpm 20 year, and 400 gpm 20 year simulations. Flow reductions predicted for the two creeks in the site area are:

> **Twin Creek** – At a continuous pumping rate of 400 gpm for 20 years from PW-101 the modified model predicts stream flow reductions from 50 gpm in the upper reaches (SF-1) to 158 gpm at the mouth (SF-13). This represents between 1.6 percent to 8 percent flow reduction from the median measured flow and a 2.2 percent (at SF-11) to 10.8 percent (at SF-1) reduction from the MDEQ index flow. Part 327 allows for 20 percent or less cumulative stream flow reduction from index flow for all large quantity water withdrawals (LQWs) developed since October 1, 2008. No other LQWs with predicted depletions from the Twin Creek watershed were identified by the MDEQ.
>
> **Chippewa Creek** - At a continuous pumping rate of 400 gpm for 20 years from PW-101 the modified model predicts stream flow reductions from 6 gpm in a downstream tributary (SF-19) to 154 gpm at the mouth SF-20 (SF-20 is not a direct measurement but

is equal to the sum of SF-17 and SF-19 flows). This represents between 3.1 percent to 18.8 percent flow reduction from the measured flows and a 4.3 percent (at SF-19) to 26.7 percent (at SF-8) reduction from the MDEQ index flow. As stated above, Part 327 allows for 20 percent or less cumulative stream flow reduction from this cold stream. No other LQWs with predicted depletions from Chippewa Creek were identified by MDEQ. The value of 26.7 percent exceeds the 20 percent allowed for flow reduction from Index flow. This is a location that should require additional monitoring/measurements.

Several areas are noted on Table 1 that suggests additional monitoring is warranted, should a permit be issued. These locations include SF-8, Northern Ridge Springs due to relatively high flow reduction estimates and Northern Boomerang Springs, Southern Boomerang Springs, White Pine Springs, and Decker Springs due to the lack of or limited measurements/monitoring data.

Part 327 Nestle Withdrawal Request from PW-101

Nestle established a baseline withdrawal under WSSN 216667 prior to the implementation of Part 327 water withdrawal registration requirements for large quantity withdrawals [greater than 70 gallons per minute (gpm)]. Subsequently, Nestle submitted a withdrawal request for an increase to 400 gpm under Site-Specific Review (SSR) 4871-20176-36 that triggered the need for the Section 17 permit. SSR 4871-20176-36 has been pending the review and decision on the Section 17 permit authorization.

Comparisons of Water Withdrawal Assessment Tool (WWAT) VS Model Stream Flow Reductions

The following sections compare the predicted stream flow reduction calculated in the Nestle modified MODFLOW groundwater model to results obtained through the online Water Withdrawal Assessment (WWAT) screening tool and the batch version of the WWAT screening tool that allows modification of the transmissivity, storage, and or stream conductance values if site-specific data is available. Batch WWAT screening tool simulations were also run adding a stream trace in White Pine Springs so the batch screening tool “recognizes” this as a potential water withdrawal point (The USGS NHD stream database used in the WWAT tool does not consider the springs as a stream since a stream trace is normally not present there).

The online WWAT and batch WWAT screening tools normally are run with a five-year simulation time. The simulation time was extended from 5 to 20 years for the WWAT batch screening tool in order to more directly compare the results of the Nestle modified three-dimensional groundwater model. The comparison for Chippewa Creek and Twin Creeks are presented in the following section. The WWAT batch screening tool run for 20 years using the transmissivity and storage values from the PW-101 aquifer test matches the results of the Nestle three-dimensional MODFLOW groundwater predictions for stream flow reductions in Chippewa Creek (the home watershed) most closely. The batch WWAT screening tool does not match the magnitude of the flow reduction in the neighboring Twin Creek watershed. When the stream trace is added to the springs for the 20-year extended WWAT screening tool simulations, the flow reduction predictions improve and are more similar to the MODFLOW results. This does illustrate that the use of a calibrated three-dimensional flow model gives more realistic values in certain cases, particularly when more than the home watershed is affected by the withdrawal.

The presence of the springs in this area is a more complicated geological setting than the design of the WWAT's screening tool was intended to include.

The modified MODFLOW groundwater model is a more complete representation of the hydrological conditions at this site that takes into account site conditions and aquifer parameters not available for use in the initial WWAT screening tool. Therefore, based on the results of the WWAT screening and the results of the modified groundwater model stream flow reduction predictions, the Part 327 registration for the 400 gpm increased withdrawal would be authorized.
Chippewa Creek (ID 11222) Estimated Flow Reductions GW Model vs WWAT

1. Nestle modified MODFLOW groundwater model predicted flow reductions to Chippewa Creek Nestle SF-17 plus SF-19 (instead of SF-20 or ~ WWAT location)
    - Historical model – 37 gpm
    - 150 gpm model after 20 years = 58 gpm
    - 250 gpm model after 20 years = 97 gpm
    - 400 gpm model after 20 years = 154 gpm

2. Online WWAT screening tool for continuous pumping (standard five years) from PW-101
    - 100 gpm continuous pumping from PW-101 =60 gpm
    - 150 gpm continuous pumping from PW-101 =91 gpm
    - 250 gpm continuous pumping from PW-101 = 151 gpm
    - 400 gpm continuous pumping from PW-101 = 241 gpm

3. WWAT Batch screening tool using T=8100 ft2/day, s= 0.14 flow reduction from Chippewa Creek at SF-20 and **no stream trace** in White Pine Springs (standard pumping five years):
    - 100 gpm continuous pumping from PW-101 – 24 gpm
    - 150 gpm continuous pumping from PW-101 – 36 gpm
    - 250 gpm continuous pumping from PW-101 – 59 gpm
    - 400 gpm continuous pumping from PW-101 – 95 gpm

4. WWAT Batch screening tool using T=8100 ft2/day, s= 0.14 flow reduction from Chippewa Creek at SF-20 and **no stream trace** in White Pine Springs (pumping 20 years):
    - 100 gpm continuous pumping from PW-101 – 38 gpm
    - 150 gpm continuous pumping from PW-101 – 57 gpm
    - 250 gpm continuous pumping from PW-101 – 95 gpm
    - 400 gpm continuous pumping from PW-101 – 152 gpm

5. WWAT Batch screening tool using T=8100 ft2/day, s= 0.14 flow reduction from Chippewa Creek at SF-20 **with a stream trace** in White Pine Springs (standard pumping five years)
    - 100 gpm continuous pumping from PW-101 – 19 gpm
    - 150 gpm continuous pumping from PW-101 – 29 gpm
    - 250 gpm continuous pumping from PW-101 – 48 gpm
    - 400 gpm continuous pumping from PW-101 – 76 gpm

6. WWAT Batch screening tool using T=8100 ft2/day, s= 0.14 flow reduction from Chippewa Creek at SF-20 **with a stream trace** in White Pine Springs (pumping 20 years)
   - 100 gpm continuous pumping from PW-101 – 14gpm
   - 150 gpm continuous pumping from PW-101 – 21 gpm
   - 250 gpm continuous pumping from PW-101 – 35 gpm
   - 400 gpm continuous pumping from PW-101 – 56 gpm

Nestle's pending SSR 4871-20176-36 is currently holding 149 gpm for the increase to 400 gpm with an additional 31 gpm available in the Chippewa Creek watershed (11222) for a total available to Nestle at this time of 180 gpm. The Nestle model is estimating 154 gpm reduction to the Chippewa Creek which would pass Part 327.

It is noted that the results for the predicted stream flow reduction to Chippewa Creek based on the Nestle modified MODFLOW model are only 1 or 2 gpm greater than the WWAT screening tool results obtained using the site-specific aquifer parameters (transmissivity and storage from the PW-101 aquifer test) and extending the run time to 20 years rather than the 5 years used for typical screening purposes.

Twin Creek (ID 13203) Estimated Flow Reductions GW Model vs WWAT

1. Nestle modified MODFLOW groundwater model predicted flow reductions to Twin Creek Nestle SF-13
   - Historical model – 38 gpm
   - 150 gpm model after 20 years = 59 gpm
   - 250 gpm model after 20 years = 99 gpm
   - 400 gpm model after 20 years = 158 gpm

2. Online WWAT screening tool for continuous pumping from PW-101 flow reduction Twin Creek (standard 5-year pumping):
   - 100 gpm continuous pumping from PW-101 = 11 gpm
   - 150 gpm continuous pumping from PW-101 = 16 gpm
   - 250 gpm continuous pumping from PW-101 = 27 gpm
   - 400 gpm continuous pumping from PW-101 = 43 gpm

3. Online WWAT screening tool for continuous pumping from PW-101 flow reduction Twin Creek (standard 20 year pumping **with stream trace in spring**):
   - 100 gpm continuous pumping from PW-101 = 26 gpm
   - 150 gpm continuous pumping from PW-101 = 39 gpm
   - 250 gpm continuous pumping from PW-101 = 65 gpm
   - 400 gpm continuous pumping from PW-101 = 104 gpm

4. WWAT Batch screening tool using T=8100 ft2/day, s= 0.14 flow reduction from Twin Creek and **no stream trace** in White Pine Springs (standard five-year pumping)
   - 100 gpm continuous pumping from PW-101 = 4 gpm
   - 150 gpm continuous pumping from PW-101 = 36 gpm
   - 250 gpm continuous pumping from PW-101 = 59 gpm

- 400 gpm continuous pumping from PW-101 = 95 gpm

5. WWAT Batch screening tool using T=8100 ft2/day, s= 0.14 flow reduction from Twin Creek and **no stream trace** in White Pine Springs (20-year pumping)
   - 100 gpm continuous pumping from PW-101 = 7 gpm
   - 150 gpm continuous pumping from PW-101 = 10 gpm
   - 250 gpm continuous pumping from PW-101 = 17 gpm
   - 400 gpm continuous pumping from PW-101 = 27 gpm

6. WWAT Batch screening tool using T=8100 ft2/day, s= 0.14 flow reduction from Twin Creek **with a stream trace** in White Pine Springs (standard five-year pumping)
   - 100 gpm continuous pumping from PW-101 = 8 gpm
   - 150 gpm continuous pumping from PW-101 = 12 gpm
   - 250 gpm continuous pumping from PW-101 = 21 gpm
   - 400 gpm continuous pumping from PW-101 = 33 gpm

7. WWAT Batch screening tool using T=8100 ft2/day, s= 0.14 flow reduction from Twin Creek **with a stream trace** in White Pine Springs (20 year pumping)
   - 100 gpm continuous pumping from PW-101 = 14 gpm
   - 150 gpm continuous pumping from PW-101 = 21 gpm
   - 250 gpm continuous pumping from PW-101 = 35 gpm
   - 400 gpm continuous pumping from PW-101 = 56 gpm

Twin Creek watershed 13203 currently has 664 gpm water available. The Nestle model estimates a flow reduction to Twin Creek of 158 gpm which would currently pass the Part 327 registration.

It is noted that the stream flow predictions based on the Nestle modified MODFLOW model are higher than those predicted using variations of the WWAT screening tool. This is likely due in part to the influence of the stream distance to Twin Creek relative to Chippewa Creek. For comparison, a stream trace was used to “identify” the springs so the screening tool adjusts the distance to the stream complex since the stream traces are what the tool uses to estimate the distance to surface water body from a pumping well.

Model Predicted Drawdowns – Table 2 -Wetlands - Figure 7 from the Addendum Report presents the graph of the measured versus model generated water levels. There appears to be a very good correlation with exception of locations like MW-101d, MW-101i or MW-106d showing a slightly higher residual than other locations. The residual is just the difference between the measured water level at a location and the water level that is predicted by the model for that location. The water level residuals shown at these well locations on Figure 5 indicate that the model is calculating a 1.0 to 1.9 foot difference between the measured and calculated water levels or a range of 0.1 percent to 0.2 percent difference (a negative residual number means that model calibrated water level is higher than the measured value by that amount). So the model is calculating higher water levels in wetland G by 0.4 ft. and the in wetland H the model has a water level 0.7 ft. higher than measured. Then it is possible that with 0.3 ft. of drawdown predicted by the model the water level change could actually be 0.7 ft. based on measured values (0.4 ft. residual + 0.3 ft. drawdown).

The modified model error between measured and calculated water levels is reported by SSPA to have a mean value of 0.1 foot with a standard deviation of 0.6 feet (variation of the residuals about the mean) and the mean of the absolute value of the residuals is 0.4 ft. Figure 5 indicates that the areas with the higher residual difference are east and southeast of the Northern Ridge Springs (-1.1 ft., 1.0 to 1.9 ft.), Wetland G (-0.4 ft.), wetland H (-0.7 ft.), wetland P (0.9 ft.), wetland U (-1.0 ft.), and north of White Pine Springs (0.5 ft. and -1.4 ft.).

On December 14, 2017, SSPA provided the revised wetlands tables that incorporated the modified model drawdown as requested. These tables are labeled Supplemental Wetland Tables S1, S2, S3, and S4 for wetlands A, CC, G, and R, respectively based on the Nestle wetland water budget analyses generally show greater drawdown in the summer or early fall months (July, August, September). For example, in Wetland G during a normal year the water level drop is predicted at 0.44 ft., 0.88 ft., and 0.99 ft. for July, August, and September, respectively. In a dry year, wetland G water levels are predicted to decline by 0.57 ft., 0.96 ft., and 1.09 ft. in July, August, and September, respectively.

On January 9, 2018, SSPA also provided the model predicted water level changes in the Decker Ponds (simulated as two lakes) for the requested pumping scenarios. These changes were as follows:

1. Drawdown in water level from PW-101 pumping 150 gpm after 20 years (drawdown):
   - o Decker Pond (Lake 1) = 0.014 feet
   - o Decker Pond (Lake 2) = 0.007 feet
2. Drawdown in water level from PW-101 pumping 250 gpm after 20 years at
   - o Decker Pond (Lake 1) = 0.023 feet
   - o Decker Pond (Lake 2) = 0.017 feet
3. Drawdown in water level from PW-101 pumping 400 gpm after 20 years at:
   - o Decker Pond (Lake 1) = 0.045 feet
   - o Decker Pond (Lake 2 = 0.033 feet

Private Wells – The Addendum Report states that five private wells were identified where drawdown is calculated to be greater than one foot but less than two feet and not expected to be impaired. However, the MDEQ Wellogic database shows at least sixteen private wells in this area. The seasonal variation in water table elevations appear to fluctuate between one and three feet based on a review of the available Nestle data from the site. The sixteen wells identified in the MDEQ Wellogic system are screened with four to five foot screens ranging in depth between 40 to 134 ft. below ground level. Static water level readings noted on the well records range from 6 to 20 feet above the screened interval. However, whatever the actual well count is, if a permit is issued it should include a condition that requires the permittee to address any impacts to private wells due to the operations of this increased withdrawal.

Model Predicted Stream Temperature and Water Level Reduction - On February 5, 2018, SSPA provided requested information regarding stream level and temperature changes as follows: "… Stream level changes were calculated at the two locations on Twin Creek with the largest percentage flow reductions due to pumping of PW-101 (SF-1 and SF-9), and on Chippewa Creek at the location with the largest percentage flow reduction (SF-16). The calculated average change in stream level due to increasing the pumping rate from 150 gpm to 400 gpm, based on stage discharge relationships, was 0.014 feet at SF-1, between 0.009 and 0.017 feet at SF-9, and 0.01 feet at SF-16. The calculated average change in stream level due to increasing the pumping rate from 0 gpm to 400 gpm was between 0.022 and 0.023 feet at SF-1, between 0.015 and 0.027 feet at SF-9, and 0.016 feet at SF-16."

The February 5, 2018, memorandum further states that SSTEMP was used to predict temperature changes in the streams due to the proposed 400 gpm withdrawal and that "These calculations were based on a stream flow reduction at SF-6 of 43 gpm, which is larger than the stream flow reduction calculated with the model described in the Addendum Report at 400 gpm after 20 years (38 gpm). The calculated average stream water temperature change is 0.16°C based on July 2014 climatic conditions, and is 0.13°C based on July 2013 conditions. Stream temperature changes would be smaller at lower flow reductions in the stream."
The implications of the modified model predicted stream temperature and water level reductions are being reviewed by Department of Natural Resources, Fisheries Division.

Conclusions/Recommendations

The modified groundwater model is adequately calibrated and can reproduce the site water levels and stream flows generally to a reasonable degree. The Nestle final calibrated model fixed the recharge rates calculated in the 2005 MDEQ Groundwater Inventory Mapping Project (GWIM). Therefore, should the recharge characteristics in the site area change significantly going forward, the effects on the predictive ability of the model will need to be re-evaluated.

There are a few areas of concern as noted above where additional monitoring/continuous data collection should be included if a permit is issued. At a minimum this would include locations SF-8, Northern Ridge Springs due to relatively high flow reduction estimates and Northern Boomerang Springs, Southern Boomerang Springs, White Pine Springs, and Decker Springs due to the lack of or limited measurements/monitoring data:

- Vertically nested wells to monitor vertical gradient changes within the aquifer or between the shallow and deeper aquifers, if there are multiple aquifers.
- Wells for water level monitoring with select continuous water level data logging
- Stream Gage Monitoring
- Pre-fabricated flume rated for the flow range at a location (i.e.SF-8) and pressure transducer to continuously measure stream stage.
- Model validation using newly collected site data with evaluation to determine the need to update the model based on the monitoring data showing that the data is not matching the model or provides information that the underlying conditions of the model are not met (i.e. precipitation and recharge).
- A Response Action Plan by Nestle should be provided if drawdown, gradient changes at the springs, stream flow reduction, stream temperature changes, or water level predictions are exceeded.

More detailed recommendations will be provided under separate cover.

TABLE 1: FLOW AND FLOW REDUCTION COMPARISONS AND ESTIMATES- NESTLE-SSPA GROUNDWATER MODEL

LOCATION	Monitoring Location	Nestle Median Measured Flow (gpm) 2007-2016	Nestle Model Calibrated Flow (gpm)	August Median Measured Flow - Nestle Data (gpm)	MDEQ Index Flow** (gpm)	MDEQ 50% Exceedance Raw Nestle Data (gpm)	Modeled Flow Reduction from Historical Pumping PW-101 2011 thru 2016 (gpm)	Nestle Model Flow Reduction Pumping PW-101 150 gpm 20YR (gpm)	% Flow Reduction from Median Measured at 150 gpm	% Reduction from Index Flow	Nestle Model Flow Reduction Pumping PW-101 250 gpm 20YR (gpm)	% Flow Reduction from Median Measured at 250 gpm	% Reduction from Index Flow	Nestle Model Flow Reduction Pumping PW-101 400 gpm 20YR (gpm)	% Flow Reduction from Median Measured Flow at 400 gpm	% Reduction from Index Flow	Residual Between Median Measured and Modeled Flow (gpm)	% Difference between Model and Median Measured Flow	Difference Between Median Measured Flow and 50% Exceedance (gpm)	% Differennce between Median Measured Flow and 50% Exceedance
Twin Creek	SF-1	724	721	629	539	727	14	22	3.0%	4.1%	36	5.0%	6.7%	58	8.0%	10.8%	3	0.4%	-3	0.4%
	SF-2	811	787	668	628	767	15	24	3.0%	3.8%	40	4.9%	6.4%	63	7.8%	10.0%	24	3.0%	44	5.6%
	SF-11	709	697	535	494	700	2	4	0.6%	0.8%	7	1.0%	1.4%	11	1.6%	2.2%	12	1.7%	9	1.3%
	SF-9	2983	3029	2231	2199	3011	35	56	1.9%	2.5%	93	3.1%	4.2%	151	5.1%	6.9%	-46	1.5%	-28	0.9%
	SF-10	3218	3092	2360	2154	3034	36	56	1.7%	2.6%	94	2.9%	4.4%	151	4.7%	7.0%	126	4.0%	184	5.9%
Mouth of the Creek	SF-13	3971	3751	3357	2693	3940	38	59	1.5%	2.2%	99	2.5%	3.7%	158	4.0%	5.9%	220	5.7%	31	0.8%
Chippewa Creek	SF-8	128	122	94	90	122	6	10	7.8%	11.1%	16	12.5%	17.8%	24	18.8%	**26.7%**	6	4.8%	6	4.8%
	SF-16	1047	1020	957	898	1037	22	37	3.5%	4.1%	61	5.8%	6.8%	96	9.2%	10.7%	27	2.6%	10	1.0%
	SF-17	2056	1955	1869	1616	2060	34	54	2.6%	3.3%	89	4.3%	5.5%	142	6.9%	8.8%	101	5.0%	-4	0.2%
	SF-18	739	687	666	628	741	11	17	2.3%	2.7%	28	3.8%	4.5%	46	6.2%	7.3%	52	7.3%	-2	0.3%
	SF-19	193	170	204	138	198	1	2	1.0%	1.4%	4	2.1%	2.9%	6	3.1%	4.3%	23	12.7%	-5	2.6%
Mouth of the Creek*	SF-20	2249	2630	NA	2244	NA	37	58	2.6%	2.6%	97	4.3%	4.3%	154	6.8%	6.9%	-381	15.6%	NA	NA
Northern Ridge Springs	weir 6	8	12	NA	NA	NA	0.01	0.01	0.1%	NA	0.02	0.3%	NA	0.03	0.4%	NA	-4	**40.0%**	NA	NA
Northern Boomerang Springs	NA	NA	15	NA	NA	NA	0.2	0.2	NA	NA	0.35	NA	NA	0.6	NA	NA	NA	NA	NA	NA
Southern Boomerang Springs	NA	NA	22	NA	NA	NA	0.3	0.4	NA	NA	0.7	NA	NA	1.1	NA	NA	NA	NA	NA	NA
White Pine Springs	SF-6	300	319	NA	NA	NA	9	14	4.7%	NA	24	8.0%	NA	38	12.7%	NA	-19	6.1%	NA	NA
Chippewa Springs	weir 5, SF-8	192	179	NA	NA	NA	8	14	7.3%	NA	23	12.0%	NA	35	18.2%	NA	13	7.0%	NA	NA
Decker Springs	NA	NA	134	NA	NA	NA	4	11	NA	NA	18	NA	NA	28	NA	NA	NA	NA	NA	NA

NA = Data not available

* Nestle Flow at SF-20 not a direct measurement but = SF-17 + SF-19

** 50% exceedance for lowest flow month

Nestle Twin Creek and WWAT drainage area = 22.34 square miles, Nestle and WWAT Chippewa Creek drainage area = 3.98 square miles

TABLE 2: Drawdown Estimates Read from the SSPA-Nestle Groundwater Model Files

A	B	C	D	E	F
Wetland	Approx. Acres	Drawdown (ft) at 150 gpm after 20 Years	Drawdown (ft) at 250 gpm after 20 Years	Drawdown (ft) at 400 gpm after 20 Years	Drawdown (ft) 400 gpm after 20 Years- from SSPA
A	7.5*	0 to 0.14	0.12 to 0.3	0.13 to 0.5	0.13
CC	1.2*	0 to 0.00017	0.0001	less than 0.06	0.05
G	0.34*	0.11	0.18 to 0.19	0.3	0.3
R	174*	0 to 0.2	0 to 0.5	0 to 0.7[1]	0.03
H	0.25	0.18	0.3	0 to 0.58	
E	2.2**	0.21	0.3 to 0.36	0.5 to 0.63	
B	0.13**	0.26	0.44	0.69	
C	0.26**	0.25	0.44	0.6	
D	0.16**	0.2	0.34	0.31	
Q	3.2**	0.11 to 0.16	0.19 to 0.28	0.28 to 0.46	
Y	0.12**	0.08	0.14	0.22	
LL	0.86**	0.12	0.2	0.3 to 0.39	
F	0.63**	0.2	0.34	0.56 to 0.57	

Drawdown estimates based on the Groundwater Vistas model files submitted to DEQ by S.S. Papadopulos & Associates (SSPA) on behalf of Nestle

* Measurement provided by Nestle

** DEQ measurement estimate based on wetland shapefile provided in the SSPA Addendum Report

[1] The drawdown estimate of 0.7 ft is located along the east edge of wetland R closest to the PW-101 well

Attachment II

Stream Flow Technical Review

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE COMMUNICATION

TO: FILE

FROM: Leah Clark, Geologist, Great Lakes Shorelands Unit
Surface Water Assessment Section, Water Resource Division

DATE: March 30, 2018

SUBJECT: Technical Review – Nestle White Pine Springs Stream Flow Data and Modeled Stream Flow Reduction

Nestle White Pine Springs Streamflow Data

Streamflow monitoring in Twin and Chippewa Creeks was performed by Nestle Water North America (NWNA) beginning in December 2000/January 2001. Streamflow data collected between 2001 and 2015 were submitted to Michigan Department of Environmental Quality (MDEQ) as part of the original Section 17 permit application. 2016 data was subsequently requested by the MDEQ and submitted by NWNA. Data is available for six locations on Twin Creek (SF-1, SF-2, SF-9, SF-10, SF-11, and SF-13) and five locations on Chippewa Creek (SF-8, SF-16, SF-17, SF-18, and SF-19). Monthly monitoring at most of these locations began January 2007. Nestle also supplied flow data for 10 weir locations on Twin and Chippewa Creeks, collected at various times between 2000 and 2015. All of these raw data were evaluated as part of the permit review. The MDEQ also reviewed model calibrations for the revised groundwater model relative to these raw data.

Measurement Methodology

In March 2015, NWNA reportedly adopted a streamflow measurement protocol consistent with United States Geological Survey (USGS) techniques and standards (Turnipseed and Sauer, 2010; Rantz et al. 1982) for collecting discharge measurements at streamflow gaging locations. This protocol included the use of Acoustic Doppler Velocimeter (ADV) technology to collect measurements at all locations except Chippewa Creek monitoring locations SF-8 and SF-19, where the channel is very narrow and shallow, lending to boundary issues when using ADV. Prior to March 2015, it is the MDEQ's understanding measurements were collected using a Marsh McBirney electromagnetic flow meter and measurements were recorded once velocity readings appeared to stabilize on the display and did not adhere to a minimum time period for allowing flow to stabilize. This instrument and methodology does not adhere to USGS standards and protocols. Since March 2015, measurements at SF-8 and SF-19 were still collected using the March McBirney but measurements were recorded after a period still collected using the March McBirney but measurements were recorded after a period of 40 seconds, allowing velocity readings to stabilize consistent with USGS protocols. Although NWNA reportedly adopted the updated streamflow measurement protocol in March 2015, Flow Tracker ADV files downloaded directly from the instrument were not retained until March 2016. Data files downloaded directly from the Flow Tracker ADV were submitted to the MDEQ for monthly measurements collected between March 2016 and December 2016.

Despite the methodology used, the streamflow data supplied by NWNA is robust and while there is seasonal fluctuation in flow data, the measured flows are consistent and the variability in the data appears to be low. That said, I did not do a complete statistical analysis with a variance test. Discrete measurements only provide a snap shot in time. However, due to the great number of measurements collected over a period of 15 years, I find the data provides a reasonable estimate of flow at these monitoring locations.

It should be noted that the MDEQ will only consider data collected in accordance with USGS protocols when evaluating index flow values used in the Water Withdrawal Assessment Tool (MCL 324.32706d).

Data Evaluation

In its evaluation of the raw streamflow data, the MDEQ compared all measurement dates listed to city of Evart precipitation data, which was supplied by NWNA at the request of the MDEQ. Streamflow data collected during or immediately following a rain event were filtered from the data set. A measurement was disregarded if at least 0.1 inch of precipitation was recorded on the day of measurement or if at least 0.2 inches were recorded within two days prior to the measurement. This approach is not based in scientific literature, but is consistent with observations made by MDEQ staff who routinely collect discrete stream flow measurements that a change in stage or flow is not observed after a very light rainfall. Of the 290 days measurements were collected, the MDEQ filtered out 112 days based on this convention. Median flows were recalculated using the filtered data set. There was no more than 5 percent difference between the raw and filtered median flows (see below). In one instance (SF-8), the median flow for the filtered data set was actually higher than the unfiltered.

Twin Creek

Monitoring Location	Median Flow (gpm) Raw Data	Median Flow (gpm) Filtered	% Diff
SF-1	728	700	3.92%
SF-2	769	759	1.31%
SF-11	701	666	5.12%
SF-9	3009	2939	2.35%
SF-10	3036	2891	4.89%
SF-13	3941	3770	4.44%

Chippewa Creek

Monitoring Location	Median Flow (gpm) Raw Data	Median Flow (gpm) Filtered	% Diff
SF-8	123	126	2.41%
SF-16	1038	1009	2.83%
SF-17	2058	2042	0.78%
SF-18	739	714	3.44%
SF-19	197	197	0.00%

Using both the raw and filtered data sets, I evaluated trends from raw data at each gaging location looking at flow trends over time (between 2001 and 2016), changes in flow before and since pumping began, and seasonal fluctuations with an emphasis on periods of summer low flow.

The following summarizes my analysis for the monitoring locations where reduction in streamflow is predicted to be greatest, generally, the locations nearest PW-101.

SF-8 Chippewa Creek

- Model predicts greatest reduction in streamflow at this location.
- Measured flow since pumping began also indicates greatest potential impact on streamflow at this location.
- It is important to note the channel at this monitoring location is only approximately 2.5 feet wide and less than 6 inches deep. The channel may be influenced by backwater during high flow periods due to an impoundment created by a crushed culvert at 10th Avenue. However, this is not expected to be an issue at low flow.
- A downward trend in stream flow is apparent when flow is plotted at SF-8 over time. This may be skewed by four higher than average flows measured in February, March, April, and May 2001. However, the measurement dates do not correlate with precipitation events immediately before or on the day of collection based on city of Evart precipitation data.

If those measurements are removed, the trend line flattens. An outlier test was conducted and the only possible statistical outlier identified was 444 gallons per minute (gpm) on February 13, 2001.

- There are two very low flows measured back to back in August and September 2015 (35 and 36 gpm, respectively) which are concerning. These were measured at a time when pumping had recently increased to a rate of over 150 gpm. Lower than average flows were also measured downstream at SF-16 and SF-17 at this time. This same decrease in flow was not measured when pumping rates increased again (to near 200 gpm) in summer 2016.
- Median flow from raw data = 122 gpm
- Median flow filtered data set = 126 gpm
- August median = 94 gpm
- Median 2015-2016 (pumping > 150 gpm) = 110 gpm

SF-16 Chippewa Creek

- No downward trend in flow is apparent when flow is plotted at SF-16 over time.
- The median flow is higher after pumping increased to 150 gpm or more.
- SF-16 is downstream of and may be influenced by the impoundment at Decker Ponds.
- Median flow raw data = 1,038 gpm
- Median flow filtered data = 1,009 gpm
- August median flow = 957 gpm
- Median 2015-2016 (pumping >150 gpm) = 1,100 gpm

SF-17 Chippewa Creek

- Slight downward trend in flow is apparent when flow is plotted at SF-17 over time.
- Median flow raw data = 2,058 gpm
- Median flow filtered data = 2,042 gpm
- August median flow = 1,869 gpm
- Median 2015-2016 (pumping >150 gpm) = 2,033 gpm

SF-18 Tributary to Chippewa Creek

- No decreasing trend in flow is apparent when flow is plotted at SF-18 over time. Data shows a small increase in flow since pumping began.
- SF-18 is a small tributary that discharges to Chippewa creek just downstream of SF-16.
- Median flow raw data = 739 gpm
- Median flow filtered data = 714 gpm
- August median flow = 666 gpm
- Median 2015-2016 (pumping >150 gpm) = 788 gpm

SF-1 Twin Creek

- A downward trend in flow is apparent when flow is plotted at SF-1 over time. This may be skewed by a few higher than average flows measured in February and March 2001. However, the measurement dates do not correlate with precipitation events immediately before or on the day of collection based on city of Evart precipitation data. If those measurements are removed, the trend line flattens. Data show a small increase in flow since pumping began.
- Median flow from raw data = 728 gpm
- Median flow filtered data set = 700 gpm
- August median = 629 gpm
- Median 2015-2016 (pumping > 150gpm) = 762 gpm

SF-9 Twin Creek

- A downward trend in flow is apparent when flow is plotted at SF-9 over time.
- Median flow from raw data = 3,009 gpm
- Median flow filtered data set = 2,939 gpm
- August median = 2,231 gpm
- Median 2015-2016 (pumping > 150gpm) = 3,009 gpm

<u>Groundwater Model - Streamflow Reduction</u>

I reviewed modeled streamflow reductions as detailed in *An Addendum to the Evaluation of Groundwater and Surface Water Conditions in the Vicinity of Well PW-101, Osceola County, Michigan* by S.S. Papadopulos & Associates, Inc. (SSPA) dated November 2017 (Addendum Report). The locations reviewed are shown on Figure 2 of the Addendum Report. The streamflow reductions were reviewed relative to index flow at each monitoring location and are summarized in the attached Table 1 - Flow Reductions Predicted by the Model for 150 gpm 250 gpm and 400 Final Draft 3-27-2018. This review follows the review of the modified model completed by Jill Van Dyke, Great Lakes Shorelands Unit, Surface Water Assessment Section, Water Resources Division (summarized in her March 29, 2018, memo to file) and assumes the same uncertainty. As requested by Jill Van Dyke and myself, drainage area and index flow (50 percent exceedance for lowest flow month) were calculated for each monitoring location by Mario Fusco, Hydraulic Studies Engineer, Dam Safety Unit, Permits Section, Water Resources Division. Mr. Fusco used the same standard method for calculating index flow used in the Water Withdrawal Assessment Program. He noted in his review that correlation between the measured flows and the nearest USGS stream gages (ID No. 04124500 East Branch Pine River near Tustin, MI and ID No. 04121500 Muskegon River at Evart, Michigan) was poor. When compared to the August median measured flow and the 50 percent exceedance for the data set (both high and low flow), the MDEQ index flow calculations appear reasonable (Table 1 attached). He also provided 50 percent exceedance values calculated for the entire data set (not just lowest flow month) at each monitoring location. Please note that when evaluating large quantity water withdrawals under Part 327, Great Lakes Preservation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA), streamflow reduction is compared to the index flow calculated at the mouth of the WWAT water management area. The mouths of the Chippewa and Twin Creek watersheds are represented by monitoring locations SF-20 and SF-13, respectively.

The target median stream and spring flows for each monitoring location used to calibrate the revised groundwater model were verified and I found them to be consistent with the flow data provided to date, with a few minor exceptions. I also found there to be very little difference between using the median flow from 2001-2016 or 2007-2016 (the period selected by Nestle for calibration of the revised groundwater model). (See attached Tables 2 through 4 - Evaluation of Stream Flow Targets). Questions or concerns identified during review of the streamflow targets are summarized in an January 19, 2018, e-mail to Jill Van Dyke. She contacted the consultant via e-mail who provided clarification in two separate memos dated January. 22, 2018, and January 25, 2018.

It is worth noting that the spring flow target for White Pine Springs used to calibrate the model has 'considerable uncertainty associated with it.' The estimate of 300 gpm for the flow target, SF-6, is based on limited data collected between 2000 and 2003 at a site where several difficulties were encountered to accurately measure flow, which according to the original groundwater modeling report included beaver dam activity and backwater. Nestle's response to this is that data are reliable at stream gaging locations upstream and downstream of the White Pine Springs on Twin Creek (SF-1 and SF-9) and that model function in this area is reasonable.

Part 327 allows for a 20 percent reduction from index flow for cold streams. This reduction is cumulative for all new or increased LQWs developed since October 1, 2008. No new or increased LQWs developed since October 1, 2008, were identified in either Chippewa or Twin Creek watersheds, other than Nestle's increase from 150 gpm baseline capacity to 250 gpm at PW-101, as registered using the WWAT. Based on review of the modified groundwater model report, the only reduction predicted to be greater than 20 percent of index flow is at SF-8, pumping 400 gpm after 20 years. However, the 400 gpm capacity includes 150 gpm of baseline capacity. The predicted impact to Chippewa Creek at SF-8 from pumping 250 gpm (which reflects the requested increase over 150 gpm baseline capacity) after 20 years is an approximately 17.8 percent decrease from index flow. Modeled reductions at the other monitoring locations were not more than 11 percent of index flow. Based on the model predictions, no more than a seven percent reduction from index flow is expected at the mouth of either creek.

Conclusions/ Recommendations

Based on review of both the measured and modeled flows at SF-8, ongoing and expanded monitoring in this location is warranted if the request to increase pumping to 400 gpm is approved. Data collection at SF-8 currently does not adhere to a USGS standard method and may be influenced by backwater during periods of high flow. If managed appropriately, this headwaters monitoring location is the only Chippewa Creek monitoring point that is upstream of multiple artificial impoundments along the creek and is a good place to monitor changes in flow as a result of pumping. However, monitoring year-round may be problematic due to possible backwater issues and in-stream monitoring equipment being prone to damage during winter months. Following my review, I consulted with USGS about the limitations to data collection at SF-8 and the monitoring approach which would provide the most accurate results. The details of that discussion are incorporated in the recommended permit conditions below, should a permit be issued.

While the predicted depletions from Twin Creek do not exceed the Part 327 threshold, continuous flow monitoring on Twin Creek is also recommended to verify the modeled flows, should a permit be issued. More information may be needed about the channel conditions at SF-1 and SF-9 to determine the best monitoring location and approach, but monitoring in the headwaters to evaluate the effects of pumping is recommended.

In considering action levels, I did take into account that index flow is a 50 percent exceedance value, which means half the time flows will be higher or lower than this value. And that the action level may be within the natural range in flow at a location. For instance, the action level at SF-8 would be 72 gpm (20 percent reduction from index flow of 90 gpm). However, it should be noted flows less than or equal to 72 gpm have been measured seven times at SF-8 including three times before pumping began in 2011. This is one basis for continuous monitoring. Required action should be based on observation of flows at or below the action level for a sustained period of time and not on a discrete basis. The recommended period of time that flow could fall below the action level before posing a threat to aquatic life would have to be determined by a fisheries biologist. A request for input was made to DNR Fisheries Division. DNR Fisheries staff noted that this is hard to assess and depends on the stream but that a month long period or reduced flow can cause stress to a trout population. On this basis and in concurrence with DNR Fisheries staff, it is recommended that pumping be reduced if sustained flows below the action level are observed for a period of 14 days.

Recommended Permit Conditions

If the decision is made to issue a permit, I recommend that the permit include the following conditions:

1. Continuous streamflow monitoring at SF-8 during the summer and fall months (June to October) to verify the modeled flow reductions, better define stream flow at this location, and assess if an adverse resource impact occurs as a result of

the permitted increase to 400 gpm. Monitoring shall be conducted using a pre-fabricated flume rated for the flow range at SF-8 and equipped with a pressure transducer set to record stream stage in at least one-hour intervals. Flume construction and streamflow measurement using a flume shall be done in accordance with USGS standards (Turnipseed and Saur, 2010; Rantz et al, 1982; and Use of Flumes in Measuring Discharge at Gaging Stations, United States Department of the Interior Geological Survey, 1965; Kilpatrick and Schneider, 1983). Monthly inspection must be conducted to ensure the flume is operating properly. If flows fall below 72 gpm for a period of 14 days, then pumping levels shall be reduced according to permit condition number ___. Permitted pumping levels may resume, if all other permit conditions are met, once sustained streamflow of 72 gpm or more is measured for an equivalent 14-day period.

2. Continuous streamflow monitoring at SF-1 during the summer and fall months (June to October) to verify the modeled flow reductions and better define stream flow at this location. Stage measurements shall be collected using a pressure transducer housed in a stilling well constructed in accordance with USGS standards for stream gaging and set to record stream stage in at least one hour intervals. Routine discharge measurements with an ADV will be required to establish a stage-discharge relationship. If flows fall below 431 gpm for a period of 14 days, then pumping levels shall be reduced according to permit condition number ___. Permitted pumping levels may resume, if all other permit conditions are met, once sustained streamflow of 431 gpm or more is measured for an equivalent 14-day period.

3. The permittee shall continue its monthly streamflow monitoring program consistent with USGS standards (Turnipseed and Sauer, 2010; Rantz et al. 1982) for collecting discharge measurements. These monitoring locations include SF-2, SF-9, SF-10, SF-11, SF-13, SF-16, SF-17, SF-18, SF-19 and Weirs 1 through 10. Monthly discrete discharge measurements shall also be collected at SF-1 and SF-8 when continuous monitoring is suspended during the winter and spring months (November to May). Monthly discharge measurements should be collected at least 72 hours after a rainfall event.

4. The streamflow monitoring results shall be submitted to the department in electronic format on an annual basis by December 31st of each year. Streamflow data shall be accompanied by documentation of daily average pumping rates for the periods of continuous flow monitoring (June through October). Annual streamflow reporting shall include stage and discharge data in table format and files downloaded directly from monitoring devices and data loggers, inspection reports, field sheets, and a description of activities, data trends, action level

exceedances, problems or equipment failures encountered, and response actions.

5. If no flow is observed at the headwater monitoring locations SF-8 and SF-1 at any point in time, pumping should immediately be reduced according to permit condition number ___, until flow conditions stabilize and return to action levels.

6. The permittee shall collect a complete round of streamflow measurements in all existing monitoring locations, as identified below, prior to increasing the withdrawal from the current level (currently authorized at 250 gpm) to the requested 400 gpm capacity. These data shall be collected in the same sampling event as additional stream stage and groundwater level measurements to assemble a complete hydrological baseline condition prior to the increase in pumping.

   SF-1, SF-2, SF-8, SF-9, SF-10, SF-11, SF-13, SF-16, SF-17, SF-18, SF-19 and Weirs 1 through 10

7. The Permittee shall submit a Monitoring Plan and Quality Assurance Project Plan (QAPP) to the MDEQ prior to increasing the withdrawal from the current level (currently authorized at 250 gpm) to the requested 400 gpm capacity. The Monitoring Plan shall provide details on specific monitoring locations, methods, maintenance and inspection schedules, reporting schedule, and reporting format. The QAPP shall include all quality assurance and quality control measures quality assurance and quality control measures methods used, equipment used, monitoring frequency, equipment calibration, staff qualifications, data and document reporting, and method references.

Literature Cited

Kilpatrick, F.A., and Schneider, V.R., 1983, Use of flumes in measuring discharge: U.S. Geological Survey Techniques of Water-Resources Investigations, book 3, chap. A14, 46 p.

Turnipseed, D.P., and Sauer, V.B., 2010, Discharge measurements at gaging stations: U.S. Geological Survey Techniques and Methods book 3, chap. A8, 87 p.

Rantz, S.E. et al, 1982, Measurement and Computation of Streamflow: Volume 1. Measurement of Stage and Discharge: U.S. Geological Survey Water-Supply Paper 2175, 284 p.

United States Department of the Interior Geological Survey, Surface Water Techniques, Book 1, Hydraulic Measurement and Computation, Chapter 16, Use of Flumes in Measuring Discharge at Gaging Stations, 1965. 27 p.

TABLE 1: FLOW AND FLOW REDUCTION COMPARISONS AND ESTIMATES- NESTLE-SSPA GROUNDWATER MODEL

LOCATION	Monitoring Location	Nestle Median Measured Flow (gpm) 2007-2016	Nestle Model Calibrated Flow (gpm)	August Median Measured Flow - Nestle Data (gpm)	MDEQ Index Flow** (gpm)	MDEQ 50% Exceedance Raw Nestle Data (gpm)	Modeled Flow Reduction from Historical Pumping PW-101 2011 thru 2016 (gpm)	Nestle Model Flow Reduction Pumping PW-101 150 gpm 20YR (gpm)	% Flow Reduction from Median Measured at 150 gpm	% Reduction from Index Flow	Nestle Model Flow Reduction Pumping PW-101 250 gpm 20YR (gpm)	% Flow Reduction from Median Measured at 250 gpm	% Reduction from Index Flow	Nestle Model Flow Reduction Pumping PW-101 400 gpm 20YR (gpm)	% Flow Reduction from Median Measured Flow at 400 gpm	% Reduction from Index Flow	Residual Between Median Measured and Modeled Flow (gpm)	% Difference between Model and Median Measured Flow	Difference Between Median Measured Flow and 50% Exceedance (gpm)	% Differennce between Median Measured Flow and 50% Exceedance
Twin Creek	SF-1	724	721	629	539	727	14	22	3.0%	4.1%	36	5.0%	6.7%	58	8.0%	10.8%	3	0.4%	-3	0.4%
	SF-2	811	787	668	628	767	15	24	3.0%	3.8%	40	4.9%	6.4%	63	7.8%	10.0%	24	3.0%	44	5.6%
	SF-11	709	697	535	494	700	2	4	0.6%	0.8%	7	1.0%	1.4%	11	1.6%	2.2%	12	1.7%	9	1.3%
	SF-9	2983	3029	2231	2199	3011	35	56	1.9%	2.5%	93	3.1%	4.2%	151	5.1%	6.9%	-46	1.5%	-28	0.9%
	SF-10	3218	3092	2360	2154	3034	36	56	1.7%	2.6%	94	2.9%	4.4%	151	4.7%	7.0%	126	4.0%	184	5.9%
Mouth of the Creek	SF-13	3971	3751	3357	2693	3940	38	59	1.5%	2.2%	99	2.5%	3.7%	158	4.0%	5.9%	220	5.7%	31	0.8%
Chippewa Creek	SF-8	128	122	94	90	122	6	10	7.8%	11.1%	16	12.5%	17.8%	24	18.8%	**26.7%**	6	4.8%	6	4.8%
	SF-16	1047	1020	957	898	1037	22	37	3.5%	4.1%	61	5.8%	6.8%	96	9.2%	10.7%	27	2.6%	10	1.0%
	SF-17	2056	1955	1869	1616	2060	34	54	2.6%	3.3%	89	4.3%	5.5%	142	6.9%	8.8%	101	5.0%	-4	0.2%
	SF-18	739	687	666	628	741	11	17	2.3%	2.7%	28	3.8%	4.5%	46	6.2%	7.3%	52	7.3%	-2	0.3%
	SF-19	193	170	204	138	198	1	2	1.0%	1.4%	4	2.1%	2.9%	6	3.1%	4.3%	23	12.7%	-5	2.6%
Mouth of the Creek*	SF-20	2249	2630	NA	2244	NA	37	58	2.6%	2.6%	97	4.3%	4.3%	154	6.8%	6.9%	-381	15.6%	NA	NA
Northern Ridge Springs	weir 6	8	12	NA	NA	NA	0.01	0.01	0.1%	NA	0.02	0.3%	NA	0.03	0.4%	NA	-4	**40.0%**	NA	NA
Northern Boomerang Springs	NA	NA	15	NA	NA	NA	0.2	0.2	NA	NA	0.35	NA	NA	0.6	NA	NA	NA	NA	NA	NA
Southern Boomerang Springs	NA	NA	22	NA	NA	NA	0.3	0.4	NA	NA	0.7	NA	NA	1.1	NA	NA	NA	NA	NA	NA
White Pine Springs	SF-6	300	319	NA	NA	NA	9	14	4.7%	NA	24	8.0%	NA	38	12.7%	NA	-19	6.1%	NA	NA
Chippewa Springs	weir 5, SF-8	192	179	NA	NA	NA	8	14	7.3%	NA	23	12.0%	NA	35	18.2%	NA	13	7.0%	NA	NA
Decker Springs	NA	NA	134	NA	NA	NA	4	11	NA	NA	18	NA	NA	28	NA	NA	NA	NA	NA	NA

NA = Data not available

* Nestle Flow at SF-20 not a direct measurement but = SF-17 + SF-19

** 50% exceedance for lowest flow month

Nestle Twin Creek and WWAT drainage area = 22.34 square miles, Nestle and WWAT Chippewa Creek drainage area = 3.98 square miles

Table 2 - Comparison of median flow from all Nestle data and DEQ filtered dataset

		2001-2016 median of full data set	2001-2016 median of DEQ filtered data set	difference	percent difference	2007-2016 median of full data set	2007-2016 median of DEQ filtered data set	difference	percent difference
East Branch	SF-1	728	700	28	4%	724	704	20	3%
Twin Creek	SF-11	734	666	68	10%	709	697	12	2%
	SF-9	3009	2939	70	2%	2983	2935	48	2%
	SF-13	3941	3770	171	4%	3971	3822	149	4%
Chippewa Creek	SF-16	1038	1009	29	3%	1041	1009	32	3%
	SF-18	739	714	25	3%	739	718	21	3%
	SF-19	197	197	0	0%	193	193	0	0%
	SF-17	2058	2042	16	1%	2056	2045	11	1%
Northern Ridge Spring	Weir 6	8	7	1	13%	8	8	0	0%
White Pine Springs	Weir 2	31	31	0	0%	33	33	0	0%
	Weir 3	48	52	-4	8%	56	56	0	0%
	Weir 4	40	41	-1	2%	41	41	0	0%
Chippewa Springs	Weir 5	59	61	-2	3%	65	64	1	2%
	SF-8	123	126	-3	2%	128	127	1	1%

Table 3 - Target median flow 2007-2016 vs. Calibrated flow

		2007-2016 median flows used in revised groundwater model	Calibrated flow	residual	percent difference
East Branch	SF-1	724	721	3	0%
Twin Creek	SF-11	709	697	12	2%
	SF-9	2983	3029	-46	2%
	SF-13	3971	3751	220	6%
Chippewa Creek	SF-16	1041	1020	21	2%
	SF-18	739	686	53	7%
	SF-19	193	170	23	13%
	SF-17	2056	1955	101	5%
Northern Ridge Spring	Weir 6	8	12	-4	40%
White Pine Springs	Weir 2	33	31	2	6%
	Weir 3	56	42	14	29%
	Weir 4	41	35	6	16%
Chippewa Springs	Weir 5	65	57	8	13%
	SF-8	128	122	6	5%
not in report:					
Decker Springs	Weir 9	18	134	-116	153%

Table 4 - Difference between using whole data set and 2007-2016

		2001-2016 median of full data set	2007-2016 median of full data set	difference	percent difference
East Branch	SF-1	728	724	4	1%
Twin Creek	SF-11	734	709	25	3%
	SF-9	3009	2983	26	1%
	SF-13	3941	3971	-30	1%
Chippewa Creek	SF-16	1038	1041	-3	0%
	SF-18	739	739	0	0%
	SF-19	197	193	4	2%
	SF-17	2058	2056	2	0%
Northern Ridge Spring	Weir 6	8	8	0	0%
White Pine Springs	Weir 2	31	33	-2	6%
	Weir 3	48	56	-8	15%
	Weir 4	40	41	-1	2%
Chippewa Springs	Weir 5	59	65	-6	10%
	SF-8	123	128	-5	4%

Attachment III

Wetland Technical Review

Nestle Part 303 Permit Determination

Prepared by Michael Pennington on March 27, 2018

Background

Nestlé Waters North America, Inc. submitted an application to the Michigan Department of Environmental Quality (MDEQ) in July 2016 seeking approval under Section 17 of the Michigan Safe Drinking Water Act, 1976 PA 399, as amended (Act 399), to increase water production from an existing well located near Evart, known as "White Pine Spring," for the purpose of bottling it. The company proposes to increase its withdrawal to a continuous pumping rate of 400 gallons per minute (gpm). Nestlé currently pumps at a capacity of up to 250 gpm. The MDEQ, Water Resources Division (WRD), staff evaluated the application to determine if a permit was required under Part 303, Wetlands Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA).

Part 303, Wetlands Protection

Part 303 requires that persons planning to conduct certain activities in regulated wetlands apply for and receive a permit from the state before beginning the activity. In accordance with Part 303, wetlands are regulated if they are any of the following:

- Connected to one of the Great Lakes or Lake St. Clair.
- Located within 1,000 feet of one of the Great Lakes or Lake St. Clair.
- Connected to an inland lake, pond, river, or stream.
- Located within 500 feet of an inland lake, pond, river, or stream.
- Not connected to one of the Great Lakes or Lake St. Clair, or an inland lake, pond, stream, or river, but are more than 5 acres in size.
- Not connected to one of the Great Lakes or Lake St. Clair, or an inland lake, pond, stream, or river, and less than 5 acres in size, but the MDEQ has determined that these wetlands are essential to the preservation of the state's natural resources and has notified the property owner.

If a wetland is determined to be regulated a permit is required from the state for the following activities:

- Deposit or permit the placing of fill material in a wetland.
- Dredge, remove, or permit the removal of soil or minerals from a wetland.
- Construct, operate, or maintain any use or development in a wetland.
- Drain surface water from a wetland.

Technical Review

WRD staff conducted a technical review of the information received by Nestlé and their consultants to determine if a wetland permit is required. The brief description of the MDEQ's technical review is summarized below.

Initial Review

The MDEQ's initial review of the potential for wetland impacts focused primarily on the Environmental Consulting and Technology (ECT) report titled, "White Pine Springs, Evart, Michigan Assessment of Wetland Effects" (2016). The report was prepared to document the likely effect of increasing the pumping rate on nearby wetlands. The report specifically addressed the potential effects on 16 wetlands within the vicinity of the production well. The report concluded that only 8 of the wetlands assessed were likely connected to the regional groundwater source aquifer due to the lack of a low-permeability confining soil layer. Of those 8 wetlands, only 5 were within potential groundwater drawdown areas in excess of .5 feet. ECT stated in the report that none of the potential wetland effects will measurably affect the functional ecology of the connected wetlands.

MDEQ wetlands staff reviewed the report and determined that the report had some deficiencies. The deficiencies were primarily related to the limited size of the study area, the lack of information about the regulated status of the wetlands, the justification provided for calling some wetlands perched and the general conclusion that the drawdown will not have a measurable effect on the functional ecology of the connected wetlands. After a thorough review of the ECT report and supporting material, MDEQ staff compiled a list of additional information that was necessary to determine if a wetland permit was required.

Request for Additional Information #1

The first request for additional information pertaining to wetlands was submitted in a February 14, 2017, letter from James (Matt) Gamble to Ms. Arlene Anderson-Vincent. With regards to wetlands, the MDEQ requested several items including additional information on vegetation within the wetlands, soil borings, monitoring wells and water level measurements and a copy of the wetland delineation previously prepared by Don Tilton and Associates. The MDEQ received the requested information on March 16, 2017, in a letter from Golder and Associates to James (Matt) Gamble. Upon receiving the information MDEQ staff started reviewing the additional information to determine if a wetland permit would be needed. A field review was also set up for staff to review the production well and associated wetlands.

Field Review

MDEQ staff conducted a field review of the production well and associated wetlands on May 19, 2017, to gather more information about the well and associated wetlands. MDEQ staff took soil borings at several of the wetlands and found discrepancies between soil data provided by ETC, which was based on a 2004 assessment by Tilton and Associates titled, "Draft Wetland Assessment, White-Cedar Osceola Project, Evart, Michigan." Most of the discrepancies were regarding identification of the appropriate confining layer that resulted in the "perched" status of the wetlands as well as the regulatory status of some of the wetlands. WRD staff concluded that some of the wetlands were perched by either a hard pan or layer of clayey soil.

Request for Additional Information #2

After a thorough review of the Golder report and on-site field review the MDEQ compiled a list of additional information that was necessary to determine if a wetland permit was required. The second request for additional information was submitted to Nestlé on June 21, 2017, in a letter from James (Matt) Gamble to Ms. Arlene Anderson-Vincent. The June 21, 2017, request focused on preparation of a more robust groundwater model, preparation of wetland water budgets for 4 wetlands connected to the water table (depressional and groundwater slope wetlands) and evaluation of all wetlands within the drawdown zone and indication of their perched condition and regulatory status. ECT responded to the request with a November 2017

Addendum to their previously provided Assessment of Wetland Effects (2016). In addition, an updated Groundwater Model was prepared by S.S. Papadopulos and Associates, Inc.

Final Review

WRD staff reviewed the wetland water budgets provided by ECT in conjunction with the updated Groundwater Model prepared by S.S. Papadopulos and Associates, Inc titled, "An Addendum to the Evaluation of Groundwater and Surface Water Conditions in the Vicinity of Well PW-101, Osceola County, Michigan." The wetland water budgets that were provided contained the inflow and outflow of groundwater in gpm as opposed to level of drawdown of the water table. WRD staff requested that gpm be converted to feet of drawdown in a series of e-mails between WRD staff and Nestlé's consultants. Revised information provided by Nestlé's consultants showed that average drawdown of wetland complexes connected to the water table ranged between .03 and .3 feet. The .3 foot drawdown was in the location of a small .34 acre depressional wetland (Wetland G as referenced in the November 2017 Addendum of Wetland Effects report).

Since the accuracy of the wetland water budgets were largely dependent on changes to the water table, WRD water withdrawal staff conducted a thorough review of the updated Groundwater Model for accuracy. Staff concluded that the modified groundwater model is adequately calibrated and can reproduce the site water levels and stream flows generally to a reasonable degree.

WRD water withdrawal staff also conducted a separate query of the model to identify areas within groundwater connected wetlands that may experience greater drawdown than the average drawdown. The query showed slightly greater potential drawdown (up to .9 feet) in small areas of some of the wetlands connected to the groundwater aquifer. In general, drawdown was higher at the wetland boundaries closest to the well point. While there appears to be a very good correlation throughout most of the drawdown zone, some locations (near MW-101d, MW-101i, or MW-106d as referenced in the updated Groundwater Model) show a slightly higher residual than other locations (the residual is the difference between the measured water level at a location and the water level that is predicted by the model for that location). Negative residuals could indicate that potential water level drawdown due to pumping could be higher (more drawdown) in wetlands that are located closer to the negative residuals. For example, near wetland G the residual is -0.4 feet, which means the model could predict a water level drawdown of 0.7 feet as opposed to the 0.3 feet predicted by the undated Groundwater Model (0.4-foot residual + 0.3-foot drawdown).

The modified model error between measured and calculated water levels is reported by S.S. Papadopulos and Associates, Inc to have a mean value of 0.1 feet with a standard deviation of 0.6 feet. Figure 5 indicates that the areas with the higher residual difference are east and southeast of the Northern Ridge Springs (-1.1 feet, 1.0 to 1.9 feet), Wetland G (-0.4 feet), Wetland H (-0.7 feet), Wetland P (0.9 feet), Wetland U (-1.0 feet), and north of White Pine Springs (0.5 feet and -1.4 feet).

WRD's Geographic Information System staff performed an overlay of drawdown values between .1-.9 feet to look at potential impacts to regulated wetlands with respect to acreage. The overlay did not take into account residual values since residuals are only estimated for points as opposed to contours. According to the overlay, the acreage of potential drawdown between the .6- and .9-foot contour interval is relatively small (.78 acres). Most of the wetlands are located in areas with very small potential drawdown. Given the small amount of potential drawdown and standard deviation of the groundwater model, WRD staff concluded that a Part 303 permit was not required.

Conclusion

We have concluded that a permit is not required at this time. The small drawdown levels predicted within wetland complexes connected to the regional aquifer are within the variability inherent in the model. We recommend incorporating baseline assessment and long-term monitoring into permit conditions under Section 17 should a permit be issued. The monitoring plan should incorporate detailed hydrology and vegetation sampling, performance standards, and reporting designed to detect potential impacts to wetlands as a result of draining surface water from a wetland. If monitoring data show measurable effects on the functional ecology of wetlands, conditions should be place in the permit to cease or reduce pumping operations.

Attachment IV

Aquatic Life and Aquatic Habitat Review

Review of Aquatic Life and Aquatic Habitat Data Relating to Water Quality
for the Nestle Permit Application

1) Yearly macroinvertebrate data were reviewed including 2003, 2008, 2009, 2010, 2011, 2012, 2013, 2015, and 2016 at 4 sites on Twin Creek (SF1, SF5, SF5-6, and SF9) and 3 sites on Chippewa Creek (SF16, SF8, and SG5). Locations are shown in Figure 1-2 in Attachment F "Evaluation of Fish, Macroinvertebrates, and Aquatic Habitat (AEM 2016a), which can be found on the Department of Environmental Quality (DEQ) Nestle permit application Web page.

   Macroinvertebrate sites were sampled mid-late July for each sampling event. Two-person sampling crews using D-framed kick nets sampled all available habitat types for 30 minutes at each sampling location. Mussels were sampled by visual inspection or D-framed kick nets for smaller fingernail clams during macroinvertebrate sampling. Nestle was provided alternative preferred mussel sampling methods (Ohio and West Virginia) in a February 14, 2017, letter from the DEQ.

   Twin Creek macroinvertebrate populations fluctuated between the 2003 and 2016 sampling events. Despite yearly variation, SF1 had 19 total family taxa in 2003 and 20 total family taxa in 2016. Chippewa Creek total family taxa at SF16 fluctuated but started and ended with 18 total family taxa in 2003 and 2016. These results provide a good range of expected taxa numbers in any given year. SG5 and SF8 were sampled for a limited time frame, mostly in 2015 and 2016. A shift from chironomids to amphipods occurred at SF8; however, sensitive family taxa increased from 4 to 7 from 2003 to 2016. Sensitive family taxa (mayflies, caddisflies, and stoneflies) varied in both creeks over the sampling period, which is typical with long-term data sets. Species richness was reviewed by looking at number of taxa present year to year as well as number of Ephemeroptera, Plecoptera, Trichoptera (EPT) taxa present year to year with figures created for these reviews.

2) Fish population and catch per unit effort data was reviewed by Department of Natural Resources (DNR), Fisheries Division, biologists.

3) Temperature data included a HOBO temperature spreadsheet, surface water temperatures, and Stream Dimensions and Water Temperature Summary by Station and Year.

   Temperature data were reviewed each month and compared to Part 4 Water Quality Standards for coldwater streams.

   Temperature grab samples:

   - SF1 showed exceedances in "Twin Creek Water Quality Data Recorded in Each Station Using a YSI Professional Plus Meter" on several occasions >20 degrees Celsius = >68 degrees Fahrenheit during July and August grab samples.
   - SF16 showed exceedances during several years >20 degrees Celsius = >68 degrees Fahrenheit during July and August grab samples.
   - SF5, SF5-6, SF9, SG5, and SF8 did not show temperature grab sample exceedances in July and August from the above mentioned data table.

The July 18, 2016, AEM report showed the following average temperatures (grab samples) for each site during the entire span of sampling among all the years:

- SF1 = 67.5°F
- SF5 = 52.7°F
- SF5-6 = 53.2°F
- SF9 = 60.3°F
- SG5 = 53.2°F
- SF8 = 50.9°F
- SF16 = 67.3°F

HOBO Temperature data (continuous data):

SF1: the data shows occasional exceedances of monthly coldwater standards and should be monitored for temperature should a permit be issued. The AEM report states that SF1 had the highest average water temperature among all Twin Creek stations. The average depth was 0.5 feet and the average width was 6.1 feet.

SF5-6: the data does not show exceedances of monthly coldwater standards.

SF9: the data shows several exceedances of monthly coldwater standards and should be monitored for temperature should a permit be issued. The AEM report states that SF9 had the second highest average water temperature in Twin Creek. The average depth was 1.0 feet and the average width was 14.1 feet.

SF8: the 2015 and 2016 data does not show exceedances of monthly coldwater standards.

SG5: the June 2015 data shows 74°F, 78°F, and 82°F data at the beginning of the dataset and drops to 58°F from 82°F within 1 hour. This 24° differential appears to show that the HOBO Temp logger was not recording water temperature and may have been recording air temperature. In 2015 and 2016 data there were no other exceedances of monthly coldwater standards.

The July 18, 2016, AEM report notes SF1 water temperature ranges of 57.38°F-76.64°F. Brown trout have been sampled at SF1 and their preferred temperature is 44.06°F-66.2°F. The average temperature noted by AEM is 65.66°F. This information has been noted to the DNR, Fisheries Division.

Memo dated 2-5-18, from C. Andrews and C. Muffels to Jill Van Dyke states that the model predicts SF6 to change 0.16°C (0.28°F) based on July 2014 climactic conditions and 0.13°C (0.23°F) based on July 2013 conditions at 400 gallons per minute (gpm) after 20 years.

4) Dissolved Oxygen data was reviewed – Information sent March 8, 2018, via e-mail from Arlene Anderson-Vincent. Upper, middle, and lower extents of each sample location were measured for temperature, conductivity, dissolved oxygen, and pH. All measurements were grab samples with a YSI professional plus meter.

   Dissolved Oxygen Water Quality Standards for grab samples is 7 milligrams per liter (mg/L).

a. SF5, SF5-6, SF16 had readings below 7 mg/L during the July and August grab samples.

5) Stream Depth
   a. Nestle provided a list of road/stream crossings in the project area along Twin and Chippewa Creeks (see Figure D9-1 under Appendix D of Nestle Response to the DEQ's Feb 2017 Request for Additional Information, which can be found on the DEQ Nestle permit application Web page). Based on review of the pictures, the following sites should be monitored if a permit is issued to assess whether any changes in water levels and connectivity of the creeks due to perched culverts and/or shallow water at the culverts:
      i. T2 upstream and downstream
      ii. T3 upstream and downstream
      iii. T8 upstream and downstream
      iv. T18 upstream and downstream
      v. C2 upstream and downstream
      vi. C3 upstream and downstream

   A February 5, 2018, memo from C. Andrews and C. Muffels to Jill Van Dyke states stream level changes were calculated at 2 locations on Twin Creek (SF1 and SF9) and 1 location on Chippewa Creek (SF16).

   <u>150-400 gpm</u>

   0.014 feet (0.168 inches) at SF1

   0.009 - 0.017 feet (0.108 - 0.204 inches) at SF9

   0.01 feet (0.12 inches) at SF16

   <u>0-400 gpm</u>

   0.022 - 0.023 feet (0.264 - 0.276 inches) at SF1

   0.015 -0.027 feet (0.18 - 0.324 inches) at SF9

   0.016 feet (0.192 inches) at SF16

<u>Conclusion</u>

Based on the predicted changes to stream flows and water depth due to the additional pumping should a permit be issued, we expect negligible impacts on benthic macroinvertebrates/aquatic life, temperatures, and dissolved oxygen levels. To ensure that this is the case, we recommend that any permit include the monitoring conditions described in the next section.

Monitoring Conditions

If a permit is issued to Nestle Waters North America, we recommend a number of monitoring conditions to ensure that aquatic life is not adversely impacted.

a. The permittee will develop a work plan and an associated Quality Assurance Project Plan (QAPP) for the monitoring activities listed in the subsequent bullets that describe the sampling and analytical methods; data analysis; data management; and reporting requirements. The plan shall be implemented following the DEQ's approval of the monitoring plan and QAPP.

b. To ensure that Twin Creek and Chippewa Creek are meeting the temperature standard for coldwater streams, continuous temperature measurements should be made on an hourly basis from June through September at 4 locations (SF1, SF9, SF8, and SF16) using an in-stream temperature logger. Logger data should be compiled once every 2 weeks, and the DEQ notified of any exceedance.

c. To ensure that Twin Creek and Chippewa Creek are meeting the dissolved oxygen standard for coldwater streams, a 2-week continuous dissolved oxygen study shall be conducted each year at 4 locations (SF1, SF9, SF8, and SF16) during hot, low-flow conditions, which typically occur in August. Sampling shall be conducted using an installed dissolved oxygen meter, with readings recorded hourly. Baseline dissolved oxygen sampling shall be conducted at these locations after approval of the monitoring plan and QAPP and prior to implementing the permitted increased pumping.

d. To ensure the protection of a healthy and diverse aquatic life community, macroinvertebrate sampling will be conducted in July each year at 4 locations (SF1, SF9, SF8, and SF16). Samples should not be collected soon after a heavy rain event when stream flows are elevated. Sample collection and analysis will be conducted according to the DEQ's Procedure WRD-SWAS-051, Qualitative Biological and Habitat Survey Protocols for Wadeable Streams and Rivers (Procedure 51), which uses a multi-metric index to score sites on a scale of -9 to +9. A baseline assessment will be conducted after approval of the monitoring plan and QAPP and prior to implementing the permitted increased pumping. Because there is some natural variability in metric score from year to year, the threshold for action will be a decline of 3 metric points from the baseline score in any 1 year or over multiple years.

   To assist with the interpretation of aquatic life results, water depth and stream width will be measured at 4 locations (SF1, SF9, SF8, and SF16) once each year during low-flow conditions (typically July or August). Results will be compared with previous measurements. In addition, water depth and stream width will be measured upstream and downstream of existing culverts at 6 road/stream crossings (T2, T3, T8, T18, C2, and C3) once each year during low-flow conditions (typically July or August).

e. To ensure the continued presence of coldwater fish species and a diverse fish community, the fish community will be monitored in July of each year at 4 locations (SF1, SF9, SF8, and SF16). The MDNR, Fisheries Division, will outline sample collection methods and data analysis techniques.

f. The permittee shall notify the DEQ within 24 hours of compiling the temperature logger data if, at any time during the 2-week period, the temperature rises above 68 degrees Fahrenheit in June, July, or August, or rises above 63 degrees Fahrenheit in September. The notification shall include all data from the 2-week period, and the permittee shall provide a report to the DEQ including an assessment of the cause of the elevated temperature and any proposed corrective actions.

g. The permittee shall notify the DEQ within 24 hours of compiling the dissolved oxygen data if, at any time during the study period, the dissolved oxygen is below 7 mg/L. The notification shall include all the dissolved oxygen data, and the permittee shall provide a report to the DEQ including an assessment of the cause of the low dissolved oxygen and any proposed corrective actions.

Prepared by: Marcy Knoll-Wilmes, Senior Aquatic Biologist
Gary Kohlhepp, Manager, Lake Michigan Unit
Surface Water Assessment Section – Water Resources Division
Michigan Department of Environmental Quality

Attachment V

Threatened and Endangered Species, Fisheries, and Wildlife Review

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

March 29, 2018

TO: FILE

FROM: Tammy J. Newcomb
Water Policy Advisory
DNR Executive Office
517-284-5812

SUBJECT: Technical Review of Threatened and Endangered Species, Fisheries, and Wildlife Review for Nestle White Pine Spring permit application

Background

Nestle Water North America, Inc. submitted an application to the Michigan Department of Environmental Quality (MDEQ) in July 2016 seeking approval under Section 17 of the Michigan Safe Drinking Water ACT, 1976 PA 399, as amended (Act 399) to increase water production (for bottled water) from an existing well (PW-101) at the site referred to as "White Pine Spring" (WPS) located north of Evart, Michigan. Nestle proposes to increase its withdrawal from a current capacity of 250 gallons per minute (gpm) to 400 gpm continuous. Staff within DNR Fisheries Division, Wildlife Division, and the Executive Office conducted site visits and evaluated the reports and technical information provided by Nestle Water North America, Inc. In addition, technical reviews of the groundwater model and surface water modeled outcomes were used to evaluate potential impacts to fish and wildlife as well as threatened and endangered species.

Michigan DNR Fisheries Division Supervisor, Scott Heintzelman, and Wildlife Division Senior Biologist Pete Kailing participated in the above referenced MDEQ permit application process. MDNR staff involvement included participation in select meetings, listening to stakeholder input, and participating in two site inspections of relevant areas to make qualitative assessment of existing conditions. MDNR staff did not conduct their own quantitative assessments, however did review relevant published reports.

The groundwater well PW-101 is near the headwaters of Twin Creek and Chippewa Creek in Osceola County. Both Twin and Chippewa Creeks are designated as coldwater trout streams.

Review of Fisheries Information

Fish were collected by the applicant's contractor using a backpack electroshocker while wading in the streams. They used a multiple-pass depletion method in 2003 (100 ft site) and then by a single pass approach from 2008 to 2016. Fish were measured, weighed, and released. Habitat such as woody and herbaceous vegetation, amount of woody debris, stream habitat type, and substrate were recorded for each station sampled. Wetted stream width and depth were also measured. Stream flow was measured at Stations SF1, SF5, SF9, SG5, SF8 and SF16 with a Marsh McBirney meter. Water quality parameters of temperature, dissolved oxygen, pH, and conductivity were also measured. Since December of 2012, water temperature has been continuously recorded on an hourly basis at sties SF1, SF5, SF6, SF5-6, and SF9. In 2015, water temperature loggers were added in SF8 and SG5 in tributaries of Chippewa Creek.

Temperature data was modeled using a long standing and well accepted stream segment temperature model (SSTemp).

Observations from the data provided:

- High variability was noted in the fish/minute index calculated between years and in using this approach, no variance estimate was feasible. As a result, it is difficult to determine differences in fish abundance between years.

- Characteristic coldwater species of American brook lamprey, mottled sculpin, brook trout, and brown trout were persistently present from 2003 through 2016.

- Temperature modeling data does not indicate a dramatic increase in temperature as a result of the requested withdrawal.

Review of Threatened and Endangered Species Information

Both Twin Creek and Chippewa Creek were assessed for aquatic Threatened or Endangered (T&E) species or those of Special Concern at the locations sampled for the fish surveys. Additionally, the Michigan Natural Features Inventory County Element List was reviewed to evaluate for the potential of any T&E species. The four mussel species and one fish species have not historically been found in the areas of these creeks. It is unlikely that these species are present in the habitats identified in Twin and Chippewa Creeks.

Additional Information Considered

Surface water flows were reviewed based on DEQ's assessment of the groundwater withdrawals to evaluate for a potential adverse resource impact. Two locations were concerning they would appear to fall more than 20% below the determined index flow. As identified by DEQ staff, SF-8 is a location that should be monitored closely.

Conclusions/Recommendations for Monitoring and Action

- DNR recommends monitoring for fish and aquatic life, including Threatened, Endangered, and Special Concern Species at the following locations: (SF1, SF5, SF9, SF8, SF16). A quantitative approach should be used to track the coldwater fish population such as 3-pass depletion methods or a mark-recapture estimate to allow for variances to be established for the estimates. We recommend that pumping be reduced or modified if characteristic fish populations show a statistically significant decline in their abundance for 3 consecutive years in combination with temperature exceedances for a coldwater stream.

- Continuous hourly temperature monitoring should also occur at the sites where fish and aquatic life sampling are to occur.

- Mussel sampling should follow the guidance as noted in Michigan Freshwater Mussel Survey Protocols and Relocation Procedures (https://www.fws.gov/midwest/eastlansing/te/pdf/MIFreshwaterMusselSurveyProtocolsRelocationProcedures.pdf)

- At SF-1 and SF-8, we recommend that pumping cease if the flows are reduced below 431 and 72 gpm (respectively) for a period of 7 consecutive days.